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# .bookmarks

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Bookmarks in MongoDB | Links for MongoDB

## The 15 most recent bookmarks in MongoDB

There are no bookmarks to display.

# 1.1 Development Cycle

**Redirection Notice**
This page should redirect to [1.2.0 Release Notes].

# Creating and Deleting Indexes

**Redirection Notice**
This page should redirect to Indexes.

# Diagnostic Tools

**Redirection Notice**
This page should redirect to Monitoring and Diagnostics.

# Django and MongoDB

**Redirection Notice**
This page should redirect to Python Language Center.

# Getting Started

**Redirection Notice**
This page should redirect to Quickstart.

# International Documentation

**Redirection Notice**
This page should redirect to International Docs.

# Monitoring

**Redirection Notice**
This page should redirect to Monitoring and Diagnostics.

# Older Downloads

**Redirection Notice**
This page should redirect to Downloads.

# PyMongo and mod_wsgi

**Redirection Notice**
This page should redirect to Python Language Center.

# Python Tutorial

**Redirection Notice**
This page should redirect to Python Language Center.

# Recommended Production Architectures

**Redirection Notice**
This page should redirect to Production Notes.

# v0.8 Details

## Existing Core Functionality

- Basic Mongo database functionality: inserts, deletes, queries, indexing.
- Master / Slave Replication
- Replica Pairs
- Server-side javascript code execution

## New to v0.8

- Drivers for Java, C++, Python, Ruby.
- db shell utility
- (Very) basic security
- $or
- Clean up logging
- Performance test baseline
- getlasterror
- Large capped collections
- Bug fixes (compound index keys, etc.)
- Import/Export utility
- Allow any _id that is unique, and verify uniqueness

## Wanted, but may not make it

- AMI's
- Unlock eval()?
- Better disk full handling
- better replica pair negotiation logic (for robustness)

# Building SpiderMonkey

**Redirection Notice**
This page should redirect to Building Spider Monkey.

# Documentation

**Redirection Notice**
This page should redirect to Home.

# Dot Notation

**Redirection Notice**
This page should redirect to Dot Notation (Reaching into Objects).

# Dot Notation

**Redirection Notice**
This page should redirect to Dot Notation (Reaching into Objects).

# Getting the Software

Placeholder - $$$ TODO

# Language Support

**Redirection Notice**
This page should redirect to Drivers.

# Mongo Administration Guide

**Redirection Notice**
This page should redirect to Admin Zone.

# Working with Mongo Objects and Classes in Ruby

**Redirection Notice**
This page should redirect to Ruby Language Center.

# MongoDB Language Support

**Redirection Notice**
This page should redirect to Language Support.

# Community Info

**Redirection Notice**
This page should redirect to Community.

# Internals

## Cursors

### Tailable Cursors

See *p/db/dbclient.h* for example of how, on the client side, to support tailable cursors.

Set

```
Option_CursorTailable = 2
```

in the `queryOptions int` field to indicate you want a tailable cursor.

If you get back no results when you query the cursor, keep the cursor live if cursorid is still nonzero. Then, you can issue future `getMore` requests for the cursor.

If a `getMore` request has the `resultFlag ResultFlag_CursorNotFound` set, the cursor is not longer valid. It should be marked as "dead" on the client side.

```
ResultFlag_CursorNotFound = 1
```

See the Queries and Cursors section of the Mongo Developers' Guide for more information about cursors.

## See Also

- The Queries and Cursors section of the Mongo Developers' Guide for more information about cursors

# TreeNavigation

# Old Pages

## Storing Data

**Redirection Notice**
This page should redirect to Inserting.

## Indexes in Mongo

**Redirection Notice**
This page should redirect to Indexes.

## HowTo

**Redirection Notice**
This page should redirect to Developer FAQ.

## Searching and Retrieving

**Redirection Notice**
This page should redirect to Querying.

## Locking

**Redirection Notice**
This page should redirect to Atomic Operations.

## Mongo Developers' Guide

**Redirection Notice**
This page should redirect to Manual.

## Locking in Mongo

**Redirection Notice**
This page should redirect to Developer FAQ.

## Mongo Database Administration

**Redirection Notice**
This page should redirect to Admin Zone.

## Mongo Concepts and Terminology

**Redirection Notice**
This page should redirect to Manual.

## MongoDB - A Developer's Tour

**Redirection Notice**
This page should redirect to Manual.

## Updates

**Redirection Notice**
This page should redirect to Updating.

## Structuring Data for Mongo

**Redirection Notice**
This page should redirect to Inserting.

## Design Overview

**Redirection Notice**
This page should redirect to Developer Zone.

## Document-Oriented Datastore

**Redirection Notice**
This page should redirect to Databases.

## Why so many "Connection Accepted" messages logged?

**Redirection Notice**
This page should redirect to Developer FAQ.

## Why are my datafiles so large?

**Redirection Notice**
This page should redirect to Developer FAQ.

## Storing Files

**Redirection Notice**
This page should redirect to GridFS.

## Introduction - How Mongo Works

**Redirection Notice**
This page should redirect to Developer Zone.

## Optimizing Mongo Performance

**Redirection Notice**
This page should redirect to Optimization.

## Mongo Usage Basics

**Redirection Notice**
This page should redirect to Tutorial.

## Server-Side Processing

**Redirection Notice**
This page should redirect to Server-side Code Execution.

# Home

## Events

- Follow us on Facebook and Twitter to get all of the latest updates!
- MongoDB Conferences:
    - Mongo Chicago - October 20
    - Mongo DC - November 18
    - MongoSV - December 3
    - Slides and Video: MongoSeattle | MongoFR | MongoUK | MongoNYC | MongoSF
- More events...

## Getting Started

Quickstart | Downloads | Tutorial

## Development

- Manual
- C | C++ | C# & .NET | ColdFusion | Erlang | Factor | Java | Javascript | PHP | Python | Ruby | Perl | More...

## Production

Production Notes | Security | Replication | Sharding | Backup

## Support

Forum | IRC | Bug tracker | Commercial support | Training | Consulting | Hosting

## Community

Blog | Articles | Twitter | [Forum] | Facebook | LinkedIn | Job Board | User groups: NY and SF

## Meta

Use Cases | Philosophy | License

## Translations

| Deutsch | Español | Français | Italiano |  | Português |  |

# Introduction

> *MongoDB wasn't designed in a lab. We built MongoDB from our own experiences building large scale, high availability, robust systems. We didn't start from scratch, we really tried to figure out what was broken, and tackle that. So the way I think about MongoDB is that if you take MySql, and change the data model from relational to document based, you get a lot of great features: embedded docs for speed, manageability, agile development with schema-less databases, easier horizontal scalability because joins aren't as important. There are lots of things that work great in relational databases: indexes, dynamic queries and updates to name a few, and we haven't changed much there. For example, the way you design your indexes in MongoDB should be exactly the way you do it in MySql or Oracle, you just have the option of indexing an embedded field.*
>
> *– Eliot Horowitz, 10gen CTO and Co-founder*

## Why MongoDB?

- **Document-oriented**
    - Documents (objects) maps nicely to programming language data types
    - Embedded documents and arrays reduce need for joins
    - Dynamically-typed (schemaless) for easy schema evolution

        - No joins and no transactions for high performance and easy scalability
- **High performance**
    - No joins and no transactions makes reads and writes fast
    - Indexes with indexing into embedded documents and arrays
    - Optional asynchronous writes
- **High availability**
    - Replicated servers with automatic master failover
- **Easy scalability**
    - "slaveOK" reads are distributed over replicated servers
    - Automatic sharding (auto-partitioning of data across servers)
        - Reads and writes are distributed over shards
            - No joins and no transactions make distributed queries easy and fast
- **Rich query language**

## Large Mongo deployment

1. One or more shards, each shard holds a portion of the total data (managed automatically). Reads and writes are automatically routed to the appropriate shard(s). Each shard is a replica set.

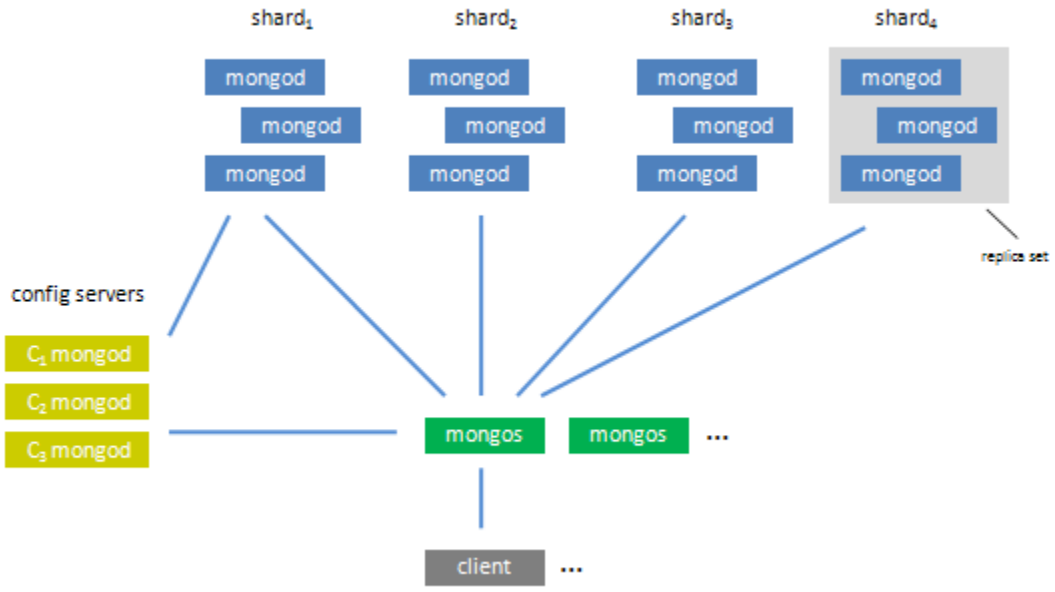
A replica set is one or more servers, each holding copies of the same data. At any given time one is primary and the rest are secondaries. If the primary goes down one of the secondaries takes over automatically as primary. All writes go to the primary, and "slaveOk" (eventually consistent) reads are distributed among all the servers.

2. Multiple config servers, each one holds a copy of the meta data indicating which data lives on which shard.

3. One or more routers, each one acts as a server for one or more clients. Clients issue queries/updates to a router and the router routes them to the appropriate shard while consulting the config servers.

4. One or more clients, each one is (part of) the user's application and issues commands to a router via the mongo client library (driver) for its language.

**`mongod`** is the server program (data or config). **`mongos`** is the router program.




### Small deployment (no partitioning)

1. One replica set (automatic failover), or one server with zero or more slaves (no automatic failover).

2. One or more clients issuing commands to the replica set as a whole or the single master (the driver will manage which server in the replica set to send to).

## Mongo data model

- A Mongo system (see setup above) holds a set of databases

- A **database** holds a set of collections
- A **collection** holds a set of documents
- A **document** is a set of fields
- A **field** is a key-value pair
- A **key** is a name (string)
- A **value** is a
  - basic type like string, integer, float, timestamp, binary, etc.,
  - a document, or
  - an array of values

### Mongo query language

To retrieve certain documents from a db collection, you supply a query document containing the fields the desired documents should match. For example, `{name: {first: 'John', last: 'Doe'}}` will match all documents in the collection with name of John Doe. Likewise, `{name.last: 'Doe'}` will match all documents with last name of Doe. Also, `{name.last: /^D/}` will match all documents with last name starting with 'D' (regular expression match).

Queries will also match inside embedded arrays. For example, `{keywords: 'storage'}` will match all documents with 'storage' in its keywords array. Likewise, `{keywords: {$in: ['storage', 'DBMS']}}` will match all documents with 'storage' or 'DBMS' in its keywords array.

If you have lots of documents in a collection and you want to make a query fast then build an index for that query. For example, `ensureIndex({name.last: 1})` or `ensureIndex({keywords: 1})`. Note, indexes occupy space and slow down updates a bit, so use them only when the tradeoff is worth it.

# Quickstart

- Quickstart OS X
- Quickstart Unix
- Quickstart Windows

For an even quicker start go to http://try.mongodb.org/.

#### See Also

- SQL to Mongo Mapping Chart

# Quickstart OS X

### Install MongoDB

The easiest way to install MongoDB is to use a package manager or the pre-built binaries:

#### *Package managers*

If you use the Homebrew package manager, run:

```
$ brew install mongodb
```

If you use MacPorts you can install with:

```
$ sudo port install mongodb
```

This will take a while to install.

#### *32-bit binaries*

Note: 64-bit is recommended.

```
$ curl http://downloads.mongodb.org/osx/mongodb-osx-i386-1.4.4.tgz > mongo.tgz
$ tar xzf mongo.tgz
```

#### *64-bit binaries*

```
$ curl http://downloads.mongodb.org/osx/mongodb-osx-x86_64-1.4.4.tgz > mongo.tgz
$ tar xzf mongo.tgz
```

### Create a data directory

By default MongoDB will store data in `/data/db`, but it won't automatically create that directory. To create it, do:

```
$ mkdir -p /data/db
```

You can also tell MongoDB to use a different data directory, with the `--dbpath` option.

### Run and connect to the server

First, start the MongoDB server in one terminal:

```
$ ./mongodb-xxxxxxx/bin/mongod
```

In a separate terminal, start the shell, which will connect to localhost by default:

```
$ ./mongodb-xxxxxxx/bin/mongo
> db.foo.save( { a : 1 } )
> db.foo.find()
```

Congratulations, you've just saved and retrieved your first document with MongoDB!

### Learn more

Once you have MongoDB installed and running, head over to the Tutorial.

## Quickstart Unix

### Install MongoDB

Note: If you are running an old version of Linux and the database doesn't start, or gives a floating point exception, try the "legacy static" version on the Downloads page instead of the versions listed below.

#### *Package managers*

Ubuntu and Debian users can now install nightly snapshots via apt. See Ubuntu and Debian packages for details.

CentOS and Fedora users should head to the CentOS and Fedora Packages page.

#### *32-bit Linux binaries*

Note: 64 bit is recommended.

```
$ curl http://downloads.mongodb.org/linux/mongodb-linux-i686-1.4.4.tgz > mongo.tgz
$ tar xzf mongo.tgz
```

#### *64-bit Linux binaries*

```
$ curl http://downloads.mongodb.org/linux/mongodb-linux-x86_64-1.4.4.tgz > mongo.tgz
$ tar xzf mongo.tgz
```

#### *Other Unixes*

See the Downloads page for some binaries, and also the Building page for information on building from source.

### Create a data directory

By default MongoDB will store data in `/data/db`, but it won't automatically create that directory. To create it, do:

```
$ sudo mkdir -p /data/db/
$ sudo chown `id -u` /data/db
```

You can also tell MongoDB to use a different data directory, with the `--dbpath` option.

### Run and connect to the server

First, start the MongoDB server in one terminal:

```
$ ./mongodb-xxxxxxx/bin/mongod
```

In a separate terminal, start the shell, which will connect to localhost by default:

```
$ ./mongodb-xxxxxxx/bin/mongo
> db.foo.save( { a : 1 } )
> db.foo.find()
```

Congratulations, you've just saved and retrieved your first document with MongoDB!

### Learn more

Once you have MongoDB installed and running, head over to the Tutorial.

## Quickstart Windows


- Download
  - 32-bit binaries
  - 64-bit binaries
- Unzip
- Create a data directory
- Run and connect to the server
- Learn more


### Download

The easiest (and recommended) way to install MongoDB is to use the pre-built binaries.

#### *32-bit binaries*

Download and extract the 32-bit .zip. The "Production" build is recommended.

#### *64-bit binaries*

Download and extract the 64-bit .zip.

Note: 64-bit is recommended, although you must have a 64-bit version of Windows to run that version.

### Unzip

Unzip the downloaded binary package to the location of your choice. You may want to rename mongo-xxxxxxx to just "mongo" for convenience.

### Create a data directory

By default MongoDB will store data in `\data\db`, but it won't automatically create that folder, so we do so here:

```
C:\> mkdir \data
C:\> mkdir \data\db
```

Or you can do this from the Windows Explorer, of course.

### Run and connect to the server

The important binaries for a first run are:

- `mongod.exe` - the database server
- `mongo.exe` - the administrative shell

To run the database, click `mongod.exe` in Explorer, or run it from a CMD window.

```
C:\> cd \my_mongo_dir\bin
C:\my_mongo_dir\bin > mongod
```

Note: It is also possible to run the server as a Windows Service. But we can do that later.

Now, start the administrative shell, either by double-clicking `mongo.exe` in Explorer, or from the CMD prompt. By default mongo.exe connects to a `mongod` server running on `localhost` and uses the database named `test`. Run `mongo --help` to see other options.

```
C:\> cd \my_mongo_dir\bin
C:\my_mongo_dir\bin> mongo
> // the mongo shell is a javascript shell connected to the db
> 3+3
6
> db
test
> // the first write will create the db:
> db.foo.insert( { a : 1 } )
> db.foo.find()
{ _id : ..., a : 1 }
```

Congratulations, you've just saved and retrieved your first document with MongoDB!

### Learn more

- Tutorial
- Windows quick links
- [Mongo Shell]

Mongo Shell Info

# Downloads

See also Packages.

| Version | OS X 32 bit | OS X 64 bit | Linux 32 bit | Linux 64 bit | Windows 32 bit | Windows 64-bit | Solaris i86pc | Solaris 64 | Source | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| **Production (Recommended)** | | | | | | | | | | |
| 1.4.3 | os x 10.5+<br>os x 10.4 | download | download *<br>legacy-static | download *<br>legacy-static | download | download | download | download | tgz zip | 5/24/2010 |
| nightly | os x 10.5+<br>os x 10.4 | download | download *<br>legacy-static | download *<br>legacy-static | download | download | download | download | tgz zip | Daily |
| **Previous Release** | | | | | | | | | | |
| 1.2.5 | os x 10.5+<br>os x 10.4 | download | download *<br>legacy-static | download *<br>legacy-static | download | download | download | download | tgz zip | 4/7/2010 |
| nightly | os x 10.5+<br>os x 10.4 | download | download *<br>legacy-static | download *<br>legacy-static | download | download | download | download | tgz zip | Daily |
| **Dev (unstable)** | | | | | | | | | | |
| 1.5.3 | os x 10.5+<br>os x 10.4 | download | download *<br>legacy-static | download *<br>legacy-static | download | download | download | download | tgz zip | 6/17/2010 |
| 1.5.x nightly | os x 10.5+<br>os x 10.4 | download | download *<br>legacy-static | download *<br>legacy-static | download | download | download | download | tgz zip | Daily |
| **Archived Releases** | list | list | list | list | list | list | list | list | list | |

- See Version Numbers
- The linux legacy-static builds are only recommended for older systems. If you try to run and get a floating point exception, try the legacy-static builds. Otherwise you should use the regular ones.
- Currently the mongod server must run on little-endian cpu (intel) so if you are using a ppc os x, mongod will not work.
- 32-bit builds are limited 2gb of data. See http://blog.mongodb.org/post/137788967/32-bit-limitations for more info
- See http://buildbot.mongodb.org/waterfall for details of builds and completion times.

### Included in Distributions

- The MongoDB database server
- The MongoDB shell
- Backup and restore tools
- Import and export tools
- GridFS tool
- The MongoDB C++ client

### Drivers

Information on how to separately download or install the drivers and tools can be found on the Drivers page.

| Language | Packages | Source | API Reference |
|---|---|---|---|
| Python | bundles | github | api |
| PHP | pecl | github | api |
| Ruby | gemcutter | github | api |
| Java | jar | github | api |
| Perl | cpan | github | api |

| | | | |
|---|---|---|---|
| C++ | included in database | github | api |

See Drivers for more information and other languages.

### Source Code

Source code for MongoDB and all drivers

### Packages

MongoDB is included in several different package managers:

- For MacPorts, see the **mongodb** and **mongodb-devel** packages.
- For FreeBSD, see the **mongodb** and **mongodb-devel** packages.
- For Homebrew, see the **mongodb** formula.
- For ArchLinux, see the **mongodb** package in the AUR.
- For Debian and Ubuntu, see Ubuntu and Debian packages.
- For Fedora and CentOS, see CentOS and Fedora Packages.

### Documentation

Pre-Exported

You can export yourself: HTML, PDF, or XML.

### Logos

MongoDB logos are available for download as attachments on this page.

### Powered By MongoDB Badges

We've made badges in beige, brown, blue and green for use on your sites that are powered by MongoDB. They are available below and in multiple sizes as attachments on this page.

### Training

If you're just getting started with MongoDB, consider registering for an upcoming training course.

<#comment><#comment><#comment>

# 1.0 Changelist

Wrote MongoDB. See documentation.

# 1.2.x Release Notes

### New Features

- More indexes per collection
- Faster index creation
- Map/Reduce
- Stored JavaScript functions
- Configurable fsync time
- Several small features and fixes

### DB Upgrade Required

There are some changes that will require doing an upgrade if your previous version is <= 1.0.x. If you're already using a version >= 1.1.x then these changes aren't required. There are 2 ways to do it:

- --upgrade
    - stop your mongod process
    - run ./mongod --upgrade
    - start mongod again
- use a slave
    - start a slave on a different port and data directory
    - when its synced, shut down the master, and start the new slave on the regular port.

Ask in the forums or IRC for more help.

### Replication Changes

- There have been minor changes in replication. If you are upgrading a master/slave setup from <= 1.1.2 you have to update the slave first.

### mongoimport

- mongoimportjson has been removed and is replaced with mongoimport that can do json/csv/tsv

### field filter changing

- We've changed the semantics of the field filter a little bit. Previously only objects with those fields would be returned. Now the field filter only changes the output, not which objects are returned. If you need that behavior, you can use $exists

### *other notes*

http://www.mongodb.org/display/DOCS/1.1+Development+Cycle

# 1.4 Release Notes

We're pleased to announce the 1.4 release of MongoDB. 1.4 is a drop in replacement for 1.2. To upgrade you just need to shutdown mongod, then restart with the new binaries. (Users upgrading from release 1.0 should review the 1.2 release notes, in particular the instructions for upgrading the DB format.)

Release 1.4 includes the following improvements over release 1.2:

### *Core server enhancements*

- concurrency improvements
- indexing memory improvements
- background index creation
- better detection of regular expressions so the index can be used in more cases

### *Replication & Sharding*

- better handling for restarting slaves offline for a while
- fast new slaves from snapshots (--fastsync)
- configurable slave delay (--slavedelay )
- replication handles clock skew on master
- $inc replication fixes
- sharding alpha 3 - notably 2 phase commit on config servers

### *Deployment & production*

- configure "slow threshold" for profiling
- ability to do fsync + lock for backing up raw files
- option for separate directory per db (--directoryperdb)
- `http://localhost:28017/_status` to get serverStatus via http
- REST interface is off by default for security (--rest to enable)
- can rotate logs with a db command, logRotate
- enhancements to serverStatus command (db.serverStatus()) - counters and replication lag stats
- new mongostat tool

### *Query language improvements*

- $all with regex
- $not
- partial matching of array elements $elemMatch
- $ operator for updating arrays

- $addToSet
- $unset
- $pull supports object matching
- $set with array indices

### *Geo*

- 2d geospatial search
- geo $center and $box searches

## 1.6 Release Notes

MongoDB 1.6 is a drop-in replacement for 1.4. To upgrade, simply shutdown `mongod` then restart with the new binaries.*

** Please note that you should upgrade to the latest version of whichever driver you're using. Certain drivers, including the Ruby driver, will require the upgrade, and all the drivers will provide extra features for connecting to replica sets.*

### *Sharding*

Sharding is now production-ready, making MongoDB horizontally scalable, with no single point of failure. A single instance of *mongod* can now be upgraded to a distributed cluster with zero downtime when the need arises.

- Sharding Tutorial
- Sharding Documentation
- Upgrading a Single Server to a Cluster

### *Replica Sets*

Replica sets, which provide automated failover among a cluster of *n* nodes, are also now available.

Plese note that replica *pairs* are now deprecated; we strongly recommend that replica pair users upgrade to replica sets.

- Replica Set Tutorial
- Replica Set Documentation
- Upgrading Existing Setups to Replica Sets

### *Other Improvements*

- The w option (and wtimeout) forces writes to be propagated to *n* servers before returning success (this works especially well with replica sets)
- $or queries
- Improved concurrency
- $slice operator for returning subsets of arrays
- 64 indexes per collection (formerly 40 indexes per collection)
- 64-bit integers can now be represented in the shell using NumberLong
- The findAndModify command now supports upserts. It also allows you to specify fields to return
- $showDiskLoc option to see disk location of a document
- Support for IPv6 and UNIX domain sockets

### *Installation*

- Windows service improvements
- The C++ client is a separate tarball from the binaries

### *1.5.x Release Notes*

- 1.5.8
- 1.5.7
- 1.5.6
- 1.5.5
- 1.5.4
- 1.5.3
- 1.5.2
- 1.5.1
- 1.5.0

You can see a full list of all changes on Jira.

Thank you everyone for your support and suggestions!

## CentOS and Fedora Packages

10gen now publishes yum-installable RPM packages for CentOS 5.4 (x86 and x86_64) and Fedora 12 and 13 (x64_64 only for the moment). For each revision in stable, unstable, and snapshot, there are four packages, e.g., mongo-stable, mongo-stable-server, mongo-stable-devel, mongo-stable-debuginfo, for each of the client, server, headers, and debugging information, respectively.

To use these packages, add one of the following files in /etc/yum.repos.d, and then yum update and yum install your preferred complement of packages.

For CentOS 5.4 on x86_64:

```
[10gen]
name=10gen Repository
baseurl=http://downloads.mongodb.org/distros/centos/5.4/os/x86_64/
gpgcheck=0
```

For CentOS 5.4 on x86

```
[10gen]
name=10gen Repository
baseurl=http://downloads.mongodb.org/distros/centos/5.4/os/i386/
gpgcheck=0
```

For Fedora 13:

```
[10gen]
name=10gen Repository
baseurl=http://downloads.mongodb.org/distros/fedora/13/os/x86_64/
gpgcheck=0
```

For Fedora 12:

```
[10gen]
name=10gen Repository
baseurl=http://downloads.mongodb.org/distros/fedora/12/os/x86_64/
gpgcheck=0
```

For Fedora 11:

```
[10gen]
name=10gen Repository
baseurl=http://downloads.mongodb.org/distros/fedora/11/os/x86_64/
gpgcheck=0
```

For the moment, these packages aren't signed. (If anybody knows how to automate signing RPMs, please let us know!)

## Ubuntu and Debian packages

> ⚠ Please read the notes on the Downloads page. Also, note that these packages are updated daily, and so if you find you can't download the packages, try updating your apt package lists, e.g., with 'apt-get update' or 'aptitude update'.

10gen publishes apt-gettable packages. Our packages are generally fresher than those in Debian or Ubuntu. We publish 3 distinct packages, named "mongodb-stable", "mongodb-unstable", "mongodb-snapshot", corresponding to our latest stable release, our latest development release, and the most recent git checkout at the time of building. Each of these packages conflicts with the others, and with the "mongodb" package in Debian/Ubuntu.

The packaging is still a work-in-progress, so we invite Debian and Ubuntu users to try them out and let us know how the packaging might be improved.

To use the packages, add a line to your /etc/apt/sources.list, then 'aptitude update' and one of 'aptitude install mongodb-stable', 'aptitude install

mongodb-unstable' or 'aptitude install mongodb-snapshot'.

For Ubuntu Lucid (10.4) (built using a prerelease installation):

```
deb http://downloads.mongodb.org/distros/ubuntu 10.4 10gen
```

For Ubuntu Karmic (9.10):

```
deb http://downloads.mongodb.org/distros/ubuntu 9.10 10gen
```

For Ubuntu Jaunty (9.4):

```
deb http://downloads.mongodb.org/distros/ubuntu 9.4 10gen
```

For Debian Lenny (5.0):

```
deb http://downloads.mongodb.org/distros/debian 5.0 10gen
```

These packages are snapshots of our git master branch, and we plan to update them frequently, so package version numbers will be of the form YYYYMMDD; when reporting issues with these packages, please include the package version in your report.

The public gpg key used for signing these packages follows. It should be possible to import the key into apt's public keyring with a command like this:

```
sudo apt-key adv --keyserver keyserver.ubuntu.com --recv 7F0CEB10
```

To configure these packages beyond the defaults, have a look at */etc/mongodb.conf*, and/or the initialization script, (*/etc/init.d/mongodb* on older, non-Upstart systems, */etc/init/mongodb.conf* on Upstart systems). Most MongoDB operational settings are in */etc/mongodb.conf*; a few other settings are in the initialization script. Note that if you customize the *userid* in the initialization script or the *dbpath* or *logpath* settings in */etc/mongodb.conf*, you must ensure that the directories and files you use are writable by the userid you run the server as.

Packages for other distros coming soon!

```
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: GnuPG v1.4.10 (Darwin)


mQENBEtsQe8BCACm5G0/ei0IxyjVEp6EEtbEbWK1Q4dKaONtiCODwB8di+L8tlUd
Ra5QYxeyV90C+dqdh34o79enXxT6idHfYYqDdob2/kAPE6vFi4sLmrWIVGCRY++7
RPclZuezPm1sxG1TRAYEsW0VZUE9ofdoQ8xlUZDyn2BSjG8OCT2e4orRg1pHgzw2
n3hnWqJNuJS4jxcRJOxI049THIGUtqBfF8bQoZw8C3Wg/R6pGghUfNjpA6uF9KAH
gnqrC0swZ1/vwIJt9fnvAlzkqLrssYtKH0rMdn5n4g5tJLqY5q/NruHMq2rhoy3r
4MC1w8GTbP7qR83wAyaLJ7xACOKqxB3SrDFJABEBAAG0I1JpY2hhcmQgS3JldXRl
ciA8cmljaGFyZEAxMGdlbi5jb20+iQE4BBMBAgAiBQJLbEHvAhsDBgsJCAcDAgYV
CAIJCgsEFgIDAQIeAQIXgAAKCRCey+xGfwzrEGXbB/4nrmf/2rEnztRelmup3duI
eepzEtw1cv3uHg2oZXGS6S7o5Fsk+amngaWelWKfkSw5La7aH5vL4tKFKUfuaME1
avInDIU/0IEs8jLrdSWq601HowLQcxAhqNPdaGONDtHw56Qhs0Ba8GA6329vLWgZ
ODnXweiNSCDrv3xbIN6IjPyyO5AoUkxmJfD0mVtp3u5Ar7kfIw7ieGGxokaHewNL
Xzqcp9rPiUR6dFw2uRvDdVRrXFUPlgVugaHKytm15JpHmQfyzQiMdYXnIz0oofJO
WM/PY1iw+QJZ2M7PnfbTJeADXIc/EoOAJDRggih533SjhiCaT6FdPMMk6rCZ5cgl
uQENBEtsQe8BCADlNPIJZVSL2i6H9X19YK4CpEqsjIUGISMB1cDT311WFSnhfuMs
GL9xYRb8dlbyeJFFOyHNkIBmH5ekCvGRfS6qJYpcUQZZcWSjEMqBYQV5cw1efd0B
ek64jfvrsLz8+YhKzn+NI8O3nyGvpEEWvOhN4hNjwkDhYbXLvAlsqagbnSMf+Htf
3lgCGYa2gLiNIqNKWCsEVAan/Er6KS39WANGXi6ih0yjReBiU8WR6Qh2ylMi2xKw
yHnTOsbWxP0hqALUa7N4AEGCXS/qn+vUz/hcIbt+eUNy45qoZcTT3dZsWGfJqknh
RFMIuPiej7/WY4Ugzes5NG02ecDkDkpJvrSNABEBAAGJAR8EGAECAAkFAktsQe8C
GwwACgkQnsvsRn8M6xABeggAlNkqbqa12L1bgaCgnGGdCiuXB3F6/VFmSQdUKpts
EuqWH6rSp30r67PupzneX++ouh+9WD5O7gJ0kP3VQJpmXjT/QnN5ANjI4kAtRZUW
qCXlXOxVAeXHL5oiKz0NM23Xc2rNAyfBQY8+SUYrKBalNBq5m68g8oogX8QD5u2F
x+6C+QK9G2EBDD/NWgkKN3GOxpQ5DTdPHI5/fjwYFs1leIaQjjiyJwAifxB/1+w0
VCHe2LDVpRXY5uBTefF2guhVYisKY6n5wNDaQpBmA8w17it5Yp8ge0HMN1A+aZ+6
L6MsuHbG2OYDZgAk8eKhvyd0y/pAhZpNuQ82MMGBmcueSA==
=74Cu
-----END PGP PUBLIC KEY BLOCK-----
```


## Version Numbers

MongoDB uses the odd-numbered versions for development releases.

There are 3 numbers in a MongoDB version: *A.B.C*

- *A* is the major version. This will rarely change and signify very large changes
- *B* is the release number. This will include many changes including features and things that possible break backwards compatibility. Even Bs will be stable branches, and odd Bs will be development.
- *C* is the revision number and will be used for bugs and security issues.

For example:

- 1.0.0 : first GA release
- 1.0.x : bug fixes to 1.0.x - highly recommended to upgrade, very little risk
- 1.1.x : development release. this will include new features that are not fully finished, and works in progress. Some things may be different than 1.0
- 1.2.x : second GA release. this will be the culmination of the 1.1.x release.

# Drivers

MongoDB currently has client support for the following programming languages:

### *mongodb.org Supported*

- C
- C++
- Java
- Javascript
- Perl
- PHP
- Python
- Ruby

### *Community Supported*

- REST

- C# and .NET
- Clojure
- ColdFusion
  - Blog post: Part 1 | Part 2 | Part 3
  - http://github.com/virtix/cfmongodb/tree/0.9
- D
  - Port of the MongoDB C Driver for D
- Delphi
  - pebongo - Early stage Delphi driver for MongoDB
- Erlang
  - emongo - An Erlang MongoDB driver that emphasizes speed and stability. "The most emo of drivers."
  - Erlmongo - an almost complete MongoDB driver implementation in Erlang
- Factor
  - http://github.com/slavapestov/factor/tree/master/extra/mongodb/
- Fantom
  - http://bitbucket.org/liamstask/fantomongo/wiki/Home
- F#
  - http://gist.github.com/218388
- Go
  - gomongo
- Groovy
  - See Java Language Center
- Haskell
  - http://hackage.haskell.org/package/mongoDB
- Javascript
- Lua
  - LuaMongo
- node.js
- Objective C
  - NuMongoDB
- PHP
  - Asynchronous PHP driver using libevent
- PowerShell
  - Blog post
- Python
- Ruby
  - MongoMapper
  - rmongo - An event-machine-based Ruby driver for MongoDB
  - jmongo A thin ruby wrapper around the mongo-java-driver for vastly better jruby performance.
  - em-mongo EventMachine MongoDB Driver (based off of RMongo).
- Scala
  - See JVM Languages
- Scheme (PLT)
  - http://planet.plt-scheme.org/display.ss?package=mongodb.plt&owner=jaymccarthy
  - docs
- Smalltalk
  - Dolphin Smalltalk

### *Get Involved, Write a Driver!*

- Writing Drivers and Tools

# C Language Center

- C Driver
  - Download
  - Build
- Notable Projects

### C Driver

**The MongoDB C Driver** is the 10gen-supported driver for MongoDB. It's written in pure C. The goal is to be super strict for ultimate portability, no dependencies, and very embeddable anywhere.

- Tutorial
- C Driver README
- Source Code

### *Download*

The C driver is hosted at GitHub.com. Check out the latest version with git.

```
$ git clone git://github.com/mongodb/mongo-c-driver.git
```

### *Build*

Building with gcc:

```
$ gcc --std=c99 -Isrc /path/to/mongo-c-driver/src/*.c YOUR_APP.c
```

Building with scons:

```
$ scons # this will produce libbson.a and libmongoc.a
$ scons --c99 # this will use c99 mode in gcc (recommended)
$ scons test # this will compile and run the unit tests (optional)
$ scons test --test-server=123.4.5.67 # use remote server for tests
```

### Notable Projects

**NuMongodb** – An Objective-C wrapper around the MongoDB C driver. It is intended for use with Nu but may be useful in other Objective-C programming applications.

If you're working on a project that you'd like to have included, let us know.

## C Tutorial


- Writing Client Code
  - Connecting
  - BSON
  - Inserting
    - Single
    - Batch
  - Querying
    - Simple Queries
    - Complex Queries
      - Sorting
      - Hints
      - Explain
  - Indexing
  - Updating
- Further Reading


This document is an introduction to usage of the MongoDB database from a C program.

First, install Mongo -- see the Quickstart for details.

Next, you may wish to take a look at the Developer's Tour guide for a language independent look at how to use MongoDB. Also, we suggest some basic familiarity with the `mongo shell` -- the shell is one's primary database administration tool and is useful for manually inspecting the contents of a database after your C program runs.

**A working C program complete with examples from this tutorial can be found here.**

### Writing Client Code

For brevity, the examples below are simply inline code.

### *Connecting*

Let's make a tutorial.c file that connects to the database:

```
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include "bson.h"
#include "mongo.h"

int main() {
    mongo_connection conn[1]; /* ptr */
    mongo_connection_options opts[1];
    mongo_conn_return status;

    strcpy( opts->host , "127.0.0.1" );
    opts->port = 27017;

    status = mongo_connect( conn, opts );

    switch (status) {
        case mongo_conn_success: printf( "connection succeeded\n" ); break;
        case mongo_conn_bad_arg: printf( "bad arguments\n" ); return 1;
        case mongo_conn_no_socket: printf( "no socket\n" ); return 1;
        case mongo_conn_fail: printf( "connection failed\n" ); return 1;
        case mongo_conn_not_master: printf( "not master\n" ); return 1;
    }

    /* CODE WILL GO HERE */

    mongo_destroy( conn );
    printf( "\nconnection closed\n" );

    return 0;
}
```

If you are using gcc on Linux or OS X, you would compile with something like this, depending on location of your include files:

```
$ gcc -Isrc --std=c99 /path/to/mongo-c-driver/src/*.c -I /path/to/mongo-c-driver/src/ tutorial.c -o
tutorial
$ ./tutorial
connection succeeded
connection closed
$
```

### *BSON*

The Mongo database stores data in BSON format. BSON is a binary object format that is JSON-like in terms of the data which can be stored (some extensions exist, for example, a Date datatype).

To save data in the database we must create `bson` objects. We use `bson_buffer` to make `bson` objects, and `bson_iterator` to enumerate `bson` objects.

Let's now create a BSON "person" object which contains name and age. We might invoke:

```
bson b[1];
bson_buffer buf[1];

bson_buffer_init( buf )
bson_append_string( buf, "name", "Joe" );
bson_append_int( buf, "age", 33 );
bson_from_buffer( b, buf );
```

Use the `bson_append_new_oid()` helper to add an object id to your object. The server will add an _id automatically if it is not included explicitly.

```
bson b[1];
bson_buffer buf[1];

bson_buffer_init( buf );
bson_append_new_oid( buf, "_id" );
bson_append_string( buf, "name", "Joe" );
bson_append_int( buf, "age", 33 );
bson_from_buffer( b, buf );
```

`bson_buffer_new_oid( ..., "_id" )` should be at the beginning of the generated object.

When you are done using the object remember to use `bson_destroy()` to free up the memory allocated by the buffer.

```
bson_destroy( b )
```

### *Inserting*

#### Single

We now save our person object in a persons collection in the database:

```
mongo_insert( conn, "tutorial.persons", b );
```

The first parameter to `mongo_insert` is the pointer to the `mongo_connection` object. The second parameter is the namespace. *tutorial* is the database and *persons* is the collection name. The third parameter is a pointer to the `bson` "person" object that we created before.

#### Batch

We can do batch inserts as well:

```
static void tutorial_insert_batch( mongo_connection *conn ) {
    bson *p, **ps;
    bson_buffer *p_buf;
    char *names[4];
    int ages[] = { 29, 24, 24, 32 };
    int i, n = 4;
    names[0] = "Eliot"; names[1] = "Mike"; names[2] = "Mathias"; names[3] = "Richard";

    ps = ( bson ** )malloc( sizeof( bson * ) * n);

    for ( i = 0; i < n; i++ ) {
        p = ( bson * )malloc( sizeof( bson ) );
        p_buf = ( bson_buffer * )malloc( sizeof( bson_buffer ) );
        bson_buffer_init( p_buf );
        bson_append_new_oid( p_buf, "_id" );
        bson_append_string( p_buf, "name", names[i] );
        bson_append_int( p_buf, "age", ages[i] );
        bson_from_buffer( p, p_buf );
        ps[i] = p;
        free( p_buf );
    }

    mongo_insert_batch( conn, "tutorial.persons", ps, n );

    for ( i = 0; i < n; i++ ) {
        bson_destroy( ps[i] );
        free( ps[i] );
    }
}
```

### *Querying*

#### Simple Queries

Let's now fetch all objects from the persons collection, and display them.

```
static void tutorial_empty_query( mongo_connection *conn) {
    mongo_cursor *cursor;
    bson empty[1];
    bson_empty( empty );

    cursor = mongo_find( conn, "tutorial.persons", empty, empty, 0, 0, 0 );
    while( mongo_cursor_next( cursor ) ) {
        bson_print( &cursor->current );
    }

    mongo_cursor_destroy( cursor );
    bson_destroy( empty );
}
```

`empty` is the empty BSON object -- we use it to represent {} which indicates an empty query pattern (an empty query is a query for all objects).

We use `bson_print()` above to print out information about each object retrieved. `bson_print()` is a diagnostic function which prints an abbreviated JSON string representation of the object.

> ⚠ `mongo_find()` returns a `mongo_cursor` which must be destroyed after use.

Let's now write a function which prints out the name (only) of all persons in the collection whose age is a given value:

```
static void tutorial_simple_query( mongo_connection *conn ) {
    bson query[1];
    bson_buffer query_buf[1];
    mongo_cursor *cursor;

    bson_buffer_init( query_buf );
    bson_append_int( query_buf, "age", 24 );
    bson_from_buffer( query, query_buf );

    cursor = mongo_find( conn, "tutorial.persons", query, NULL, 0, 0, 0 );
    while( mongo_cursor_next( cursor ) ) {
        bson_iterator it[1];
        if ( bson_find( it, &cursor->current, "name" )) {
                printf( "name: %s\n", bson_iterator_string( it ) );
        }
    }

    bson_destroy( query );
}
```

Our query above, written as JSON, is of the form

```
{ age : <agevalue> }
```

Queries are BSON objects of a particular format.

In the mongo shell (which uses javascript), we could invoke:

```
use tutorial;
db.persons.find( { age : 24 } );
```

**Complex Queries**

Sometimes we want to do more then a simple query. We may want the results to be sorted in a special way, or what the query to use a certain index.

***Sorting***

Let's now make the results from previous query be sorted alphabetically by name.  To do this, we change the query statement from:

```
bson_buffer_init( query_buf );
bson_append_int( query_buf, "age", 24 );
bson_from_buffer( query, query_buf );
```

to:

```
bson_buffer_init( query_buf );
bson_append_start_object( query_buf, "$query" );
bson_append_int( query_buf, "age", 24 );
bson_append_finish_object( query_buf );
bson_append_start_object( query_buf, "$orderby" );
bson_append_int( query_buf, "name", 1);
bson_append_finish_object( query_buf );
bson_from_buffer( query, query_buf );
```

***Hints***

While the mongo query optimizer often performs very well, explicit "hints" can be used to force mongo to use a specified index, potentially improving performance in some situations. When you have a collection indexed and are querying on multiple fields (and some of those fields are indexed), pass the index as a hint to the query:

```
bson_buffer_init( query_buf );
bson_append_start_object( query_buf, "$query" );
bson_append_int( query_buf, "age", 24 );
bson_append_string( query_buf, "name", "Mathias" );
bson_append_finish_object( query_buf );
bson_append_start_object( query_buf, "$hint" );
bson_append_int( query_buf, "name", 1);
bson_append_finish_object( query_buf );
bson_from_buffer( query, query_buf );
```

***Explain***

A great way to get more information on the performance of your database queries is to use the $explain feature. This will return "explain plan" type info about a query from the database.

```
bson_buffer_init( query_buf );
bson_append_start_object( query_buf, "$query" );
bson_append_int( query_buf, "age", 33 );
bson_append_finish_object( query_buf );
bson_append_bool( query_buf, "$explain", 1);
bson_from_buffer( query, query_buf );
```

## *Indexing*

Let's suppose we want to have an index on age so that our queries are fast.  We would use:

```
static void tutorial_index( mongo_connection * conn ) {
    bson key[1];
    bson_buffer key_buf[1];

    bson_buffer_init( key_buf );
    bson_append_int( key_buf, "name", 1 );
    bson_from_buffer( key, key_buf );

    mongo_create_index( conn, "tutorial.persons", key, 0, NULL );

    bson_destroy( key );

    printf( "simple index created on \"name\"\n" );

    bson_buffer_init( key_buf );
    bson_append_int( key_buf, "age", 1 );
    bson_append_int( key_buf, "name", 1 );
    bson_from_buffer( key, key_buf );

    mongo_create_index( conn, "tutorial.persons", key, 0, NULL );

    bson_destroy( key );

    printf( "compound index created on \"age\", \"name\"\n" );
}
```

### *Updating*

Use the `mongo_update()` method to perform a database update . For example the following update in the mongo shell :

```
> use tutorial
> db.persons.update( { name : 'Joe', age : 33 },
...                  { $inc : { visits : 1 } } )
```

is equivalent to running the following C function:

```
static void tutorial_update( mongo_connection *conn ) {
    bson cond[1], op[1];
    bson_buffer cond_buf[1], op_buf[1];

    bson_buffer_init( cond_buf );
    bson_append_string( cond_buf, "name", "Joe");
    bson_append_int( cond_buf, "age", 33);
    bson_from_buffer( cond, cond_buf );

    bson_buffer_init( op_buf );
    bson_append_start_object( op_buf, "$inc" );
    bson_append_int( op_buf, "visits", 1 );
    bson_append_finish_object( op_buf );
    bson_from_buffer( op, op_buf );

    mongo_update(conn, "tutorial.persons", cond, op, 0);

    bson_destroy( cond );
    bson_destroy( op );
}
```

## Further Reading

This overview just touches on the basics of using Mongo from C++.  There are many more capabilities.  For further exploration:

- See the language-independent Developer's Tour;

- Experiment with the `mongo` shell;
- Consider getting involved to make the product (either C driver, tools, or the database itself) better!

# C Sharp Language Center

### C# Drivers

- mongodb-csharp driver
- simple-mongodb driver
- NoRM

### F#

- F# Example

### Community Articles

- A List of C# MongoDB Tools
- Experimenting with MongoDB from C#
- Using MongoDB from C#
- Introduction to MongoDB for .NET
- Using Json.NET and Castle Dynamic Proxy with MongoDB
- Implementing a Blog Using ASP.NET MVC and MongoDB
- Intro Article using a Post and Comments Example

### Tools

- MongoDB.Emitter Document Wrapper
- log4net appender

### Support

- http://groups.google.com/group/mongodb-csharp
- http://groups.google.com/group/mongodb-user
- IRC: #mongodb on freenode

### See Also

- C++ Language Center

# Driver Syntax Table

The wiki generally gives examples in JavaScript, so this chart can be used to convert those examples to any language.

| JavaScript | Python | PHP | Ruby |
|---|---|---|---|
| [ ] | [] | `array()` | [] |
| {} | {} | `new stdClass` | {} |
| { x : 1 } | {"x": 1} | `array('x' => 1)` | {'x' => 1} |
| `connect("www.example.net")` | `Connection("www.example.net")` | `new Mongo("www.example.net")` | `Mongo.new("www.example.` |
| `cursor.next()` | `cursor.next()` | `$cursor->getNext()` | `cursor.next_object()` |
| `cursor.hasNext()` | * | `$cursor->hasNext()` | * |
| `collection.findOne()` | `collection.find_one()` | `$collection->findOne()` | `collection.find_one()` |
| `db.eval()` | `db.eval()` | `$db->execute()` | `db.eval()` |

* does not exist in that language

# Javascript Language Center

MongoDB can be

- Used by clients written in Javascript;
- Uses Javascript internally server-side for certain options such as map/reduce;
- Has a shell that is based on Javascript for administrative purposes.

### [node.JS and V8]

See the node.JS page.

### SpiderMonkey

The MongoDB shell extends SpiderMonkey.  See the MongoDB shell documentation.

### Narwhal

- http://github.com/sergi/narwhal-mongodb

### MongoDB Server-Side Javascript

Javascript may be executed in the MongoDB server processes for various functions such as query enhancement and map/reduce processing. See Server-side Code Execution.

# node.JS

Node.js is used to write event-driven, scalable network programs in server-side JavaScript. It is similar in purpose to Twisted, EventMachine, etc. It runs on Google's V8.

#### Web Frameworks

- ExpressJS Mature web framework with MongoDB session support.

#### 3rd Party ORM/ODM

- Mongoose - Asynchronous JavaScript Driver with optional support for Modeling.

#### 3rd Party Drivers

- node-mongodb - Async Node interface to MongoDB (written in C)
- node-mongodb-native - Native async Node interface to MongoDB.
- mongo-v8-driver - V8 MongoDB driver (experimental, written in C++).

# JVM Languages

moved to Java Language Center

# Python Language Center

**Redirection Notice**
This page should redirect to http://api.mongodb.org/python.

# PHP Language Center

### Using MongoDB in PHP

***To access MongoDB from PHP you will need:***

- The MongoDB server running - the server is the "mongo**d**" file, not the "mongo" client (note the "d" at the end)

- The MongoDB PHP driver installed

### Installing the PHP Driver

#### *NIX

Run:

```
sudo pecl install mongo
```

Open your php.ini file and add to it:

```
extension=mongo.so
```

It is recommended to add this to the section with the other "extensions", but it will work from anywhere within the php.ini file.

Restart your web server (Apache, nginx, etc.) for the change to take effect.

See the installation docs for configuration information and OS-specific installation instructions.

#### Windows

- Download the correct driver for your environment from http://github.com/mongodb/mongo-php-driver/downloads
  - VC6 is for Apache (VC9 is for IIS)
  - Thread safe is for running PHP as an Apache module (typical installation), non-thread safe is for CGI
- Unzip and add the php_mongo.dll file to your PHP extensions directory (usually the "ext" folder in your PHP installation.)
- Add to your php.ini:

  ```
  extension=php_mongo.dll
  ```

- Restart your web server (Apache, IIS, etc.) for the change to take effect

For more information, see the Windows section of the installation docs.

### Using the PHP Driver

To get started, see the Tutorial. Also check out the API Documentation.

### See Also

- PHP Libraries, Frameworks, and Tools for working with Drupal, Cake, Symfony, and more from MongoDB.
- Admin UIs

## Installing the PHP Driver

**Redirection Notice**
This page should redirect to http://www.php.net/manual/en/mongo.installation.php.

## PHP Libraries, Frameworks, and Tools

The PHP community has created a huge number of libraries to make working with MongoDB easier and integrate it with existing frameworks.

#### *CakePHP*

- MongoDB datasource for CakePHP. There's also an introductory blog post on using it with Mongo.

#### *Codeigniter*

- MongoDB-Codeigniter-Driver

***Doctrine***

ODM (Object Document Mapper) is an experimental Doctrine MongoDB object mapper. The Doctrine\ODM\Mongo namespace is an experimental project for a PHP 5.3 MongoDB Object Mapper. It allows you to easily write PHP 5 classes and map them to collections in MongoDB. You just work with your objects like normal and Doctrine will transparently persist them to Mongo.

This project implements the same "style" of the Doctrine 2 ORM project interface so it will look very familiar to you and it has lots of the same features and implementations.

- Documentation - API, Reference, and Cookbook
- Official blog post
- Screencast
- Blog post on using it with Symfony
- Bug tracker

***Drupal***

- MongoDB Integration - Views (query builder) backend, a watchdog implementation (logging), and field storage.

***Fat-Free Framework***

Fat-Free is a powerful yet lightweight PHP 5.3+ Web development framework designed to help you build dynamic and robust applications - fast!

***Kohana Framework***

- Mango at github
  An ActiveRecord-like library for PHP, for the Kohana PHP Framework.
  See also PHP Language Center#MongoDb PHP ODM further down.

***Lithium***

Lithium supports Mongo out-of-the-box.

- Tutorial on creating a blog backend.

***Log4php***

- A log4php appender for MongoDB

***Memcached***

- MongoNode
  PHP script that replicates MongoDB objects to Memcached.

***Symfony 2***

- Symfony 2 Logger
  A centralized logger for Symfony applications. See the blog post.
- sfMongoSessionStorage - manages session storage via MongoDB with symfony.
- sfStoragePerformancePlugin - This plugin contains some extra storage engines (MongoDB and Memcached) that are currently missing from the Symfony (>= 1.2) core.

***Vork***

Vork, the high-performance enterprise framework for PHP natively supports MongoDB as either a primary datasource or used in conjunction with an RDBMS. Designed for scalability & Green-IT, Vork serves more traffic with fewer servers and can be configured to operate without any disk-IO.

Vork provides a full MVC stack that outputs semantically-correct XHTML 1.1, complies with Section 508 Accessibility guidelines & Zend-Framework coding-standards, has SEO-friendly URLs, employs CSS-reset for cross-browser display consistency and is written in well-documented object-oriented E_STRICT PHP5 code.

An extensive set of tools are built into Vork for ecommerce (cc-processing, SSL, PayPal, AdSense, shipment tracking, QR-codes), Google Maps, translation & internationalization, Wiki, Amazon Web Services, Social-Networking (Twitter, Meetup, ShareThis, YouTube, Flickr) and much more.

***Zend Framework***

- Shanty Mongo is a prototype mongodb adapter for the Zend Framework. It's intention is to make working with mongodb documents as

natural and as simple as possible. In particular allowing embeded documents to also have custom document classes.

- ZF Cache Backend
  A ZF Cache Backend for MongoDB. It support tags and auto-cleaning.
- There is a Zend_Nosql_Mongo component proposal.

### *Stand-Alone Tools*

#### *ActiveMongo*

ActiveMongo is a really simple ActiveRecord for MongoDB in PHP.

There's a nice introduction to get you started at http://crodas.org/activemongo.php.

#### *MapReduce API*

A MapReduce abstraction layer. See the blog post.

- MongoDB-MapReduce-PHP at github

#### *MongoDb PHP ODM*

MongoDb PHP ODM is a simple object wrapper for the Mongo PHP driver classes which makes using Mongo in your PHP application more like ORM, but without the suck. It is designed for use with Kohana 3 but will also integrate easily with any PHP application with almost no additional effort.

#### *Mongodloid*

A nice library on top of the PHP driver that allows you to make more natural queries (`$query->query('a == 13 AND b >= 8 && c % 3 == 4');`), abstracts away annoying $-syntax, and provides getters and setters.

- Project Page
- Downloads
- Documentation

#### *Morph*

A high level PHP library for MongoDB. Morph comprises a suite of objects and object primitives that are designed to make working with MongoDB in PHP a breeze.

- Morph at code.google.com

#### *simplemongophp*

Very simple layer for using data objects see blog post

- simplemongophp at github

#### *Uniform Server 6-Carbo with MongoDB and phpMoAdmin*

The Uniform Server is a lightweight WAMP server solution for running a web server under Windows without having anything to install; just unpack and run it. Uniform Server 6-Carbo includes the latest versions of Apache2, Perl5, PHP5, MySQL5 and phpMyAdmin. The Uniform Server MongoDB plugin adds the MongoDB server, phpMoAdmin browser administration interface, the MongoDB PHP driver and a Windows interface to start and stop both Apache and MongoDB servers. From this interface you can also start either the Mongo-client or phpMoAdmin to administer MongoDB databases.

- Uniform Server 6-Carbo and MongoDB plugin at SourceForge
- Uniform Server web site

## PHP - Storing Files and Big Data

**Redirection Notice**
This page should redirect to http://www.php.net/manual/en/class.mongogridfs.php.

## Troubleshooting the PHP Driver

**Redirection Notice**
This page should redirect to http://www.php.net/manual/en/mongo.trouble.php.

# Ruby Language Center

This is an overview of the available tools and suggested practices for using Ruby with MongoDB. Those wishing to skip to more detailed discussion should check out the Ruby Driver Tutorial, Getting started with Rails or Rails 3, and MongoDB Data Modeling and Rails. There are also a number of good external resources worth checking out.


- Ruby Driver
  - Installing / Upgrading
  - BSON
- Object Mappers
- Notable Projects


## Ruby Driver

Install the C extension for any performance-critical applications.

**The MongoDB Ruby driver** is the 10gen-supported driver for MongoDB. It's written in pure Ruby, with a recommended C extension for speed. The driver is optimized for simplicity. It can be used on its own, but it also serves as the basis for various object-mapping libraries.

- Tutorial
- Ruby Driver README
- API Documentation
- Source Code

### *Installing / Upgrading*

The ruby driver is hosted at Rubygems.org. Before installing the driver, make sure you're using the latest version of rubygems (currently 1.3.6):

```
$ gem update --system
```

Then install the gems:

```
$ gem install mongo
```

To stay on the bleeding edge, check out the latest source from github:

```
$ git clone git://github.com/mongodb/mongo-ruby-driver.git
$ cd mongo-ruby-driver/
```

Then, install the driver from there:

```
$ rake gem:install
```

### *BSON*

In versions of the Ruby driver prior to 0.20, the code for serializing to BSON existed in the mongo gem. Now, all BSON serialization is handled by the required bson gem.

```
gem install bson
```

For significantly improved performance, install the bson extensions gem:

```
gem install bson_ext
```

If you're running on Windows, you'll need the Ruby DevKit installed in order to compile the C extensions.

As long it's in Ruby's load path, `bson_ext` will be loaded automatically when you require `bson`.

Note that beginning with version 0.20, the mongo_ext gem is no longer used.

To learn more about the Ruby driver, see the Ruby Tutorial.

### Object Mappers

If you need validations, associations, and other high-level data modeling functions, consider using one of the available object mappers. Many of these exist in the Ruby ecosystem; here we host a list of the most popular ones.

### Notable Projects

Tools for working with MongoDB in Ruby are being developed daily. A partial list can eb found in the Projects and Libraries section of our external resources page.

If you're working on a project that you'd like to have included, let us know.

## Ruby Tutorial

This tutorial gives many common examples of using MongoDB with the Ruby driver. If you're looking for information on data modeling, see MongoDB Data Modeling and Rails. Links to the various object mappers are listed on our object mappers page.

Interested in GridFS? Checkout GridFS in Ruby.

As always, the latest source for the Ruby driver can be found on github.


- Installation
- A Quick Tour
  - Using the RubyGem
  - Making a Connection
  - Listing All Databases
  - Dropping a Database
  - Authentication (Optional)
  - Getting a List Of Collections
  - Getting a Collection
  - Inserting a Document
  - Finding the First Document In a Collection using `find_one()`
  - Adding Multiple Documents
  - Counting Documents in a Collection
  - Using a Cursor to get all of the Documents
  - Getting a Single Document with a Query
  - Getting a Set of Documents With a Query
  - Querying with Regular Expressions
  - Creating An Index
  - Creating and querying on a geospatial index
  - Getting a List of Indexes on a Collection
  - Database Administration
- See Also


### Installation

The mongo-ruby-driver gem is served through Rubygems.org. To install, make sure you have the latest version of rubygems.

```
gem update --system
```

Next, install the mongo rubygem:

```
gem install mongo
```

The required `bson` gem will be installed automatically.

For optimum performance, install the bson_ext gem:

```
gem install bson_ext
```

After installing, you may want to look at the examples directory included in the source distribution. These examples walk through some of the basics of using the Ruby driver.

The full API documentation can be viewed here.

## A Quick Tour

### Using the RubyGem

All of the code here assumes that you have already executed the following Ruby code:

```
require 'rubygems'  # not necessary for Ruby 1.9
require 'mongo'
```

### Making a Connection

An Mongo::Connection instance represents a connection to MongoDB. You use a Connection instance to obtain an Mongo:DB instance, which represents a named database. The database doesn't have to exist - if it doesn't, MongoDB will create it for you.

You can optionally specify the MongoDB server address and port when connecting. The following example shows three ways to connect to the database "mydb" on the local machine:

```
db = Mongo::Connection.new.db("mydb")
db = Mongo::Connection.new("localhost").db("mydb")
db = Mongo::Connection.new("localhost", 27017).db("mydb")
```

At this point, the `db` object will be a connection to a MongoDB server for the specified database. Each DB instance uses a separate socket connection to the server.

If you're trying to connect to a replica set, see Replica Sets in Ruby.

### Listing All Databases

```
connection = Mongo::Connection.new # (optional host/port args)
connection.database_names.each { |name| puts name }
connection.database_info.each { |info| puts info.inspect}
```

### Dropping a Database

```
connection.drop_database('database_name')
```

### Authentication (Optional)

MongoDB can be run in a secure mode where access to databases is controlled through name and password authentication. When run in this mode, any client application must provide a name and password before doing any operations. In the Ruby driver, you simply do the following with the connected mongo object:

```
auth = db.authenticate(my_user_name, my_password)
```

If the name and password are valid for the database, `auth` will be `true`. Otherwise, it will be `false`. You should look at the MongoDB log for further information if available.

### Getting a List Of Collections

Each database has zero or more collections. You can retrieve a list of them from the db (and print out any that are there):

```
db.collection_names.each { |name| puts name }
```

and assuming that there are two collections, name and address, in the database, you would see

```
name
address
```

as the output.

#### Getting a Collection

You can get a collection to use using the `collection` method:

```
coll = db.collection("testCollection")
```

This is aliased to the [] method:

```
coll = db["testCollection"]
```

Once you have this collection object, you can now do things like insert data, query for data, etc.

#### Inserting a Document

Once you have the collection object, you can insert documents into the collection. For example, lets make a little document that in JSON would be represented as

```
{
   "name" : "MongoDB",
   "type" : "database",
   "count" : 1,
   "info" : {
               x : 203,
               y : 102
             }
}
```

Notice that the above has an "inner" document embedded within it. To do this, we can use a Hash or the driver's OrderedHash (which preserves key order) to create the document (including the inner document), and then just simply insert it into the collection using the `insert()` method.

```
doc = {"name" => "MongoDB", "type" => "database", "count" => 1,
       "info" => {"x" => 203, "y" => '102'}}
coll.insert(doc)
```

#### Finding the First Document In a Collection using `find_one()`

To show that the document we inserted in the previous step is there, we can do a simple `find_one()` operation to get the first document in the collection. This method returns a single document (rather than the `Cursor` that the `find()` operation returns).

```
my_doc = coll.find_one()
puts my_doc.inspect
```

and you should see:

```
{"_id"=>#<BSON::ObjectID:0x118576c ...>, "name"=>"MongoDB", "info"=>{"x"=>203, "y"=>102}, "type"=>
"database", "count"=>1}
```

Note the `_id` element has been added automatically by MongoDB to your document.

#### Adding Multiple Documents

To demonstrate some more interesting queries, let's add multiple simple documents to the collection. These documents will have the following form:

```
{
   "i" : value
}
```

Here's how to insert them:

```
100.times { |i| coll.insert("i" => i) }
```

Notice that we can insert documents of different "shapes" into the same collection. These records are in the same collection as the complex record we inserted above. This aspect is what we mean when we say that MongoDB is "schema-free".

#### Counting Documents in a Collection

Now that we've inserted 101 documents (the 100 we did in the loop, plus the first one), we can check to see if we have them all using the `count()` method.

```
puts coll.count()
```

and it should print `101`.

#### Using a Cursor to get all of the Documents

To get all the documents from the collection, we use the `find()` method. `find()` returns a `Cursor` object, which allows us to iterate over the set of documents that matches our query. The Ruby driver's Cursor implemented Enumerable, which allows us to use `Enumerable#each`, {{Enumerable#map}, etc. For instance:

```
coll.find().each { |row| puts row.inspect }
```

and that should print all 101 documents in the collection.

#### Getting a Single Document with a Query

We can create a *query* hash to pass to the `find()` method to get a subset of the documents in our collection. For example, if we wanted to find the document for which the value of the "i" field is 71, we would do the following ;

```
coll.find("i" => 71).each { |row| puts row.inspect }
```

and it should just print just one document:

```
{"_id"=>#<BSON::ObjectID:0x117de90 ...>, "i"=>71}
```

#### Getting a Set of Documents With a Query

We can use the query to get a set of documents from our collection. For example, if we wanted to get all documents where "i" > 50, we could write:

```
coll.find("i" => {"$gt" => 50}).each { |row| puts row }
```

which should print the documents where i > 50. We could also get a range, say 20 < i <= 30:

```
coll.find("i" => {"$gt" => 20, "$lte" => 30}).each { |row| puts row }
```

#### Querying with Regular Expressions

Regular expressions can be used to query MongoDB. To find all names that begin with 'a':

```
coll.find({"name" => /^a/})
```

You can also construct a regular expression dynamically. To match a given search string:

```
search_string = params['search']

# Constructor syntax
coll.find({"name" => Regexp.new(search_string)})

# Literal syntax
coll.find({"name" => /#{search_string}/})
```

Although MongoDB isn't vulnerable to anything like SQL-injection, it may be worth checking the search string for anything malicious.

#### Creating An Index

MongoDB supports indexes, and they are very easy to add on a collection. To create an index, you specify an index name and an array of field names to be indexed, or a single field name. The following creates an ascending index on the "i" field:

```
# create_index assumes ascending order; see method docs
# for details
coll.create_index("i")
```

To specify complex indexes or a descending index you need to use a slightly more complex syntax - the index specifier must be an Array of [field name, direction] pairs. Directions should be specified as Mongo::ASCENDING or Mongo::DESCENDING:

```
# explicit "ascending"
coll.create_index([["i", Mongo::ASCENDING]])
```

#### Creating and querying on a geospatial index

First, create the index on a field containing long-lat values:

```
people.create_index([["loc", Mongo::GEO2D]])
```

Then get a list of the twenty locations nearest to the point 50, 50:

```
people.find({"loc" => {"$near" => [50, 50]}}, {:limit => 20}).each do |p|
  puts p.inspect
end
```

#### Getting a List of Indexes on a Collection

You can get a list of the indexes on a collection using `coll.index_information()`.

#### Database Administration

A database can have one of three profiling levels: off (:off), slow queries only (:slow_only), or all (:all). To see the database level:

```
puts db.profiling_level   # => off (the symbol :off printed as a string)
db.profiling_level = :slow_only
```

Validating a collection will return an interesting hash if all is well or raise an exception if there is a problem.

```
p db.validate_collection('coll_name')
```

### See Also

- Ruby Driver Official Docs
- MongoDB Koans A path to MongoDB enlightenment via the Ruby driver.
- MongoDB Manual

## Replica Pairs in Ruby

> Replica Sets will replace replica pairs in MongoDB 1.6. If you are just now setting up an instance, you may want to wait for that and use master/slave replication in the meantime.

Here follow a few considerations for those using the Ruby driver with MongoDB and replica pairing.

- Setup
- Connection Failures
- Recovery
- Testing
- Further Reading

#### Setup

First, make sure that you've correctly paired two `mongod` instances. If you want to do this on the same machine for testing, make sure you've created two data directories. The init commands are as follows:

```
./mongod --pairwith localhost:27018 --dbpath /data/left --port 27017
./mongod --pairwith localhost:27017 --dbpath /data/right --port 27018
```

When you instantiate a Ruby connection, you'll have to make sure that the driver knows about both instances:

```
@connection = Connection.paired([['localhost', 27017], ['localhost', 27018]])
```

#### Connection Failures

Imagine that our master node goes offline. How will the driver respond?

At first, the driver will try to send operations to what was the master node. These operations will fail, and the driver will raise a **ConnectionFailure** exception. It then becomes the client's responsibility to decide how to handle this.

If the client decides to retry, it's not guaranteed that the former slave will have been promoted to master yet, so it's still possible that the driver will raise another **ConnectionFailure**. However, once the former slave has become master, typically within a few seconds, subsequent operations will succeed.

#### Recovery

Driver users may wish to wrap their database calls with failure recovery code. Here's one possibility:

```
# Ensure retry upon failure
def rescue_connection_failure(max_retries=5)
    success = false
    retries = 0
    while !success
      begin
        yield
        success = true
      rescue Mongo::ConnectionFailure => ex
        retries += 1
        raise ex if retries >= max_retries
        sleep(1)
      end
    end
  end
end

# Wrapping a call to #count()
rescue_connection_failure do
  @db.collection('users').count()
end
```

Of course, the proper way to handle connection failures will always depend on the individual application. We encourage object-mapper and application developers to publish any promising results.

#### Testing

The Ruby driver (>= 0.17.2) includes some unit tests for verifying proper replica pair behavior. They reside in **tests/replica**. You can run them individually with the following rake tasks:

```
rake test:pair_count
rake test:pair_insert
rake test:pair_query
```

Make sure you have a replica pair running locally before trying to run these tests.

#### Further Reading

- Replica Pairs
- Pairing Internals

## Replica Sets in Ruby

Here follow a few considerations for those using the Ruby driver with MongoDB and replica sets.


- Setup
- Connection Failures
- Recovery
- Testing
- Further Reading


#### Setup

First, make sure that you've configured and initialized a replica set.

Connecting to a replica set from the Ruby driver is easy. If you only want to specify a single node, simply pass that node to `Connection.new`:

```
@connection = Connection.new('foo.local', 27017)
```

If you want to pass in multiple seed nodes, use `Connection.multi`:

```
@connection = Connection.multi([['n1.mydb.net', 27017],
   ['n2.mydb.net', 27017], ['n3.mydb.net', 27017]])
```

In both cases, the driver will attempt to connect to a master node and, when found, will merge any other known members of the replica set into the seed list.

#### Connection Failures

Imagine that our master node goes offline. How will the driver respond?

At first, the driver will try to send operations to what was the master node. These operations will fail, and the driver will raise a **ConnectionFailure** exception. It then becomes the client's responsibility to decide how to handle this.

If the client decides to retry, it's not guaranteed that another member of the replica set will have been promoted to master right away, so it's still possible that the driver will raise another **ConnectionFailure**. However, once a member has been promoted to master, typically within a few seconds, subsequent operations will succeed.

The driver will essentially cycle through all known seed addresses until a node identifies itself as master.

#### Recovery

Driver users may wish to wrap their database calls with failure recovery code. Here's one possibility:

```
# Ensure retry upon failure
def rescue_connection_failure(max_retries=5)
    success = false
    retries = 0
    while !success
      begin
        yield
        success = true
      rescue Mongo::ConnectionFailure => ex
        retries += 1
        raise ex if retries >= max_retries
        sleep(1)
      end
    end
  end
end

# Wrapping a call to #count()
rescue_connection_failure do
  @db.collection('users').count()
end
```

Of course, the proper way to handle connection failures will always depend on the individual application. We encourage object-mapper and application developers to publish any promising results.

#### Testing

The Ruby driver (>= 1.0.6) includes some unit tests for verifying replica set behavior. They reside in **tests/replica_sets**. You can run them individually with the following rake tasks:

```
rake test:replica_set_count
rake test:replica_set_insert
rake test:pooled_replica_set_insert
rake test:replica_set_query
```

Make sure you have a replica set running on localhost before trying to run these tests.

#### Further Reading

- Replica Sets
- [Replics Set Configuration]

# GridFS in Ruby

GridFS, which stands for "Grid File Store," is a specification for storing large files in MongoDB. It works by dividing a file into manageable chunks and storing each of those chunks as a separate document. GridFS requires two collections to achieve this: one collection stores each file's metadata (e.g., name, size, etc.) and another stores the chunks themselves. If you're interested in more details, check out the GridFS Specification.

Prior to version 0.19, the MongoDB Ruby driver implemented GridFS using the GridFS::GridStore class. This class has been deprecated in favor of two new classes: Grid and GridFileSystem. These classes have a much simpler interface, and the rewrite has resulted in a significant speed improvement. **Reads are over twice as fast, and write speed has been increased fourfold**. 0.19 is thus a worthwhile upgrade.


- The Grid class
  - Saving files
  - File metadata
  - Safe mode
  - Deleting files
- The GridFileSystem class
  - Saving files
  - Deleting files
  - Metadata and safe mode
- Advanced Users


## *The Grid class*

The Grid class represents the core GridFS implementation. Grid gives you a simple file store, keyed on a unique ID. This means that duplicate filenames aren't a problem. To use the Grid class, first make sure you have a database, and then instantiate a Grid:

```
@db = Mongo::Connection.new.db('social_site')

@grid = Grid.new(@db)
```

### Saving files

Once you have a Grid object, you can start saving data to it. The data can be either a string or an IO-like object that responds to a #read method:

```
# Saving string data
id = @grid.put("here's some string / binary data")

# Saving IO data and including the optional filename
image = File.open("me.jpg")
id2   = @grid.put(image, :filename => "me.jpg")
```

Grid#put returns an object id, which you can use to retrieve the file:

```
# Get the string we saved
file = @grid.get(id)

# Get the file we saved
image = @grid.get(id2)
```

### File metadata

There are accessors for the various file attributes:

```
  image.filename
# => "me.jpg"

  image.content_type
# => "image/jpg"

  image.file_length
# => 502357

  image.upload_date
# => Mon Mar 01 16:18:30 UTC 2010

  # Read all the image's data at once
  image.read

  # Read the first 100k bytes of the image
  image.read(100 * 1024)
```

When putting a file, you can set many of these attributes and write arbitrary metadata:

```
# Saving IO data
  file = File.open("me.jpg")
  id2  = @grid.put(file,
           :filename     => "my-avatar.jpg"
           :content_type => "application/jpg",
           :_id          => 'a-unique-id-to-use-in-lieu-of-a-random-one',
           :chunk_size   => 100 * 1024,
           :metadata     => {'description' => "taken after a game of ultimate"})
```

#### Safe mode

A kind of safe mode is built into the GridFS specification. When you save a file, and MD5 hash is created on the server. If you save the file in safe mode, an MD5 will be created on the client for comparison with the server version. If the two hashes don't match, an exception will be raised.

```
  image = File.open("me.jpg")
  id2   = @grid.put(image, "my-avatar.jpg", :safe => true)
```

#### Deleting files

Deleting a file is as simple as providing the id:

```
  @grid.delete(id2)
```

### *The GridFileSystem class*

GridFileSystem is a light emulation of a file system and therefore has a couple of unique properties. The first is that filenames are assumed to be unique. The second, a consequence of the first, is that files are versioned. To see what this means, let's create a GridFileSystem instance:

#### Saving files

```
  @db = Mongo::Connection.new.db("social_site")

  @fs = GridFileSystem.new(@db)
```

Now suppose we want to save the file 'me.jpg.' This is easily done using a filesystem-like API:

```
image = File.open("me.jpg")
@fs.open("me.jpg", "w") do |f|
  f.write image
end
```

We can then retrieve the file by filename:

```
image = @fs.open("me.jpg", "r") {|f| f.read }
```

No problems there. But what if we need to replace the file? That too is straightforward:

```
image = File.open("me-dancing.jpg")
@fs.open("me.jpg", "w") do |f|
  f.write image
end
```

But a couple things need to be kept in mind. First is that the original 'me.jpg' will be available until the new 'me.jpg' saves. From then on, calls to the #open method will always return the most recently saved version of a file. But, and this the second point, old versions of the file won't be deleted. So if you're going to be rewriting files often, you could end up with a lot of old versions piling up. One solution to this is to use the :delete_old options when writing a file:

```
image = File.open("me-dancing.jpg")
@fs.open("me.jpg", "w", :delete_old => true) do |f|
  f.write image
end
```

This will delete all but the latest version of the file.

#### Deleting files

When you delete a file by name, you delete all versions of that file:

```
@fs.delete("me.jpg")
```

#### Metadata and safe mode

All of the options for storing metadata and saving in safe mode are available for the GridFileSystem class:

```
image = File.open("me.jpg")
@fs.open('my-avatar.jpg', w,
            :content_type => "application/jpg",
            :metadata     => {'description' => "taken on 3/1/2010 after a game of ultimate"},
            :_id          => 'a-unique-id-to-use-instead-of-the-automatically-generated-one',
            :safe         => true) { |f| f.write image }
```

### *Advanced Users*

Astute code readers will notice that the Grid and GridFileSystem classes are merely thin wrappers around an underlying GridIO class. This means that it's easy to customize the GridFS implementation presented here; just use GridIO for all the low-level work, and build the API you need in an external manager class similar to Grid or GridFileSystem.

## Rails - Getting Started

Using Rails 3? See Rails 3 - Getting Started

This tutorial describes how to set up a simple Rails application with MongoDB, using MongoMapper as an object mapper. We assume you're using Rails versions prior to 3.0.


- Configuration
- Testing
- Coding


**Using a Rails Template**
All of the configuration steps listed below, and more, are encapsulated in this Rails template (raw version), based on a similar one by Ben Scofield . You can create your project with the template as follows:

```
rails project_name -m "http://gist.github.com/219223.txt"
```

Be sure to replace **project_name** with the name of your project.

If you want to set up your project manually, read on.

### *Configuration*

1. We need to tell MongoMapper which database we'll be using. Save the following to **config/initializers/database.rb**:

```
MongoMapper.database = "db_name-#{Rails.env}"
```

Replace **db_name** with whatever name you want to give the database. The **Rails.env** variable will ensure that a different database is used for each environment.

2. If you're using Passenger, add this code to **config/initializers/database.rb**.

```
if defined?(PhusionPassenger)
   PhusionPassenger.on_event(:starting_worker_process) do |forked|
     MongoMapper.connection.connect_to_master if forked
   end
end
```

3. Clean out **config/database.yml**. This file should be blank, as we're not connecting to the database in the traditional way.

4. Remove ActiveRecord from environment.rb.

```
config.frameworks -= [:active_record]
```

5. Add MongoMapper to the environment. This can be done by opening **config/environment.rb** and adding the line:

```
config.gem 'mongo_mapper'
```

Once you've done this, you can install the gem in the project by running:

```
rake gems:install
rake gems:unpack
```

### *Testing*

It's important to keep in mind that with MongoDB, we cannot wrap test cases in transactions. One possible work-around is to invoke a **teardown** method after each test case to clear out the database.

To automate this, I've found it effective to modify **ActiveSupport::TestCase** with the code below.

```
# Drop all columns after each test case.
def teardown
  MongoMapper.database.collections.each do |coll|
    coll.remove
  end
end

# Make sure that each test case has a teardown
# method to clear the db after each test.
def inherited(base)
  base.define_method teardown do
    super
  end
end
```

This way, all test classes will automatically invoke the teardown method. In the example above, the teardown method clears each collection. We might also choose to drop each collection or drop the database as a whole, but this would be considerably more expensive and is only necessary if our tests manipulate indexes.

Usually, this code is added in **test/test_helper.rb**. See the aforementioned rails template for specifics.

### *Coding*

If you've followed the foregoing steps (or if you've created your Rails with the provided template), then you're ready to start coding. For help on that, you can read about modeling your domain in Rails.

## Rails 3 - Getting Started

It's not difficult to use MongoDB with Rails 3. Most of it comes down to making sure that you're not loading ActiveRecord and understanding how to use Bundler, the new Ruby dependency manager.


- Install the Rails 3
- Configure your application
- Bundle and Initialize
  - Bundling
  - Initializing
- Running Tests
- ActiveModel Compatibility
- Conclusion
- See also


### *Install the Rails 3*

If you haven't done so already, install Rails 3.

```
# Use sudo if your setup requires it
gem install rails
```

### *Configure your application*

The important thing here is to avoid loading ActiveRecord. One way to do this is with the `--skip-activerecord` switch. So you'd create your app skeleton like so:

```
rails new my_app --skip-activerecord
```

Alternatively, if you've already created your app (or just want to know what this actually does), have a look at `config/application.rb` and change the first lines from this:

```
require "rails/all"
```

to this:

```
require "action_controller/railtie"
require "action_mailer/railtie"
require "active_resource/railtie"
require "rails/test_unit/railtie"
```

It's also important to make sure that the reference to active_record in the generator block is commented out:

```
# Configure generators values. Many other options are available, be sure to check the documentation.
# config.generators do |g|
#   g.orm             :active_record
#   g.template_engine :erb
#   g.test_framework  :test_unit, :fixture => true
# end
```

As of this this writing, it's commented out by default, so you probably won't have to change anything here.

### *Bundle and Initialize*

The final step involves bundling any gems you'll need and then creating an initializer for connecting to the database.

#### Bundling

Edit `Gemfile`, located in the Rails root directory. By default, our `Gemfile` will only load Rails:

```
gem "rails", "3.0.0"
```

Normally, using MongoDB will simply mean adding whichever OM framework you want to work with, as these will require the "mongo" gem by default.

```
# Edit this Gemfile to bundle your application's dependencies.

source 'http://gemcutter.org'

gem "rails", "3.0.0"
gem "mongo_mapper"
```

However, there's currently an issue with loading bson_ext, as the current gemspec isn't compatible with the way Bundler works. We'll be fixing that soon; just pay attention to this issue.

In the meantime, you can use the following work-around:

```
# Edit this Gemfile to bundle your application's dependencies.

require 'rubygems'
require 'mongo'
source 'http://gemcutter.org'

gem "rails", "3.0.0"
gem "mongo_mapper"
```

Requiring `rubygems` and `mongo` before running the `gem` command will ensure that `bson_ext` is loaded. If you'd rather not load `rubygems`, just make sure that both `mongo` and `bson_ext` are in your load path when you require `mongo`.

Once you've configured your `Gemfile`, run the bundle installer:

```
bundle install
```

#### Initializing

Last item is to create an initializer to connect to MongoDB. Create a Ruby file in `config/initializers`. You can give it any name you want; here we'll call it `config/initializers/mongo.rb`:

```
MongoMapper.connection = Mongo::Connection.new('localhost', 27017)
MongoMapper.database = "#myapp-#{Rails.env}"

if defined?(PhusionPassenger)
   PhusionPassenger.on_event(:starting_worker_process) do |forked|
     MongoMapper.connection.connect_to_master if forked
   end
end
```

### *Running Tests*

A slight modification is required to get `rake test` working (thanks to John P. Wood). Create a file `lib/tasks/mongo.rake` containing the following:

```
namespace :db do
  namespace :test do
    task :prepare do
      # Stub out for MongoDB
    end
  end
end
```

Now the various `rake test` tasks will run properly. See John's post for more details.

### *ActiveModel Compatibility*

ActiveModel is a series of interfaces designed to make any object-mapping library compatible with the various helper methods across the Rails stack. To see the status of ActiveModel integration on the various object mappers, see our object mappers page.

Briefly, Mongoid supports ActiveModel via a prerelease branch. MongoMapper will be adding support in the near future. In the meantime, use the MongoMapper Rails 3 Branch.

### *Conclusion*

That should be all. You can now start creating models based on whichever OM you've installed.

Note that this document is a work in progress. If you have any helpful comments, please add them below.

### *See also*

- Rails 3 App skeleton with MongoMapper
- Rails 3 App skeleton with Mongoid and Devise
- Rails 3 Release Notes

## MongoDB Data Modeling and Rails

This tutorial discusses the development of a web application on Rails and MongoDB.  MongoMapper will serve as our object mapper.  The goal is to provide some insight into the design choices required for building on MongoDB.  To that end, we'll be constructing a simple but non-trivial social news application. The source code for **newsmonger** is available on github for those wishing to dive right in.


- Modeling Stories
    - Caching to Avoid N+1
    - A Note on Denormalization

    - Fields as arrays
    - Atomic Updates
- Modeling Comments
    - Linear, Embedded Comments
    - Nested, Embedded Comments
    - Comment collections
- Unfinished business


Assuming you've configured your application to work with MongoMapper, let's start thinking about the data model.

### *Modeling Stories*

A news application relies on stories at its core, so we'll start with a Story model:

```
class Story
  include MongoMapper::Document

  key :title,     String
  key :url,       String
  key :slug,      String
  key :voters,    Array
  key :votes,     Integer, :default => 0
  key :relevance, Integer, :default => 0

  # Cached values.
  key :comment_count, Integer, :default => 0
  key :username,      String

  # Note this: ids are of class ObjectId.
  key :user_id,   ObjectId
  timestamps!

  # Relationships.
  belongs_to :user

  # Validations.
  validates_presence_of :title, :url, :user_id
end
```

Obviously, a story needs a title, url, and user_id, and should belong to a user. These are self-explanatory.

#### Caching to Avoid N+1

When we display our list of stories, we'll need to show the name of the user who posted the story. If we were using a relational database, we could perform a join on users and stores, and get all our objects in a single query. But MongoDB does not support joins and so, at times, requires bit of denormalization. Here, this means caching the 'username' attribute.

#### A Note on Denormalization

Relational purists may be feeling uneasy already, as if we were violating some universal law. But let's bear in mind that MongoDB collections are not equivalent to relational tables; each serves a unique design objective. A normalized table provides an atomic, isolated chunk of data. A document, however, more closely represents an object as a whole. In the case of a social news site, it can be argued that a username is intrinsic to the story being posted.

What about updates to the username? It's true that such updates will be expensive; happily, in this case, they'll be rare. The read savings achieved in denormalizing will surely outweigh the costs of the occasional update. Alas, this is not hard and fast rule: ultimately, developers must evaluate their applications for the appropriate level of normalization.

#### Fields as arrays

With a relational database, even trivial relationships are blown out into multiple tables. Consider the votes a story receives. We need a way of recording which users have voted on which stories. The standard way of handling this would involve creating a table, 'votes', with each row referencing user_id and story_id.

With a document database, it makes more sense to store those votes as an array of user ids, as we do here with the 'voters' key.

For fast lookups, we can create an index on this field. In the MongoDB shell:

```
db.stories.ensureIndex('voters');
```

Or, using MongoMapper, we can specify the index in **config/initializers/database.rb**:

```
Story.ensure_index(:voters)
```

To find all the stories voted on by a given user:

```
Story.all(:conditions => {:voters => @user.id})
```

#### Atomic Updates

Storing the `voters` array in the `Story` class also allows us to take advantage of atomic updates. What this means here is that, when a user votes on a story, we can

1. ensure that the voter hasn't voted yet, and, if not,
2. increment the number of votes and
3. add the new voter to the array.

MongoDB's query and update features allows us to perform all three actions in a single operation. Here's what that would look like from the shell:

```
// Assume that story_id and user_id represent real story and user ids.
db.stories.update({_id: story_id, voters: {'$ne': user_id}},
  {'$inc': {votes: 1}, '$push': {voters: user_id}});
```

What this says is "get me a story with the given id whose `voters` array does not contain the given user id and, if you find such a story, perform two atomic updates: first, increment `votes` by 1 and then push the user id onto the `voters` array."

This operation highly efficient; it's also reliable. The one caveat is that, because update operations are "fire and forget," you won't get a response from the server. But in most cases, this should be a non-issue.

A MongoMapper implementation of the same update would look like this:

```
  def self.upvote(story_id, user_id)
    collection.update({'_id' => story_id, 'voters' => {'$ne' => user_id}},
      {'$inc' => {'votes' => 1}, '$push' => {'voters' => user_id}})
  end
```

### *Modeling Comments*

In a relational database, comments are usually given their own table, related by foreign key to some parent table. This approach is occasionally necessary in MongoDB; however, it's always best to try to embed first, as this will achieve greater query efficiency.

#### Linear, Embedded Comments

Linear, non-threaded comments should be embedded. Here are the most basic MongoMapper classes to implement such a structure:

```
class Story
  include MongoMapper::Document
  many :comments
end
```

```
class Comment
  include MongoMapper::EmbeddedDocument
  key :body, String

  belongs_to :story
end
```

If we were using the Ruby driver alone, we could save our structure like so:

```
@stories  = @db.collection('stories')
  @document = {:title => "MongoDB on Rails",
               :comments => [{:body     => "Revelatory! Loved it!",
                              :username => "Matz"
                             }
                            ]
              }
  @stories.save(@document)
```

Essentially, comments are represented as an array of objects within a story document. This simple structure should be used for any one-to-many relationship where the many items are linear.

**Nested, Embedded Comments**

But what if we're building threaded comments? An admittedly more complicated problem, two solutions will be presented here. The first is to represent the tree structure in the nesting of the comments themselves. This might be achieved using the Ruby driver as follows:

```
@stories  = @db.collection('stories')
  @document = {:title => "MongoDB on Rails",
               :comments => [{:body     => "Revelatory! Loved it!",
                              :username => "Matz",
                              :comments => [{:body     => "Agreed.",
                                             :username => "rubydev29"
                                            }
                                           ]
                             }
                            ]
              }
  @stories.save(@document)
```

Representing this structure using MongoMapper would be tricky, requiring a number of custom mods.

But this structure has a number of benefits. The nesting is captured in the document itself (this is, in fact, how Business Insider represents comments). And this schema is highly performant, since we can get the story, and all of its comments, in a single query, with no application-side processing for constructing the tree.

One drawback is that alternative views of the comment tree require some significant reorganizing.

**Comment collections**

We can also represent comments as their own collection. Relative to the other options, this incurs a small performance penalty while granting us the greatest flexibility. The tree structure can be represented by storing the unique path for each leaf (see Mathias's original post on the idea). Here are the relevant sections of this model:

```
class Comment
  include MongoMapper::Document

  key :body,       String
  key :depth,      Integer, :default => 0
  key :path,       String,  :default => ""

  # Note: we're intentionally storing parent_id as a string
  key :parent_id,  String
  key :story_id,   ObjectId
  timestamps!

  # Relationships.
  belongs_to :story

  # Callbacks.
  after_create :set_path

  private

  # Store the comment's path.
  def set_path
    unless self.parent_id.blank?
      parent        = Comment.find(self.parent_id)
      self.story_id = parent.story_id
      self.depth    = parent.depth + 1
      self.path     = parent.path + ":" + parent.id
    end
    save
  end
```

The path ends up being a string of object ids. This makes it easier to display our comments nested, with each level in order of karma or votes. If we specify an index on story_id, path, and votes, the database can handle half the work of getting our comments in nested, sorted order.

The rest of the work can be accomplished with a couple grouping methods, which can be found in the newsmonger source code.

It goes without saying that modeling comments in their own collection also facilitates various site-wide aggregations, including displaying the latest, grouping by user, etc.

### *Unfinished business*

Document-oriented data modeling is still young. The fact is, many more applications will need to be built on the document model before we can say anything definitive about best practices. So the foregoing should be taken as suggestions, only. As you discover new patterns, we encourage you to document them, and feel free to let us know about what works (and what doesn't).

Developers working on object mappers and the like are encouraged to implement the best document patterns in their code, and to be wary of recreating relational database models in their apps.

## Object Mappers for Ruby and MongoDB

Although it's possible to use the Ruby driver by itself, sometimes you want validations, associations, and many of the other conveniences provided by ActiveRecord. Here, then, is a list of the most popular object mappers available for working with Ruby and MongoDB.


- Recommendations
- Libraries
  - MongoMapper
  - Mongoid
  - Mongomatic
  - MongoDoc
  - MongoModel
  - Candy
  - MongoRecord


### *Recommendations*

First we advise that you get to know how the database itself works. This is best accomplished by playing with the shell and experimenting with the Ruby driver (or any of the other drivers, for that matter)*.

Once you understand how MongoDB works, you'll be in a good position to choose the object mapper that best suits your needs. So long as you pick an OM that's used in production and is actively developed, you really can't make a bad choice.

### *Libraries*

#### MongoMapper

John Nunemaker's OM. **Used in production** and actively-developed. ActiveModel support forthcoming.

**Installation:**

- gem install mongo_mapper

**Source:**

- mongo_mapper on github

**Documentation:**

- MongoMapper on google groups
- #mongomapper on freenode.

**Articles:**

- Getting Started with MongoMapper
- MongoMapper and Rails
- More MongoMapper Awesomeness.

#### Mongoid

> If you're using Mongoid, please read the Using Mongoid page on this site.

Durran Jordan's OM. **Used in production** and actively-developed. Supports ActiveModel and Rails 3.

**Installation:**

- gem install mongoid

**Source:**

- mongoid on github

**Documentation:**

- Docs at mongoid.org

#### Mongomatic

A simple object mapper emphasizing MongoDB idioms.

**Installation:**

- gem install mongomatic

**Source:**

- mongomatic on github

#### MongoDoc

MongoDoc is a simple, fast ODM for MongoDB. The project will eventually be merged into Mongoid.

**Installation:**

- gem install mongodoc

**Source:**

- mongodoc on github

#### MongoModel

Sam Pohlenz's OM. Actively-developed.

**Notes:**

An OM with emphaisis on ActiveModel compatibility.

**Installation:**

- gem install mongomodel

**Source:**

- mongomodel on github

#### Candy

Stephen Eley's OM. Actively-developed.

**Notes:**

From the README:
Candy's goal is to provide the simplest possible object persistence for the MongoDB database. By "simple" we mean "nearly invisible." Candy doesn't try to mirror ActiveRecord or DataMapper. Instead, we play to MongoDB's unusual strengths – extremely fast writes and a set of field-specific update operators – and do away with the cumbersome, unnecessary methods of last-generation workflows.

**Installation:**

- gem install candy

**Source:**

- candy on github

#### MongoRecord

10gen's original OM.

**Notes:**
MongoRecord is an ActiveRecord-like OM, and the first of its kind developed for MongoDB. Favored by a contingent of developers for its simplicity, MongoRecord currently receives a lot of love from Nate Wiger.

**Installation:**

- gem install mongo_record

**Source:**

- mongo-record on github

## Using Mongoid

Mongoid is a mature ODM for MongoDB. Much work has gone into the project, and it sports an active user community and excellent documentation. That said, we've seen a few of Mongoid's design decisions cause problems for users in production. This page is an attempt to make current and future users aware of these issues.

> ⚠ Most of the issues mentioned here will be resolved with the release of Mongoid 2.0.

These principles should be applied to every MongoDB object mapper, regardless of implementation language. We still recommend Mongoid, but only if the following points are taken into account.


    - Object ids should be stored as object ids, not as strings.
    - Index creation shouldn't be defined in the model and triggered on load.
    - Embedded documents and related documents are both appropriate solutions.
    - Automated sorting by _id ( #last method).
    - Safe mode should not be enabled for every operation by default.
- Final thoughts


#### *Object ids should be stored as object ids, not as strings.*

**Problem:**
Mongoid currently stores object ids as string, by default. There are a couple of problems with this. The first is that the object id type is the reigning convention; if you ever need to switch languages or ODMs, you'll find yourself in trouble, since all other projects will expect an object id proper and not a string. Since it's impossible to change the _id attribute, the only way to convert a collection to use object ids proper is to rewrite the collection. For many users, this would be incredibly inconvenient.

The second problem is that storing an object id as a string requires 16 extra bytes of storage per object id. This will be duplicated in any index where it appears. Thus, storing object ids as strings needlessly increases storage size.

A final problem with storing object ids as strings is that upserts will always insert an object id proper. If you ever want to use upserts, you must store object ids and object ids proper. Otherwise, your collection will contain object ids of multiple types.

**Solution**
In the Mongoid config, make sure you set

```
use_object_ids: true
```

All object mappers should use real, non-string object ids by default.

***Index creation shouldn't be defined in the model and triggered on load.***

**Problem**
Mongoid (and MongoMapper) allows developers to define indexes on the model layer. Because of this, we've now seen numerous examples of developers accidentally triggering new index builds on production boxes. This can cause unwanted downtime and worse, depending on how the developers react.

We've also noticed that this index creation API doesn't encourage compound indexes, which are often the best choice for certain queries. If you're not familiar with compound indexes, read our indexing advice

**Solution**
The best solution for the moment is to avoid defining indexes in the model. We'd recommend creating some kind of rake task that updates indexes so that you never inadvertently trigger an index creation. You can easily accomplish this with the Ruby driver API. Read the docs on create_index

It's also important to know how and when to create compound indexes. Again, check our this indexing advice.

***Embedded documents and related documents are both appropriate solutions.***

**Problem**
The Mongoid API and documentation can lead newer users to believe that embedded documents are almost always the way to represent one-to-many relations. However, there are plenty of situations where storing the related documents in a separate collection is the better choice.

Too much embedding can lead to extra large documents (> 100kb), which can be hard to work with. In addition, these large documents can be inefficient when updating on the server, transferring across the network, and/or serializing to and from BSON.

**Solution**
Know that related documents can be a good choice just as frequently as embedded documents. Consult these schema design resources:

- Schema design docs
- MongoDB Schema Design slides
- Schema Design in MongoDB Video from MongoNY

***Automated sorting by _id (#last method).***

**Problem**
We've seen methods that invoke automated sorts by _id to preserve order. This is fine if the right indexes are defined, but can start to result in slow queries as the collection grows.

**Solution**
If you have large collections, be sure that you have the proper indexes defined so that sorts on _id don't slow down your system.

***Safe mode should not be enabled for every operation by default.***

**Problem**
Mongoid uses :safe mode by default for every insert and update. This isn't always necessary. Safe mode should be used when an error is expected or when you want to use replication acknowledgment.

**Solution**
We suggest disabling safe mode in the Mongoid config, especially if performance is critical.

```
persist_in_safe_mode: false
```

Then, decide which operations actually need it. If you have a unique on a collection, or if you're doing updates that you think could fail, then safe mode is a good idea. If you're logging, doing analytics, or performing a bulk insert, it may not be necessary.

The API should allow users to set safe mode on individual insert and update operations.

#### Final thoughts

This isn't an indictment of Mongoid or of any other object mapper. We think Mongoid is a great project, and we hope to see it continue to flourish.

But we've seen enough pain caused by some of its design decisions to warrant this page. Our only hope is that the recommendations here help users have a better experience with Mongoid and MongoDB.

## Ruby External Resources

There are a number of good resources appearing all over the web for learning about MongoDB and Ruby. A useful selection is listed below. If you know of others, do let us know.

- Screencasts
- Presentations
- Articles
- Projects
- Libraries

### *Screencasts*

Introduction to MongoDB - Part I
An introduction to MongoDB via the MongoDB shell.

Introduction to MongoDB - Part II
In this screencast, Joon You teaches how to use the Ruby driver to build a simple Sinatra app.

Introduction to MongoDB - Part III
For the final screencast in the series, Joon You introduces MongoMapper and Rails.

RailsCasts: MongoDB & MongoMapper
Ryan Bates' RailsCast introducing MongoDB and MongoMapper.

### *Presentations*

Introduction to MongoDB (Video)
Mike Dirolf's introduction to MongoDB at Pivotal Labs, SF.

MongoDB: A Ruby Document Store that doesn't rhyme with 'Ouch' (Slides)
Wynn Netherland's introduction to MongoDB with some comparisons to CouchDB.

MongoDB (is) for Rubyists (Slides)
Kyle Banker's presentation on why MongoDB is for Rubyists (and all human-oriented programmers).

Introduction to Mongoid and MongoDB (Video)
Durran Jordan discusses Mongoid, MongoDB, and how HashRocket uses these tools in production.

### *Articles*

Why I Think Mongo is to Databases What Rails was to Frameworks
What if a key-value store mated with a relational database system?
John Nunemaker's articles on MongoDB.

A series of articles on aggregation with MongoDB and Ruby:
1. Part I: Introduction of Aggregation in MongoDB
2. Part II: MongoDB Grouping Elaborated
3. Part III: Introduction to Map-Reduce in MongoDB

Does the MongoDB Driver Support Feature X?
An explanation of how the MongoDB drivers usually automatically support new database features.

### *Projects*

Mongo Queue
An extensible thread safe job/message queueing system that uses mongodb as the persistent storage engine.

Resque-mongo
A port of the Github's Resque to MongoDB.

Mongo Admin
A Rails plugin for browsing and managing MongoDB data. See the live demo.

Sinatra Resource
Resource Oriented Architecture (REST) for Sinatra and MongoMapper.

Shorty
A URL-shortener written with Sinatra and the MongoDB Ruby driver.

NewsMonger
A simple social news application demonstrating MongoMapper and Rails.

Data Catalog API
From Sunlight Labs, a non-trivial application using MongoMapper and Sinatra.

Watchtower
An example application using Mustache, MongoDB, and Sinatra.

Shapado
A question and answer site similar to Stack Overflow. Live version at shapado.com.

### *Libraries*

ActiveExpando
An extension to ActiveRecord to allow the storage of arbitrary attributes in MongoDB.

ActsAsTree (MongoMapper)
ActsAsTree implementation for MongoMapper.

Machinist adapter (MongoMapper)
Machinist adapter using MongoMapper.

Mongo-Delegate
A delegation library for experimenting with production data without altering it. A quite useful pattern.

Remarkable Matchers (MongoMapper)
Testing / Matchers library using MongoMapper.

OpenIdAuthentication, supporting MongoDB as the datastore
Brandon Keepers' fork of OpenIdAuthentication supporting MongoDB.

MongoTree (MongoRecord)
MongoTree adds parent / child relationships to MongoRecord.

Merb_MongoMapper
a plugin for the Merb framework for supporting MongoMapper models.

Mongolytics (MongoMapper)
A web analytics tool.

Rack-GridFS
A Rack middleware component that creates HTTP endpoints for files stored in GridFS.

## Frequently Asked Questions - Ruby

This is a list of frequently asked questions about using Ruby with MongoDB. If you have a question you'd like to have answered here, please add it in the comments.


- Can I run [insert command name here] from the Ruby driver?
- Does the Ruby driver support an EXPLAIN command?
- I see that BSON supports a symbol type. Does this mean that I can store Ruby symbols in MongoDB?
- Why can't I access random elements within a cursor?
- Why can't I save an instance of TimeWithZone?
- I keep getting CURSOR_NOT_FOUND exceptions. What's happening?
- I periodically see connection failures between the driver and MongoDB. Why can't the driver retry the operation automatically?


Can I run [insert command name here] from the Ruby driver?

Yes. You can run any of the available database commands from the driver using the DB#command method. The only trick is to use an OrderedHash when specifying the command. For example, here's how you'd run an asynchronous fsync from the driver:

```
# This command is run on the admin database.
@db = Mongo::Connection.new.db('admin')

# Build the command.
cmd = OrderedHash.new
cmd['fsync'] = 1
cmd['async'] = true

# Run it.
@db.command(cmd)
```

It's important to keep in mind that some commands, like `fsync`, must be run on the `admin` database, while other commands can be run on any database. If you're having trouble, check the command reference to make sure you're using the command correctly.

Does the Ruby driver support an EXPLAIN command?

Yes. `explain` is, technically speaking, an option sent to a query that tells MongoDB to return an explain plan rather than the query's results. You can use `explain` by constructing a query and calling explain at the end:

```
@collection = @db['users']
result = @collection.find({:name => "jones"}).explain
```

The resulting explain plan might look something like this:

```
{"cursor"=>"BtreeCursor name_1",
 "startKey"=>{"name"=>"Jones"},
 "endKey"=>{"name"=>"Jones"},
 "nscanned"=>1.0,
 "n"=>1,
 "millis"=>0,
 "oldPlan"=>{"cursor"=>"BtreeCursor name_1",
             "startKey"=>{"name"=>"Jones"},
             "endKey"=>{"name"=>"Jones"}
 },
 "allPlans"=>[{"cursor"=>"BtreeCursor name_1",
               "startKey"=>{"name"=>"Jones"},
               "endKey"=>{"name"=>"Jones"}}]
 }
```

Because this collection has an index on the "name" field, the query uses that index, only having to scan a single record. "n" is the number of records the query will return. "millis" is the time the query takes, in milliseconds. "oldPlan" indicates that the query optimizer has already seen this kind of query and has, therefore, saved an efficient query plan. "allPlans" shows all the plans considered for this query.

I see that BSON supports a symbol type. Does this mean that I can store Ruby symbols in MongoDB?

You can store Ruby symbols in MongoDB, but only as values. BSON specifies that document keys must be strings. So, for instance, you can do this:

```
@collection = @db['test']

boat_id = @collection.save({:vehicle  => :boat})
car_id  = @collection.save({"vehicle" => "car"})

@collection.find_one('_id' => boat_id)
{"_id" => ObjectID('4bb372a8238d3b5c8c000001'), "vehicle" => :boat}


@collection.find_one('_id' => car_id)
{"_id" => ObjectID('4bb372a8238d3b5c8c000002'), "vehicle" => "car"}
```

Notice that the symbol values are returned as expected, but that symbol keys are treated as strings.

Why can't I access random elements within a cursor?

MongoDB cursors are designed for sequentially iterating over a result set, and all the drivers, including the Ruby driver, stick closely to this directive. Internally, a Ruby cursor fetches results in batches by running a MongoDB `getmore` operation. The results are buffered for efficient iteration on the client-side.

What this means is that a cursor is nothing more than a device for returning a result set on a query that's been initiated on the server. Cursors are not containers for result sets. If we allow a cursor to be randomly accessed, then we run into issues regarding the freshness of the data. For instance, if I iterate over a cursor and then want to retrieve the cursor's first element, should a stored copy be returned, or should the cursor re-run the query? If we returned a stored copy, it may not be fresh. And if the the query is re-run, then we're technically dealing with a new cursor.

To avoid those issues, we're saying that anyone who needs flexible access to the results of a query should store those results in an array and then access the data as needed.

Why can't I save an instance of TimeWithZone?

MongoDB stores times in UTC as the number of milliseconds since the epoch. This means that the Ruby driver serializes Ruby Time objects only. While it would certainly be possible to serialize a TimeWithZone, this isn't preferable since the driver would still deserialize to a Time object.

All that said, if necessary, it'd be easy to write a thin wrapper over the driver that would store an extra time zone attribute and handle the serialization/deserialization of TimeWithZone transparently.

I keep getting CURSOR_NOT_FOUND exceptions. What's happening?

The most likely culprit here is that the cursor is timing out on the server. Whenever you issue a query, a cursor is created on the server. Cursor naturally time out after ten minutes, which means that if you happen to be iterating over a cursor for more than ten minutes, you risk a CURSOR_NOT_FOUND exception.

There are two solutions to this problem. You can either:

1. Limit your query. Use some combination of `limit` and `skip` to reduce the total number of query results. This will, obviously, bring down the time it takes to iterate.

2. Turn off the cursor timeout. To do that, invoke `find` with a block, and pass `:timeout => true`:

```
@collection.find({}, :timeout => false) do |cursor|
  cursor.each do |document
    # Process documents here
  end
end
```

I periodically see connection failures between the driver and MongoDB. Why can't the driver retry the operation automatically?

A connection failure can indicate any number of failure scenarios. Has the server crashed? Are we experiencing a temporary network partition? Is there a bug in our ssh tunnel?

Without further investigation, it's impossible to know exactly what has caused the connection failure. Furthermore, when we do see a connection failure, it's impossible to know how many operations prior to the failure succeeded. Imagine, for instance, that we're using safe mode and we send an `$inc` operation to the server. It's entirely possible that the server has received the `$inc` but failed on the call to `getLastError`. In that case, retrying the operation would result in a double-increment.

Because of the indeterminacy involved, the MongoDB drivers will not retry operations on connection failure. How connection failures should be handled is entirely dependent on the application. Therefore, we leave it to the application developers to make the best decision in this case.

The drivers will reconnect on the subsequent operation.

# Java Language Center

### *Basics*

- Tutorial
- API Documentation
- Downloads

### *Specific Topics*

- Concurrency
- Saving Objects
- Data Types

### 3rd Party

#### POJO Mappers

- Morphia - Type-Safe Wrapper with DAO/Datastore abstractions
- pojo to MongoDB
- mungbean
- daybreak PoJo mapping for Java & MongoDB using Java 5 annotations.

#### Code Generation

- Sculptor - mongodb-based DSL -> Java (code generator)
- GuicyData - DSL -> Java generator with Guice integration
  - Blog Entries

#### Misc

- log4j -> mongodb appender
- (Experimental, Type4) JDBC driver

#### Other JVM-based Languages

- Clojure
- Groovy
  - Groovy Tutorial for MongoDB
  - MongoDB made more Groovy
  - GMongo, a Groovy wrapper to the mongodb Java driver
  - GMongo 0.5 Released
- Scala
  - Lift-MongoDB - Wrapper, Mapper, and Record back-end implementation. Part of the Lift Web Framework .
  - mongo-scala-driver is a thin wrapper around mongo-java-driver to make working with MongoDB more Scala-like.
    - Wiki
    - Mailing list
  - Casbah Casbah is a Scala oriented series of wrappers and extensions to the MongoDB Java driver to provide a more scala-friendly interface to MongoDB. Implements the Scala 2.8 collection interfaces to improve interaction, and a fluid query syntax which closely matches the MongoDB interface. Support for ORM-style Object mapping is coming soon, as well.
    - Tutorial
    - Mailing List
    - GitHub Project Page
- JavaScript
  - MongoDB-Rhino - A toolset to provide full integration between the Rhino JavaScript engine for the JVM and MongoDB. Uses the MongoDB Java driver.
- JRuby
  - jmongo A thin ruby wrapper around the mongo-java-driver for vastly better jruby performance.

If there is a project missing here, just add a comment or email the list and we'll add it.

#### Presentations

- Using MongoDB with Scala - Brendan McAdams' Presentation at the New York Scala Enthusiasts (August 2010)
- Java Development - Brendan McAdams' Presentation from MongoNYC (May 2010)
- Java Development - James Williams' Presentation from MongoSF (April 2010)
- Building a Mongo DSL in Scala at Hot Potato - Lincoln Hochberg's Presentation from MongoSF (April 2010)

## Java Driver Concurrency

The Java MongoDB driver is thread safe. If you are using in a web serving environment, for example, you should create a single Mongo instance, and you can use it in every request.  The Mongo object maintains an internal pool of connections to the database (default pool size of 10).

However, if you want to ensure complete consistency in a "session" (maybe an http request), you probably want the driver to use the same socket for that session (which isn't necessarily the case since Mongo instances have built-in connection pooling). This is only necessary for a write heavy environment, where you might read data that you wrote.

To do that, you would do something like:

```
DB db...;
db.requestStart();

code....

db.requestDone();
```

## Java - Saving Objects Using DBObject

The Java driver provides a DBObject interface to save custom objects to the database.

For example, suppose one had a class called Tweet that they wanted to save:

```
public class Tweet implements DBObject {
    /* ... */
}
```

Then you can say:

```
Tweet myTweet = new Tweet();
myTweet.put("user", userId);
myTweet.put("message", msg);
myTweet.put("date", new Date());

collection.insert(myTweet);
```

When a document is retrieved from the database, it is automatically converted to a DBObject. To convert it to an instance of your class, use DBCollection.setObjectClass():

```
collection.setObjectClass(Tweet);

Tweet myTweet = (Tweet)collection.findOne();
```

## Java Tutorial


- Introduction
- A Quick Tour
    - Making A Connection
    - Authentication (Optional)
    - Getting A List Of Collections
    - Getting A Collection
    - Inserting a Document
    - Finding the First Document In A Collection using `findOne()`
    - Adding Multiple Documents
    - Counting Documents in A Collection
    - Using a Cursor to Get All the Documents
    - Getting A Single Document with A Query
    - Getting A Set of Documents With a Query
    - Creating An Index
    - Getting a List of Indexes on a Collection
- Quick Tour of the Administrative Functions
    - Getting A List of Databases

- Dropping A Database

### Introduction

This page is a brief overview of working with the MongoDB Java Driver.

For more information about the Java API, please refer to the online API Documentation for Java Driver

### A Quick Tour

Using the Java driver is very simple. First, be sure to include the driver jar `mongo.jar` in your classpath. The following code snippets come from the `examples/QuickTour.java` example code found in the driver.

#### Making A Connection

To make a connection to a MongoDB, you need to have at the minimum, the name of a database to connect to. The database doesn't have to exist - if it doesn't, MongoDB will create it for you.

Additionally, you can specify the server address and port when connecting. The following example shows three ways to connect to the database *mydb* on the local machine :

```
import com.mongodb.Mongo;
import com.mongodb.DB;
import com.mongodb.DBCollection;
import com.mongodb.BasicDBObject;
import com.mongodb.DBObject;
import com.mongodb.DBCursor;

Mongo m = new Mongo();
Mongo m = new Mongo( "localhost" );
Mongo m = new Mongo( "localhost" , 27017 );

DB db = m.getDB( "mydb" );
```

At this point, the `db` object will be a connection to a MongoDB server for the specified database. With it, you can do further operations.

Note: The Mongo object instance actually represents a pool of connections to the database; you will only need one object of class Mongo even with multiple threads.  See the concurrency doc page for more information.

#### Authentication (Optional)

MongoDB can be run in a secure mode where access to databases is controlled through name and password authentication. When run in this mode, any client application must provide a name and password before doing any operations. In the Java driver, you simply do the following with the connected mongo object :

```
boolean auth = db.authenticate(myUserName, myPassword);
```

If the name and password are valid for the database, `auth` will be `true`. Otherwise, it will be `false`. You should look at the MongoDB log for further information if available.

Most users run MongoDB without authentication in a trusted environment.

#### Getting A List Of Collections

Each database has zero or more collections. You can retrieve a list of them from the db (and print out any that are there) :

```
Set<String> colls = db.getCollectionNames();

for (String s : colls) {
    System.out.println(s);
}
```

and assuming that there are two collections, name and address, in the database, you would see

```
name
address
```

as the output.

#### *Getting A Collection*

To get a collection to use, just specify the name of the collection to the getCollection(`String collectionName`) method:

```
DBCollection coll = db.getCollection("testCollection")
```

Once you have this collection object, you can now do things like insert data, query for data, etc

#### *Inserting a Document*

Once you have the collection object, you can insert documents into the collection. For example, lets make a little document that in JSON would be represented as

```
{
   "name" : "MongoDB",
   "type" : "database",
   "count" : 1,
   "info" : {
               x : 203,
               y : 102
             }
}
```

Notice that the above has an "inner" document embedded within it. To do this, we can use the BasicDBObject class to create the document (including the inner document), and then just simply insert it into the collection using the `insert()` method.

```
BasicDBObject doc = new BasicDBObject();

        doc.put("name", "MongoDB");
        doc.put("type", "database");
        doc.put("count", 1);

        BasicDBObject info = new BasicDBObject();

        info.put("x", 203);
        info.put("y", 102);

        doc.put("info", info);

        coll.insert(doc);
```

#### *Finding the First Document In A Collection using `findOne()`*

To show that the document we inserted in the previous step is there, we can do a simple findOne() operation to get the first document in the collection. This method returns a single document (rather than the DBCursor that the find() operation returns), and it's useful for things where there only is one document, or you are only interested in the first. You don't have to deal with the cursor.

```
DBObject myDoc = coll.findOne();
System.out.println(myDoc);
```

and you should see

```
{ "_id" : "49902cde5162504500b45c2c" , "name" : "MongoDB" , "type" : "database" , "count" : 1 , "info"
: { "x" : 203 , "y" : 102} , "_ns" : "testCollection"}
```

Note the `_id` and `_ns` elements have been added automatically by MongoDB to your document. Remember, MongoDB reserves element names that start with _ for internal use.

#### *Adding Multiple Documents*

In order to do more interesting things with queries, let's add multiple simple documents to the collection. These documents will just be

```
{
   "i" : value
}
```

and we can do this fairly efficiently in a loop

```
for (int i=0; i < 100; i++) {
    coll.insert(new BasicDBObject().append("i", i));
}
```

Notice that we can insert documents of different "shapes" into the same collection. This aspect is what we mean when we say that MongoDB is "schema-free"

#### *Counting Documents in A Collection*

Now that we've inserted 101 documents (the 100 we did in the loop, plus the first one), we can check to see if we have them all using the `getCount()` method.

```
System.out.println(coll.getCount());
```

and it should print `101`.

#### *Using a Cursor to Get All the Documents*

In order to get all the documents in the collection, we will use the `find()` method. The `find()` method returns a `DBCursor` object which allows us to iterate over the set of documents that matched our query. So to query all of the documents and print them out :

```
DBCursor cur = coll.find();

        while(cur.hasNext()) {
            System.out.println(cur.next());
        }
```

and that should print all 101 documents in the collection.

#### *Getting A Single Document with A Query*

We can create a *query* to pass to the `find()` method to get a subset of the documents in our collection. For example, if we wanted to find the document for which the value of the "i" field is 71, we would do the following ;

```
BasicDBObject query = new BasicDBObject();

        query.put("i", 71);

        cur = coll.find(query);

        while(cur.hasNext()) {
            System.out.println(cur.next());
        }
```

and it should just print just one document

```
{ "_id" : "49903677516250c1008d624e" , "i" : 71 , "_ns" : "testCollection"}
```

#### *Getting A Set of Documents With a Query*

We can use the query to get a set of documents from our collection. For example, if we wanted to get all documents where "i" > 50, we could write :

```
query = new BasicDBObject();

        query.put("i", new BasicDBObject("$gt", 50));  // e.g. find all where i > 50

        cur = coll.find(query);

        while(cur.hasNext()) {
            System.out.println(cur.next());
        }
```

which should print the documents where i > 50. We could also get a range, say 20 < i <= 30 :

```
query = new BasicDBObject();

        query.put("i", new BasicDBObject("$gt", 20).append("$lte", 30));  // i.e.   20 < i <= 30

        cur = coll.find(query);

        while(cur.hasNext()) {
            System.out.println(cur.next());
        }
```

#### *Creating An Index*

MongoDB supports indexes, and they are very easy to add on a collection. To create an index, you just specify the field that should be indexed, and specify if you want the index to be ascending (1) or descending (-1). The following creates an ascending index on the "i" field :

```
coll.createIndex(new BasicDBObject("i", 1));  // create index on "i", ascending
```

#### *Getting a List of Indexes on a Collection*

You can get a list of the indexes on a collection :

```
List<DBObject> list = coll.getIndexInfo();

        for (DBObject o : list) {
            System.out.println(o);
        }
```

and you should see something like

```
{ "name" : "i_1" , "ns" : "mydb.testCollection" , "key" : { "i" : 1} , "_ns" : "system.indexes"}
```

### *Quick Tour of the Administrative Functions*

#### *Getting A List of Databases*

You can get a list of the available databases:

```
Mongo m = new Mongo();

        for (String s : m.getDatabaseNames()) {
            System.out.println(s);
        }
```

#### *Dropping A Database*

You can drop a database by name using the `Mongo` object:

```
m.dropDatabase("my_new_db");
```

## Java Types

- Object Ids
- Regular Expressions
- Dates/Times
- Database References
- Binary Data
- Embedded Documents
- Arrays

#### *Object Ids*

`com.mongodb.ObjectId` is used to autogenerate unique ids.

```
ObjectId id = new ObjectId();
ObjectId copy = new ObjectId(id);
```

#### *Regular Expressions*

The Java driver uses `java.util.regex.Pattern` for regular expressions.

```
Pattern john = Pattern.compile("joh?n", CASE_INSENSITIVE);
BasicDBObject query = new BasicDBObject("name", john);

// finds all people with "name" matching /joh?n/i
DBCursor cursor = collection.find(query);
```

#### *Dates/Times*

The java.util.Date class is used for dates.

```
Date now = new Date();
BasicDBObject time = new BasicDBObject("ts", now);

collection.save(time);
```

#### *Database References*

`com.mongodb.DBRef` can be used to save database references.

```
DBRef addressRef = new DBRef(db, "foo.bar", address_id);
DBObject address = addressRef.fetch();

DBObject person = BasicDBObjectBuilder.start()
    .add("name", "Fred")
    .add("address", addressRef)
    .get();
collection.save(person);

DBObject fred = collection.findOne();
DBRef addressObj = (DBRef)fred.get("address");
addressObj.fetch()
```

***Binary Data***

An array of bytes (`byte[]`) can be used for binary data.

***Embedded Documents***

Suppose we have a document that, in JavaScript, looks like:

```
{
    "x" : {
        "y" : 3
    }
}
```

The equivalent in Java is:

```
BasicDBObject y = new BasicDBObject("y", 3);
BasicDBObject x = new BasicDBObject("x", y);
```

***Arrays***

Anything that extends List in Java will be saved as an array.

So, if you are trying to represent the JavaScript:

```
{
    "x" : [
        1,
        2,
        {"foo" : "bar"},
        4
    ]
}
```

you could do:

```
ArrayList x = new ArrayList();
x.add(1);
x.add(2);
x.add(new BasicDBObject("foo", "bar"));
x.add(4);

BasicDBObject doc = new BasicDBObject("x", x);
```

# C++ Language Center

A C++ driver is available for communicating with the MongoDB.  As the database is written in C++, the driver actually uses some core MongoDB code -- this is the same driver that the database uses itself for replication.

The driver has been compiled successfully on Linux, OS X, Windows, and Solaris.

- API Documentation
- MongoDB C++ Client Tutorial
- Using BSON from C++
- HOWTO
  - Connecting
  - Tailable Cursors
- Mongo Database and C++ Driver Source Code (at github).  See the client subdirectory for client driver related files.
- Download

**Additional Notes**

- The Building documentation covers compiling the entire database, but some of the notes there may be helpful for compiling client applications too.
- There is also a pure C driver for MongoDB.  For true C++ apps we recommend using the C++ driver.

# C++ BSON Library

- Overview
- Examples
- API Docs
- Short Class Names

### *Overview*

The MongoDB C++ driver library includes a bson package that implements the BSON specification (see http://www.bsonspec.org/). This library can be used standalone for object serialization and deserialization even when one is not using MongoDB at all.

Include `bson/bson.h` or `db/jsobj.h` in your application (not both). `bson.h` is new and may not work in some situations, was is good for light header-only usage of BSON (see the bsondemo.cpp example).

Key classes:

- BSONObj a BSON object
- BSONElement a single element in a bson object. This is a key and a value.
- BSONObjBuilder used to make BSON objects
- BSONObjIterator to enumerate BSON objects

Let's now create a BSON "person" object which contains name and age.  We might invoke:

```
BSONObjBuilder b;
b.append("name", "Joe");
b.append("age", 33);
BSONObj p = b.obj();
```

Or more concisely:

```
BSONObj p = BSONObjBuilder().append("name", "Joe").append("age", 33).obj();
```

We can also create objects with a stream-oriented syntax:

```
BSONObjBuilder b;
b << "name" << "Joe" << "age" << 33;
BSONObj p = b.obj();
```

The macro BSON lets us be even more compact:

```
BSONObj p = BSON( "name" << "Joe" << "age" << 33 );
```

Use the GENOID helper to add an object id to your object.  The server will add an _id automatically if it is not included explicitly.

```
BSONObj p = BSON( GENOID << "name" << "Joe" << "age" << 33 );
// result is: { _id : ..., name : "Joe", age : 33 }
```

GENOID should be at the beginning of the generated object.  We can do something similar with the non-stream builder syntax:

```
BSONObj p =
  BSONObjBuilder().genOID().append("name","Joe").append("age",33).obj();
```

### *Examples*

- http://github.com/mongodb/mongo/blob/master/bson/bsondemo/bsondemo.cpp

### *API Docs*

- http://api.mongodb.org/cplusplus/

### *Short Class Names*

Add

```
using namespace bson;
```

to your code to use the following shorter more C++ style names for the BSON classes:

```
// from bsonelement.h
namespace bson {
    typedef mongo::BSONElement be;
    typedef mongo::BSONObj bo;
    typedef mongo::BSONObjBuilder bob;
}
```

(Or one could use `bson::bo` fully qualified for example).

Also available is `bo::iterator` as a synonym for `BSONObjIterator`.

## C++ Tutorial


- Installing the Driver Library and Headers
  - Unix
    - Full Database Source Driver Build
    - Driver Build
  - Windows
- Compiling
- Writing Client Code
  - Connecting
  - BSON
  - Inserting

    - Querying
    - Indexing
    - Sorting
    - Updating
- Further Reading


This document is an introduction to usage of the MongoDB database from a C++ program.

First, install Mongo -- see the Quickstart for details.

Next, you may wish to take a look at the Developer's Tour guide for a language independent look at how to use MongoDB. Also, we suggest some basic familiarity with the `mongo shell` -- the shell is one's primary database administration tool and is useful for manually inspecting the contents of a database after your C++ program runs.

## Installing the Driver Library and Headers

A good source for general information about setting up a MongoDB development environment on various operating systems is the building page.

The normal database distribution used to include the C++ driver, but there were many problems with library version mismatches so now you have to build from source. You can either get the full source code for the database and just build the C++ driver or download the driver separately and build it.

### *Unix*

For Unix, the Mongo driver library is `libmongoclient.a`. For either build, run `scons --help` to see all options.

#### Full Database Source Driver Build

To install the libraries, run:

```
scons --full install
```

`--full` tells the install target to include the library and header files; by default library and header files are installed in */usr/local*.

You can use `--prefix` to change the install path: `scons --prefix /opt/mongo --full install`. You can also specify `--sharedclient` to build a shared library instead of a statically linked library.

#### Driver Build

If you download the driver source code separately, you can build it by running `scons` (no options).

### *Windows*

For more information on Boost setup see the Building for Windows page.

## Compiling

The C++ drivers requires the pcre and boost libraries (with headers) to compile. Be sure they are in your include and lib paths. You can usually install them from your OS's package manager if you don't already have them.

## Writing Client Code

Note: for brevity, the examples below are simply inline code. In a real application one will define classes for each database object typically.

### *Connecting*

Let's make a tutorial.cpp file that connects to the database (see client/examples/tutorial.cpp for full text of the examples below):

```
#include <iostream>
#include "client/dbclient.h"

using namespace mongo;

void run() {
  DBClientConnection c;
  c.connect("localhost");
}

int main() {
  try {
    run();
    cout << "connected ok" << endl;
  } catch( DBException &e ) {
    cout << "caught " << e.what() << endl;
  }
  return 0;
}
```

If you are using gcc on Linux or OS X, you would compile with something like this, depending on location of your include files and libraries:

```
$ g++ tutorial.cpp -lmongoclient -lboost_thread-mt -lboost_filesystem -lboost_program_options -o
tutorial
$ ./tutorial
connected ok
$
```

Depending on your boost version you might need to link against the *boost_system* library as well: **-lboost_system**. Also, you may need to append "-mt" to boost_filesystem and boost_program_options. And, of course, you may need to use -I and -L to specify the locations of your mongo and boost headers and libraries.

### *BSON*

The Mongo database stores data in BSON format. BSON is a binary object format that is JSON-like in terms of the data which can be stored (some extensions exist, for example, a Date datatype).

To save data in the database we must create objects of class BSONObj. The components of a BSONObj are represented as BSONElement objects. We use BSONObjBuilder to make BSON objects, and BSONObjIterator to enumerate BSON objects.

Let's now create a BSON "person" object which contains name and age. We might invoke:

```
BSONObjBuilder b;
b.append("name", "Joe");
b.append("age", 33);
BSONObj p = b.obj();
```

Or more concisely:

```
BSONObj p = BSONObjBuilder().append("name", "Joe").append("age", 33).obj();
```

We can also create objects with a stream-oriented syntax:

```
BSONObjBuilder b;
b << "name" << "Joe" << "age" << 33;
BSONObj p = b.obj();
```

The macro BSON lets us be even more compact:

```
BSONObj p = BSON( "name" << "Joe" << "age" << 33 );
```

Use the GENOID helper to add an object id to your object.  The server will add an _id automatically if it is not included explicitly.

```
BSONObj p = BSON( GENOID << "name" << "Joe" << "age" << 33 );
// result is: { _id : ..., name : "Joe", age : 33 }
```

GENOID should be at the beginning of the generated object.  We can do something similar with the non-stream builder syntax:

```
BSONObj p =
  BSONObjBuilder().genOID().append("name","Joe").append("age",33).obj();
```

### *Inserting*

We now save our person object in a persons collection in the database:

```
c.insert("tutorial.persons", p);
```

The first parameter to insert is the namespace.  tutorial is the database and persons is the collection name.

### *Querying*

Let's now fetch all objects from the persons collection, and display them.  We'll also show here how to use count().

```
cout << "count:" << c.count("tutorial.persons") << endl;

  auto_ptr<DBClientCursor> cursor =
    c.query("tutorial.persons", emptyObj);
  while( cursor->more() )
      cout << cursor->next().toString() << endl;
```

emptyObj is the empty BSON object -- we use it to represent {} which indicates an empty query pattern (an empty query is a query for all objects).

We use BSONObj::toString() above to print out information about each object retrieved.  BSONObj::toString is a diagnostic function which prints an abbreviated JSON string representation of the object.  For full JSON output, use BSONObj::jsonString.

Let's now write a function which prints out the name (only) of all persons in the collection whose age is a given value:

```
void printIfAge(DBClientConnection&c, int age) {
  auto_ptr<DBClientCursor> cursor =
    c.query("tutorial.persons", QUERY( "age" << age ) );
  while( cursor->more() ) {
    BSONObj p = cursor->next();
    cout << p.getStringField("name") << endl;
  }
}
```

getStringField() is a helper that assumes the "name" field is of type string.  To manipulate an element in a more generic fashion we can retrieve the particular BSONElement from the enclosing object:

```
BSONElement name = p["name"];
// or:
//BSONElement name = p.getField("name");
```

See the api docs, and jsobj.h, for more information.

Our query above, written as JSON, is of the form

```
{ age : <agevalue> }
```

Queries are BSON objects of a particular format -- in fact, we could have used the BSON() macro above instead of QUERY(). See class Query in dbclient.h for more information on Query objects, and the Sorting section below.

In the mongo shell (which uses javascript), we could invoke:

```
use tutorial;
db.persons.find( { age : 33 } );
```

### *Indexing*

Let's suppose we want to have an index on age so that our queries are fast. We would use:

```
c.ensureIndex("tutorial.persons", fromjson("{age:1}"));
```

The ensureIndex method checks if the index exists; if it does not, it is created. ensureIndex is intelligent and does not repeat transmissions to the server; thus it is safe to call it many times in your code, for example, adjacent to every insert operation.

In the above example we use a new function, fromjson. fromjson converts a JSON string to a BSONObj. This is sometimes a convenient way to specify BSON. Alternatively we could have written:

```
c.ensureIndex("tutorial.persons", BSON( "age" << 1 ));
```

### *Sorting*

Let's now make the results from printIfAge sorted alphabetically by name. To do this, we change the query statement from:

```
auto_ptr<DBClientCursor> cursor = c.query("tutorial.persons", QUERY( "age" << age ) );
```

to

```
to  auto_ptr<DBClientCursor> cursor = c.query("tutorial.persons", QUERY( "age" << age ).sort("name")
);
```

Here we have used Query::sort() to add a modifier to our query expression for sorting.

### *Updating*

Use the update() method to perform a database update . For example the following update in the mongo shell :

```
> use tutorial
> db.persons.update( { name : 'Joe', age : 33 },
...                  { $inc : { visits : 1 } } )
```

is equivalent to the following C++ code:

```
db.update( "tutorial.persons" ,
           BSON( "name" << "Joe" << "age" << 33 ),
           BSON( "$inc" << BSON( "visits" << 1 ) ) );
```

## Further Reading

This overview just touches on the basics of using Mongo from C++. There are many more capabilities. For further exploration:

- See the language-independent Developer's Tour;
- Experiment with the `mongo` shell;

- Review the doxygen API docs;
- See connecting pooling information in the API docs;
- See GridFS file storage information in the API docs;
- See the HOWTO pages under the C++ Language Center
- Consider getting involved to make the product (either C++ driver, tools, or the database itself) better!

## Connecting

The C++ driver includes several classes for managing collections under the parent class DBClientInterface.

In general, you will want to instantiate either a DBClientConnection object, or a DBClientPaired object. DBClientConnection is our normal connection class for a connection to a single MongoDB database server (or shard manager). We use DBClientPaired to connect to database replica pairs.

See http://api.mongodb.org/cplusplus/ for details on each of the above classes.

Note : replica pairs will soon be replaced by Replica Sets; a new / adjusted interface will be available then.

# Perl Language Center


- Installing
  - CPAN
  - Manual (Non-CPAN) Installation
  - Big-Endian Systems
- Next Steps
- MongoDB Perl Tools
  - `Entities::Backend::MongoDB`
  - `MojoX::Session::Store::MongoDB`
  - `MongoDB::Admin`
  - `Mongoose`
  - `Mongrel`
  - `MongoX`


### Installing

> Start a MongoDB server instance (`mongod`) before installing so that the tests will pass. The `mongod` cannot be running as a slave for the tests to pass.
>
> Some tests may be skipped, depending on the version of the database you are running.

#### *CPAN*

```
$ sudo cpan MongoDB
```

The Perl driver is available through CPAN as the package `MongoDB`. It should build cleanly on *NIX and Windows (via Strawberry Perl). It is also available as an ActivePerl module.

#### *Manual (Non-CPAN) Installation*

If you would like to try the latest code or are contributing to the Perl driver, it is available at Github. There is also documentation generated after every commit.

You can see if it's a good time to grab the bleeding edge code by seeing if the build is green.

To build the driver, run:

```
$ perl Makefile.PL
$ make
$ make test # make sure mongod is running, first
$ sudo make install
```

Please note that the tests will not pass without a `mongod` process running.

### *Big-Endian Systems*

The driver will work on big-endian machines, but the database will not. The tests assume that `mongod` will be running on localhost unless %ENV{MONGOD} is set. So, to run the tests, start the database on a little-endian machine (at, say, "example.com") and then run the tests with:

```
MONGOD=example.com make test
```

A few tests that require a database server on "localhost" will be skipped.

### Next Steps

There is a tutorial and API documentation on CPAN.

If you're interested in contributing to the Perl driver, check out Contributing to the Perl Driver.

### MongoDB Perl Tools

#### `Entities::Backend::MongoDB`

`Entities::Backend::MongoDB` is a backend for the Entities user management and authorization system stores all entities and relations between them in a MongoDB database, using the MongoDB module. This is a powerful, fast backend that gives you all the features of MongoDB.

#### `MojoX::Session::Store::MongoDB`

`MojoX::Session::Store::MongoDB` is a store for `MojoX::Session` that stores a session in a MongoDB database. Created by Ask Bjørn Hansen.

#### `MongoDB::Admin`

`MongoDB::Admin` is a collection of MongoDB administrative functions. Created by David Burley.

#### `Mongoose`

`Mongoose` is an attempt to bring together the full power of Moose with MongoDB. Created by Rodrigo de Oliveira Gonzalez.

#### `Mongrel`

`Mongrel` provides a simple database abstraction layer for MongoDB. Mongrel uses the Oogly data validation framework to provide you with a simple way to create codebased schemas that have data validation built-in, etc.

#### `MongoX`

MongoX - DSL sugar for MongoDB

## Contributing to the Perl Driver

The easiest way to contribute is to file bugs and feature requests on Jira.

If you would like to help code the driver, read on...

### *Finding Something to Help With*

#### *Fixing Bugs*

You can choose a bug on Jira and fix it. Make a comment that you're working on it, to avoid overlap.

#### *Writing Tests*

The driver could use a lot more tests. We would be grateful for any and all tests people would like to write.

#### *Adding Features*

If you think a feature is missing from the driver, you're probably right. Check on IRC or the mailing list, then go ahead and create a Jira case and add the feature. The Perl driver was a bit neglected for a while (although it's now getting a lot of TLC) so it's missing a lot of things that the other drivers have. You can look through their APIs for ideas.

### *Contribution Guildlines*

The best way to make changes is to create an account on [Github], fork the driver, make your improvements, and submit a merge request.

To make sure your changes are approved and speed things along:

- Write tests. Lots of tests.
- Document your code.
- Write POD, when applicable.

Bonus (for C programmers, particularly):

- Make sure your change works on Perl 5.8, 5.10, Windows, Mac, Linux, etc.

### *Code Layout*

The important files:

```
| perl_mongo.c # serialization/deserialization
| mongo_link.c # connecting to, sending to, and receiving from the database
- lib
   - MongoDB
      | Connection.pm # connection, queries, inserts... everything comes through here
      | Database.pm
      | Collection.pm
      | Cursor.pm
      | OID.pm
      | GridFS.pm
      - GridFS
         | File.pm
- xs
   | Mongo.xs
   | Connection.xs
   | Cursor.xs
   | OID.xs
```

## Perl Tutorial

**Redirection Notice**
This page should redirect to http://search.cpan.org/dist/MongoDB/lib/MongoDB/Tutorial.pod.

# Online API Documentation

MongoDB API and driver documentation is available online. It is updated daily.

- Java Driver API Documentation
- C++ Driver API Documentation
- Python Driver API Documentation
- Ruby Driver API Documentation
- PHP Driver API Documentation

# Writing Drivers and Tools

### See Also

- Mongo Query Language
- mongosniff
- --objcheck command line parameter

## Overview - Writing Drivers and Tools

This section contains information for developers that are working with the low-level protocols of Mongo - people who are writing drivers and higher-level tools.

Documents of particular interest :

| | |
|---|---|
| BSON http://bsonspec.org | Description of the BSON binary document format. Fundamental to how Mongo and it's client software works. |
| Mongo Wire Protocol | Specification for the basic socket communications protocol used between Mongo and clients. |
| Mongo Driver Requirements | Description of what functionality is expected from a Mongo Driver |
| GridFS Specification | Specification of GridFS - a convention for storing large objects in Mongo |
| Mongo Extended JSON | Description of the extended JSON protocol for the REST-ful interface (ongoing development) |

Additionally we recommend driver authors take a look at existing driver source code as an example.

### bsonspec.org

### Mongo Driver Requirements

This is a high-level list of features that a driver for MongoDB might provide. We attempt to group those features by priority. This list should be taken with a grain of salt, and probably used more for inspiration than as law that must be adhered to. A great way to learn about implementing a driver is by reading the source code of any of the existing drivers, especially the ones listed as "mongodb.org supported".

High priority

- BSON serialization/deserialization
- full cursor support (e.g. support OP_GET_MORE operation)
- close exhausted cursors via OP_KILL_CURSORS
- support for running database commands
- handle query errors
- convert all strings to UTF-8 (part of proper support for BSON)
- hint, explain, count, $where
- database profiling: set/get profiling level, get profiling info
- advanced connection management (replica pairs, slave okay)
- automatic reconnection

Medium priority

- validate a collection in a database
- buffer pooling
- Tailable cursor support

A driver should be able to connect to a single server. By default this must be `localhost:27017`, and must also allow the server to be specified by hostname and port.

```
Mongo m = new Mongo();   // go to localhost, default port
```

```
Mongo m = new Mongo(String host, int port);
```

How the driver does this is up to the driver - make it idiomatic. However, a driver should make it explicit and clear what is going on.

Pair Mode Connection

A driver must be able to support "Pair Mode" configurations, where two mongod servers are specified, and configured for hot-failover.

The driver should determine which of the pair is the current master, and send all operations to that server. In the event of an error, either socket error or a "not a master" error, the driver must restart the determination process. It must not assume the other server in the pair is now the master.

```
ServerPair sp = new ServerPair(INETAddr...);
Mongo m = new Mongo(sp)
```

A driver may optionally allow a driver to connect deliberately to the "non-master" in the pair, for debugging, admin or operational purposes.

```
ServerPair sp = new ServerPair(INETAddr...);
sp.setTarget(ServerPair.SHADOW_MASTER);
Mongo m = new Mongo(sp);
```

1. **Cluster Mode** Connect to master in master-slave cluster

```
ServerCluster sc = new ServerCluster(INETAddr...); // again, give one and discover?
Mongo m = new Mongo(sc);
```

## Connect to slave in read-only mode in master-slave cluster

```
ServerCluster sc = new ServerCluster(INETAddr...); // again, give one and discover?
sc.setTarget(...)
Mongo m = new Mongo(sc);

or maybe make it like *Default/Simple* w/ a flag?
```

Other than that, we need a way to get a DB object :

```
Mongo m = new Mongo();

DB db = m.getDB(name);
```

And a list of db names (useful for tools...) :

```
List<String> getDBNameList();
```

Database Object

Simple operations on a database object :

```
/**
 *  get name of database
 */
String    dbName = db.getName();

/**
 * Get a list of all the collection names in this database
 */
List<String> cols = db.getCollectionNames();

/**
 * get a collection object.  Can optionally create it if it
 *  doesn't exist, or just  be strict.  (XJDM has strictness as an option)
 */
Collection coll = db.getCollection(string);

/**
 * Create a collection w/ optional options.  Can fault
 * if the collection exists, or can just return it if it already does
 */
Collection coll = db.createCollection( string);
Collection coll = db.createCollection( string, options);

/**
 * Drop a collection by its name or by collection object.
 * Driver could invalidate any outstanding Collection objects
 * for that collection, or just hope for the best.
 */
boolean  b  = db.dropCollection(name);
boolean  b  = db.dropCollection(Collection);

/**
 * Execute a command on the database, returning the
 * BSON doc with the results
 */
Document d = db.executeCommand(command);

/**
 * Close the [logical] database
 */
void  db.close();

/**
 * Erase / drop an entire database
 */
bool dropDatabase(dbname)
```

Database Administration

These methods have to do with database metadata: profiling levels and collection validation. Each admin object is associated with a database. These methods could either be built into the Database class or provided in a separate Admin class whose instances are only available from a database instance.

```
/* get an admin object from a database object. */
Admin admin = db.getAdmin();

/**
 * Get profiling level. Returns one of the strings "off", "slowOnly", or
 * "all". Note that the database returns an integer. This method could
 * return an int or an enum instead --- in Ruby, for example, we return
 * symbols.
 */
String profilingLevel = admin.getProfilingLevel();

/**
 * Set profiling level. Takes whatever getProfilingLevel() returns.
 */
admin.setProfilingLevel("off");

/**
 * Retrieves the database's profiling info.
 */
Document profilingInfo = admin.getProfilingInfo();

/**
 * Returns true if collection is valid; raises an exception if not.
 */
boolean admin.validateCollection(collectionName);
```

Collection Basic Ops

```
/**
 *   full query capabilities - limit, skip, returned fields, sort, etc
 */
Cursor        find(...);

void          insert(...) // insert one or more objects into the collection, local variants on args
void          remove(query) // remove objects that match the query
void          modify(selector, modifier)  // modify all objects that match selector w/ modifier object
void          replace(selector, object)   // replace first object that match selector w/ specified
object
void          repsert(selector, object)   // replace first object that matches, or insert  **upsert w/
modifier makes no logical sense*
long          getCount();
long          getCount(query);
```

Index Operations

```
void          createIndex( index_info)
void          dropIndex(name)
void          dropIndexes()
List<info>    getIndexInformation()
```

Misc Operations

```
document      explain(query)
options       getOptions();
string        getName();
void          close();
```

Cursor Object

```
document      getNextDocument()
iterator      getIterator()  // again, local to language
bool          hasMore()
void          close()
```

## Spec, Notes and Suggestions for Mongo Drivers

Assume that the BSON objects returned from the database may be up to 4MB. This size may change over time but for now the limit is 4MB per object. We recommend you test your driver with 4MB objects.

### *See Also*

- Driver Requirements
- BSON
- The main Database Internals page

## Feature Checklist for Mongo Drivers

### *Functionality Checklist*

This section lists tasks the driver author might handle.

#### Essential

- BSON serialization/deserialization
- Basic operations: `query`, `save`, `update`, `remove`, `ensureIndex`, `findOne`, `limit`, `sort`
- Fetch more data from a cursor when necessary (dbGetMore)
- Sending of KillCursors operation when use of a cursor has completed (ideally for efficiently these are sent in batches)
- Convert all strings to utf8
- Authentication

#### Recommended

- automatic doc_id generation (important when using replication)
- Database $cmd support and helpers
- Detect { `$err: ...` } response from a db query and handle appropriately --see Error Handling in Mongo Drivers
- Automatically connect to proper server, and failover, when connecting to a Replica Set
- `ensureIndex` commands should be cached to prevent excessive communication with the database. (Or, the driver user should be informed that `ensureIndex` is not a lightweight operation for the particular driver.)
- Support for objects up to 4MB in size

#### More Recommended

- lasterror helper functions
- `count()` helper function
- `$where` clause
- `eval()`
- File chunking
- hint fields
- explain helper
- Automatic _id index creation (maybe the db should just do this???)

#### More Optional

- `addUser`, `logout` helpers
- Allow client user to specify Option_SlaveOk for a query
- Tailable cursor support
- In/out buffer pooling (if implementing in a garbage collected languages)

#### More Optional

- [connection pooling]
- Automatic reconnect on connection failure
- DBRef Support:
    - Ability to generate easily
    - Automatic traversal

### *See Also*

- The Driver and Integration Center for information about the latest drivers
- The [top page] for this section
- The main Database Internals page
- The starting point for all Home

## Conventions for Mongo Drivers

### *Interface Conventions*

It is desirable to keep driver interfaces consistent when possible. Of course, idioms vary by language, and when they do adaptation is appropriate. However, when the idiom is the same, keeping the interfaces consistent across drivers is desirable.

### *Terminology*

In general, use these terms when naming identifiers. Adapt the names to the normal "punctuation" style of your language `-- foo_bar` in C might be `fooBar` in Java.

- *database* - what does this mean?
- *collection*
- *index*

# Driver Testing Tools

#### Object IDs

- driverOIDTest for testing toString

```
> db.runCommand( { "driverOIDTest" : new ObjectId() } )
{
        "oid" : ObjectId("4b8991f221752a6e61a88267"),
        "str" : "4b8991f221752a6e61a88267",
        "ok" : 1
}
```

# Mongo Wire Protocol


- Introduction
- Messages Types and Formats
  - Standard Message Header
  - Request Opcodes
- Client Request Messages
  - OP_UPDATE
  - OP_INSERT
  - OP_QUERY
  - OP_GETMORE
  - OP_DELETE
  - OP_KILL_CURSORS
  - OP_MSG
- Database Response Messages
  - OP_REPLY


### *Introduction*

The Mongo Wire Protocol is a simple socket-based, request-response style protocol. Clients communicate with the database server through a regular TCP/IP socket.

> **Default Socket Port**
> The default port is 27017, but this is configurable and will vary.

Clients should connect to the database with a regular TCP/IP socket. Currently, there is no connection handshake.

> To describe the message structure, a C-like `struct` is used. The types used in this document (`cstring`, `int32`, etc.) are the same as those defined in the BSON specification. The standard message header is typed as `MsgHeader`. Integer constants are in capitals (e.g. `ZERO` for the integer value of 0).
>
> In the case where more than one of something is possible (like in a OP_INSERT or OP_KILL_CURSORS), we again use the notation from the BSON specification (e.g. `int64*`). This simply indicates that one or more of the specified type can be written to the socket, one after another.

> **Byte Ordering**
> Note that like BSON documents, all data in the mongo wire protocol is little-endian.

### *Messages Types and Formats*

TableOfContents

There are two types of messages, client requests and database responses, each having a slightly different structure.

Standard Message Header

In general, each message consists of a standard message header followed by request-specific data. The standard message header is structured as follows :

```
struct MsgHeader {
    int32   messageLength; // total message size, including this
int32   requestID;     // identifier for this message
int32   responseTo;    // requestID from the original request
//   (used in reponses from db)
int32   opCode;        // request type - see table below
}
```

**`messageLength`** : This is the total size of the message in bytes. This total includes the 4 bytes that holds the message length.

**`requestID`** : This is a client or database-generated identifier that uniquely identifies this message. For the case of client-generated messages (e.g. CONTRIB:OP_QUERY and CONTRIB:OP_GET_MORE), it will be returned in the `responseTo` field of the CONTRIB:OP_REPLY message. Along with the `reponseTo` field in responses, clients can use this to associate query responses with the originating query.

**`responseTo`** : In the case of a message from the database, this will be the requestID taken from the CONTRIB:OP_QUERY or CONTRIB:OP_GET_MORE messages from the client. Along with the `requestID` field in queries, clients can use this to associate query responses with the originating query.

**`opCode`** : Type of message. See the table below in the next section.

Request Opcodes

TableOfContents

The following are the currently supported opcodes :

| Opcode Name | opCode value | Comment |
|---|---|---|
| OP_REPLY | 1 | Reply to a client request. responseTo is set |
| OP_MSG | 1000 | generic msg command followed by a string |
| OP_UPDATE | 2001 | update document |
| OP_INSERT | 2002 | insert new document |
| RESERVED | 2003 | formerly used for OP_GET_BY_OID |
| OP_QUERY | 2004 | query a collection |
| OP_GET_MORE | 2005 | Get more data from a query. See Cursors |

| | | |
|---|---|---|
| OP_DELETE | 2006 | Delete documents |
| OP_KILL_CURSORS | 2007 | Tell database client is done with a cursor |

### *Client Request Messages*

TableOfContents

Clients can send all messages except for CONTRIB:OP_REPLY. This is reserved for use by the database.

Note that only the CONTRIB:OP_QUERY and CONTRIB:OP_GET_MORE messages result in a response from the database. There will be no response sent for any other message.

You can determine if a message was successful with a $$$ TODO get last error command.

OP_UPDATE

The OP_UPDATE message is used to update a document in a collection. The format of a OP_UPDATE message is

```
struct OP_UPDATE {
    MsgHeader header;             // standard message header
int32     ZERO;               // 0 - reserved for future use
cstring   fullCollectionName; // "dbname.collectionname"
int32     flags;              // bit vector. see below
document  selector;           // the query to select the document
document  update;             // specification of the update to perform
}
```

**`fullCollectionName`** : The full collection name. The full collection name is the concatenation of the database name with the collection name, using a "." for the concatenation. For example, for the database "foo" and the collection "bar", the full collection name is "foo.bar".

**`flags`** :

| bit num | name | description |
|---|---|---|
| 0 | Upsert | If set, the database will insert the supplied object into the collection if no matching document is found. |
| 1 | MultiUpdate | If set, the database will update all matching objects in the collection. Otherwise only updates first matching doc. |
| 2-31 | Reserved | Must be set to 0. |

**`selector`** : BSON document that specifies the query for selection of the document to update.

**`update`** : BSON document that specifies the update to be performed. For information on specifying updates see the documentation on Updating.

There is no response to an OP_UPDATE message.

OP_INSERT

The OP_INSERT message is used to insert one or more documents into a collection. The format of the OP_INSERT message is

```
struct {
    MsgHeader header;             // standard message header
int32     ZERO;               // 0 - reserved for future use
cstring   fullCollectionName; // "dbname.collectionname"
document* documents;          // one or more documents to insert into the collection
}
```

**`fullCollectionName`** : The full collection name. The full collection name is the concatenation of the database name with the collection name, using a "." for the concatenation. For example, for the database "foo" and the collection "bar", the full collection name is "foo.bar".

**`documents`** : One or more documents to insert into the collection. If there are more than one, they are written to the socket in sequence, one after another.

There is no response to an OP_INSERT message.

OP_QUERY

The OP_QUERY message is used to query the database for documents in a collection. The format of the OP_QUERY message is :

```
struct OP_QUERY {
    MsgHeader header;                // standard message header
int32     flags;                  // bit vector of query options.  See below for details.
cstring   fullCollectionName;    // "dbname.collectionname"
int32     numberToSkip;          // number of documents to skip
int32     numberToReturn;        // number of documents to return
//  in the first OP_REPLY batch
document  query;                 // query object.  See below for details.
[ document  returnFieldSelector; ] // Optional. Selector indicating the fields
//  to return.  See below for details.
}
```

**`flags`** :

| bit num | name | description |
|---|---|---|
| 0 | Reserved | Must be set to 0. |
| 1 | TailableCursor | Tailable means cursor is not closed when the last data is retrieved. Rather, the cursor marks the final object's position. You can resume using the cursor later, from where it was located, if more data were received. Like any "latent cursor", the cursor may become invalid at some point (CursorNotFound) – for example if the final object it references were deleted. |
| 2 | SlaveOk | Allow query of replica slave. Normally these return an error except for namespace "local". |
| 3 | OplogReplay | Internal replication use only - driver should not set |
| 4 | NoCursorTimeout | The server normally times out idle cursors after an inactivity period (10 minutes) to prevent excess memory use. Set this option to prevent that. |
| 5 | AwaitData | Use with TailableCursor. If we are at the end of the data, block for a while rather than returning no data. After a timeout period, we do return as normal. |
| 6 | Exhaust | Stream the data down full blast in multiple "more" packages, on the assumption that the client will fully read all data queried. Faster when you are pulling a lot of data and know you want to pull it all down. Note: the client is not allowed to not read all the data unless it closes the connection. |
| 7-31 | Reserved | Must be set to 0. |

**`fullCollectionName`** : The full collection name. The full collection name is the concatenation of the database name with the collection name, using a "." for the concatenation. For example, for the database "foo" and the collection "bar", the full collection name is "foo.bar".

**`numberToSkip`** : Sets the number of documents to omit - starting from the first document in the resulting dataset - when returning the result of the query.

**`numberToReturn`** : Limits the number of documents in the **first** CONTRIB:OP_REPLY message to the query. However, the database will still establish a cursor and return the `cursorID` to the client if there are more results than `numberToReturn`. If the client driver offers 'limit' functionality (like the SQL **LIMIT** keyword), then it is up to the client driver to ensure that no more than the specified number of document are returned to the calling application. If `numberToReturn` is 0, the db will used the default return size. If the number is negative, then the database will return that number and close the cursor. No futher results for that query can be fetched. If `numberToReturn` is 1 the server will treat it as -1 (closing the cursor automatically).

**`query`** : BSON document that represents the query. The query will contain one or more elements, all of which must match for a document to be included in the result set. Possible elements include `$query`, `$orderby`, `$hint`, `$explain`, and `$snapshot`.

**`returnFieldsSelector`** : OPTIONAL BSON document that limits the fields in the returned documents. The returnFieldsSelector contains one or more elements, each of which is the name of a field that should be returned, and and the integer value 1. In JSON notation, a returnFieldsSelector to limit to the fields "a", "b" and "c" would be :

```
{ a : 1, b : 1, c : 1}
```

The database will respond to an OP_QUERY message with an CONTRIB:OP_REPLY message.

OP_GETMORE

The OP_GETMORE message is used to query the database for documents in a collection. The format of the OP_GETMORE message is :

```
struct {
    MsgHeader header;             // standard message header
int32     ZERO;               // 0 - reserved for future use
cstring   fullCollectionName; // "dbname.collectionname"
int32     numberToReturn;     // number of documents to return
int64     cursorID;           // cursorID from the OP_REPLY
}
```

**`fullCollectionName`** : The full collection name. The full collection name is the concatenation of the database name with the collection name, using a "." for the concatenation. For example, for the database "foo" and the collection "bar", the full collection name is "foo.bar".

**`numberToReturn`** : Limits the number of documents in the **first** CONTRIB:OP_REPLY message to the query. However, the database will still establish a cursor and return the `cursorID` to the client if there are more results than `numberToReturn`. If the client driver offers 'limit' functionality (like the SQL **LIMIT** keyword), then it is up to the client driver to ensure that no more than the specified number of document are returned to the calling application. If `numberToReturn` is 0, the db will used the default return size.

**`cursorID`** : Cursor identifier that came in the CONTRIB:OP_REPLY. This must be the value that came from the database.

The database will respond to an OP_GETMORE message with an CONTRIB:OP_REPLY message.

OP_DELETE

The OP_DELETE message is used to remove one or more messages from a collection. The format of the OP_DELETE message is :

```
struct {
    MsgHeader header;             // standard message header
int32     ZERO;               // 0 - reserved for future use
cstring   fullCollectionName; // "dbname.collectionname"
int32     flags;              // bit vector - see below for details.
document  selector;           // query object.  See below for details.
}
```

**`fullCollectionName`** : The full collection name. The full collection name is the concatenation of the database name with the collection name, using a "." for the concatenation. For example, for the database "foo" and the collection "bar", the full collection name is "foo.bar".

**`flags`** :

| bit num | name | description |
|---|---|---|
| 0 | SingleRemove | If set, the database will remove only the first matching document in the collection. Otherwise all matching documents will be removed. |
| 1-31 | Reserved | Must be set to 0. |

**`selector`** : BSON document that represent the query used to select the documents to be removed. The selector will contain one or more elements, all of which must match for a document to be removed from the collection. Please see $$$ TODO QUERY for more information.

There is no reponse to an OP_DELETE message.

OP_KILL_CURSORS

The OP_KILL_CURSORS message is used to close an active cursor in the database. This is necessary to ensure that database resources are reclaimed at the end of the query. The format of the OP_KILL_CURSORS message is :

```
struct {
    MsgHeader header;             // standard message header
int32     ZERO;               // 0 - reserved for future use
int32     numberOfCursorIDs; // number of cursorIDs in message
int64*    cursorIDs;         // sequence of cursorIDs to close
}
```

**`numberOfCursorIDs`** : The number of cursors that are in the message.

**`cursorIDs`** : "array" of cursor IDs to be closed. If there are more than one, they are written to the socket in sequence, one after another.

Note that if a cursor is read until exhausted (read until OP_QUERY or OP_GETMORE returns zero for the cursor id), there is no need to kill the

cursor.

OP_MSG

Deprecated. OP_MSG sends a diagnostic message to the database. The database sends back a fixed resonse. The format is

```
struct {
    MsgHeader header;  // standard message header
cstring   message; // message for the database
}
```

Drivers do not need to implement OP_MSG.

### *Database Response Messages*

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OP_REPLY

The OP_REPLY message is sent by the database in response to an CONTRIB:OP_QUERY or CONTRIB:OP_GET_MORE message. The format of an OP_REPLY message is:

```
struct {
    MsgHeader header;         // standard message header
int32     responseFlags;  // bit vector - see details below
int64     cursorID;       // cursor id if client needs to do get more's
int32     startingFrom;   // where in the cursor this reply is starting
int32     numberReturned; // number of documents in the reply
document* documents;      // documents
}
```

**`responseFlags`** :

| bit num | name | description |
|---|---|---|
| 0 | CursorNotFound | Set when getMore is called but the cursor id is not valid at the server. Returned with zero results. |
| 1 | QueryFailure | Set when query failed. Results consist of one document containing an "$err" field describing the failure. |
| 2 | ShardConfigStale | Drivers should ignore this. Only mongos will ever see this set, in which case, it needs to update config from the server. |
| 3 | AwaitCapable | Set when the server supports the AwaitData Query option. If it doesn't, a client should sleep a little between getMore's of a Tailable cursor. Mongod version 1.6 supports AwaitData and thus always sets AwaitCapable. |
| 4-31 | Reserved | Ignore |

**`cursorID`** : The cursorID that this OP_REPLY is a part of. In the event that the result set of the query fits into one OP_REPLY message, `cursorID` will be 0. This `cursorID` must be used in any CONTRIB:OP_GET_MORE messages used to get more data, and also must be closed by the client when no longer needed via a CONTRIB:OP_KILL_CURSORS message.

## BSON


- bsonspec.org
- BSON and MongoDB
- Language-Specific Examples
  - C
  - C++
  - Java
  - PHP
  - Python
  - Ruby
- MongoDB Document Types


### *bsonspec.org*

BSON is a bin-ary-en-coded seri-al-iz-a-tion of JSON-like doc-u-ments. BSON is designed to be lightweight, traversable, and efficient. BSON, like JSON, supports the embedding of objects and arrays within other objects and arrays. See bsonspec.org for the spec and more information in general.

### *BSON and MongoDB*

MongoDB uses BSON as the data storage and network transfer format for "documents".

BSON at first seems BLOB-like, but there exists an important difference: the Mongo database understands BSON internals. This means that MongoDB can "reach inside " BSON objects, even nested ones. Among other things, this allows MongoDB to build indexes and match objects against query expressions on both top-level and nested BSON keys.

See also: the BSON blog post.

### *Language-Specific Examples*

We often map from a language's "dictionary" type – which may be its native objects – to BSON.  The mapping is particularly natural in dynamically typed languages:

```
JavaScript: {"foo" : "bar"}
Perl: {"foo" => "bar"}
PHP: array("foo" => "bar")
Python: {"foo" : "bar"}
Ruby: {"foo" => "bar"}
Java: DBObject obj = new BasicDBObject("foo", "bar");
```

#### *C*

```
bson b;
bson_buffer buf;
bson_buffer_init( &buf )
bson_append_string( &buf, "name", "Joe" );
bson_append_int( &buf, "age", 33 );
bson_from_buffer( &b, &buf );
bson_print( &b );
```

See http://github.com/mongodb/mongo-c-driver/blob/master/src/bson.h for more information.

#### *C++*

```
BSONObj p = BSON( "name" << "Joe" << "age" << 33 );
cout << p.toString() << endl;
cout << p["age"].number() << endl;
```

See the BSON section of the C++ Tutorial for more information.

#### *Java*

```
BasicDBObject doc = new BasicDBObject();
doc.put("name", "MongoDB");
doc.put("type", "database");
doc.put("count", 1);
BasicDBObject info = new BasicDBObject();
info.put("x", 203);
info.put("y", 102);
doc.put("info", info);
coll.insert(doc);
```

#### *PHP*

The PHP driver includes `bson_encode` and `bson_decode` functions. `bson_encode` takes any PHP type and serializes it, returning a string of bytes:

```
$bson = bson_encode(null);
$bson = bson_encode(true);
$bson = bson_encode(4);
$bson = bson_encode("hello, world");
$bson = bson_encode(array("foo" => "bar"));
$bson = bson_encode(new MongoDate());
```

Mongo-specific objects (`MongoId`, `MongoDate`, `MongoRegex`, `MongoCode`) will be encoded in their respective BSON formats. For other objects, it will create a BSON representation with the key/value pairs you would get by running `for ($object as $key => $value)`.

`bson_decode` takes a string representing a BSON object and parses it into an associative array.

***Python***

```
>>> from pymongo.bson import BSON
>>> bson_string = BSON.from_dict({"hello": "world"})
>>> bson_string
'\x16\x00\x00\x00\x02hello\x00\x06\x00\x00\x00world\x00\x00'
>>> bson_string.to_dict()
{u'hello': u'world'}
```

PyMongo also supports "ordered dictionaries" through the **pymongo.son** module. The **BSON** class can handle **SON** instances using the same methods you would use for regular dictionaries.

***Ruby***

There are now two gems that handle BSON-encoding: bson and bson_ext. These gems can be used to work with BSON independently of the MongoDB Ruby driver.

```
irb
>> require 'rubygems'
=> true
>> require 'bson'
=> true
>> doc = {:hello => "world"}
>> bson = BSON.serialize(doc).to_s
=> "\026\000\000\000\002hello\000\006\000\000\000world\000\000"
>> BSON.deserialize(bson.unpack("C*"))
=> {"hello" => "world"}
```

The BSON class also supports ordered hashes. Simply construct your documents using the OrderedHash class, also found in the MongoDB Ruby Driver.

### *MongoDB Document Types*

MongoDB uses BSON documents for three things:

1. Data storage (user documents). These are the regular JSON-like objects that the database stores for us. These BSON documents are sent to the database via the INSERT operation. User documents have limitations on the "element name" space due to the usage of special characters in the JSON-like query language.
    a. A user document element name cannot begin with "$".
    b. A user document element name cannot have a "." in the name.
    c. The element name "_id" is reserved for use as a primary key id, but you can store anything that is unique in that field.
    The database expects that drivers will prevent users from creating documents that violate these constraints.
2. Query "Selector" Documents : Query documents (or selectors) are BSON documents that are used in QUERY, DELETE and UPDATE operations. They are used by these operations to match against documents. Selector objects have no limitations on the "element name" space, as they must be able to supply special "marker" elements, like "$where" and the special "command" operations.
3. "Modifier" Documents : Documents that contain 'modifier actions' that modify user documents in the case of an update (see Updating).

## Mongo Extended JSON

Mongo's REST interface supports storage and retrieval of JSON documents. Special representations are used for BSON types that do not have obvious JSON mappings, and multiple representations are allowed for some such types. The REST interface supports three different modes for document output { Strict, JS, TenGen }, which serve to control the representations used. Mongo can of course understand all of these

representations in REST input.

- **Strict** mode produces output conforming to the JSON spec http://www.json.org.
- **JS** mode uses some Javascript types to represent certain BSON types.
- **TenGen** mode uses some Javascript types and some 10gen specific types to represent certain BSON types.

The following BSON types are represented using special conventions:

| Type | Strict | JS | TenGen | Explanation |
|---|---|---|---|---|
| data_binary | `{ "$binary" : "<bindata>" , "$type" : "<t>" }` | `{ "$binary" : "<bindata>", "$type" : "<t>" }` | `{ "$binary" : "<bindata>", "$type" : "<t>" }` | <bindata> is the base64 representation of a binary string. <t> is the hexadecimal representation of a single byte indicating the data type. |
| data_date | `{ "$date" : <date> }` | `Date( <date> )` | `Date( <date> )` | <date> is the JSON representation of a 64 bit unsigned integer for milliseconds since epoch. |
| data_regex | `{ "$regex" : "<sRegex>", "$options" : "<sOptions>" }` | `/<jRegex>/<jOptions>` | `/<jRegex>/<jOptions>` | <sRegex> is a string of valid JSON characters. <jRegex> is a string that may contain valid JSON characters and unescaped "" characters, but may not contain unescaped '/' characters. <sOptions> is a string containing letters of the alphabet. <jOptions> is a string that may contain only the characters 'g', 'i', and 'm'. Because the JS and TenGen representations support a limited range o options, any nonconforming options will be dropped when converting to this representation. |

| | | | | |
|---|---|---|---|---|
| data_oid | `{ "$oid" : "<id>" }` | `{ "$oid" : "<id>" }` | `ObjectId( "<id>" )` | <id> is a 24 character hexadecimal string. Note that these representations require a data_oid value to have an associated field name "_id". |
| data_ref | `{ "$ref" : "<name>", "$id" : "<id>" }` | `{ "$ref" : "<name>" , "$id" : "<id>" }` | `Dbref( "<name>", "<id>" )` | <name> is a string of valid JSON characters. <id> is a 24 character hexadecimal string. |

# GridFS Specification


- Introduction
- Specification
  - Storage Collections
    - `files`
    - `chunks`
  - Indexes


### *Introduction*

GridFS is a storage specification for large objects in MongoDB. It works by splitting large object into small chunks, usually 256k in size. Each chunk is stored as a separate document in a `chunks` collection. Metadata about the file, including the filename, content type, and any optional information needed by the developer, is stored as a document in a `files` collection.

So for any given file stored using GridFS, there will exist one document in `files` collection and one or more documents in the `chunks` collection.

If you're just interested in using GridFS, see the docs on storing files. If you'd like to understand the GridFS implementation, read on.

### *Specification*

#### *Storage Collections*

GridFS uses two collections to store data:

- `files` contains the object metadata
- `chunks` contains the binary chunks with some additional accounting information

In order to make more than one GridFS namespace possible for a single database, the files and chunks collections are named with a prefix. By default the prefix is `fs.`, so any default GridFS store will consist of collections named `fs.files` and `fs.chunks`. The drivers make it possible to change this prefix, so you might, for instance, have another GridFS namespace specifically for photos where the collections would be `photos.files` and `photos.chunks`.

Here's an example of the standard GridFS interface in Java:

```
/*
 * default root collection usage - must be supported
 */
GridFS myFS = new GridFS(myDatabase);              // returns a default GridFS (e.g. "fs" root
collection)
myFS.storeFile(new File("/tmp/largething.mpg"));   // saves the file into the "fs" GridFS store

/*
 * specified root collection usage - optional
 */

GridFS myContracts = new GridFS(myDatabase, "contracts");             // returns a GridFS where
"contracts" is root
myFS.retrieveFile("smithco", new File("/tmp/smithco_20090105.pdf"));  // retrieves object whose
filename is "smithco"
```

Note that the above API is for demonstration purposes only - this spec does not (at this time) recommend any API. See individual driver documentation for API specifics.

`files`

Documents in the `files` collection require the following fields:

```
{
  "_id" : <unspecified>,                  // unique ID for this file
"length" : data_number,                 // size of the file in bytes
"chunkSize" : data_number,              // size of each of the chunks.  Default is 256k
"uploadDate" : data_date,               // date when object first stored
"md5" : data_string                     // result of running the "filemd5" command on this file's
chunks
}
```

Any other desired fields may be added to the files document; common ones include the following:

```
{
  "filename" : data_string,               // human name for the file
"contentType" : data_string,            // valid mime type for the object
"aliases" : data_array of data_string,  // optional array of alias strings
"metadata" : data_object,               // anything the user wants to store
}
```

Note that the _id field can be of any type, per the discretion of the spec implementor.

`chunks`

The structure of documents from the `chunks` collection is as follows:

```
{
  "_id" : <unspecified>,         // object id of the chunk in the _chunks collection
"files_id" : <unspecified>,    // _id of the corresponding files collection entry
"n" : chunk_number,            // chunks are numbered in order, starting with 0
"data" : data_binary,          // the chunk's payload as a BSON binary type
}
```

Notes:

- The `_id` is whatever type you choose. As with any MongoDB document, the default will be a BSON object id.
- The `files_id` is a foreign key containing the `_id` field for the relevant `files` collection entry

***Indexes***

GridFS implementations should create a unique, compound index in the `chunks` collection for `files_id` and n. Here's how you'd do that from

the shell:

```
db.fs.chunks.ensureIndex({files_id:1, n:1}, {unique: true});
```

This way, a chunk can be retrieved efficiently using it's `files_id` and n values. Note that GridFS implementations should use findOne operations to get chunks individually, and should **not** leave open a cursor to query for all chunks. So to get the first chunk, we could do:

```
db.fs.chunks.findOne({files_id: myFileID, n: 0});
```

## Implementing Authentication in a Driver

The current version of Mongo supports only very basic authentication. One authenticates a username and password in the context of a particular database. Once authenticated, the user has full read and write access to the database in question.

The `admin` database is special. In addition to several commands that are administrative being possible only on `admin`, authentication on `admin` gives one read and write access to all databases on the server. Effectively, `admin` access means root access to the db.

Note on a single socket we may authenticate for any number of databases, and as different users. This authentication persists for the life of the database connection (barring a `logout` command).

### The Authentication Process

Authentication is a two step process. First the driver runs a `getnonce` command to get a nonce for use in the subsequent authentication. We can view a sample `getnonce` invocation from `dbshell`:

```
> db.$cmd.findOne({getnonce:1})
{ "nonce":"7268c504683936e1" , "ok":1
```

The nonce returned is a hex String.

The next step is to run an `authenticate` command for the database on which to authenticate. The authenticate command has the form:

```
{ authenticate : 1, user : username, nonce : nonce, key : digest }
```

where

- *username* is a username in the database's system.users collection;
- *nonce* is the nonce returned from a previous getnonce command;
- *digest* is the hex encoding of a MD5 message digest which is the MD5 hash of the concatenation of (*nonce*, *username*, *password_digest* ), where *password_digest* is the user's password value in the `pwd` field of the associated user object in the database's system.users collection. `pwd` is the hex encoding of MD5( username + ":mongo:" + *password_text*).

Authenticate will return an object containing

```
{ ok : 1 }
```

when successful.

Details of why an authentication command failed may be found in the Mongo server's log files.

The following code from the Mongo Javascript driver provides an example implementation:

```
DB.prototype.addUser = function( username , pass ){
    var c = this.getCollection( "system.users" );

    var u = c.findOne( { user : username } ) || { user : username };
    u.pwd = hex_md5( username + ":mongo:" + pass );
    print( tojson( u ) );

    c.save( u );
}

DB.prototype.auth = function( username , pass ){
    var n = this.runCommand( { getnonce : 1 } );

    var a = this.runCommand(
        {
            authenticate : 1 ,
            user : username ,
            nonce : n.nonce ,
            key : hex_md5( n.nonce + username + hex_md5( username + ":mongo:" + pass ) )
        }
    );

    return a.ok;
}
```

### Logout

Drivers may optionally implement the logout command which deauthorizes usage for the specified database for this connection. Note other databases may still be authorized.

Alternatively, close the socket to deauthorize.

```
> db.$cmd.findOne({logout:1})
{
    "ok" : 1.0
}
```

### Replica Pairs and Authentication

For drivers that support replica pairs, extra care with replication is required.

When switching from one server in a pair to another (on a failover situation), you must reauthenticate. Clients will likely want to cache authentication from the user so that the client can reauthenticate with the new server when appropriate.

Be careful also with operations such as Logout - if you log out from only half a pair, that could be an issue.

Authenticating with a server in slave mode is allowed.

### See Also

- Security and Authentication

## Notes on Pooling for Mongo Drivers

Note that with the db write operations can be sent asynchronously or synchronously (the latter indicating a getlasterror request after the write).

When asynchronous, one must be careful to continue using the same connection (socket). This ensures that the next operation will not begin until after the write completes.

### Pooling and Authentication

An individual socket connection to the database has associated authentication state. Thus, if you pool connections, you probably want a separate pool for each authentication case (db + username).

### Pseudo-code

The following pseudo-code illustrates our recommended approach to implementing connection pooling in a driver's connection class. This handles authentication, grouping operations from a single "request" onto the same socket, and a couple of other gotchas:

```
class Connection:
   init(pool_size, addresses, auto_start_requests):
      this.pool_size = pool_size
      this.addresses = addresses
      this.auto_start_requests = auto_start_requests
      this.thread_map = {}
      this.locks = Lock[pool_size]
      this.sockets = Socket[pool_size]
      this.socket_auth = String[pool_size][]
      this.auth = {}

      this.find_master()

   find_master():
      for address in this.addresses:
         if address.is_master():
            this.master = address

   pick_and_acquire_socket():
      choices = random permutation of [0, ..., this.pool_size - 1]

      choices.sort(order: ascending,
                   value: size of preimage of choice under this.thread_map)

      for choice in choices:
         if this.locks[choice].non_blocking_acquire():
            return choice

      sock = choices[0]
      this.locks[sock].blocking_acquire()
      return sock

   get_socket():
      if this.thread_map[current_thread] >= 0:
         sock_number = this.thread_map[current_thread]
         this.locks[sock_number].blocking_acquire()
      else:
         sock_number = this.pick_and_lock_socket()
         if this.auto_start_requests or current_thread in this.thread_map:
            this.thread_map[current_thread] = sock_number

      if not this.sockets[sock_number]:
         this.sockets[sock_number] = Socket(this.master)

      return sock_number

   send_message_without_response(message):
      sock_number = this.get_socket()
      this.check_auth()
      this.sockets[sock_number].send(message)
      this.locks[sock_number].release()

   send_message_with_response(message):
      sock_number = this.get_socket()
      this.check_auth()
      this.sockets[sock_number].send(message)
      result = this.sockets[sock_number].receive()
      this.locks[sock_number].release()
      return result

   # start_request is only needed if auto_start_requests is False
   start_request():
      this.thread_map[current_thread] = -1
```

```
   end_request():
      delete this.thread_map[current_thread]

   authenticate(database, username, password):
      # TODO should probably make sure that these credentials are valid,
      # otherwise errors are going to be delayed until first op.
      this.auth[database] = (username, password)

   logout(database):
      delete this.auth[database]

   check_auth(sock_number):
      for db in this.socket_auth[sock_number]:
         if db not in this.auth.keys():
            this.sockets[sock_number].send(logout_message)
            this.socket_auth[sock_number].remove(db)
      for db in this.auth.keys():
         if db not in this.socket_auth[sock_number]:
            this.sockets[sock_number].send(authenticate_message)
            this.socket_auth[sock_number].append(db)

# somewhere we need to do error checking - if you get not master then everything
# in this.sockets gets closed and set to null and we call find_master() again.
```

```
# we also need to reset the socket_auth information - nothing is authorized yet
# on the new master.
```

### See Also

- The Driver and Integration Center for information about the latest drivers
- The [top page] for this section
- The main Database Internals page
- The starting point for all Home

### Driver and Integration Center

## Connecting Drivers to Replica Sets

Ideally a MongoDB driver can connect to a cluster of servers which represent a replica set, and automatically find the right set member with which to communicate. Failover should be automatic too. The general steps are:

1. The user, when opening the connection, specifies host[:port] for one or more members of the set. Not all members need be specified -- in fact the exact members of the set might change over time. This list for the connect call is the *seed list*.
2. The driver then connects to all servers on the seed list, perhaps in parallel to minimize connect time. Send an ismaster command to each server.
3. When the server is in replSet mode, it will return a *hosts* field with all members of the set that are potentially eligible to serve data. The client should cache this information. Ideally this refreshes too, as the set's config could change over time.
4. Choose a server with which to communicate.
    a. If ismaster == true, that server is primary for the set. This server can be used for writes and immediately consistent reads.
    b. If secondary == true, that server is not primary, but is available for eventually consistent reads. In this case, you can use the *primary* field to see which server the master should be.
5. If an error occurs with the current connection, find the new primary and resume use there.

For example, if we run the ismaster command on a non-primary server, we might get something like:

```
> db.runCommand("ismaster")
{
        "ismaster" : false,
        "secondary" : true,
        "hosts" : [
                "ny1.acme.com",
                "ny2.acme.com",
                "sf1.acme.com"
        ],
        "passives" : [
             "ny3.acme.com",
             "sf3.acme.com"
        ],
        "arbiters" : [
            "sf2.acme.com",
        ]
        "primary" : "ny2.acme.com",
        "ok" : true
}
```

There are three servers with priority > 0 (*ny1*, *ny2*, and *sf1*), two passive servers (*ny3* and *sf3*), and an arbiter (*sf2*). The primary should be *ny2*, but the driver should call ismaster on that server before it assumes it is.

## Error Handling in Mongo Drivers

If an error occurs on a query (or getMore operation), Mongo returns an error object instead of user data.

The error object has a first field guaranteed to have the reserved key `$err`. For example:

```
{ $err : "some error message" }
```

The `$err` value can be of any type but is usually a string.

Drivers typically check for this return code explicitly and take action rather than returning the object to the user. The query results flags include a set bit when $err is returned.

```
/* db response format

Query or GetMore: // see struct QueryResult
int resultFlags;
  int64 cursorID;
  int startingFrom;
  int nReturned;
  list of marshalled JSObjects;

*/

struct QueryResult : public MsgData {
  enum {
    ResultFlag_CursorNotFound = 1, /* returned, with zero results, when getMore is called but the
cursor id is not valid at the server. */
    ResultFlag_ErrSet = 2          /* { $err : ... } is being returned */
  };
  ...
};
```

### See Also

- The Driver and Integration Center for information about the latest drivers
- The [top page] for this section
- The main Database Internals page
- The starting point for all Home

# Developer Zone

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If you have a comment or question about anything, please contact us through IRC (freenode.net#mongodb) or the mailing list, rather than leaving a comment at the bottom of a page. It is easier for us to respond to you through those channels.

## Introduction

MongoDB is a collection-oriented, schema-free document database.

By *collection-oriented*, we mean that data is grouped into sets that are called 'collections'. Each collection has a unique name in the database, and can contain an unlimited number of documents. Collections are analogous to tables in a RDBMS, except that they don't have any defined schema.

By *schema-free*, we mean that the database doesn't need to know anything about the structure of the documents that you store in a collection. In fact, you can store documents with different structure in the same collection if you so choose.

By *document*, we mean that we store data that is a structured collection of key-value pairs, where keys are strings, and values are any of a rich set of data types, including arrays and documents. We call this data format "BSON" for "Binary Serialized dOcument Notation."

## MongoDB Operational Overview

MongoDB is a server process that runs on Linux, Windows and OS X. It can be run both as a 32 or 64-bit application. We recommend running in 64-bit mode, since Mongo is limited to a total data size of about 2GB for all databases in 32-bit mode.

The MongoDB process listens on port 27017 by default (note that this can be set at start time - please see Command Line Parameters for more information).

Clients connect to the MongoDB process, optionally authenticate themselves if security is turned on, and perform a sequence of actions, such as inserts, queries and updates.

MongoDB stores its data in files (default location is `/data/db/`), and uses memory mapped files for data management for efficiency.

MongoDB can also be configured for automatic data replication , as well as automatic fail-over .

For more information on MongoDB administration, please see Mongo Administration Guide.

### MongoDB Functionality

As a developer, MongoDB drivers offer a rich range of operations:

- Queries: Search for documents based on either query objects or SQL-like "where predicates". Queries can be sorted, have limited return sizes, can skip parts of the return document set, and can also return partial documents.
- Inserts and Updates : Insert new documents, update existing documents.
- Index Management : Create indexes on one or more keys in a document, including substructure, deleted indexes, etc
- General commands : Any MongoDB operation can be managed via DB Commands over the regular socket.

## cookbook.mongodb.org

**Redirection Notice**
This page should redirect to http://cookbook.mongodb.org.

## Tutorial


- Getting the Database
- Getting A Database Connection
- Inserting Data into A Collection
- Accessing Data From a Query
- Specifying What the Query Returns
- `findOne()` - Syntactic Sugar
- Limiting the Result Set via `limit()`
- More Help
- What Next


### Getting the Database

First, run through the Quickstart guide for your platform to get up and running.

### Getting A Database Connection

Let's now try manipulating the database with the database shell . (We could perform similar operations from any programming language using an appropriate driver.  The shell is convenient for interactive and administrative use.)

Start the MongoDB JavaScript shell with:

```
$ bin/mongo
```

By default the shell connects to database "test" on localhost.  You then see:

```
MongoDB shell version: <whatever>
url: test
connecting to: test
type "help" for help
>
```

`"connecting to:"` tells you the name of the database the shell is using. To switch databases, type:

```
> use mydb
switched to db mydb
```

To see a list of handy commands, type `help`.

> **Tip for Developers with Experience in Other Databases**
> You may notice, in the examples below, that we never create a database or collection. MongoDB does not require that you do so. As soon as you insert something, MongoDB creates the underlying collection and database. If you query a collection that does not exist, MongoDB treats it as an empty collection.
>
> Switching to a database with the `use` command won't immediately create the database - the database is created lazily the first time data is inserted. This means that if you `use` a database for the first time it won't show up in the list provided by `` `show dbs` `` until data is inserted.

### Inserting Data into A Collection

Let's create a test collection and insert some data into it. We will create two objects, `j` and `t`, and then save them in the collection *things*.

In the following examples, '>' indicates commands typed at the shell prompt.

```
> j = { name : "mongo" };
{"name" : "mongo"}
> t = { x : 3 };
{ "x" : 3  }
> db.things.save(j);
> db.things.save(t);
> db.things.find();
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
{ "_id" : ObjectId("4c2209fef3924d31102bd84b"), "x" : 3 }
>
```

A few things to note :

- We did not predefine the collection. The database creates it automatically on the first insert.
- The documents we store can have any "structure" - in fact in this example, the documents have no common data elements at all. In practice, one usually stores documents of the same structure within collections. However, this flexibility means that schema migration and augmentation are very easy in practice - rarely will you need to write scripts which perform "alter table" type operations.
- Upon being inserted into the database, objects are assigned an object ID (if they do not already have one) in the field `_id`.
- When you run the above example, your ObjectID values will be different.

Let's add some more records to this collection:

```
> for (var i = 1; i <= 20; i++) db.things.save({x : 4, j : i});
> db.things.find();
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
{ "_id" : ObjectId("4c2209fef3924d31102bd84b"), "x" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd856"), "x" : 4, "j" : 1 }
{ "_id" : ObjectId("4c220a42f3924d31102bd857"), "x" : 4, "j" : 2 }
{ "_id" : ObjectId("4c220a42f3924d31102bd858"), "x" : 4, "j" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd859"), "x" : 4, "j" : 4 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85a"), "x" : 4, "j" : 5 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85b"), "x" : 4, "j" : 6 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85c"), "x" : 4, "j" : 7 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85d"), "x" : 4, "j" : 8 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85e"), "x" : 4, "j" : 9 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85f"), "x" : 4, "j" : 10 }
{ "_id" : ObjectId("4c220a42f3924d31102bd860"), "x" : 4, "j" : 11 }
{ "_id" : ObjectId("4c220a42f3924d31102bd861"), "x" : 4, "j" : 12 }
{ "_id" : ObjectId("4c220a42f3924d31102bd862"), "x" : 4, "j" : 13 }
{ "_id" : ObjectId("4c220a42f3924d31102bd863"), "x" : 4, "j" : 14 }
{ "_id" : ObjectId("4c220a42f3924d31102bd864"), "x" : 4, "j" : 15 }
{ "_id" : ObjectId("4c220a42f3924d31102bd865"), "x" : 4, "j" : 16 }
{ "_id" : ObjectId("4c220a42f3924d31102bd866"), "x" : 4, "j" : 17 }
{ "_id" : ObjectId("4c220a42f3924d31102bd867"), "x" : 4, "j" : 18 }
has more
```

Note that not all documents were shown - the shell limits the number to 20 when automatically iterating a cursor. Since we already had 2 documents in the collection, we only see the first 18 of the newly-inserted documents.

If we want to return the next set of results, there's the `it` shortcut. Continuing from the code above:

```
{ "_id" : ObjectId("4c220a42f3924d31102bd866"), "x" : 4, "j" : 17 }
{ "_id" : ObjectId("4c220a42f3924d31102bd867"), "x" : 4, "j" : 18 }
has more
> it
{ "_id" : ObjectId("4c220a42f3924d31102bd868"), "x" : 4, "j" : 19 }
{ "_id" : ObjectId("4c220a42f3924d31102bd869"), "x" : 4, "j" : 20 }
```

Technically, find() returns a cursor object. But in the cases above, we haven't assigned that cursor to a variable. So, the shell automatically iterates over the cursor, giving us an initial result set, and allowing us to continue iterating with the **it** command.

But we can also work with the cursor directly; just how that's done is discussed in the next section.

### Accessing Data From a Query

Before we discuss queries in any depth, lets talk about how to work with the results of a query - a cursor object. We'll use the simple `find()` query method, which returns everything in a collection, and talk about how to create specific queries later on.

In order to see all the elements in the collection when using the mongo shell, we need to explicitly use the cursor returned from the `find()` operation.

Lets repeat the same query, but this time use the cursor that `find()` returns, and iterate over it in a while loop :

```
> var cursor = db.things.find();
> while (cursor.hasNext()) printjson(cursor.next());
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
{ "_id" : ObjectId("4c2209fef3924d31102bd84b"), "x" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd856"), "x" : 4, "j" : 1 }
{ "_id" : ObjectId("4c220a42f3924d31102bd857"), "x" : 4, "j" : 2 }
{ "_id" : ObjectId("4c220a42f3924d31102bd858"), "x" : 4, "j" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd859"), "x" : 4, "j" : 4 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85a"), "x" : 4, "j" : 5 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85b"), "x" : 4, "j" : 6 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85c"), "x" : 4, "j" : 7 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85d"), "x" : 4, "j" : 8 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85e"), "x" : 4, "j" : 9 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85f"), "x" : 4, "j" : 10 }
{ "_id" : ObjectId("4c220a42f3924d31102bd860"), "x" : 4, "j" : 11 }
{ "_id" : ObjectId("4c220a42f3924d31102bd861"), "x" : 4, "j" : 12 }
{ "_id" : ObjectId("4c220a42f3924d31102bd862"), "x" : 4, "j" : 13 }
{ "_id" : ObjectId("4c220a42f3924d31102bd863"), "x" : 4, "j" : 14 }
{ "_id" : ObjectId("4c220a42f3924d31102bd864"), "x" : 4, "j" : 15 }
{ "_id" : ObjectId("4c220a42f3924d31102bd865"), "x" : 4, "j" : 16 }
{ "_id" : ObjectId("4c220a42f3924d31102bd866"), "x" : 4, "j" : 17 }
{ "_id" : ObjectId("4c220a42f3924d31102bd867"), "x" : 4, "j" : 18 }
{ "_id" : ObjectId("4c220a42f3924d31102bd868"), "x" : 4, "j" : 19 }
{ "_id" : ObjectId("4c220a42f3924d31102bd869"), "x" : 4, "j" : 20 }
```

The above example shows cursor-style iteration. The `hasNext()` function tells if there are any more documents to return, and the `next()` function returns the next document. We also used the built-in `tojson()` method to render the document in a pretty JSON-style format.

When working in the JavaScript shell, we can also use the functional features of the language, and just call `forEach` on the cursor. Repeating the example above, but using `forEach()` directly on the cursor rather than the while loop:

```
> db.things.find().forEach(printjson);
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
{ "_id" : ObjectId("4c2209fef3924d31102bd84b"), "x" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd856"), "x" : 4, "j" : 1 }
{ "_id" : ObjectId("4c220a42f3924d31102bd857"), "x" : 4, "j" : 2 }
{ "_id" : ObjectId("4c220a42f3924d31102bd858"), "x" : 4, "j" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd859"), "x" : 4, "j" : 4 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85a"), "x" : 4, "j" : 5 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85b"), "x" : 4, "j" : 6 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85c"), "x" : 4, "j" : 7 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85d"), "x" : 4, "j" : 8 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85e"), "x" : 4, "j" : 9 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85f"), "x" : 4, "j" : 10 }
{ "_id" : ObjectId("4c220a42f3924d31102bd860"), "x" : 4, "j" : 11 }
{ "_id" : ObjectId("4c220a42f3924d31102bd861"), "x" : 4, "j" : 12 }
{ "_id" : ObjectId("4c220a42f3924d31102bd862"), "x" : 4, "j" : 13 }
{ "_id" : ObjectId("4c220a42f3924d31102bd863"), "x" : 4, "j" : 14 }
{ "_id" : ObjectId("4c220a42f3924d31102bd864"), "x" : 4, "j" : 15 }
{ "_id" : ObjectId("4c220a42f3924d31102bd865"), "x" : 4, "j" : 16 }
{ "_id" : ObjectId("4c220a42f3924d31102bd866"), "x" : 4, "j" : 17 }
{ "_id" : ObjectId("4c220a42f3924d31102bd867"), "x" : 4, "j" : 18 }
{ "_id" : ObjectId("4c220a42f3924d31102bd868"), "x" : 4, "j" : 19 }
{ "_id" : ObjectId("4c220a42f3924d31102bd869"), "x" : 4, "j" : 20 }
```

In the case of a `forEach()` we must define a function that is called for each document in the cursor.

In the mongo shell, you can also treat cursors like an array :

```
> var cursor = db.things.find();
> printjson(cursor[4]);
{ "_id" : ObjectId("4c220a42f3924d31102bd858"), "x" : 4, "j" : 3 }
```

When using a cursor this way, note that all values up to the highest accessed (cursor[4] above) are loaded into RAM at the same time. This is inappropriate for large result sets, as you will run out of memory. Cursors should be used as an iterator with any query which returns a large

number of elements.

In addition to array-style access to a cursor, you may also convert the cursor to a true array:

```
> var arr = db.things.find().toArray();
> arr[5];
{ "_id" : ObjectId("4c220a42f3924d31102bd859"), "x" : 4, "j" : 4 }
```

Please note that these array features are specific to mongo - The Interactive Shell, and not offered by all drivers.

MongoDB cursors are not snapshots - operations performed by you or other users on the collection being queried between the first and last call to `next()` of your cursor *may or may not* be returned by the cursor. Use explicit locking to perform a snapshotted query.

### Specifying What the Query Returns

Now that we know how to work with the cursor objects that are returned from queries, lets now focus on how to tailor queries to return specific things.

In general, the way to do this is to create "query documents", which are documents that indicate the pattern of keys and values that are to be matched.

These are easier to demonstrate than explain. In the following examples, we'll give example SQL queries, and demonstrate how to represent the same query using MongoDB via the mongo shell. This way of specifying queries is fundamental to MongoDB, so you'll find the same general facility in any driver or language.

**SELECT * FROM things WHERE name="mongo"**

```
> db.things.find({name:"mongo"}).forEach(printjson);
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
```

**SELECT * FROM things WHERE x=4**

```
> db.things.find({x:4}).forEach(printjson);
{ "_id" : ObjectId("4c220a42f3924d31102bd856"), "x" : 4, "j" : 1 }
{ "_id" : ObjectId("4c220a42f3924d31102bd857"), "x" : 4, "j" : 2 }
{ "_id" : ObjectId("4c220a42f3924d31102bd858"), "x" : 4, "j" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd859"), "x" : 4, "j" : 4 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85a"), "x" : 4, "j" : 5 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85b"), "x" : 4, "j" : 6 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85c"), "x" : 4, "j" : 7 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85d"), "x" : 4, "j" : 8 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85e"), "x" : 4, "j" : 9 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85f"), "x" : 4, "j" : 10 }
{ "_id" : ObjectId("4c220a42f3924d31102bd860"), "x" : 4, "j" : 11 }
{ "_id" : ObjectId("4c220a42f3924d31102bd861"), "x" : 4, "j" : 12 }
{ "_id" : ObjectId("4c220a42f3924d31102bd862"), "x" : 4, "j" : 13 }
{ "_id" : ObjectId("4c220a42f3924d31102bd863"), "x" : 4, "j" : 14 }
{ "_id" : ObjectId("4c220a42f3924d31102bd864"), "x" : 4, "j" : 15 }
{ "_id" : ObjectId("4c220a42f3924d31102bd865"), "x" : 4, "j" : 16 }
{ "_id" : ObjectId("4c220a42f3924d31102bd866"), "x" : 4, "j" : 17 }
{ "_id" : ObjectId("4c220a42f3924d31102bd867"), "x" : 4, "j" : 18 }
{ "_id" : ObjectId("4c220a42f3924d31102bd868"), "x" : 4, "j" : 19 }
{ "_id" : ObjectId("4c220a42f3924d31102bd869"), "x" : 4, "j" : 20 }
```

The query expression is an document itself. A query document of the form { a:A, b:B, ... } means "where a==A and b==B and ...". More information on query capabilities may be found in the Queries and Cursors section of the Mongo Developers' Guide.

MongoDB also lets you return "partial documents" - documents that have only a subset of the elements of the document stored in the database. To do this, you add a second argument to the `find()` query, supplying a document that lists the elements to be returned.

To illustrate, lets repeat the last example `find({x:4})` with an additional argument that limits the returned document to just the "j" elements:

**SELECT j FROM things WHERE x=4**

```
> db.things.find({x:4}, {j:true}).forEach(printjson);
{ "_id" : ObjectId("4c220a42f3924d31102bd856"), "j" : 1 }
{ "_id" : ObjectId("4c220a42f3924d31102bd857"), "j" : 2 }
{ "_id" : ObjectId("4c220a42f3924d31102bd858"), "j" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd859"), "j" : 4 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85a"), "j" : 5 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85b"), "j" : 6 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85c"), "j" : 7 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85d"), "j" : 8 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85e"), "j" : 9 }
{ "_id" : ObjectId("4c220a42f3924d31102bd85f"), "j" : 10 }
{ "_id" : ObjectId("4c220a42f3924d31102bd860"), "j" : 11 }
{ "_id" : ObjectId("4c220a42f3924d31102bd861"), "j" : 12 }
{ "_id" : ObjectId("4c220a42f3924d31102bd862"), "j" : 13 }
{ "_id" : ObjectId("4c220a42f3924d31102bd863"), "j" : 14 }
{ "_id" : ObjectId("4c220a42f3924d31102bd864"), "j" : 15 }
{ "_id" : ObjectId("4c220a42f3924d31102bd865"), "j" : 16 }
{ "_id" : ObjectId("4c220a42f3924d31102bd866"), "j" : 17 }
{ "_id" : ObjectId("4c220a42f3924d31102bd867"), "j" : 18 }
{ "_id" : ObjectId("4c220a42f3924d31102bd868"), "j" : 19 }
{ "_id" : ObjectId("4c220a42f3924d31102bd869"), "j" : 20 }
```

Note that the "_id" field is always returned.

### `findOne()` - Syntactic Sugar

For convenience, the mongo shell (and other drivers) lets you avoid the programming overhead of dealing with the cursor, and just lets you retrieve one document via the `findOne()` function. `findOne()` takes all the same parameters of the `find()` function, but instead of returning a cursor, it will return either the first document returned from the database, or `null` if no document is found that matches the specified query.

As an example, lets retrieve the one document with `name=='mongo'`. There are many ways to do it, including just calling `next()` on the cursor (after checking for `null`, of course), or treating the cursor as an array and accessing the 0th element.

However, the `findOne()` method is both convenient and efficient:

```
> printjson(db.things.findOne({name:"mongo"}));
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
```

This is more efficient because the client requests a single object from the database, so less work is done by the database and the network. This is the equivalent of `find({name:"mongo"}).limit(1)`.

### Limiting the Result Set via `limit()`

You may limit the size of a query's result set by specifing a maximum number of results to be returned via the `limit()` method.

This is highly recommended for performance reasons, as it limits the work the database does, and limits the amount of data returned over the network. For example:

```
> db.things.find().limit(3);
{ "_id" : ObjectId("4c2209f9f3924d31102bd84a"), "name" : "mongo" }
{ "_id" : ObjectId("4c2209fef3924d31102bd84b"), "x" : 3 }
{ "_id" : ObjectId("4c220a42f3924d31102bd856"), "x" : 4, "j" : 1 }
```

### More Help

In addition to the general "help" command, you can call help on `db` and `db.whatever` to see a summary of methods available.

If you are curious about what a function is doing, you can type it without the {{()}}s and the shell will print the source, for example:

```
> printjson
function (x) {
    print(tojson(x));
}
```

`mongo` is a full JavaScript shell, so any JavaScript function, syntax, or class can be used in the shell. In addition, MongoDB defines some of its own classes and globals (e.g., `db`). You can see the full API at http://api.mongodb.org/js/.

### What Next

After completing this tutorial the next step to learning MongoDB is to dive into the manual for more details.

# Manual

This is the MongoDB manual. Except where otherwise noted, all examples are in JavaScript for use with the mongo shell. There is a table available giving the equivalent syntax for each of the drivers.


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## Connections

MongoDB is a database server: it runs in the foreground or background and waits for connections from the user. Thus, when you start MongoDB, you will see something like:

```
~/$ ./mongod
#
# some logging output
#
Tue Mar  9 11:15:43 waiting for connections on port 27017
Tue Mar  9 11:15:43 web admin interface listening on port 28017
```

It will stop printing output at this point but it hasn't frozen, it is merely waiting for connections on port 27017. Once you connect and start sending commands, it will continue to log what it's doing. You can use any of the MongoDB drivers or Mongo shell to connect to the database.

You *cannot* connect to MongoDB by going to http://localhost:27017 in your web browser. The database *cannot* be accessed via HTTP on port 27017.

### *Standard Connection String Format*

> ⚠ The uri scheme described on this page is not yet supported by all of the drivers. Refer to a specific driver's documentation to see how much (if any) of the standard connection uri is supported. All drivers support an alternative method of specifying connections if this format is not supported.

```
mongodb://[username:password@]host1[:port1][,host2[:port2],...[,hostN[:portN]]][/database]
```

- `mongodb://` is a required prefix to identify that this is a string in the standard connection format.
- `username:password@` are optional. If given, the driver will attempt to login to a database after connecting to a database server.
- `host1` is the only required part of the URI. It identifies a server address to connect to.
- `:portX` is optional and defaults to :27017 if not provided.
- `/database` is the name of the database to login to and thus is only relevant if the `username:password@` syntax is used. If not specified the "admin" database will be used by default.

As many hosts as necessary may be specified (for connecting to replica pairs/sets).

### *Examples*

Connect to a database server running locally on the default port:

```
mongodb://localhost
```

Connect and login to the admin database as user "fred" with password "foobar":

```
mongodb://fred:foobar@localhost
```

Connect and login to the "baz" database as user "fred" with password "foobar":

```
mongodb://fred:foobar@localhost/baz
```

Connect to a replica pair, with one server on example1.com and another server on example2.com:

```
mongodb://example1.com:27017,example2.com:27017
```

Connect to a replica set with three servers running on localhost (on ports 27017, 27018, and 27019):

```
mongodb://localhost,localhost:27018,localhost:27019
```

### *Connection Pooling*

The server will use one thread per TCP connection, therefore it is highly recomended that your application use some sort of connection pooling. Luckily, most drivers handle this for you behind the scenes. One notable exception is setups where your app spawns a new process for each request, such as CGI and some configurations of PHP.

## Databases

Each MongoDB server can support multiple *databases*. Each database is independent, and the data for each database is stored separately, for security and ease of management.

A database consists of one or more *collections*, the *documents* (objects) in those collections, and an optional set of security credentials for controlling access.


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## Commands

#### Introduction

The Mongo database has a concept of a *database command*. Database commands are ways to ask the database to perform special operations, or to request information about its current operational status.


- Introduction
- Privileged Commands
- Getting Help Info for a Command
- More Command Documentation

- List of Database Commands


A command is sent to the database as a query to a special collection namespace called `$cmd`. The database will return a single document with the command results - use `findOne()` for that if your driver has it.

The general command syntax is:

```
db.$cmd.findOne( { <commandname>: <value> [, options] } );
```

The shell provides a helper function for this:

```
db.runCommand( { <commandname>: <value> [, options] } );
```

For example, to check our database's current profile level setting, we can invoke:

```
> db.runCommand({profile:-1});
{
    "was" : 0.0 ,
    "ok" : 1.0
}
```

For many db commands, some drivers implement wrapper methods are implemented to make usage easier. For example, the mongo shell offers

```
> db.getProfilingLevel()
0.0
```

Let's look at what this method is doing:

```
> print( db.getProfilingLevel )
function () {
    var res = this._dbCommand({profile:-1});
    return res ? res.was : null;
}

> print( db._dbCommand )
function (cmdObj) {
    return this.$cmd.findOne(cmdObj);
}
```

Many commands have helper functions - see your driver's documentation for more information.

#### Privileged Commands

Certain operations are for the database administrator only. These privileged operations may only be performed on the special database named `admin`.

```
> use admin;
> db.runCommand("shutdown"); // shut down the database
```

If the db variable is not set to 'admin', you can use _adminCommand to switch to the right database automatically (and just for that operation):

```
> db._adminCommand("shutdown");
```

(For this particular command there is also a shell helper function, db.shutdownServer.)

#### Getting Help Info for a Command

Use commandHelp in shell to get help info for a command:

```
> db.commandHelp("datasize")
help for: datasize  example: { datasize:"blog.posts", keyPattern:{x:1}, min:{x:10}, max:{x:55} }
NOTE: This command may take awhile to run
```

(Help is not yet available for some commands.)

#### More Command Documentation

- Clone Database
- fsync Command
- Index-Related Commands
- Last Error Commands
- Windows Service
- Viewing and Terminating Current Operation
- Validate Command
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- List of Database Commands

- Commands Quick Reference Card

## Clone Database

MongoDB includes commands for copying a database from one server to another.

```
// copy an entire database from one name on one server to another
// name on another server.  omit <from_hostname> to copy from one
// name to another on the same server.
db.copyDatabase(<from_dbname>, <to_dbname>, <from_hostname>);
// if you must authenticate with the source database
db.copyDatabase(<from_dbname>, <to_dbname>, <from_hostname>, <username>, <password>);
// in "command" syntax (runnable from any driver):
db.runCommand( { copydb : 1, fromdb : ..., todb : ..., fromhost : ... } );
// command syntax for authenticating with the source:
n = db.runCommand( { copydbgetnonce : 1, fromhost: ... } );
db.runCommand( { copydb : 1, fromhost: ..., fromdb: ..., todb: ..., username: ..., nonce: n.nonce,
key: <hash of username, nonce, password > } );

// clone the current database (implied by 'db') from another host
var fromhost = ...;
print("about to get a copy of database " + db + " from " + fromhost);
db.cloneDatabase(fromhost);
// in "command" syntax (runnable from any driver):
db.runCommand( { clone : fromhost } );
```

## fsync Command


- fsync Command
- Lock, Snapshot and Unlock
  - Caveats
  - Snapshotting Slaves
- See Also


Version 1.3.1 and higher

The fsync command allows us to flush all pending writes to datafiles.  More importantly, it also provides a lock option that makes backups easier.

#### *fsync Command*

The fsync command forces the database to flush all datafiles:

```
> use admin
> db.runCommand({fsync:1});
```

By default the command returns after synchronizing.  To return immediately use:

```
> db.runCommand({fsync:1,async:true});
```

To fsync on a regular basis, use the --syncdelay command line option (see mongod --help output).  By default a full flush is forced every 60 seconds.

#### *Lock, Snapshot and Unlock*

The fsync command supports a lock option that allows one to safely snapshot the database's datafiles. While locked, all write operations are blocked, although read operations are still allowed. After snapshotting, use the unlock command to unlock the database and allow locks again. Example:

```
> use admin
switched to db admin
> db.runCommand({fsync:1,lock:1})
{
 "info" : "now locked against writes",
 "ok" : 1
}
> db.currentOp()
{
 "inprog" : [
 ],
 "fsyncLock" : 1
}

>// do some work here: for example, snapshot datafiles...
>// runProgram("/path/to/my-filesystem-snapshotting-script.sh")

> db.$cmd.sys.unlock.findOne();
{ "ok" : 1, "info" : "unlock requested" }
> // unlock is now requested.  it may take a moment to take effect.
> db.currentOp()
{ "inprog" : [ ] }
```

Caveats

While the database can be read while locked for snapshotting, if a write is attempted, this will block readers due to the database's use of a read/write lock. This should be addressed in the future : http://jira.mongodb.org/browse/SERVER-1423

Snapshotting Slaves

The above procedure works on replica slaves. The slave will not apply operations while locked. However, see the above caveats section.

#### *See Also*

- Backups

### Index-Related Commands

#### *Create Index*

`ensureIndex()` is the helper function for this. Its implementation creates an index by adding its info to the `system.indexes` table.

```
> db.myCollection.ensureIndex(<keypattern>);
> // same as:
> db.system.indexes.insert({ name: "name", ns: "namespaceToIndex",
  key: <keypattern> });
```

Note: Once you've inserted the index, all subsequent document inserts for the given collection will be indexed, as will all pre-existing documents in the collection. If you have a large collection, this can take a significant amount of time and will block other operations. However, beginning with version 1.3.2, you can specify that indexing happen in the background. See the background indexing docs for details.

You can query system.indexes to see all indexes for a table *`foo`*:

```
>db.system.indexes.find( { ns: "foo" } );
```

In some drivers, `ensureIndex()` remembers if it has recently been called, and foregoes the insert operation in that case.  Even if this is not the case, `ensureIndex()` is a cheap operation, so it may be invoked often to ensure that an index exists.

#### *Dropping an Index*

From the shell:

```
db.mycollection.dropIndex(<name_or_pattern>)
db.mycollection.dropIndexes()

// example:
t.dropIndex( { name : 1 } );
```

From a driver (raw command object form; many drivers have helpers):

```
{ deleteIndexes: <collection_name>, index: <index_name> }
// "*" for <index_name> will drop all indexes except _id
```

#### *Index Namespace*

Each index has a namespace of its own for the btree buckets. The namespace is:

```
<collectionnamespace>.$<indexname>
```

This is an internal namespace that cannot be queried directly.

### Last Error Commands

Since MongoDB doesn't wait for a response by default when writing to the database, a couple commands exist for ensuring that these operations have succeeded. These commands can be invoked automatically with many of the drivers when saving and updating in "safe" mode. But what's really happening is that a special command called `getlasterror` is being invoked. Here, we explain how this works.


- getlasterror
  - Drivers
  - Use Cases
  - Mongo Shell Behavior
  - fsync option
  - With Replication
- getPrevError


#### getlasterror

The `getlasterror` command checks for an error on the last database operation for this connection. Since it's a command, there are a few ways to invoke it:

```
> db.$cmd.findOne({getlasterror:1})
```

Or

```
> db.runCommand("getlasterror")
```

Or you can use the helper:

```
> db.getLastError()
```

For more about commands, see the command documentation.

#### *Drivers*

The drivers support `getlasterror` in the command form and many also offer a "safe" mode for operations. If you're using Python, for example, you automatically call getlasterror on insert as follows:

```
collection.save({"name": "MongoDB"}, safe=True)
```

If the save doesn't succeed, an exception will be raised. For more on "safe" mode, see your driver's documentation.

#### *Use Cases*

getlasterror is primarily useful for write operations (although it is set after a command or query too). Write operations by default do not have a return code: this saves the client from waiting for client/server turnarounds during write operations. One can always call getLastError if one wants a return code.

If you're writing data to MongoDB on multiple connections, then it can sometimes be important to call `getlasterror` on one connection to be certain that the data has been committed to the database. For instance, if you're writing to connection #1 and want those writes to be reflected in reads from connection #2, you can assure this by calling `getlasterror` after writing to connection #1.

Note: The special mongo wire protocol killCursors operation does not support getlasterror. (This is really only of significant to driver developers .)

#### *Mongo Shell Behavior*

The database shell performs a `resetError()` before each read/eval/print loop command evaluation - and automatically prints the error, if one occurred, after each evaluation. Thus, after an error, at the shell prompt `db.getLastError()` will return null. However, if called before returning to the prompt, the result is as one would expect:

```
> try { db.foo.findOne() } catch(e) { print("preverr:" + tojson(db.getPrevError())); print("lasterr:"
+ tojson(db.getLastError()));}
preverr:{"err" : "unauthorized" , "nPrev" : 1 , "ok" : 1}
lasterr:"unauthorized"
```

#### *fsync option*

Include the fsync option to force the database to fsync all files before returning (v1.3+):

```
> db.runCommand({getlasterror:1,fsync:true})
{ "err" : null, "n" : 0, "fsyncFiles" : 2, "ok" : 1 }
```

#### *With Replication*

See blocking for replication.

#### getPrevError

*Note: getPrevError may be deprecated in the future.*

When performing bulk write operations, `resetError()` and `getPrevError()` can be an efficient way to check for success of the operation. For example if we are inserting 1,000 objects in a collection, checking the return code 1,000 times over the network is slow. Instead one might do something like this:

```
db.resetError();
for( loop 1000 times... )
    db.foo.save(something...);
if( db.getPrevError().err )
    print("didn't work!");
```

## Windows Service

On windows mongod.exe has native support for installing and running as a windows service.

### *Service Related Commands*

The service related commands are:

```
mongod --install
mongod --service
mongod --remove
mongod --reinstall
```

You may also option pass the following to --install and --reinstall

```
--serviceName {arg}
--serviceUser {arg}
--servicePassword {arg}
```

The --install and --remove options install and remove the mongo daemon as a windows service respectively. The --service option starts the service. --reinstall will attempt to remove the service, and then install it. If the service is not already installed, --reinstall will still work.

Both --remove and --reinstall will stop the service if it is currently running.

To change the name of the service use --serviceName. To make mongo execute as a local or domain user, as opposed to the Local System account, use --serviceUser and --servicePassword.

Whatever other arguments you pass to mongod.exe on the command line alongside --install are the arguments that the service is configured to execute mongod.exe with. Take for example the following command line:

```
mongod --bind_ip 127.0.0.1 --logpath d:\mongo\logs --logappend --dbpath d:\mongo\data --directoryperdb
--install
```

Will cause a service to be created called Mongo that will execute the following command:

```
mongod --bind_ip 127.0.0.1 --logpath d:\mongo\logs --logappend --dbpath d:\mongo\data --directoryperdb
```

## Viewing and Terminating Current Operation

- View Current Operation(s) in Progress
- Terminate (Kill) an Operation in Progress

### View Current Operation(s) in Progress

```
> db.currentOp();
> // same as: db.$cmd.sys.inprog.findOne()
{ inprog: [ { "opid" : 18 , "op" : "query" , "ns" : "mydb.votes" ,
              "query" : "{ score : 1.0 }" , "inLock" : 1 }
          ]
}
```

Fields:

- opid - an incrementing operation number.  Use with killOp().
- op - the operation type (query, update, etc.)
- ns - namespace for the operation (database + collection name)
- query - the query spec, if operation is a query

NOTE: currentOp's output format varies from version 1.0 and version 1.1 of MongoDB.  The format above is for 1.1 and higher.

You can also do

```
db.$cmd.sys.inprog.find()
```

or this version which prints all connections

```
db.$cmd.sys.inprog.find( { $all : 1 } )
```

### Terminate (Kill) an Operation in Progress

```
// <= v1.2
> db.killOp()
> // same as: db.$cmd.sys.killop.findOne()
{"info" : "no op in progress/not locked"}

// v>= 1.3
> db.killOp(1234/*opid*/)
> // same as: db.$cmd.sys.killop.findOne({op:1234})
```

### Validate Command

Use this command to check that a collection is valid (not corrupt) and to get various statistics.

This command scans the entire collection and its indexes and will be very slow on large datasets.

From the `mongo` shell:

```
> db.foo.validate()
{"ns" : "test.foo" , "result" : "
validate
  details: 08D03C9C ofs:963c9c
  firstExtent:0:156800 ns:test.foo
  lastExtent:0:156800 ns:test.foo
  # extents:1
  datasize?:144 nrecords?:3 lastExtentSize:2816
  padding:1
  first extent:
    loc:0:156800 xnext:null xprev:null
    ns:test.foo
    size:2816 firstRecord:0:1568b0 lastRecord:0:156930
  3 objects found, nobj:3
  192 bytes data w/headers
  144 bytes data wout/headers
  deletedList: 0000000100000000000
  deleted: n: 1 size: 2448
  nIndexes:1
    test.foo.$x_1 keys:3
" , "ok" : 1 , "valid" : true , "lastExtentSize" : 2816}
```

From a driver one might invoke the driver's equivalent of:

```
> db.$cmd.findOne({validate:"foo" } );
```

`validate` takes an optional scandata parameter which skips the scan of the base collection (but still scans indexes).

```
> db.$cmd.findOne({validate:"foo", scandata:true});
```

### getLastError

> **Redirection Notice**
> This page should redirect to Last Error Commands in about 3 seconds.

Most drivers, and the db shell, support a getlasterror capability.  This lets one check the error code on the last operation.

Database commands, as well as queries, have a direct return code.

getlasterror is primarily useful for write operations (although it is set after a command or query too).  Write operations by default do not have a return code: this saves the client from waiting for client/server turnarounds during write operations.  One can always call getLastError if one wants a return code.

```
> db.runCommand("getlasterror")
> db.getLastError()
```

Note: The special mongo wire protocol killCursors operation does not support getlasterror. (This is really only of significant to driver developers .)

#### getPrevError

*Note: getPrevError may be deprecated in the future.*

When performing bulk write operations, `resetError()` and `getPrevError()` can be an efficient way to check for success of the operation. For example if we are inserting 1,000 objects in a collection, checking the return code 1,000 times over the network is slow. Instead one might do something like this:

```
db.resetError();
for( loop 1000 times... )
    db.foo.save(something...);
if( db.getPrevError().err )
    print("didn't work!");
```

#### Last Error in the Shell

The database shell performs a `resetError()` before each read/eval/print loop command evaluation - and automatically prints the error, if one occurred, after each evaluation. Thus, after an error, at the shell prompt `db.getLastError()` will return null. However, if called before returning to the prompt, the result is as one would expect:

```
> try { db.foo.findOne() } catch(e) { print("preverr:" + tojson(db.getPrevError())); print("lasterr:"
+ tojson(db.getLastError()));}
preverr:{"err" : "unauthorized" , "nPrev" : 1 , "ok" : 1}
lasterr:"unauthorized"
```

#### FSync with GetLastError

Include the fsync option to force the database to fsync all files before returning (v1.3+):

```
> db.runCommand({getlasterror:1,fsync:true})
{ "err" : null, "n" : 0, "fsyncFiles" : 2, "ok" : 1 }
```

### List of Database Commands

List of MongoDB Commands

See the Commands page for details on how to invoke a command.

Also: with v1.5+, run `mongod` with `--rest` enabled, and then go to http://localhost:28017/_commands

Commands Quick Reference Card

## Mongo Metadata

The <dbname>.system.* namespaces in MongoDB are special and contain database system information. System collections include:

- `system.namespaces` lists all namespaces.
- `system.indexes` lists all indexes.
- Additional namespace / index metadata exists in the database.ns files, and is opaque.
- `system.profile` stores database profiling information.
- `system.users` lists users who may access the database.
- `local.sources` stores replica slave configuration data and state.
- Information on the structure of a stored object is stored within the object itself. See BSON .

There are several restrictions on manipulation of objects in the system collections. Inserting in `system.indexes` adds an index, but otherwise that table is immutable (the special drop index command updates it for you). `system.users` is modifiable. `system.profile` is droppable.

Note: $ is a reserved character. Do not use it in namespace names or within field names. Internal collections for indexes use the $ character in their names. These collection store b-tree bucket data and are not in BSON format (thus direct querying is not possible).

# Collections

MongoDB collections are essentially named groupings of documents. You can think of them as roughly equivalent to relational database tables.

### *Details*

A MongoDB collection is a collection of BSON documents. These documents are usually have the same structure, but this is not a requirement since MongoDB is a *schema-free* database. You may store a heterogeneous set of documents within a collection, as you do not need predefine the collection's "columns" or fields.

A collection is created when the first document is inserted.

Collection names should begin with letters or an underscore and may include numbers; $ is reserved. Collections can be organized in namespaces; these are named groups of collections defined using a dot notation. For example, you could define collections blog.posts and blog.authors, both reside under "blog". Note that this is simply an organizational mechanism for the user -- the collection namespace is flat from the database's perspective.

Programmatically, we access these collections using the dot notation. For example, using the mongo shell:

```
if( db.blog.posts.findOne() )
    print("blog.posts exists and is not empty.");
```

The maximum size of a collection name is 128 characters (including the name of the db and indexes). It is probably best to keep it under 80/90 chars.

See also:

- Capped Collections
- Using a Large Number of Collections

## Capped Collections

Capped collections are fixed sized collections that have a very high performance auto-FIFO age-out feature (age out is based on insertion order).

In addition, capped collections automatically, with high performance, maintain insertion order for the objects in the collection; this is very powerful for certain use cases such as logging.

### *Creating a Fixed Size (capped) Collection*

Unlike a standard collection, you must explicitly create a capped collection, specifying a collection size in bytes. The collection's data space is then preallocated. Note that the size specified includes database headers.

```
db.createCollection("mycoll", {capped:true, size:100000})
```

### *Usage and Restrictions*

- You may insert new objects in the capped collection.
- You may update the existing objects in the collection. However, the objects must not grow in size. If they do, the update will fail. (There are some possible workarounds which involve pre-padding objects; contact us in the support forums for more information, if help is needed.)
- The database does not allow deleting objects from a capped collection. Use the `drop()` method to remove all rows from the collection. Note: After the drop you must explicitly recreate the collection.
- Maximum size for a capped collection is currently 1e9 bytes on a thirty-two bit machine. The maximum size of a capped collection on a sixty-four bit machine is constrained only by system resources.

### *Behavior*

- Once the space is fully utilized, newly added objects will replace the oldest objects in the collection.
- If you perform a `find()` on the collection with no ordering specified, the objects will always be returned in insertion order. Reverse order is always retrievable with find().sort({$natural:-1}).

### *Applications*

- **Logging.** Capped collections provide a high-performance means for storing logging documents in the database. Inserting objects in an unindexed capped collection will be close to the speed of logging to a filesystem. Additionally, with the built-in LRU mechanism, you are

not at risk of using excessive disk space for the logging.
- **Caching.** If you wish to cache a small number of objects in the database, perhaps cached computations of information, the capped tables provide a convenient mechanism for this. Note that for this application you will likely use an index on the capped table as there will be more reads than writes.
- **Auto Archiving.** If you know you want data to automatically "roll out" over time as it ages, a capped collection can be an easier way to support than writing manual archival cron scripts.

### *Recommendations*

- For maximum performance, do not create indexes on a capped collection. If the collection will be written to much more than it is read from, it is better to have no indexes. Note that you may create indexes on a capped collection; however, you are then moving from "log speed" inserts to "database speed" inserts -- that is, it will still be quite fast by database standards.
- Use natural ordering to retrieve the most recently inserted elements from the collection efficiently. This is (somewhat) analogous to tail on a log file.

### *Capping the Number of Objects*

You may also cap the number of objects in the collection. Once the limit is reached, items roll out on a least recently inserted basis.

To cap on number of objects, specify a `max:` parameter on the `createCollection()` call.

**Note:** When specifying a cap on the number of objects, you must also cap on size. Be sure to leave enough room for your chosen number of objects or items will roll out faster than expected. You can use the `validate()` utility method to see how much space an existing collection uses, and from that estimate your size needs.

```
db.createCollection("mycoll", {capped:true, size:100000, max:100});
db.mycoll.validate();
```

**Tip:** When programming, a handy way to store the most recently generated version of an object can be a collection capped with `max=1`.

### *Preallocating space for a normal collection*

The `createCollection` command may be used for non capped collections as well. For example:

```
db.createCollection("mycoll", {size:10000000});
db.createCollection("mycoll", {size:10000000, autoIndexId:false});
```

Explicitly creating a non capped collection via `createCollection` allows parameters of the new collection to be specified. For example, specification of a collection size causes the corresponding amount of disk space to be preallocated for use by the collection. The `autoIndexId` field may be set to true or false to explicitly enable or disable automatic creation of a unique key index on the `_id` object field. By default, such an index is created for non capped collections but is not created for capped collections.

> ⚠ An index is not automatically created on _id for capped collections by default

### *See Also*

- The Sorting and Natural Order section of this Guide

## Using a Large Number of Collections

A technique one can use with MongoDB in certain situations is to have several collections to store information instead of a single collection. By doing this, certain repeating data no longer needs to be stored in every object, and an index on that key may be eliminated. More importantly for performance (depending on the problem), the data is then clustered by the grouping specified.

For example, suppose we are logging objects/documents to the database, and want to have M logs: perhaps a dev log, a debug log, an ops log, etc. We could store them all in one collection 'logs' containing objects like:

```
{ log : 'dev', ts : ..., info : ...  }
```

However, if the number of logs is not too high, it might be better to have a collection per log. We could have a 'logs.dev' collection, a 'logs.debug' collection, 'logs.ops', etc.:

```
// logs.dev:
{ ts : ..., info : ... }
```

Of course, this only makes sense if we do not need to query for items from multiple logs at the same time.

Generally, having a large number of collections has no significant performance penalty, and results in very good performance.

### *Limits*

By default MongoDB has a limit of approximately 24,000 *namespaces* per database. Each collection counts as a namespace, as does each index. Thus if every collection had one index, we can create up to 12,000 collections. Use the --nssize parameter to set a higher limit.

Be aware that there is a certain minimum overhead per collection -- a few KB. Further, any index will require at least 8KB of data space as the b-tree page size is 8KB.

#### --nssize

If more collections are required, run mongod with the --nssize parameter specified. This will make the <database>.ns file larger and support more collections. Note that --nssize sets the size used for newly created .ns files -- if you have an existing database and wish to resize, after running the db with --nssize, run the db.repairDatabase() command from the shell to adjust the size.

Maximum .ns file size is 2GB.

## Data Types and Conventions

### MongoDB (BSON) Data Types

Mongo uses special data types in addition to the basic JSON types of string, integer, boolean, double, null, array, and object. These types include date, object id, binary data, regular expression, and code. Each driver implements these types in language-specific ways, see your driver's documentation for details.

See BSON for a full list of database types.

### Internationalization

- See Internationalized strings

### Database References

- See Database References and Schema Design

## Internationalized Strings

MongoDB supports UTF-8 for strings in stored objects and queries. (Specifically, BSON strings are UTF-8.)

Generally, drivers for each programming language convert from the language's string format of choice to UTF-8 when serializing and deserializing BSON. For example, the Java driver converts Java Unicode strings to UTF-8 on serialization.

In most cases this means you can effectively store most international characters in MongoDB strings. A few notes:

- MongoDB regex queries support UTF-8 in the regex string.
- Currently, sort() on a string uses strcmp: sort order will be reasonable but not fully international correct. Future versions of MongoDB may support full UTF-8 sort ordering.

## Object IDs

Documents in MongoDB are required to have a key, _id, which uniquely identifies them.


- Document IDs: _id
- The BSON ObjectId Datatype
    - BSON ObjectID Specification
    - Document Timestamps
- Sequence Numbers


### *Document IDs: _id*

Every MongoDB document has an _id field as its first attribute. This value usually a BSON ObjectId. Such an id must be unique for each member of a collection; this is enforced if the collection has an index on _id, which is the case by default.

If a user tries to insert a document without providing an *`id`, the database will automatically generate an _object id* and store it the _id field.

Users are welcome to use their own conventions for creating ids; the _id value may be of any type so long as it is a unique.

### *The BSON ObjectId Datatype*

Although _id values can be of any type, a special BSON datatype is provided for object ids. This type is a 12-byte binary value designed to have a reasonably high probability of being unique when allocated. All of the officially-supported MongoDB drivers use this type by default for _id values. Also, the Mongo database itself uses this type when assigning _id values on inserts where no _id value is present.

In the MongoDB shell, ObjectId() may be used to create ObjectIds. `ObjectId(`*`string`*`)` creates an object ID from the specified hex string.

```
> x={ name: "joe" }
{ name : "joe" }
> db.people.save(x)
{ name : "joe" , _id : ObjectId( "47cc67093475061e3d95369d" ) }
> x
{ name : "joe" , _id : ObjectId( "47cc67093475061e3d95369d" ) }
> db.people.findOne( { _id: ObjectId( "47cc67093475061e3d95369d" ) } )
{ _id : ObjectId( "47cc67093475061e3d95369d" ) , name : "joe" }
> db.people.findOne( { _id: new ObjectId( "47cc67093475061e3d95369d" ) } )
{ _id : ObjectId( "47cc67093475061e3d95369d" ) , name : "joe" }
```

#### BSON ObjectID Specification

A BSON ObjectID is a 12-byte value consisting of a 4-byte timestamp (seconds since epoch), a 3-byte machine id, a 2-byte process id, and a 3-byte counter. Note that the timestamp and counter fields must be stored big endian unlike the rest of BSON. This is because they are compared byte-by-byte and we want to ensure a mostly increasing order. Here's the schema:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| time | | | | machine | | | pid | | inc | | |

#### Document Timestamps

One useful consequence of this specification is that it provides documents with a creation timestamp for free. All of the drivers implement methods for extracting these timestamps; see the relevant api docs for details.

### *Sequence Numbers*

Traditional databases often use monotonically increasing sequence numbers for primary keys. In MongoDB, the preferred approach is to use Object IDs instead. Object IDs are more synergistic with sharding and distribution.

However, sometimes you may want a sequence number. The Insert if Not Present section of the Atomic Operations page shows an example of how to do this.

## Database References


- Simple Manual References
- DBRef
- DBRef in Different Languages / Drivers
  - C#
  - C++
  - Java
  - Javascript (mongo shell)
  - PHP
  - Python
  - Ruby
- See Also


As MongoDB is non-relational (no joins), references ("foreign keys") between documents are generally resolved client-side by additional queries to the server. Two conventions are common for references in MongoDB: first simple manual references, and second, the DBRef standard, which many drivers support explicitly.

Note: Often embedding of objects eliminates the need for references, but sometimes references are still appropriate.

### *Simple Manual References*

Generally, manually coded references work just fine.  We simply store the value that is present in _id in some other document in the database. For example:

```
> p = db.postings.findOne();
{
 "_id" : ObjectId("4b866f08234ae01d21d89604"),
 "author" : "jim",
 "title" : "Brewing Methods"
}
> // get more info on author
> db.users.findOne( { _id : p.author } )
{ "_id" : "jim", "email" : "jim@gmail.com" }
```

### *DBRef*

DBRef is a more formal specification for creating references between documents.  DBRefs (generally) include a collection name as well as an object id.  Most developers only use DBRefs if the collection can change from one document to the next.  If your referenced collection will always be the same, the manual references outlined above are more efficient.

A DBRef is a reference from one document (object) to another within a database.  A database reference is a standard embedded (JSON/BSON) object: we are defining a convention, not a special type. By having a standard way to represent, drivers and data frameworks can add helper methods which manipulate the references in standard ways.

DBRef's have the advantage of allowing optional automatic **client-side** dereferencing with some drivers, although more features may be added later. In many cases, you can just get away with storing the _id as a reference then dereferencing manually as detailed in the "Simple Manual References" section above.

Syntax for a DBRef reference value is

```
{ $ref : <collname>, $id : <idvalue>[, $db : <dbname>] }
```

where `<collname>` is the collection name referenced (without the database name), and `<idvalue>` is the value of the _id field for the object referenced. `$db` is optional (currently unsupported by many of the drivers) and allows for references to documents in other databases (specified by `<dbname>`).

> ⚠ The ordering for DBRefs does matter, fields must be in the order specified above.

The old BSON DBRef datatype is deprecated.

### *DBRef in Different Languages / Drivers*

#### C#

Use the DBRef class. It takes the collection name and _id as parameters to the constructor. Then you can use the FollowReference method on the Database class to get the referenced document.

#### C++

The C++ driver does not yet provide a facility for automatically traversing DBRefs. However one can do it manually of course.

#### Java

Java supports DB references using the DBRef class.

#### Javascript (mongo shell)

Example:

```
> x = { name : 'Biology' }
{ "name" : "Biology" }
> db.courses.save(x)
> x
{ "name" : "Biology", "_id" : ObjectId("4b0552b0f0da7d1eb6f126a1") }
> stu = { name : 'Joe', classes : [ new DBRef('courses', x._id) ] }
// or we could write:
// stu = { name : 'Joe', classes : [ {$ref:'courses',$id:x._id} ] }
> db.students.save(stu)
> stu
{
        "name" : "Joe",
        "classes" : [
                {
                        "$ref" : "courses",
                        "$id" : ObjectId("4b0552b0f0da7d1eb6f126a1")
                }
        ],
        "_id" : ObjectId("4b0552e4f0da7d1eb6f126a2")
}
> stu.classes[0]
{ "$ref" : "courses", "$id" : ObjectId("4b0552b0f0da7d1eb6f126a1") }
> stu.classes[0].fetch()
{ "_id" : ObjectId("4b0552b0f0da7d1eb6f126a1"), "name" : "Biology" }
>
```

#### PHP

PHP supports DB references with the MongoDBRef class, as well as creation and deferencing methods at the database (MongoDB::createDBRef and MongoDB::getDBRef) and collection (MongoCollection::createDBRef and MongoCollection::getDBRef) levels.

#### Python

To create a DB reference in python use the pymongo.dbref.DBRef class. You can also use the dereference method on Database instances to make dereferencing easier.

Python also supports auto-ref and auto-deref - check out the auto_reference example.

#### Ruby

Ruby also supports DB references using the DBRef class and a dereference method on DB instances.  For example:

```
@db   = Connection.new.db("blog")
@user = @db["users"].save({:name => "Smith"})
@post = @db["posts"].save({:title => "Hello World", :user_id => @user.id})
@ref  = DBRef.new("users", @post.user_id)
assert_equal @user, @db.dereference(@ref)
```

### *See Also*

- Schema Design

## GridFS

GridFS is a specification for storing large files in MongoDB. All of the officially supported driver implement the GridFS spec.


- Rationale
- Implementation
- Language Support
- Command Line Tools
- See also


### *Rationale*

The database supports native storage of binary data within BSON objects.  However, BSON objects in MongoDB are limited to 4MB in size.  The

GridFS spec provides a mechanism for transparently dividing a large file among multiple documents. This allows us to efficiently store large objects, and in the case of especially large files, such as videos, permits range operations (e.g., fetching only the first N bytes of a file).

### *Implementation*

To facilitate this, a standard is specified for the chunking of files. Each file has a metadata object in a files collection, and one or more chunk objects in a chunks collection. Details of how this is stored can be found in the GridFS Specification; however, you do not really need to read that, instead, just look at the GridFS API in each language's client driver or mongofiles tool.

### *Language Support*

Most drivers include GridFS implementations; for languages not listed below, check the driver's API documentation. (If a language does not include support, see the GridFS specification -- implementing a handler is usually quite easy.)

### *Command Line Tools*

Command line tools are available to write and read GridFS files from and to the local filesystem.

### *See also*

- C++
- A PHP GridFS Blog Article

## When to use GridFS

This page is under construction

#### When to use GridFS

- Lots of files. GridFS tends to handle large numbers (many thousands) of files better than many file systems.
- User uploaded files. When users upload files you tend to have a lot of files, and want them replicated and backed up. GridFS is a perfect place to store these as then you can manage them the same way you manage your data. You can also query by user, upload date, etc... directly in the file store, without a layer of indirection
- Files that often change. If you have certain files that change a lot - it makes sense to store them in GridFS so you can modify them in one place and all clients will get the updates. Also can be better than storing in source tree so you don't have to deploy app to update files.

#### When not to use GridFS

- Few small static files. If you just have a few small files for a website (js,css,images) its probably easier just to use the file system.

# Indexes

Indexes enhance query performance, often dramatically. It's important to think about the kinds of queries your application will need so that you can define relevant indexes. Once that's done, actually creating the indexes in MongoDB is relatively easy.

Indexes in MongoDB are conceptually similar to those in RDBMSes like MySQL. You will want an index in MongoDB in the same sort of situations where you would have wanted an index in MySQL.


- Basics
  - Default Indexes
  - Embedded Keys
  - Documents as Keys
  - Arrays
- Compound Keys Indexes
- Unique Indexes
  - Missing Keys
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- Background Index Building
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- Geospatial
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## Basics

An index is a data structure that collects information about the values of the specified fields in the documents of a collection. This data structure is used by Mongo's query optimizer to quickly sort through and order the documents in a collection. Formally speaking, these indexes are implemented as "B-Tree" indexes.

In the shell, you can create an index by calling the `ensureIndex()` function, and providing a document that specifies one or more keys to index. Referring back to our *examples* database from Mongo Usage Basics, we can index on the 'j' field as follows:

```
db.things.ensureIndex({j:1});
```

The `ensureIndex()` function only creates the index if it does not exist.

Once a collection is indexed on a key, random access on query expressions which match the specified key are fast. Without the index, MongoDB has to go through each document checking the value of specified key in the query:

```
db.things.find({j : 2});  // fast - uses index
db.things.find({x : 3});  // slow - has to check all because 'x' isn't indexed
```

You can run `db.things.getIndexes();` to see the existing indexes on the collection.

### Default Indexes

An index is always created on `_id`. This index is special and cannot be deleted. The _id index enforces uniqueness for its keys. For Capped Collections no index is created.

### Embedded Keys

With MongoDB you can even index on a key inside of an embedded document. For example:

```
db.things.ensureIndex({"address.city": 1})
```

### Documents as Keys

Indexed fields may be of any type, including documents:

```
db.factories.insert( { name: "xyz", metro: { city: "New York", state: "NY" } } );
db.factories.ensureIndex( { metro : 1 } );
// this query can use the above index:
db.factories.find( { metro: { city: "New York", state: "NY" } } );
```

An alternative to documents as keys it to create a compound index such as:

```
db.factories.ensureIndex( { "metro.city" : 1, "metro.state" : 1 } );
// these queries can use the above index:
db.factories.find( { "metro.city" : "New York", "metro.state" : "NY" } );
db.factories.find( { "metro.city" : "New York" } );
db.factories.find().sort( { "metro.city" : 1, "metro.state" : 1 } );
db.factories.find().sort( { "metro.city" : 1 } )
```

There are pros and cons to the two approaches. When using the entire (sub-)document as a key, compare order is predefined and is ascending key order in the order the keys occur in the BSON document. With compound indexes reaching in, you can mix ascending and descending keys, and the query optimizer will then be able to use the index for queries on solely the first key(s) in the index too.

### Arrays

When a document's stored value for a index key field is an array, MongoDB indexes each element of the array. See the Multikeys page for more information.

## Compound Keys Indexes

In addition to single-key basic indexes, MongoDB also supports multi-key "compound" indexes. Just like basic indexes, you use the

`ensureIndex()` function in the shell to create the index, but instead of specifying only a single key, you can specify several :

```
db.things.ensureIndex({j:1, name:-1});
```

When creating an index, the number associated with a key specifies the direction of the index, so it should always be 1 (ascending) or -1 (descending). Direction doesn't matter for single key indexes or for random access retrieval but is important if you are doing sorts or range queries on compound indexes.

If you have a compound index on multiple fields, you can use it to query on the beginning subset of fields. So if you have an index on

```
a,b,c
```

you can use it query on

```
a
```

```
a,b
```

```
a,b,c
```

> **New in 1.6+**
> Now you can also use the compound index to service any combination of equality (and some inequality) queries from the constitute fields.

### *Unique Indexes*

MongoDB supports unique indexes, which guarantee that no documents are inserted whose values for the indexed keys match those of an existing document. To create an index that guarantees that no two documents have the same values for both `firstname` and `lastname` you would do:

```
db.things.ensureIndex({firstname: 1, lastname: 1}, {unique: true});
```

#### *Missing Keys*

When a document is saved to a collection with unique indexes, any missing indexed keys will be inserted with null values. Thus, it won't be possible to insert multiple documents missing the same indexed key.

```
db.things.ensureIndex({firstname: 1}, {unique: true});
  db.things.save({lastname: "Smith"});

  // Next operation will fail because of the unique index on firstname.
db.things.save({lastname: "Jones"});
```

#### *Duplicate Values*

A unique index cannot be created on a key that has duplicate values. If you would like to create the index anyway, keeping the first document the database indexes and deleting all subsequent documents that have duplicate values, add the `dropDups` option.

```
db.things.ensureIndex({firstname : 1}, {unique : true, dropDups : true})
```

### *Background Index Building*

By default, building an index blocks other database operations.  v1.3.2 and higher has a background index build option .

### *Dropping Indexes*

To delete all indexes on the specified collection:

```
db.collection.dropIndexes();
```

To delete a single index:

```
db.collection.dropIndex({x: 1, y: -1})
```

Running directly as a command without helper:

```
// note: command was "deleteIndexes", not "dropIndexes", before MongoDB v1.3.2
// remove index with key pattern {y:1} from collection foo
db.runCommand({dropIndexes:'foo', index : {y:1}})
// remove all indexes:
db.runCommand({dropIndexes:'foo', index : '*'})
```

### *ReIndex*

The reIndex command will rebuild all indexes for a collection.

```
db.myCollection.reIndex()
// same as:
db.runCommand( { reIndex : 'myCollection' } )
```

Usually this is unnecessary. You may wish to do this if the size of your collection has changed dramatically or the disk space used by indexes seems oddly large.

Repair database recreates all indexes in the database.

### *Additional Notes on Indexes*

- MongoDB indexes (and string equality tests in general) are case sensitive.
- When you update an object, if the object fits in its previous allocation area, only those indexes whose keys have changed are updated. This improves performance. Note that if the object has grown and must move, all index keys must then update, which is slower.
- Index information is kept in the system.indexes collection, run db.system.indexes.find() to see example data.

#### *Index Performance*

Indexes make retrieval by a key, including ordered sequential retrieval, very fast. Updates by key are faster too as MongoDB can find the document to update very quickly.

However, keep in mind that each index created adds a certain amount of overhead for inserts and deletes. In addition to writing data to the base collection, keys must then be added to the B-Tree indexes. Thus, indexes are best for collections where the number of reads is much greater than the number of writes. For collections which are write-intensive, indexes, in some cases, may be counterproductive. Most collections are read-intensive, so indexes are a good thing in most situations.

#### *Using `sort()` without an Index*

You may use `sort()` to return data in order without an index if the data set to be returned is small (less than four megabytes). For these cases it is best to use `limit()` and `sort()` together.

### *Geospatial*

- See Geospatial Indexing page.

### *Webinar*

Indexing with MongoDB webinar video (http://bit.ly/bQK1Op) and slides (http://bit.ly/9qeMjC). More detailed slides (http://bit.ly/dAHrQk).

## Using Multikeys to Simulate a Large Number of Indexes

One way to work with data that has a high degree of options for queryability is to use the multikey indexing feature where the keys are objects. For example:

```
> x = {
> ... _id : "abc",
> ... cost : 33,
> ... attribs : [
> ...          { color : 'red' },
> ...          { shape : 'rect' },
> ...          { color : 'blue' },
> ...          { avail : true } ]
> ... };
> db.foo.insert(x);
> db.foo.ensureIndex({attribs:1});
> db.foo.find( { attribs : {color:'blue'} } ); // uses index
> db.foo.find( { attribs : {avail:false} } );  // uses index
```

In addition to being able to have an unlimited number of attributes types, we can also add new types dynamically.

This is mainly useful for simply attribute lookups; the above pattern is not necessary helpful for sorting or certain other query types.

#### See Also

Discussion thread MongoDB for a chemical property search engine for a more complex real world example.

## Geospatial Indexing


- Creating the Index
- Querying
- Compound Indexes
- geoNear Command
- Bounds Queries
- The Earth is Round but Maps are Flat
  - New Spherical Model
- Sharded Environments
- Implementation


v1.3.3+

MongoDB supports two-dimensional geospatial indexes. It is designed with location-based queries in mind, such as "find me the closest N items to my location." It can also efficiently filter on additional criteria, such as "find me the closest N museums to my location."

In order to use the index, you need to have a field in your object that is either a sub-object or array where the first 2 elements are x,y coordinates (or y,x - just be consistent; it might be advisible to use order-preserving dictionaries/hashes in your client code, to ensure consistency). Some examples:

```
{ loc : [ 50 , 30 ] }
{ loc : { x : 50 , y : 30 } }
{ loc : { foo : 50 , y : 30 } }
{ loc : { lat : 40.739037, long: 73.992964 } }
```

#### Creating the Index

```
db.places.ensureIndex( { loc : "2d" } )
```

By default, the index assumes you are indexing latitude/longitude and is thus configured for a [-180..180] value range.

If you are indexing something else, you can specify some options:

```
db.places.ensureIndex( { loc : "2d" } , { min : -500 , max : 500 } )
```

that will scale the index to store values between -500 and 500. Currently geo indexing is limited to indexing squares with no "wrapping" at the outer boundaries. You cannot insert values on the boundaries, for example, using the code above, the point `(-500, -500)` could not to be inserted.

you can only have 1 geo2d index per collection right now

### Querying

The index can be used for exact matches:

```
db.places.find( { loc : [50,50] } )
```

Of course, that is not very interesting. More important is a query to find points near another point, but not necessarily matching exactly:

```
db.places.find( { loc : { $near : [50,50] } } )
```

The above query finds the closest points to (50,50) and returns them sorted by distance (there is no need for an additional sort parameter). Use limit() to specify a maximum number of points to return (a default limit of 100 applies if unspecified):

```
db.places.find( { loc : { $near : [50,50] } } ).limit(20)
```

You can also use $near with a maximum distance

```
db.places.find( { loc : { $near : [50,50] , $maxDistance : 5 } } ).limit(20)
```

### Compound Indexes

MongoDB geospatial indexes optionally support specification of secondary key values. If you are commonly going to be querying on both a location and other attributes at the same time, add the other attributes to the index. The other attributes are annotated within the index to make filtering faster. For example:

```
db.places.ensureIndex( { location : "2d" , category : 1 } );
db.places.find( { location : { $near : [50,50] }, category : 'coffee' } );
```

### geoNear Command

While the find() syntax above is typically preferred, MongoDB also has a geoNear command which performs a similar function. The geoNear command has the added benefit of returning the distance of each item from the specified point in the results, as well as some diagnostics for troubleshooting.

```
> db.runCommand( { geoNear : "places" , near : [50,50], num : 10 } );
> db.runCommand({geoNear:"asdf", near:[50,50]})
{
        "ns" : "test.places",
        "near" : "1100110000001111110000001111110000001111110000001111",
        "results" : [
                {
                        "dis" : 69.29646421910687,
                        "obj" : {
                                "_id" : ObjectId("4b8bd6b93b83c574d8760280"),
                                "y" : [
                                        1,
                                        1
                                ],
                                "category" : "Coffee"
                        }
                },
                {
                        "dis" : 69.29646421910687,
                        "obj" : {
                                "_id" : ObjectId("4b8bd6b03b83c574d876027f"),
                                "y" : [
                                        1,
                                        1
                                ]
                        }
                }
        ],
        "stats" : {
                "time" : 0,
                "btreelocs" : 1,
                "btreelocs" : 1,
                "nscanned" : 2,
                "nscanned" : 2,
                "objectsLoaded" : 2,
                "objectsLoaded" : 2,
                "avgDistance" : 69.29646421910687
        },
        "ok" : 1
}
```

The above command will return the 10 closest items to (50,50). (The `loc` field is automatically determined by checking for a 2d index on the collection.)

If you want to add an additional filter, you can do so:

```
> db.runCommand( { geoNear : "places" , near : [ 50 , 50 ], num : 10,
... query : { type : "museum" } } );
```

`query` can be any regular mongo query.

**Bounds Queries**

v1.3.4

`$within` can be used instead of `$near` to find items within a shape. At the moment, `$box` (rectangles) and `$center` (circles) are supported.

To query for all points within a rectangle, you must specify the lower-left and upper-right corners:

```
> box = [[40, 40], [60, 60]]
> db.places.find({"loc" : {"$within" : {"$box" : box}}})
```

A circle is specified by a center point and radius:

```
> center = [50, 50]
> radius = 10
> db.places.find({"loc" : {"$within" : {"$center" : [center, radius]}}})
```

#### The Earth is Round but Maps are Flat

The current implementation assumes an idealized model of a flat earth, meaning that an arcdegree of latitude (y) and longitude (x) represent the same distance everywhere. This is only true at the equator where they are both about equal to 69 miles or 111km. However, at the 10gen offices at { x : -74 , y : 40.74 } one arcdegree of longitude is about 52 miles or 83 km (latitude is unchanged). This means that something 1 mile to the north would seem closer than something 1 mile to the east.

#### *New Spherical Model*

In 1.7.0 we added support for correctly using spherical distances by adding "Sphere" to the name of the query. For example, use `$nearSphere` or `$centerSphere` (`$boxSphere` doesn't really make sense so it isn't supported). If you use the geoNear command to get distance along with the results, you just need to add `spherical:true` to the list of options.

There are a few caveats that you must be aware of when using spherical distances:

1. The code assumes that you are using decimal degrees in (X,Y) / (longitude, latitude) order. This is the same order used for the GeoJSON spec.
2. All distances use radians. This allows you to easily multiply by the radius of the earth (about 6371 km or 3959 miles) to get the distance in your choice of units. Conversely, divide by the radius of the earth when doing queries.
3. We don't currently handle wrapping at the poles or at the transition from -180° to +180° longitude, however we detect when a search would wrap and raise an error.

#### Sharded Environments

Support for geospatial in sharded collections is coming; please watch this ticket: http://jira.mongodb.org/browse/SHARDING-83.

In the meantime sharded clusters can use geospatial indexes for unsharded collections within the cluster.

#### Implementation

The current implementation encodes geographic hash codes atop standard MongoDB b-trees. Results of $near queries are exact. The problem with geohashing is that prefix lookups don't give you exact results, especially around bit flip areas. MongoDB solves this by doing a grid by grid search after the initial prefix scan. This guarantees performance remains very high while providing correct results.

## Indexing as a Background Operation

> ⚠ Slaves and replica secondaries build all indexes in the foreground in certain releases (including the latest). Thus even when using background:true on the primary, the slave/secondary will be unavailable to service queries while the index builds there.

By default the `ensureIndex()` operation is blocking, and will stop other operations on the database from proceeding until completed. However, in v1.3.2+, a background indexing option is available.

To build an index in the background, add `background:true` to your index options. Examples:

```
> db.things.ensureIndex({x:1}, {background:true});
> db.things.ensureIndex({name:1}, {background:true, unique:true,
... dropDups:true});
```

With background mode enabled, other operations, including writes, will not be obstructed during index creation. The index is not used for queries until the build is complete.

Although the operation is 'background' in the sense that other operations may run concurrently, the command will not return to the shell prompt until completely finished. To do other operations at the same time, open a separate mongo shell instance.

Please note that background mode building uses an incremental approach to building the index which is slower than the default foreground mode: time to build the index will be greater.

While the build progresses, it is possible to see that the operation is still in progress with the `db.currentOp()` command (will be shown as an

insert to system.indexes). You may also use `db.killOp()` to terminate the build process.

While the build progresses, the index is visible in system.indexes, but it is not used for queries until building completes.

***Notes***

- Only one index build at a time is permitted per collection.
- Some administrative operations, such as repairDatabase, are disallowed while a background indexing job is in progress.
- v1.4 and higher (for production usage)

## Multikeys

MongoDB provides an interesting "multikey" feature that can automatically index arrays of an object's values. A good example is tagging. Suppose you have an article tagged with some category names:

```
$ dbshell
> db.articles.save( { name: "Warm Weather", author: "Steve",
                      tags: ['weather', 'hot', 'record', 'april'] } )
> db.articles.find()
{"name" : "Warm Weather" , "author" : "Steve" ,
 "tags" : ["weather","hot","record","april"] , "_id" : "497ce4051ca9ca6d3efca323"}
```

We can easily perform a query looking for a particular value in the `tags` array:

```
> db.articles.find( { tags: 'april' } )
{"name" : "Warm Weather" , "author" : "Steve" ,
 "tags" : ["weather","hot","record","april"] , "_id" : "497ce4051ca9ca6d3efca323"}
```

Further, we can index on the tags array. Creating an index on an array element indexes results in the database indexing each element of the array:

```
> db.articles.ensureIndex( { tags : 1 } )
true
> db.articles.find( { tags: 'april' } )
{"name" : "Warm Weather" , "author" : "Steve" ,
 "tags" : ["weather","hot","record","april"] , "_id" : "497ce4051ca9ca6d3efca323"}
> db.articles.find( { tags: 'april' } ).explain()
{"cursor" : "BtreeCursor tags_1" , "startKey" : {"tags" : "april"} ,
 "endKey" : {"tags" : "april"} , "nscanned" : 1 , "n" : 1 , "millis" : 0 }
```

### *Embedded object fields in an array*

Additionally the same technique can be used for fields in embedded objects:

```
> db.posts.find( { "comments.author" : "julie" } )
{"title" : "How the west was won" ,
 "comments" : [{"text" : "great!" , "author" : "sam"},
               {"text" : "ok" , "author" : "julie"}],
 "_id" : "497ce79f1ca9ca6d3efca325"}
```

### *Querying on all values in a given set*

By using the $all query option, a set of values may be supplied each of which must be present in a matching object field. For example:

```
> db.articles.find( { tags: { $all: [ 'april', 'record' ] } } )
{"name" : "Warm Weather" , "author" : "Steve" ,
 "tags" : ["weather","hot","record","april"] , "_id" : "497ce4051ca9ca6d3efca323"}
> db.articles.find( { tags: { $all: [ 'april', 'june' ] } } )
> // no matches
```

### *Parallel Arrays*

When using a compound index, at most one of indexed values in any document can be an array. So if we have an index on `{a: 1, b: 1}`, the following documents are both fine:

```
{a: [1, 2], b: 1}
{a: 1, b: [1, 2]}
```

This document, however, will fail to be inserted, with an error message "cannot index parallel arrays":

```
{a: [1, 2], b: [1, 2]}
```

The problem with indexing parallel arrays is that each value in the cartesian product of the compound keys would have to be indexed, which can get out of hand very quickly.

### *See Also*

- The Multikeys section of the Full Text Search in Mongo document for information about this feature.

## Indexing Advice and FAQ

We get a lot of questions about indexing. Here we provide answers to a number of these. There are a couple of points to keep in mind, though. First, indexes in MongoDB work quite similarly to indexes in MySQL, and thus many of the techniques for building efficient indexes in MySQL apply to MongoDB.

Second, and even more importantly, know that advice on indexing can only take you so far. The best indexes for your application should always be based on a number of important factors, including the kinds of queries you expect, the ratio of reads to writes, and even the amount of free memory on your system. This means that the best strategy for designing indexes will always be to profile a variety of index configurations with data sets similar to the ones you'll be running in production, and see which perform best. There's no substitute for good empirical analyses.

**Note**: if you're brand new to indexing, you may want to read this introductory article first.


- Indexing Strategies
  - Create indexes to match your queries.
  - One index per query.
  - Make sure your indexes can fit in RAM.
  - Be careful about single-key indexes with low selectivity.
  - Use `explain`.
    - Understanding `explain`'s output.
  - Pay attention to the read/write ratio of your application.
  - Indexing Properties
    - 1. The sort column must be the last column used in the index.
    - 2. The range query must also be the last column in an index. This is an axiom of 1 above.
    - 3. Only use a range query or sort on one column.
    - 4. Conserve indexes by re-ordering columns used on equality (non-range) queries.
    - 5. MongoDB's $ne or $nin operator's aren't efficient with indexes.
- FAQ
  - I've started building an index, and the database has stopped responding. What's going on? What do I do?
  - I'm using $ne or $nin in a query, and while it uses the index, it's still slow. What's happening?
- Using Multikeys to Simulate a Large Number of Indexes


#### Indexing Strategies

Here are some general principles for building smart indexes.

Create indexes to match your queries.

If you only query on a single key, then a single-key index will do. For instance, maybe you're searching for a blog post's slug:

```
db.posts.find({ slug : 'state-of-mongodb-2010' })
```

In this case, a unique index on a single key is best:

```
db.ensureIndex({ slug: 1 }, {unique: true});
```

However, it's common to query on multiple keys and to sort the results. For these situations, compound indexes are best. Here's an example for querying the latest comments with a 'mongodb' tag:

```
db.comments.find({ tags : 'mongodb'}).sort({ created_at : -1 });
```

And here's the proper index:

```
db.comments.ensureIndex({tags : 1, created_at : -1});
```

Note that if we wanted to sort by `created_at` ascending, this index would be less effective.

One index per query.

It's sometimes thought that queries on multiple keys can use multiple indexes; this is not the case with MongoDB. If you have a query that selects on multiple keys, and you want that query to use an index efficiently, then a compound-key index is necessary.

Make sure your indexes can fit in RAM.

The shell provides a command for returning the total index size on a given collection:

```
db.comments.totalIndexSize();
65443
```

If your queries seem sluggish, you should verify that your indexes are small enough to fit in RAM. For instance, if you're running on 4GB RAM and you have 3GB of indexes, then your indexes probably aren't fitting in RAM. You may need to add RAM and/or verify that all the indexes you've created are actually being used.

Be careful about single-key indexes with low selectivity.

Suppose you have a field called 'status' where the possible values are 'new' and 'processeed'. If you add an index on 'status' then you've created a low-selectivity index, meaning that the index isn't going to be very helpful in locating records and might just be be taking up space.

A better strategy, depending on your queries, of course, would be to create a compound index that includes the low-selectivity field. For instance, you could have a compound-key index on 'status' and 'created_at.'

Another option, again depending on your use case, might be to use separate collections, one for each status. As with all the advice here, experimentation and benchmarks will help you choose the best approach.

Use `explain`.

MongoDB includes an `explain` command for determining how your queries are being processed and, in particular, whether they're using an index. `explain` can be used from of the drivers and also from the shell:

```
db.comments.find({ tags : 'mongodb'}).sort({ created_at : -1 }).explain();
```

This will return lots of useful information, including the number of items scanned, the time the query takes to process in milliseconds, which indexes the query optimizer tried, and the index ultimately used.

If you've never used `explain`, now's the time to start.

Understanding `explain`'s output.

There are three main fields to look for when examining the `explain` command's output:

- cursor: the value for cursor can be either `BasicCursor` or `BtreeCursor`. The second of these indicates that the given query is using an index.
- nscanned: he number of documents scanned.
- n: the number of documents returned by the query. You want the value of n to be close to the value of `nscanned`. What you want to avoid is doing a collection scan, that is, where every document in the collection is accessed. This is the case when `nscanned` is equal to the number of documents in the collection.
- millis: the number of milliseconds require to complete the query. This value is useful for comparing indexing strategies, indexed vs. non-indexed queries, etc.

Pay attention to the read/write ratio of your application.

This is important because, whenever you add an index, you add overhead to all insert, update, and delete operations on the given collection. If your application is read-heavy, as are most web applications, the additional indexes are usually a good thing. But if your application is write-heavy, then be careful when creating new indexes, since each additional index with impose a small write-performance penalty.

In general, **don't be cavalier about adding indexes**. Indexes should be added to complement your queries. Always have a good reason for adding a new index, and make sure you've benchmarked alternative strategies.

Indexing Properties

Here are a few properties of compound indexes worth keeping in mind (Thanks to Doug Green and Karoly Negyesi for their help on this).

These examples assume a compound index of three fields: a, b, c. So our index creation would look like this:

```
db.foo.ensureIndex({a: 1, b: 1, c: 1})
```

Here's some advice on using an index like this:

> This information is no longer strictly correct in 1.6.0+; compound indexes can now be used to service queries where range or filter fields are used within the compound index, not just fields used from left to right. Please run explain to see how the compound index is used.

1. The sort column must be the last column used in the index.

Good:

- find(a=1).sort(a)
- find(a=1).sort(b)
- find(a=1, b=2).sort(c)

Bad:

- find(a=1).sort(c)
- even though c is the last column used in the index, a is that last column used, so you can only sort on a or b.

2. The range query must also be the last column in an index. This is an axiom of 1 above.

Good:

- find(a=1,b>2)
- find(a>1 and a<10)
- find(a>1 and a<10).sort(a)

Bad:

- find(a>1, b=2)

3. Only use a range query or sort on one column.

Good:

- find(a=1,b=2).sort(c)
- find(a=1,b>2)
- find(a=1,b>2 and b<4)
- find(a=1,b>2).sort(b)

Bad:

- find(a>1,b>2)
- find(a=1,b>2).sort(c)

4. Conserve indexes by re-ordering columns used on equality (non-range) queries.

Imagine you have the following two queries:

- find(a=1,b=1,d=1)
- find(a=1,b=1,c=1,d=1)

A single index defined on a, b, c, and d can be used for both queries.
If, however, you need to sort on the final value, you might need two indexes

5. MongoDB's $ne or $nin operator's aren't efficient with indexes.

- When excluding just a few documents, it's better to retrieve extra rows from MongoDB and do the exclusion on the client side.

**FAQ**

I've started building an index, and the database has stopped responding. What's going on? What do I do?

Building an index can be an IO-intensive operation, especially you have a large collection. This is true on any database system that supports secondary indexes, including MySQL. If you'll need to build an index on a large collection in the future, you'll probably want to consider building the index in the background, a feature available beginning with 1.3.2. See the docs on background indexing for more info.

As for the long-building index, you only have a few options. You can either wait for the index to finish building or kill the current operation (see `killOp()`). If you choose the latter, the partial index will be deleted.

I'm using $ne or $nin in a query, and while it uses the index, it's still slow. What's happening?

The problem with $ne and $nin is that much of an index will match queries like these. If you need to use $nin, it's often best to make sure that an additional, more selective criterion is part of the query.

## Inserting

When we insert data into MongoDB, that data will always be in document-form. Documents are data structure analogous to JSON, Python dictionaries, and Ruby hashes, to take just a few examples. Here, we discuss more about document-orientation and describe how to insert data into MongoDB.


- Document-Orientation
- JSON
- Mongo-Friendly Schema
  - Store Example


### *Document-Orientation*

Document-oriented databases store "documents" but by document we mean a structured document – the term perhaps coming from the phrase "XML document". However other structured forms of data, such as JSON or even nested dictionaries in various languages, have similar properties.

The documents stored in Mongo DB are JSON-like. JSON is a good way to store object-style data from programs in a manner that is language-independent and standards based.

To be efficient, MongoDB uses a format called BSON which is a binary representation of this data. BSON is faster to scan for specific fields than JSON. Also BSON adds some additional types such as a data data type and a byte-array (bindata) datatype. BSON maps readily to and from JSON and also to various data structures in many programming languages.

Client drivers serialize data to BSON, then transmit the data over the wire to the db. Data is stored on disk in BSON format. Thus, on a retrieval, the database does very little translation to send an object out, allowing high efficiency. The client driver unserialized a received BSON object to its native language format.

### *JSON*

For example the following "document" can be stored in Mongo DB:

```
{ author: 'joe',
  created : new Date('03/28/2009'),
  title : 'Yet another blog post',
  text : 'Here is the text...',
  tags : [ 'example', 'joe' ],
  comments : [ { author: 'jim', comment: 'I disagree' },
               { author: 'nancy', comment: 'Good post' }
  ]
}
```

This document is a blog post, so we can store in a "posts" collection using the shell:

```
> doc = { author : 'joe', created : new Date('03/28/2009'), ... }
> db.posts.insert(doc);
```

MongoDB understands the internals of BSON objects -- not only can it store them, it can query on internal fields and index keys based upon them.  For example the query

```
> db.posts.find( { "comments.author" : "jim" } )
```

is possible and means "find any blog post where at least one comment subjobject has author == 'jim'".

### *Mongo-Friendly Schema*

Mongo can be used in many ways, and one's first instincts when using it are probably going to be similar to how one would write an application with a relational database. While this work pretty well, it doesn't harness the real power of Mongo. Mongo is designed for and works best with a rich object model.

#### Store Example

If you're building a simple online store that sells products with a relation database, you might have a schema like:

```
item
     title
     price
     sku
  item_features
     sku
     feature_name
     feature_value
```

You would probably normalize it like this because different items would have different features, and you wouldn't want a table with all possible features. You could model this the same way in mongo, but it would be much more efficient to do

```
item : {
           "title" : <title> ,
           "price" : <price> ,
           "sku"   : <sku>   ,
           "features" : {
              "optical zoom" : <value> ,
              ...
           }
  }
```

This does a few nice things

- you can load an entire item with one query
- all the data for an item is on the same place on disk, thus only one seek is required to load

Now, at first glance there might seem to be some issues, but we've got them covered.

- you might want to insert or update a single feature. mongo lets you operate on embedded files like:

```
db.items.update( { sku : 123 } , { "$set" : { "features.zoom" : "5" } } )
```

- Does adding a feature require moving the entire object on disk? No. mongo has a padding heuristic that adapts to your data so it will leave some empty space for the object to grow. This will prevent indexes from being changed, etc.

## Legal Key Names

Key names in inserted documents are limited as follows:

- The '$' character must not be the first character in the key name.
- The '.' character must not appear anywhere in the key name.

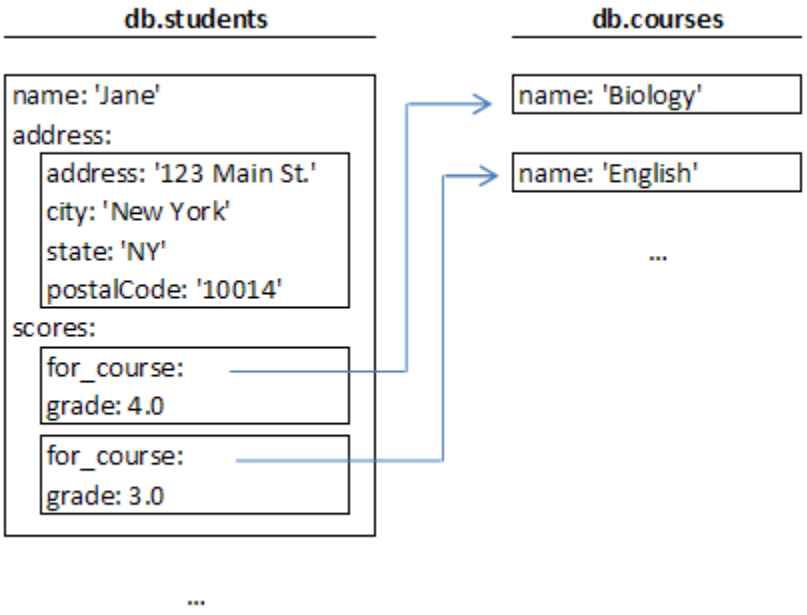
## Schema Design


- Introduction
- Embed vs. Reference
- Use Cases
- Index Selection
- How Many Collections?
- See Also


#### Introduction

With Mongo, you do less "normalization" than you would perform designing a relational schema because there are no server-side "joins". Generally, you will want one database collection for each of your top level objects.

You do not want a collection for every "class" - instead, embed objects. For example, in the diagram below, we have two collections, students and courses. The student documents embed address documents and the "score" documents, which have references to the courses.




Compare this with a relational schema, where you would almost certainly put the scores in a separate table, and have a foreign-key relationship back to the students.

#### Embed vs. Reference

The key question in Mongo schema design is "does this object merit its own collection, or rather should it embed in objects in other collections?" In relational databases, each sub-item of interest typically becomes a separate table (unless denormalizing for performance). In Mongo, this is not recommended - embedding objects is much more efficient. Data is then colocated on disk; client-server turnarounds to the database are eliminated. So in general the question to ask is, "why would I not want to embed this object?"

So why are references slow? Let's consider our students example. If we have a student object and perform:

```
print( student.address.city );
```

This operation will always be fast as address is an embedded object, and is always in RAM if student is in RAM. However for

```
print( student.scores[0].for_course.name );
```

if this is the first access to `scores[0]`, the shell or your driver must execute the query

```
// pseudocode for driver or framework, not user code

student.scores[0].for_course = db.courses.findOne({_id:_course_id_to_find_});
```

Thus, each reference traversal is a query to the database. Typically, the collection in question is indexed on `_id`. The query will then be reasonably fast. However, even if all data is in RAM, there is a certain latency given the client/server communication from appserver to database. In general, expect 1ms of time for such a query on a ram cache hit. Thus if we were iterating 1,000 students, looking up one reference per student would be quite slow - over 1 second to perform even if cached. However, if we only need to look up a single item, the time is on the order of 1ms, and completely acceptable for a web page load. (Note that if already in db cache, pulling the 1,000 students might actually take much less than 1 second, as the results return from the database in large batches.)

Some general rules on when to embed, and when to reference:

- "First class" objects, that are at top level, typically have their own collection.
- Line item detail objects typically are embedded.
- Objects which follow an object modelling "contains" relationship should generally be embedded.
- Many to many relationships are generally by reference.
- Collections with only a few objects may safely exist as separate collections, as the whole collection is quickly cached in application server memory.
- Embedded objects are harder to reference than "top level" objects in collections, as you cannot have a DBRef to an embedded object (at least not yet).
- It is more difficult to get a system-level view for embedded objects. For example, it would be easier to query the top 100 scores across all students if Scores were not embedded.
- If the amount of data to embed is huge (many megabytes), you may reach the limit on size of a single object.
- If performance is an issue, embed.

#### Use Cases

Let's consider a few use cases now.

1. Customer / Order / Order Line-Item

- `orders` should be a collection. `customers` a collection. line-items should be an array of line-items embedded in the `order` object.

1. Blogging system.

- `posts` should be a collection. `post author` might be a separate collection, or simply a field within posts if only an email address. `comments` should be embedded objects within a post for performance.

#### Index Selection

A second aspect of schema design is index selection. As a general rule, *where you want an index in a relational database, you want an index in Mongo.*

- The `_id` field is automatically indexed.
- Fields upon which keys are looked up should be indexed.
- Sort fields generally should be indexed.

The MongoDB profiling facility provides useful information for where an index should be added that is missing.

Note that adding an index slows writes to a collection, but not reads. Use lots of indexes for collections with a high read : write ratio (assuming one does not mind the storage overage). For collections with more writes than reads, indexes are very expensive.

#### How Many Collections?

As Mongo collections are polymorphic, one could have a collection `objects` and put everything in it! This approach is taken by some object databases. For performance reasons, we do not recommend this approach. Data within a Mongo collection tends to be contiguous on disk. Thus, table scans of the collection are possible, and efficient. Collections are very important for high throughput batch processing.

#### See Also

- Schema Design talk from MongoNY
- DBRef
- Trees in MongoDB
- MongoDB Data Modeling and Rails
  *Next: Advanced Queries*

## Trees in MongoDB


- Patterns
  - Full Tree in Single Document
  - Parent Links
  - Child Links
  - Array of Ancestors
  - Materialized Paths (Full Path in Each Node)
  - acts_as_nested_set
- See Also


The best way to store a tree usually depends on the operations you want to perform; see below for some different options. In practice, most developers find that one of the "Full Tree in Single Document", "Parent Links", and "Array of Ancestors" patterns works best.

### *Patterns*

#### Full Tree in Single Document

```
{
  comments: [
    {by: "mathias", text: "...", replies: []}
    {by: "eliot", text: "...", replies: [
      {by: "mike", text: "...", replies: []}
    ]}
  ]
}
```

Pros:

- Single document to fetch per page
- One location on disk for whole tree
- You can see full structure easily

Cons:

- Hard to search
- Hard to get back partial results
- Can get unwieldy if you need a huge tree (there is a 4MB per doc limit)

#### Parent Links

Storing all nodes in a single collection, with each node having the id of its parent, is a simple solution. The biggest problem with this approach is getting an entire subtree requires several query turnarounds to the database (or use of db.eval).

```
> t = db.tree1;

> t.find()
{ "_id" : 1 }
{ "_id" : 2, "parent" : 1 }
{ "_id" : 3, "parent" : 1 }
{ "_id" : 4, "parent" : 2 }
{ "_id" : 5, "parent" : 4 }
{ "_id" : 6, "parent" : 4 }

> // find children of node 4
> t.ensureIndex({parent:1})
> t.find( {parent : 4 } )
{ "_id" : 5, "parent" : 4 }
{ "_id" : 6, "parent" : 4 }
```

### Child Links

Another option is storing the ids of all of a node's children within each node's document. This approach is fairly limiting, although ok if no operations on entire subtrees are necessary. It may also be good for storing graphs where a node has multiple parents.

```
> t = db.tree2
> t.find()
{ "_id" : 1, "children" : [ 2, 3 ] }
{ "_id" : 2 }
{ "_id" : 3, "children" : [ 4 ] }
{ "_id" : 4 }

> // find immediate children of node 3
> t.findOne({_id:3}).children
[ 4 ]

> // find immediate parent of node 3
> t.ensureIndex({children:1})
> t.find({children:3})
{ "_id" : 1, "children" : [ 2, 3 ] }
```

### Array of Ancestors

Here we store all the ancestors of a node in an array. This makes a query like "get all descendents of x" fast and easy.

```
> t = db.mytree;

> t.find()
{ "_id" : "a" }
{ "_id" : "b", "ancestors" : [ "a" ], "parent" : "a" }
{ "_id" : "c", "ancestors" : [ "a", "b" ], "parent" : "b" }
{ "_id" : "d", "ancestors" : [ "a", "b" ], "parent" : "b" }
{ "_id" : "e", "ancestors" : [ "a" ], "parent" : "a" }
{ "_id" : "f", "ancestors" : [ "a", "e" ], "parent" : "e" }
{ "_id" : "g", "ancestors" : [ "a", "b", "d" ], "parent" : "d" }

> t.ensureIndex( { ancestors : 1 } )

> // find all descendents of b:
> t.find( { ancestors : 'b' })
{ "_id" : "c", "ancestors" : [ "a", "b" ], "parent" : "b" }
{ "_id" : "d", "ancestors" : [ "a", "b" ], "parent" : "b" }
{ "_id" : "g", "ancestors" : [ "a", "b", "d" ], "parent" : "d" }

> // get all ancestors of f:
> anc = db.mytree.findOne({_id:'f'}).ancestors
[ "a", "e" ]
> db.mytree.find( { _id : { $in : anc } } )
{ "_id" : "a" }
{ "_id" : "e", "ancestors" : [ "a" ], "parent" : "a" }
```

ensureIndex and MongoDB's multikey feature makes the above queries efficient.

In addition to the ancestors array, we also stored the direct parent in the node to make it easy to find the node's immediate parent when that is necessary.

### Materialized Paths (Full Path in Each Node)

Materialized paths make certain query options on trees easy. We store the full path to the location of a document in the tree within each node. Usually the "array of ancestors" approach above works just as well, and is easier as one doesn't have to deal with string building, regular expressions, and escaping of characters. (Theoretically, materialized paths will be *slightly* faster.)

The best way to do this with MongoDB is to store the path as a string and then use regex queries. Simple regex expressions beginning with "^" can be efficiently executed. As the path is a string, you will need to pick a delimiter character -- we use ',' below. For example:

```
> t = db.tree
test.tree

> // get entire tree -- we use sort() to make the order nice
> t.find().sort({path:1})
{ "_id" : "a", "path" : "a," }
{ "_id" : "b", "path" : "a,b," }
{ "_id" : "c", "path" : "a,b,c," }
{ "_id" : "d", "path" : "a,b,d," }
{ "_id" : "g", "path" : "a,b,g," }
{ "_id" : "e", "path" : "a,e," }
{ "_id" : "f", "path" : "a,e,f," }
{ "_id" : "g", "path" : "a,b,g," }

> t.ensureIndex( {path:1} )

> // find the node 'b' and all its descendents:
> t.find( { path : /^a,b,/ } )
{ "_id" : "b", "path" : "a,b," }
{ "_id" : "c", "path" : "a,b,c," }
{ "_id" : "d", "path" : "a,b,d," }
{ "_id" : "g", "path" : "a,b,g," }

// or if its path not already known:
> b = t.findOne( { _id : "b" } )
{ "_id" : "b", "path" : "a,b," }
> t.find( { path : new RegExp("^" + b.path) } )
{ "_id" : "b", "path" : "a,b," }
{ "_id" : "c", "path" : "a,b,c," }
{ "_id" : "d", "path" : "a,b,d," }
{ "_id" : "g", "path" : "a,b,g," }
```

Ruby example: http://github.com/banker/newsmonger/blob/master/app/models/comment.rb

**acts_as_nested_set**

See http://api.rubyonrails.org/classes/ActiveRecord/Acts/NestedSet/ClassMethods.html

This pattern is best for datasets that rarely change as modifications can require changes to many documents.

### *See Also*

- Sean Cribbs blog post (source of several ideas on this page).

## Optimization


- Additional Articles
- Optimizing A Simple Example
  - Optimization #1: Create an index
  - Optimization #2: Limit results
  - Optimization #3: Select only relevant fields
- Using the Profiler
- Optimizing Statements that Use `count()`
- Increment Operations
- Circular Fixed Size Collections
- Server Side Code Execution
- Explain
- Hint
- See Also


### *Additional Articles*

- Optimizing Object IDs
- Optimizing Storage of Small Objects

### *Optimizing A Simple Example*

This section describes proper techniques for optimizing database performance.

Let's consider an example. Suppose our task is to display the front page of a blog - we wish to display headlines of the 10 most recent posts. Let's assume the posts have a timestamp field `ts`.

The simplest thing we could write might be:

```
articles = db.posts.find().sort({ts:-1}); // get blog posts in reverse time order

for (var i=0; i< 10; i++) {
   print(articles[i].getSummary());
}
```

#### *Optimization #1: Create an index*

Our first optimization should be to create an index on the key that is being used for the sorting:

```
db.posts.ensureIndex({ts:1});
```

With an index, the database is able to sort based on index information, rather than having to check each document in the collection directly. This is much faster.

#### *Optimization #2: Limit results*

MongoDB cursors return results in groups of documents that we'll call 'chunks'. The chunk returned might contain more than 10 objects - in some cases, much more. These extra objects are a waste of network transmission and resources both on the app server and the database.

As we know how many results we want, and that we do not want all the results, we can use the `limit()` method for our second optimization.

```
articles = db.posts.find().sort({ts:-1}).limit(10); // 10 results maximum
```

Now, we'll only get 10 results returned to client.

#### *Optimization #3: Select only relevant fields*

The blog post object may be very large, with the post text and comments embedded. Much better performance will be achieved by selecting only the fields we need:

```
articles = db.posts.find({}, {ts:1,title:1,author:1,abstract:1}).sort({ts:-1}).limit(10);
articles.forEach( function(post) { print(post.getSummary()); } );
```

The above code assumes that the `getSummary()` method only references the fields listed in the `find()` method.

Note if you fetch only select fields, you have a partial object. An object in that form cannot be updated back to the database:

```
a_post = db.posts.findOne({}, Post.summaryFields);
a_post.x = 3;
db.posts.save(a_post); // error, exception thrown
```

### *Using the Profiler*

MongoDB includes a database profiler which shows performance characteristics of each operation against the database. Using the profiler you can find queries (and write operations) which are slower than they should be; use this information, for example, to determine when an index is needed. See the Database Profiler page for more information.

### *Optimizing Statements that Use `count()`*

To speed operations that rely on `count()`, create an index on the field involved in the count query expression.

```
db.posts.ensureIndex({author:1});
db.posts.find({author:"george"}).count();
```

### *Increment Operations*

MongoDB supports simple object field increment operations; basically, this is an operation indicating "increment this field in this document at the server". This can be much faster than fetching the document, updating the field, and then saving it back to the server and are particularly useful for implementing real time counters. See the Updates section of the Mongo Developers' Guide for more information.

### *Circular Fixed Size Collections*

MongoDB provides a special circular collection type that is pre-allocated at a specific size. These collections keep the items within well-ordered even without an index, and provide very high-speed writes and reads to the collection. Originally designed for keeping log files - log events are stored in the database in a circular fixed size collection - there are many uses for this feature. See the Capped Collections section of the Mongo Developers' Guide for more information.

### *Server Side Code Execution*

Occasionally, for maximal performance, you may wish to perform an operation in process on the database server to eliminate client/server network turnarounds. These operations are covered in the Server-Side Processing section of the Mongo Developers' Guide.

### *Explain*

A great way to get more information on the performance of your database queries is to use the `$explain` feature. This will display "explain plan" type info about a query from the database.

When using the mongo - The Interactive Shell, you can find out this "explain plan" via the `explain()` function called on a cursor. The result will be a document that contains the "explain plan".

```
db.collection.find(query).explain();
```

provides information such as the following:

```
{
    "cursor" : "BasicCursor",
    "indexBounds" : [ ],
    "nscanned" : 57594,
    "nscannedObjects" : 57594,
    "n" : 3 ,
    "millis" : 108
}
```

This will tell you the type of cursor used (`BtreeCursor` is another type – which will include a lower & upper bound), the number of records the DB had to examine as part of this query, the number of records returned by the query, and the time in milliseconds the query took to execute.

### *Hint*

While the mongo query optimizer often performs very well, explicit "hints" can be used to force mongo to use a specified index, potentially improving performance in some situations. When you have a collection indexed and are querying on multiple fields (and some of those fields are indexed), pass the indexe as a hint to the query. You can do this in two different ways. You may either set it per query, or set it for the entire collection.

To set the hint for a particular query, call the `hint()` function on the cursor before accessing any data, and specify a document with the key to be used in the query:

```
db.collection.find({user:u, foo:d}).hint({user:1});
```

**Be sure to Index**
For the above hints to work, you need to have run `ensureIndex()` to index the collection on the user field.

To force the query optimizer to not use indexes (do a table scan), use:

```
> db.collection.find().hint({$natural:1})
```

### *See Also*

- Query Optimizer
- currentOp()
- Sorting and Natural Order

## Optimizing Object IDs

The _id field in MongoDB objects is very important and is always indexed. This page lists some recommendations.

Use the collections 'natural primary key' in the _id field.

_id's can be any type, so if your objects have a natural unique identifier, consider using that in _id to both save space and avoid an additional index.

Use _id values that are roughly in ascending order.

If the _id's are in a somewhat well defined order, on inserts the entire b-tree for the _id index need not be loaded. BSON ObjectIds are allocated in a manner such that they have this property.

Store GUIDs as BinData, rather than as strings

BSON includes a binary data datatype for storing byte arrays. Using this will make the id values, and their respective keys in the _id index, twice as small.

Note that unlike the BSON Object ID type (see above), most UUIDs do not have a rough ascending order, which creates additional caching needs for their index.

```
> # mongo shell bindata info:
> help misc
        b = new BinData(subtype,base64str)  create a BSON BinData value
        b.subtype()                         the BinData subtype (0..255)
        b.length()                          length of the BinData data in bytes
        b.hex()                             the data as a hex encoded string
        b.base64()                          the data as a base 64 encoded string
        b.toString()
```

## Optimizing Storage of Small Objects

MongoDB records have a certain amount of overhead per object (BSON document) in a collection. This overhead is normally insignificant, but if your objects are tiny (just a few bytes, maybe one or two fields) it would not be. Below are some suggestions on how to optimize storage efficiently in such situations.

#### Using the _id Field Explicitly

Mongo automatically adds an object ID to each document and sets it to a unique value. Additionally this field in indexed. For tiny objects this takes up significant space.

The best way to optimize for this is to use _id explicitly. Take one of your fields which is unique for the collection and store its values in _id. By doing so, you have explicitly provided IDs. This will effectively eliminate the creation of a separate _id field. If your previously separate field was indexed, this eliminates an extra index too.

#### Using Small Field Names

Consider a record

```
{ last_name : "Smith", best_score: 3.9 }
```

The strings "last_name" and "best_score" will be stored in each object's BSON. Using shorter strings would save space:

```
{ lname : "Smith", score : 3.9 }
```

Would save 9 bytes per document. This of course reduces expressiveness to the programmer and is not recommended unless you have a collection where this is of significant concern.

Field names are not stored in indexes as indexes have a predefined structure. Thus, shortening field names will not help the size of indexes. In

general it is not necessary to use short field names.

#### Combining Objects

Fundamentally, there is a certain amount of overhead per document in MongoDB. One technique is combining objects. In some cases you may be able to embed objects in other objects, perhaps as arrays of objects. If your objects are tiny this may work well, but will only make sense for certain use cases.

## Query Optimizer

The MongoDB query optimizer generates query plans for each query submitted by a client. These plans are executed to return results. Thus, MongoDB supports ad hoc queries much like say, MySQL.

The database uses an interesting approach to query optimization though. Traditional approaches (which tend to be cost-based and statistical) are not used, as these approaches have a couple of problems.

First, the optimizer might consistently pick a bad query plan. For example, there might be correlations in the data of which the optimizer is unaware. In a situation like this, the developer might use a query hint.

Also with the traditional approach, query plans can change in production with negative results. No one thinks rolling out new code without testing is a good idea. Yet often in a production system a query plan can change as the statistics in the database change on the underlying data. The query plan in effect may be a plan that never was invoked in QA. If it is slower than it should be, the application could experience an outage.

The Mongo query optimizer is different. It is not cost based -- it does not model the cost of various queries. Instead, the optimizer simply tries different query plans and learn which ones work well. Of course, when the system tries a really bad plan, it may take an extremely long time to run. To solve this, *when testing new plans, MongoDB executes multiple query plans in parallel*. As soon as one finishes, it terminates the other executions, and the system has learned which plan is good. This works particularly well given the system is non-relational, which makes the space of possible query plans much smaller (as there are no joins).

Sometimes a plan which was working well can work poorly -- for example if the data in the database has changed, or if the parameter values to the query are different. In this case, if the query seems to be taking longer than usual, the database will once again run the query in parallel to try different plans.

This approach adds a little overhead, but has the advantage of being much better at worst-case performance.

#### See Also

- MongoDB hint() and explain() operators

# Querying

One of MongoDB's best capabilities is its support for dynamic (ad hoc) queries. Systems that support dynamic queries don't require any special indexing to find data; users can find data using any criteria. For relational databases, dynamic queries are the norm. If you're moving to MongoDB from a relational databases, you'll find that many SQL queries translate easily to MongoDB's document-based query language.


- Query Expression Objects
- Query Options
  - Field Selection
  - Sorting
  - Skip and Limit
  - slaveOk
- Cursors
- More info
- Quick Reference Card
- See Also


### *Query Expression Objects*

MongoDB supports a number of query objects for fetching data. Queries are expressed as BSON documents which indicate a query pattern. For example, suppose we're using the MongoDB shell and want to return every document in the `users` collection. Our query would look like this:

```
db.users.find({})
```

In this case, our selector is an empty document, which matches every document in the collection. Here's a more selective example:

```
db.users.find({'last_name': 'Smith'})
```

Here our selector will match every document where the `last_name` attribute is 'Smith.'

MongoDB support a wide array of possible document selectors. For more examples, see the MongoDB Tutorial or the section on Advanced Queries. If you're working with MongoDB from a language driver, see the driver docs:

## *Query Options*

### Field Selection

In addition to the query expression, MongoDB queries can take some additional arguments. For example, it's possible to request only certain fields be returned. If we just wanted the social security numbers of users with the last name of 'Smith,' then from the shell we could issue this query:

```
// retrieve ssn field for documents where last_name == 'Smith':
db.users.find({last_name: 'Smith'}, {'ssn': 1});

  // retrieve all fields *except* the thumbnail field, for all documents:
db.users.find({}, {thumbnail:0});
```

Note the `_id` field is always returned even when not explicitly requested.

### Sorting

MongoDB queries can return sorted results. To return all documents and sort by last name in ascending order, we'd query like so:

```
db.users.find({}).sort({last_name: 1});
```

### Skip and Limit

MongoDB also supports **skip** and **limit** for easy paging. Here we skip the first 20 last names, and limit our result set to 10:

```
db.users.find().skip(20).limit(10);
db.users.find({}, {}, 10, 20); // same as above, but less clear
```

### slaveOk

When querying a replica pair or replica set, drivers route their requests to the master mongod by default; to perform a query against an (arbitrarily-selected) slave, the query can be run with the slaveOk option. Here's how to do so in the shell:

```
db.getMongo().setSlaveOk(); // enable querying a slave
db.users.find(...)
```

Note: some language drivers permit specifying the slaveOk option on each find(), others make this a connection-wide setting. See your language's driver for details.

## *Cursors*

Database queries, performed with the find() method, technically work by returning a *cursor*. Cursors are then used to iteratively retrieve all the documents returned by the query. For example, we can iterate over a cursor in the mongo shell like this:

```
> var cur = db.example.find();
> cur.forEach( function(x) { print(tojson(x))});
{"n" : 1 , "_id" : "497ce96f395f2f052a494fd4"}
{"n" : 2 , "_id" : "497ce971395f2f052a494fd5"}
{"n" : 3 , "_id" : "497ce973395f2f052a494fd6"}
>
```

## *More info*

This was just an introduction to querying in Mongo. For the full details please look in at the pages in the "Querying" sub-section to the right of your screen.

### *Quick Reference Card*

Download the Query and Update Modifier Quick Reference Card

### *See Also*

- Queries and Cursors
- Advanced Queries
- Query Optimizer

## Mongo Query Language

Queries in MongoDB are expressed as JSON (BSON). Usually we think of query object as the equivalent of a SQL "WHERE" clause:

```
> db.users.find( { x : 3, y : "abc" } ).sort({x:1}); // select * from users where x=3 and y='abc'
order by x asc;
```

However, the MongoDB server actually looks at all the query parameters (ordering, limit, etc.) as a single object. In the above example from the mongo shell, the shell is adding some syntactic sugar for us. Many of the drivers do this too. For example the above query could also be written:

```
> db.users.find( { $query : { x : 3, y : "abc" }, $orderby : { x : 1 } } );
```

The possible specifies in the query object are:

- $query - the evaluation or "where" expression
- $orderby - sort order desired
- $hint - hint to query optimizer
- $explain - if true, return explain plan results instead of query results
- $snapshot - if true, "snapshot mode"

## Retrieving a Subset of Fields

By default on a find operation, the entire object is returned. However we may also request that only certain fields be returned. This is somewhat analogous to the list of column specifiers in a SQL SELECT statement (projection). Regardless of what field specifiers are included, the `_id` field is always returned.

```
// select z from things where x="john"
db.things.find( { x : "john" }, { z : 1 } );
```

#### Field Negation

We can say "all fields except x" – for example to remove specific fields that you know will be large:

```
// get all posts about 'tennis' but without the comments field
db.posts.find( { tags : 'tennis' }, { comments : 0 } );
```

#### Dot Notation

You can retrieve partial sub-objects via Dot Notation.

```
> t.find({})
{ "_id" : ObjectId("4c23f0486dad1c3a68457d20"), "x" : { "y" : 1, "z" : [ 1, 2, 3 ] } }
> t.find({}, {'x.y':1})
{ "_id" : ObjectId("4c23f0486dad1c3a68457d20"), "x" : { "y" : 1 } }
```

#### Retrieving a Subrange of Array Elements

You can use the $slice operator to retrieve a subrange of elements in an array.

> **New in MongoDB 1.5.1**

```
db.posts.find({}, {comments:{$slice: 5}}) // first 5 comments
db.posts.find({}, {comments:{$slice: -5}}) // last 5 comments
db.posts.find({}, {comments:{$slice: [20, 10]}}) // skip 20, limit 10
db.posts.find({}, {comments:{$slice: [-20, 10]}}) // 20 from end, limit 10
```

#### See Also

- example slice1

## Advanced Queries


- Introduction
- Retrieving a Subset of Fields
  - $slice operator
- Conditional Operators
  - <, <=, >, >=
  - $ne
  - $in
  - $nin
  - $mod
  - $all
  - $size
  - `$exists`
  - `$type`
  - $or
- Regular Expressions
- Value in an Array
  - $elemMatch
- Value in an Embedded Object
- Meta operator: $not
- Javascript Expressions and `$where`
- Cursor Methods
  - `sort()`
  - `limit()`
  - `skip()`
  - `snapshot()`
  - `count()`
- `group()`
- Special operators
- See Also


#### Introduction

MongoDB offers a rich query environment with lots of features. This page lists some of those features.

Queries in MongoDB are represented as JSON-style objects, very much like the documents we actually store in the database.  For example:

```
// i.e., select * from things where x=3 and y="foo"
db.things.find( { x : 3, y : "foo" } );
```

Note that any of the operators on this page can be combined in the same query document. For example, to find all document where j is not equal to 3 and k is greater than 10, you'd query like so:

```
db.things.find({j: {$ne: 3}, k: {$gt: 10} });
```

#### Retrieving a Subset of Fields

By default on a find operation, the entire document/object is returned. However we may also request that only certain fields are returned. Note

that the _id field is always returned automatically.

```
// select z from things where x=3
db.things.find( { x : 3 }, { z : 1 } );
```

You can also remove specific fields that you know will be large:

```
// get all posts about mongodb without comments
db.posts.find( { tags : 'mongodb' }, { comments : 0 } );
```

***$slice operator***

**New in MongoDB 1.5.1**

You can use the $slice operator to retrieve a subset of elements in an array.

```
db.posts.find({}, {comments:{$slice: 5}}) // first 5 comments
db.posts.find({}, {comments:{$slice: -5}}) // last 5 comments
db.posts.find({}, {comments:{$slice: [20, 10]}}) // skip 20, limit 10
db.posts.find({}, {comments:{$slice: [-20, 10]}}) // 20 from end, limit 10
```

More examples at example slice1

**Conditional Operators**

**<, <=, >, >=**

Use these special forms for greater than and less than comparisons in queries, since they have to be represented in the query document:

```
db.collection.find({ "field" : { $gt: value } } );   // greater than  : field > value
db.collection.find({ "field" : { $lt: value } } );   // less than  :  field < value
db.collection.find({ "field" : { $gte: value } } );  // greater than or equal to : field >= value
db.collection.find({ "field" : { $lte: value } } );  // less than or equal to : field <= value
```

For example:

```
db.things.find({j : {$lt: 3}});
db.things.find({j : {$gte: 4}});
```

You can also combine these operators to specify ranges:

```
db.collection.find({ "field" : { $gt: value1, $lt: value2 } } );    // value1 < field < value
```

***$ne***

Use $ne for "not equals".

```
db.things.find( { x : { $ne : 3 } } );
```

***$in***

The `$in` operator is analogous to the SQL `IN` modifier, allowing you to specify an array of possible matches.

```
db.collection.find( { "field" : { $in : array } } );
```

Let's consider a couple of examples. From our *things* collection, we could choose to get a subset of documents based upon the value of the 'j' key:

```
db.things.find({j:{$in: [2,4,6]}});
```

Suppose the collection `updates` is a list of social network style news items; we want to see the 10 most recent updates from our friends. We might invoke:

```
db.updates.ensureIndex( { ts : 1 } ); // ts == timestamp
var myFriends = myUserObject.friends; // let's assume this gives us an array of DBRef's of my friends
var latestUpdatesForMe = db.updates.find( { user : { $in : myFriends } } ).sort( { ts : -1 }
).limit(10);
```

***$nin***

The `$nin` operator is similar to `$in` except that it selects objects for which the specified field does not have any value in the specified array. For example

```
db.things.find({j:{$nin: [2,4,6]}});
```

would match {`j:1,b:2`} but not {`j:2,c:9`}.

***$mod***

The `$mod` operator allows you to do fast modulo queries to replace a common case for where clauses. For example, the following $where query:

```
db.things.find( "this.a % 10 == 1")
```

can be replaced by:

```
db.things.find( { a : { $mod : [ 10 , 1 ] } } )
```

***$all***

The `$all` operator is similar to `$in`, but instead of matching any value in the specified array all values in the array must be matched. For example, the object

```
{ a: [ 1, 2, 3 ] }
```

would be matched by

```
db.things.find( { a: { $all: [ 2, 3 ] } } );
```

but not

```
db.things.find( { a: { $all: [ 2, 3, 4 ] } } );
```

An array can have more elements than those specified by the `$all` criteria. `$all` specifies a minimum set of elements that must be matched.

***$size***

The `$size` operator matches any array with the specified number of elements. The following example would match the object {`a:["foo"]`}, since that array has just one element:

```
db.things.find( { a : { $size: 1 } } );
```

You cannot use `$size` to find a range of sizes (for example: arrays with more than 1 element). If you need to query for a range, create an extra

`size` field that you increment when you add elements.

#### *$exists*

Check for existence (or lack thereof) of a field.

```
db.things.find( { a : { $exists : true } } ); // return object if a is present
db.things.find( { a : { $exists : false } } ); // return if a is missing
```

Currently $exists is not able to use an index. Indexes on other fields are still used.

#### *$type*

The `$type` operator matches values based on their BSON type.

```
db.things.find( { a : { $type : 2 } } ); // matches if a is a string
db.things.find( { a : { $type : 16 } } ); // matches if a is an int
```

Possible types are:

| Type Name | Type Number |
|---|---|
| Double | 1 |
| String | 2 |
| Object | 3 |
| Array | 4 |
| Binary data | 5 |
| Object id | 7 |
| Boolean | 8 |
| Date | 9 |
| Null | 10 |
| Regular expression | 11 |
| JavaScript code | 13 |
| Symbol | 14 |
| JavaScript code with scope | 15 |
| 32-bit integer | 16 |
| Timestamp | 17 |
| 64-bit integer | 18 |
| Min key | 255 |
| Max key | 127 |

For more information on types and BSON in general, see http://www.bsonspec.org.

#### *$or*

The `$or` operator lets you use a boolean or expression to do queries. You give $or a list of expressions, any of which can satisfy the query.

**New in MongoDB 1.5.3**

Simple:

```
db.foo.find( { $or : [ { a : 1 } , { b : 2 } ] } )
```

With another field

```
db.foo.find( { name : "bob" , $or : [ { a : 1 } , { b : 2 } ] } )
```

The `$or` operator retrieves matches for each or clause individually and eliminates duplicates when returning results. A number of `$or` optimizations are planned for 1.8. See this thread for details.

#### Regular Expressions

You may use regexes in database query expressions:

```
db.customers.find( { name : /acme.*corp/i } );
```

For simple prefix queries (also called rooted regexps) like `/^prefix/`, the database will use an index when available and appropriate (much like most SQL databases that use indexes for a `LIKE 'prefix%'` expression). This only works if you don't have `i` (case-insensitivity) in the flags.

> While `/^a/`, `/^a.*/`, and `/^a.*$/` are equivalent and will all use an index in the same way, the later two require scanning the whole string so they will be slower. The first format can stop scanning after the prefix is matched.

MongoDB uses PCRE for regular expressions. Valid flags are:

- `i` - Case insensitive. Letters in the pattern match both upper and lower case letters.
- `m` - Multiline. By default, Mongo treats the subject string as consisting of a single line of characters (even if it actually contains newlines). The "start of line" metacharacter (^) matches only at the start of the string, while the "end of line" metacharacter ($) matches only at the end of the string, or before a terminating newline.
  When `m` it is set, the "start of line" and "end of line" constructs match immediately following or immediately before internal newlines in the subject string, respectively, as well as at the very start and end. If there are no newlines in a subject string, or no occurrences of ^ or $ in a pattern, setting `m` has no effect.
- `x` - Extended. If set, whitespace data characters in the pattern are totally ignored except when escaped or inside a character class. Whitespace does not include the VT character (code 11). In addition, characters between an unescaped # outside a character class and the next newline, inclusive, are also ignored.
  This option makes it possible to include comments inside complicated patterns. Note, however, that this applies only to data characters. Whitespace characters may never appear within special character sequences in a pattern, for example within the sequence `(?(` which introduces a conditional subpattern.

#### Value in an Array

To look for the value "red" in an array field `colors`:

```
db.things.find( { colors : "red" } );
```

That is, when "colors" is inspected, if it is an array, each value in the array is checked. This technique may be mixed with the embedded object technique below.

#### *$elemMatch*

Version 1.3.1 and higher.

Use $elemMatch to check if an element in an array matches the specified match expression.

```
> t.find( { x : { $elemMatch : { a : 1, b : { $gt : 1 } } } } )
{ "_id" : ObjectId("4b5783300334000000000aa9"),
  "x" : [ { "a" : 1, "b" : 3 }, 7, { "b" : 99 }, { "a" : 11 } ]
}
```

Note that a single array element must match all the criteria specified; thus, the following query is semantically different in that each criteria can match a different element in the x array:

```
> t.find( { "x.a" : 1, "x.b" : { $gt : 1 } } )
```

See the dot notation page for more.

#### Value in an Embedded Object

For example, to look `author.name=="joe"` in a postings collection with embedded author objects:

```
db.postings.find( { "author.name" : "joe" } );
```

See the dot notation page for more.

#### Meta operator: $not

Version 1.3.3 and higher.

The $not meta operator can be used to negate the check performed by a standard operator. For example:

```
db.customers.find( { name : { $not : /acme.*corp/i } } );
```

```
db.things.find( { a : { $not : { $mod : [ 10 , 1 ] } } } );
```

> $not is not supported for regular expressions specified using the `{$regex: ...}` syntax. When using $not, all regular expressions should be passed using the native BSON type (e.g. `{"$not": re.compile("acme.*corp")}` in PyMongo)

#### Javascript Expressions and `$where`

In addition to the structured query syntax shown so far, you may specify query expressions as Javascript. To do so, pass a string containing a Javascript expression to `find()`, or assign such a string to the query object member `$where`. The database will evaluate this expression for each object scanned. When the result is true, the object is returned in the query results.

For example, the following statements all do the same thing:

```
db.myCollection.find( { a : { $gt: 3 } } );
db.myCollection.find( { $where: "this.a > 3" } );
db.myCollection.find("this.a > 3");
f = function() { return this.a > 3; } db.myCollection.find(f);
```

Javascript executes more slowly than the native operators listed on this page, but is very flexible. See the server-side processing page for more information.

#### Cursor Methods

##### *`sort()`*

`sort()` is analogous to the ORDER BY statement in SQL - it requests that items be returned in a particular order. We pass `sort()` a key pattern which indicates the desired order for the result.

```
db.myCollection.find().sort( { ts : -1 } ); // sort by ts, descending order
```

`sort()` may be combined with the `limit()` function. In fact, if you do not have a relevant index for the specified key pattern, `limit()` is recommended as there is a limit on the size of sorted results when an index is not used. Without a `limit()`, or index, a full in-memory sort must be done but by using a `limit()` it reduces the memory and increases the speed of the operation by using an optimized sorting algorithm.

##### *`limit()`*

`limit()` is analogous to the LIMIT statement in MySQL: it specifies a maximum number of results to return. For best performance, use `limit()` whenever possible. Otherwise, the database may return more objects than are required for processing.

```
db.students.find().limit(10).forEach( function(student) { print(student.name + "<p>"); } );
```

In the shell (and most drivers), a limit of `0` is equivalent to setting no limit at all.

#### *skip()*

The `skip()` expression allows one to specify at which object the database should begin returning results. This is often useful for implementing "paging". Here's an example of how it might be used in a JavaScript application:

```
function printStudents(pageNumber, nPerPage) {
   print("Page: " + pageNumber);
   db.students.find().skip((pageNumber-1)*nPerPage).limit(nPerPage).forEach( function(student) {
print(student.name + "<p>"); } );
}
```

#### *snapshot()*

Indicates use of snapshot mode for the query. Snapshot mode assures no duplicates are returned, or objects missed, which were present at both the start and end of the query's execution (even if the object were updated). If an object is new during the query, or deleted during the query, it may or may not be returned, even with snapshot mode.

Note that short query responses (less than 1MB) are always effectively snapshotted.

Currently, snapshot mode may not be used with sorting or explicit hints.

#### *count()*

The `count()` method returns the number of objects matching the query specified. It is specially optimized to perform the count in the MongoDB server, rather than on the client side for speed and efficiency:

```
nstudents = db.students.find({'address.state' : 'CA'}).count();
```

Note that you can achieve the same result with the following, but the following is slow and inefficient as it requires all documents to be put into memory on the client, and then counted. Don't do this:

```
nstudents = db.students.find({'address.state' : 'CA'}).toArray().length; // VERY BAD: slow and uses
excess memory
```

On a query using skip() and limit(), count ignores these parameters by default.  Use count(true) to have it consider the skip and limit values in the calculation.

```
n = db.students.find().skip(20).limit(10).count(true);
```

#### group()

The `group()` method is analogous to GROUP BY in SQL. `group()` is more flexible, actually, allowing the specification of arbitrary reduction operations. See the Aggregation section of the Mongo Developers' Guide for more information.

#### Special operators

Only return the index key:

```
db.foo.find()._addSpecial("$returnKey" , true )
```

Limit the number of items to scan:

```
db.foo.find()._addSpecial( "$maxScan" , 50 )
```

Set the query:

```
db.foo.find()._addSpecial( "$query" : {x : {$lt : 5}} )
// same as
db.foo.find({x : {$lt : 5}})
```

Sort results:

```
db.foo.find()._addSpecial( "$orderby", {x : -1} )
// same as
db.foo.find().sort({x:-1})
```

Explain the query instead of actually returning the results:

```
db.foo.find()._addSpecial( "$explain", true )
// same as
db.foo.find().explain()
```

Snapshot query:

```
db.foo.find()._addSpecial( "$snapshot", true )
// same as
db.foo.find().snapshot()
```

Set index bounds (see min and max Query Specifiers for details):

```
db.foo.find()._addSpecial("$min" , {x: -20})._addSpecial("$max" , { x : 200 })
```

Show disk location of results:

```
db.foo.find()._addSpecial("$showDiskLoc" , true)
```

Force query to use the given index:

```
db.foo.find()._addSpecial("$hint", {_id : 1})
```

**See Also**

* Optimizing Queries (including explain() and hint())

## Dot Notation (Reaching into Objects)

- Dot Notation vs. Subobjects
- Array Element by Position
- Matching with $elemMatch

MongoDB is designed for store JSON-style objects.  The database understands the structure of these objects and can reach into them to evaluate

query expressions.

Let's suppose we have some objects of the form:

```
> db.persons.findOne()
{ name: "Joe", address: { city: "San Francisco", state: "CA" } ,
  likes: [ 'scuba', 'math', 'literature' ] }
```

Querying on a top-level field is straightforward enough using Mongo's JSON-style query objects:

```
> db.persons.find( { name : "Joe" } )
```

But what about when we need to reach into embedded objects and arrays? This involves a bit different way of thinking about queries than one would do in a traditional relational DBMS. To reach into embedded objects, we use a "dot notation":

```
> db.persons.find( { "address.state" : "CA" } )
```

Reaching into arrays is implicit: if the field being queried is an array, the database automatically assumes the caller intends to look for a value within the array:

```
> db.persons.find( { likes : "math" } )
```

We can mix these styles too, as in this more complex example:

```
> db.blogposts.findOne()
{ title : "My First Post", author: "Jane",
  comments : [{ by: "Abe", text: "First" },
              { by : "Ada", text : "Good post" } ]
}
> db.blogposts.find( { "comments.by" : "Ada" } )
```

We can also create indexes of keys on these fields:

```
db.persons.ensureIndex( { "address.state" : 1 } );
db.blogposts.ensureIndex( { "comments.by" : 1 } );
```

***Dot Notation vs. Subobjects***

Suppose there is an author id, as well as name. To store the author field, we can use an object:

```
> db.blog.save({ title : "My First Post", author: {name : "Jane", id : 1}})
```

If we want to find any authors named Jane, we use the notation above:

```
> db.blog.findOne({"author.name" : "Jane"})
```

To match only objects with these exact keys and values, we use an object:

```
db.blog.findOne({"author" : {"name" : "Jane", "id" : 1}})
```

Note that

```
db.blog.findOne({"author" : {"name" : "Jane"}})
```

will not match, as subobjects have to match exactly (it would match an object with one field: `{"name" : "Jane"}`). Note that the embedded document must also have the same key order, so:

```
db.blog.findOne({"author" : {"id" : 1, "name" : "Jane"}})
```

will not match, either. This can make subobject matching unwieldy in languages whose default document representation is unordered.

#### *Array Element by Position*

Array elements also may be accessed by specific array position:

```
// i.e. comments[0].by == "Abe"
> db.blogposts.find( { "comments.0.by" : "Abe" } )
```

(The above examples use the mongo shell's Javascript syntax.  The same operations can be done in any language for which Mongo has a driver available.)

#### *Matching with $elemMatch*

Using the $elemMatch query operator (mongod >= 1.3.1), you can match an entire document within an array. This is best illustrated with an example. Suppose you have the following two documents in your collection:

```
// Document 1
{ "foo" : [
      {
        "shape" : "square",
        "color" : "purple",
        "thick" : false
      },
      {
        "shape" : "circle",
        "color" : "red",
        "thick" : true
      }
] }


// Document 2
{ "foo" : [
      {
        "shape" : "square",
        "color" : "red",
        "thick" : true
      },
      {
        "shape" : "circle",
        "color" : "purple",
        "thick" : false
      }
] }
```

You want to query for a purple square, and so you write the following:

```
db.foo.find({"foo.shape": "square", "foo.color": "purple"})
```

The problem with this query is that it will match the second in addition to matching the first document. In other words, the standard query syntax won't restrict itself to a single document within the `foo` array. As mentioned above, subobjects have to match exactly, so

```
db.foo.find({foo: {"shape": "square", "color": "purple"} } )
```

won't help either, since there's a third attribute specifying thickness.

To match an entire document within the foo array, you need to use $elemMatch. To properly query for a purple square, you'd use $elemMatch like so:

```
db.foo.find({foo: {"$elemMatch": {shape: "square", color: "purple"}}})
```

The query will return the first document, which contains the purple square you're looking for.

## Full Text Search in Mongo


- Introduction
- Multikeys (Indexing Values in an Array)
- Text Search
- Comparison to Full Text Search Engines
- Real World Examples


#### Introduction

Mongo provides some functionality that is useful for text search and tagging.

#### Multikeys (Indexing Values in an Array)

The Mongo multikey feature can automatically index arrays of values. Tagging is a good example of where this feature is useful. Suppose you have an article object/document which is tagged with some category names:

```
obj = {
  name: "Apollo",
  text: "Some text about Apollo moon landings",
  tags: [ "moon", "apollo", "spaceflight" ]
}
```

and that this object is stored in `db.articles`. The command

```
db.articles.ensureIndex( { tags: 1 } );
```

will index all the tags on the document, and create index entries for "moon", "apollo" and "spaceflight" for that document.

You may then query on these items in the usual way:

```
> print(db.articles.findOne( { tags: "apollo" } ).name);
Apollo
```

The database creates an index entry for each item in the array. Note an array with many elements (hundreds or thousands) can make inserts very expensive. (Although for the example above, alternate implementations are equally expensive.)

#### Text Search

It is fairly easy to implement basic full text search using multikeys. What we recommend is having a field that has all of the keywords in it, something like:

```
{ title : "this is fun" ,
  _keywords : [ "this" , "is" , "fun" ]
}
```

Your code must split the title above into the keywords before saving.  Note that this code (which is not part of Mongo DB) could do stemming, etc. too. (Perhaps someone in the community would like to write a standard module that does this...)

#### Comparison to Full Text Search Engines

MongoDB has interesting functionality that makes certain search functions easy. That said, it is not a dedicated full text search engine.

For example, dedicated engines provide the following capabilities:

- built-in text stemming
- ranking of queries matching various numbers of terms (can be done with MongoDB, but requires user supplied code to do so)
- bulk index building

Bulk index building makes building indexes fast, but has the downside of not being realtime. MongoDB is particularly well suited for problems where the search should be done in realtime. Traditional tools are often not good for this use case.

#### Real World Examples

The Business Insider web site uses MongoDB for its blog search function in production.

Mark Watson's opinions on Java, Ruby, Lisp, AI, and the Semantic Web - A recipe example in Ruby.

## min and max Query Specifiers

The `min()` and `max()` functions may be used in conjunction with an index to constrain query matches to those having index keys between the min and max keys specified. The `min()` and `max()` functions may be used individually or in conjunction. The index to be used may be specified with a `hint()` or one may be inferred from pattern of the keys passed to `min()` and/or `max()`.

```
db.f.find().min({name:"barry"}}.max({name:"larry"}).hint({name:1});
db.f.find().min({name:"barry"}}.max({name:"larry"});
db.f.find().min({last_name:"smith",first_name:"john"}};
```

If you're using the standard query syntax, you must distinguish between the `$min` and `$max` keys and the query selector itself. See here:

```
db.f.find({$min: {name:"barry"}, $max: {name:"larry"}, $query:{}});
```

The min() value is included in the range and the max() value is excluded.

Normally, it is much preferred to use $gte and $lt rather than to use min and max, as min and max require a corresponding index. Min and max are primarily useful for compound keys: it is difficult to express the last_name/first_name example above without this feature (it can be done using $where).

min and max exist primarily to support the mongos (sharding) process.

## OR operations in query expressions

Query objects in Mongo by default AND expressions together. Before 1.5.3 MongoDB did not include an "$or" operator for such queries, however there are ways to express such queries.

### *$in*

The $in operator indicates a "where value in ..." expression. For expressions of the form x == a OR x == b, this can be represented as

```
{ x : { $in : [ a, b ] } }
```

### *$where*

We can provide arbitrary Javascript expressiosn to the server via the $where operator. This provides a means to perform OR operations. For example in the mongo shell one might invoke:

```
db.mycollection.find( { $where : function() { return this.a == 3 || this.b == 4; } } );
```

The following syntax is briefer and also works; however, if additional structured query components are present, you will need the $where form:

```
db.mycollection.find( function() { return this.a == 3 || this.b == 4; } );
```

### *$or*

The `$or` operator lets you use a boolean or expression to do queries. You give $or a list of expressions, any of which can satisfy the query.

**New in MongoDB 1.5.3**

Simple:

```
db.foo.find( { $or : [ { a : 1 } , { b : 2 } ] } )
```

With another field

```
db.foo.find( { name : "bob" , $or : [ { a : 1 } , { b : 2 } ] } )
```

The `$or` operator retrieves matches for each or clause individually and eliminates duplicates when returning results.

#### See Also

Advanced Queries

## Queries and Cursors

Queries to MongoDB return a cursor, which can be iterated to retrieve results. The exact way to query will vary with language driver. Details below focus on queries from the MongoDB shell (i.e. the `mongo` process).

The shell `find()` method returns a cursor object which we can then iterate to retrieve specific documents from the result. We use `hasNext()` and `next()` methods for this purpose.

```
for( var c = db.parts.find(); c.hasNext(); ) {
   print( c.next());
}
```

Additionally in the shell, `forEach()` may be used with a cursor:

```
db.users.find().forEach( function(u) { print("user: " + u.name); } );
```

#### Array Mode in the Shell

Note that in some languages, like JavaScript, the driver supports an "array mode". Please check your driver documentation for specifics.

In the db shell, to use the cursor in array mode, use array index [] operations and the `length` property.

Array mode will load all data into RAM up to the highest index requested. Thus it should ***not*** be used for any query which can return very large amounts of data: you will run out of memory on the client.

You may also call `toArray()` on a cursor. `toArray()` will load all objects queries into RAM.

#### Getting a Single Item

The shell `findOne()` method fetches a single item. Null is returned if no item is found.

`findOne()` is equivalent in functionality to:

```
function findOne(coll, query) {
    var cursor = coll.find(query).limit(1);
    return cursor.hasNext() ? cursor.next() : null;
}
```

**Tip:** If you only need one row back and multiple match, `findOne()` is efficient, as it performs the `limit()` operation, which limits the objects returned from the database to one.

#### Querying Embedded Objects

To find an exact match of an entire embedded object, simply query for that object:

```
db.order.find( { shipping: { carrier: "usps" } } );
```

The above query will work if { carrier: "usps" } is an exact match for the entire contained shipping object. If you wish to match any sub-object with `shipping.carrier == "usps"`, use this syntax:

```
db.order.find( { "shipping.carrier" : "usps" } );
```

See the dot notation docs for more information.

#### Greater Than / Less Than

```
db.myCollection.find( { a : { $gt : 3 } } );
db.myCollection.find( { a : { $gte :3 } } );
db.myCollection.find( { a : { $lt :3 } } );
db.myCollection.find( { a : { $lte :3 } } ); // a <= 3
```

#### Latent Cursors and Snapshotting

A latent cursor has (in addition to an initial access) a latent access that occurs after an intervening write operation on the database collection (i.e., an insert, update, or delete). Under most circumstances, the database supports these operations.

Conceptually, a cursor has a current position. If you delete the item at the current position, the cursor automatically skips its current position forward to the next item.

Mongo DB cursors do not provide a snapshot: if other write operations occur during the life of your cursor, it is unspecified if your application will see the results of those operations or not. See the snapshot docs for more information.

#### Auditing allocated cursors

Information on allocated cursors may be obtained using the {`cursorInfo:1`} command.

```
db.runCommand({cursorInfo:1})
```

#### See Also

- Advanced Queries
- Multikeys in the HowTo

### Tailable Cursors

> Tailable cursors are only allowed on capped collections and can only return objects in natural order.

> If the field you wish to "tail" is indexed, simply requerying for { *field* : { $gt : *value* } } is already quite efficient. Tailable will be slightly faster in situations such as that. However, if the field is not indexed, tailable provides a huge improvement in performance. Situations without indexes are the real use case for a tailable cursor.

MongoDB has a feature known as tailable cursors which are similar to the Unix "tail -f" command.

Tailable means the cursor is not closed once all data is retrieved. Rather, the cursor marks the last known object's position and you can resume using the cursor later, from where that object was located, provided more data is available.

The cursor may become invalid if, for example, the last object returned is at the end of the collection and is deleted. Thus, you should be prepared to requery if the cursor is "dead". You can determine if a cursor is dead by checking its id. An id of zero indicates a dead cursor (use isDead in the c++ driver).

In addition, the cursor may be dead upon creation if the initial query returns no matches. In this case a requery is required to create a persistent tailable cursor.

MongoDB replication uses this feature to follow the end of the master server's replication op log collection -- the tailable feature eliminates the

need to create an index for the oplog at the master, which would slow log writes.

C++ example:

```
#include "client/dbclient.h"

using namespace mongo;

/* "tail" the namespace, outputting elements as they are added.
   For this to work something field -- _id in this case -- should be increasing
   when items are added.
*/
void tail(DBClientBase& conn, const char *ns) {
  // minKey is smaller than any other possible value
BSONElement lastId = minKey.firstElement();
  // { $natural : 1 } means in forward capped collection insertion order
Query query = Query().sort("$natural");
  while( 1 ) {
    auto_ptr<DBClientCursor> c =
      conn.query(ns, query, 0, 0, 0, QueryOption_CursorTailable);
    while( 1 ) {
      if( !c->more() ) {
  if( c->isDead() ) {
    // we need to requery
break;
  }
  sleepsecs(1); // all data (so far) exhausted, wait for more
continue; // we will try more() again
}
      BSONObj o = c->next();
      lastId = o["_id"];
      cout << o.toString() << endl;
    }

    // prepare to requery from where we left off
query = QUERY( "_id" << GT << lastId ).sort("$natural");
  }
}
```

***See Also***

- http://github.com/mongodb/mongo-snippets/blob/master/cpp-examples/tailable_cursor.cpp

## Server-side Code Execution


- `$where` Clauses and Functions in Queries
  - Restrictions
- Map/Reduce
- Using `db.eval()`
  - Examples
  - Limitations of `eval`
    - Write locks
    - Sharding
- Storing functions server-side
- Notes on Concurrency
- Running .js files via a mongo shell instance on the server


Mongo supports the execution of code inside the database process.

#### `$where` Clauses and Functions in Queries

In addition to the regular document-style query specification for `find()` operations, you can also express the query either as a string containing a SQL-style WHERE predicate clause, or a full JavaScript function.

When using this mode of query, the database will call your function, or evaluate your predicate clause, for each object in the collection.

In the case of the string, you must represent the object as "this" (see example below). In the case of a full JavaScript function, you use the normal JavaScript function syntax.

The following four statements in mongo - The Interactive Shell are equivalent:

```
db.myCollection.find( { a : { $gt: 3 } } );
db.myCollection.find( { $where: "this.a > 3" });
db.myCollection.find( "this.a > 3" );
db.myCollection.find( { $where: function() { return this.a > 3;}});
```

The first statement is the preferred form. It will be at least slightly faster to execute because the query optimizer can easily interpret that query and choose an index to use.

You may mix data-style find conditions and a function. This can be advantageous for performance because the data-style expression will be evaluated first, and if not matched, no further evaluation is required. Additionally, the database can then consider using an index for that condition's field. To mix forms, pass your evaluation function as the `$where` field of the query object. For example:

```
db.myCollection.find( { active: true, $where: function() { return obj.credits - obj.debits < 0; } } );
```

You may mix data-style find conditions and a function. This can be advantageous for performance because the data-style expression will be evaluated first, and if not matched, no further evaluation is required. Additionally, the database can then consider using an index for that condition's field. For example:

```
db.myCollection.find( { active: true, $where: "this.credits - this.debits < 0" } );
```

#### *Restrictions*

Do not write to the collection being inspected from the `$where` expression.

#### Map/Reduce

MongoDB supports Javascript-based map/reduce operations on the server. See the map/reduce documentation for more information.

#### Using `db.eval()`

> ⚠ Use map/reduce instead of db.eval() for long running jobs. db.eval blocks other operations!

`db.eval()` is used to evaluate a function (written in JavaScript) at the database server.
This is useful if you need to touch a lot of data lightly. In that scenario, network transfer of the data could be a bottleneck.

`db.eval()` returns the return value of the function that was invoked at the server. If invocation fails an exception is thrown.

For a trivial example, we can get the server to add 3 to 3:

```
> db.eval( function() { return 3+3; } );
6
>
```

Let's consider an example where we wish to erase a given field, `foo`, in every single document in a collection. A naive client-side approach would be something like

```
function my_erase() {
  db.things.find().forEach( function(obj) {
                      delete obj.foo;
                      db.things.save(obj);
                    } );
}

my_erase();
```

Calling `my_erase()` on the client will require the entire contents of the collection to be transmitted from server to client and back again.

Instead, we can pass the function to `eval()`, and it will be called in the runtime environment of the server. On the server, the `db` variable is set to the current database:

```
db.eval(my_erase);
```

***Examples***

```
> myfunc = function(x){ return x; };

> db.eval( myfunc, {k:"asdf"} );
{ k : "asdf"  }

> db.eval( myfunc, "asdf" );
"asdf"

> db.eval( function(x){ return x; }, 2 );
2.0
```

If an error occurs on the evaluation (say, a null pointer exception at the server), an exception will be thrown of the form:

```
{ dbEvalException: { errno : -3.0 , errmsg : "invoke failed" , ok : 0.0  } }
```

Example of using `eval()` to do equivalent of the Mongo `count()` function:

```
function mycount(collection) {
  return db.eval( function(){return db[collection].find({},{_id:ObjId()}).length();} );
}
```

Example of using `db.eval()` for doing an atomic increment, plus some calculations:

```
function inc( name , howMuch ){
    return db.eval(
        function(){
            var t = db.things.findOne( { name : name } );
            t = t || { name : name , num : 0 , total : 0 , avg : 0 };
            t.num++;
            t.total += howMuch;
            t.avg = t.total / t.num;
            db.things.save( t );
            return t;
        }
    );
}

db.things.remove( {} );
print( tojson( inc( "eliot" , 2 )) );
print( tojson( inc( "eliot" , 3 )) );
```

***Limitations of `eval`***

Write locks

It's important to be aware that `eval` takes a write lock. This means that you can't use `eval` to run other commands that themselves take a write lock. To take an example, suppose you're running a replica set and want to add a new member. You may be tempted to do something like this from a driver:

```
db.eval("rs.add('ip-address:27017')");
```

As we just mentioned, `eval` will take a write lock on the current node. Therefore, this won't work because you can't add a new replica set member if any of the existing nodes is write-locked.

The proper approach is to run the commands to add a node manually. `rs.add` simply queries the `local.system.replSet` collection, updates the config object, and run the `replSetReconfig` command. You can do this from the driver, which, in addition to not taking out the `eval` write

lock, manages to more directly perform the operation.

Sharding

Note also that `eval` doesn't work with sharding. If you expect your system to be sharded eventually, it's probably best to avoid `eval` altogether.

#### Storing functions server-side

> in version 1.1.1 and above

There is a special system collection called `system.js` that can store JavaScript function to be re-used. To store a function, you would do:

```
db.system.js.save( { _id : "foo" , value : function( x , y ){ return x + y; } } );
```

_id is the name of the function, and is unique per database.

Once you do that, you can use `foo` from any JavaScript context (db.eval, $where, map/reduce)

See http://github.com/mongodb/mongo/tree/master/jstests/storefunc.js for a full example

#### Notes on Concurrency

eval() blocks the entire mongod process while running. Thus, its operations are atomic but prevent other operations from processing.

When more concurrency is needed consider using map/reduce instead of eval().

#### Running .js files via a mongo shell instance on the server

This is a good technique for performing batch administrative work. Run `mongo` on the server, connecting via the `localhost` interface. The connection is then very fast and low latency. This is friendlier than db.eval() as db.eval() blocks other operations.

## Sorting and Natural Order

"Natural order" is defined as the database's native ordering of objects in a collection.

When executing a `find()` with no parameters, the database returns objects in forward natural order.

For standard tables, natural order is not particularly useful because, although the order is often close to insertion order, it is not *guaranteed* to be. However, for Capped Collections, natural order is guaranteed to be the insertion order. This can be very useful.

In general, the natural order feature is a very efficient way to store and retrieve data in insertion order (much faster than say, indexing on a timestamp field). But remember, the collection must be capped for this to work.

In addition to forward natural order, items may be retrieved in reverse natural order. For example, to return the 50 most recently inserted items (ordered most recent to less recent) from a capped collection, you would invoke:

```
> c=db.cappedCollection.find().sort({$natural:-1}).limit(50)
```

Sorting can also be done on arbitrary keys in any collection. For example, this sorts by 'name' ascending, then 'age' descending:

```
> c=db.collection.find().sort({name : 1, age : -1})
```

### *See Also*

- The Capped Collections section of this Guide
- Advanced Queries
- The starting point for all Home

## Aggregation

Mongo includes utility functions which provide server-side `count, distinct,` and `group by` operations. More advanced aggregate functions can be crafted using MapReduce.

- Count

- Distinct
- Group
  - Examples
  - Using Group from Various Languages
- Map/Reduce
- See Also


### *Count*

`count()` returns the number of objects in a collection or matching a query. If a document selector is provided, only the number of matching documents will be returned.

`size()` is like `count()` but takes into consideration any limit() or skip() specified for the query.

```
db.collection.count(selector);
```

For example:

```
print( "# of objects: " + db.mycollection.count() );
print( db.mycollection.count( {active:true} );
```

`count` is faster if an index exists for the condition in the selector. For example, to make the count on `active` fast, invoke

```
db.mycollection.ensureIndex( {active:1} );
```

### *Distinct*

The distinct command returns returns a list of distinct values for the given `key` across a collection.

Command is of the form:

```
{ distinct : <collection_name>, key : <key>[, query : <query>] }
```

although many drivers have a helper function for distinct.

```
> db.addresses.insert({"zip-code": 10010})
> db.addresses.insert({"zip-code": 10010})
> db.addresses.insert({"zip-code": 99701})

> // shell helper:
> db.addresses.distinct("zip-code");
[ 10010, 99701 ]

> // running as a command manually:
> db.runCommand( { distinct: 'addresses', key: 'zip-code' } )
{ "values" : [ 10010, 99701 ], "ok" : 1 }
```

`distinct` may also reference a nested key:

```
> db.comments.save({"user": {"points": 25}})
> db.comments.save({"user": {"points": 31}})
> db.comments.save({"user": {"points": 25}})

> db.comments.distinct("user.points");
[ 25, 31 ]
```

You can add an optional query parameter to distinct as well

```
> db.address.distinct( "zip-code" , { age : 30 } )
```

Note: the distinct command results are returned as a single BSON object.  If the results could be large (> 4 megabytes), use map/reduce instead.

### *Group*

Note: currently one must use map/reduce instead of group() in sharded MongoDB configurations.

`group` returns an array of grouped items. The command is similar to SQL's group by. The SQL statement

```
select a,b,sum(c) csum from coll where active=1 group by a,b
```

corresponds to the following in MongoDB:

```
db.coll.group(
           {key: { a:true, b:true },
            cond: { active:1 },
            reduce: function(obj,prev) { prev.csum += obj.c; },
            initial: { csum: 0 }
            });
```

Note: the result is returned as a single BSON object and for this reason must be fairly small – less than 10,000 keys, else you will get an exception. For larger grouping operations without limits, please use map/reduce .

`group` takes a single object parameter containing the following fields:

- *`key`*: Fields to group by.
- *`reduce`*: The `reduce` function aggregates (reduces) the objects iterated. Typical operations of a reduce function include summing and counting. `reduce` takes two arguments: the current document being iterated over and the aggregation counter object. In the example above, these arguments are named `obj` and `prev`.
- *`initial`*: initial value of the aggregation counter object.
- *`keyf`*: An optional function returning a "key object" to be used as the grouping key. Use this instead of *`key`* to specify a key that is not an existing member of the object (or, to access embedded members). Set in lieu of *`key`*.
- *`cond`*: An optional condition that must be true for a row to be considered. This is essentially a `find()` query expression object. If null, the reduce function will run against all rows in the collection.
- *`finalize`*: An optional function to be run on each item in the result set just before the item is returned. Can either modify the item (e.g., add an average field given a count and a total) or return a replacement object (returning a new object with just _id and average fields). See jstests/group3.js for examples.

To order the grouped data, simply sort it client-side upon return. The following example is an implementation of `count()` using `group()`.

```
function gcount(collection, condition) {
  var res =
    db[collection].group(
           { key: {},
             initial: {count: 0},
             reduce: function(obj,prev){ prev.count++;},
             cond: condition } );
  // group() returns an array of grouped items.  here, there will be a single
// item, as key is {}.
return res[0] ? res[0].count : 0;
}
```

#### Examples

The examples assume data like this:

```
{ domain: "www.mongodb.org"
, invoked_at: {d:"2009-11-03", t:"17:14:05"}
, response_time: 0.05
, http_action: "GET /display/DOCS/Aggregation"
}
```

Show me stats for each http_action in November 2009:

```
db.test.group(
   { cond: {"invoked_at.d": {$gte: "2009-11", $lt: "2009-12"}}
   , key: {http_action: true}
   , initial: {count: 0, total_time:0}
   , reduce: function(doc, out){ out.count++; out.total_time+=doc.response_time }
   , finalize: function(out){ out.avg_time = out.total_time / out.count }
   } );

[
  {
    "http_action" : "GET /display/DOCS/Aggregation",
    "count" : 1,
    "total_time" : 0.05,
    "avg_time" : 0.05
  }
]
```

Show me stats for each domain for each day in November 2009:

```
db.test.group(
   { cond: {"invoked_at.d": {$gte: "2009-11", $lt: "2009-12"}}
   , key: {domain: true, invoked_at.d: true}
   , initial: {count: 0, total_time:0}
   , reduce: function(doc, out){ out.count++; out.total_time+=doc.response_time }
   , finalize: function(out){ out.avg_time = out.total_time / out.count }
   } );

[
  {
    "http_action" : "GET /display/DOCS/Aggregation",
    "count" : 1,
    "total_time" : 0.05,
    "avg_time" : 0.05
  }
]
```

#### Using Group from Various Languages

Some language drivers provide a group helper function.  For those that don't, one can manually issue the db command for group.  Here's an example using the Mongo shell syntax:

```
> db.foo.find()
{"_id" :  ObjectId( "4a92af2db3d09cb83d985f6f")  , "x" : 1}
{"_id" :  ObjectId( "4a92af2fb3d09cb83d985f70")  , "x" : 3}
{"_id" :  ObjectId( "4a92afdab3d09cb83d985f71")  , "x" : 3}

> db.$cmd.findOne({group : {
... ns : "foo",
... cond : {},
... key : {x : 1},
... initial : {count : 0},
... $reduce : function(obj,prev){prev.count++;}}})
{"retval" : [{"x" : 1 , "count" : 1},{"x" : 3 , "count" : 2}] , "count" : 3 , "keys" : 2 , "ok" : 1}
```

If you use the database command with `keyf` (instead of `key`) it must be prefixed with a $. For example:

```
db.$cmd.findOne({group : {
... ns : "foo",
... $keyf : function(doc) { return {"x" : doc.x}; },
... initial : {count : 0},
... $reduce : function(obj,prev) { prev.count++; }}})
```

### *Map/Reduce*

MongoDB provides a MapReduce facility for more advanced aggregation needs. CouchDB users: please note that basic queries in MongoDB do not use map/reduce.

### *See Also*

- jstests/eval2.js for an example of group() usage
- Advanced Queries

## Removing

### *Removing Objects from a Collection*

To remove objects from a collection, use the `remove()` function in the mongo shell. (Other drivers offer a similar function, but may call the function "delete". Please check your driver's documentation ).

`remove()` is like `find()` in that it takes a JSON-style query document as an argument to select which documents are removed. If you call `remove()` without a document argument, or with an empty document {}, it will remove all documents in the collection. Some examples :

```
db.things.remove({});    // removes all
db.things.remove({n:1}); // removes all where n == 1
```

If you have a document in memory and wish to delete it, the most efficient method is to specify the item's document _id value as a criteria:

```
db.things.remove({_id: myobject._id});
```

You may be tempted to simply pass the document you wish to delete as the selector, and this will work, but it's inefficient.

> **References**
> If a document is deleted, any existing references to the document will still exist in the database. These references will return null when evaluated.

#### Concurrency and Remove

v1.3+ supports concurrent operations while a remove runs. If a simultaneous update (on the same collection) grows an object which matched the remove criteria, the updated object may not be removed (as the operations are happening at approximately the same time, this may not even be surprising). In situations where this is undesireable, pass {$atomic : true} in your filter expression:

```
db.videos.remove( { rating : { $lt : 3.0 }, $atomic : true } )
```

The remove operation is then completely atomic – however, it will also block other operations while executing.

## Updating

MongoDB supports atomic, in-place updates as well as more traditional updates for replacing an entire document.

- update()
- `save()` in the mongo shell
- Modifier Operations
    - $inc
    - $set
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    - $push
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  - Upserts with Modifiers

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    - Object Padding
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- See Also


### update()

`update()` replaces the document matching criteria entirely with objNew. If you only want to modify some fields, you should use the atomic modifiers below.

Here's the MongoDB shell syntax for `update()`:

`db.collection.update( criteria, objNew, upsert, multi )`

Arguments:

- *`criteria`* - query which selects the record to update;
- *`objNew`* - updated object or $ operators (e.g., $inc) which manipulate the object
- *`upsert`* - if this should be an "upsert"; that is, if the record does not exist, insert it
- *`multi`* - if all documents matching *`criteria`* should be updated

> If you are coming from SQL, be aware that by default, update() only modifies the first matched object. If you want to modify all matched objects you need to use the multi flag

### save() in the mongo shell

The save() command in the mongo shell provides a shorthand syntax to perform a single object update with upsert:

```
// x is some JSON style object
db.mycollection.save(x); // updates if exists; inserts if new
```

`save()` does an upsert if `x` has an _id field and an insert if it does not. Thus, normally, you will not need to explicitly request upserts, just use `save()`.

Upsert means "update if present; insert if missing".

```
myColl.update( { name: "Joe" }, { name: "Joe", age: 20 }, true );
```

### Modifier Operations

Modifier operations are highly-efficient and useful when updating existing values; for instance, they're great for incrementing a number.

So, while a conventional implementation does work:

```
var j=myColl.findOne( { name: "Joe" } );
j.n++;
myColl.save(j);
```

a modifier update has the advantages of avoiding the latency involved in querying and returning the object. The modifier update also features operation atomicity and very little network data transfer.

To perform an atomic update, simply specify any of the special update operators (which always start with a '$' character) with a relevant update document:

```
db.people.update( { name:"Joe" }, { $inc: { n : 1 } } );
```

The preceding example says, "Find the first document where 'name' is 'Joe' and then increment 'n' by one."

While not shown in the examples, most modifier operators will accept multiple field/value pairs when one wishes to modify multiple fields. For example, the following operation would set x to 1 and y to 2:

```
{ $set : { x : 1 , y : 2 } }
```

Also, multiple operators are valid too:

```
{ $set : { x : 1 }, $inc : { y : 1 } }
```

**$inc**

```
{ $inc : { field : value } }
```

increments *field* by the number *value* if *field* is present in the object, otherwise sets *field* to the number *value*.

**$set**

```
{ $set : { field : value } }
```

sets *field* to *value*. All datatypes are supported with `$set`.

**$unset**

```
{ $unset : { field : 1} }
```

Deletes a given field. v1.3+

**$push**

```
{ $push : { field : value } }
```

appends *value* to *field*, if *field* is an existing array, otherwise sets *field* to the array [*value*] if *field* is not present. If *field* is present but is not an array, an error condition is raised.

**$pushAll**

```
{ $pushAll : { field : value_array } }
```

appends each value in *value_array* to *field*, if *field* is an existing array, otherwise sets *field* to the array *value_array* if *field* is not present. If *field* is present but is not an array, an error condition is raised.

**$addToSet**

```
{ $addToSet : { field : value } }
```

Adds value to the array only if its not in the array already, if *field* is an existing array, otherwise sets *field* to the array *value* if *field* is not present. If *field* is present but is not an array, an error condition is raised.

To add many valuest.update

```
{ $addToSet : { a : { $each : [ 3 , 5 , 6 ] } } }
```

**$pop**

```
{ $pop : { field : 1  } }
```

removes the last element in an array (ADDED in 1.1)

```
{ $pop : { field : -1  } }
```

removes the first element in an array (ADDED in 1.1) |

**$pull**

```
{ $pull : { field : _value } }
```

removes all occurrences of *`value`* from *`field`*, if *`field`* is an array. If *`field`* is present but is not an array, an error condition is raised.

**$pullAll**

```
{ $pullAll : { field : value_array } }
```

removes all occurrences of each value in *`value_array`* from *`field`*, if *`field`* is an array. If *`field`* is present but is not an array, an error condition is raised.

**$rename**

Version 1.7.2+ only.

```
{ $rename : { old_field_name : new_field_name } }
```

Renames the field with name 'old_field_name' to 'new_field_name'. Does not expand arrays to find a match for 'old_field_name'.

### *The $ positional operator*

Version 1.3.4+ only.

The $ operator (by itself) means "position of the matched array item in the query". Use this to find an array member and then manipulate it. For example:

```
> t.find()
{ "_id" : ObjectId("4b97e62bf1d8c7152c9ccb74"), "title" : "ABC",
  "comments" : [ { "by" : "joe", "votes" : 3 }, { "by" : "jane", "votes" : 7 } ] }

> t.update( {'comments.by':'joe'}, {$inc:{'comments.$.votes':1}}, false, true )

> t.find()
{ "_id" : ObjectId("4b97e62bf1d8c7152c9ccb74"), "title" : "ABC",
  "comments" : [ { "by" : "joe", "votes" : 4 }, { "by" : "jane", "votes" : 7 } ] }
```

Currently the $ operator only applies to the **first** matched item in the query. For example:

```
> t.find();
{ "_id" : ObjectId("4b9e4a1fc583fa1c76198319"), "x" : [ 1, 2, 3, 2 ] }
> t.update({x: 2}, {$inc: {"x.$": 1}}, false, true);
> t.find();
{ "_id" : ObjectId("4b9e4a1fc583fa1c76198319"), "x" : [ 1, 3, 3, 2 ] }
```

The positional operator cannot be combined with an `upsert` since it requires a matching array element. If your update results in an insert then the "$" will literally be used as the field name.

Using "$unset" with an expression like this "array.$" will result in the array item becoming `null`, not being removed. You can issue an update with "{$pull:{x:null}}" to remove all nulls.

```
> t.insert({x: [1,2,3,4,3,2,3,4]})
> t.find()
{ "_id" : ObjectId("4bde2ad3755d00000000710e"), "x" : [ 1, 2, 3, 4, 3, 2, 3, 4 ] }
> t.update({x:3}, {$unset:{"x.$":1}})
> t.find()
{ "_id" : ObjectId("4bde2ad3755d00000000710e"), "x" : [ 1, 2, null, 4, 3, 2, 3, 4 ] }
```

### *Upserts with Modifiers*

You may use upsert with a modifier operation. In such a case, the modifiers will be applied to the update *`criteria`* member and the resulting object will be inserted. The following upsert example may insert the object {`name:"Joe",x:1,y:1`}.

```
db.people.update( { name:"Joe" }, { $inc: { x:1, y:1 } }, true );
```

There are some restrictions. A modifier may not reference the `_id` field, and two modifiers within an update may not reference the same field, for example the following is not allowed:

```
db.people.update( { name:"Joe" }, { $inc: { x: 1 }, $set: { x: 5 } } );
```

### *Pushing a Unique Value*

To add a value to an array only if not already present:

Starting in 1.3.3, you can do

```
update( {_id:'joe'},{"$addToSet": { tags : "baseball" } } );
```

For older versions, add $ne : <value> to your query expression:

```
update( {_id:'joe', tags: {"$ne": "baseball"}},
        {"$push": { tags : "baseball" } } );
```

## Checking the Outcome of an Update Request

As described above, a non-upsert update may or may not modify an existing object. An upsert will either modify an existing object or insert a new object. The client may determine if its most recent message on a connection updated an existing object by subsequently issuing a `getlasterror` command ( `db.runCommand( "getlasterror" )` ). If the result of the `getlasterror` command contains an `updatedExisting` field, the last message on the connection was an update request. If the `updatedExisting` field's value is true, that update request caused an existing object to be updated; if `updatedExisting` is false, no existing object was updated. An `upserted` field will contain the new `_id` value if an insert is performed (new as of 1.5.4).

## Notes

### *Object Padding*

When you update an object in MongoDB, the update occurs in-place if the object has not grown in size. This is good for insert performance if the collection has many indexes.

Mongo adaptively learns if objects in a collection tend to grow, and if they do, it adds some padding to prevent excessive movements.  This statistic is tracked separately for each collection.

### *Blocking*

Staring in 1.5.2, multi updates yield occasionally so you can safely update large amounts of data. If you want a multi update to be truly atomic, you can use the $atomic flag.

### See Also

- findandmodify Command
- Atomic Operations

## Atomic Operations


- Modifier operations
- "Update if Current"
    - The ABA Nuance
- "Insert if Not Present"
- Find and Modify (or Remove)
- Applying to Multiple Objects At Once


MongoDB supports atomic operations *on single documents*. MongoDB does not support traditional locking and complex transactions for a number of reasons:

- First, in sharded environments, distributed locks could be expensive and slow. Mongo DB's goal is to be lightweight and fast.
- We dislike the concept of deadlocks. We want the system to be simple and predictable without these sort of surprises.
- We want Mongo DB to work well for realtime problems. If an operation may execute which locks large amounts of data, it might stop some small light queries for an extended period of time. (We don't claim Mongo DB is perfect yet in regards to being "real-time", but we certainly think locking would make it even harder.)

MongoDB does support several methods of manipulating single documents atomically, which are detailed below.

#### Modifier operations

The Mongo DB update command supports several modifiers, all of which atomically update an element in a document. They include:

- $set - set a particular value
- $unset - set a particular value (since 1.3.0)
- $inc - increment a particular value by a certain amount
- $push - append a value to an array
- $pushAll - append several values to an array
- $pull - remove a value(s) from an existing array
- $pullAll - remove several value(s) from an existing array

These modifiers are convenient ways to perform certain operations atomically.

#### "Update if Current"

Another strategy for atomic updates is "Update if Current". This is what an OS person would call Compare and Swap. For this we

1. Fetch the object.
2. Modify the object locally.
3. Send an update request that says "update the object to this new value if it still matches its old value".

Should the operation fail, we might then want to try again from step 1.

For example, suppose we wish to fetch one object from inventory. We want to see that an object is available, and if it is, deduct it from the inventory. The following code demonstrates this using mongo shell syntax (similar functions may be done in any language):

```
> t=db.inventory
> s = t.findOne({sku:'abc'})
{"_id" : "49df4d3c9664d32c73ea865a" , "sku" : "abc" , "qty" : 30}
> qty_old = s.qty;
> --s.qty;
> t.update({_id:s._id, qty:qty_old}, s); db.$cmd.findOne({getlasterror:1});
{"err" :  , "updatedExisting" : true , "n" : 1 , "ok" : 1} // it worked
```

For the above example, we likely don't care the exact sku quantity as long as it is as least as great as the number to deduct. Thus the following code is better, although less general -- we can get away with this as we are using a predefined modifier operation ($inc). For more general updates, the "update if current" approach shown above is recommended.

```
> t.update({sku:"abc",qty:{$gt:0}}, { $inc : { qty : -1 } } ) ; db.$cmd.findOne({getlasterror:1})
{"err" : , "updatedExisting" : true , "n" : 1 , "ok" : 1} // it worked
> t.update({sku:"abcz",qty:{$gt:0}}, { $inc : { qty : -1 } } ) ; db.$cmd.findOne({getlasterror:1})
{"err" : , "updatedExisting" : false , "n" : 0 , "ok" : 1} // did not work
```

#### *The ABA Nuance*

In the first of the examples above, we basically did "update object if *qty* is unchanged". However, what if since our read, *sku* had been modified? We would then overwrite that change and lose it!

There are several ways to avoid this problem ; it's mainly just a matter of being aware of the nuance.

1. Use the entire object in the update's query expression, instead of just the _id and qty field.
2. Use $set to set the field we care about. If other fields have changed, they won't be effected then.
3. Put a version variable in the object, and increment it on each update.
4. When possible, use a $ operator instead of an update-if-current sequence of operations.

#### "Insert if Not Present"

Another optimistic concurrency scenario involves inserting a value when not already there. When we have a unique index constraint for the criteria, we can do this. The following example shows how to insert monotonically increasing _id values into a collection using optimistic concurrency:

```
function insertObject(o) {
    x = db.myCollection;
    while( 1 ) {
        // determine next _id value to try
var c = x.find({},{_id:1}).sort({_id:-1}).limit(1);
        var i = c.hasNext() ? c.next()._id + 1 : 1;
        o._id = i;
        x.insert(o);
        var err = db.getLastErrorObj();
        if( err && err.code ) {
            if( err.code == 11000 /* dup key */ )
                continue;
            else
                print("unexpected error inserting data: " + tojson(err));
        }
        break;
    }
}
```

#### Find and Modify (or Remove)

See the findandmodify Command documentation for more information.

#### Applying to Multiple Objects At Once

You can use multi-update to apply the same modifier to every relevant object. By default a multi-update will allow some other operations (which could be writes) to interleave. Thus, tthis will only be pseudo-atomic (pseudo-isolated). To make it fullly isolated you can use the $atomic motifier:

not isolated:

```
db.foo.update( { x : 1 } , { $inc : { y : 1 } } , false , true );
```

isolated:

```
db.foo.update( { x : 1 , $atomic : 1 } , { $inc : { y : 1 } } , false , true );
```

## findandmodify Command

### Find and Modify (or Remove)

> v1.3.0 and higher

MongoDB 1.3+ supports a "find, modify, and return" command. This command can be used to atomically **modify a document** (at most one) and return it. Note that, by default, the document returned will not include the modifications made on the update.

> If you don't need to return the document, you can use Update (which can affect multiple documents, as well).

The general form is

```
db.runCommand( { findandmodify : <collection>,
                 <options> } )
```

The MongoDB shell includes a helper method, findAndModify(), for executing the command. Some drivers provide helpers also.

At least one of the *update* or *remove* parameters is required; the other arguments are optional.

| Argument | Description | Default |
|---|---|---|
| *query* | a filter for the query | {} |
| *sort* | if multiple docs match, choose the first one in the specified sort order as the object to manipulate | {} |
| *remove* | set to a true to remove the object before returning | N/A |
| *update* | a modifier object | N/A |
| *new* | set to true if you want to return the modified object rather than the original. Ignored for remove. | false |
| *fields* | see Retrieving a Subset of Fields (1.5.0+) | All fields |
| *upsert* | create object if it doesn't exist. examples (1.5.4+) | false |

The *sort* option is useful when storing queue-like data. Let's take the example of fetching the highest priority job that hasn't been grabbed yet and atomically marking it as grabbed:

```
job = db.jobs.findAndModify({
    query: {inprogress:false},
    sort:{priority:-1},
    update: {$set: {inprogress: true, started: new Date()}}
});
```

You could also simply remove the object to be returned, but be careful. If the client crashes before processing the job, the document will be lost forever.

```
job = db.jobs.findAndModify({sort:{priority:-1}, remove:true}});
```

See the tests for more examples.

If your driver doesn't provide a helper function for this command, run the command directly with something like this:

```
job = db.runCommand({ findandmodify : "jobs",
                      sort : { priority : -1 },
                      remove : true
                    }).value;
```

### Sharding limitations

*findandmodify* will behave the same when called through a *mongos* as long as the collection it is modifying is unsharded. If the collection is sharded, then the query must contain the shard key. This is the same as regular sharded updates.

#### See Also

- Atomic Operations

## Updating Data in Mongo

- Updating a Document in the mongo Shell with `save()`
- Embedding Documents Directly in Documents
- Database References

#### Updating a Document in the mongo Shell with `save()`

As shown in the previous section, the `save()` method may be used to save a new document to a collection. We can also use `save()` to update an existing document in a collection.

Continuing with the *example* database from the last section, lets add new information to the document {`name:"mongo"`} that already is in the collection.

```
> var mongo = db.things.findOne({name:"mongo"});
> print(tojson(mongo));
{"_id" : "497dab624ee47b3a675d2d9c" , "name" : "mongo"}
> mongo.type = "database";
database
> db.things.save(mongo);
> db.things.findOne({name:"mongo"});
{"_id" : "497dab624ee47b3a675d2d9c" , "name" : "mongo" , "type" : "database"}
>
```

This was a simple example, adding a string valued element to the existing document. When we called `save()`, the method saw that the document already had an "_id" field, so it simply performed an update on the document.

In the next two sections, we'll show how to embed documents within documents (there are actually two different ways), as well as show how to query for documents based on values of embedded documents.

#### Embedding Documents Directly in Documents

As another example of updating an existing document, lets embed a document within an existing document in the collection. We'll keep working with the original {`name:"mongo"`} document for simplicity.

```
> var mongo = db.things.findOne({name:"mongo"});
> print(tojson(mongo));
{"_id" : "497da93d4ee47b3a675d2d9b" , "name" : "mongo", "type" : "database"}
> mongo.data = { a:1, b:2};
{"a" : 1 , "b" : 2}
> db.things.save(mongo);
> db.things.findOne({name:"mongo"});
{"_id" : "497da93d4ee47b3a675d2d9b" , "name" : "mongo" , "type" : "database", "data" : {"a" : 1 , "b"
: 2}}
>
```

As you can see, we added new data to the mongo document, adding {`a:1, b:2`} under the key "data".

Note that the value of "data" is a document itself - it is embedded in the parent mongo document. With BSON, you may nest and embed documents to any level. You can also query on embedded document fields, as shown here:

```
> db.things.findOne({ "data.a" : 1});
{"_id" : "497da93d4ee47b3a675d2d9b" , "name" : "mongo" , "data" : {"a" : 1 , "b" : 2}}
> db.things.findOne({ "data.a" : 2});
>
```

Note that the second `findOne()` doesn't return anything, because there are no documents that match.

#### Database References

Alternatively, a document can reference other documents which are not embedded via a *database reference*, which is analogous to a foreign key

in a relational database. A database reference (or "DBRef" for short), is a reference implemented according to the Database References. Most drivers support helpers for creating DBRefs. Some also support additional functionality, like dereference helpers and auto-referencing. See specific driver documentation for examples / more information

Lets repeat the above example, but create a document and place in a different collection, say *otherthings*, and embed that as a reference in our favorite "mongo" object under the key "otherdata":

```
// first, save a new doc in the 'otherthings' collection

> var other = { s : "other thing", n : 1};
> db.otherthings.save(other);
> db.otherthings.find();
{"_id" : "497dbcb36b27d59a708e89a4" , "s" : "other thing" , "n" : 1}

// now get our mongo object, and add the 'other' doc as 'otherthings'

> var mongo = db.things.findOne();
> print(tojson(mongo));
{"_id" : "497dab624ee47b3a675d2d9c" , "name" : "mongo" , "type" : "database" , "data" : {"a" : 1 , "b"
: 2}}
> mongo.otherthings = new DBRef( 'otherthings' , other._id );
{"s" : "other thing" , "n" : 1 , "_id" : "497dbcb36b27d59a708e89a4"}
> db.things.save(mongo);
> db.things.findOne().otherthings.fetch();
{"_id" : "497dab624ee47b3a675d2d9c" , "name" : "mongo" , "type" : "database" , "data" : {"a" : 1 , "b"
: 2} , "otherthings" : {"_id" : "497dbcb36b27d59a708e89a4" , "s" : "other thing" , "n" : 1}}

// now, lets modify our 'other' document, save it again, and see that when the dbshell
// gets our mongo object and prints it, if follows the dbref and we have the new value

> other.n = 2;
2
> db.otherthings.save(other);
> db.otherthings.find();
{"_id" : "497dbcb36b27d59a708e89a4" , "s" : "other thing" , "n" : 2}
> db.things.findOne().otherthings.fetch();
{"_id" : "497dab624ee47b3a675d2d9c" , "name" : "mongo" , "type" : "database" , "data" : {"a" : 1 , "b"
: 2} , "otherthings" : {"_id" : "497dbcb36b27d59a708e89a4" , "s" : "other thing" , "n" : 2}}
>
```

## MapReduce

Map/reduce in MongoDB is useful for batch manipulation of data and aggregation operations. It is similar in spirit to using something like Hadoop with all input coming from a collection and output going to a collection. Often, in a situation where you would have used GROUP BY in SQL, map/reduce is the right tool in MongoDB.

> Indexing and standard queries in MongoDB are separate from map/reduce. If you have used CouchDB in the past, note this is a big difference: MongoDB is more like MySQL for basic querying and indexing. See the queries and indexing documentation for those operations.


- Overview
  - Map Function
  - Reduce Function
  - Finalize Function
- Sharded Environments
- Examples
  - Shell Example 1
  - Shell Example 2
  - More Examples
  - Note on Permanent Collections
- Parallelism
- Presentations
- See Also


### Overview

Version 1.1.1 and above

`map/reduce` is invoked via a database command. The database creates a temporary collection to hold output of the operation. The collection is cleaned up when the client connection closes, or when explicitly dropped. Alternatively, one can specify a permanent output collection name. `map` and `reduce` functions are written in JavaScript and execute on the server.

Command syntax:

```
db.runCommand(
 { mapreduce : <collection>,
   map : <mapfunction>,
   reduce : <reducefunction>
   [, query : <query filter object>]
   [, sort : <sort the query.  useful for optimization>]
   [, limit : <number of objects to return from collection>]
   [, out : <output-collection name>]
   [, keeptemp: <true|false>]
   [, finalize : <finalizefunction>]
   [, scope : <object where fields go into javascript global scope >]
   [, verbose : true]
 }
);
```

- `keeptemp` - if true, the generated collection is not treated as temporary. Defaults to false. When `out` is specified, the collection is automatically made permanent.
- `finalize` - function to apply to all the results when finished
- `verbose` - provide statistics on job execution time
- `scope` - can pass in variables that can be access from map/reduce/finalize example mr5

Result:

```
{ result : <collection_name>,
  counts : {
       input :  <number of objects scanned>,
       emit  : <number of times emit was called>,
       output : <number of items in output collection>
  } ,
  timeMillis : <job_time>,
  ok : <1_if_ok>,
  [, err : <errmsg_if_error>]
}
```

A command helper is available in the MongoDB shell :

```
db.collection.mapReduce(mapfunction,reducefunction[,options]);
```

`map`, `reduce`, and `finalize` functions are written in JavaScript.

### *Map Function*

The `map` function references the variable `this` to inspect the current object under consideration. A map function must call `emit(key,value)` at least once, but may be invoked any number of times, as may be appropriate.

```
function map(void) -> void
```

### *Reduce Function*

The `reduce` function receives a key and an array of values. To use, reduce the received values, and return a result.

```
function reduce(key, value_array) -> value
```

The MapReduce engine may invoke reduce functions iteratively; thus, these functions must be idempotent. That is, the following must hold for your reduce function:

```
for all k,vals : reduce( k, [reduce(k,vals)] ) == reduce(k,vals)
```

If you need to perform an operation only once, use a finalize function.

> ⚠ The output of emit (the 2nd param) and reduce should be the same format to make iterative reduce possible. If not, there will be weird bugs that are hard to debug.

> ⚠ Currently, the return value from a reduce function cannot be an array (it's typically an object or a number).

### *Finalize Function*

A `finalize` function may be run after reduction. Such a function is optional and is not necessary for many map/reduce cases. The finalize function takes a key and a value, and returns a finalized value.

```
function finalize(key, value) -> final_value
```

## Sharded Environments

In sharded environments, data processing of map/reduce operations runs in parallel on all shards.

## Examples

### *Shell Example 1*

The following example assumes we have an `events` collection with objects of the form:

```
{ time : <time>, user_id : <userid>, type : <type>, ... }
```

We then use MapReduce to extract all users who have had at least one event of type "sale":

```
> m = function() { emit(this.user_id, 1); }
> r = function(k,vals) { return 1; }
> res = db.events.mapReduce(m, r, { query : {type:'sale'} });
> db[res.result].find().limit(2)
{ "_id" : 8321073716060 , "value" : 1 }
{ "_id" : 7921232311289 , "value" : 1 }
```

If we also wanted to output the number of times the user had experienced the event in question, we could modify the reduce function like so:

```
> r = function(k,vals) {
...     var sum=0;
...     for(var i in vals) sum += vals[i];
...     return sum;
... }
```

Note, here, that we cannot simply return `vals.length`, as the reduce may be called multiple times.

### *Shell Example 2*

```
$ ./mongo
> db.things.insert( { _id : 1, tags : ['dog', 'cat'] } );
> db.things.insert( { _id : 2, tags : ['cat'] } );
> db.things.insert( { _id : 3, tags : ['mouse', 'cat', 'dog'] } );
> db.things.insert( { _id : 4, tags : []  } );

> // map function
> m = function(){
...    this.tags.forEach(
...        function(z){
...            emit( z , { count : 1 } );
...        }
...    );
...};

> // reduce function
> r = function( key , values ){
...    var total = 0;
...    for ( var i=0; i<values.length; i++ )
...        total += values[i].count;
...    return { count : total };
...};

> res = db.things.mapReduce(m,r);
> res
{"timeMillis.emit" : 9 , "result" : "mr.things.1254430454.3" ,
 "numObjects" : 4 , "timeMillis" : 9 , "errmsg" : "" , "ok" : 0}

> db[res.result].find()
{"_id" : "cat" , "value" : {"count" : 3}}
{"_id" : "dog" , "value" : {"count" : 2}}
{"_id" : "mouse" , "value" : {"count" : 1}}

> db[res.result].drop()
```

#### *More Examples*

- example mr1
- Finalize example: example mr2

#### *Note on Permanent Collections*

Even when a permanent collection name is specified, a temporary collection name will be used during processing. At map/reduce completion, the temporary collection will be renamed to the permanent name atomically. Thus, one can perform a map/reduce job periodically with the same target collection name without worrying about a temporary state of incomplete data. This is very useful when generating statistical output collections on a regular basis.

### Parallelism

As of right now, MapReduce jobs on a single mongod process are single threaded. This is due to a design limitation in current JavaScript engines. We are looking into alternatives to solve this issue, but for now if you want to parallelize your MapReduce jobs, you will need to either use sharding or do the aggregation client-side in your code.

### Presentations

Map/reduce, geospatial indexing, and other cool features - Kristina Chodorow at MongoSF (April 2010)

### See Also

- Aggregation
- Kyle's Map/Reduce basics

## Data Processing Manual

DRAFT - TO BE COMPLETED.

This guide provides instructions for using MongoDB batch data processing oriented features including map/reduce.

By "data processing", we generally mean operations performed on large sets of data, rather than small interactive operations.

### Import

One can always write a program to load data of course, but the mongoimport utility also works for some situations. mongoimport supports importing from json, csv, and tsv formats.

A common usage pattern would be to use mongoimport to load data in a relatively raw format and then use a server-side script (db.eval() or map/reduce ) to reduce the data to a more clean format.

### See Also

- Import/Export Tools
- Server-Side Code Execution
- Map/Reduce

# mongo - The Interactive Shell


- Introduction
- More Information
- Some Notes on Datatypes in the Shell
  - Numbers
  - Dates
  - BinData
- Presentations


## Introduction

The MongoDB distribution includes `bin/mongo`, the MongoDB interactive shell. This utility is a JavaScript shell that allows you to issue commands to MongoDB from the command line. (Basically, it is an extended SpiderMonkey shell.)

The shell is useful for:

- inspecting a database's contents
- testing queries
- creating indices
- other administrative functions.

When you see sample code in this wiki and it looks like JavaScript, assume it is a shell example. See the driver syntax table for a chart that can be used to convert those examples to any language.

## More Information

- Shell Overview
- Shell Reference
- Shell APIDocs

## Some Notes on Datatypes in the Shell

### *Numbers*

The shell treats all numbers as floating-point values. If you have long/integer BSON data from the database you may see something like this:

```
"bytes" : {
   "floatApprox" : 575175
}
```

or something like this for larger numbers:

```
"bytes" : {
   "floatApprox" : 5284376243087482000,
   "top" : 1230364721,
   "bottom" : 4240317554
}
```

In addition, setting/incrementing any number will (most likely) change the data type to a floating point value

### *Dates*

The Date() function returns a string and a "**new** Date()" will return an object (which is what you should use to store values).

```
> Date()
Sun May 02 2010 19:07:40 GMT-0700 (Pacific Daylight Time)
> new Date()
"Sun May 02 2010 19:07:43 GMT-0700 (Pacific Daylight Time)"
> typeof(new Date())
object
> typeof(Date())
string
```

### *BinData*

The BSON BinData datatype is represented via class BinData in the shell. Run `help misc` for more information.

## Presentations

- CRUD and the JavaScript Shell - Presentation by Mike Dirolf at MongoSF (April 2010)

# Overview - The MongoDB Interactive Shell

### *Starting the Shell*

The interactive shell is included in the standard MongoDB distribution. To start the shell, go into the root directory of the distribution and type

```
./bin/mongo
```

It might be useful to add *`mongo_distribution_root`*`/bin` to your `PATH` so you can just type `mongo` from anywhere.

If you start with no parameters, it connects to a database named "test" running on your local machine on the default port (27017). You can see the db to which you are connecting by typing `db`:

```
./mongo
type "help" for help
> db
test
```

You can pass `mongo` an optional argument specifying the address, port and even the database to initially connect to:

| | |
|---|---|
| `./mongo` *`foo`* | connects to the *`foo`* database on your local machine |
| `./mongo 192.168.13.7/`*`foo`* | connects to the *`foo`* database on 192.168.13.7 |
| `./mongo dbserver.mydomain.com/`*`foo`* | connects to the *`foo`* database on dbserver.mydomain.com |
| `./mongo 192.168.13.7:9999/`*`foo`* | connects to the *`foo`* database on 192.168.13.7 on port 9999 |

### *Connecting*

If you have not connected via the command line, you can use the following commands:

```
conn = new Mongo(host);
db = conn.getDB(dbname);
db.auth(username,password);
```

where `host` is a string that contains either the name or address of the machine you want to connect to (e.g. "192.168.13.7") or the machine and port (e.g. "192.168.13.7:9999"). Note that host in an optional argument, and can be omitted if you want to connect to the database instance running on your local machine. (e.g. `conn = new Mongo()`)

Alternatively you can use the `connect` helper method:

```
> db = connect("localhost:27020/mytestdb"); // example with a nonstandard port #
```

### *Basics Commands*

The following are three basic commands that provide information about the available databases, and collections in a given database.

| | |
|---|---|
| `show dbs` | displays all the databases on the server you are connected to |
| `use` *`db_name`* | switches to *`db_name`* on the same server |
| `show collections` | displays a list of all the collections in the current database |

### *Querying*

`mongo` uses a JavaScript API to interact with the database. Because `mongo` is also a complete JavaScript shell, `db` is the variable that is the current database connection.

To query a collection, you simply specify the collection name as a property of the `db` object, and then call the `find()` method. For example:

```
db.foo.find();
```

This will display the first 10 objects from the *`foo`* collection. Typing ***`it`*** after a find() will display the next 10 subsequent objects.

By setting the shellBatchSize you can change this:

```
DBQuery.shellBatchSize = #
```

If the shell does not accept the collection name (for example if it starts with a number, contains a space etc), use

```
db['foo'].find()
```

instead.

### *Inserting Data*

In order to insert data into the database, you can simply create a JavaScript object, and call the `save()` method. For example, to save an object `{ name: "sara"}` in a collection called *foo*, type:

```
db.foo.save({ name : "sara"});
```

Note that MongoDB will implicitly create any collection that doesn't already exist.

### *Modifying Data*

Let's say you want to change someone's address. You can do this using the following `mongo` commands:

```
person = db.people.findOne( { name : "sara" } );
person.city = "New York";
db.people.save( person );
```

### *Deleting Data*

| | |
|---|---|
| `db.`*`foo`*`.drop()` | drop the entire *`foo`* collection |
| `db.`*`foo`*`.remove()` | remove all objects from the collection |
| db.*foo*.remove( { name : "sara" } ) | remove objects from the collection where `name` is `sara` |

### *Indexes*

| | |
|---|---|
| `db.`*`foo`*`.getIndexKeys()` | get all fields that have indexes on them |
| `db.`*`foo`*`.ensureIndex({ _field_ : 1 })` | create an index on *`field`* if it doesn't exist |

### Line Continuation

If a line contains open '(' or '{' characters, the shell will request more input before evaluating:

```
> function f() {
... x = 1;
... }
>
```

You can press Ctrl-C to escape from "..." mode and terminate line entry.

### See Also

- MongoDB Shell Reference

## dbshell Reference


- Command Line
- Special Command Helpers
- Basic Shell Javascript Operations
- Queries
- Error Checking
- Administrative Command Helpers
- Opening Additional Connections
- Miscellaneous
- Examples


### *Command Line*

| | |
|---|---|
| `--help` | Show command line options |
| `--nodb` | Start without a db, you can connect later with `new Mongo()` or `connect()` |
| `--shell` | After running a .js file from the command line, stay in the shell rather than terminating |

### *Special Command Helpers*

Non-javascript convenience macros:

| | |
|---|---|
| `help` | Show help |
| `db.help()` | Show help on db methods |

| | |
|---|---|
| `db.myColl.help()` | Show help on collection methods |
| `show dbs` | Print a list of all databases on this server |
| `use dbname` | Set the db variable to represent usage of *dbname* on the server |
| `show collections` | Print a list of all collections for current database |
| `show users` | Print a list of users for current database |
| `show profile` | Print most recent profiling operations that took >= 1ms |

### *Basic Shell Javascript Operations*

| | |
|---|---|
| `db` | The variable that references the current database object / connection. Already defined for you in your instance. |
| `db.auth(user,pass)` | Authenticate with the database (if running in secure mode). |
| `coll = db.collection` | Access a specific *collection* within the database. |
| `cursor = coll.find();` | Find all objects in the collection. See queries. |
| `coll.remove(objpattern );` | Remove matching objects from the collection.<br>*objpattern* is an object specifying fields to match. E.g.: `coll.remove( { name: "Joe" } );` |
| `coll.save(object)` | Save an object in the collection, or update if already there.<br>If your object has a presave method, that method will be called before the object is saved to the db (before both updates and inserts) |
| `coll.insert(object)` | Insert object in collection. No check is made (i.e., no upsert) that the object is not already present in the collection. |
| `coll.update(...)` | Update an object in a collection. See the Updating documentation; update() has many options. |
| `coll.ensureIndex( { name : 1 } )` | Creates an index on `tab.name`. Does nothing if index already exists. |
| `coll.update(...)` | |
| `coll.drop()` | Drops the collection `coll` |
| `db.getSisterDB(name)` | Return a reference to another database using this same connection. Usage example:<br>`db.getSisterDB('production').getCollectionNames()` |

### *Queries*

| | |
|---|---|
| `coll.find()` | Find all. |
| `it` | Continue iterating the last cursor returned from find(). |
| `coll.find( criteria );` | Find objects matching *criteria* in the collection. E.g.: `coll.find( { name: "Joe" } );` |
| `coll.findOne( criteria );` | Find and return a single object. Returns null if not found. If you want only one object returned, this is more efficient than just `find()` as `limit(1)` is implied. You may use regular expressions if the element type is a string, number, or date: `coll.find( { name: /joe/i } );` |
| `coll.find( criteria, fields );` | Get just specific fields from the object. E.g.: `coll.find( {}, {name:true} );` |
| `coll.find().sort( {field:1[, field :1] });` | Return results in the specified order (field ASC). Use -1 for DESC. |
| `coll.find( criteria ).sort( { field : 1 } )` | Return the objects matching *criteria*, sorted by *field*. |
| `coll.find( ... ).limit(n)` | Limit result to *n* rows. Highly recommended if you need only a certain number of rows for best performance. |

| | |
|---|---|
| `coll.find( ... ).skip(n )` | Skip *n* results. |
| `coll.count()` | Returns total number of objects in the collection. |
| `coll.find( ... ).count()` | Returns the total number of objects that match the query. Note that the number ignores limit and skip; for example if 100 records match but the limit is 10, `count()` will return 100. This will be faster than iterating yourself, but still take time. |

More information: see queries.

### *Error Checking*

| | |
|---|---|
| `db.getLastError()` | Returns error from the last operation. |
| `db.getPrevError()` | Returns error from previous operations. |
| `db.resetError()` | Clear error memory. |

### *Administrative Command Helpers*

| | |
|---|---|
| `db.cloneDatabase(fromhost)` | Clone the current database from the other host specified. fromhost database must be in noauth mode. |
| `db.copyDatabase(fromdb, todb, fromhost)` | Copy fromhost/fromdb to todb on this server. fromhost must be in noauth mode. |
| `db.repairDatabase()` | Repair and compact the current database. This operation can be very slow on large databases. |
| `db.addUser(user,pwd)` | Add user to current database. |
| `db.getCollectionNames()` | get list of all collections. |
| `db.dropDatabase()` | Drops the current database. |

### *Opening Additional Connections*

| | |
|---|---|
| `db = connect("<host>:<port>/<dbname>")` | Open a new database connection. One may have multiple connections within a single shell, however, automatic getLastError reporting by the shell is done for the 'db' variable only. See here for an example of connect(). |
| `conn = new Mongo("hostname")` | Open a connection to a new server. Use `getDB()` to select a database thereafter. |
| `db = conn.getDB("dbname")` | Select a specific database for a connection |

### *Miscellaneous*

| | |
|---|---|
| `Object.bsonsize(db.foo.findOne())` | prints the bson size of a db object (mongo version 1.3 and greater) |
| `db.foo.findOne().bsonsize()` | prints the bson size of a db object (mongo versions predating 1.3) |

For a full list of functions, see the shell API.

### *Examples*

The MongoDB source code includes a jstests/ directory with many mongo shell scripts.

# Developer FAQ

- What's a "namespace"?
- How do I copy all objects from one database collection to another?
- If you remove an object attribute is it deleted from the store?
- Are null values allowed?
- Does an update fsync to disk immediately?
- How do I do transactions/locking?
- How do I do equivalent of SELECT count * and GROUP BY?

- What are so many "Connection Accepted" messages logged?
- What RAID should I use?
- Can I run on Amazon EBS? Any issues?
- Why are my data files so large?

- Do I Have to Worry About SQL Injection
- How does concurrency work
- SQL to Mongo Mapping Chart
- What is the Compare Order for BSON Types

Also check out Markus Gattol's excellent FAQ on his website.

**What's a "namespace"?**

MongoDB stores BSON objects in *collections*. The concatenation of the database name and the collection name (with a period in between) is called a *namespace*.

For example, `acme.users` is a namespace, where `acme` is the database name, and `users` is the collection name. Note that periods can occur in collection names, so a name such as `acme.blog.posts` is legal too (in that case `blog.posts` is the collection name.

**How do I copy all objects from one database collection to another?**

See below. The code below may be ran server-side for high performance with the eval() method.

```
db.myoriginal.find().forEach( function(x){db.mycopy.save(x)} );
```

**If you remove an object attribute is it deleted from the store?**

Yes, you remove the attribute and then re-`save()` the object.

**Are null values allowed?**

For members of an object, yes. You cannot add null to a database collection though as null isn't an object. You can add {}, though.

**Does an update fsync to disk immediately?**

No, writes to disk are lazy by default. A write may hit disk a couple of seconds later. For example, if the database receives a thousand increments to an object within one second, it will only be flushed to disk once. (Note fsync options are available though both at the command line and via getLastError.)

**How do I do transactions/locking?**

MongoDB does not use traditional locking or complex transactions with rollback, as it is designed to be lightweight and fast and predictable in its performance. It can be thought of as analogous to the MySQL MyISAM autocommit model. By keeping transaction support extremely simple, performance is enhanced, especially in a system that may run across many servers.

The system provides alternative models for atomically making updates that are sufficient for many common use cases. See the wiki page Atomics Operations for detailed information.

**How do I do equivalent of SELECT count * and GROUP BY?**

See aggregation.

**What are so many "Connection Accepted" messages logged?**

If you see a tremendous number of connection accepted messages in the mongod log, that means clients are repeatedly connecting and disconnected. This works, but is inefficient.

With CGI this is normal. If you find the speed acceptable for your purposes, run mongod with --quiet to suppress these messages in the log. If you need better performance, switch to a solution where connections are pooled -- such as an Apache module.

**What RAID should I use?**

We recommend not using RAID-5, but rather, RAID-10 or the like. Both will work of course.

**Can I run on Amazon EBS? Any issues?**

Works fine in our experience; more information here.

**Why are my data files so large?**

MongoDB does aggressive preallocation of reserved space to avoid file system fragmentation. This is configurable. More info here.

## Do I Have to Worry About SQL Injection

Generally, with MongoDB we are not building queries from strings, so traditional SQL Injection attacks are not a problem. More details and some nuances are covered below.

MongoDB queries are represented as BSON objects. Typically the programming language gives a convenient way to build these objects that is injection free. For example in C++ one would write:

```
BSONObj my_query = BSON( "name" << a_name );
auto_ptr<DBClientCursor> cursor = c.query("tutorial.persons", my_query);
```

my_query then will have a value such as { name : "Joe" }. If my_query contained special characters such as ", :, {, etc., nothing bad happens, they are just part of the string.

### *Javascript*

Some care is appropriate when using server-side Javascript. For example when using the $where statement in a query, do not concatenate user supplied data to build Javascript code; this would be analogous to a SQL injection vulnerability. Fortunately, most queries in MongoDB can be expressed without Javascript. Also, we can mix the two modes. It's a good idea to make all the user-supplied fields go straight to a BSON field, and have your Javascript code be static and passed in the $where field.

If you need to pass user-supplied values into a $where clause, a good approach is to escape them using the CodeWScope mechanism. By setting the user values as variables in the scope document you will avoid the need to have them eval'ed on the server-side.

If you need to use db.eval() with user supplied values, you can either use a CodeWScope or you can supply extra arguments to your function. Something like: db.eval(function(userVal){...}, user_value); This will ensure that user_value gets sent as data rather than code.

### *User-Generated Keys*

Sometimes it is useful to build a BSON object where the key is user-provided. In these situations, keys will need to have substitutions for the reserved $ and . characters. If you are unsure what characters to use, the Unicode full width equivalents aren't a bad choice: U+FF04 () and U+FFOE ()

For example:

```
BSONObj my_object = BSON( a_key << a_name );
```

The user may have supplied a $ value within a_key. my_object could be { $where : "things" }. Here we can look at a few cases:

- Inserting. Inserting into the the database will do no harm. We are not executing this object as a query, we are inserting the data in the database.
  Note: properly written MongoDB client drivers check for reserved characters in keys on inserts.
- Update. update(query, obj) allows $ operators in the obj field. $where is not supported in update. Some operators are possible that manipulate the single document only -- thus, the keys should be escaped as mentioned above if reserved characters are possible.
- Querying. Generally this is not a problem as for { x : user_obj }, dollar signs are not top level and have no effect. In theory one might let the user build a query completely themself and provide it to the database. In that case checking for $ characters in keynames is important. That however would be a highly unusual case.

One way to handle user-generated keys is to always put them in sub-objects. Then they are never at top level (where $operators live) anyway.

### *See Also*

- http://groups.google.com/group/mongodb-user/browse_thread/thread/b4ef57912cbf09d7

## How does concurrency work

- mongos
- mongod
  - v1.0-v1.2 Concurrency
  - Viewing Operations in Progress
  - Read/Write Lock
  - Operations
  - On Javascript

- Multicore

### mongos

For sharded environments, mongos can perform any number of operations concurrently. This results in downstream operations to mongod instances. Execution of operations at each mongod is independent; that is, one mongod does not block another.

### mongod

The original mongod architecture is concurrency friendly; however, some work with respect to granular locking and latching is not yet done. This means that some operations can block others. This is particular true in versions < 1.3. Version 1.3+ has improvements to concurrency, although future work will make things even better.

#### *v1.0-v1.2 Concurrency*

In these versions of mongod, most operations prevent concurrent execution of other operations. In many circumstances, this worked reasonably as most operations can be executed very quickly.

The following operations do have concurrent support in v1.2 and below:

1. db.currentOp() and db.killOp() commands
2. map/reduce
3. queries returning large amounts of data do interleave with other operations (but does block when scanning data that is not returned)

The rest of this document focuses on concurrency for v1.3+.

#### *Viewing Operations in Progress*

Use `db.currentOp()` to view operations in progress, and `db.killOp()` to terminate an operation.

You can also see operations in progress from the adminstrative Http Interface.

#### *Read/Write Lock*

mongod uses a read/write lock for many operations. Any number of concurrent read operations are allowed, but typically only one write operation (although some write operations *yield* and in the future more concurrency will be added). The write lock acquisition is greedy: a pending write lock acquisition will prevent further read lock acquisitions until fulfilled.

#### *Operations*

| Operation | Lock type | Notes |
|---|---|---|
| OP_QUERY (query ) | Acquires read lock | see also: SERVER-517 |
| OP_GETMORE (get more from cursor ) | Acquires read lock | |
| OP_INSERT (insert ) | Acquires write lock | Inserts are normally fast and short-lived operations |
| OP_DELETE (remove ) | Acquires write lock | Yields while running to allow other operations to interleave. |
| OP_UPDATE (update ) | Acquires write lock | Will yield for interleave (1.5.2+) |
| map/reduce | At times locked | Allows substantial concurrent operation. |
| create index | See notes | Batch build acquires write lock. But a background build option is available. |
| db.eval() | Acquires write lock | |
| getLastError command | Non-blocking | |
| ismaster command | Non-blocking | |
| serverStatus command | Non-blocking | |

#### *On Javascript*

Only one thread in the mongod process executes Javascript at a time (other database operations are often possible concurrent with this).

### *Multicore*

With read operations, it is easy for mongod 1.3+ to saturate all cores. However, because of the read/write lock above, write operations will not yet fully utilize all cores. This will be improved in the future.

## SQL to Mongo Mapping Chart

This page not done. Please help us finish it!

| MySQL Program | Mongo Program |
|---|---|
| `mysqld` | `mongod` |
| `mysql` | `mongo` |

MongoDB queries are expressed as JSON (BSON) objects. This quick reference chart shows examples as both SQL and in Mongo Query Language syntax.

The query expression in MongoDB (and other things, such as index key patterns) is represented as JSON. However, the actual verb (e.g. "find") is done in one's regular programming language. The exact forms of these verbs vary by language. The examples below are Javascript and can be executed from the mongo shell.

| SQL Statement | Mongo Query Language Statement |
|---|---|
| `CREATE TABLE USERS (a Number, b Number)` | implicit; can be done explicitly |
| `INSERT INTO USERS VALUES(1,1)` | `db.users.insert({a:1,b:1})` |
| `SELECT a,b FROM users` | `db.users.find({}, {a:1,b:1})` |
| `SELECT * FROM users` | `db.users.find()` |
| `SELECT * FROM users WHERE age=33` | `db.users.find({age:33})` |
| `SELECT a,b FROM users WHERE age=33` | `db.users.find({age:33}, {a:1,b:1})` |

| | |
|---|---|
| SELECT * FROM users WHERE age=33 ORDER BY name | db.users.find({age:33}).sort({name:1}) |
| SELECT * FROM users WHERE age>33 | db.users.find({'age':{$gt:33}})}) |
| SELECT * FROM users WHERE age<33 | db.users.find({'age':{$lt:33}})}) |
| SELECT * FROM users ORDER BY name DESC | db.users.find().sort({name:-1}) |
| CREATE INDEX myindexname ON users(name) | db.users.ensureIndex({name:1}) |
| SELECT * FROM users WHERE a=1 and b='q' | db.users.find({a:1,b:'q'}) |
| SELECT * FROM users LIMIT 10 SKIP 20 | db.users.find().limit(10).skip(20) |
| SELECT * FROM users LIMIT 1 | db.users.findOne() |
| EXPLAIN SELECT * FROM users WHERE z=3 | db.users.find({z:3}).explain() |
| SELECT DISTINCT last_name FROM users | db.users.distinct('last_name') |
| SELECT COUNT(*y)<br>FROM users | db.users.count() |
| SELECT COUNT(*y)<br>FROM users where AGE > 30 | db.users.find({age: {'$gt': 30}}).count() |

| | |
|---|---|
| `SELECT COUNT(AGE) from users` | `db.users.find({age: {'$exists': true }}).count()` |
| `UPDATE users SET a=1 WHERE b='q'` | `db.users.update({b:'q'}, {$set:{a:1}}, false, true)` |

## What is the Compare Order for BSON Types

MongoDB allows objects in the same collection which have values which may differ in type. When comparing values from different types, a convention is utilized as to which value is less than the other. This (somewhat arbitary but well defined) ordering is listed below.

Note that some types are treated as equivalent for comparison purposes -- specifically numeric types which undergo conversion before comparison.

See also the BSON specification.

- Null
- Numbers (ints, longs, doubles)
- Symbol, String
- Object
- Array
- BinData
- ObjectID
- Boolean
- Date, Timestamp
- Regular Expression

Example (using the mongo shell ):

```
> t = db.mycoll;
> t.insert({x:3});
> t.insert( {x : 2.9} );
> t.insert( {x : new Date()} );
> t.insert( {x : true } )
> t.find().sort({x:1})
{ "_id" : ObjectId("4b03155dce8de6586fb002c7"), "x" : 2.9 }
{ "_id" : ObjectId("4b03154cce8de6586fb002c6"), "x" : 3 }
{ "_id" : ObjectId("4b031566ce8de6586fb002c9"), "x" : true }
{ "_id" : ObjectId("4b031563ce8de6586fb002c8"), "x" : "Tue Nov 17 2009 16:28:03 GMT-0500 (EST)" }
```

### *MinKey and MaxKey*

In addition to the above types MongoDB internally uses a special type for MinKey and MaxKey which are less than, and greater than all other possible BSON element values, respectively.

#### *From the mongo Javascript Shell*

For example we can continue our example from above adding two objects which have x key values of MinKey and MaxKey respectively:

```
> t.insert( { x : MaxKey } )
> t.insert( { x : MinKey } )
> t.find().sort({x:1})
{ "_id" : ObjectId("4b04094b7c65b846e2090112"), "x" : { $minKey : 1 } }
{ "_id" : ObjectId("4b03155dce8de6586fb002c7"), "x" : 2.9 }
{ "_id" : ObjectId("4b03154cce8de6586fb002c6"), "x" : 3 }
{ "_id" : ObjectId("4b031566ce8de6586fb002c9"), "x" : true }
{ "_id" : ObjectId("4b031563ce8de6586fb002c8"), "x" : "Tue Nov 17 2009 16:28:03 GMT-0500 (EST)" }
{ "_id" : ObjectId("4b0409487c65b846e2090111"), "x" : { $maxKey : 1 } }
```

#### *From C++*

See also the Tailable Cursors page for an example of using MinKey from C++. See also minKey and maxKey definitions in jsobj.h.

# Admin Zone


- Production Notes
- Replication
- Sharding
- Hosting Center
- Monitoring and Diagnostics
- Backups
- Durability and Repair
- Security and Authentication
- Admin UIs
- Starting and Stopping Mongo
- GridFS Tools
- DBA Operations from the Shell
- Architecture and Components
- Windows
- Troubleshooting


## Community Admin-Related Articles

- boxedice.com - notes from a production deployment
- Survey of Admin UIs for MongoDB
- MongoDB Nagios Check
- MongoDB Cacti Graphs

## See Also

- Commands in Developer Zone

# Production Notes


- Architecture
  - Production Options
  - Backups
- Recommended Unix System Settings
- TCP Port Numbers
- File Systems
- Tips
- See Also


## Architecture

### *Production Options*

- Master Slave
  - 1 master, *N* slaves - failover is handled manually
- Version 1.6: Replica Sets
  - *N* servers, 1 is always primary, auto-failover, auto-recovery

### *Backups*

- Import Export Tools

## Recommended Unix System Settings

- Turn off *atime*
- Set file descriptor limit to 4k+ (see *etc/limits* and *ulimit*)
- **Do not** use large VM pages with Linux (more info)

### TCP Port Numbers

Default TCP port numbers for MongoDB processes:

- Standalone *mongod* – 27017
- *mongos* – 27017
- shard server (`mongod --shardsvr`) – 27018
- config server (`mongod --configsvr`) – 27019
- web stats page for *mongod* – add 1000 to port number (28017, by default)

### File Systems

- MongoDB uses large files for storing data, and preallocates these. Some filesystems are much better at this
  - ext4
  - xfs

### Tips

- Handling Halted Replication

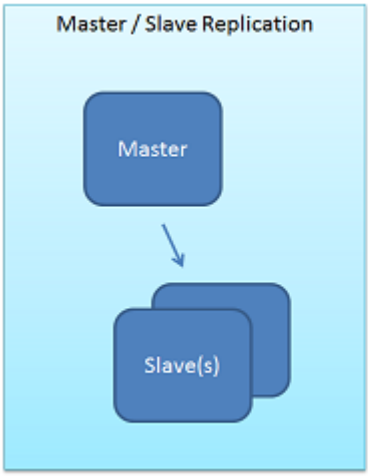
### See Also

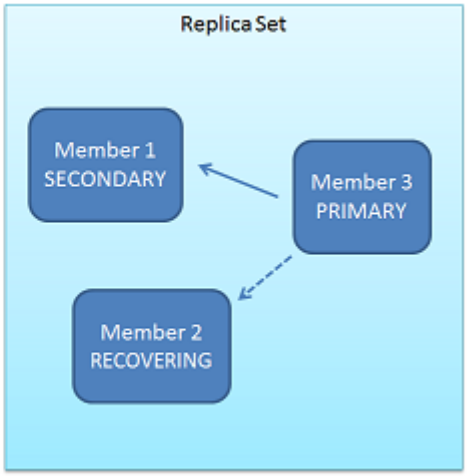
- Starting and Stopping the Database

## Replication

MongoDB supports asynchronous replication of data between servers for failover and redundancy. Only one server (in the set/shard) is active for writes (the primary, or master) at a given time. With a single active master at any point in time, strong consistency semantics are available. One can optionally send read operations to the slaves/secondaries when eventual consistency semantics are acceptable.

- Master-Slave Replication
- Replica Sets




#### Which should I use?

- if using <v1.6 : master/slave
- if need automatic fail-over and recovery (easy administration): replica sets
- if using `--auth` (security) or `--slavedelay` : for now, master/slave
- if using sharding : either, but replica sets are best for clusters that are not small
- if risk averse : master/slave (replica sets are new to v1.6.0)

#### Verifying propagation of writes with `getlasterror`

A client can block until a write operation has been replicated to N servers -- read more here .

#### Presentations

- Replication Video
- Replication Slides Only

## Verifying Propagation of Writes with getLastError

> v1.5+.

A client can block until a write operation has been replicated to N servers. Use the getlasterror command with a new parameter `w`:

```
db.runCommand( { getlasterror : 1 , w : 2 } )
```

If `w` is not set, or equals 1, the command returns immediately, implying the data is on 1 server (itself). If w is 2, then the data is on the current server and 1 other server (a secondary).

The higher `w` is, the longer acknowledgement may take. A recommended way of using this feature in a web context is to do all the write operations for a page, then call this once if needed. That way you're only paying the cost once.

There is an optional `wtimeout` parameter that allows you to timeout after a certain number of milliseconds and perhaps return an error or warning to a user. For example, the following will wait for 3 seconds before giving up:

```
> db.runCommand({getlasterror : 1, w : 40, wtimeout : 3000})
{
        "err" : null,
        "n" : 0,
        "wtimeout" : true,
        "waited" : 3006,
        "errmsg" : "timed out waiting for slaves",
        "ok" : 0
}
```

Note: the current implementation returns when the data has been delivered to w servers.  Future versions will provide more options for delivery vs. say, physical fsync at the server.

See also replica set configuration for information on how to change the getlasterror default parameters.

## Replica Sets

> v1.6.0 and higher.

Replica sets are an elaboration on the existing master/slave replication, adding automatic failover and automatic recovery of member nodes.

Replica Sets are "Replica Pairs version 2" and are available in MongoDB version 1.6.  Replica Pairs will be deprecated.

### *Features*

- Supports 1-7 servers in the cluster
- Automatic failover and recovery
- Data center aware (v1.6.1) (rack aware too, eventually)
- Supports passive set members (slaves) that are never primary

### *Docs*

To get started:

- Try it out
- Learn how to configure your set

If you would like to start using replica sets with an existing system:

- Learn how to migrate your existing setup
- Upgrade your client code to use replica set connections (see also your driver's documentation for details)

When running replica sets, it is important to know about:

- The admin UI
- Administrative commands

### *More Docs*

- Sample Replica Set Config Session.pdf
- Limits
- Design Concepts
- HowTo
  - Resyncing a Very Stale Replica Set Member
  - Adding a New Set Member
  - Adding an Arbiter
  - About the local database
  - Reconfiguring when members are up
  - Reconfiguring when members are down
  - Data Center Awareness

### *See Also*

- Replication Video
- Replica Sets Slides

## About the local database

`mongod` reserves the database `local` for special functionality. It is special in that its contents are never replicated.

#### Using the database for end-user data

You may place end user application data in local, if you would like it to not replicate to other servers. Put your collections under `local.usr.*`.

#### Replica Sets

Replica sets use the following collections in `local`:

- `local.system.replset` the replica set's configuration object is stored here. (View via the `rs.conf()` helper in the shell – or query it directly.)
- `local.oplog.rs` is a capped collection that is the oplog. You can use the `--oplogSize` command line parameter to set the size of this collection.
- `local.replset.minvalid` sometimes contains an object used internally by replica sets to track sync status

#### Master/Slave Replication

- Master
  - `local.oplog.$main` the "oplog"
  - `local.slaves`
- Slave
  - `local.sources`
- Other
  - `local.me`
  - `local.pair.*` (replica pairs, which are deprecated)

## Data Center Awareness

The 1.6.0 build of replica sets does not support much in terms of data center awareness. However additional functionality will be added in the future. Below are some suggestions configurations which work today.

#### *Primary plus DR site*

Use one site, with one or more set members, as primary. Have a member at a remote site with priority=0. For example:

```
{ _id: 'myset',
  members: [
   { _id:0, host:'sf1', priority:1 },
   { _id:1, host:'sf2', priority:1 },
   { _id:2, host:'ny1', priority:0 }
  ]
}
```

***Multi-site with local reads***

Another configuration would be to have one member in each of three data centers. One node arbitrarily becomes primary, the others though are secondaries and can process reads locally.

```
{ _id: 'myset',
  members: [
   { _id:0, host:'sf1', priority:1 },
   { _id:1, host:'ny1', priority:1 },
   { _id:2, host:'uk1', priority:1 }
  ]
}
```

## Reconfiguring a replica set when members are down

One may modify a set when some members are down as long as a majority is established. In that case, simply send the reconfig command to the current primary.

If there is no primary (and this condition is not transient), no majority is available. Reconfiguring a minority partition would be dangerous as two sides of a network partition won't both be aware of the reconfiguration. Thus, this is not allowed.

However, in some administrative circumstances we will want to take action even though there is no majority. Suggestions on how to deal with this are outlined below.

**Example 1**

*A replica set has three members, which in the past were healthy. Two of the servers are permanently destroyed. We wish to bring the remaining member online immediately.*

One option is to make the last standing mongod a standalone server and not a set member:

1. stop the surviving `mongod`
2. consider doing a backup...
3. delete the `local.*` datafiles in the data directory. this will prevent potential future confusion if it is ever restarted with --replSet in the future.
4. restart `mongod` without the `--replSet` parameter.

We are now back online with a single node that is not a replica set member. Clients can use it for both reads and writes.

**Example 2**

*A replica set has three members, which in the past were healthy. Two of the servers are permanently destroyed. We wish to bring the remaining member online and add a new member to its set.*

We cannot reconfigure the existing set with only 1 of 3 members available. However, we can "break the mirror" and start a new set:

1. stop the surviging `mongod`
2. consider doing a backup...
3. delete the `local.*` datafiles in the data directory.
4. restart the `mongod` with a new replica set name
5. initiate this new set
6. then, add the new second member

**Example 3**

*A replica set has five members, which in the past were healthy. Three of the servers are permanently destroyed. We wish to bring the remaining members online.*

As in example 2 we will use the "break the mirror" technique. Unfortunately one of the two members must be re-synced.

1. stop the surviging `mongod`'s
2. consider doing a backup...
3. delete the `local.*` datafiles on server 1
4. delete (ideally just move to a backup location) all the datafiles from server 2
5. restart both `mongod`'s with the new replica set name on the command line for each
6. initiate this new set on server 1
7. then, add the new second member (server 2)

**See Also**

- Reconfiguring when Members are Up

## Reconfiguring when Members are Up

Use the rs.reconfig() helper in the shell. You can also do this from other languages/drivers using the replSetReconfig command directly. (Run "rs.reconfig" in the shell with no parenthesis to see what it does.)

```
$ mongo
> // example : give 1st set member 2 votes
> cfg = rs.conf();
> cfg.members[0].votes = 2;
> rs.reconfig(cfg);
```

Requirements:

- You must connect to the current primary.
- A majority of members of the set must be up.

Note that you may experience a short downtime period while the set renegotiates master after a reconfiguration. This typically is 10-20 seconds. As always, it is best to do admin work during planned maintenance windows regardless just to be safe.

**See Also**

- Reconfiguring when members are down

## Replica Set Design Concepts

***1.***

A write is only truly committed once it has replicated to a majority of members of the set. For important writes, the client should request acknowledgement of this with a `getLastError({w:...})` call.

***2.***

Writes which are committed at the primary of the set may be visible before the true cluster-wide commit has occurred. Thus we have "READ UNCOMMITTED" read semantics. These more relaxed read semantics make theoretically achievable performance and availability higher (for example we never have an object locked in the server where the locking is dependent on network performance).

***3.***

On a failover, if there is data which has not replicated from the primary, the data is dropped (thus the use of getlasterror in #1 above).

> Data is backed up on rollback, although the assumption is that in most cases this data is never recovered as that would require operator intervention: http://jira.mongodb.org/browse/SERVER-1512.

***Rationale***

Merging back old operations later, after another node has accepted writes, is a hard problem. One then has multi-master replication, with potential for conflicting writes. Typically that is handled in other products by manual version reconciliation code by developers. We think that is too much work : we want MongoDB usage to be less developer work, not more. Multi-master also can make atomic operation semantics problematic.

It is possible (as mentioned above) to manually recover these events, via manual DBA effort, but we believe in large system with many, many nodes that such efforts become impractical.

#### *Comments*

Some drivers support 'safe' write modes for critical writes. For example via setWriteConcern in the Java driver.

Additionally, defaults for { w : ... } parameter to getLastError can be set in the replica set's configuration.

Note a call to getLastError will cause the client to have to wait for a response from the server. This can slow the client's throughput on writes if large numbers are made because of the client/server network turnaround times. Thus for "non-critical" writes it often makes sense to make no getLastError check at all, or only a single check after many writes.

## Replica Sets Troubleshooting

can't get local.system.replset config from self or any seed (EMPTYCONFIG)

Set needs to be initiated. Run `rs.initiate()` from the shell.

If the set is already initiated and this is a new node, verify it is present in the replica set's configuration and there are no typos in the host names:

```
> // send to a working node in the set:
> rs.conf()
```

## Replica Set Tutorial

This tutorial will guide you through the basic configuration of a replica set on a single machine. If you're attempting to deploy replica sets in production, be sure to read the comprehensive replica set documentation. Also, do keep in mind that **replica sets are production-ready as of MongoDB 1.6**.


- Introduction
- Starting the nodes
- Initializing the set
- Replication
- Failing Over
- Changing the replica set configuration
- Running with two nodes
- Drivers


### *Introduction*

A replica set is group of *N* `mongod` nodes that work together to provide automated failover.

Setting up a replica set is a two-step process that requires starting each node and then formally initiating the set. Here, we'll be configuring a set of three nodes, which is standard.

Once the `mongod` nodes are started, we'll issue a command to properly initialize the set. After a few seconds, one node will be elected master, and you can begin writing to and querying the set.

### *Starting the nodes*

First, create a separate data directory for each of the nodes in the set:

```
mkdir -p /data/r0
mkdir -p /data/r1
mkdir -p /data/r2
```

Next, start each `mongod` process with the `--replSet` parameter. The parameter requires that you specify the name of the replica set. Let's call our replica set "foo." We'll launch our first node like so:

```
mongod --replSet foo --port 27017 --dbpath /data/r0
```

The second node gets launched on port 27018:

Let's start the second node on port 27018:

```
mongod --replSet foo --port 27018 --dbpath /data/r1
```

And, finally, we'll start a third node on port 27019.

```
mongod --replSet foo --port 27019 --dbpath /data/r2
```

You should now have three nodes running. At this point, each node should be printing the following warning:

```
Mon Aug  2 11:30:19 [startReplSets] replSet can't get local.system.replset config from self or any
seed (EMPTYCONFIG)
```

We can't use the replica set until we've initialized it, which we'll do next.

### *Initializing the set*

We can initiate the replica set by connecting to one of the members and running the replSetInitiate command. This command takes a configuration object that specifies the name of the set and each of the members.

```
mongo localhost:27017
[kyle@arete ~$]$ mongo localhost:27017
MongoDB shell version: 1.5.7
connecting to: localhost:27017/test
> config = {_id: 'foo', members: [
                          {_id: 0, host: 'localhost:27017'},
                          {_id: 1, host: 'localhost:27018'},
                          {_id: 2, host: 'localhost:27019'}]
           }

> rs.initiate(config);
{
   "info" : "Config now saved locally.  Should come online in about a minute.",
   "ok" : 1
}
```

We specify the config object and then pass it to `rs.initiate()`. Then, if everything is in order, we get a response saying that the replica set will be online in a minute. During this time, one of the nodes will be elected master.

To check the status of the set, run `rs.status`:

```
> rs.status()
{
 "set" : "foo",
 "date" : "Mon Aug 02 2010 11:39:08 GMT-0400 (EDT)",
 "myState" : 1,
 "members" : [
  {
   "name" : "arete.local:27017",
   "self" : true,
  },
  {
   "name" : "localhost:27019",
   "health" : 1,
   "uptime" : 101,
   "lastHeartbeat" : "Mon Aug 02 2010 11:39:07 GMT-0400",
  },
  {
   "name" : "localhost:27018",
   "health" : 1,
   "uptime" : 107,
   "lastHeartbeat" : "Mon Aug 02 2010 11:39:07 GMT-0400",
  }
 ],
 "ok" : 1
}
```

You'll see that both of the other members of the set are up. You may also notice that the `myState` value is 1, indicating that we're connected to the master node; a value of 2 indicates a slave.

You can also check the set's status in the HTTP Admin UI.

### *Replication*

Go ahead and write something to the master node:

```
db.messages.save({name: "ReplSet Tutorial"});
```

If you pay attention to the logs on the slave nodes, you'll see the write being replicated. This initial replication is essential for failover; **the system won't fail over to a new master until an initial sync between nodes is complete**.

### *Failing Over*

Now, the purpose of a replica set is to provide automated failover. This means that, if the master node is killed, a slave node can take over. To see how this works in practice, go ahead and kill the master node with ^C:

```
^CMon Aug  2 11:50:16 got kill or ctrl c or hup signal 2 (Interrupt), will terminate after current cmd
ends
Mon Aug  2 11:50:16 [interruptThread] now exiting
Mon Aug  2 11:50:16  dbexit:
```

If you look at the logs on the slave nodes, you'll see a series of messages indicating failover. On our first slave, we see this:

```
Mon Aug  2 11:50:16 [ReplSetHealthPollTask] replSet info localhost:27017 is now down (or slow to
respond)
Mon Aug  2 11:50:17 [conn1] replSet info voting yea for 2
Mon Aug  2 11:50:17 [rs Manager] replSet not trying to elect self as responded yea to someone else
recently
Mon Aug  2 11:50:27 [rs_sync] replSet SECONDARY
```

And on the second, this:

```
Mon Aug  2 11:50:17 [ReplSetHealthPollTask] replSet info localhost:27017 is now down (or slow to
respond)
Mon Aug  2 11:50:17 [rs Manager] replSet info electSelf 2
Mon Aug  2 11:50:17 [rs Manager] replSet PRIMARY
Mon Aug  2 11:50:27 [initandlisten] connection accepted from 127.0.0.1:61263 #5
```

Both nodes notice that the master has gone down and, as a result, a new primary node is elected. In this case, the node at port 27019 is promoted. If we bring the failed node on 27017 back online, it will come up as a slave.

### *Changing the replica set configuration*

There are times when you'll want to change the replica set configuration. Suppose, for instance, that you want to adjust the number of votes available to each node. To do this, you need to pass a new configuration object to the database's `replSetReconfig` command. Here's how.

First, define the new configuation:

```
new_config = {_id: 'foo', members: [
                          {_id: 0, host: 'localhost:27017', votes: 1},
                          {_id: 1, host: 'localhost:27018', votes: 2},
                          {_id: 2, host: 'localhost:27019', votes: 3}]
           }
```

Then, add the version to the config object. To do this, you'll need to increment the old config version.

```
use local
old_config = db.system.replset.findOne();
new_config.version = old_config.version + 1;
```

Finally, reconfigure:

```
use admin
db.runCommand({replSetReconfig: new_config});
```

### *Running with two nodes*

Suppose you want to run replica sets with just two database servers. This is possible as long as you also use an arbiter on a separate node; most likely, running the arbiter on one or more application servers will be ideal. With an arbiter in place, the replica set will behave appropriately, recovering automatically during both network partitions and node failures (e.g., machine crashes).

You start up an arbiter just as you would a standard replica set node, with the `--replSet` option. However, when initiating, you need to include the `arbiterOnly` option in the config document.
With an arbiter, the configuration presented above would look like this instead:

```
config = {_id: 'foo', members: [
                          {_id: 0, host: 'localhost:27017'},
                          {_id: 1, host: 'localhost:27018'},
                          {_id: 2, host: 'localhost:27019', arbiterOnly: true}]
           }
```

The other requirement here is that the total number of votes for the database nodes needs to consist of a majority. This means that if you have two database nodes and ten arbiters, there's a total of twelve votes. So the best bet in this case it to give each database node enough votes so that even if all but a single arbiter goes down, the master still has enough votes to stay up. In that situation, each database node would need at least three votes.

For more information on arbiters and other interesting config options, see the replica set configuration docs.

### *Drivers*

All of the MongoDB drivers are designed to take any number of replica set seed hosts from a replica set and then cache the hosts of any other known members.

With this complete set of potential master nodes, the driver can automatically find the new master if the current master fails. See your driver's documentation for details. If you happen to be using the Ruby driver, check out Replica Sets in Ruby.

## Replica Set Configuration


- Command Line
- Initial Setup
- The Replica Set Config Object
- Shell Example 1
- Shell Example 2
- See Also


### *Command Line*

Each `mongod` participating in the set should have a `--replSet` parameter on its command line. The syntax is

```
mongod --replSet setname
```

*setname* is the logical name of the set.

> The --rest command line parameter is also recommended when using replica sets, as the web admin interface of mongod (normally at port 28017) shows status information on the set.

### *Initial Setup*

We use the initiate command for initial configuration of a replica set. Send the initiate command to a single server with the set to christen the set. The member being initiated may have initial data; the other servers in the set should be empty.

```
> db.runCommand( { replSetInitiate : <config_object> } )
```

A shorthand way to type the above is via a helper method in the shell:

```
> rs.initiate(<config_object>)
```

A quick way to initiate a set is to leave out the config object parameter.  The initial set will then consist of the member to which the shell is communicating, along with all the seeds that member knows of.  However, see the configuration object details below for more options.

```
> rs.initiate()
```

### *The Replica Set Config Object*

local.system.replset holds a singleton object which contains the replica set configuration. The config object automatically propagates among members of the set. The object is not directly manipulated, but rather changed via commands (such as replSetInitiate).

The config object has the form:

```
{
  _id : <setname>,

  members: [
    {
      _id : <ordinal>,
      host : <hostname[:port]>,
      [, priority: <priority>]
      [, arbiterOnly : true]
      [, votes : <n>]
      [, hidden : true]
      [, slaveDelay : <n>]
      [, buildIndexes : <bool>]
    }
    , ...
  ],

  settings: {
    [getLastErrorDefaults: <lasterrdefaults>]
    [, heartbeatSleep : <seconds>]
    [, heartbeatTimeout : <seconds>]
    [, heartbeatConnRetries : <n>]
  }
}
```

- `_id` - the set name. must match command line setting.
- `members` - an array of servers in the set.
  - `_id` - each member has an _id ordinal, typically beginning with zero and numbered in increasing order. when a node is retired (removed from the config), its _id should not be reused.
  - `host` - host name and optionally the port for the member
  - `priority` - priority a server has for potential election as primary. The highest priority member which is up will become primary. Default 1.0. Priority zero means server can never be primary.
  - `arbiterOnly` - participates in consensus, but receives no data.
  - `votes` - number of votes this set member gets in elections. Default 1.
  - `hidden` - when true, do not advertise the member's existence to clients in isMaster command responses. (v1.7+)
  - `slaveDelay` - how far behind this slave's replication should be (in seconds). Defaults to 0 (as up-to-date as possible). Can be used to recover from human errors (accidentally dropping a database, etc.). This option can only be set on passive members. (v1.6.3+)
  - `buildIndexes` - boolean, defaults to `true`. If the priority is 0, you can set `buildIndexes` to `false` to prevent indexes from being created on this member. This could be useful on a machine which is for backup-only as there is less overhead on writes if there are no secondary indexes. Note: the _id index is always created.
- `settings` for the replica set as a whole. Heartbeat params are optional as reasonable settings are predefined.
  - `getLastErrorDefaults` specifies defaults for the getlasterror command. If the client calls getLastError with no parameters, the default object specified here is used. (v1.6.2+)
  - `heartbeatSleep` how frequently nodes should send a heartbeat to each other (default: 2 seconds, must be greater than 10 milliseconds).
  - `heartbeatTimeout` indicates how long a node needs to fail to send data before we note a problem (default: 10 seconds, must be greater than 10 milliseconds).
  - `heartbeatConnRetries` is how many times after `heartbeatTimeout` to try connecting again and getting a new heartbeat (default: 3 tries).

### *Shell Example 1*

```
> // all at once method
> cfg = {
... _id : "acme_a",
... members : [
... { _id : 0, host : "sf1.acme.com" },
... { _id : 1, host : "sf2.acme.com" },
... { _id : 2, host : "sf3.acme.com" } ] }
> rs.initiate(cfg)
> rs.status()
```

### *Shell Example 2*

```
$ # incremental configuration method
$ mongo sf1.acme.com/admin
> rs.initiate();
> rs.add("sf2.acme.com");
> rs.add("sf3.acme.com");
> rs.status();
```

#### *See Also*

- Adding a New Set Member

### Adding a New Set Member

Adding a new node to an existing replica set is easy. The new node should either have an empty data directory or a recent copy of the data from another set member. When we start the new node, we only need to provide the replica set name:

```
$ ./mongod --replSet foo
```

After bringing up the new server (we'll call it `broadway:27017`) we need to add it to the set - we connect to our primary server using the shell:

```
$ ./mongo
MongoDB shell version: ...
connecting to: test
> rs.add("broadway:27017");
{ "ok" : 1 }
```

After adding the node it will perform a full resync and come online as a secondary. If the node is started with a recent copy of data from another node in the set it won't need a full resync.

See also:
Adding an Arbiter

### Adding an Arbiter

*Arbiters* are nodes in a replica set that only participate in elections: they don't have a copy of the data and will never become the primary node (or even a readable secondary). They are mainly useful for breaking ties during elections (e.g. if a set only has two members).

To add an arbiter, bring up a new node and point it at the replica set using the `--replSet` flag - this part is identical to when Adding a New Set Member. To start as an arbiter, we'll use `rs.addArb()` instead of `rs.add()`. While connected to the current primary:

```
> rs.addArb("broadway:27017");
{ "ok" : 1 }
```

#### *See Also*

- Adding a New Set Member

## Upgrading to Replica Sets

- Upgrading From a Single Server
- Upgrading From Replica Pairs or Master/Slave
- Upgrading Drivers

#### Upgrading From a Single Server

If you're running MongoDB on a single server, upgrading to replica sets is trivial (and a good idea!). First, we'll initiate a new replica set with a single node. We need a name for the replica set - in this case we're using `foo`. Start by shutting down the server and restarting with the `--replSet` option, and our set name:

```
$ ./mongod --replSet foo
```

Add the --rest option too (just be sure that port is secured): the <host>:28017/_replSet diagnostics page is incredibly useful.

The server will allocate new *local* data files before starting back up. Consider pre-allocating those files if you need to minimize downtime.

Next we'll connect to the server from the shell and initiate the replica set:

```
$ ./mongo
MongoDB shell version: ...
connecting to: test
> rs.initiate();
{
    "info2" : "no configuration explicitly specified -- making one",
    "info" : "Config now saved locally.  Should come online in about a minute.",
    "ok" : 1
}
```

The server should now be operational again, this time as the primary in a replica set consisting of just a single node. The next step is to add some additional nodes to the set.

**Upgrading From Replica Pairs or Master/Slave**

Version 1.6.1 will have more seamless support for upgrading, track this case for details: http://jira.mongodb.org/browse/SERVER-1553.

With 1.6.0 the best way to upgrade is to simply restart the current master as a single server replica set, and then add any slaves after wiping their data directory. To find the master in a replica pair, use the `ismaster` command.

Once you know the master, the process will look like this:

```
m$ # shutdown mongod master and slave
m$ killall mongod
s$ killall mongod

m$ # backup your /data/db directory on the master
m$ cp /data/db/* /to_somewhere_backup/

s$ # we start empty on the slave.  so let's save the old data (assuming drive large enough)
s$ mv /data/db /data/old_slave_data
s$ mkdir /data/db
s$ # /data/db is now empty

m$ mongod --rest --replSet mysetname
m$ mongo
m> rs.initiate()
m> // try these:
m> db.isMaster()
m> rs.help()
m> rs.status()
m> rs.conf()
m> // see also http://localhost:28017/_replSet

s$ # start replica set member on the old slave.
s$ # it has no data and will do a full sync initially
s$ mongod --rest --replSet mysetname
s$ mongo m/admin

m> // still in the mongo shell on the master
m> rs.add("s") // "s" is your slave host name
m> rs.status(); // see also http://localhost:28017/_replSet

arb$ # we should now add an arbiter so break ties on elections and
arb$ #  know who is up in a network partition.
arb$ # arbiter is very lightweight and can run on about any server
arb$ #  including 32 bit servers.
arb$ # we use different directories and ports here so that the server
arb$ #  is still available as a "normal" mongod server if that is
arb$ #  desired and also to avoid confusion.  the /data/arb directory
arb$ #  will be very light in content.
arb$ mkdir /data/arb
arb$ mongod --rest --replSet mysetname --dbpath /data/arb --port 30000 --oplogSize 8

m> rs.addArb("arb:30000"); // replace 'arb' with your arb host name
m> rs.status()
```

#### Upgrading Drivers

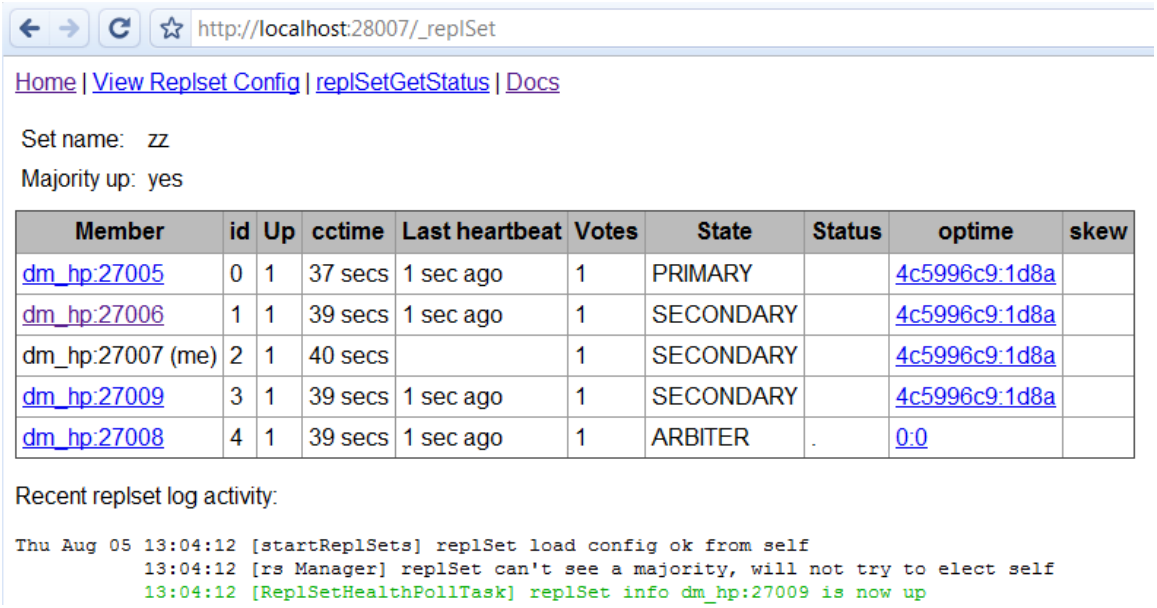
There are new versions of most MongoDB Drivers which support replica sets elegantly. See the documentation pages for the specific driver of interest.

## Replica Set Admin UI

The `mongod` process includes a simple administrative UI for checking the status of a replica set.

To use, first enable `--rest` from the `mongod` command line. The rest port is the db port plus 1000 (thus, the default is 28017). Be sure this port is secure before enabling this.

Then you can navigate to `http://<hostname>:28017/` in your web browser. Once there, click Replica Set Status (/_replSet) to move to the Replica Set Status page.




**See Also**

- Http Interface

## Replica Set Commands

- Shell Helpers
- Commands
  - { isMaster : 1 }
  - { replSetGetStatus : 1 }
  - { replSetInitiate : <config> }
  - { replSetStepDown : true }
  - { replSetFreeze : <bool> }
  - { replSetReconfig: <config> }

### *Shell Helpers*

```
rs.help()                       show help
rs.status()                     { replSetGetStatus : 1 }
rs.initiate()                   { replSetInitiate : null } initiate
                                    with default settings
rs.initiate(cfg)                { replSetInitiate : cfg }
rs.add(hostportstr)             add a new member to the set
rs.add(membercfgobj)            add a new member to the set
rs.addArb(hostportstr)          add a new member which is arbiterOnly:true
rs.stepDown()                   { replSetStepDown : true }
rs.conf()                       return configuration from local.system.replset
db.isMaster()                   check who is primary
```

### *Commands*

#### *{ isMaster : 1 }*

Checks if the node to which we are connecting is currently primary. Most drivers do this check automatically and then send requires to the current primary.

Returns an object that looks like:

```
{
    "ismaster" : false,
    "secondary" : true,
    "hosts" : [
        "sf1.example.com",
        "sf4.example.com",
        "ny3.example.com"
    ],
    "passives" : [
        "sf3.example.com",
        "sf2.example.com",
        "ny2.example.com",
    ],
    "arbiters" : [
        "ny1.example.com",
    ]
    "primary" : "sf4.example.com",
    "ok" : 1
}
```

The *hosts* array lists primary and secondary servers, the *passives* array lists passive servers, and the *arbiters* array lists arbiters.

If the "`ismaster`" field is `false`, there will be a "`primary`" field that indicates which server is primary.

***{ replSetGetStatus : 1 }***

Status information on the replica set from this node's point of view.

The output looks like:

```
{
    "set" : "florble",
    "date" : "Wed Jul 28 2010 15:01:01 GMT-0400 (EST)",
    "myState" : 1,
    "members" : [
        {
            "name" : "dev1.example.com",
            "self" : true,
            "errmsg" : ""
        },
        {
            "name" : "dev2.example.com",
            "health" : 1,
            "uptime" : 13777,
            "lastHeartbeat" : "Wed Jul 28 2010 15:01:01 GMT-0400 (EST)",
            "errmsg" : "initial sync done"
        }
    ],
    "ok" : 1
}
```

The *myState* field indicates the state of this server. Valid states are:

| | |
|---|---|
| 0 | Starting up, phase 1 |
| 1 | Primary |
| 2 | Secondary |
| 3 | Recovering |
| 4 | Fatal error |
| 5 | Starting up, phase 2 |

| | |
|---|---|
| 6 | Unknown state |
| 7 | Arbiter |
| 8 | Down |

The *health* field is 1 if the server is up and 0 if it is down.

The *errmsg* field can contain informational messages, as shown above.

***{ replSetInitiate : <config> }***

Initiate a replica set. Run this command at one node only, to initiate the set. Whatever data is on the initiating node becomes the initial data for the set. This is a one time operation done at cluster creation. See also Configuration.

***{ replSetStepDown : true }***

Step down as primary. Node will become eligible to be primary again after 1 minute. (Presumably, another node will take over by then if it were eligible.)

This command will be enhanced later to allow specification of a min duration of the step-down.

***{ replSetFreeze : <bool> }***

Freezing a replica set prevents failovers from occurring. This can be useful during maintenance.

Note: As of v1.6.0, replSetFreeze is not yet implemented.

***{ replSetReconfig: <config> }***

Adjust configuration of a replica set (just like initialize)

```
db._adminCommand({replSetReconfig: cfg })
```

Note: db._adminCommand is short-hand for db.getSisterDB("admin").runCommand();

## Replica Set FAQ

How long does failover take?

Failover thresholds are configurable. With the defaults, it may take 20-30 seconds for the primary to be declared down by the other members and a new primary elected. During this window of time, the cluster is down for "primary" operations – that is, writes and strong consistent reads. However, you may execute eventually consistent queries to secondaries at any time, including during this window.

Should I use replica sets or replica pairs?

After 1.6, use Replica Sets.

## Connecting to Replica Sets from Clients

Most drivers have been updated to provide ways to connect to a replica set. In general, this is very similar to how the drivers support connecting to a replica pair.

Instead of taking a pair of hostnames, the drivers will typically take a comma separated list of host[:port] names. This is a *seed host list*; it need not be every member of the set. The driver then looks for the primary from the seeds. The seed members will report back other members of the set that the client is not aware of yet. Thus we can add members to a replica set without changing client code.

#### With Sharding

With sharding, the client connects to a `mongos` process. The `mongos` process will then automatically find the right member(s) of the set.

#### See Also

- Driver authors should review Connecting Drivers to Replica Sets.

## Replica Sets Limits

#### v1.6

- Authentication mode not supported. JIRA
- Limits on config changes to sets at first. Especially when a lot of set members are down.
- Map/reduce writes new collections to the server. Because of this, for now it may only be used on the primary. This will be enhanced later.

## Resyncing a Very Stale Replica Set Member

#### Error RS102

MongoDB writes operations to an oplog. For replica sets this data is stored in collection local.oplog.rs. This is a capped collection and wraps when full "RRD"-style. Thus, it is important that the oplog collection is large enough to buffer a good amount of writes when some members of a replica set are down. If too many writes occur, the down nodes, when they resume, cannot catch up. In that case, a full resync would be required.

#### Sizing the oplog

The command line `--oplogSize` parameter sets the oplog size. A good rule of thumb is 5 to 10% of total disk space. On 64 bit builds, the default is large and similar to this percentage. You can check your existing oplog sizes from the `mongo` shell :

```
> use local
> db.oplog.rs.stats()
```

#### What to do on a sync error

If one of your members has been offline and is now too far behind to catch up, you will need to resync. There are a number of ways to do this.

1. Delete all data. If you stop the failed `mongod`, delete all data, and restart it, it will automatically resynchronize itself. Of course this may be slow if the database is huge or the network slow.

2. Copy data from another member. You can copy all the data files from another member of the set IF you have a snapshot of that member's data file's. This can be done in a number of ways. The simplest is to stop `mongod` on the source member, copy all its files, and then restart `mongod` on both nodes. The Mongo fsync and lock feature is another way to achieve this. On a slow network, snapshotting all the datafiles from another (inactive) member to a gziped tarball is a good solution. Also similar strategies work well when using SANs and services such as Amazon Elastic Block Service snapshots.

3. Find a member with older data. Each member of the replica set has an oplog. It is possible that a member has a larger oplog than the current primary.

## Replica Set Internals


- Design Concepts
- Configuration
  - Command Line
  - Node Types
  - local.system.replset
  - Set Initiation (Initial Setup)
- Design
  - Server States
  - Applying Operations
  - OpOrdinal
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  - Failover
  - Resync (Connecting to a New Primary)
  - Consensus
  - Increasing Durability
  - Reading from Secondaries and Staleness
- Example
- Administration
- Future Versions


#### Design Concepts

Check out the Replica Set Design Concepts for some of the core concepts underlying MongoDB Replica Sets.

#### Configuration

#### *Command Line*

We specify --replSet *set_name/seed_hostname_list* on the command line. *seed_hostname_list* is a (partial) list of some members of the set. The system then fetches full configuration information from the collection local.system.replset. *set_name* is specified to help the system catch misconfigurations.

#### *Node Types*

Conceptually, we have some different types of nodes:

- Standard - a standard node as described above. Can transition to and from being a *primary* or a *secondary* over time. There is only one primary (master) server at any point in time.
- Passive - a server can participate as if it were a member of the replica set, but be specified to never be Primary.
- Arbiter - member of the cluster for consensus purposes, but receives no data. Arbiters cannot be seed hosts.

Each node in the set has a *priority* setting. On a resync (see below), the rule is: choose as master the node with highest priority that is healthy. If multiple nodes have the same priority, pick the node with the freshest data. For example, we might use 1.0 priority for Normal members, 0.0 for passive (0 indicates cannot be primary no matter what), and 0.5 for a server in a less desirable data center.

#### *local.system.replset*

This collection has one document storing the replica set's configuration. See the configuration page for details.

#### *Set Initiation (Initial Setup)*

For a new cluster, on negotiation the max OpOrdinal is zero everywhere. We then know we have a new replica set with no data yet. A special command

```
{replSetInitiate:1}
```

is sent to a (single) server to begin things.

### Design

#### *Server States*

- *Primary* - Can be thought of as "master" although which server is primary can vary over time. Only 1 server is primary at a given point in time.
- *Secondary* - Can be thought of as a slave in the cluster; varies over time.
- *Recovering* - getting back in sync before entering Secondary mode.

#### *Applying Operations*

Secondaries apply operations from the Primary. Each applied operation is also written to the secondary's local oplog. We need only apply from the current primary (and be prepared to switch if that changes).

#### *OpOrdinal*

We use a monotonically increasing ordinal to represent each operation.

These values appear in the oplog (local.oplog.$main). maxLocalOpOrdinal() returns the largest value logged. This value represents how up-to-date we are. The first operation is logged with ordinal 1.

Note two servers in the set could in theory generate different operations with the same ordinal under some race conditions. Thus for full uniqueness we must look at the combination of server id and op ordinal.

#### *Picking Primary*

We use a consensus protocol to pick a primary. Exact details will be spared here but that basic process is:

1. get maxLocalOpOrdinal from each server.
2. if a majority of servers are not up (from this server's POV), remain in Secondary mode and stop.
3. if the last op time seems very old, stop and await human intervention.
4. else, using a consensus protocol, pick the server with the highest maxLocalOpOrdinal as the Primary.

Any server in the replica set, when it fails to reach master, attempts a new election process.

#### *Heartbeat Monitoring*

All nodes monitor all other nodes in the set via heartbeats.  If the current primary cannot see half of the nodes in the set (including itself), it will fall back to secondary mode. This monitoring is a way to check for network partitions. Otherwise in a network partition, a server might think it is still primary when it is not.

#### *Assumption of Primary*

When a server becomes primary, we assume it has the latest data. Any data newer than the new primary's will be discarded. Any discarded data is backed up to a flat file as raw BSON, to allow for the possibility of manual recovery (see this case for some details). In general, manual recovery will not be needed - if data must be guaranteed to be committed it should be written to a majority of the nodes in the set.

#### *Failover*

We renegotiate when the primary is unavailable, see Picking Primary.

#### *Resync (Connecting to a New Primary)*

When a secondary connects to a new primary, it must resynchronize its position. It is possible the secondary has operations that were never committed at the primary. In this case, we roll those operations back. Additionally we may have new operations from a previous primary that never replicated elsewhere. The method is basically:

- for each operation in our oplog that DNE at the primary, (1) remove from oplog and (2) resync the document in question by a query to the primary for that object. update the object, deleting if it does not exist at the primary.

We can work our way back in time until we find a few operations that are consistent with the new primary, and then stop.

Any data that is removed during the rollback is stored offline (see Assumption of Primary, so one can manually recover it. It can't be done automatically because there may be conflicts.

Reminder: you can use w= to ensure writes make it to a majority of slaves before returning to the user, to ensure no writes need to be rolled back.

#### *Consensus*

Fancier methods would converge faster but the current method is a good baseline. Typically only ~2 nodes will be jockeying for primary status at any given time so there isn't be much contention:

- query all others for their maxappliedoptime
- try to elect self if we have the highest time and can see a majority of nodes
    - if a tie on highest time, delay a short random amount first
    - elect (selfid,maxoptime) msg -> others
- if we get a msg and our time is higher, we send back NO
- we must get back a majority of YES
- if a YES is sent, we respond NO to all others for 1 minute. Electing ourself counts as a YES.
- repeat as necessary after a random sleep

#### *Increasing Durability*

We can trade off durability versus availability in a replica set. When a primary fails, a secondary will assume primary status with whatever data it has. Thus, we have some desire to see that things replicate quickly. Durability is guaranteed once a majority of servers in the replica set have an operation.

To improve durability clients can call getlasterror and wait for acknowledgement until replication of a an operation has occurred. The client can then selectively call for a blocking, somewhat more synchronous operation.

#### *Reading from Secondaries and Staleness*

Secondaries can report via a command how far behind the primary they are. Then, a read-only client can decide if the server's data is too stale or close enough for usage.

#### Example

```
server-a: secondary oplog: ()
server-b: secondary oplog: ()
server-c: secondary oplog: ()
…
server-a: primary oplog: (a1,a2,a3,a4,a5)
server-b: secondary oplog: ()
server-c: secondary oplog: ()
…
server-a: primary oplog: (a1,a2,a3,a4,a5)
server-b: secondary oplog: (a1)
server-c: secondary oplog: (a1,a2,a3)
…
```

```
// server-a goes down
…
server-b: secondary oplog: (a1)
server-c: secondary oplog: (a1,a2,a3)
...
server-b: secondary oplog: (a1)
server-c: primary oplog: (a1,a2,a3) // c has highest ord and becomes primary
...
server-b: secondary oplog: (a1,a2,a3)
server-c: primary oplog: (a1,a2,a3,c4)
...
server-a resumes
...
server-a: recovering oplog: (a1,a2,a3,a4,a5)
server-b: secondary oplog: (a1,a2,a3)
server-c: primary oplog: (a1,a2,a3,c4)
…
server-a: recovering oplog: (a1,a2,a3,c4)
server-b: secondary oplog: (a1,a2,a3,c4)
server-c: primary oplog: (a1,a2,a3,c4)
…
server-a: secondary oplog: (a1,a2,a3,c4)
server-b: secondary oplog: (a1,a2,a3,c4)
server-c: primary oplog: (a1,a2,a3,c4,c5,c6,c7,c8)
…
server-a: secondary oplog: (a1,a2,a3,c4,c5,c6,c7,c8)
server-b: secondary oplog: (a1,a2,a3,c4,c5,c6,c7,c8)
server-c: primary oplog: (a1,a2,a3,c4,c5,c6,c7,c8)
```

In the above example, server-c becomes primary after server-a fails. Operations (a4,a5) are lost. c4 and c5 are new operations with the same ordinals.

#### Administration

See the Replica Set Commands page for full info.

Commands:

- { replSetFreeze : <bool> } "freeze" or unfreeze a set. When frozen, new nodes cannot be elected master. Used when doing administration. Details TBD.
- { replSetGetStatus : 1 } get status of the set, from this node's POV
- { replSetInitiate : 1 }
- { ismaster : 1 } check if this node is master

#### Future Versions

- add support for replication trees / hierarchies
- replicating to a slave that is not a member of the set (perhaps we do not need this given we have the Passive set member type)

## Master Slave


- Configuration and Setup
- Command Line Options
  - Master
  - Slave
  - --slavedelay
- Diagnostics
- Security
- Administrative Tasks
  - Failing over to a Slave (Promotion)
  - Inverting Master and Slave
  - Creating a slave from an existing master's disk image
  - Creating a slave from an existing slave's disk image
  - Resyncing a slave that is too stale to recover
- See Also


### Configuration and Setup

To configure an instance of Mongo to be a master database in a master-slave configuration, you'll need to start two instances of the database, one in *master* mode, and the other in *slave* mode.

**Data Storage**
The following examples explicitly specify the location of the data files on the command line. This is unnecessary if you are running the master and slave on separate machines, but in the interest of the readers who are going try this setup on a single node, they are supplied in the interest of safety.

```
$ bin/mongod --master [--dbpath /data/masterdb/]
```

As a result, the master server process will create a `local.oplog.$main` collection. This is the "transaction log" which queues operations which will be applied at the slave.

To configure an instance of Mongo to be a slave database in a master-slave configuration:

```
$ bin/mongod --slave --source <masterhostname>[:<port>]  [--dbpath /data/slavedb/]
```

Details of the source server are then stored in the slave's `local.sources` collection.  Instead of specifying the `--source` parameter, one can add an object to `local.sources` which specifies information about the master server:

```
$ bin/mongo <slavehostname>/local
> db.sources.find(); // confirms the collection is empty.  then:
> db.sources.insert( { host: <masterhostname> } );
```

- *`host: masterhostname`* is the IP address or FQDN of the master database machine. Append *`:port`* to the server hostname if you wish to run on a nonstandard port number.
- *`only: databasename`* (optional) if specified, indicates that only the specified database should replicate. NOTE: A bug with `only` is fixed in v1.2.4+.

A slave can pull from multiple upstream masters. In such a situation add multiple configuration objects to the `local.sources` collection. See the One Slave Two Masters doc page.

A slave may become out of sync with a master if it falls far behind the data updates available from that master, or if the slave is terminated and then restarted some time later when relevant updates are no longer available from the master. If a slave becomes out of sync, replication will terminate and operator intervention is required by default if replication is to be restarted. An operator may restart replication using the {`resync:1`} command. Alternatively, the command line option `--autoresync` causes a slave to restart replication automatically (after ten second pause) if it becomes out of sync. If the `--autoresync` option is specified, the slave will not attempt an automatic resync more than once in a ten minute periond.

The `--oplogSize` command line option may be specified (along with `--master`) to configure the amount of disk space in megabytes which will be allocated for storing updates to be made available to slave nodes. If the `--oplogSize` option is not specified, the amount of disk space for storing updates will be 5% of available disk space (with a minimum of 1GB) for 64bit machines, or 50MB for 32bit machines.

## Command Line Options

### Master

```
--master              master mode
  --oplogSize arg       size limit (in MB) for op log
```

### Slave

```
--slave               slave mode
  --source arg          arg specifies master as <server:port>
  --only arg            arg specifies a single database to replicate
  --slavedelay arg      arg specifies delay (in seconds) to be used
                        when applying master ops to slave
  --autoresync          automatically resync if slave data is stale
```

### --slavedelay

Sometimes its beneficial to have a slave that is purposefully many hours behind to prevent human error. In MongoDB 1.3.3+, you can specify this with the --slavedelay mongod command line option. Specify the delay in seconds to be used when applying master operations to the slave.

Specify this option at the slave. Example command line:

```
mongod --slave --source mymaster.foo.com --slavedelay 7200
```

## Diagnostics

Check master status from the `mongo` shell with:

```
// inspects contents of local.oplog.$main on master and reports status:
db.printReplicationInfo()
```

Check slave status from the `mongo` shell with:

```
// inspects contents of local.sources on the slave and reports status:
db.printSlaveReplicationInfo()
```

(Note you can evaluate the above functions without the parenthesis above to see their javascript source and a bit on the internals.)

As of 1.3.2, you can do this on the slave

```
db._adminCommand( { serverStatus : 1 , repl : N } )
```

`N` is the level of diagnostic information and can have the following values:

- 0 - none
- 1 - local (doesn't have to connect to other server)
- 2 - remote (has to check with the master)

## Security

When security is enabled, one must configure a user account for the local database that exists on both servers.

The slave-side of a replication connection first looks for a user repl in local.system.users. If present, that user is used to authenticate against the local database on the source side of the connection. If repl user does not exist, the first user object in local.system.users is tried.

The local database works like the admin database: an account for local has access to the entire server.

Example security configuration when security is enabled:

```
$ mongo <slavehostname>/admin -u <existingadminusername> -p<adminpassword>
> use local
> db.addUser('repl', <replpassword>);
^c
$ mongo <masterhostname>/admin -u <existingadminusername> -p<adminpassword>
> use local
> db.addUser('repl', <replpassword>);
```

## Administrative Tasks

### Failing over to a Slave (Promotion)

To permanently fail over from a down master (*A*) to a slave (*B*):

- shut down *A*
- stop `mongod` on B
- backup or delete local.* datafiles on B
- restart `mongod` on B with the `--master` option

Note that is a one time cutover and the "mirror" is broken. A cannot be brought back in sync with B without a full resync.

### Inverting Master and Slave

If you have a master (*A*) and a slave (*B*) and you would like to reverse their roles, this is the recommended sequence of steps. Note the following

assumes *A* is healthy and up.

1. Halt writes on *A* (using the fsync command)
2. Make sure *B* is caught up
3. Shut down *B*
4. Wipe *local.** on B to remove old local.sources
5. Start up *B* with the `--master` option
6. Do a write on *B* (primes the oplog)
7. Shut down *B*. *B* will now have a new set of local.* files.
8. Shut down *A* and replace *A*'s *local.** files with a copy of *B*'s new *local.** files.
9. Start *B* with the `--master` option
10. Start *A* with all the usual slave options plus `--fastsync`

If *A* is **not** healthy but the hardware is okay (power outage, server crash, etc.):

- Skip the first two steps
- Replace all of *A*'s files with *B*'s files in step 7.

If the hardware is not okay, replace *A* with a new machine and then follow the instructions in the previous paragraph.

#### Creating a slave from an existing master's disk image

`--fastsync` is a way to start a slave starting with an existing master disk image/backup. This option declares that the adminstrator guarantees the image is correct and completely up to date with that of the master. If you have a full and complete copy of data from a master (and the master is not accepting new writes concurrently!) you can use this option to avoid a full synchronization upon starting the slave.

#### Creating a slave from an existing slave's disk image

You can just copy the other slave's data file snapshot without any special options. Note data snapshots should only be taken when a `mongod` process is down or in fsync-and-lock state.

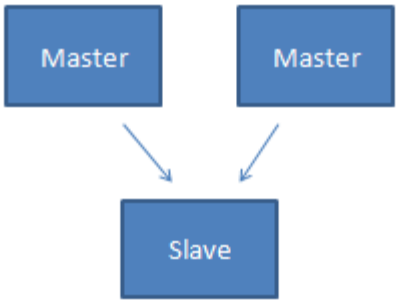
#### Resyncing a slave that is too stale to recover

Slaves asynchronously apply write operations from the master. These operations are stored in the master's oplog. The oplog is finite in length. If a slave is too far behind, a full resync will be necessary. See the Halted Replication page.

### See Also

- Replica Sets

## One Slave Two Masters




This document shows an example session with one slave pulling data from two different masters.

> Despite the example shown here, it is better, simpler, and generally recommended to have multiple `mongod --slave` processes on a single box than to have one process pull from multiple masters.

A few notes:

- Each master host has a different hostname (hostname:port).
- Pulling the same database from two different databases can have unexpected results. This can be done in certainly limited ways, as the data will tend to be merged, but there are some edge cases: for example the two masters should have exactly the same set of collections

or else some may not show up. Generally, this is not recommended.
- Slaving a replica pair is unfortunately not currently supported – see SERVER-30.

```
$ mkdir /data/1
$ mkdir /data/2
$ mkdir /data/3
$ ./mongod --port 27020 --dbpath /data/1 --master &
$ ./mongod --port 27021 --dbpath /data/2 --master &
$ ./mongod --port 27022 --dbpath /data/3 --slave  &

$ # add some data to masters
$ ./mongo localhost:27020
> use db1
> db.foo.insert({x:1})
> db.foo.insert({x:2})
^C
$ # master 2
$ ./mongo localhost:27021
> use db2
> db.foo.insert({x:999, note:"in db2"})
^C

$ # configure slave
$ ./mongo localhost:27022
> use local
> db.sources.insert({host:"localhost:27020"})
> db.sources.insert({host:"localhost:27021"})
> db.sources.find()
{ "_id" : ObjectId("4b8ecfac0cb095ca52b62949"), "host" : "localhost:27020" }
{ "_id" : ObjectId("4b8ecfc30cb095ca52b6294a"), "host" : "localhost:27021" }

> // wait a little, still connected to slave

> use db1
> db.foo.count()
2
> use db2
> db.foo.find()
{ "_id" : ObjectId("4b8ed00a1d42d47b3afa3c47"), "x" : 999, "note" : "in db2" }
> db.printSlaveReplicationInfo()
source:   localhost:27020
syncedTo: Wed Mar 03 2010 16:04:35 GMT-0500 (EST)
          = 2717secs ago (0.75hrs)
source:   localhost:27021
syncedTo: Wed Mar 03 2010 16:09:31 GMT-0500 (EST)
          = 2421secs ago (0.67hrs)
>
```

## Replica Pairs


- Setup of Replica Pairs
- Consistency
- Security
- Replacing a Replica Pair Server
- Querying the slave
- What is and when should you use an arbiter?
- Working with an existing (non-paired) database
- See Also


### Setup of Replica Pairs

> Replica Sets will soon replace replica pairs.  If you are just now setting up an instance, you may want to wait for that and use master/slave replication in the meantime.

Mongo supports a concept of *replica pairs*. These databases automatically coordinate which is the master and which is the slave at a given point in time.

At startup, the databases will negotiate which is master and which is slave. Upon an outage of one database server, the other will automatically take over and become master from that point on. In the event of another failure in the future, master status would transfer back to the other server. The databases manage this themselves internally.

**Note:** Generally, start with empty /data/db directories for each pair member when creating and running the pair for the first time. See section on Existing Databases below for more information.

To start a pair of databases in this mode, run each as follows:

```
$ ./mongod --pairwith <remoteserver> --arbiter <arbiterserver>
```

where

- *`remoteserver`* is the hostname of the other server in the pair. Append `:port` to the server hostname if you wish to run on a nonstandard port number.
- *`arbiterserver`* is the hostname (and optional port number) of an *arbiter*. An arbiter is a Mongo database server that helps negotiate which member of the pair is master at a given point in time. Run the arbiter on a third machine; it is a "tie-breaker" effectively in determining which server is master when the members of the pair cannot contact each other. You may also run with no arbiter by not including the --arbiter option. In that case, both servers will assume master status if the network partitions.

One can manually check which database is currently the master:

```
$ ./mongo
> db.$cmd.findOne({ismaster:1});
{ "ismaster" : 0.0 , "remote" : "192.168.58.1:30001" , "ok" : 1.0  }
```

(Note: When security is on, `remote` is only returned if the connection is authenticated for the `admin` database.)

However, Mongo drivers with replica pair support normally manage this process for you.

### Consistency

Members of a pair are only eventually consistent on a failover. If machine L of the pair was master and fails, its last couple seconds of operations may not have made it to R - R will not have those operations applied to its dataset until L recovers later.

### Security

Example security configuration when security is enabled:

```
$ ./mongo <lefthost>/admin -u <adminusername> -p<adminpassword>
> use local
> db.addUser('repl', <replpassword>);
^c
$ ./mongo <righthost>/admin -u <adminusername> -p<adminpassword>
> use local
> db.addUser('repl', <replpassword>);
```

### Replacing a Replica Pair Server

When one of the servers in a Mongo replica pair set fails, should it come back online, the system recovers automatically. However, should a machine completely fail, it will need to be replaced, and its replacement will begin with no data. The following procedure explains how to replace one of the machines in a pair.

Let's assume nodes (`n1`, `n2`) is the old pair and that `n2` dies. We want to switch to (`n1`,`n3`).

1. If possible, assure the dead `n2` is offline and will not come back online: otherwise it may try communicating with its old pair partner.
2. We need to tell `n1` to pair with `n3` instead of `n2`. We do this with a `replacepeer` command. Be sure to check for a successful return value from this operation.

```
n1> ./mongo n1/admin
> db.$cmd.findOne({replacepeer:1});
{
    "info" : "adjust local.sources hostname; db restart now required" ,
    "ok" : 1.0
}
```

At this point, n1 is still running but is reset to not be confused when it begins talking to n3 in the future. The server is still up although replication is now disabled.

3. Restart n1 with the right command line to talk to n3

```
n1> ./mongod --pairwith n3 --arbiter <arbiterserver>
```

4. Start n3 paired with n1.

```
n3> ./mongod --pairwith n1 --arbiter <arbiterserver>
```

Note that n3 will not accept any operations as "master" until fully synced with n1, and that this may take some time if there is a substantial amount of data on n1.

### Querying the slave

You can query the slave if you set the slave ok flag. In the shell:

```
db.getMongo().setSlaveOk()
```

### What is and when should you use an arbiter?

The arbiter is used in some situations to determine which side of a pair is master. In the event of a network partition (left and right are both up, but can't communicate) whoever can talk to the arbiter becomes master.

If your left and right server are on the same switch, an arbiter isn't necessary. If you're running on the same ec2 availability zone, probably not needed as well. But if you've got left and right on different ec2 availability zones, then an arbiter should be used.

### Working with an existing (non-paired) database

Care must be taken when enabling a pair for the first time if you have existing datafiles you wish to use that were created from a singleton database. Follow the following procedure to start the pair. Below, we call the two servers "left" and "right".

- assure no mongod processes are running on both servers
- we assume the data files to be kept are on server left. Check that there is no local.* datafiles in left's /data/db (--dbpath) directory. If there are, remove them.
- check that there are no datafiles at all on right's /data/db directory
- start the left process with the appropriate command line including --pairwith argument
- start the right process with the appropriate paired command line

If both left and right servers have datafiles in their dbpath directories at pair initiation, errors will occur. Further, you do not want a local database (which contains replication metadata) during initiation of a new pair.

### See Also

- Replica Pairs in Ruby

## Master Master Replication

Mongo does not support full master-master replication.  However, for certain restricted use cases master-master can be used.  Generally speaking, we don't recommend the using a master-master configuration with MongoDB.

Master-master usages is eventually consistent.

To configure master-master, simply run both databases with both the --master and --slave parameters.  For example, to set up this configuration on a single machine as a test one might run:

```
$ nohup mongod --dbpath /data1/db --port 27017 --master --slave --source localhost:27018 > /tmp/dblog1
&
$ nohup mongod --dbpath /data2/db --port 27018 --master --slave --source localhost:27017 > /tmp/dblog2
&
```

This mode is safe for:

- insert operations
- delete operations by _id;
- any query

Master-master should not be used if:

- concurrent updates of single object may occur (including $inc and other updates)

A sample test session on a single computer follows:

```
$ # terminal 1, we run a mongod on default db port (27017)
$ ./mongod --slave --master --source localhost:10000

$ # terminal 2, we run a mongod on port 10000
$ ./mongod --slave --master --dbpath /data/slave --port 10000 --source localhost

$ # terminal 3, we run the shell here
$ ./mongo
> // 'db' is now connected to localhost:27017/test
> z = connect("localhost:10000/test")
> // 'z' is now connected to localhost:10000/test db

> db.foo.insert({x:7});
> z.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
> db.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}

> db.foo.insert({x:8})
> db.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
{"_id" :  ObjectId( "4ab9182a938798896fd8a906")  , "x" : 8}
> z.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
{"_id" :  ObjectId( "4ab9182a938798896fd8a906")  , "x" : 8}

> z.foo.save({x:9})
> z.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
{"_id" :  ObjectId( "4ab9182a938798896fd8a906")  , "x" : 8}
{"_id" :  ObjectId( "4ab9188ac50e4c10591ce3b7")  , "x" : 9}
> db.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
{"_id" :  ObjectId( "4ab9182a938798896fd8a906")  , "x" : 8}
{"_id" :  ObjectId( "4ab9188ac50e4c10591ce3b7")  , "x" : 9}

> z.foo.remove({x:8})
> db.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
{"_id" :  ObjectId( "4ab9188ac50e4c10591ce3b7")  , "x" : 9}
> z.foo.find()
{"_id" :  ObjectId( "4ab917d7c50e4c10591ce3b6")  , "x" : 7}
{"_id" :  ObjectId( "4ab9188ac50e4c10591ce3b7")  , "x" : 9}

> db.foo.drop()
{"nIndexesWas" : 1 , "msg" : "all indexes deleted for collection" , "ns" : "test.foo" , "ok" : 1}
> db.foo.find()
> z.foo.find()
>
```

## Replication Oplog Length

Replication uses an operation log ("oplog") to store write operations. These operations replay asynchronously on other nodes.

The length of the oplog is important if a secondary is down. The larger the log, the longer the secondary can be down and still recover. Once the oplog has exceeded the downtime of the secondary, there is no way for the secondary to apply the operations; it will then have to do a full synchronization of the data from the primary.

By default, on 64 bit builds, oplogs are quite large - perhaps 5% of disk space. Generally this is a reasonable setting.

The `mongod --oplogSize` command line parameter sets the size of the oplog.

This collection is named:

- local.oplog.$main for master/slave replication;
- local.oplog.rs for replica sets

### *See also*

- The Halted Replication page
- Resyncing a Very Stale Replica Set Member

## Halted Replication

> These instructions are for master/slave replication. For replica sets, see Resyncing a Very Stale Replica Set Member instead.

If you're running mongod with master-slave replication, there are certain scenarios where the slave will halt replication because it hasn't kept up with the master's oplog.

The first is when a slave is prevented from replicating for an extended period of time, due perhaps to a network partition or the killing of the slave process itself. The best solution in this case is to resyc the slave. To do this, open the mongo shell and point it at the slave:

```
$ mongo <slave_host_and_port>
```

Then run the resync command:

```
> use admin
> db.runCommand({resync: 1})
```

This will force a full resync of all data (which will be very slow on a large database). The same effect can be achieve dby stopping `mongod` on the slave, delete all slave datafiles, and restarting it.

### Increasing the OpLog Size

Since the oplog is a capped collection, it's allocated to a fixed size; this means that as more data is entered, the collection will loop around and overwrite itself instead of growing beyond its pre-allocated size. If the slave can't keep up with this process, then replication will be halted. The solution is to increase the size of the master's oplog. There are a couple of ways to do this, depending on how big your oplog will be and how much downtime you can stand. But first you need to figure out how big an oplog you need.

If the current oplog size is wrong, how do you figure out what's right? The goal is not to let the oplog age out in the time it takes to clone the database. The first step is to print the replication info. On the master node, run this command:

```
> db.printReplicationInfo();
```

You'll see output like this:

```
configured oplog size:   1048.576MB
log length start to end: 7200secs (2hrs)
oplog first event time:  Wed Mar 03 2010 16:20:39 GMT-0500 (EST)
oplog last event time:   Wed Mar 03 2010 18:20:39 GMT-0500 (EST)
now:                     Wed Mar 03 2010 18:40:34 GMT-0500 (EST)
```

This indicates that you're adding data to the database at a rate of 524MB/hr. If an initial clone takes 10 hours, then the oplog should be at least 5240MB, so something closer to 8GB would make for a safe bet.

The standard way of changing the oplog size involves stopping the `mongod` master, deleting the local.* oplog datafiles, and then restarting with the oplog size you need, measured in MB:

```
$ # Stop mongod - killall mongod or kill -2 or ctrl-c) - then:
$ rm /data/db/local.*
$ mongod --oplog=8038 --master
```

Once you've changed the oplog size, restart with slave with --autoresync:

```
mongod --slave --autoresync
```

This method of oplog creation might pose a problem if you need a large oplog (say, > 10GB), since the time it takes `mongod` to pre-allocate the oplog files may mean too much downtime. If this is the case, read on.

### Manually Allocating OpLog Files

An alternative approach is to create the oplog files manually before shutting down `mongod`. Suppose you need an 20GB oplog; here's how you'd go about creating the files:

1. Create a temporary directory, /tmp/local.
2. You'll be creating ten 2GB datafiles. Here's a shell script for doing just that:

```
cd /tmp/local
  for i in {0..9}
      do
      echo $i
      head -c 2146435072 /dev/zero > local.$i
      done
```

Note that the datafiles aren't exactly 2GB due MongoDB's max int size.

3. Shut down the `mongod` master (kill -2) and then replace the oplog files:

```
$ mv /data/db/local.* /safe/place
$ mv /tmp/local/* /data/db/
```

4. Restart the master with the new oplog size:

```
$ mongod --master --oplogSize=20000
```

5. Finally, resync the slave. This can be done by shutting down the slave, deleting all its datafiles, and restarting it.

## Sharding

MongoDB scales horizontally via an auto-sharding architecture.

Sharding offers:

- Scaling out to thousands of nodes
- Easy addition of new machines
- Automatic balancing for changes in load and data distribution
- Zero single points of failure
- Automatic failover

*Sharding will be production-ready in MongoDB v1.6, estimated to be released in Aug 6th, 2010. * Please see the limitations page for progress updates and current restrictions.

### Documentation

1. What Is Sharding?
Here we provide an introduction to MongoDB's auto-sharding, highlighting its philosophy, use cases, and its core components.

2. How To Set Up and Manage a Cluster
How to set up a sharding cluster and manage it.

- Configuration
- Administration
- Failover

3. Sharding Internals
Auto-Sharding implementation details.

4. Restrictions and Limitations
Sharding in the 1.5.x development branch is not yet production-ready. Here you can find out the current limitations and keep track of progress towards the 1.6 production release.

5. FAQ
Common questions.

### Presentations and Further Materials

- Sharding Presentation from MongoSF April 2010

## Sharding Introduction

MongoDB supports an automated sharding architecture, enabling horizontal scaling across multiple nodes. For applications that outgrow the resources of a single database server, MongoDB can convert to a sharded cluster, automatically managing failover and balancing of nodes, with few or no changes to the original application code.

This document explains MongoDB's auto-sharding approach to scalability in detail and provides an architectural overview of the various components that enable it.

Be sure to acquaint yourself with the current limitations.


- MongoDB's Auto-Sharding
  - Sharding in a Nutshell
  - Balancing and Failover
  - Scaling Model
- Architectural Overview
  - Shards
    - Shard Keys
    - Chunks
  - Config Servers
  - Routing Processes
  - Operation Types
  - Server Layout
  - Configuration


### MongoDB's Auto-Sharding

#### *Sharding in a Nutshell*

Sharding is the partitioning of data among multiple machines in an order-preserving manner. To take an example, let's imagine sharding a collection of users by their state of residence. If we designate three machines as our shard servers, the first of those machines might contain users from Alaska to Kansas, the second from Kentucky to New York, and the third from North Carolina to Wyoming.

Our application connects to the sharded cluster through a `mongos` process, which routes operations to the appropriate shard(s). In this way, the sharded MongoDB cluster continues to look like a single-node database system to our application. But the system's capacity is greatly enhanced. If our `users` collection receives heavy writes, those writes are now distributed across three shard servers. Queries continue to be efficient, as well, because they too are distributed. And since the documents are organized in an order-preserving manner, any operations specifying the state of residence will be routed only to those nodes containing that state.

Sharding occurs on a per-collection basis, not on the database as a whole. This makes sense since, as our application grows, certain collections will grow much larger than others. For instance, if we were building a service like Twitter, our collection of tweets would likely be several orders of magnitude larger than the next biggest collection. The size and throughput demands of such a collection would be prime for sharding, whereas smaller collections would still live on a single server. In the context on MongoDB's sharded architecture, non-sharded collections will reside on just one of the sharded nodes.

#### *Balancing and Failover*

A sharded architecture needs to handle balancing and failover. Balancing is necessary when the load on any one shard node grows out of proportion with the remaining nodes. In this situation, the data must be redistributed to equalize load across shards.

Automated failover is also quite important since proper system functioning requires that each shard node be always online. In practice, this means that each shard consists of more than one machine in a configuration known as a *replica set*. A replica set is a set of *n* servers, frequently three or more, each of which contains a replica of the entire data set for the given shard. One of the *n* servers in a replica set will always be master. If the

master replica fails, the remaining replicas are capable of electing a new master. Thus is automated failover provided for the individual shard.

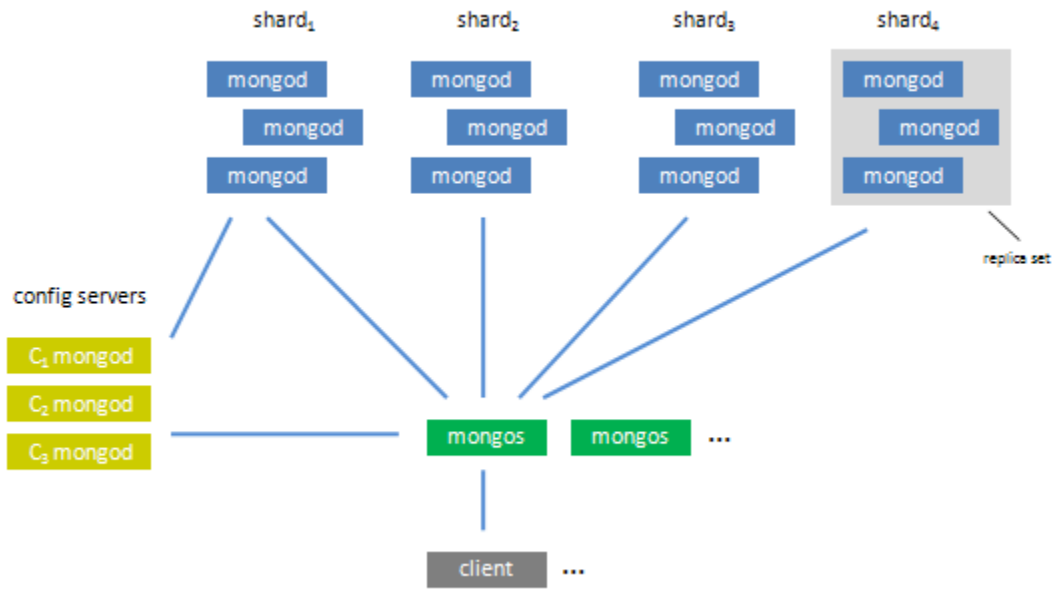
Replica sets were another focus of development in 1.5.x (along with sharding). See the documentation on replica sets for more details.

### *Scaling Model*

MongoDB's auto-sharding scaling model shares many similarities with Yahoo's PNUTS and Google's BigTable. Readers interested in detailed discussions of distributed databases using order-preserving partitioning are encouraged to look at the PNUTS and BigTable white papers.

## Architectural Overview

A MongoDB shard cluster consists of two or more shards, one or more config servers, and any number of routing processes to which the application servers connect. Each of these components is described below in detail.




### *Shards*

Each shard consists of one or more servers and stores data using `mongod` processes (`mongod` being the core MongoDB database process). In a production situation, each shard will consist of multiple replicated servers per shard to ensure availability and automated failover. The set of servers/`mongod` process within the shard comprise a *replica set*.

Replica sets, as discussed earlier, represent an improved version of MongoDB's replication (SERVER-557).

For testing, you can use sharding with a single `mongod` instance per shard. If you need redundancy, use one or more slaves for each shard's `mongod` master. This configuration will require manual failover until replica sets become available.

#### Shard Keys

To partition a collection, we specify a shard key pattern. This pattern is similar to the key pattern used to define an index; it names one or more fields to define the key upon which we distribute data. Some example shard key patterns include the following:

```
{ state : 1 }
{ name : 1 }
{ _id : 1 }
{ lastname : 1, firstname : 1 }
{ tag : 1, timestamp : -1 }
```

MongoDB's sharding is order-preserving; adjacent data by shard key tends to be on the same server. The config database stores all the metadata indicating the location of data by range:

| collection | minkey | maxkey | location |
|---|---|---|---|
| users | { name : 'Miller' } | { name : 'Nessman' } | $shard_2$ |
| users | { name : 'Nessman' } | { name : 'Ogden' } | $shard_4$ |
| ... | | | |

**Chunks**

A chunk is a contiguous range of data from a particular collection. Chunks are described as a triple of `collection`, `minKey`, and `maxKey`. Thus, the shard key K of a given document assigns that document to the chunk where minKey <= K < maxKey.

Chunks grow to a maximum size, usually 200MB. Once a chunk has reached that approximate size, the chunk *splits* into two new chunks. When a particular shard has excess data, chunks will then *migrate* to other shards in the system. The addition of a new shard will also influence the migration of chunks.

When choosing a shard key, keep in mind that these values should be *granular* enough to ensure an even distribution of data. For instance, in the above example, where we're sharding on `name`, we have to be careful that we don't have a disproportionate number of users with the same name. In that case, the individual chunk can become too large and find itself unable to split, e.g., where the entire range comprises just a single key.

Thus, if it's possible that a single value within the shard key range might grow exceptionally large, it's best to use a compound shard key instead so that further discrimination of the values will be possible.

### *Config Servers*

The config servers store the cluster's metadata, which includes basic information on each shard server and the chunks contained therein.

Chunk information is the main data stored by the config servers. Each config server has a complete copy of all chunk information. A two-phase commit is used to ensure the consistency of the configuration data among the config servers.

If any of the config servers is down, the cluster's meta-data goes read only. However, even in such a failure state, the MongoDB cluster can still be read from and written to.

### *Routing Processes*

The `mongos` process can be thought of as a routing and coordination process that makes the various components of the cluster look like a single system. When receiving client requests, the `mongos` process routes the request to the appropriate server(s) and merges any results to be sent back to the client.

`mongos` processes have no persistent state; rather, they pull their state from the config server on startup. Any changes that occur on the the config servers are propagated to each `mongos` process.

`mongos` processes can run on any server desired. They may be run on the shard servers themselves, but are lightweight enough to exist on each application server. There are no limits on the number of `mongos` processes that can be run simultaneously since these processes do not coordinate between one another.

### *Operation Types*

Operations on a sharded system fall into one of two categories: *global* and *targeted*.

For targeted operations, `mongos` communicates with a very small number of shards -- often a single shard. Such targeted operations are quite efficient.

Global operations involve the `mongos` process reaching out to all (or most) shards in the system.

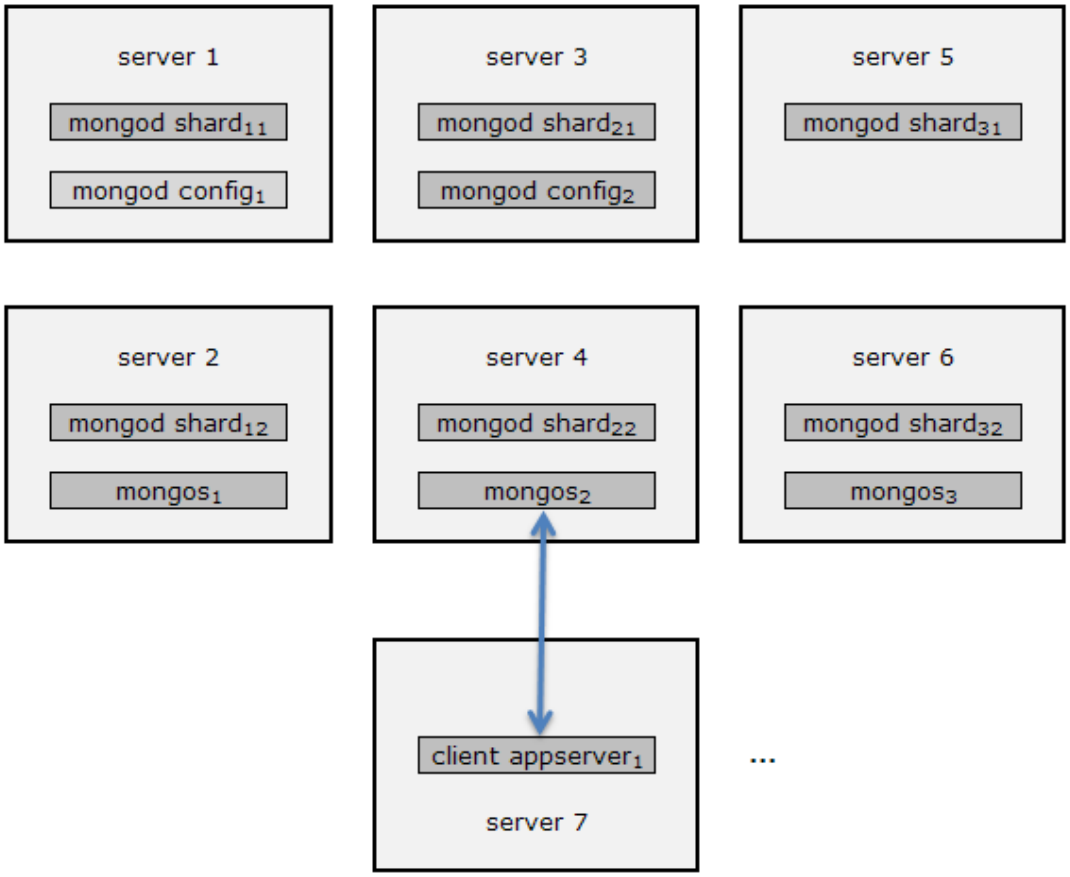
The following table shows various operations and their type. For the examples below, assume a shard key of { x : 1 }.

| Operation | Type | Comments |
|---|---|---|
| db.foo.find( { x : 300 } ) | Targeted | Queries a single shard. |
| db.foo.find( { x : 300, age : 40 } ) | Targeted | Queries a single shard. |
| db.foo.find( { age : 40 } ) | Global | Queries all shards. |
| db.foo.find() | Global | sequential |

| | | |
|---|---|---|
| db.foo.find(...).count() | Variable | Same as the corresponding find() operation |
| db.foo.find(...).sort( { age : 1 } ) | Global | parallel |
| db.foo.find(...).sort( { x : 1 } ) | Global | sequential |
| db.foo.count() | Global | parallel |
| db.foo.insert( <object> ) | Targeted | |
| db.foo.update( { x : 100 }, <object> )<br>db.foo.remove( { x : 100 } ) | Targeted | |
| db.foo.update( { age : 40 }, <object> )<br><br>db.foo.remove( { age : 40 } ) | Global | |
| db.getLastError() | | |
| db.foo.ensureIndex(...) | Global | |

### *Server Layout*

Machines may be organized in a variety of fashions. For instance, it's possible to have separate machines for each config server process, `mongos` process, and `mongod` process. However, this can be overkill since the load is almost certainly low on the config servers. Here, then, is an example where some sharing of physical machines is used to lay out a cluster.




Yet more configurations are imaginable, especially when it comes to `mongos`. For example, it's possible to run `mongos` processes on all of servers 1-6. Alternatively, as suggested earlier, the `mongos` processes can exists on each application server (server 7). There is some potential benefit to this configuration, as the communications between app server and `mongos` then can occur over the localhost interface.

### *Configuration*

Sharding becomes a bit easier to understand one you've set it up. It's even possible to set up a sharded cluster on a single machine. To try it for yourself, see the configuration docs.

# Configuring Sharding

### Introduction

This document describes the steps involved in setting up a basic sharding cluster. A sharding cluster requires, at minimum, three components:

1. Two or more shards.
2. At least one config server.
3. A `mongos` routing process.

For testing purposes, it's possible to start all the required processes on a single server, whereas in a production situation, a number of server configurations are possible.

Once the shards, config servers, and `mongos` processes are running, configuration is simply a matter of issuing a series of commands to establish the various shards as being part of the cluster. Once the cluster has been established, you can begin sharding individual collections.

This document is fairly detailed; if you're the kind of person who prefers a terse, code-only explanation, see the sample shard configuration. If you'd like a quick script to set up a test cluster on a single machine, we have a python sharding script that can do the trick.


- Introduction
- 1. Sharding Components
    - Shard Servers
    - Config Servers
    - `mongos` Router
- 2. Configuring the Shard Cluster
    - Adding shards
        - Optional Parameters
    - Listing shards
    - Removing a shard
- Enabling Sharding on a Database
- 3. Sharding a Collection
- Relevant Examples and Docs


### 1. Sharding Components

First, start the individual shards, config servers, and `mongos` processes.

Shard Servers

Run `mongod` on the shard servers. Use the --shardsvr command line parameter to indicate this `mongod` is a shard. For auto failover support, replica sets will be required. See replica sets for more info.

Note that replica pairs will never be supported as shards.

To get started with a simple test, we recommend running a single `mongod` process per shard, as a test configuration doesn't demand automated failover.

Config Servers

Run `mongod` on the config server(s) with the --configsvr command line parameter. If the config servers are running on a shared machine, be sure to provide a separate dbpath for the config data (--dbpath command line parameter).

`mongos` Router

Run `mongos` on the servers of your choice. Specify the --configdb parameter to indicate location of the config database(s).

### 2. Configuring the Shard Cluster

Once the shard components are running, issue the sharding commands. You may want to automate or record your steps below in a .js file for replay in the shell when needed.

Start by connecting to one of the `mongos` processes, and then switch to the `admin` database before issuing any commands.

Keep in mind that once these commands are run, the configuration data will be persisted to the config servers. So, regardless of the number of `mongos` processes you've launched, you'll only need run these commands on one of those processes.

You can connect to the admin database via `mongos` like so:

```
./mongo <mongos-hostname>:<mongos-port>/admin
> db
admin
```

***Adding shards***

Each shard can consist of more than one server (see replica sets); however, for testing, only a single server with one `mongod` instance need be used.

You must explicitly add each shard to the cluster's configuration using the `addshard` command:

```
> db.runCommand( { addshard : "<serverhostname>[:<port>]" } );
{"ok" : 1 , "added" : ...}
```

Run this command once for each shard in the cluster.

If the individual shards consist of replica sets, they can be added by specifying *replicaSetName* /<serverhostname>[:port][,serverhostname2[:port],...], where at least one server in the replica set is given.

```
> db.runCommand( { addshard : "foo/<serverhostname>[:<port>]" } );
{"ok" : 1 , "added" : "foo"}
```

Optional Parameters

**name**
Each shard has a name, which can be specified using the `name` option. If no name is given, one will be assigned automatically.

**maxSize**
The `addshard` command accepts an optional `maxSize` parameter. This parameter lets you tell the system a maximum amount of disk space in megabytes to use on the specified shard. If unspecified, the system will use the entire disk. maxSize is useful when you have machines with different disk capacities or when you want to prevent storage of too much data on a particular shard.

As an example:

```
> db.runCommand( { addshard : "sf103", maxSize:100000 } );
```

***Listing shards***

To see current set of configured shards, run the `listshards` command:

```
> db.runCommand( { listshards : 1 } );
```

This way, you can verify that all the shard have been committed to the system.

***Removing a shard***

Before a shard can be removed, we have to make sure that all the chunks and databases that once lived there were relocated to other shards. The 'removeshard' command takes care of "draining" the chunks out of a shard for us. To start the shard removal, you can issue the command

```
> db.runCommand( { removeshard : "localhost:10000" } );
{ msg : "draining started succesfully" , state: "started" , shard :"localhost:10000" , ok : 1
```

That will put the shard in "draining mode". Its chunks are going to be moved away slowly over time, so not to cause any disturbance to a running system. The command will return right away but the draining task will continue on the background. If you issue the command again during it, you'll get a progress report instead:

```
> db.runCommand( { removeshard : "localhost:10000" } );
{ msg: "draining ongoing" ,  state: "ongoing" , remaining : { chunks :23 , dbs : 1 }, ok : 1 }
```

Whereas the chunks will be removed automatically from that shard, the databases hosted there will need to be moved manually. (This has to do

with a current limitation that will go away eventually):

```
> db.runCommand( { moveprimary : "test", to : "localhost:10001" } );
{ "primary" : "localhost:10001", "ok" : 1 }
```

When the shard is empty, you could issue the 'removeshard' command again and that will clean up all metadata information:

```
> db.runCommand( { removeshard : "localhost:10000" } );
{ msg: "remove shard completed succesfully" , stage: "completed", host: "localhost:10000", ok : 1 }
```

After the 'removeshard' command reported being done with that shard, you can take that process down.

#### Enabling Sharding on a Database

Once you've added the various shards, you can enable sharding on a database. This is an important step; without it, all collection in the database will be stored on the same shard.

```
> db.runCommand( { enablesharding : "<dbname>" } );
```

Once enabled, `mongos` will place different collections for the database on different shards, with the caveat that each collection will still exists on one shard only. To enable real partitioning of data, we have to shard an individual collection.

#### 3. Sharding a Collection

Use the `shardcollection` command to shard a collection. When you shard a collection, you must specify the shard key. If there is data in the collection, mongo will require an index to be create upfront (it speeds up the chunking process) otherwise an index will be automatically created for you.

```
> db.runCommand( { shardcollection : "<namespace>",
                   key : <shardkeypatternobject> });
```

For example, let's assume we want to shard a GridFS `chunks` collection stored in the `test` database. We'd want to shard on the `files_id` key, so we'd invoke the `shardcollection` command like so:

```
> db.runCommand( { shardcollection : "test.fs.chunks", key : { files_id : 1 } } )
{"ok" : 1}
```

One note: a sharded collection can have only one unique index, which must exist on the shard key. No other unique indexes can exist on the collection.

Of course, a unique shard key wouldn't make sense on the GridFS chunks collection. But it'd be practically a necessity for a users collection sharded on email address:

```
db.runCommand( { shardcollection : "test.users" , key : { email : 1 } , unique : true } );
```

#### Relevant Examples and Docs

**Examples**

- Sample configuration session
- The following example shows how to run a simple shard setup on a single machine for testing purposes: Sharding JS Test.

**Docs**

- Sharding Administration
- Notes on TCP Port Numbers

## A Sample Configuration Session

The following example uses two shards (one server each), one config db, and one *mongos* process, all running on a single test server. In addition to the script below, a python script for starting and configuring shard components on a single machine is available.

#### *Creating the Shards*

First, start up a couple _mongod_s to be your shards.

```
$ mkdir /data/db/a /data/db/b
$ ./mongod --shardsvr --dbpath /data/db/a --port 10000 > /tmp/sharda.log &
$ cat /tmp/sharda.log
$ ./mongod --shardsvr --dbpath /data/db/b --port 10001 > /tmp/shardb.log &
$ cat /tmp/shardb.log
```

Now you need a configuration server and *mongos*:

```
$ mkdir /data/db/config
$ ./mongod --configsvr --dbpath /data/db/config --port 20000 > /tmp/configdb.log &
$ cat /tmp/configdb.log
$ ./mongos --configdb localhost:20000 > /tmp/mongos.log &
$ cat /tmp/mongos.log
```

*mongos* does not require a data directory, it gets its information from the config server.

> In a real production setup, mongod's, mongos's and configs would live on different machines. The use of hostnames or IP addresses is mandatory in that case. 'localhost' appearance here is merely illustrative – but fully functional – and should be confined to single-machine, testing scenarios only.

You can toy with sharding by using a small `--chunkSize`, e.g. 1MB. This is more satisfying when you're playing around, as you won't have to insert 200MB of documents before you start seeing them moving around. It should not be used in production.

```
$ ./mongos --configdb localhost:20000 --chunkSize 1 > /tmp/mongos.log &
```

#### *Setting up the Cluster*

We need to run a few commands on the shell to hook everything up. Start the shell, connecting to the *mongos* process (at localhost:27017 if you followed the steps above).

To set up our cluster, we'll add the two shards (*a* and *b*).

```
$ ./mongo
MongoDB shell version: 1.6.0
connecting to: test
> use admin
switched to db admin
> db.runCommand( { addshard : "localhost:10000" } )
{ "shardadded" : "shard0000", "ok" : 1 }
> db.runCommand( { addshard : "localhost:10001" } )
{ "shardadded" : "shard0001", "ok" : 1 }
```

Now you need to tell the database that you want to spread out your data at a database and collection level. You have to give the collection a key (or keys) to partition by.
This is similar to creating an index on a collection.

```
> db.runCommand( { enablesharding : "test" } )
{"ok" : 1}
> db.runCommand( { shardcollection : "test.people", key : {name : 1} } )
{"ok" : 1}
```

#### *Administration*

To see what's going on in the cluster, use the *config* database.

```
> use config
switched to db config
> show collections
chunks
databases
lockpings
locks
mongos
settings
shards
system.indexes
version
```

These collections contain all of the sharding configuration information.

## Upgrading from a Non-Sharded System

A `mongod` process can become part of a sharded cluster without any change to that process or downtime. If you haven't done so yet, feel free to have a look at the Sharding Introduction to familiarize yourself with the components of a sharded cluster and at the Sample Configuration Sesssion to get to know the basic commands involved.

> Sharding is a new feature introduced at the 1.6.0 release. This page assumes your non-sharded `mongod` is on that release.

### *Adding the `mongod` process to a cluster*

If you haven't changed the `mongod` default port, it would be using port 27017. You care about this now because a mongo shell will always try to connect to it by default. But in a sharded environment, **you want your shell to connect to a `mongos` instead**.

If the port 27017 is taken by a `mongod` process, you'd need to bring up the `mongos` in a different port. Assuming that port is 30000 you can connect your shell to it by issuing:

```
$ mongo <mongos-host-address>:30000/admin
```

We're switching directly to the `admin` database on the `mongos` process. That's where we will be able to issue the following command

```
MongoDB shell version: 1.6.0
connecting to: <mongos-address>:30000/admin
> db.runCommand( { addshard : "192.168.25.203:27017" } )
> { "shardAdded" : "shard0000", "ok" : 1 }
```

The host address and port you see on the command are the original `mongod`'s. All the databases of that process were added to the cluster and are accessible now through `mongos`.

```
> db.runCommand( { listdatabases : 1 } )
{
        "databases" : [
                {
                     "name" : "mydb"
                     ...
                     "shards" : {
                             "shard0000" : <size-in-shard00000>
                     }
                },
                ...
```

Note that that doesn't mean that the database or any of its collections is sharded. They haven't moved (see next). All we did so far is to make them visible within the cluster environment.

You should stop accessing the former stand-alone `mongod` directly and should have all the clients connect to a `mongos` process, just as we've been doing here.

### *Sharding a collection*

All the databases of your `mongod`-process-turned-shard can be chunked and balanced among the cluster's shards. The commands and examples to do so are listed at the
Configuring Sharding page. Note that a chunk size defaults to 200MB in version 1.6.0, so if you want to change that – for testing purposes, say – you would do so by starting the `mongos` process with the additional --chunkSize parameter.

### *Difference between upgrading and starting anew*

You should pay attention to the host addresses and ports when upgrading, is all.
Again, if you haven't changed the default ports of your `mongod` process, it would be listening on 27017, which is the port that `mongos` would try to bind by default, too.

## Sharding Administration

Here we present a list of useful commands for obtaining information about a sharding cluster.

To set up a sharding cluster, see the docs on sharding configuration.

- Identifying a Shard Cluster
- List Existing Shards
- List Which Databases are Sharded
- View Sharding Details
- Chunk Operations

#### Identifying a Shard Cluster

```
// Test if we're speaking to a mongos process or
// straight to a mongod process
> db.runCommand({ isdbgrid : 1});

// if connected to mongos, this command returns { ismaster: 0.0, msg: "isdbgrid" }
> db.runCommand({ismaster:1});
```

#### List Existing Shards

```
> db.runCommand({ listShards : 1});
{"servers" :
 [{"_id" :  ObjectId( "4a9d40c981ba1487ccfaa634")  ,
   "host" : "localhost:10000"},
  {"_id" :  ObjectId( "4a9d40df81ba1487ccfaa635")  ,
   "host" : "localhost:10001"}
 ],
 "ok" : 1
}
```

#### List Which Databases are Sharded

Here we query the config database, albeit through `mongos`. The `getSisterDB` command is used to return the config database.

```
> config = db.getSisterDB("config")
> config.system.namespaces.find()
```

#### View Sharding Details

```
> use admin
> db.printShardingStatus();

// A very basic sharding configuration on localhost
sharding version: { "_id" : 1, "version" : 2 }
  shards:
      { "_id" : ObjectId("4bd9ae3e0a2e26420e556876"), "host" : "localhost:30001" }
      { "_id" : ObjectId("4bd9ae420a2e26420e556877"), "host" : "localhost:30002" }
      { "_id" : ObjectId("4bd9ae460a2e26420e556878"), "host" : "localhost:30003" }

  databases:
 { "name" : "admin", "partitioned" : false,
          "primary" : "localhost:20001",
          "_id" : ObjectId("4bd9add2c0302e394c6844b6") }
 my chunks

        { "name" : "foo", "partitioned" : true,
          "primary" : "localhost:30002",
          "sharded" : { "foo.foo" : { "key" : { "_id" : 1 }, "unique" : false } },
          "_id" : ObjectId("4bd9ae60c0302e394c6844b7") }
        my chunks
        foo.foo { "_id" : { $minKey : 1 } } -->> { "_id" : { $maxKey : 1 } }
                  on : localhost:30002 { "t" : 1272557259000, "i" : 1 }
```

Notice the output to the `printShardingStatus` command. First, we see the locations the the three shards comprising the cluster. Next, the various databases living on the cluster are displayed.

The first database shown is the admin database, which has not bee partitioned. The **primary** field indicates the location of the database, which, in the case of the admin database, is on the config server running on port 20001.

The second database *is* partitioned, and it's easy to see the shard key and the location and ranges of chunks comprising the partition. Since there's no data in the `foo` database, only a single chunk exists. That single chunk includes the entire range of possible shard keys.

#### Chunk Operations

MongoDB v1.6 will managing the arrangement chunks automatically. However, it may be desirable to move a chunk manually; here's the command to do that:

```
db.runCommand( { moveChunk : "test.blog.posts" ,
                 find : { author : "eliot" } ,
                 to : "shard1" } )
```

Parameters:

- `movechunk`: a full collection namespace, including the database name
- `find`: a query expression that falls within the chunk to be moved
- `to`: shard id where the chunk will be moved

## Sharding and Failover

A properly-configured MongoDB shard cluster will have no single point of failure.

This document describes the various potential failure scenarios of components within a shard cluster, and how failure is handled in each situation.

#### 1. Failure of a `mongos` routing process.

One `mongos` routing process will be run on each application server, and that server will communicate to the cluster exclusively through the `mongos` process. `mongos` process aren't persistent; rather, they gather all necessary config data on startup from the config server.

This means that the failure of any one application server will have no effect on the shard cluster as a whole, and all other application servers will continue to function normally. Recovery is simply a matter starting up a new app server and `mongos` process.

#### 2. Failure of a single `mongod` server within a shard.

Each shard will consist of a group of *n* servers in a configuration known as a replica set. If any one server in the replica set fails, read and write operations on the shard are still permitted. What's more, no data need be lost on the failure of a server because the replica allows an option on write that forces replication of the write before returning. This is similar to setting *W* to 2 on Amazon's Dynamo.

Replica sets will be available as of MongoDB v1.6. Read more about replica set internals or follow the jira issue.

**3. Failure of all `mongod` servers comprising a shard.**

If all replicas within a shard are down, the data within that shard will be unavailable. However, operations that can be resolved at other shards will continue to work properly. See the documentation on global and targeted operations to see why this is so.

If the shard is configured as a replica set, with at least one member of the set in another data center, then an outage of an entire shard is extremely unlikely. This will be the recommended configuration for maximum redundancy.

**4. Failure of a config server.**

A production shard cluster will have three config server processes, each existing on a separate machine. Writes to config servers use a two-phase commit to ensure an atomic and replicated transaction of the shard cluster's metadata.

On the failure of any one config server, the system's metadata becomes read-only. The system will continue to function, but chunks will be unable to split within a single shard or migrate across shards. For most use cases, this will present few problems, since changes to the chunk metadata will be infrequent.

That said, it will be important that the down config server be restored in a reasonable time period (say, a day) so that shards do not become unbalanced due to lack of migrates (again, for many production situations, this may not be an urgent matter).

# Sharding Limits

## Sharding Release 1 (MongoDB v1.6.0)

## Differences from Unsharded Configurations

- Sharding must be ran in trusted security mode, without explicit security.
- Shard keys are immutable in the current version.
- All (non-multi)updates, upserts, and inserts must include the current shard key. This may cause issues for anyone using a mapping library since you don't have full control of updates.

$where

$where works with sharding.  However do not reference the db object from the $where function (one normally does not do this anyway).

db.eval

db.eval() may not be used with sharded collections.  However, you may use db.eval() if the evaluation function accesses unsharded collections within your database.  Use map/reduce in sharded environments.

getPrevError

getPrevError is unsupported for sharded databases, and may remain so in future releases (TBD). Let us know if this causes a problem for you.

Unique Indexes

For a sharded collection, you may only (optionally) specify a unique constraint on the shard key.  Other secondary indexes work (via a global operation) as long as no unique constraint is specified.

## Scale Limits

Goal is support of systems of up to 1,000 shards.  Testing so far has been limited to clusters with a modest number of shards (e.g., 20).  More information will be reported here later on any scaling limitations which are encountered.

MongoDB sharding supports two styles of operations -- targeted and global.  On giant systems, global operations will be of less applicability.

# Sharding Internals

This section includes internal implementation details for MongoDB auto sharding.  See also the main sharding documentation.

Note: some internals docs could be out of date -- if you see that let us know so we can fix.

### *Internals*

- Moving Chunks
- Sharding Config Schema
- Sharding Design
- Sharding Use Cases
- Shard Ownership
- Splitting Chunks


### *Unit Tests*

```
./mongo --nodb jstests/sharding/*js
```

## Moving Chunks

- inc version
- try to set on from
- if set is successful, have it "locked"
- start transfer
- finish transfer
- commit result

max version for a shard is MAX( chunks on shard )
this poses slight problem when moving last chunk off of a shard, so add a special marker

## Sharding Config Schema

Sharding configuration schema. This lives in the config servers.

#### Collections

version

This is a singleton that contains the current meta-data version number.

```
> db.getCollection("version").findOne()
{ "_id" : 1, "version" : 2 }
```

settings

Key/Value table for configurable options (chunkSize)

```
> db.settings.find()
{ "_id" : "chunksize", "value" : 200 }
{ "_id" : "balancer", "who" : "ubuntu:27017", "x" : ObjectId("4bd0cb39503139ae28630ee9") }
```

shards

Stores information about the shards.

```
> db.shards.findOne()
{ "_id" : "shard0", "host" : "localhost:30001" }
```

databases

```
{
  "_id" : "admin",
  "partitioned" : false,
  "primary" : "localhost:20001"
}
```

chunks

```
{
 "_id" : "test.foo-x_MinKey",
 "lastmod" : {
  "t" : 1271946858000,
  "i" : 1
 },
 "ns" : "test.foo",
 "min" : {
  "x" : { $minKey : 1 }
 },
 "max" : {
  "x" : { $maxKey : 1 }
 },
 "shard" : "localhost:30002"
}
```

mongos

Record of all mongos affiliated with this cluster. mongos will ping every 30 seconds so we know who is alive.

```
> db.mongos.findOne()
{
 "_id" : "erh-wd1:27017",
 "ping" : "Fri Apr 23 2010 11:08:39 GMT-0400 (EST)",
 "up" : 30
}
```

changelog

Human readable log of all meta-data changes. Capped collection that defaults to 10mb.

```
> db.changelog.findOne()
{
 "_id" : "erh-wd1-2010-3-21-17-24-0",
 "server" : "erh-wd1",
 "time" : "Wed Apr 21 2010 13:24:24 GMT-0400 (EST)",
 "what" : "split",
 "ns" : "test.foo",
 "details" : {
  "before" : {
   "min" : {
    "x" : { $minKey : 1 }
   },
   "max" : {
    "x" : { $maxKey : 1 }
   }
  },
  "left" : {
   "min" : {
    "x" : { $minKey : 1 }
   },
   "max" : {
    "x" : 5
   }
  },
  "right" : {
   "min" : {
    "x" : 5
   },
   "max" : {
    "x" : { $maxKey : 1 }
   }
  }
 }
}
```

#### Changes

##### *2 (<= 1.5.0) -> 3 (1.5.1)*

- shards : _id is now the name
- databases : _id is now the db name
- general : all references to a shard can be via name or host

## Sharding Design

#### concepts

- *config database* - the top level database that stores information about servers and where things live.
- *shard*. this can be either a single server or a replica pair.
- *database* - one top level namespace. a database can be partitioned or not
- *chunk* - a region of data from a particular collection. A chunk can be though of as (*collectionname,fieldname,lowvalue,highvalue*). The range is inclusive on the low end and exclusive on the high end, *i.e.*, [lowvalue,highvalue).

#### components and database collections

- config database
- config.servers - this contains all of the servers that the system has. These are logical servers. So for a replica pair, the entry would be *192.168.0.10,192.168.0.11*
- config.databases - all of the databases known to the system. This contains the *primary* server for a database, and information about whether its partitioned or not.
    - config.shards - a list of all database *shards*. Each shard is a db pair, each of which runs a db process.
    - config.homes - specifies which shard is *home* for a given client db.
- shard databases
    - *client*.system.chunklocations - the home shard for a given client db contains a *client*.system.chunklocations collection. this

collection lists where to find particular chunks; that is, it maps chunk->shard.
- mongos process
  - "routes" request to proper db's, and performs merges. can have a couple per system, or can have 1 per client server.
  - gets chunk locations from the client db's home shard. load lazily to avoid using too much mem.
    - chunk information is cached by mongos. This information can be stale at a mongos (it is always up to date at the owning shard; you cannot migrate an item if the owning shard is down). If so, the shard contacted will tell us so and we can then retry to the proper location.

#### db operations

- moveprimary - move a database's primary server
- migrate - migrate a chunk from one machine to another.
  - lock and migrate
  - shard db's coordinate with home shard to atomically pass over ownership of the chunk (two phase commit)
- split - split a chunk that is growing too large into pieces.  as the two new chunks are on the same machine after the split, this is really just a metadata update and very fast.
- reconfiguration operations
  - add shard - dbgrid processes should lazy load information on a new (unknown) shard when encountered.
  - retire shard - in background gradually migrate all chunks off

#### minimizing lock time

If a chunk is migrating and is 50MB, that might take 5-10 seconds which is too long for the chunk to be locked.

We could perform the migrate much like Cloner works,where we copy the objects and then apply all operations that happened during copying. This way lock time is minimal.

## Sharding Use Cases

What specific use cases do we want to address with db partioning (and other techniques) that are challenging to scale? List here for discussion.

- video site (e.g., youtube) (also, GridFS scale-up)
  - seems straightforward: partition by video
  - for related videos feature, see search below
- social networking (e.g., facebook)
  - this can be quite hard to partition, because it is difficult to cluster people.
- very high RPS sites with small datasets
  - N replicas, instead of partioning, might help here
    - replicas only work if the dataset is really small as we are using/wasting the same RAM on each replica. thus, partioning might help us with ram cache efficiency even if entire data set fits on one or two drives.
- twitter
- search & tagging

### *Log Processing*

Use cases related to map-reduce like things.

- massive sort
- top N queries per day
- compare data from two nonadjacent time periods

## Shard Ownership

By shard ownership we mean which server owns a particular key range.

Early draft/thoughts will change:

#### Contract

- the master copy of the ownership information is in the config database
- mongos instances have cached info on which server owns a shard. this information may be stale.
- mongod instances have definitive information on who owns a shard (atomic with the config db) when they know about a shards ownership

#### mongod

The mongod processes maintain a cache of shards the mongod instance owns:

```
map<ShardKey,state> ownership
```

State values are as follows:

- missing - no element in the map means no information available. In such a situation we should query the config database to get the state.
- 1 - this instance owns the shard
- 0 - this instance does not own the shard (indicates we queried the config database and found another owner, and remembered that fact)

**Initial Assignment of a region to a node.**

This is trivial: add the configuration to the config db. As the ShardKey is new, no nodes have any cached information.

**Splitting a Key Range**

The mongod instance A which owns the range R breaks it into R1,R2 which are still owned by it. It updates the config db. We take care to handle the config db crashing or being unreachable on the split:

```
lock(R) on A
update the config db -- ideally atomically perhaps with eval().  await return code.
ownership[R].erase
unlock(R) on A
```

After the above the cache has no information on the R,R1,R2 ownerships, and will requery configdb on the next request. If the config db crashed and failed to apply the operation, we are still consistent.

**Migrate ownership of keyrange R from server A->B. We assume here that B is the coordinator of the job:**

```
B copies range from A
lock(R) on A and B
  B copies any additional operations from A (fast)
  clear ownership maps for R on A and B.  B waits for a response from A on this operation.
  B then updates the ownership data in the config db. (Perhaps even fsyncing.) await return code.
  unlock(R) on B
  delete R on A (cleanup)
unlock (R) on A
```

We clear the ownership maps first. That way, if the config db update fails, nothing bad happens, IF mongos filters data upon receipt for being in the correct ranges (or in its query parameters).

R stays locked on A for the cleanup work, but as that shard no longer owns the range, this is not an issue even if slow. It stays locked for that operation in case the shard were to quickly migrate back.

**Migrating Empty Shards**

Typically we migrate a shard after a split. After certain split scenarios, a shard may be empty but we want to migrate it.

## Splitting Chunks

Normally, splitting chunks is done automatically for you. Currently, the splits happen as a side effect of inserting (and are transparent). In the future, there may be other cases where a chunk is automatically split.

A recently split chunk may be moved immediately to a new shard if the system finds that future insertions will benefit from that move. (Chunk moves are transparent, too.)

Moreover, MongoDB has a sub-system called Balancer, which constantly monitors shards loads and, as you guessed, moves chunks around if it finds an imbalance. Balancing chunks automatically helps incremental scalability. If you add a new shard to the system, some chunks will eventually be moved to that shard to spread out the load.

That all being said, in certain circumstances one may need to force a split manually.

> ⚠ The Balancer will treat all chunks the same way, regardless if they were generated by a manual or an automatic split.

The following command splits the chunk where the _id 99 would reside using that key as the split point. Note that a key need not exist for a chunk

to use it in its range.

```
> use admin
switched to db admin
> db.runCommand( { split : "test.foo" , middle : { _id : 99 } } )
...
```

The following command splits the chunk where the _id 99 would reside in two. The key used as the middle key is computed internally to roughly divide the chunk in equally sized parts.

```
> use admin
switched to db admin
> db.runCommand( { split : "test.foo" , find : { _id : 99 } } )
...
```

## Sharding FAQ


- How does sharding work with replication?
- Where do unsharded collections go if sharding is enabled for a database?
- When will data be on more than one shard?
- What happens if I try to update a document on a chunk that is being migrated?
- What if a shard is down or slow and I do a query?
- How do queries distribute across shards?
- Now that I sharded my collection, how do I <...> (e.g. drop it)?
- If I don't shard on _id how is it kept unique?
- Why is all my data on one server?


How does sharding work with replication?

Each shard is a logical collection of partitioned data. The shard could consist of a single server or a cluster of replicas. Typically in production one would use a replica set for each shard.

Where do unsharded collections go if sharding is enabled for a database?

In alpha 2 unsharded data goes to the "primary" for the database specified (query config.databases to see details). Future versions will parcel out unsharded collections to different shards (that is, a collection could be on any shard, but will be on only a single shard if unsharded).

When will data be on more than one shard?

MongoDB sharding is range based. So all the objects in a collection get put into a chunk. Only when there is more than 1 chunk is there an option for multiple shards to get data. Right now, the chunk size is 50mb, so you need at least 50mb for a migration to occur.

What happens if I try to update a document on a chunk that is being migrated?

The update will go through immediately on the old shard, and then the change will be replicated to the new shard before ownership transfers.

What if a shard is down or slow and I do a query?

If a shard is down, the query will return an error. If a shard is responding slowly, mongos will wait for it. You won't get partial results.

How do queries distribute across shards?

There are a few different cases to consider, depending on the query keys and the sort keys. Suppose 3 distinct attributes, X, Y, and Z, where X is the shard key. A query that keys on X and sorts on X will translate straightforwardly to a series of queries against successive shards in X-order. A query that keys on X and sorts on Y will execute in parallel on the appropriate shards, and perform a merge sort keyed on Y of the documents found. A query that keys on Y must run on all shards: if the query sorts by X, the query will serialize over shards in X-order; if the query sorts by Z, the query will parallelize over shards and perform a merge sort keyed on Z of the documents found.

Now that I sharded my collection, how do I <...> (e.g. drop it)?

Even if chunked, your data is still part of a collection and so all the collection commands apply.

If I don't shard on _id how is it kept unique?

If you don't use _id as the shard key then it is your responsibility to keep the _id unique. If you have duplicate _id values in your collection **bad things will happen** (as mstearn says).

Why is all my data on one server?

MongoDB sharding breaks data into chunks. By default, these chunks are 200mb. Sharding will keep chunks balanced across shards. This

means that you need many chunks to trigger balancing, typically 2gb of data or so. db.printShardingStatus() will tell you how many chunks you have, typically need 10 to start balancing.

# Hosting Center

## Cloud-Style

- MongoHQ provides cloud-style hosted MongoDB instances
- Mongo Machine is currently in private beta

## Dedicated Servers

- ServerBeach offers preconfigured, dedicated MongoDB servers Blog
- EngineYard supports MongoDB on its private cloud.

## VPS

- (mt) Media Temple's (ve) server platform is an excellent choice for easy MongoDB deployment.
- Dreamhost offers instant configuration and deployment of MongoDB
- LOCUM Hosting House is a project-oriented shared hosting and VDS. MongoDB is available for all customers as a part of their subscription plan.

## Setup Instructions for Others

- Amazon EC2
- Joyent
- Linode
- Webfaction

# Amazon EC2

- Instance Types
- Linux
- EC2 TCP Port Management
- EBS Snapshotting
- EBS vs. Local Drives

MongoDB runs well on Amazon EC2 .  This page includes some notes in this regard.

### *Instance Types*

MongoDB works on most EC2 types including Linux and Windows.  We recommend you use a 64 bit instance as this is required for all MongoDB databases of significant size.  Additionally, we find that the larger instances tend to be on the freshest ec2 hardware.

### *Linux*

One can download a binary or build from source. Generally it is easier to download a binary. We can download and run the binary without being root. For example on 64 bit Linux:

```
[~]$ curl -O http://downloads.mongodb.org/linux/mongodb-linux-x86_64-1.0.1.tgz
[~]$ tar -xzf mongodb-linux-x86_64-1.0.1.tgz
[~]$ cd mongodb-linux-x86_64-1.0.1/bin
[bin]$ ./mongod --version
```

Before running the database one should decide where to put datafiles.  Run df -h to see volumes.  On some images /mnt will be the many locally attached storage volume. Alternatively you may want to use Elastic Block Store which will have a different mount point.  Regardless, create a

directory in the desired location and then run the database:

```
mkdir /mnt/db
./mongod --fork --logpath ~/mongod.log --dbpath /mnt/db/
```

### *EC2 TCP Port Management*

By default the database will now be listening on port 27017.  The web administrative UI will be on port 28017.

### *EBS Snapshotting*

v1.3.1+

If your datafiles are on an EBS volume, you can snapshot them for backups.  Use the fsync lock command to lock the database to prevent writes. Then, snapshot the volume.  Then use the unlock command to allow writes to the database again. See the fsync documentation for more information.

This method may also be used with slave databases.

### *EBS vs. Local Drives*

Local drives may be faster than EBS; however, they are impermanent. One strategy is to have a hot server which uses local drives and a slave which uses EBS for storage.

We have seen sequential read rates by MongoDB from ebs (unstriped) of 400Mbps on an extra large instance box.  (YMMV)

## Joyent

The prebuilt MongoDB Solaris 64 binaries work with Joyent accelerators.

Some newer gcc libraries are required to run -- see sample setup session below.

```
$ # assuming a 64 bit accelerator
$ /usr/bin/isainfo -kv
64-bit amd64 kernel modules

$ # get mongodb
$ # note this is 'latest' you may want a different version
$ curl -O http://downloads.mongodb.org/sunos5/mongodb-sunos5-x86_64-latest.tgz
$ gzip -d mongodb-sunos5-x86_64-latest.tgz
$ tar -xf mongodb-sunos5-x86_64-latest.tar
$ mv "mongodb-sunos5-x86_64-2009-10-26" mongo

$ cd mongo

$ # get extra libraries we need (else you will get a libstdc++.so.6 dependency issue)
$ curl -O http://downloads.mongodb.org.s3.amazonaws.com/sunos5/mongo-extra-64.tgz
$ gzip -d mongo-extra-64.tgz
$ tar -xf mongo-extra-64.tar
$ # just as an example - you will really probably want to put these somewhere better:
$ export LD_LIBRARY_PATH=mongo-extra-64
$ bin/mongod --help
```

# Monitoring and Diagnostics

- Query Profiler
- Http Console
- db.serverStatus() from mongo shell
- Trending/Monitoring Adaptors
- Hosted Monitoring
- Database Record/Replay

- Checking Server Memory Usage
- Database Profiler
- Munin configuration examples
- Http Interface
- mongostat
- mongosniff

- Admin UIs

### Query Profiler

Use the Database Profiler to analyze slow queries.

### Http Console

The mongod process includes a simple diagnostic screen at http://localhost:28017/. See the Http Interface docs for more information.

### db.serverStatus() from mongo shell

```
> db.stats()
> db.serverStatus()
> db.foo.find().explain()
> help
> db.help()
> db.foo.help()
```

Server Status Fields

- globalLock - totalTime & lockTime are total microsecs since startup that there has been a write lock
- mem - current usage in megabytes
- indexCounters - counters since startup, may rollover
- opcounters - operation counters since startup
- asserts - assert counters since startup

### Trending/Monitoring Adaptors

- munin, and another munin
- ganglia
- cacti

Chris Lea from (mt) Media Temple has made an easy to install Ubuntu package for the munin plugin.

### Hosted Monitoring

- Server Density
- scout app slow queries

### Database Record/Replay

Recording database operations, and replaying them later, is sometimes a good way to reproduce certain problems in a controlled environment.

To enable logging:

```
db._adminCommand( { diagLogging : 1 } )
```

To disable:

```
db._adminCommand( { diagLogging : 0 } )
```

Values for diagLogging:

- 0 off. Also flushes any pending data to the file.
- 1 log writes
- 2 log reads
- 3 log both
  Note: if you log reads, it will record the findOnes above and if you replay them, that will have an effect!

Output is written to diaglog.bin_ in the /data/db/ directory (unless --dbpath is specified).

To replay the logged events:

```
nc ''database_server_ip'' 27017 < ''somelog.bin'' | hexdump -c
```

## Checking Server Memory Usage

### *Checking using DB Commands*

The serverStatus() command provides memory usage information.

```
> db.serverStatus()
```

*add: how to interpret, what would indicate a memory leak*

### *Checking via Unix Commands*

`mongod` uses memory-mapped files; thus the memory stats in top are not that useful. On a large database, virtual bytes/VSIZE will tend to be the size of the entire database, and if the server doesn't have other processes running, resident bytes/RSIZE will be the total memory of the machine (as this counts file system cache contents).

`vmstat` can be useful. Try running `vmstat 2`. On OS X, use `vm_stat`.

### *Checking in Windows*

Help, any Windows admin experts our there? What should be here?

### *Historial Memory Leak Bugs (that are fixed)*

| (4 issues) | | |
|---|---|---|
| **Key** | **FixVersion** | **Summary** |
| SERVER-1827 | 1.7.1 | Memory leak when there's multiple query plans with empty result |
| SERVER-768 | 1.3.4 | Memory leak and high memory usage from snapshots thread |
| SERVER-774 | | MessagingPorts are leaking |
| SERVER-1897 | | admin page plugins and handlers leak memory |

## Database Profiler

Mongo includes a profiling tool to analyze the performance of database operations.

See also the currentOp command.

### *Enabling Profiling*

To enable profiling, from the `mongo` shell invoke:

```
> db.setProfilingLevel(2);
{"was" : 0 , "ok" : 1}
> db.getProfilingLevel()
2
```

Profiling levels are:

- 0 - off
- 1 - log slow operations (>100ms)
- 2 - log all operations

Starting in 1.3.0, you can also enable on the command line, `--profile=1`

> When profiling is enabling, there is continual writing to the system.profile table. This is very fast but does use a write lock which has certain implications for concurrency. An alternative which has no impact on concurrency is to use the currentOp command.

### *Viewing*

Profiling data is recorded in the database's `system.profile` collection. Query that collection to see the results.

```
> db.system.profile.find()
{"ts" : "Thu Jan 29 2009 15:19:32 GMT-0500 (EST)" , "info" : "query test.$cmd ntoreturn:1 reslen:66
nscanned:0  <br>query: { profile: 2 }  nreturned:1 bytes:50" , "millis" : 0}
...
```

To see output without $cmd (command) operations, invoke:

```
db.system.profile.find( function() { return this.info.indexOf('$cmd')<0; } )
```

To view operations for a particular collection:

```
> db.system.profile.find( { info: /test.foo/ } )
{"ts" : "Thu Jan 29 2009 15:19:40 GMT-0500 (EST)" , "info" : "insert test.foo" , "millis" : 0}
{"ts" : "Thu Jan 29 2009 15:19:42 GMT-0500 (EST)" , "info" : "insert test.foo" , "millis" : 0}
{"ts" : "Thu Jan 29 2009 15:19:45 GMT-0500 (EST)" , "info" : "query test.foo ntoreturn:0 reslen:102
nscanned:2  <br>query: {}  nreturned:2 bytes:86" , "millis" : 0}
{"ts" : "Thu Jan 29 2009 15:21:17 GMT-0500 (EST)" , "info" : "query test.foo ntoreturn:0 reslen:36
nscanned:2  <br>query: { $not: { x: 2 } }  nreturned:0 bytes:20" , "millis" : 0}
{"ts" : "Thu Jan 29 2009 15:21:27 GMT-0500 (EST)" , "info" : "query test.foo ntoreturn:0 exception
bytes:53" , "millis" : 88}
```

To view operations slower than a certain number of milliseconds:

```
> db.system.profile.find( { millis : { $gt : 5 } } )
{"ts" : "Thu Jan 29 2009 15:21:27 GMT-0500 (EST)" , "info" : "query test.foo ntoreturn:0 exception
bytes:53" , "millis" : 88}
```

To see newest information first:

```
db.system.profile.find().sort({$natural:-1})
```

The mongo shell includes a helper to see the most recent 5 profiled events that took at least 1ms to execute. Type show profile at the command prompt to use this feature.

### *Understanding the Output*

The output reports the following values:

- `ts` Timestamp of the profiled operation.
- `millis` Time, in milliseconds, to perform the operation. This time does not include time to acquire the lock or network time, just the time for the server to process.
- `info` Details on the operation.
  - `query` A database query operation. The query info field includes several additional terms:
    - `ntoreturn` Number of objects the client requested for return from a query. For example, <code>findOne()</code> sets ntoreturn to 1. <code>limit()</code> sets the appropriate limit. Zero indicates no limit.
    - `query` Details of the query spec.
    - `nscanned` Number of objects scanned in executing the operation.
    - `reslen` Query result length in bytes.
    - `nreturned` Number of objects returned from query.
  - `update` A database update operation. <code>save()</code> calls generate either an update or insert operation.
    - `fastmod` Indicates a fast modify operation. See Updates. These operations are normally quite fast.
    - `fastmodinsert` - indicates a fast modify operation that performed an upsert.

    - `upsert` Indicates on upsert performed.
    - `moved` Indicates the update moved the object on disk (not updated in place). This is slower than an in place update, and normally occurs when an object grows.
  - `insert` A database insert.
  - `getmore` For large queries, the database initially returns partial information. `getmore` indicates a call to retrieve further information.

### *Optimizing Query Performance*

- If `nscanned` is much higher than `nreturned`, the database is scanning many objects to find the target objects. Consider creating an index to improve this.

- `reslen` A large number of bytes returned (hundreds of kilobytes or more) causes slow performance. Consider passing <code>find()</code> a second parameter of the member names you require.

`Note:` There is a cost for each index you create. The index causes disk writes on each insert and some updates to the collection. If a rare query, it may be better to let the query be "slow" and not create an index. When a query is common relative to the number of saves to the collection, you will want to create the index.

### *Optimizing Update Performance*

- Examine the `nscanned` info field. If it is a very large value, the database is scanning a large number of objects to find the object to update. Consider creating an index if updates are a high-frequency operation.
- Use fast modify operations when possible (and usually with these, an index). See Updates.

### *Profiler Performance*

When enabled, profiling affects performance, although not severely.

Profile data is stored in the database's `system.profile` collection, which is a Capped Collection. By default it is set to a very small size and thus only includes recent operations.

### *Configuring "Slow"*

Since 1.3.0 there are 2 ways to configure "slow"

- --slowms on the command line when starting mongod (or file config)
- db.setProfilingLevel( level , slowms )

```
db.setProfilingLevel( 1 , 10 );
```

will log all queries over 10ms to system.profile

### *See Also*

- Optimization
- explain()
- Viewing and Terminating Current Operation

## Munin configuration examples

### Overview

Munin can use be used monitoring aspects of you running system. The following is a mini tutorial to help you setup and use the MongoDB plugin with munin.

### Setup

Munin is made up of two components

- agent and plugins that are installed on the system you want to monitor
- server which polls the agent(s) and creates the basic web pages and graphs to visualize the data

### Install

You can download from SourceForge , but pre-built packages are also available. For example on Ubuntu you can do the following

### *Agent install*

To install the agent, repeat the following steps on each node you want to monitor

```
shell> sudo apt-get install munin-node
```

### *Server install*

The server needs to be installed once. It relies on apache2, so you will need to ensure that it is installed as well

```
shell> apt-get install apache2
shell> apt-get install munin
```

## Configuration

Both the agent(s) and server need to be configured with the IP address and port to contact each other. In the following examples we will use these nodes

- db1 : 10.202.210.175
- db2 : 10.203.22.38
- munin-server : 10.194.102.70

### *Agent configuration*

On each node, add an entry as follows into
for db1:

```
/etc/munin/munin-node.conf
host_name db1-ec2-174-129-52-161.compute-1.amazonaws.com
allow ^10\.194\.102\.70$
```

for db2:

```
/etc/munin/munin-node.conf
host_name db2-ec2-174-129-52-161.compute-1.amazonaws.com
allow ^10\.194\.102\.70$
```

- host_name : can be whatever you like, this name will be used by the server
- allow : this is the IP address of the server, enabling the server to poll the agent

### *Server configuration*

Add an entry for each node that is being monitored as follows in

```
[db1-ec2-174-129-52-161.compute-1.amazonaws.com]
address 10.202.210.175
use_node_name no

[db2-ec2-184-72-191-169.compute-1.amazonaws.com]
address 10.203.22.38
use_node_name no
```

- the name in between the [] needs to match the name set in the agents munin-node.conf
- address :  IP address of the node where the agent is running
- use_node_name : dtermine if the IP or the name between [] is used to contact the agent

## MongoDB munin plugin

A plugin is available that provide metrics for

- B-Tree stats
- Current connections

- Memory usage
- Database operations (inserts, updates, queries etc.)

The plugin can be installed as follows on each node where MongoDB is running

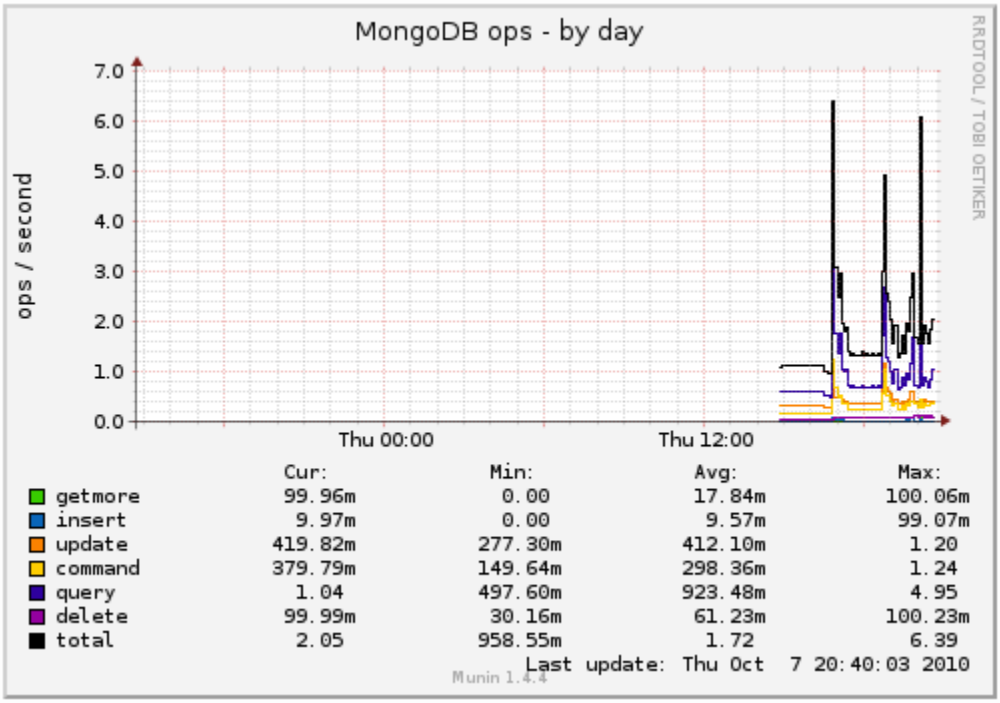
```
shell> wget http://github.com/erh/mongo-munin/tarball/master
shell> tar xvf erh-mongo-munin-*tar.gz
shell> cp erh-mongo-munin-*/mongo_* /etc/munin/plugins/
```

### Check your setup

After installing the plugin and making the configuration changes, force the server to update the information to check your setup is correct using the following

```
shell> sudo -u munin /usr/share/munin/munin-update
```

If everything is setup correctly, you will get a chart like this




### Advanced charting

If you are running a large MongoDB cluster, you may want to aggregate the values (e.g. inserts per second) across all the nodes in the cluster. Munin provides a simple way to aggregate.

```
/etc/munin/munin.conf
[compute-1.amazonaws.com;CLUSTER]
update no
```

* Defines a new segment called CLUSTER

- update no : munin can generate the chart based on existing data, this tell munin not to poll the agents for the data

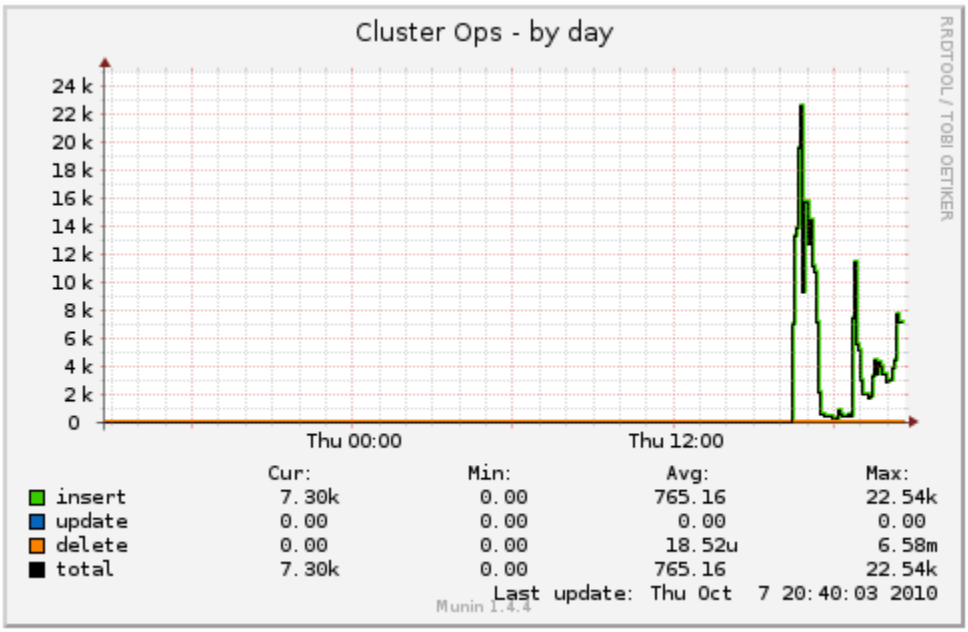
Now lets define a chart to aggregate the inserts, updates and deletefor the cluster

```
cluster_ops.graph_title Cluster Ops
cluster_ops.graph_category mongodb
cluster_ops.graph_total total
cluster_ops.total.graph no
cluster_ops.graph_order insert update delete
cluster_ops.insert.label insert
cluster_ops.insert.sum \
  db1-ec2-174-129-52-161.compute-1.amazonaws.com:mongo_ops.insert \
  db2-ec2-184-72-191-169.compute-1.amazonaws.com:mongo_ops.insert
cluster_ops.update.label update
cluster_ops.update.sum \
  db1-ec2-174-129-52-161.compute-1.amazonaws.com:mongo_ops.insert \
  db2-ec2-184-72-191-169.compute-1.amazonaws.com:mongo_ops.insert
cluster_ops.delete.label delete
cluster_ops.delete.sum \
  db1-ec2-174-129-52-161.compute-1.amazonaws.com:mongo_ops.insert \
  db2-ec2-184-72-191-169.compute-1.amazonaws.com:mongo_ops.insert
```

* cluster_ops : name of this chart

- cluster_ops.graph_category mongodb : puts this chart into the "mongodb" category. Allows you to collect similar charts on a single page
- cluster_ops.graph_order insert update delete : indicates the order of the line son the key for the chart
- cluster_ops.insert : represents a single line on the chart, in this case the "insert"
- cluster_ops.insert.sum : indicates the values are summed
    - db1-ec2-174-129-52-161.compute-1.amazonaws.com : indicates the node to aggregate
    - mongo_ops.insert : indicates the chart (mongo_ops) and the counter (insert) to aggregate

And this is what is looks like




## Http Interface


- REST Interfaces
    - Sleepy Mongoose (Python)
    - MongoDB Rest (Node.js)
- HTTP Console
    - HTTP Console Security
- Simple REST Interface
    - JSON in the simple REST interface
- See Also


### REST Interfaces

#### *Sleepy Mongoose (Python)*

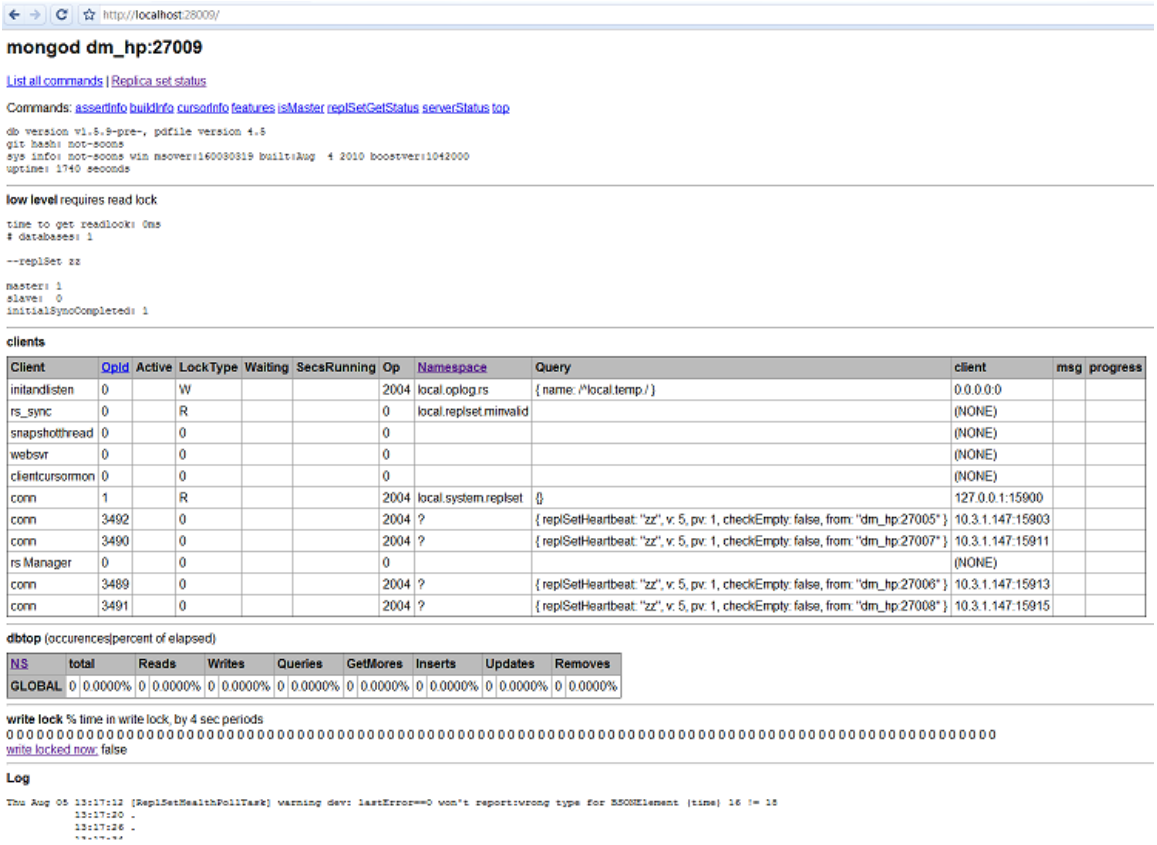
Sleepy Mongoose is a full featured REST interface for MongoDB which is available as a separate project.

### *MongoDB Rest (Node.js)*

MongoDB Rest is an **alpha** REST interface to MongoDB, which uses the MongoDB Node Native driver.

## HTTP Console

MongoDB provides a simple http interface listing information of interest to administrators. This interface may be accessed at the port with numeric value 1000 more than the configured mongod port; the default port for the http interface is 28017. To access the http interface an administrator may, for example, point a browser to http://localhost:28017 if mongod is running with the default port on the local machine.




Here is a description of the informational elements of the http interface:

| element | description |
|---|---|
| db version | database version information |
| git hash | database version developer tag |
| sys info | mongod compilation environment |
| dblocked | indicates whether the primary mongod mutex is held |
| uptime | time since this mongod instance was started |
| assertions | any software assertions that have been raised by this mongod instance |
| replInfo | information about replication configuration |
| currentOp | most recent client request |
| # databases | number of databases that have been accessed by this mongod instance |
| curclient | last database accessed by this mongod instance |
| Cursors | describes outstanding client cursors |

| | |
|---|---|
| master | whether this mongod instance has been designated a master |
| slave | whether this mongod instance has been designated a slave |
| initialSyncCompleted | whether this slave or repl pair node has completed an initial clone of the mongod instance it is replicating |
| DBTOP | Displays the total time the mongod instance has devoted to each listed collection, as well as the percentage of available time devoted to each listed collection recently and the number of reads, writes, and total calls made recently |
| dt | Timing information about the primary mongod mutex |

### *HTTP Console Security*

If security is configured for a mongod instance, authentication is required for a client to access the http interface from another machine.

## Simple REST Interface

The mongod process includes a simple read-only REST interface for convenience. For full REST capabilities we recommend using an external tool such as Sleepy.Mongoose.

Note: in v1.3.4+ of MongoDB, this interface is disabled by default. Use `--rest` on the command line to enable.

To get the contents of a collection (note the trailing slash):

```
http://127.0.0.1:28017/databaseName/collectionName/
```

To add a limit:

```
http://127.0.0.1:28017/databaseName/collectionName/?limit=-10
```

To skip:

```
http://127.0.0.1:28017/databaseName/collectionName/?skip=5
```

To query for {a : 1}:

```
http://127.0.0.1:28017/databaseName/collectionName/?filter_a=1
```

Separate conditions with an &:

```
http://127.0.0.1:28017/databaseName/collectionName/?filter_a=1&limit=-10
```

Same as `db.$cmd.findOne({listDatabase:1})` on the "admin" database in the shell:

```
http://localhost:28017/admin/$cmd/?filter_listDatabases=1&limit=1
```

### *JSON in the simple REST interface*

The simple ReST interface uses strict JSON (as opposed to the shell, which uses Dates, regular expressions, etc.). To display non-JSON types, the web interface wraps them in objects and uses the key for the type. For example:

```
# ObjectIds just become strings
"_id" : "4a8acf6e7fbadc242de5b4f3"

# dates
"date" : { "$date" : 1250609897802 }

# regular expressions
"match" : { "$regex" : "foo", "$options" : "ig" }
```

The code type has not been implemented yet and causes the DB to crash if you try to display it in the browser.

See Mongo Extended JSON for details.

### See Also

- Replica Set Admin UI
- Diagnostic Tools

## mongostat

Use the mongostat utility to quickly view statistics on a running mongod instance.

```
connected to: 127.0.0.1
insert/s query/s update/s delete/s getmore/s command/s flushes/s mapped  vsize    res locked % idx miss %    q t|r|w  conn       time
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:33
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:34
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:35
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:36
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:37
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:38
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:39
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:40
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:41
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:42
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:43
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:44
       0       0        0        0        0        1        0      0     60      8        0          0      0|0|0     1   13:20:45
```

Run *mongostat --help* for help.

```
Fields:
   inserts/s    - # of inserts per second
   query/s      - # of queries per second
   update/s     - # of updates per second
   delete/s     - # of deletes per second
   getmore/s    - # of get mores (cursor batch) per second
   command/s    - # of commands per second
   flushes/s    - # of fsync flushes per second
   mapped       - amount of data mmaped (total data size) megabytes
   vsize        - virtual size of process in megabytes
   res          - resident size of process in megabytes
   faults/s     - # of pages faults/sec (linux only)
   locked       - percent of time in global write lock
   idx miss     - percent of btree page misses (sampled)
   q t|r|w      - lock queue lengths (total|read|write)
   conn         - number of open connections
```

## mongosniff

Unix releases of MongoDB include a utility called mongosniff. This utility is to MongoDB what tcpdump is to TCP/IP; that is, fairly low level and for complex situations. The tool is quite useful for authors of driver tools.

```
$ ./mongosniff --help
Usage: mongosniff [--help] [--forward host:port] [--source (NET <interface> | FILE <filename>)]
[<port0> <port1> ...]
--forward       Forward all parsed request messages to mongod instance at
                specified host:port
--source        Source of traffic to sniff, either a network interface or a
                file containing perviously captured packets, in pcap format.
                If no source is specified, mongosniff will attempt to sniff
                from one of the machine's network interfaces.
<port0>...      These parameters are used to filter sniffing.  By default,
                only port 27017 is sniffed.
--help          Print this help message.
```

### *Building*

mongosniff is including in the binaries for Unix distributions. As mongosniff depends on libpcap, the MongoDB SConstruct only builds mongosniff if libpcap is installed.

```
sudo yum install libpcap-devel
scons mongosniff
```

#### *Example*

To monitor localhost:27017, run `ifconfig` to find loopback's name (usually something like `lo` or `lo0`). Then run:

```
mongosniff --source NET lo
```

If you get the error message "error opening device: socket: Operation not permitted" or "error finding device: no suitable device found", try running it as root.

## Backups


- Fsync, Write Lock and Backup
- Shutdown and Backup
- Exports
- Slave Backup
- Community Stuff


Several strategies exist for backing up MongoDB databases.  A word of warning: it's not safe to back up the mongod data files (by default in /data/db/) while the database is running and writes are occurring; such a backup may turn out to be corrupt.  See the fsync option below for a way around that.

### Fsync, Write Lock and Backup

MongoDB v1.3.1 and higher supports an fsync and lock command with which we can flush writes, lock the database to prevent writing, and then backup the datafiles.

While in this locked mode, all writes will block. If this is a problem consider one of the other methods below.

For example, you could use LVM2 to create a snapshot after the fsync+lock, and then use that snapshot to do an offsite backup in the background. This means that the server will only be locked while the snapshot is taken. Don't forget to unlock after the backup/snapshot is taken.

### Shutdown and Backup

A simple approach is just to stop the database, back up the data files, and resume. This is safe but of course requires downtime.

### Exports

The mongodump utility may be used to dump an entire database, even when the database is running and active. The dump can then be restored later if needed.

### Slave Backup

Another good technique for backups is replication to a slave database.  The slave polls master continuously and thus always has a nearly-up-to-date copy of master.

We then have several options for backing up the slave:

1. Fsync, write lock, and backup the slave.
2. Shut it down, backup, and restart.
3. Export from the slave.

For methods 1 and 2, after the backup the slave will resume replication, applying any changes made to master in the meantime.

Using a slave is advantageous because we then always have backup database machine ready in case master fails (failover). But a slave also gives us the chance to back up the full data set without affecting the performance of the master database.

### Community Stuff

- http://github.com/micahwedemeyer/automongobackup

# How to do Snapshotted Queries in the Mongo Database

> This document refers to query snapshots. For backup snapshots of the database's datafiles, see the fsync lock page.

MongoDB does not support full point-in-time snapshotting. However, some functionality is available which is detailed below.

#### Cursors

A MongoDB query returns data as well as a cursor ID for additional lookups, should more data exist. Drivers lazily perform a "getMore" operation as needed on the cursor to get more data. Cursors may have latent getMore accesses that occurs after an intervening write operation on the database collection (i.e., an insert, update, or delete).

Conceptually, a cursor has a current position. If you delete the item at the current position, the cursor automatically skips its current position forward to the next item.

Mongo DB cursors do not provide a snapshot: if other write operations occur during the life of your cursor, it is unspecified if your application will see the results of those operations. In fact, it is even possible (although unlikely) to see the same object returned twice if the object were updated and grew in size (and thus moved in the datafile). To assure no update duplications, use snapshot() mode (see below).

#### Snapshot Mode

snapshot() mode assures that objects which update during the lifetime of a query are returned once and only once. This is most important when doing a find-and-update loop that changes the size of documents that are returned ($inc does not change size).

```
> // mongo shell example
> var cursor = db.myCollection.find({country:'uk'}).snapshot();
```

Even with snapshot mode, items inserted or deleted during the query may or may not be returned; that is, this mode is not a true point-in-time snapshot.

Because snapshot mode traverses the _id index, it may not be used with sorting or explicit hints. It also cannot use any other index for the query.

You can get the same effect as snapshot by using any unique index on a field(s) that will not be modified (probably best to use explicit hint() too). If you want to use a non-unique index (such as creation time), you can make it unique by appending _id to the index at creation time.

## Import Export Tools

- mongoimport
  - Example: Importing Interesting Types
- mongoexport
- mongodump
  - Example: Dumping Everything
  - Example: Dumping a Single Collection
  - Example: Dumping a Single Collection to Stdout
- mongorestore
- bsondump

> If you just want to do Clone Database from one server to another you don't need these tools.

> These tool just work with the raw data (the documents in the collection); they do not save, or load, the metadata like the defined indexes or (capped) collection properties. You will need to (re)create those yourself in a separate step, before loading that data. Vote here to change this.

### *mongoimport*

This utility takes a single file that contains 1 JSON/CSV/TSV string per line and inserts it. You have to specify a database and a collection.

```
options:
  --help                  produce help message
  -v [ --verbose ]        be more verbose (include multiple times for more
                          verbosity e.g. -vvvvv)
  -h [ --host ] arg       mongo host to connect to ("left,right" for pairs)
  -d [ --db ] arg         database to use
  -c [ --collection ] arg collection to use (some commands)
  -u [ --username ] arg   username
  -p [ --password ] arg   password
  --dbpath arg            directly access mongod data files in the given path,
                          instead of connecting to a mongod instance - needs to
                          lock the data directory, so cannot be used if a
                          mongod is currently accessing the same path
  --directoryperdb        if dbpath specified, each db is in a separate
                          directory
  -f [ --fields ] arg     comma seperated list of field names e.g. -f name,age
  --fieldFile arg         file with fields names - 1 per line
  --ignoreBlanks          if given, empty fields in csv and tsv will be ignored
  --type arg              type of file to import.  default: json (json,csv,tsv)
  --file arg              file to import from; if not specified stdin is used
  --drop                  drop collection first
  --headerline            CSV,TSV only - use first line as headers
```

**Example: Importing Interesting Types**

MongoDB supports more types that JSON does, so it has a special format for representing some of these types as valid JSON. For example, JSON has no date type. Thus, to import data containing dates, you structure your JSON like:

```
{"somefield" : 123456, "created_at" : {"$date" : 1285679232000}}
```

Then `mongoimport` will turn the `created_at` value into a Date.

Note: the $-prefixed types must be enclosed in double quotes to be parsed correctly.

### *mongoexport*

This utility takes a collection and exports to either JSON or CSV. You can specify a filter for the query, or a list of fields to output.

> ⚠ Neither JSON nor TSV/CSV can represent all data types. Please be careful not to lose or change data (types) when using this. For full fidelity please use mongodump.

If you want to output CSV, you have to specify the fields in the order you want them.

Example

```
options:
  --help                  produce help message
  -v [ --verbose ]        be more verbose (include multiple times for more
                          verbosity e.g. -vvvvv)
  -h [ --host ] arg       mongo host to connect to ("left,right" for pairs)
  -d [ --db ] arg         database to use
  -c [ --collection ] arg where 'arg' is the collection to use
  -u [ --username ] arg   username
  -p [ --password ] arg   password
  --dbpath arg            directly access mongod data files in the given path,
                          instead of connecting to a mongod instance - needs to
                          lock the data directory, so cannot be used if a
                          mongod is currently accessing the same path
  --directoryperdb        if dbpath specified, each db is in a separate
                          directory
  -q [ --query ] arg      query filter, as a JSON string
  -f [ --fields ] arg     comma seperated list of field names e.g. -f name,age
  --csv                   export to csv instead of json
  -o [ --out ] arg        output file; if not specified, stdout is used
```

### *mongodump*

This takes a database and outputs it in a binary representation. This is mostly used for doing hot backups of a database.

> ⚠ If you're using sharding and try to migrate data this way, this will dump shard configuration information and overwrite configurations upon restore.

```
options:
  --help                   produce help message
  -v [ --verbose ]         be more verbose (include multiple times for more
                           verbosity e.g. -vvvvv)
  -h [ --host ] arg        mongo host to connect to ("left,right" for pairs)
  -d [ --db ] arg          database to use
  -c [ --collection ] arg  collection to use (some commands)
  -u [ --username ] arg    username
  -p [ --password ] arg    password
  --dbpath arg             directly access mongod data files in the given path,
                           instead of connecting to a mongod instance - needs
                           to lock the data directory, so cannot be used if a
                           mongod is currently accessing the same path
  --directoryperdb         if dbpath specified, each db is in a separate
                           directory
  -o [ --out ] arg (=dump) output directory
  --query
```

#### Example: Dumping Everything

To dump all of the collections in all of the databases, run `mongodump` with just the `--host`:

```
$ ./mongodump --host prod.example.com
connected to: prod.example.com
all dbs
DATABASE: log    to   dump/log
        log.errors to dump/log/errors.bson
                713 objects
        log.analytics to dump/log/analytics.bson
                234810 objects
DATABASE: blog    to    dump/blog
        blog.posts to dump/log/blog.posts.bson
                59 objects
DATABASE: admin    to    dump/admin
```

You'll then have a folder called "dump" in your current directory.

If you're running `mongod` locally on the default port, you can just do:

```
$ ./mongodump
```

**Example: Dumping a Single Collection**

If we just want to dump a single collection, we can specify it and get a single .bson file.

```
$ ./mongodump --db blog --collection posts
connected to: 127.0.0.1
DATABASE: blog        to     dump/blog
        blog.posts to dump/blog/posts.bson
                 59 objects
```

**Example: Dumping a Single Collection to Stdout**

In version 1.7.0+, you can use stdout instead of a file by specifying `--out stdout`:

```
$ ./mongodump --db blog --collection posts --out - > blogposts.bson
```

*mongodump* creates a file for each database collection, so we can only dump one collection at a time to stdout.

### *mongorestore*

This takes the output from mongodump and restores it.

```
usage: ./mongorestore [options] [directory or filename to restore from]
options:
  --help                  produce help message
  -v [ --verbose ]        be more verbose (include multiple times for more
                          verbosity e.g. -vvvvv)
  -h [ --host ] arg       mongo host to connect to ("left,right" for pairs)
  -d [ --db ] arg         database to use
  -c [ --collection ] arg collection to use (some commands)
  -u [ --username ] arg   username
  -p [ --password ] arg   password
  --dbpath arg            directly access mongod data files in the given path,
                          instead of connecting to a mongod instance - needs to
                          lock the data directory, so cannot be used if a
                          mongod is currently accessing the same path
  --directoryperdb        if dbpath specified, each db is in a separate
                          directory
  --drop                  drop each collection before import
  --objcheck              validate object before inserting
```

### *bsondump*

> Added in 1.6

This takes a bson file and converts it to json/debug output.

```
usage: ./bsondump [options] [filename]
options:
  --help                  produce help message
  --type arg (=json)      type of output: json,debug
```

# Durability and Repair


- Single Server Durability
- Repair Command
- Validate Command
- `--syncdelay` Command Line Option
- See Also


## Single Server Durability

The v1.8 release of MongoDB will have single server durability. You can follow the Jira here : http://jira.mongodb.org/browse/SERVER-980. Specifically, in v1.8, journaling will be added to the storage engine.

We recommend using replication to keep copies of data for now – and likely forever – as a single server could fail catastrophically regardless.

## Repair Command

> There is a bug with repair and replica sets in MongoDB v1.6.0. Please see this Jira for information: http://jira.mongodb.org/browse/SERVER-1614. Do NOT run repair without reading this first. This bug applies to 1.6.0 only. Will be fixed in 1.6.1. In the meantime there are workarounds.

After a machine crash or or `kill -9` termination, consider running the *repairDatabase* command. This command will check all data for corruption, remove any corruption found, and compact data files a bit.

In the event of a hard crash, we recommend running a repair – analogous to running *fsck*. If a slave crashes, another option is just to restart the slave from scratch.

From the command line:

```
mongod --repair
```

From the shell (you have to do for all dbs including local if you go this route):

```
> db.repairDatabase();
```

During a repair operation, *mongod* must store temporary files to disk. By default, *mongod* creates temporary directories under the dbpath for this purpose. Alternatively, the `--repairpath` command line option can be used to specify a base directory for temporary repair files.

Note that repair is a slow operation which inspects the entire database.

If the databases exited uncleanly and you attempt to restart the database, *mongod* will print:

```
**************
old lock file: /data/db/mongod.lock.  probably means unclean shutdown
recommend removing file and running --repair
see: http://dochub.mongodb.org/core/repair for more information
*************
```

Then it will exit. After running with `--repair`, *mongod* will start up normally.

### Validate Command

Alternatively one could restart and run the *validate* command on select collections. The *validate* command checks if the contents of a collection are valid.

For example, here we validate the `users` collection:

```
> db.users.validate();
{
 "ns" : "test.users",
 "result" : " validate
  details: 0x1243dbbdc ofs:740bdc
  firstExtent:0:178b00 ns:test.users
  lastExtent:0:178b00 ns:test.users
  # extents:1
  datasize?:44 nrecords?:1 lastExtentSize:8192
  padding:1
  first extent:
    loc:0:178b00 xnext:null xprev:null
    nsdiag:test.users
    size:8192 firstRecord:0:178bb0 lastRecord:0:178bb0
  1 objects found, nobj:1
  60 bytes data w/headers
  44 bytes data wout/headers
  deletedList: 0000000010000000000
  deleted: n: 1 size: 7956
  nIndexes:2
    test.users.$_id_ keys:1
    test.users.$username_1 keys:1 ",
 "ok" : 1,
 "valid" : true,
 "lastExtentSize" : 8192
}
```

### `--syncdelay` Command Line Option

Since 1.1.4, the `--syncdelay` option controls how often changes are flushed to disk (the default is 60 seconds). If replication is not being used, it may be desirable to reduce this default.

### See Also

- What About Durability? (MongoDB Blog)
- *fsync* Command
- MongoDB (Single-Server) Data Durability Guide

# Security and Authentication

## Running Without Security (Trusted Environment)

This is the default option and is recommended.

One valid way to run the Mongo database is in a trusted environment, with no security and authentication (much like how one would use, say, memcached). Of course, in such a configuration, one must be sure only trusted machines can access database TCP ports.

The current versions of sharding and replica sets requires trusted (nonsecure) mode.

## Mongo Security

The current version of Mongo supports only very basic security. One authenticates a username and password in the context of a particular database. Once authenticated, a normal user has full read and write access to the database in question while a read only user only has read access.

The `admin` database is special. In addition to several commands that are administrative being possible only on `admin`, authentication on `admin` gives one read and write access to all databases on the server. Effectively, `admin` access means root access to the server process.

Run the database (`mongod` process) with the `--auth` option to enable security. You **must** either have added a user to the `admin` db before starting the server with `--auth`, or add the first user from the localhost interface.

## Configuring Authentication and Security

Authentication is stored in each database's `system.users` collection. For example, on a database projectx, `projectx.system.users` will contain user information.

We should first configure an administrator user for the entire db server process. This user is stored under the special `admin` database.

If no users are configured in `admin.system.users`, one may access the database from the localhost interface without authenticating. Thus, from the server running the database (and thus on localhost), run the database shell and configure an administrative user:

```
$ ./mongo
> use admin
> db.addUser("theadmin", "anadminpassword")
```

We now have a user created for database `admin`. Note that if we have not previously authenticated, we now must if we wish to perform further operations, as there is a user in `admin.system.users`.

```
> db.auth("theadmin", "anadminpassword")
```

We can view existing users for the database with the command:

```
> db.system.users.find()
```

Now, let's configure a "regular" user for another database.

```
> use projectx
> db.addUser("joe", "passwordForJoe")
```

Finally, let's add a readonly user. (only supported in 1.3.2+)

```
> use projectx
> db.addUser("guest", "passwordForGuest", true)
```

### Changing Passwords

The shell `addUser` command may also be used to update a password: if the user already exists, the password simply updates.

Many Mongo drivers provide a helper function equivalent to the db shell's addUser method.

### Deleting Users

To delete a user:

```
db.system.users.remove( { user: username } )
```

### Ports

You can also do ip level security. See Production Notes for what ports MongoDB uses.

# Admin UIs

Several administrative user interfaces, or GUIs, are available for MongoDB. Tim Gourley's blog has a good summary of the tools.

- Fang of Mongo
- Futon4Mongo
- Mongo3
- MongoHub
- MongoVUE
- Mongui
- Myngo
- Opricot
- PHPMoAdmin
- RockMongo

- The built-in replica set admin UI

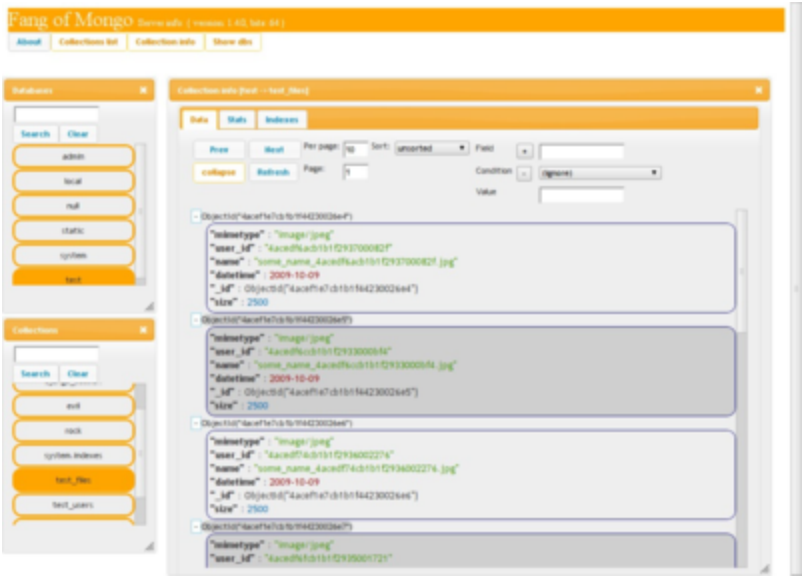
#### Commercial Offerings

- DatabaseMaster

## Details

#### Fang of Mongo

A web-based user interface for MongoDB build with django and jquery.




It will allow you to explore content of mongodb with simple but (hopefully) pleasant user interface.

Features:

- field name autocompletion in query builder
- data loading indicator
- human friendly collection stats
- disabling collection windows when there is no collection selected
- twitter stream plugin
- many more minor usability fixes
- works well on recent chrome and firefox

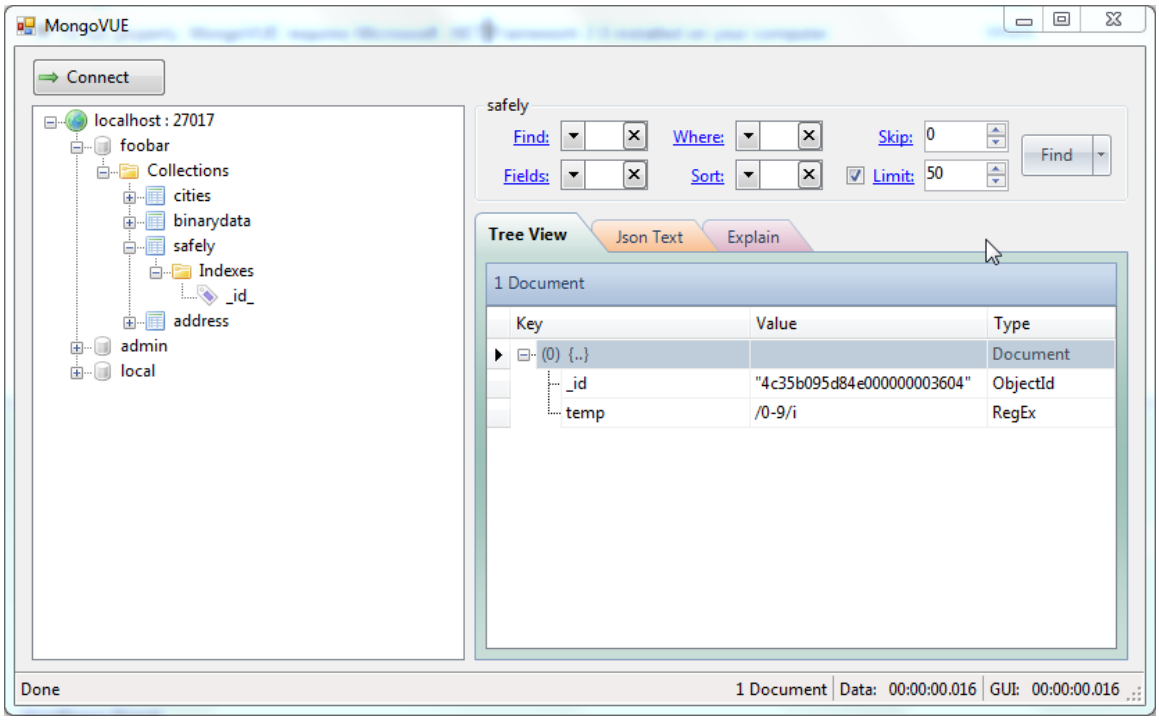
See it in action at: http://blueone.pl:8001/fangofmongo/
Get it from github: http://github.com/Fiedzia/Fang-of-Mongo
Or track progress on twitter: @fangofmongo

**MongoHub**

MongoHub is a native OS X GUI.

**MongoVUE**

MongoVUE is a .NET GUI for MongoDB.




**Opricot**

Opricot is a hybrid GUI/CLI/Scripting web frontend implemented in PHP to manage your MongoDB servers and databases. Use as a point-and-click adventure for basic tasks, utilize scripting for automated processing or repetitive things.

Opricot combines the following components to create a fully featured administration tool:

- An interactive console that allows you to either work with the database through the UI, or by using custom Javascript.
- A set of simple commands that wrap the Javascript driver, and provide an easy way to complete the most common tasks.
- Javascript driver for Mongo that works on the browser and talks with the AJAX interface.
- Simple server-side AJAX interface for communicating with the MongoDB server (currently available for PHP).

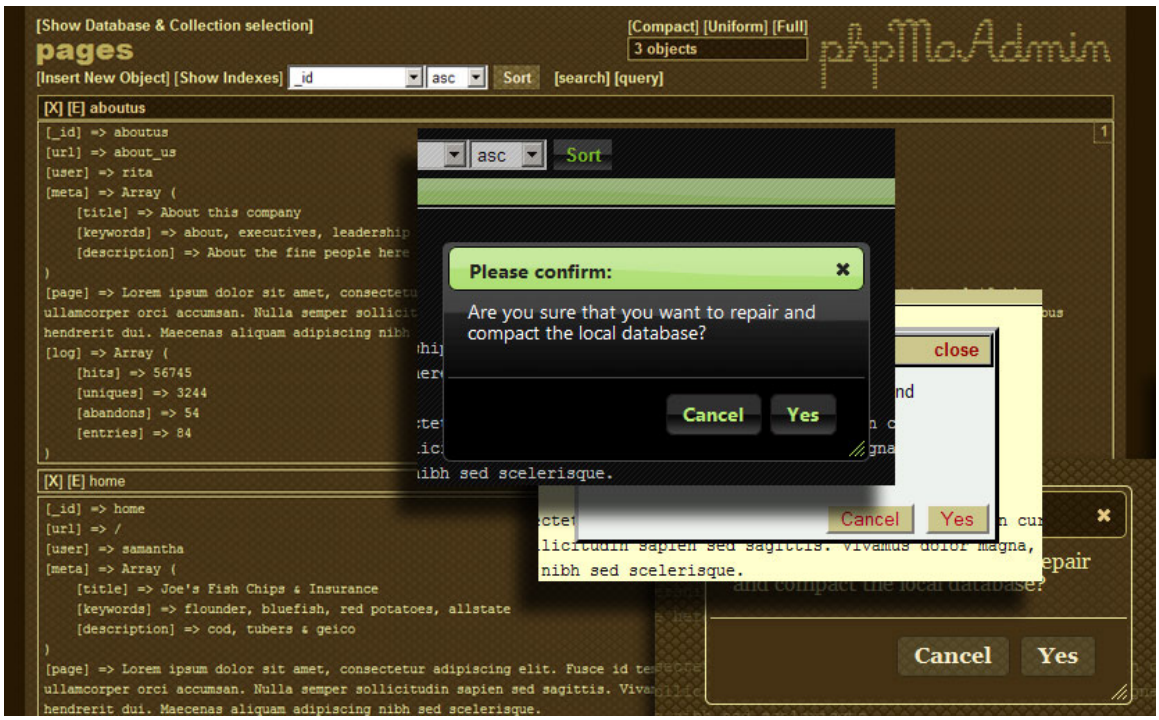
**PHPMoAdmin**

PHPMoAdmin is a MongoDB administration tool for PHP built on a stripped-down version of the Vork high-performance framework.

- Nothing to configure - place the moadmin.php file anywhere on your web site and it just works!
- Fast AJAX-based XHTML 1.1 interface operates consistently in every browser!
- Self-contained in a single 95kb file!
- Works on any version of PHP5 with the MongoDB NoSQL database installed & running.
- Super flexible - search for exact-text, text with * wildcards, regex or JSON (with Mongo-operators enabled)
- Option to enable password-protection for one or more users; to activate protection, just add the username-password(s) to the array at the top of the file.
- E_STRICT PHP code is formatted to the Zend Framework coding standards + fully-documented in the phpDocumentor DocBlock standard.
- Textareas can be resized by dragging/stretching the lower-right corner.
- Free & open-source! Release under the GPLv3 FOSS license!
- Option to query MongoDB using JSON or PHP-array syntax
- Multiple design themes to choose from
- Instructional error messages - phpMoAdmin can be used as a PHP-Mongo connection debugging tool

PHPMoAdmin can help you discover the source of connection issues between PHP and Mongo. Download phpMoAdmin, place the moadmin.php file in your web site document directory and navigate to it in a browser. One of two things will happen:

- You will see an error message explaining why PHP and Mongo cannot connect and what you need to do to fix it
- You will see a bunch of Mongo-related options, including a selection of databases (by default, the "admin" and "local" databases always exist) - if this is the case your installation was successful and your problem is within the PHP code that you are using to access MongoDB, troubleshoot that from the Mongo docs on php.net

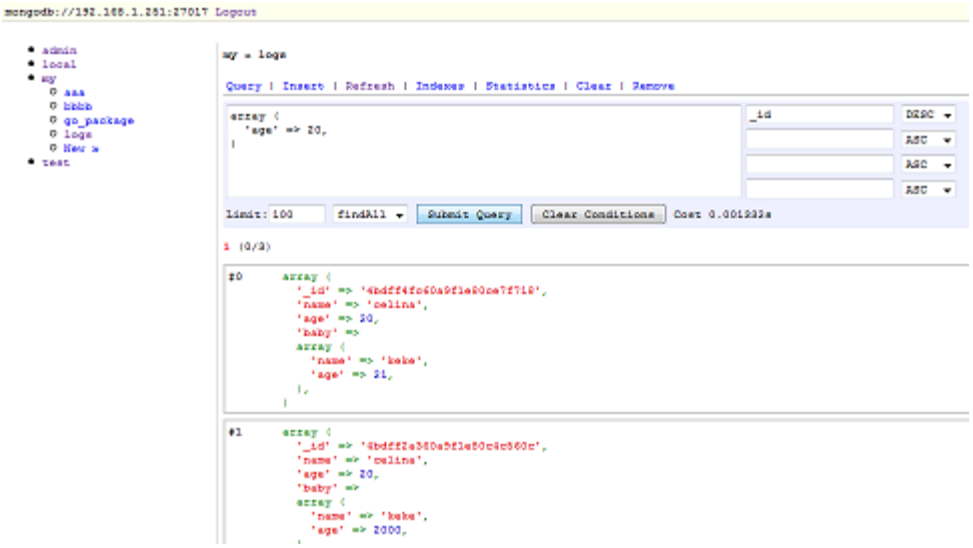



**RockMongo**

RockMongo is a MongoDB management tool, written in PHP 5.

Main features:

- easy to install, and open source
- multiple hosts, and multiple administrators for one host
- password protection
- query dbs
- advanced collection query tool
- read, insert, update, duplicate and remove single row
- query, create and drop indexes
- clear collection
- remove and change (only work in higher php_mongo version) criteria matched rows
- view collection statistics

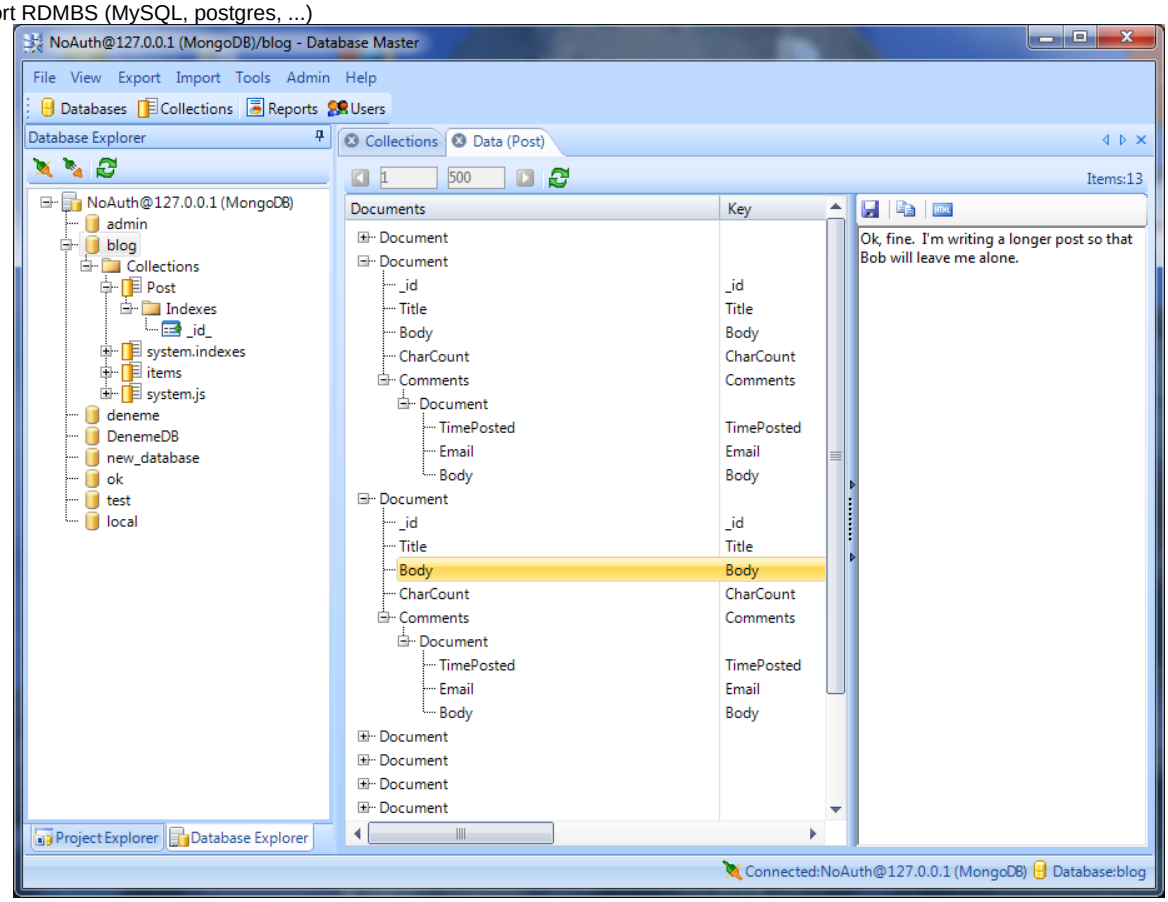



### *Commercial Tools*

**Database Master**

Database Master from Nucleon Software
Seems to be written in .net for windows (windows installer).
Features:

- Tree view for dbs and collections
- Create/Drop indexes
- Server/DB stats
- Support RDMBS (MySQL, postgres, ...)




## Starting and Stopping Mongo

- Starting Mongo
  - Default Data Directory, Default Port
  - Alternate Data Directory, Default Port
  - Alternate Port
  - Running as a Daemon
- Stopping Mongo
  - Control-C
  - Sending shutdownServer() message from the mongo shell
  - Sending a Unix INT or TERM signal
- Memory Usage


MongoDB is run as a standard program from the command line. Please see Command Line Parameters for more information on those options.

The following examples assume that you are in the directory where the Mongo executable is, and the Mongo executable is called `mongod`.

## Starting Mongo

### *Default Data Directory, Default Port*

To start Mongo in default mode, where data will be stored in the `/data/db` directory (or `c:\data\db` on Windows), and listening on port 27017, just type

```
$ ./mongod
```

### *Alternate Data Directory, Default Port*

To specify a directory for Mongo to store files, use the `--dbpath` option:

```
$ ./mongod --dbpath /var/lib/mongodb/
```

Note that you must create the directory and set its permissions appropriately ahead of time -- Mongo will not create the directory if it doesn't exist.

### *Alternate Port*

You can specify a different port for Mongo to listen on for connections from clients using the `--port` option

```
$ ./mongod --port 12345
```

This is useful if you want to run more than one instance of Mongo on a machine (e.g., for running a master-slave pair).

### *Running as a Daemon*

Note: these options are only available in MongoDB version 1.1 and later.

This will fork the Mongo server and redirect its output to a logfile.  As with `--dbpath`, you must create the log path yourself, Mongo will not create parent directories for you.

```
$ ./mongod --fork --logpath /var/log/mongodb.log --logappend
```

## Stopping Mongo

### *Control-C*

If you have Mongo running in the foreground in a terminal, you can simply "Ctrl-C" the process. This will cause Mongo to do a clean exit, flushing and closing it's data files. Note that it will wait until all ongoing operations are complete.

### *Sending shutdownServer() message from the mongo shell*

The shell can request that the server terminate.

```
$ ./mongo
> db.shutdownServer()
```

This command only works from localhost, or, if one is authenticated.

From a driver (where the helper function may not exist), one can run the command

```
{ "shutdown" : 1 }
```

#### *Sending a Unix INT or TERM signal*

You can cleanly stop `mongod` using a SIGINT or SIGTERM signal on Unix-like systems. Either ^C, "`kill -2 PID`," or `kill -15 PID` will work.

> Sending a KILL signal `kill -9` will probably cause damage as `mongod` will not be able to cleanly exit. (In such a scenario, run the repairDatabase command.)
>
> After a unclean shutdown, MongoDB will say it was not shutdown cleanly, and ask you to do a repair. This is absolutely not the same as corruption, this is MongoDB saying it can't 100% verify what's going on, and to be paranoid, run a repair.

### Memory Usage

Mongo uses memory mapped files to access data, which results in large numbers being displayed in tools like top for the mongod process. This is not a concern, and is normal when using memory-mapped files. Basically, the size of mapped data is shown in the virtual size parameter, and resident bytes shows how much data is being cached in RAM.

You can get a feel for the "inherent" memory footprint of Mongo by starting it fresh, with no connections, with an empty /data/db directory and looking at the resident bytes.

## Logging

MongoDB outputs some important information to stdout while its running. There are a number of things you can do to control this

### *Command Line Options*

- --quiet - less verbose output
- -v - more verbose output. use more v's (such as -vvvvvv) for higher levels of verbosity
- --logpath <file> output to file instead of stdout
    - if you use logpath, you can rotate the logs by either running the logRotate command (1.3.4+) or sending SIGUSR1

```
> db.runCommand("logRotate");
```

```
shell> kill -SIGUSR1 <mongod process id>
```

## Command Line Parameters

MongoDB can be configured via command line parameters in addition to File Based Configuration. You can see the currently supported set of command line options by running the database with `-h [ --help ]` as a single parameter:

```
$ ./mongod --help
```

Information on usage of these parameters can be found in Starting and Stopping Mongo.

The following list of options is not complete; for the complete list see the usage information as described above.

### *Basic Options*

| | |
|---|---|
| `-h \| --help` | Shows all options |
| `-f \| --config <file>` | Specify a configuration file to use |
| `--port <portno>` | Specifies the port number on which Mongo will listen for client connections. Default is 27017 |
| `--dbpath <path>` | Specifies the directory for datafiles. Default is `/data/db` or `c:\data\db` |
| `--fork` | Fork the server process |
| `--bind_ip <ip>` | Specifies a single IP that the database server will listen for |
| `--directoryperdb` | Specify use of an alternative directory structure, in which files for each database are kept in a unique directory. (since 1.3.2) |
| `--quiet` | Reduces amount of log output |
| `--nohttpinterface` | Disable the HTTP interface (localhost:28017) |
| `--rest` | Allow extended operations at the Http Interface |
| `--logpath <file>` | File to write logs to (instead of stdout). You can rotate the logs by sending SIGUSR1 to the server. |
| `--logappend` | Append to existing log file, instead of overwritting |
| `--repairpath <path>` | Root path for temporary files created during database repair. Default is `dbpath` value. |
| `--cpu` | Enables periodic logging of CPU utilization and I/O wait |
| `--noauth` | Turns off security. This is currently the default |
| `--auth` | Turn on security |
| `-v[v[v[v[v]]]] \| --verbose` | Verbose logging output (`-vvvvv` is most verbose, `-v == --verbose`) |
| `--objcheck` | Inspect all client data for validity on receipt (useful for developing drivers) |
| `--quota` | Enable db quota management |
| `--diaglog <n>` | Set oplogging level where n is 0=off (default) 1=W 2=R 3=both 7=W+some reads |
| `--nocursors` | Diagnostic/debugging option |
| `--nohints` | Ignore query hints |
| `--noscripting` | Turns off server-side scripting. This will result in greatly limited functionality |
| `--notablescan` | Turns off table scans. Any query that would do a table scan fails |
| `--noprealloc` | Disable data file preallocation |
| `--smallfiles` | Use a smaller default file size |
| `--nssize <MB>` | Specifies .ns file size for new databases |
| `--sysinfo` | Print system info as detected by Mongo and exit |
| `--nounixsocket` | disable listening on unix sockets (will not create socket files at /tmp/mongodb-<port>.sock) |
| `--upgrade` | Upgrade database files to new format if necessary<br>(required when upgrading from <= 1.0 to 1.1+) |

### *Master/Slave Replication Options*

| | |
|---|---|
| `--master` | Designate this server as a master in a master-slave setup |
| `--slave` | Designate this server as a slave in a master-slave setup |
| `--source <server:port>` | Specify the source (master) for a slave instance |
| `--only <db>` | Slave only: specify a single database to replicate |
| `--arbiter <server:port>` | Address of arbiter server |

| | |
|---|---|
| `--autoresync` | Automatically resync if slave data is stale |
| `--oplogSize <MB>` | Custom size for replication operation log |

### *Replica Set Options*

| | |
|---|---|
| `--replSet <setname>[/<seedlist>]` | Use replica sets with the specified logical set name. Typically the optional seed host list need not be specified. |
| `--oplogSize <MB>` | Custom size for replication operation log |

## File Based Configuration

In addition to accepting Command Line Parameters, MongoDB can also be configured using a configuration file. A configuration file to use can be specified using the `-f` or `--config` command line options. On some packaged installs of MongoDB (for example Ubuntu & Debian) the default file can be found in /etc/mongodb.conf which is automatically used when starting and stopping MongoDB from the service.

The following example configuration file demonstrates the syntax to use:

```
# This is an example config file for MongoDB.

dbpath = /var/lib/mongodb
bind_ip = 127.0.0.1
noauth = true # use 'true' for options that don't take an argument
verbose = true # to disable, comment out.
```

### Parameters

#### *Basic database configuration*

| Parameter | Meaning | Example |
|---|---|---|
| dbpath | Location of the database files | dbpath=/var/lib/mongodb |
| port | Port the mongod will listen on | port=27017 |
| logpath | Full filename path to where log messages will be written | logpath=/var/log/mongodb/mongodb.log |
| logappend | Whether the log file will be appended (TRUE) or over-written (FALSE) | logappend=true |

#### *Logging*

| Parameter | Meaning | Example |
|---|---|---|
| cpu | Enable periodic logging (TRUE) of CPU utilization and I/O wait | cpu = true |
| verbose | Verbose logging output | verbose=true |

#### *Security*

| Parameter | Meaning | Example |
|---|---|---|
| noauth | Turn authorization on/off. Off is currently the default | noauth = true |
| auth | Turn authorization on/off. Off is currently the default | auth=false |

#### *Administration & Monitoring*

| Parameter | Meaning | Example |
|---|---|---|
| nohttpinterface | Disable the HTTP interface. The default port is 1000 more than the dbport | nohttpinterface = true |
| noscripting | Turns off server-side scripting. This will result in greatly limited functionality | noscripting = true |

| | | |
|---|---|---|
| notablescan | Turns off table scans. Any query that would do a table scan fails. | notablescan = true |
| noprealloc | Disable data file preallocation. | noprealloc = true |
| nssize | Specify .ns file size for new databases in MB | nssize = 16 |
| mms-token | Account token for Mongo monitoring server. | mms-token=mytoken |
| mms-name | Server name for Mongo monitoring server. | mms-name=monitor.example.com |
| mms-interval | Ping interval for Mongo monitoring server in seconds. | mms-interval=15 |

### *Replication*

| Parameter | Meaning | Example |
|---|---|---|
| master | In replicated mongo databases, specify here whether this is a slave or master | master = true |
| slave | In replicated mongo databases, specify here whether this is a slave or master | slave = true |
| source | Specify the | source = master.example.com |
| only | Slave only: specify a single database to replicate | only = master.example.com |
| pairwith | Address of a server to pair with. | pairwith = master.example.com:27017 |
| arbiter | Address of arbiter server | arbiter = aribiter.example.com:27018 |
| autoresync | Automatically resync if slave data is stale | autoresync |
| oplogSize | Custom size for replication operation log in MB. | oplogSize=100 |
| opIdMem | Size limit for in-memory storage of op ids in Bytes | opIdMem=1000 |

### *Sharding*

| Parameter | Meaning | Example |
|---|---|---|
| shardsvr | Indicates that this mongod will participate in sharding | shardsvr=true |

#### *Notes*

- Lines starting with octothorpes (#) are comments
- Options are case sensitive
- The syntax is assignment of a value to an option name
- All command line options are accepted

# GridFS Tools

## File Tools

`mongofiles` is a tool for manipulating GridFS from the command line.

Example:

```
$ ./mongofiles list
connected to: 127.0.0.1

$ ./mongofiles put libmongoclient.a
connected to: 127.0.0.1
done!

$ ./mongofiles list
connected to: 127.0.0.1
libmongoclient.a 12000964

$ cd /tmp/

$ ~/work/mon/mongofiles get libmongoclient.a

$ ~/work/mongo/mongofiles get libmongoclient.a
connected to: 127.0.0.1
done write to: libmongoclient.a

$ md5 libmongoclient.a
MD5 (libmongoclient.a) = 23a52d361cfa7bad98099c5bad50dc41

$ md5 ~/work/mongo/libmongoclient.a
MD5 (/Users/erh/work/mongo/libmongoclient.a) = 23a52d361cfa7bad98099c5bad50dc41
```

## DBA Operations from the Shell

This page lists common DBA-class operations that one might perform from the MongoDB shell.

Note one may also create .js scripts to run in the shell for administrative purposes.

```
help                        show help
show dbs                    show database names
show collections            show collections in current database
show users                  show users in current database
show profile                show most recent system.profile entries with time >= 1ms
use <db name>               set curent database to <db name>

db.addUser (username, password)
db.removeUser(username)

db.cloneDatabase(fromhost)
db.copyDatabase(fromdb, todb, fromhost)
db.createCollection(name, { size : ..., capped : ..., max : ... } )

db.getName()
db.dropDatabase()
db.printCollectionStats()

db.currentOp() displays the current operation in the db
db.killOp() kills the current operation in the db

db.getProfilingLevel()
db.setProfilingLevel(level) 0=off 1=slow 2=all

db.getReplicationInfo()
db.printReplicationInfo()
db.printSlaveReplicationInfo()
db.repairDatabase()

db.version() current version of the server

db.shutdownServer()
```

Commands for manipulating and inspecting a collection:

```
db.foo.drop() drop the collection
db.foo.dropIndex(name)
db.foo.dropIndexes()
db.foo.getIndexes()
db.foo.ensureIndex(keypattern,options) - options object has these possible
                                         fields: name, unique, dropDups

db.foo.find( [query] , [fields])       - first parameter is an optional
                                         query filter. second parameter
                                         is optional
                                         set of fields to return.
                                   e.g. db.foo.find(
                                                  { x : 77 } ,
                                                  { name : 1 , x : 1 } )
db.foo.find(...).count()
db.foo.find(...).limit(n)
db.foo.find(...).skip(n)
db.foo.find(...).sort(...)
db.foo.findOne([query])

db.foo.getDB() get DB object associated with collection

db.foo.count()
db.foo.group( { key : ..., initial: ..., reduce : ...[, cond: ...] } )

db.foo.renameCollection( newName ) renames the collection

db.foo.stats()
db.foo.dataSize()
db.foo.storageSize() - includes free space allocated to this collection
db.foo.totalIndexSize() - size in bytes of all the indexes
db.foo.totalSize() - storage allocated for all data and indexes
db.foo.validate() (slow)

db.foo.insert(obj)
db.foo.update(query, object[, upsert_bool])
db.foo.save(obj)
db.foo.remove(query)                   - remove objects matching query
                                         remove({}) will remove all
```

# Architecture and Components

MongoDB has two primary components to the database server. The first is the mongod process which is the core database server. In many cases, mongod may be used as a self-contained system similar to how one would use mysqld on a server. Separate mongod instances on different machines (and data centers) can replicate from one to another.

Another MongoDB process, mongos, facilitates auto-sharding. mongos can be thought of as a "database router" to make a cluster of mongod processes appear as a single database. See the sharding documentation for more information.

### Database Caching

With relational databases, object caching is usually a separate facility (such as memcached), which makes sense as even a RAM page cache hit is a fairly expensive operation with a relational database (joins may be required, and the data must be transformed into an object representation). Further, memcached type solutions are more scaleable than a relational database.

Mongo eliminates the need (in some cases) for a separate object caching layer. Queries that result in file system RAM cache hits are very fast as the object's representation in the database is very close to its representation in application memory. Also, the MongoDB can scale to any level and provides an object cache and database integrated together, which is very helpful as there is no risk of retrieving stale data from the cache. In addition, the complex queries a full DBMS provides are also possible.

# Windows

## Windows Quick Links and Reference Center

### Running MongoDB on Windows

See the Quickstart page for info on how to install and run the database for the first time.

### Running as a Service

See the Windows Service page.

### The MongoDB Server

Get pre-built binaries on the Downloads page. Binaries are available for both 32 bit and 64 bit Windows. MongoDB uses memory-mapped files for data storage, so for servers managing more than 2GB of data you will definitely need the 64 bit version (and a 64 bit version of Windows).

### Writing Apps

You can write apps in almost any programming language – see the Drivers page. In particular C#, .NET, PHP, C and C++ work just fine.

- C Sharp Language Center

### Building

We recommend using the pre-built binaries, but Mongo builds fine with Visual Studio 2008 and 2010. See the Building for Windows page.

### Versions of Windows

We have successfully ran MongoDB (mongod etc.) on:

- Windows Server 2008 R2 64 bit
- Windows 7 (32 bit and 64 bit)
- Windows XP
- Vista

# Troubleshooting


- Excessive Disk Space
- Too Many Open Files

- mongod process "disappeared"
- See Also


## mongod process "disappeared"

Scenario here is the log ending suddenly with no error or shutdown messages logged.

On Unix, check /var/log/messages:

```
$ grep mongod /var/log/messages
$ grep score /var/log/messages
```

## See Also

- Diagnostic Tools

## Excessive Disk Space

You may notice that for a given set of data the MongoDB datafiles in /data/db are larger than the data set inserted into the database.  There are several reasons for this.

Preallocation

Each datafile is preallocated to a given size.  (This is done to prevent file system fragmentation, among other reasons.)  The first file for a database is <dbname>.0, then <dbname>.1, etc.  <dbname>.0 will be 64MB, <dbname>.1 128MB, etc., up to 2GB.  Once the files reach 2GB in size, each successive file is also 2GB.

Thus if the last datafile present is say, 1GB, that file might be 90% empty if it was recently reached.

Additionally, on Unix, mongod will preallocate an additional datafile in the background and do background initialization of this file. These files are prefilled with zero bytes. This inititialization can take up to a minute (less on a fast disk subsystem) for larger datafiles; without prefilling in the background this could result in significant delays when a new file must be prepopulated.

You can disable preallocation with the --noprealloc option to the server. This flag is nice for tests with small datasets where you drop the db after each test. It shouldn't be used on production servers.

For large databases (hundreds of GB or more) this is of no signficant consequence as the unallocated space is small.

Deleted Space

MongoDB maintains deleted lists of space within the datafiles when objects or collections are deleted. This space is reused but never freed to the operating system.

To compact this space, run db.repairDatabase() from the mongo shell (note this operation will block and is slow).

When testing and investigating the size of datafiles, if your data is just test data, use db.dropDatabase() to clear all datafiles and start fresh.

Checking Size of a Collection

Use the validate command to check the size of a collection -- that is from the shell run:

```
> db.<collectionname>.validate();

> // these are faster:
> db.<collectionname>.dataSize(); // just data size for collection
> db.<collectionname>.storageSize(); // allocation size including unused space
> db.<collectionname>.totalSize(); // data + index
> db.<collectionname>.totalIndexSize(); // index data size
```

This command returns info on the collection data but note there is also data allocated for associated indexes. These can be checked with validate too, if one looks up the index's namespace name in the system.namespaces collection. For example:

```
> db.system.namespaces.find()
{"name" : "test.foo"}
{"name" : "test.system.indexes"}
{"name" : "test.foo.$_id_"}
> > db.foo.$_id_.validate()
{"ns" : "test.foo.$_id_" , "result" : "
validate
  details: 0xb3590b68 ofs:83fb68
  firstExtent:0:8100 ns:test.foo.$_id_
  lastExtent:0:8100 ns:test.foo.$_id_
  # extents:1
  datasize?:8192 nrecords?:1 lastExtentSize:131072
  padding:1
  first extent:
    loc:0:8100 xnext:null xprev:null
    ns:test.foo.$_id_
    size:131072 firstRecord:0:81b0 lastRecord:0:81b0
  1 objects found, nobj:1
  8208 bytes data w/headers
  8192 bytes data wout/headers
  deletedList: 0000000000001000000
  deleted: n: 1 size: 122688
  nIndexes:0
" , "ok" : 1 , "valid" : true , "lastExtentSize" : 131072}
```

## Too Many Open Files

If you receive the error "too many open files" or "too many open connections" in the mongod log, there are a couple of possible reasons for this.

First, to check what file descriptors are in use, run lsof (some variations shown below):

```
lsof | grep mongod
lsof | grep mongod | grep TCP
lsof | grep mongod | grep data | wc
```

If most lines include "TCP", there are many open connections from client sockets. If most lines include the name of your data directory, the open files are mostly datafiles.

### *ulimit*

If the numbers from lsof look reasonable, check your ulimit settings. The default for file handles (often 1024) might be too low for production usage. Run ulimit -a (or limit -a depending on shell) to check.

Use ulimit -n X to change the max number of file handles to X. If your OS is configured to not allow modifications to that setting you might need to reconfigure first. On ubuntu you'll need to edit /etc/security/limits.conf and add a line something like the following (where user is the username and X is the desired limit):

```
user hard nofile X
```

Upstart uses a different mechanism for setting file descriptor limits - add something like this to your job file:

```
limit nofile X
```

### *High TCP Connection Count*

If lsof shows a large number of open TCP sockets, it could be that one or more clients is opening too many connections to the database. Check that your client apps are using connection pooling.

# Contributors


- JS Benchmarking Harness
- MongoDB kernel code development rules
- Project Ideas
- UI
- Source Code
- Building
- Database Internals
- Contributing to the Documentation

- 10gen Contributor Agreement


## JS Benchmarking Harness

CODE:

```
db.foo.drop();
db.foo.insert( { _id : 1 } )

ops = [
    { op : "findOne" , ns : "test.foo" , query : { _id : 1 } }
]

for ( x = 1; x<=128; x*=2){
    res = benchRun( { parallel : x ,
                      seconds : 5 ,
                      ops : ops
                    } )
    print( "threads: " + x + "\t queries/sec: " + res.query )
}
```

More info:

http://github.com/mongodb/mongo/commit/3db3cb13dc1c522db8b59745d6c74b0967f1611c

# MongoDB kernel code development rules

Coding conventions for the MongoDB C++ code...


- Git Commit Rules
- Kernel class rules
- Kernel code style
- Kernel concurrency rules
- Kernel exception architecture
- Kernel Logging
- Kernel string manipulation
- Writing Tests


## Git Commit Rules

- commit messages should have the case in the message SERVER-XXX
- commit messages should be descriptive enough that a glance can tell the basics
- commits should only include 1 thought.

## Kernel class rules

#### new classes

- By default, use `explicit` constructors
- Inherit from boost::noncopyable unless you have implemented copy constructor and assignment.

#### non-publics

Put the public interface at the top and the private stuff at the bottom. Except when the compiler insists otherwise.

#### inheritance

- No multiple inheritance.
- Be very careful about adding the FIRST virtual function to a class as you then have a vtable entry for every object.
- If anything is virtual, make your destructor virtual.

- details on destructor guards? when and where?

## Kernel code style


- case
- inlines
- strings
- brackets
- class members
- templates
- namespaces
- start of file
- assertions


#### case

Use camelCase for

- most `varNames`
- `--commandLineOptions`
- { commandNames : 1 }

#### inlines

- Put long inline functions in a `-inl.h` file.

- If your inline function is a single line long, put it and its decl on the same line e.g.:

```
    int length() const { return _length; }
```

- If a function is not performance sensitive, and it isn't one (or 2) lines long, put it in the cpp file.

#### strings

See

- utils/mongoutils/str.h
- bson/stringdata.h

Use `str::startsWith()`, `str::endsWith()`, not `strstr()`.

Use `<< 'c'` not `<< "c"`.

Use `str[0] == '\0'` not `strlen(str) == 0`.

See Kernel string manipulation.

#### brackets

```
if ( 0 ) {
}
```

#### class members

```
class Foo {
   int _bar;
};
```

#### templates

```
set<int> s;
```

#### namespaces

```
namespace foo {
   int foo;
   namespace bar {
      int bar;
   }
}
```

#### start of file

```
// @file <filename>
license
```

#### assertions

See Kernel exception architecture.

## Kernel concurrency rules

All concurrency code must be placed under `utils/concurrency`. You will find several helper libraries there.

Several rules are listed below. Don't break them. If you think there is a real need let's have the group weigh in and get a concensus on the

exception.

- Do not use/add recursive locks.
- Do not use rwlocks.
- Always acquire locks in a consistent order. In fact, the MutexDebugger can assist with verification of this. MutexDebugger is on for _DEBUG builds and will alert if locks are taken in opposing orders during the run.

## Kernel exception architecture

There are several different types of assertions used in the MongoDB code. In brief:

- `assert` should be used for internal assertions. However, massert is preferred.
- `massert` is an internal assertion with a message.
- `uassert` is used for a user error
- `wassert` warn (log) and continue

Both `massert` and `uassert` take error codes, so that all errors have codes associated with them. These error codes are assigned randomly, so there aren't segments that have meaning. scons checks for duplicates, but if you want the next available code you can run:

```
python buildscripts/errorcodes.py
```

A failed assertion throws an `AssertionException` or a child of that. The inheritance hierarchy is something like:

- std::exception
  - mongo::DBException
    - mongo::AssertionException
      - mongo::UserAssertionException
      - mongo::MsgAssertionException

See `util/assert_util.h`.

Generally, code in the server should be prepared to catch a DBException. UserAssertionException's are particularly common as errors and should be expected. We use resource acquisition is initialization heavily.

## Kernel Logging

- Basic Rules
  - cout/cerr should never be used
- Normal Logging

  - `log( int x )`

  debugging with levels of verbosity

  - `log()`

  informational

  - `warning()`

  warnings

  - `error()`

  errors
- Debugging Helpers
  - PRINT = prints variable name and (string)
  - GEODEBUG, etc... = used for incredibly verbose logging for a section of code that has to be turned on at compile time

## Kernel string manipulation

For string manipulation, use the `util/mongoutils/str.h` library.

#### `mongoutils`

MongoUtils has its own namespace. Its code has these basic properties:

1. are not database specific, rather, true utilities
2. are cross platform
3. may require boost headers, but not libs (header-only works with mongoutils)
4. are clean and easy to use in any c++ project without pulling in lots of other stuff
5. apache license

#### `str.h`

`mongoutils/str.h` provides string helper fucntions for each manipulation. Add new functions here rather than lines and lines of code to your app that are not generic.

Typically these fucntions return a string and take two as paramters : string f(string,string). Thus we wrap them all in a namespace called `str`.

#### `StringData`

See also `bson/stringdata.h`.

## Writing Tests

We have three general flavors of tests currently.

#### Lightweight startup test.

You can inherit from class `UnitTest` and make a test that runs at program startup. These tests run EVERY TIME the program starts. Thus, they should be minimal: the test should ideally take 1ms or less to run. Why run the tests in the general program? This gives some validation at program run time that the build is reasonable. For example, we test that pcre supports UTF8 regex in one of these tests at startup. If someone had built the server with other settings, this would be flagged upon execution, even if the test suite has not been invoked.

#### dbtests

#### jstests

#### See Also

- Smoke Tests

# Project Ideas

If you're interested in getting involved in the MongoDB community (or the open source community in general) a great way to do so is by starting or contributing to a MongoDB related project. Here we've listed some project ideas for you to get started on. For some of these ideas projects are already underway, and for others nothing (that we know of) has been started yet.

### A GUI

One feature that is often requested for MongoDB is a GUI, much like CouchDB's futon or phpMyAdmin. There are a couple of projects working on this sort of thing that are worth checking out:

http://github.com/sbellity/futon4mongo
http://www.mongodb.org/display/DOCS/Http+Interface
http://www.mongohq.com

We've also started to spec out the features that a tool like this should provide.

### Try Mongo!

It would be neat to have a web version of the MongoDB Shell that allowed users to interact with a real MongoDB instance (for doing the tutorial, etc). A project that does something similar (using a basic MongoDB emulator) is here:

http://github.com/banker/mongulator

### Real-time Full Text Search Integration

It would be interesting to try to nicely integrate a search backend like Xapian, Lucene or Sphinx with MongoDB. One idea would be to use MongoDB's oplog (which is used for master-slave replication) to keep the search engine up to date.

### GridFS FUSE

There is a project working towards creating a FUSE filesystem on top of GridFS - something like this would create a bunch of interesting potential uses for MongoDB and GridFS:

http://github.com/mikejs/gridfs-fuse

### GridFS Web Server Modules

There are a couple of modules for different web servers designed to allow serving content directly from GridFS:

Nginx: http://github.com/mdirolf/nginx-gridfs
Lighttpd: http://bitbucket.org/bwmcadams/lighttpd-gridfs

### Framework Adaptors

Working towards adding MongoDB support to major web frameworks is a great project, and work has been started on this for a variety of different frameworks (please use google to find out if work has already been started for your favorite framework).

### Logging and Session Adaptors

MongoDB works great for storing logs and session information. There are a couple of projects working on supporting this use case directly.

Logging:
Zend: http://raphaelstolt.blogspot.com/2009/09/logging-to-mongodb-and-accessing-log.html
Python: http://github.com/andreisavu/mongodb-log
Rails: http://github.com/peburrows/mongo_db_logger

Sessions:
web.py: http://github.com/whilefalse/webpy-mongodb-sessions
Beaker: http://pypi.python.org/pypi/mongodb_beaker

### Package Managers

Add support for installing MongoDB with your favorite package manager and let us know!

### Locale-aware collation / sorting

MongoDB doesn't yet know how to sort query results in a locale-sensitive way.  If you can think up a good way to do it and implement it, we'd like to know!

### Drivers

If you use an esoteric/new/awesome programming language write a driver to support MongoDB! Again, check google to see what people have started for various languages.

Some that might be nice:

- Scheme (probably starting with PLT)
- GNU R
- Visual Basic
- Lisp (e.g, Common Lisp)
- Delphi
- Falcon

### Write a killer app that uses MongoDB as the persistance layer!

## UI

Spec/requirements for a future MongoDB admin UI.

- list databases
    - repair, drop, clone?
- collections
    - validate(), datasize, indexsize, clone/copy

- indexes
- queries - explain() output
- security: view users, adjust
- see replication status of slave and master
- sharding
- system.profile viewer ; enable disable profiling
- curop / killop support

## Source Code

All source for MongoDB, it's drivers, and tools is open source and hosted at Github .

- Mongo Database (includes C++ driver)
- Python Driver
- PHP Driver
- Ruby Driver
- Java Driver
- Perl Driver

(Additionally, community drivers and tools also exist and will be found in other places.)

### See Also

- Building
- License

## Building

This section provides instructions on setting up your environment to write Mongo drivers or other infrastructure code. For specific instructions, go to the document that corresponds to your setup.

Note: see the Downloads page for prebuilt binaries!

Sub-sections of this section:

- Building Boost
- Building for FreeBSD
- Building for Linux
- Building for OS X
- Building for Solaris
- Building for Windows
- Building Spider Monkey
- scons

### See Also

- The main Database Internals page
- Building with V8

## Building Boost

- Windows

MongoDB uses the [www.boost.org] C++ libraries.

### Windows

See also the prebuilt libraries page.

By default c:\boost\ is checked for the boost files. Include files should be under \boost\boost, and libraries in \boost\lib.

First download the boost source. Then use the 7 Zip utility to extra the files. Place the extracted files in C:\boost.

Then we will compile the required libraries.

See buildscripts/buildboost.bat and buildscripts/buildboost64.bat for some helpers.

```
> rem set PATH for compiler:
> "C:\Program Files (x86)\Microsoft Visual Studio 10.0\VC\vcvarsall.bat"
>
> rem build the bjam make tool:
> cd \boost\tools\jam\src\
> build.bat
>
> cd \boost
> tools\jam\src\bin.ntx86\bjam --help
> rem see also mongo/buildscripts/buildboost*.bat
> rem build DEBUG libraries:
> tools\jam\src\bin.ntx86\bjam variant=debug threading=multi --with-program_options --with-filesystem
--with-date_time --with-thread
> mkdir lib
> move stage\lib\* lib\
```

## Building for FreeBSD

On FreeBSD 8.0 and later, there is a mongodb port you can use.

For FreeBSD <= 7.2:

1. Get the database source: http://www.github.com/mongodb/mongo.
2. Update your ports tree:

   ```
   $ sudo portsnap fetch && portsnap extract
   ```

   The packages that come by default on 7.2 and older are too old, you'll get weird errors when you try to run the database)
3. Install SpiderMonkey:

   ```
   $ cd /usr/ports/lang/spidermonkey && make && make install
   ```

4. Install scons:

   ```
   $ cd /usr/ports/devel/scons && make && make install
   ```

5. Install boost: (it will pop up an X "GUI", select `PYTHON`)

   ```
   $ cd /usr/ports/devel/boost-all && make && make install
   ```

6. Install libexecinfo:

   ```
   $ cd /usr/ports/devel/libexecinfo && make && make install
   ```

7. Change to the database source directory
8. `scons .`

### *See Also*

- Building for Linux - many of the details there including how to clone from git apply here too.

## Building for Linux


- General Instructions
- Special Notes about Spider Monkey
- Package Requirements
  - Fedora
    - Fedora 8 or 10
    - Ubuntu
    - Ubuntu 8.04

    - Ubuntu 9.04 and 9.10
    - Ubuntu 10.04
- See Also


### General Instructions

1. Install Dependencies - see platform specific below
2. get source

```
git clone git://github.com/mongodb/mongo.git
# pick a stable version unless doing true dev
git tag -l
# Switch to a stable branch (unless doing development) --
# an even second number indicates "stable".  (Although with
# stharding you will want the latest if the latest is less
# than 1.6.0.) For example:
git checkout r1.4.1
```

3. build

```
scons all
```

4. install

```
scons --prefix=/opt/mongo install
```

### Special Notes about Spider Monkey

Most pre-built spider monkey binaries don't have UTF8 compiled in. Additionally, ubuntu has a weird version of spider monkey that doesn't support everything we use. If you get any warnings during compile time or runtime, we highly recommend building spider monkey from source. See Building Spider Monkey for more information.

We currently support spider monkey 1.6 and 1.7, although there is some degredation with 1.6, so we recommend using 1.7. We have not yet tested 1.8, but will once it is officially released.

### Package Requirements

#### *Fedora*

##### Fedora 8 or 10

```
sudo yum -y install git tcsh scons gcc-c++ glibc-devel
sudo yum -y install boost-devel pcre-devel js-devel readline-devel
#for release builds:
sudo yum -y install boost-devel-static readline-static ncurses-static
```

##### Ubuntu

See spider monkey note above.

##### Ubuntu 8.04

```
apt-get -y install tcsh git-core scons g++
apt-get -y install libpcre++-dev libboost-dev libreadline-dev xulrunner-1.9-dev
apt-get -y install libboost-program-options-dev libboost-thread-dev libboost-filesystem-dev
libboost-date-time-dev
```

##### Ubuntu 9.04 and 9.10

```
apt-get -y install tcsh git-core scons g++
apt-get -y install libpcre++-dev libboost-dev libreadline-dev xulrunner-1.9.1-dev
apt-get -y install libboost-program-options-dev libboost-thread-dev libboost-filesystem-dev
libboost-date-time-dev
```

**Ubuntu 10.04**

```
apt-get -y install tcsh git-core scons g++
apt-get -y install libpcre++-dev libboost-dev libreadline-dev xulrunner-dev
apt-get -y install libboost-program-options-dev libboost-thread-dev libboost-filesystem-dev
libboost-date-time-dev
```

### See Also

- The Building page for setup information for other operating systems
- The main Database Internals page

## Building for OS X


- Upgrading to Snow Leopard
- Setup
  - Package Manager Setup (32bit)
  - Manual Setup
    - Install Apple developer tools
    - Install libraries (32bit option)
    - Install libraries (64bit option)
- Compiling
- XCode
- Troubleshooting


To set up your OS X computer for MongoDB development:

### Upgrading to Snow Leopard

If you have installed Snow Leopard, the builds will be 64 bit -- so if moving from a previous OS release, a bit more setup may be required than one might first expect.

1. Install XCode tools for Snow Leopard.
2. Install MacPorts (snow leopard version). If you have MacPorts installed previously, we've had the most success by running `rm -rf /opt/local` first.
3. Update/install packages: `sudo port install boost pcre`.
4. Update/install SpiderMonkey with `sudo port install spidermonkey`. (If this fails, see the note on #2 above.)

### Setup

1. Install git. If not already installed, download the source and run `./configure; make; sudo make install`
   - Then: git clone git://github.com/mongodb/mongo.git (more info)
   - Then: git tag -l to see tagged version numbers
   - Switch to a stable branch (unless doing development) -- an even second number indicates "stable". (Although with stharding you will want the latest if the latest is less than 1.6.0.) For example:
     - git checkout r1.4.1
   - If you do not wish to install git you can instead get the source code from the Downloads page.

1. Install gcc.
   gcc version 4.0.1 (from XCode Tools install) works, but you will receive compiler warnings. The easiest way to upgrade gcc is to install the iPhone SDK.

#### *Package Manager Setup (32bit)*

1. Install libraries (using macports)

```
port install boost pcre++ spidermonkey
```

#### *Manual Setup*

**Install Apple developer tools**

**Install libraries (32bit option)**

1. Download boost {{boost 1.37.0 http://downloads.sourceforge.net/boost/boost_1_37_0.tar.gz}}Apply the following patch:

```
diff -u -r a/configure b/configure
--- a/configure 2009-01-26 14:10:42.000000000 -0500
+++ b/configure 2009-01-26 10:21:29.000000000 -0500
@@ -9,9 +9,9 @@

 BJAM=""
 TOOLSET=""
-BJAM_CONFIG=""
+BJAM_CONFIG="--layout=system"
 BUILD=""
 PREFIX=/usr/local
 EPREFIX=
diff -u -r a/tools/build/v2/tools/darwin.jam b/tools/build/v2/tools/darwin.jam
--- a/tools/build/v2/tools/darwin.jam   2009-01-26 14:22:08.000000000 -0500
+++ b/tools/build/v2/tools/darwin.jam   2009-01-26 10:22:08.000000000 -0500
@@ -367,5 +367,5 @@

 actions link.dll bind LIBRARIES
 {
-    "$(CONFIG_COMMAND)" -dynamiclib -Wl,-single_module -install_name "$(<:B)$(<:S)" -L
"$(LINKPATH)" -o "$(<)" "$(>)" "$(LIBRARIES)" -l$(FINDLIBS-SA) -l$(FINDLIBS-ST)
$(FRAMEWORK_PATH) -framework$(_)$(FRAMEWORK:D=:S=) $(OPTIONS) $(USER_OPTIONS)
+    "$(CONFIG_COMMAND)" -dynamiclib -Wl,-single_module -install_name
"/usr/local/lib/$(<:B)$(<:S)" -L"$(LINKPATH)" -o "$(<)" "$(>)" "$(LIBRARIES)" -l$(FINDLIBS-SA)
-l$(FINDLIBS-ST) $(FRAMEWORK_PATH) -framework$(_)$(FRAMEWORK:D=:S=) $(OPTIONS) $(USER_OPTIONS)
 }
```

   then,

```
./configure; make; sudo make install
```

2. Install `pcre` `http://www.pcre.org/` (must enable UTF8)

```
./configure --enable-utf8 --enable-unicode-properties  --with-match-limit=200000
--with-match-limit-recursion=4000; make; sudo make install
```

3. Install c++ unit test framework `http://unittest.red-bean.com/` (optional)

```
./configure; make; sudo make install
```

**Install libraries (64bit option)**

(The 64bit libraries will be installed in /usr/64/{include,lib}.)

1. Download SpiderMonkey: ftp://ftp.mozilla.org/pub/mozilla.org/js/js-1.7.0.tar.gz

Apply the following patch:

```
diff -u  -r js/src/config/Darwin.mk js-1.7.0/src/config/Darwin.mk
--- js/src/config/Darwin.mk 2007-02-05 11:24:49.000000000 -0500
+++ js-1.7.0/src/config/Darwin.mk 2009-05-11 10:18:37.000000000 -0400
@@ -43,7 +43,7 @@
 # Just ripped from Linux config
 #

-CC = cc
+CC = cc -m64
 CCC = g++
 CFLAGS +=  -Wall -Wno-format
 OS_CFLAGS = -DXP_UNIX -DSVR4 -DSYSV -D_BSD_SOURCE -DPOSIX_SOURCE -DDARWIN
@@ -56,9 +56,9 @@
 #.c.o:
 #      $(CC) -c -MD $*.d $(CFLAGS) $<

-CPU_ARCH = $(shell uname -m)
+CPU_ARCH = "X86_64"
 ifeq (86,$(findstring 86,$(CPU_ARCH)))
-CPU_ARCH = x86
+CPU_ARCH = x86_64
 OS_CFLAGS+= -DX86_LINUX
 endif
 GFX_ARCH = x
@@ -81,3 +81,14 @@
 # Don't allow Makefile.ref to use libmath
 NO_LIBM = 1

+ifeq ($(CPU_ARCH),x86_64)
+# Use VA_COPY() standard macro on x86-64
+# FIXME: better use it everywhere
+OS_CFLAGS += -DHAVE_VA_COPY -DVA_COPY=va_copy
+endif
+
+ifeq ($(CPU_ARCH),x86_64)
+# We need PIC code for shared libraries
+# FIXME: better patch rules.mk & fdlibm/Makefile*
+OS_CFLAGS += -DPIC -fPIC
+endif
```

compile and install

```
cd src
make -f Makefile.ref
sudo JS_DIST=/usr/64 make -f Makefile.ref export
```

remove the dynamic library

```
sudo rm /usr/64/lib64/libjs.dylib
```

# Download boost {{boost 1.37.0 http://downloads.sourceforge.net/boost/boost_1_37_0.tar.gz}}Apply the following patch:

```
diff -u -r a/configure b/configure
--- a/configure 2009-01-26 14:10:42.000000000 -0500
+++ b/configure 2009-01-26 10:21:29.000000000 -0500
@@ -9,9 +9,9 @@

 BJAM=""
 TOOLSET=""
-BJAM_CONFIG=""
+BJAM_CONFIG="architecture=x86 address-model=64 --layout=system"
 BUILD=""
-PREFIX=/usr/local
+PREFIX=/usr/64
 EPREFIX=
 LIBDIR=
 INCLUDEDIR=
diff -u -r a/tools/build/v2/tools/darwin.jam b/tools/build/v2/tools/darwin.jam
--- a/tools/build/v2/tools/darwin.jam   2009-01-26 14:22:08.000000000 -0500
+++ b/tools/build/v2/tools/darwin.jam   2009-01-26 10:22:08.000000000 -0500
@@ -367,5 +367,5 @@

 actions link.dll bind LIBRARIES
 {
-    "$(CONFIG_COMMAND)" -dynamiclib -Wl,-single_module -install_name "$(<:B)$(<:S)" -L"$(LINKPATH)"
-o "$(<)" "$(>)" "$(LIBRARIES)" -l$(FINDLIBS-SA) -l$(FINDLIBS-ST) $(FRAMEWORK_PATH)
-framework$(_)$(FRAMEWORK:D=:S=) $(OPTIONS) $(USER_OPTIONS)
+    "$(CONFIG_COMMAND)" -dynamiclib -Wl,-single_module -install_name "/usr/64/lib/$(<:B)$(<:S)" -L
"$(LINKPATH)" -o "$(<)" "$(>)" "$(LIBRARIES)" -l$(FINDLIBS-SA) -l$(FINDLIBS-ST) $(FRAMEWORK_PATH)
-framework$(_)$(FRAMEWORK:D=:S=) $(OPTIONS) $(USER_OPTIONS)
 }
```

then,

```
./configure; make; sudo make install
```

# Install `pcre` http://www.pcre.org/ (must enable UTF8)

```
CFLAGS="-m64" CXXFLAGS="-m64" LDFLAGS="-m64" ./configure --enable-utf8 --with-match-limit=200000
--with-match-limit-recursion=4000 --enable-unicode-properties --prefix /usr/64; make; sudo make
install
```

# Install unit test framework http://unittest.red-bean.com/ (optional)

```
CFLAGS="-m64" CXXFLAGS="-m64" LDFLAGS="-m64" ./configure --prefix /usr/64; make; sudo make install
```

### Compiling

To compile 32bit, just run

```
scons
```

To compile 64bit on 10.5 (64 is default on 10.6), run

```
scons --64
```

### XCode

You can open the project with:

```
$ open mongo.xcodeproj/
```

You need to add an executable target.:

1. In the mongo project window, go to the **Executables**, right click and choose **Add**->**NewCustomExecutable**.
2. Name it `db`. Path is *./db/db*.
   It will appear under **Executables**".
3. Double-click on it.
4. Under **general**, set the working directory to the project directory.
5. Under **arguments**, add `run`.
6. Go to **general prefs (cmd ,)**, go to **debugging** and turn off `lazy load`.
   (Seems to be an issue that prevents breakpoints from working in debugger?)

### Troubleshooting

- Undefined symbols: "_PR_NewLock", referenced from: _JS_Init in libjs.a.
  - Try not using the scons `--release` option (if you are using it). That option attempts to use static libraries.

## Building for Solaris

MongoDB server currently supports little endian Solaris operation. (Although most drivers – not the database server – work on both.)

Community: Help us make this rough page better please! (And help us add support for big endian please...)

### *Prerequisites:*

- g++ 4.x (SUNWgcc)
- scons (need to install from source)
- spider monkey Building Spider Monkey
- pcre (SUNWpcre)
- boost (need to install from source)

### *See Also*

- Joyent
- Building for Linux - many of the details there including how to clone from git apply here too

## Building for Windows

MongoDB can be compiled for Windows (32 and 64 bit) using Visual C++. SCons is the make mechanism, although a .vcproj/.sln is also included in the project for convenience when using the Visual Studio IDE.

There are several dependencies exist which are listed below; you may find it easier to simply download a pre-built binary.

- Building with Visual Studio 2008
- Building with Visual Studio 2010
- Building the Shell

### *See Also*

- Prebuilt Boost Libraries
- Prebuilt SpiderMonkey for VS2010
- Building Boost
- Building SpiderMonkey
- Windows Quick Links
- scons

### Boost 1.41.0 Visual Studio 2010 Binary

> ⚠ This is OLD and was for the VS2010 BETA. See the new Boost and Windows page instead.

The following is a prebuilt boost binary (libraries) for Visual Studio 2010 beta 2.

The MongoDB vcxproj files assume this package is unzipped under c:\Program Files\boost\boost_1_41_0\.

- http://downloads.mongodb.org/misc/boost_1_41_0_binary_vs10beta2.zipx

Note: we're not boost build gurus please let us know if there are things wrong with the build.

See also the prebuilt boost binaries at http://www.boostpro.com/download.

## Boost and Windows


- Visual Studio 2010
  - Prebuilt from mongodb.org
  - Building Yourself
- Visual Studio 2008
  - Prebuilt from mongodb.org
  - Prebuilt from boostpro.com
  - Building Yourself
- Additional Notes


### *Visual Studio 2010*

#### *Prebuilt from mongodb.org*

Click here for a prebuilt boost library for Visual Studio 2010. 7zip format.

#### *Building Yourself*

- Download the boost source from boost.org. Move it to C:\boost\.
- Run `C:\Program Files (x86)\Microsoft Visual Studio 10.0\vc\vcvarsall.bat`.
- From the MongoDB source project, run buildscripts\buildboost.bat. Or, buildboost64.bat for the 64 bit version.
- We have successfully compiled version 1.42 – you might want to try that version or higher. See additional notes section at end of this page too.

### *Visual Studio 2008*

#### *Prebuilt from mongodb.org*

Click here for a prebuilt boost library for Visual Studio 2008. 7zip format. This file has what you need to build MongoDB, but not some other boost libs, so it's partial.

#### *Prebuilt from boostpro.com*

Or, you can download a complete prebuilt boost library for 32 bit VS2008 at http://www.boostpro.com/products/free. Install the prebuilt libraries for Boost version 1.35.0 (or higher - generally newer is better). During installation, for release builds choose `static multithread libraries for installation`. The Debug version of the project uses the DLL libraries; choose all multithread libraries if you plan to do development. From the BoostPro installer, be sure to select all relevant libraries that mongodb uses -- for example, you need Filesystem, Regex, Threads, and ProgramOptions (and perhaps others).

#### *Building Yourself*

- Download the boost source from boost.org. Move it to C:\boost\.
- From the Visual Studio 2008 IDE, choose Tools.Visual Studio Command Prompt to get a command prompt with all PATH variables set nicely for the C++ compiler.
- From the MongoDB source project, run buildscripts\buildboost.bat. Or, buildboost64.bat for the 64 bit version.

### *Additional Notes*

When using bjam, MongoDB expects

- `variant=debug` for debug builds, and `variant=release` for release builds
- `threading=multi`
- `link=static runtime-link=static` for release builds
- `address-model=64` for 64 bit

## Building the Mongo Shell on Windows

You can build the mongo shell with either scons or a Visual Studio 2010 project file.

#### Scons

```
scons mongo
```

#### Visual Studio 2010 Project File

A VS2010 vcxproj file is availabe for building the shell. From the mongo directory open shell/msvc/mongo.vcxproj.

The project file assumes that GNU readline is installed in ../readline/ relative to the mongo project. If you would prefer to build without having to install readline, remove the definition of USE_READLINE in the preprocessor definitions section of the project file, and exclude readline.lib from the project.

The project file currently only supports 32 bit builds of the shell (scons can do 32 and 64 bit). However this seems sufficient given there is no real need for a 64 bit version of the shell.

#### Readline Library

The shell uses the GNU readline library to facilitate command line editing and history. You can build the shell without readline but would then lose that functionality. USE_READLINE is defined when building with readline. SCons will look for readline and if not found build without it.

#### See Also

- Prebuilt readline for Windows 32 bit at SourceForge (DLL version)

## Building with Visual Studio 2008

- Get the MongoDB Source Code
- Get Boost Libraries
- Get SpiderMonkey
- Building MongoDB from the IDE
- Install SCons
- Building MongoDB with SCons
- Troubleshooting

MongoDB can be compiled for Windows (32 and 64 bit) using Visual C++. SCons is the make mechanism, although a solution file is also included in the project for convenience when using the Visual Studio IDE.

There are several dependencies exist which are listed below; you may find it easier to simply download a pre-built binary.

### *Get the MongoDB Source Code*

Download the source code from Downloads.

Or install Git. Then:

- `git clone git://github.com/mongodb/mongo.git` (more info)
- `git tag -l` to see tagged version numbers
- Switch to a stable branch (unless doing development) -- an even second number indicates "stable". (Although with sharding you will want the latest if the latest is less than 1.6.0.) For example:
  - `git checkout r1.4.1`

### *Get Boost Libraries*

- Click here for a prebuilt boost library for Visual Studio. 7zip format. This file has what you need to build MongoDB, but not some other boost libs, so it's partial.
- See the Boost and Windows page for other options.

The Visual Studio project files are setup to look for boost in the following locations:

- c:\program files\boost\latest
- c:\boost
- \boost

You can unzip boost to c:\boost, or use an NTFS junction point to create a junction point to one of the above locations. Some versions of windows come with linkd.exe, but others require you to download Sysinternal's junction.exe to accomplish this task. For example, if you installed boost 1.42 via the installer to the default location of **c:\Program Files\boost\boost_1_42**, You can create a junction point with the following command:

```
junction "c:\Program Files\boost\latest" "c:\Program Files\boost\boost_1_42"
```

This should return the following output:

```
Junction v1.05 - Windows junction creator and reparse point viewer
Copyright (C) 2000-2007 Mark Russinovich
Systems Internals - http://www.sysinternals.com

Created: c:\Program Files\boost\latest
Targetted at: c:\Program Files\boost\boost_1_42
```

### *Get SpiderMonkey*

Build a SpiderMonkey js engine library (js.lib) – details here.

### *Building MongoDB from the IDE*

Open the db/db.sln solution file.

Note: currently the `mongo` shell and C++ client libraries must be built from scons. Also, for the VS2008 project files, 64 bit must be built from scons (although you can do 64 bit with db_10.sln in vs2010).

### *Install SCons*

If building with scons, install SCons:

- First install Python: http://www.python.org/download/releases/2.6.4/.
- Then SCons itself: http://sourceforge.net/projects/scons/files/scons/1.2.0/scons-1.2.0.win32.exe/download.
- Add the python scripts directory (e.g., C:\Python26\Scripts) to your PATH.

### *Building MongoDB with SCons*

The SConstruct file from the MongoDB project is the preferred way to perform production builds. Run scons in the mongo project directory to build.

If scons does not automatically find Visual Studio, preset your path for it by running the VS2010 vcvars*.bat file.

To build:

```
scons                   // build mongod
scons mongoclient.lib   // build C++ client driver library
scons all               // build all end user components
scons .                 // build all including unit test
```

### *Troubleshooting*

> If you are using `scons`, check the file `config.log` which is generated.

- **Can't find jstypes.h when compiling.** This file is generated when building SpiderMonkey. See the Building SpiderMonkey page for more info.
- **Can't find / run cl.exe when building with scons.** See troubleshooting note on the Building SpiderMonkey page.
- **Error building program database.** (VS2008.) Try installing the Visual Studio 2008 Service Pack 1.

## Building with Visual Studio 2010

- Get the MongoDB Source Code
- Get Boost Libraries
- Get SpiderMonkey
- Building MongoDB from the IDE
- Install SCons

- Building MongoDB with SCons
- Troubleshooting

MongoDB can be compiled for Windows (32 and 64 bit) using Visual C++. SCons is the make mechanism, although a solution file is also included in the project for convenience when using the Visual Studio IDE.

There are several dependencies exist which are listed below; you may find it easier to simply download a pre-built binary.

### *Get the MongoDB Source Code*

Download the source code from Downloads.

Or install Git. Then:

- `git clone git://github.com/mongodb/mongo.git` (more info)
- `git tag -l` to see tagged version numbers
- Switch to a stable branch (unless doing development) -- an even second number indicates "stable". (Although with sharding you will want the latest if the latest is less than 1.6.0.) For example:
    - `git checkout r1.4.1`

### *Get Boost Libraries*

- Click here for a prebuilt boost library for Visual Studio. 7zip format. This file has what you need to build MongoDB, but not some other boost libs, so it's partial.
- See the Boost and Windows page for other options. Use v1.42 or higher with VS2010.

### *Get SpiderMonkey*

- Download prebuilt libraries and headers here for VS2010. Place these files in ../js/ relative to your mongo project directory.
- Or (more work) build SpiderMonkey js.lib yourself – details here.

### *Building MongoDB from the IDE*

Open the db/db_10.sln solution file.

Note: a separate project file exists for the `mongo` shell. Currently the C++ client libraries must be built from scons (this obviously needs to be fixed...)

### *Install SCons*

If building with scons, install SCons:

- First install Python: http://www.python.org/download/releases/2.6.4/.
- Then SCons itself: http://sourceforge.net/projects/scons/files/scons/1.2.0/scons-1.2.0.win32.exe/download.
- Add the python scripts directory (e.g., C:\Python26\Scripts) to your PATH.

### *Building MongoDB with SCons*

The SConstruct file from the MongoDB project is the preferred way to perform production builds. Run scons in the mongo project directory to build.

If scons does not automatically find Visual Studio, preset your path for it by running the VS2010 vcvars*.bat file.

To build:

```
scons                   // build mongod
scons mongoclient.lib   // build C++ client driver library
scons all               // build all end user components
scons .                 // build all including unit test
```

### *Troubleshooting*

If you are using `scons`, check the file `config.log` which is generated.

- Can't find jstypes.h when compiling.
    - This file is generated when building SpiderMonkey. See the Building SpiderMonkey page for more info.

- Can't find / run cl.exe when building with scons.
    - See troubleshooting note on the Building SpiderMonkey page.
- LINK : fatal error LNK1104: cannot open file js64d.lib js64r.lib js32d.lib js32r.lib
    - Get the prebuilt spidermonkey libraries -- or copy your self-built js.lib to the above name.

# Building Spider Monkey


- Building js.lib - Unix
    - Remove any existing xulrunner
    - Download
    - Build
    - Install
- Building js.lib - Windows
    - Prebuilt
    - Download
    - Build
    - Troubleshooting scons
- See Also


MongoDB uses SpiderMonkey for server-side Javascript execution. The mongod project requires a file js.lib when linking. This page details how to build js.lib.

Note: V8 Javascript support is under development.

## Building js.lib - Unix

### Remove any existing xulrunner

First find out what has been installed

```
dpkg -l | grep xulrunner
```

e.g.

```
ubuntu910-server64:mongo$ sudo dpkg -l | grep xul
ii  xulrunner-1.9.1                  1.9.1.13+build1+nobinonly-0ubuntu0.9.10.1 XUL + XPCOM
application runner
ii  xulrunner-1.9.1-dev              1.9.1.13+build1+nobinonly-0ubuntu0.9.10.1 XUL + XPCOM
development files
```

Next remove the two installed packages

```
sudo apt-get remove xulrunner-1.9.1-dev xulrunner-1.9.1
```

### Download

```
curl -O ftp://ftp.mozilla.org/pub/mozilla.org/js/js-1.7.0.tar.gz
tar zxvf js-1.7.0.tar.gz
```

### Build

```
cd js/src
export CFLAGS="-DJS_C_STRINGS_ARE_UTF8"
make -f Makefile.ref
```

SpiderMonkey does not use UTF-8 by default, so we enable before building.

An experimental SConstruct build file is available here.

#### Install

```
JS_DIST=/usr make -f Makefile.ref export
```

By default, the mongo scons project expects spidermonkey to be located at ../js/.

### Building js.lib - Windows

#### Prebuilt

- VS2008: a prebuilt SpiderMonkey library and headers for Win32 is attached to this document (this file may or may not work depending on your compile settings and compiler version).
- VS2010 prebuilt libraries

Alternatively, follow the steps below to build yourself.

#### Download

From an msysgit or cygwin shell, run:

```
curl -O ftp://ftp.mozilla.org/pub/mozilla.org/js/js-1.7.0.tar.gz
tar zxvf js-1.7.0.tar.gz
```

#### Build

cd js/src

```
export CFLAGS="-DJS_C_STRINGS_ARE_UTF8"
make -f Makefile.ref
```

If cl.exe is not found, launch Tools...Visual Studio Command Prompt from inside Visual Studio -- your path should then be correct for make.

If you do not have a suitable make utility installed, you may prefer to build using scons. An experimental SConstruct file to build the js.lib is available in the mongodb/snippets project. For example:

```
cd
git clone git://github.com/mongodb/mongo-snippets.git
cp mongo-snippets/jslib-sconstruct js/src/SConstruct
cd js/src
scons
```

#### Troubleshooting scons

Note that scons does not use your PATH to find Visual Studio. If you get an error running cl.exe, try changing the following line in the msvc.py scons source file from:

```
MVSdir = os.getenv('ProgramFiles') + r'\Microsoft Visual Studio 8'
```

to

```
MVSdir = os.getenv('ProgramFiles') + r'\Microsoft Visual Studio ' + version
```

### See Also

- Building MongoDB

## scons

Use scons to build MongoDB, and related utilities and libraries.  See the SConstruct file for details.

Run `scons --help` to see all options.

### *Targets*

Run `scons <target>`.

- `scons .`
- `scons all`
- `scons mongod` build mongod
- `scons mongo` build the shell
- `scons shell` build just the generated shell `.cpp` files
- `scons mongoclient` build just the client lib

### *Options*

- `--d` debug build
- `--dd` debug build with _DEBUG defined (extra asserts etc.)
- `--release`
- `--32` force 32 bit
- `--64` force 64 bit
- `--clean`

### *Troubleshooting*

scons generates a `config.log` file. See this file when there are problems building.

### *See Also*

Smoke Tests

# Database Internals

This section provides information for developers who want to write drivers or tools for MongoDB, \ contribute code to the MongoDB codebase itself, and for those who are just curious how it works internally.

Sub-sections of this section:

- Caching
- Cursors
- Error Codes
- Internal Commands
- Replication Internals
- Smoke Tests
- Pairing Internals

## Caching

#### *Memory Mapped Storage Engine*

This is the current storage engine for MongoDB, and it uses memory-mapped files for all disk I/O. Using this strategy, the operating system's virtual memory manager is in charge of caching. This has several implications:

- There is no redundancy between file system cache and database cache: they are one and the same.
- MongoDB can use all free memory on the server for cache space automatically without any configuration of a cache size.
- Virtual memory size and resident size will appear to be very large for the mongod process. This is benign: virtual memory space will be just larger than the size of the datafiles open and mapped; resident size will vary depending on the amount of memory not used by other processes on the machine.
- Caching behavior (such as LRU'ing out of pages, and laziness of page writes) is controlled by the operating system: quality of the VMM implementation will vary by OS.

## Cursors

**Redirection Notice**
This page should redirect to Internals.

## Error Codes

| Error Code | Description | Comments |
|---|---|---|
| 10003 | objects in a capped ns cannot grow | |
| 11000 | duplicate key error | _id values must be unique in a collection |
| 11001 | duplicate key on update | |
| 12000 | idxNo fails | an internal error |
| 12001 | can't sort with $snapshot | the $snapshot feature does not support sorting yet |
| 12010, 12011, 12012 | can't $inc/$set an indexed field | |
| 13440 | bad offset accessing a datafile | Run a database --repair |
| | | |

## Internal Commands

Most commands have helper functions and do not require the `$cmd.findOne()` syntax. These are primarily internal and administrative.

```
> db.$cmd.findOne({assertinfo:1})
{
    "dbasserted" : false , // boolean: db asserted
"asserted" : false , // boolean: db asserted or a user assert have happend
"assert" : "" ,  // regular assert
"assertw" : "" , // "warning" assert
"assertmsg" : "" , // assert with a message in the db log
"assertuser" : "" , // user assert - benign, generally a request that was not meaningful
"ok" : 1.0
}

> db.$cmd.findOne({serverStatus:1})
{
  "uptime" : 6 ,
  "globalLock" : {
                    "totalTime" : 6765166 ,
                    "lockTime" : 2131 ,
                    "ratio" : 0.00031499596610046226
                  } ,
   "mem" : {
                    "resident" : 3 ,
                    "virtual" : 111 ,
                    "mapped" : 32
   } ,
  "ok" : 1
}



> admindb.$cmd.findOne({replacepeer:1})
{
    "info" : "adjust local.sources hostname; db restart now required" ,
    "ok" : 1.0
}

// close all databases.  a subsequent request will reopen a db.
> admindb.$cmd.findOne({closeAllDatabases:1});
```

## Replication Internals

On the *master* mongod instance, the `local` database will contain a collection, `oplog.$main`, which stores a high-level transaction log. The

transaction log essentially describes all actions performed by the user, such as "insert this object into this collection." Note that the oplog is not a low-level redo log, so it does not record operations on the byte/disk level.

The *slave* mongod instance polls the `oplog.$main` collection from *master*. The actual query looks like this:

```
local.oplog.$main.find({ ts: { $gte: ''last_op_processed_time'' } }).sort({$natural:1});
```

where 'local' is the master instance's `local` database. `oplog.$main` collection is a capped collection, allowing the oldest data to be aged out automatically.

See the Replication section of the Mongo Developers' Guide for more information.

### `OpTime`

An `OpTime` is a 64-bit timestamp that we use to timestamp operations. These are stored as Javascript `Date` datatypes but are *not* JavaScript Date objects. Implementation details can be found in the `OpTime` class in *repl.h*.

### *Applying OpTime Operations*

Operations from the oplog are applied on the slave by reexecuting the operation. Naturally, the log includes write operations only.

Note that inserts are transformed into upserts to ensure consistency on repeated operations. For example, if the slave crashes, we won't know exactly which operations have been applied. So if we're left with operations 1, 2, 3, 4, and 5, and if we then apply 1, 2, 3, 2, 3, 4, 5, we should achieve the same results. This repeatability property is also used for the initial cloning of the replica.

### Tailing

After applying operations, we want to wait a moment and then poll again for new data with our `$gte`operation. We want this operation to be fast, quickly skipping past old data we have already processed. However, we do not want to build an index on `ts`, as indexing can be somewhat expensive, and the oplog is write-heavy. Instead, we use a table scan in [natural] order, but use a tailable cursor to "remember" our position. Thus, we only scan once, and then when we poll again, we know where to begin.

### Initiation

To create a new replica, we do the following:

```
t = now();
cloneDatabase();
end = now();
applyOperations(t..end);
```

`cloneDatabase`effectively exports/imports all the data in the database. Note the actual "image" we will get may or may not include data modifications in the time range (`t..end`). Thus, we apply all logged operations from that range when the cloning is complete. Because of our repeatability property, this is safe.

See class `Cloner` for more information.

## Smoke Tests

*smoke.py* lets you run a subsets of the tests in *jstests*. When it is running tests, it starts up an instance of mongod, runs the tests, and then shuts it down again. You can run it while running other instances of MongoDB on the same machine: it uses ports in the 30000 range and its own data directories.

For the moment, *smoke.py* must be run from the top-level directory of a MongoDB source repository. This directory must contain at least the `mongo` and `mongod` binaries. To run certain tests, you'll also need to build the tools and `mongos`. It's a good idea to run `scons .` before running the tests.

To run *smoke.py* you'll need a recent version of PyMongo.

To see the possible options, run:

```
$ python buildscripts/smoke.py --help
Usage: smoke.py [OPTIONS] ARGS*

Options:
  -h, --help            show this help message and exit
  --mode=MODE           If "files", ARGS are filenames; if "suite", ARGS are
                        sets of tests (suite)
  --test-path=TEST_PATH
                        Path to the test executables to run, currently only
                        used for 'client' (none)
  --mongod=MONGOD_EXECUTABLE
                        Path to mongod to run (/Users/mike/10gen/mongo/mongod)
  --port=MONGOD_PORT    Port the mongod will bind to (32000)
  --mongo=SHELL_EXECUTABLE
                        Path to mongo, for .js test files
                        (/Users/mike/10gen/mongo/mongo)
  --continue-on-failure
                        If supplied, continue testing even after a test fails
  --from-file=FILE      Run tests/suites named in FILE, one test per line, '-'
                        means stdin
  --smoke-db-prefix=SMOKE_DB_PREFIX
                        Prefix to use for the mongods' dbpaths ('')
  --small-oplog         Run tests with master/slave replication & use a small
                        oplog
```

To run specific tests, use the *--mode=files* option:

```
python buildscripts/smoke.py --mode=files jstests/find1.js
```

You can specify as many files as you want.

You can also run a suite of tests. Suites are predefined and include:

- *test*
- *all*
- *perf*
- *js*
- *quota*
- *jsPerf*
- *disk*
- *jsSlowNightly*
- *jsSlowWeekly*
- *parallel*
- *clone*
- *repl*
- *auth*
- *sharding*
- *tool*
- *client*
- *mongosTest*

To run a suite, specify the suite's name:

```
python buildscripts/smoke.py js
```

## Pairing Internals

### *Policy for reconciling divergent oplogs*

In a paired environment, a situation may arise in which each member of a pair has logged operations as master that have not been applied to the other server. In such a situation, the following procedure will be used to ensure consistency between the two servers:

1. The new master will scan through its own oplog from the point at which it last applied an operation from it's peer's oplog to the end. It will create a set C of object ids for which changes were made. It will create a set M of object ids for which only modifier changes were made. The values of C and M will be updated as client operations are applied to the new master.

2. The new master will iterate through its peer's oplog, applying only operations that will not affect an object having an id in C.
3. For any operation in the peer's oplog that may not be applied due to the constraint in the previous step, if the id of the of the object in question is in M, the value of the whole object on the new master is logged to the new master's oplog.
4. The new slave applies all operations from the new master's oplog.

# Contributing to the Documentation

Qualified volunteers are welcome to assist in editing the wiki documentation. Contact us for more information.

## Emacs tips for MongoDB work

You can edit confluence directly from emacs:

First, follow the basic instructions on http://code.google.com/p/confluence-el/

Change the confluence-url in their sample setup to http://mongodb.onconfluence.com/rpc/xmlrpc

Might also want to change the default space to DOCS or DOCS-ES or whatever space you edit the most.

### etags setup (suggested by mstearn)

First, install "exuberant ctags", which has nicer features than GNU etags.

http://ctags.sourceforge.net/

Then, run something like this in the top-level mongo directory to make an emacs-style TAGS file:

```
ctags -e --extra=+qf --fields=+iasnfSKtm --c++-kinds=+p  --recurse .
```

Then you can use M-x visit-tags-table, M-., M-* as normal.

## Mongo Documentation Style Guide

This page provides information for everyone adding to the Mongo documentation on Confluence. It covers:

- General Notes on Writing Style
- Guide to Confluence markup for specific situations
- Some general notes about doc production

### General Notes on Writing Style

#### *Voice*

Active voice is almost always preferred to passive voice.

To make this work, however, you may find yourself anthropromorphizing components of the system - that is, treating the driver or the database as an agent that actually does something. ("The dbms writes the new record to the collection" is better than "the new record is written to the database", but some purists may argue that the dbms doesn't do anything - it's just code that directs the actions of the processor - but then someone else says "yes, but does the processor really do anything?" and so on and on.) It is simpler and more economical to write as if these components are actually doing things, although you as the infrastructure developers might have to stop and think about which component is actually performing the action you are describing.

#### *Tense*

Technical writers in general prefer to keep descriptions of processes in the present tense: "The dbms writes the new collection to disk" rather than "the dbms will write the new collection to disk." You save a few words that way.

### MongoDB Terminology

It would be good to spell out precise definitions of technical words and phrases you are likely to use often, like the following:

- Mongo
- database (do you want "a Mongo database"? Or a Mongo database instance?)
- dbms (I have't seen this term often - is it correct to talk about "the Mongo DBMS"?)
- Document
- Record

- Transaction (I stopped myself from using this term because my understanding is the Mongo doesn't support "transactions" in the sense of operations that are logged and can be rolled back - is this right?)

These are just a few I noted while I was editing. More should be added. It would be good to define these terms clearly among yourselves, and then post the definitions for outsiders.

### Markup for terms

It's important to be consistent in the way you treat words that refer to certain types of objects. The following table lists the types you will deal with most often, describes how they should look, and (to cut to the chase) gives you the Confluence markup that will achieve that appearance.

| Type | Appearance | Markup |
|---|---|---|
| Object name (the type of "object" that "object-oriented programming" deals with) | monospace | {{ `term` }} |
| short code fragment inline | monospace | {{ `term` }} |
| file path/name, extension | italic | _term_ |
| programming command, statement or expression | monospace | {{ `term` }} |
| variable or "replaceable item" | monospace italic | `_term_` |
| Placeholders in paths, directories, or other text that would be italic anyway | angle brackets around <item> | <item> |
| GUI element (menus menu items, buttons | bold | *term* |
| First instance of a technical term | italic | _term_ |
| tag (in HTML or XML, for example) | monospace | {{ `term` }} |
| Extended code sample | code block | {code}<br>program code<br><br>{code} |

In specifying these, I have relied on the O'Reilly Style Guide, which is at:

http://oreilly.com/oreilly/author/stylesheet.html

This guide is a good reference for situations not covered here.

I should mention that for the names of GUI objects I followed the specification in the Microsoft Guide to Technical Publications.

### *Other Confluence markup*

If you are editing a page using Confluence's RTF editor, you don't have to worry about markup. Even if you are editing markup directly, Confluence displays a guide on the right that shows you most of the markup you will need.

### *References and Links*

Confluence also provides you with a nice little utility that allows you to insert a link to another Confluence page by searching for the page by title or by text and choosing it from a list. Confluence handles the linking markup. You can even use it for external URLs.

The one thing this mechanism does NOT handle is links to specific locations within a wiki page. Here is what you have to know if you want to insert these kinds of links:

- Every heading you put in a Confluence page ("h2.Title", "h3.OtherTitle", etc.) becomes an accessible "anchor" for linking.
- You can also insert an anchor anywhere else in the page by inserting "{anchor\:*anchorname}" where _anchorname* is the unique name you will use in the link.
- To insert a link to one of these anchors, you must go into wiki markup and add the anchor name preceded by a "#". Example: if the page `MyPage` contains a heading or an ad-hoc anchor named `GoHere`, the link to that anchor from within the same page would look like `[#GoHere]`, and a link to that anchor from a different page would look like `[MyPage#GoHere]`. (See the sidebar for information about adding other text to the body of the link.)

### *Special Characters*

- You will often need to insert code samples that contain curly braces. As Dwight has pointed out, Confluence gets confused by this unless you "escape" them by preceding them with a backslash, thusly:

```
\{  \}
```

You must do the same for "[", "]", "_" and some others.
Within a {code} block you don't have to worry about this. If you are inserting code fragments inline using {{ and }}, however, you still need to escape these characters. Further notes about this:

- If you are enclosing a complex code expression with {{ and }}, do NOT leave a space between the last character of the expression and the }}. This confuses Confluence.
- Confluence also gets confused (at least sometimes) if you use {{ and }}, to enclose a code sample that includes escaped curly brackets.

### About MongoDB's Confluence wiki

Confluence has this idea of "spaces". Each person has a private space, and there are also group spaces as well.

The MongoDB Confluence wiki has three group spaces defined currently:

- Mongo Documentation - The publicly accessible area for most Mongo documentation
- Contributor - Looks like, the publicly accessible space for information for "Contributors"
- Private - a space open to MongoDB developers, but not to the public at large.
  As I said in my email on Friday, all of the (relevant) info from the old wiki now lives in the "Mongo Documentation"

### *Standard elements of Wiki pages*

You shouldn't have to spend a lot of time worrying about this kind of thing, but I do have just a few suggestions:

- Since these wiki pages are (or can be) arranged hierarchically, you may have "landing pages" that do little more than list their child pages. I think Confluence actually adds a list of children automatically, but it only goes down to the next hierarchical level. To insert a hierarchical list of a page's children, all you have to do is insert the following Confluence "macro":

  ```
  {children:all=true}
  ```

  See the Confluence documentation for more options and switches for this macro.

- For pages with actual text, I tried to follow these guidelines:
  - For top-level headings, I used "h2" not "h1"
  - I never began a page with a heading. I figured the title of the page served as one.
  - I always tried to include a "See Also" section that listed links to other Mongo docs.
  - I usually tried to include a link to the "Talk to us about Mongo" page.

# Community

## General Community Resources

- ***User Mailing List***

  The user list is for general questions about using, configuring, and running MongoDB and the associated tools and drivers. The list is open to everyone

- ***IRC chat***

  irc://irc.freenode.net/#mongodb

- ***Blog***

  http://blog.mongodb.org/

- ***Bugtracker***

  File, track, and vote on bugs and feature requests. There is issue tracking for MongoDB and all supported drivers

- ***Announcement Mailing List***

  http://groups.google.com/group/mongodb-announce - for release announcement and important bug fixes.

- ***Store***

Visit our Cafepress store for Mongo-related swag.

## Resources for Driver and Database Developers

- ***Developer List***

  This mongodb-dev mailing list is for people developing drivers and tools, or who are contributing to the MongoDB codebase itself.

- ***Source***

  The source code for the database and drivers is available at the http://github.com/mongodb.

## Job Board

- Click Here to access the Job Board. The Board is a community resource for all employers to post MongoDB-related jobs. Please feel free to post/investigate positions!

# MongoDB Commercial Services Providers

Note: if you provide consultative or support services for MongoDB and wish to be listed here, just let us know.

- Support
  - 10gen
- Training
- Hosting
- Consulting
  - 10gen
  - Hashrocket
  - LightCube Solutions
  - Squeejee
  - ZOPYX
  - Mijix

### Support

#### *10gen*

10gen began the MongoDB project, and offers commercial MongoDB support services.

### Training

10gen offers MongoDB training.

### Hosting

See the MongoDB Hosting Center.

### Consulting

#### *10gen*

10gen offers consulting services for MongoDB application design, development, and production operation. These services are typically advisory in nature with the goal of building higher in-house expertise on MongoDB for the client.

#### *Hashrocket*

Hashrocket is a full-service design and development firm that builds successful web businesses. Hashrocket continually creates and follows best practices and surround themselves with passionate and talented craftsmen to ensure the best results for you and your business.

#### *LightCube Solutions*

LightCube Solutions provides PHP development and consulting services, as well as a lightweight PHP framework designed for MongoDB called 'photon'

### *Squeejee*

Squeejee builds web applications on top of MongoDB with multiple sites already in production.

### *ZOPYX*

ZOPYX Ltd is a German-based consulting and development company in the field of Python, Zope & Plone. Lately we added MongoDB to our consulting and development portofolio. As one of the first projects we were involved in the launch of the BRAINREPUBLIC social platform.

### *Mijix*

MijiX, a software development studio based on Indonesia, provides consulting for MongoDB in Asia-Pacific area.

# User Feedback

"I just have to get my head around that mongodb is really _this_ good"
-muckster, #mongodb

"Guys at Redmond should get a long course from you about what is the software development and support "
-kunthar@gmail.com, mongodb-user list

"#mongoDB keep me up all night. I think I have found the 'perfect' storage for my app "
-elpargo, Twitter

"Maybe we can relax with couchdb but with mongodb we are completely in dreams"
-namlook, #mongodb

"Dude, you guys are legends!"
-Stii, mongodb-user list

"Times I've been wowed using MongoDB this week: 7."
-tpitale, Twitter

## Community Blog Posts

B is for Billion
-Wordnik (July 9, 2010)

[Reflections on MongoDB]
-Brandon Keepers, Collective Idea (June 15, 2010)

Building a Better Submission Form
-New York Times Open Blog (May 25, 2010)

Notes from a Production MongoDB Deployment
-Boxed Ice (February 28, 2010)

NoSQL in the Real World
-CNET (February 10, 2010)

Why I Think Mongo is to Databases what Rails was to Frameworks
-John Nunemaker, Ordered List (December 18, 2009)

MongoDB a Light in the Darkness...
-EngineYard (September 24, 2009)

Introducing MongoDB
-Linux Magazine (September 21, 2009)

Choosing a non-relational database; why we migrated from MySQL to MongoDB
-Boxed Ice (July 7, 2010)

The Other Blog - The Holy Grail of the Funky Data Model
-Tom Smith (June 6, 2009)

GIS Solved - Populating a MongoDb with POIs
-Samuel

## Community Presentations

Scalable Event Analytics with MongoDb and Ruby on Rails
Jared Rosoff at RubyConfChina (June 2010)

How Python, TurboGears, and MongoDB are Transforming SourceForge.net
Rick Copeland at PyCon 2010

MongoDB
Adrian Madrid at Mountain West Ruby Conference 2009, video

MongoDB - Ruby friendly document storage that doesn't rhyme with ouch
Wynn Netherland at Dallas.rb Ruby Group, slides

MongoDB
jnunemaker at Grand Rapids RUG, slides

Developing Joomla! 1.5 Extensions, Explained (slide 37)
Mitch Pirtle at Joomla!Day New England 2009, slides

Drop Acid (slide 31) (video)
Bob Ippolito at Pycon 2009

Python and Non-SQL Databases (in French, slide 21)
Benoit Chesneau at Pycon France 2009, slides

Massimiliano Dessì at the Spring Framework Italian User Group

- MongoDB (in Italian)
- MongoDB and Scala (in Italian)

Presentations and Screencasts at Learnivore
Frequently-updated set of presentations and screencasts on MongoDB.

### Benchmarking

We keep track of user benchmarks on the Benchmarks page.

## Job Board

### Redirecting...

**Redirection Notice**
This page should redirect to http://jobs.mongodb.org/ in about 2 seconds.

# About

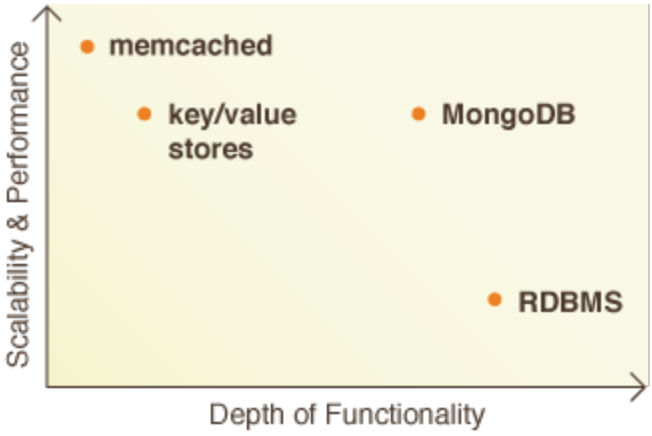

- Philosophy
- Use Cases
- Production Deployments
- Mongo-Based Applications
- Events
- Slide Gallery
- Articles
- Benchmarks
- FAQ
- Product Comparisons
- Licensing


## Philosophy

### Design Philosophy

- Databases are specializing - the "one size fits all" approach no

longer applies.
- By reducing transactional semantics the db provides, one can still solve an interesting set of problems where performance is very important, and horizontal scaling then becomes easier.
- The (JSON) document data model is easy to code to, easy to manage (schemaless), and yields excellent performance by grouping relevant data together internally.
- A non-relational approach is the best path to database solutions which scale horizontally to many machines.
- While there is an opportunity to relax certain capabilities for better performance, there is also a need for deeper functionality than that provided by pure key/value stores.
- Database technology should run anywhere, being available both for running on your own servers or VMs, and also as a cloud pay-for-what-you-use service.




# Use Cases

See also the Production Deployments page for a discussion of how companies like Shutterfly, foursquare, bit.ly, Etsy, SourceForge, etc. use MongoDB.

#### Use Case Articles

- Using MongoDB for Real-time Analytics
- Using MongoDB for Logging
- Full Text Search in Mongo
- MongoDB and E-Commerce
- Archiving

#### Well Suited

- Operational data store of a web site. MongoDB is very good at real-time inserts, updates, and queries. Scalability and replication are provided which are necessary functions for large web sites' real-time data stores. Specific web use case examples:
    - content management
    - comment storage, management, voting
    - real time page view counters
    - user registration, profile, session data
- Caching. With its potential for high performance, MongoDB works well as a caching tier in an information infrastructure. The persistent backing of Mongo's cache assures that on a system restart the downstream data tier is not overwhelmed with cache population activity.
- High volume problems. Problems where a traditional DBMS might be too expensive for the data in question. In many cases developers would traditionally write custom code to a filesystem instead using flat files or other methodologies.
- Storage of program objects and JSON data (and equivalent). Mongo's BSON data format makes it very easy to store and retrieve data in a document-style / "schemaless" format. Addition of new properties to existing objects is easy and does not require blocking "ALTER TABLE" style operations.
- Document and Content Management Systems - as a document-oriented (JSON) database, MongoDB's flexible schemas are a good fit for this.
- Electronic record keeping - similar to document management.

#### Less Well Suited

- Systems with a heavy emphasis on complex transations such as banking systems and accounting. These systems typically require multi-object transactions, which MongoDB doesn't support. It's worth noting that, unlike many "NoSQL" solutions, MongoDB does support atomic operations on single documents. As documents can be rich entities; for many use cases, this is sufficient.
- Traditional Business Intelligence. Data warehouses are more suited to new, problem-specific BI databases. However note that MongoDB can work very well for several reporting and analytics problems where data is predistilled or aggregated in runtime -- but classic, nightly batch load business intelligence, while possible, is not necessarily a sweet spot.
- Problems requiring SQL.

# Use Case - Session Objects

MongoDB is a good tool for storing HTTP session objects.

One implementation model is to have a sessions collection, and store the session object's _id value in a browser cookie.

With its update-in-place design and general optimization to make updates fast, the database is efficient at receiving an update to the session object on every single app server page view.

### *Aging Out Old Sessions*

The best way to age out old sessions is to use the auto-LRU facility of capped collections. The one complication is that objects in capped

collections may not grow beyond their initial allocation size.  To handle this, we can "pre-pad" the objects to some maximum size on initial addition, and then on further updates we are fine if we do not go above the limit.  The following mongo shell javascript example demonstrates padding.

(Note: a clean padding mechanism should be added to the db so the steps below are not necessary.)

```
> db.createCollection('sessions', { capped: true, size : 1000000 } )
{"ok" : 1}
> p = "";
> for( x = 0; x < 100; x++ ) p += 'x';
> s1 = { info: 'example', _padding : p };
{"info" : "example" , "_padding" :
"xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"
}
> db.sessions.save(s1)
> s1
{"info" : "example" , "_padding" :
"xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"
, "_id" :  ObjectId( "4aafb74a5761d147677233b0") }

> // when updating later
> s1 = db.sessions.find( { _id : ObjectId( "4aafb74a5761d147677233b0") } )
{"_id" :  ObjectId( "4aafb74a5761d147677233b0")  , "info" : "example" , "_padding" :
"xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"
}
> delete s._padding;
true
>  s.x = 3; // add a new field
3
> db.sessions.save(s);
> s
{"_id" :  ObjectId( "4aafb5a25761d147677233af")  , "info" : "example" , "x" : 3}
```

## Production Deployments

*If you're using MongoDB in production, we'd love to list you here!  Please complete this web form or email meghan@10gen.com and we will add you.*

| Company | Use Case |
|---|---|
| shutterfly | Shutterfly is an Internet-based social expression and personal publishing service. MongoDB is used for various persistent data storage requirements within Shutterfly. MongoDB helps Shutterfly build an unrivaled service that enables deeper, more personal relationships between customers and those who matter most in their lives. For more information, view Kenny Gorman's presentation *Implementing MongoDB at Shutterfly* from MongoSF (April 2010): Slides and Video. |
| foursquare | Foursquare is a location based social network that incorporates gaming elements.<br>• MongoDB at foursquare presentation: Slides and Video (May 2010) |
| bit.ly | bit.ly allows users to shorten, share, and track links. bit.ly uses MongoDB to store user history. For more information:<br>• bit.ly user history, auto-sharded presentation at MongoNYC (May 2010) |
| intuit | Intuit is one of the world's largest providers of software and services for small businesses and individuals. Intuit uses MongoDB to track user engagement and activity in real-time across its network of websites for small businesses |

| | |
|---|---|
| sourceforge | MongoDB is used for back-end storage on the SourceForge front pages, project pages, and download pages for all projects.<br><br>• Scaling SourceForge with MongoDB - OSCON Presentation (July 2010)<br>• MongoDB at SourceForge - QCon London Presentation (March 2010)<br>• How Python, TurboGears, and MongoDB are Transforming SourceForge.net - PyCon (February 2010)<br>• SourceForge.net releases Ming - SourceForge blog (December 2009)<br>• TurboGears on Sourceforge - Compound Thinking (July 2009) |
| Etsy | Etsy is a website that allows users to buy and sell handmade items. Read the MongoDB at Etsy blog series:<br><br>• Part 1 - May 19, 2010<br>• Part 2 - July 3, 2010 |
| The New York Times | The New York Times is using MongoDB in a form-building application for photo submissions. Mongo's lack of schema gives producers the ability to define any combination of custom form fields. For more information:<br><br>• Building a Better Submission Form - NYTimes Open Blog (May 25, 2010)<br>• A Behind the Scenes Look at the New York Times Moment in Time Project - Hacks/Hackers Blog (July 28, 2010) |
| examiner.com the insider source for local | Examiner.com is the fastest-growing local content network in the U.S., powered by the largest pool of knowledgeable and passionate contributors in the world. Launched in April 2008 with 60 cities, Examiner.com now serves hundreds of markets across the U.S. and Canada.<br><br>Examiner.com migrated their site from Cold Fusion and SQL Server to Drupal 7 and MongoDB. Details of the deployment are outlined in an Acquia case study |
| Boxed Ice | BoxedIce's server monitoring solution - Server Density - stores 600 million+ documents in MongoDB.<br><br>• BoxedIce blog posts:<br>  • Automating partitioning, sharding and failover with MongoDB<br>  • Why we migrated from mysql to mongodb<br>  • Notes from a production deployment<br>  • Humongous Data at Server Density: Approaching 1 Billion Documents in MongoDB<br>• Presentations:<br>  • Humongous Data at Server Density - MongoUK Presentation (June 2010)<br>  • MongoDB in Production at Boxed Ice - Webinar (May 2010) |
| wordnik All the words. | Wordnik stores its entire text corpus in MongoDB - 1.2TB of data in over 5 billion records. The speed to query the corpus was cut to 1/4 the time it took prior to migrating to MongoDB. More about MongoDB at Wordnik:<br><br>• B is for Billion - Wordnik Blog (July 2010)<br>• MongoDB: Migration from Mysql at Wordnik - Scalable Web Architectures (May 2010)<br>• Tony Tam's Presentation at MongoSF (April 2010)<br>• What has technology done for words lately? - Wordnik blog (February 2010) |
| ShareThis® | ShareThis makes it easy to share ideas and get to the good stuff online. ShareThis is the world's largest sharing network reaching over 400 million users across 150,000 sites and 785,000 domains across the web |
| BUSINESS INSIDER | Business Insider has been using MongoDB since the beginning of 2008. All of the site's data, including posts, comments, and even the images, are stored on MongoDB. For more information:<br><br>• How This Web Site Uses MongoDB (November 2009 Article)<br>• How Business Insider Uses MongoDB (May 2010 Presentation) |

| | |
|---|---|
| | GitHub, the social coding site, is using MongoDB for an internal reporting application. |
| | Gilt Groupe is an invitation only luxury shopping site. Gilt uses MongoDB for real time ecommerce analytics.<br>• Gilt CTO Mike Bryzek's presentation at MongoSF in April 2010.<br>• Hummingbird - a real-time web traffic visualization tool developed by Gilt and powered by MongoDB |
| | IGN Entertainment, a unit of News Corporation, is a leading Internet media and services provider focused on the videogame and entertainment enthusiast markets. IGN's properties reached more than 37.3 million unique users worldwide February 2010, according to Internet audience measurement firm comScore Media Metrix. MongoDB powers IGN's real-time traffic analytics and RESTful Content APIs. |
| | OpenSky is a free online platform that helps people discover amazing products; share them with their friends, family and followers; and earn money. OpenSky uses MongoDB, Symfony 2, Doctrine 2, PHP 5.3, PHPUnit 3.5, jQuery, node.js, Git (with gitflow) and a touch of Java and Python. OpenSky uses MongoDB for just about everything (not just analytics). Along the way they've developed MongoODM (PHP) and MongoDB drivers for Mule and CAS. |
| | CollegeHumor is a comedy website. MongoDB is used in CollegeHumor for internal analytics and link exchange application. |
| | Evite uses MongoDB for analytics and quick reporting.<br>• Tracking and visualizing mail logs with MongoDB and gviz_api - Grig Gheorghiu's blog (July 2010) |
| | Disqus is an innovative blog-commenting system. |
| | MongoHQ provides a hosting platform for MongoDB and also uses MongoDB as the back-end for its service. Our hosting centers page provides more information about MongoHQ and other MongoDB hosting options. |
| | Justin.tv is the easy, fun, and fast way to share live video online. MongoDB powers Justin.tv's internal analytics tools for virality, user retention, and general usage stats that out-of-the-box solutions can't provide. Read more about Justin.tv's broadcasting architecture. |
| | Chartbeat is a revolutionary real-time analytics service that enables people to understand emergent behaviour in real-time and exploit or mitigate it. Chartbeat stores all historical analytics data in MongoDB.<br>• The Secret Weapons Behind Chartbeat - Kushal's coding blog (April 2010)<br>• Kushal Dave's Presentation at MongoNYC (May 2010) |
| | Hot Potato is a social tool that organizes conversations around events. For more information:<br>• Hot Potato's presentation about using Scala and MongoDB at the New York Tech Talks Meetup (March 2010)<br>• Hot Potato presentation at MongoSF (April 2010)<br>• Hot Potato Infrastructure from Hot Potato blog (May 2010)<br>• Hot Potato presentation at MongoNYC (May 2010) |

| | |
|---|---|
| Eventbrite Events Made Easy | Eventbrite gives you all the online tools you need to bring people together for an event and sell tickets. EventBrite uses MongoDB to track page views.<br><br>• Why you should track page views with MongoDB - EventBrite Blog (June 2010) |
| Flowdock | Flowdock is a modern web-based team messenger, that helps your team to become more organized simply by chatting. Flowdock backend uses MongoDB to store all messages.<br><br>• Why Flowdock migrated from Cassandra to MongoDB - Flowdock Blog (July 2010) |
| Chicago Tribune | The Chicago Tribune uses MongoDB in its Illinois School Report Cards application, which is generated from a nearly 9,000 column denormalized database dump produced annually by the State Board of Education. The application allows readers to search by school name, city, county, or district and to view demographic, economic, and performance data for both schools and districts. |
| SUGARCRM. THE CLOUD IS OPEN | Sugar CRM uses MongoDB to power the backend of its preview feedback mechanism. It captures users' comments and whether they like or dislike portions of the application all from within beta versions of Sugar. |
| where® www.where.com | WHERE® is a local search and recommendation service that helps people discover places, events and mobile coupons in their area. Using WHERE, people can find everything from the weather, news, and restaurant reviews, to the closest coffee shop, cheapest gas, traffic updates, movie showtimes and offers from local merchants. WHERE is available as a mobile application and as a web service at Where.com. here, Inc. uses MongoDB to store geographic content for the WHERE application and for WHERE Ads™ - a hyper-local ad network. |
| PhoneTag™ | PhoneTag is a service that automatically transcribes voicemail to text and delivers it in real-time via e-mail and SMS. PhoneTag stores the metadata and transcriptions for every voicemail it process in MongoDB. |
| | Harmony is a powerful web-based platform for creating and managing websites. It helps developers with content editors work together with unprecedented flexibility and simplicity. From stylesheets, images and templates, to pages, blogs, and comments, every piece of Harmony data is stored in MongoDB. Switching to MongoDB from MySQL drastically simplified Harmony's data model and increased the speed at which we can deliver features.<br><br>• Steve Smith's presentation about Harmony at MongoSF (April 2010) |
| HASHROCKET EXPERTLY CRAFTED WEB | Hashrocket is an expert web design and development group. Hashrocket built PharmMD, a fully-featured Medication Management application in Ruby on Rails. The system contains functionality for identifying and resolving drug-related problems for millions of patients. |
| yottaa ALPHA | Yottaa offers Performance Analytics, a cloud service that monitors, ranks and analyzes the performance of millions of web sites, providing an open database to answer questions such as “why performance matters” and “how fast is my site”. Yottaa is using Ruby on Rails and MongoDB to build their scalable analytics engine.<br><br>• How Yottaa Uses MongoDB - Jared Rosoff's presentation at MongoBoston (September 2010)<br>• Scalable Event Analytics with MongoDB and Ruby - Jared Rosoff's presentation at RubyConfChina (June 2010) |
| BuzzFeed | BuzzFeed is a trends aggregator that uses a web crawler and human editors to find and link to popular stories around the web. BuzzFeed moved an analytics system tracking over 400 million monthly events from MySQL to MongoDB. |

| | |
|---|---|
| ubiquity | The Mozilla open-source Ubiquity Herd project uses MongoDB for back-end storage. Source code is available on bitbucket. |
| Codaset | Codaset is an open system where you can browse and search through open source projects, and check out what your friends are coding.<br>• The awesomeness that is MongoDB and NoSQL, is taking over Codaset - Codaset Blog (May 2010)<br>• Handling Dates in MongoDB - Codaset Blog (July 2010) |
| SHOPwiki | Shopwiki uses Mongo as a data store for its shopping search engine, where they commit all the data generated, such as custom analytics. Mongo's performance is such that ShopWiki uses it in cases where MySQL would just not be practical. ShopWiki is also using it as a storage engine for all R&D and data-mining efforts where MongoDB's document oriented architecture offers maximum flexibility.<br>• Avery's Talk at MongoNYC - ShopWiki Dev Blog (June 2010) |
| mypunchbowl | MyPunchbowl.com is a start to finish party planning site that uses MongoDB for tracking user behavior and datamining.<br>• *Ryan Angilly on Replacing MySQL with MongoDB (Zero to Mongo)* on The Bitsource<br>• MongoDB for Dummies: How MyPunchbowl went from 0 to production in under 3 days - Presentation at MongoNYC (May 2010) |
| Sunlight LABS | Sunlight Labs is a community of open source developers and designers dedicated to opening up our government to make it more transparent, accountable and responsible. MongoDB powers the National Data Catalog, and the Drumbone API, which is an aggregator of data about members of Congress.<br>• Civic Hacking - Video from Luigi Montanez's presentation at MongoNYC (May 2010)<br>• How We Use MongoDB at Sunlight blog post (May 2010) |
| photostre.am | photostre.am streams image data from flickr and uses MongoDB as it's only database.<br>• MongoDB in Production at photostre.am - photostre.am blog (June 2010) |
| fotopedia.com The first collaborative photo encyclopedia | Fotopedia uses MongoDB as storage backend for its copy of wikipedia data, storage for users and albums timelines, a feature that is currently under heavy refactoring, and as the "metacache", an index of every tiny html fragment in its varnish cache for proactive invalidation of stale content.<br>• MongoDB: Our Swiss Army Datastore - Presentation at MongoFR in June 2010: Slides and Video |
| Grooveshark | Grooveshark currently uses Mongo to manage over one million unique user sessions per day. |
| stickybits | Stickybits is a fun and social way to attach digital content to real world objects. |
| EA | MongoDB is being used for the game feeds component. It caches game data from different sources which gets served to ea.com, rupture.com and the EA download manager. |
| struq | Struq develops technology that personalises the contents and design of online display advertising in real time. |

| | |
|---|---|
| Pitchfork | Pitchfork is using MongoDB for their year-end readers survey and internal analytics. |
| floxee | Floxee, a web toolkit for creating Twitter directories, leverages MongoDB for back-end storage. The award-winning TweetCongress is powered by Floxee. |
| Sailthru | Sailthru is an email service provider that uses MongoDB for click-stream analysis and reporting. |
| silentale | Silentale keeps track of your contacts and conversations from multiple platforms and allows you to search and access them from anywhere. Silentale is using MongoDB as the back-end for indexing and searching on millions of stored messages of different types. More details on Silentale can be found in this TechCrunch article.<br>• One Year with MongoDB presentation from MongoUK (June 2010): Slides and Video |
| teach street LEARN SOMETHING NEW | TeachStreet helps people find local and online classes by empowering teachers with robust tools to manage their teaching businesses. MongoDB powers our real-time analytics system which provide teachers with insight into the performance and effectiveness of their listings on TeachStreet.<br>• Slides from Mongo Seattle - TeachStreet blog (July 2010) |
| DEFENSIO | Defensio is a comment-spam blocker that uses MongoDB for back-end storage. |
| TweetSaver | TweetSaver is a web service for backing up, searching, and tagging your tweets. TweetSaver uses MongoDB for back-end storage. |
| BLOOM | Bloom Digital's AdGear platform is a next-generation ad platform. MongoDB is used for back-end reporting storage for AdGear. |
| klatu networks | KLATU Networks designs, develops and markets asset monitoring solutions which helps companies manage risk, reduce operating costs and streamline operations through proactive management of the status, condition, and location of cold storage assets and other mission critical equipment. KLATU uses MongoDB to store temperature, location, and other measurement data for large wireless sensor networks. KLATU chose MongoDB over competitors for scalability and query capabilities. |
| | songkick lets you track your favorite artists so you never miss a gig again.<br>• Speeding up your Rails app with MongoDB - Presentation at MongoUK (June 2010) |
| Detexify² | Detexify is a cool application to find LaTeX symbols easily. It uses MongoDB for back-end storage. Check out the blog post for more on why Detexfy is using MongoDB. |
| SLUGGY FREELANCE | http://sluggy.com/ is built on MongoDB, mongodb_beaker, and MongoKit.<br>• From MySQL to MongoDB at Sluggy.com - Brendan McAdams' presentation at MongoNYC (May 2010) |
| style signal | Stylesignal is using MongoDB to store opinions from social media, blogs, forums and other sources to use in their sentiment analysis system, Zeitgeist. |
| | @trackmeet helps you take notes with twitter, and is built on MongoDB |
| eflyover | eFlyoverleverages the Google Earth Browser Plugin and MongoDB to provide interactive flyover tours of over two thousand golf courses worldwide. |
| shapado | Shapado is a multi-topic question and answer site in the style of Stack Overflow. Shapado is written in Rails and uses MongoDB for back-end storage. |

| | |
|---|---|
| Sifino | Sifino enables students to help each other with their studies. Students can share notes, course summaries, and old exams, and can also ask and respond to questions about particular courses. |
| GAMECHANGER | GameChanger provides mobile apps that replace pencil-and-paper scorekeeping and online tools that distribute real-time game updates for amateur sports.<br>• Tornado, MongoDB, and the Realtime Web - Kiril Savino's presentation at MongoNYC (May 2010)<br>• GameChanger and MongoDB: a case study in MySQL conversion - Kiril Savino's blog (September 2010) |
| soliMAP | soliMAP is a map-based ad listings site that uses MongoDB for storage. |
| MyBankTracker | MyBankTracker iPhone App uses MongoDB for the iPhone app's back-end server. |
| bill monitor | BillMonitor uses MongoDB to store all user data, including large amounts of billing information. This is used by the live site and also by BillMonitor's internal data analysis tools. |
| Tubricator | Tubricator allows you to create easy to remember links to YouTube videos. It's built on MongoDB and Django. |
| mu.ly | Mu.ly uses MongoDB for user registration and as a backend server for its iPhone Push notification service. MongoDB is mu.ly's Main backend database and absolute mission critical for mu.ly. |
| AVINU | Avinu is a Content Management System (CMS) built on the Vork enterprise framework and powered by MongoDB. |
| edelight | edelight is a social shopping portal for product recommendations.<br>• MongoDB: Wieso Edelight statt MySQL auf MongoDB setzt - Exciting Ecommerce blog (September 2010) |
| TOPSY | Topsy is a search engine powered by Tweets that uses Mongo for realtime log processing and analysis. |
| CODE PEEK | Codepeek is using MongoDB and GridFS for storing pastes. |
| Similaria | Similaria.pl is an online platform, created to connect users with people and products that match them. |
| totutam | ToTuTam uses Mongo to store information about events in its portal and also to store and organise information about users preferences. |

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| themoviedb.org | themoviedb.org is a free, user driven movie database that uses MongoDB as its primary database. |
| OCW Search | OCW Search is a search engine for OpenCourseWare. It stores all the course materials in MongoDB and uses Sphinx to index these courses.<br>• Full Text Search with Sphinx - Presentation from MongoUK (June 2010) |
| Mixero Reducing the noise | Mixero is the new generation Twitter client for people who value their time and are tired of information noise. Mixero uses Mongo to store users' preferences and data. |
| Biggo система управления сайтами | Biggo is an advanced site constructor with e-commerce modules. Biggo uses MongoDB for stats collection. |
| kabisa ICT agile solutions | Kabisa is a web development firm specializing in Ruby on Rails and Java / J2EE. Kabisa uses MongoDB for many of its client projects, including a mobile news application for iPhone and Android. |
| DOKDOK | DokDok makes it easy and automatic for users to find, work on and share the latest version of any document - right from their inbox. DokDok migrated to a Mongo backend in August 2009. See Bruno Morency's presentation Migrating to MongoDB for more information. |
| enbil.nu | Enbil is a swedish website for finding, and comparing, rental cars. MongoDB is used for storing and querying data about geographical locations and car rental stations. |
| Websko | Websko is a content management system designed for individual Web developers and cooperative teams. MongoDB's lack of schema gives unlimited possibilities for defining manageable document oriented architecture and is used for back-end storage for all manageable structure and data content. Websko is written in Rails, uses MongoMapper gem and in-house crafted libraries for dealing with Mongo internals. |
| markitfor.me | markitfor.me is a bookmarking service that makes your bookmarks available via full-text search so you don't have to remember tags or folders. You can just search for what you're looking for and the complete text of all of your bookmarked pages will be searched. MongoDB is used as the datastore for the marked pages. |
| backpage pics | Backpage Pics is a website that displays backpage.com adult classified listings as an image gallery. MongoDB is used to store listing data. *Please note that this website is NSFW.* |
| Joomla Ads | Joomla Ads uses MongoDB for its back-end reporting services. |
| beta musweet Music. Realtime. | musweet keeps track of what artists and bands publish on the social web. |

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| | Eiwa System Management, Inc. is a software development firm that has been using MongoDB for various projects since January 2010. |
| | Morango is an internet strategy consultancy based in London, which uses MongoDB in production on several client projects.<br>• Building a Content Management System with MongoDB - Presentation from MongoUK (June 2010) |
| | PeerPong discovers everyone's expertise and connects you to the best person to answer any question. We index users across the entire web, looking at public profiles, real-time streams, and other publicly available information to discover expertise and to find the best person to answer any question. |
| | ibibo ("I build, I bond") is a social network using MongoDB for its dashboard feeds. Each feed is represented as a single document containing an average of 1000 entries; the site currently stores over two million of these documents in MongoDB. |
| | MediaMath is the leader in the new and rapidly growing world of digital media trading. |
| | Zoofs is a new way to discover YouTube videos that people are talking about on Twitter. Zoofs camps in Twitter searching for tweets with YouTube video links, and then ranks them based on popularity. |
| | Oodle is an online classifieds marketplace that serves up more than 15 million visits a month and is the company behind the popular Facebook Marketplace. Oodle is using Mongo for storing user profile data for our millions of users and has also open sourced its Mongo ORM layer. |
| | Funadvice relaunched using the MongoDB and MongoMapper. Read the Funadvice CTO's post to MongoDB User Forum from May 2010 for more details. |
| | Ya Sabe is using MongoDB for the backend storage of business listings. Yasabe.com is the first local search engine built for Hispanics in the US with advanced search functionality. You can find and discover more than 14 million businesses via the web or your mobile phone. All the information is in both Spanish and in English. |
| | LoteriaFutbol.com is a Fantasy Soccer Portal recently launched for the World Soccer Cup: South Africa 2010. Mongo has been used entirely to store data about users, groups, news, tournaments and picks. It uses the PHP driver with a Mongo module for Kohana v3 (Mango). |
| | Kehalim switched over to MongoDB 1 year ago after exhausting other cloud and relational options. As a contextual affiliate network, Kehalim stores all of its advertisers, ads and even impressions on top of MongoDB. MongoDB has outed both MySQL and memcached completely and also provides great hadoop-like alternative with its own map-reduce. |
| | Squarespace is an innovative web publishing platform that consists of a fully hosted and managed GUI environment for creating and maintaining websites. Squarespace's new social modules utilize Mongo to store large amounts of social data that is pulled in from around the Internet and displayed in native widgets that are fully integrated with the platform. |
| | Givemebeats.net is an e-commerce music site that allows people to buy beats (music instrumentals) produced by some of the best producers in the world. Now we entirely use MongoDB to store users profile, beats information, and transaction statistics. |

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| Cheméo High Quality Chemical Properties | Cheméo, a search engine for chemical properties, is built on top of MongoDB. For a fairly extensive explanation of the tools and software used and some MongoDB tips, please go to chemeo.com/doc/technology. |
| planetaki | Planetaki is place were you can read all your favourite websites in one place. MongoDB has replaced MySQL for the storage backend that does all the heavy lifting and caching of each website's news feed.<br>• Planetaki Powered by MongoDB - SamLown.com (June 2010) |
| 视觉中国 www.ChinaVisual.com | [ChinaVisual.com] is the leading and largest vertical portal and community for creative people in China. ChinaVisual.com moved from mysql to mongoDB in early 2009. Currently MongoDB powers its most major production and service, like file storage, session server, and user tracking. |
| Row Feeder | RowFeeder is an easy social media monitoring solution that allows people to track tweets and Facebook posts in a spreadsheet. RowFeeder uses MongoDB to keep up with the high volume of status updates across multiple social networks as well as generate basic stats.<br>• MongoDB for Real Time Data Collection and Stats Generation - Presentation at Mongo Seattle (July 2010) |
| MMX | Mini Medical Record is designed to facilitate medical care for all members of the public. While useful for everyone, it is especially useful for travelers, professional road warriors, homeless, substance dependent, and other members of the public who receive care through multiple medical systems. |
| OPEN DINING NETWORK | Open Dining Network is a restaurant data and food ordering platform that provides a RESTful API to take web and mobile orders. MongoDB is used to manage all restaurant, customer, and order information. |
| urlist | URLi.st is a small web application to create and share list of links. The web application is coded in Python (using the pylons framework) and uses MongoDB (with pymongo 1.6) in production to power its data layer. |
| Pinterest | Pinterest is a community to share collections of things you love. Pinterest is built in Python and uses MongoDB for its internal analytics tools and huge data sets like contacts imported from gmail and yahoo. |
| LEARNBOOST | LearnBoost is a free and amazing gradebook web app that leverages MongoDB for its data storage needs. LearnBoost is the creator of Mongoose, a JavaScript async ORM for MongoDB that is flexible, extensible and simple to use.<br>• Mongoose - LearnBoost blog (May 2010) |
| www.kidiso.com KIDISO turning the web into a safe playground | Kidiso is a safe online playground for children up to 13, with advanced parental controls. In the current setup, we are using MongoDB for logging, analysis tasks, and background jobs that aggregate data for performance (ie search results and allowed content). |
| | Carbon Calculated provides an open platform that aggregates carbon and green house gas emissions for everything in the world, from passenger transport, raw materials, through to consumer goods. Built on top of this platform, Carbon Calculated offers a suite of products that make carbon calculation accessible and intuitive. |

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| | Vowch is a simple platform for telling the world about all the people, places and things that matter most to you. It is a platform for making positive, public endorsements for anyone or anything from a Twitter account.<br>• View a vowch for MongoDB: http://vow.ch/2ij |
| | HolaDoctor.com is the most comprehensive health and wellness portal available in Spanish for the global online Hispanic community. MongoDB is being used to store all the content for the site, including GridFS to store article images. Session data is also being persisted on our MongoDB cluster using a custom PHP save handler. |
| | Ros Spending is the first Russian public spending monitoring project. It includes information about 1,400,000 federal government and 210,000 regional government contracts, as well as information about more than 260,000 suppliers and 26,000 customers. MongoDB stores all reports, customer and supplier information, stats and pre-cached queries. The project was initiated by the Institute of Contemporary Development and launched publicly in July 2010 during the Tver economic forum. |
| | BlueSpark designs and develops iPhone and iPad applications and specializes in Adobe Flash development, we have a passion for creating great user experiences and products that feel simple to use. |
| | [Aghora] is a time attendance application specially designed for the requirements of the Brasilian governmental requirements. Our whole application is based on PHP and MongoDB. Click here for more information. |
| | Man of the House is the real man's magazine, a guide for the jack of all trades trying to be better – at work and at home, as a father and as a husband. The entire backend of the site depends on MongoDB. |
| | PeerIndex is an algorithmic authority ranking web service that uses MongoDB to scale processing of the firehose of social media, as a distributed data store and middle cache for fast site performance. |
| | sahibinden.com is an online classifieds marketplace that serves more than 14.5 million unique visitors and over 1.5 billion pageviews a month. sahibinden.com is using MongoDB for storing classifieds data and caching. |
| | Remembersaurus is a flashcard website targeted at language learners which helps the learners focus on the cards that they are having the hardest time remembering.We're using MongoDB for all of our backend storage, but it's been particularly useful for helping log how well each user knows each of the cards they are studying. |
| | Shadelight is a unique fantasy roleplaying game where you play one of the legendary Guardians of Elumir. Set out on magical quests, battle mysterious creatures and explore a truly unique fantasy world. |
| | Ylastic is using MongoDB extensively in production. For example, MongoDB powers Ylastic's monitors capability. |
| | BRAINREPUBLIC is a social network for anyone to wants to talk face-to-face - or just audio or chat - with like-minded people from anywhere at anytime. |

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| | Friendmaps is a tool that allows users to view all of their social networks on a single map. |
| | The affiliate marketing platform Jounce has gone live using MongoDB as the main storage solution for its search data. As of August 2010, ~10 million offers are stored in the database. |
| | Virb Looking for a place to park your portfolio, your band, your website? Build an elegantly simple website with Virb. You provide the content, we'll help with the rest — for only $10/month. |
| | Deal Machine is a streamlined CRM that makes sales fun and effective. We use MongoDB as our main storage. It has helped us a lot to make the web app better and more scalable. |
| | arrivalguides.com is the largest network of free online (and pdf) travel guides. arrivalguides.com recently launched a new site where they rewrote the whole application switching from SQL server to MongoDB using the NoRM Driver for C#. The website is purely driven by MongoDB as the database backend. |
| | The Hype Machine keeps track of emerging music on the web. We use MongoDB to accelerate storage and retrieval of user preferences, and other core site data. MongoDB's web-native design and high performance in our workloads was what got our attention. It's from the future! |
| | Scrabbly is a massively multiplayer online ~~scrabble~~ crossword. Uses MongoDB geospatial indexing.<br>• Building a Scrabble MMO in 48 Hours - Startup Monkeys Blog (September 2010) |
| | ChatPast synchronizes your chat history from multiple chat clients (Live, Skype, etc.), across multiple computers. Search them, slice them, and get just the data you want. Find everything you've ever talked about. Business users can push important IM conversations into SalesForce and 37 Signals products (Highrise, BaseCamp, etc) seamlessly. |
| | Stockopedia initially began using MongoDB for its internal analytics system - tracking all activity around 20000+ stocks, sectors and investment topics. Stockopedia is now confidently using the same foundation for building real time analytics, recommendation, categorization and discovery features for both publishers and investors conducting and publishing investment research on the Stockopedia platform. |
| | TravelPost is a community built by travel enthusiasts for travel enthusiasts. Today, the site has millions of reviews, photos and blogs. TravelPost uses MongoDB for backend storage and analytics applications. |
| | SoulGoal stores or caches all user data and facebook information in MongoDB. |

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| | Top Twitter Trends is an experimental and on-going project built with today's trending and cutting-edge technologies such as node.js, nginx, and MongoDB. |
| | bongi.mobi is a place for you to build your own mobi free site from your mobile device! Technologies include: fast document orientated database (MongoDB), full handset detection, image/font resizing (based on handset capabilities), mobile ad serving, geolocation, multimedia (images, video, music), analytics and tracking, click-2-call, SMS, email modules, 3rd party API integration. |
| | CoStore is an online platform for data exchange, collaboration and data entry. CoStore helps you with importing, transforming and collaborating on all sorts of data files. CoStore also provides reporting tools, such as charts, graphs and network visualizations. CoStore runs in the browser, so you can access it wherever you need it. MongoDB is used as the backend; it stores the data and also runs query steps, which are MapReduce operations. |
| | Vuzz answers questions like "What are everyone else's opinions?" through showing people's ranking charts. At Vuzz, people can vote, talk about, create and share rankings, and communicate with people that share the same interests as you. By adding up people's votes and showing ranking charts, Vuzz wants to be your time machine that shows people's interests and changes in trend from the past to current. Vuzz has been listed on Killerstartups and jp.Techcrunch. Vuzz uses MongoDB as the main applicatin database. |
| | Bakodo is a barcode search engine with a social component that helps users make informed decisions while they are shopping. Users can scan barcodes using the camera in their mobile phone and get information about the products they are looking at: where to buy it, lower prices, local stores, and most importantly, what their friends think about it. Bakodo uses MongoDB to store their massive index of million of products. |
| | noclouds.org is a online system, completely open source and still in development, where users can upload and share information about files. MongoDB has been used since the beginning of the project for almost all systems. |

### See also

- MongoDB Apps
- Use Cases
- User Feedback

## Mongo-Based Applications

*Please list applications that leverage MongoDB here. If you're using MongoDB for your application, we'd love to list you here! Email meghan@10gen.com.*

### See Also

- Production Deployments - Companies and Sites using MongoDB
- Hosting Center

### Applications Using MongoDB

#### CMS

#### *HarmonyApp*

Harmony is a powerful web-based platform for creating and managing websites. It helps connect developers with content editors, for unprecedented flexibility and simplicity. For more information, view Steve Smith's presentation on Harmony at MongoSF (April 2010).

#### *c5t*

Content-management using TurboGears and Mongo

#### *Websko*

Websko is a content management system designed for individual Web developers and cooperative teams.

### *Graylog2*

Graylog2 is an open source syslog server implementation that stores logs in MongoDB and provides a Rails frontend.

**Analytics**

### *Hummingbird*

Hummingbird is a real-time web traffic visualization tool developed by Gilt Groupe

# Events

**Follow us on Facebook and Twitter to get all of the latest updates!**

## Mongo Conferences

## 10gen Weekly "Office Hours"

Submit a proposal to present at an upcoming MongoDB conference!

- ***Mongo Berlin October 4***

  One day, bilingual conference in Berlin, Germany. Talks in both English and German.
  Click here for conference agenda and registration.

- ***Mongo Chicago October 20***

  One day conference in Chicago, IL.
  Click here for conference agenda and registration.

- ***Mongo DC November 18***

  One day conference in Washington, DC.
  Click here for conference agenda and registration.

- ***Mongo SV December 3***

  One day conference in Mountain View, CA
  Click here for conference agenda and registration.

### *New York: Wednesdays 4 - 6:30pm ET*

10gen holds weekly open "office hours" with whiteboarding, hack sessions, etc., in NYC. Come over to 10gen headquarters to meet the MongoDB team.

17 West 18th Street - 8th Floor
Between 5th & 6th Ave
** Please note that the doorbell says "ShopWiki"*

### *San Francisco: Mondays 5 - 7pm PT*

On the west coast? Stop by the Epicenter Cafe in San Francisco on Mondays to meet 10gen Software Engineer Aaron Staple. Look for a laptop with a "Powered by MongoDB" sticker.

Epicenter Cafe
764 Harrison St
Between 4th St & Lapu St
** Please note that office hours will **not** be held on Monday 10/11 as it is a holiday*

## MongoDB Webinars

## Training

- ***Deployment Best Practices***

  October 12 at 12:30pm ET / 9:30am PT
  Register

- ***Keeping your data safe: replication, backup/restore, mongodump***

  November 1 at 12:30pm ET / 9:30am PT
  Register

- ***San Francisco***

  MongoDB Training for Administrators
  September 28 & 29
  More Info and Registration

**Check out the MongoDB Meetup groups:**

New York MongoDB User Group

San Francisco MongoDB User Group

## Conferences and Meetups

### United States

### Europe

### Asia

#### *Northeast*

Databases and Data Driven Applications Series 1, Class 1: Intro to OOP
girldevelopit
October 6 - October 27
New York, NY

Mongo and Ecommerce: A Perfect Combination
Steve Francia, VP Engineering, OpenSky
New York MongoDB User Group
October 19

#### *Midwest*

Mongo Chicago October 20
One day conference in Chicago, IL.
Click here for conference agenda and registration.

Inside MongoDB: The Internals of an Open Source Database
Eliot Horowitz, CTO, 10gen
ChicagoDB

October 18

### *West Coast*

Silicon Valley NoSQL Meetup
A NoSQL Evening in Palo Alto
Palo Alto, CA
October 26

ZendCon 2010
Converting your MySQL app to NoSQL with MongoDB
MongoDB for Mobile Applications
Alvin Richards, 10gen
Santa Clara, CA
November 2

QCon 2010
Consistency Models in New Generation Databases
Dwight Merriman, 10gen
San Francisco, CA
November 4

### *Southwest*

### *South*

Introduction to MongoDB
Mohammad Azam, Sogeti
Houston Tech Fest
October 9

Mongo - one year later
Marcin Szajek (Programa.pl) and Mciej Dziardziel (Adwertajzing)
PyCon Ukraine
October 23-24

MongoDB - The NoSQL madness continues
Jan Krutisch
Codebits
Lisbon
November 11-13

Building Web Applications with MongoDB
Roger Bodamer, SVP Products and Engineering, 10gen
Devoxx
Metropolis Antwerp, Belgium
November 15

## Media from Recent Events and Conferences

**Slide Gallery** | **More Presentations and Video**

If you're interested in having someone present MongoDB at your conference or meetup, or if you would like to list your MongoDB event on this page, contact meghan at 10gen dot com. Want some MongoDB stickers to give out at your talk? Complete the Swag Request Form.

# Video & Slides from Recent Events and Presentations

Table of Contents:

[ MongoDB Conferences ] [ Ruby/Rails ] [ Python ] [ Alt.NET ] [ User Experiences ] [ More about MongoDB ]

### MongoDB Conferences

One-day conferences hosted by 10gen. 10gen develops and supports MongoDB.

MongoUK Video (June 2010)

MongoFR Video (June 2010)
MongoNYC (May 2010) and MongoSF (April 2010) Video
MongoSF (April 2010) Slides & Video

### Ruby/Rails

Practical Ruby Projects with MongoDB
Alex Sharp, OptimisCorp
Ruby Midwest - June 2010

Scalable Event Analytics with MongoDB and Ruby
Jared Rosoff, Yottaa
RubyConfChina - June 26, 2010

The MongoDB Metamorphosis (Kyle Banker, 10gen)
Million Dollar Mongo (Obie Fernandez & Durran Jordan, Hashrocket)
Analyze This! (Blythe Dunham)
RailsConf
Baltimore, MD
June 7-10

MongoDB
Seth Edwards
London Ruby Users Group
London, UK
Wednesday April 14
Video & Slides

MongoDB: The Way and its Power
Kyle Banker, Software Engineer, 10gen
RubyNation
Friday April 9 & Saturday April 10
Reston, VA
Slides | Video

MongoDB Rules
Kyle Banker, Software Engineer, 10gen
Mountain West Ruby Conference
Salt Lake City, UT
Thursday March 11 & Friday March 12
Slides

MongoDB & Mongoid
Durran Jordan, Hashrocket
RubyJax
February 23, 2010
Video

MongoDB Isn't Water
Kyle Banker, Software Engineer, 10gen
Chicago Ruby
February 2, 2010
Video | Slides | Photos

Introduction to Mongo DB
Joon Yu, RubyHead
teachmetocode.com
Nov-Dec, 2009
Screencasts

### Python

How Python, TurboGears, and MongoDB are Transforming SourceForge.net
Rick Copeland, SourceForge.net
PyCon - Atlanta, GA
February 21, 2010
Slides

### Alt.NET

.NET and MongoDB - Building Applications with NoRM and MongoDB
Alex Hung
July 28, 2010

## User Experiences

The Future of Content Technologies
Scaling Web Applications with NonSQL Databases: Business Insider Case Study
Ian White, Lead Developer, Business Insider
Gilbane Conference
San Francisco, CA
Thursday, May 20
Slides

Chartbeat and MongoDb - a perfect marriage
Kushal Dave, CTO, Chartbeat & Mike Dirolf, Software Engineer, 10gen
New York City Cloud Computing Meetup
New York, NY
May 18
Slides

Why MongoDB is Awesome
John Nunemaker, CTO, Ordered List
DevNation Chicago
May 15
Slides

Humongous Data at Server Density: Approaching 1 Billion Documents in MongoDB
David Mytton, Founder, Boxed Ice
Webinar
Wednesday May 5
Recording & Slides

Humongous Drupal
DrupalCon San Francisco
Karoly Negyesi, Examiner.com
Saturday April 17
Slides | Video

MongoDB: huMONGOus Data at SourceForge
Mark Ramm, Web Developer, SourceForge
QCon London
Thursday March 11
Slides

Migrating to MongoDB
Bruno Morency, DokDok
Confoo.ca
March 10 - 12
Slides

## More about MongoDB

Recording of Michael Dirolf on MongoDB @ E-VAN 07 June 2010

NoSQL-Channeling the Data Explosion
Dwight Merriman, CEO, 10gen
Inside MongoDB: the Internals of an Open-Source
Mike Dirolf, Software Engineer, 10gen
Gluecon
Denver, CO
Wednesday May 26 & Thursday May 27

Schema Design with MongoDB
Kyle Banker, Software Engineer, 10gen
Webinar
Tuesday April 27
Recording and Slides

Dropping ACID with MongoDB
Kristina Chodorow, Software Engineer, 10gen
San Francisco MySQL Meetup
San Francisco, CA
Monday, April 12
Video

Introduction to MongoDB
Mike Dirolf, Software Engineer, 10gen

Emerging Technologies for the Enterprise Conference
Philadelphia, PA
Friday, April 9
Slides

Indexing with MongoDB
Aaron Staple, Software Engineer, 10gen
Webinar
Tuesday April 6, 2010
Video | Slides

TechZing Interview with Mike Dirolf, Software Engineer, 10gen
Monday, April 5
Podcast

Hot Potato and MongoDB
New York Tech Talks Meetup
Justin Shaffer and Lincoln Hochberg
New York, NY
Tuesday March 30
Video

MongoDB Day
Geek Austin Data Series
Austin, TX
Saturday March 27
Photo

Mongo Scale!
Kristina Chodorow, Software Engineer, 10gen
Webcast
Friday March 26
Webcast

NoSQL Live Boston
Boston, MA
Thursday March 11
Recap with slides and MP3

MongoDB: How it Works
Mike Dirolf, Software Engineer, 10gen
Monday March 8, 12:30 PM Eastern Time
Slides

Intro to MongoDB
Alex Sharp, Founder / Lead Software Architect, FrothLogic
LA WebDev Meetup
February 23, 2010
Slides

Introduction to MongoDB
Kristina Chodorow, Software Engineer, 10gen
FOSDEM - Brussels, Belgium
February 7, 2010
Video | Slides | Photos

*If you're interested in having someone present MongoDB at your conference or meetup, or if you would like to list your MongoDB event on this page, contact meghan at 10gen dot com.*

## Slide Gallery

**Click here to visit our full listing of videos & slides from recent events and presentations.**

| Introduction to MongoDB | User Experience |
|---|---|
| slideshare \| Get your SlideShare Playlist | slideshare \| Get your SlideShare Playlist |

| Ruby/Rails | Python |
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| slideshare \| Get your SlideShare Playlist | slideshare \| Get your SlideShare Playlist |
| **Java** | **PHP** |
| slideshare \| Get your SlideShare Playlist | slideshare \| Get your SlideShare Playlist |
| **MongoDB & Cloud Services** | **More About MongoDB** |
| slideshare \| Get your SlideShare Playlist | slideshare \| Get your SlideShare Playlist |

# Articles

See also the User Feedback page for community presentations, blog posts, and more.

### Best of the MongoDB Blog

- What is the Right Data Model? - (for non-relational databases)
- Why Schemaless is Good
- The Importance of Predictability of Performance
- Capped Collections - one of MongoDB's coolest features
- Using MongoDB for Real-time Analytics
- Using MongoDB for Logging
- http://blog.mongodb.org/tagged/best+of

### Articles / Key Doc Pages

- On Atomic Operations
- Reaching into Objects - how to do sophisticated query operations on nested JSON-style objects
- Schema Design
- Full Text Search in Mongo
- MongoDB Production Deployments

### Videos

- MongoDB Blip.tv Channel
- MongoDB for Rubyists (February 2010 Chicago Ruby Meetup)
- Introduction to MongoDB (FOSDEM February 2010)
- NY MySql Meetup - NoSQL, Scaling, MongoDB
- Teach Me To Code - Introduction to MongoDB
- DCVIE

# Benchmarks

If you've done a benchmark, we'd love to hear about it!  Let us know at *kristina at 10gen dot com*.

March 9, 2010 - Speed test between django_mongokit and postgresql_psycopg2 benchmarks creating, editing, and deleting.

February 15, 2010 - Benchmarking Tornado's Sessions flatfile, Memcached, MySQL, Redis, and MongoDB compared.

January 23, 2010 - Inserts and queries against MySQL, CouchDB, and Memcached.

May 10, 2009 - MongoDB vs. CouchDB vs. Tokyo Cabinet

July 2, 2009 - MongoDB vs. MySQL

September 25, 2009 - MongoDB inserts using Java.

August 11, 2009 - MySQL vs. MongoDB vs. Tokyo Tyrant vs. CouchDB inserts and queries using PHP.

August 23, 2009 - MySQL vs. MongoDB in PHP: Part 1 (inserts), Part 2 (queries), aginst InnoDB with and without the query log and MyISAM.

November 9, 2009 - MySQL vs. MongoDB in PHP and Ruby inserts (original Russian, English translation)

Disclaimer: these benchmarks were created by third parties not affiliated with MongoDB. MongoDB does not guarantee in any way the correctness, thoroughness, or repeatability of these benchmarks.

### See Also

- http://blog.mongodb.org/post/472834501/mongodb-1-4-performance

# FAQ

This FAQ answers basic questions for new evaluators of MongoDB. See also:

- Developer FAQ
- Sharding FAQ

### MongoDB Intro FAQ

- MongoDB Intro FAQ
  - What kind of database is the Mongo database?
  - What languages can I use to work with the Mongo database?
  - Does it support SQL?
  - Is caching handled by the database?
  - What language is MongoDB written in?
  - What are the 32-bit limitations?

#### *What kind of database is the Mongo database?*

MongoDB is an document-oriented DBMS. Think of it as MySQL but JSON (actually, BSON ) as the data model, not relational. There are no joins. If you have used object-relational mapping layers before in your programs, you will find the Mongo interface similar to use, but faster, more powerful, and less work to set up.

#### *What languages can I use to work with the Mongo database?*

Lots! See the drivers page.

#### *Does it support SQL?*

No, but MongoDB does support ad hoc queries via a JSON-style query language. See the Tour and Advanced Queries pages for more information on how one performs operations.

#### *Is caching handled by the database?*

For simple queries (with an index) Mongo should be fast enough that you can query the database directly without needing the equivalent of memcached. The goal is for Mongo to be an alternative to an `ORM/memcached/mysql` stack. Some MongoDB users do like to mix it with memcached though.

#### *What language is MongoDB written in?*

The database is written in C++. Drivers are usually written in their respective languages, although some use C extensions for speed.

#### *What are the 32-bit limitations?*

MongoDB uses memory-mapped files. When running on a 32-bit operating system, the total storage size for the server (data, indexes, everything) is 2gb. If you are running on a 64-bit os, there is virtually no limit to storage size. See the blog post for more information.

# Product Comparisons

## Interop Demo (Product Comparisons)

### *Interop 2009 MongoDB Demo*

Code: http://github.com/mdirolf/simple-messaging-service/tree/master

## MongoDB, CouchDB, MySQL Compare Grid

pending...

| | CouchDB | MongoDB | MySQL |
|---|---|---|---|
| Data Model | Document-Oriented (JSON) | Document-Oriented (BSON) | Relational |
| Data Types | string,number,boolean,array,object | string, int, double, boolean, date, bytearray, object, array, others | link |
| Large Objects (Files) | Yes (attachments) | Yes (GridFS) | blobs? |
| Horizontal partitioning scheme | CouchDB Lounge | Auto-sharding (v1.6) | ? |
| Replication | Master-master (with developer supplied conflict resolution) | Master-slave (and "replica sets") | Master-slave |
| Object(row) Storage | One large repository | Collection based | Table based |
| Query Method | Map/reduce of javascript functions to lazily build an index per query | Dynamic; object-based query language | Dynamic; SQL |
| Secondary Indexes | Yes | Yes | Yes |
| Atomicity | Single document | Single document | Yes - advanced |
| Interface | REST | Native drivers ; REST add-on | Native drivers |
| Server-side batch data manipulation | ? | Map/Reduce, server-side javascript | Yes (SQL) |
| Written in | Erlang | C++ | C++ |
| Concurrency Control | MVCC | Update in Place | |
| Geospatial Indexes | GeoCouch | Yes. (As of June 2010, coordinate system is cartesian. Spherical coming soon.) | ? |
| Distributed Consistency Model | Eventually consistent (master-master replication with versioning and version reconciliation) | Strong consistency. Eventually consistent reads from secondaries are available. | Strong consistency. Eventually consistent reads from secondaries are available. |

### *See Also*

- Comparing Mongo DB and Couch DB

## Comparing Mongo DB and Couch DB

We are getting a lot of questions "how are mongo db and couch different?" It's a good question: both are document-oriented databases with schemaless JSON-style object data storage. Both products have their place -- we are big believers that databases are specializing and "one size fits all" no longer applies.

We are not CouchDB gurus so please let us know in the forums if we have something wrong.

### *MVCC*

One big difference is that CouchDB is MVCC based, and MongoDB is more of a traditional update-in-place store. MVCC is very good for certain classes of problems: problems which need intense versioning; problems with offline databases that resync later; problems where you want a large amount of master-master replication happening. Along with MVCC comes some work too: first, the database must be compacted periodically, if there are many updates. Second, when conflicts occur on transactions, they must be handled by the programmer manually (unless the db also does conventional locking -- although then master-master replication is likely lost).

MongoDB updates an object in-place when possible. Problems require high update rates of objects are a great fit; compaction is not necessary. Mongo's replication works great but, without the MVCC model, it is more oriented towards master/slave and auto failover configurations than to complex master-master setups. With MongoDB you should see high write performance, especially for updates.

### *Horizontal Scalability*

One fundamental difference is that a number of Couch users use replication as a way to scale. With Mongo, we tend to think of replication as a way to gain reliability/failover rather than scalability. Mongo uses (auto) sharding as our path to scalabity (sharding is GA as of 1.6). In this sense MongoDB is more like Google BigTable. (We hear that Couch might one day add partitioning too.)

### *Query Expression*

Couch uses a clever index building scheme to generate indexes which support particular queries. There is an elegance to the approach, although one must predeclare these structures for each query one wants to execute. One can think of them as materialized views.

Mongo uses traditional dynamic queries. As with, say, MySQL, we can do queries where an index does not exist, or where an index is helpful but only partially so. Mongo includes a query optimizer which makes these determinations. We find this is very nice for inspecting the data administratively, and this method is also good when we *don't* want an index: such as insert-intensive collections. When an index corresponds perfectly to the query, the Couch and Mongo approaches are then conceptually similar. We find expressing queries as JSON-style objects in MongoDB to be quick and painless though

### *Atomicity*

Both MongoDB and CouchDB support concurrent modifications of single documents. Both forego complex transactions involving large numbers of objects.

### *Durability*

The products take different approaches to durability. CouchDB is a "crash-only" design where the db can terminate at any time and remain consistent. MongoDB take a different approach to durability. On a machine crash, one then would run a repairDatabase() operation when starting up again (similar to MyISAM). MongoDB recommends using replication -- either LAN or WAN -- for true durability as a given server could permanently be dead. To summarize: CouchDB is better at durability when using a single server with no replication.

### *Map Reduce*

Both CouchDB and MongoDB support map/reduce operations. For CouchDB map/reduce is inherent to the building of all views. With MongoDB, map/reduce is only for data processing jobs but not for traditional queries.

### *Javascript*

Both CouchDB and MongoDB make use of Javascript. CouchDB uses Javascript extensively including in the building of views .

MongoDB supports the use of Javascript but more as an adjunct. In MongoDB, query expressions are typically expressed as JSON-style query objects; however one may also specify a javascript expression as part of the query. MongoDB also supports running arbitrary javascript functions server-side and uses javascript for map/reduce operations.

### *REST*

Couch uses REST as its interface to the database. With its focus on performance, MongoDB relies on language-specific database drivers for access to the database over a proprietary binary protocol. Of course, one could add a REST interface atop an existing MongoDB driver at any time -- that would be a very nice community project. Some early stage REST implementations exist for MongoDB.

### *Performance*

Philosophically, Mongo is very oriented toward performance, at the expense of features that would impede performance. We see Mongo DB being useful for many problems where databases have not been used in the past because databases are too "heavy". Features that give MongoDB good performance are:

- client driver per language: native socket protocol for client/server interface (not REST)
- use of memory mapped files for data storage
- collection-oriented storage (objects from the same collection are stored contiguously)
- update-in-place (not MVCC)
- written in C++

### *Use Cases*

It may be helpful to look at some particular problems and consider how we could solve them.

- if we were building Lotus Notes, we would use Couch as its programmer versioning reconciliation/MVCC model fits perfectly. Any problem where data is offline for hours then back online would fit this. In general, if we need several eventually consistent master-master

replica databases, geographically distributed, often offline, we would use Couch.
- if we had very high performance requirements we would use Mongo. For example, web site user profile object storage and caching of data from other sources.
- for a problem with very high update rates, we would use Mongo as it is good at that. For example, updating real time analytics counters for a web sites (pages views, visits, etc.)

Generally, we find MongoDB to be a very good fit for building web infrastructure.

## Licensing

> If you are using a vanilla MongoDB server from either source or binary packages you have NO obligations. You can ignore the rest of this page.

- MongoDB Database
  - Free Software Foundation's GNU AGPL v3.0.
  - Commercial licenses are also available from 10gen.
- Drivers:
  - mongodb.org "Supported Drivers": Apache License v2.0.
  - Third parties have created drivers too; licenses will vary there.
- Documentation: Creative Commons.

From our blog post on the AGPL:

> *Our goal with using AGPL is to preserve the concept of copyleft with MongoDB. With traditional GPL, copyleft was associated with the concept of distribution of software. The problem is that nowadays, distribution of software is rare: things tend to run in the cloud. AGPL fixes this "loophole" in GPL by saying that if you use the software over a network, you are bound by the copyleft. Other than that, the license is virtually the same as GPL v3.*
>
> *Note however that it is **never** required that applications using mongo be published. The copyleft applies only to the mongod and mongos database programs. This is why Mongo DB drivers are all licensed under an Apache license. Your application, even though it talks to the database, is a separate program and "work".*

If you intend to modify the server and distribute or provide access to your modified version you are required to release the full source code for the modified MongoDB server. To reiterate, you **only** need to provide the source for the MongoDB server and not your application (assuming you use the provided interfaces rather than linking directly against the server).

A few example cases of when you'd be required to provide your changes to MongoDB to external users:

| Case | Required |
|---|---|
| Hosting company providing access MongoDB servers | yes |
| Public-facing website using MongoDB for content | yes |
| Internal use website using MongoDB | no |
| Internal analysis of log files from a web site | no |

Regardless of whether you are *required* to release your changes we request that you do. The preferred way to do this is via a github fork. Then we are likely to include your changes so everyone can benefit.

# International Docs

> Most documentation for MongoDB is currently written in English. We are looking for volunteers to contribute documentation in other languages. If you're interested in contributing to documentation in another language please email **roger at 10gen dot com**.

### Language Homepages

- 
- Deutsch
- Español
- Français
- [!hu.png! Magyar]
- Italiano

- 
- Português
- 
- 

# Books

## Now Available

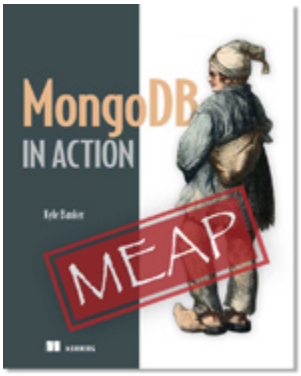
MongoDB: The Definitive Guide
By Kristina Chodorow and Mike Dirolf

## Available for Pre-Order

The Definitive Guide to MongoDB: The NoSQL Database for Cloud and Desktop Computing

By Peter Membrey

MongoDB for Web Development
By Mitch Pirtle




MongoDB in Action
by Kyle Banker

# Doc Index

## Space Index


| | | | |
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| L ... 8 | M ... 31 | N ... 2 | O ... 13 |
| R ... 27 | S ... 28 | T ... 7 | U ... 13 |
| X ... 0 | Y ... 0 | Z ... 0 | !@#$ ... 0 |

**0-9**

1.0 Changelist
Wrote MongoDB. See documentation

1.1 Development Cycle

1.2.x Release Notes
New Features More indexes per collection Faster index creation Map/Reduce Stored JavaScript functions Configurable fsync time Several small features and fixes DB Upgrade Required There are some changes that will require doing an upgrade ...

1.4 Release Notes
We're pleased to announce the 1.4 release of MongoDB. 1.4 is a drop in replacement for 1.2.

**A**

A Sample Configuration Session
following example uses two shar
test server. In addition to the scri
machine ...

About

About the local database
mongod}} reserves the database
Using the database for enduser c
replicate to other servers. Put ...

To upgrade you just need to shutdown mongod, then restart with the new binaries. (Users upgrading from release 1.0 should review the 1.2 release notes 1.2.x ...

1.6 Release Notes
MongoDB 1.6 is a dropin replacement for 1.4. To upgrade, simply shutdown {{mongod}} then restart with the new binaries. \ Please note that you should upgrade to the latest version of whichever driver you're using. Certain drivers, including the Ruby driver, will require the upgrade ...

Adding a New Set Member
Adding a new node to an existing recent copy of the data from anot

Adding an Arbiter
Arbiters are nodes in a replica se become the primary node (or eve (e.g. if a set only has two membe

Admin UIs
Several administrative user interf http://blog.timgourley.com/post/4 of Mongo Futon4Mongo http://git #MongoVUE Mongui ...

Admin Zone
Community AdminRelated Article http://blog.boxedice.com/2010/02 http://blog.timgourley.com/post/4 http://tag1consulting.com/blog/m

Advanced Queries
Introduction MongoDB offers a ri Queries in MongoDB are represe database.  For example: //

Aggregation
Mongo includes utility functions v advanced aggregate functions ca Count {{count()}} returns the num

Amazon EC2
MongoDB runs well on Amazon E regard. Instance Types MongoDE use a 64 ...

Architecture and Components
MongoDB has two primary comp core database server.  In r use mysqld on a server ...

Articles
See also the User Feedback DO the MongoDB Blog What is the R (for nonrelational databases) Wh

Atomic Operations
MongoDB supports atomic opera complex transactions for a numb slow.  Mongo DB's goal is

**B**

Backups
Several strategies exist for backing up MongoDB databases.  A word of warning: it's not safe to back up the mongod data files (by default in /data/db/) while the database is running and writes are occurring; such a backup may turn out to be corrupt.  ...

Benchmarks
you've done a benchmark, we'd love to hear about it\!  Let us know at kristina at 10gen dot com. March 9, 2010 Speed test between djangomongokit and postgresqlpsycopg2 http://www.peterbe.com/plog/speedtestbetweendjangomongokitandpostgresqlpsycopg2 benchmarks creating, editing, and deleting ...

Books
Now Available By Kristina Chodorow and Mike Dirolf Available for PreOrder By Peter Membrey By Mitch Pirtle !bankercover.jpg! MongoDB in Action http://manning.com/banker/ by Kyle Banker

Boost 1.41.0 Visual Studio 2010 Binary
OLD and was for the VS2010 BETA. See the new Boost and Windows page instead. The following is a prebuilt boost http://www.boost.org/ binary (libraries) for Visual Studio 2010 beta 2. The MongoDB vcxproj files assume this package is unzipped under c:\Program ...

Boost and Windows
Visual Studio 2010 Prebuilt from mongodb.org Click here http://www.mongodb.org/pages/viewpageattachments.action?pageId=12157032 for a prebuilt boost library for Visual Studio 2010.  7zip http://www.7zip.org/ format. Building Yourself Download the boost source ...

BSON
bsonspec.org http://www.bsonspec.org/ BSON is a bin-aryen-coded seri-al-iz-a-tion of JSONlike

**C**

C Language Center
C Driver {}The MongoDB C Drive super strict for ultimate portability README http://github.com/mong

C Sharp Language Center
C# Drivers mongodbcsharp drive http://code.google.com/p/simpler http://gist.github.com/218388 Co

C Tutorial
document is an introduction to us Quickstart for details. Next, you r guide for a language independen

C++ BSON Library
Overview The MongoDB C driver http://www.bsonspec.org/). This l one is not using MongoDB at all.

C++ Language Center
C\ driver is available for commun uses some core MongoDB code been compiled successfully on Li

C++ Tutorial
document is an introduction to us Quickstart for details. Next, you r guide for a language independen

doc-u-ments. BSON is designed to be lightweight, traversable, and efficient. BSON, like JSON, supports the embedding of objects and arrays within other objects ...

bsonspec.org

Building

section provides instructions on setting up your environment to write Mongo drivers or other infrastructure code. For specific instructions, go to the document that corresponds to your setup. Note: see the Downloads DOCS:Downloads page for prebuilt binaries\! Subsections of this section ...

Building Boost

MongoDB uses the www.boost.org Boost C\ libraries. Windows See also the prebuilt libraries http://www.mongodb.org/pages/viewpageattachments.action?pageId=12157032 page. By default c:\boost\ is checked for the boost files. Include files should be under \boost\boost ...

Building for FreeBSD

FreeBSD 8.0 and later, there is a mongodb port you can use. For FreeBSD <= 7.2: # Get the database source: http://www.github.com/mongodb/mongo. # Update your ports tree: $ sudo portsnap fetch && portsnap extract The packages that come by default on 7.2 ...

Building for Linux

General Instructions # Install Dependencies see platform specific below # get source git clone git://github.com/mongodb/mongo.git # pick a stable version unless doing true dev git tag l # Switch to a stable branch (unless ...

Building for OS X

set up your OS X computer for MongoDB development: Upgrading to Snow Leopard If you have installed Snow Leopard, the builds will be 64 bit \\ so if moving from a previous OS release, a bit more setup may be required ...

Building for Solaris

MongoDB server currently supports little endian Solaris operation.  (Although most drivers not the database server work on both.) Community: Help us make this rough page better please\!  (And help us add support for big ...

Building for Windows

MongoDB can be compiled for Windows (32 and 64 bit) using Visual C.  SCons http://www.scons.org/ is the make mechanism, although a .vcproj/.sln is also included in the project for convenience when using the Visual Studio IDE. There are several dependencies ...

Building Spider Monkey

MongoDB uses SpiderMonkey http://www.mozilla.org/js/spidermonkey/ for serverside Javascript execution. The mongod project requires a file js.lib when linking. This page details how to build js.lib. Note: V8 http://code.google.com/p/v8/ Javascript support is under ...

Building SpiderMonkey

Building the Mongo Shell on Windows

You can build the mongo shell with either scons or a Visual Studio 2010 project file. Scons scons mongo Visual Studio 2010 Project File A VS2010 vcxproj file is availabe for building the shell. From the mongo directory open ...

Building with Visual Studio 2008

MongoDB can be compiled for Windows (32 and 64 bit) using Visual C. SCons http://www.scons.org/ is the make mechanism, although a solution file is also included in the project for convenience when using the Visual Studio IDE. There are several dependencies exist ...

Building with Visual Studio 2010

MongoDB can be compiled for Windows (32 and 64 bit) using Visual C. SCons http://www.scons.org/ is the make mechanism, although a solution file is also included in the project for convenience when using the Visual Studio IDE. There are several dependencies exist ...

Caching

Memory Mapped Storage Engine all disk I/O.  Using this stra This has several implications: Th

Capped Collections

Capped collections are fixed size based on insertion order). In add for the objects in the collection; tl

CentOS and Fedora Packages

10gen now publishes yuminstalla only for the moment). For each re mongostableserver, mongostable

Checking Server Memory Usage

Checking using DB Commands T {}add: how to interpret.  wh memorymapped files; thus the m

Clone Database

MongoDB includes commands fc name on one server to another // on the same ...

Collections

MongoDB collections are essenti relational database tables. Detail are usually have the same struct

Command Line Parameters

MongoDB can be configured via currently supported set of comma ./mongod help Information on usa

Commands

Introduction The Mongo databas database to perform special oper Commands A command is sent t

Community

General Community Resources U general questions about using, c to everyone IRC chat irc://irc.free

Community Info

Comparing Mongo DB and Couch D

We are getting a lot of questions documentoriented databases wit we are big believers that databas

Configuring Sharding

Introduction This document desc requires, at minimum, three comp process. For testing ...

Connecting

C\ driver includes several classes will want to instantiate either a D our normal connection class for a

Connecting Drivers to Replica Sets

Ideally a MongoDB driver can co automatically find the right set m general steps are: # The user ...

Connecting to Replica Sets from Clie

Most drivers have been updated drivers support connecting to a re comma separated list of host ...

Connections

MongoDB is a database server: i when you start MongoDB, you wi waiting ...

Contributing to the Documentation

Qualified volunteers are welcome

Contributing to the Perl Driver

easiest way to contribute is to file like to help code the driver, read

Contributors
10gen Contributor Agreement htt
Conventions for Mongo Drivers
Interface Conventions It is desira language, and when they do ada consistent across drivers is desir
cookbook.mongodb.org
Creating and Deleting Indexes
Cursors

**D**

Data Center Awareness
1.6.0 build of replica sets does not support much in terms of data center awareness. However additional functionality will be added in the future. Below are some suggestions configurations which work today. Primary plus DR site Use one site ...
Data Processing Manual
DRAFT TO BE COMPLETED. This guide provides instructions for using MongoDB batch data processing oriented features including map/reduce DOCS:MapReduce. By "data processing", we generally mean operations performed on large sets of data, rather than small ...
Data Types and Conventions
MongoDB (BSON) Data Types Mongo uses special data types in addition to the basic JSON types of string, integer, boolean, double, null, array, and object. These types include date, object id Object IDs, binary data, regular ...
Database Internals
section provides information for developers who want to write drivers or tools for MongoDB, \ contribute code to the MongoDB codebase itself, and for those who are just curious how it works internally. Subsections of this section
Database Profiler
Mongo includes a profiling tool to analyze the performance of database operations. See also the currentOp DOCS:Viewing and Terminating Current Operation command. Enabling Profiling To enable profiling, from the {{mongo}} shell invoke: > db.setProfilingLevel(2); > db.getProfilingLevel() 2 Profiling ...
Database References
MongoDB is nonrelational (no joins), references ("foreign keys") between documents are generally resolved clientside by additional queries to the server. Two conventions are common for references in MongoDB: first simple manual references, and second, the DBRef standard, which many drivers support ...
Databases
Each MongoDB server can support multiple databases. Each database is independent, and the data for each database is stored separately, for security and ease of management. A database consists of one or more collections, the documents (objects) in those collections, and an optional set ...
DBA Operations from the Shell
page lists common DBAclass operations that one might perform from the MongoDB shell DOCS:mongo The Interactive Shell. Note one may also create .js scripts to run in the shell for administrative purposes. help show help show ...
dbshell Reference
Command Line {{\help}} Show command line options {{\nodb}} Start without a db, you can connect later with {{new Mongo()}} or {{connect()}} {{\shell}} After running a .js file from the command line, stay in the shell rather than ...
Design Overview
Developer FAQ
Also check out Markus Gattol's excellent FAQ on his website http://sunoano.name/ws/publicxhtml/mongodb.html. What's a "namespace"? MongoDB stores BSON objects in collections. The concatenation of the database name and the collection name (with a period in between) is called a namespace ...
Developer Zone
Tutorial Shell mongo The Interactive Shell Manual Databases Collections Indexes Data Types and Conventions GridFS Inserting Updating Querying Removing Optimization Developer FAQ Cookbook http://cookbook.mongodb.org If you have a comment or question about anything, please ...
Diagnostic Tools
Django and MongoDB
Do I Have to Worry About SQL Injection
Generally, with MongoDB we are not building queries from strings, so traditional SQL Injection

**E**

Emacs tips for MongoDB work
You can edit confluence directly t http://code.google.com/p/conflue http://mongodb.onconfluence.cor
Error Codes
Error Code \\ Description \\ Comr values must be unique in a collec
Error Handling in Mongo Drivers
an error occurs on a query (or ge has a first field guaranteed to hav
Events
Follow us on Facebook http://ww http://www.twitter.com/mongodb Submit a proposal http://www.10
Excessive Disk Space
You may notice that for a given s the database.  There are s size.  (This is done to prev

http://en.wikipedia.org/wiki/SQLinjection attacks are not a problem. More details and some nuances are covered below. MongoDB queries are represented as BSON objects. Typically the programming ...

Doc Index

Document-Oriented Datastore

Documentation

Dot Notation

Dot Notation

Dot Notation (Reaching into Objects)

MongoDB is designed for store JSONstyle objects.  The database understands the structure of these objects and can reach into them to evaluate query expressions. Let's suppose we have some objects of the form: > db.persons.findOne() { name: "Joe", address: , likes: 'scuba', 'math ...

Downloads

See also #Packages. Version OS X 32 bit OS X 64 bit Linux 32 bit Linux 64 bit Windows 32 bit Windows 64bit Solaris i86pc Solaris 64 Source Date Change ...

Driver and Integration Center

Driver Syntax Table

wiki generally gives examples in JavaScript, so this chart can be used to convert those examples to any language. JavaScript Python PHP Ruby Java C\ Perl \ \ \\ {{array()}} \\ {{BasicDBList}} BSONObj \ \ {} {} {{new stdClass}} {} {{BasicDBObject}} BSONObj {} \ \ {{array('x ...

Driver Testing Tools

Object IDs driverOIDTest for testing toString > db.runCommand

Drivers

MongoDB currently has client support for the following programming languages: mongodb.org Supported C C Language Center C\ C Language Center Java Java Language Center Javascript Javascript Language Center Perl Perl Language Center ...

Durability and Repair

Single Server Durability The v1.8 release of MongoDB will have single server durability. You can follow the Jira here : http://jira.mongodb.org/browse/SERVER980. Specifically, in v1.8, journaling will be added to the storage engine. We recommend using replication to keep copies ...

**F**

FAQ

FAQ answers basic questions for new evaluators of MongoDB. See also: Developer FAQ DOCS:Sharding FAQ MongoDB Intro FAQ What kind of database is the Mongo database? MongoDB is an documentoriented DBMS. Think of it as MySQL but JSON (actually ...

Feature Checklist for Mongo Drivers

Functionality Checklist This section lists tasks the driver author might handle. Essential BSON serialization/deserialization Basic operations: {{query}}, {{save}}, {{update}}, {{remove}}, {{ensureIndex}}, {{findOne}}, {{limit}}, {{sort}} Fetch more data from a cursor when necessary ...

File Based Configuration

addition to accepting command line parameters, MongoDB can also be configured using a configuration file. A configuration file to use can be specified using the {{\f}} or {{\\config}} command line options. On some packaged installs of MongoDB (for example Ubuntu & Debian ...

findandmodify Command

Find and Modify (or Remove) v1.3.0 and higher MongoDB 1.3\ supports a "find, modify, and return" command.  This command can be used to atomically modify a document (at most one) and return it. Note that, by default, the document returned will not include the modifications made on the update ...

Frequently Asked Questions - Ruby

list of frequently asked questions about using Ruby with MongoDB. If you have a question you'd like to have answered here, please add it in the comments. Can I run \insert command name here\ from the Ruby driver? Yes ...

fsync Command

Version 1.3.1 and higher The fsync command allows us to flush all pending writes to datafiles.  More importantly, it also provides a lock option that makes backups easier. fsync Command The fsync command forces the database to flush all ...

Full Text Search in Mongo

Introduction Mongo provides some functionality that is useful for text search and tagging. Multikeys (Indexing Values in an Array) The Mongo multikey feature can automatically index arrays of values. Tagging is a good example of where this feature is useful. Suppose you ...

**G**

Geospatial Indexing

v1.3.3\ MongoDB supports twodi
as "find me the closest N items t
closest N museums to my locatio

getLastError

Most drivers, and the db shell, su
operation. Database commands
primarily useful for write ...

Getting Started

Getting the Software

Placeholder $$$ TODO

Git Commit Rules

commit messages should have th
that a glance can tell the basics o

GridFS

GridFS is a specification for storin
spec DOCS:GridFS Specification
DOCS:BSON objects.  Ho

GridFS in Ruby

GridFS, which stands for "Grid Fi
into manageable chunks and sto
achieve this: one collection store

GridFS Specification

Introduction GridFS is a storage
chunks, usually 256k in size. Eac
the file, including the filename, co

GridFS Tools

File Tools {{mongofiles}} is a tool
./mongofiles list connected to: 12

./mongofiles list connected to: 12

## H

Halted Replication
instructions are for master/slave replication. For replica sets, see DOCS:Resyncing a Very Stale Replica Set Member instead. If you're running mongod with masterslave replication DOCS:Master Slave, there are certain scenarios where the slave will halt replication because ...

Home
Events Follow us on Facebook http://www.facebook.com/#!/pages/MongoDB/397955415556 and Twitter http://www.twitter.com/mongodb to get all of the latest updates\! MongoDB Conferences: Mongo Chicago http://bit.ly/mongochicago \ October 20 Mongo DC http://bit.ly/mongodc2010 ...

Hosting Center
CloudStyle provides cloudstyle hosted MongoDB instances is currently in private beta Dedicated Servers offers preconfigured, dedicated MongoDB servers supports MongoDB on its private cloud. VPS 's is an excellent choice for . offers instant configuration and deployment of MongoDB ...

How does concurrency work
mongos For sharded DOCS:Sharding environments, mongos can perform any number of operations concurrently. This results in downstream operations to mongod instances. Execution of operations at each mongod is independent; that is, one mongod does not block another. mongod The original mongod ...

How to do Snapshotted Queries in the Mongo Database
document refers to query snapshots. For backup snapshots of the database's datafiles, see the fsync lock page fsync Command. MongoDB does not support full pointintime snapshotting. However, some functionality is available which is detailed below. Cursors A MongoDB query ...

HowTo

Http Interface
REST Interfaces Sleepy Mongoose (Python) Sleepy Mongoose http://www.snailinaturtleneck.com/blog/2010/02/22/sleepymongooseamongodbrestinterface/ is a full featured REST interface for MongoDB which is available as a separate project. MongoDB Rest (Node.js) MongoDB Rest http://github.com/tdegrunt/mongodbrest is an alpha ...

## I

Implementing Authentication in a Dri
current version of Mongo suppor
in the context of a particular data
database in question. The {{admi

Import Export Tools
you just want to do DOCS:Clone
with the raw data (the documents
(capped ...

Index-Related Commands
Create Index {{ensureIndex()}} is
the {{system.indexes}} table. > dI
Note: Once you've inserted the ir

Indexes
Indexes enhance query performa
application will need so that you
MongoDB is relatively easy. Inde

Indexes in Mongo

Indexing Advice and FAQ
We get a lot of questions about ir
to keep in mind, though. First, inc
techniques for building efficient ir

Indexing as a Background Operation
Slaves and replica secondaries b
when using background:true on t
builds there. By default the {{ensı

Inserting
When we insert data into Mongol
to JSON, Python dictionaries, an
documentorientation and describ

Installing the PHP Driver

Internal Commands
Most commands Commands hav
primarily internal and administrat
, "ok" : 1 } > admindb.$cmd.findC

Internals
Cursors Tailable Cursors See p/c
OptionCursorTailable = 2 in the {
results when ...

International Docs
Most documentation for MongoD
documentation in other language
email roger at 10gen dot com. La

International Documentation

Internationalized Strings
MongoDB supports UTF8 for stri
UTF8.) Generally, drivers for eac
when serializing and deserializin

Interop Demo (Product Comparisons
Interop 2009 MongoDB Demo Co

Introduction
MongoDB wasn't designed in a la
robust systems. We didn't start fr

Introduction - How Mongo Works

## J

Java - Saving Objects Using DBObject
Java driver provides a DBObject interface to save custom objects to the database. For example, suppose one had a class called Tweet that they wanted to save: public class Tweet implements DBObject Then you can say: Tweet myTweet = new Tweet ...

Java Driver Concurrency
Java MongoDB driver is thread safe. If you are using in a web serving environment, for example, you should create a single Mongo instance, and you can use it in every

## K

Kernel class rules
new classes By default, use {{exp
constructor and assignment. non
when the compiler insists otherw

Kernel code style
case Use camelCase for most {{v
If your inline function is a single li

request.  The Mongo object maintains an internal pool of connections ...

Java Language Center
Basics Tutorial Java Tutorial API Documentation http://api.mongodb.org/java/index.html Downloads http://github.com/mongodb/mongojavadriver/downloads Specific Topics Concurrency Java Driver Concurrency Saving Objects Java Saving Objects Using DBObject Data ...

Java Tutorial
Introduction This page is a brief overview of working with the MongoDB Java Driver. For more information about the Java API, please refer to the online API Documentation for Java Driver http://api.mongodb.org/java/index.html A Quick Tour Using the Java driver is very ...

Java Types
Object Ids {{com.mongodb.ObjectId}} http://api.mongodb.org/java/0.11/com/mongodb/ObjectId.html is used to autogenerate unique ids. ObjectId id = new ObjectId(); ObjectId copy = new ObjectId(id); Regular Expressions The Java driver uses {{java.util.regex.Pattern}} http://java.sun.com ...

Javascript Language Center
MongoDB can be Used by clients written in Javascript; Uses Javascript internally serverside for certain options such as map/reduce; Has a shell DOCS:mongo The Interactive Shell that is based on Javascript for administrative purposes. node.JS and V8 See the node.JS page. node.JS ...

Job Board
Redirecting

Joyent
prebuilt DOCS:Downloads MongoDB Solaris 64 binaries work with Joyent accelerators.  Some newer gcc libraries are required to run \\ see sample setup session below. $ # assuming a 64 bit accelerator $ /usr/bin/isainfo kv ...

JS Benchmarking Harness
CODE: db.foo.drop(); db.foo.insert( ) ops = { op : "findOne" , ns : "test.foo" , query : } for ( x = 1; x<=128; x=2){ res = benchRun( ) print( "threads: " x "\t queries/sec: " res.query ) } More info: http://github.com/mongodb/mongo/commit/3db3cb13dc1c522db8b59745d6c74b0967f1611c

JVM Languages
moved to Java Language Center

performance ...

Kernel concurrency rules
All concurrency code must be pla
rules are listed below. Don't brea
concensus ...

Kernel exception architecture
several different types of assertic
assertions. However, massert is
user error {{wassert}} warn (log)

Kernel Logging
Basic Rules cout/cerr should nev
informational warning() warnings
GEODEBUG, etc ...

Kernel string manipulation
string manipulation, use the {{util
has these basic properties: # are
headers, but not libs ...

**L**

Language Support

Last Error Commands
Since MongoDB doesn't wait for a response by default when writing to the database, a couple commands exist for ensuring that these operations have succeeded. These commands can be invoked automatically with many of the drivers when saving and updating in "safe" mode. But what's really happening ...

Legal Key Names
Key names in inserted documents are limited as follows: The '$' character must not be the first character in the key name. The '.' character must not appear anywhere in the key name

Licensing
you are using a vanilla MongoDB server from either source or binary packages you have NO obligations. You can ignore the rest of this page. MongoDB Database Free Software Foundation's GNU AGPL v3.0 http://www.fsf.org/licensing/licenses/agpl3.0 ...

List of Database Commands
iframe src ="http://api.mongodb.org/internal/current/commands.html" width="100%" height="1000px" frameborder="0"> <a href="http://api.mongodb.org/internal/current/commands.html">List of MongoDB Commands</a> </iframe> See the Commands page for details on how to invoke a command ...

Locking

Locking in Mongo

Logging
MongoDB outputs some important information to stdout while its running. There are a number of things you can do to control this Command Line Options \quiet less verbose output \v more verbose output. use more v's (such as vvvvvv ...

**M**

Manual
MongoDB manual.  Excep
mongo The Interactive Shell.&nb
of the drivers

MapReduce
Map/reduce in MongoDB is usefu
using something like Hadoop witl
where you would have used ...

Master Master Replication
Mongo does not support full mas
can be used.  Generally sp
Mastermaster usages is eventua

Master Slave
Configuration and Setup To confi
you'll need to start two instances
examples explicitly specify the lo

min and max Query Specifiers
min()}} and {{max()}} functions m
index keys between the min and
conjunction. The index to be use

mongo - The Interactive Shell
Introduction The MongoDB distril
a JavaScript shell that allows you
SpiderMonkey https://developer.

Mongo Administration Guide

Mongo Concepts and Terminology

Mongo Database Administration

Mongo Developers' Guide

Mongo Documentation Style Guide
page provides information for eve
on Writing Style Guide to Conflue

Notes on Writing Style Voice Acti

Mongo Driver Requirements
highlevel list of features that a dri
list should be taken with a grain c
great way to learn about ...

Mongo Extended JSON
Mongo's REST interface support
BSON types that do not have obv
The REST interface supports thr

Mongo Metadata
dbname>.system. namespaces i
collections include: {{system.nam
namespace / index metadata exi

Mongo Query Language
Queries in MongoDB are express
"WHERE" clause: > db.users.finc
MongoDB server ...

Mongo Usage Basics

Mongo Wire Protocol
Introduction The Mongo Wire Pro
with the database server through
vary. Clients should connect to th

Mongo-Based Applications
Please list applications that lever
here\!  Email meghan@10
Hosting Center Applications ...

MongoDB - A Developer's Tour

MongoDB Commercial Services Pro
Note: if you provide consultative
10gen began the MongoDB proje
See the MongoDB ...

MongoDB Data Modeling and Rails
tutorial discusses the developme
object mapper.  The goal i
MongoDB.  To that end, w

MongoDB kernel code development
Coding conventions for the Mong

MongoDB Language Support

MongoDB, CouchDB, MySQL Comp
pending... CouchDB \\ MongoDB
DocumentOriented (BSON http://
string,number,boolean,array,obje

mongosniff
Unix releases of MongoDB includ
is, fairly low level and for comple
Usage: mongosniff help forward

mongostat
Use the mongostat utility to quick
align=center,width=700!
http://www.mongodb.org/downloa
Run mongostat help for help. Fie

Monitoring

Monitoring and Diagnostics
Admin UIs Query Profiler Use the
includes a simple diagnostic scre
db.serverStatus() from mongo ...

Moving Chunks
inc version try to set on from if se
for a shard is MAX( chunks on sh

Multikeys
MongoDB provides an interesting
example is tagging. Suppose you
db.articles.find() We can ...

Munin configuration examples
Overview Munin http://muninmon

a mini tutorial to help you setup a
agent and plugins ...

## N

node.JS
Node.js is used to write eventdriven, scalable network programs in serverside JavaScript. It is similar in purpose to Twisted, EventMachine, etc. It runs on Google's V8. Web Frameworks ExpressJS http://expressjs.com Mature web framework with MongoDB session support. 3rd Party ...

Notes on Pooling for Mongo Drivers
Note that with the db write operations can be sent asynchronously or synchronously (the latter indicating a getlasterror request after the write). When asynchronous, one must be careful to continue using the same connection (socket). This ensures that the next operation will not begin until after ...

## O

Object IDs
Documents in MongoDB are requ
MongoDB document has an \id fi

Object Mappers for Ruby and Mongo
Although it's possible to use the I
other conveniences provided by
working with Ruby and MongoDE

Old Pages

Older Downloads

One Slave Two Masters
mms.png align=center! This docu
masters. Despite the example sh
slave}} processes on a single ...

Online API Documentation
MongoDB API and driver docum
http://api.mongodb.org/java C Dr
Documentation http://api.mongoc

Optimization
Additional Articles DOCS:Optimiz
Example This section describes
Suppose our task is to display th

Optimizing Mongo Performance

Optimizing Object IDs
id field in MongoDB objects is ve
collections 'natural primary key' i

Optimizing Storage of Small Objects
MongoDB records have a certain
This overhead is normally insigni
not be.  Below ...

OR operations in query expressions
Query objects in Mongo by defau
operator for such queries, howev
value in ..." expression.  F

Overview - The MongoDB Interactive
Starting the Shell The interactive
root directory of the distribution a
{{PATH}} so you can just type {{m

Overview - Writing Drivers and Tools
section contains information for c
writing drivers and higherlevel too
BSON binary document format. F

## P

Pairing Internals
Policy for reconciling divergent oplogs In a paired environment, a situation may arise in which each member of a pair has logged operations as master that have not been applied to the other server. In such a situation, the following procedure will be used to ensure consistency between the two ...

Perl Language Center
Installing Start a MongoDB server instance ({{mongod}}) before installing so that the tests will pass. The {{mongod}} cannot be running as a slave for the tests to pass. Some tests may be skipped, depending on the version of the database you are running. CPAN $ sudo cpan MongoDB ...

Perl Tutorial

Philosophy
Design Philosophy !featuresPerformace.png align=right! Databases are specializing the "one size fits all" approach no longer applies. By reducing transactional semantics the db provides, one can still solve an interesting set of problems where performance is very ...

PHP - Storing Files and Big Data

PHP Language Center
Using MongoDB in PHP To access MongoDB from PHP you will need: The MongoDB server

## Q

Queries and Cursors
Queries to MongoDB return a cu
language driver. Details below fo
{{mongo}} process). The shell ...

Query Optimizer
MongoDB query optimizer gener
to return results. Thus, MongoDE
approach ...

Querying
One of MongoDB's best capabilit
don't require any special indexing

Quickstart
Quickstart OS X Quickstart Unix
DOCS:SQL to Mongo Mapping C

Quickstart OS X
Install MongoDB The easiest way
managers If you use the Homebr
If you use MacPorts http://www.m

running the server is the "mongo{}d" file, not the "mongo" client (note the "d" at the end) The MongoDB PHP driver installed Installing the PHP Driver \NIX Run ...

PHP Libraries, Frameworks, and Tools
PHP community has created a huge number of libraries to make working with MongoDB easier and integrate it with existing frameworks. CakePHP MongoDB datasource http://github.com/ichikaway/mongoDBDatasource/downloads for CakePHP. There's also an introductory blog post http://markstory.com ...

Product Comparisons

Production Deployments
you're using MongoDB in production, we'd love to list you here\!  Please complete this web form https://10gen.wufoo.com/forms/productiondeploymentdetails/ or email meghan@10gen.com and we will add you. <DIV mcestyle="textalign:center;margin:0" style ...

Production Notes
Architecture Production Options Master Slave 1 master, N slaves failover is handled manually Version 1.6: Replica Sets N servers, 1 is always primary, autofailover, autorecovery Backups Import Export Tools Recommended Unix System ...

Project Ideas
you're interested in getting involved in the MongoDB community (or the open source community in general) a great way to do so is by starting or contributing to a MongoDB related project. Here we've listed some project ideas for you to get started on. For some of these ideas ...

PyMongo and mod_wsgi

Python Language Center

Python Tutorial

Quickstart Unix
Install MongoDB Note: If you are exception, try the "legacy static" managers Ubuntu and Debian ...

Quickstart Windows
Download The easiest (and reco Download Downloads and extrac Downloads and extract the 64bit

## R

Rails - Getting Started
Using Rails 3? See Rails 3 Getting Started This tutorial describes how to set up a simple Rails application with MongoDB, using MongoMapper as an object mapper. We assume you're using Rails versions prior to 3.0 ...

Rails 3 - Getting Started
difficult to use MongoDB with Rails 3. Most of it comes down to making sure that you're not loading ActiveRecord and understanding how to use Bundler http://github.com/carlhuda/bundler/blob/master/README.markdown, the new Ruby dependency manager. Install the Rails ...

Recommended Production Architectures

Reconfiguring a replica set when members are down
One may modify a set when some members are down as long as a majority is established.  In that case, simply send the reconfig command to the current primary. DOCS:Reconfiguring when Members are Up If there is no primary (and this condition is not transient), no majority is available. Reconfiguring ...

Reconfiguring when Members are Up
Use the rs.reconfig() helper in the shell. You can also do this from other languages/drivers using the replSetReconfig command directly. (Run "rs.reconfig" in the shell with no parenthesis to see what it does.) $ mongo > // example : give 1st set member 2 ...

Removing
Removing Objects from a Collection To remove objects from a collection, use the {{remove()}} function in the mongo shell mongo The Interactive Shell. (Other drivers offer a similar function, but may call the function "delete". Please check your driver's documentation ...

Replica Pairs
Setup of Replica Pairs Replica Sets will soon replace replica pairs.  If you are just now setting up an instance, you may want to wait for that and use master/slave replication in the meantime. Mongo supports a concept of replica ...

Replica Pairs in Ruby
Replica Sets will replace replica pairs in MongoDB 1.6.  If you are just now setting up an instance, you may want to wait for that and use master/slave replication in the meantime. Here follow a few considerations for those using ...

Replica Set Admin UI
mongod}} process includes a simple administrative UI for checking the status of a replica set. To use, first enable {{\rest}} from the {{mongod}} command line. The rest port is the db port plus 1000 (thus, the default is 28017). Be sure this port is secure ...

Replica Set Commands
Shell Helpers rs.help() show help rs.status() rs.initiate() initiate with default settings rs.initiate(cfg) rs.add(hostportstr) add a new member to the set rs.add(membercfgobj) add a new member to the set rs.addArb(hostportstr) add a new member which ...

## S

Schema Design
Introduction With Mongo, you do there are no serverside "joins". G do not want ...

scons
Use scons to build MongoDB, an \help}} to see all options. Targets {{scons ...

Searching and Retrieving

Security and Authentication
Running Without Security (Truste the Mongo database is in a truste say, memcached).  Of cou

Server-side Code Execution
Mongo supports the execution of addition to the regular document as a string containing a SQLstyle

Server-Side Processing

Shard Ownership
shard ownership we mean which master copy of the ownership inf owns a shard ...

Sharding
MongoDB scales horizontally via addition of new machines Autom Automatic failover Sharding ...

Sharding Administration
Here we present a list of useful c cluster, see the docs on sharding speaking to a mongos process ...

Sharding and Failover
properlyconfigured MongoDB sh potential failure scenarios of com of a {{mongos}} routing process.

Sharding Config Schema
Sharding configuration schema. current metadata version numbe options (chunkSize) > db.settings

Sharding Design

Replica Set Configuration
Command Line Each {{mongod}} participating in the set should have a {{\replSet}} parameter on its command line. The syntax is mongod replSet setname {}setname is the logical name of the set. The rest command line parameter is also recommended when using replica ...

Replica Set Design Concepts
1. A write is only truly committed once it has replicated to a majority of members of the set. For important writes, the client should request acknowledgement of this with a {{getLastError(\ )}} DOCS:Verifying Propagation of Writes with getLastError call. 2. Writes which are committed at the primary of the set ...

Replica Set FAQ
How long does failover take? Failover thresholds are configurable. With the defaults, it may take 2030 seconds for the primary to be declared down by the other members and a new primary elected. During this window of time, the cluster is down for "primary" operations that is, writes and strong ...

Replica Set Internals
Design Concepts Check out the Replica Set Design Concepts for some of the core concepts underlying MongoDB Replica Sets. Configuration Command Line We specify \replSet setname/seedhostnamelist on the command line. seedhostnamelist is a (partial) list of some members ...

Replica Set Tutorial
tutorial will guide you through the basic configuration of a replica set on a single machine. If you're attempting to deploy replica sets in production, be sure to read the comprehensive replica set documentation Replica Sets. Also, do keep in mind that replica sets ...

Replica Sets
v1.6.0 and higher. Replica sets are an elaboration on the existing master/slave replication DOCS:Replication, adding automatic failover and automatic recovery of member nodes. Replica Sets are "Replica Pairs version 2" and are available in MongoDB version 1.6.  ...

Replica Sets in Ruby
Here follow a few considerations for those using the Ruby driver Ruby Tutorial with MongoDB and replica sets DOCS:Replica Sets. Setup First, make sure that you've configured and initialized a replica set. Connecting to a replica set from the Ruby ...

Replica Sets Limits
v1.6 Authentication mode not supported. JIRA http://jira.mongodb.org/browse/SERVER1567 Limits on config changes to sets at first. Especially when a lot of set members are down. Map/reduce writes new collections to the server.  Because of this, for now it may only ...

Replica Sets Troubleshooting
can't get local.system.replset config from self or any seed (EMPTYCONFIG) Set needs to be initiated. Run {{rs.initiate()}} from the shell. If the set is already initiated and this is a new node, verify it is present in the replica set's configuration and there are no typos in the host names: > // send ...

Replication
MongoDB supports asynchronous replication of data between servers for failover and redundancy. Only one server (in the set/shard) is active for writes (the primary, or master) at a given time. With a single active master at any point in time, strong consistency semantics are available ...

Replication Internals
master mongod instance, the {{local}} database will contain a collection, {{oplog.$main}}, which stores a highlevel transaction log. The transaction log essentially describes all actions performed by the user, such as "insert this object into this collection." Note that the oplog is not a lowlevel redo log ...

Replication Oplog Length
Replication uses an operation log ("oplog") to store write operations. These operations replay asynchronously on other nodes. The length of the oplog is important if a secondary is down. The larger the log, the longer the secondary can be down and still recover. Once the oplog has ...

Resyncing a Very Stale Replica Set Member
Error RS102 MongoDB writes operations to an oplog.  For replica sets this data is stored in collection local.oplog.rs.  This is a capped collection and wraps when full "RRD"style.  Thus, it is important that the oplog collection is large enough to buffer ...

Retrieving a Subset of Fields
default on a find operation, the entire object is returned. However we may also request that only certain fields be returned. This is somewhat analogous to the list of column specifiers in a SQL SELECT statement (projection).  Regardless of what field specifiers are included ...

Ruby External Resources
number of good resources appearing all over the web for learning about MongoDB and Ruby. A useful selection is listed below. If you know of others, do let us know. Screencasts Introduction to MongoDB Part I http://www.teachmetocode.com/screencasts ...

concepts config database \ the to
this can be either a single server
or not chunk \ a region ...

Sharding FAQ
How does sharding work with rep
of a single server or a cluster of r
Where ...

Sharding Internals
section includes internal impleme
documentation. DOCS:Sharding

Sharding Introduction
MongoDB supports an automate
applications that outgrow the res
automatically managing failover a

Sharding Limits
Sharding Release 1 (MongoDB v
security mode, without explicit se
version. All (nonmulti)updates, up

Sharding Use Cases
What specific use cases do we w
List here for discussion. video sit
related videos ...

Slide Gallery
Click here http://www.mongodb.c
from recent events and presentat
style="width:422px;margin:auto;"

Smoke Tests
smoke.py lets you run a subsets
the tests, and then shuts it down
...

Sorting and Natural Order
Natural order" is defined as the d
parameters, the database returns
useful because, although the ord

Source Code
All source for MongoDB, it's drive
Database http://github.com/mong
http://github.com/mongodb/mong

Spec, Notes and Suggestions for Mo
Assume that the BSON DOCS:B
over time but for now the limit is

Splitting Chunks
Normally, splitting chunks is done
are transparent). In the future, th
be moved immediately to a new s

SQL to Mongo Mapping Chart
page not done. Please help us fi
{{mongo}} \\ MongoDB queries a
chart shows examples as both S

Starting and Stopping Mongo
MongoDB is run as a standard p
information on those options. The
is, and the Mongo executable is

Storing Data

Storing Files

Structuring Data for Mongo

Ruby Language Center
an overview of the available tools and suggested practices for using Ruby with MongoDB. Those wishing to skip to more detailed discussion should check out the Ruby Driver Tutorial Ruby Tutorial, Getting started with Rails Rails Getting Started Rails ...

Ruby Tutorial
tutorial gives many common examples of using MongoDB with the Ruby driver. If you're looking for information on data modeling, see MongoDB Data Modeling and Rails. Links to the various object mappers are listed on our object mappers page http://www.mongodb.org ...

**T**

Tailable Cursors
Tailable cursors are only allowed on capped collections and can only return objects in natural order http://www.mongodb.org/display/DOCS/SortingandNaturalOrder. If the field you wish to "tail" is indexed, simply requerying for \{ field : \ } is already quite efficient.  Tailable ...

Too Many Open Files
you receive the error "too many open files" or "too many open connections" in the mongod log, there are a couple of possible reasons for this. First, to check what file descriptors are in use, run lsof (some variations shown below): lsof grep ...

TreeNavigation

Trees in MongoDB
best way to store a tree usually depends on the operations you want to perform; see below for some different options.  In practice, most developers find that one of the "Full Tree in Single Document", "Parent Links", and "Array of Ancestors" patterns ...

Troubleshooting
mongod process "disappeared" Scenario here is the log ending suddenly with no error or shutdown messages logged. On Unix, check /var/log/messages: $ grep mongod /var/log/messages $ grep score /var/log/messages See Also Diagnostic ...

Troubleshooting the PHP Driver

Tutorial
Getting the Database First, run through the Quickstart guide for your platform to get up and running. Getting A Database Connection Let's now try manipulating the database with the database shell DOCS:mongo The Interactive Shell . (We could perform similar ...

**U**

Ubuntu and Debian packages
Please read the notes on the Do
find you can't download the pack
10gen ...

UI
Spec/requirements for a future M
indexsize, clone/copy indexes qu
master ...

Updates

Updating
MongoDB supports atomic, inpla
update() {{update()}} replaces the
fields, you should use ...

Updating Data in Mongo
Updating a Document in the mon
be used to save a new document
collection. Continuing with the ex

Upgrading from a Non-Sharded Syst
mongod}} process can become p
done so yet, feel free to have a lo
http://www.mongodb.org/display/

Upgrading to Replica Sets
Upgrading From a Single Server
good idea\!). First, we'll initiate a
we're ...

Use Case - Session Objects
MongoDB is a good tool for storin
and store the session object's \id
make updates fast, the database

Use Cases
See also the Production Deploym
Shutterfly, foursquare, bit.ly, Etsy
Analytics http://blog.mongodb.org

User Feedback
I just have to get my head around
should get a long course from yo
\kunthar@gmail.com, mongodbu

Using a Large Number of Collections
technique one can use with Mong
single collection.  By doing
on that key may be eliminated ...

Using Mongoid
Mongoid is a mature ODM for Mo
and excellent documentation. Th
production. This page is an atten

Using Multikeys to Simulate a Large
One way to work with data that h
indexing feature where the keys
> ... , > ... , > ... > ... }; > db.foo.in

**V**

v0.8 Details
Existing Core Functionality Basic Mongo database functionality: inserts, deletes, queries, indexing. Master / Slave Replication Replica Pairs Serverside javascript code execution New to v0.8 Drivers for Java, C, Python, Ruby. db shell utility ...

Validate Command

**W**

What is the Compare Order for BSO
MongoDB allows objects in the s
values from different types, a cor
arbitary but well ...

When to use GridFS

Use this command to check that a collection is valid (not corrupt) and to get various statistics. This command scans the entire collection and its indexes and will be very slow on large datasets. From the {{mongo}} shell: > db.foo.validate() From a driver one might invoke the driver's equivalent ...

Verifying Propagation of Writes with getLastError

v1.5. A client can block until a write operation has been replicated to N servers. Use the getlasterror command with a new parameter {{w}}: db.runCommand( ) If {{w}} is not set, or equals 1, the command returns immediately, implying the data is on 1 server ...

Version Numbers

MongoDB uses the oddnumbered versions for development releases http://en.wikipedia.org/wiki/Softwareversioning#Oddnumberedversionsfordevelopmentreleases. There are 3 numbers in a MongoDB version: A.B.C A is the major version. This will rarely change and signify very large changes B is the release number. This will include many changes ...

Video & Slides from Recent Events and Presentations

Table of Contents: MongoDB Conferences Oneday conferences hosted by 10gen http://www.10gen.com/. 10gen develops and supports MongoDB. MongoUK Video (June 2010) http://skillsmatter.com/event/cloudgrid/mongouk MongoFR Video (June 2010) http://lacantine.ubicast.eu/categories ...

Viewing and Terminating Current Operation

View Current Operation(s) in Progress > db.currentOp(); > // same as: db.$cmd.sys.inprog.findOne() { inprog: { "opid" : 18 , "op" : "query" , "ns" : "mydb.votes" , "query" : " " , "inLock" : 1 } } Fields: opid an incrementing operation number.  Use with killOp(). op the operation type ...

page is under construction When
of files better than many file syste

Why are my datafiles so large?

Why so many "Connection Accepted

Windows

Windows Quick Links and Refere
DOCS:Quickstart Windows for in
the Windows Service page. The

Windows Service

windows mongod.exe has native
The service related commands a
option pass the following to \insta

Working with Mongo Objects and Cla

Writing Drivers and Tools

See Also DOCS:Mongo Query La
Parameters

Writing Tests

We have three general flavors of
make a test that runs at program
minimal ...

**X**

**Y**

**Z**

**!@#$**