Conception d'Applications Interactives : Applications Web

Séance #5 - Côté serveur II

NoSQL - MongoDB

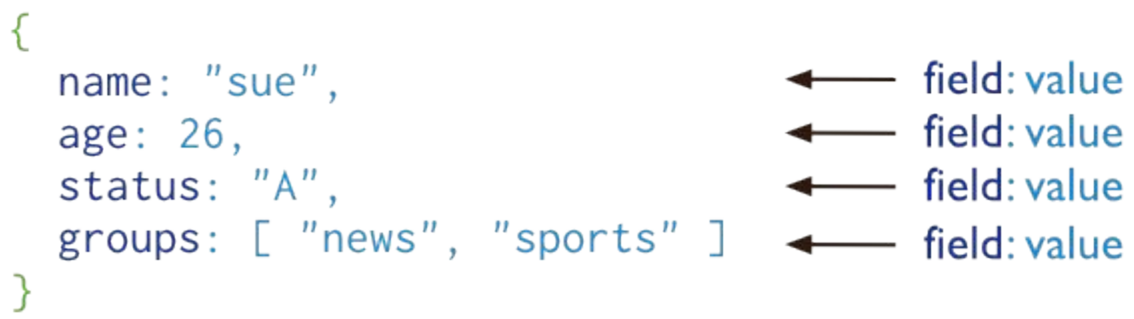
Introduction à MongoDB

What's MongoDB

open-source document database
that provides high performance,
high availability,
and automatic scaling

Document database

A record in MongoDB is a document, which is a data structure composed of field and value pairs

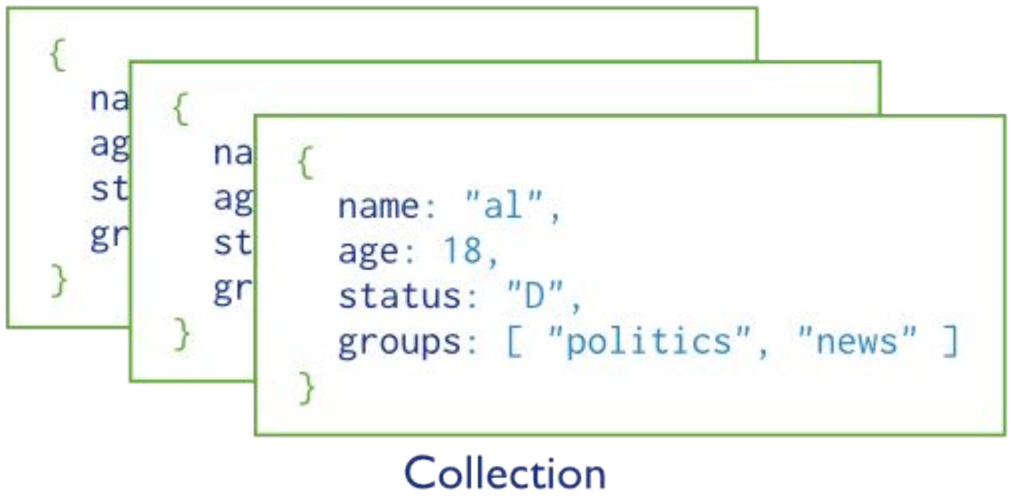


```
{
   name: "sue",
   age: 26,
   status: "A",
   groups: [ "news", "sports" ]
}
```

Documents are similar to JSON objects

Document database

Documents are stored in collections



```
{
  name: "al",
  age: 18,
  status: "D",
  groups: [ "politics", "news" ]
}
```

Collections share common indexes

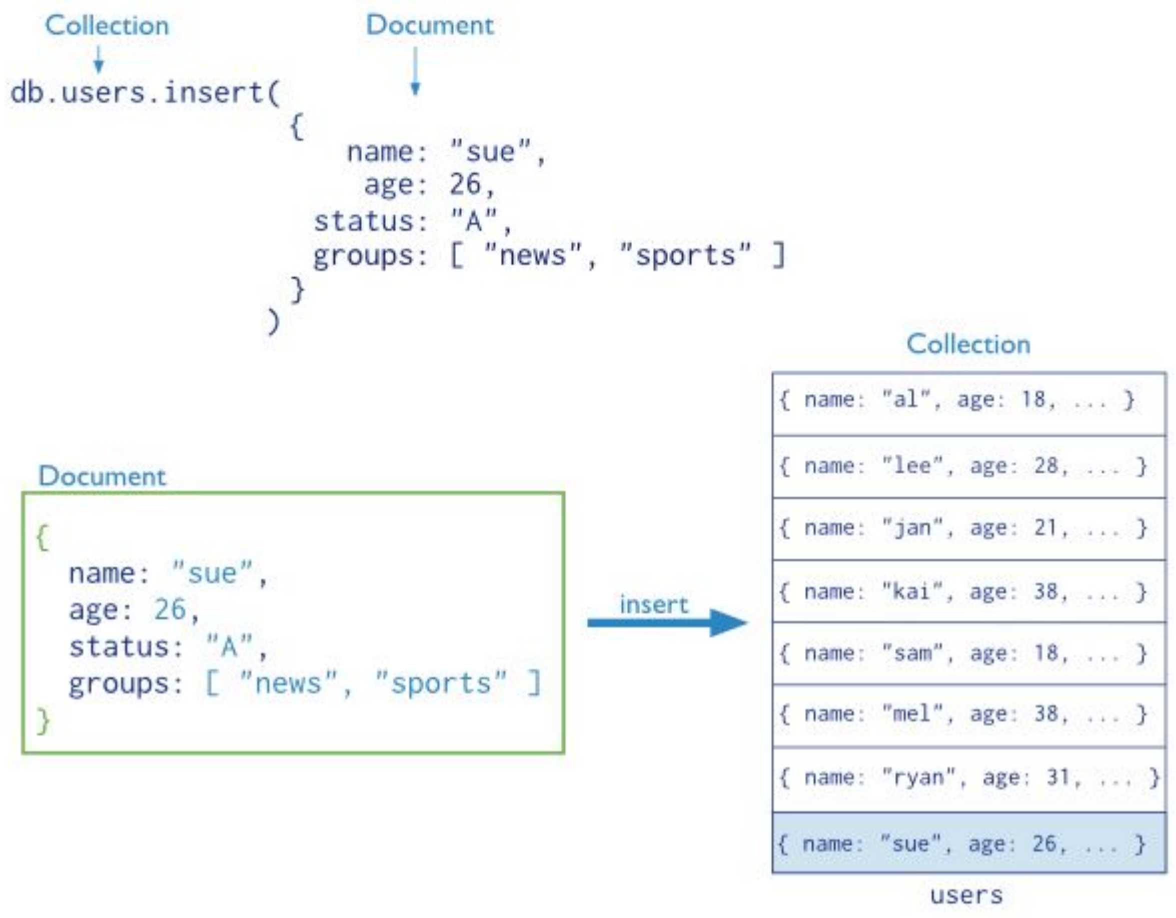
Collections & documents

- No predefined schema
  - Documents in a collection can have different fields
  - Fields can be added, modified or deleted at any time

- Documents follow BSON (JSON-like) format
  - Key-value pairs (hashes)

```
{
    "_id": ObjectId("223EBC5477A124425"),
    "Last Name": "Gonzalez",
    "First Name": "Horacio",
    "Date of Birth": "1976-05-05",
}
```

Insert data



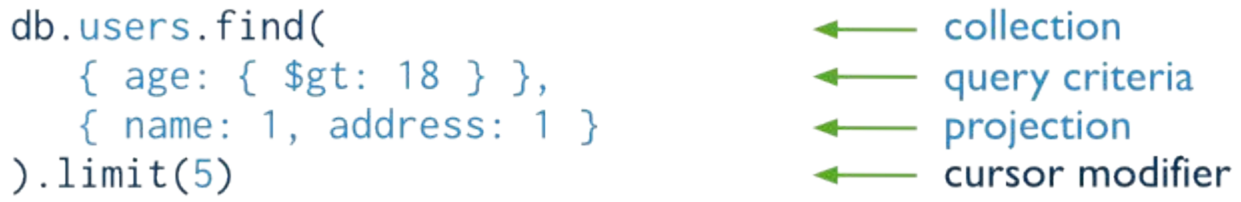
```
db.users.insert(
                 {
                    name: "sue",
                     age: 26,
                  status: "A",
                  groups: [ "news", "sports" ]
                 }
               )
```

```
{
  name: "sue",
  age: 26,
  status: "A",
  groups: [ "news", "sports" ]
}
```

```
{ name: "al", age: 18, ... }
{ name: "lee", age: 28, ... }
{ name: "jan", age: 21, ... }
{ name: "kai", age: 38, ... }
{ name: "sam", age: 18, ... }
{ name: "mel", age: 38, ... }
{ name: "ryan", age: 31, ... }
{ name: "sue", age: 26, ... }
```

Query data

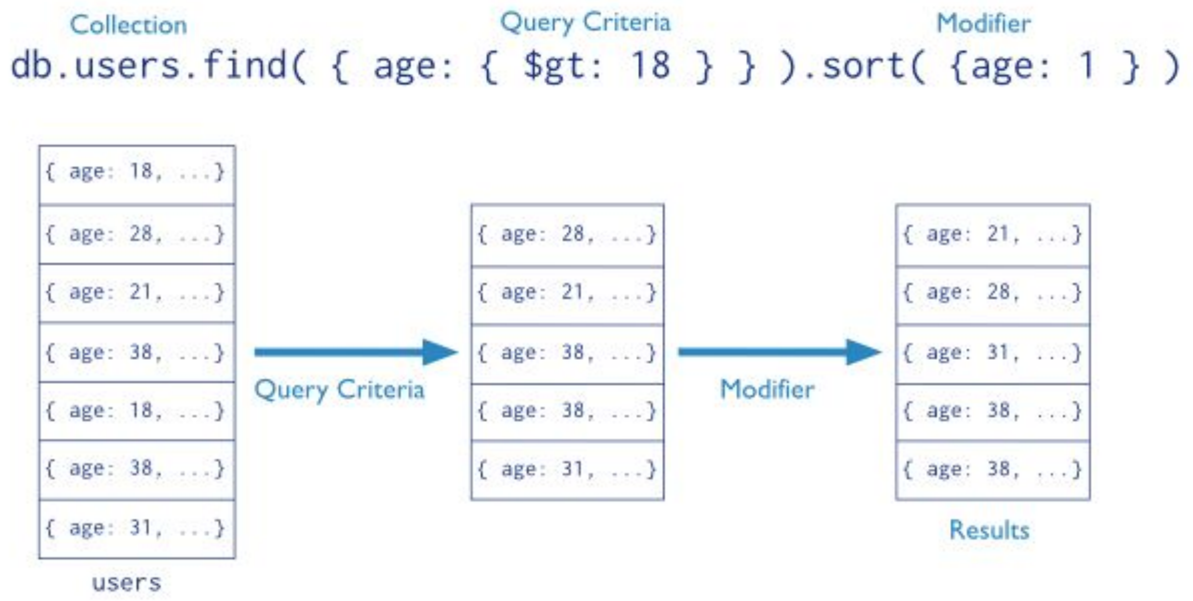
- db.collection.find()



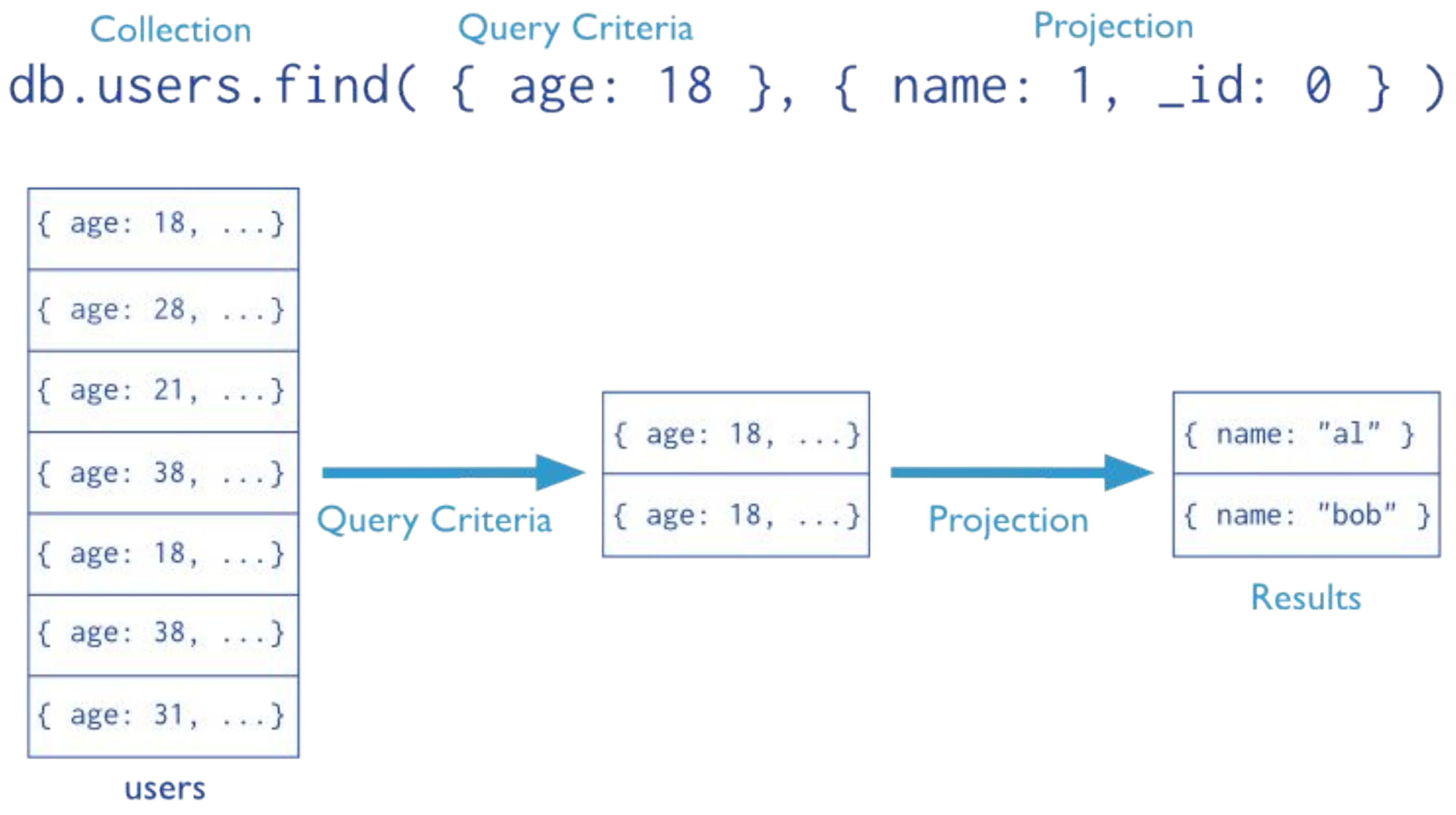
```
db.users.find(
   { age: { $gt: 18 } },
   { name: 1, address: 1 }
).limit(5)
```

It returns a cursor, an iterable object

Query data


Collection
Query Criteria
Modifier
db.users.find({ age: { $gt: 18 } }).sort({age: 1 })
{ age: 18, ...}
{ age: 28, ...}
{ age: 21, ...}
{ age: 38, ...}
{ age: 18, ...}
{ age: 38, ...}
{ age: 31, ...}
users
Query Criteria
{ age: 28, ...}
{ age: 21, ...}
{ age: 38, ...}
{ age: 38, ...}
{ age: 31, ...}
Modifier
{ age: 21, ...}
{ age: 28, ...}
{ age: 31, ...}
{ age: 38, ...}
{ age: 38, ...}
Results

Projections



RDBMS vs MongoDB

RDBMS

- Databases have tables
- Tables have rows
- Rows have cell
- Cells contain types simples
- Schemas are rigid

MongoDB

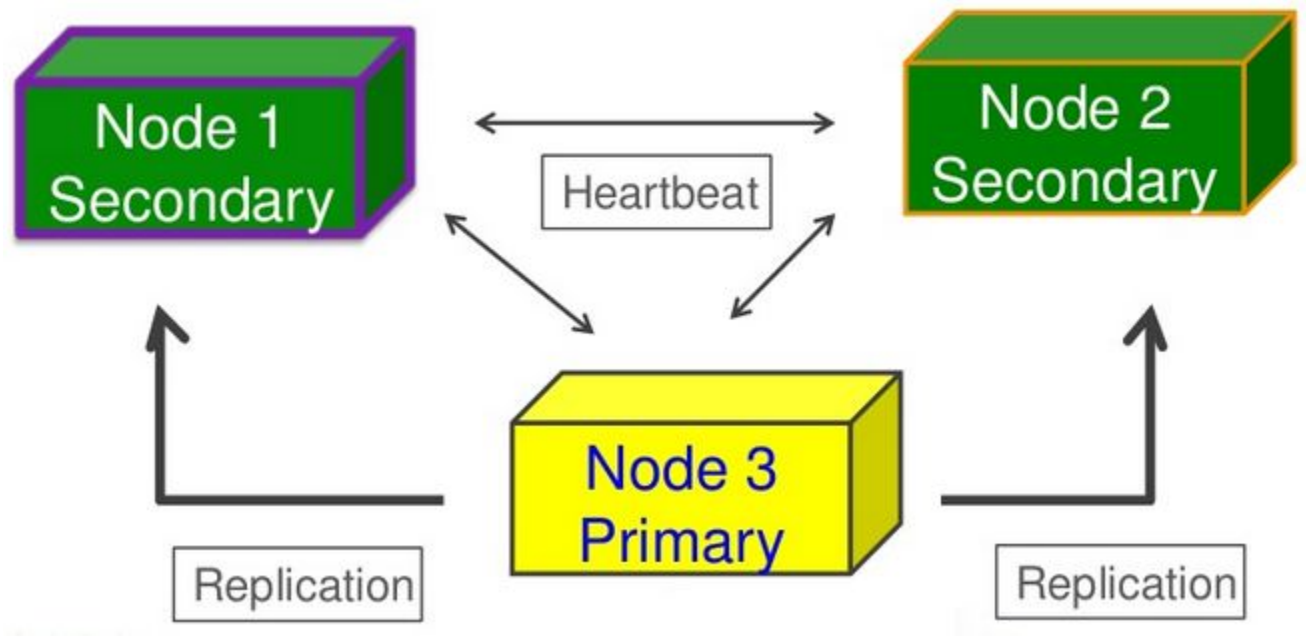
- Database have collections
- Collections have documents
- Documents have fields
- Fields contain
  - Types simples
  - Arrays
  - Other documents
- Schemas are fluid

Key features

- High performance
- High availability
- Automatic scaling

High availability

- Election at initialization or when primary lost



Installing MongoDB

1. Download MongoDB
   `http://www.mongodb.org/downloads`

2. Install the msi (win) or uncompress the tgz (linux)
   e.g. `C:\mongodb` or `/opt/mongodb`

3. Create a data directory
   e.g. `/opt/mongodb_data` or `C:\mongodb_data`

4. Run mongo demon
   `C:\mongodb\bin\mongod.exe --dbpath C:\mongodb_data` or

   `/opt/mongodb/bin/mongod --dbpath /opt/mongdob_data`

Running MongoDD

```
horacio@horacio-xps:~$ mongod --dbpath /opt/data/

2015-05-06T23:46:14.392+0200 I JOURNAL  [initandlisten] journal dir=/opt/data/journal
2015-05-06T23:46:14.394+0200 I JOURNAL  [initandlisten] recover : no journal files present, no recovery needed
2015-05-06T23:46:14.431+0200 I CONTROL  [initandlisten] MongoDB starting : pid=5493 port=27017 dbpath=/opt/data/
64-bit host=horacio-xps
2015-05-06T23:46:14.431+0200 I CONTROL  [initandlisten] db version v3.0.2
2015-05-06T23:46:14.431+0200 I CONTROL  [initandlisten] git version: 6201872043ecbbc0a4cc169b5482dcf385fc464f
2015-05-06T23:46:14.431+0200 I CONTROL  [initandlisten] build info: Linux build6.nj1.10gen.cc
2.6.32-431.3.1.el6.x86_64 #1 SMP Fri Jan 3 21:39:27 UTC 2014 x86_64 BOOST_LIB_VERSION=1_49
2015-05-06T23:46:14.431+0200 I CONTROL  [initandlisten] allocator: tcmalloc
2015-05-06T23:46:14.431+0200 I CONTROL  [initandlisten] options: { storage: { dbPath: "/opt/data/" } }
2015-05-06T23:46:14.433+0200 I STORAGE  [initandlisten] info openExisting file size 16777216 but
mmapv1GlobalOptions.smallfiles=false: /opt/data/startupweekendbrest.0
2015-05-06T23:46:14.440+0200 I INDEX   [initandlisten] allocating new ns file /opt/data/local.ns, filling with
zeroes...
2015-05-06T23:46:14.532+0200 I STORAGE  [FileAllocator] allocating new datafile /opt/data/local.0, filling with
zeroes...
2015-05-06T23:46:14.532+0200 I STORAGE  [FileAllocator] creating directory /opt/data/_tmp
2015-05-06T23:46:14.572+0200 I STORAGE  [FileAllocator] done allocating datafile /opt/data/local.0, size: 64MB,
took 0.023 secs
2015-05-06T23:46:14.585+0200 I NETWORK  [initandlisten] waiting for connections on port 27017
```

Tools in MongoDB

- `mongod` - primary daemon process
- `mongo` - command-line client
- `mongostat` - command-line stats summary
- `mongotop` - command-line performance tracker

Connecting to a MongoDB instance

```
mongo --host 127.0.0.1 --port 27017
```

or using default parameters

```
mongo
```

- Default host: 127.0.0.1
- Default port: 27017

```
horacio@horacio-xps:~$ mongo
MongoDB shell version: 3.0.2
connecting to: test
```

First steps

- To view available databases:

```
> show dbs
local          0.078GB
test           0.031GB
```

- To choose a database:

```
> use test
switched to db test
```

First steps

- To check what's the current database:

```
> db
```

- To get some help:

```
> help
```

- To show the collections within a database:

```
> show collections
```

Enter some data

```
> a = {"Last Name": "Gonzalez","First Name": "Horacio","Date of Birth":
"1976-05-05" }

{
    "Last Name" : "Gonzalez",
    "First Name" : "Horacio",
    "Date of Birth" : "1976-05-05"
}

> db.test.insert(a)

WriteResult({ "nInserted" : 1 })

> b={"Field A": "Value A", "Field B": "Value B"}

{ "Field A" : "Value A", "Field B" : "Value B" }

> db.test.insert(b)

WriteResult({ "nInserted" : 1 })
```

Query data

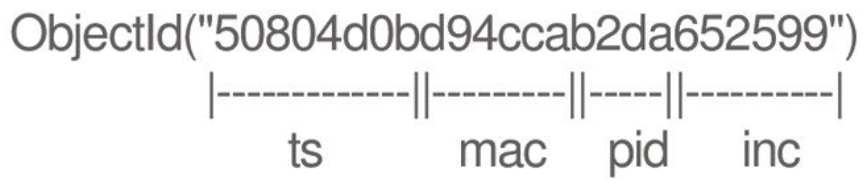
- Find all the elements in a collection

```
> db.test.find()

{ "_id" : ObjectId("554a9944b5091037c44dddcc"), "Last Name" : "Gonzalez",
"First Name" : "Horacio", "Date of Birth" : "1976-05-05" }
{ "_id" : ObjectId("554a998eb5091037c44dddcd"), "Field A" : "Value A", "Field
B" : "Value B" }
```

_id

- Primary key
- Automatically indexed
- Generated as an ObjectId if not provided
- Must be unique and immutable

ObjectId: Special 12 byte value unique across cluster



```
ObjectId("50804d0bd94ccab2da652599")
         |------------||---------||-----||----------|
              ts           mac      pid      inc
```

Using JavaScript in mongo

```
> for(var i=0; i<5; i++) db.test.insert({a:42, b:i})
WriteResult({ "nInserted" : 1 })
> db.test.find()
{ "_id" : ObjectId("554a990f0ebf783b63a57776"), "Last Name" : "Gonzalez", "First
Name" : "Horacio", "Date of Birth" : "1976-05-05" }
{ "_id" : ObjectId("554a9944b5091037c44dddcc"), "Last Name" : "Gonzalez", "First
Name" : "Horacio", "Date of Birth" : "1976-05-05" }
{ "_id" : ObjectId("554a998eb5091037c44dddcd"), "Field A" : "Value A", "Field B" :
"Value B" }
{ "_id" : ObjectId("554a9c21b5091037c44dddce"), "a" : 42, "b" : 0 }
{ "_id" : ObjectId("554a9c21b5091037c44dddcf"), "a" : 42, "b" : 1 }
{ "_id" : ObjectId("554a9c21b5091037c44dddd0"), "a" : 42, "b" : 2 }
{ "_id" : ObjectId("554a9c21b5091037c44dddd1"), "a" : 42, "b" : 3 }
{ "_id" : ObjectId("554a9c21b5091037c44dddd2"), "a" : 42, "b" : 4 }
```

Query for specific documents

```
> db.test.find({"Field A": "Value A"})

{ "_id" : ObjectId("554a998eb5091037c44dddcd"), "Field A" : "Value A", "Field B" :
"Value B" }
```

```
> db.test.find({ b: { $gt: 2 } }).sort({ b: -1 })

{ "_id" : ObjectId("554a9c21b5091037c44dddd2"), "a" : 42, "b" : 4 }
{ "_id" : ObjectId("554a9c21b5091037c44dddd1"), "a" : 42, "b" : 3 }
```

Conditional operators:

`$all, $exists, $type, $mod, $or, $and, $not, $nor $size,`

`$eq, $ne, $lt, $lte, $gt, $gte, $in, $nin...`

Querying with RegEx

```
> db.test.findOne({ "Last Name": /Gon/})
{
    "_id" : ObjectId("554a990f0ebf783b63a57776"),
    "Last Name" : "Gonzalez",
    "First Name" : "Horacio",
    "Date of Birth" : "1976-05-05"
}
```

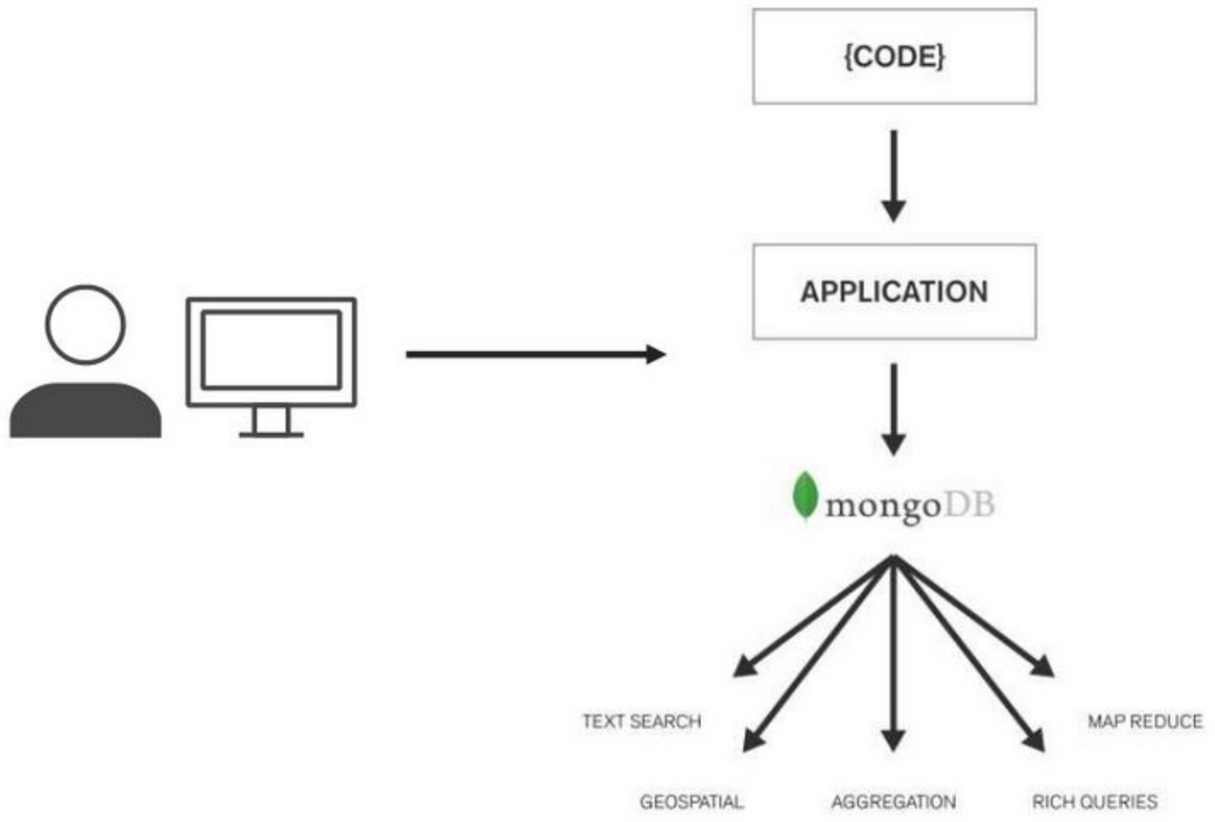
Operations

```
> db.test.insert(record)

> db.test.find(query)[.skip(X)][.limit(Y)]
> db.test.findOne(query)

> db.test.remove(query[, justone=false])

> db.test.update(query, record)
> db.test.update(query, $set: {changes})
```

Creating index

```
> db.test.ensureIndex({ b: 1 })
{
    "createdCollectionAutomatically" : false,
    "numIndexesBefore" : 1,
    "numIndexesAfter" : 2,
    "ok" : 1
}
```

MongoDB is fully featured



Exercice 1

- Install MongoDB
- Run mongod
- Connect using mongo
- Create a collection, add some object, tests some queries

Doc:

Methods:
http://docs.mongodb.org/manual/reference/method/

Operators:
http://docs.mongodb.org/manual/reference/operator/query/

Exercice 2

Model and create a collection to store the beer data
for the Vue-Beers project

https://github.com/LostInBrittany/vue-beers

- Tests some queries

Interacting with MongoDB from NodeJS app

The most direct way : MongoDB JS driver

http://mongodb.github.io/node-mongodb-native/

Full featured driver easily installed as npm dep:

```
npm install mongodb
```

Exercice 3

Create a simple NodeJS app that connects to the Beers database and prints on screen the beer list

Exercice 4

Add a MongoDB as a backup for Node-Beers