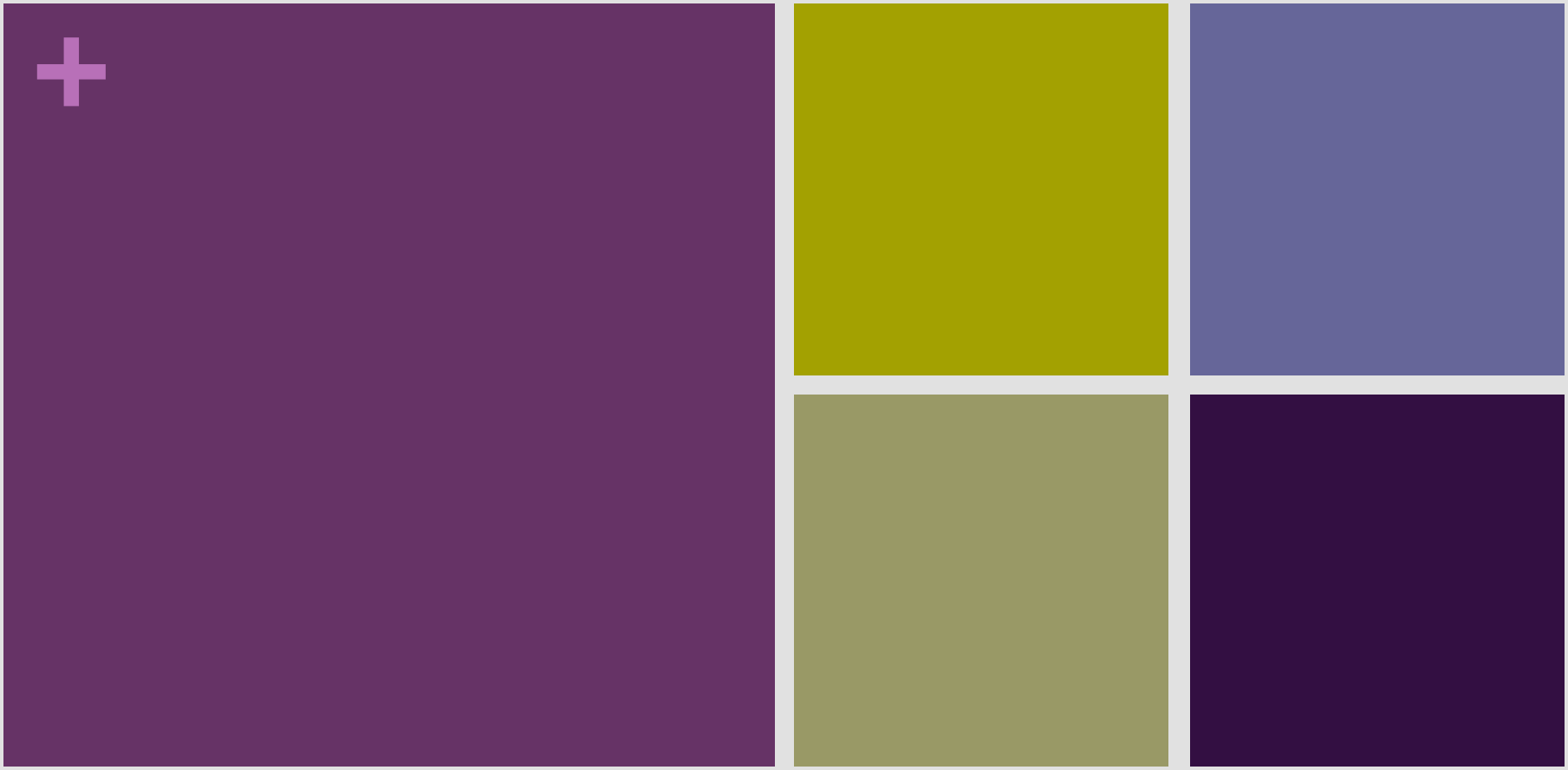


MongoDB
Half-Day Workshop

Bryan Nehl – Copyright 2015

Revised: 2015-06-01

MongoDB for Java Developers

- $: whoami
  - Bryan Nehl
  - Systems Developer
  - @k0emt
  - dbBear.com
  - How did I start with MongoDB?

You

- Developer/Analyst/DBA
- JavaScript
- Familiar with JSON
- Able to work at the command prompt / terminal
- Curious, Engaged, Respectful

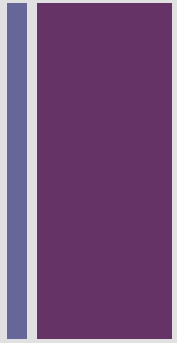
You

- What is your background?
- What do you want to get out of today?

Your computer

- Windows 7 or 8, Linux or OS X
  - WHY?
- Editor or IDE of your choice
- Optional: Development Environment
  - Please reserve development experimentation for lab time

Workshop Primary Goal

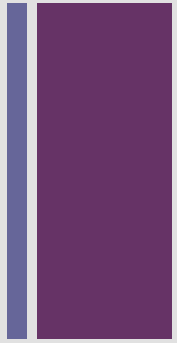


It is my primary goal that you leave the workshop with a functioning MongoDB environment, knowledge of the fundamentals with the skills to do routine queries and operations on the data.

Workshop Topics

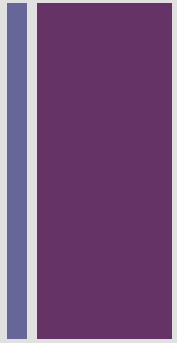
- Introduction and Installation
- Security
- Storage Engines
- Schema – databases, collections and documents
- Creating, Reading, Updating and Deleting (CRUD)
- Advanced CRUD – sub documents, arrays, sorting, limiting…
- Backups
- Gotchas
- Performance/Indexes
- Aggregation Framework
- GridFS
- Replication
- Sharding Overview
- Open Lab Time

Why MongoDB?



- Document Oriented Schema
- Scalable
  - Commodity Hardware
  - Horizontal
- Fast – memory mapped files
- GridFS

Languages / Drivers



- Java, Groovy, Scala
- Python, PHP, Perl
- node.js, ruby, go
- C#, C++, C

+

{“section” : “Installation” }

www.mongodb.org/downloads

File Setup

- Review the flash drive contents
- Copy the contents to your computer
  - You can skip non-applicable installation files
- Create a project working directory "workshop"

unzip install

- Easy
- Manual updates
- Manual path setup

Windows

- Which file to get?
  - zip / msi
  - which version / release?
- --smallfiles
  - Initial size reduced
  - Journal files from 1G to 128M
- Unzip
- Set your PATH
- mkdir –p c:\data\db

Linux

- --smallfiles
- Unzip
- Untar
- Set up your path
- mkdir –p /data/db
  - Set permissions
- Packages

OS X

- Take the unzip, path, /data/db approach
- Home Brew
  - Easy updates
  - Don't do it if you use Mac Ports
  - http://mxcl.github.io/homebrew/
  - `ruby -e "$(curl -fsSL https://raw.github.com/mxcl/homebrew/go)"`
  - brew update; brew install mongodb
- Mac Ports

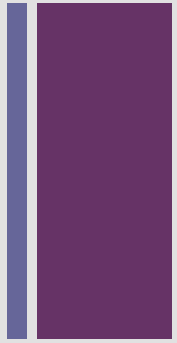
Config File

- --config C:\mongodb\mongod.cfg
- /etc/mongodb.conf
  - smallfiles = true
- Home brew
  - /usr/local/etc/mongod.conf
- http://docs.mongodb.org/manual/reference/configuration-options/

Storage Engines

- What is a storage engine?
- What storage engines can we choose from?
- What is different about them?

Security



- Layered – start with your network
- Authentication
  - Challenge – Response
  - LDAP, Kerberos
  - Certificate
- Authorization
  - Role based access for users

http://docs.mongodb.org/manual/security/

Developer startup

```
mongod --smallfiles --oplogSize 16 --nojournal
```

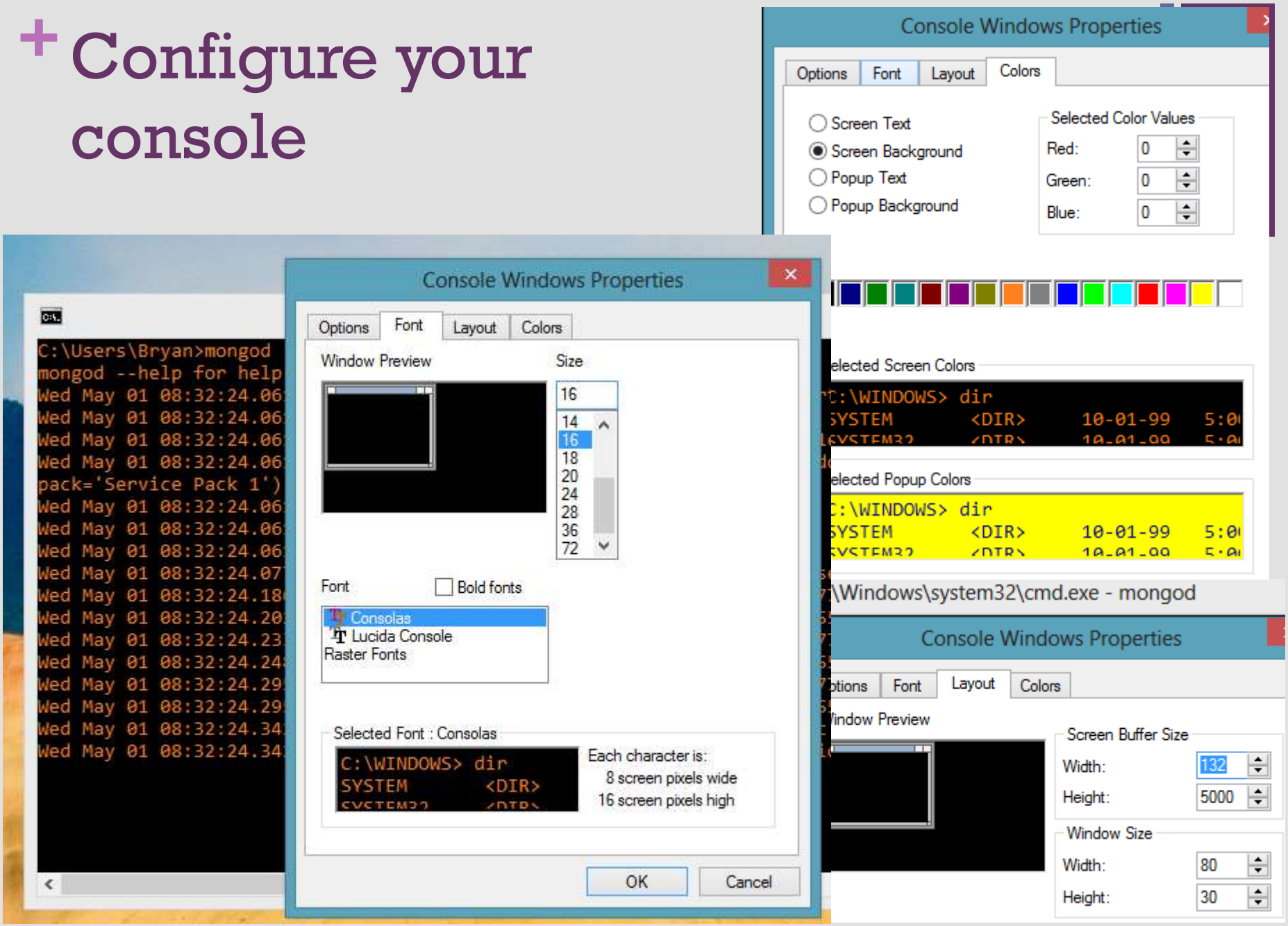
Verifying Installation

- mongod
  - --version
  - Windows: start, <ctrl><c>
  - OS X/Linux: --fork, kill, <ctrl><c>
  - use admin; db.shutdownServer()
- mongo
  - The prompt
  - db.version()
  - quit()

Development Drivers

- Start at MongoDB.org -> drivers
  - Java / Groovy / JVM
  - JavaScript / Node.js
  - Python
  - C / C++ / C#
  - Go / Erlang
  - Perl / PHP
  - Ruby / Scala
- http://docs.mongodb.org/ecosystem/drivers/

Configure your console

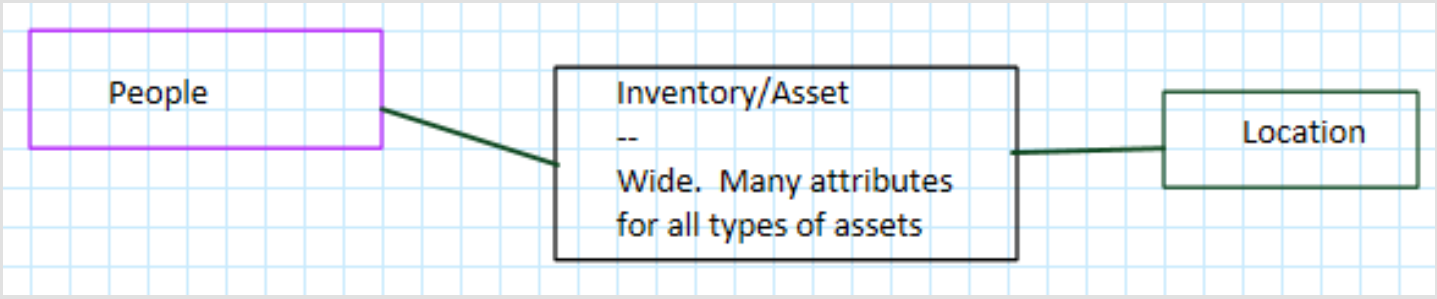


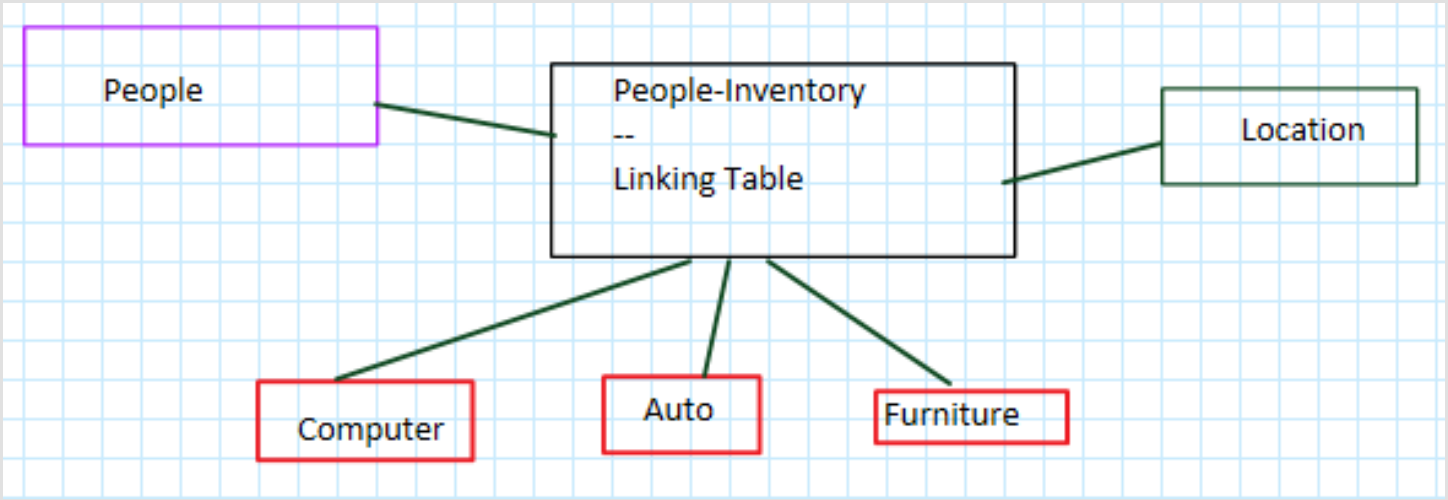
{“section” : “Schema”}

Relational Design Exercise

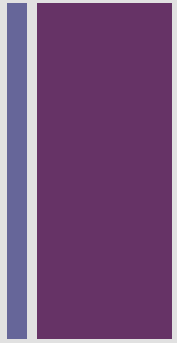
- Using standard relational techniques design an inventory management system that tracks assets.
- Example assets are: vehicles, computers, tables and chairs.
- I want to be able to store a lot of detail.
  - Where is the asset?
  - To whom is an asset assigned?
  - Vehicle detail like: make, model, VIN, color, etc.
  - Table detail like: material type, size, condition, color, etc.

Relational


People
Inventory/Asset
--
Wide. Many attributes
for all types of assets
Location

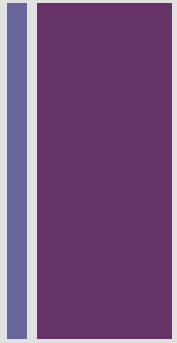

People
People-Inventory
--
Linking Table
Location
Computer
Auto
Furniture

MongoDB Document Structure



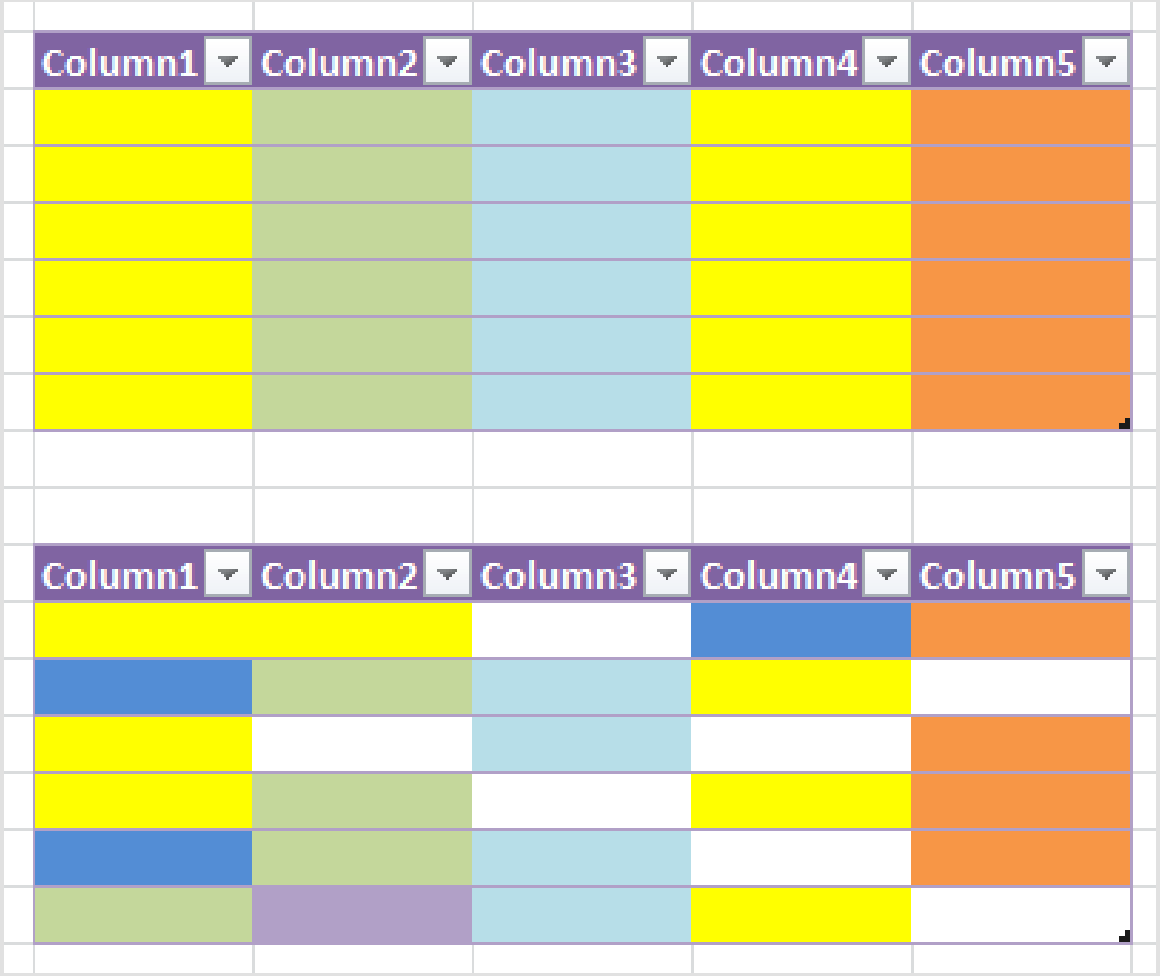
- Databases
- Collections
- Documents
- Fields

JSON Review

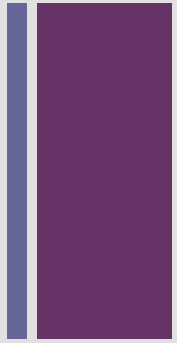


- json.org
- {“key” : “values”}
- JSON types
  - string, number, object, array, true, false, null
- Lists
- Sub-documents

Relational / Document Structure

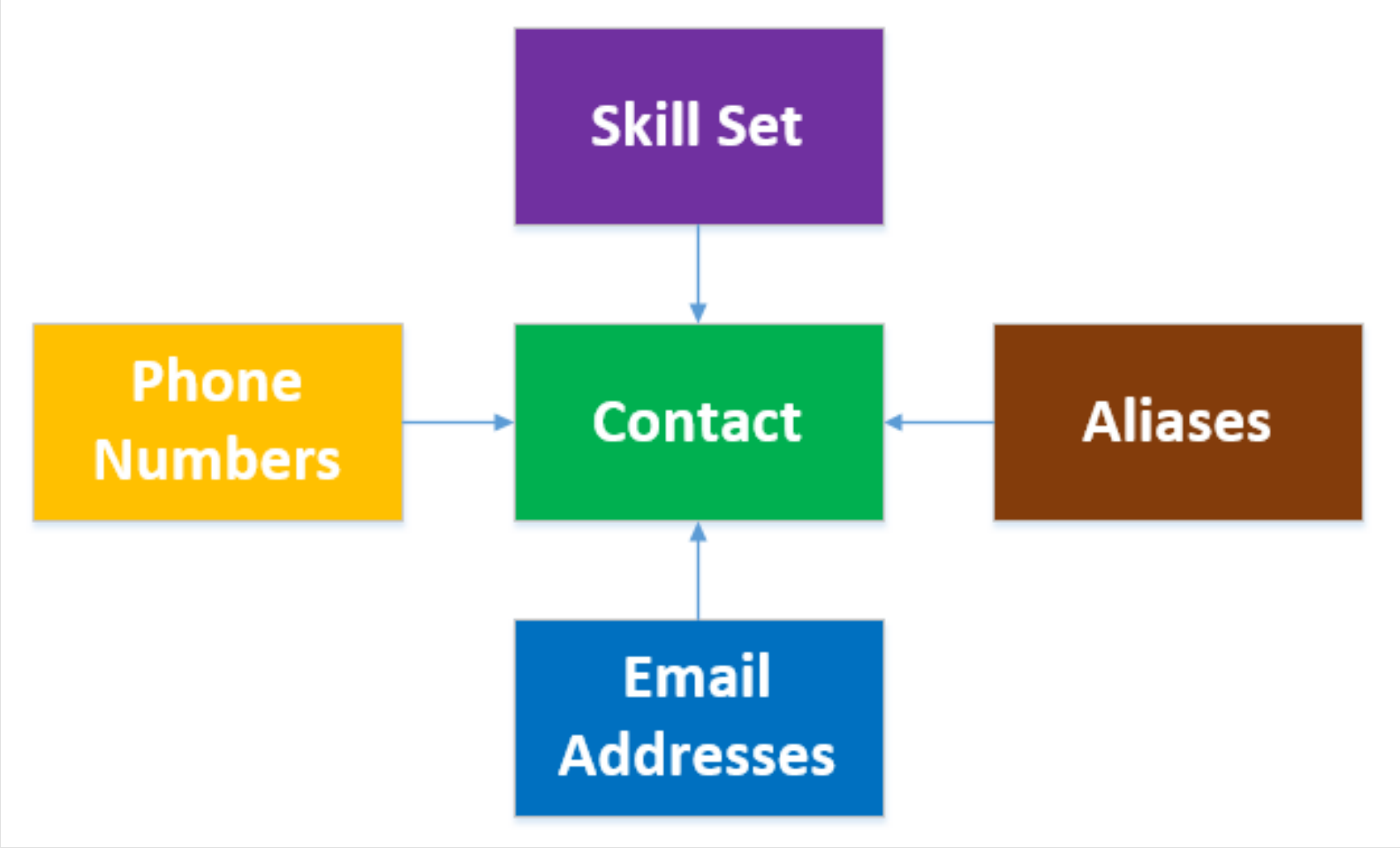


Document Oriented Schema Design

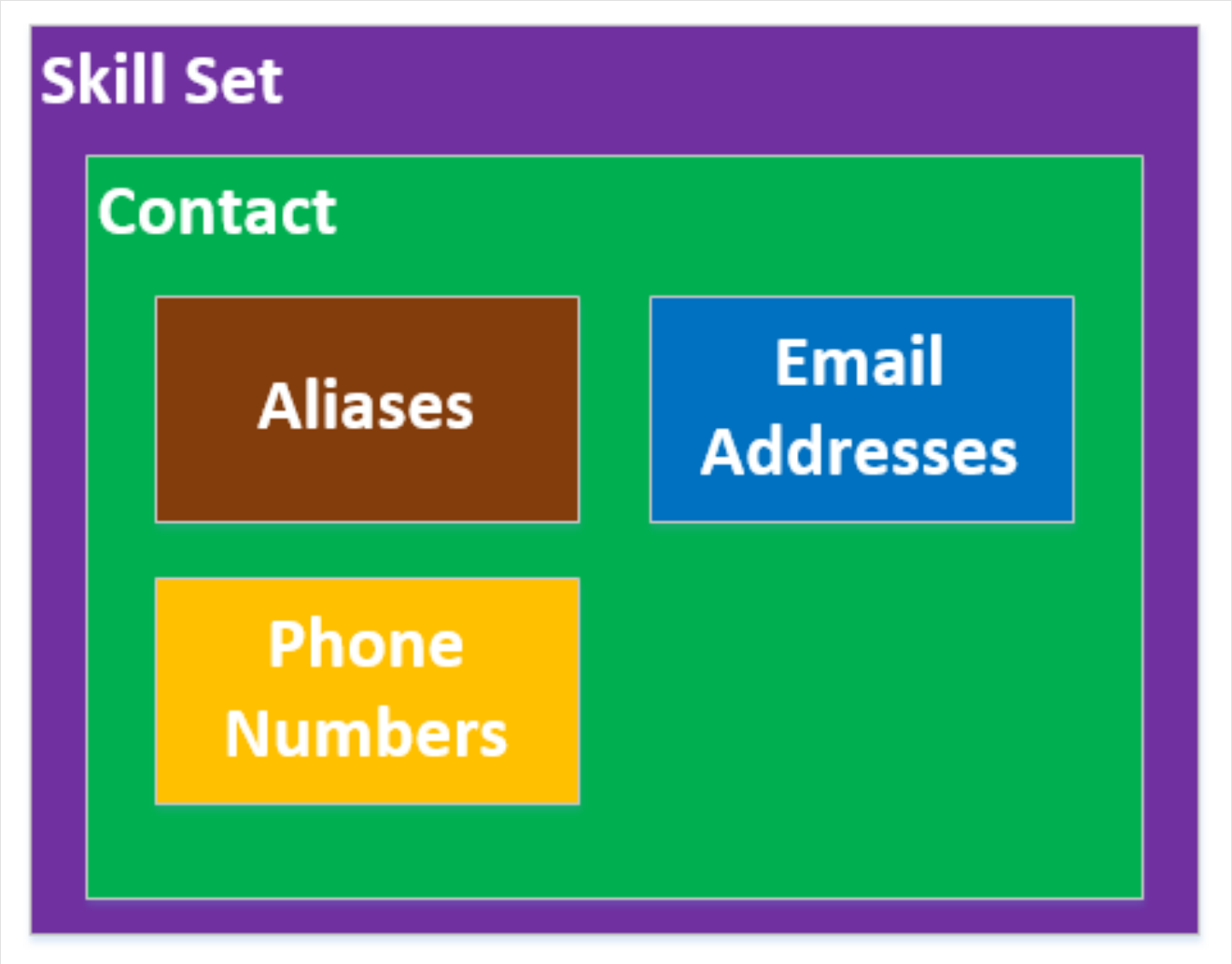


- Naming
  - avoid the . (dot)
  - key name length matters
- No Joins
- Consider the Access Pattern

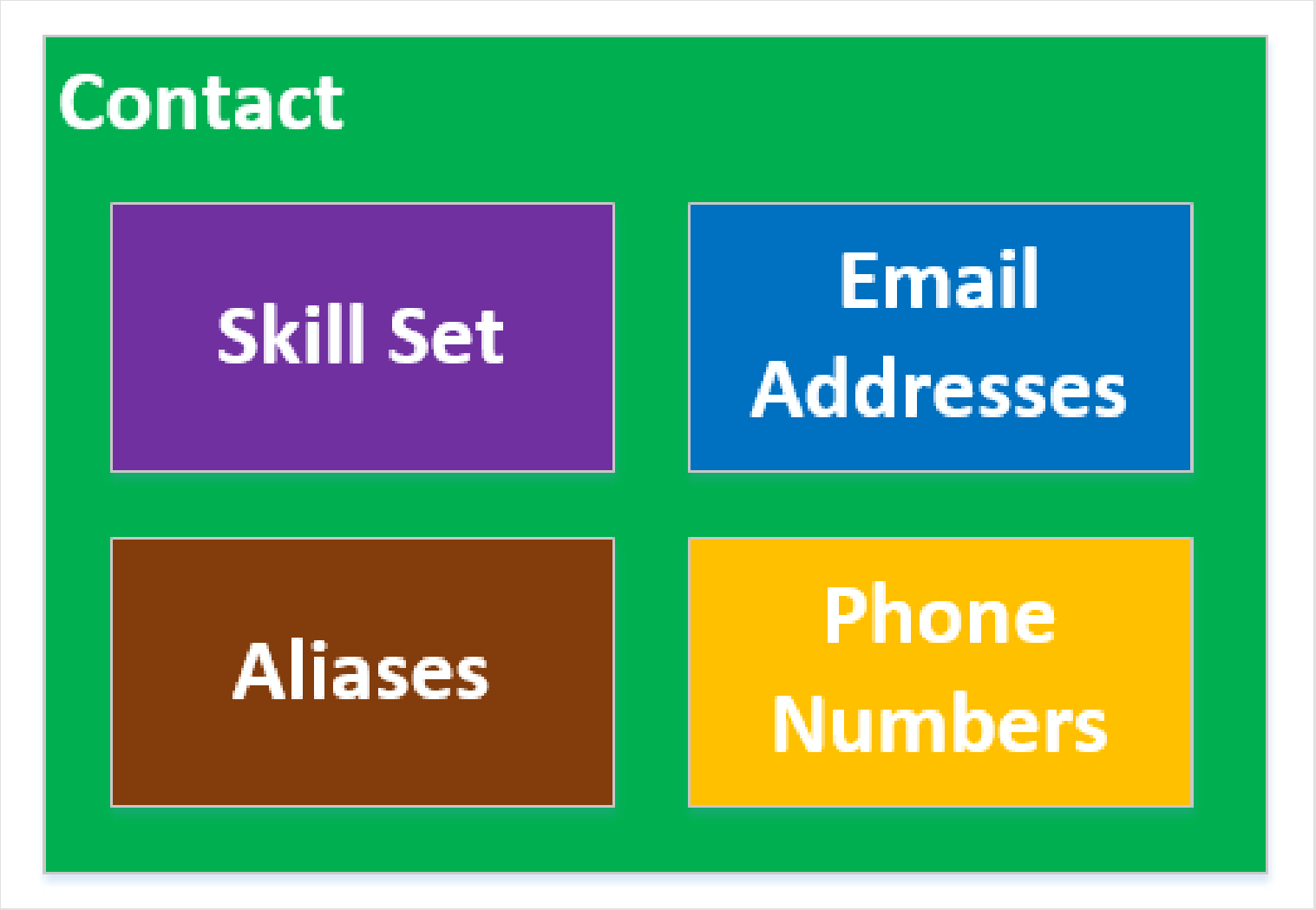
Contacts: Relational Design



Contacts: Document Design Skills



Contacts: Document Design



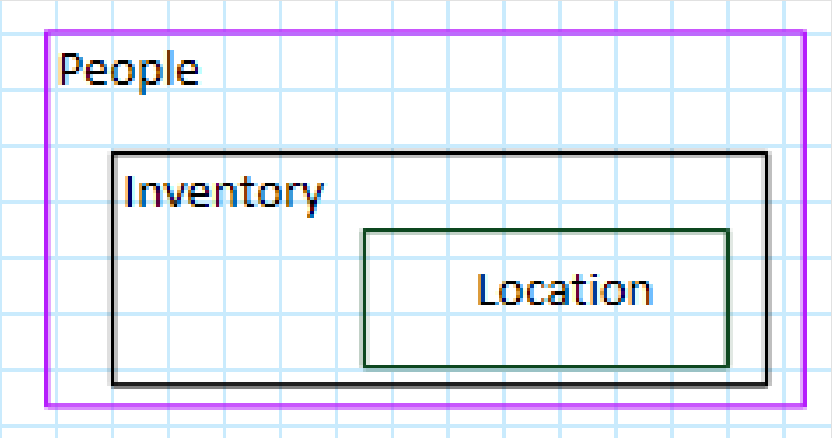
Document Design Example

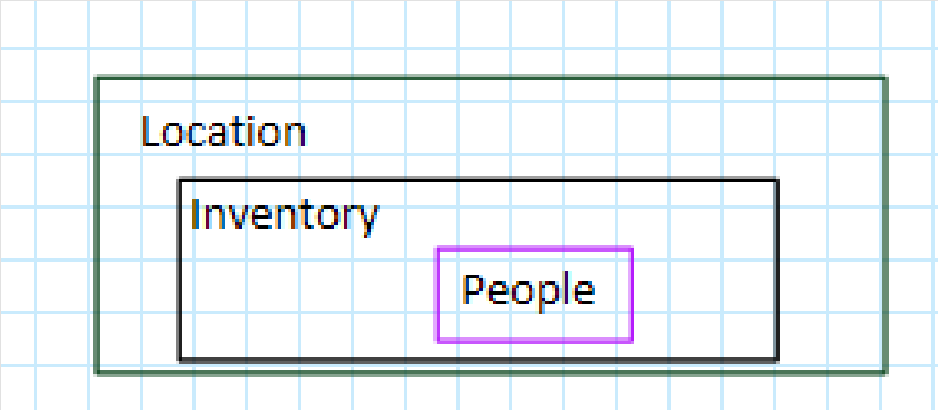
```
{
        "_id" : ObjectId("558a216c65a77e96ea4a89af"),
        "name" : "Joe",
        "skills" : [
                "mongodb",
                "json",
                "ETL"
        ],
        "email" : [
                "one@one.com",
                "2@two.org",
                "3@tres.info"
        ],
        "aliases" : [
                "schmoe"
        ],
        "phones" : [
                {
                        "type" : "cell",
                        "digits" : "555-123-4567"
                },
                {
                        "type" : "home",
                        "digits" : "555-789-0000"
                }
        ]
}
```

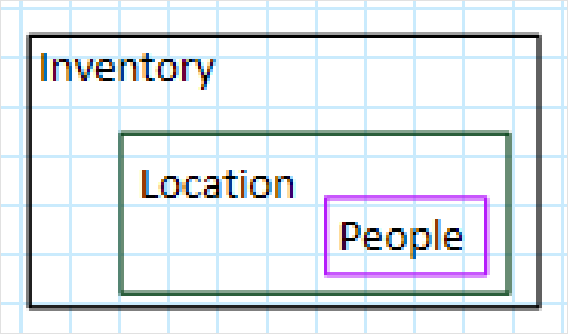
Inventory System: Document Design

- How would we organize this same sort of information in a document oriented system like MongoDB?
- ***Consider the access pattern****(s).*
  - *Inventory part of Personnel System*
  - *Inventory part of Location Review*
  - *Inventory the primary focus*

Potential Document Design







Gotchas

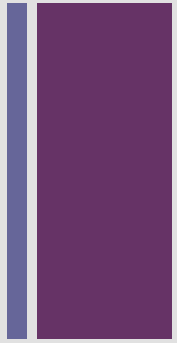
Gotchas

- If you misspell…
  - Database / collection / field
- Production defaults for Windows/Linux
  - Remember to configure your dev box!
- GUI interfaces are still immature
- Joins have to be done in code
- No Transactions (individual operations are atomic)
- Cut-n-paste of formatted “quotes”

Gotchas

- Give the shell something syntactically wrong and it'll eat it
- Isn't as strict about deleting multiple documents as it is about updating them
- Improperly repeat a field name in a query and it'll use the last criteria specified
- Differences between regular queries and the aggregation framework

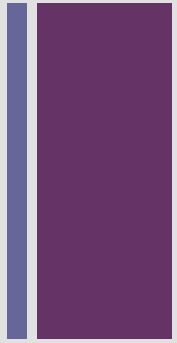
Gotchas



- Operations are atomic
- No Transactions
- Single write operations are atomic
- http://docs.mongodb.org/manual/tutorial/isolate-sequence-of-operations/

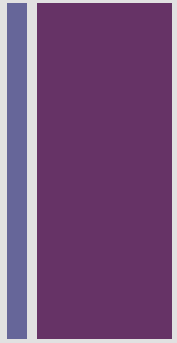
{“section” : “CRUD”,
“alternateText” : “Create, Read, Update, Delete” }

Start your engines!



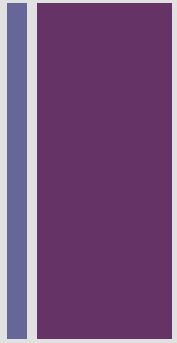
- Start up mongod
  - --smallfiles --nojournal
- Start up mongo
- Open your editor or IDE

mongo – the shell



- Javascript
- JSON
  - Variance from strict JSON

Database basics



- show dbs
- use databaseName
- db is a pointer
- show collections

The local database

- Contains internal settings and replication configuration information.
- Is not replicated
- http://docs.mongodb.org/manual/reference/local-database/

JSON Review

- **json.org**
- {“key” : “values”}
- JSON types
  - string, number, object, array, true, false, null
- Lists
- Sub-documents

Create -- insert

- use workshop
- db.stuff.insert({“hello”:”world”})
- db.stuff.insert({“greeting” : ”people”, ”name” : ”me”})
- show collections
- show dbs

Read -- findOne

- db.stuff.findOne()

_id

- Unique
  - Default is ObjectID
  - A document may be fully duplicated except for the _id
- Any Type
- **ObjectId** is
  - Globally Unique Identifier (GUID)
  - A 12-byte BSON type, constructed using:
  - A 4-byte value representing the seconds since the Unix epoch
  - A 3-byte machine identifier
  - A 2-byte process id
  - A 3-byte counter, starting with a random value

Read -- find

- db.stuff.find()
- db.stuff.find().pretty()
- db.stuff.find({“name”:”me”})
- db.stuff.find({“NAME”:”me”})
- db.stuff.find({“name”:”ME”})
- db.stuff.find({“_id”: ObjectId(“…”)})

it

- find() returns a cursor
- *it* gets the next set

```
for(var i = 0; i < 30; i++ ) {
db.stuff.insert({"counter":i}) }

db.stuff.find()
```

CODE: inserts and finds

- Driver
- Connect to the database server
- Use a database
- Work with a collection
  - **inserts** – `InsertDemo.java`
  - **finds** – `FindDemo.java`
- Close the connection

Example Java Code

```
MongoClient mongoClient = new MongoClient("localhost");
DB stuffDb = mongoClient.getDB("workshop");
DBCollection exampleCol = stuffDb.getCollection("examples");
DBObject document;

document = exampleCol.findOne(new BasicDBObject("someField",5));
System.out.println(document);

DBCursor cursor = exampleCol.find();
while(cursor.hasNext()) {
     document = cursor.next();
     System.out.println("c doc: " + document);
}

mongoClient.close();
```

Example Python code

```
from pymongo import MongoClient

client = MongoClient("localhost")
db = client.workshop
col = db.examples

doc = col.find_one({"someField": 5})
print doc

for doc in col.find():
    print "c doc: " + str(doc)

client.close()
```

Update

- db.stuff.insert({"name":"joe"})
- db.stuff.insert({"name":"jo"})
- db.stuff.**update**({"name":"jo"},{"city":"COU"})
- db.stuff.find({"name":"jo"})???
- db.stuff.find()
- db.stuff.insert({"name":"jo"})
- db.stuff.**update**({"name":"jo"}, { **$set**: {"city":"COU"}})
- db.stuff.find({"name":"jo"})

Update multiple documents

- for(var i = 0; i < 5; i++) { db.stuff.insert({"_id":i, "multiDemo":1}) }
- db.stuff.find({"multiDemo":1})
- db.stuff.**update**({"multiDemo":1}, {$set: {"updated":1} })
- db.stuff.find({"multiDemo":1}) **???**
- db.stuff.**update**({"multiDemo":1}, {$set:{"updated":1} }, **{multi : true}**)
- db.stuff.find({"multiDemo":1})
- http://docs.mongodb.org/manual/core/update/#update-multiple-documents

Upserting

- db.stuff.find({"color":"blue"})
- db.stuff.update({"color":"blue"}, {$set:{”iDidIt":true}}, **{upsert:true}**)
- db.stuff.find({"color":"blue"})
- db.stuff.update({"color":"blue"}, {$set:{"primary":true}}, **{upsert:true}**)
- db.stuff.find({"color":"blue"})

Updates can be expensive

- Document collections incorporate a dynamically adjusted paddingFactor
- Document growth past padded size causes a move on disk
- compact and repairDatabase strip the padding
- http://docs.mongodb.org/manual/core/write-operations/#write-operations-padding-factor

Delete – remove()

- db.stuff.find({"counter":1})
- db.stuff.**remove**({"counter":1})
- db.stuff.find({"counter":1})

Delete – remove()

- Does remove() need the multi option?
  - `for(var i = 0; i < 5; i++) { db.stuff.insert({"_id":i, "removeDemo":1}) }`
  - `db.stuff.find()`
  - `db.stuff.remove({"removeDemo":1})`
  - `db.stuff.find()`
- `justOne optional parameter`

{“section” : “Advanced CRUD”, “tags” : [
“Advanced”, “Create”,
“Read”, “Update”,
“Delete”] }

Regular expressions

- db.stuff.find({“name” : /^[m]/})
  - value in name starts with m
- db.stuff.find({“name” : {$regex:/[o]$/}})
  - value in name ends with o

Arrays – the basics

- db.junk.insert({"section":"Advanced CRUD", "tags":["Advanced","Create","Read","Update","Delete"]})
- Keep their order
- db.junk.find({tags:"Read"})
- db.junk.find({tags:[”Read”]})

Arrays – $push

- db.demo.insert({"demo":"array"})
  - {“demo”:”array”} ← there is no magic here. It’s just a document.
- db.demo.update({"demo":"array"},
  {$push: {"movies": "dune"}})
- db.demo.findOne({"demo":"array"})
- db.demo.update({"demo":"array"},
  {$push: {"movies": "dune"}})
- db.demo.findOne({"demo":"array"})
- http://docs.mongodb.org/manual/reference/operator/update-array/

Arrays – $push and $pull

- db.demo.update({"demo":"array"}, **{$pull:{"movies":"dune"}}**)
- db.demo.findOne({"demo":"array"})
- db.demo.update({"demo":"array"}, {$push: {"movies": {**$each**: ["dune","tron"]} } })
- db.demo.findOne({"demo":"array"})
- db.demo.update({"demo":"array"}, **{$pull:{"movies":["dune"]}}**)
- db.demo.findOne({"demo":"array"})

Arrays – $addToSet

- db.demo.update({"demo":"array"}, {**$addToSet:** {"movies":"dune"}})
- db.demo.findOne({"demo":"array"})
- db.demo.update({"demo":"array"}, {**$addToSet:** {"movies":"dune"}})
- db.demo.findOne({"demo":"array"}) // duplicated?
- db.demo.update({"demo":"array"}, {$addToSet: {"movies":"aliens"}})
- db.demo.findOne({"demo":"array"})
- db.demo.update({"demo":"array"}, {$addToSet: {"*books*":"ghost"}})
- db.demo.findOne({"demo":"array"})

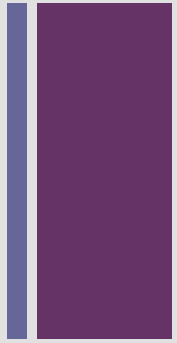
$set and $unset

- db.demo.insert({"demo":"setting"})
- db.demo.findOne({"demo":"setting"})
- db.demo.update({"demo":"setting"}, {**$set**:{"newkey":true}})
- db.demo.findOne({"demo":"setting"})
- db.demo.update({"demo":"setting"}, {**$unset**:{"newkey":true}})
- db.demo.findOne({"demo":"setting"})

+

{“section” : “Backups”}

Database Size



- show dbs
- db.stats()
- db.stuff.stats(1024)
- db.runCommand({listDatabases:1})
- use admin
- db.runCommand({listDatabases:1})
- db.runCommand({listCommands:1})

MongoImport

- mongoimport
  - Unicode / UTF-8 and CP1252
  - Types of imports – external file types
  - --drop
  - --upsert
- mongoimport --db workshop --collection names < names.json
- db.names.count()
- db.names.findOne()

MongoExport

- mongoexport
  - Types supported – csv, json, etc.
- mongoexport --db workshop --collection names > new_names.json
- Compare the names.json and new_names.json files

MongoDump

- File System Snapshots are the recommended backup approach.
- mongodump and mongorestore create and restore
  - Can be run directly against the data files – no mongod running
- mongodump --help
  - Can use cross machine
  - Has default no argument behavior
- mongodump --db workshop --out workshop_dump
  - Check the directory

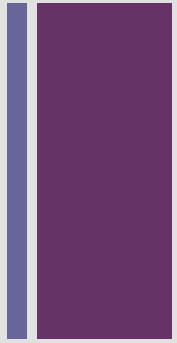
MongoRestore

- mongorestore --help
- mongorestore --db new_workshop workshop_dump/workshop
  - Note the --drop option
- In the mongo shell
  - show dbs
  - Examine new_workshop…

+

```
{“section” : “Advanced CRUD”,
“part” : ”deux”,
“tags” :[ “Advanced”,“Create”,
“Read”,“Update”,“Delete”] }
```

find – limiting the returned fields



- use workshop
- db.names.findOne()
- db.names.find({}, {'city': **1**, 'name': **1**, 'district': **1**})
- db.names.find({}, {'_id':**0**, 'scores':**0**})
- db.names.find({}, {'city':**1**, 'scores':**0**})
- db.names.find({}, {'_id':**0**, 'scores':**1**})

sort, skip and limit

- db.names.find({},{“scores”:0}).**limit(5)**
- Skip and Limit are always applied after Sort
- db.names.find({},{“scores”:0}).limit(5).**sort({“city”:1})**
- db.names.find({},{“scores”:0}).limit(5).**sort({“city”:1, “name”:1})**
- db.names.find({},{“scores”:0}).limit(5).sort({“city”:1, “name”:1}).**skip(2)**

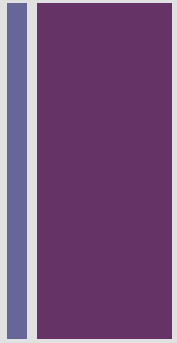
Pretty

- db.names.find().limit(3).**pretty()**
- db.names.find({},{“scores”:0}).limit(3).**pretty()**

$and or comma? And $or

- db.names.findOne({"age":87,"scores":87})
- What if I want to find someone that has a score of 0 and a score of 100?
- db.names.findOne({"scores":0,"scores":100})
- db.names.findOne({**$and**: [{"scores": 0}, {"scores": 100}] })
- db.names.findOne({**$or**: [{"scores": 0}, {"scores": 100}] })

Subdocuments



- db.demo.insert({"demo":"subdocs", subdoc: {"sub": "one"} })
- db.demo.findOne({"demo":"subdocs"})
- db.demo.update({"demo":"subdocs"}, {$set:{"**subdoc.ver**":1}})
- db.demo.findOne({"demo":"subdocs"})
- db.demo.findOne({"**subdoc.ver**":1})

Count, $gt, $lte, $not, and $ne

- db.names.find({ age: { **$lte**: 21} }).**count**()
- db.names.find({ age: { **$not** : { **$gt**: 21} } }).count()
- db.names.find({ *madeup*: { **$gt**: 21} }).count()
- db.names.find({ *madeup*: { **$not** : { **$lte**: 21} } }).count()
- db.names.find({ age: { **$ne**: 21} }).count()
- db.names.find({ color: { **$ne**: "purple"} }, {scores:0}).count()

$in and $exists

- db.names.find({name:"STOUT"}).count()
- db.names.find({name:"BROCK"}).count()
- db.names.find({name:
  { **$in**:["STOUT","BROCK"] } }).count()
- db.*demo*.find({movies: { **$exists**: true } })

- http://docs.mongodb.org/manual/reference/operator/

+

{“section” : “Dropping stuff”}

Dropping – Document Review

- use habit
- db.badhabit.insert({“sneeze”:”spray”})
  - show dbs
  - show collections
- db.badhabit.remove({“sneeze”:”spray”})
  - show dbs
  - show collections

Dropping – Collections and DB

- db.badhabit.drop()
  - show collections
  - db
- db.dropDatabase()
  - show dbs
  - db ???

Dropping – DB

- use new_workshop
- db.dropDatabase()
  - show dbs
  - db ???
- use workshop

Tab completion!

- db.<TAB>
- db.collection.<TAB>
- What's the method do?
  - db.collection.insert
    - Notice NO ( )'s after the insert

+

{“section” : “Performance”}

explain()

- db.names.find({"age":55}).explain()
- As of version 3.x there are now three modes
  - queryPlanner – the default
  - executionStats
  - allPlansExecution
- http://docs.mongodb.org/manual/reference/explain/

Indexes

- Enhance query performance
  - Introduces insert overhead
  - Use a B-tree data structure
- Only one index is used per operation
  - find, sort, update, etc.
- When can an index be used?
  - Index is a,b,c and query is a or -a or a,b or a,b,-c (yes)
  - Index is a and query is a,b,c (no)
  - The query has to use some **left** subset of the index
- http://docs.mongodb.org/manual/core/indexes/

Covers

- An index "covers" a query if:
  - All the fields in the query are part of the index **and**
  - All the fields returned in the documents that match the query are in the same index

The _id index

- db.names.find({“_id”:65}).explain()

Indexes & getIndexes

- db.junk.insert({"boo":"bunny","days":42})
- db.junk.insert({"boo":"bear","days":33})
- db.junk.createIndex({"boo":1,"days":1})
- db.junk.getIndexes()
- db.junk.find().sort({boo:1,days:-1}).explain()
- db.junk.find().sort({boo:-1,days:-1}).explain()
- db.junk.createIndex({"days":1})
- db.junk.getIndexes()
- db.junk.find().sort({days:-1}).explain()
- db.junk.find({},{_id:0,days:1}).sort({days:-1}).explain()

Unique indexes

- db.junk.createIndex({"boo":1},{unique:true})
- db.junk.insert({"boo":"bear"})
- **Multiple unique indexes?**
- db.junk.createIndex({"days":1, "boo":1},{“unique”:true})

- http://docs.mongodb.org/manual/core/indexes/

Revise existing index

- db.junk.createIndex({”days":1},{unique:true})
- db.junk.insert({”days”:42})
- What happened?
- db.junk.getIndexes()
  - To revise an index, you must drop it and create it with the new specification.

dropIndex / dropIndexes

- db.*collection*.**dropIndex**({full:1, index:1, specification:1})
- db.junk.**dropIndex**({"boo":1})
- db.junk.getIndexes()
- db.junk.**dropIndexes**()
- db.junk.getIndexes()

Indexes & getIndexes (names)

- db.names.createIndex({"name":1})
- db.names.find({"name":"HUMPHREY"}).explain('**executionStats**')
  - How many HUMPHREYs are there?
  - Check totalKeysExamined and totalDocsExamined
  - executionTimeMillis probably 0 now too
- db.names.find({meh:''meh''}).sort({name: 1}).explain()

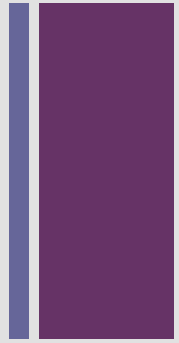
Multikey indexes

- **Only one Array type field per index**
- **Order is important**
- db.names.createIndex({"city":1,"name":1})
- db.names.find({"city":"Munich","name":"HUMPHREY"}).explain()
- db.names.find({"name":"HUMPHREY","city":"Munich"}).explain()
- db.names.find({"name":"HUMPHREY"}).sort({"city":1,"name":1}).explain()
- db.names.find({"**meh**":"HUMPHREY"}).sort({"city":1,"name":1}).explain()
- db.names.find({}).sort({"city":-1,"name":1}).explain()
- http://docs.mongodb.org/manual/core/indexes/#multikey-indexes

Mongostat

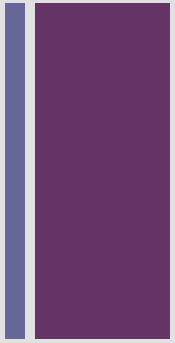
- mongostat
- What's going on with mongod / mongos?
- http://docs.mongodb.org/manual/reference/mongostat/

mongotop



- mongotop
- Where are the reads and writes happening?
- http://docs.mongodb.org/manual/reference/mongotop/

.stats()

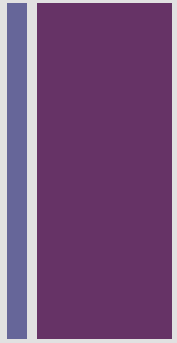


- db.stats()
- db.names.stats()

system.profile

- db.getProfilingStatus( )
- db.setProfilingLevel(0)
- db.getProfilingStatus( )
- db.runCommand({ profile: 1, slowms: 200 })
- db.getProfilingStatus( )
- db.names.find().sort({"age":1})
- db.**system.profile**.find().pretty()
- db.setProfilingLevel(0)

Logs



- mongo.log
  - /usr/local/var/log/mongodb
- Windows
  - By default no log, check the console
- Slow queries are in the log

Mongo Monitoring Service (MMS)

- What is it?
- mms.mongodb.com
- http://www.mongodb.com/products/mongodb-monitoring-service

Further research

- Sparse indexes
- Query hint() the index to use
- mongod
  - --profile level
  - --slowms

+

{“section” : “Aggregation”}

Aggregation Framework

- Often compared/contrasted with:
  - Map-Reduce (lightweight alternative)
  - SQL (where, order by, group by)
  - Pipe line architecture
- In version 2.6:
  - returns a cursor
  - Can output to a collection
  - Can do disk based sorting

Stages

- Pipeline style architecture
- $project, $match, $limit, $skip, $unwind, $group, $sort
- db.collection.aggregate({*pipeline operations*}, {}…)
- db.collection.aggregate(**[** {pipeline operations}, {}… **]**)

- http://docs.mongodb.org/manual/core/aggregation/
  - Also contains information on optimization
- http://docs.mongodb.org/manual/reference/aggregation/

$limit, $match and $project

- db.names.aggregate({**$limit** : 3})
- db.names.aggregate({**$match**: {"city": "Columbia"}}, {$limit:3})
- db.names.aggregate({$match:{"city": "Columbia"}}, {$limit:3}, {**$project**:{city:1,district:1 }})
- db.names.aggregate({$match:{"city":"Columbia"}}, {$limit:3}, {**$project**:{city:1, **schoolDistrict : "$district"** }})
- db.names.aggregate({$match:{"city":"Columbia"}}, {$limit:3}, {$project:{city:1, district:1,
  higherDistrict: {$gt: ["$district", "M"] } }})

$skip

- db.names.aggregate({$match:{"city":"Columbia"}}, {$limit:3})
- db.names.aggregate({$match:{"city":"Columbia"}}, {$limit:3}, **{$skip:2}**, {$project:{city:1, district:1 }})
- db.names.aggregate({$match:{"city":"Columbia"}}, **{$skip:2}**, {$limit:3}, {$project:{city:1, district:1 }})

$group, *$sum* and $sort

- db.names.aggregate({**$group**:{_id: "$city"}})
- db.names.aggregate({$group:{_id: "$city", population:{**$sum**:1}} })
- db.names.aggregate({$group:{_id: **null**, population:{$sum:1}} })
- db.names.aggregate({$group:{_id: **{}**, population:{$sum:1}} })
- db.names.aggregate({$group: {_id: "$city", population: {$sum:1}}}, {**$sort**: {"_id": 1 }})
- db.names.aggregate({$group:{_id: "$city", population:{$sum:1}}}, {**$match**:{"_id":"Zurich" }})

$unwind

- db.names.aggregate({$match:{"city":"Columbia"}}, {$limit:1}, **{$unwind: "$scores"}**)
- db.names.find({_id:3})
- db.names.aggregate({$match:{"_id":3}}, {$unwind: "$scores"}, {$group:{_id:"$_id", **totalPoints:{$sum:"$scores"}** } })
- db.names.aggregate({$match:{"_id":3}}, **{$unwind: "$scores"}**, {$group:{ _id: "$_id", max: {**$max**: "$scores"}}})

Aggregation Exercise

- What are the top 5 occurring names?
- What is the _id of the person with the *highest* overall score *average* in Columbia's "Z" district?
  - Person with "_id" : 58737 has the *lowest* score
- HINTS:
  - Build the query in stages!
  - Start with $limit and $match
  - $avg
  - Verify expected results at each stage

Aggregation Answers

- db.names.aggregate(
  {$group: {_id: "$name", frequency: {$sum: 1} } },
  {$sort: {"frequency":-1}},
  {$limit: 5})

- db.names.aggregate(
  {$match: {city: "Columbia","district": "Z" }},
  {$unwind: "$scores"},
  {$group:{_id: "$_id", average: {$avg: "$scores"}}},
  {$sort: {"average": -1}},
  {$limit: 5})

+ {“section” : “GridFS”,
“alternate” : “where did I put that file?”}

Introduction

- Store and Retrieve *files*
- Uses two collections
- Meta data and pointer stored in .files
- Chunks of binary data stored in .chunks

mongofiles

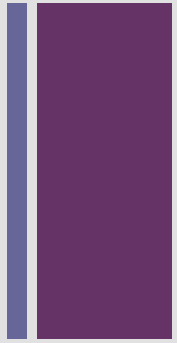
- **$:** mongofiles --db workshop put census_surnames.xls
- show collections
- db.fs.files.findOne()
- db.fs.chunks.findOne()
- mongofiles --db workshop get census_surnames.xls --local surnames.xls
- http://docs.mongodb.org/manual/reference/mongofiles/

CODE: GridFS with Java

- Puts in a file with metadata
- Retrieve a file by metadata search
- Save the retrieved file
- Examine the collections in the shell

+ {“section” : “Replication”, “alternate”: “Department of Redundancy Department”}

Replication



- Ensures redundancy
- Backup
- Automatic failover
- Replication is implemented with groups of servers known as replica sets.

- http://docs.mongodb.org/manual/replication/

Node Types and Attributes

- Primary
- Secondary
  - Hidden
  - Delayed
  - Arbiter
  - Non-voting

- http://docs.mongodb.org/manual/core/replication/

Fail Over

- The Primary Server goes down, now what?
- Voting Secondary's elect new Primary
- Elected Secondary Promotes to Primary
- Old primary comes back on line
- It rejoins as secondary
  - Unless it has a higher priority attribute set
- It syncs back up
- Rollback?

Configuration

- Development Environment
  - Multiple mongod on a single machine
  - *Different* port number per mongod
  - What does replication on a single machine accomplish?
- Production Environment
  - One mongod per server
  - Default port number
  - Odd number of mongod (50/7)
  - Virtual Server versus Physical servers

Hands on, Spin up a Replica Set

- From your flash drive backup files, copy **repset** to your "workshop" working directory
- Start up the nodes
  - mongod --port 27001 --dbpath n1 --logpath n1/node.log --config repset.conf
  - mongod --port 27002 --dbpath n2 --logpath n2/node.log --config repset.conf
  - mongod --port 27003 --dbpath n3 --logpath n3/node.log --config repset.conf
- Windows
  - Use repset_windows.conf and start at the beginning of the line
  - **start** mongod --port 27001 --dbpath n1 --logpath n1/node.log --config **repset_windows.conf**

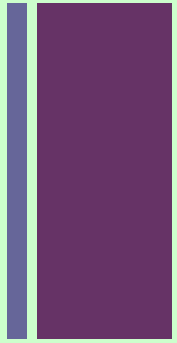
Hands on, Spin up a Replica Set

- Initiate the replication set
  - mongo --port 27001 --shell config.json
  - rs.initiate(cfg)
  - rs.status()
    - Notice prompt SECONDARY or PRIMARY?
- show dbs

Hands on, Spin up a Replica Set

- Insert some data on PRIMARY
  - db.grass.insert({keepOff:true})
- Connect to a SECONDARY
  - mongo –port 27002
- Query for the data – show collections
  - Secondary reads not OK, why?
- Reconfigure to allow SECONDARY read
  - rs.slaveOk()
  - db.grass.findOne()
  - db.grass.insert({mow:true})

CODE: replicasets



- Connecting to a replica set
- Handling of Primary node failure
- Write concern
- Safe Writes – RepSetWriting.java
- Safe Reads – RepSetReading.java

Shutdown your replica set

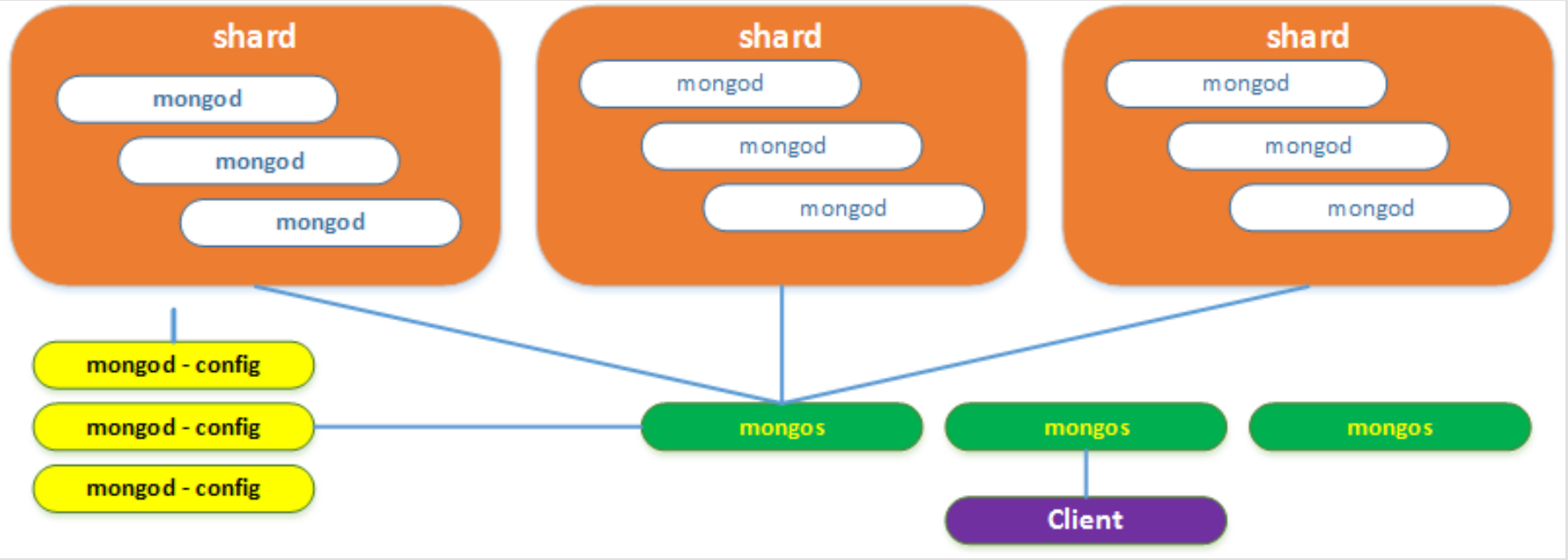
- Poke around in the database directories `n1`
  - Check out the log file
  - Check out the lock file
- Close running consoles
- Find and kill processes

+ {“section” : “Sharding”, “alternate”: “distributed read-write scaling” }

Sharding

- Sharding distributes a single logical database system across a cluster of machines
- Shards
  - Store a portion of the collection – size scalability
  - Balance read/write load and data across machines
  - Enabled per database and collection
- mongos
  - used to access the shards
  - Utilize config servers which have metadata
    - About the cluster
    - About where the chunks are for the shards
- http://docs.mongodb.org/manual/sharding/

Production Sharding Environment



{“section” : “afterword”,
+ “alternate” : [“experiment”, “ask questions”,” open lab time”]}

MongoDB Resources

- MongoDB University
  - Python, Java, node.js, C#
  - Administration & Operations

https://university.mongodb.com/

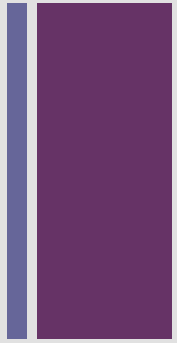
http://docs.mongodb.org/manual/

http://mongodb.org

Conferences

- **MongoDB World**
- Strata
  - PyData & PyCon
  - Kansas City Developer Conference
  - BigDataSummitKC.org

Mentors



- From MongoDB
- User Groups and Forums
- Within your company

Where do I go from here?

- Check out the MongoDB documentation
  - Capped Collections & Capped Arrays
  - Geospatial / GIS, GeoJSON support
  - Role-based privileges
  - Full Text Search (default on v2.6+)
  - Learn more about sharding
  - Query Operators
  - Map-Reduce
  - Storage Engines
- Experiment
  - Share your experience – blog, tweet, present
  - GitHub and Gists

Practice – open lab time

- Experimenting ideas
  - Personal Journal
  - Personnel System
  - Asset Management System
  - Advanced Queries & Aggregation Framework

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