MongoDB Performance Tuning Mastery

MongoDB Meetup London
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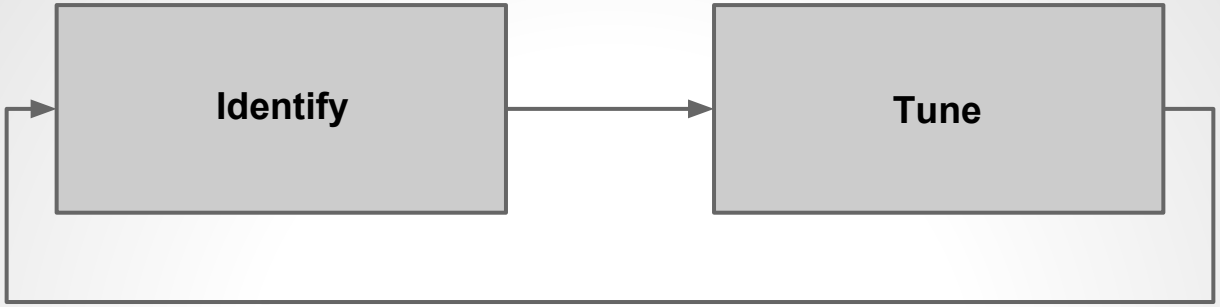
Order Matters

1. Schema design
2. Workload tuning 
3. Instance tuning
4. Reactive tuning

Schema Design

- Why MongoDB?
- Resist your urge to model relationally
- Develop sound workload patterns
- Test those patterns

Workload Tuning



- Profile
- Explain
- Tune

Profiler

```
while performance_problems():
    bad_statements = find_candidates()
    for statement in bad_statements:
        statement.explain()
```

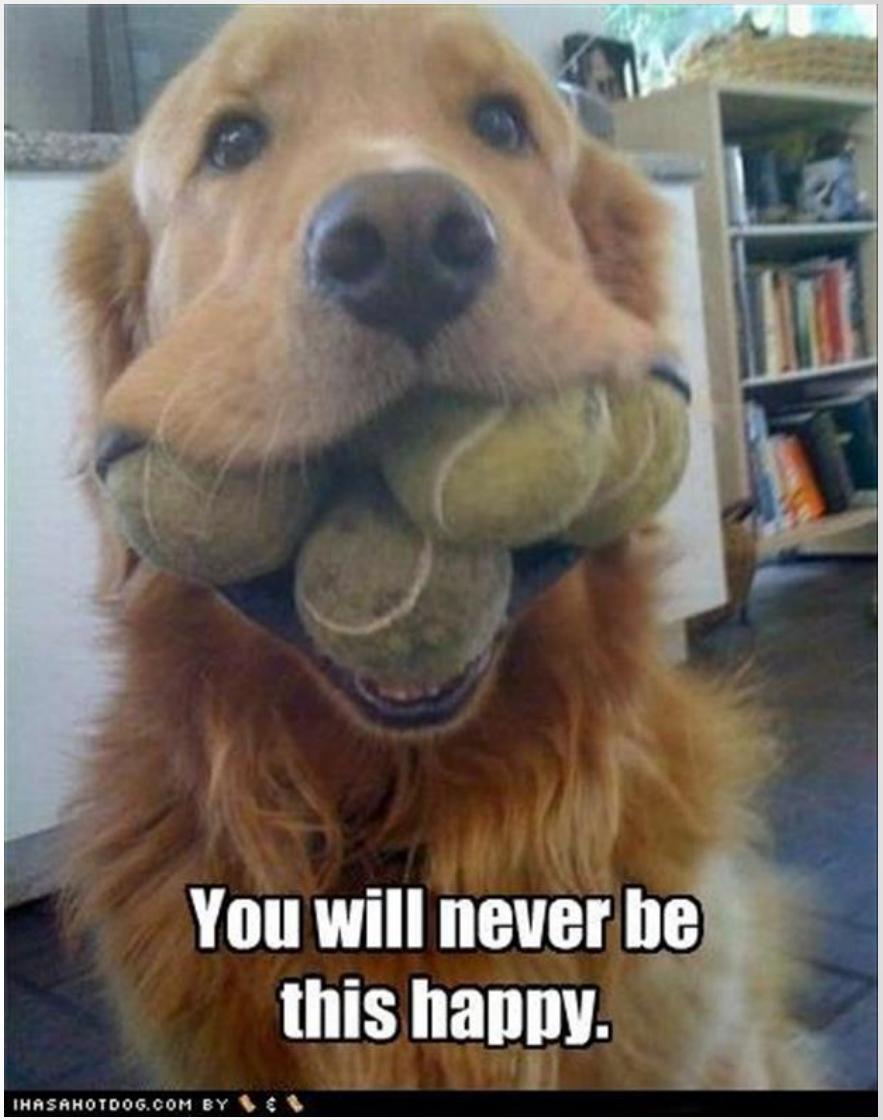
- What is the function for performance_problems()?
- If true, then tools()

Profiler

- Per DB, capped
- db.system.profile

- Your most important tool

- Leave it on. Yes, I said that. Leave it the F*&K on.



Profiler

```
$> db.setProfilingLevel(2);
{ "was" : 0, "slowms" : 100, "ok" : 1 }

$> db.testme.save({"name":"Kenny"});

$> db.system.profile.find().pretty()
{     "ts" : ISODate("2013-02-11T18:45:06.857Z"),
      "op" : "insert",
      "ns" : "test.testme",
      "keyUpdates" : 0,
      "numYield" : 0,
      "lockStats" : {..},
      "millis" : 0,
      "client" : "127.0.0.1",
      "user" : "" }
```

Profiler

```
{
 "ts" : ISODate("2012-09-14T16:34:00.010Z"),      // date it occurred
      "op" : "query",                             // the operation type
      "ns" : "game.players",                           // the db and collection
      "query" : { "total_games" : 1000 },         // query document
      "ntoreturn" : 0,                            // # docs returned with limit()
      "ntoskip" : 0,                                   // # of docs to skip()
      "nscanned" : 959967,                        // number of docs scanned
      "keyUpdates" : 0,                                // updates of secondary indexes
      "numYield" : 1,                             // # of times yields took place
      "lockStats" : { ... },                           // subdoc of lock stats
      "nreturned" : 0,                            // # docs actually returned
      "responseLength" : 20,                           // size of doc
      "millis" : 859,                             // how long it took
      "client" : "127.0.0.1",                          // client asked for it
      "user" : ""                                      // the user asking for it
}
```

http://docs.mongodb.org/manual/reference/database-profiler/

Profiler: Finding Candidates

```
// response time by operation type
db.system.profile.aggregate(
{ $group : {
   _id :"$op",
   count:{$sum:1},
   "max response time":{$max:"$millis"},
   "avg response time":{$avg:"$millis"}
}});

// slowest by namespace
db.system.profile.aggregate(
{ $group : {
  _id :"$ns",
  count:{$sum:1},
  "max response time":{$max:"$millis"},
  "avg response time":{$avg:"$millis"}
}},
{$sort: {
 "max response time":-1}
});
```

```
// slowest by client
db.system.profile.aggregate(
{$group : {
  _id :"$client",
  count:{$sum:1},
  "max response time":{$max:"$millis"},
  "avg response time":{$avg:"$millis"}
}},
{$sort: {
  "max response time":-1}
});

// summary moved vs non-moved
db.system.profile.aggregate(
 { $group : {
   _id :"$moved",
   count:{$sum:1},
   "max response time":{$max:"$millis"},
   "avg response time":{$avg:"$millis"}
 }});
```

Explain: What am I looking for?

- fastmod
- nscanned != nreturned
- key updates
- moves
- lock waits
- just returning too much data (count or size or both)
- bad cardinality

Explain

- Take the document from profiler output, explain it
- Look at results, make corrections
- Rinse and repeat

Explain

```
$>db.system.profile.find({"op":"query","ns":"test.testme"}).pretty();
{     "ts" : ISODate("2013-02-11T19:53:16.302Z"),
      "op" : "query",
      "ns" : "test.testme",
      "query" : { "name" : 1 },
      "ntoreturn" : 0,
      "ntoskip" : 0,
      "nscanned" : 32001,                                  // why scanning so many?
      "keyUpdates" : 0,
      "numYield" : 0,
      "lockStats" : {...},
      "nreturned" : 1,                                  // just to return 1
      "responseLength" : 56,
      "millis" : 29,                                       // slow!
      "client" : "127.0.0.1",
      "user" : ""
}
```

Explain

```
$> db.testme.find({ "name": 1 }).explain()
{
 "cursor" : "BasicCursor",                                    // Basic
      "isMultiKey" : false,
      "n" : 1,
      "nscannedObjects" : 32001,
      "nscanned" : 32001,
      "nscannedObjectsAllPlans" : 32001,
      "nscannedAllPlans" : 32001,
      "scanAndOrder" : false,
      "indexOnly" : false,
      "nYields" : 0,
      "nChunkSkips" : 0,
      "millis" : 14,
      "indexBounds" : {
                                                               // WTF!
      },
      ...
}
```

Explain

```
$> db.testme.ensureIndex({"name":-1});
$> db.testme.find({"name":1}).explain()
{
        "cursor" : "BtreeCursor name_-1",                                    // Btree
        "isMultiKey" : false,
        "n" : 1,
        "nscannedObjects" : 1,
        "nscanned" : 1,
        "nscannedObjectsAllPlans" : 1,
        "nscannedAllPlans" : 1,
        "scanAndOrder" : false,
        "indexOnly" : false,
        "nYields" : 0,
        "nChunkSkips" : 0,
        "millis" : 0,
        "indexBounds" : {
                "name" : [
                        [
                                1,                                           // w00t!
                                1
                        ]
                ]
        },
        ...
}
```

Now I need tools

Response time analysis

- Response time analysis techniques come from Oracle community circa 2000-2004.
- Response time = service time + queue time (time_to_complete + time_waiting_in_queue)
- Each document in profile collection a couple response time attributes.
  - millis
  - timeAcquiring
  - timeLocked
- The only true measure of response time in MongoDB
- Aids in prioritization of tuning opportunities. Finding the bang for the buck, or the immediate performance problem.

Definitions:

`system.profile.lockStats.timeLockedMicros`

The time in microseconds the operation held a specific lock. For operations that require more than one lock, like those that lock the **`local`**database to update the *oplog*, then this value may be longer than the total length of the operation (i.e. **`millis`**.)

`system.profile.lockStats.timeAcquiringMicros`

The time in microseconds the operation spent waiting to acquire a specific lock.

`system.profile.millis`
The time in milliseconds for the server to perform the operation. This time does not include network time nor time to acquire the lock.

Response time analysis

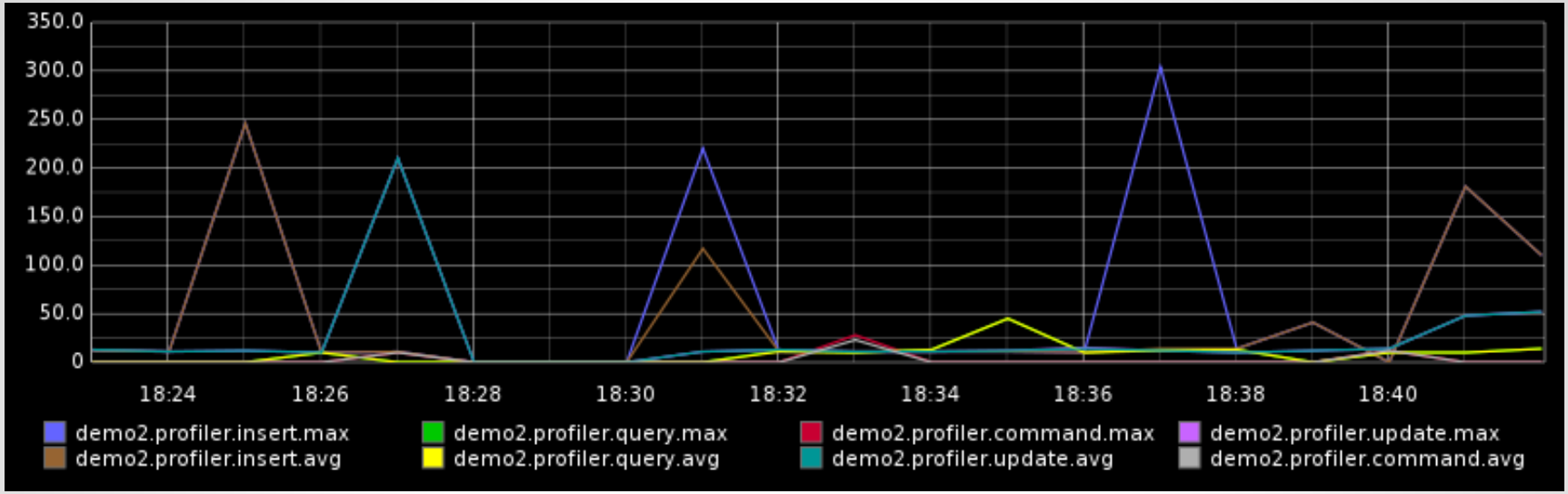
```
$>db.system.profile.aggregate(
        [
                { $project : {
                                "op" : "$op",
                                "millis" : "$millis",
                                "timeAcquiringMicrosrMS" : { $divide : [ "$lockStats.timeAcquiringMicros.r", 1000 ] },
                                "timeAcquiringMicroswMS" : { $divide : [ "$lockStats.timeAcquiringMicros.w", 1000 ] },
                                "timeLockedMicrosrMS" : { $divide : [ "$lockStats.timeLockedMicros.r", 1000 ] },
                                "timeLockedMicroswMS" : { $divide : [ "$lockStats.timeLockedMicros.w", 1000 ] } }
                },
                { $project : {
                                "op" : "$op",
                                "millis" : "$millis",
                                "total_time" : { $add : [ "$millis", "$timeAcquiringMicrosrMS", "$timeAcquiringMicroswMS" ] },
                                "timeAcquiringMicrosrMS" : "$timeAcquiringMicrosrMS",
                                "timeAcquiringMicroswMS" : "$timeAcquiringMicroswMS",
                                "timeLockedMicrosrMS" : "$timeLockedMicrosrMS",
                                "timeLockedMicroswMS" : "$timeLockedMicroswMS" }
                },
                { $group : {
                                _id : "$op",
                                "average response time" : { $avg : "$millis" },
                                "average response time + acquire time": { $avg: "$total_time"},
                                "average acquire time reads" : { $avg : "$timeAcquiringMicrosrMS" },
                                "average acquire time writes" : { $avg : "$timeAcquiringMicroswMS" },
                                "average lock time reads" : { $avg : "$timeLockedMicrosrMS" },
                                "average lock time writes" : { $avg : "$timeLockedMicroswMS" } }
                }
        ]
);
```

Response time analysis

```
{
      "_id" : "insert",
      "average response time" : 0.07363770250368189,                    // time executing
      "average acquire time reads" : 0,
      "average acquire time writes" : 5.623796023564078,                // time waiting
      "average lock time reads" : 0,
      "average lock time writes" : 0.25491826215022123            // time in lock.. woah.
}

{
      "_id" : "update",
      "average response time" : 0.23551171393341552,                    // time executing.. moves?
      "average acquire time reads" : 0,
      "average acquire time writes" : 10.261996300863133,               // lots of waiting
      "average lock time reads" : 0,
      "average lock time writes" : 0.3795672009864362                   // time in lock.. again!
}
```

Response time analysis



- Python code to get you started with profiler and graphite:

  https://github.com/kgorman/slum

Instance Tuning

- Mongostat
- Cache management, Hot Set, and Disk I/O.
- Locks and Sharding
- Some thoughts on Hardware

Links

http://www.kennygorman.com/mongodb-profiler-helpful-queries/

https://gist.github.com/kgorman/134896c7414fde8e090b

https://github.com/kgorman/slum

https://github.com/kgorman/ocean

http://docs.mongodb.org/manual/reference/database-profiler/

http://docs.mongodb.org/manual/reference/method/cursor.explain/#explain-output-fields-core

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