Scala with MongoDB

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Novus Partners, Inc.

New York Scala Enthusiasts
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Outline

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Who Am I?

- Started in Perl - lots of MySQL + Sybase (some PostgreSQL + Oracle)
- Spent time in C, PHP, Java, Python, C#
- Built a bond trading platform with Perl and Java
- Last few years - lots of Python
- Last year - IronPython, C#, MongoDB...
- Research into NoSQL Tools led to MongoDB

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Briefly - Sluggy.com Rundown

- I've maintained systems (and some code) for Sluggy.com since 1999
- Original system was Perl + FreeBSD (flat files)
- Eventually migrated to Linux + PHP w/ MySQL
- Last Year: Rewrote with Python (Pylons) + MongoDB (pymongo + MongoKit), went live 1 year ago.
- With Mongo, serving 50GB/day (1.5TB of traffic/month on a single slicehost virtual machine)
- Opened my eyes to the new world of NoSQL
- See my talk from MongoNYC 2010 on our migration + what was learned

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Current Gig

- Started at Novus Partners last fall
- Was toying with Scala while looking for work
- Dove into first project with Scala - haven't looked back.
- Existing Java development team now working in Scala
- Just expanded development team to another Scala developer
- Introduced MongoDB for rapid & flexible data interaction for frontend.
- Several Open Source packages yielded...
  - Casbah (mongoDB + Scala driver layer)
  - Luau (mongoDB + Hadoop integration, written in Scala)

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Introducing MongoDB

- Categorized as a “Document-Oriented Database”
  - Features of both Key-Value Stores & RDBMS’
  - Rich query interface.
  - Works with JSON-like Documents
  - Favors embedding related data over “foreign key” relationships
- Free license (A-GPL) cross-platform (Packages for Linux, Windows, Mac OS X, Windows, FreeBSD & Solaris)
- Cursor-based query results
- Serverside Javascript
  - Stored Javascript functions server-side
  - Powerful aggregation - Map/Reduce, Group Commands
  - JS Statements in queries (no indexes though)
- Indexing system is much like RDBMS, includes Geospatial support.
- Scalable file storage with GridFS
- Data scalability with Replica Sets & Autosharding

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Programming with MongoDB

- Provides a native API which allows interaction to adapt to the programming language (rather than vice versa).
- Official drivers for...
  - C
  - C++
  - Java
  - JavaScript
  - Perl
  - PHP
  - Python
  - Ruby
- Community supported drivers include...
  - .Net: C# & F#
  - JVM: Clojure, Scala, Groovy
  - Erlang
  - Haskell
  - Go
  - ... and many more.

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  - ... and many more.

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But is anyone actually *using* it?!?

MongoDB is deployed in production at companies including...

- New York Times
- Foursquare
- bit.ly
- SourceForge
- Etsy
- Disqus
- Github
- ... The Large Hadron Collider.

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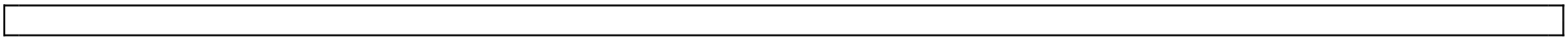
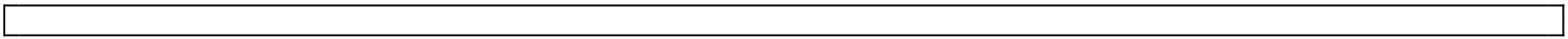
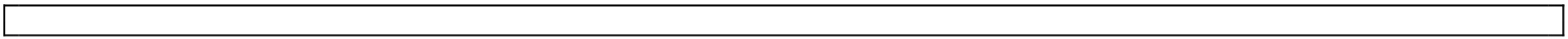
The basics of Querying



Query Objects



Geospatial Support



Finally, Data Scalability.

- Replica Sets
- AutoSharding

Outline

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Using Scala with the official Java Driver I

- JVM Object are JVM Objects...

```
import com.mongodb._

val conn = new Mongo()
val db = conn.getDB("test")
val coll = db.getCollection("testData")

val pies = new BasicDBList()
pies.add("cherry")
pies.add("blueberry")
pies.add("apple")
pies.add("rhubarb")
pies.add("3.14")

val doc = new BasicDBObject()
doc.put("foo", "bar")
doc.put("spam", "eggs")
doc.put("up", "down")
doc.put("pie", pies)

coll.insert(doc)
```

- ... Not terribly “Scala-ey”.

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Using Scala with the official Java Driver II

- The Java driver works, but doesn't fit well in Scala.
- You need to convert your Scala objects to Java Objects, and get nothing but Java Objects out.
- Gets messy quickly.

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The Scala Community Adapted... I

Compare the previous with various Scala drivers.

- mongo-scala-driver wraps & enhances the Java driver:

```
import com.mongodb._
import com.osinka.mongodb._

val conn = new Mongo()
val db = conn.getDB("test")
val coll = db.getCollection("testData").asScala

coll << Map(
  "foo" -> "bar",
  "spam" -> "eggs",
  "up" -> "down",
  "pie" -> List(
    "cherry",
    "blueberry",
    "apple",
    "rhubarb",
    "3.14"
  )
)
```

The Scala Community Adapted... II

- .. Much better, although I was confused initially. Has a object<->MongoDB mapping layer.
- lift-mongodb has more than one way to do it... here's just a taste:

```
import com.mongodb._

import net.liftweb.mongodb._
import net.liftweb.json._
import net.liftweb.json.JsonAST.JObject
import net.liftweb.json.JsonDSL._

implicit val formats = DefaultFormats.lossless

MongoDB.defineDb(DefaultMongoIdentifier,
                 MongoAddress(MongoHost("localhost", 27017)), "test")

val json = JsonParser.parse("""
{ "foo": "bar",
  "spam": "eggs",
  "up": "down",
  "pie": [
    "cherry",
    "blueberry",
    "apple",
    "rhubarb",
    "3.14"
```

The Scala Community Adapted... III

```
  ]
}
""").asInstanceOf[JObject]

MongoDB.useCollection("testData")( coll => {
  coll.save(JObjectParser.parse(json))
})
```

- ... Lift's JS & JSON tools make it very flexible, as we'll see later. Also has an ActiveRecord style Object<->MongoDB Mapping layer.
- Casbah reflects my own attempt at creating a sane interface between Scala & MongoDB. Influenced by pymongo:

The Scala Community Adapted... IV

```
import com.novus.casbah.mongodb.Imports._

val coll = MongoConnection()("test")("testData")

val builder = MongoDBObject.newBuilder
builder += "foo" -> "bar"
builder += "spam" -> "eggs"
builder += "up" -> "down"
builder += "pie" -> List("cherry", "blueberry",
                         "apple", "rhubarb", "3.14")

coll += builder.result
```

- ... The syntax is still growing but is meant to match Scala syntax sanely. Object<->MongoDB Mapping coming soon.
- We're going to cover several tools, although I know Casbah best.

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Helping Java + Scala Interact

- Implicits, “Pimp My Library” and various conversion helper tools simplify the work of interacting with Java.
- Scala and Java have their own completely different collection libraries.
- Some builtins ship with Scala to make this easier.

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Interoperability in Scala 2.7.x

- Scala 2.7.x shipped with `scala.collection.jcl`.
- `scala.collection.jcl.Conversions` contained some implicit converters, but only to and from the wrapper versions - no support for “real” Scala collections.
- Neglected useful base interfaces like `Iterator` and `Iterable`
- @jorgeortiz85 provided `scala-javautils`, which used “Pimp My Library” to do a better job.

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Interoperability in Scala 2.8.x

- Scala 2.8.x improves the interop game significantly.
- JCL is gone - focus has shifted to proper interoperability w/ built-in types.
- `scala.collection.jcl.Conversions` replaced by `scala.collection.JavaConversions` - provides implicit conversions to & from Scala & Java Collections.
- Includes support for the things missing in 2.7 (`Iterable`, `Iterator`, etc.)
- Great for places where the compiler can guess what you want (implicits); falls short in some cases (like BSON Encoding, as we found in Casbah)
- @jorgeortiz85 has updated `scala-javautils` for 2.8 with `scalaj-collection`
- Explicit `asJava` / `asScala` methods for conversions. Adds `foreach` method to Java collections.

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So WTF is an 'Implicit', anyway?

- Implicit Arguments
  - 'Explicit' arguments indicates a method argument you pass, well *explicitly*.
  - 'Implicit' indicates a method argument which is... *implied*. (But you can pass them explicitly too.)
  - Implicit arguments are passed in Scala as an additional argument list:

```
import com.mongodb._
import org.bson.types.ObjectId

def query(id: ObjectId)(implicit coll: DBCollection) = coll.findOne(id)

val conn = new Mongo()
val db = conn.getDB("test")
implicit val coll = db.getCollection("testData")

// coll is passed implicitly
query(new ObjectId())

// or we can override the argument
query(new ObjectId())(db.getCollection("testDataExplicit"))
```

  - How does this differ from default arguments?

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So WTF is an 'Implicit', anyway?

- Implicit Methods/Conversions
  - If you try passing a type to a Scala method argument which doesn't match...

```
def printNumber(x: Int) = println(x)

printNumber(5)
printNumber("212") // won't compile
```

  - A fast and loose example, but simple. Fails to compile.
  - But with implicit methods, we can provide a conversion path...

```
implicit def strToNum(x: String) = x.toInt
def printNumber(x: Int) = println(x)

printNumber(5)
printNumber("212")
```

  - In a dynamic language, this may be called "monkey patching". Unlike Perl, Python, etc. Scala resolves implicits at compile time.

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Pimp My Library

- Coined by Martin Odersky in a 2006 Blog post. Similar to C# extension methods, Ruby modules.
- Uses implicit conversions to tack on new methods at runtime.
- Either return a new “Rich_” or anonymous class...

```
import com.mongodb.gridfs.{GridFSInputFile => MongoGridFSInputFile}

class GridFSInputFile protected[mongodb](override val underlying:
      MongoGridFSInputFile) extends GridFSFile {
  def filename_=(name: String) = underlying.setFilename(name)
  def contentType_=(cT: String) = underlying.setContentType(cT)
}

object PimpMyMongo {
  implicit def mongoConnAsScala(conn: Mongo) = new {
    def asScala = new MongoConnection(conn)
  }

  implicit def enrichGridFSInput(in: MongoGridFSInputFile) =
    new GridFSInputFile(in)
}

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```

- A note: with regards to type boundaries, [A <: SomeType]

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Shameless Self Promotion

- Why Casbah?
- Background in pymongo + MongoKit
- Java driver too... “Java-ey”
- Didn’t quite “get” scamongo and mongo-scala-driver early on
- scamongo’s base didn’t fix most of my issues w/ the Java Driver (just helped connection management)
- scamongo’s ORM libraries were dependent on Lift (now scamongo is defunct and has become lift-mongo)
- mongo-scala-driver’s shapes, etc were *very* confusing to me as a newbie w/o much functional background

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Casbah is Born

- Borrowed bits I liked/understood from other places and built something that felt comfortable to me
- Early on, very pythonic
- Query DSL, grown from wanting a feel close to the “metal” based on generic MongoDB knowledge
- Heavily influenced in structure by `jorgeortiz85`’s libraries
- Quickly grew as I used more and more MongoDB with Scala; features have been grown organically from my own needs.

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Interacting with DBObjects I

- `DBObject` is far too structurally Java.
- Sought to make them more usable & readable from Scala
- Most recently - match Scala 2.8 collection Factory/Builders
- Implicit conversions of `Product` (base for Tuple), `Map`. Explicit method `asDBObject` for corner cases.
- 'Pimped' version of `DBObject` via `MongoDBObject` - lets DBObject implement Scala's `Map` trait.

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Interacting with DBObjects II

```
import com.novus.casbah.mongodb.Imports._  // Only import needed - mongoDB type
      aliases imported too

val coll = MongoConnection()("test")("testData")

// Map
val map: DBObject = Map(
  "foo" -> "bar",
  "spam" -> "eggs",
  "up" -> "down",
  "pie" -> List(
    "cherry",
    "blueberry",
    "apple",
    "rhubarb",
    "3.14"
  )
)

// 'Product'
val product: DBObject =
( "foo" -> "bar",
  "spam" -> "eggs",
  "up" -> "down",
  "pie" -> List(
    "cherry",
    "blueberry",
    "apple",
```

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Interacting with DBObjects III

```
    "rhubarb",
    "3.14"
  )
).asDBObject // Explicit conversion method

// "Factory" method
val constructed: DBObject = MongoDBObject(
  "foo" -> "bar",
  "spam" -> "eggs",
  "up" -> "down",
  "pie" -> List(
    "cherry",
    "blueberry",
    "apple",
    "rhubarb",
    "3.14"
  )
)

// We showed the builder before
val builder = MongoDBObject.newBuilder
builder += "foo" -> "bar"
builder += "spam" -> "eggs"
builder += "up" -> "down"
builder += "pie" -> List("cherry", "blueberry",
                         "apple", "rhubarb", "3.14")

val built: DBObject = builder.result
```

Interacting with DBObjects IV

```
// Also responds to the 'Map' methods...
built += "x" -> "y"
built.getOrElse("x", throw new Error("Can't find value for X"))
/* res15: AnyRef = y */
```

- DBCollection behaves as a Scala `Iterable`, but interaction is mostly the same (with addition of methods like +=).

Fluid Query Syntax I

- My thought: Instead of keeping track of **Yet Another API**, MongoDB's Query Objects should "just work".
- Two kinds of Query Operators - 'Bareword' and 'Core'.
- Bareword Operators can be started as 'bare' statements:

```
val setMulti = $set ("foo" -> 5, "bar" -> "N", "spam" -> "eggs")
/* setMulti: DBObject = { "$set" : { "foo" : 5 , "bar" : "N" , "spam" : "eggs"}} */
val pushAll = $pushAll ("foo" -> (5, 10, 15, 20, 25, 38, 12, "bar", "spam", 86,
     "eggs", "omg", 412, "ponies"))
/* pushAll: DBObject = { "$pushAll" : { "foo" : [ 5 , 10 , 15 , 20 , 25 , 38 , 12 ,
     "bar" , "spam" , 86 , "eggs" , "omg" , 412 , "ponies"]}} */
```

- Core Operators need to be anchored to the right of a `DBObject` or a String (typically representing a field name):

Fluid Query Syntax II

```
// Find any documents where "foo" is between 5 and 15
val findFoo: DBObject = "foo" $gte 5 $lte 15
/* findFoo: DBObject = { "foo" : { "$gte" : 5 , "$lte" : 15}} */
// Find any documents where "bar" contains 1, 8 or 12
val findIn: DBObject = "foo" $in (1, 8, 12)
/* findIn: DBObject = { "foo" : { "$in" : [ 1 , 8 , 12]}} */
```

- Just a small taste - all MongoDB Query Objects are supported (For 1.4.x syntax - 1.6.x ($or, etc. soon))

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Other Features I

- Custom convertor implementations which allow most Scala types to be serialized cleanly to MongoDB. (Joda time serialization/deserialization support).
- Improved GridFS Functionality (loan pattern, support for `scala.io.Source`)
- Wrapper objects for Map/Reduce system (Help parse results to warn of errors, etc)

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Coming Soon I

- Max Afonov @max4f working on annotation driven object mapping.
- Investigating ActiveRecord implementation, with fluid query syntax support.
- Support for MongoDB 1.6.x features.

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Outline

- Akka has an implementation of STM inspired by Clojure's; allows datastructures such as Maps and Vectors to become transactional.
- Akka STM supports persistence to several backends including MongoDB.
- Allows you to setup relatively simple, code managed concurrent transactions with state stored safely in MongoDB.
- Supports JTA; not yet distributed (Dependent on Multiverse, which is working on distributed STM)

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Links

- mongo-scala-driver http://github.com/alaz/mongo-scala-driver
- lift-mongo http://www.assembla.com/wiki/show/liftweb/MongoDB
- FourSquare's Lift Mongo DSL Code ... coming soon? @jliszka
- Casbah http://novus.github.com/docs/casbah
- Jorge Ortiz' (@jorgeortiz85) Libraries
  - scala-javautils (Scala 2.7.x) http://github.com/jorgeortiz85/scala-javautils
  - scalaj-collection (Scala 2.8.x) http://github.com/scalaj/scalaj-collection
- This presentation

  http://github.com/bwmcadams/presentations/tree/master/scala_mongodb/scalany_aug10/

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- IRC - freenode.net #mongodb
- MongoDB Mailing List http://groups.google.com/group/mongodb-user
- Casbah Mailing List http://groups.google.com/group/mongodb-casbah-user
- Boston MongoDB Conference - Sept. 20 (Cambridge, Mass.)
  http://10gen.com/conferences/mongoboston2010
- MongoDB NY Users Group
  http://www.meetup.com/New-York-MongoDB-User-Group/

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