

# What The Hell Is This „Scala“ Anyway?

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# What's to come?

- What is Scala?
- Basic Language Features
- Collections
- Functional Code
- Concurrency and Actors

# What is Scala?

- Scala is a hybrid OO/functional language
- It runs on the JVM
- It is statically typed
- It was designed by Martin Odersky

# Hybrid? Like a pretentious Toyota?

- More like two programming paradigms complementing each other
- Many scripting langs have done this for ages
- Why not do this in a fast, statically typed language?

**OO + FP + strong type system = Fun!**

# Martin Odersky?

## Who's that?

- Not the guy who invented peanut butter!
- But he co-wrote GJ which became javac of Java 1.3+.
- He also co-designed Java Generics
- He's currently a professor at EPFL in Lausanne, Switzerland

# Why do we even need another language?

- Concurrency is more prevalent than ever
- In bigger environments, you want more powerful, higher level abstractions
- You want functional programming (oh yes, you do!)

```
10  BASICS
```

```
20  GOTO 10
```

# The obligatory (and only) comparison to Java

```
public class Employee {  
    private final String name;  
    private double salary;  
  
    public Employee(String name, double salary) {  
        this.name = name;  
        this.setSalary(salary);  
    }  
  
    public String getName() { return name; }  
    public double getSalary() { return salary; }  
    public void setSalary(double salary) {  
        this.salary = salary;  
    }  
}
```



# The obligatory (and only) comparison to Java

That code becomes

```
class Employee(val name: String, var salary: Double)
```

# So the basic syntax is...?

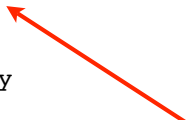
**Class declaration**



**Fields & Constructor args**



```
class Employee(val name: String, var salary: Double) {  
  
    def changeSalary(amount: Double) {  
        salary += amount  
    }  
  
    def total = salary  
}
```



**Added some method  
declarations for fun**

# What else is there to know?

- There are no static methods. You place those in singleton objects instead.
- In Scala everything REALLY is an object:

```
val x = 1 + 2  
val y = 2.+(3)
```



**Many things that seem to be keywords  
are just methods!**

# Inheritance & Traits

- Like Java, Scala does not do straight multiple inheritance
- Scala's *traits* are richer than interfaces though.
  - They may implement methods and fields.
  - They can be mixed in at runtime

# Ye olde Logger example

```
trait Logging {  
  val level: Level  
  
  def log(msg: String) {  
    preferredLogLib.log(level, msg)  
  }  
}  
  
val app = new ImportantApp(...) with  
Logging { val level = DEBUG }  
  
app.log("Shit -> Fan!!!")
```

**Shamelessly nabbed from Dean Wampler's excellent slides!**

["Coll", "ect", "ions"]

# Let's have a look at collections

Lists are fun(ctional):

```
scala> val nums = 1 :: 2 :: 3 :: 4 :: 5 :: Nil  
nums: List[Int] = List(1, 2, 3, 4, 5)
```

```
scala> nums head  
res0: Int = 1
```

```
scala> nums tail  
res1: List[Int] = List(2, 3, 4, 5)
```

# Let's have a look at collections

**The compiler does some awesome inference!**

```
scala> nums map {_ * 2}
res2: List[Int] = List(2, 4, 6, 8, 10)
```

```
scala> nums reduceLeft {_ + _}
res3: Int = 15
```

```
scala> nums filter {_ % 2 == 0}
res4: List[Int] = List(2, 4)
```

**Function Literals instead of clunky anon inner classes**



# Don't go without a map

```
val salaries = Map(  
  "Ralf" -> 2000.0,  
  "Erik" -> 1500.0,  
  "Don" -> 1500.0  
)
```

```
val employees = for((name, salary) <- salaries)  
  yield new Employee(name, salary)
```

# The Option type

```
scala> salaries.get("Ralf")  
res0: Option[Double] = Some(2000.0)
```

```
scala> salaries.get("Kurt")  
res1: Option[Double] = None
```

- It is either None or Some(value)
- It is iterable via for-comprehension
- It helps prevent NPEs

# We have more Options

```
for(kurt <- salaries.get("Kurt")) println(kurt)
```

won't print anything, but won't throw an NPE either,  
because kurt has value „None“

- Java collections return null all the time
- Those can be wrapped, because

```
scala> Option(null)  
res0: Option[Null] = None
```

**Note: If you're using null and you're not  
working with Java libraries, you're doing it  
wrong!**

# While we're looking at for...

for can also accumulate results:

```
for(i <- 1 to 5) yield {i*2}
```

returns

```
Vector(2, 4, 6, 8, 10)
```

```
for(i <- 1 to 5 if (i % 2 == 0)) yield i
```

returns

```
Vector(2, 4)
```

More Functional  
Code

# Why would you want functional programming?

- You want to take away the pain from coding concurrent or parallel algorithms.
- Means: You want to minimize shared mutable state.
- You want to keep your code concise.

# An immutable Employee

```
case class Employee(name: String, salary: Double) {  
  
  def modifySalary(modify: Double => Double) = {  
    Employee(name, modify(salary))  
  }  
  ...  
}
```

**Since we're immutable now, we  
return a new instance here**



- Just adding the keyword „case“ to a class gives us:

- A factory method for object construction
- All fields are automatically considered as vals
- Implementations of toString, hashCode and equals
- Enables pattern matching

**Allows for testing  
structural equality**



# Pattern Matching

## Remember Option?

```
Option(dbResultSet.getString("name")) match {  
  case Some(s: String) => s  
  case None => ""  
}
```

At first glance this looks like a mightier  
switch doesn't it?




# Pattern Matching

Let's take a simple model of expressions:

```
sealed trait Expr
case class Num(value: Int) extends Expr
case class Plus(left: Expr, right: Expr) extends Expr
case class Minus(left: Expr, right: Expr) extends Expr
case class Mult(left: Expr, right: Expr) extends Expr
case class Div(left: Expr, right: Expr) extends Expr
```

To evaluate instances of those, we can just do this:

```
def eval(e: Expr): Int = e match {
  case Num(n) => n
  case Plus(l, r) => eval(l) + eval(r)
  case Minus(l, r) => eval(l) - eval(r)
  case Mult(l, r) => eval(l) * eval(r)
  case Div(l, r) if (eval(r) != 0) => eval(l) / eval(r)
  case _: Div => throw new Exception("Division by zero")
}
```



**We can inspect the structure of case class instances**

# It's everywhere

Pattern matching doesn't just happen inside a  
match expression:

**We had it here!**



```
val employees = for((name, salary) <- salaries)  
  yield new Employee(name, salary)
```

...and we'll see it again.

# Function literals

You can declare anonymous functions („lambdas“) like this:

```
scala> val fun = (x: Int) => x * 2  
fun: (Int) => Int = <function1>
```

( You've already seen it used with collections: )

```
scala> nums map {_ * 2}  
res2: List[Int] = List(2, 4, 6, 8, 10)
```

# Putting lambdas to use

```
class Employee(val name: String, var salary: Double) {  
  
    def changeSalary(amount: Double) {  
        salary += amount  
    }  
  
    def total = salary  
}
```

- This `changeSalary()` method can only add or subtract from the employee's salary.
- A 5% wage increase is unnecessarily complicated.
- Might as well use the field's Getter/Setter instead.

# Putting lambdas to use

That's more like it:

```
class Employee(val name: String, var salary: Double) {  
  
  def modifySalary(modifier: Double => Double) {  
    salary = modifier(salary)  
  }  
  
  def total = salary  
}
```

We can increase this employee's salary by 5% easily now:

```
scala> var simon = new Employee("Simon", 2000.0)  
simon: Employee = Employee@f1d5566
```

```
scala> simon.modifySalary((x: Double) => x * 1.05)
```

**Or even shorter:            \* 1.05**



# Currying

Currying means partially applying a function

```
scala> val fun = (x: Int) => (y: Int) => x * y  
fun: (Int) => (Int) => Int = <function1>
```

```
scala> val timesTwo = fun(2)  
bytwo: (Int) => Int = <function1>
```

```
scala> nums map timesTwo  
res0: List[Int] = List(2, 4, 6, 8, 10)
```

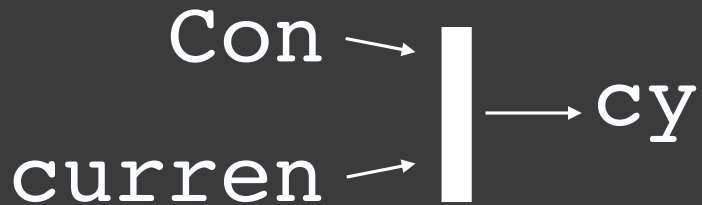
# Functions as objects

- Any object can be used like a function by implementing an `apply( )` method.
- In fact, functions are just objects:

```
trait Function1[-T1, +R] {  
  def apply(v1: T1): R  
}
```



**We're of course eliding some  
convenience methods here**





# Hanging by a thread...

Just use Java threads if you want to:

```
scala> new Thread {println("Serious Business!")}  
Serious Business!  
res0: java.lang.Thread = Thread[Thread-4,5,main]
```

But if you do, you'll be facing the lock and synchronization issues that come with the paradigm.

# Actors

- Small entities that communicate by sending each other messages
- side-effecting behaviour can be contained within one actor.
- Only the actors' inboxes need to be synchronized.
- In Scala, actors run on a threadpool that is expanded as needed.
- not necessarily 1 actor == 1 thread

# Actors

A Scala actor implements the Actor trait:

```
class UselessActor extends Actor {  
  def act() = {  
    println("Look ma, I'm acting!")  
  }  
}
```

```
scala> val wahlberg = new UselessActor()  
wahlberg: UselessActor = UselessActor@7bc8b313
```

```
scala> wahlberg.start()  
res0: scala.actors.Actor = UselessActor@7bc8b313  
Look ma, I'm acting!
```

# Actors

Using `react()` or `receive()` and `loop()`, an actor can communicate via messages.

```
class SimpleActor extends Actor {  
  def act() = loop {  
    react {  
      case s: String => println("Received: " + s)  
    }  
  }  
}
```

# Actor communication

```
case class Ping(sender: Actor)
case class Pong(count: Int, sender: Actor)
case object Stop
```

```
class PingActor(val max: Int) extends Actor {
  var count = 0

  def act() = loop {
    react {
      case Ping(sender) => if (count == max) {
        sender ! Stop
        self ! Stop
      } else {
        count += 1
        println("Got Ping no. " + count)
        sender ! Pong(count, self)
      }
      case Stop => {
        println("Exiting!")
        exit()
      }
    }
  }
}
```

```
class PongActor extends Actor {

  def replyTo(target: Actor) {
    val sender = self
    actor {
      Thread.sleep(1000)
      target ! Ping(sender)
    }
  }

  def act() = loop {
    react {
      case Pong(count, sender) => {
        println("Got Pong no. " + count)
        replyTo(sender)
      }
      case Stop => {
        println("Exiting!")
        exit()
      }
    }
  }
}
```

# Also:

```
val billMurray = new GreatActor()
```

# Oh the songs we didn't sing...

- implicit conversions and parameters
- XML literals
- combinator parsing
- the power of the type system
  - advanced inheritance
  - type bounds
  - structural typing
  - type classes and higher kinded types
  - fluffy kittens

# Scala Sources

## Sites

[www.scala-lang.org](http://www.scala-lang.org) - main language site

[www.implicit.ly](http://www.implicit.ly) - news about Scala software releases

[www.scala-ide.org](http://www.scala-ide.org) - home of the Scala Eclipse plugin

[www.akka.io](http://www.akka.io) - Akka concurrency framework

[www.liftweb.net](http://www.liftweb.net) - Lift web framework

## Free online books

[programming-scala.labs.oreilly.com](http://programming-scala.labs.oreilly.com) - „Programming Scala“  
by Dean Wampler and Alex Payne

[www.artima.com/pinsltd](http://www.artima.com/pinsltd) - „Programming in Scala“ 1st ed. by  
Lex Spoon, Bill Venners and Martin Odersky

[simply.liftweb.com](http://simply.liftweb.com) - Simply Lift by David Pollak

[www.scala-lang.org/docu/files/ScalaByExample.pdf](http://www.scala-lang.org/docu/files/ScalaByExample.pdf) - „Scala  
By Example“ (Draft), a PDF tutorial on Scala by Martin  
Odersky

## Sources

[Seductions of Scala](#) - by Dean Wampler - excellent presentation!



# That's all folks!

## Questions?

Thanks for advice and encouragement to:

Dean Wampler (@deanwampler)

Heiko Seeberger (@hseeberger)

Mario Gleichmann (@mariogleichmann)

Ralf Lämmel (@reallynotabba)

scalaz

scalate

Akka

squeryl

# Bonus Round: The Scala Environment

specs

Scala-IDE

Play

sbt

ScalaTest

Lift

# How to manage Scala projects

- ant - if you're that masochistically inclined
- maven-scala-plugin
  - From the official scala-tools Maven Repo:  
<http://scala-tools.org/repo-releases>
- sbt - Simple Build Tool

# Simple Build Tool

- Basically replaces Maven
- Uses Apache Ivy for dependency management
- Comfortably XML-free
- Lots of plugins

# IDE Integration

- IntelliJ IDEA plugin
  - Great code completion, analysis and refactoring support
  - Sometimes a bit unstable
- Scala-IDE for Eclipse:
  - Has for a long time been so-so
  - On it's way for a complete overhaul for Scala 2.9 (looks promising)
- Bundles for vim, emacs, TextMate, Insert your favorite editor here...

# Akka

- Platform for scalable, event-driven and fault tolerant applications
- Provides very lightweight actors (~600 bytes per Instance)
- Software Transactional Memory
- „Let-it-Crash“ philosophy
- Java and Scala API

# Noteworthy Libs & Frameworks

- Lift - a View-First web application framework
- Play - If you prefer MVC instead
- scalaz - Pure functional data structures for Scala (inspired by Haskell)
- Scalate - Scala Template Engine
- Scalatest, Scalacheck and Specs2 - three TDD/BDD libraries