2. Short introduction to Scala

Nelma Moreira & **José Proença**

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CISTER – U.Porto, Porto, Portugal

https://fm-dcc.github.io/cp2425

Motivation

Why Scala?

Used by many modern concurrency frameworks

- Syntactic flexibility
- Programming models as Embedded Domain Specific Languages
- Many useful features

Safe language

- Automatic garbage collection
- Automatic bound checks
- No pointer arithmetic
- Static type safety

Java interoperability

- Compiled to Java bytecode
- Can use existing Java libraries
- Good interaction with Java's rich ecosystem
- Chosen by some Java-compatible frameworks

Executing Scala

Running with SBT

```scala
object SquareOf5 extends App {
  def square(x: Int): Int = x * x
  val s = square(5)
  println(s"Result:␣$s")
}
```

Call stack vs. object heap

where are values stored?

Concurrent threads:

do not share the call stack,

share the object heap,

Running with SBT

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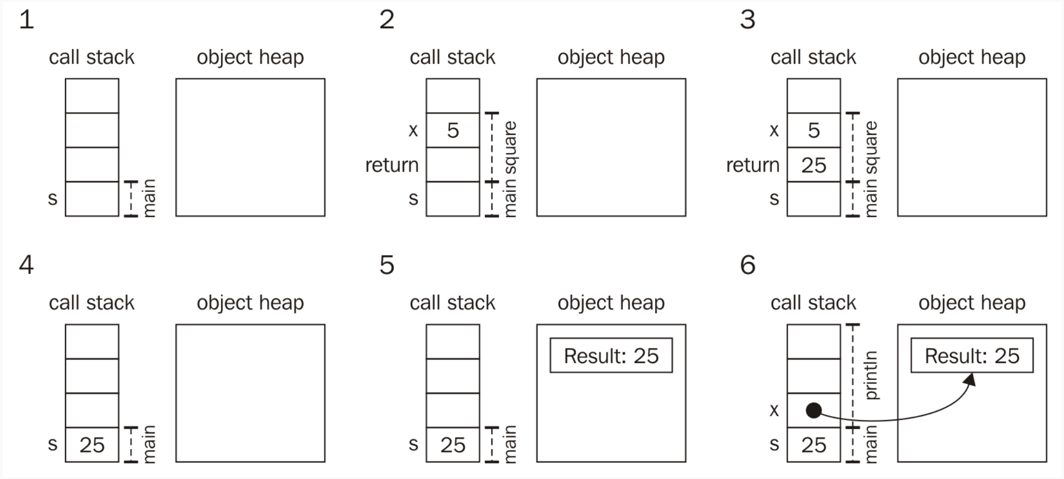
Local: SBT (practical lessons)

Online: `https://scastie.scala-lang.org/cIf3BCTQRBybqMcQpYArGA`

Stack and Heap



[in *"Learning Concurrent Programming in Scala"*, pg. 19]

Scala in a nutshell

Creating a Printer class

```scala
class Printer(val greeting: String) {
  def printMessage(): Unit =
      println(greeting + "!")
  def printNumber(x: Int): Unit = {
    println("Number:␣" + x)
  }
}
```

One `greeting` parameter

Two methods

Creating a Printer class

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  def printNumber(x: Int): Unit = {
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  }
}
```

Using the class

```scala
val printy = new Printer("Hi")
          // instantiate
printy.printMessage() // ?
printy.printNumber(5) // ?
```

Singleton objects

```
object Test {
  val Pi = 3.14
}
```

Using the object

```
val x = Test.Pi * 5 * 5
    // no need to instantiate
```

Traits (similar to Java Interfaces)

```scala
trait Logging {
  def log(s: String): Unit // just declared
  def warn(s: String) = log("WARN:␣" + s)
  def error(s: String) = log("ERROR:␣" + s)
}
class PrintLogging extends Logging {
  def log(s: String) = println(s)
}
```

Using traits

```scala
val x = new PrintLogging
val y = new Logging {
  def log(s:String): Unit =
    println(s)
}
```

Type parameters

```
class Pair[A,B](val fst: A, val snd: B)
```

Using Pair

```
val x: Pair[Int,String] = new
    Pair(4,"a")
val y = new Pair(2,5) // infer
    type
```

Lambdas (anonymous functions)

```
val twice_a: Int=>Int = (x:Int) => x*2
val twice_b = (x:Int) => x*2
val twice_c: Int=>Int = x => x*2
val twice_d: Int=>Int = _ * 2
```

Using lambdas

```
val x = twice_a(4)
```

Byname parameters (lazy)

```scala
def runTwice(body: =>Unit) = {
  body
  body
}
```

Using Byname

```scala
runTwice { // prints "Hello" twice
  println("Hello")
}
```

"for" expressions and comprehension

```
for (i <- 0 until 10) println(i)
// equivalent to
0.until(10).foreach(i => println(i))

val negatives_a =
  for (i <- 0 until 10) yield -i
val negatives_b =
  (0 until 10).map(i => -1 * i)
```

"for" expressions and comprehension

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val negatives_b =
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```

```
val pairs_a =
  for (x <- 0 until 4;
       y <- 0 until 4) yield (x, y)
val pairs_b =
  (0 until 4).flatMap(x =>
    (0 until 4).map(y =>
      (x, y)))
```

Scala collections and string interpolation

Common collections:

`Seq[T]`, `List[T]`, `Set[T]`, `Map[K,V]`

```
val msgs_a: Seq[String] =
    Seq("Hello", "world!")
val msgs_b: List[String]=
    "Hello"::"World"::Nil
val msgs_c: Set[String]=
    Set("Hello", "world!")
val msgs_d: Map[String,Int]=
    Map("Hello"->5, "world!"->6)
```

String interpolation:

```
val number = 7
val msg =
  s"After␣$number␣comes␣${number+1}!"
```

Pattern matching

```scala
val successors =
  Map(1 -> 2, 2 -> 3, 3 -> 4)
successors.get(5) match {
  case Some(n) =>
    println(s"Successor␣is:␣$n")
  case None    =>
    println("Could␣not␣find␣successor.")
}
```

```scala
trait IntOrError
case class MyInt(i:Int)
    extends IntOrError
case class MyError(e:String)
    extends IntOrError

//...
def show(ie: IntOrError)
  ie match {
    case MyInt(i)   =>
        println(s"Number:␣$i")
    case MyError(e) =>
        println(s"Error:␣$e")
  }
}
```

Try-catch

```
trait IntOrError
case class MyInt(i:Int)       extends
    IntOrError
case class MyError(e:String) extends
    IntOrError

//...
def getInt(ie: IntOrError)
  ie match {
    case MyInt(i)   => i
    //case MyError(e) => ???
    // (match error if an error is found)
  }
}
```

```
def showInt(ie:IntOrError) =
  try {
    println(s"Int␣value:␣$
        {getInt(i)}")
  } catch {
    case _: Throwable =>
        println("Got␣some␣error␣
        -␣probably␣not␣an␣int.")
  } finally {
    // always executes
    // (for side-effects, not to
        return results)
    println("Done␣showing")
  }
```

Operator overloading

```scala
class Position(val x: Int, val y: Int) {
  def +(that: Position) =
    new Position(x + that.x, y + that.y)
  def *(n: Int) =
    new Position(x * n, y * n)
}
```

Using operators

```scala
val p1 = new Position(3,4)
val p2 = p1 + p1 * 2 //?
```

Package objects

File
src/main/scala/cp/lablessons/package.scala

```
package cp

package object lablessons {
  def log(msg: String): Unit =
    println(
      s"${Thread.currentThread.getName}:␣$msg"
    )
}
```

The `log` function is used throughout these lessons

Requires starting with
`package cp.lablessons`

Wrap up

- Stack and Heap
- Singleton objects
- Traits (similar to Java Interfaces)
- Type parameters
- Lambdas (anonymous functions)
- Byname parameters (lazy)
- “`for`” expressions
- “`for`” comprehension
- Scala collections and string interpolation
- Pattern matching
- Try-catch
- Operator overloading
- Package objects