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Stairway to Scala - Flight 5

Functions and closures

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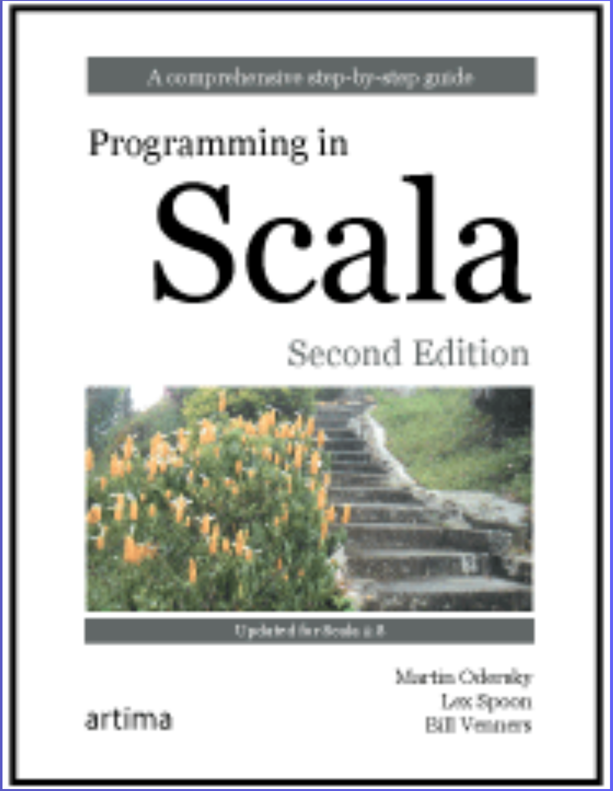

Flight 5 goal

Familiarize you with scala closures, and functions as first class citizens. (chapter 8)

Private methods

- Just like Java, Scala can have private methods

```
import scala.io.Source
object LongLines {
  def processFile(filename: String, width: Int) {
    val source = Source.fromFile(filename)
    for (line <- source.getLines)
      processLine(filename, width, line)
  }
  private def processLine(filename: String, width: Int,
        line: String) {
    if (line.length > width)
    println(filename +": "+ line.trim)
  }
}
```

Local functions

- But, with Scala there is another option:

```
def processFile(filename: String, width: Int) {
    def processLine(filename: String, width: Int, line: String) {
        if (line.length > width)
            print(filename +": "+ line)
    }
    val source = Source.fromFile(filename)
    for (line <- source.getLines) {
        processLine(filename, width, line)
    }
}
```

Local functions and scope

- But now, filename and width are in scope!

```
def processFile(filename: String, width: Int) {
    def processLine(line: String) {
        if (line.length > width)
            print(filename +": "+ line)
    }
    val source = Source.fromFile(filename)
    for (line <- source.getLines) {
        processLine(line)
    }
}
```

First class functions

- Why use method names at all? Function Literals:

```
(x: Int) => x + 1
```

- => indicates that this function converts the thing on the left: (x: Int) into the thing on the right: x + 1
- Function Values are compiled Function Literals (and are consequently objects in the runtime)
- You can store function values in variables:

```
scala> var increase = (x : Int) => x + 1
scala> increase(10)
res0: Int = 11
```

Can assign functions to variables

- For more than 1 statement per function literal, use { }

```
val increase = (x: Int) => {
    println("We ")
    println("are ")
    println("here!")
    x + 1
}
```

- The expression on the last line is what is evaluated and returned

Can pass functions as arguments to other functions

```
scala> val someNumbers = List(-5, 0, 5, 10)
someNumbers: List[Int] = List(-5, 0, 5, 10)
scala> someNumbers.foreach((x: Int) => println(x))
-5
0
5
10
```

- Functions that take other functions are called higher-order functions

Short forms of function literals

```
scala> someNumbers.filter((x: Int) => x > 0)
res6: List[Int] = List(5, 10)
```

- In this case, the type qualifier for x is redundant because the type of the someNumbers list is known, can omit it:

```
scala> someNumbers.filter((x) => x > 0)
res7: List[Int] = List(5, 10)
or
scala> someNumbers.filter(x => x > 0)
res8: List[Int] = List(5, 10)
```

Placeholder syntax

- If each param appears only one time in the function literal, you can use placeholder syntax:

```
scala> someNumbers.filter(_ > 0)
res9: List[Int] = List(5, 10)
```

- Specifying type information for placeholder syntax:

```
scala> val f = (_: Int) + (_: Int)
f: (Int, Int) => Int = <function>
scala> f(5, 10)
res11: Int = 15
```

Converting a method into a function value

```
scala> def sum(a: Int, b: Int, c: Int) = a + b + c
sum: (a: Int,b: Int,c: Int)Int

scala> sum(1, 2, 3)
res0: Int = 6

scala> val a = (a: Int, b: Int, c: Int) => sum(a, b, c)
a: (Int, Int, Int) => Int = <function3>

scala> a(1, 2, 3)
res1: Int = 6
```

Using underscore to represent an entire parameter list

```
scala> val b = sum(_, _, _)
b: (Int, Int, Int) => Int = <function3>

scala> b(1, 2, 3)
res2: Int = 6

scala> val c = sum _
c: (Int, Int, Int) => Int = <function3>

scala> c(1, 2, 3)
res3: Int = 6
```

Partially applied function

```
scala> val d = sum(1, _: Int, 3)
d: (Int) => Int = <function1>

scala> d(2)
res4: Int = 6
```

And if typing an underscore is too much

```
scala> val someNumbers = List(-11, -10, -5, 0, 5, 10)

scala> someNumbers.foreach(x => println(x))

scala> someNumbers.foreach(println _)

scala> someNumbers.foreach(println)

scala> someNumbers foreach println
```

Free variables and closures

```
  scala> (x: Int) => x + more
<console>:6: error: not found: value more
      (x: Int) => x + more
                  ^

scala> var more = 1
more: Int = 1

scala> val addMore = (x: Int) => x + more
addMore: (Int) => Int = <function1>

scala> addMore(10)
res1: Int = 11
```

Visibility of changes

```
scala> more = 9999
more: Int = 9999

scala> addMore(10)
res2: Int = 10009
```

What about parameters and local variables?

```
scala> def makeIncreaser(more: Int) = (x: Int) => x +
more
makeIncreaser: (more: Int)(Int) => Int

scala> val inc1 = makeIncreaser(1)
inc1: (Int) => Int = <function1>

scala> val inc9999 = makeIncreaser(9999)
inc9999: (Int) => Int = <function1>

scala> inc1(10)
res3: Int = 11

scala> inc9999(10)
res4: Int = 10009
```

Repeated parameters (varargs)

```
scala> def echo(args: String*) =
     |   for (arg <- args) println(arg)
echo: (args: String*)Unit

scala> echo()

scala> echo("hi")
hi

scala> echo("hi", "there")
hi
there
```

Argument expansion

```
scala> val arr = Array("hi", "there", "grandma")
arr: Array[java.lang.String] = Array(hi, there, grandma)

scala> echo(arr)
<console>:8: error: type mismatch;
 found   : Array[java.lang.String]
 required: String
       echo(arr)
            ^

scala> echo(arr: _*)
hi
there
grandma
```

Named arguments

```
scala> def speed(distance: Float, time: Float): Float =
     |   distance / time

scala> speed(100, 10)

scala> speed(distance=100, time=10)

scala> speed(time=10, distance=100)
```

Default parameter values

```
  def printTime(out: java.io.PrintStream = Console.out) =
    out.println("time = "+ System.currentTimeMillis())

  def printTime2(out: java.io.PrintStream = Console.out,
                 divisor: Int = 1) =
    out.println("time = "+ System.currentTimeMillis()/divisor)

printTime2(out=Console.err)

printTime2(divisor=1000)
```

Tail recursion

```
def approximate(guess: Double): Double =
  if (isGoodEnough(guess)) guess
  else approximate(improve(guess))

def approximateLoop(initialGuess: Double): Double = {
  var guess = initialGuess
  while (!isGoodEnough(guess))
    guess = improve(guess)
  guess
}
```