# Exercises: Introduction to Scala

**DCC-FCUP, University of Porto**
**José Proença**
**Concurrent Programming – Part 2**

---

These exercises are taken mainly from the book "*Learning Concurrent Programming in Scala*", and are designed to test the knowledge of the Scala programming language. You should solve them by sketching out a pseudocode solution, rather than a complete Scala program.

**Exercise 1.** Set up your computer to compile and run Scala.

**1.1.** Install SBT – http://www.scala-sbt.org.

**1.2.** Open a Command Promp.

**1.3.** Create a folder for the project:
```
> mkdir cp2425
> cd cp2425
```

**1.4.** Create a source code directory for our exercises:
```
> mkdir -p src/main/scala/cp/lablessons/
```

**1.5.** Create the configuration file `build.sbt` below at the root of `cp2425` (empty lines are mandatory).

```
name := "CP2425"

version := "1.0"

scalaVersion := "2.12.18"
```

**1.6.** Make your hello-world program. Use your favourite editor `EDIT`.
```
> mkdir src/main/scala/cp/lablessons/lesson1
> EDIT src/main/scala/cp/lablessons/lesson1/HelloWorld.scala
```

```scala
package cp.lablessons.lesson1

object HelloWorld extends App {
  println("Hello,_world!")
}
```

**1.7.** Go back to the terminal and run SBT to start an interactive shell:
```
> sbt
```

**1.8.** Run your program:
```
sbt> run
```

> *Note:* *You can also compile,* ~*compile,* `console`*, and many other. For example, you can compile and run java from the command line:*
> `java -cp ~/.sbt/boot/scala-2.12.12/lib/scala-library.jar:target/scala-2.12/classes/`
> `cp.lablessons.lesson1.HelloWorld`
> *If multiple Apps exist, run a specific one with the command:*
> `sbt> runMain cp.lablessons.lesson1.HelloWorld`

**1.9.** Extend the `build.sbt` with dependencies that we may need during the semester.

```
resolvers ++= Seq(
  "Sonatype_OSS_Snapshots" at
    "https://oss.sonatype.org/content/repositories/snapshots",
  "Sonatype_OSS_Releases" at
    "https://oss.sonatype.org/content/repositories/releases",
  "Typesafe_Repository" at
    "https://repo.typesafe.com/typesafe/releases/"
)

libraryDependencies ++= Seq(
  "commons-io" % "commons-io" % "2.4"
  ,"com.typesafe.akka" %% "akka-actor" % "2.8.5"
  ,"com.typesafe.akka" %% "akka-remote" % "2.8.5"
)
)
```

If you are in the SBT shell and you modify the `build.sbt` you need to reload it:
sbt> reload

**Exercise 2.** Implement and test a `compose` method with the following signature:

```
def compose[A, B, C](g: B => C, f: A => B): A => C = ???
```

This method must return a function `h`, which is the composition of the functions `f` and `g`.

**Exercise 3.** Implement and test a `fuse` method with the following signature:

```
def fuse[A, B](a: Option[A], b: Option[B]): Option[(A, B)] = ???
```

The resulting `Option` object should contain a tuple of values from the Option objects `a` and `b`, given that both `a` and `b` are non-empty. Implement two variations: with for-comprehensions and with pattern matching.

**Exercise 4.** Implement and test a `check` method, which takes a set of values of type `T` and a function of type `T => Boolean`:

```
def check[T](xs: Seq[T])(pred: T => Boolean): Boolean = ???
```

The method must return true if and only if the `pred` function returns true for all the values in `xs` without throwing an exception. Use the `check` method as follows:

```
check(0 until 10)(40 / _ > 0)
```

> **Note:** The `check` method has a curried definition: instead of just one parameter list, it has two of them. Curried definitions allow a nicer syntax when calling the function, but are otherwise semantically equivalent to single-parameter list definitions.

**Exercise 5.** Modify the `Pair` class from the theoretical lessons so that it can be used in a pattern match. Implement a method `+(other:Pair): Pair` using pattern matching and test it.

**Exercise 6.** Implement and test a permutations function, which, given a string, returns a sequence of strings that are lexicographic permutations of the input string:

```
def permutations(x: String): Seq[String]
```

**Exercise 7.** Implement and test a combinations function that, given a sequence of elements, produces an iterator over all possible combinations of length n. A combination is a way of selecting elements from the collection so that every element is selected once, and the order of elements does not matter. For example, given a collection Seq(1,4,9,16), combinations of length 2 are Seq(1,4), Seq(1,9), Seq(1,16), Seq(4,9), Seq(4,16), and Seq(9,16). The combinations function has the following signature:

```
def combinations(n: Int, xs: Seq[Int]): Iterator[Seq[Int]]
```

See the Iterator API in the standard library documentation. (Suggestion: implement first a functional variation that returns Seq[Seq[Int]], without the iterator.)

**Exercise 8.** Implement and test a method that takes a regular expression, and returns a partial function from a string to lists of matches within that string:

```
def matcher(regex: String): PartialFunction[String,List[String]]
```

The partial function should not be defined if there are no matches within the argument strings. Otherwise, it should use the regular expression to output the list of matches.