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Scala Overview

Scala is the future:
- truly object-oriented
- functional
- powerful static type system
- runs on JVM, seamlessly interoperates with Java (mostly ...)

Today we’ll have a whirlwind tour of the Scala ecosystem and basics of Scala’s command-line tools.
To run Scala you need

- Java 6 or later – the more up to date the better – either from [OpenJDK](https://openjdk.java.net) or [Oracle](https://www.oracle.com).
- Scala
- SBT, the Scala Build Tool (technically SBT stands for Simple Build Tool, but it’s not simple, so I refuse to call it Simple Build Tool)

If you use Linux I recommend using your distro’s package manager. For Mac users, I recommend [Homebrew](https://brew.sh).
The Scala REPL

Like Python, invoking the scala runtime without arguments launches the REPL (Read-Eval-Print Loop):

```
$ scala
Welcome to Scala version 2.11.1 (Java HotSpot(TM) 64-Bit Server VM, Java 1.8.0_11).
Type in expressions to have them evaluated.
Type :help for more information.

scala>
```

REPLs are awesome, as you’ll see.
Values and Variables

Every value has a type which, when possible, is inferred in the absence of an explicit type annotation.

Types come after names, name: Type

vals are immutable, vars are reassignable
Functions

Every function has a value

```scala
def mean(nums: Double*) = nums.sum / nums.size
mean: (nums: Double*)Double

mean(100, 95)
res24: Double = 97.5
```

Note that:

- The function body is a single expression, so no need for curly braces (but legal to include them).
- Every function has a type, which includes its argument list and result type (Scala uses term "result" type instead of "return" type).
- The type of the function is `(nums: Double*) Double` which means "a function taking a variable number of Double parameters and returning a Double"
- The result type is inferred.
More on Functions

Every block is an expression whose value is the last value in the block.

```scala
scala> def normalize(s: String): String = {
|   val trimmed = s.trim()
|   val upper = trimmed.toUpperCase
|   upper
| }
normalize: (s: String)String

scala> normalize(" aBcd 
res18: String = ABCD
```

A function that returns nothing returns something, in particular the single instance of the `Unit` type (Scala’s equivalent of Java’s `void`).

```scala
scala> def shout(s: String) {
|   println(s.toUpperCase)
| }
shout: (s: String)Unit

scala> shout("hello")
HELLO
```

Note that the lack of a `=` in the function definition.
Classes and Objects

Take a moment to appreciate the boilerplate-free beauty here:

```scala
scala> class Person(val name: String)
defined class Person

scala> val bob = new Person("Bob")
bob: Person = Person@7c3c453b

scala> bob.name
res19: String = Bob

scala> class GtStud(name: String, val gtname: String) extends Person(name)
defined class GtStud

scala> val alice = new GtStud("Alice", "alice1")
alice: GtStud = GtStud@13908f9c

scala> alice.name
res22: String = Alice

scala> alice.gtname
res23: String = alice1
```
Scala code can be delivered as a program or a library.

- Two kinds of scala programs: scripts and applications
  - A Scala script is a file containing Scala code, the last line of which is an executable expression or statement
  - A Scala application is an object, defined with Scala’s `object` keyword, that has a method with the signature `def main(args: Array[String])` (name of parameter doesn’t have to be `args`, but has to be of type `Array[String]`)

- A library is a `.jar` file containing a tree of Scala classes
  - Technically, a `.jar` file contains a tree of JVM (Java Virtual Machine) bytecode classes that could be compiled from any source language, such as Java, Scala, Jython, Groovy, Clojure, etc.

To compile and run Scala code you need JRE 1.6 or higher (1.7 or 1.8 recommended).
Given a file `foo.scala` with the following content:

```scala
class Writer(val repetitions: Int = 1) {

    def say(text: String) {
        sayRepeatedly(text, repetitions)
    }
}

def sayRepeatedly(text: String, times: Int) {
    println(text*times)
}

val repetitions = if (args.length > 0) args(0).toInt else 1
val writer = new Writer(repetitions)
writer.say("foo.scala run as a Scala script.")
```

we can run it like this:

```
[chris@nijinsky ~/examples]
$ scala foo.scala
foo.scala run as a Scala script.
```
Add following lines to top of Scala script to turn into a Unix shell script:

```
#!/bin/sh
exec scala "$0" "$@"
```

and run it like this:

```
[chris@nijinsky ~/examples]
$ chmod +x foo.scala
[chris@nijinsky ~/examples]
$ ./foo.scala
foo.scala run as a Scala script.
```

On Windows you can achieve the same effect by giving your file a .bat extension and putting this at the top:

```
::#!
@echo off
call scala %0 %*
goto :eof
::!#`

(Chris Simpkins (Georgia Tech))

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Compiling Scala Code

Let’s try compiling our `foo.scala` file:

```
[chris@nijinsky ~/examples]
$ scalac foo.scala
foo.scala:8: error: expected class or object definition
def sayRepeatedly(text: String, times: Int) {
  ^
foo.scala:12: error: expected class or object definition
val repetitions = if (args.length > 0) args(0).toInt else 1
  ^
foo.scala:13: error: expected class or object definition
val writer = new Writer(repetitions)
  ^
foo.scala:14: error: expected class or object definition
writer.say("foo.scala run as a Scala script.")
  ^
four errors found
```

We have to remove the executable expressions and statements and move the function `sayRepeatedly` inside a class or object. Compiling is for class and object definitions.
Scala Applications

Here’s `foo2.scala`, which defines a Scala application that does the same thing as our script.

```scala
object Example {
  def main(args: Array[String]) {
    val repetitions = if (args.length > 0) args(0).toInt else 1
    val writer = new Writer(repetitions)
    writer.say("Example object run as a Scala application.")
  }
}

class Writer(val repetitions: Int = 1) {
  def sayRepeatedly(text: String, times: Int) {
    println(text*times)
  }
  def say(text: String) {
    sayRepeatedly(text, repetitions)
  }
}
```
Compiling and Running Scala Applications

Given our

```
[chris@nijinsky ~/examples]
$scalac foo2.scala
[chris@nijinsky ~/examples]
$ ls
Example$.class Example.class Writer$.class Writer.class
foo.scala foo2.scala
```

Now we can run this Scala application like this:

```
[chris@nijinsky ~/examples]
$ scala -cp . Example
Example object run as a Scala application.
```
The Scala Built tool, **SBT**, is a very powerful build system. Invoke it in interactive mode with `sbt`. Here are a few useful commands:

```
$ sbt
> help        # Describe commands.
> tasks       # Show the most commonly-used, available tasks.
> tasks -V    # Show ALL the available tasks.
> compile     # Incrementally compile the code.
> test         # Incrementally compile the code and run the tests.
> clean        # Delete all build artifacts.
> ~test        # Run incr. compiles and tests whenever files are saved.
# This works for any command prefixed by "~".
> console      # Start the Scala REPL with project classes loaded
> run          # Run one of the "main" routines in the project.
> show x       # Show the definition of variable "x".
> eclipse      # Generate Eclipse project files.
> gen-idea     # Generate IntelliJ IDEA project files.
> exit         # Quit the REPL (also control-d works).
```
The simplest way to define a build in SBT is with a `build.sbt` in the project’s root directory, which typically looks something like this:

```scala
name := "afabl"

version := "0.3"

scalaVersion := "2.11.1"

libraryDependencies += "org.scalatest" % "scalatest_2.10" % "2.1.0" % "test"
```

- SBT assumes the Maven **standard directory layout**; can configure different layout, but shouldn’t
- Note the blank lines between each line in `build.sbt`; those are necessary
- SBT uses **Ivy** for dependency management, which uses Maven’s repository system; you can use any Java library in any accessible Maven repo
Editor and IDE Support for Scala

All three major Java IDEs (IntelliJ, Ecliplise, and NetBeans) have Scala plugins, but Eclipse and IntelliJ are far more popular. Plugins support all the usual things:

- compile-as-you-go with error highlighting
- autocompletion
- finding symbols, definitions, etc.
- refactoring (probably the most compelling feature of IDEs)

plus a unique feature for Scala: worksheets ([Eclipse](https://www.eclipse.org), [IntelliJ](https://www.intellijs.com)).

From an SBT project you can create an Eclipse or IntelliJ project with

```
sbt eclipse
```

or

```
sbt gen-idea
```

and re-run whenever you change the SBT build definition.
Where to Go from Here

Lots more to learn. I recommend using one or both of the first two of these books for self study:

- **Programming in Scala, 2ed** - "the" Scala book, written by Martin himself (and GT PhD grad Lex Spoon). Focuses on language (no discussion of tools like SBT) and is a bit outdated (written for Scala 2.8 so, e.g., covers old Actors library instead of now standard Akka), but is an excellent book.

- **Programming Scala, 2ed** by Wampler and Payne. Pre-publish release as an ebook. If you only get one Scala book, get this one. Covers the language and tools, such as SBT.

- **Learning Scala** by Schwartz. A gentle introduction. Also an early release ebook. I’m am deferring judgment on its quality.

- **Scala Cookbook** by Alexander. Your standard O’Reilly cookbook, with much more tutorial-style coverage of tools and tasks like web services and database access, as well as common general programming tasks.