Scala Ecosystem

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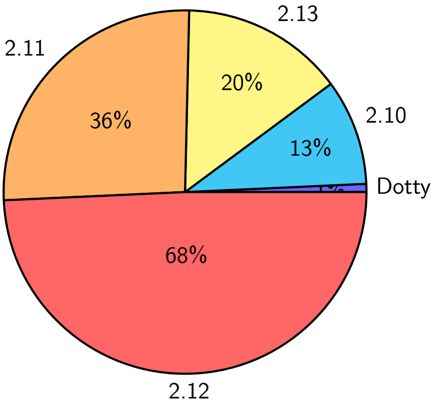
Overview

as of Apr 2020

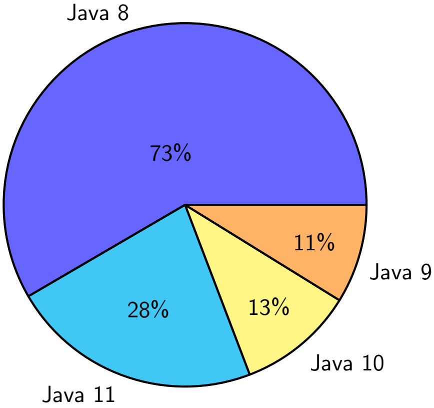
Scala versions

Which versions of Scala do you regularly use?



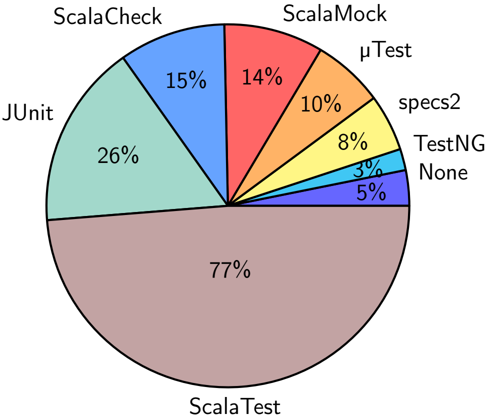
JVM Platform

Which versions of Java do you regularly use?



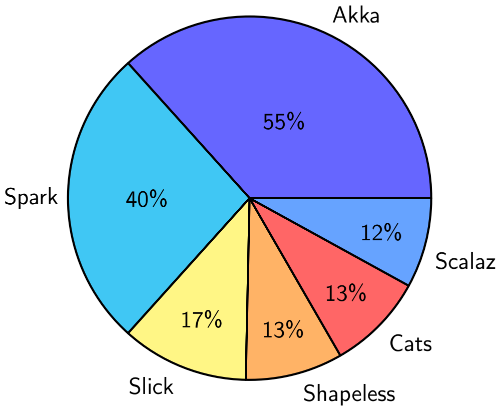
Testing

Which unit-testing frameworks do you regularly use?



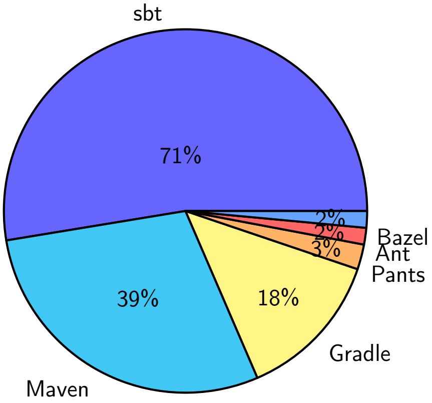
Most Popular Libraries

Which frameworks / libraries do you regularly use?



Build System

Which build systems do you regularly use?



SBT

What is a build system?

Build system is a tool to help automate development processess such as compilation of source coude, running tests and deploying the resulting application.

Real world projects

- $n * 10^5 - n * 10^6 LOC$
- 10-1000 developers on the same codebase
- $n * 10^5$ tests
- 10-100 steps to build the final application

The problem

Given: n source files

Basic tasks:

- compile sources to class files
- find classes that are tests and run? them
- run the application from classes

Build tool interface

- command line: `sbt ;compile;test;`, `mvn install`, `make -j8`
- configuration: Makefile, build.sbt, pom.xml
- remote API: gradle-daemon, sbt-server, BSP

sbt

simple build tool

- build files are defined in Scala
- incremental compilation
- test framork integrations
- build jar artifacts and publish them
- . . .

Project structure

```
build.sbt
src/
  main/
    resources/ <files to include in main jar here>
    scala/     <main Scala sources>
    java/      <main Java sources>
  test/
    scala/     <test Scala sources>
    java/      <test Java sources>
target/        <build results>
```

SBT command line basics

- run sbt in your project directory with no arguments:

```
$ sbt
```

- specify tasks to run:

```
$ sbt clean compile "testOnly TestA TestB"
```

- common commands:
  - reload — Reloads the build definition
  - clean — Deletes all generated files (in the target directory)
  - compile — Compiles the main sources
  - test — Compiles and runs all tests
  - console — run interpreter with a classpath including the compiled sources and all dependencies

Build defiinition

The build definition is described in `build.sbt` (actually any files named *.sbt) in the project's base directory. SBT build definitions consists of:

- a set of subproject definitions

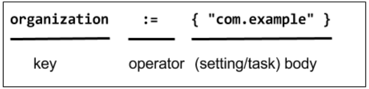
```scala
lazy val root = (project in file(".")).settings(
    name := "Hello",
    scalaVersion := "2.12.7")
```

- setting expressions

```scala
ThisBuild / organization := "com.example"
ThisBuild / scalaVersion := "2.12.10"
ThisBuild / version      := "0.1.0-SNAPSHOT"
```

SBT Settings

Settings are a sequence of key-value pairs generated by setting operators.



```
organization  :=  { "com.example" }
```

setting/task expression

- 3 kinds of keys:
  - `SettingKey[T]` — a key for a value computed once
  - `TaskKey[T]` — a key for a value, called a task, that has to be recomputed each time, potentially with side effects
  - `InputKey[T]` — a key for a task that has command line arguments as input

Key initialization operators

- := — initialize key discarding prevoius value
- += — append single element to prevoius value
- ++= — append a collection to prevoius value

SBT Task Graph

Rather than thinking of settings as key-value pairs, a better analogy would be to think of it as a directed acyclic graph (DAG) of tasks where the edges denote happens-before. Let's call this the task graph.

- depend on other values by using `.value method`
- setting keys cannot depend on tasks
- show key dependencies with `inspect` task

SBT Task Graph

```
scalacOptions := {
  val ur = update.value  // update task happens-before scalacOptions
  val x = clean.value    // clean task happens-before scalacOptions
  // ---- scalacOptions begins here ----
  ur.allConfigurations.take(3)
}
```

Scopes

Previously we pretended that a key like name corresponded to one entry in sbt's map of key-value pairs. This was a simplification. In truth, each key can have an associated value in more than one context, called a scope

- a key can have a different value in each project
- compile key has a different value for main and test sources
- a global key can be "overridden"in a project

```
projA / Compile / console / scalacOptions
```

Scope Axis

- subproject axis
- configuration axis
- task axis

Subprojects

A project is defined by declaring a lazy val of type Project. For example, :

```
lazy val core = (project in file("core"))
  .settings(
    // other settings
  )

lazy val util = (project in file("util"))
  .settings(
    // other settings
  ).dependsOn(core)
```

Aggregation and Dependencies

Aggregation

Aggregation means that running a task on the aggregate project will also run it on the aggregated projects

```
lazy val root = (project in file(".")).aggregate(util, core)

lazy val util = (project in file("util"))
lazy val core = (project in file("core"))
```

Aggregation and Dependencies

Aggregation

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```
lazy val root = (project in file(".")).aggregate(util, core)

lazy val util = (project in file("util"))
lazy val core = (project in file("core"))
```

Classpath dependencies

A project may depend on code in another project. This is done by adding a dependsOn method call

Classpath dependencies

```
lazy val util = (project in file("util"))

lazy val core = (project in file("core"))
  .dependsOn(util)

lazy val app = (project in file("app"))
  .dependsOn(core % "test->test;compile->compile")
```

Configurations

- `Compile` which defines the main build (src/main/scala).
- `Test` which defines how to build tests (src/test/scala).
- `Runtime` which defines the classpath for the run task.

Referring to scopes

Key scoping is done using the "/"operator:

```
organization := name.value
Compile / name := "hello"
packageBin / name := "hello"
Compile / packageBin / name := "hello"
```

Library dependencies

Unmanaged dependencies

Jar files that are assumed to already exist in the filesystem

```
unmanagedBase := baseDirectory.value / "custom_lib_folder"
unmanagedJars += baseDirectory.value / "myLib.jar"
```

Library dependencies

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Jar files that are assumed to already exist in the filesystem

```
unmanagedBase := baseDirectory.value / "custom_lib_folder"
unmanagedJars += baseDirectory.value / "myLib.jar"
```

Managed dependencies

Dependencies that are managed by some dependendency management programs such as Coursier or Apache Ivy

```
// libraryDependencies += groupID % artifactID % revision % configuration
libraryDependencies += "org.apache.derby" % "derby" % "10.4.1.3"
```

Managed dependencies

- `libraryDependencies` is a pre-defined key in `sbt.Keys`:

```
libraryDependencies = settingKey[Seq[ModuleID]]("Declares managed dependencies.")
```

- % is an extension method of `String` thar creates a `ModuleID`
- %% inserts binary Scala version suffix into the artifact id:

```
libraryDependencies += "org.scala-tools" % "scala-stm_2.11" % "0.3"
libraryDependencies += "org.scala-tools" %% "scala-stm" % "0.3"
```

- use 3rd % operator to provide scope:

```
libraryDependencies += "org.apache.derby" % "derby" % "10.4.1.3" % "test"
libraryDependencies += "org.apache.derby" % "derby" % "10.4.1.3" % Test
```

Extended build structure

sbt is recursive

The `project` directory is another build inside your build, which knows how to build your build

```
hello/                     # your build's root project's base directory
    Hello.scala         # a source file in your build's root project
    build.sbt              # build.sbt is part of the source code for
                           #   meta-build's root project inside project/;
                           #   the build definition for your build
    project/            # base directory of meta-build's root project
        build.sbt          # this is part of the source code for
                           #   meta-meta-build's root project in project/project;
                           #   build definition's build definition
        project/        # base directory of meta-meta-build's root project;
                        #   the build definition project for the build definition
            MetaDeps.scala # source file in the root project of
                           #   meta-meta-build in project/project/
```

Tracking dependencies in one place

One way of using the fact that .scala files under project is a part of the build is to create `project/Dependencies.scala` to track dependencies in one place.

```scala
object Dependencies {
  lazy val akkaVersion = "2.3.8"
  // Libraries
  val akkaActor = "com.typesafe.akka" %% "akka-actor" % akkaVersion
  val specs2core = "org.specs2" %% "specs2-core" % "2.4.17"
  // Projects
  val backendDeps =
    Seq(akkaActor, specs2core % Test)
}
```

Tracking dependencies in one place

build.sbt

```scala
import Dependencies._

ThisBuild / organization := "com.example"
ThisBuild / version      := "0.1.0-SNAPSHOT"
ThisBuild / scalaVersion := "2.12.10"

lazy val backend = (project in file("backend"))
  .settings(
    name := "backend",
    libraryDependencies ++= backendDeps
  )
```

SBT plugins

Prts of a build definition can be loaded from classes and jars — thus creating plugins

- plugins are added with `addSbtPlugin(...)`:

  ```
  addSbtPlugin("com.eed3si9n" % "sbt-assembly" % "0.11.2")
  ```

- since plugin runs inside the build itself, it has to be added by the meta-build

  e.g. into `project/plugins.sbt`

- some plugins are not enabled automatically:

```
lazy val util = (project in file("util"))
  .enablePlugins(FooPlugin, BarPlugin)
  .settings(
    name := "hello-util"
  )
```