Introduction to Bazel

{ Fast, Correct } — Choose two

https://bazel.build/

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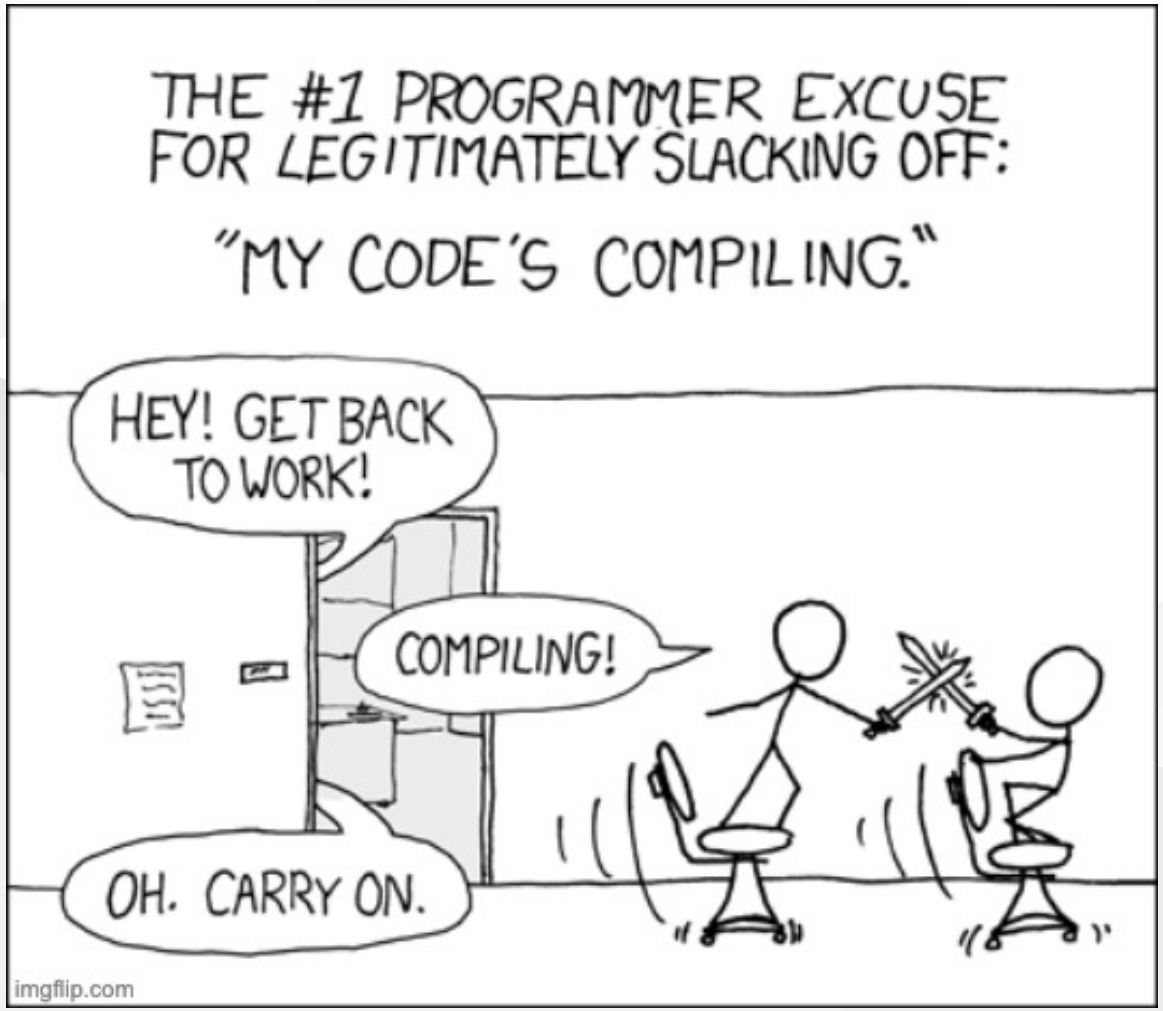
Agenda

- Reminder of the "problem"
- Bazel Concept
- Bazel and Scala tutorial



Reminder of the Problem

- Building large applicaton is slow
- Building slowly is expensive

Options to alleviate the problem

- Optimize Scala compilation (maybe using scalac-profiling)
- Optimize sbt build
  - -Dsbt.traces=true
  - Custom configuration
- Split to multi-repo
- Compile Scala Faster with Hydra - Triplequote

Still, build time increase as project grows

Bazel for rescue!

Build system developed by Google

- Artifact based build system
  - ↔️ Task based build system (make, ant, sbt...)
- {Fast, Correct} Choose two
  - ➡️ Scalable even in Google scale

{Task, Artifact}-based build system

- **Task based build system**
  - **Imperative** set of tasks (imagine Makefile).
  - You can do pretty much anything.
- **Artifact based build system**
  - **Declative** set of artifacts to build, deps, and limited options
  - Only build, test, and run.

[Software Engineering at Google | chapter 18]

{Fast, Correct} choose two ✌️

Hermeticity

> When given the same input source code and product configuration, a hermetic build system always returns the same output by isolating the build from changes to the host system.

➡️ **Correct** ➡️ reliable remote build cache ➡️ **Fast**

Dark side of Bazel

- Poor IDE support (it's getting better though...)
- More build settings
- Explicit dependency management
- Less flexibility

Is Bazel a right path?

Not sure, yet! Bazel is not the only option

- Split to multi-repo
- Stick with sbt and micro-optimize build
- Compile Scala Faster with Hydra - Triplequote
- **Or, Scale with Bazel**

When to use Bazel? - Earthly Blog

All team members MUST learn Bazel

More build configurations (than sbt)

➡️ everyone have more opportunity to write build settings

➡️ All developers MUST learn Bazel!

Otherwise...

> “ New team mebers didn't learn Bazel ... most of the members could not write Bazel-related code and they just use what there is. ”

(Japanese blog) Say goodbye to Bazel and start using make

Questions so far?

Bazel Tutorial for Scala

What you'll learn

- The essential building blocks of Bazel
  - What the Bazel project looks like
  - What inside `WORKSPACE` and `BUILD` files
  - What is `Label` in Bazel
- How to build jar from Scala fiels using `rules_scala`

tanishiking/bazel-tutorial-scala

Install Bazel

Use Bazelisk! It checks `.bazelversion` and download Bazel executable.

[bazelbuild/bazelisk: A user-friendly launcher for Bazel.]

> Install it as the bazel binary in your PATH (e.g. copy it to /usr/local/bin/bazel). Never worry about upgrading Bazel to the latest version again

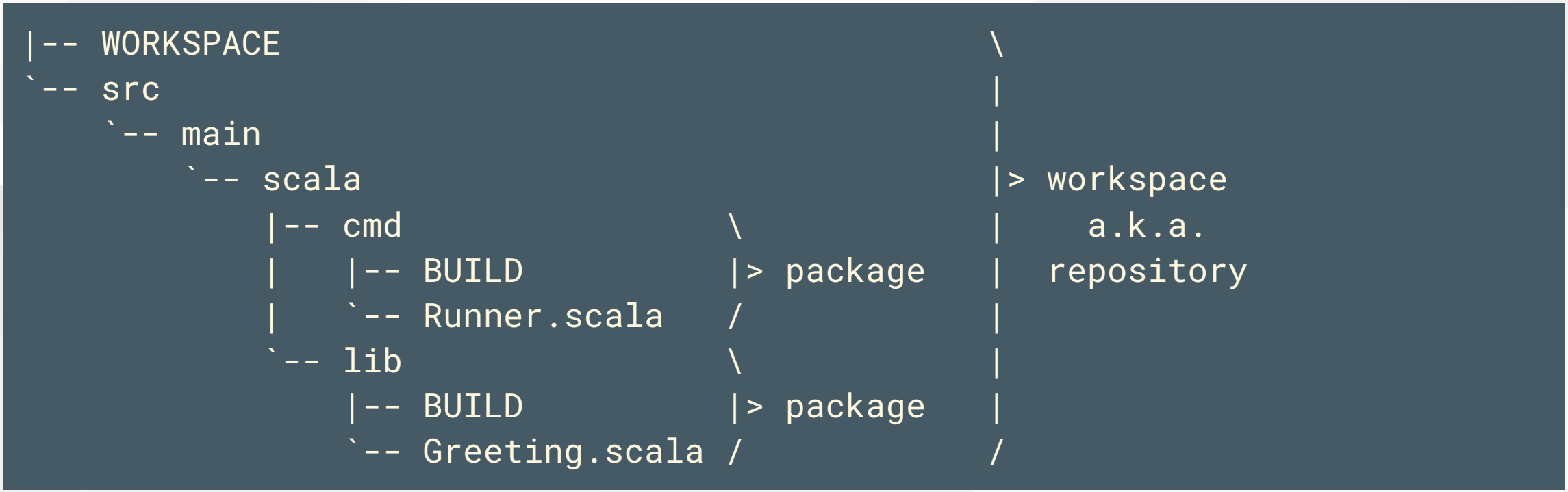
```
alias bazel="bazelisk" # I personally do
```

bazel-tutorial-scala/01_scala_tutorial

```
|-- WORKSPACE
`-- src
    `-- main
        `-- scala
            |-- cmd
            |   |-- BUILD
            |   `-- Runner.scala
            `-- lib
                |-- BUILD
                `-- Greeting.scala
```

- `WORKSPACE` file is about getting stuff from the outside world into your Bazel project. Located at the project root.
- `BUILD` files are about what happening inside of your Bazel project

Terminology



- The whole directory to build with Bazel is called `workspace`
- A `package` is a collection of related files and a `BUILD` file

Understand `WORKSPACE`

```
load("@bazel_tools//tools/build_defs/repo:http.bzl", "http_archive")
# ...
http_archive(
    name = "io_bazel_rules_scala",
    sha256 = "77a3b9308a8780fff3f10cdbbe36d55164b85a48123033f5e970fdae262e8eb2",
    strip_prefix = "rules_scala-20220201",
    type = "zip",
    url = "https://github.com/bazelbuild/rules_scala/releases/download/20220201/rules_scala-20220201.zip",
)
```

https://github.com/tanishiking/bazel-tutorial-scala/blob/main/01_scala_tutorial/WORKSPACE

Basically, just copy and pasted from bazelbuild/rules_scala

Scala files

```
// cat src/main/scala/lib/Greeting.scala
package lib
object Greeting { def sayHi = println("Hi!") }
```

```
// cat src/main/scala/cmd/Runner.scala
package cmd
import lib.Greeting
object Runner { def main(args: Array[String]) = { Greeting.sayHi } }
```

- `lib/Greeting.scala` is a library moduel that provides `lib.Greeting`.
- `cmd/Runner.scala` depends on `lib.Greeting`.

Understand `BUILD` file for `lib`

```
# cat src/main/scala/lib/BUILD
load("@io_bazel_rules_scala//scala:scala.bzl", "scala_library")

scala_library(
    name = "greeting",
    srcs = ["Greeting.scala"],
)
```

- `scala_library` is called `rule` in Bazel that describes what to build
- An instance of `rule` is called `target`.

document: rules_scala/scala_library.md

Let's build!

`bazel build <targets>`

```
❯ bazel build //src/main/scala/lib:greeting
...
Target //src/main/scala/lib:greeting up-to-date:
  bazel-bin/src/main/scala/lib/greeting.jar
```

Wait, what `//src/main/scala/lib:greeting` means!?

Label

Label uniquely identifies a `target`. Canonical form of label looks like

@myrepo//my/app/main:app_binary

- **@myrepo//** - repository name defined in `WORKSPACE`, we can omit `@myrepo` and `//` to refer same repository.
- **my/app/main** - path to the package relative to repository root.
- **:app_binary** - target name

Labels | Bazel

Label

```
❯ bazel build //src/main/scala/lib:greeting
...
Target //src/main/scala/lib:greeting up-to-date:
  bazel-bin/src/main/scala/lib/greeting.jar
```

//src/main/scala/lib:greeting

- **//** - (abbreviated) repo name
- **src/main/scala/lib** - path to `BUILD` file (from workspace root)
- **:greeting** - target name to build

Depends on `lib` target!

```
# cat src/main/scala/cmd/BUILD
load("@io_bazel_rules_scala//scala:scala.bzl", "scala_binary")
scala_binary(
    name = "runner", main_class = "cmd.Runner",
    srcs = ["Runner.scala"],
    deps = ["//src/main/scala/lib:greeting"],
)
```

scala_binary rule generate a jar file, and shell script to run the jar

Enumerate all dependent targets in `deps` attr

Dependencies | Bazel

Build the binary!

Oops build failed

```
❯ bazel build //src/main/scala/cmd:runner

ERROR: .../01_scala_tutorial/src/main/scala/cmd/BUILD:3:13:
in scala_binary rule //src/main/scala/cmd:runner:
target '//src/main/scala/lib:greeting' is not visible from
target '//src/main/scala/cmd:runner'.
```

By default, all targetss' visibility is `private`, targets in the same packages can access them.

Make `lib` visible from `cmd` package

```
 scala_library(
     name = "greeting",
     srcs = ["Greeting.scala"],
+    visibility = ["//src/main/scala/cmd:__pkg__"],
 )
```

visibility controll access grants to packages

- `//src/main/scala/cmd:__pkg__` grants access to the package `//src/main/scala/cmd`
- `"//visibility:public"` grants access to all packages

Build the binary! (again)

```
❯ bazel build //src/main/scala/cmd:runner
...
INFO: Found 1 target...
Target //src/main/scala/cmd:runner up-to-date:
  bazel-bin/src/main/scala/cmd/runner.jar
  bazel-bin/src/main/scala/cmd/runner
```

```
❯ ./bazel-bin/src/main/scala/cmd/runner
Hi!
```

Tips: Wildcard

Usually build all targets by `$ bazel build //...`

- `//...` All targets in packages in the workspace.
- `//foo/...` All rule targets in all packages beneath the directory foo

Building multiple targets

Tips: bazel query

bazel query is useful to find target

```
❯ bazel query //... | grep lib
//src/main/scala/lib:greeting
```

- `bazel query //...` to list all targets in the repo
- `bazel query //... --output=location` to show the location of target definitions
- `bazel query "rdeps(//..., //src/main/scala/lib:greeting)"`
  - reverse deps of `:greeting` from `//...`

Tutorial for `rules_jvm_external`

What you'll learn

- How to download external dependencies from maven repositories.
- How to depend on downloaded packages

https://github.com/tanishiking/bazel-tutorial-scala/blob/main/02_scala_maven

rules_jvm_external

bazelbuild/rules_jvm_external is a popular ruleset to resolve and download JVM dependencies.

Download `rules_jvm_external` in `WORKSPACE` as always

```
RULES_JVM_EXTERNAL_TAG = "2.5"
RULES_JVM_EXTERNAL_SHA = "249e8129914be6d987ca57754516be35a14ea866c616041ff0cd32ea94d2f3a1"
http_archive(
    name = "rules_jvm_external",
    sha256 = RULES_JVM_EXTERNAL_SHA,
    strip_prefix = "rules_jvm_external-%s" % RULES_JVM_EXTERNAL_TAG,
    url = "https://github.com/bazelbuild/rules_jvm_external/archive/%s.zip" % RULES_JVM_EXTERNAL_TAG,
)
```

Download JVM deps

```
# WORKSPACE
load("@rules_jvm_external//:defs.bzl", "maven_install")
maven_install(
    artifacts = [
        "org.scalameta:scalameta_2.13:4.5.13",
        "com.lihaoyi:pprint_2.13:0.7.3",
    ],
    repositories = [
        "https://repo1.maven.org/maven2",
    ],
)
```

Use downloaded libraries

```
# cat src/main/scala/example/BUILD
scala_binary(
# ...
    deps = [
        "@maven//:com_lihaoyi_pprint_2_13",
        "@maven//:org_scalameta_scalameta_2_13",
    ],
)
```

“ The default label syntax for an artifact `foo.bar:baz-qux:1.2.3` is `@maven//:foo_bar_baz_qux` https://github.com/bazelbuild/rules_jvm_external#usage ”

Build it!

```
❯ bazel build //src/main/scala/example:app
Target //src/main/scala/example:app up-to-date:
  bazel-bin/src/main/scala/example/app.jar
  bazel-bin/src/main/scala/example/app

❯ bazel-bin/src/main/scala/example/app "object main { println(1) }"
Source(
  stats = List(
    Defn.Object(
      ...
```

Tips: find library's label

bazel query again!

Enumerate all targets under `@maven` repo, and grep `pprint`

```
❯ bazel query @maven//... | grep pprint
@maven//:com_lihaoyi_pprint_2_13
@maven//:com_lihaoyi_pprint_2_13_0_7_3
```

Now you learnt all Bazel basics 🎉

Wanna learn more?

- Bazel getting started
  - Recommend to skim through **Java tutorial** and **Build concepts**
- bazelbuild/rules_scala
- bazelbuild/rules_jvm_external
- tanishiking/bazel-playground
  - You can find my Bazel example projects 😄
- Software Engineering at Google, chapter 18
  - To learn the philosophy of Bazel

Topics I didn't cover

- Target granularity and trade-offs
  - read How to choose the right build unit granularity | by Natan Silnitsky | Wix Engineering | Medium
- Bazel devtools (attached some links in the following slide)
- Remote Caching
- Remote Execution

Interesting Bazel talks and articles

- Awesome Bazel | awesome-bazel
- How to successfully migrate to Bazel from Maven or Gradle. (Natan Silnitsky, Israel - Youtube
- When to use Bazel? - Earthly Blog
- How to choose the right build unit granularity | Medium
- A Bable in Bazel Blog posts about Bazel internal

Bazel dev tools

- IntelliJ with Bazel
  - Bazel IDE for IntelliJ, developed by Jetbrains + Bazel team
- Bazel - Visual Studio Marketplace
  - Syntax highlight + format + lint
- bazel-stack-vscode - Visual Studio Marketplace
  - Experimental IDE for VSCode
- JetBrains/bazel-bsp required for Scala IDE work with Bazel
- buildtools/buildifier Bazel formatter and linter
- Gazelle Bazel build file generator, Scala is not yet supported

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