Build Systems

CSE 403, Spring 2018

What does a developer do?

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- Install dependencies
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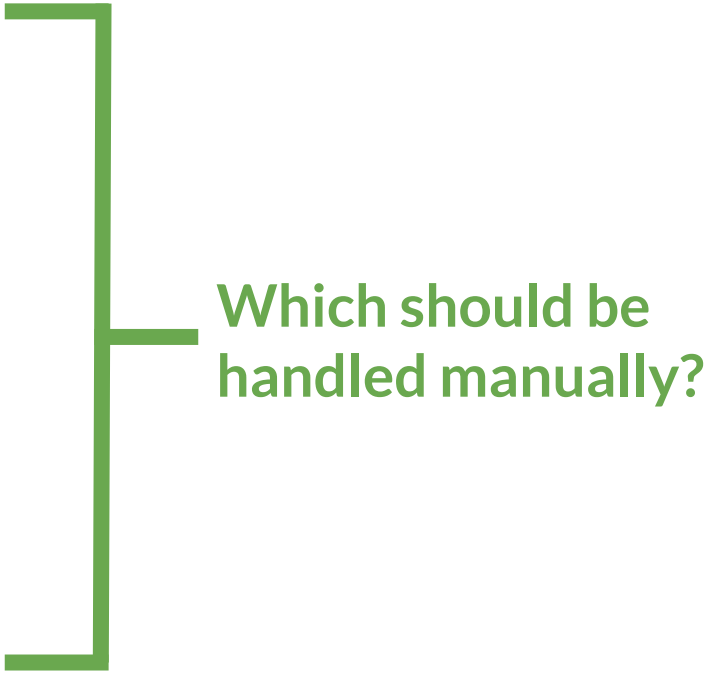

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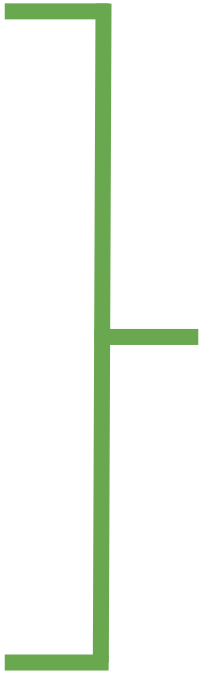

Which should be handled manually?

NONE!

What to do instead?

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Automate with a build system!

What is a build system?

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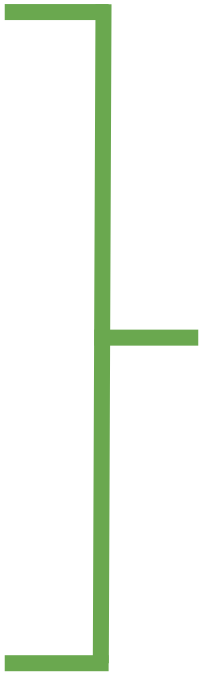

A good build system handles all these

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All tasks!

Tasks

Tasks are code!

Tasks

Tasks are code!

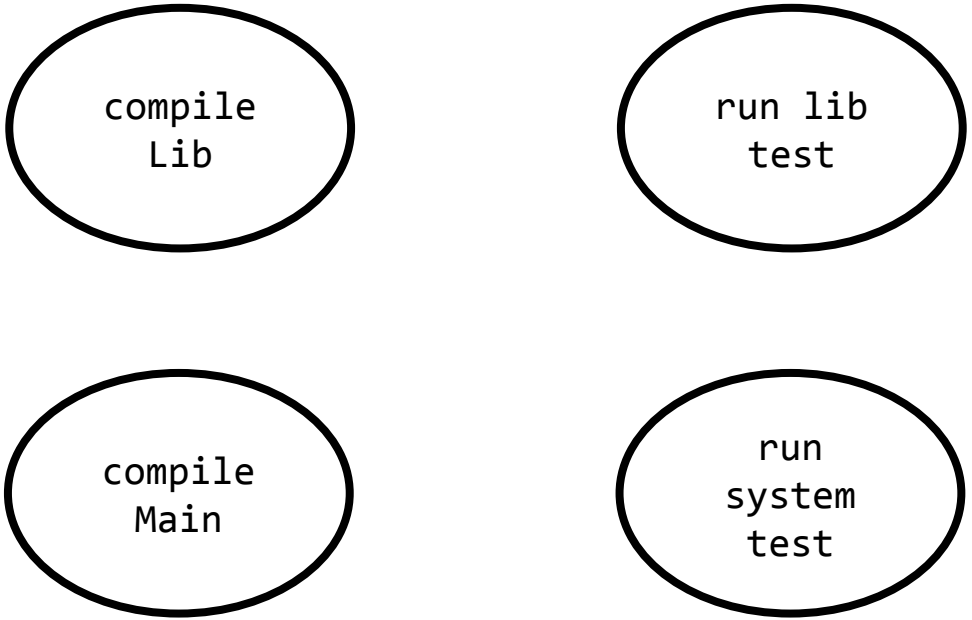
- Should be checked into version control
- Should be code-reviewed
- Should be tested

Dependencies between tasks

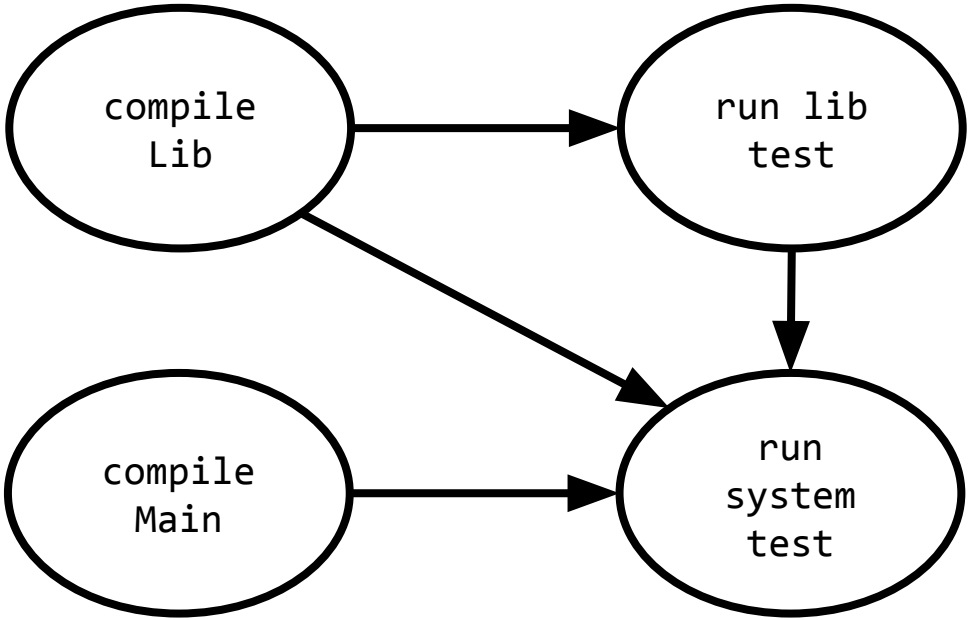
```
> ls src/

Lib.java   LibTest.java   Main.java    SystemTest.java
```

Dependencies between tasks



Dependencies between tasks



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Determining task ordering

- Dependencies between tasks form a directed acyclic graph

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Topological sort!

Topological sort

- Any ordering on the nodes such that all dependencies are satisfied

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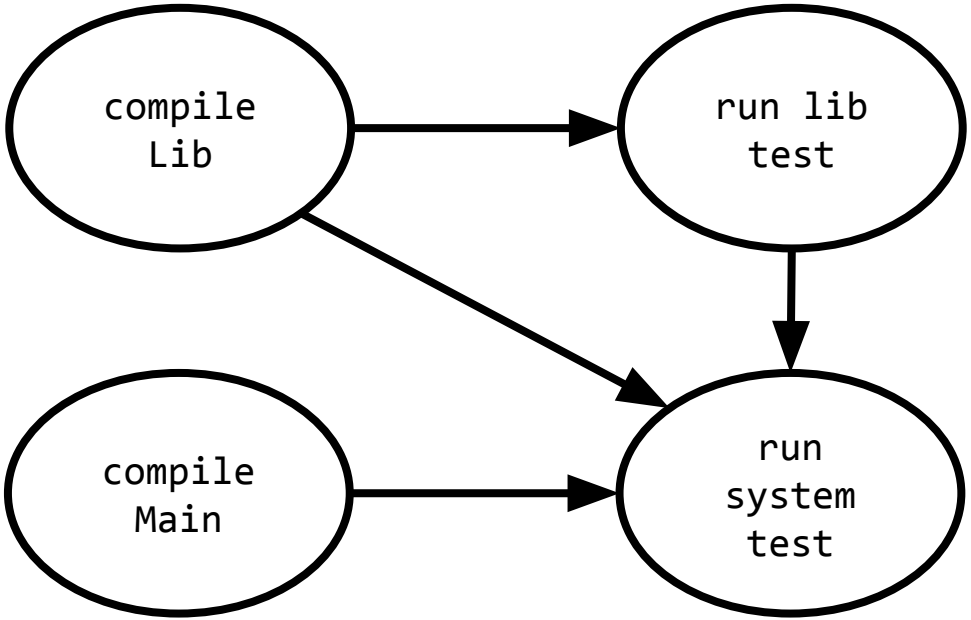
- Implement by computing *indegree* (number of incoming edges) for each node

Topological sort



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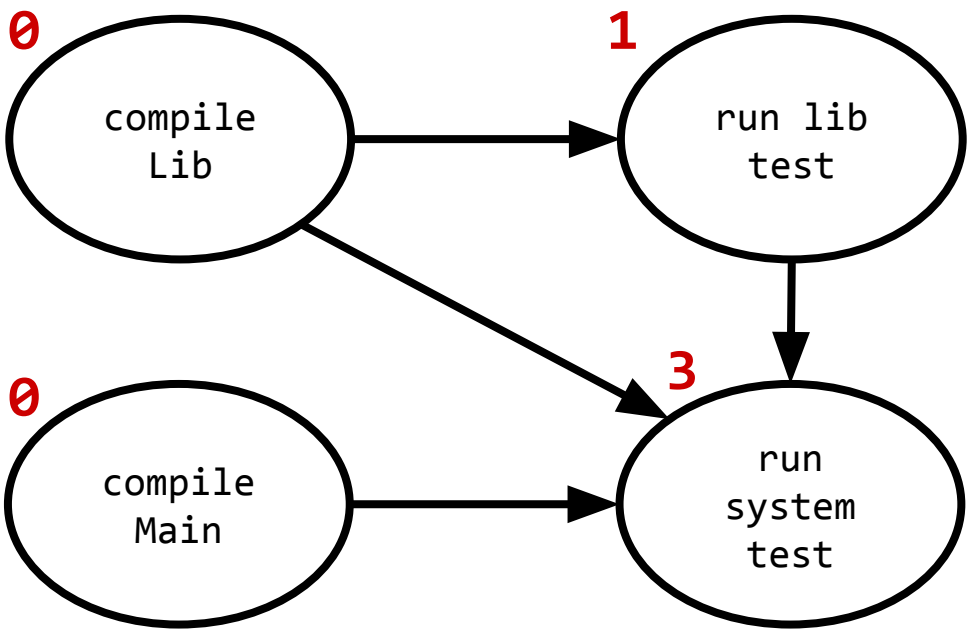

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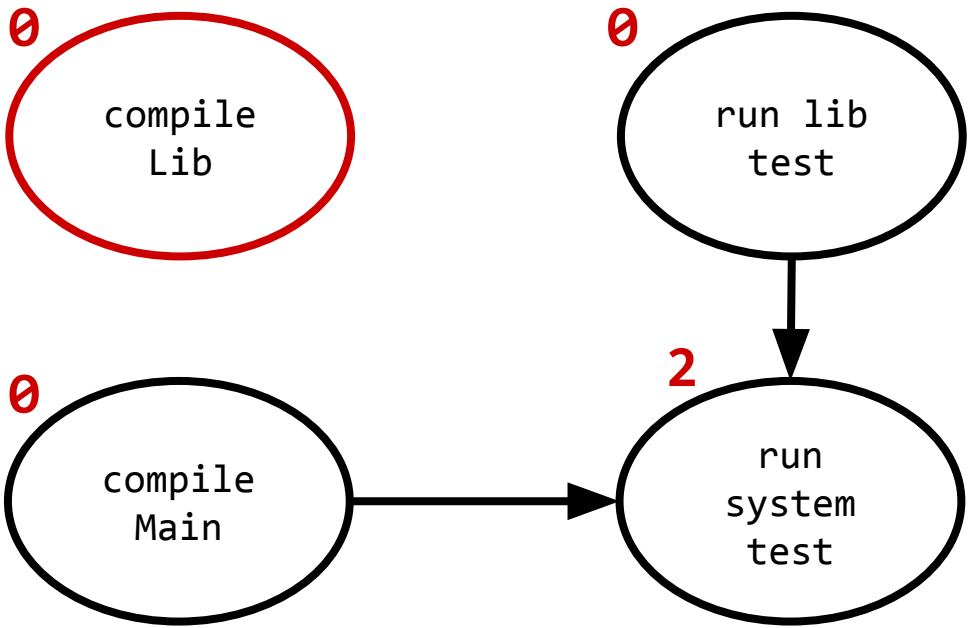

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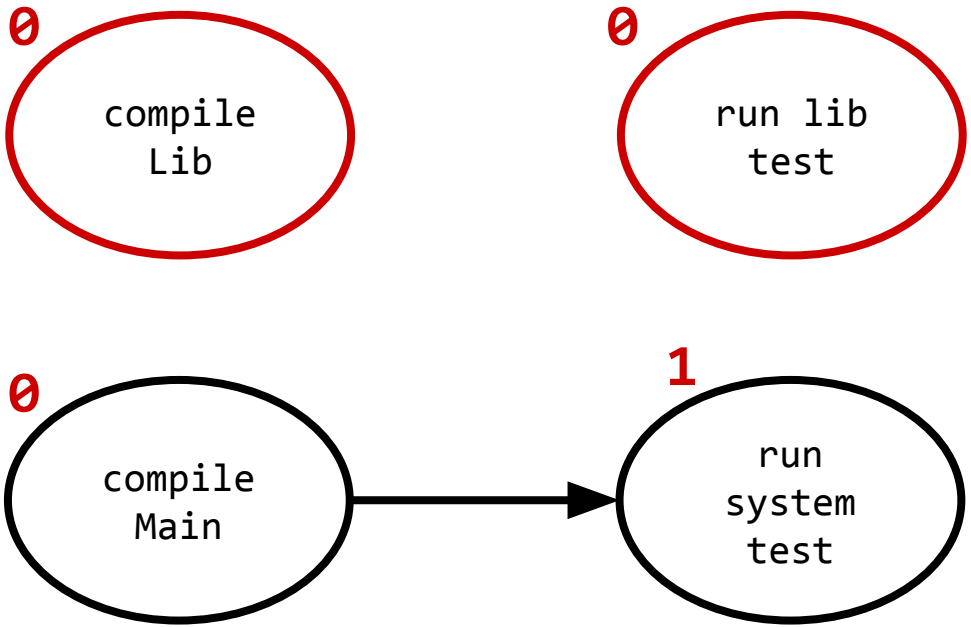

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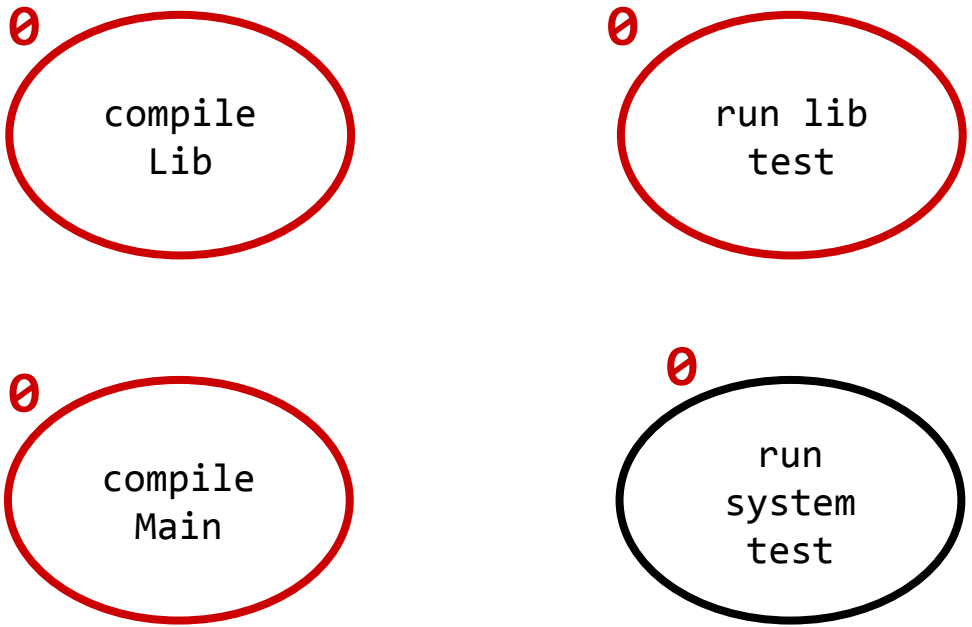

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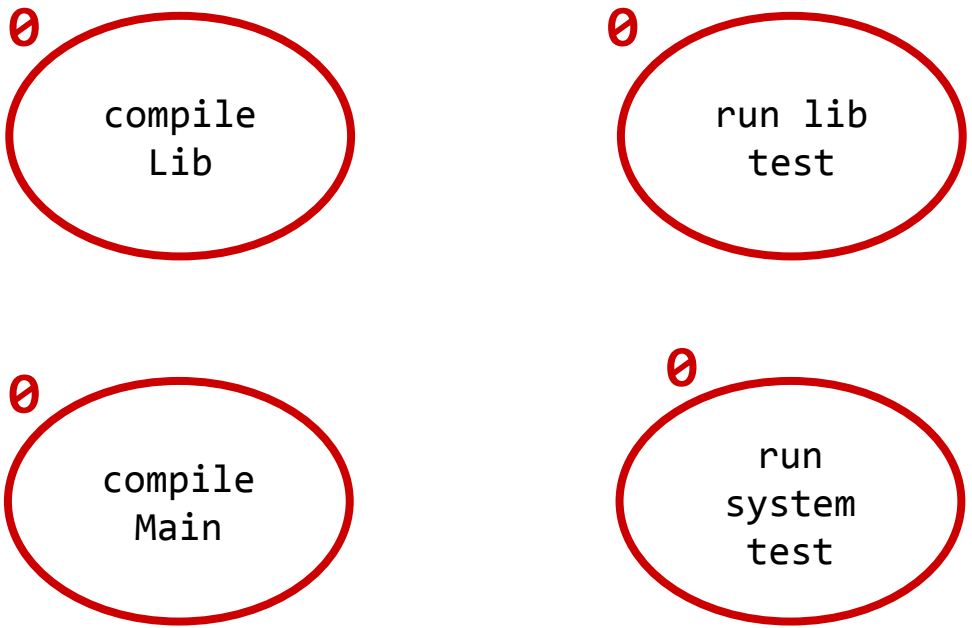
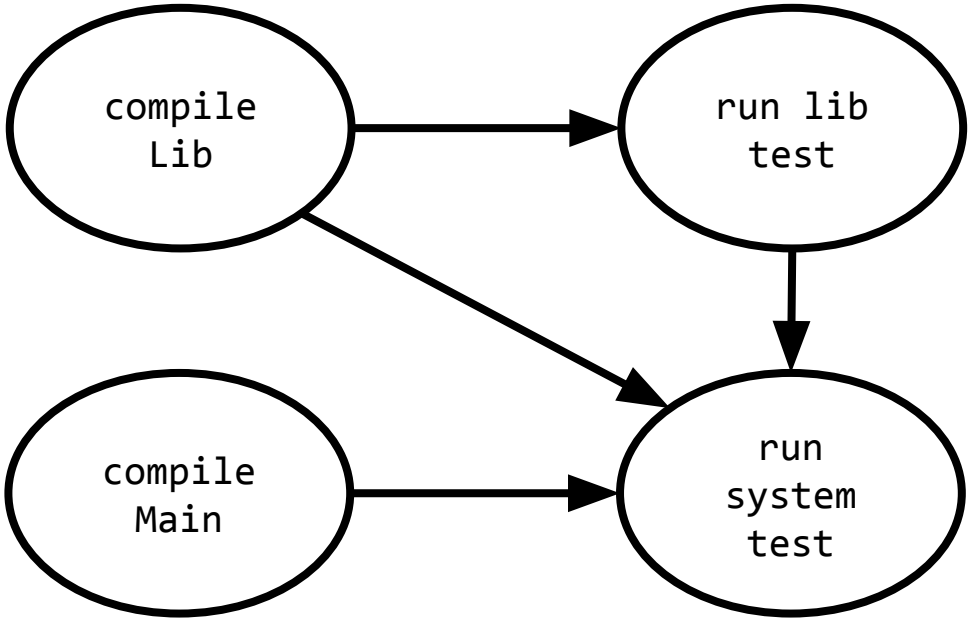


Topological sort

Valid sorts:

1. compile Lib, run lib test, compile Main, run system test



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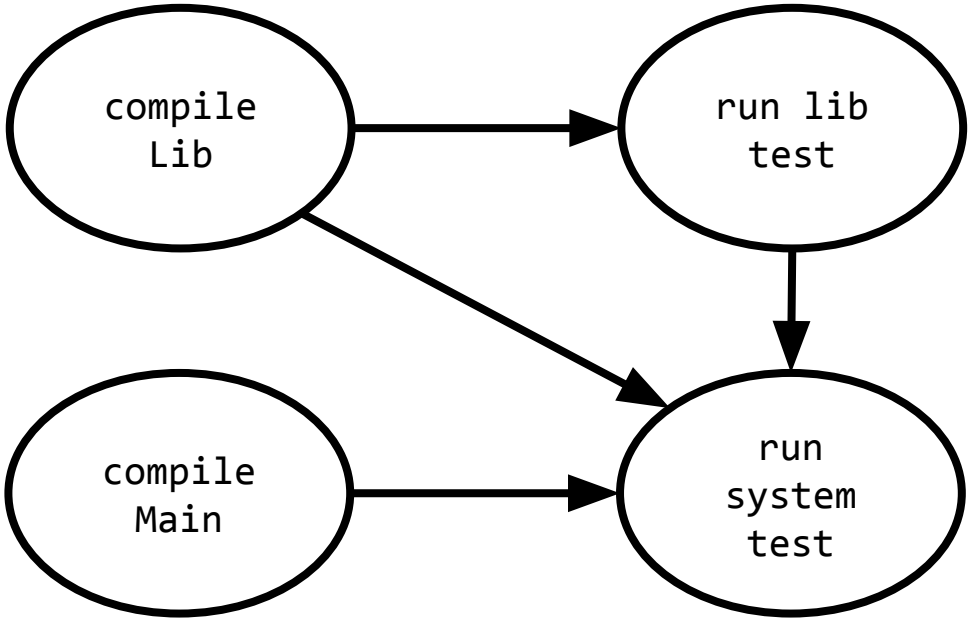

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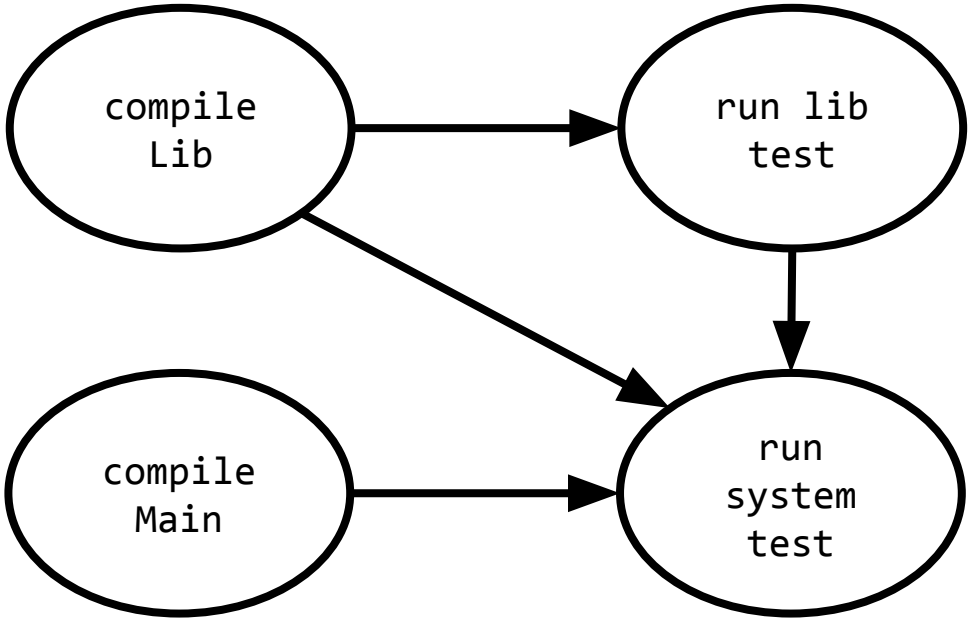

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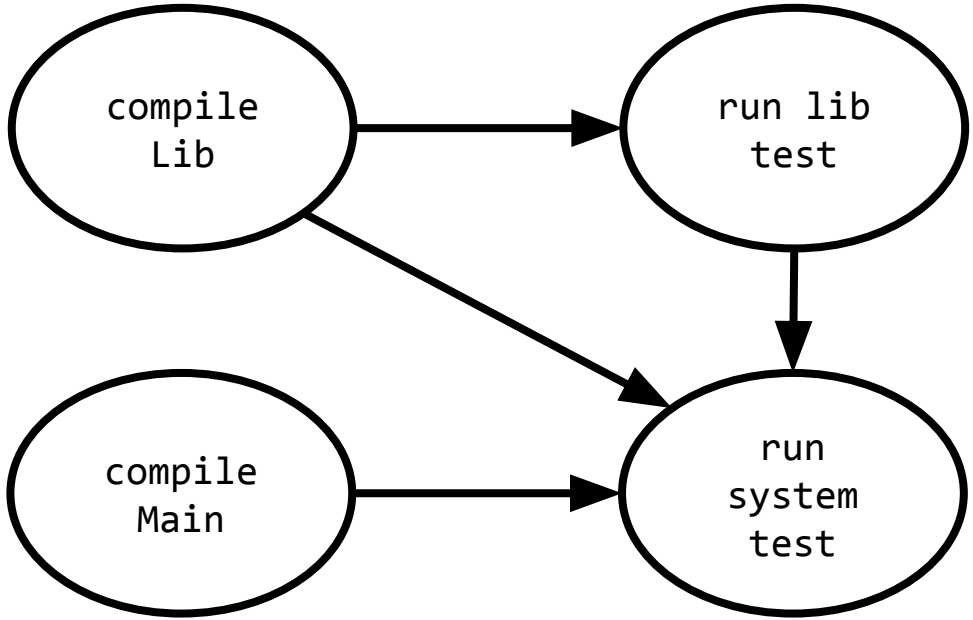
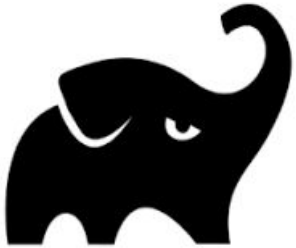


Why is this order silly?

Examples of modern build systems

`gradle`



https://gradle.org/

Apache's open-source successor to ant, maven

`bazel`

https://www.bazel.build/

Google's internal build tool, open-sourced

Example task: `gradle`

```
task reformat(type: Exec, dependsOn: getCodeFormatScripts, group: 'Format') {
   description 'Format the Java source code'
   // jdk8 and checker-qual have no source, so skip
   onlyIf { !project.name.is('jdk8') && !project.name.is('checker-qual') }
   executable 'python'
   doFirst {
       args += "${formatScriptsHome}/run-google-java-format.py"
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       args += getJavaFilesToFormat(project.name)
   }
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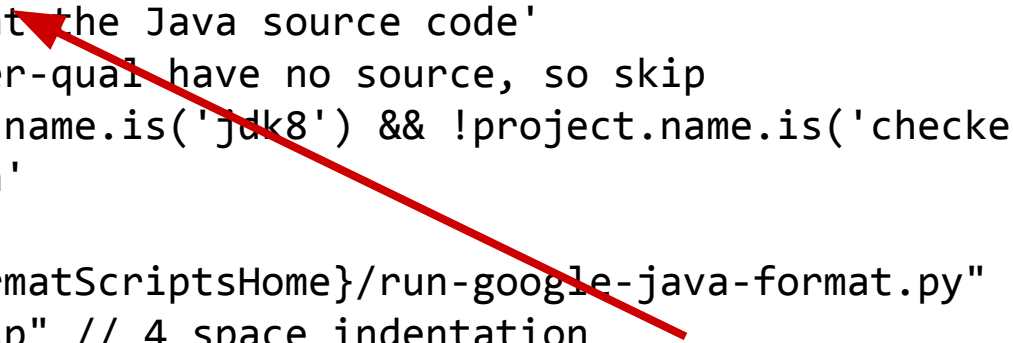

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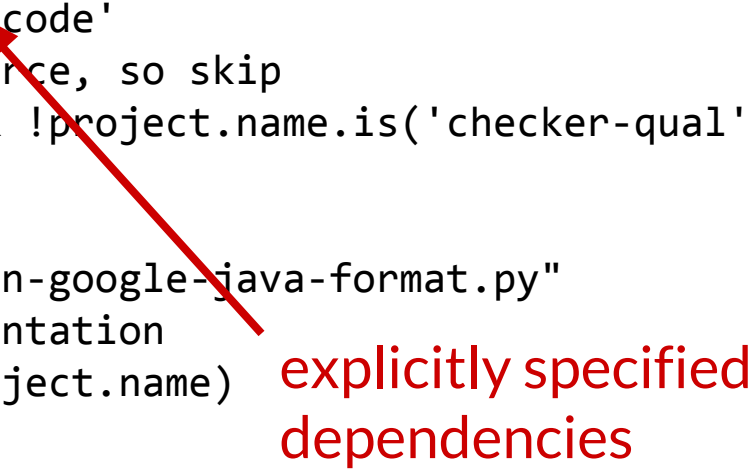

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task reformat(type: Exec, dependsOn: getCodeFormatScripts, group: 'Format') {
   description 'Format the Java source code'
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Example task: `bazel`

```
java_binary(
    name = "dux",
    main_class = "org.dux.cli.DuxCLI",
    deps = ["@google_options//:compile",
            "@checker_qual//:compile",
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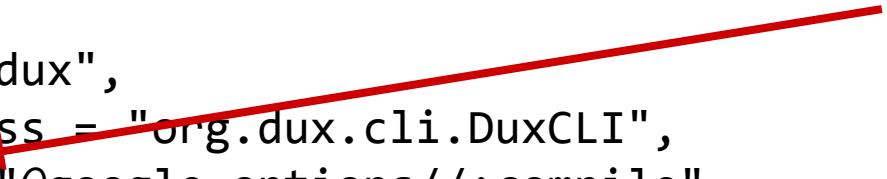

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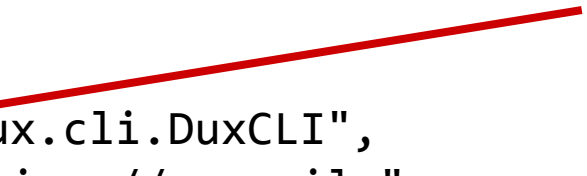

explicitly specified dependencies (also bazel tasks)

External and internal dependencies

- A list of tasks (internal) or libraries (external)

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dependencies {
    compile group:
        'org.hibernate',
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        version : '3.6.7.Final'
    testCompile group:
        'junit',
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}
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https://docs.gradle.org/current/userguide/artifact dependencies tutorial.html

Why list dependencies?

- Reproducibility!

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Dependencies between tasks

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  - **How to speed up?**

How to speed up builds?

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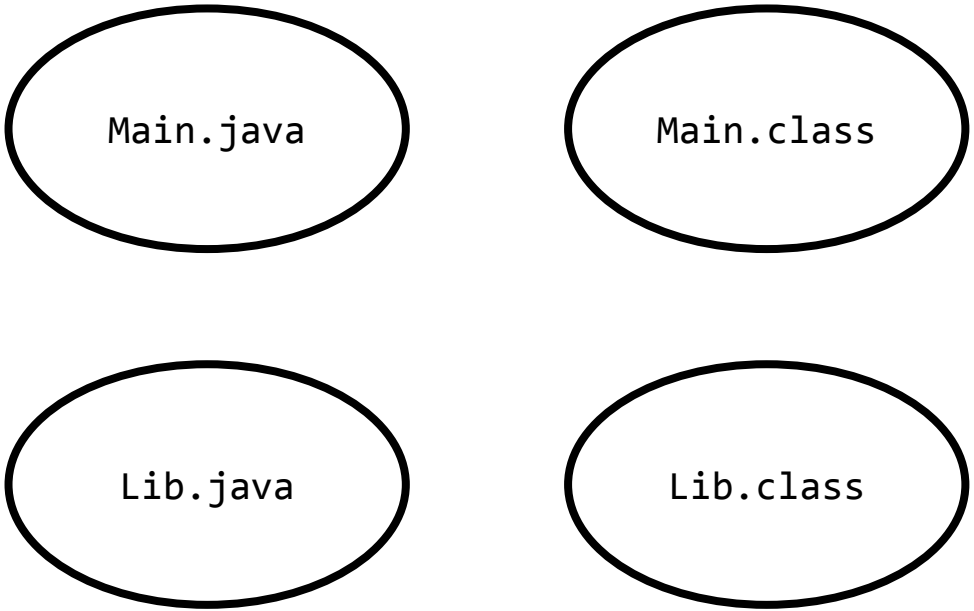
- Incrementalize - only rebuild what you have to

Incrementalization



Incrementalization

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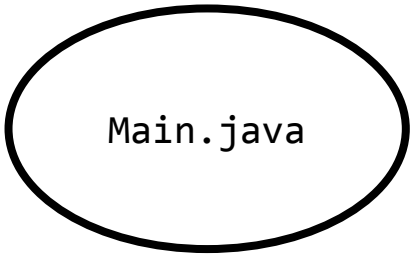

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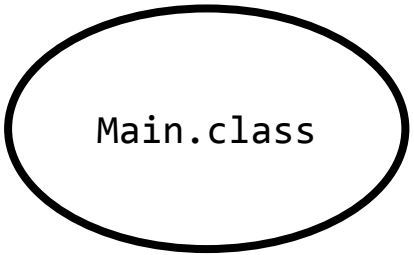

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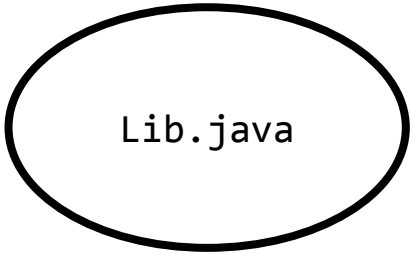

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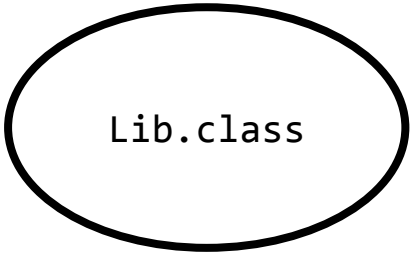

Incrementalization

- Compute hash codes for inputs to each task
- When about to execute a task, check input hashes - if they match the last time the task was executed, skip it!

How to speed up builds?

- Incrementalize - only rebuild what you have to
- Execute many tasks in parallel
- Cache artifacts in the cloud

Best practices

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- Always use a build tool
- Have a build server that builds and tests your code on every commit (continuous integration)
- Don’t break the build