CS 254: Concurrent Object-Oriented Programming with Java & Android

Course Overview & Logistics

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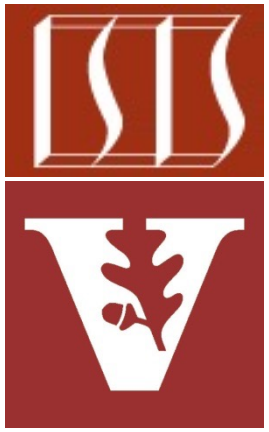

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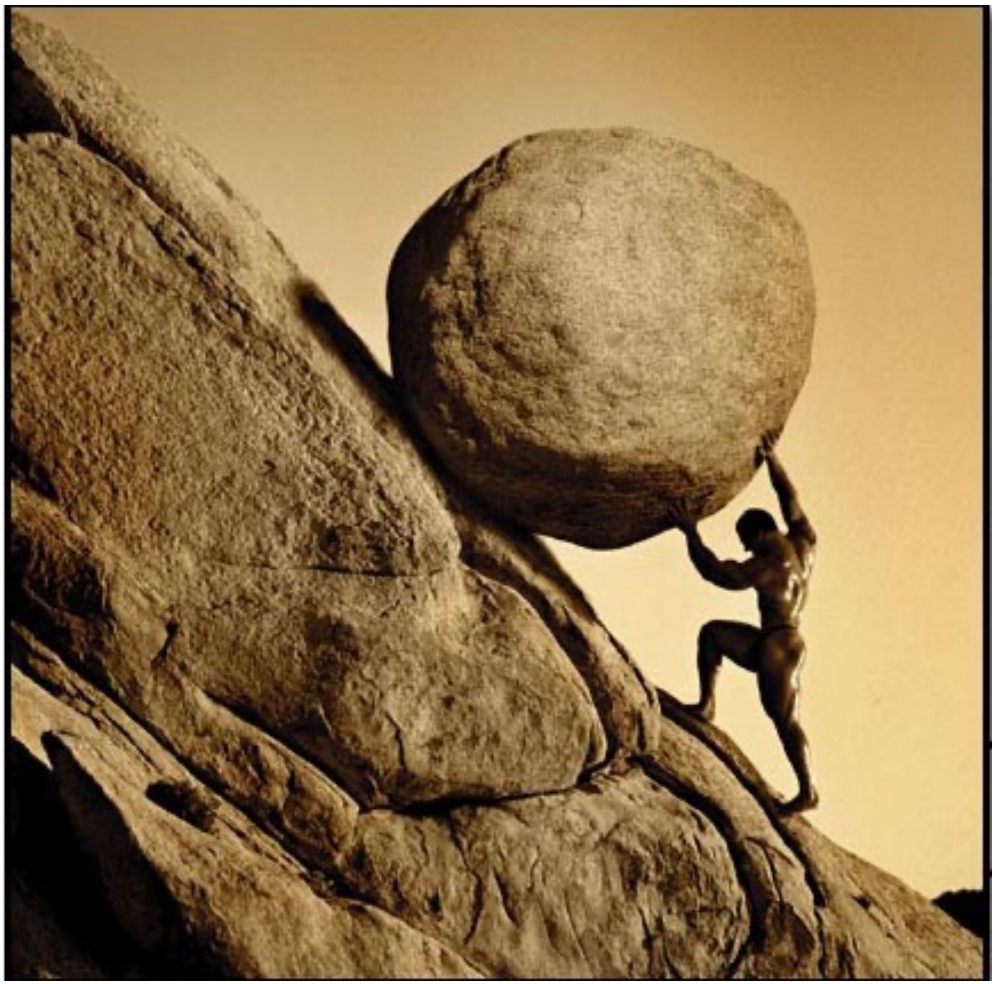
Learning Objectives in this Lesson

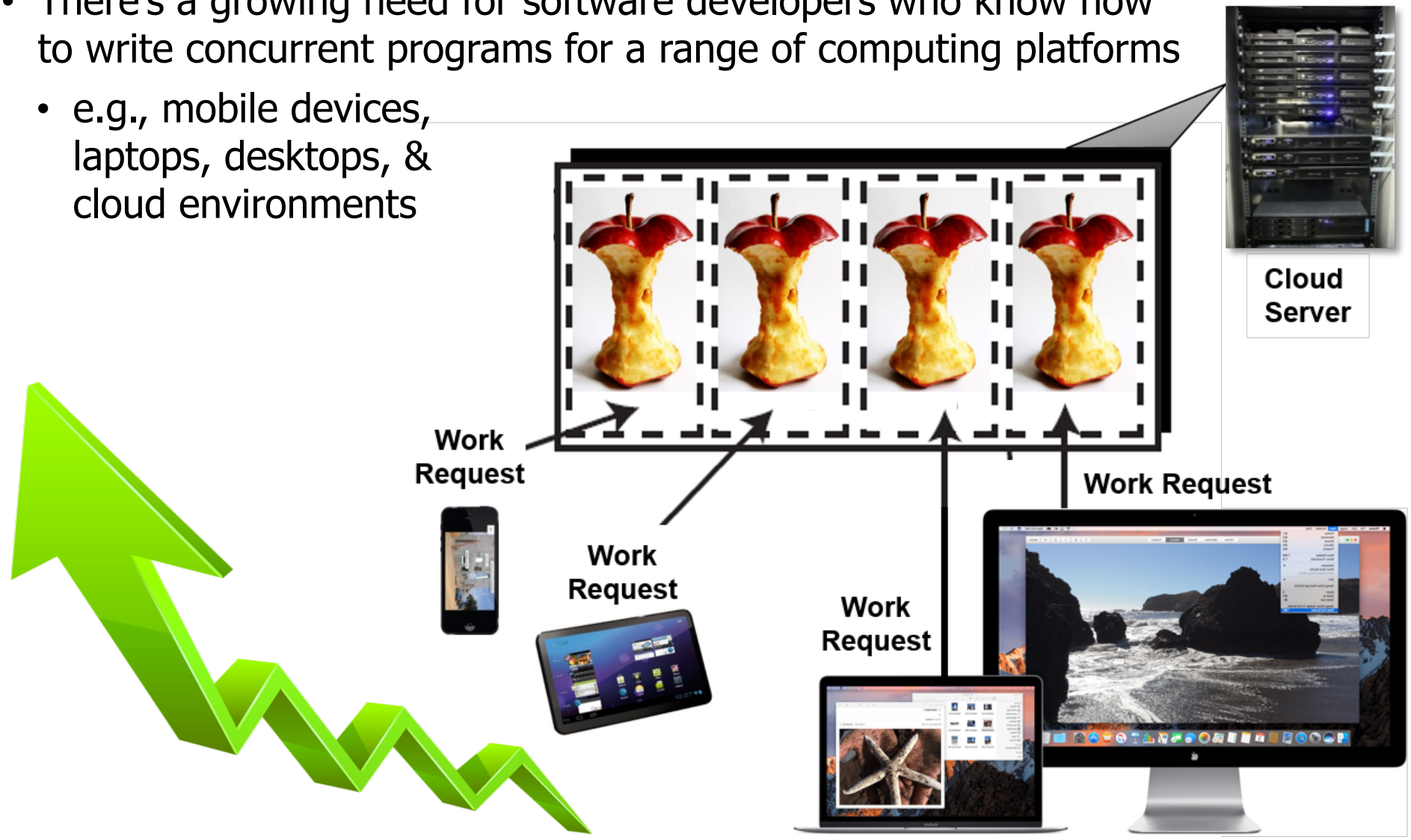
- Understand the course topics & logistics
  - Course philosophy
  - Course contents
  - Structure of the lecture material
  - Overview of the assignments & assessments
  - Setting up the Java & Android IDE on Android Studio
  - Setting up GitLab et al.
  - Accessing Android & Java source code



Course Philosophy

Course Philosophy

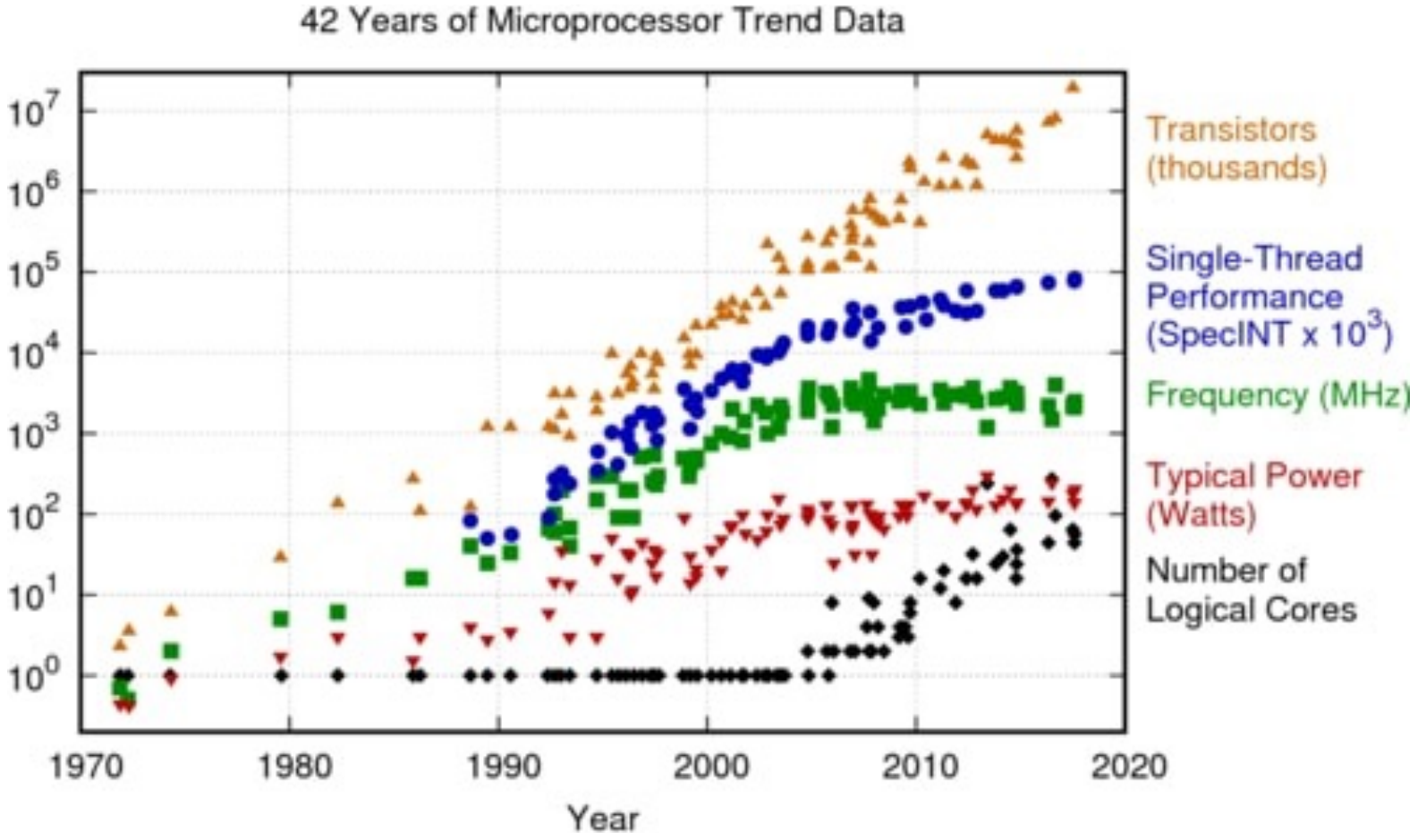
- There's a growing need for software developers who know how to write concurrent programs for a range of computing platforms
  - e.g., mobile devices, laptops, desktops, & cloud environments



The topics covered in this course apply to many platforms, not just Android

Course Philosophy

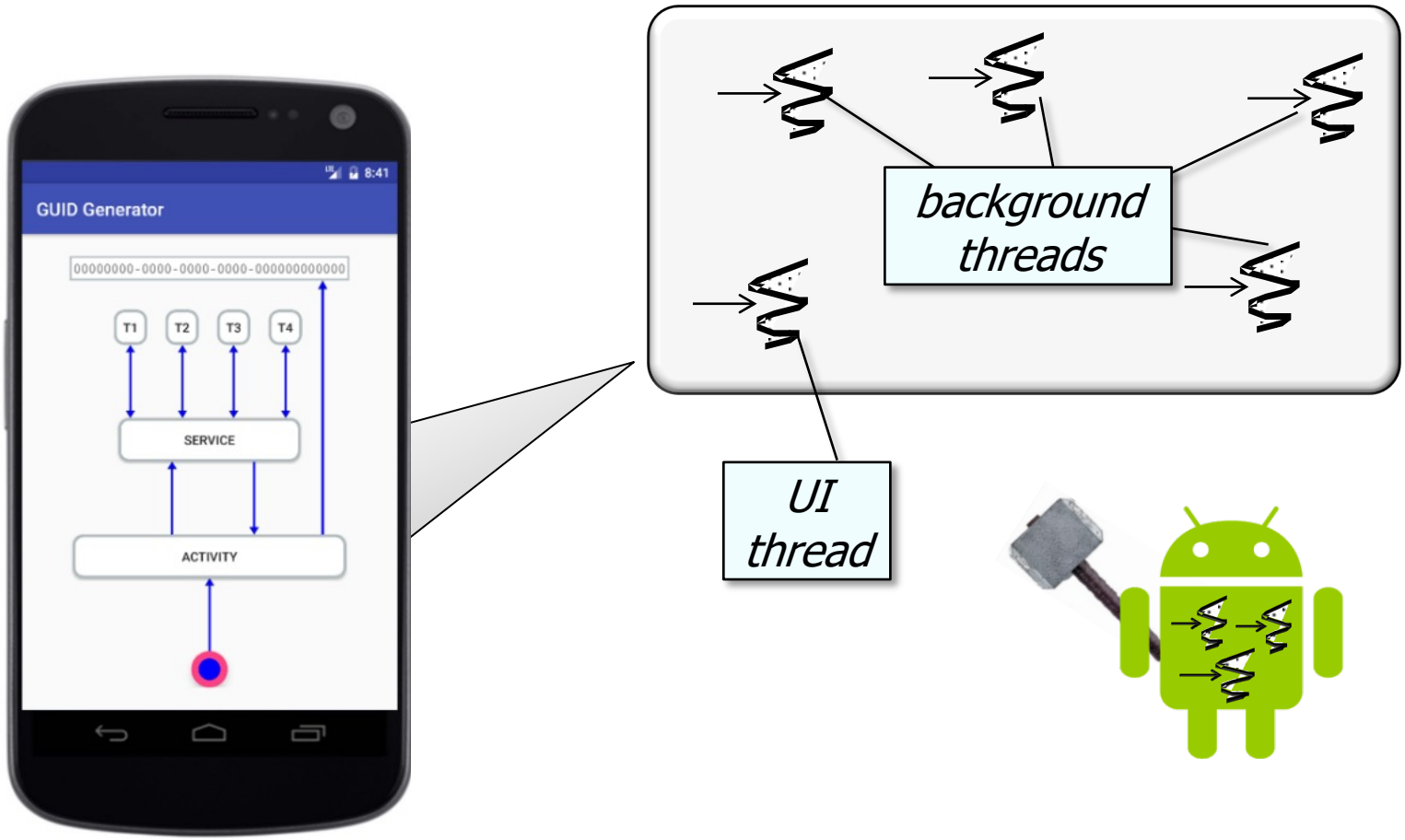
- Demand is driven by advances in software & hardware infrastructure
  - e.g., multi-core & many core processors, mass storage, ubiquitous network connectivity, & commodity hardware & software platforms



See www.gotw.ca/publications/concurrency-ddj.htm

Course Philosophy

- Concurrency is also commonly used to offload work from the user interface (UI) thread to background thread(s) in mobile devices



See developer.android.com/training/multiple-threads/communicate-ui.html

Course Philosophy

- Effective techniques & practices for designing & programming concurrent (mobile) apps are *not* best learned through generalities & platitudes

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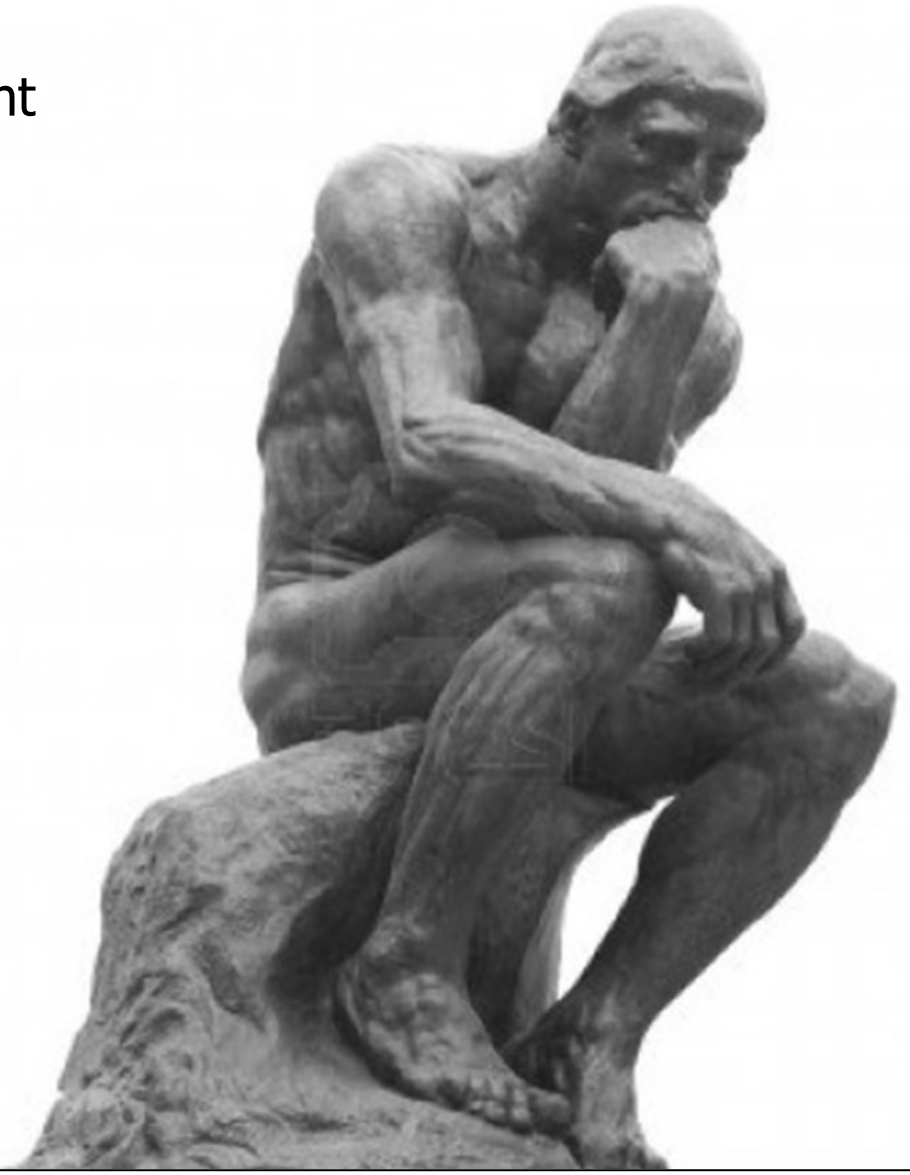

"Sitting & thinking" is not sufficient…

Course Philosophy

- Instead, it's better to see *by example* how concurrent programs can be made
  - *easier* to write & read,
  - *easier* to maintain & modify,
  - *more* efficient & resilient

  by applying time-proven software patterns & object-oriented (& some functional) design & programming techniques

This course involves lots of hands-on software development & testing!

Summary of the Course Contents

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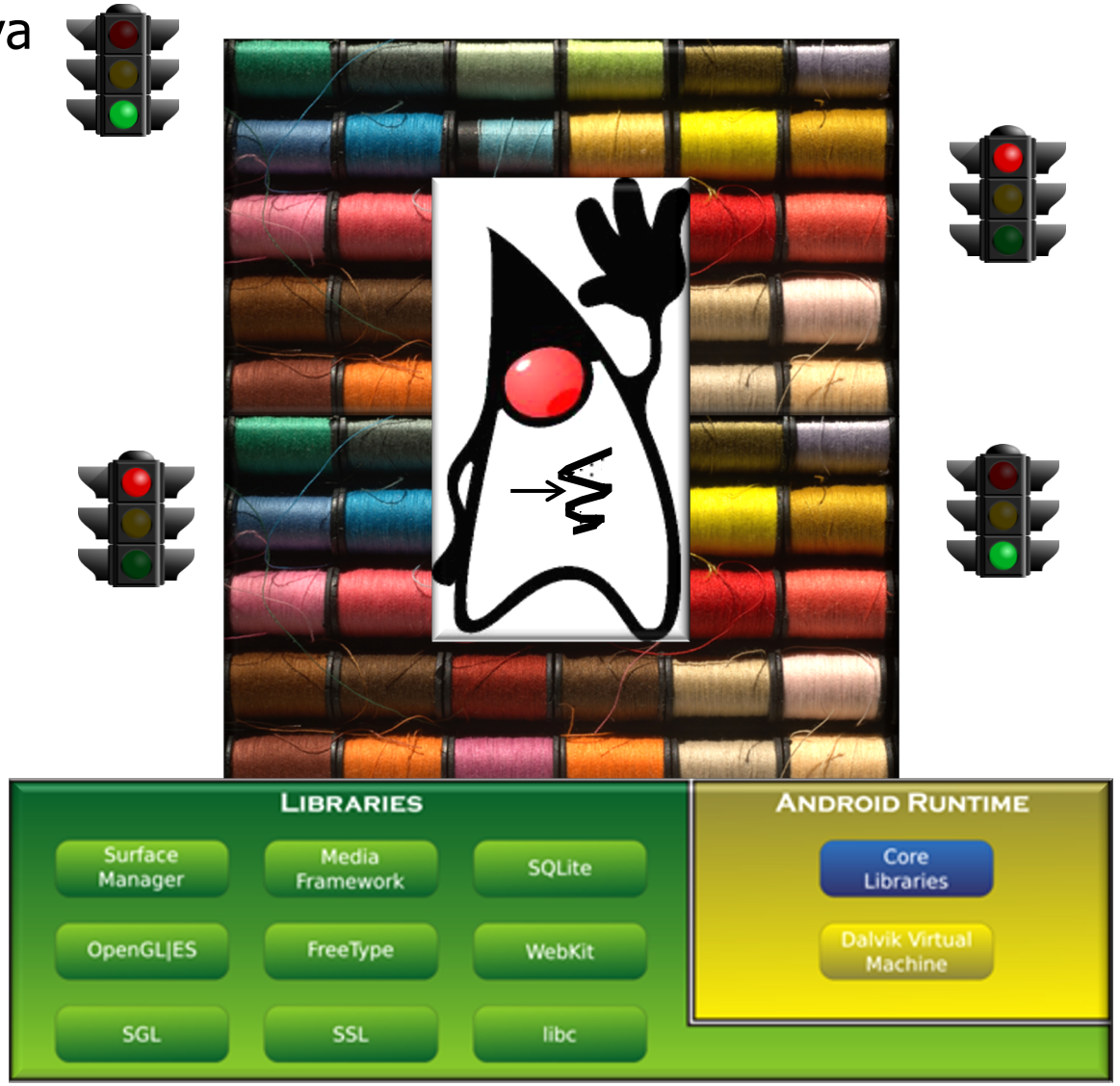
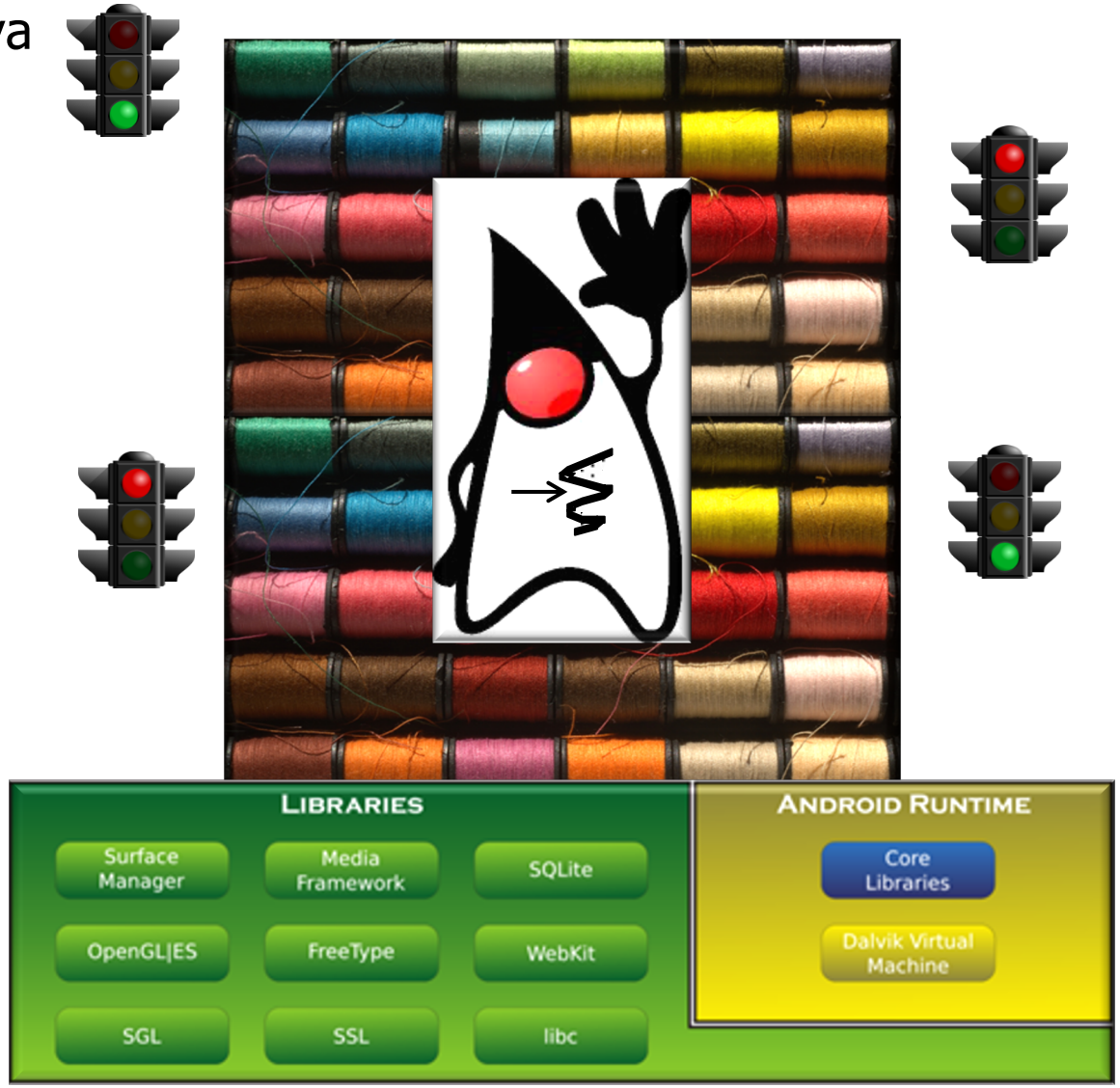
- Coverage of foundational Java concurrency mechanisms



See www.orctom.com/2017/04/21/java-locks-and-concurrency

Summary of Course Contents

- Coverage of foundational Java concurrency mechanisms
  - e.g., Java threading & synchronizer mechanisms



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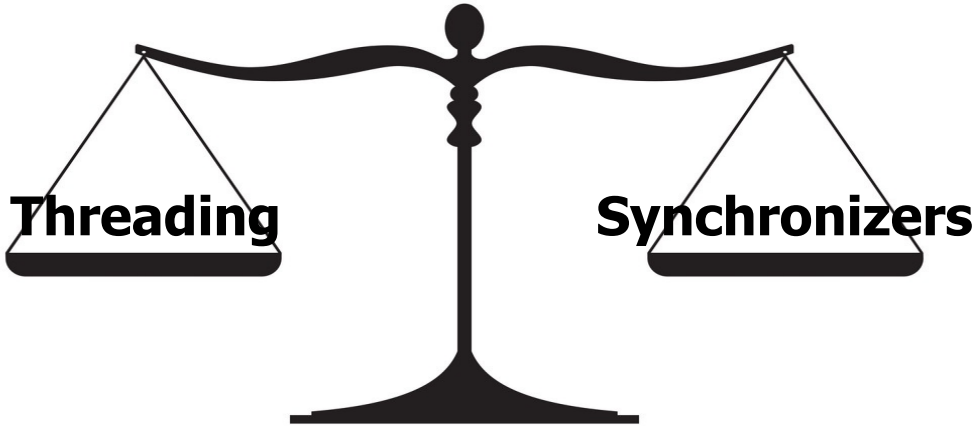


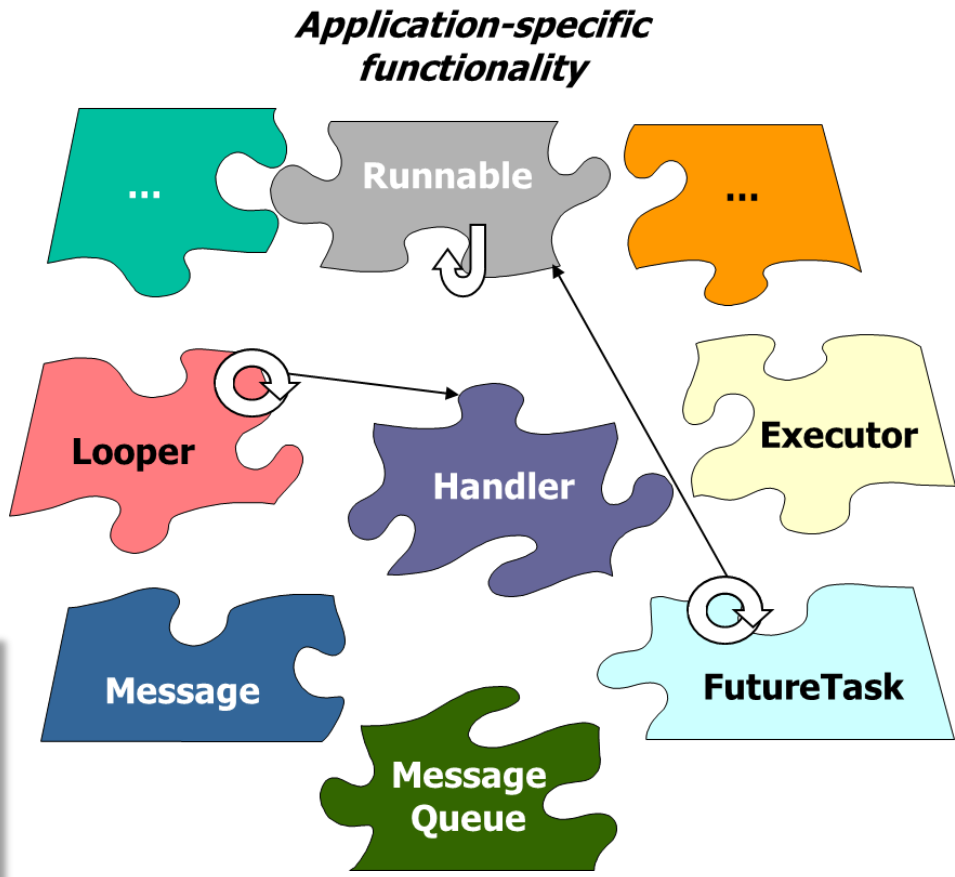
Threading mechanisms
- Thread
- Runnable
- Executor
- ExecutorService
- ScheduledExecutorService
- ExecutorCompletionService
- Future
- FutureTask
- ThreadPoolExecutor
- ForkJoinPool

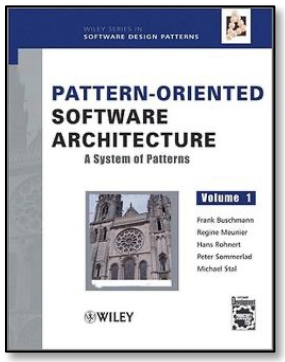
Synchronizer mechanisms
- Synchronized methods & statements
- Notification methods
- ReentrantLock
- ReentrantReadWriteLock
- StampedLock
- ConditionObject
- Semaphore
- CountDownLatch
- CyclicBarrier
- Phaser

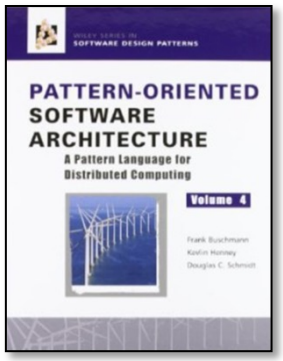
We provide roughly equal focus on Java synchronization mechanisms & Java threading mechanisms in this course

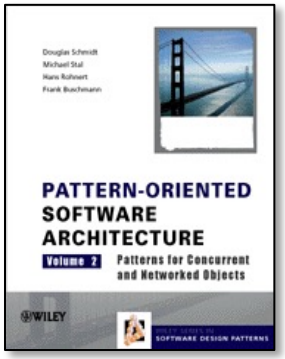
Summary of Course Contents

- Coverage of foundational Java concurrency mechanisms
- Patterns/frameworks for concurrent programming









See en.wikipedia.org/wiki/Concurrency_pattern

Summary of Course Contents

- Coverage of foundational Java concurrency mechanisms
- Patterns/frameworks for concurrent programming
- We assume you know (or can quickly learn) Android, Android Studio, modern Java, & Git

See item #12 at github.com/douglascraigschmidt/CS254/wiki/CS-254-FAQ

Structure of the Lecture Material

Structure of the Lecture Material

- This course has three main topics

Section	Topics

Java Threading	• Coverage of basic & advanced Java threading mechanisms, e.g.
	  • Java Threads & Runnables
	  • The Java Executor framework

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Java Synchronization	• Coverage of basic & advanced Java synchronization mechanisms, e.g., • Build-in monitor objects • Myriad synchronizer classes in java.util.concurrent

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Software Patterns	• Concurrency patterns

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	  • Build-in monitor objects
	  • Myriad synchronizer classes in java.util.concurrent

Software Patterns	• Concurrency patterns

We'll bounce around when covering these topics to facilitate assignments

Structure of the Lecture Material

- This course has three main topics
  - Each topic is composed of lessons

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  - Each lesson is composed of parts

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  - Each topic is composed of lessons
  - Each lesson is composed of parts
  - Each part is a single lecture

Screencasts of each lesson "part" & PDF versions of the slides will be uploaded to www.dre.vanderbilt.edu/~schmidt/cs254#lectures

Structure of the Lecture Material

- This course has three main topics
  - Each topic is composed of lessons
  - Each lesson is composed of parts
  - Each part is a single lecture
    - Each part is composed of segments

Structure of the Lecture Material

- There will be periodic tests on material covered in the lectures

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  - All tests (including the final) are "closed book," "closed Internet," "closed electronics," etc.

1st test quiz will be on Wednesday, January 26th via Brightspace

Structure of the Lecture Material

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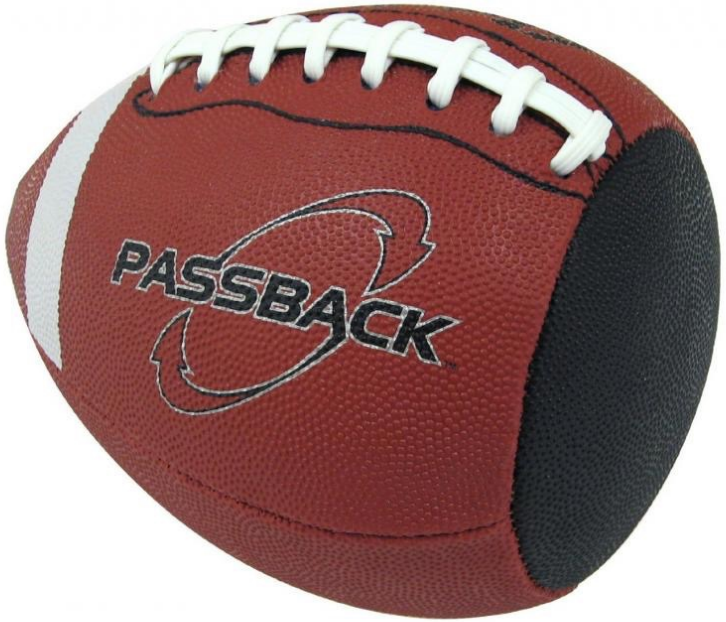
  - All tests (including the final) are "closed book," "closed Internet," "closed electronics," etc.
  - We'll try to grade & review the tests by the next class



One of the benefits of a smaller class ;-)

Structure of the Lecture Material

- There will be periodic tests on material covered in the lectures
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I recommend that you study for tests by reviewing slides & watching screencasts available at www.dre.vanderbilt.edu/~schmidt/cs254#lectures

Structure of the Lecture Material

- There will be periodic tests on material covered in the lectures
  - All tests (including the final) are "closed book," "closed Internet," "closed electronics," etc.
  - We'll try to grade & review the tests by the next class
    - If you don't attend the next class & don't get your quiz you will be penalized 50%

See www.dre.vanderbilt.edu/~schmidt/cs254/work-summary.html#quizzes

Structure of the Lecture Material

- There will be periodic tests on material covered in the lectures
  - All tests (including the final) are "closed book," "closed Internet," "closed electronics," etc.
  - We'll try to grade & review the tests by the next class
    - If you don't attend the next class & don't get your quiz you will be penalized 50%
    - Likewise, if you just show up for the test & don't attend class you'll be penalized 50%

See www.dre.vanderbilt.edu/~schmidt/cs254/work-summary.html#quizzes

Structure of the Lecture Material

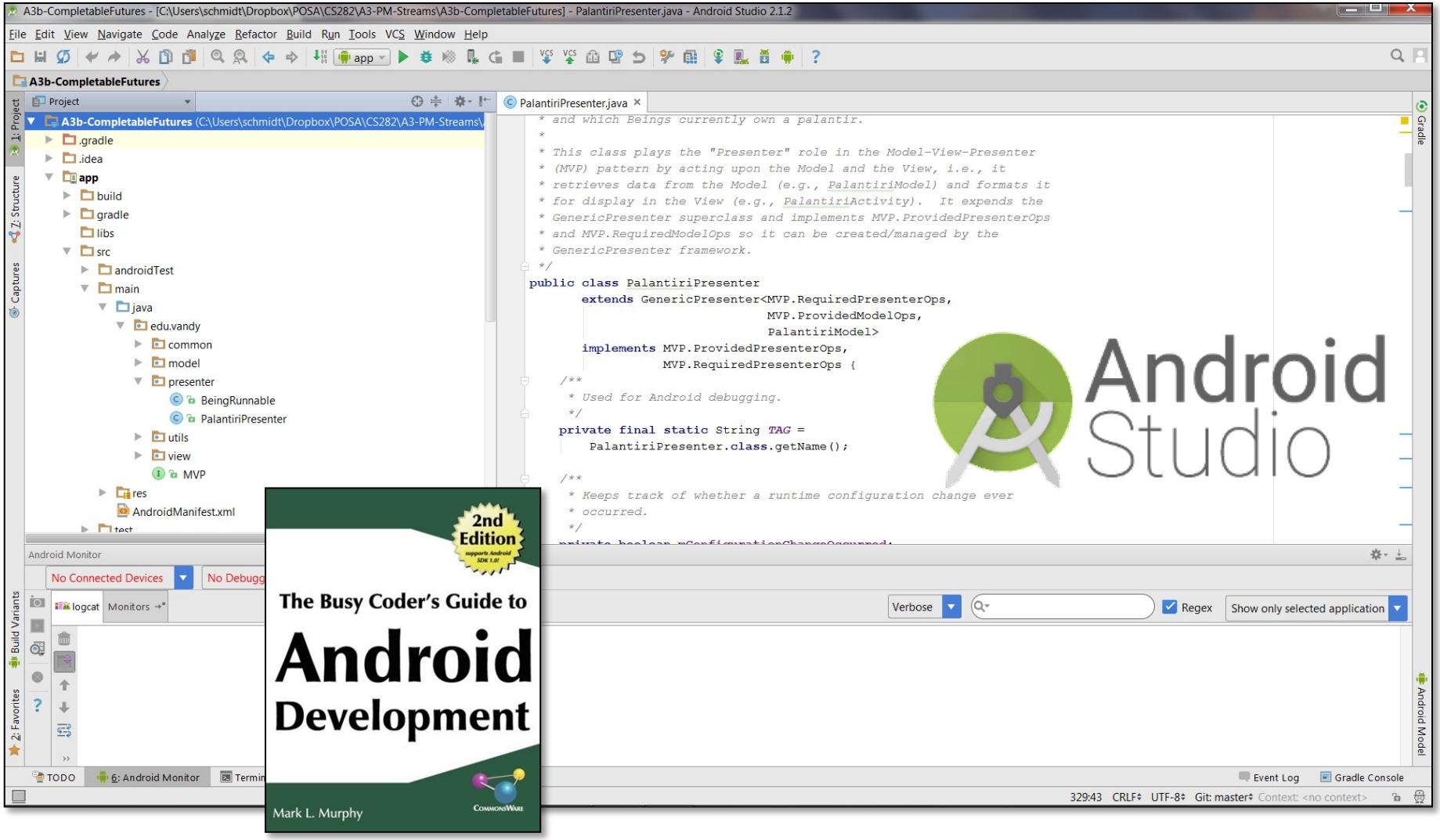
- There may be a final exam that can cover all the lectures
  - The focus will be on the last week(s) of the semester

The final exam is noon to 3pm, Monday, May 2nd via Brightspace

Overview of the Assignments & Assessments

Overview of Assignments & Assessments

- Programming assignments should be written in Java 11 using Android Studio



You can use any IDE, but your final submission *must* build/run with the latest Android Studio & Android 11 "R" (API level 30)

Overview of Assignments & Assessments

- Programming assignments should be written in Java 11 using Android Studio
  - The Java 11 runtime environment (JRE) comes pre-installed with Android now

You can use cool Java 11 features starting with Android Studio "Arctic Fox"

Overview of Assignments & Assessments

- Android programming assignments must be submitted using Android Studio

- A wizard for creating new apps
- A visual editor for creating GUIs
- An editor for manipulating Android XML descriptors needed for your app
- An emulator for testing your apps on your PC
- A debugger for finding errors in the emulator or on a device

See developer.android.com/sdk

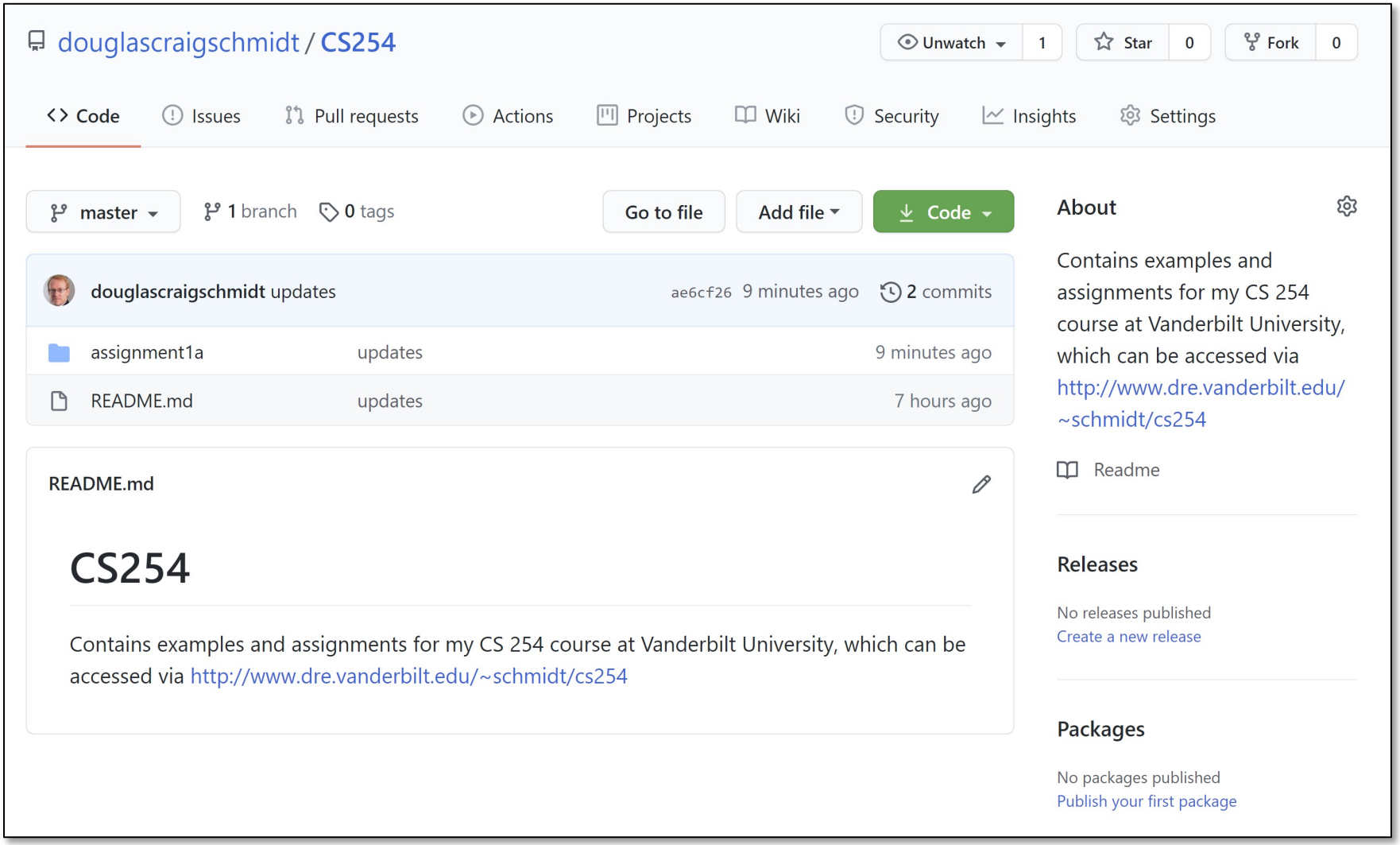
Overview of Assignments & Assessments

- Android programming assignments must be submitted using Android Studio
  - Please install Android 11 "R" (API level 30)

See en.wikipedia.org/wiki/Android_11

Overview of Assignments & Assessments

- All source code for assignments & examples available at GitHub



Go to GitHub at github.com/douglascraigschmidt/CS254

Overview of Assignments & Assessments

- All source code for assignments & examples available at GitHub
  - You will need to learn how to use GitLab et al.

See item #13 at github.com/douglascraigschmidt/CS254/wiki/CS-254-FAQ

Overview of Assignments & Assessments

- All source code for assignments & examples available at GitHub
  - You will need to learn how to use GitLab et al.
  - Be prepared to update your repositories multiple times
    - i.e., you need to understand Git!

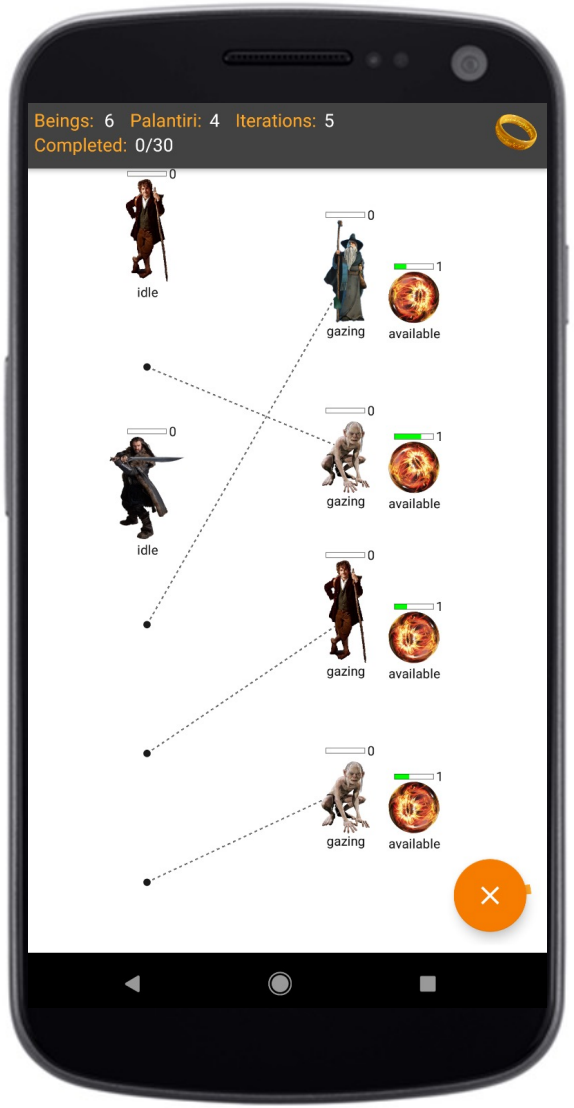
Overview of Assignments & Assessments

- Assignments will provide a range of experience with modern Java & Android concurrent programs

See github.com/douglascraigschmidt/CS254

Overview of Assignments & Assessments

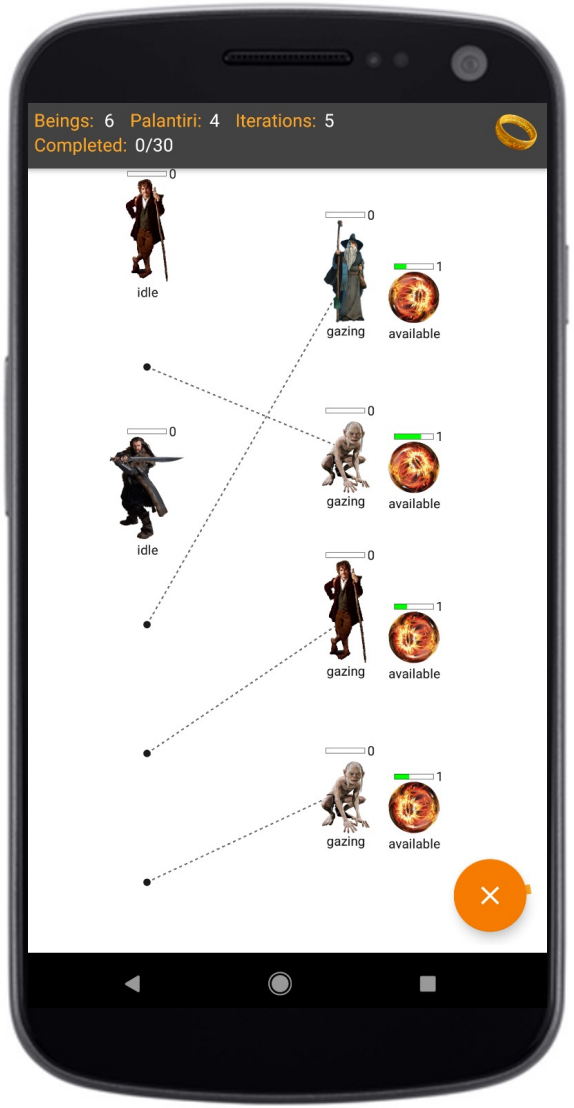
- In particular, you'll implement multiple variants of a Java concurrent resource manager & an associated Android app



See en.wikipedia.org/wiki/Palantir

Overview of Assignments & Assessments

- In particular, you'll implement multiple variants of a Java concurrent resource manager & an associated Android app, e.g.
  - Java Thread & Runnable
  - Java Executor framework (e.g., ExecutorService, ExecutorCompletionService, & ForkJoinPool)
  - Java Semaphore, built-in monitor objects, Stamped Lock, ReentrantLock, ConcurrentHashMap, etc.



The topics covered by the assignments generalize to more than Android!

Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff

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  - Assignments *must* be submitted on time or you'll get a 0

See item #4 at github.com/douglascraigschmidt/CS254/wiki/CS-254-FAQ

Overview of Assignments & Assessments

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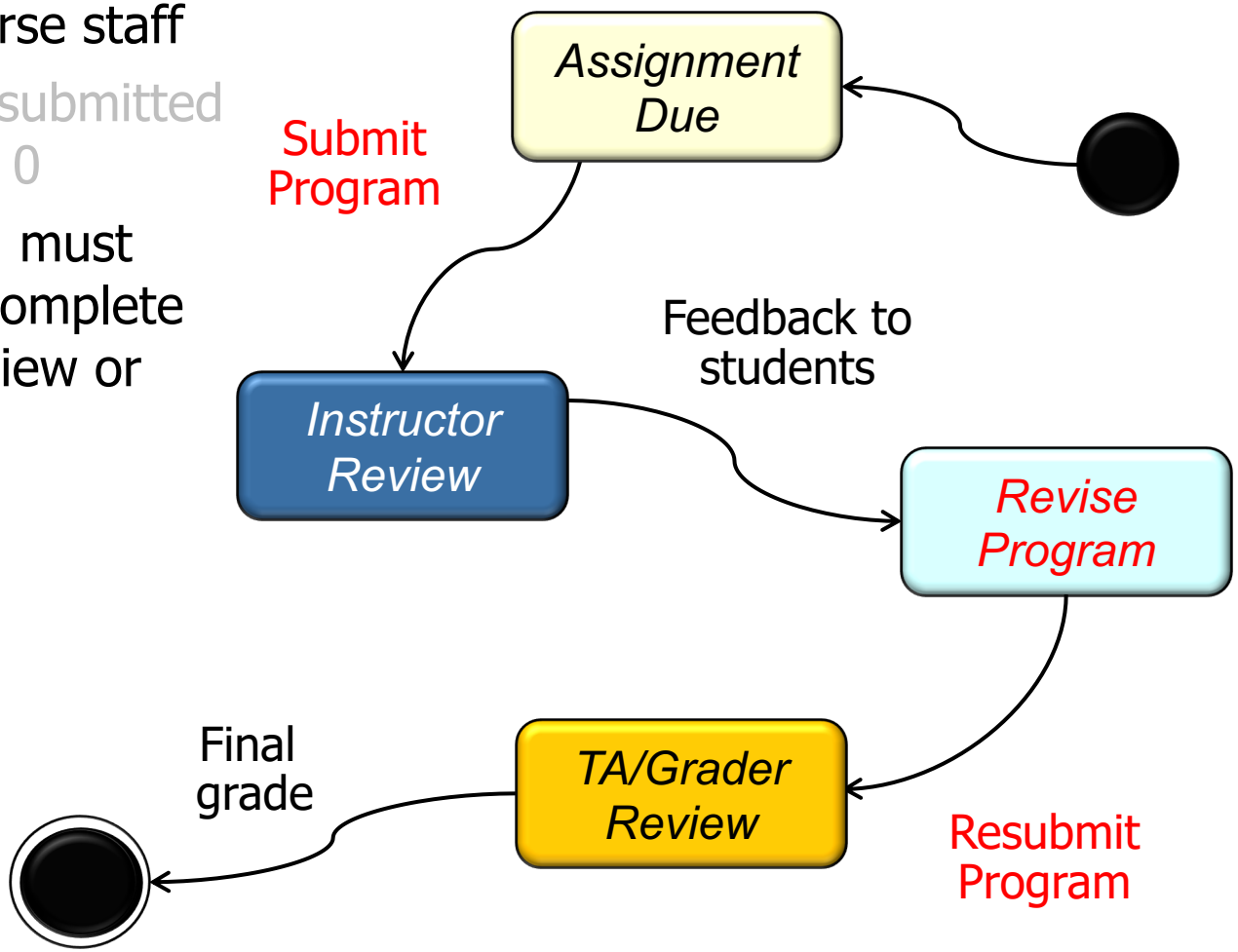
  - Assignments *must* be submitted on time or you'll get a 0
  - Your initial submission must compile & be largely complete or you won't get a review or a final grade



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See www.dre.vanderbilt.edu/~schmidt/cs254/assignments.html

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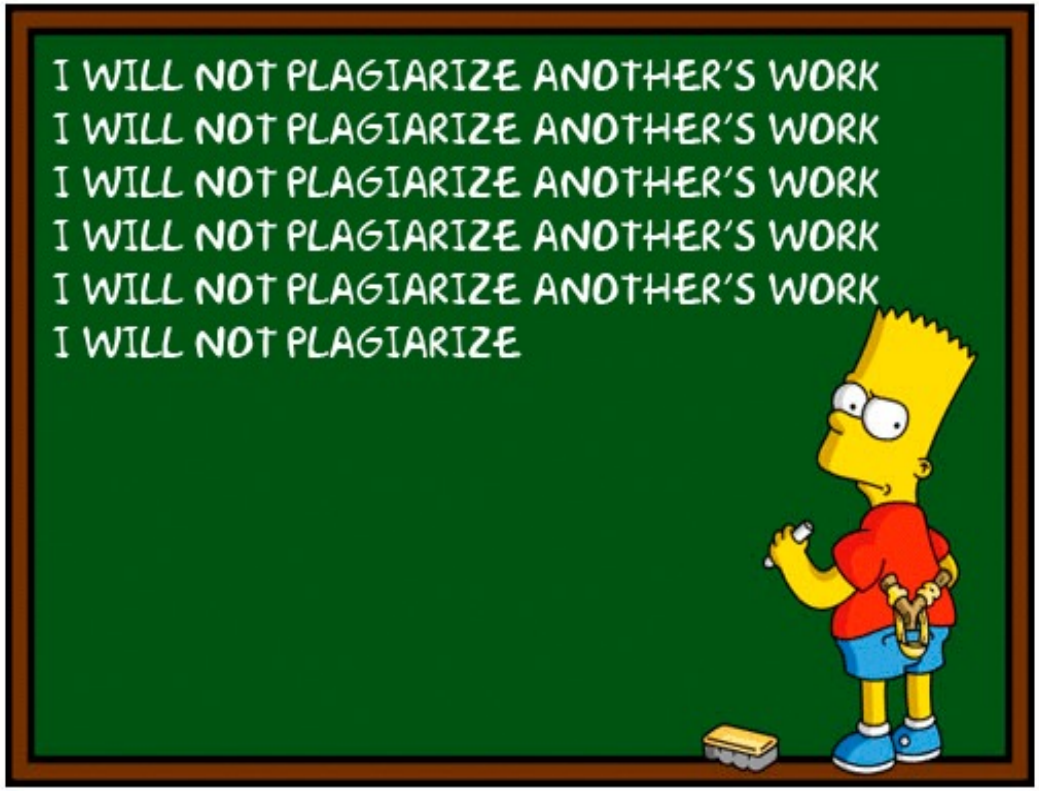
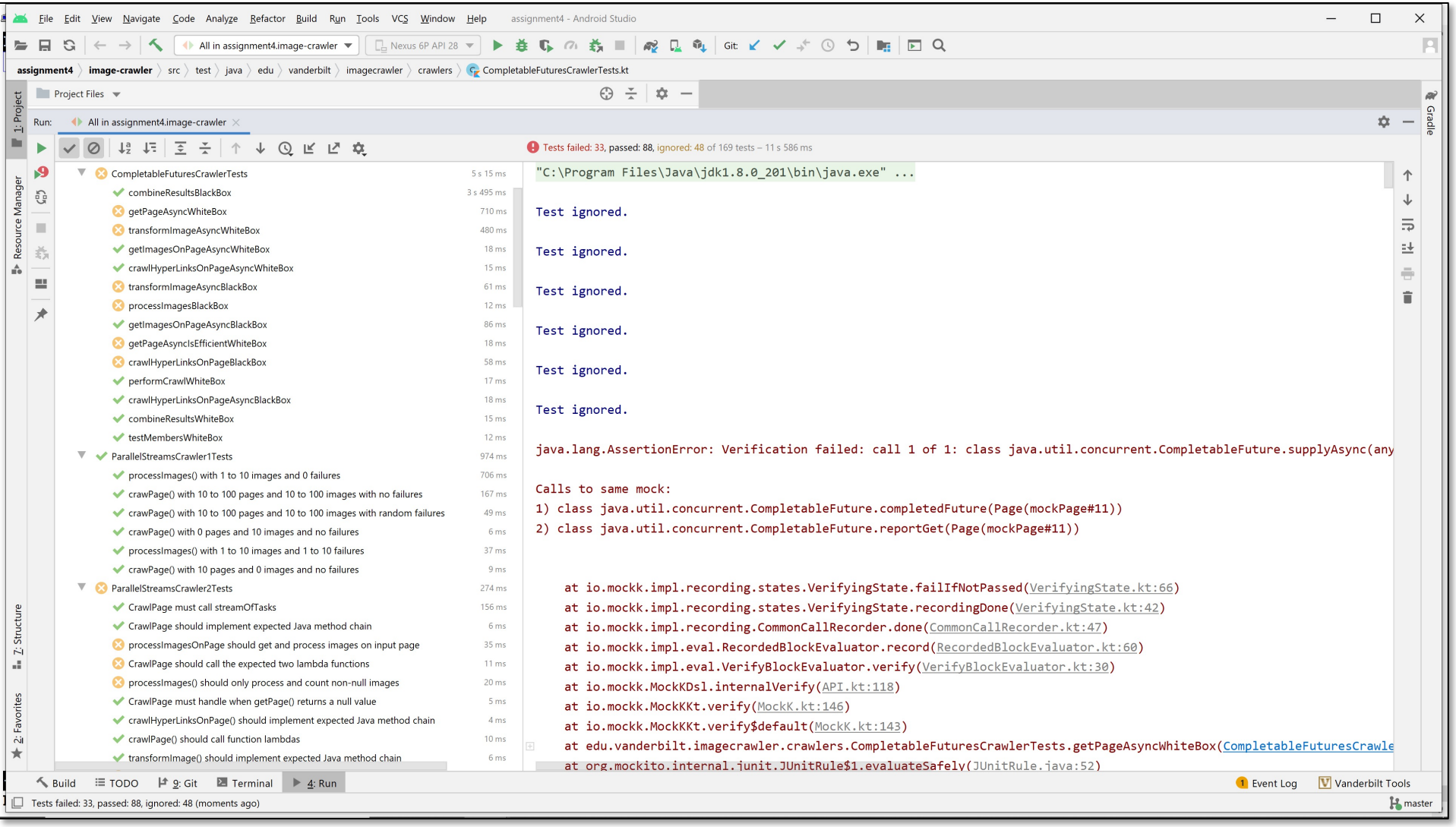
  - Work *must* be your own
    - This applies for quizzes & programming assignments



www.vanderbilt.edu/student_handbook/the-honor-system#statement-of-the-honor-code

Overview of Assignments & Assessments

- The bulk of your grade is based on the results of the automated unit tests



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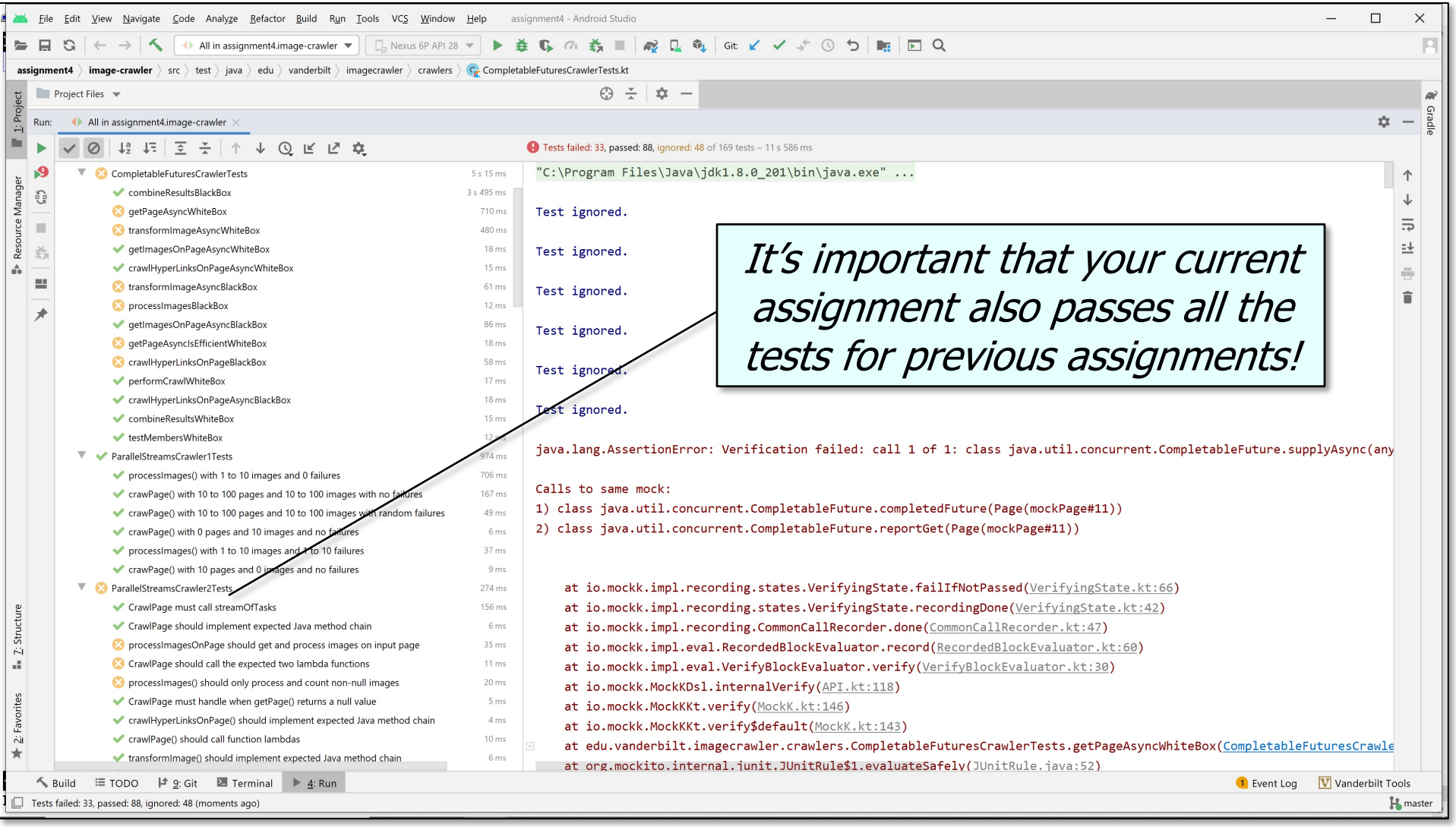

See item #16 at github.com/douglascraigschmidt/CS254/wiki/CS-254-FAQ

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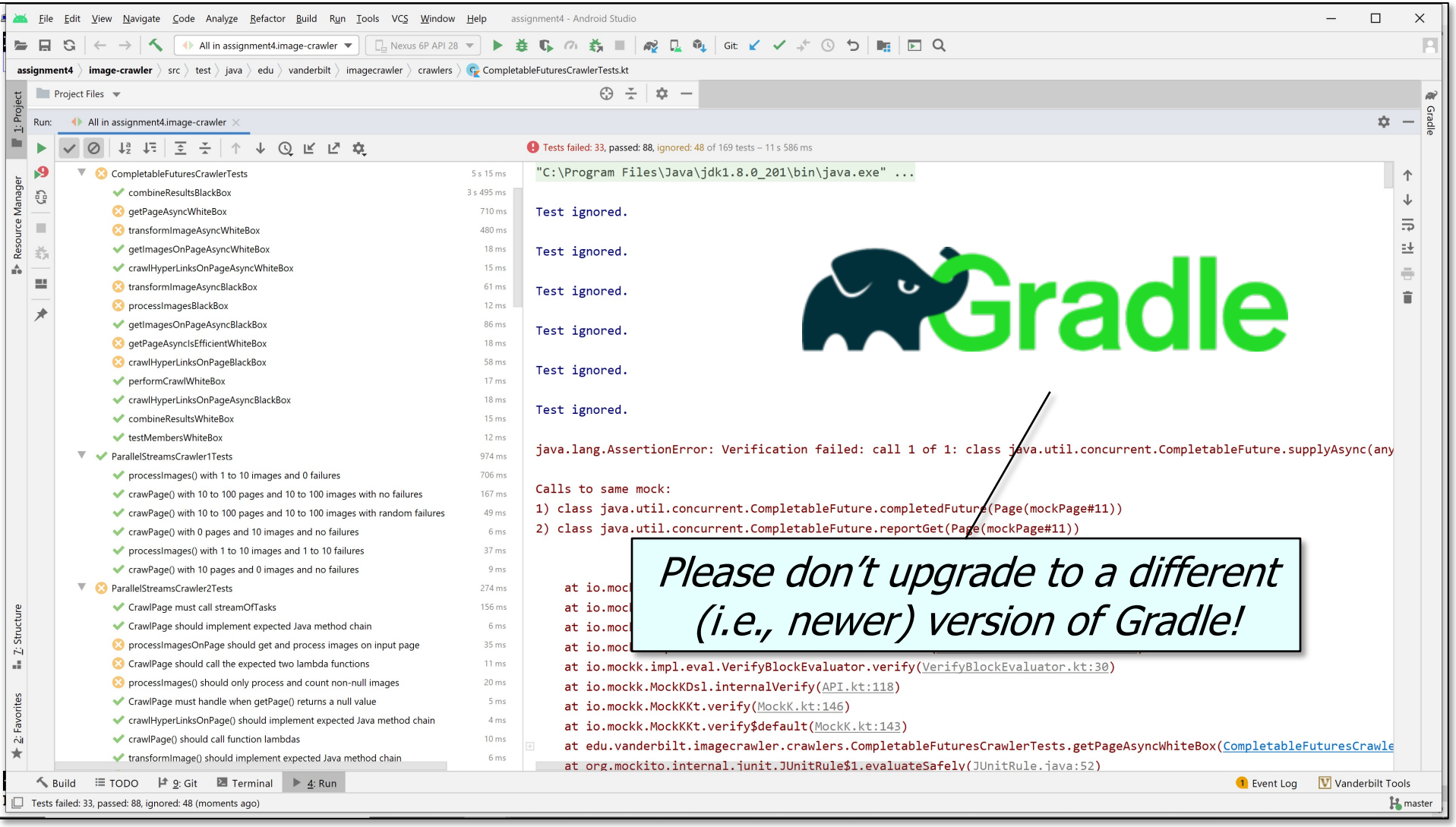
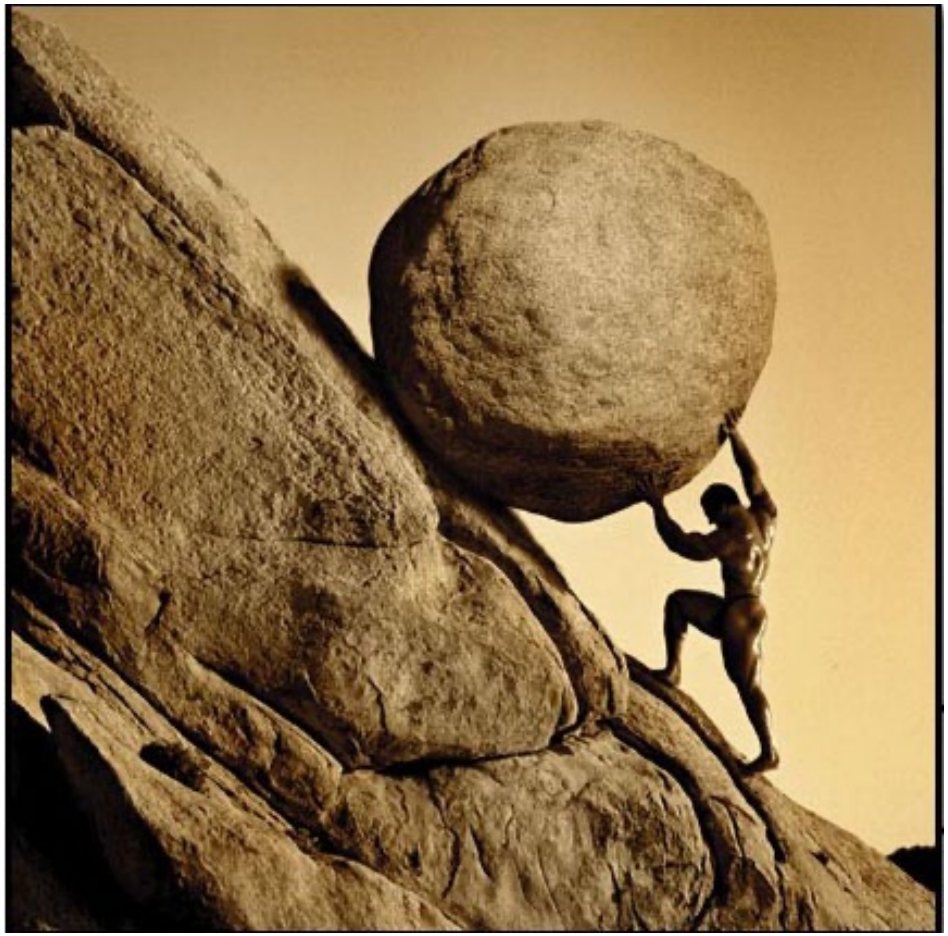


See item #17 at github.com/douglascraigschmidt/CS254/wiki/CS-254-FAQ

Overview of Assignments & Assessments

- The relative weighting of each portion of the course is:
  - 45% Quizzes
  - 40% Programming projects
  - 10% Final exam
  - 05% Participation



These weightings may change, depending on various factors

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    - Participation includes attendance, involvement, & "following directions"

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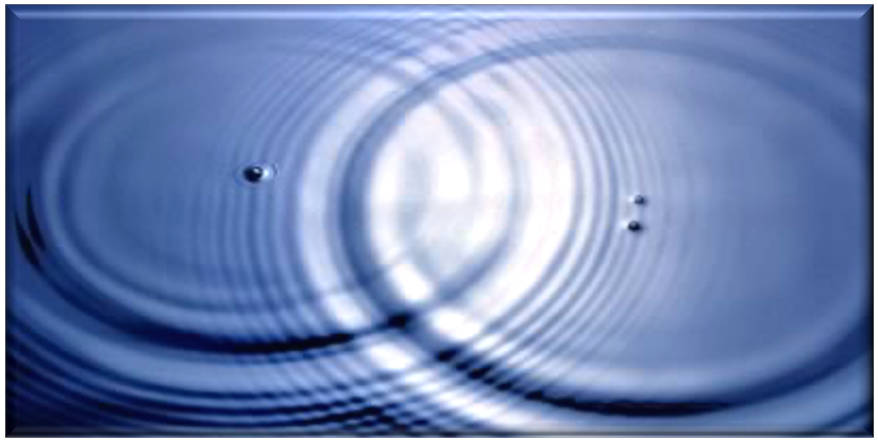
Attendance also affects other aspects of your quiz & assignment grades



See www.dre.vanderbilt.edu/~schmidt/cs254/work-summary.html#quizzes & www.dre.vanderbilt.edu/~schmidt/cs254/assignments.html

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Don't expect to get an A in this class if you do not actively participate!!!!

Setting Up the Android & Java IDE on Android Studio

Installing Java/Android Developer Tools

- To use Android, you need to install the latest release of Android Studio

Android Studio provides the fastest tools for building apps on every type of Android device.

Download Android Studio

2020.3.1 for Windows 64-bit (912 MiB)

Download options

Release notes

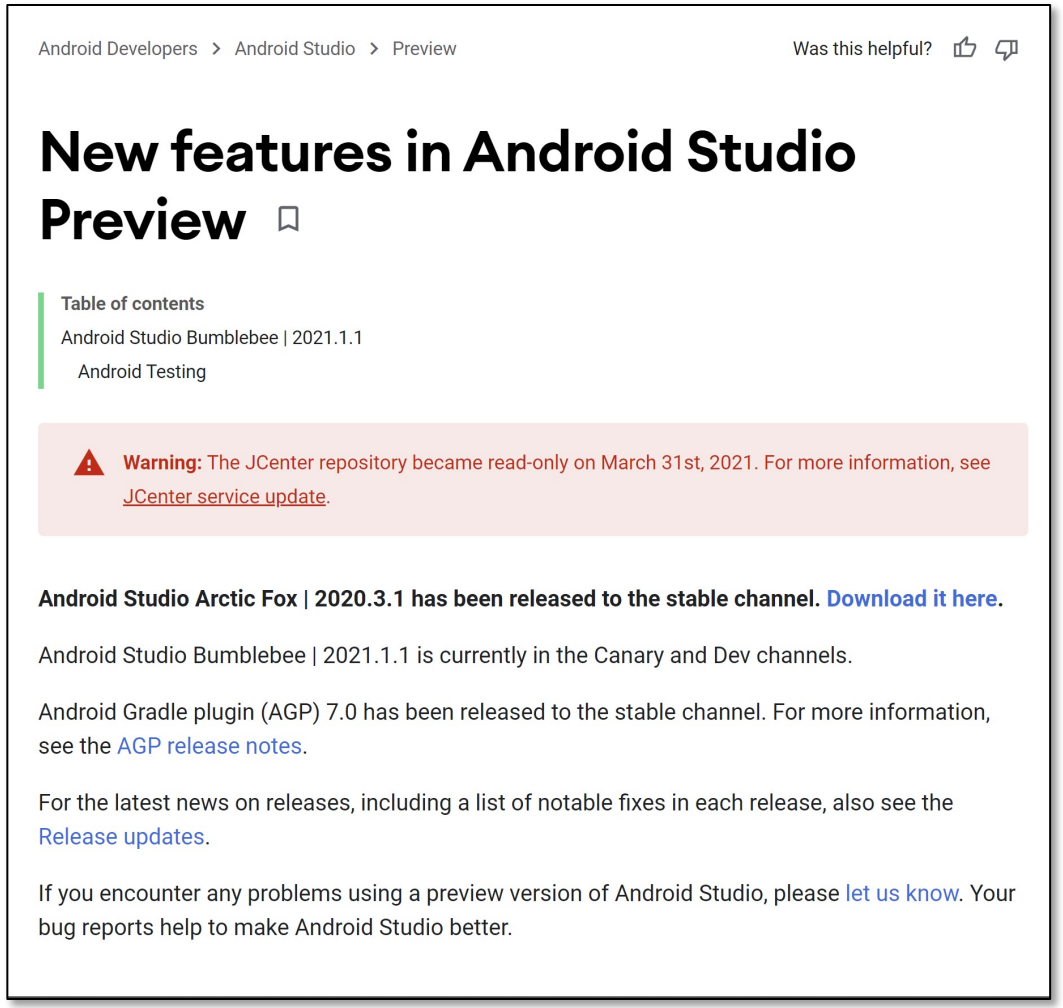
See developer.android.com/studio

Installing Java/Android Developer Tools

- Installation steps

Installing Java/Android Developer Tools

- Installation steps
  - Download & install the latest version of Android Studio



Android Developers > Android Studio > Preview

Was this helpful?

New features in Android Studio Preview

Table of contents

Android Studio Bumblebee | 2021.1.1

Android Testing

Warning: The JCenter repository became read-only on March 31st, 2021. For more information, see JCenter service update.

Android Studio Arctic Fox | 2020.3.1 has been released to the stable channel. Download it here.

Android Studio Bumblebee | 2021.1.1 is currently in the Canary and Dev channels.

Android Gradle plugin (AGP) 7.0 has been released to the stable channel. For more information, see the AGP release notes.

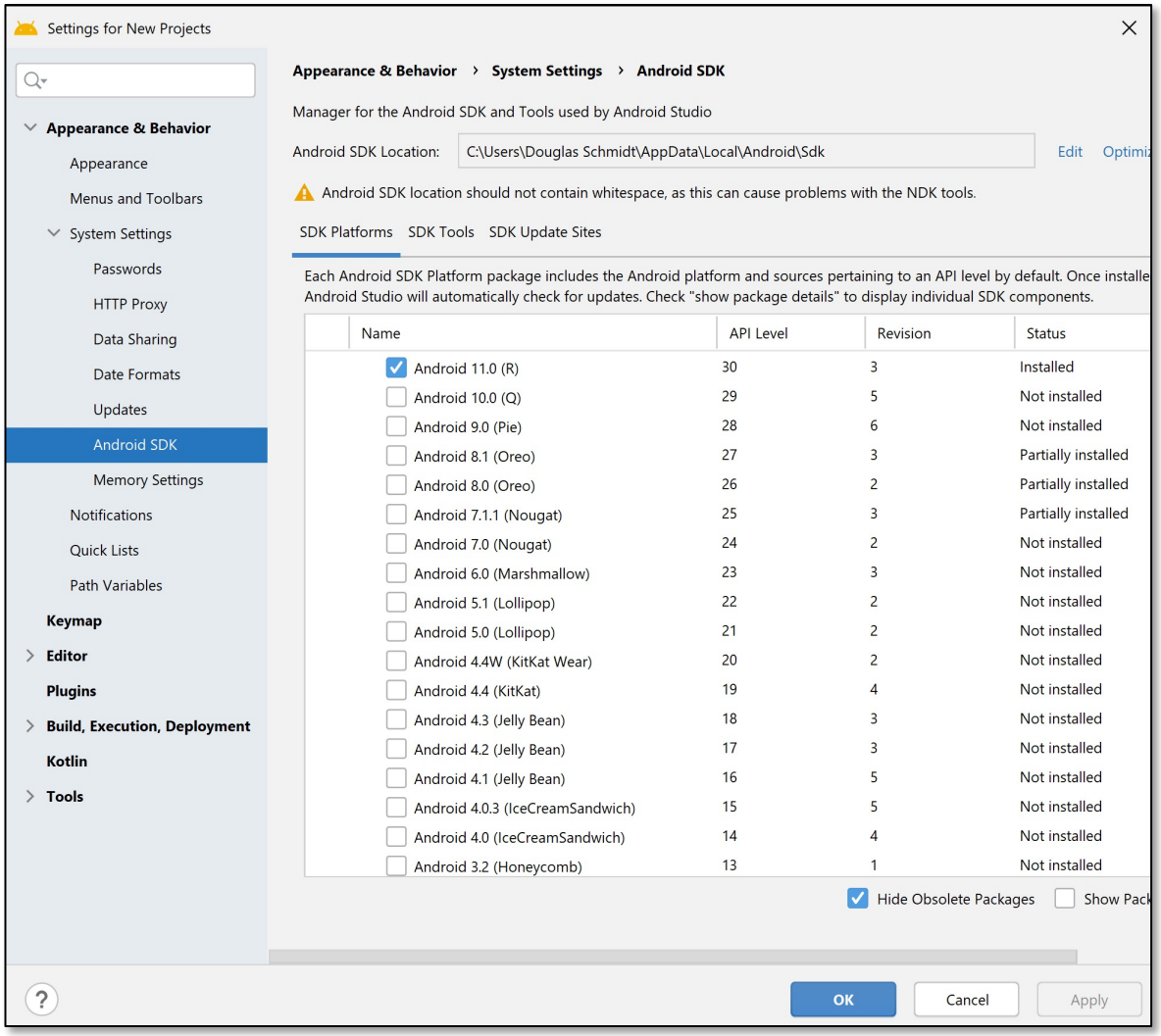
For the latest news on releases, including a list of notable fixes in each release, also see the Release updates.

If you encounter any problems using a preview version of Android Studio, please let us know. Your bug reports help to make Android Studio better.

See developer.android.com/studio

Add Components to the SDK

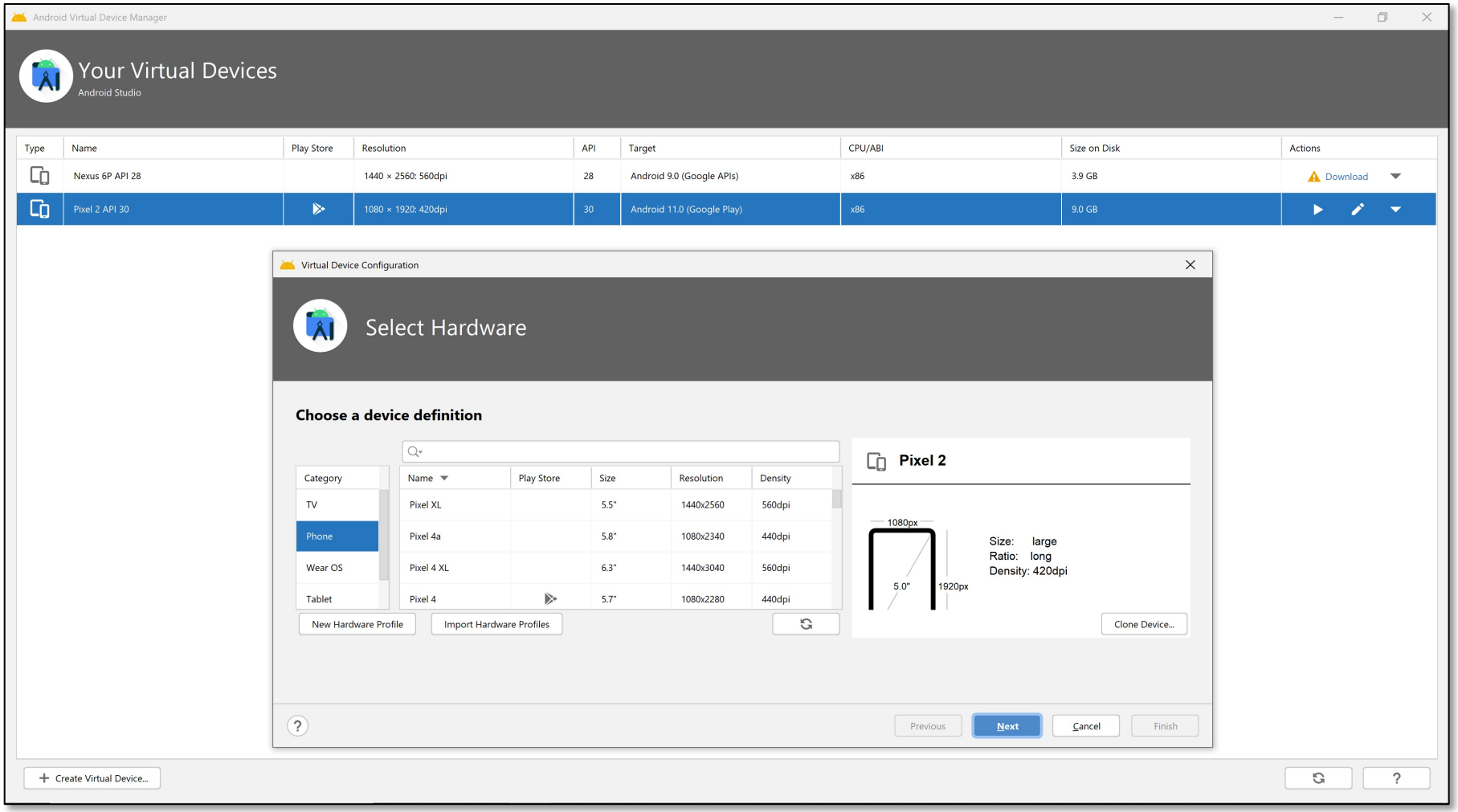
- Launch the Android Studio SDK Manager
  - Select "R" version of Android (11, API 30)



See developer.android.com/studio/intro/update.html

Add Components to the SDK

- Launch the Android Studio Virtual Device Manager
  - Create an Android API 30 emulator



developer.android.com/tools/devices/managing-avds.html

Intel HAXM Virtualization Driver

- **Requirements**
  - Intel virtualization extensions (VT, VT-x, vmx)
  - AMD virtualization extensions (AMD-v, SVM) [only supported on Linux]
  - Download an x86 emulator image
- **Windows & Mac OSX**
  - <sdk>/extras/intel/Hardware_Accelerated_Execution_Manager/IntelHAXM.exe/dmg
- **Linux**
  - Install KVM & pass "-enable-kvm" flag to emulator when starting

developer.android.com/studio/run/emulator-acceleration

Setting Up GitLab et al.

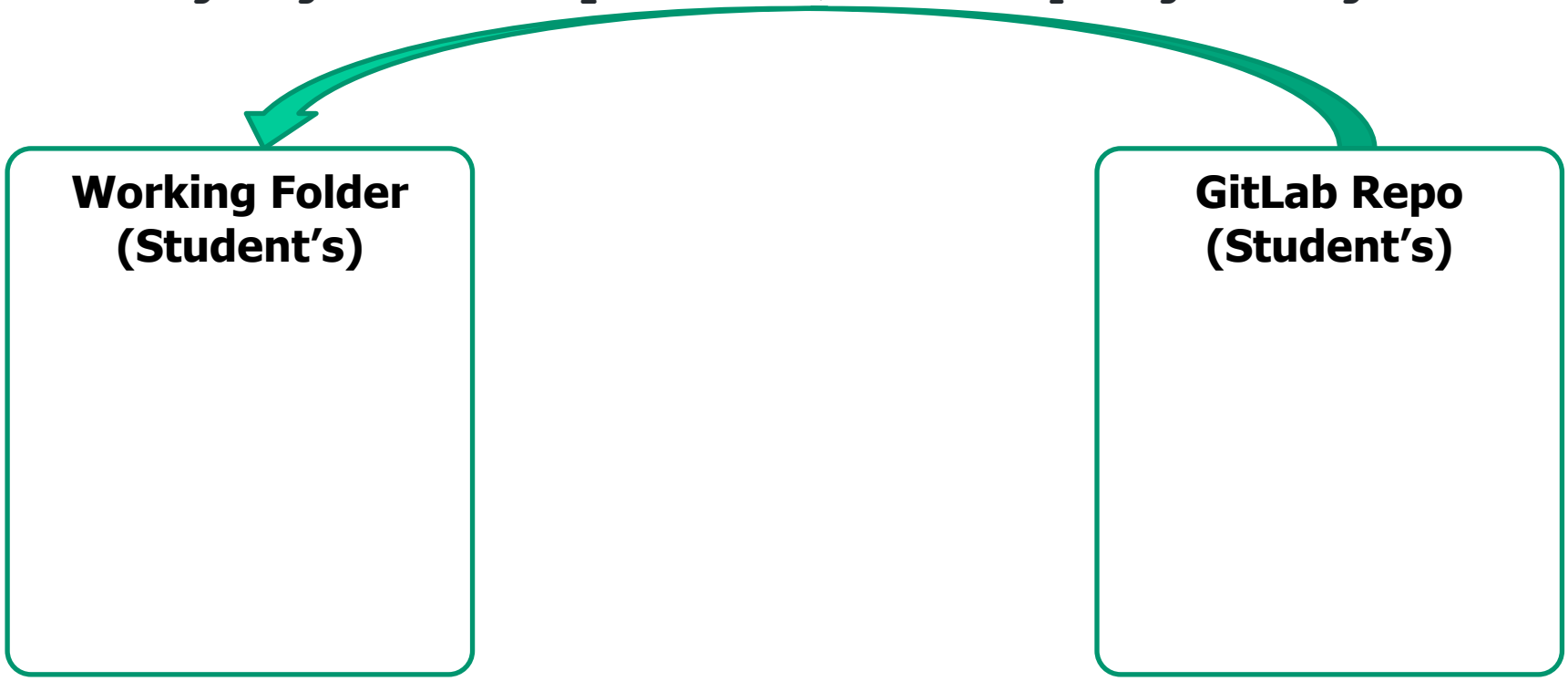
Setting Up GitLab et al.

1. Create Your GitLab Repo

`www.gitlab.com`

2. Clone your GitLab repo

```
git clone git@gitlab.com:your-name/CS-254-spring-2022.git
```




```
cd CS-254-spring-2022
```

3. Change Director into Your Working Folder

See docs.gitlab.com/ee/ssh for info on setting up an SSH key for GitLab et al.

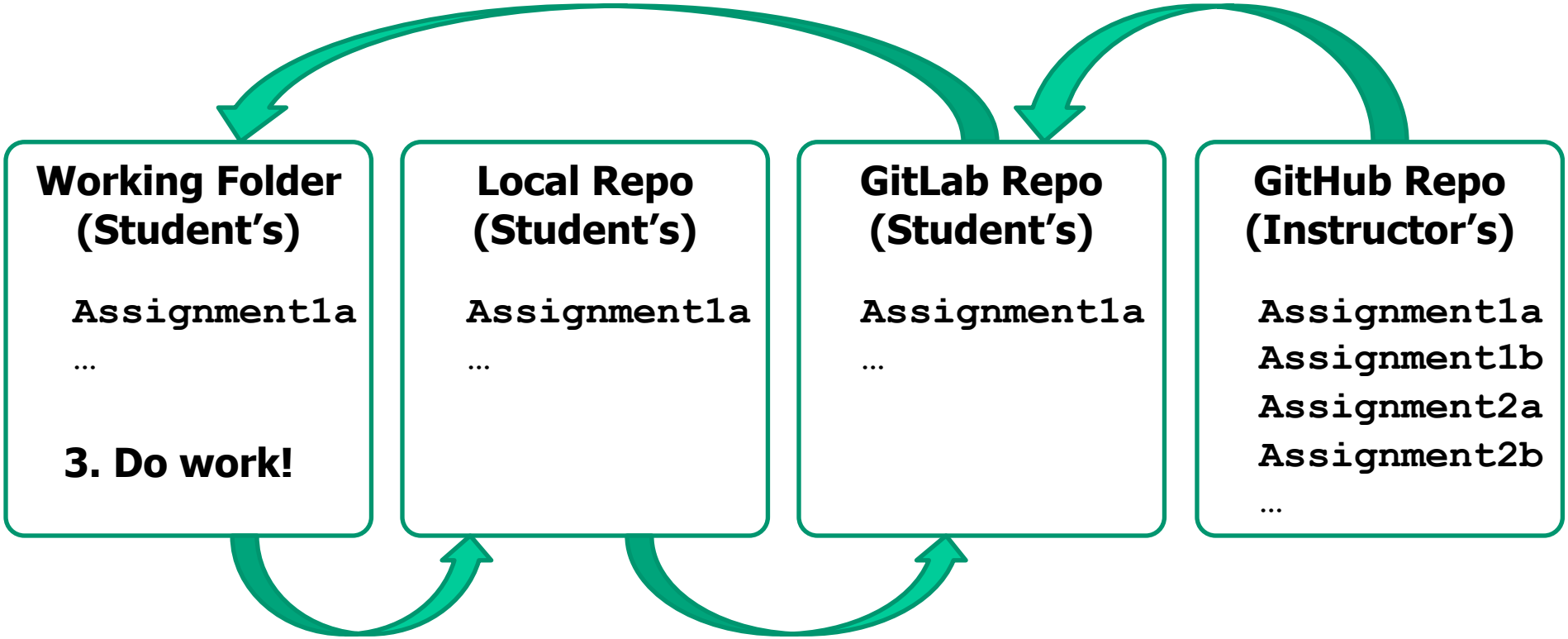
Setting Up GitLab et al.

1. Update from Read-Only GitHub Repo

```
git remote add skeletons
  git@github.com:douglascraigschmidt/CS254.git
```

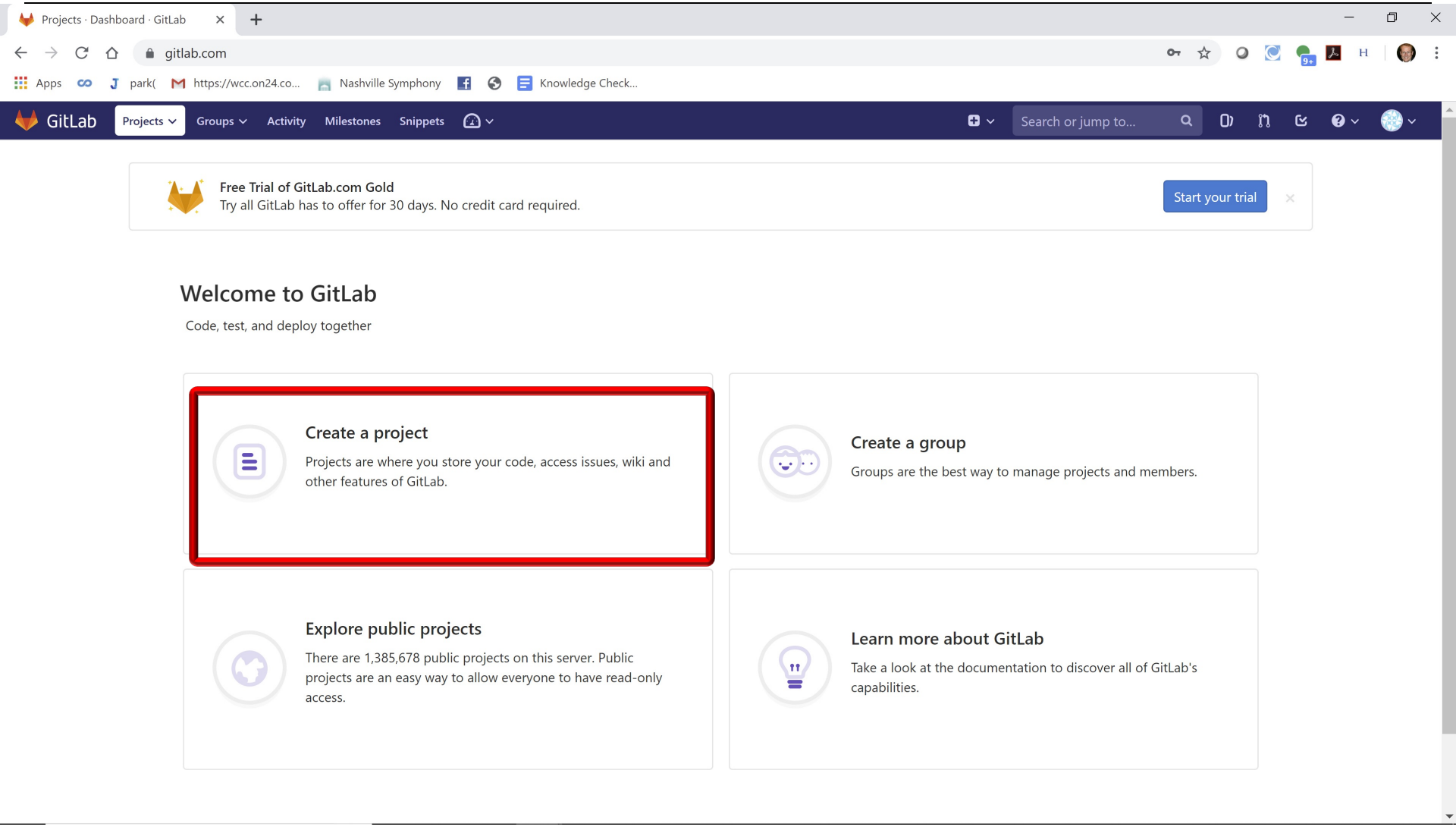
2. Get Current Version

```
git pull skeletons master
```

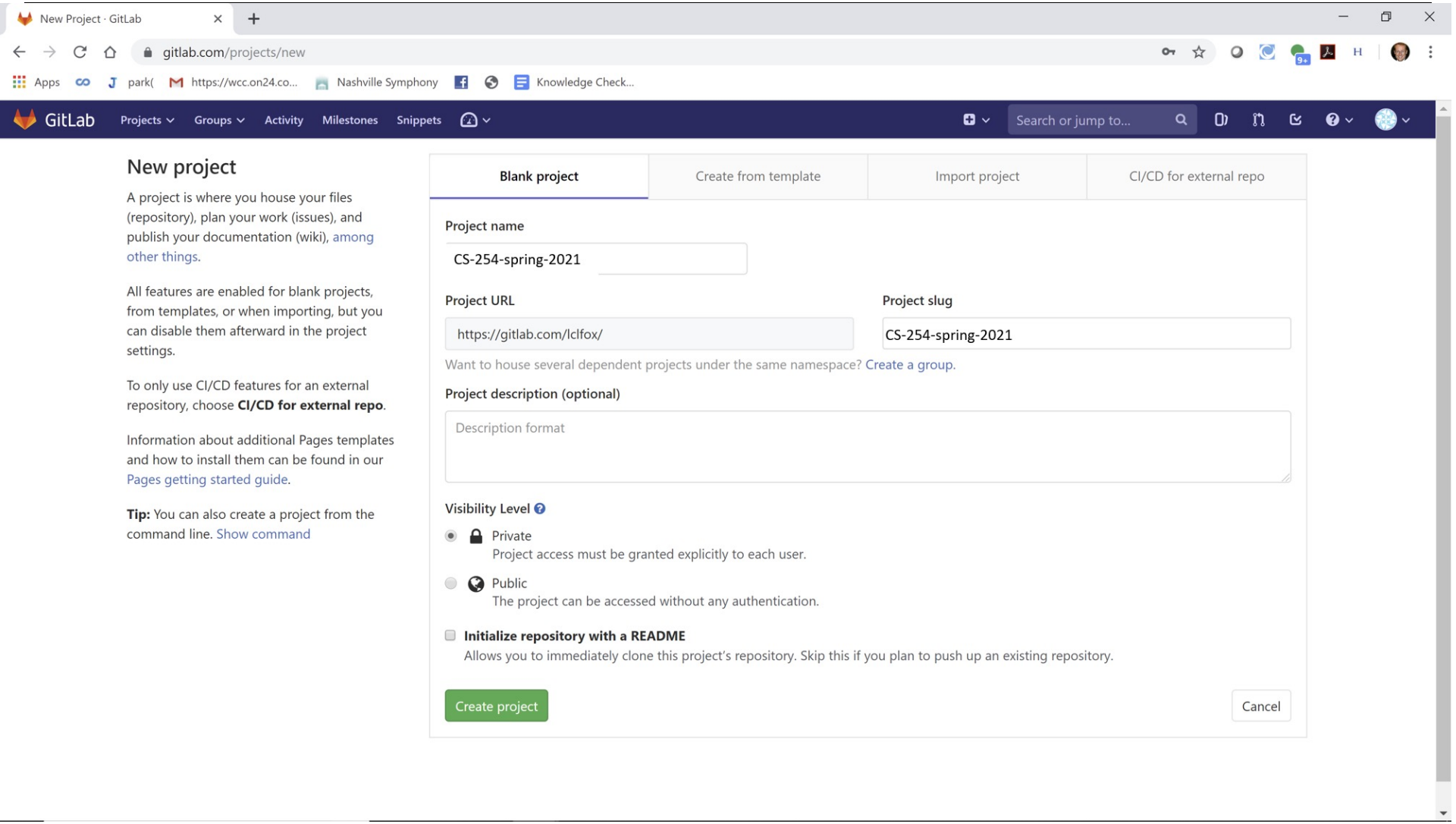


See item #13 at github.com/douglascraigschmidt/CS254/wiki/CS-254-FAQ

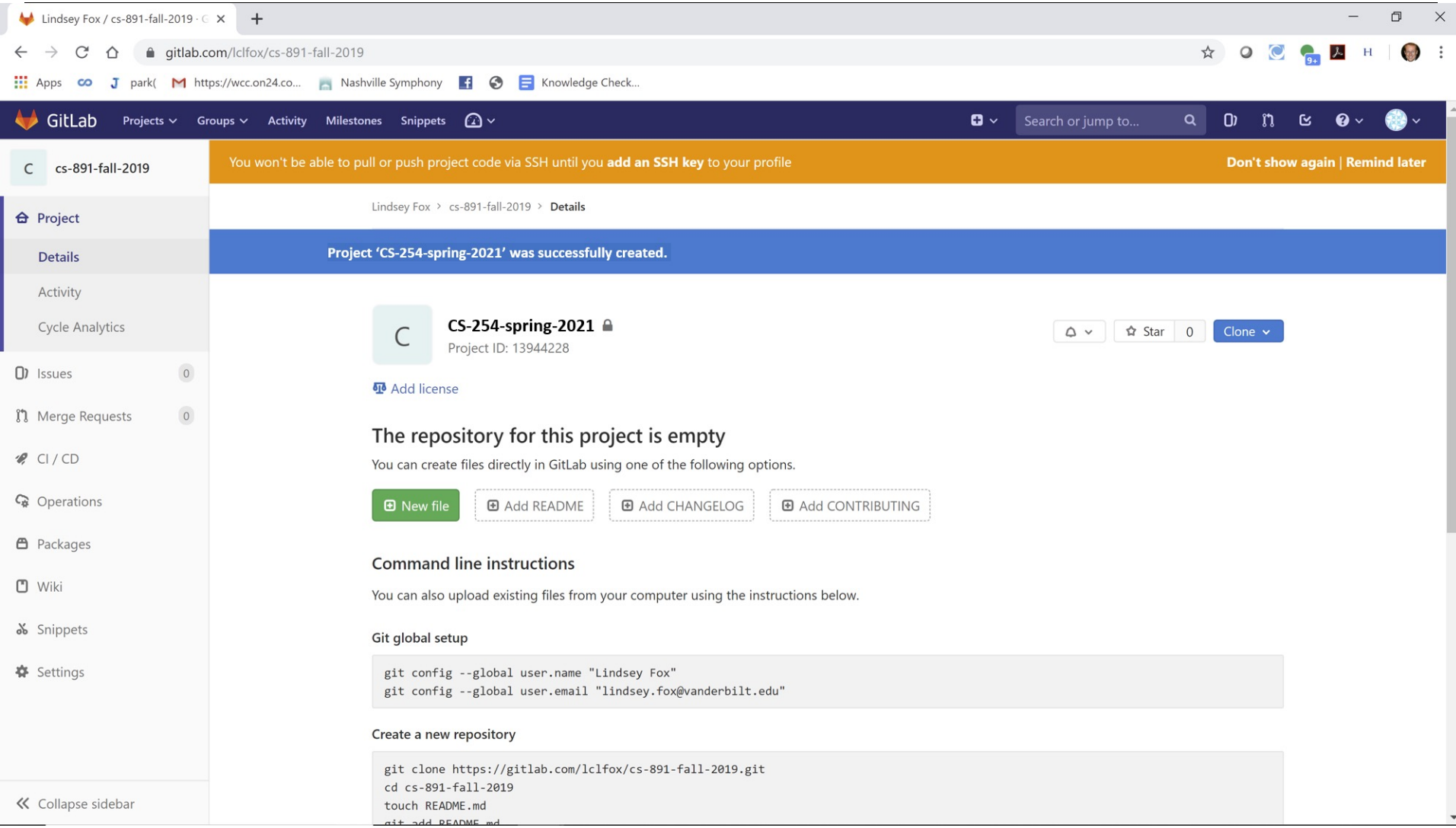
Setting Up GitLab et al.



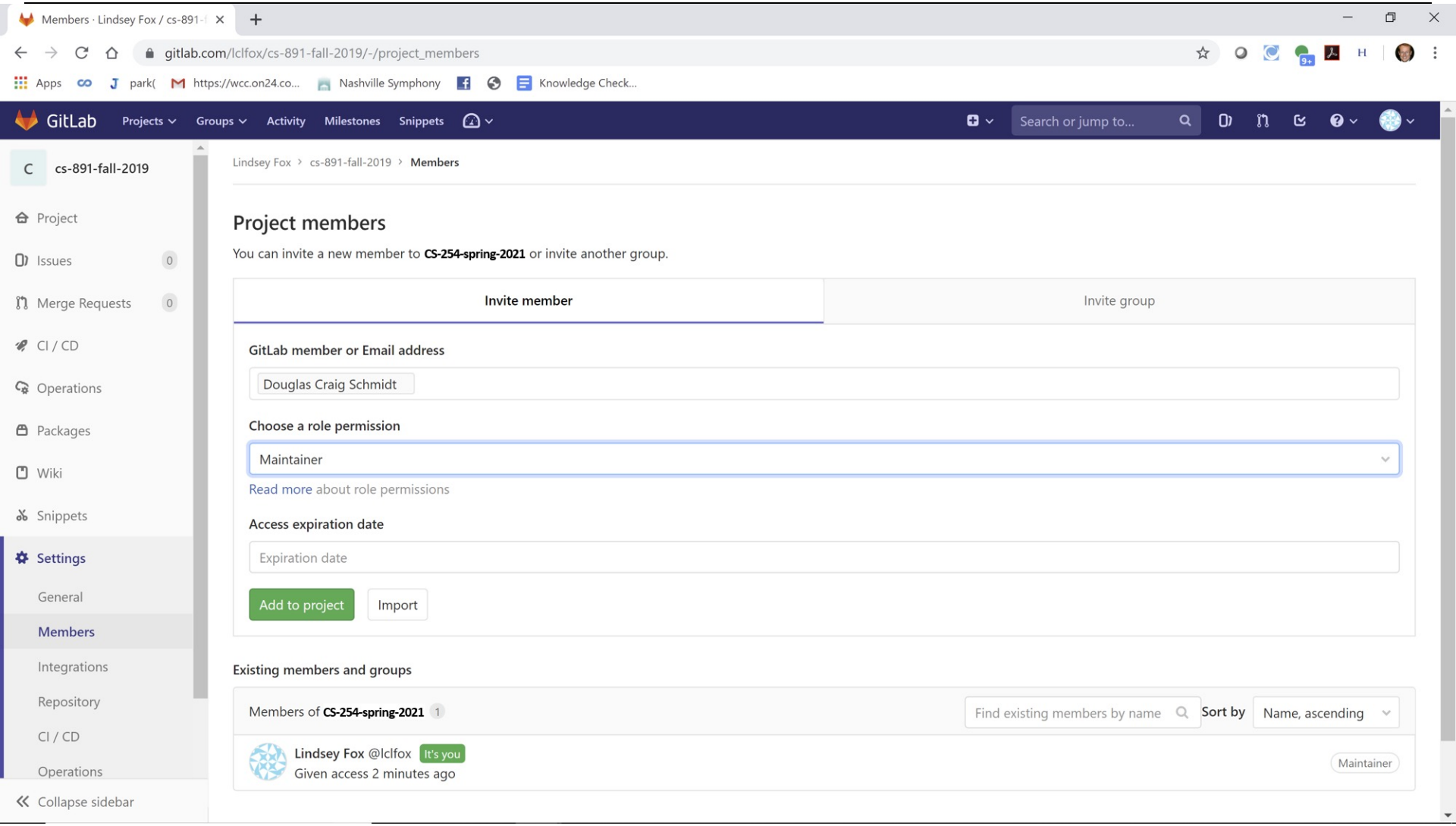
Setting Up GitLab et al.



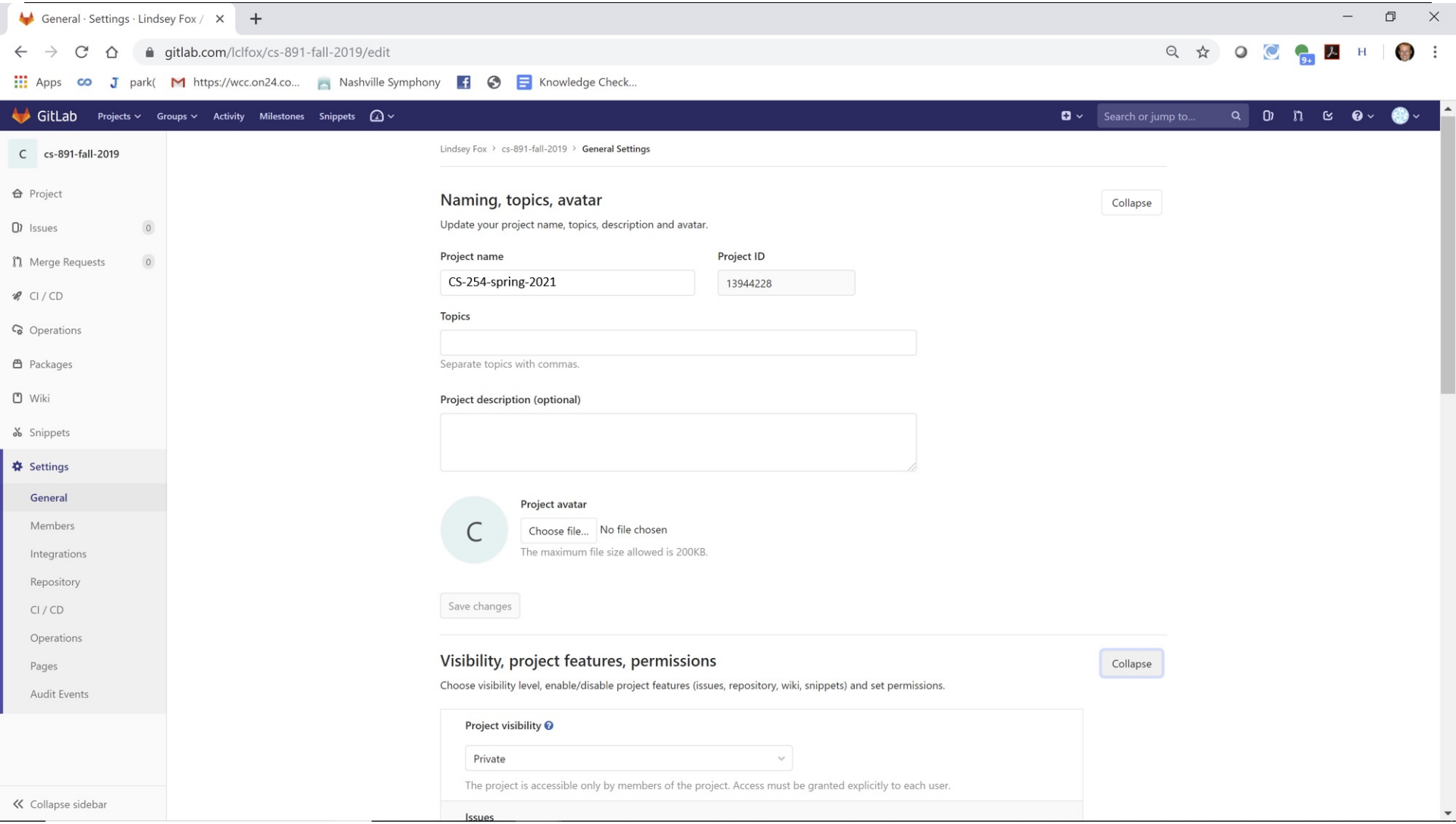
Setting Up GitLab et al.



Setting Up GitLab et al.



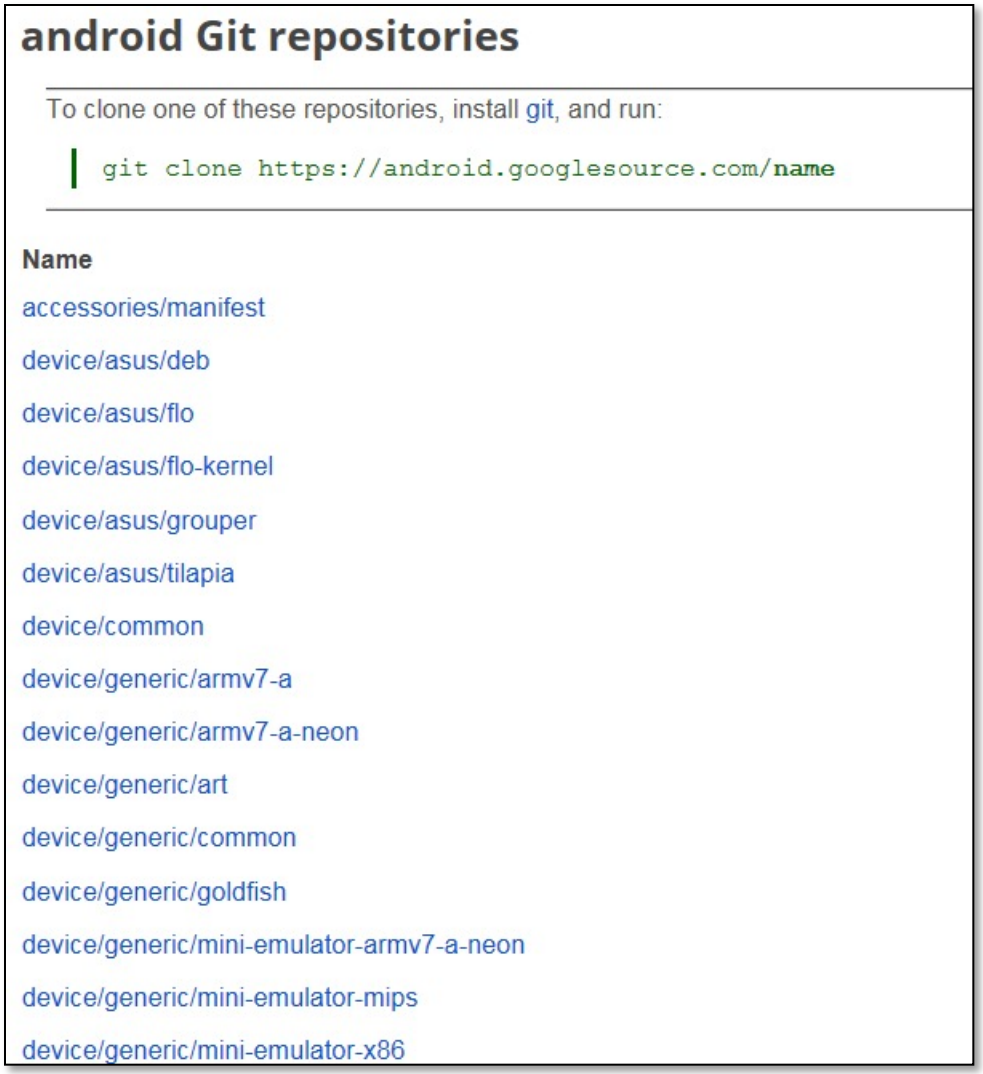
Setting Up GitLab et al.



Accessing Java & Android Source Code

Accessing Java & Android Source Code

- Android source code is available
  - For browsing android.googlesource.com



Accessing Java & Android Source Code

- Android source code is available
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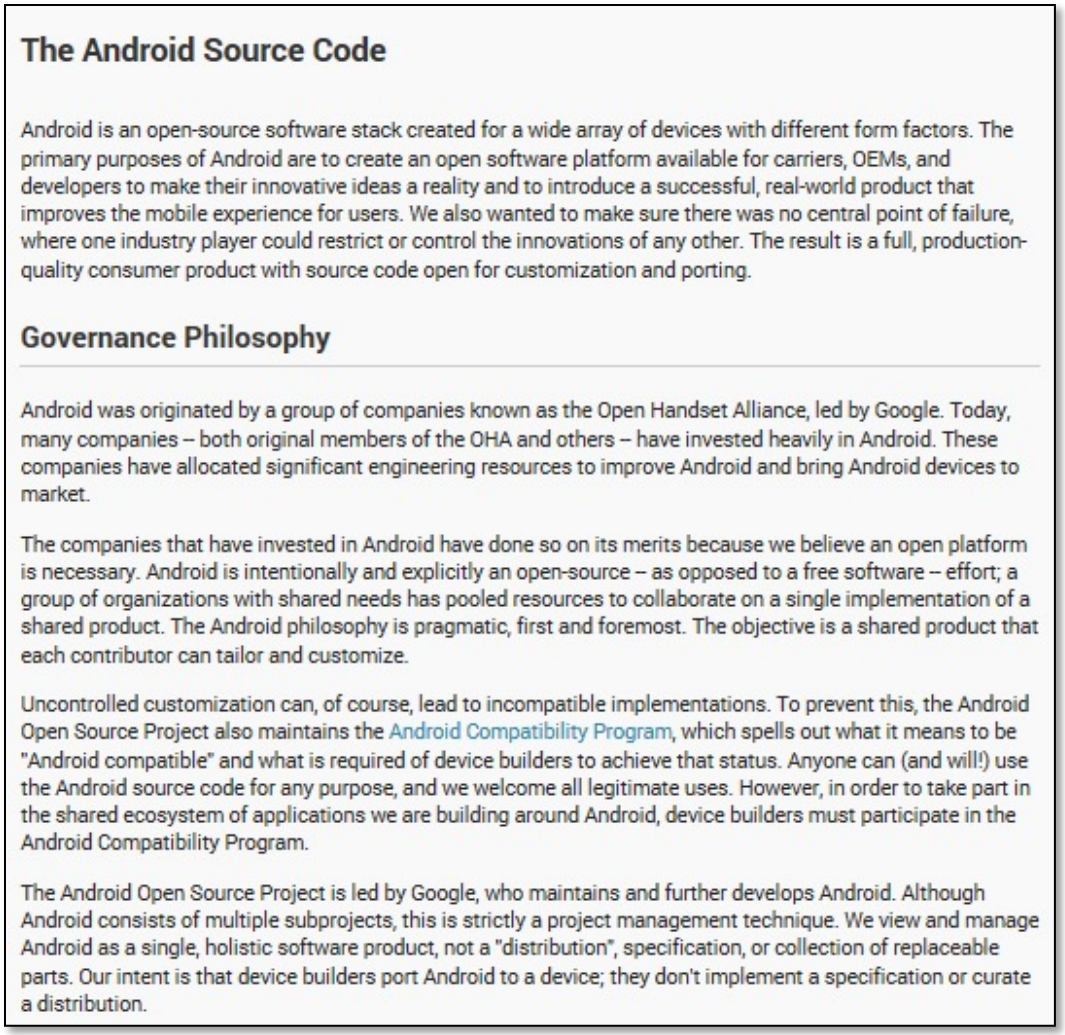
  - For downloading source.android.com



The Android Source Code

Android is an open-source software stack created for a wide array of devices with different form factors. The primary purposes of Android are to create an open software platform available for carriers, OEMs, and developers to make their innovative ideas a reality and to introduce a successful, real-world product that improves the mobile experience for users. We also wanted to make sure there was no central point of failure, where one industry player could restrict or control the innovations of any other. The result is a full, production-quality consumer product with source code open for customization and porting.

Governance Philosophy

Android was originated by a group of companies known as the Open Handset Alliance, led by Google. Today, many companies -- both original members of the OHA and others -- have invested heavily in Android. These companies have allocated significant engineering resources to improve Android and bring Android devices to market.

The companies that have invested in Android have done so on its merits because we believe an open platform is necessary. Android is intentionally and explicitly an open-source -- as opposed to a free software -- effort; a group of organizations with shared needs has pooled resources to collaborate on a single implementation of a shared product. The Android philosophy is pragmatic, first and foremost. The objective is a shared product that each contributor can tailor and customize.

Uncontrolled customization can, of course, lead to incompatible implementations. To prevent this, the Android Open Source Project also maintains the Android Compatibility Program, which spells out what it means to be "Android compatible" and what is required of device builders to achieve that status. Anyone can (and will!) use the Android source code for any purpose, and we welcome all legitimate uses. However, in order to take part in the shared ecosystem of applications we are building around Android, device builders must participate in the Android Compatibility Program.

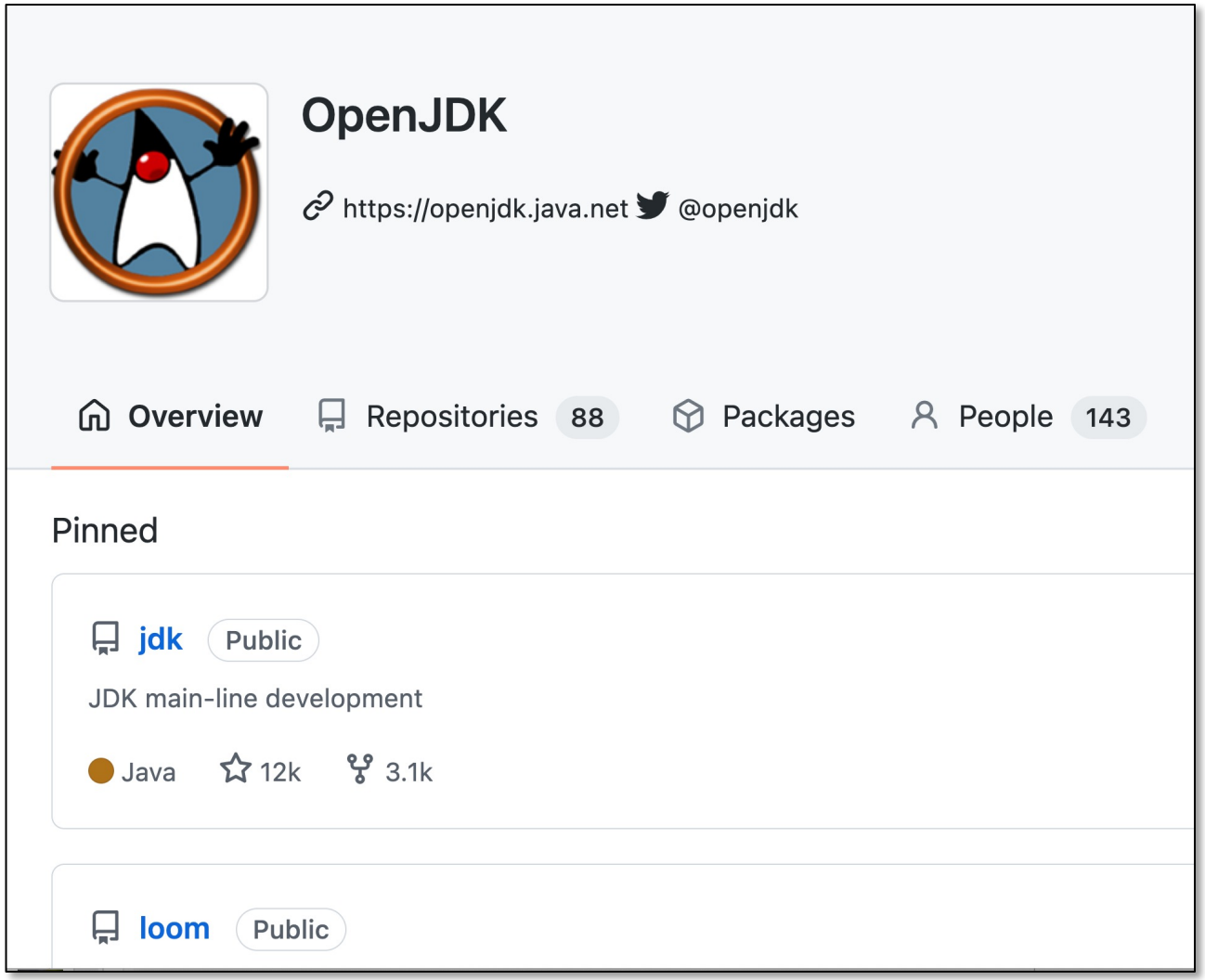
The Android Open Source Project is led by Google, who maintains and further develops Android. Although Android consists of multiple subprojects, this is strictly a project management technique. We view and manage Android as a single, holistic software product, not a "distribution", specification, or collection of replaceable parts. Our intent is that device builders port Android to a device; they don't implement a specification or curate a distribution.

Accessing Java & Android Source Code

- Java 11 source code is available
  - For browsing zgrepcode.com

Accessing Java & Android Source Code

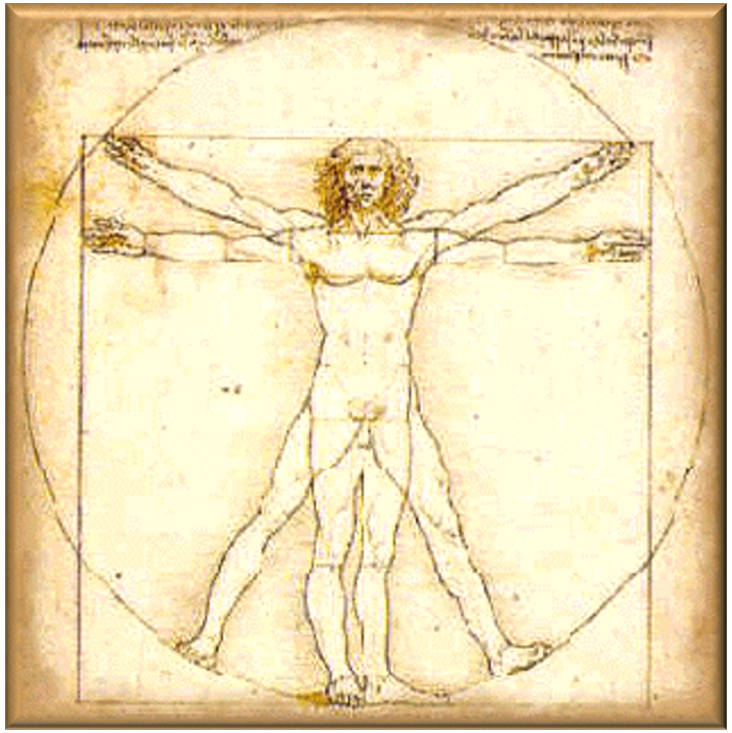
- Java 11 source code is available
  - For browsing zgrepcode.com
  - For downloading github.com/openjdk



Summary

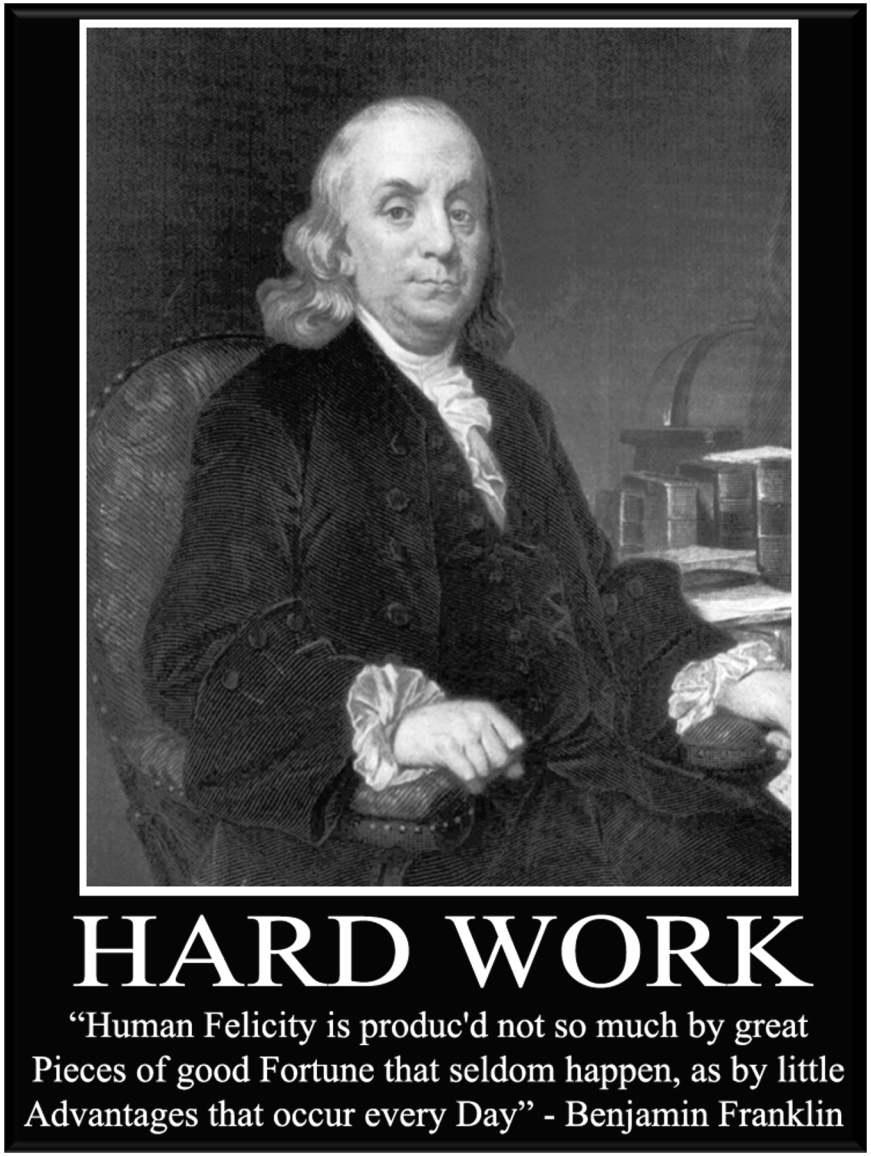
Summary

- You will get out of this course what you put into it



Summary

- You will get out of this course what you put into it
  - Be prepared to work hard



Summary

- You will get out of this course what you put into it
  - Be prepared to work hard
  - Do *not* miss deadlines…

See github.com/douglascraigschmidt/CS254/wiki/Assignment-Deadlines

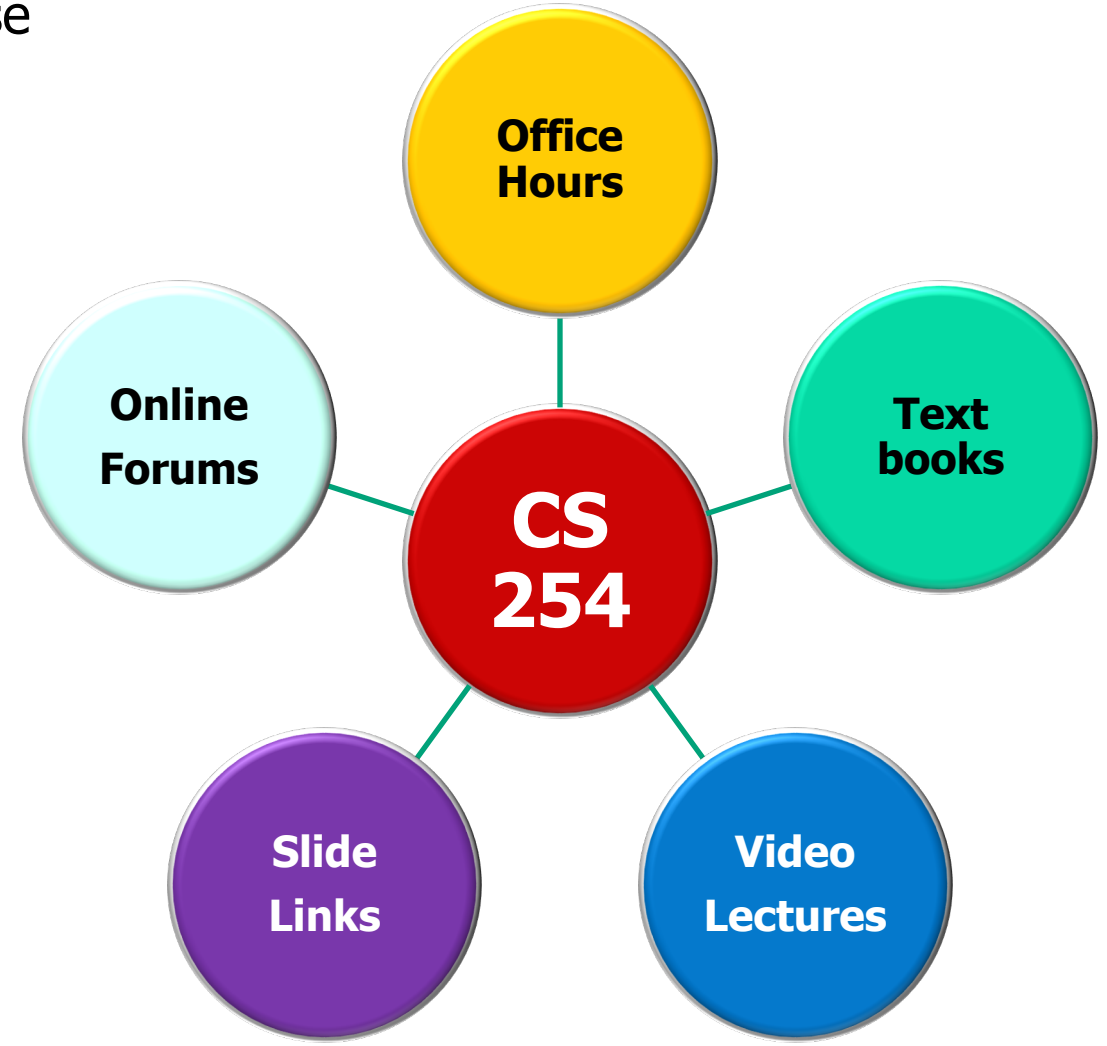
Summary

- You will get out of this course what you put into it
  - Be prepared to work hard
  - Do *not* miss deadlines…
  - Participate in discussions in class & on piazza

See piazza.com/vanderbilt/spring2022/cs254

Summary

- You will get out of this course what you put into it
  - Be prepared to work hard
  - Do *not* miss deadlines…
  - Participate in discussions in class & on piazza
- Avail yourself of available resources



See www.dre.vanderbilt.edu/~schmidt/cs254

Summary

- You will get out of this course what you put into it
  - Be prepared to work hard
  - Do *not* miss deadlines…
  - Participate in discussions in class & on piazza
  - Avail yourself of available resources

Please resist the urge to email me directly unless it's a confidential matter or you'd like to schedule a meeting!

Summary

- There are abundant opportunities!

BROAD CATEGORY	2020 SALARY PROJECTION	2019 SALARY PROJECTION	% CHANGE
Engineering	$69,961	$69,188	1.1%
Computer Science	$67,411	$67,539	-0.2%
Math & Sciences	$62,488	$62,177	0.5%
Business	$57,939	$57,657	0.5%
Social Sciences	$57,425	$57,310	0.2%
Communications	$56,484	$52,056	8.5%
Humanities	$53,617	$56,651	-5.4%
Agriculture & Natural Resources	$53,504	$55,750	-4.0%

See www.naceweb.org/job-market/compensation/starting-salary-projections-for-top-earning-degrees-level

Summary

- If there's an emergency, pay attention to the escape route!
  - See engineering.vanderbilt.edu/about/evacuationplans.php