# CS 891: Scalable Microservices: Overview (Part 2)

**Douglas C. Schmidt**
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

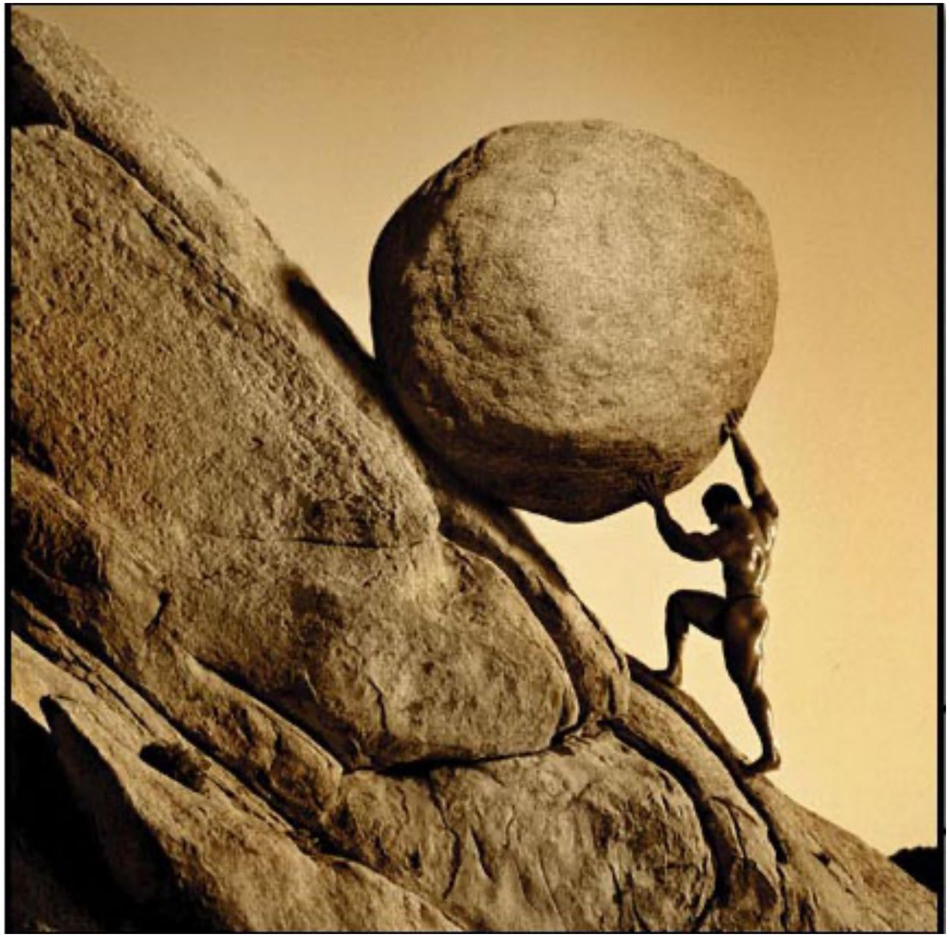
Professor of Computer Science

Institute for Software
Integrated Systems

Vanderbilt University
Nashville, Tennessee, USA

# Learning Objectives in this Lesson

- Understand the course topics & logistics
  - Course philosophy
  - Course contents
  - Structure of the lecture material
  - Overview of the assignments & assessments



# Overview of Assignments & Assessments

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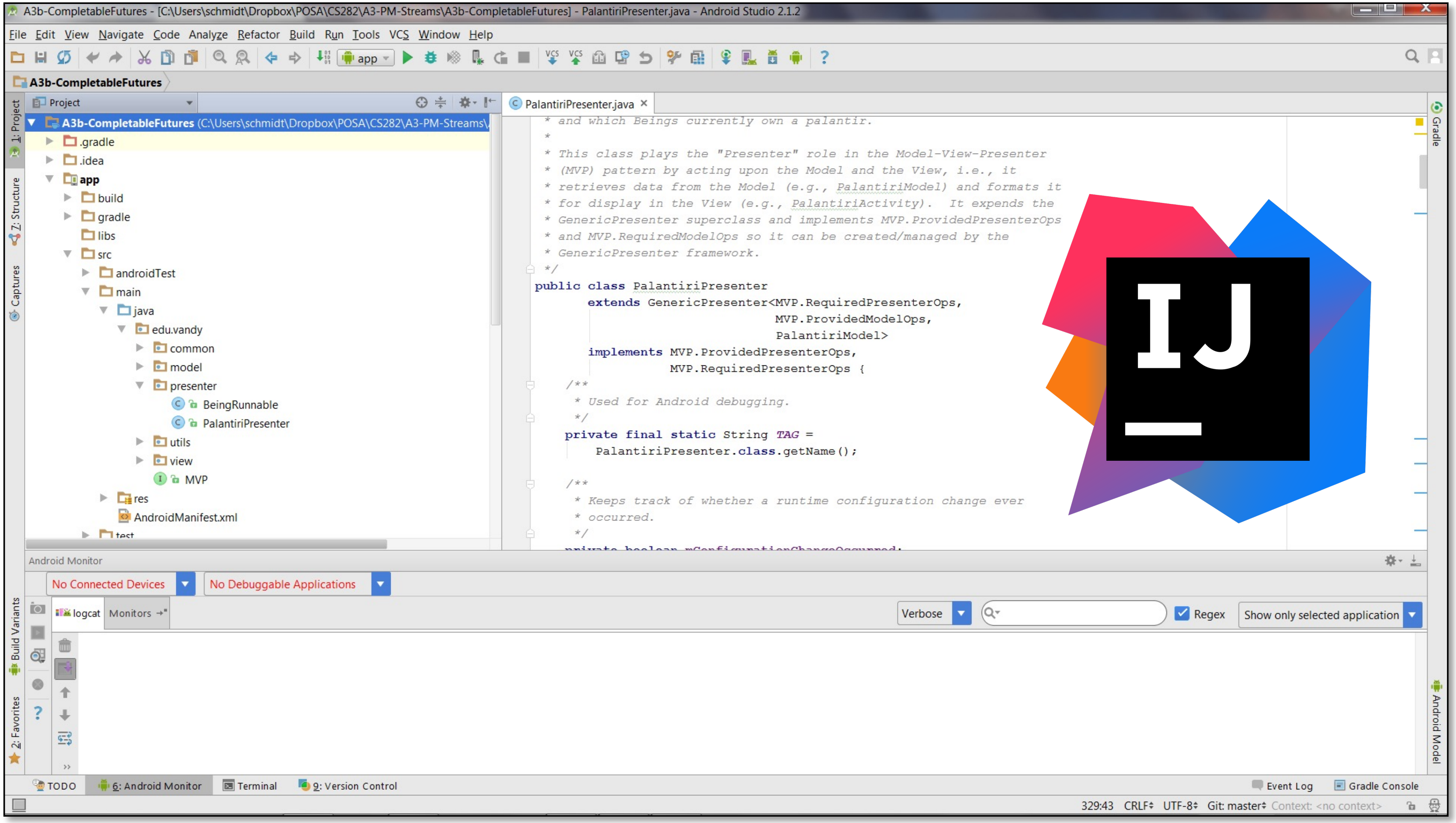
- Programming assignments are written in modern Java using IntelliJ



```java
 * and which Beings currently own a palantir.
 *
 * This class plays the "Presenter" role in the Model-View-Presenter
 * (MVP) pattern by acting upon the Model and the View, i.e., it
 * retrieves data from the Model (e.g., PalantiriModel) and formats it
 * for display in the View (e.g., PalantiriActivity).  It expends the
 * GenericPresenter superclass and implements MVP.ProvidedPresenterOps
 * and MVP.RequiredModelOps so it can be created/managed by the
 * GenericPresenter framework.
 */
public class PalantiriPresenter
       extends GenericPresenter<MVP.RequiredPresenterOps,
                                MVP.ProvidedModelOps,
                                PalantiriModel>
       implements MVP.ProvidedPresenterOps,
                  MVP.RequiredPresenterOps {
    /**
     * Used for Android debugging.
     */
    private final static String TAG =
        PalantiriPresenter.class.getName();

    /**
     * Keeps track of whether a runtime configuration change ever
     * occurred.
     */
    private boolean mConfigurationChangeOccurred;
```

You can use any IDE, but your final submission *must* build & run with the latest IntelliJ & Java 19

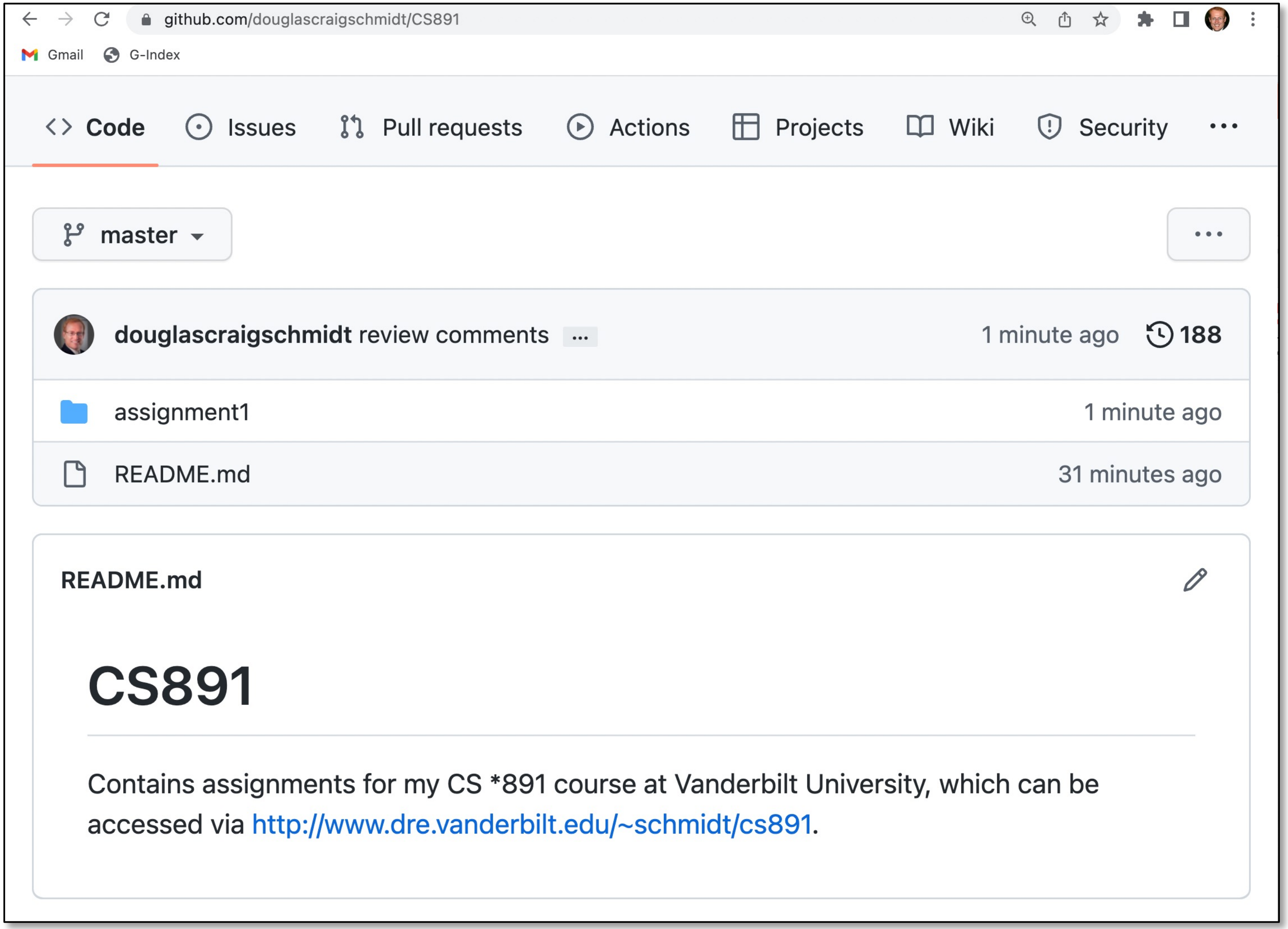
# Overview of Assignments & Assessments

- Programming assignments are written in modern Java using IntelliJ
  - The Java 19 runtime environment (JRE) can be downloaded via IntelliJ

See github.com/douglascraigschmidt/CS891/wiki/Installing-Software

# Overview of Assignments & Assessments

- All source code for assignments & examples available at GitHub



douglascraigschmidt review comments ... 1 minute ago 188

| | |
|---|---|
| assignment1 | 1 minute ago |
| README.md | 31 minutes ago |

README.md

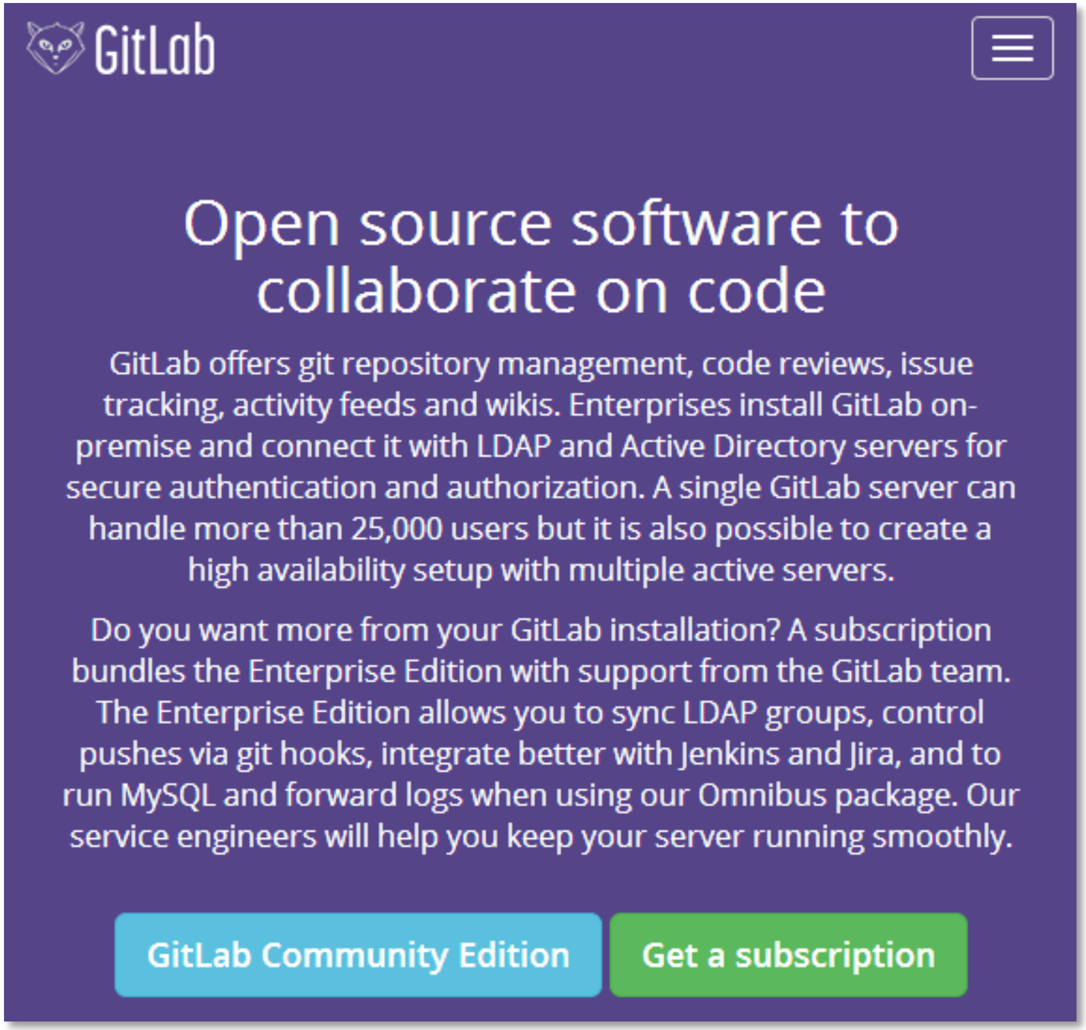
## CS891

Contains assignments for my CS *891 course at Vanderbilt University, which can be accessed via http://www.dre.vanderbilt.edu/~schmidt/cs891.

Go to GitHub at github.com/douglascraigschmidt/CS891

# Overview of Assignments & Assessments

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



## Open source software to collaborate on code

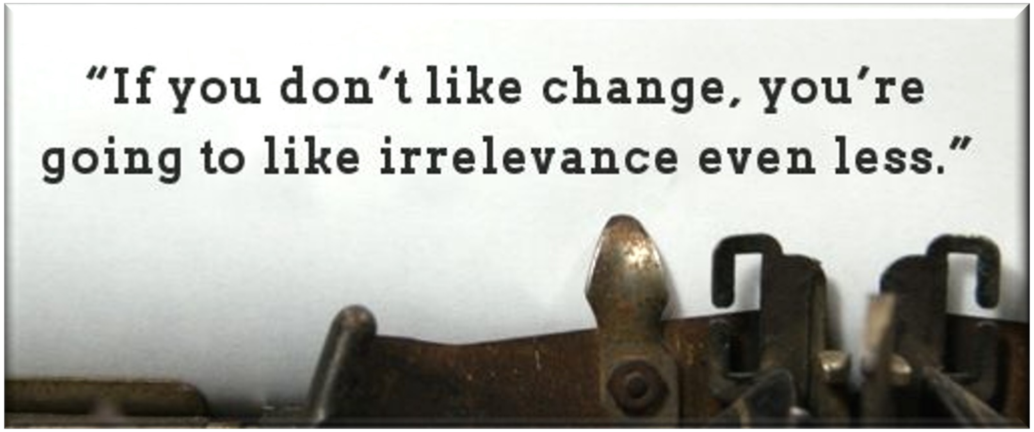
GitLab offers git repository management, code reviews, issue tracking, activity feeds and wikis. Enterprises install GitLab on-premise and connect it with LDAP and Active Directory servers for secure authentication and authorization. A single GitLab server can handle more than 25,000 users but it is also possible to create a high availability setup with multiple active servers.

Do you want more from your GitLab installation? A subscription bundles the Enterprise Edition with support from the GitLab team. The Enterprise Edition allows you to sync LDAP groups, control pushes via git hooks, integrate better with Jenkins and Jira, and to run MySQL and forward logs when using our Omnibus package. Our service engineers will help you keep your server running smoothly.

We'll discuss how to setup GitLab shortly

# Overview of Assignments & Assessments

- All source code for assignments & exam
  - You will need to learn how to use GitLab et al.
  - Be prepared to update your repositories occasionally



"If you don't like change, you're going to like irrelevance even less."

# Overview of Assignments & Assessments

- Assignments will provide a range of experience with modern Java concurrent & parallel microservices

Go to GitHub at [github.com/douglascraigschmidt/CS891](https://github.com/douglascraigschmidt/CS891)

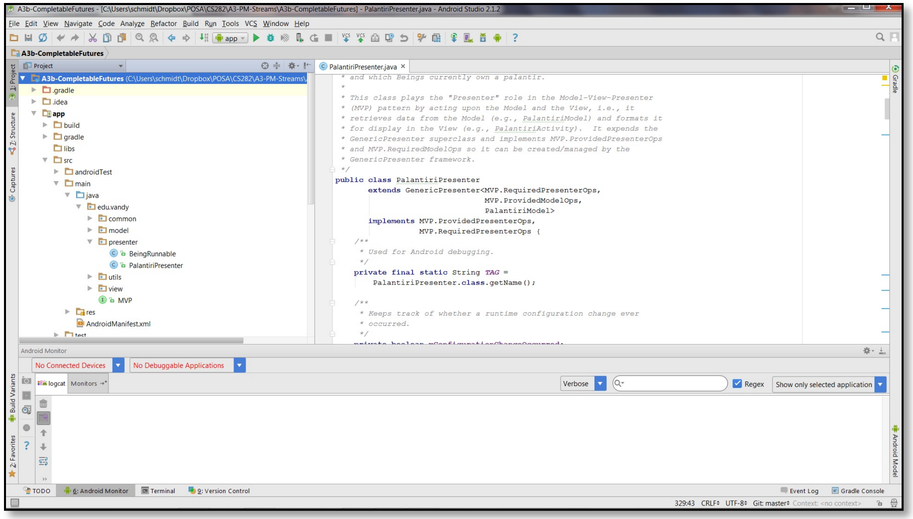
# Overview of Assignments & Assessments

- Assignments will provide a range of experience with modern Java concurrent & parallel microservices
  - Implement a microservice-based movie recommendation system on Spring using modern Java features, e.g.
    - Java lambda expressions, method references, & functional interfaces
    - Java sequential streams
    - Java structured concurrency
    - Java reactive streams
    - Spring WebMVC & WebFlux

The topics covered by the assignments may change during the semester

# Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff & automated tools


A3b-CompletableFutures - [C:\Users\schmidt\Dropbox\POSA\CS282\A3-PM-Streams\A3b-CompletableFutures] - PalantiriPresenter.java - Android Studio 2.1.2
File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
A3b-CompletableFutures
Project
A3b-CompletableFutures (C:\Users\schmidt\Dropbox\POSA\CS282\A3-PM-Streams\
.gradle
.idea
app
build
gradle
libs
src
androidTest
main
java
edu.vandy
common
model
presenter
BeingRunnable
PalantiriPresenter
utils
view
MVP
res
AndroidManifest.xml
test
PalantiriPresenter.java
Android Monitor
No Connected Devices
No Debuggable Applications
logcat
Monitors
Verbose
Regex
Show only selected application
TODO
6: Android Monitor
Terminal
9: Version Control
Event Log
Gradle Console
329:43 CRLF UTF-8 Git: master Context: <no context>

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 * and which Beings currently own a palantir.
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 * This class plays the "Presenter" role in the Model-View-Presenter
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    /**
     * Keeps track of whether a runtime configuration change ever
     * occurred.
     */
```

# Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff & automated tools

*Assignments must be submitted correctly & on time or they will not be reviewed (no exceptions)*

See [github.com/douglascraigschmidt/CS891/wiki/CS-891-FAQ](https://github.com/douglascraigschmidt/CS891/wiki/CS-891-FAQ)

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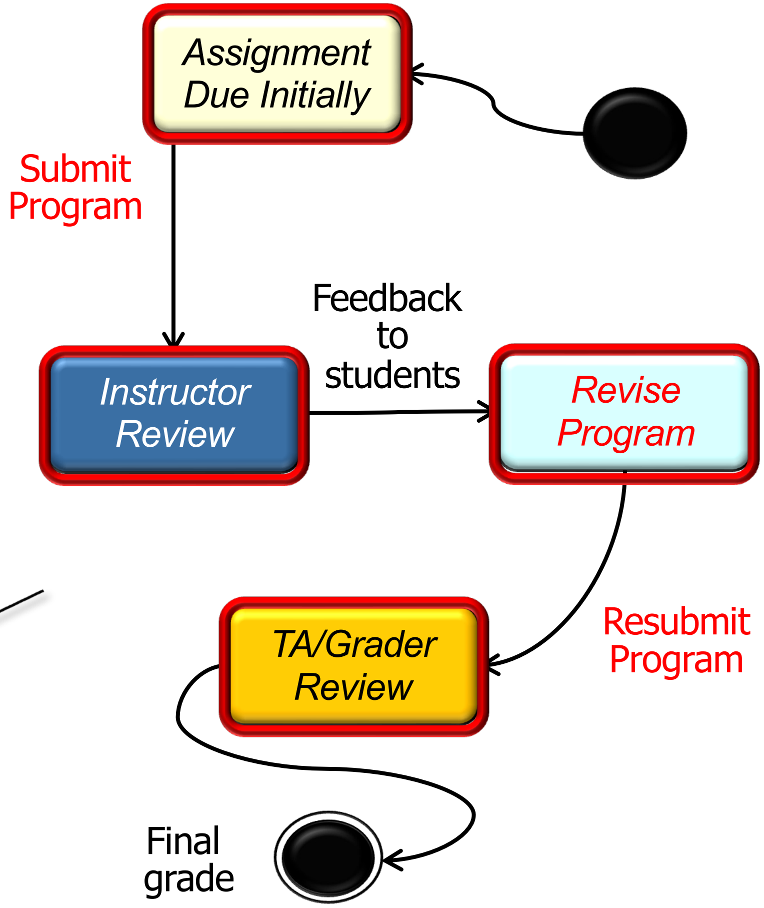

Assignment Due Initially

Submit Program

Instructor Review

Feedback to students

Revise Program

Resubmit Program

TA/Grader Review

Final grade

*Your initial submission must compile & be largely complete or you won't get a review*

See [www.dre.vanderbilt.edu/~schmidt/cs891/assignments.html](http://www.dre.vanderbilt.edu/~schmidt/cs891/assignments.html)

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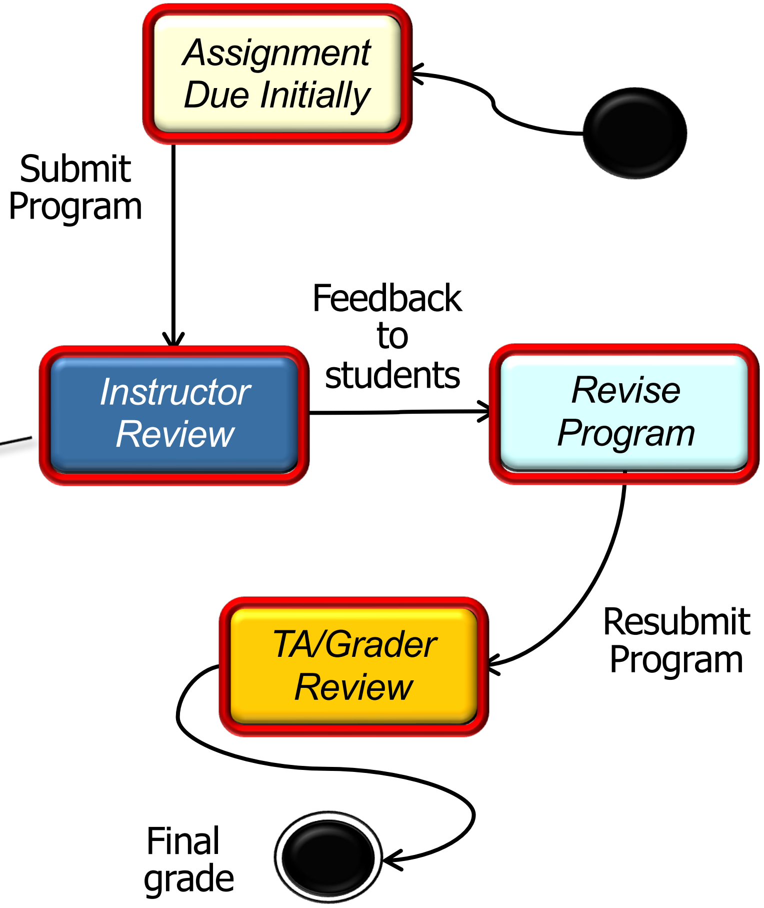

*Assignment Due Initially*

Submit Program

*Instructor Review*

Feedback to students

*Revise Program*

Resubmit Program

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Final grade

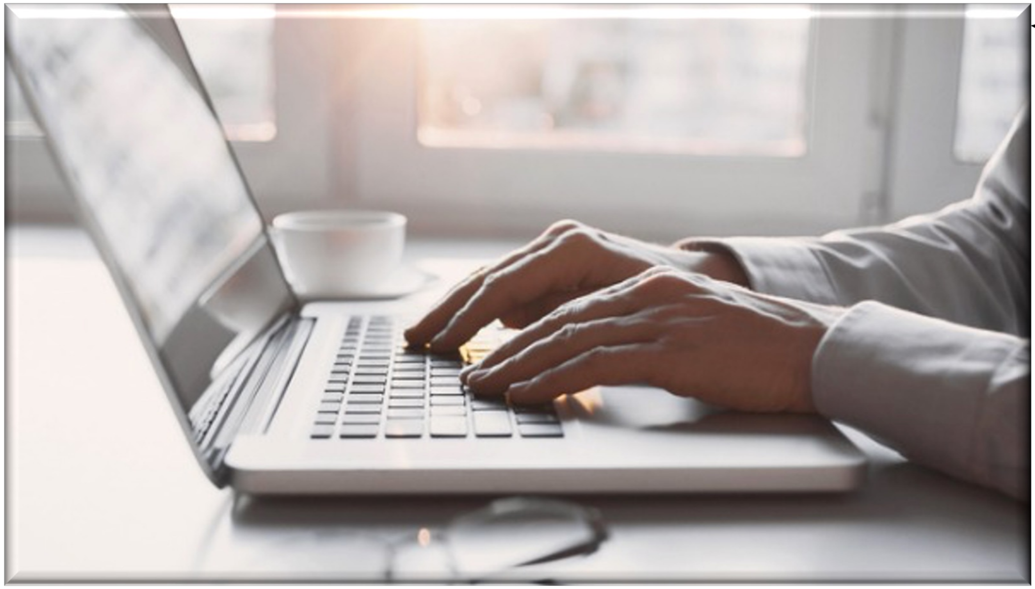
*We use ChatGPT to automate key steps in reviewing student solutions to programming assignments*

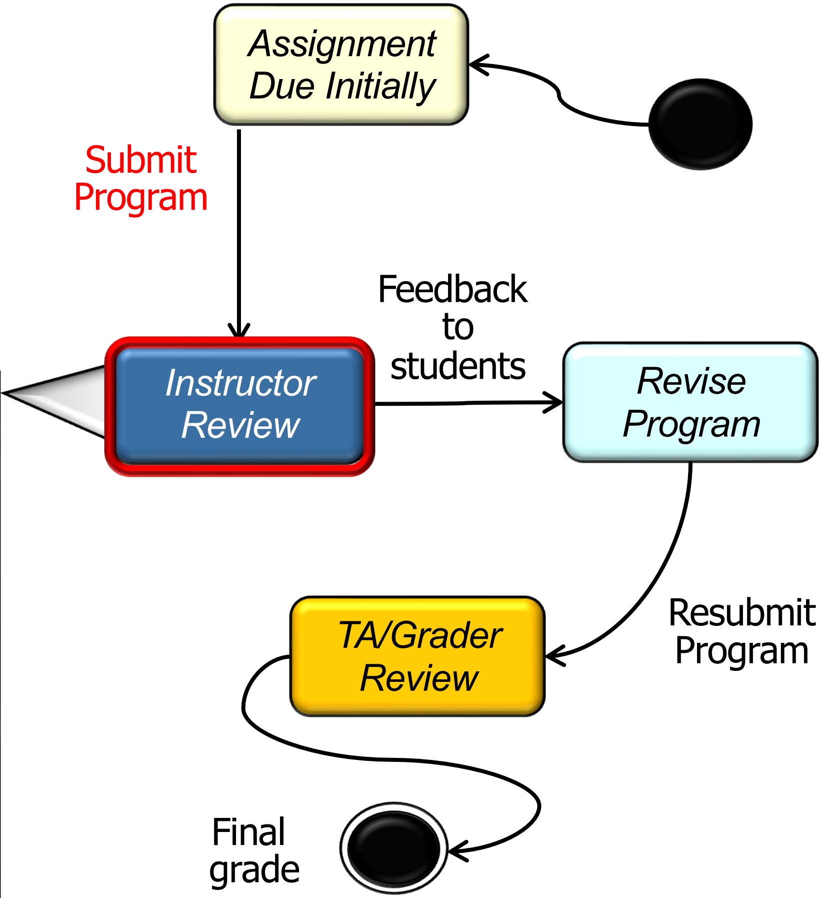
**ChatGPT**

This is a form of "discrepancy analysis" that can leverage generative AI!

# Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff & automated tools





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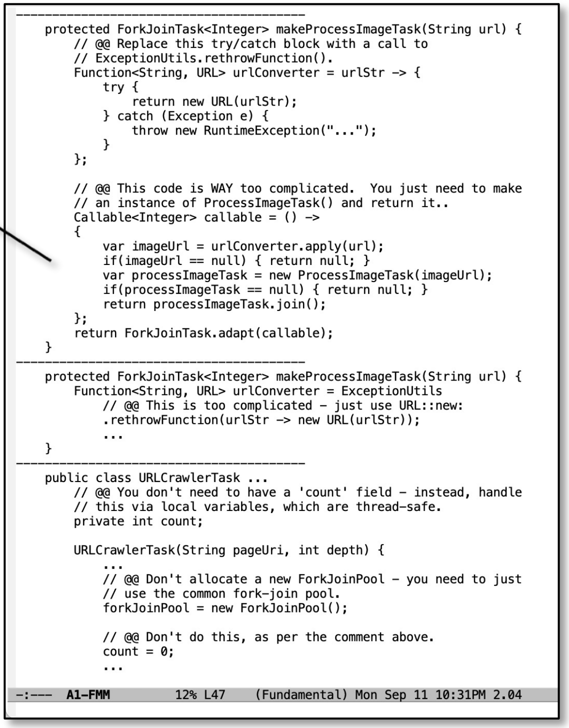
Final grade

# Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff & automated tools

*Historically, I couldn't leverage knowledge of these FMMs between course offerings..*

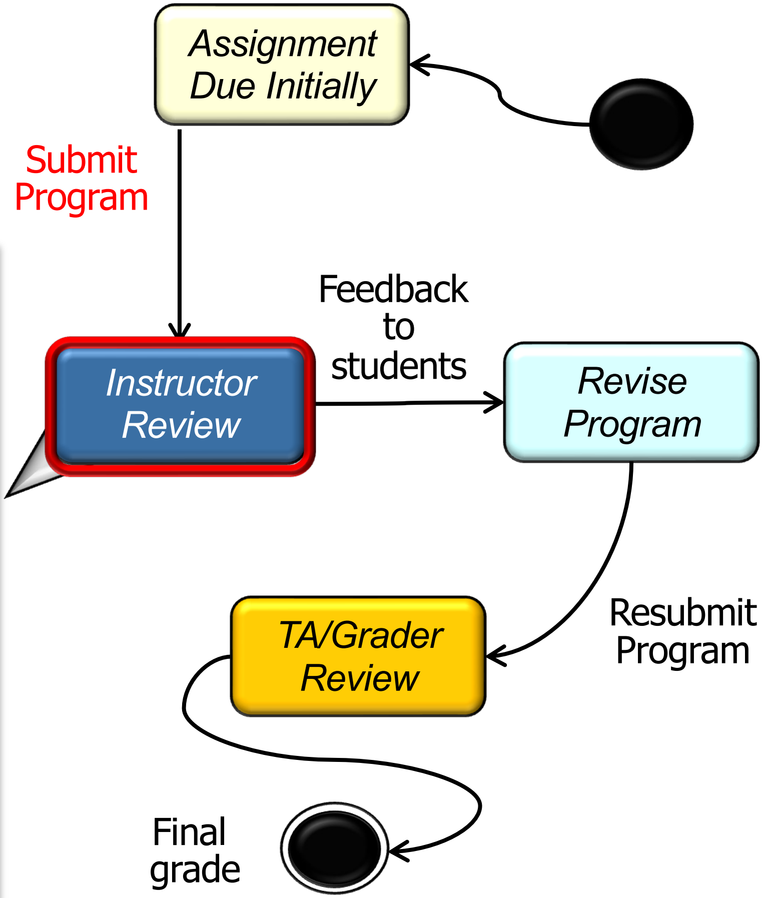


```
----------------------------------------
    protected ForkJoinTask<Integer> makeProcessImageTask(String url) {
        // @@ Replace this try/catch block with a call to
        // ExceptionUtils.rethrowFunction().
        Function<String, URL> urlConverter = urlStr -> {
            try {
                return new URL(urlStr);
            } catch (Exception e) {
                throw new RuntimeException("...");
            }
        };

        // @@ This code is WAY too complicated.  You just need to make
        // an instance of ProcessImageTask() and return it..
        Callable<Integer> callable = () ->
        {
            var imageUrl = urlConverter.apply(url);
            if(imageUrl == null) { return null; }
            var processImageTask = new ProcessImageTask(imageUrl);
            if(processImageTask == null) { return null; }
            return processImageTask.join();
        };
        return ForkJoinTask.adapt(callable);
    }
----------------------------------------
    protected ForkJoinTask<Integer> makeProcessImageTask(String url) {
        Function<String, URL> urlConverter = ExceptionUtils
            // @@ This is too complicated - just use URL::new:
            .rethrowFunction(urlStr -> new URL(urlStr));
            ...
    }
----------------------------------------
    public class URLCrawlerTask ...
        // @@ You don't need to have a 'count' field - instead, handle
        // this via local variables, which are thread-safe.
        private int count;

        URLCrawlerTask(String pageUri, int depth) {
            ...
            // @@ Don't allocate a new ForkJoinPool - you need to just
            // use the common fork-join pool.
            forkJoinPool = new ForkJoinPool();

            // @@ Don't do this, as per the comment above.
            count = 0;
            ...
-:---  A1-FMM        12% L47    (Fundamental) Mon Sep 11 10:31PM 2.04
```



See youtu.be/2P5CGYSXPKg for an example of a "frequently made mistakes" (FMM) video

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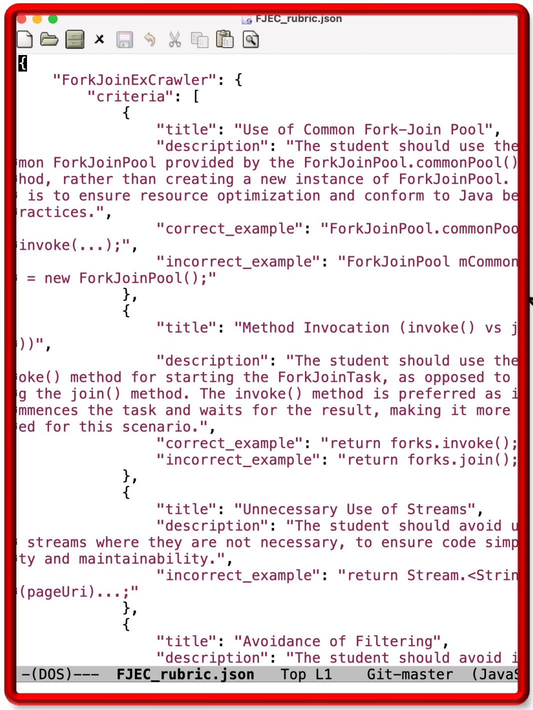

```
{
    "ForkJoinExCrawler": {
        "criteria": [
            {
                "title": "Use of Common Fork-Join Pool",
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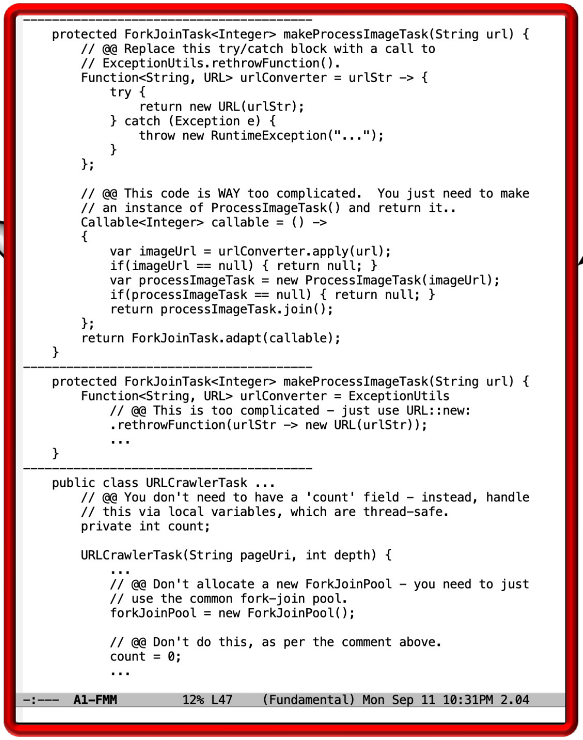
-(DOS)---  FJEC_rubric.json   Top L1    Git-master  (JavaS
```



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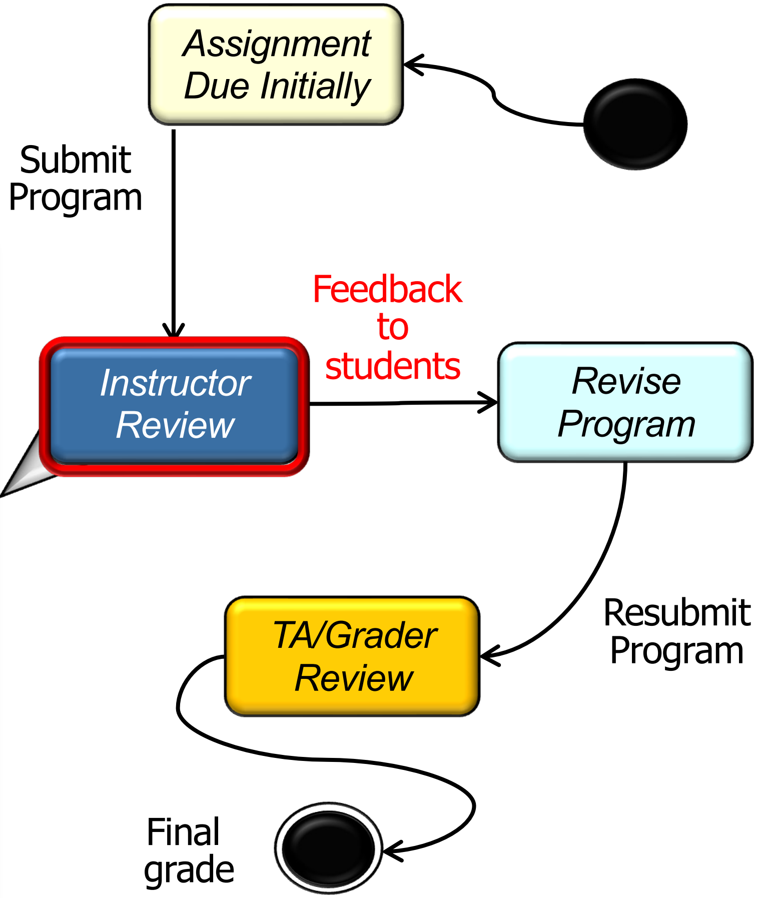

Assignment Due Initially

Submit Program

Instructor Review

Feedback to students

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Resubmit Program

TA/Grader Review

Final grade

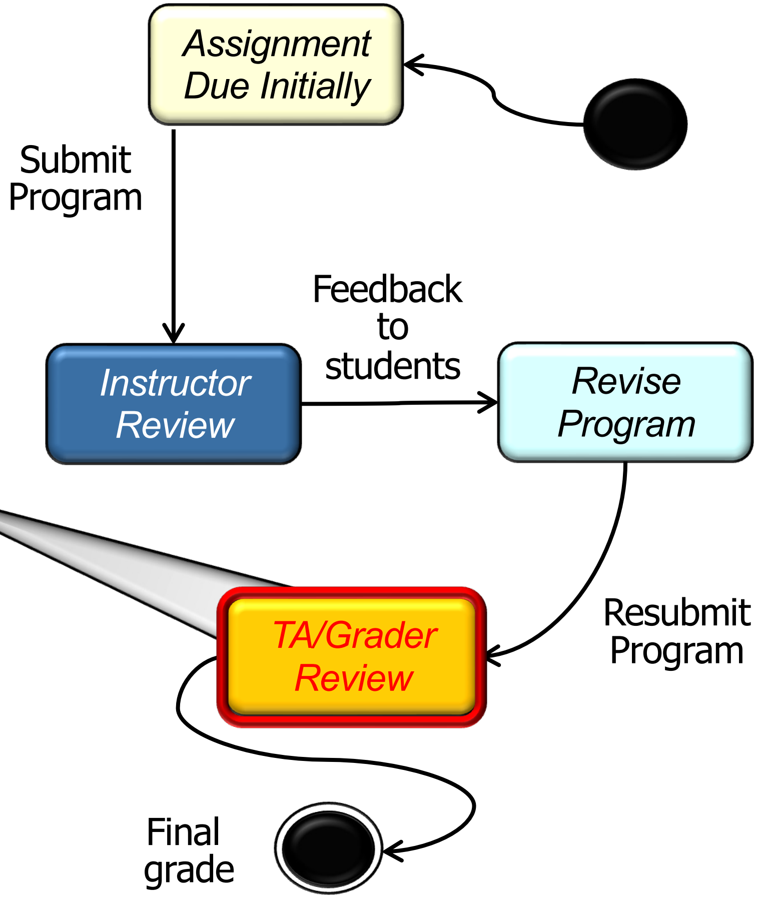
**ChatGPT**

ChatGPT generates an automated grading rubric based on my FMM analysis

# Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff & automated tools

My TAs/graders no longer have to read my mind to evaluate student final submissions consistently



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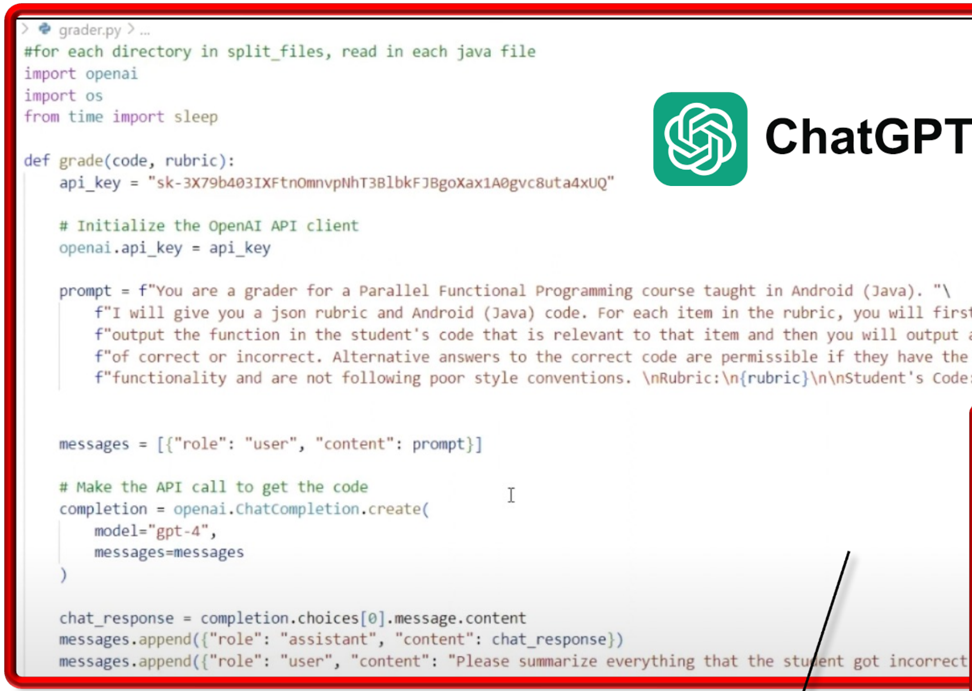


grader.py > ...

```python
#for each directory in split_files, read in each java file
import openai
import os
from time import sleep

def grade(code, rubric):
    api_key = "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"

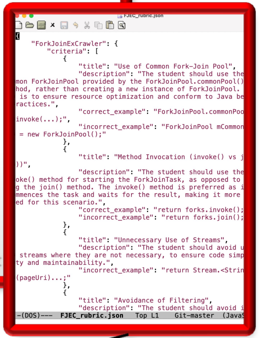
    # Initialize the OpenAI API client
    openai.api_key = api_key

    prompt = f"You are a grader for a Parallel Functional Programming course taught in Android (Java). "\
        f"I will give you a json rubric and Android (Java) code. For each item in the rubric, you will first "\
        f"output the function in the student's code that is relevant to that item and then you will output a grade "\
        f"of correct or incorrect. Alternative answers to the correct code are permissible if they have the same "\
        f"functionality and are not following poor style conventions. \nRubric:\n{rubric}\n\nStudent's Code:\n{code}"


    messages = [{"role": "user", "content": prompt}]

    # Make the API call to get the code
    completion = openai.ChatCompletion.create(
        model="gpt-4",
        messages=messages
    )

    chat_response = completion.choices[0].message.content
    messages.append({"role": "assistant", "content": chat_response})
    messages.append({"role": "user", "content": "Please summarize everything that the student got incorrect
```



FJEC_rubric.json

```
{
    "ForkJoinExCrawler": {
        "criteria": [
            {
                "title": "Use of Common Fork-Join Pool",
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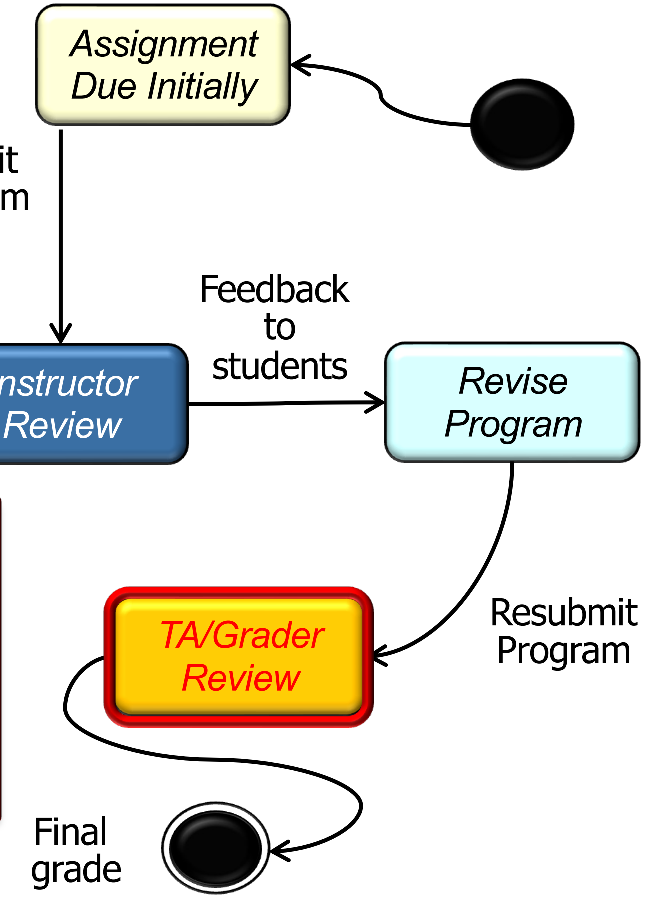
-(DOS)---  FJEC_rubric.json   Top L1    Git-master  (JavaS
```

*We've trained ChatGPT-4 to analyze student final submissions for frequently made mistakes*

Submit Program



See [www.dre.vanderbilt.edu/~schmidt/PDF/GreAIter-paper.pdf](www.dre.vanderbilt.edu/~schmidt/PDF/GreAIter-paper.pdf)

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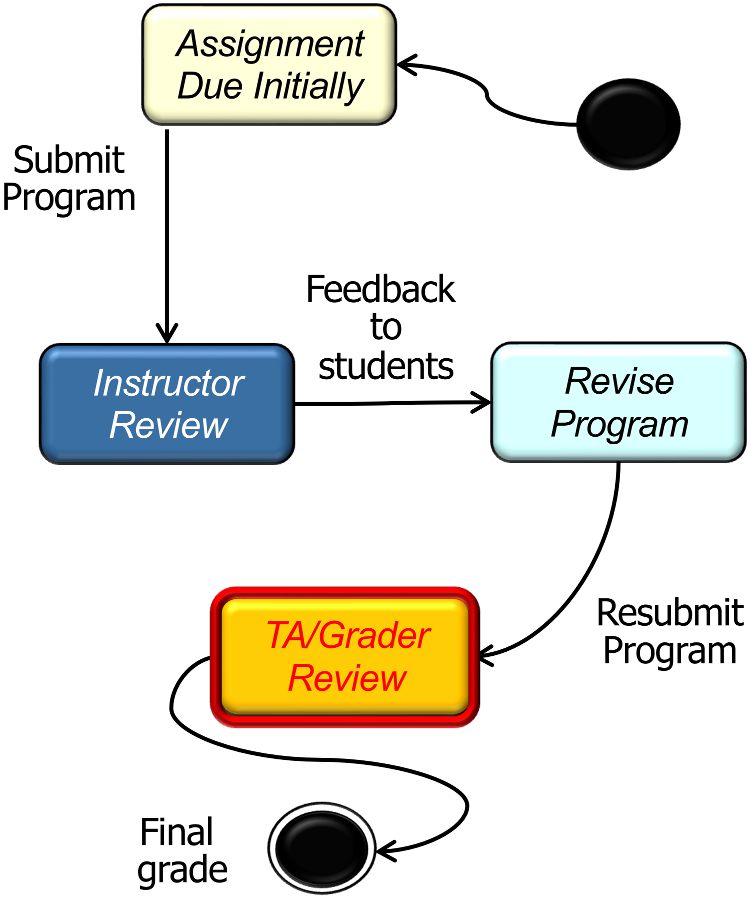

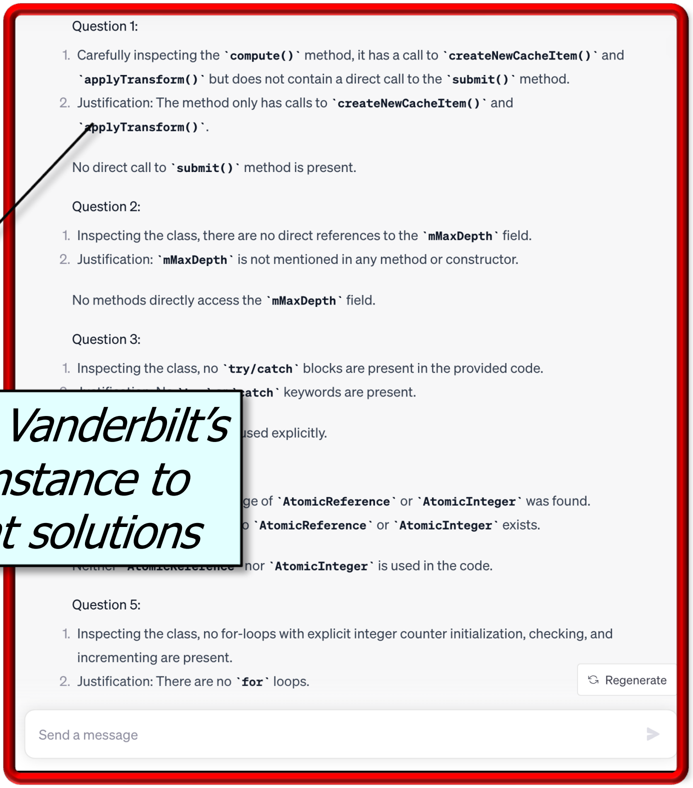

Question 1:

1. Carefully inspecting the `compute()` method, it has a call to `createNewCacheItem()` and `applyTransform()` but does not contain a direct call to the `submit()` method.
2. Justification: The method only has calls to `createNewCacheItem()` and `applyTransform()`.

No direct call to `submit()` method is present.

Question 2:

1. Inspecting the class, there are no direct references to the `mMaxDepth` field.
2. Justification: `mMaxDepth` is not mentioned in any method or constructor.

No methods directly access the `mMaxDepth` field.

Question 3:

1. Inspecting the class, no `try/catch` blocks are present in the provided code.
2. catch` keywords are present.

used explicitly.

ge of `AtomicReference` or `AtomicInteger` was found.

o `AtomicReference` or `AtomicInteger` exists.

nor `AtomicInteger` is used in the code.

Question 5:

1. Inspecting the class, no for-loops with explicit integer counter initialization, checking, and incrementing are present.
2. Justification: There are no `for` loops.

*My TAs/graders use Vanderbilt's private ChatGPT instance to assess final student solutions*

**ChatGPT**

Issues with false positives are handled efficiently & scalably via augmented intelligence (AI+)

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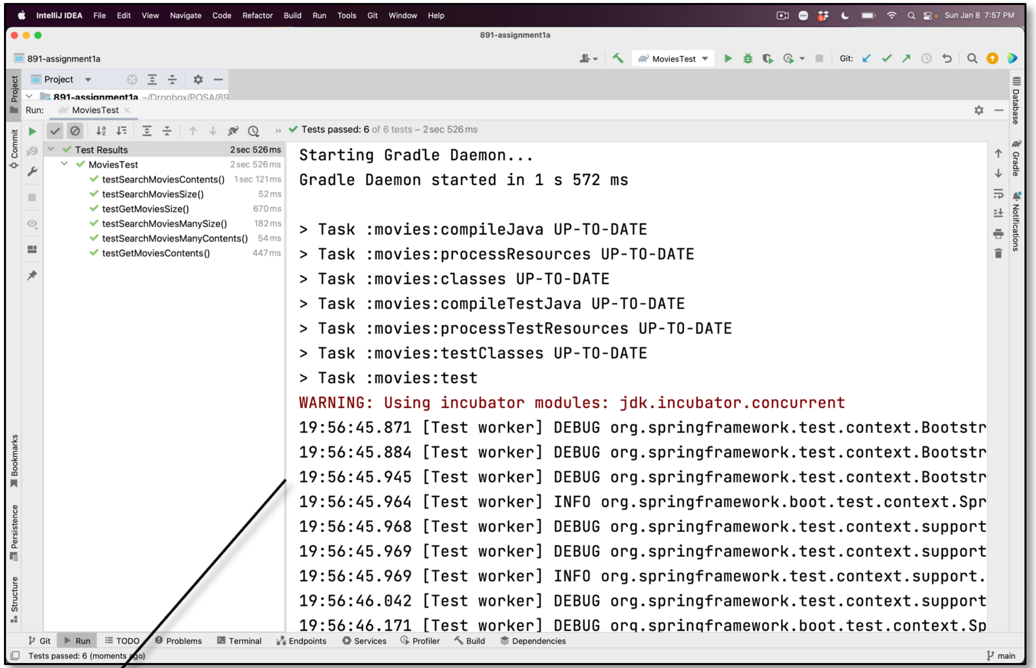


Run: MoviesTest

✓ Tests passed: 6 of 6 tests – 2 sec 526 ms

| | |
|---|---|
| ✓ Test Results | 2 sec 526 ms |
| ✓ MoviesTest | 2 sec 526 ms |
| ✓ testSearchMoviesContents() | 1 sec 121 ms |
| ✓ testSearchMoviesSize() | 52 ms |
| ✓ testGetMoviesSize() | 670 ms |
| ✓ testSearchMoviesManySize() | 182 ms |
| ✓ testSearchMoviesManyContents() | 54 ms |
| ✓ testGetMoviesContents() | 447 ms |

```
Starting Gradle Daemon...
Gradle Daemon started in 1 s 572 ms

> Task :movies:compileJava UP-TO-DATE
> Task :movies:processResources UP-TO-DATE
> Task :movies:classes UP-TO-DATE
> Task :movies:compileTestJava UP-TO-DATE
> Task :movies:processTestResources UP-TO-DATE
> Task :movies:testClasses UP-TO-DATE
> Task :movies:test
WARNING: Using incubator modules: jdk.incubator.concurrent
19:56:45.871 [Test worker] DEBUG org.springframework.test.context.Bootstr
19:56:45.884 [Test worker] DEBUG org.springframework.test.context.Bootstr
19:56:45.945 [Test worker] DEBUG org.springframework.test.context.Bootstr
19:56:45.964 [Test worker] INFO org.springframework.boot.test.context.Spr
19:56:45.968 [Test worker] DEBUG org.springframework.test.context.support
19:56:45.969 [Test worker] DEBUG org.springframework.test.context.support
19:56:45.969 [Test worker] INFO org.springframework.test.context.support.
19:56:46.042 [Test worker] DEBUG org.springframework.test.context.support
19:56:46.171 [Test worker] DEBUG org.springframework.boot.test.context.Sp
```

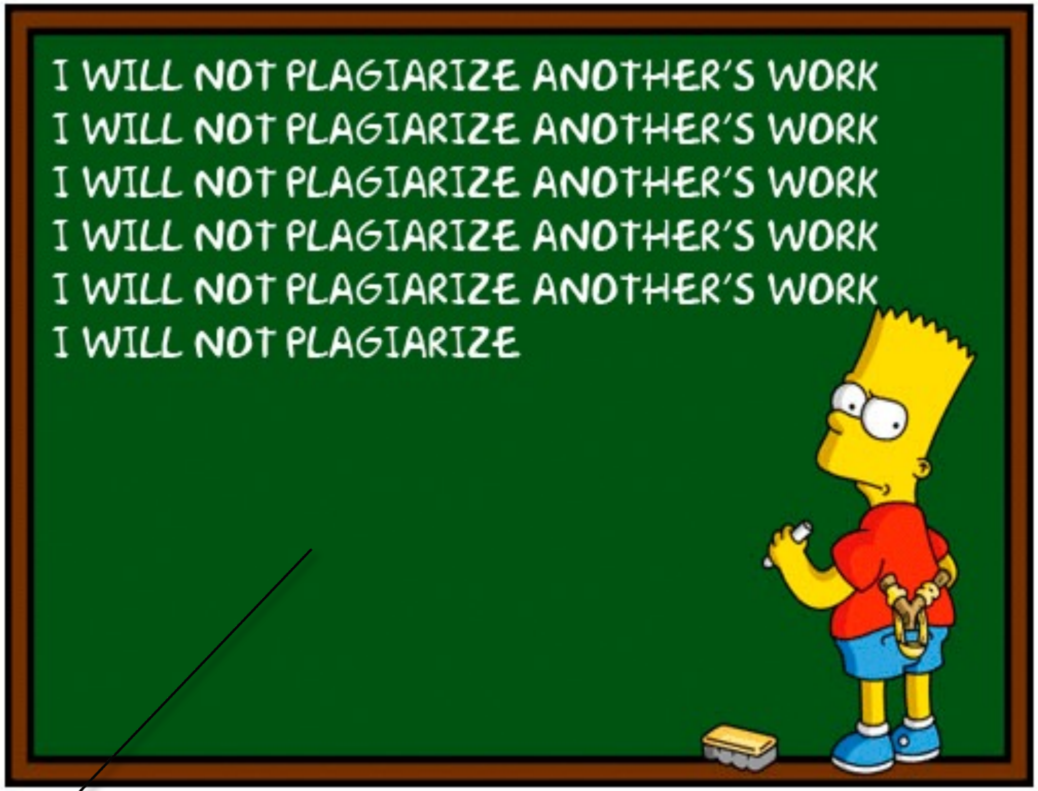
Tests passed: 6 (moments ago)

*You must also run the regression tests & push a screenshot of the results to GitLab*

See [www.dre.vanderbilt.edu/~schmidt/cs891/assignments.html](http://www.dre.vanderbilt.edu/~schmidt/cs891/assignments.html)

# Overview of Assignments & Assessments

- Assignment assessments will be done via reviews by course staff & automated tools


I WILL NOT PLAGIARIZE ANOTHER'S WORK
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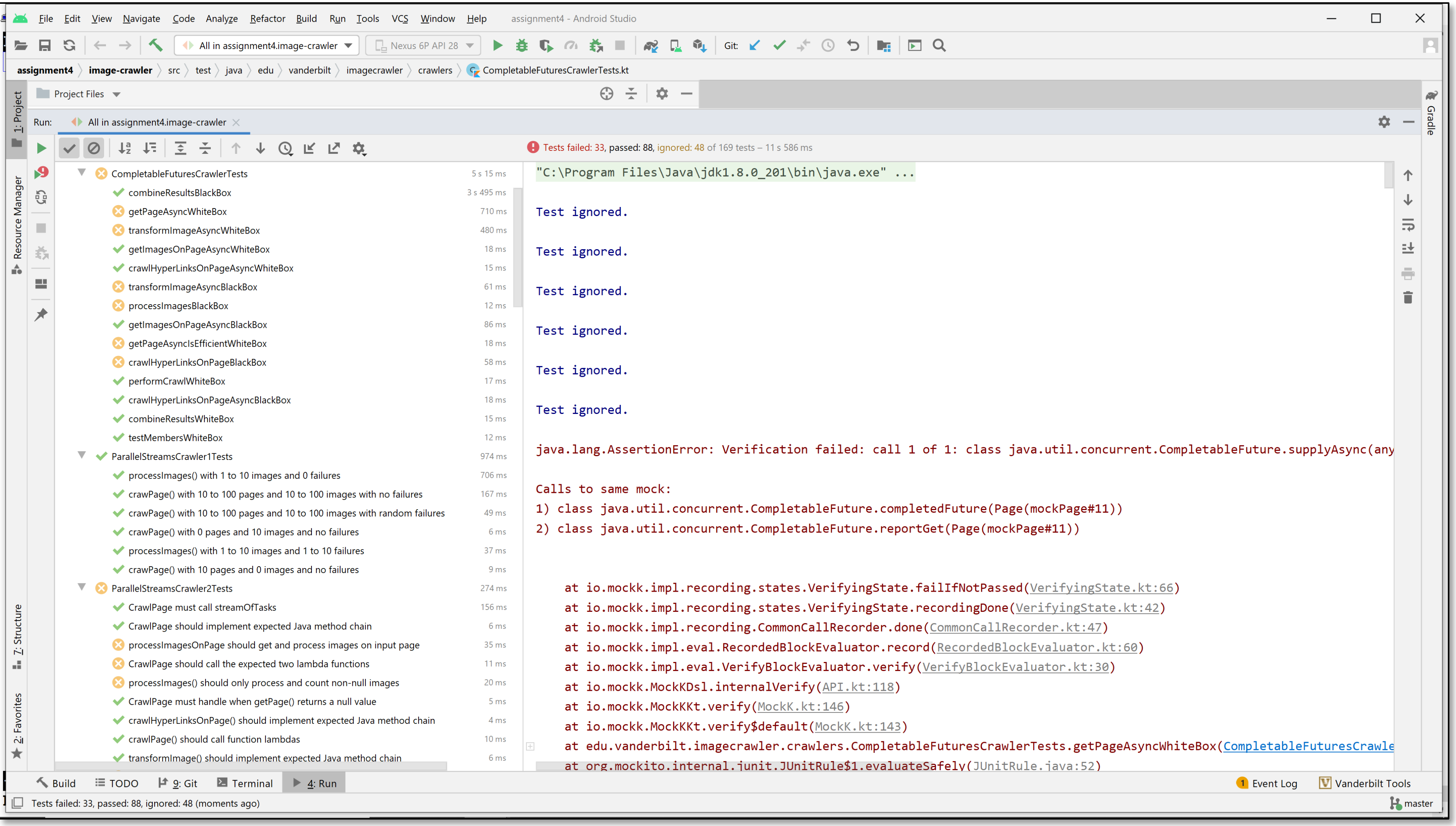
I WILL NOT PLAGIARIZE

*Work must be your own (this rule applies for quizzes, exams, & programming assignments)*

[www.vanderbilt.edu/student_handbook/the-honor-system#statement-of-the-honor-code](http://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


File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help
assignment4 - Android Studio
All in assignment4.image-crawler
Nexus 6P API 28
Git:
assignment4 〉 image-crawler 〉 src 〉 test 〉 java 〉 edu 〉 vanderbilt 〉 imagecrawler 〉 crawlers 〉 CompletableFuturesCrawlerTests.kt
Project Files
1: Project
Resource Manager
7: Structure
2: Favorites
Gradle
Run:
All in assignment4.image-crawler
Build
TODO
9: Git
Terminal
4: Run
Event Log
Vanderbilt Tools
master

Tests failed: 33, passed: 88, ignored: 48 of 169 tests – 11 s 586 ms

```
CompletableFuturesCrawlerTests                                              5 s 15 ms
    combineResultsBlackBox                                                  3 s 495 ms
    getPageAsyncWhiteBox                                                    710 ms
    transformImageAsyncWhiteBox                                             480 ms
    getImagesOnPageAsyncWhiteBox                                            18 ms
    crawlHyperLinksOnPageAsyncWhiteBox                                      15 ms
    transformImageAsyncBlackBox                                             61 ms
    processImagesBlackBox                                                   12 ms
    getImagesOnPageAsyncBlackBox                                            86 ms
    getPageAsyncIsEfficientWhiteBox                                         18 ms
    crawlHyperLinksOnPageBlackBox                                           58 ms
    performCrawlWhiteBox                                                    17 ms
    crawlHyperLinksOnPageAsyncBlackBox                                      18 ms
    combineResultsWhiteBox                                                  15 ms
    testMembersWhiteBox                                                     12 ms
ParallelStreamsCrawler1Tests                                                974 ms
    processImages() with 1 to 10 images and 0 failures                      706 ms
    crawPage() with 10 to 100 pages and 10 to 100 images with no failures   167 ms
    crawPage() with 10 to 100 pages and 10 to 100 images with random failures  49 ms
    crawPage() with 0 pages and 10 images and no failures                   6 ms
    processImages() with 1 to 10 images and 1 to 10 failures                37 ms
    crawPage() with 10 pages and 0 images and no failures                   9 ms
ParallelStreamsCrawler2Tests                                                274 ms
    CrawlPage must call streamOfTasks                                       156 ms
    CrawlPage should implement expected Java method chain                   6 ms
    processImagesOnPage should get and process images on input page         35 ms
    CrawlPage should call the expected two lambda functions                 11 ms
    processImages() should only process and count non-null images           20 ms
    CrawlPage must handle when getPage() returns a null value               5 ms
    crawlHyperLinksOnPage() should implement expected Java method chain     4 ms
    crawlPage() should call function lambdas                                10 ms
    transformImage() should implement expected Java method chain            6 ms
```

```
"C:\Program Files\Java\jdk1.8.0_201\bin\java.exe" ...

Test ignored.

Test ignored.

Test ignored.

Test ignored.

Test ignored.

Test ignored.

java.lang.AssertionError: Verification failed: call 1 of 1: class java.util.concurrent.CompletableFuture.supplyAsync(any

Calls to same mock:
1) class java.util.concurrent.CompletableFuture.completedFuture(Page(mockPage#11))
2) class java.util.concurrent.CompletableFuture.reportGet(Page(mockPage#11))


    at io.mockk.impl.recording.states.VerifyingState.failIfNotPassed(VerifyingState.kt:66)
    at io.mockk.impl.recording.states.VerifyingState.recordingDone(VerifyingState.kt:42)
    at io.mockk.impl.recording.CommonCallRecorder.done(CommonCallRecorder.kt:47)
    at io.mockk.impl.eval.RecordedBlockEvaluator.record(RecordedBlockEvaluator.kt:60)
    at io.mockk.impl.eval.VerifyBlockEvaluator.verify(VerifyBlockEvaluator.kt:30)
    at io.mockk.MockKDsl.internalVerify(API.kt:118)
    at io.mockk.MockKKt.verify(MockK.kt:146)
    at io.mockk.MockKKt.verify$default(MockK.kt:143)
    at edu.vanderbilt.imagecrawler.crawlers.CompletableFuturesCrawlerTests.getPageAsyncWhiteBox(CompletableFuturesCrawle
    at org.mockito.internal.junit.JUnitRule$1.evaluateSafely(JUnitRule.java:52)
```

Tests failed: 33, passed: 88, ignored: 48 (moments ago)

See [www.dre.vanderbilt.edu/~schmidt/cs891/assignments.html](www.dre.vanderbilt.edu/~schmidt/cs891/assignments.html)

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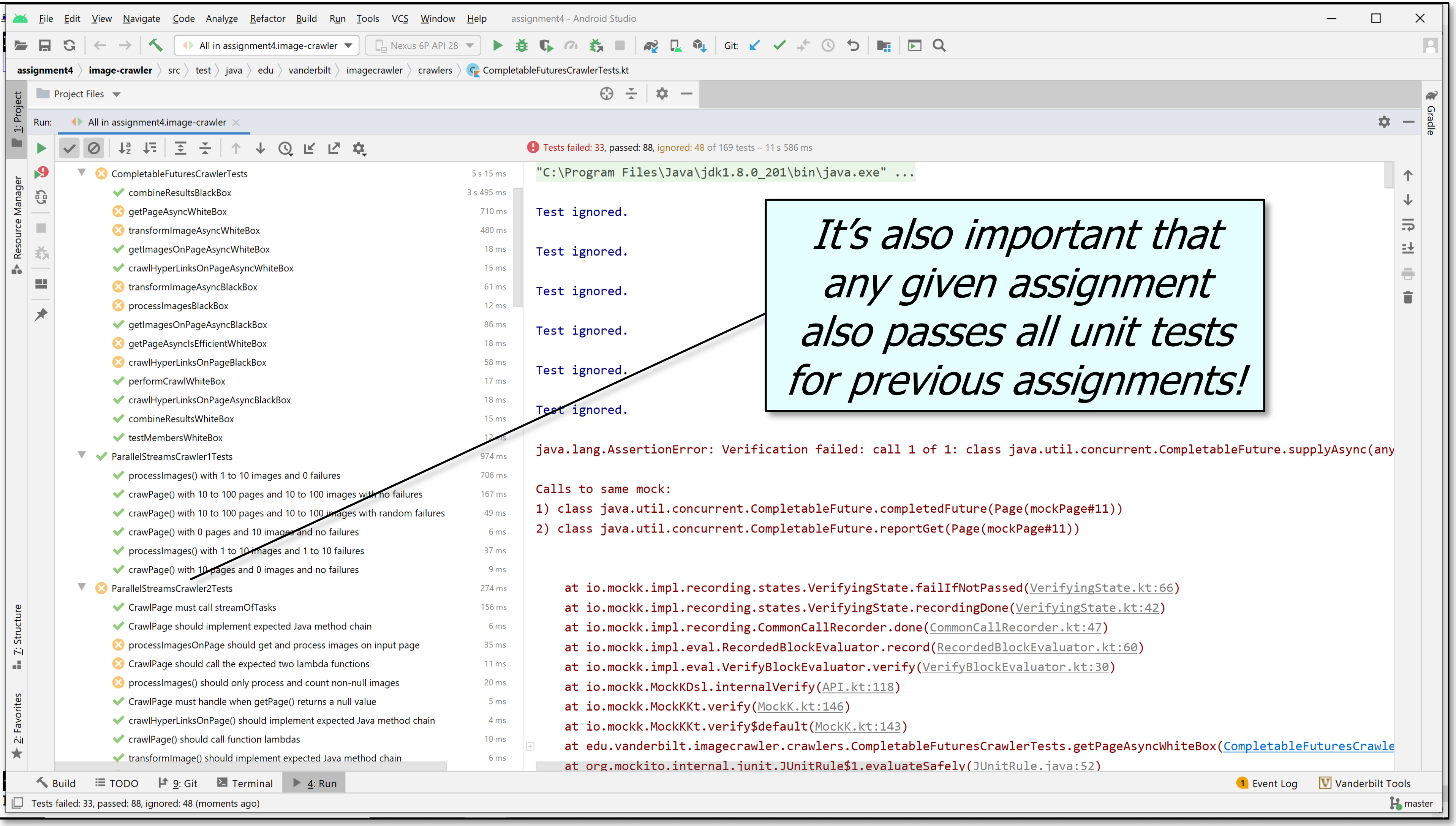
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ParallelStreamsCrawler2Tests 274 ms
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```

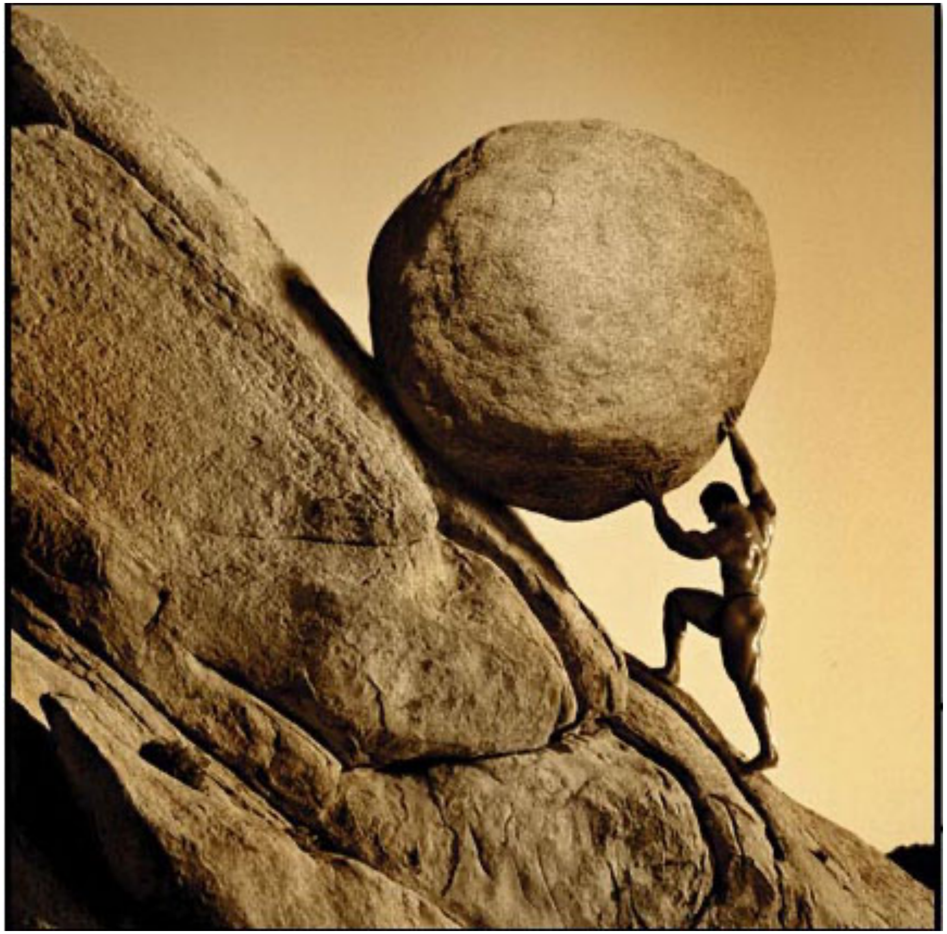
Tests failed: 33, passed: 88, ignored: 48 (moments ago)

*It's also important that any given assignment also passes all unit tests for previous assignments!*

See items #15 & #19 at github.com/douglascraigschmidt/CS891/wiki/CS-891-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

# Overview of Assignments & Assessments

- The relative weighting of each portion of the course is:
  - 45% Quizzes
  - 40% Programming projects
  - 10% Final exam
  - 05% Participation
    - Participation includes attendance, involvement, & "following directions"

*Following directions is essential, particularly wrt running unit tests for programming assignments..*

See items #15 & #19 at [github.com/douglascraigschmidt/CS891/wiki/CS-891-FAQ](github.com/douglascraigschmidt/CS891/wiki/CS-891-FAQ)

# CS 891: Scalable Microservices: Overview (Part 2)