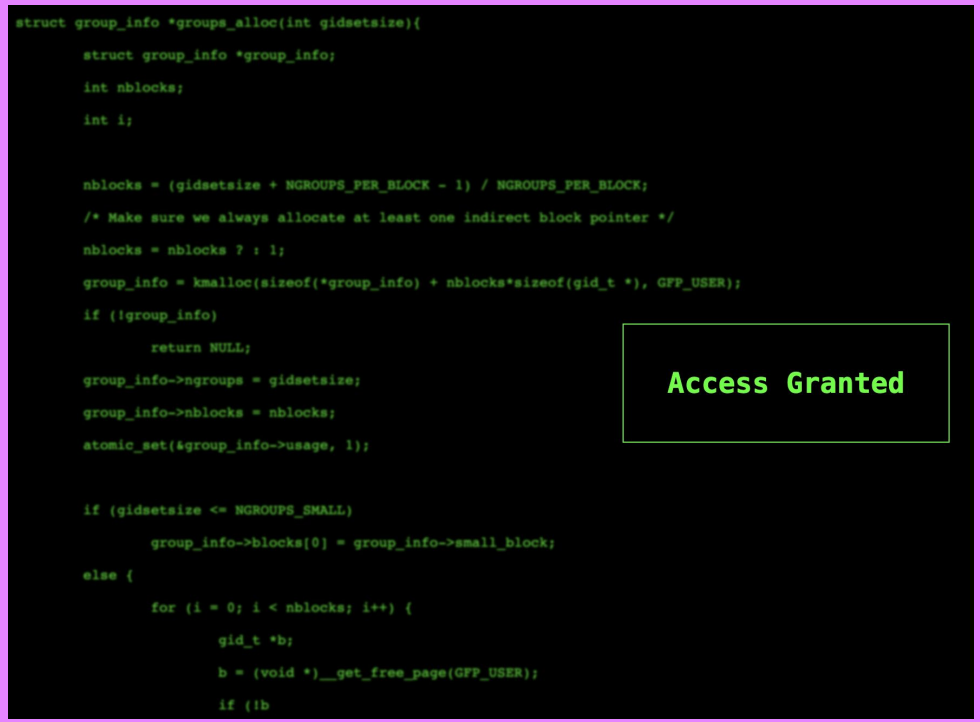
HTA Lectures

Cybersecurity

And Why You Should Study It!
Allie :)



What is Cybersecurity?

“The state of being protected against the criminal or unauthorized use of electronic data, or the measures taken to achieve this.”

Basically, security of online data :)

“CIA Triad”

Confidentiality

Shhh…can you keep a secret?

All data should be kept private at all times! You need to be **super** careful about **who** has access to **what** (i.e. who is **authorized** to see the data).

Most common attack due to weak confidentiality:

Man-in-the-Middle Attacks

Man in the Middle Attacks

Uh oh, someone is eavesdropping on you!

- When a bad guy positions themself in a private conversation between a user and an application.
- Goal: steal personal information (passwords, credit card numbers, social security numbers)
- Tricky because skilled hackers can make it seem like nothing is wrong (they can hide really well)

Basically:
You send some hot gossip in the mail, and your mailman opens the envelope, reads the information, then reseals it and nobody will ever know!

Integrity

Don't let anyone mess with your data!

In addition to being private, data needs to be trustworthy! Integrity of data is upheld if the data is accurate and reliable (basically, nobody can get in the system and change it without permission)

How to make sure attackers can't compromise data integrity? Hide your data! Fancy techniques like encryption, hashing, and more can protect your data.

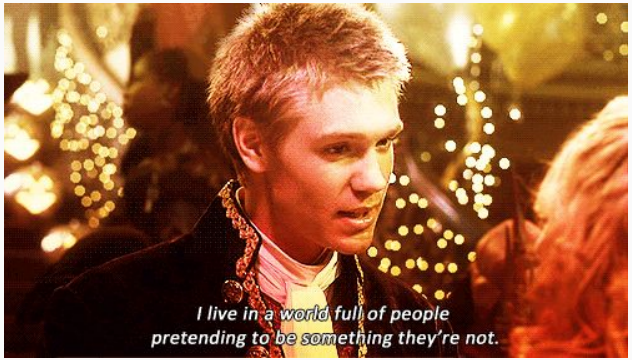
What Can Go Wrong with Data Integrity?

Instead of one specific “main attack,” problems with data integrity arise from:

Problems with authentication and authorization

If someone gets into the system but they’re lying about their identity

…very bad :(



Availability

Ok now my data is super secret and private but wait…now who gets to see it?

Data isn't much good to a company if nobody can access it; the tricky part of cybersecurity is making sure that people are actually able to access the top secret data.

Systems need to work! If a system is compromised and there is no recovery plan, data can get lost, or at least take a long time to access (making customers very very angry)

What if it's compromised on purpose… introducing the Denial of Service (DoS) attack

Denial of Service (DoS) Attacks

Uh oh, someone wants to make it hard to get your data!

- Hacker spams a server with traffic
- Special case: **Distributed** DoS attack: hacker uses multiple computers to flood the target
- Overflows the server and interrupts the service being provided

CS15 example: GPTA uses **rate limiting:** you can only enter queries every 15 seconds, so the server doesn't get overloaded

What can you do about it

Three main pathways:

1. Policy (non-technical)
2. Blue Team (technical defense)
3. Red Team (technical offense)

Non-technical Cybersecurity Roles

- Names like “Policy Writer”, “Governance and Risk”
- **Great for people who care about security but don’t love the technical aspect**
- Security engineers follow rules to secure their systems → you can write the rulebook!
- Skills required: *security awareness, writing skills, critical thinking, top-level understanding of technology*

Blue Team

- Technical **defensive** role
- Responsible for securing and protecting systems
- Planning: design a secure system
- Threat protection: always be alert!
- Roles like “Application Security”, “Cloud Security”
- **Great for people interested in coding and how computer systems work**
- High projected salaries (very slay)

Red Team

- Technical **offensive** role
- Blue Team works hard to secure the system…Red Team tries to break it
- (Legal) hacking into company systems to find weak points to fix
- Roles like “Penetration Testing”
- **Great for people interested in coding and who like to break things!**
- High projected salaries

Interested in learning more?

There are some awesome security classes in the Brown CS department!

- **CS22**: learn the math behind encryption (you should all take it :))
- **CS33**: computer systems are super important in security (pre-req for other security classes also)
- **CS1040**: Cryptography (how to secure online communication)
- **CS1650**: Software Security and Exploitation (hacking into the system!)
- **CS1660**: Intro to Computer Systems Security
- **CS1510**: Intro to Cryptography and Computer Security
- **CS1515**: Applied Cryptography


The Battle
of Marathon

490 BCE


Black Sea
Caspian Sea
Aral Sea
Mediterranean Sea
Red Sea
Persian Gulf
Arabian Sea
Thrace
Macedon
Pella
Aigai
Eion
Odessos
Dioscurias
Sinope
Herakleia
Byzantion
Doriscus
Sestos
Dascylium
Paphlagonia
Mysia
Gappadocia
Phrygia
Sardis
Lydia
Mylasa
Caria
Pisidia
Ikonion
Mazaca
Cilicia
Rhodos
Xanthos
Tarsos
Issus
Tushpa
Caspians
Armenia
Ganzak
Media
Thapsacus
Mesopotamia
Arbela
Hecatompylos
Rhages
Ecbatana
Parthia
Aria
Chorasmia
Sakas
Cyropolis
Maracanda
Sogdiana
Margiana
Merv
Bactra
Bactria
Gandhara
Pushkalavati
Taxila
India
Arachosia
Arachoti
Pactyans
Drangiana
Farah
Sagartia
Carmania
Anshan
Pasargadae
Persepolis
Persis
Utians
Gedrosia
Maka
Sindomana
Paricanians
Susiana
Susa
Opis
BABYLON
Babylonia
Uruk
Gerrha
Magan
Cyrene
Barca
Libya
Amunia
Sais
Memphis
Ammonium
Egypt
Hermopolis
Thebes
Pelusium
Jerusalem
Sidon
Tyre
Damascus
Syria
Tayma
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II
III
IV
V
VI
VII
VIII
IX
X
XI
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XVII
XVIII
XIX
XX
Legend
Major population centers
Population centers
Capital labels denoted with underline
XI Divisions of the Achaemenid Empire according to Herodotus
Unruly territories with limited Persian authority
Royal road of Darius the Great


Thrace
Macedon
Pella
Aigai
Eion
Doriscus
Byzantion
Odessos
Black Sea
Herakleia
Sinope
Dioscurias
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Mediterranean Sea
Cyrene
Barca
Sidon
Tyre
Damascus
Opis
Amunia
Jerusalem
BABYLON
Libya
Sais
Pelusium
Memphis
Ammonium
VI
Egypt


Pella
Aigai
Eion
Doriscus
Byzan
Sestos
Sardis
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Thebes
Tayma
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Uruk
Opis
Babylonia
Susa
Susiana
Ecbatana
Hecatompylos
Rhages
Parthia
Aria
Margiana
Merv
Bactra
Bactria
Gandhara
Pushkalavati
Taxila
India
Chorasmia
Sakas
Cyropolis
Maracanda
Sogdiana
Arachosia
Arachoti
Pactyans
Drangiana
Farah
Sagartia
Carmania
Pasargadae
Persepolis
Anshan
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Paricanians
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Maka
Sindomana
Gerrha
Magan
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Athens population: 315,000
(about 0.3% of the world population)

Persian Empire population: 50,000,000
(about 50% of the world population)

Who wins?

Athens

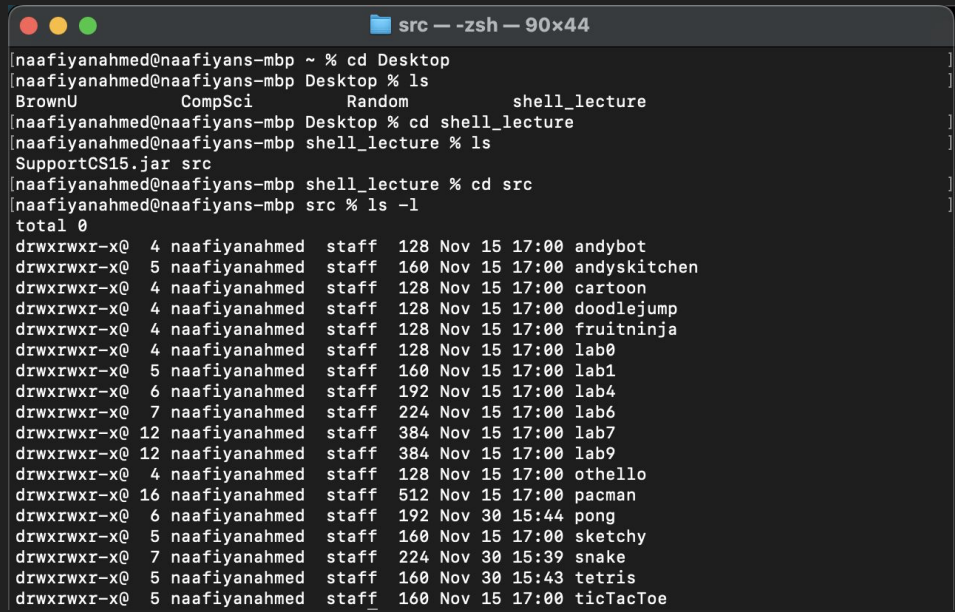
But how??

What is a Shell?

- User interface for operating system commands
- Shells:
  - Graphical User Interface (GUI)
  - Command Line Interface (CLI)
- Goal to create an effective workflow to accomplish certain tasks

CLI (Command Line Interface)

- The main graphical component is a window that allows you to enter text input
- User types text commands the program will run
  - REPL (Read Eval Print Loop)
- ex. Terminal
- Shell specific scripting languages
  - ex. bash, zsh



CLI: Good Idea or Bad Idea?

Pros	Cons
● Faster ○ GUI takes a lot to load ○ Practice provides fluidity ● Accessible!	● Learning curve ● Reduced interaction for user ○ No clicking or dragging ● Aesthetics = whack

Common Commands

```
cd      - change directory (tip: use tabs to autocomplete)
ls      - list directory contents
touch   - create a new file or “touches” existing file
rm      - remove a file
mkdir   - create a directory
rmdir   - remove a directory
mv      - move one file to another location
cp      - copy one file
cat     - print the contents of a file
chmod   - change file modes/permissions
grep    - returns all occurrences of a string in a given text
clear   - clear the terminal
```

Flags

java

- java -version

ls

- ls -a

rm

- rm -rf

open (Mac only but there are Windows equivalents)

- open -e <text file>

man

- man <command name>

Chaining Commands

- Piping
  - Redirects the output of one command into the input of another
  - `command_1 | command_2 | command_3 | .... | command_N`
  - Ex: `ls -a | wc -l` passes the output of `ls` into `wc`

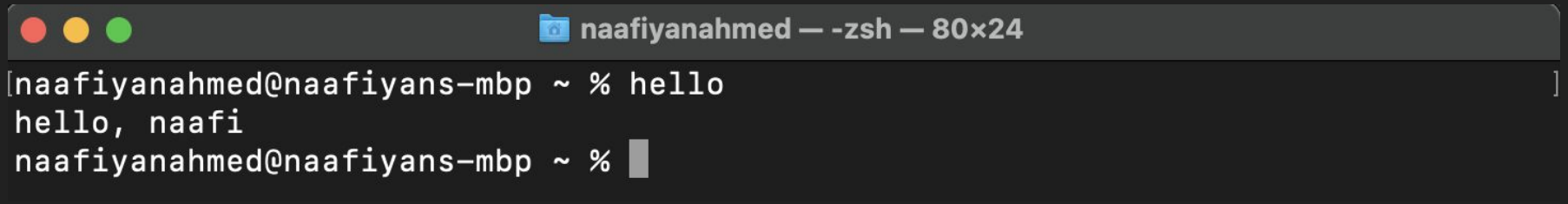
- && (AND)
  - Chains a sequence of commands together
  - `command_1 && command_2 && command_3 && .... && command_N`
  - Ex: `cd src && ls` will go into src directory and list all contents

Useful Tips and Tricks

- Retyping a recent command?
  - Press the up (and down) arrow to navigate history
  - Control + R to do a back-history search
  - `history`
- Don’t remember the filepath or command?
  - Press Tab once for autocomplete, twice for a list of everything in that directory
- Want to stop something you accidentally ran?
  - Ctrl-C to interrupt the process
  - Ctrl-Z to pause a process
    - Can then send to foreground (fg) or background (bg) using the process ID

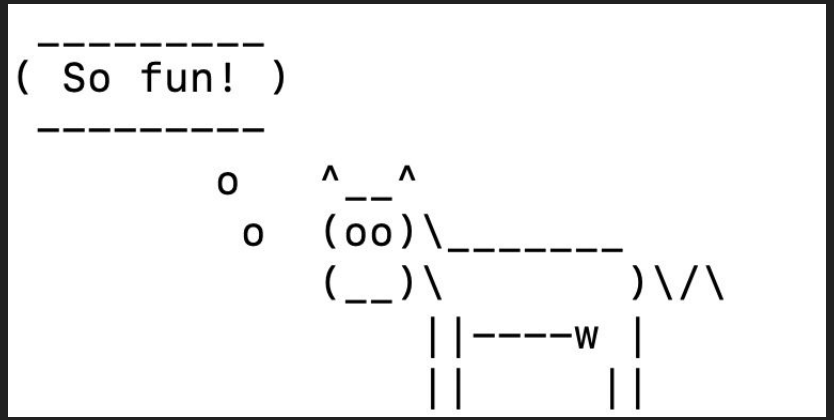
Useful Tips and Tricks

- Wish you had a shortcut for a long command?
  - Create an alias in `.zshrc` or `.bash_profile`
    - `alias compile_run_pong="cd pong && javac *.java && cd .. && java pong.App"`
  - open -e ~/.zshrc → type your alias (save file) → refresh your terminal → enjoy



~FUN~ Commands

- `date`
- `yes <text>`
- `figlet <text>`
- `sl`
- `telnet towel.blinkenlights.nl`
- `trans [-brief]`
- `fortune`
- `cowsay <text>`
- `animal-to`



**Note: for some of these commands, download may be required (Google is your friend)*

Text Editors in the Terminal

- nano
- vim
- emacs

Interested?

Introduction to Computer Systems

This course covers the organization of computer systems (in terms of storage units, caches, processors, and I/O controllers) and teaches you assembly and C language programming.

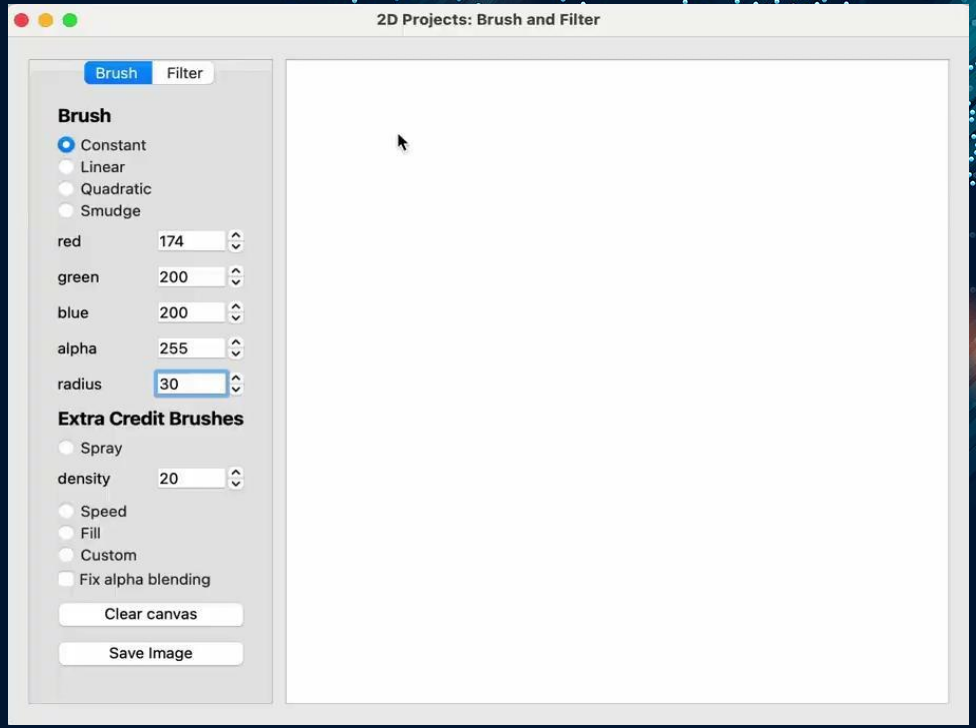
Modern Computer Graphics

When your simulations become more real than reality


YAHOO!

Beyond JavaFX

- Raster graphics, used in CS1230, work with a fixed number of colored pixels
  - 2D arrays, anyone?
  - Manually compute the value of each pixel according to what you want to see
  - Used to simulate scenes or draw your own, filter and transform images



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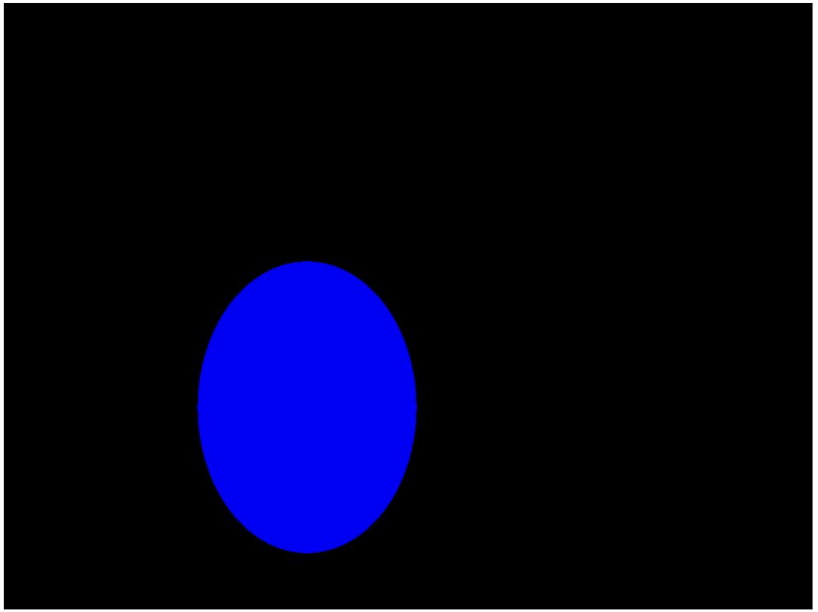
Toxic beauty standards for spheres #427

L Lexi Henrion
2 months ago in Projects – Project 3: Intersect

STAR WATCHING 283 VIEWS

27

After spending days debugging int-float errors, the unit sphere render finally was born



Only to be told that the way he looks is "wrong" and he is "too long" and "looks squished. "A sphere is a symbol of perfection," they say. "That is an oval," they say. Heartless and cruel.

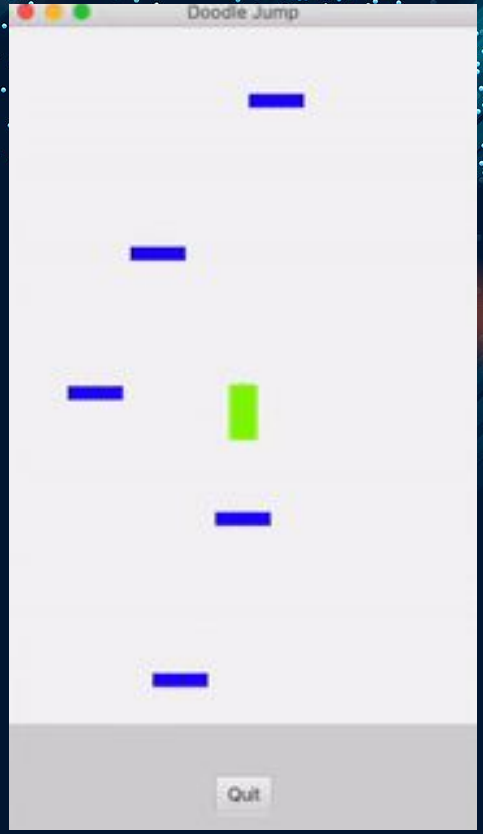
I feel sad having to make him conform to arbitrary beauty standards at such a young age. When will there be an SRC discussion on these toxic and restrictive standards for spheres?

Simulating Our World

Let there be light!

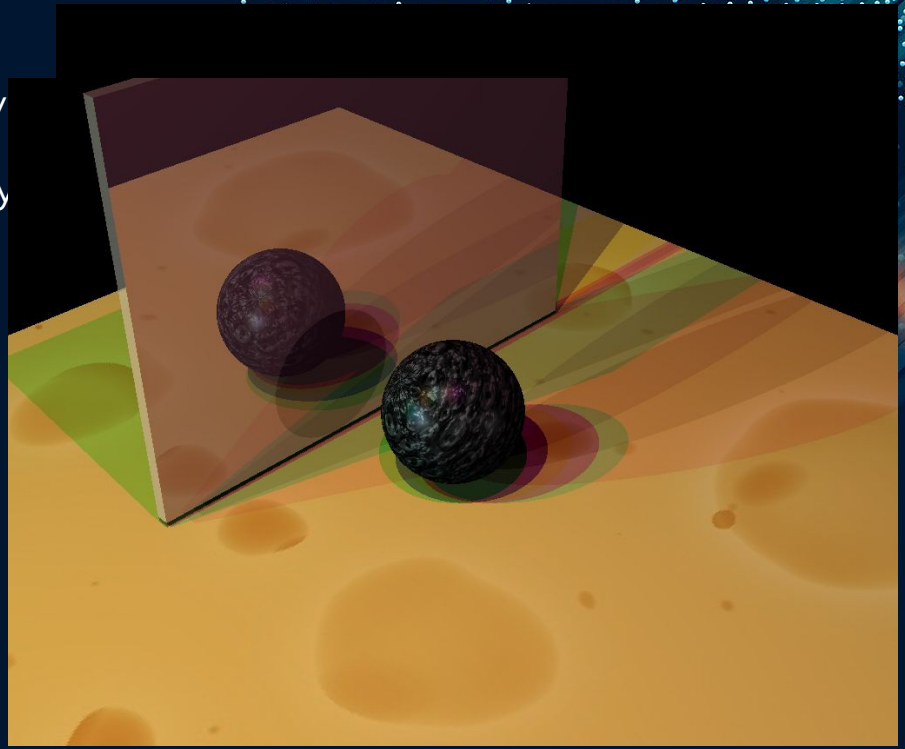
How do we simulate our world on a screen?

- **BIG IDEA: use mathematical / physical laws of motion to describe the movement and appearance of the objects you code**
- Using gravity + collision detection in Doodle Jump
  - You didn't have to hardcode where exactly the doodle would be at every time step
  - That would have made your program crazy long and impossible to play!

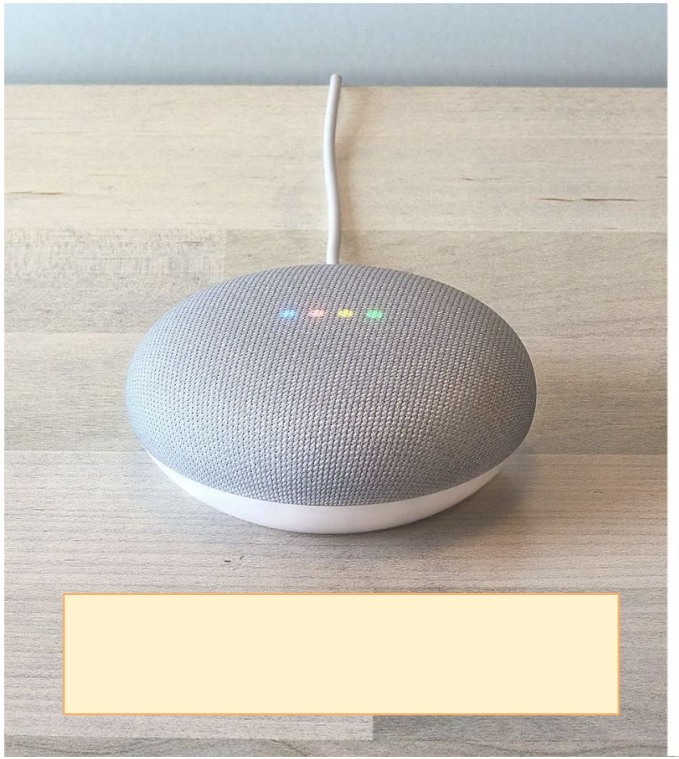


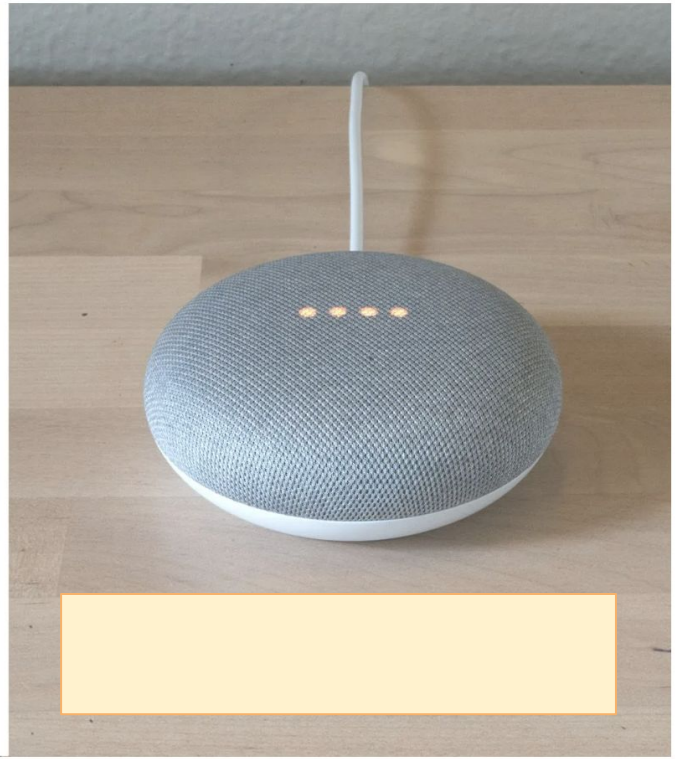
Raytracing + Pathtracing

- Describe a scene and have a computer render it “photorealistically”
- In real life, things appear the way they do because of the way light interacts with them
- Follow light rays from a light source and figure out how much light hits the spot in the image, and where the lights bounce off the objects



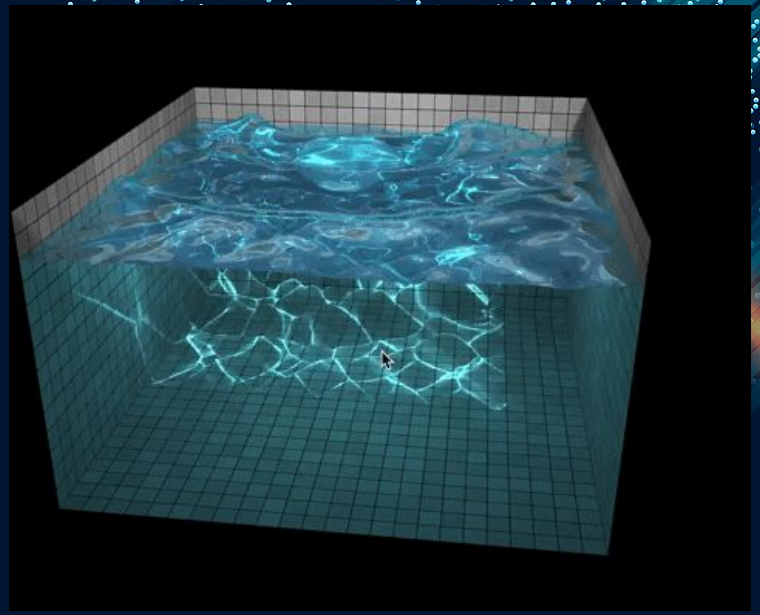
Which one is real?



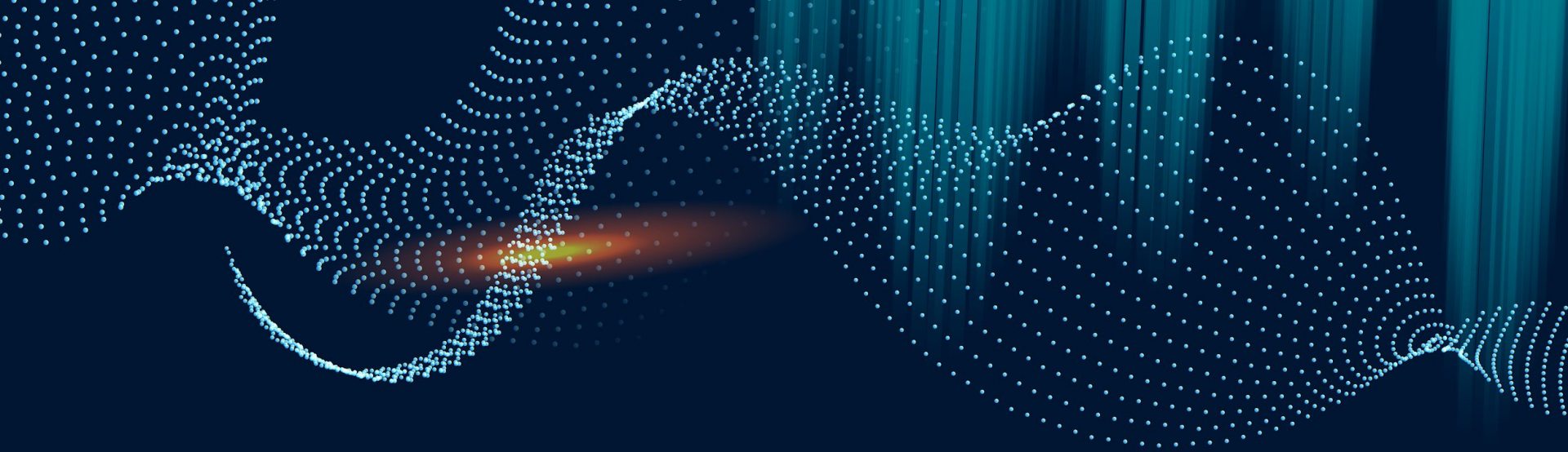


Real World Features On Your Screen

- Not everything we want to render is a solid object, we also want real life features (like water) with realistic interactions
- We're able to bring these features to life through these simulations, and they're only improving from here
- Like earlier, we don't hard code these features, we use math and clever coding techniques to simulate real life objects digitally
    - splashes, ripples, reflections, buoyancy of the ball, etc



Water Simulation made by Evan Wallace, former Brown CS Student and Co-Founder of Figma
https://madebyevan.com/webgl-water/

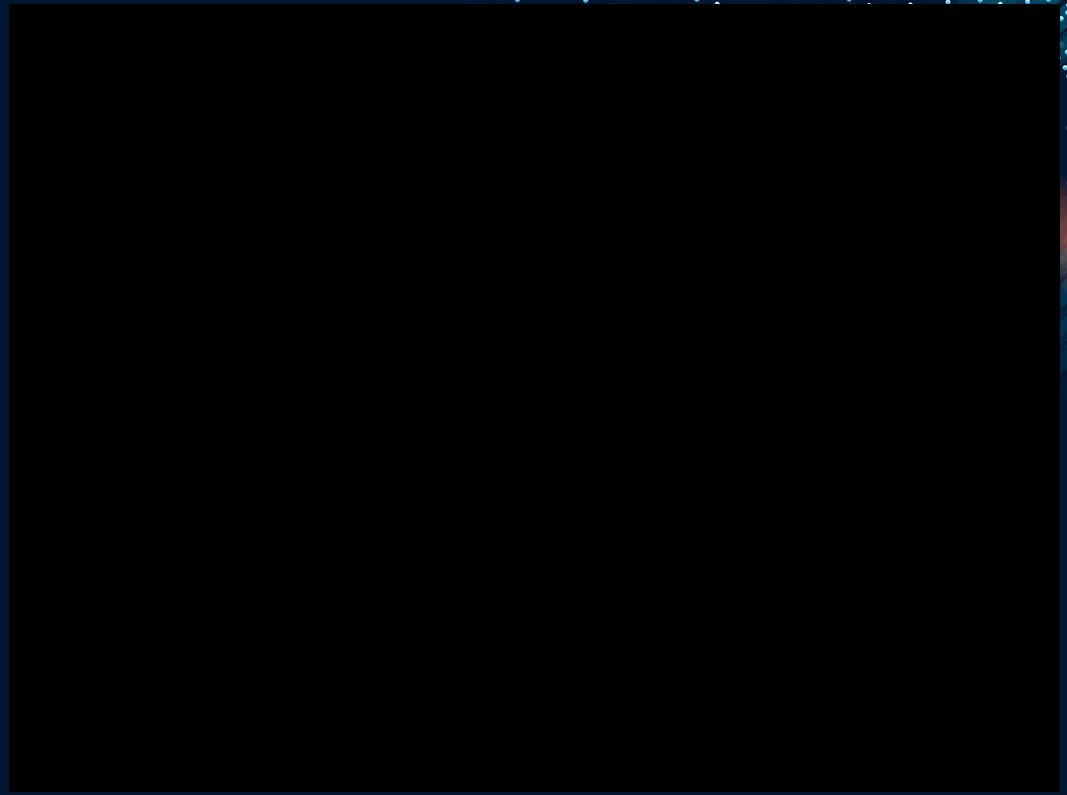


AI

Applications and Implications

How can we use AI to optimize creativity?

- **Creation takes time!**
- Animation: a drawing for every frame, ~24 frames/second
- A lot faster to visualize an image mentally than to put “on paper!”
- Right: timelapse of 30 hours of work for 8 comic pages



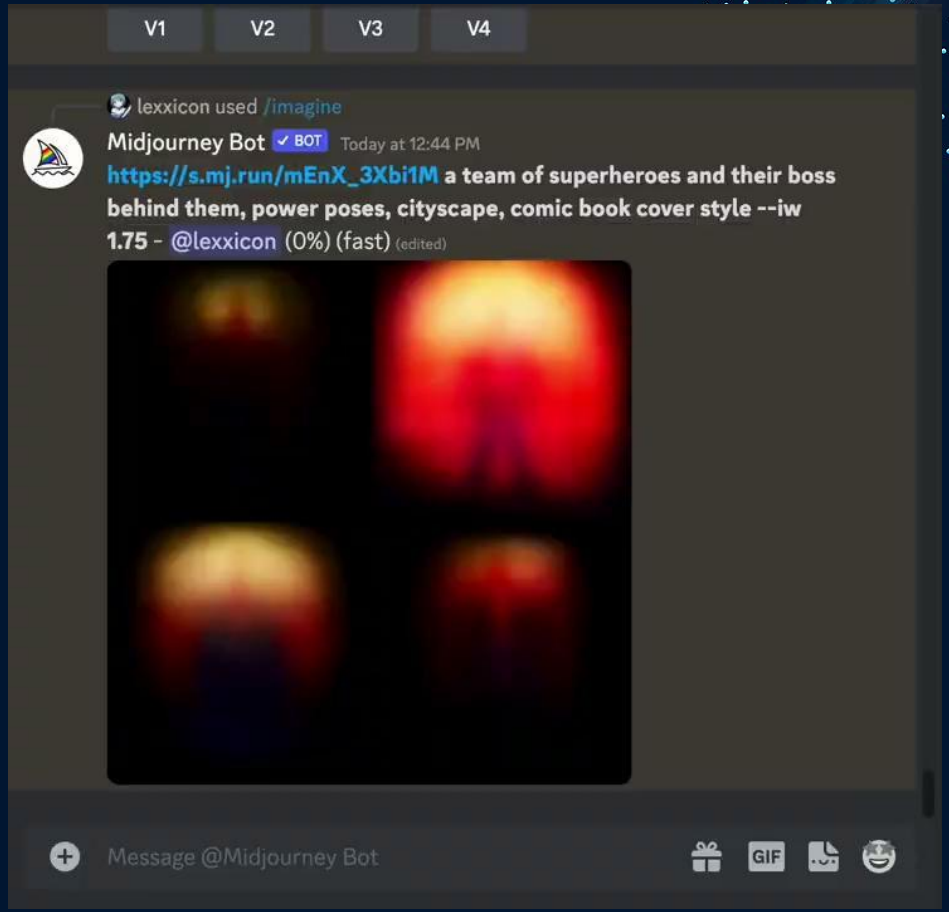
The good, the bad, and the ugly

- AI trained off of stolen datasets
    - big ethical debate
- On the other hand, creation has been “gatekept”
    - art not known as a lucrative field
    - making some projects requires a huge amount of funding or a big studio
- Not going away anytime soon, so how can we creatives harness it to work for us and not against?

Silly Premise: Andy's X-Men

- We want to make a cover for comic, Andy's X-Men
- We have a sketch, but we want to make polished concept art. Can AI help?
    - yes! (to an extent)

Midjourney AI: Powerful, but unwieldy

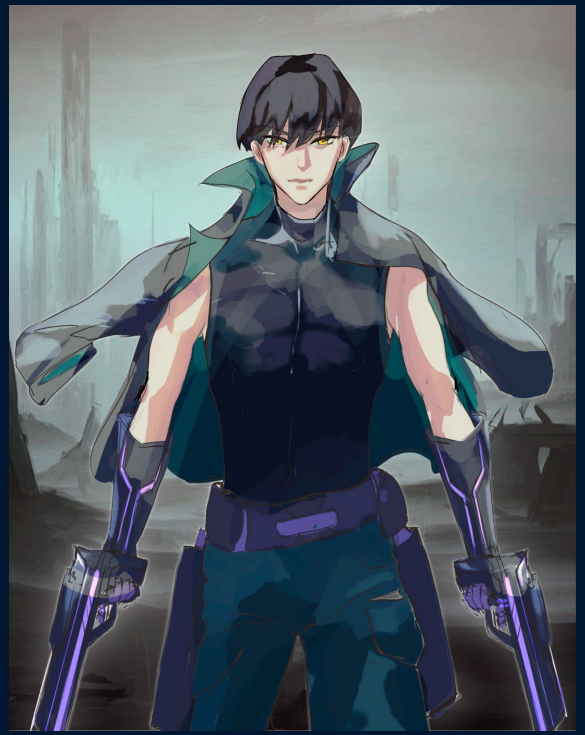


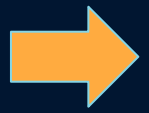
Infinite Variations!

- Great for brainstorming
- Less great for polishing existing concepts

Infinite Variations!

Render photorealistically





Example use case: In-Betweens (“Tweening”) & Rotoscoping

- **Tweening:** Animations are composed of key frames (like specific poses) and in-betweens, which are frames between keyframes to make motion smooth. Tweening is the process of drawing the in-between frames
- **Rotoscoping:** Drawing over video to make an animation
    - Classic Disney movies like The Little Mermaid were made this way!
- Can be tedious and repetitive

More Graphics!

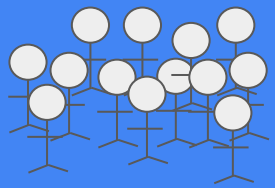
- Here are some resources:
- Two minute papers youtube channel (highly highly recommend, even for non-graphics related videos)
- Pixar graphics library
- Here are some classes you could take!
- CS1230: Introduction to Computer Graphics (requires CS200)
- CS1250: Introduction to Computer Animation
- CS2240: Interactive Computer Graphics (requires CS1230)

Industry

Anastasio

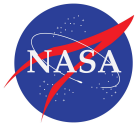
So you want to get a job?

Of course we do. That's why I got into CS in the first place



What even is “industry”?

Government



HealthCare.gov

Non Profit

Khan Academy

girls who code

C O
D E

techsoup

KIVA

change.org

For Profit

PIXAR

Adobe

Meta

Microsoft

amazon

ACTIVISION

teespring

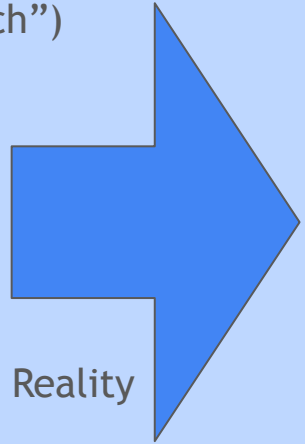
Google

Figma

mongoDB.

What does “industry” look like?

- Education Tech (“EdTech”)
- Health Tech
- Financial Tech (“FinTech”)
- Consumer Tech
- Animation
- Video Games
- AI Tech
- Bio Tech
- Ad Tech
- Robotics
- Virtual and Augmented Reality
- Security
- Databases
- Communication
- Lots and Lots More…



Coursera, Khan Academy, Duolingo,Canvas
athenaHealth, HealthCare.gov, Clover, Flatiron
Stripe, Jane Street, Square, Bloomberg
Google, Facebook, Apple, DropBox
Pixar, Dreamworks
Activision, Blizzard, Bungie, EA, Valve
OpenAI
Novo Nordisk, Moderna Inc., BioNTech
…
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Types of Careers: SWE

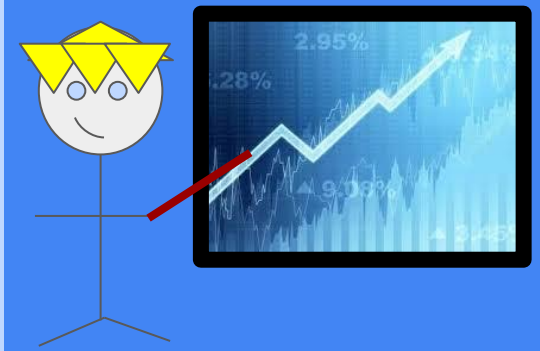
- Software Engineer/Developer (often called SWE)
  - Focus on creating and coding the software
  - Variety of specialties: Test/Quality Assurance (QA), etc.
  - Not a code monkey, not coding 10-12 hours a day
    - Often in meetings collaborating on design, setting requirements, and talking to prospective customers
    - Depends on company/job, so research/ask about it during process
  - Can work on different parts of applications:
    - Specialists: Frontend, Backend, Databases
    - Generalist: “Full-Stack”

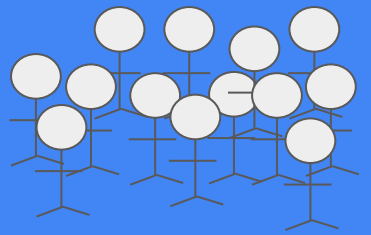
Types of Careers: PM

- Project/Program/Product Manager
  - Some of our best HTAs have gone into Program Management
  - Focus defining what the product should be and what features it should have
  - Includes some level of project management/coordination
  - Work with both prospective users and software developers
  - Technical position
  - Some PMs code and make prototypes
  - Can’t just tell everyone what to do. Have to convince the engineers that your plans are the best for the product
  - Being a PM doesn’t mean you can’t be a SWE after (and vice versa)

Other Types of Careers

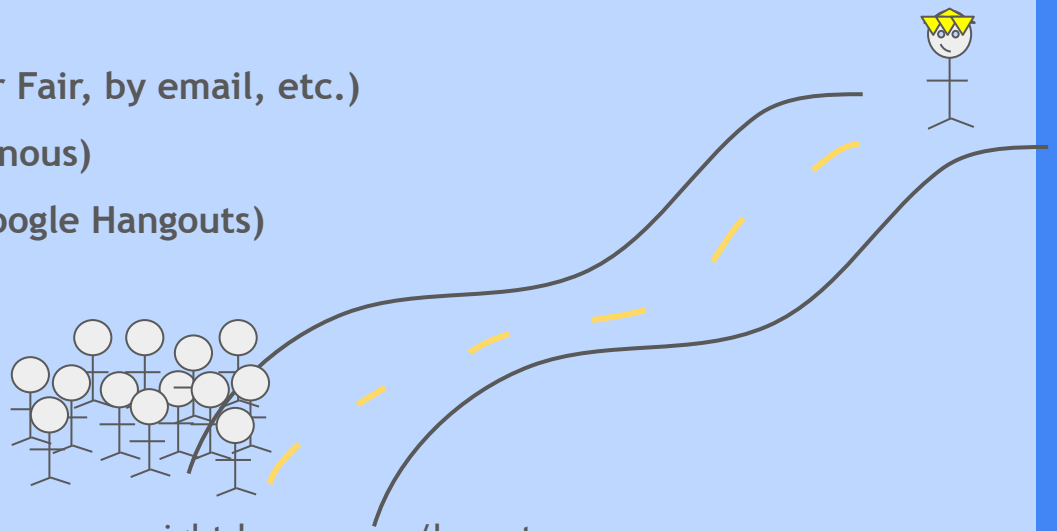
- UX (User Experience) Designer
- UI (User Interface) Designer
- UX vs. UI
- Data Scientist
- Systems Programmer
- IT Architect
- And many more!





The Road to Jobs/Internships*

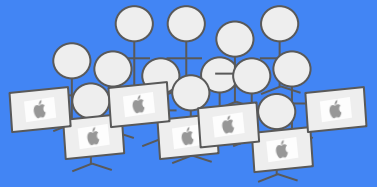
- ❑ Research companies
- ❑ Apply (online, at Tech Fair, at Career Fair, by email, etc.)
- ❑ Online Assessment (usually asynchronous)
- ❑ Technical interview (Phone/Zoom/Google Hangouts)
- ❑ Onsite Interview
- ❑ Offer



*Disclaimer: This may vary by company, some might have more/less steps

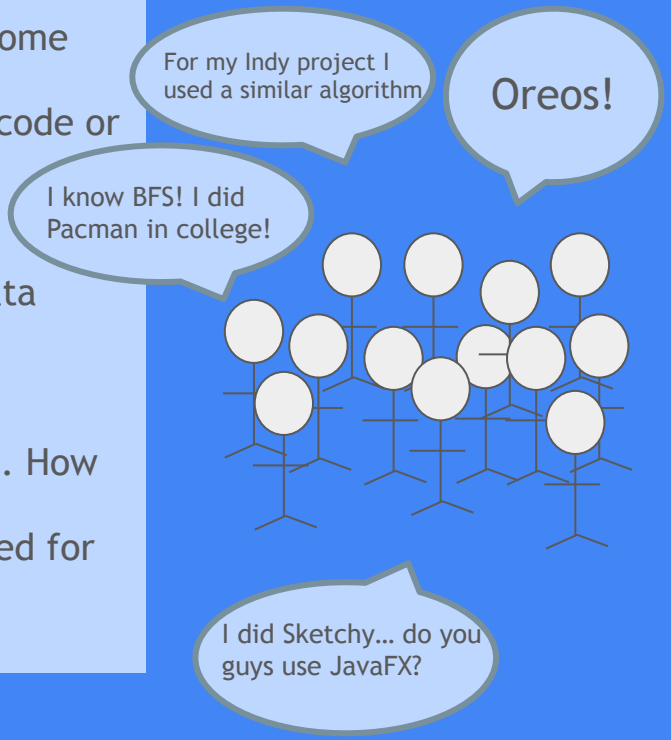
Online Coding Assessments

- Many software development jobs & internships nowadays require some form of an online coding challenge/assessment to weed out applications
- You code on an IDE of their choosing, interviewer gives some problem that you have to solve
- In 45 minutes to an hour, you are expected to reason through different ideas and write code or pseudocode for a solution
- If coding, can normally use whatever language you are most comfortable in
- Imagine you are turning in a CS15 Assignment! Make sure to code with style and be efficient.
- Your solution doesn't necessarily have pass all the tests cases, be totally right, or sometimes even work at all to advance to the next round.



Technical Interviews

- Similar skillset to a Coding Assessment
- On an online coding pad or on whiteboard, interviewer gives some problem that you have to solve
- You are expected to reason through different ideas and write code or pseudocode for a solution
- Expect to talk aloud and show your work
- Most importantly, they just want to see how you think
- Problems are often algorithmic and/or involve some sort of data structure:
  - “How could you reverse a LinkedList?”
  - “How could you build a Queue using two Stacks?”
  - “Imagine <long scenario about some hypothetical game>. How would you account for <specific case or rule>?”
- Many of the foundational data structures and algorithms needed for technical interviews are covered in lots of depth in CS200 :)



What might an internship look like?

Working at a small company/start up
< 50 people

- Typically only designing 1-2 products
- Small user base → take more risks in project features
  - Have a larger say in the direction of the project
- Fast paced → push out features as fast as you can build them (every couple of days)

Working at a mid level - large company
> 200 people

- Building many products, can get exposed to multiple different technologies in one company
- Larger user base → take less risks, work is heavily reviewed
  - Might not have as much freedom, but affect many more users
- Slower paced → features pushed out every couple of weeks/once per month

What I Wish I Knew About CS Earlier...

& Why You Belong Here

Sarah

Only Some of the Resources at Brown

- WiCS - Women in Computer Science
  - Mentorship program, meetings and events
  - Supports the Artemis Project, a free summer camp for rising ninth-grade girls from the Providence area who show interest in science and technology.
- Mosaic+
  - Advocate for diversity within Brown's CS community
  - Big-little system, workshops, group study
- The UTA Program
  - Has changed my life!!

There is more to CS than SWE

In fact, there are jobs out there that you and I have never even heard of…

Random CS Internships I've Explored

- Computer Science Teaching
- Product Management/Technical Project Management
- Technical Writing/Documentation Team
- Technical Specialist for Law Firm

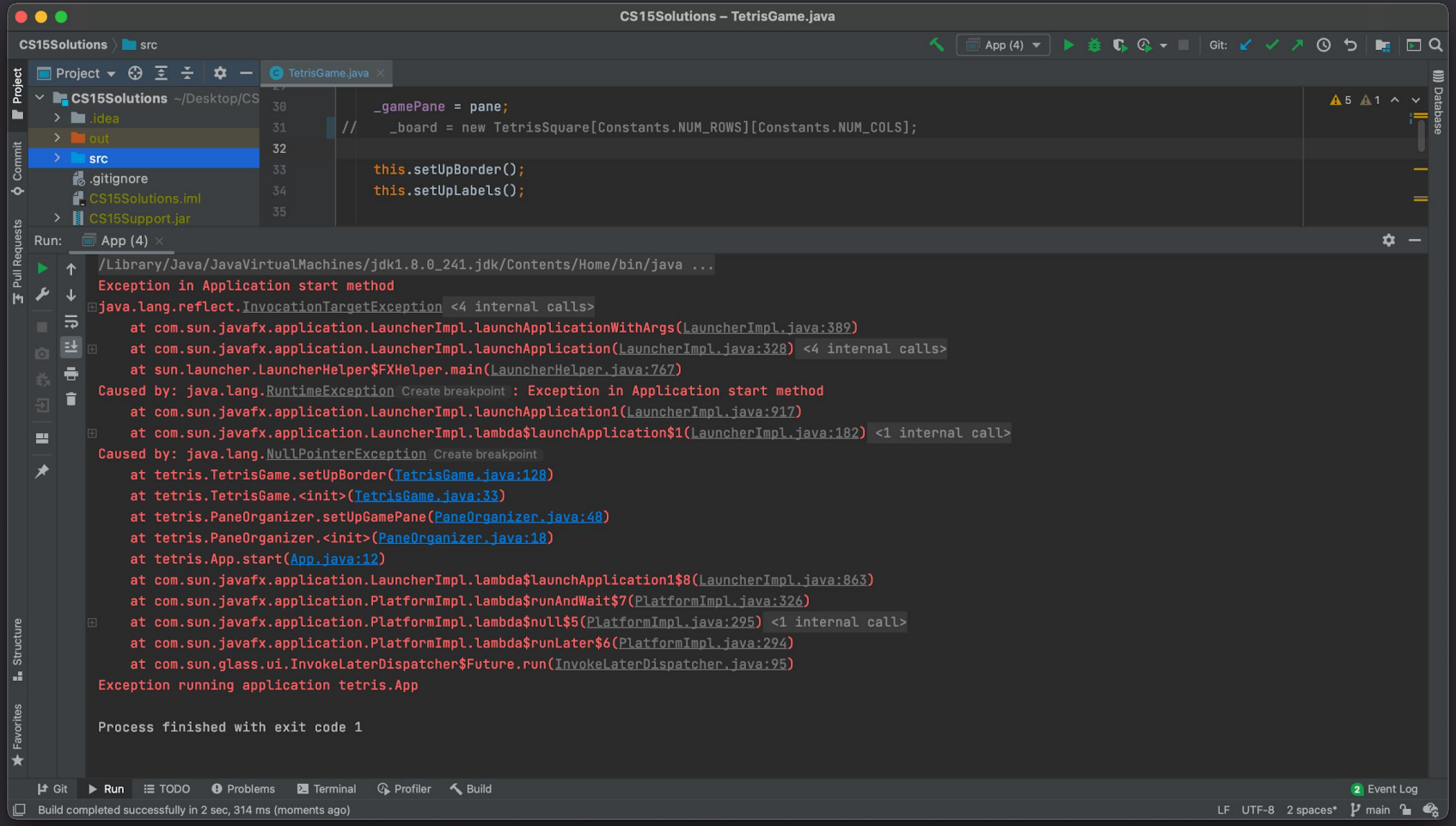
And there are so many more! (UX Designer, Systems Architect, Database Administrator, Healthcare AI Developer, Quant Analysts)

“Everyone in this country should learn how to program because it teaches you how to think”

– Steve Jobs.

So… what makes a good programmer?


JS
CSS
GO


CS15Solutions – TetrisGame.java
CS15Solutions 〉 src
App (4)
Git:
Project
CS15Solutions ~/Desktop/CS
.idea
out
src
.gitignore
CS15Solutions.iml
CS15Support.jar
TetrisGame.java
30 _gamePane = pane;
31 // _board = new TetrisSquare[Constants.NUM_ROWS][Constants.NUM_COLS];
32
33 this.setUpBorder();
34 this.setUpLabels();
35
Run: App (4)
/Library/Java/JavaVirtualMachines/jdk1.8.0_241.jdk/Contents/Home/bin/java ...
Exception in Application start method
java.lang.reflect.InvocationTargetException <4 internal calls>
at com.sun.javafx.application.LauncherImpl.launchApplicationWithArgs(LauncherImpl.java:389)
at com.sun.javafx.application.LauncherImpl.launchApplication(LauncherImpl.java:328) <4 internal calls>
at sun.launcher.LauncherHelper$FXHelper.main(LauncherHelper.java:767)
Caused by: java.lang.RuntimeException Create breakpoint : Exception in Application start method
at com.sun.javafx.application.LauncherImpl.launchApplication1(LauncherImpl.java:917)
at com.sun.javafx.application.LauncherImpl.lambda$launchApplication$1(LauncherImpl.java:182) <1 internal call>
Caused by: java.lang.NullPointerException Create breakpoint
at tetris.TetrisGame.setUpBorder(TetrisGame.java:128)
at tetris.TetrisGame.<init>(TetrisGame.java:33)
at tetris.PaneOrganizer.setUpGamePane(PaneOrganizer.java:48)
at tetris.PaneOrganizer.<init>(PaneOrganizer.java:18)
at tetris.App.start(App.java:12)
at com.sun.javafx.application.LauncherImpl.lambda$launchApplication1$8(LauncherImpl.java:863)
at com.sun.javafx.application.PlatformImpl.lambda$runAndWait$7(PlatformImpl.java:326)
at com.sun.javafx.application.PlatformImpl.lambda$null$5(PlatformImpl.java:295) <1 internal call>
at com.sun.javafx.application.PlatformImpl.lambda$runLater$6(PlatformImpl.java:294)
at com.sun.glass.ui.InvokeLaterDispatcher$Future.run(InvokeLaterDispatcher.java:95)
Exception running application tetris.App
Process finished with exit code 1
Git
Run
TODO
Problems
Terminal
Profiler
Build
Event Log
Build completed successfully in 2 sec, 314 ms (moments ago)
LF
UTF-8
2 spaces*
main

The TAs are not better programmers than you.

We just have more experience.

About Store

Gmail Images

java how to

java how to **throw exception**

java how to **call a method**

java how to **print an array**

java how to **convert string to int**

java how to **compare strings**

java how to **read a text file**

java how to **initialize an array**

java how to **add to an array**

Java: How to Program
Book by Harvey Deitel and Paul Deitel

java how to **write to a file**

Google Search I'm Feeling Lucky

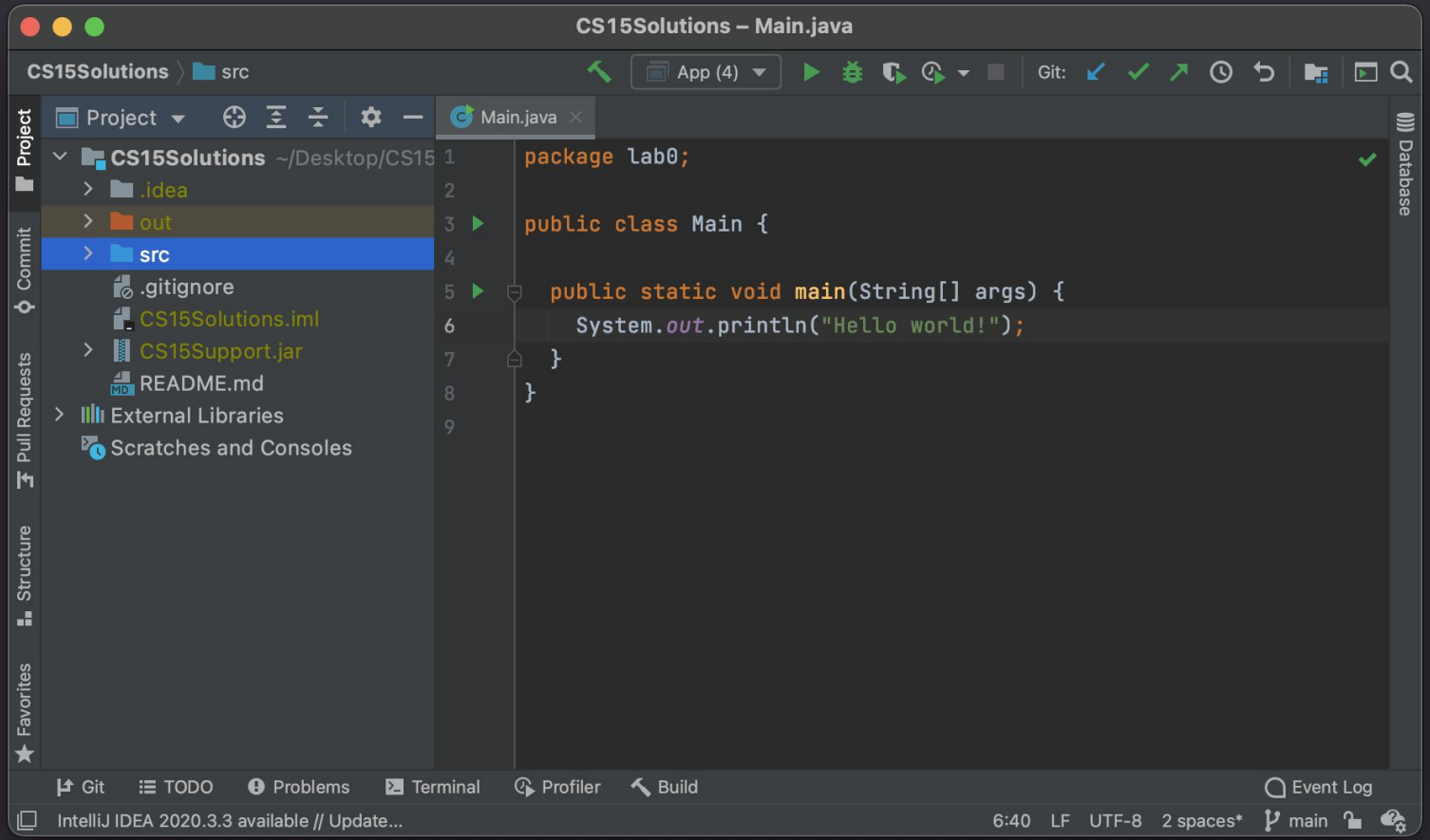
Report inappropriate predictions

Problems become familiar problems.

~~“I did something wrong…”~~
~~“Now it doesn’t work…”~~

“Where have I seen this before?”
“How can I figure out what happened?”
“Where can I find more information?”

Struggling + Frustration → Learning


CS15Solutions – Main.java
CS15Solutions
src
App (4)
Git:
Project
Main.java
CS15Solutions ~/Desktop/CS15
.idea
out
src
.gitignore
CS15Solutions.iml
CS15Support.jar
README.md
External Libraries
Scratches and Consoles
package lab0;
public class Main {
public static void main(String[] args) {
System.out.println("Hello world!");
}
}
Project
Commit
Pull Requests
Structure
Favorites
Database
Git
TODO
Problems
Terminal
Profiler
Build
Event Log
IntelliJ IDEA 2020.3.3 available // Update...
6:40
LF
UTF-8
2 spaces*
main

Title	Sales	Platforr
Minecraft †#	176,000,000	Multi-platform
Tetris †#	170,000,000	Multi-platform

FUNCTIONALITY

For this assignment, you'll navigate a `CS15Robot` called AndyBot through a maze—surpassing daunting obstacles such as walls and an especially trifling roadblock. Your task is to call move methods on the AndyBot to move it out of the maze (off-screen) so the "Winner!" message appears.

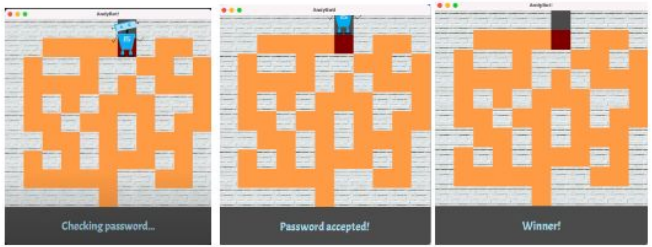
1. Don't try to move your bot into a wall because it will cause AndyBot to get stuck.

2. The red at the end of the maze represents the roadblock. To pass it, AndyBot will have to submit a secret password (it will be a number). Unfortunately, this password will be different every time you run the program. Luckily, the maze will help you if you call the right methods (**hint:** think about who has this information when calling the method)!

3. Once AndyBot is on the maroon square (the square directly underneath the gray square) it may enter the password. If AndyBot tries to enter the password before it reaches the square, the password will not be accepted as that is too early to input it.

4. Once AndyBot submits the correct password, make sure to move your AndyBot upwards 2 more steps and off-screen to victory. The bottom screen should read "WINNER!"

5. A successful program will match the pattern shown below:



Step 4. Set up the `Timeline` that will be in charge of updating the doodle's location and displaying the graphical changes. (To test if your `Timeline` is working, you can start with printlines)

Step 5. Set up the KeyEvent handler so you can use the left and right arrows to get your doodle to move.

Step 6. Add "wrapping" capabilities so the doodle reappears on the other side when it moves offscreen.

Step 7. Add some physics simulation so that your doodle falls.

Step 8. Start with creating one *basic* platform and add/test collision detection with that platform.

Step 9. Generate a whole screen of semi-randomly positioned platforms so that your doodle can jump its way upwards!

Step 10. Add the vertical scrolling so that when the doodle tries to pass a certain height, it stops moving, and all the platforms move downward. (**WARNING!** This step is tricky! Really think about the best way to implement this -- careful design and pseudocode will simplify this step greatly.)

Step 11. As platforms scroll down, be sure to delete them and generate new ones both graphically and logically.

Step 12. Add the moving, disappearing, and extra bounce platforms.

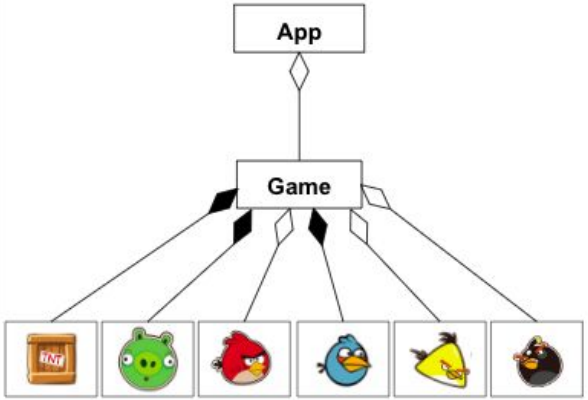
Step 13. When the game is over, stop the `Timeline`, display a "Game Over" label, and make sure the Doodle can no longer be moved with the arrow keys.

Step 14. Add score tracking to the game.

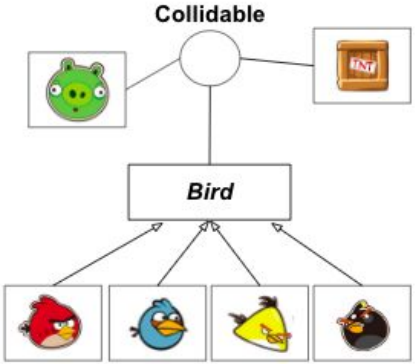
Programming with a Partner

Example Final Design

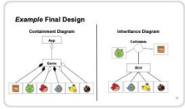
Containment Diagram



Inheritance Diagram



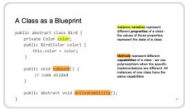
25



26

How might the code emphasize OOP concepts?

27



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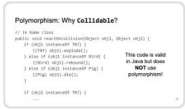


29

`instanceOf` is ***bad*** because it indicates a poor use of (or lack of) polymorphism!

do not use `instanceOf`!

🤮**you'll lose points**🤮

30

`instanceOf` is ***bad*** because it indicates a poor use of (or lack of) polymorphism!

do not use `instanceOf`!

🤮you'll lose points🤮

29

Click to add speaker notes

Socially Responsible Computing

cs15.prj.pongSupport

Class CS15Paddle

java.lang.Object
    cs15.prj.pongSupport.CS15Paddle

```
public class CS15Paddle
extends java.lang.Object
```

A SUPPORT class that models one pong paddle.

Constructor Summary

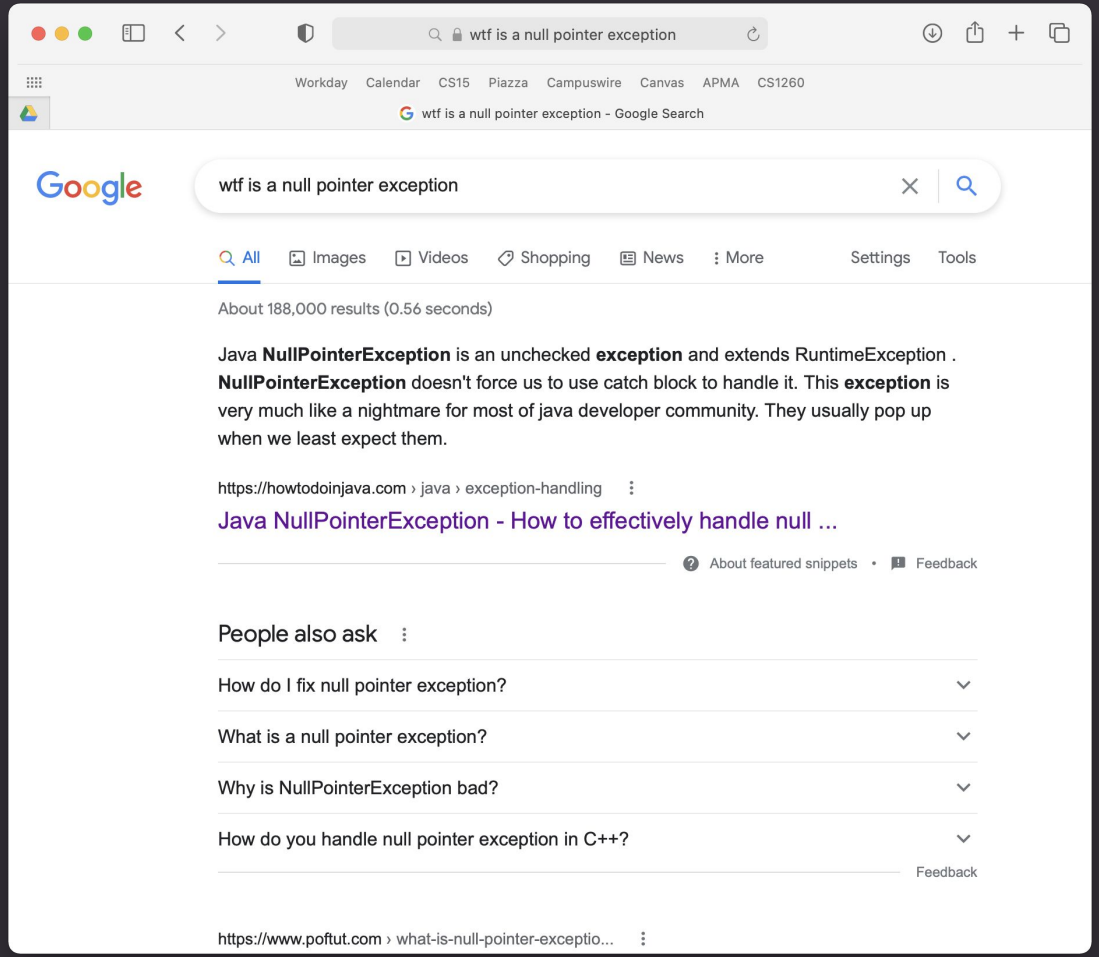
Constructors

Constructor and Description
`CS15Paddle(boolean isLeftPaddle)` Creates a new paddle in the pong game.

Method Summary

All Methods | **Instance Methods** | **Concrete Methods**

Modifier and Type	Method and Description
`void`	`checkCollision(CS15Ball ball)` Checks if the paddle instance is colliding with a ball.


wtf is a null pointer exception
Workday Calendar CS15 Piazza Campuswire Canvas APMA CS1260
wtf is a null pointer exception - Google Search
Google
wtf is a null pointer exception
All Images Videos Shopping News More Settings Tools
About 188,000 results (0.56 seconds)
Java NullPointerException is an unchecked exception and extends RuntimeException . NullPointerException doesn't force us to use catch block to handle it. This exception is very much like a nightmare for most of java developer community. They usually pop up when we least expect them.
https://howtodoinjava.com › java › exception-handling
Java NullPointerException - How to effectively handle null ...
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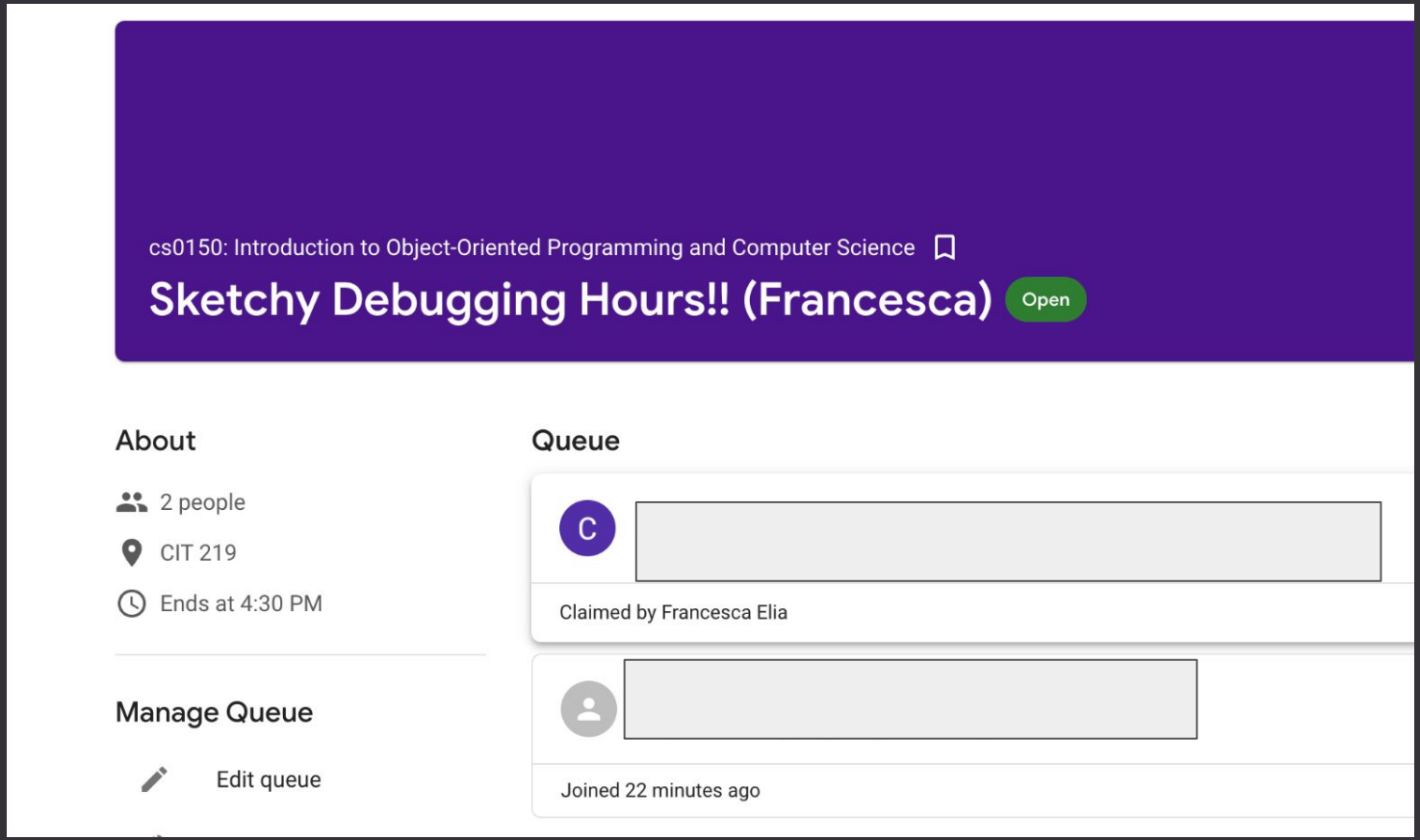
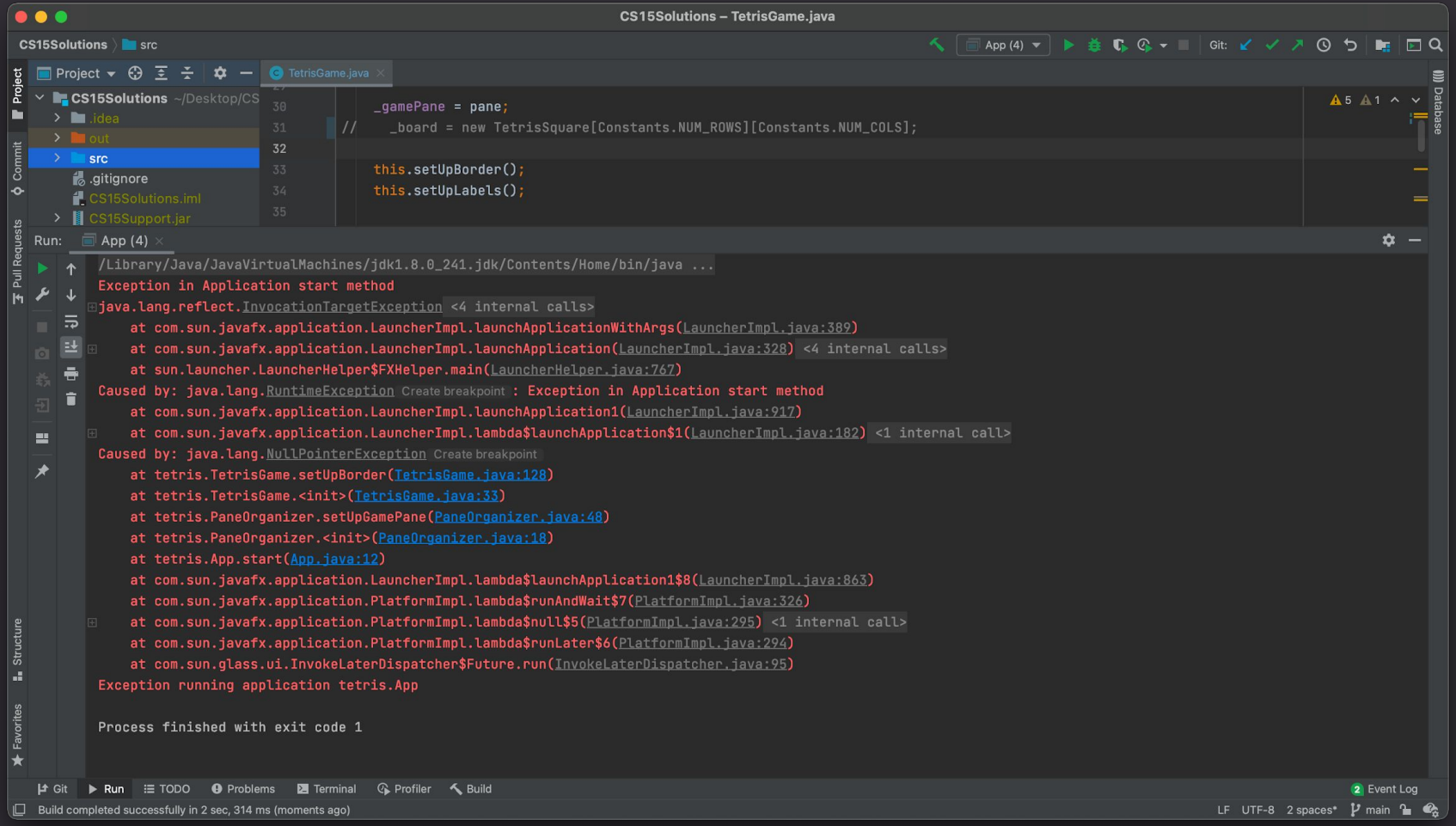
People also ask
How do I fix null pointer exception?
What is a null pointer exception?
Why is NullPointerException bad?
How do you handle null pointer exception in C++?
Feedback
https://www.poftut.com › what-is-null-pointer-exceptio...


cs0150: Introduction to Object-Oriented Programming and Computer Science
Sketchy Debugging Hours!! (Francesca)
Open
About
2 people
CIT 219
Ends at 4:30 PM
Manage Queue
Edit queue
Queue
C
Claimed by Francesca Elia
Joined 22 minutes ago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/Library/Java/JavaVirtualMachines/jdk1.8.0_241.jdk/Contents/Home/bin/java ...
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at com.sun.javafx.application.LauncherImpl.launchApplication(LauncherImpl.java:328) <4 internal calls>
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Exception running application tetris.App
Process finished with exit code 1
Git
Run
TODO
Problems
Terminal
Profiler
Build
Event Log
Build completed successfully in 2 sec, 314 ms (moments ago)
LF
UTF-8
2 spaces*
main

You're learning *how* to learn.

The Goal of CS

~~Know how to code everything~~

Know how to figure out how to do what you want to do.

Part of that process *includes* not knowing what to do.

AND THAT'S COMPLETELY FINE.

What makes a good programmer?

- Knows how to write code,
- Learns and masters relevant tools,
- Persistent against stupid computers,
- Always willing to learn,
- And a pro at a little extra googling.

You’re already on your way.

Go get ‘em.

Announcements

Apply to TA CS15 for next fall!

How do I apply?

- Applications for next fall will come out in early/mid March
- Application is short and non-binding
- We'll send an email to the whole course when applications are out!

Why should I apply?

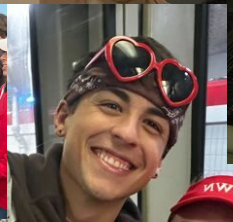
- Participate in the skits!
- Make friends for life!
- Master Java and OOP!
- Mentor new CS students!
- Improve the course!



























IMAX
IMAX








Lastly, we present... the best of the commit messages

You had a way with words...

finished!!!
itted 12 days ago

jk it was a bracket mistake
itted 12 days ago

cs15 TAs this is beyond me
12 days ago

poop
itted 12 days ago

poop
itted 12 days ago

poop
13 days ago

me when i chase ball
committed on Oct 19

me when i run in a field in circles w my tongue out
committed on Oct 19

YAYYYY
committed on Oct 19

poo
drews508 committed 14 days ago

lkhvkj
drews508 committed 14 days ago

lets g
drews508 committed 14 days ago

ljhufu
drews508 committed 14 days ago

gird your loins
committed on Nov 1

updated

AAAAAAAAAAAAA

Added comments

Added comments

AAAAAAAAAAAAA

AAAAAAAAAAAAA

shit
committed on Nov 1

bello
committed on Nov 1

fuckkeerrrrr
committed on Nov 1

fuck
committed on Nov 1

fuck
committed on Nov 1

grrr
mmitted on Nov 1

platform makes doodle go poof??
committed on Oct 27

Sometimes GitHub is hard...

please keep code i am begging please dont delete
committed 20 days ago

shapes are movinggit add -A
committed 17 days ago

pieces workgit add -A
committed 18 days ago

j'aime pas git pull
committed 29 days ago

inch inch
committed 29 days ago

lolilol
committed 29 days ago

trying to MERGE
committed on Nov 1

trying to merge p.3
committed on Nov 1

fruitninjaFINAL
committed on Oct 11

fruitninja save 22
committed on Oct 11

fruitninja save 21
committed on Oct 11

fruitninja save 20
devinallardneptune committed on Oct 11

fruitninja save 19
committed on Oct 11

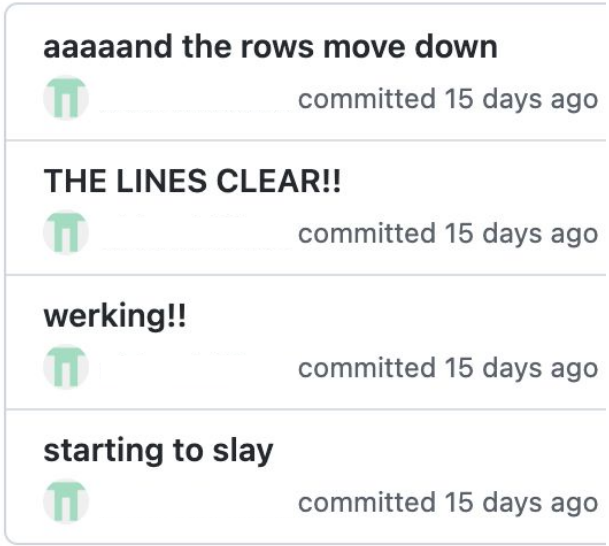
fruitninja save 18
committed on Oct 11

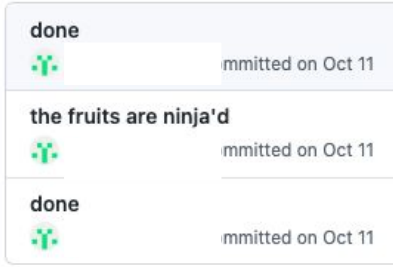
fruitninja save 17
committed on Oct 11

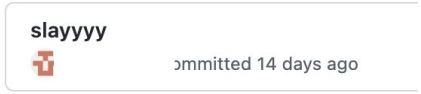
fruitninja save 16
committed on Oct 11

fruitninja save 15
committed on Oct 11

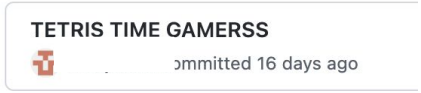
We've seen you at your highest highs...



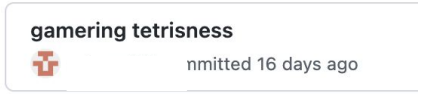


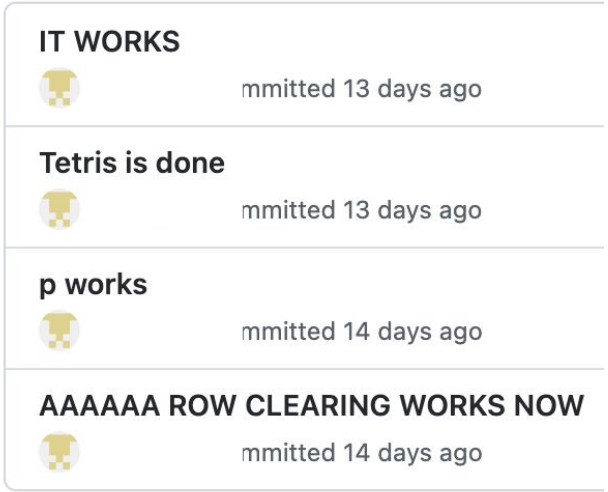


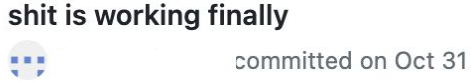
Commits on Nov 13, 2022



Commits on Nov 12, 2022







...and your lowest lows

i hate this even more now
committed 26 days ago

i hate this project
committed 26 days ago

fixed?
committed 26 days ago

it won't work?
ommitted 26 days ago

YAHOOoOO
ommitted 26 days ago

this is bad.
committed 15 days ago

i dont know if i can do this
committed 15 days ago

its on Nov 12, 2022

eheifefhehfehfeifehfeihfehifehf
committed 16 days ago

tetris is the bane of my existence
committed 16 days ago

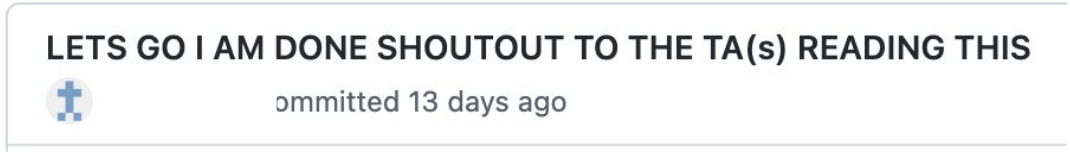
lordhavemercy
committed 26 days ago

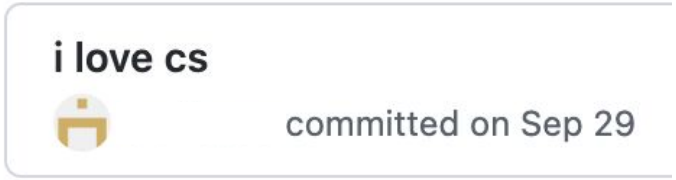
nothing works anymore.
committed 17 days ago

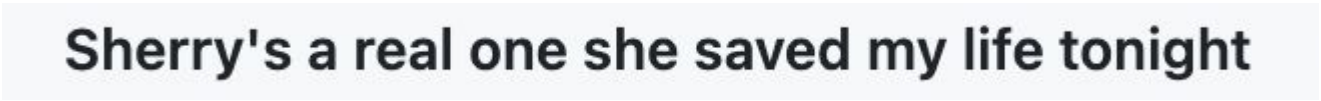
constantly in pain

I couldn't do it, i sat here for 12 hours straight but i still couldn...	2 weeks ago
i was overdramatic, i got it done	2 weeks ago

We love you too <3







Yes ;)


does anyone read this
committed 27 days ago
can the TAs read this??
committed on Sep 15

And finally... some never before seen t shirt designs

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<3 <3