HTA Lectures

1

Cybersecurity

And Why You Should Study It!
Allie :)

2

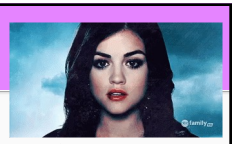
What is Cybersecurity?

"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 :)

3

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

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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!

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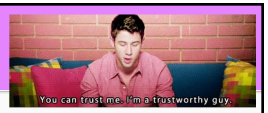
Integrity



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.

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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 :(

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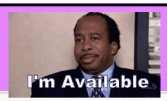
Availability



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

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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

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What can you do about it

Three main pathways:

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

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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*

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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)

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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

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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

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15

490 BCE

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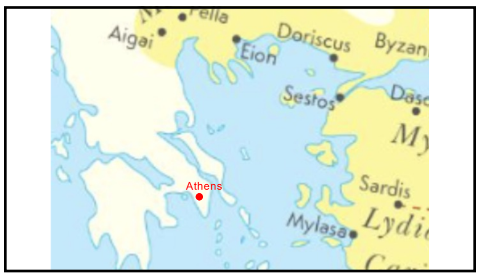
17

18


Aigai
Eion
Doriscus
Sestos
Sardis
Mylasa

19


Aigai
Eion
Doriscus
Sestos
Athens
Sardis
Mylasa

20


Black Sea
Athens
Parthia
Legend

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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)

22

Who wins?

23

Athens

24

But how??

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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

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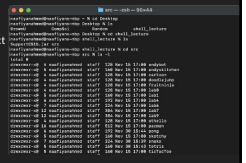
CLI (Command Line Interface)

- 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



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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

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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
```

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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>
```

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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

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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

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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

```
naafiyanahmed — -zsh — 80×24
naafiyanahmed@naafiyans-mbp ~ % hello
hello, naafi
naafiyanahmed@naafiyans-mbp ~ %
```

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~FUN~ Commands

```
 _________
( So fun! )
 _________
        o   ^__^
         o  (oo)\_______
            (__)\       )\/\
                ||----w |
                ||     ||
```

- `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)*

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Text Editors in the Terminal

- `nano`
- `vim`
- `emacs`

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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.

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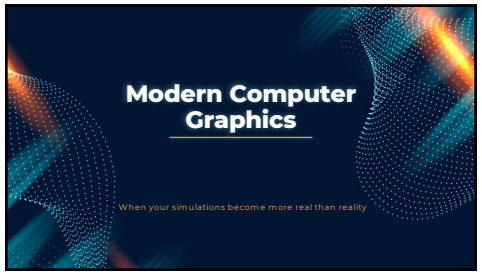
Modern Computer Graphics
When your simulations become more real than reality

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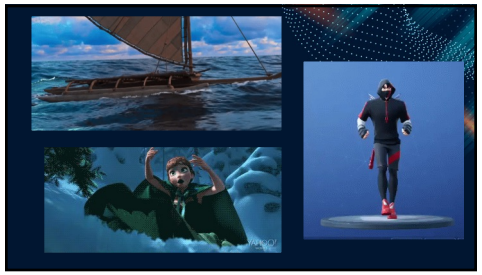

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Beyond JavaFX
Raster graphics, used in CS1230, work with a fixed number of colored pixels
2D arrays, anyone?
Manually compute the value of each pixel according to what you want to see
Used to simulate scenes or draw your own, filter and transform images

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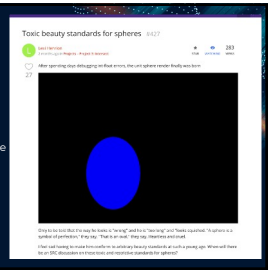
Beyond JavaFX

- 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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Simulating Our World

Let there be light!

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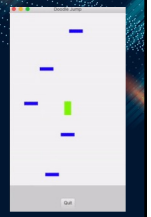
How do we simulate our world on a screen?

- **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!



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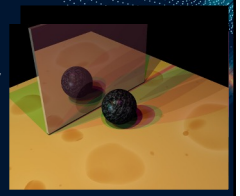
Raytracing + Pathtracing

- 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



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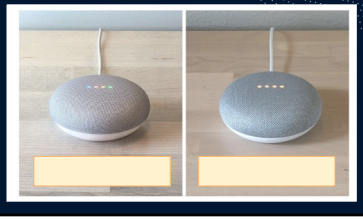
Which one is real?



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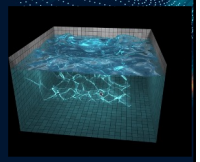
Real World Features On Your Screen

- 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/

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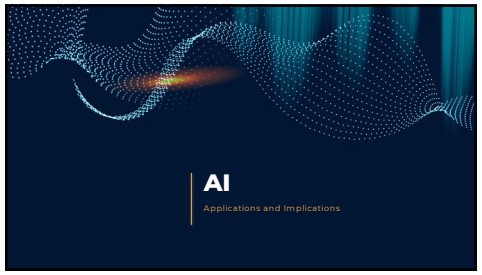

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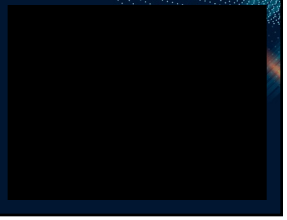
How can we use AI to optimize creativity?

- **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



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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?

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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)

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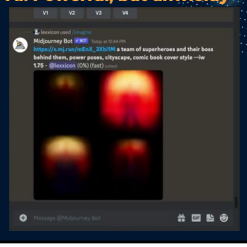
Midjourney AI: Powerful, but unwieldy



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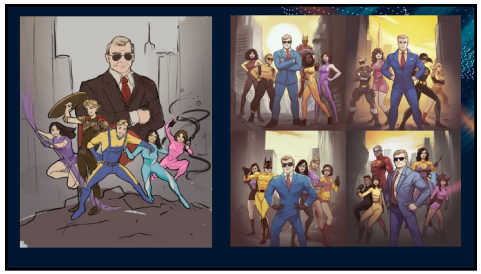

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Infinite Variations!
Great for brainstorming
Less great for polishing existing concepts

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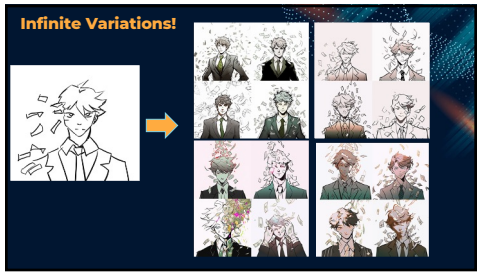
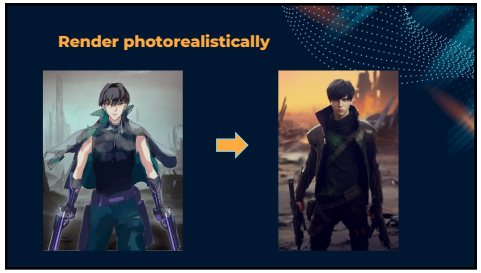

Infinite Variations!

53


Render photorealistically

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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

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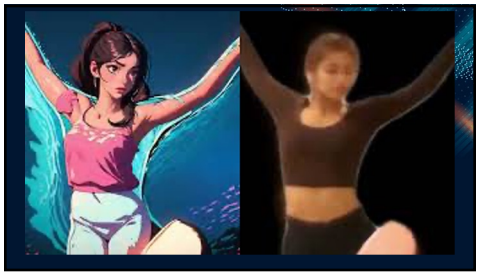

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More Graphics!

- 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)

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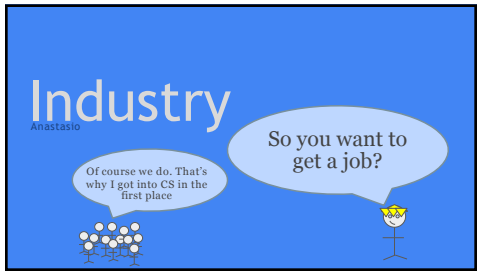
Industry
Anastasio
So you want to get a job?
Of course we do. That's why I got into CS in the first place

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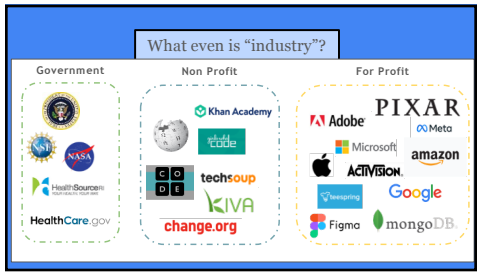
What even is "industry"?
Government
Non Profit
For Profit
HealthCare.gov
Khan Academy
techsoup
KIVA
change.org
PIXAR
Adobe
Meta
Microsoft
amazon
ACTIVISION
Google
Figma
mongoDB.

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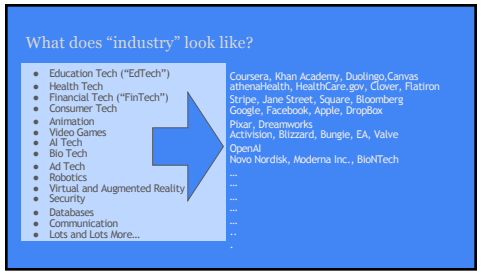
What does "industry" look like?
Education Tech ("EdTech")
Health Tech
Financial Tech ("FinTech")
Consumer Tech
Animation
Video Games
AI Tech
Bio Tech
Ad Tech
Robotics
Virtual and Augmented Reality
Security
Databases
Communication
Lots and Lots More...
Coursera, Khan Academy, Duolingo,Canvas
athenaHealth, 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"

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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)

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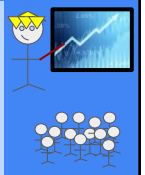
Other Types of Careers

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



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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

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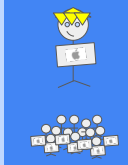
Online Coding Assessments

- 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.



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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 :)

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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

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What I Wish I Knew About CS Earlier...

& Why You Belong Here

Sarah

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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!!

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There is more to CS than SWE

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

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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)

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"Everyone in this country should learn how to program because it teaches you how to think"
– Steve Jobs.

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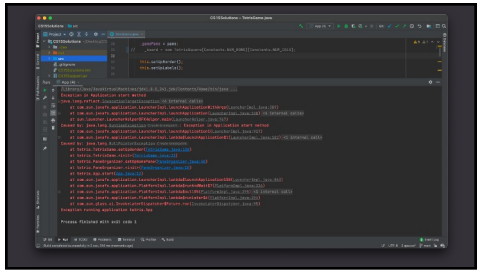
So… what makes a good programmer?

73

74

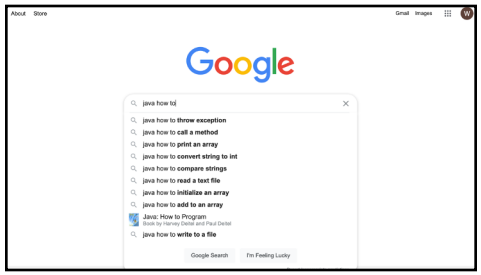


75

The TAs are not better programmers than you.

We just have more experience.

76



77

Problems become familiar problems.

78

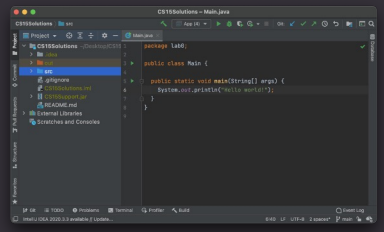
~~"I did something wrong…"~~
~~"Now it doesn't work…"~~

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

79

Struggling + Frustration → Learning

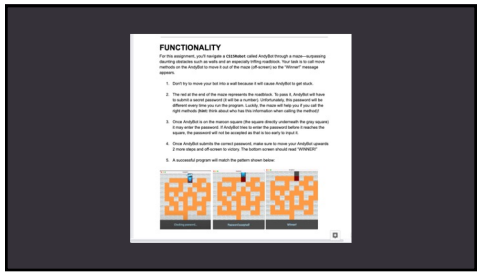
80



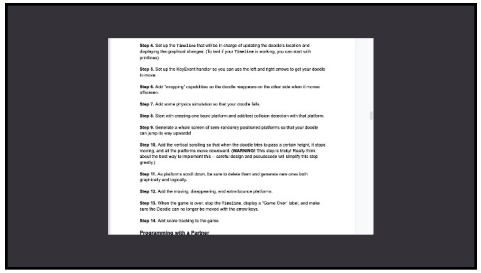
81


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

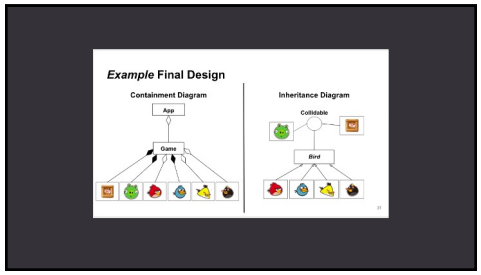
82


FUNCTIONALITY

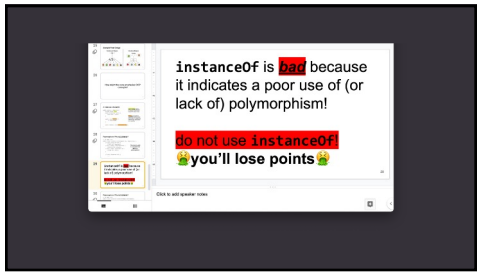
83



84


Example Final Design
Containment Diagram
App
Game
Inheritance Diagram
Collidable
Bird

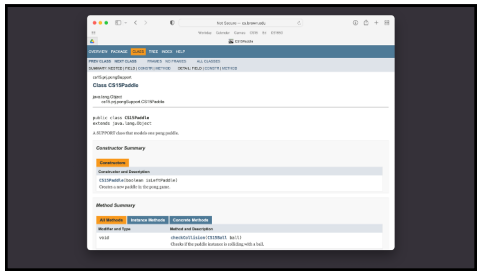
85


instanceOf is bad because it indicates a poor use of (or lack of) polymorphism!
do not use instanceOf!
you'll lose points

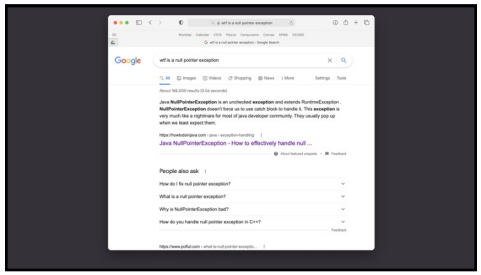
86


Socially
Responsible
Computing

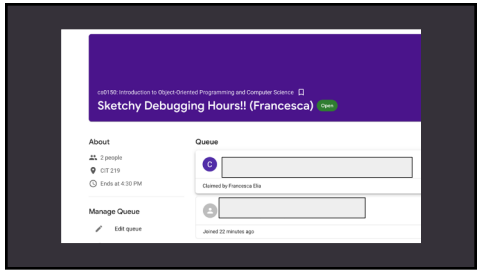
87


Class CS15Paddle
Constructor Summary
Method Summary

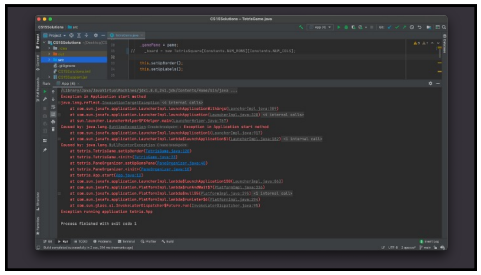
88


Google
wtf is a null pointer exception
People also ask

89


Sketchy Debugging Hours!! (Francesca)
Open
About
Queue
Manage Queue
Edit queue

90



91

You're learning *how* to learn.

92

The Goal of CS

~~Know how to code everything~~

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

93

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

AND THAT'S COMPLETELY FINE.

94

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.




95

You're already on your way.

Go get 'em.

96

Announcements

97

Apply to TA CS15 for next fall!

98

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!

99

Why should I apply?

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

100

101

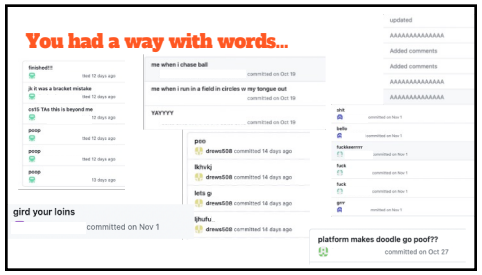
102

103

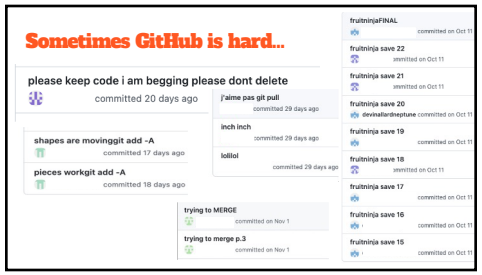
104

Lastly, we present… the best of the commit messages

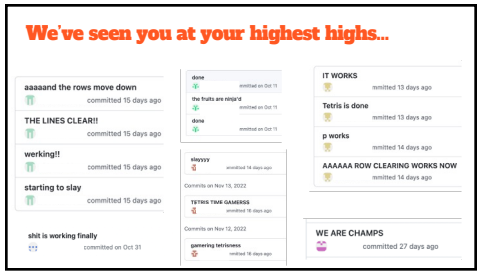
105


You had a way with words...
gird your loins
committed on Nov 1
platform makes doodle go poof??
committed on Oct 27

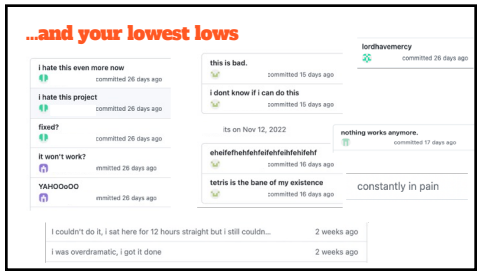
106


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
lollol
committed 29 days ago
trying to MERGE
committed on Nov 1
trying to merge p.3
committed on Nov 1
fruitninjaFINAL
fruitninja save 22
fruitninja save 21
fruitninja save 20
fruitninja save 19
fruitninja save 18
fruitninja save 17
fruitninja save 16
fruitninja save 15

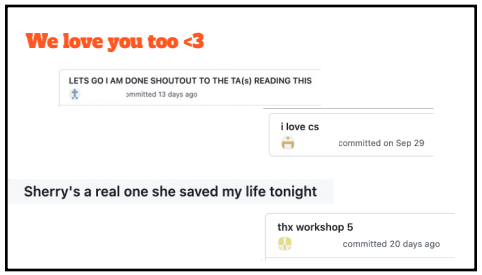
107


We've seen you at your highest highs...
aaaaand the rows move down
committed 15 days ago
THE LINES CLEAR!!
committed 15 days ago
werking!!
committed 15 days ago
starting to slay
committed 15 days ago
shit is working finally
committed on Oct 31
IT WORKS
Tetris is done
p works
AAAAAA ROW CLEARING WORKS NOW
WE ARE CHAMPS
committed 27 days ago

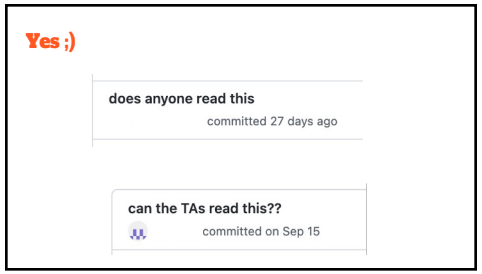
108


...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?
committed 26 days ago
YAHOOoOO
committed 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

109


We love you too <3
LETS GO I AM DONE SHOUTOUT TO THE TA(s) READING THIS
committed 13 days ago
i love cs
committed on Sep 29
Sherry's a real one she saved my life tonight
thx workshop 5
committed 20 days ago

110


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

111

And finally… some never before seen t shirt designs

112

And finally… some never before seen t shirt designs

113

<3 <3

114