

# CS31: Introduction to Computer Systems

**Week 1, Class 1**  
**Welcome!**  
**01/23/24**

Dr. Sukrit Venkatagiri  
Swarthmore College





# Welcome to CS31!

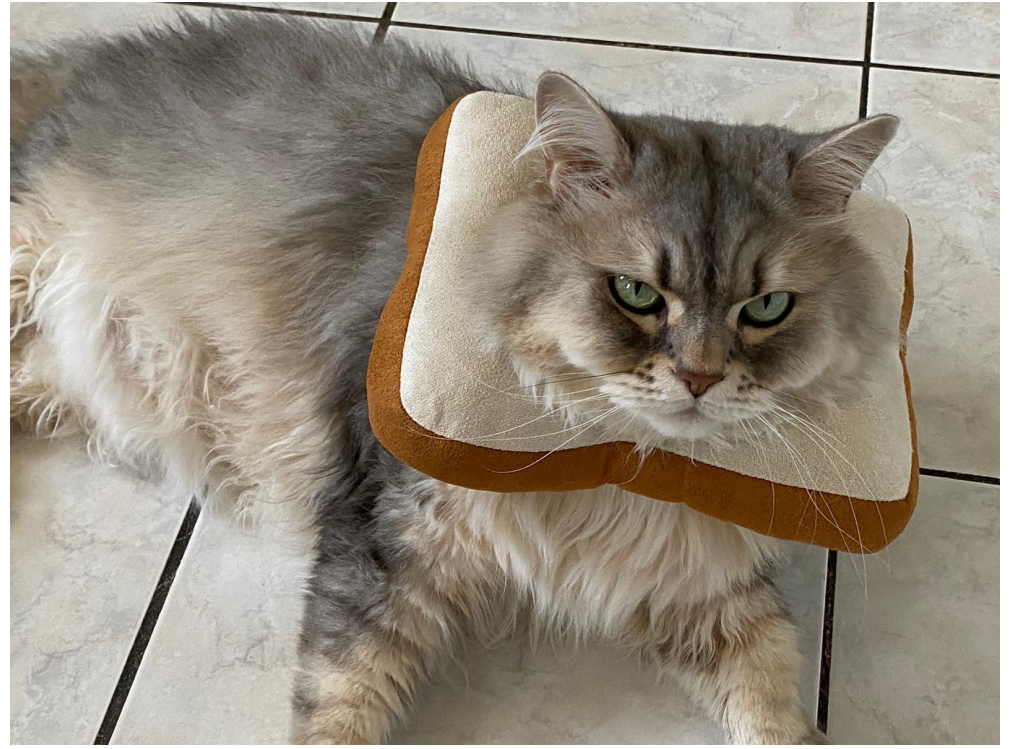
Today:

- Why computer systems are awesome & sometimes scary
- What this course is about
- Course logistics and initial setup



# If you're on the wait list...

- **Please sign in!**
- Attend class on Thursday **and** one of the labs on Friday to stay on the wait list
- Everyone else: **sign the attendance sheet**



Toaster



# Previously: Election Integrity Partnership

 The New York Times

## Biggest Surge of Misinformation May Arrive After Election Day, Researchers Say

People who study disinformation  
ballot-counting delays and  
Nov 7, 2022



 The New York Times

## G.O.P. Targets Researchers Who Study Disinformation Ahead of 2024 Election

A legal campaign against universities and think tanks seeks to undermine the fight  
against false claims about  
Jun 19, 2023



 PolitiFact

## Why vote spikes on graphs shared by Mike Lindell are not evidence of stolen elections

MyPillow CEO Mike Lindell, an ardent supporter of former President Donald Trump, has  
shared numerous debunked conspiracy.

Nov 11, 2022



# Course Staff



Dr. Sukrit Venkatagiri (he/him)  
SCI 258

Sections CS31 & Lab A

Office Hours\*  
Tue 2:30-4pm  
Wed 3:30-5pm



Jocelyn Corey (she/her)  
SCI 252 B

Labs B & D

Wed 1-3pm



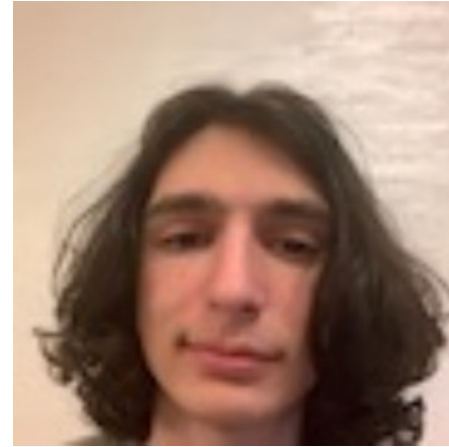
# Ninjas!

Sessions on Wednesdays  
6-10 PM at SCI 256

Marlea



Ben



Arden



Lisa



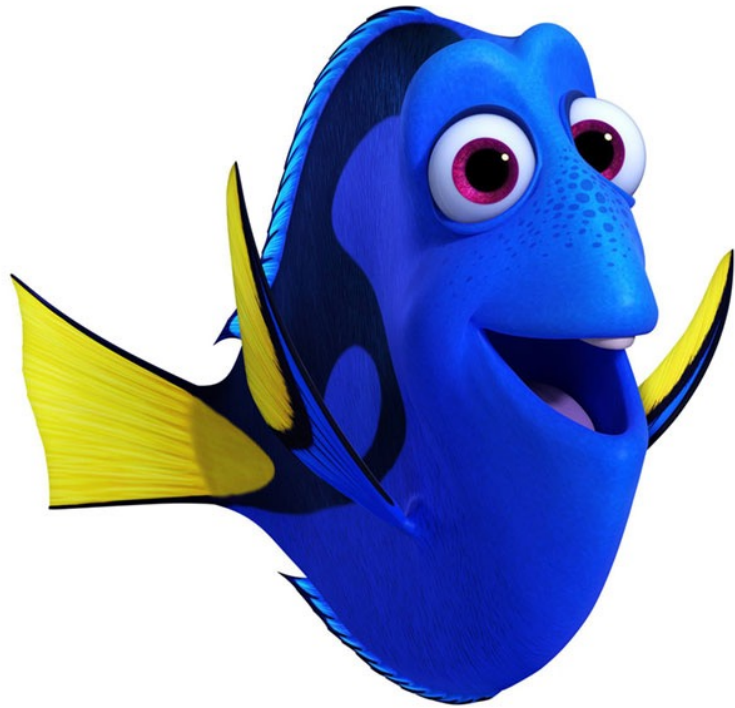


# Grader



Aishi





**Why should I take  
CS31?**



**Because I have to...**



That's not a good reason,  
bruh



# Pacman

Pacman freaks out if  
you complete level  
255

Why?



# Therac-25

- Anyone heard of this?
- Very similar to Pacman bug, only with tragic consequences
- Radiation therapy machine, mis-dosed patients




<https://ethicsunwrapped.utexas.edu/case-study/therac-25>

# Toyota Acceleration (2009-2011)

EDN EDN Magazine

Toyota's killer firmware: Bad design and its consequences - EDN



On Thu  
uninter  
Oct 28

ABC News  
<https://abcnews.go.com> > Blotter > story

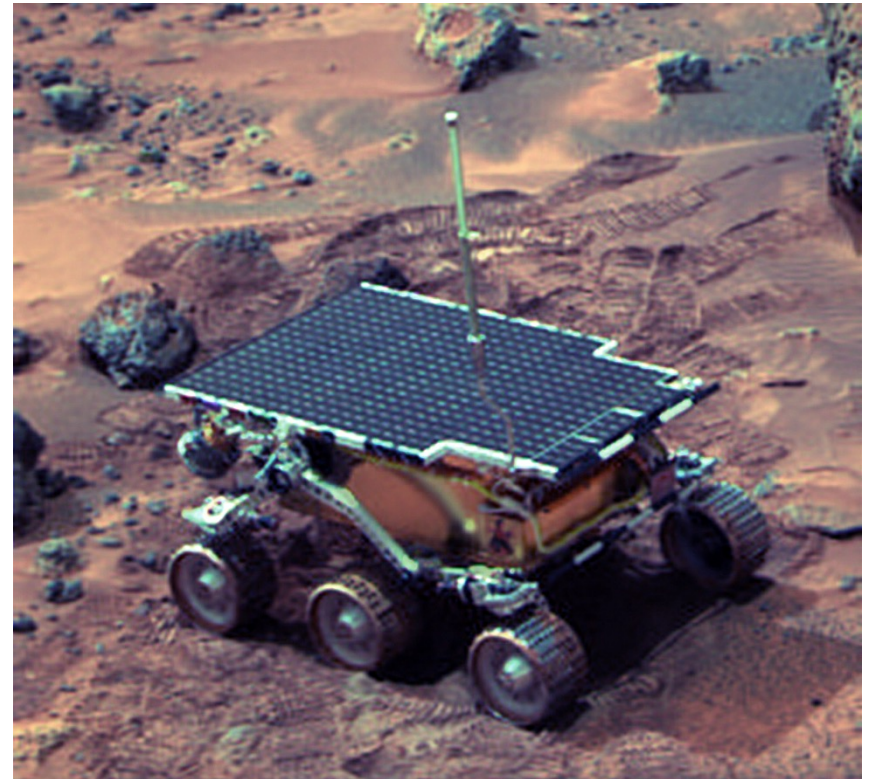
**Toyota to Pay \$1.2B for Hiding Deadly 'Unintended Acceleration'**

Mar 19, 2014 — Car manufacturer **Toyota** has agreed to pay a staggering \$1.2 billion to avoid prosecution for covering up severe safety problems with ...

- ~9 million vehicles recalled
- “Stack overflow” => Unintended acceleration

# Mars Pathfinder (1997)

- Frequently locked up and stopped responding (automatic reboot)
- “Priority inversion” in parallel software





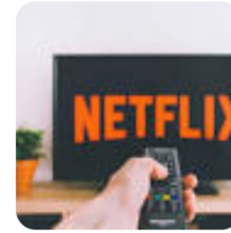
# Environmental impact of (inefficient) computer systems


 Brightly.eco

## Is Streaming Bad for the Planet? A Deeper Look Into Netflix, Spotify, and More

Even our streaming obsession can harm the planet. This is the environmental impact of Netflix, Spotify, and more.

Mar 8, 2023




 Tom's Hardware

## Just Five ChatGPT Queries Can Use 16oz of Water, Say Researchers

Data centers are causing environmental stress not just due to power demands, but also due to water usage.

Sep 10, 2023



 Harvard Business Review


## How to Make Generative AI Greener

Generative AI is impressive, but the hidden environmental costs and impact of these models are often overlooked. Companies can take eight steps to reduce their carbon footprint.

Jul 20, 2023



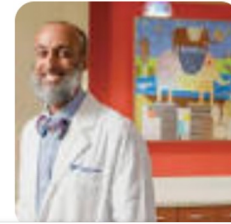
# Computer systems to the rescue

 Yale School of Medicine

## The New Machinery of Medicine: How Gene Sequencing and High-Performance Computing Are Revolutionizing Care

For patients suffering from genetic disorders or diseases that may be cured by a combination of

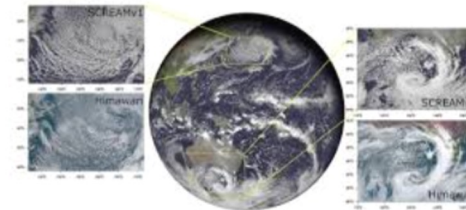
May 12, 2022



 Argonne National Laboratory

## Argonne team's climate modeling work wins Gordon Bell Prize, highest honor in high performance computing

Nov 16

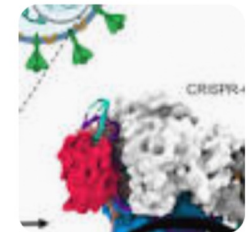


 | Inside UCR

## UC Riverside engineers are using supercomputers to investigate rapid, CRISPR-based COVID-19 tests

A group led by Giulia Palermo, an assistant professor of bioengineering in the Marlan and Rosemary Bourns College of Engineering,...

Jun 17, 2020

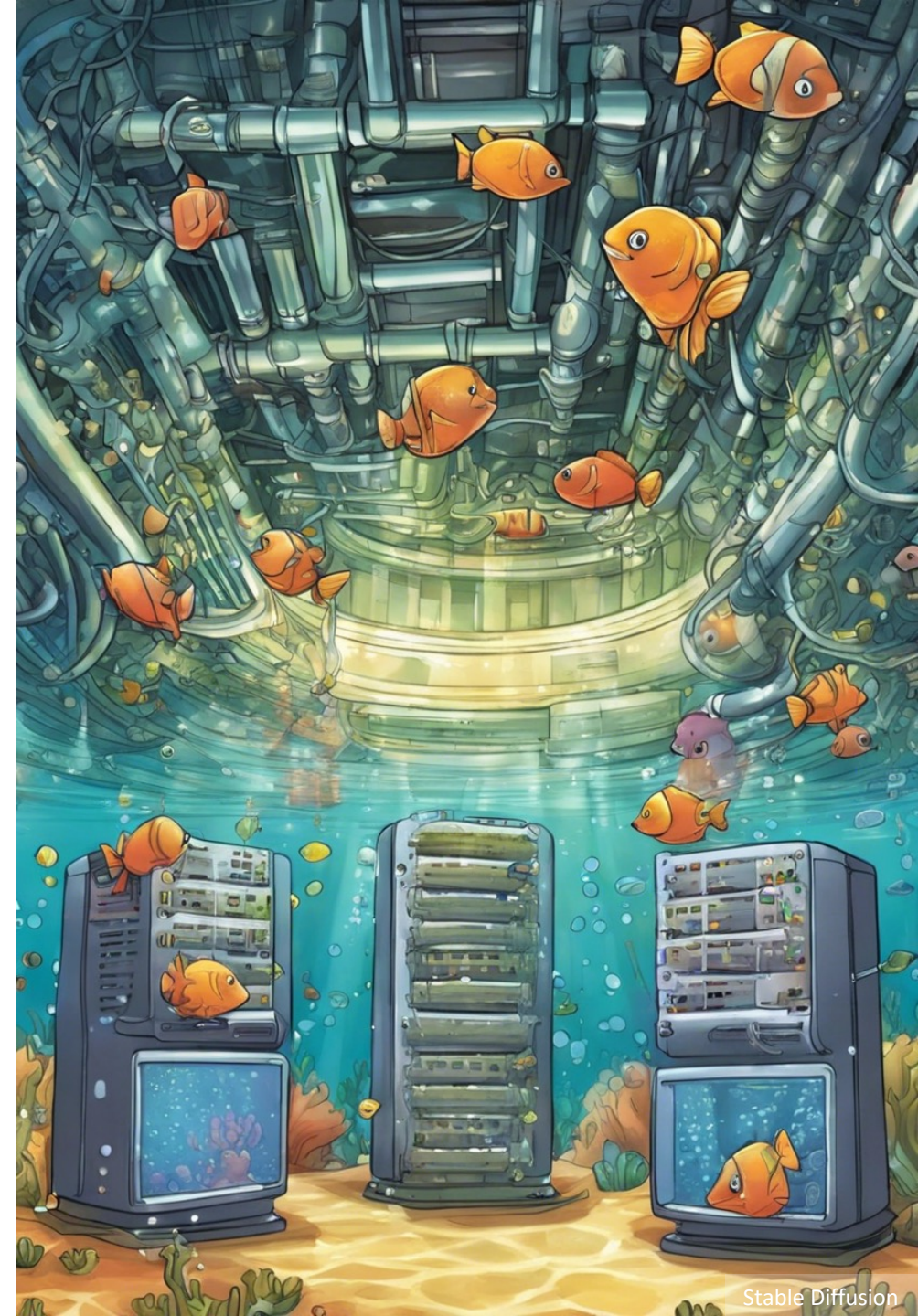


# In CS31, you will learn...

How your programs *really* execute

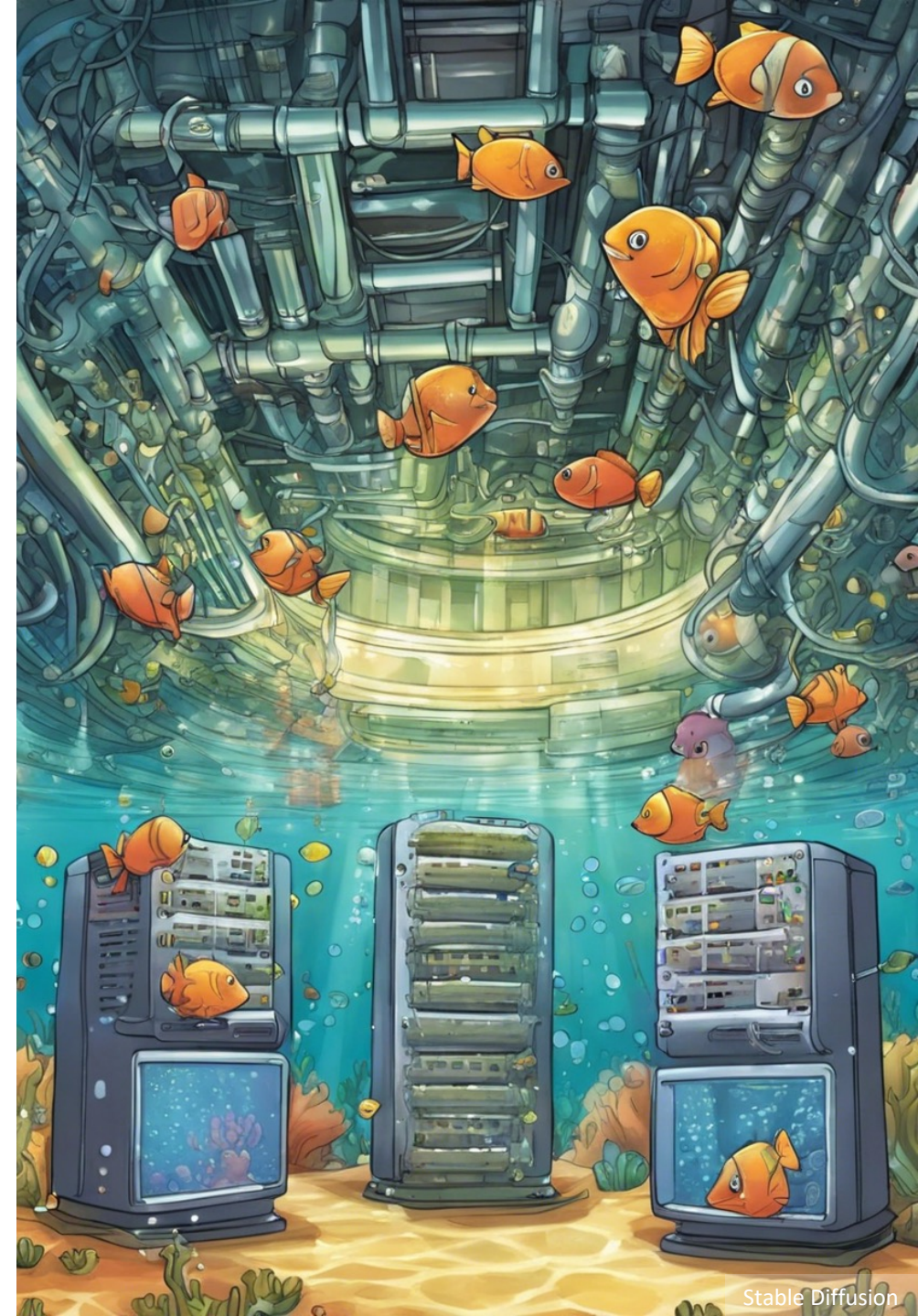
1<sup>st</sup> half: focus on hardware execution

2<sup>nd</sup> half: focus on operating system



# In CS31, you will learn...

1. How a program executes on the hardware
2. The system's costs of program execution
3. An introduction to operating systems
4. Foundations of parallel programming
5. The real-world relevance (and impact!) of computer systems



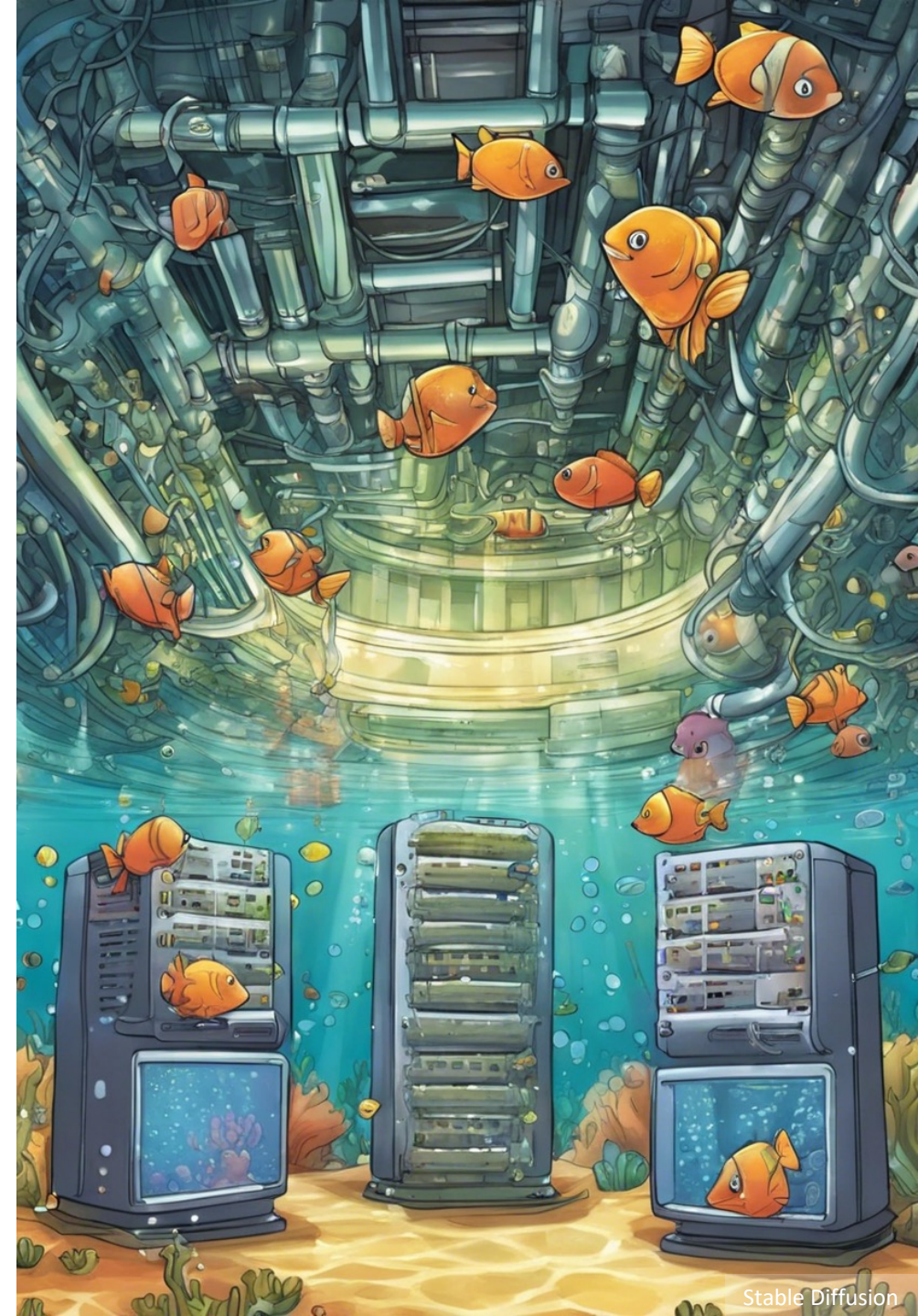
# You'll be able to answer...

How does software actually  
*run* on hardware?

How do computers run  
*multiple* software programs?

Why does my phone slow  
down when I have too many  
apps open?

Why is gaming so terrible on  
Macs?

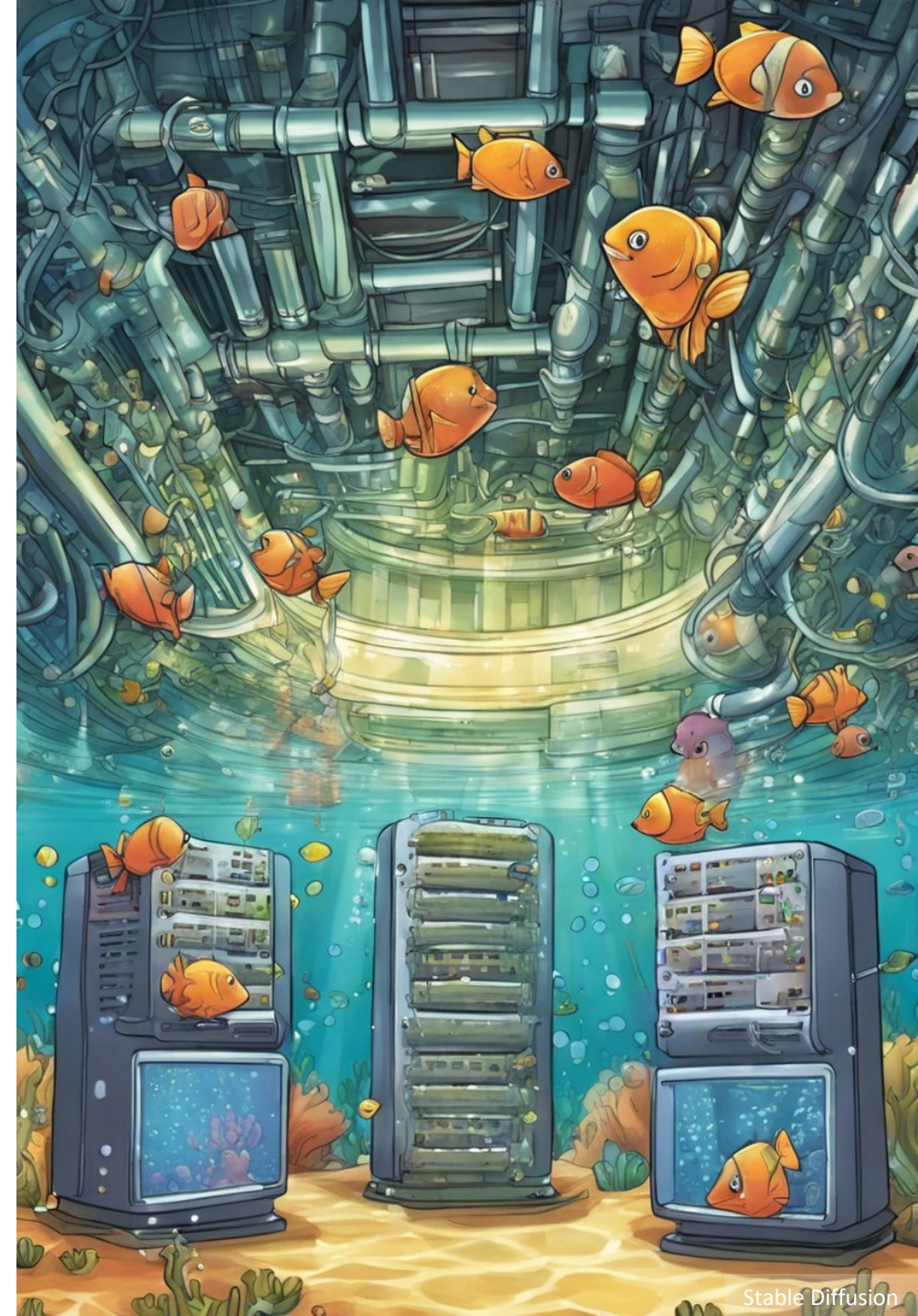


# More consequentially...

What enables computers to quickly identify new vaccines and medical treatments?

How and why is everything “in the cloud”?

Why are the US and China fighting over... computer chips?



# Nine Whys (10 minutes)

- **Pair up, and take turns asking:**

Why are you in CS31?

Because...

Why?

Because...

Why?

.

.

.

# What is a computer system?

- Hardware and/or software that...
  - allows the user to interact with programs
  - allows programs to run and use machine's *resources*
  - makes computer easier to use
- Improves the computer's capabilities
  - performance
  - reliability
  - security
  - usability

GIF of a MSNBC newscaster signaling to their desk, saying "Let's get down to details."





# Turn undesirable into desirable

- Turn undesirable inconveniences: reality
  - Complexity of hardware
  - Single processor
  - Limited memory
- Into desirable conveniences: illusions
  - Simple, easy-to-use resources
  - Multiple/unlimited number of processors
  - Large/unlimited amount of memory

# Three Big Ideas

- Abstraction
  - What is the desired illusion?
  - How do we interact with it?
- Mechanism
  - How do we create the desired illusion?
  - How does it work?
- Policy
  - How do we make it work well, to meet a goal?

# Logistics

- How to Be A Good Classmate
- Resources
- Instruction Style
- Clickers (!)
- Grading
- Policies and Academic Dishonesty

# Our Shared Values in this Class

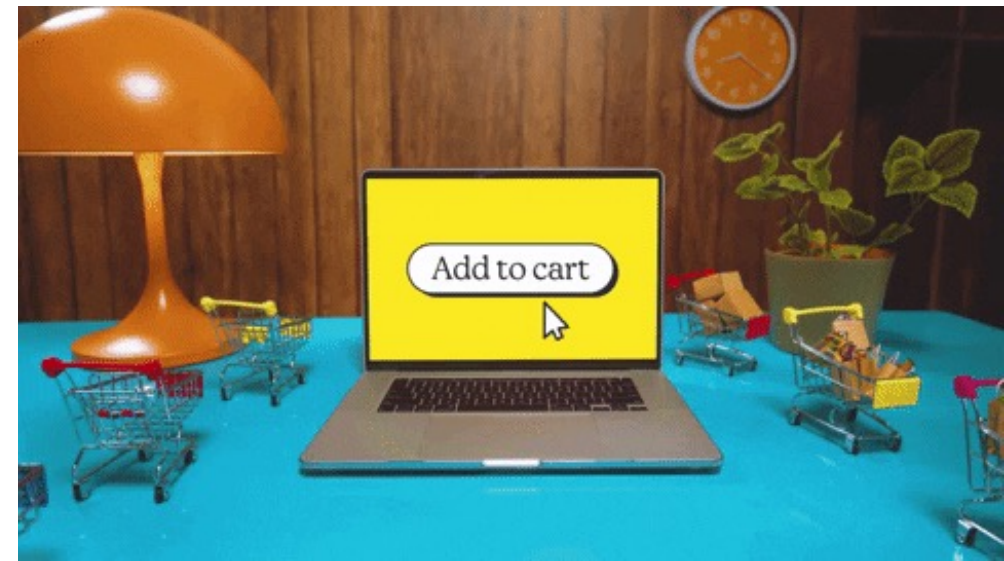
*Diversity, inclusion, and a mutual sense of belonging* are all core values of this course. All participants in this course must be treated with respect by other members of the Swarthmore CS community. We must all strive, students and faculty both, to never make anyone feel unwelcome or unsafe in any way. Violations of these principles are viewed as unacceptable, and we take them very seriously. If you ever feel discriminated against or otherwise excluded, no matter how minor the offense, we encourage you to reach out to Sukrit, Jocelyn, or one of the College Deans.

- Differing background / experience
  - Class year
  - Having taken CS 35
  - Pre-college experience

# How to be a Good Classmate

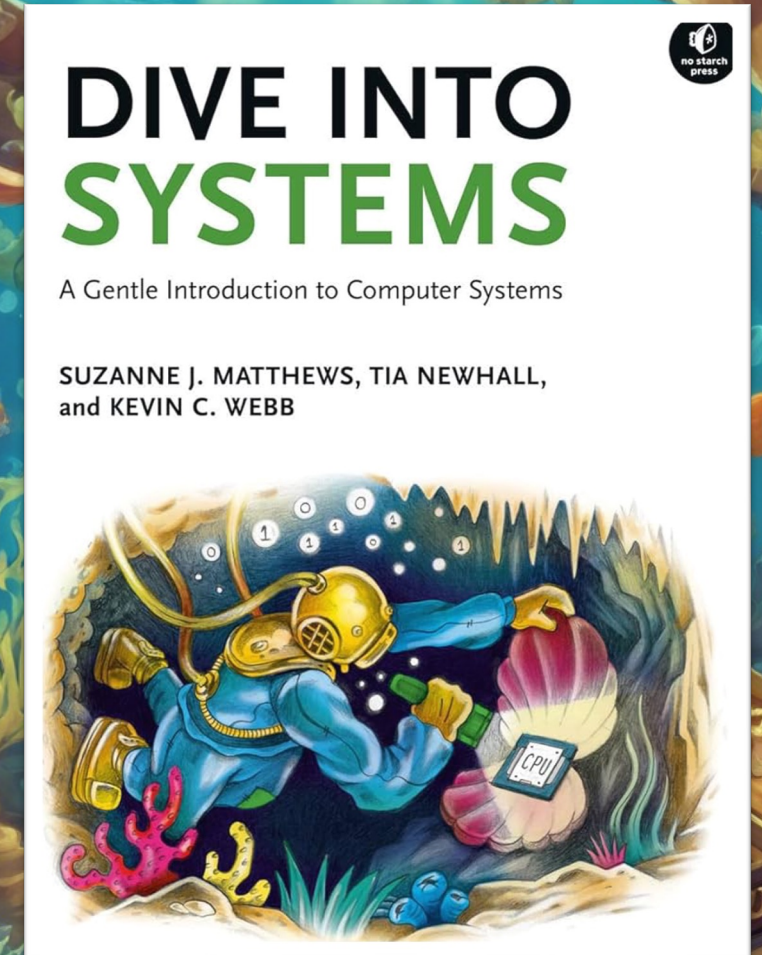
- **Everyone** deserves to be — and participate — in class & lab
- We can **all** learn something from one another
- Come to class prepared (readings, assignments)
- Give others a chance to answer
- Avoid distracting others during class

GIF of a mouse clicking on “add to cart” on a laptop screen as shopping carts revolve around it



# Resources

- **Textbook** (free, online, homebrewed): *Dive Into Systems* by Matthews, Newhall, and Webb
- **Q&A Forum: EdSTEM**
  - [edstem.org/us/courses/52394](https://edstem.org/us/courses/52394)
- **Slides & recordings** on course website
  - [cs.swarthmore.edu/~sukrit/cs31/s24/](https://cs.swarthmore.edu/~sukrit/cs31/s24/)
- **Course updates:** email + EdSTEM



# Instruction Style: Active Learning

- An approach to instruction that involves *actively* engaging students with the course material through discussions, problem solving, case studies, and other methods<sup>1</sup>
- A 2014 meta-analysis of 225 science, engineering, and mathematics education studies by Freeman et al.<sup>2</sup> demonstrated that active learning can **significantly increase course grades** over didactic (lecture). Students in courses **without** active learning were **1.5 times more likely to fail** the course than students in courses with active learning<sup>3</sup>

[1] [queensu.ca/teachingandlearning/modules/active/04\\_what\\_is\\_active\\_learning.html](https://queensu.ca/teachingandlearning/modules/active/04_what_is_active_learning.html)

[2] Freeman, Scott, et al. "Active learning increases student performance in science, engineering, and mathematics." *Proceedings of the national academy of sciences* 111.23 (2014): 8410-8415.

[3] <https://cei.umn.edu/teaching-resources/active-learning/why-use-active-learning>

# Instruction Style: Active Learning

- Pre-reading
- Worksheets
- Spaced repetition & practice
- Think, pair, share
- Peer instruction

Big Geno from *Hey Arnold!*  
extending his hand out,  
asking “Do we have a deal?”





# Spaced Repetition & Practice

- You do the “easy” part before class
- Class is reserved for interactive, customized experiences
- To learn, YOU must actively work with a problem and construct your own understanding of it

Readings



First Exposure



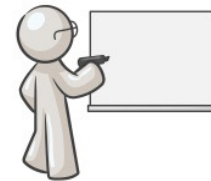
Reading Quiz



Gauge  
understanding



Instruction



Explore, add  
context,  
Provide feedback



Labs/Exam



Show knowledge  
& mastery

# In-Class Worksheets & Discussion

- Based on readings for that day
- Think: Individually think about the questions (1-2 minutes)
- Pair: Analyze problems with your group (2-3 minutes)
  - Ninjas and I will walk around discussing these with you
  - Practice analyzing and talking about challenging concepts
  - Reach consensus
  - If you have questions, raise your hand and I'll come over
- Share: Briefly summarize what answer(s) your group arrived at and why

# Clickers!



- Lets you vote on questions in real time
- Like pub trivia, except the subject is always computer systems 🙄

- **Clicker registration:**
- If you don't register your clicker, I can't give you credit for quizzes / participation!
- Participation scores count from next week



# How many of the following are computer systems? Why?

- Laptops
- Smart Vehicles
- Apple Watches, Smart Watches
- Medical Implants
- Mars Rover

A: 1

B: 2

C: 3

D: 4

E: 5

# Grading

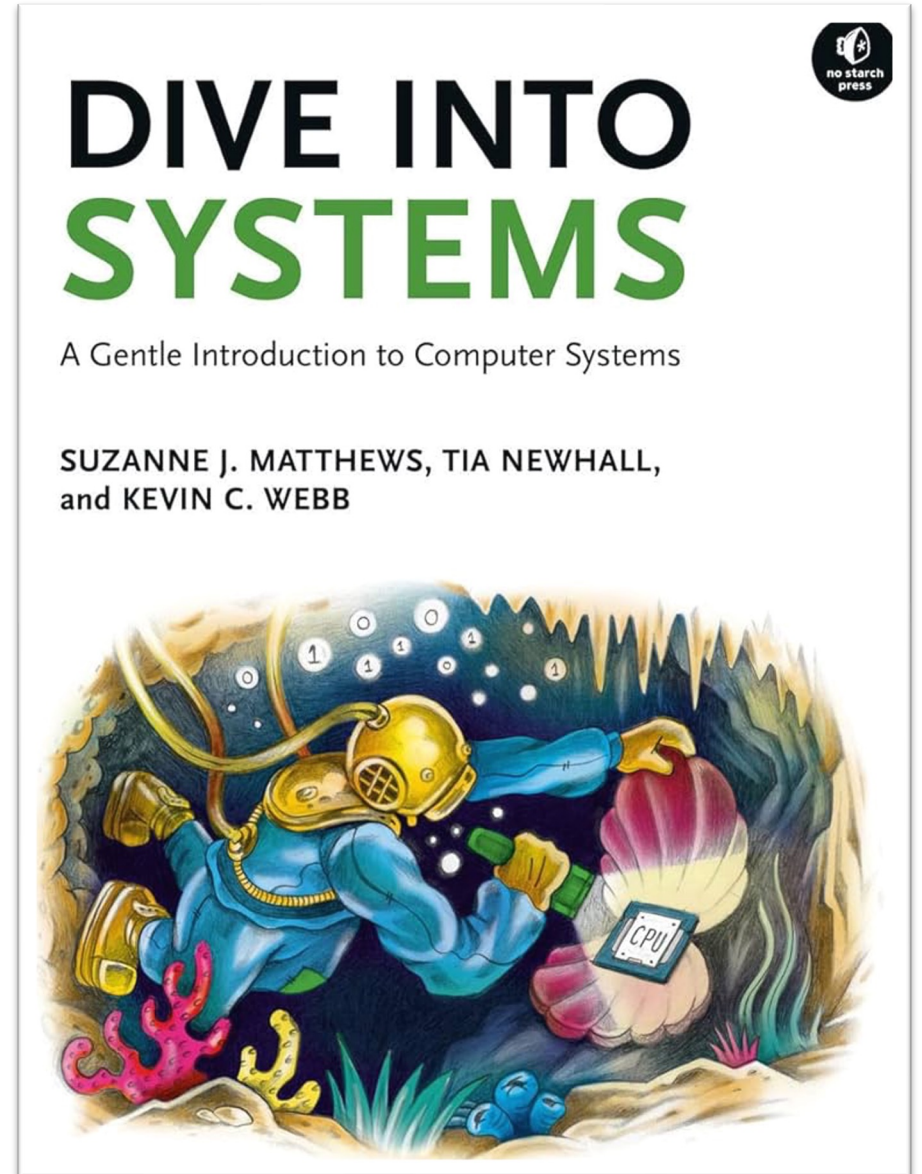
- 5% Class participation
- 5% Reading quizzes
- 5% Homework assignments
- 30% Lab assignments
- 25% Midterm Exam
- 30% Final Exam (date TBD)

Life happens. I will drop your three lowest quizzes/no-shows, no questions asked.



# Reading Quizzes

- Readings from online textbook <https://diveintosystems.org>
- Target difficulty: did you read?
- Goal: incentivize / reward preparation
  - Can be an easy 5%!

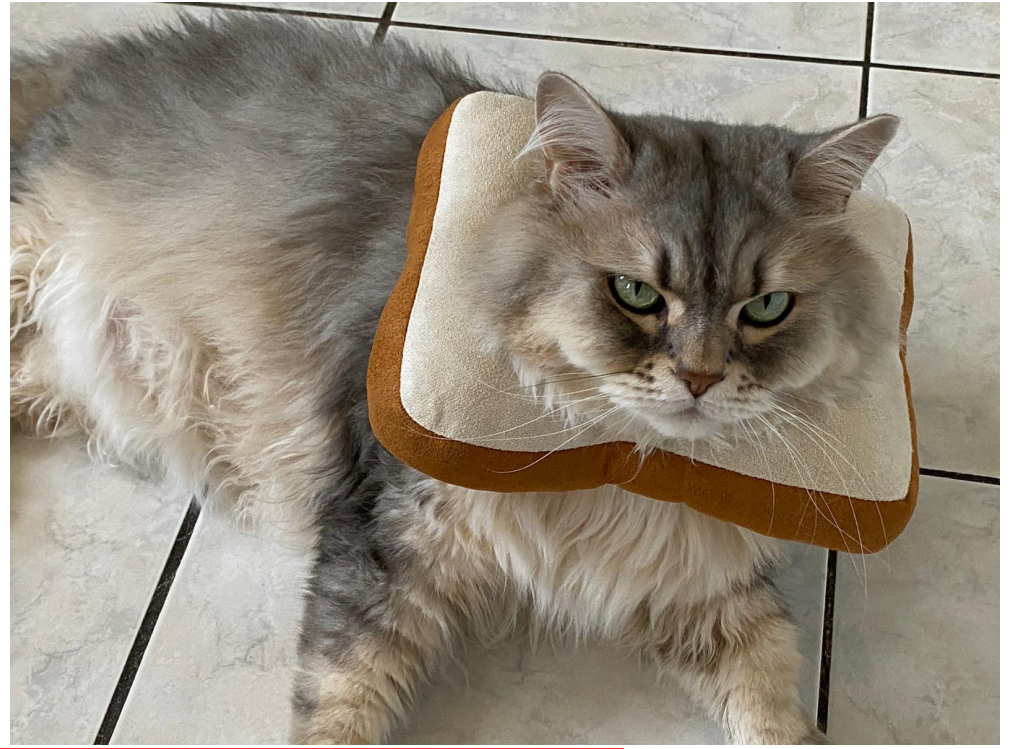


# Late Submission Policy

- 5 total late days
- Email BEFORE you want to use them
- The class gets to decide the split:
  - HW vs. Lab assignments

Big Geno from *Hey Arnold!*  
extending his hand out,  
asking “Do we have a deal?”





OpenAI Dall-E

Toaster



# Academic Dishonesty Policy

- Collaboration
  - You may discuss approaches, not solutions
  - You must submit your own work
  - Exams may include questions on programming
- Cheating
  - We take this **very seriously**. It can have a negative impact on your course grade, your GPA and your record at Swarthmore and beyond.
  - **Don't do it!**

# Academic Dishonesty Policy

- Some examples of cheating on labs:
  - Screen sharing with folks not in your lab partnership
  - “Let me read my code out to you, or share the exact API for a particular function”
  - Share in words the content in your code: “I first used strncpy to copy the string up to n bytes, and then appended a null character at the end”
  - I’m applying a “security mindset” to “think like an attacker” on course assessment infrastructure
  - I just used ChatGPT to help with “some” of my assignment.

# Academic Dishonesty Policy

- Examples of how **not** to cheat:
  - **Behave as though you are a CS ninja**
  - “What approaches did you try so far?”, “Looks like you have gotten more of the string than you need to, use man pages to look at other string functions”
  - Don’t know how to help your friend? Ask them to post to EdSTEM to the class or send a post privately to me.
  - *Don’t shortcut your learning or others’*

# We're here to help

- It's been a weird couple of years ...and it's okay to not be on top of everything
- Please reach out to:
  - Us (Sukrit, Jocelyn)
  - Your Academic Advisors
  - Student Deans
  - Counseling & Psychological Services
  - Friends
  - Family



Meme of a cartoon dog surrounded by fire, saying "this is fine."

by KC Green

# Administrative Questions?

- All of this info is on the class website
- Feel free to ask on class discussion board (EdSTEM)

# Email Guidelines

- For *general* or *lab* questions, please use EdSTEM rather than email:
  - Your classmates benefit from your questions
  - Your classmates can answer your questions
  - I will check the forum frequently
  - You can ask anonymously, if you'd prefer
- For *personal* questions, feel free to email me directly:

**sukrit+cs31@swarthmore.edu**

# Tentative Schedule

- Midterm Exam – **March 7th**, during class time
- Final Exam — TBD
  
- Labs — mostly done in groups
  - Released on Fridays (lab section)
  - Due on Thursdays
- HWs — mostly done in groups
  - Released on Thursdays
  - Due on Fridays

# Your TODO List

- **Now:** Log in to EdSTEM: [edstem.org/us/courses/52394](https://edstem.org/us/courses/52394)
- **By Wednesday:** Register your clicker  
[forms.gle/CbSuUKkA3beeFwvE](https://forms.gle/CbSuUKkA3beeFwvE)
- **By Thursday:** Labs are partnered – fill out the match survey  
[forms.gle/GwqvwwsLYhNFCzzB6](https://forms.gle/GwqvwwsLYhNFCzzB6)
- **Before lab on Friday:** Complete Lab 0
- Readings posted on course web page, read them before each class.





# If you're on the wait list...

- **Please sign in!**
- Attend class on Thursday **and** one of the labs on Friday to stay on the wait list

**Questions for me?**

**SEE YOU SOON!**

