CS 31: Intro to Systems Course Introduction

Kevin Webb

Swarthmore College

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What This Class Is About

1. How a program executes on the hardware
2. The systems costs of program execution
3. An introduction to operating systems
4. Foundations of parallel programming

Instructor: Kevin Webb

- http://www.cs.swarthmore.edu/~kwebb/
- Please call me Kevin (or Professor/Dr. Webb)
- Research: Control platforms for networks, CS Education
- Making stuff (woodworking, electronics), cactus/fruit plants, PC games

Instructor: Kevin Webb

- http://www.cs.swarthmore.edu/~kw
- Please call me Kevin (or Professor/D
- Research: Control platforms for netw
- Making stuff (woodworking, electron

Office Hours

- Mondays 12:30 PM – 1:30 PM
- Tuesdays 10:30 AM – Noon
- By appointment
- (I'll also often be around Tuesdays after class, I just can't promise 100% of the time)

- 255 Science Center

Ninjas!

- Sessions Sundays 7-11 PM in SCI 256

Amy

Zach

Ryan

Trisha

Charles (Charlie) Kazer

- CS Department lab lecturer

Resources

- EdSTEM Q&A Forum
  - https://edstem.org/us/courses/24357/discussion/
- Slides & recordings on course website
- Lab sections:
  - SCI 240
  - Wednesdays 8:50-10:20, 1:15-2:45, 3:00-4:30

Email Policy

- 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
- For *personal* questions, feel free to directly email me.
- I will attempt to respond to within 24 hours (often sooner)

Please be mindful…

- 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 Kevin, Charlie, or one of the college deans.

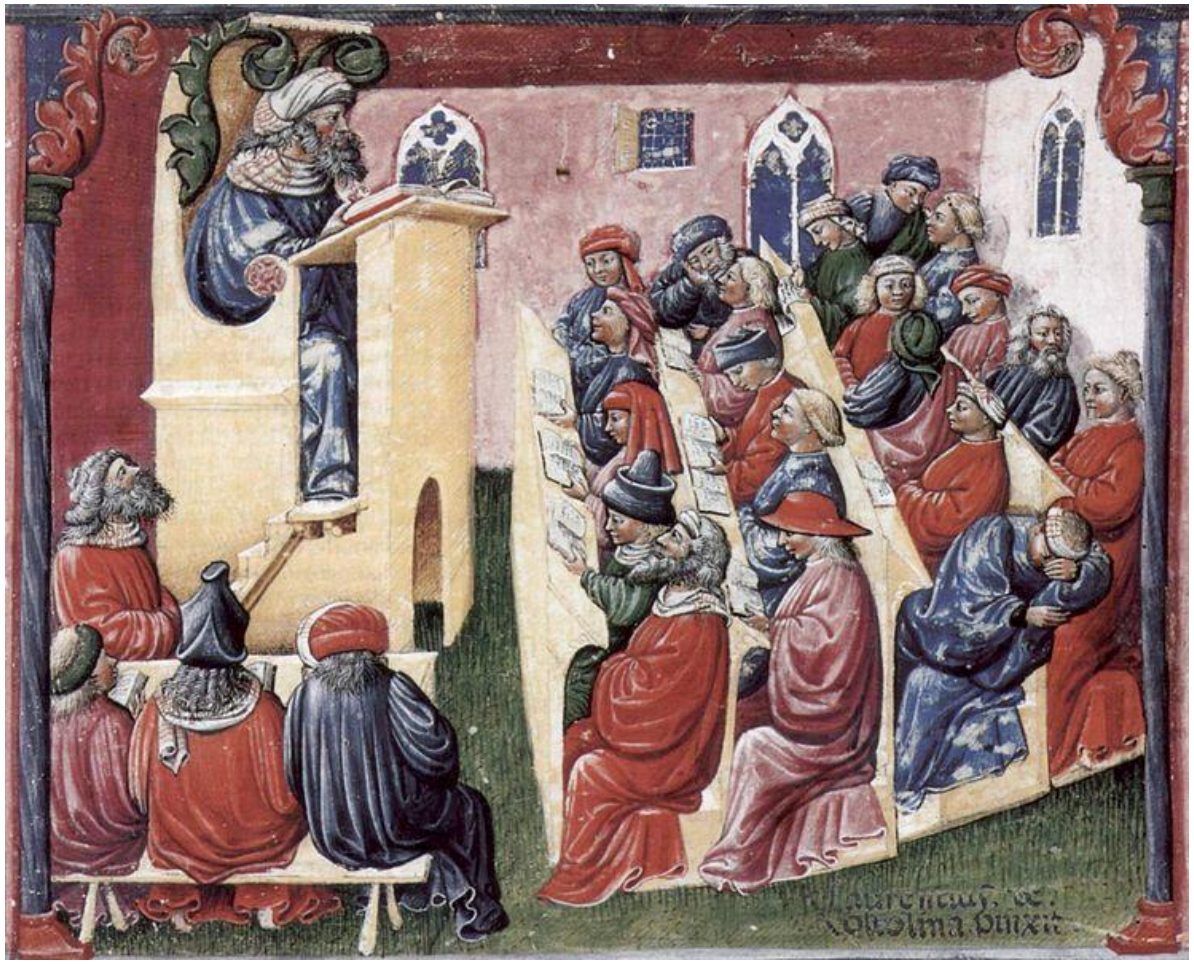
- Differing background / experience
  - Class year
  - Having taken CS 35
  - Pre-college experience

How does this class work?

- This class is designed a bit differently from what you might normally be used to.
  - Class will be centered around discussion
  - Requires your participation

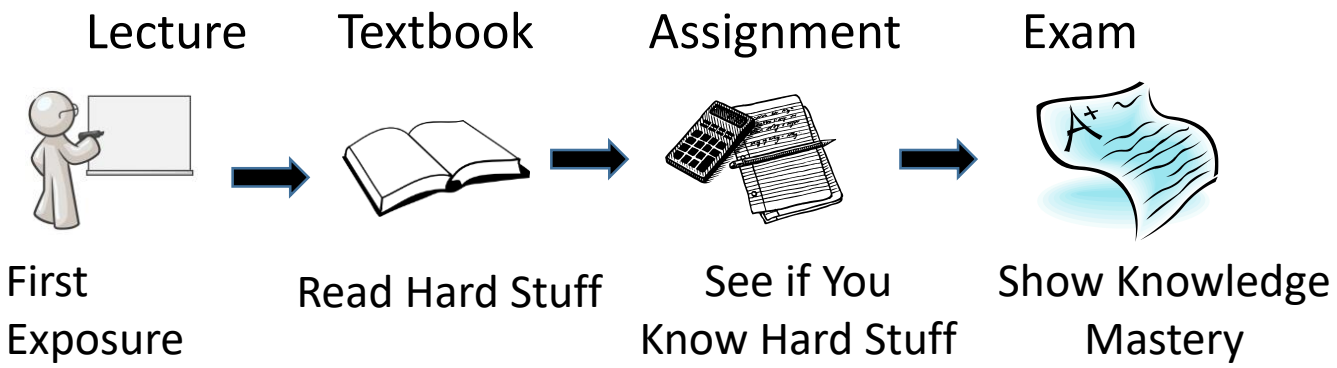
- Ever considered why we have lectures?

Traditional Lectures:



- Roughly one millenium old

Traditional Lectures:



- Little opportunity for expert feedback
- Might as well skip class and watch video lectures!
  - (I am not actually suggesting this. Please attend your classes!)

Interactive Classes with Peer Instruction

- You do the “easy” part before class.

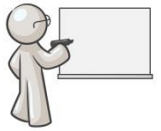
Textbook, videos, website

First Exposure

In class quiz

Gauge understanding

Instruction



Fill in gaps,
Explore details,
Add context,
Provide feedback

Exam

Show Knowledge Mastery

- Class is reserved for interactive, customized experiences
- Research on how people learn:
  - Everyone constructs their own understanding
  - To learn, YOU must actively work with a problem and construct your own understanding of it

Clickers!

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

Clickers!

- We'll be using frequency 'AA'
  - Should be default for new clickers
  - To set, hold power button for a few seconds, press A twice

- Don't worry, I'll send confirmation via EdSTEM

Peer Instruction

- Short quiz at the beginning of class
- During class: pose carefully designed questions
  - Solo vote: Think for yourself and select answer
  - Discuss: Analyze problem in teams of 3
    - Practice analyzing, talking about challenging concepts
    - Reach consensus
    - If you have questions, raise your hand and I'll come over
  - Group vote: Everyone in group votes
    - You must all vote the same to get your point
  - Class wide discussion:
    - Led by YOU (students) – tell us what you talked about in discussion that everyone should know!

Why Peer Instruction?

- You get a chance to think.
- I get feedback as to what you understand.
- It’s more engaging!
- Research shows it promotes more learning than traditional lecture.

Giving out Candy

- To people willing to
  - Ask a question
  - Share an explanation
  - Summarize what their group talked about
- Your explanations are CRITICAL for fellow students' learning

Example Question

- Individual vote
- Group discussion / group vote
  - Room should be LOUD
- Class discussion

How many of the following statements are true?

A: 0 B: 1 C: 2 D: 3 E: 4

Grading

- 5% Reading Quizzes
- 5% Class participation
- 25% Midterm Exam
- 30% Final Exam
- 35% Lab Assignments and Homeworks

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- 25% Midterm Exam
- 30% Final Exam
- 35% Lab Assignments and Homeworks

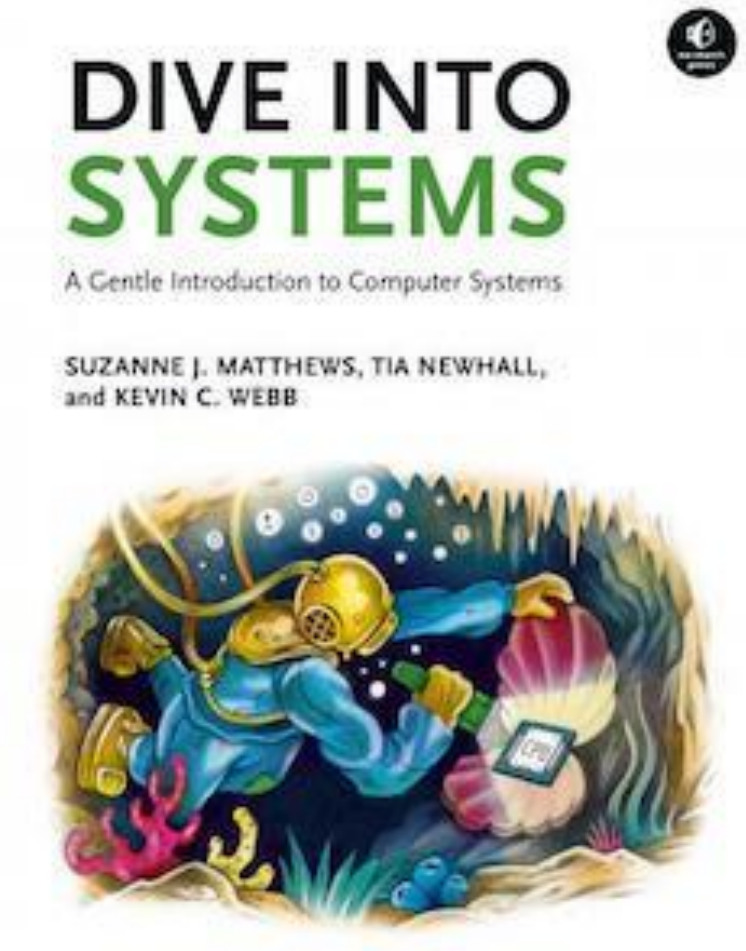
- I will drop your three lowest quizzes/no-shows.

Reading Quizzes

- Readings from online textbook https://diveintosystems.org

- Target difficulty: did you read?

- Goal: incentivize / reward preparation
  - Can be an easy 5%!



Policies

- Collaboration
  - You may discuss approaches, not solutions
  - You must submit your own work
  - Exams may include questions on programming
- Cheating
  - Zero tolerance for cheating, don’t do it!
- Lab Lateness
  - 48 hours of extra time for the semester

Tentative Schedule

- Midterm – Oct 6, during class time
- Final - TBD
- Labs
  - Out on Wednesdays (lab section)
  - Due on Tuesdays

Administrative Questions?

- All of this info (should be) on class website
- Feel free to ask on class discussion board

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

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?

Why should you care?

- To know how your computer works
  - What may be wrong with your programs
  - How to enhance your computer, applications
- Systems programmers get respect
  - In high demand, get paid well
- Real-world impact

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, misdosed patients

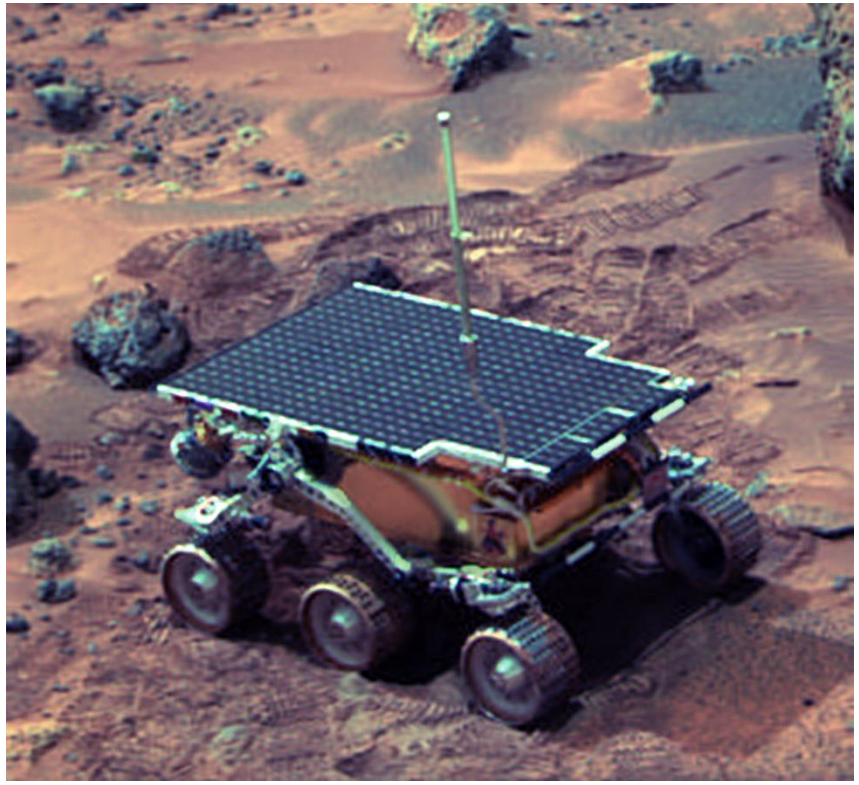
Toyota Acceleration (2009-2011)

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

Mars Pathfinder (1997)

- Frequently locked up and stopped responding
  - (automatic reboot)

- “Priority inversion” in parallel software



Pokémon Yellow

- Cleverly “hacked”, game completed in 1:36
- “Buffer overflow” exploit

This Course

- How your programs *really* execute

- 1st half: focus on hardware execution
- 2nd half: focus on operating system

Clicker Registration

- https://forms.gle/YUqD2WJWji1Gd2BU8

- If you don’t register your clicker, I can’t give you credit for quizzes / participation!

Background Survey

- Gives us better information for forming partnerships

- https://forms.gle/CDf9FdMztKsVcM2y7

- Please fill this out ASAP!
  I'll be setting up partnerships for lab 1 this evening.

Your TODO list

- Readings posted on course web page.
- Log in to EdSTEM
- Fill out background / partnership survey
- Register your clicker, if you didn’t already…

If you're on the wait list…

- Please sign in!

- Attend a lab tomorrow to stay on the wait list.