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/

• Hobbies: Making stuff (woodworking, ceramics, electronics), cactus/fruit plants, PC games

• Research: Control platforms for networks

• I’m (relatively) new here!

• Please call me Kevin (or Professor/Dr. Webb)
Office Hours

• Tuesday 12:30 – 2:00 PM
• Friday 2:30 – 3:30 PM
• By appointment

• 255 Science Center
Ninjas!

- Brooke, Ryerson, Shawn, and Zoe

- Sessions Sundays 7-11 PM in 256
Resources

• Piazza Q&A Forum
  – https://piazza.com/swarthmore/spring2015/cs31/home

• Slides & audio on course website

• Lab sections:
  – Science Center 256
  – Wednesday 1:15-2:45, Wednesday 3:00-4:30
Email Policy

• Please use Piazza rather than email
  – Your classmates benefit from your questions
  – Your classmates can answer your questions
  – I will check the forum frequently

• I will attempt to respond to within 24 hours

• If you do email me, please use kwebb@cs...
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 millennium 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 multiple choice questions in real time.
- Like pub trivia, except the subject is always systems.
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
The best TV series is:

A: Arrested Development  
B: Breaking Bad  
C: Firefly  
D: The Wire

E: Some other series (be prepared to discuss what and why!)
Discussion Groups

• Three people each.

• Try to work with the same group throughout the semester.

• Help each other explore the material!
Grading

• 5% Reading Quizzes
• 5% Class participation
• 25% Midterm Exam
• 30% Final Exam
• 35% Lab Assignments
Grading

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

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

• New experiment this semester: no textbook

• Readings from online sources
Reading Quizzes

• Target low difficulty: did you read?

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

• You may bring handwritten notes.
Supplemental Textbook

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
  – Email me your submission after the deadline
Tentative Schedule

• Midterm – March 5, in class

• 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 Piazza 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
The scheduled office hour times are...

Tuesday 12:30 – 2:00 PM, Friday 2:30 – 3:30 PM

A. Great, I don’t have a scheduling conflict with either one.

B. Probably ok, I don’t have a scheduling conflict with at least one of them.

C. Not good, I have a scheduling conflict with both of them!

D. I’m not sure, I don’t know my scheduled yet.
The majority of my prior programming experience is in...

A. Python (CS 21)

B. Python (Some other source)

C. C or C++

D. Java

E. Some other language
Clicker Registration
Reading

• Up next: C programming basics
  – Reading: “C for Python Programmers”
  – Sections 1.5-2.5

• Sign up on Piazza!

• Please let me know about:
  – Your preferred name, if different than roster name
  – Disability accommodations