CMPS 10: Following National NSF Initiative for CS Principles

Introduction to Computer Science
Prof. Charlie McDowell. Office E2 349B.
OH Tues/Wed/Thur 2-3pm

Introductions ...
- Instructor: Charlie McDowell, Prof. of CS
- Teaching Assistants:
  - Stacey Mason
  - Sean Smith

Remington Maxwell
Lester Pi
Sara Woods
Jennifer Volk

This class: Computer Science Principles
- A new way of teaching CMPS 10 to align with a new AP course
- Supported by NSF and College Board
- Started five years ago ... number of different pilot courses. We started here at UCSC changing CMPS 10 Spring 2011 and it is still evolving a bit.
- In a few years (2015) there will be a standard AP high school course and an AP exam
- We are trying to understand what people think is interesting about computer science (or not)
- So......

The most interesting things in Computer Science are......

AIMS: Cover the Seven Big Ideas in computing
- As defined by the College Board for new AP test
  1. Computing is a creative human activity that enables innovation
  2. Abstraction is a way to understand and solve problems
  3. Data and information help to create knowledge
  4. Algorithms are tools for developing and expressing solutions to computational problems
  5. Programming is a creative process that produces computational artifacts
  6. Digital devices, systems, and the networks that interconnect them enable and foster computational approaches to solving problems
  7. Computing enables innovation in other fields, like science, engineering, humanities, etc.
- We will have pre- and post-surveys
- We want your feedback about what in computing you find exciting and interesting
Two Aspects to the 7 Big Ideas

- **Computational Principles** – “bits can represent all information” – that everyone should know
- **Computational Thinking** – thinking approaches you can use to solve (your) problems with computers
- At least one homework assignment each week. Need to keep up and keep on top of them.
- Class should not be ‘too hard’, similar classes being taught at 8th grade and high school level
- At the end: understand much better what is going on inside your phone, computer, facebook, google
- Hope you might even consider a double major in CS

**BACKGROUND:**

- Why teach a new version of CS Principles?
- Projected National SHORTAGE: 150K jobs in 2015

**Why teach a new version of CS Principles?**

One part of the solution:

- Attract students not typically attracted to CS

**Computing as part of our lives**

- “Computing capacity is increasing at 58% annually, telecommunications at 28%, and storage at 23% per year. The former rate is approximately the rate of Moore’s Law, a doubling every 18 months. Communications are doubling every 34 months and storage every 40 months. Information has been expanding at this rate for the past decade.”
Increase of Computing Power

What does increased computer power really mean?

- Computing techniques same, but can do it now
- Miniaturization & Mobile
- Apple SIRI:
  - Speech recognition and Text to Speech
  - PERSONALIZED & CONTEXT: who and where the user is

Big Data is here

How big?

- "The full scale of how much information we make is hard to appreciate. We humans collectively now have capacity to store approximately 300 exabytes of information (that's giga giga bytes). This is close to the total amount of information stored in one person's DNA. Or, as Hilbert puts it, it's the equivalent of 80 Library of Alexandrias per person on the planet. And remember, the technium is doubling its capacity every year and a half, and your DNA is not... Broadcasting has grown at about the same speed as world's GDP; but our information storage capacity has grown 4 times faster and telecommunication capacity has grown roughly 5 times faster than the world's economic power." Kevin Kelly
  - kilo, mega, giga, tera, peta, exa (10^18)

Why might you be interested in CS? A job?

  - Although the economy continues to face many challenges, the startup and tech industries are very much alive. The IPO window slightly opened up for companies like LinkedIn, Pandora, Groupon, Zynga, and Carbonite. We saw monster rounds of funding for companies like Facebook, Twitter, Dropbox. The appetite for seed and angel investing was extremely active. Tech incubators and accelerator programs kept popping up.
  - 2012 was a very busy year for hiring at startup companies, and it doesn't look like it has slowed down in 2013.

What areas are the most competitive areas for talent (hiring challenges) these days?

  - Software Engineers and Web Developers: The demand for top-tier engineering talent sharply outweighs the supply in almost every major city especially in San Francisco, New York, and Boston. This is a major, major pain point and problem that almost every company is facing, regardless of the technology "stack" their engineers are working on.
  - Creative Design and User Experience: After engineers, the biggest challenge for companies is finding high-quality creative design and user-experience talent. Since almost every company is trying to create a highly compelling user experience that keeps people engaged with their product, it is tough to find people who have this type of experience (especially with mobile devices including tablets) and a demonstrated track record of success.
  - Product Management: It is always helpful for an early-stage company to hire someone who has very relevant and specific experience in your industry. This is especially true for product managers, since the person in this role will interface with customers and define the product strategy and use cases. However, be prepared, as it will be a challenge to find people with experience in these high-growth industries: consumer web, e-commerce, mobile, software as a service, and cloud computing.
More missing talent

- **Marketing**
  - I’m not talking about old-school marketing communications. Companies are looking for expert online marketers who know how to create a buzz of inbound marketing or viral traffic through the web, social media, and content discovery. Writing a good press release just doesn’t cut it anymore, so everyone is looking for the savvy online marketing professional who understands how the current state of the web operates and knows how to make it work to their benefit.

- **Analytics**
  - Since data is becoming more and more accessible, smart companies are increasingly making decisions driven by metrics. Analytics is becoming a central hub across companies where everything (web, marketing, sales, operations) is being measured and each decision is supported by data. Thus, we are seeing a high level of demand for analytics and business intelligence professionals who almost act like internal consultants; they help determine what should be measured and then build out the capability for a company.

- **Big Data**
  - Even Salesforce wants to be able to predict what you might buy from your past spending patterns, and spending of others like you.

The designer who programs?


The powerful fusion of great design, great engineering, and real authority in the hands of those people, results in magical user experiences.

Introduction to this class

- Getting started with Processing: Reas and Fry (buy it)
- Supplemented with reading/watching online sources, e.g. Wikipedia, You Tube

Class Structure

- a “lectures” a week— I will talk, show you how stuff works, discuss various topics, **ask you to discuss stuff**
- Clickers to motivate classroom discussion and direct class time
- Lecture slides will be available before class and should be **read before class**
- Lecture videos will be put online after the lecture
- Homework – exercises that help you learn the material ... plan to spend about one hour a day (that’s 7 hours per week)
- Sections: Plan to go once or twice a week. Put it on your schedule!
- Midterm, Final

How does this class work?

- This class is designed a bit differently from what you might normally be used to
  - “Lecture” will be focused around **YOU**
    - What YOU understand
  - A “clicker” is required for this class
    - It’s not optional, using it will be 5% of your grade
    - Clickers are used to help both YOU and ME figure out what you understand and what you might need some help with
  - So, lecture will be different
    - Ever thought about why we have “lecture”?
Why do we have lecture?

GREAT Innovations:
The printing press, The web

- You don’t have to trust the monk!
  - Read it and analyze for YOURSELF!
  - If I rephrase it for you, what purpose does that serve?
- Traditional class structures often look like:

  First Exposure
  Lecture
  Textbook
  Read Hard Stuff
  Homework
  See if You Know Hard Stuff
  Exam
  Show Knowledge Mastery

- You get very little opportunity for “expert” feedback

Peer Instruction-Based Design

- Greater opportunity for expert feedback!
- Research on how people learn:
  - Everyone constructs their own understanding
  - I can’t dump understanding into your brain
  - To learn YOU must actively work with a problem and construct your own understanding of it

Lecture: Peer Instruction

- Pose carefully designed question
  - 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 or the TAs will come around
  - 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!
Giving out Candy

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

How to do well in this class

- Come to class & go to section every week at least once
- Make a sincere effort to understand the material
- Go online to work on this class each day ...
  - Submit work that you alone created, except for the pair programming assignments
  - Do your pair programming as a pair. Always work together.
  - Make constructive comments about improving this class

More details.

- http://courses.soe.ucsc.edu/courses/cmps10/Fall13/01
- ecommons.ucsc.edu
- piazza.com
- Labs
  - Location: Soc Sci I PC (Room 135)
  - Assigned Lab Times:
    - A: Mondays, 4:00-5:30pm
    - B: Wednesdays, 11:00am-12:30pm
    - C: Wednesdays, 12:30-2:00pm
    - D: Wednesdays, 4:00-5:30pm
    - E: Thursdays, 9:30am-11:00am
    - F: Thursdays, 11:00am-12:30pm
    - G: Fridays, 9:30-11:00am
    - H: Fridays, 3:00-4:30pm

A Brief Word About Programming

- Some people panic at the mention of the word programming ... as if saying it would cause them to become social outcasts, nerdy, ...
- Programming is actually fun, and creative!
  - You get immediate feedback if what you are doing is working
  - Programming is solving a puzzle, have to stick to it
- Programming’s a career; it takes years to learn
- We teach some programming in this class as part of teaching computational thinking
  - You wont be a programmer at the end
  - You will, I hope, think differently as a result

A Brief Word About Programming

- This is NOT a programming class. If you just want to learn to program, take CMPS 5J or 5P or 12A or CMPE 13.
- You will get just enough exposure to programming to have a better understanding of what a program is and what it means to write a program.
Announcements

- Please note that we are no longer receiving Accommodation Authorization forms from the DRC.
- DRC students must bring form to me, to turn in to the Faculty Services desk.
- To DO: Familiarize yourself with the class Web page at classes.soe.ucsc.edu/cmps010/Fall13/01

Know:

- The location of announcements, assignments, etc.
  - Look at the syllabus for the whole quarter, midterm etc.
  - The Academic Conduct guideline

Assignment 1: Lightbot 2.0

- Lightbot shows up on many gaming sites but whether or not it’s a “game” is a topic for Tuesday
  - You direct a robot around a “blocks world”
  - It’s pretty easy, and should be fun. I will explain Tuesday what the homework is intended to show.

Assignment 1: Lightbot 2.0

- Goal: The point of this exercise is to start class enjoyably, and to set the context for the second lecture. Have fun!
  - Using a web browser, visit http://armorgames.com/play/6061/light-bot-20. Click Play!
  - After the opening visuals, click “Play.”
  - Assignment, Parts A, B, Challenge C
  - writeup

Introductions ...

- Instructor Charlie McDowell, Prof. of CS
  - Academic Degrees:
    - B.S. Computer Science & Applied Math Cal Poly SLO, M.S./Ph.D. Computer Science UC San Diego
    - Non-academic positions: Lawrence Livermore National Lab and Digital Equipment Corporation
  - Research Interests: Computer science education, software systems/tools, parallel computing
  - Associate Dean for Undergraduate Affairs in the School of Engineering
  - Teaching this course as an overload – I really care!
  - Co-chair for the Academic Alliance of the National Center for Women and Information Technology

Why NCWIT

- The National Center for Women & Information Technology is a non-profit community of more than 300 prominent corporations, academic institutions, government agencies, and non-profits working to increase women’s participation in technology and computing. NCWIT helps organizations recruit, retain, and advance women from K-12 and higher education through industry and entrepreneurial careers by providing community, evidence, and action.
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<th>People Who Build Technology Should Represent The People Who Use It</th>
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<td>- Although women today comprise half the world’s population and more than half of the U.S. professional workforce, they play only a small role in inventing the technology of tomorrow. The lack of girls and women in computing and technology represents a failure to capitalize on the benefits of diverse perspectives: in a world dependent on innovation, it can bring the best and broadest problem-solvers to the table; and at a time when technology drives economic growth, it can yield a larger and more competitive workforce.</td>
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<td>- The U.S. Bureau of Labor Statistics predicts that IT will be one of the fastest-growing sectors of the U.S. economy, adding nearly 1.4 million job openings by 2018. Over two-thirds of these jobs could go unfilled due to the insufficient pool of college graduates with computing-related degrees. Women represent a vastly untapped talent pool.</td>
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<td>- Groups with greater diversity solve complex problems better and faster than do homogenous groups, and the presence of women in a group is more likely to increase the collective intelligence (problem-solving ability, creativity) of the group.</td>
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<th>People Who Build Technology Should Represent The People Who Use It</th>
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<td>- Companies with the highest representation of women in their management teams have a 34% higher return on investment than did those with few or no women.</td>
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<th>Okay that’s me!</th>
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<tr>
<td>- Do your homework</td>
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<td>- Come to class on Tuesday prepared to talk about your experiences with Lightbot!</td>
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