Introduction to Computer Science

Nathan Whitehead
Baskin Engineering 259A
Office hours: Tues 10-11 am, Thur 4-5 pm
Introductions

- Instructor: Nathan Whitehead
- Teaching Assistants:
  - Amita Misra
  - Chris 'Topher' Maraffi

- ... and you?

- More about us in a minute, BUT FIRST...
A new way of teaching CMPS 10 to align with new AP course

Supported by NSF and College Board

Started three years ago... pilot courses. We started at UCSC changing CMPS 10 in Spring 2011

In a few years (2015) there will be a standard AP high school course and an AP exam called CS Principles

We want to understand what people think is interesting about computer science (or not)

SO...
We want to know what you are like and what you think about computer scientists

- We want you to fill out a survey about you and what you think of computer science
- We'll do a similar survey at the end
- Who's already done it?

- Get it done by Tuesday
- Should take less than 15 minutes
What are the most interesting things happening in computing right now?

- Social media?
- Mobile apps?
- Your ideas!!
The most interesting things in Computer Science are...
This class
- Pilot class: taught by Larry Snyder, CSE 120
- Follow-on to pilot taught by Kelvin Sung, UW Bothell
  - Also taught to 8th grade class
- Marilyn Walker and Charlie McDowell at UCSC developed syllabus for CMPS 10
- There will be a new high school AP exam for CS principles by 2015
Introduction to this class

- http://www.bitsbook.com/excerpts/
- *Getting Started with Processing*, Reas and Fry (buy it)
- Supplemented with reading/watching online sources, e.g. Wikipedia, YouTube
Aim: Cover the Seven Big Ideas in computing

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 sciences, engineering, humanities, etc.

– 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'

- **Computational Thinking**
  - Thinking approaches you can use to solve your problems with computers
Goals

- One or two homeworks every week
  - Need to keep up and stay on top of things.

- Class should not be 'too hard'
  - Similar class taught at 8th grade and high school level

- At the end
  - understand much better what is happening inside your phone, computer, Facebook, Google

- You might like this class so much you decide to double major in CS
This is a really fun programming language that lets you make lots of cool things with minimal effort!

http://www.processing.org
Welcome to Project AWESOmE! (Advancing Women's Education in the School Of Engineering)

Announcement: We are hosting a Welcome Tea! All are welcome to attend, especially women considering careers in computer science. Come find out more about the major, the graduate programs, and other cool events we host! Meet faculty and current undergrad and grad students and be part of the effort to increase the participation of women in computing.
You might like this class so much that you decide to double major in CS
Why teach a new version of CS Principles?
Why teach a new version of CS Principles?

Figure 1. Computer Science Listed as Probable Major Among Incoming Freshmen
Source: HERI at UCLA
Why teach a new version of CS Principles?

Figure 3. Portion of Bachelor's Degrees Granted to Women
Source: National Science Foundation. Data were not reported for 1999.
One part of the solution:

- Attract students not typically attracted to CS

### Table 10a. Ethnicity of Bachelor’s Recipients

<table>
<thead>
<tr>
<th></th>
<th>CS</th>
<th>CE</th>
<th>I</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresident Alien</td>
<td>584</td>
<td>99</td>
<td>73</td>
<td>756</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
<td>27</td>
<td>6</td>
<td>13</td>
<td>46</td>
</tr>
<tr>
<td>Asian</td>
<td>1,034</td>
<td>250</td>
<td>173</td>
<td>1,457</td>
</tr>
<tr>
<td>Black or African-American</td>
<td>236</td>
<td>57</td>
<td>120</td>
<td>413</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>20</td>
<td>3</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>White</td>
<td>4,650</td>
<td>901</td>
<td>1,024</td>
<td>6,575</td>
</tr>
<tr>
<td>Multiracial, not Hispanic</td>
<td>65</td>
<td>13</td>
<td>1</td>
<td>79</td>
</tr>
<tr>
<td>Resident Hispanic, any race</td>
<td>373</td>
<td>65</td>
<td>116</td>
<td>554</td>
</tr>
<tr>
<td><strong>Total have Ethnicity Data for</strong></td>
<td><strong>6,989</strong></td>
<td><strong>1,394</strong></td>
<td><strong>1,523</strong></td>
<td><strong>9,906</strong></td>
</tr>
<tr>
<td>Resident, race/ethnicity unknown</td>
<td>455</td>
<td>96</td>
<td>119</td>
<td>670</td>
</tr>
<tr>
<td>Residency unknown</td>
<td>1,564</td>
<td>103</td>
<td>258</td>
<td>1,925</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9,008</strong></td>
<td><strong>1,593</strong></td>
<td><strong>1,900</strong></td>
<td><strong>12,501</strong></td>
</tr>
</tbody>
</table>
Calling all tech-savvy high school girls, coders, gamers, and web divas!

Apply for the NCWIT Award for Aspirations in Computing at www.aspirations.org

The NCWIT Award for Aspirations in Computing is a National Center for Women & Information Technology award.
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.
People Who Build Technology Should Represent the People Who Use it

- Women are half of world population, more than half of U.S. workforce
- Lack of women in computing is a failure
  - Missing out on benefits of diverse perspectives
  - Groups with greater diversity solve complex problems better and faster than homogeneous groups
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.
People Who Build Technology Should Represent the People Who Use it

- U.S. Bureau of Labor Statistics predicts IT will be one of fastest growing sectors in the U.S. economy
  - 1.4 million job openings by 2018
  - 2/3 may go unfilled due to lack of graduates with CS degrees
Most Exciting Things in Computing Now: mobile, pervasive, personalized, always on
Computing as part of our lives

- **Computing capacity**
  - Increasing 58% annually
  - Doubling every 18 months

- **Telecommunications capacity**
  - Increasing 28% annually
  - Doubling every 34 months

- **Storage capacity**
  - Increasing 23% annually
  - Doubling every 40 months

- Expanding at these rates for decades
What does increased computer power really mean?

- Computing techniques same as past, but can do it now
- Miniaturization & Mobile
- Apple SIRI
  - Speech recognition, text-to-speech
  - Personalized
  - Context
Big Data is here
Big Data

- Every company in the world wants access to information about your online behavior
  - What apps you use
  - What you buy online
  - Where you go
- Storage (disk space) is incredibly cheap and plentiful
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. This is close the total amount of information stored in one person’s DNA. Or, as Hilbert puts it, it’s the equivalent of 80 Libraries of Alexandria 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.
Why might you be interested in CS? A job?

- Employers are *desperate* to hire qualified CS majors
- Pay is *good*
- Demand is only increasing over time
- More and more industries are becoming software companies
  - *'Software is eating the world'*
  - Bookseller: Amazon
  - Marketing: Google
  - Recruiting: LinkedIn
  - Music: Apple
Fastest growing occupations by 2016

<table>
<thead>
<tr>
<th>2006 National Employment Matrix code and title</th>
<th>Code</th>
<th>Employment</th>
<th>Change</th>
<th>Quartile rank by 2006 median annual earnings (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td></td>
<td>Number</td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td>Network systems and data communications analysts</td>
<td>15-1081</td>
<td>262</td>
<td>402</td>
<td>53.4, 140</td>
</tr>
<tr>
<td>Personal and home care aides</td>
<td>39-9021</td>
<td>767</td>
<td>1,156</td>
<td>50.6, 389</td>
</tr>
<tr>
<td>Home health aides</td>
<td>31-1011</td>
<td>787</td>
<td>1,171</td>
<td>48.7, 384</td>
</tr>
<tr>
<td>Computer software engineers, applications</td>
<td>15-1031</td>
<td>507</td>
<td>733</td>
<td>44.6, 226</td>
</tr>
</tbody>
</table>

VH = very high
VL = very low

This file represents Table 2, Fastest growing occupations, 2006-16, in "Occupational employment projections, November 2007 Monthly Labor Review."
What areas are the most competitive 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 market 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 management, 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, as 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**: Safeway wants to know what you might want to buy based on your spending patterns, and spending of others like you.
Class Structure
Class Structure

- 2 '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
- Homework - exercises that help you learn the material ... plan to spend one hour a day (that's 7 hours per week)
- Lab sections: plan to go once or twice a week
  - You can go to sections other than the one you signed up for as long as there's space in the lab
  - The TAs are eager to help you
- Quizzes with clickers in class to make sure you are getting the core ideas
- Midterm, Final
How does this class work?

- This class is designed a bit differently from what you might normally be used to
  - 'Lecture' is focused around YOU
  - What YOU understand

- A 'clicker' is required for this class
  - It is not optional, using it is 5% of your grade
  - Clickers help figure out what you understand and what you might need help with

- So, lecture will be different
  - Ever thought about why we have 'lecture'?
Why do we have lecture?
Why do we have lecture?
You don't have to trust the monk!
- Read it and analyze it for YOURSELF!
- If I tell you what's in a book, what purpose does that serve?

Traditional class structures often look like:

- You get very little opportunity for 'expert' feedback
- Greater opportunity for expert feedback!

- Research on how people learn:
  - Everyone constructs their own understanding
  - To learn YOU must actively work with a problem and construct your own understanding
Lecture: Peer Instruction

- I'll ask a question
  - Solo vote: Think for yourself and select an answer
  - Discuss: Analyze problem in teams of 3
    • Practice analyzing, talking about challenging concepts
    • Reach consensus
    • If you have questions raise your hand
  - 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 your small group that everyone should know!
How to do well in this class

- Come to class & go to lab section every week at least once
- Make a sincere effort to understand the material
- Get some work done every day
- Submit work
  - You alone created (except for pair programming assignments)
- Do pair programming as a pair
  - Always work together
Details

- Course webpage
  - https://courses.soe.ucsc.edu/courses/cmps10/Winter14/01
- eCommons
  - https://ecommons.ucsc.edu/
  - Know how to get/submit homeworks!
- Piazza
  - http://piazza.com/ucsc/winter2014/cmps10
  - Use the forum. Check if your question has already been answered. Help others.
- Lab Sections
  - 01A: M 11:00AM-12:45PM JBE 109
  - 01B: M 3PM-4:45PM JBE 109
  - 01C: M 5PM-6:45PM JBE 109
  - 01G: Tu 9AM-11AM Soc Sci 1 135
  - 01D: Tu 2PM-3:45PM JBE 109
  - 01E: W 4:30PM-6:15PM JBE 109
  - 01F: F 10AM-12PM JBE 109
  - 01H: F 1PM-2:45PM Soc Sci 1 135
Announcements

- If you qualify for accommodation for a disability please bring me the form from the Disability Resource Center within the first two weeks of class

- TO DO: familiarize yourself with class webpage, eCommons
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
  - It's solving a puzzle, have to stick to it
- Programming is a career; takes years to learn
- We teach programming in this class as part of teaching computational thinking
  - You won't be an expert programmer at the end
  - You will think differently at the end
First Homework

- Get started, try to finish by Thursday
- Writeup due Tuesday
  - Note: HW 2 is also due Tuesday
Homework 1: Lightbot 2.0

- Lightbot shows up on many gaming sites, whether it is actually a 'game' is a topic for Thursday
  - You direct a robot around a 'block world'
  - Should be easy and fun. We'll discuss what the homework is intended to show next time.
Homework 1: Lightbot 2.0

- Using Chrome or Firefox browser visit: http://armorgames.com/play/6061/light-bot-20
- After the opening visuals, click 'Play'
- Follow assignment instructions
  Parts A, B, Challenge C, writeup
Get to it!

- Homework 1
- Fill out pre-class survey
- Reading assignment for next time - read Computer History from Wikipedia up to 'Bugs'
Introductions ... What our interests are

- Teaching assistants
  - Amita Misra
  - Chris 'Topher' Maraffi
- Instructor: Nathan Whitehead

- What we are doing in computer science
- What we think is exciting
Instructor: Nathan Whitehead

- Academic degrees:
  - B.A. Physics and Mathematics Whitman College 1999,
    M.S. Mathematics University of Illinois--Urbana
    Champaign 2003, Ph.D. Computer Science UCSC 2008
- Industry: NVIDIA, Lab126/Amazon

- Interests: computer security, high performance GPU
  computing, online teaching, programming languages