Learning Goals

- [CT Impact] Justify the need for diversity in the field of Computer Science with at least two different, valid reasons
- [CT Impact] Outline changes in enrolment of women in Computer Science over the last 40 years
- [CT Impact] List several theories as to why there are few women in computer science
There are lots of different kinds of diversity that computer science doesn't do well at

- Gender
- Ethnic/racial
- Disabilities

Note that many of the stats that I have come from the US. They still generally hold for Canada, but it's harder to get good numbers/graphs.
Let's start with the percentage of women getting which Bachelors degrees

Percent Female US Bachelors Degrees

- Agriculture
- Architecture
- Biology
- Business
- Communications and Journalism
- Computer Science
- Education
- Engineering
- English
- Foreign Languages
- Health Professions
- Physical Sciences
- Psychology

CS, Bio, Math, Ed
Underrepresented minorities in the US

31% of US population was Black, Hispanic, or First Nations in 2010

Science and engineering bachelor’s degrees earned by underrepresented minorities, by field: 1991–2010

NOTE: Data not available for 1999.
SOURCE: Women, Minorities, and Persons with Disabilities in Science and Engineering:
UBC Computer Science
Overall enrollment numbers

Total Undergraduate Enrollment by Degree Type

- CS Majors & Software Eng. Majors
- CS Double & Combined Majors
- Minor
- BUCCS
- BA
- BCS
- COGS
- Cumulative (All Degree Types)
Female Enrollment by Degree Type

- CS Majors & Software Eng. Majors
- CS Double & Combined Majors
- Minor
- BUCS
- BA
- BCS
- COGS
- Cumulative (All Degree Types)

Percentage of women

https://www.cs.ubc.ca/our-department/women/statistics
Why diversity matters: need for breadth of ideas/cognitive diversity

Different ideas come from different people with different experiences and perspectives
Example: A Braille Math translator

• Nicole Torcolini lost most of her sight at age four due to cancer. She created a computer-based assistive technology device that translates visually incomprehensible braille math (Nemeth), produced on an electronic braille notetaker, into easily-readable print.

• Nicole’s first CS advisor was Richard Ladner at the University of Washington; he grew up with deaf parents and that sparked his interest in technologies for deaf-blind people.

Why diversity matters: need for breadth of ideas/cognitive diversity

Different ideas come from different people with different perspectives

Some of these differences can seem quite silly but be quite profound

“[A speaker] gave an uproariously funny talk about the difficulty women have with a car that has been designed for the 50th-percentile male. Women have different needs, women carry purses, women use a vehicle differently, women are of a different size, etc., all of which make the 'male car' difficult to use.

As I said, it was a very funny talk. However, when I mentioned this to my wife, who has a long involvement with the Defense Department, she said, 'Yes, and it's just as true of fighter planes where it's not funny; it's a life and death matter.'"

- Bill Wulf – member of the National Academy of Engineering

http://www.nae.edu/Publications/Bridge/CompetitiveMaterialsandSolutions/DiversityinEngineering.aspx
Why diversity matters: there are more computer science jobs than qualified people

"120K technical computing jobs produced annually, but we graduate only 40K BS degrees in computer science disciplines (i.e., 80K new jobs go unfilled each year)"

Why diversity matters: computer science is of growing importance to other fields

Local Examples:

• Computational cancer genomics: Sorhab Shah develops statistical models and algorithms to interpret cancer mutations

• Classical studies: Siobhan McElduff digitizes old book catalogues to understand pricing and what it tells us about the world
Shouldn’t we worry about the lack of men in teaching and nursing, too?

- I worry about that, too
- Note that this is a recent turn of events (http://www.nytimes.com/2014/09/07/sunday-review/why-dont-more-men-go-into-teaching.html?_r=0)
- But this is a computer science class
- Plus female dominated fields tend to pay substantially less and have less prestige than male dominated fields (this happened in nursing and teaching, too)
Why are there so few women, and overall lack of diversity, in Computer Science?

- We have some guesses
- No one's entirely sure
- But there are some factors that we can say are issues (we'll do those next)
One problem: it starts early

We can use high school Advanced Placement (AP) exams as a proxy for this

Overall:

Computer Science

Communicators, Techies, Creators

Let’s look at boys vs girls’ comfort with three types of computer-related tasks
This impacts comfort with tech

<table>
<thead>
<tr>
<th>Communicators</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texting your friends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uploading pictures</td>
<td>88%</td>
<td>90%</td>
</tr>
<tr>
<td>Instant Messaging</td>
<td>84%</td>
<td>92%</td>
</tr>
<tr>
<td>Subscribing to an RSS feed</td>
<td>13%</td>
<td>35%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Techies</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning how to use a new software program</td>
<td>62%</td>
<td>84%</td>
</tr>
<tr>
<td>Setting up a new computer</td>
<td>37%</td>
<td>75%</td>
</tr>
<tr>
<td>Setting up a wireless network</td>
<td>26%</td>
<td>59%</td>
</tr>
<tr>
<td>Creating a spreadsheet with formulas</td>
<td>26%</td>
<td>45%</td>
</tr>
<tr>
<td>Fixing a computer when something goes wrong</td>
<td>26%</td>
<td>58%</td>
</tr>
<tr>
<td>Writing your own computer program to solve a problem</td>
<td>12%</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creators</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editing movies or music on a computer</td>
<td>46%</td>
<td>66%</td>
</tr>
<tr>
<td>Using a computer to do graphic design</td>
<td>42%</td>
<td>54%</td>
</tr>
<tr>
<td>Designing, creating, and maintaining your own personal website</td>
<td>46%</td>
<td>41%</td>
</tr>
<tr>
<td>Programming a new computer game</td>
<td>28%</td>
<td>45%</td>
</tr>
<tr>
<td>Creating new effects for graphics or music-editing software</td>
<td>28%</td>
<td>41%</td>
</tr>
<tr>
<td>Creating new features for a website</td>
<td>27%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Who’s more likely to like computer science: Communicators, Techies, or Creators? Why?

- **Techies**
  - Took AP Computer Science: 12% (Communicators: 4%, Creators: 10%)
  - Think Computing would be a good choice of major: 53% (Communicators: 4%, Creators: 74%)
  - Think Computer Science/IT would be a good career: 75% (Communicators: 46%, Creators: 68%)
  - Intend to study Computer Science/Technology in college or pursue a career in Computing: 14% (Communicators: 9%, Creators: 6%)

- **Creators**
  - Took AP Computer Science: 10% (Communicators: 4%, Techies: 12%)
  - Think Computing would be a good choice of major: 74% (Communicators: 4%, Techies: 82%)
  - Think Computer Science/IT would be a good career: 68% (Communicators: 46%, Techies: 75%)
  - Intend to study Computer Science/Technology in college or pursue a career in Computing: 9% (Communicators: 6%, Techies: 14%)

- **Communicators**
  - Took AP Computer Science: 4% (Techies: 12%, Creators: 10%)
  - Think Computing would be a good choice of major: 74% (Techies: 12%, Creators: 74%)
  - Think Computer Science/IT would be a good career: 46% (Techies: 12%, Creators: 68%)
  - Intend to study Computer Science/Technology in college or pursue a career in Computing: 6% (Techies: 12%, Creators: 9%)
This in turn impacts what students "like"
Then there’s whether people feel that computer scientists are like them.
Why lack of diversity? Bias

Reminder:

**Conscious bias** is when you're biased and you know it (and you're generally not sorry)

**Unconscious bias** is when you're biased... and you may not know it (and if you do, you're sorry)... and you may even be biased against what you believe!
Bias exists many ways

"A research article written by a woman and published in any of the top journals will still receive significantly fewer citations than if that same article had been written by a man."

"Articles published by women in the top IR [International Relations] journals are cited less often than those written by men even after controlling for the age of publication, whether the author came from a [top research] school, the topic under study, the quality of the publishing venue, the methodological and theoretical approach, and the author’s tenure status."

http://curt-rice.com/2013/10/19/the-great-citation-hoax-proof-that-women-are-worse-researchers-than-men/
It even exists in how we think about ourselves

Self-citations are citations made to the author's own work

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-authored</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0.40</td>
<td>0.02</td>
<td>0.37–0.43</td>
</tr>
<tr>
<td>Women</td>
<td>0.25</td>
<td>0.03</td>
<td>0.19–0.31</td>
</tr>
<tr>
<td>Difference</td>
<td>0.15***</td>
<td>0.04</td>
<td>0.07–0.24</td>
</tr>
<tr>
<td>Coauthored</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>0.91</td>
<td>0.04</td>
<td>0.83–1.00</td>
</tr>
<tr>
<td>Women</td>
<td>0.41</td>
<td>0.16</td>
<td>0.08–0.74</td>
</tr>
<tr>
<td>Difference</td>
<td>0.50**</td>
<td>0.24</td>
<td>0.03–0.97</td>
</tr>
<tr>
<td>Men</td>
<td>0.91</td>
<td>0.04</td>
<td>0.83–1.00</td>
</tr>
<tr>
<td>Mixed gender</td>
<td>0.89</td>
<td>0.06</td>
<td>0.77–1.01</td>
</tr>
<tr>
<td>Difference</td>
<td>−0.02</td>
<td>0.08</td>
<td>−0.17–0.13</td>
</tr>
</tbody>
</table>

Notes: ** p < .05; *** p < .01.

http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=9038606
“Many researchers have concluded that stereotypical images, like the gamer from T.V.’s Southpark [...], frequently appear among the list of factors that deter some students from seeing themselves in the field.”
– Carol Frieze, 2011

Impostor syndrome is the feeling that you’re not as good as people think you are. It’s the feeling that you’re a fake.

Confidence in ability to write a computer program:

- Students with high math ACT scores
  - Male CS majors: 63%
  - Male non-CS majors: 60%
  - **Female CS majors: 48%**
  - Female non-CS majors: 44%

- Students with low math ACT scores
  - Male CS majors: 53%
  - **Male non-CS majors: 49%**
  - Female CS majors: 37%
  - Female non-CS majors: 34%

Especially interesting: High-scoring female CS students vs. low-scoring male non-CS students
“I’m simply stating that the distribution of preferences and abilities of men and women differ in part due to biological causes and that these differences may explain why we don’t see equal representation of women in tech and leadership.” – James Damore

What are two other reasons we covered in class that account for some of the representation differences? Why? What is at least one thing covered in class that we would expect to be different if this were true?
How to broaden participation in CS?

BC and other Canadian provinces have plans to introduce “coding” into the high school curriculum

Computing the value of coding ahead of its introduction to B.C. curriculum

TRACY SHERLOCK
More from Tracy Sherlock

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https://www.cs.ubc.ca/grades-k-12/girlsmarts
What is UBC doing?

One example: Girlsmarts  UBC CS's annual workshops for grade 6 and 7 girls
Subjects like cybersecurity, hardware, robotics, HTML, Human Computer Interaction

https://www.cs.ubc.ca/grades-k-12/girlsmarts
In case you're interested in more...

There's are annual celebrations of women in computer science:  
http://www.gracehopper.org
http://www.can-cwic.ca/
Learning Goals Revisited

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