CS 182: Ethics, Public Policy, and Technological Change

Rob Reich
Mehran Sahami
Jeremy Weinstein
Hilary Cohen
Today’s Agenda

- Who builds technology?
  - Trends in CS education
- Tech culture
  - Who is technology built for?
  - Founders and funding
- What can be done?
A Historical View of CS Enrollment at Stanford

CS major declarations
A Slightly More Well-Known Graph

NASDAQ composite index
The Obvious Correlation

- Normalize both graphs by 1998 values
  - Adjust for a one year lag time in declarations

Correlation = 0.61
By 2003, ... sensational news stories appeared about a supposedly horrific loss of these [computer programming] jobs [due to offshoring].

-- The Washington Times, June 6, 2004

Correlation up to 2003 = 0.88
The Times They Are A-Changin'

CS BS Major Declarations

Top 5 majors in 1995:
1. Bio Sciences
2. Human Biology
3. Economics
4. Psychology
5. English

By 2012, CS became largest major at Stanford

In 2008-09 new CS curriculum went into effect

Declarations in 2019 are 4.5 times the figure in 2007

Top 5 majors in 1995:
1. Bio Sciences
2. Human Biology
3. Economics
4. Psychology
5. English

By 2012, CS became largest major at Stanford

In 2008-09 new CS curriculum went into effect

Declarations in 2019 are 4.5 times the figure in 2007
A Broader Trend

Source: CRA Taulbee Survey, May 2020
Demographics: Gender

<table>
<thead>
<tr>
<th>Year</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993/94</td>
<td>74</td>
<td>10</td>
</tr>
<tr>
<td>1994/95</td>
<td>77</td>
<td>14</td>
</tr>
<tr>
<td>1995/96</td>
<td>59</td>
<td>21</td>
</tr>
<tr>
<td>1996/97</td>
<td>92</td>
<td>13</td>
</tr>
<tr>
<td>1997/98</td>
<td>110</td>
<td>28</td>
</tr>
<tr>
<td>1998/99</td>
<td>121</td>
<td>29</td>
</tr>
<tr>
<td>1999/00</td>
<td>128</td>
<td>24</td>
</tr>
<tr>
<td>2000/01</td>
<td>138</td>
<td>33</td>
</tr>
<tr>
<td>2001/02</td>
<td>127</td>
<td>31</td>
</tr>
<tr>
<td>2002/03</td>
<td>108</td>
<td>18</td>
</tr>
<tr>
<td>2003/04</td>
<td>103</td>
<td>14</td>
</tr>
<tr>
<td>2004/05</td>
<td>64</td>
<td>10</td>
</tr>
<tr>
<td>2005/06</td>
<td>79</td>
<td>7</td>
</tr>
<tr>
<td>2006/07</td>
<td>78</td>
<td>9</td>
</tr>
<tr>
<td>2007/08</td>
<td>105</td>
<td>18</td>
</tr>
<tr>
<td>2008/09</td>
<td>129</td>
<td>30</td>
</tr>
<tr>
<td>2009/10</td>
<td>118</td>
<td>28</td>
</tr>
<tr>
<td>2010/11</td>
<td>197</td>
<td>49</td>
</tr>
<tr>
<td>2011/12</td>
<td>195</td>
<td>66</td>
</tr>
<tr>
<td>2012/13</td>
<td>231</td>
<td>89</td>
</tr>
<tr>
<td>2013/14</td>
<td>255</td>
<td>110</td>
</tr>
<tr>
<td>2014/15</td>
<td>229</td>
<td>103</td>
</tr>
<tr>
<td>2015/16</td>
<td>257</td>
<td>123</td>
</tr>
<tr>
<td>2016/17</td>
<td>237</td>
<td>140</td>
</tr>
<tr>
<td>2017/18</td>
<td>277</td>
<td>109</td>
</tr>
<tr>
<td>2018/19</td>
<td>213</td>
<td>104</td>
</tr>
<tr>
<td>2019/20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Female CS Graduates in 2019
Stanford: 34%
Top 160 CS departments: 21%

Source for 160 CS departments: CRA Taulbee Survey, May 2020
Demographics: Race (percentages)

- Native American/Alaska Native
- Black/African American
- Hispanic/Latino
- Hawaiian/Pacific Islander
- Asian
- White
- Two or more, not hispanic/latino
- International/nonresident
- Unknown/decline to state

CS majors vs All Stanford undergrads
Comparison to 160 CS Departments

- Native American/Alaska Native: 0.00%
- Black/African American: 0.00%
- Hispanic/Latino: 0.00%
- Hawaiian/Pacific Islander: 0.00%
- Asian: 40.00%
- White: 45.00%
- Two or more, not Hispanic/Latino: 15.00%
- International/Nonresident: 20.00%

Source for 160 CS departments: CRA Taulbee Survey, May 2020
An Interesting Experiment

- Given enormous demand for CS education, some universities are not able to take all majors
  - Create barriers (e.g., min. GPA) to declare CS as major
  - Such barriers disproportionately impact women and underrepresented groups (based on less prior exposure to computing)

- So how should access to major be determined?
  - Univ. of Washington: top X students by GPA in intro CS/Math courses
  - UC San Diego (major changes): by lottery

- Which do you think is more fair?
- Which do you wished was used at the school you attended?

- Side note: Stanford CS is committed to not instituting a cap on the size of the CS major and allowing anyone to declare
Today’s Agenda

• Who builds technology?
  • Trends in CS education
• Tech culture
  • Who is technology built for?
  • Founders and funding
• What can be done?
**Tech Culture**

- **Who is technology built for?**
  - Often reflects demographics and socio-economics of those who build it
  - But there is greater equalization with greater adoption

### Percent of households using application

<table>
<thead>
<tr>
<th>Income Range</th>
<th>Facebook</th>
<th>LinkedIn</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; $30,000</td>
<td>80%</td>
<td>40%</td>
</tr>
<tr>
<td>$30k-$60k</td>
<td>80%</td>
<td>40%</td>
</tr>
<tr>
<td>$60k-$70k</td>
<td>80%</td>
<td>40%</td>
</tr>
<tr>
<td>$70k-$80k</td>
<td>80%</td>
<td>40%</td>
</tr>
<tr>
<td>$80k-$100k</td>
<td>80%</td>
<td>40%</td>
</tr>
<tr>
<td>&gt; $100,000</td>
<td>80%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Source: https://khoros.com/resources/social-media-demographics-guide
Who Gets Access?

What do you look for in entrepreneurs?
"What matters most is their passion -- their focus on serving a large, unmet market need with an outstanding team and disruptive innovation. Their commitment to technical excellence, and obsessing on customers (not competition). Their pursuit of reasonable financings, but unreasonable, audacious goals. Their sense of urgency. Their ambition, vision, confidence and humility in putting their team first. They must be missionaries, not mercenaries."

-- John Doerr (Kleiner Perkins website)

"That correlates more with any other success factor that I’ve seen in the world’s greatest entrepreneurs. If you look at Bezos, or Andreessen, David Filo, the founders of Google, they all seem to be white, male, nerds who’ve dropped out of Harvard or Stanford and they absolutely have no social life"

-- John Doerr (recorded at a National Venture Capital Association meeting in 2008)

Quote from NVCA Source: https://www.businessinsider.com/john-doerr-the-greatest-tech-entrepreneurs-are-white-male-nerds-2015-3
"We close out the decade with 20 percent of global startups raising their first funding round in 2019 having a female founder.

The proportion of female co-founded companies has doubled since 2009 which stood at 10 percent."

Source: Gené Teare, EoY 2019 Diversity Report: 20 Percent Of Newly Funded Startups In 2019 Have A Female Founder, CrunchBase News, January 21, 2020
"In the tech community, venture capital firms acknowledged the problem — less than 1% of founders who receive venture funding are Black, despite making up over 13% of the US population.

... [Evaluated] all the startups globally with a total funding amount of $500,000 — $20,000,000 and who raised a round between July 1 and October 1 [in 2020]. There were over 1383 companies here and our team went through one by one, to see how many Black founders there were."

<table>
<thead>
<tr>
<th>Companies</th>
<th>Total Funds Raised in Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Startups</td>
<td>$5,882,471,765.00</td>
</tr>
<tr>
<td>Startups with Black Founders</td>
<td>$114,852,638.00</td>
</tr>
</tbody>
</table>

Source: Hallo Research: Black Founder Funding Q3 2020
https://medium.com/halloapp/hallo-research-black-founder-funding-cef159448b1e
Close to Home

Video: https://twitter.com/i/status/1268674513325064192

Source: Elliot Robinson, Twitter, June 4, 2020
https://twitter.com/TheValuesVC/status/1268674513325064192
Diversity in Industry

Source: Kate Rooney and Yasmin Khorram, "Tech companies say they value diversity, but reports show little change in last six years," CNBC, June 12, 2020.
https://www.cnbc.com/2020/06/12/six-years-into-diversity-reports-big-tech-has-made-little-progress.html
Toxic Culture

• Nearly 40% of employees surveyed indicated that unfairness or mistreatment played a major role in their decision to leave their company, and underrepresented men were most likely to leave due to unfairness.
• 1 in 10 women experienced unwanted sexual attention, while LGBT employees were most likely to be bullied and/or experience public humiliation.
• 78% of employees reported experiencing some form of unfair behavior or treatment; Women from all backgrounds experienced/observed significantly more unfairness than men and unfairness was more pronounced in tech companies than non-tech companies.
• Underrepresented men and women of color experienced stereotyping at twice the rate of White and Asian men and women; 30% of underrepresented women of color were passed over for promotion.

Source: Kapor Center, Tech Leavers Study
As of May [2020], Google reported that 5.9% of its employees and contractors are Latino and 3.7% are Black — [this lack of diversity] extends up through the ranks of top executives, entrepreneurs who found companies, and venture capitalists who invest in startups.

... Even the graduating class of computer science majors at Stanford, Silicon Valley’s elite training ground, is more diverse than the companies just down the road from campus.
Maybe It's Not Just in Industry

- Do you seek out diversity in project teams?
  - Why/why not?

- How often do you critically reflect on diversity
  - In the people you work with?
  - In the projects you pursue?
Today’s Agenda

• Who builds technology?
  • Trends in CS education
• Tech culture
  • Who is technology built for?
  • Founders and funding
• What can be done?
What Can Be Done?

"Our mission is to increase the number of successful black entrepreneurs in technology."

Black Founders is creating an ecosystem that stimulates tech entrepreneurship and fosters economic growth. We develop global programs that equip entrepreneurs, inspire innovation, and allow us to share resources.

FEMALE FOUNDERS FUND

FUNDING THE FUTURE

Investing in the exponential power of exceptional female talent.
Diversity Matters

• What do these technology scholars have in common?
  • They are leaders in showing how technology can lead to discrimination
  • Their personal experiences were a driving force in their research

• Their scholarship has produced:
  • Significant rethinking of how technology is evaluated
  • Testimony before Congress
  • Changes in tech business practices
  • Greater awareness of these issues throughout the industry

Joy Buolamwini
Timnit Gebru
Safiya Noble
"Students in schools in California and nationwide lack access to AP CS A coursework, with underrepresented students of color and low-income students far less likely to have access to computing courses. Even when AP Computer Science courses are available, underrepresented students are less likely to have prior exposure to computer science at home or in out-of-school activities..."

Source: Kapor Center for Social Impact, Computer Science in California's Schools: 2016 AP CS Results and Implications
The need:
- Over 500,000 current openings for computing jobs in US
- CS majors earn 40% more than college average
- 90% of parents want their child to study CS in high school

The opportunity:
- For students who try AP CS in high school:
  - Women are ten times more likely to major in it
  - Black and Latinx students are seven times more likely

The problem:
- Only 45% of high schools teach CS
- Unequal distribution of access
The Imbalance

Race & Ethnicity by Gender for Computer Science Majors

The closest comparable data for the 6 Digit Course Computer Science is from the 2 Digit Course Computer and Informaton.

5% of US population
62% of US population
18% of US population
12% of US population
0.2% of US population

Dataset: NCES IPEDS
Source: Department of Education

Department of Education data from 2016
US population data from American Community Survey 2017
AP CS Participation in California

**AP CS Participation Rates and CA HS Population**

- **African American/Black**: 1% % of AP CS Testtakers, 6% % of CA HS Population
- **Hispanic/Latinx**: 15% % of AP CS Testtakers, 53% % of CA HS Population
- **White**: 29% % of AP CS Testtakers, 25% % of CA HS Population
- **Asian/Pacific Islander**: 48% % of AP CS Testtakers, 12% % of CA HS Population
- **Native American/Alaskan Native**: 0.10% % of AP CS Testtakers, 1% % of CA HS Population

**AP CS A Participation in CA by Gender**

- **Male**: 73%
- **Female**: 27%

Source: California Department of Education (2016); College Board (2016)
Computer Science: Essential Knowledge for All Students

Computer science skills are critical for success, and as long as there are gaps in access, the skills gap will only get wider.
Concepts and Practices of Framework

Core Concepts:
1. Computing Systems
2. Networks and the Internet
3. Data and Analysis
4. Algorithms and Programming
5. Impacts of Computing

Crosscutting Concepts:
1. Abstraction
2. System Relationships
3. Human-Computer Interaction
4. Privacy and Security
5. Communication and Coordination

Core Practices:
1. Fostering an Inclusive Computing Culture
2. Collaborating Around Computing
3. Recognizing and Defining Computational Problems
4. Developing and Using Abstractions
5. Creating Computational Artifacts
6. Testing and Refining Computational Artifacts
7. Communicating About Computing
What the Framework is Used For?

The framework of concepts and practices will inform the development of _________ by _________.

(pick one)
- standards
- curriculum
- professional development

(pick one)
- states
- districts
- organizations (ex: CSTA)
Who Was Involved?

• States and Districts

Arkansas  Iowa  New Jersey  Districts:
California  Maryland  North Carolina  Charles County Public Schools
Georgia  Massachusetts  Utah  Chicago Public Schools
Idaho  Nebraska  Washington  NYC Department of Education
Indiana  Nevada  San Francisco Unified

• Industry: Google, Amazon, Microsoft, Apple...

• Organizations: College Board, PLTW, Achieve, CCSSO, NGA, ISTE, NAF...

• 25 advisors from the CS Education community
Gov. Jerry Brown on Tuesday signed into law a bill that begins a three-year planning process to expand computer science education for all grades in California’s public schools, beginning in kindergarten.
Brown appoints 15 to new K-12 computer science panel

Gov. Jerry Brown appointed 15 technology and education experts Friday to a newly created panel charged with making recommendations on the implementation of K-12 computer science standards in California.
State budget proposal would fund computer science coordinator, broadband expansion

Budget reveals plan to expand computer science classes to all students.

Gov. Gavin Newsom is proposing $15 million to expand broadband internet to more schools and an additional $1 million to hire a state computer science coordinator as a “down payment” on a comprehensive plan to provide access to computer science classes to all California students.
Gov. Jerry Brown appointed 15 technology and education experts Friday to a newly created panel charged with making recommendations on the implementation of K-12 computer science standards in California.

The new panel members are:

Agodi E. Onyeador, 17, of Pittsburg. Onyeador has been a student at Oakland Technical High School since 2014, where she has been a consulting representative for Supporting People of Color Now since 2015. She was a summer math and science honors academy scholar for the Level Playing Field Institute from 2015 to 2017 and was a mentee at the Intel Computer Science Academy from 2016 to 2017

Source: Carolyn Jones, Brown appoints 15 to new K-12 computer science panel, EdSource, February 12, 2018