Booming Enrollments and Gender Diversity
How do we Keep History from Repeating Itself?

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Computer science enrollments are booming!

Interest in CS enrollment has tripled or quadrupled in recent years. (Soper, 2014; Brown, 2016)

This is true across a variety of academic institutions. (Lazowska, Roberts & Kurose, 2014)
WE’VE SEEN THIS BEFORE...

Bachelor’s Degrees in Computer and Information Sciences

Degrees Conferred

Total CS Enrollment

(Source: NCES)
AND IT’S BAD FOR DIVERSITY…

Bachelor’s Degrees in Computer and Information Sciences

(Source: NCES)
THE LARGEST DROPS IN GENDER DIVERSITY IN CS CO-OCCUR WITH CYCLIC DROPS IN ENROLLMENT

Students are losing interest in the field, but more women are leaving at a faster rate.

<table>
<thead>
<tr>
<th></th>
<th>Late 80s</th>
<th>Early 00s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>↓ 35%</td>
<td>↓ 30%</td>
</tr>
<tr>
<td>Female</td>
<td>↓ 53%</td>
<td>↓ 56%</td>
</tr>
</tbody>
</table>

Decreases in female participation precede overall decreases by a few years.
WHY DID THIS HAPPEN?

It's complicated…

A lot of possibilities…

But let's look at a few
CS DEPARTMENTS RESTRICT ACCESS

Faced with record enrollments, departments can either increase faculty/staff or restrict access. (Roberts, 1999)

Formally

Enrollment caps, stricter acceptance criteria

Women with equal credentials are viewed as less qualified for STEM positions than male peers. (Lent et al., 1986; Trix & Psenka, 2003; Moss-Racusin et al., 2012)

This is especially true in male-dominated fields. (Hill et al., 2013)

Enrollment caps increase perceptions of CS as “too hard”, “competitive”, or “cut throat.” (Roberts, 1999)

Informally

Make introductory courses more difficult in order to “weed out” students early

Women are more likely to underrate their abilities and possibilities for future success, even with no difference in performance. (Beyer et al., 2003; Zappert & Stansbury, 1985; Williams & Montgomery, 1995; Pajares, 2005; Hill et al., 2013)

Women (but not men) who perform well in STEM areas are also more likely to perform well in the humanities. (Lubinsky & Benlow, 2006)
GENDERED BRANDING

When an industry is growing and needs more professionals...

FEMINIZE!

“A whole new kind of work for women: programming. [...] And if it doesn’t sounds like women’s work – well, it just is.”

“It’s just like planning a dinner.”
(The Computer Girls, Cosmopolitan, 1967)

“An industry that was doubling in size every year or two simply could not afford to discriminate against women.”
(Ensmenger, 2009)
GENDERED Branding

When an industry has reached its capacity and wants only the most qualified...

MASCULINIZE!

Language changes from “everyone can do it (even women)” to being an elite field for only the most qualified. (Ashcraft, 2015)

Stereotypically masculine personas develop about what a computer scientist should look and be like. (Ensmenger, 2009; Ashcraft, 2015)

(HBO Silicon Valley, source IMDB)
WHAT ABOUT THIS BOOM?

Will it happen again?

What signs can we look for?
# SOME SIGNS OF HISTORY REPEATING ITSELF

<table>
<thead>
<tr>
<th>Struggling with Capacity</th>
<th>Feminization of the Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>“So many students, how can we handle them all!?”</td>
<td>“We need more people”</td>
</tr>
<tr>
<td></td>
<td>“Anyone can do it”</td>
</tr>
</tbody>
</table>

Universities are hiring more faculty and finding more space, but are still having to turn away record numbers of students. *(Military Times, May 2016)*

Seeing an increased discussion on how to handle enrollment booms. *(eg. Booming Enrollments—What is the Impact, CRA, 2015; Google Computer Science Capacity Awards, 2015)*

“Apple Announces ‘Everyone Can Code’ Initiative…” *(Edsurge, Sep 2016)*

Arguments that we need more trained professionals and consequently need more women to pursue the field *(eg. she++: The Documentary, 2013; NSF Press Release 13-200, Dec 2013)*
TO TELL US MORE...

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We have had some recent successes

Computer science now top major for women at Stanford University

By Sarah McBride | SAN FRANCISCO
Computer science has for the first time become the most popular major for female students at Stanford University, a hopeful sign for those trying to build up the thin ranks of women in the technology field.
Many of you know this wonderful book
When did we lock the clubhouse?

“When women stopped coding,” *Planet Money*, October 21, 2014
What happened to computer science in 1984?

This decline was caused by a fall in student demand after the dot-com crash.

This decline was caused by a collapse in capacity as colleges and universities found themselves unable to satisfy demand.

Source: National Center for Education Statistics
### Where did students go after 1984?

<table>
<thead>
<tr>
<th>Field of study</th>
<th>1985-86</th>
<th>1990-91</th>
<th>change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area, ethnic, cultural, gender, and group studies</td>
<td>3,021</td>
<td>3,021</td>
<td>58.1%</td>
</tr>
<tr>
<td>English languages and literature/letters</td>
<td>34,083</td>
<td>34,083</td>
<td>49.8%</td>
</tr>
<tr>
<td>Psychology</td>
<td>40,628</td>
<td>40,628</td>
<td>44.4%</td>
</tr>
<tr>
<td>Liberal arts and sciences, general studies, and humanities</td>
<td>21,336</td>
<td>21,336</td>
<td>43.1%</td>
</tr>
<tr>
<td>Social sciences and history</td>
<td>93,840</td>
<td>93,840</td>
<td>33.3%</td>
</tr>
<tr>
<td>Theology and religious vocations</td>
<td>5,510</td>
<td>4,799</td>
<td>−12.9%</td>
</tr>
<tr>
<td>Engineering</td>
<td>77,391</td>
<td>62,448</td>
<td>−19.3%</td>
</tr>
<tr>
<td>Agriculture and natural resources</td>
<td>16,823</td>
<td>13,124</td>
<td>−22.0%</td>
</tr>
<tr>
<td>Physical sciences and science technologies</td>
<td>21,711</td>
<td>16,334</td>
<td>−24.8%</td>
</tr>
<tr>
<td>Computer and information sciences</td>
<td>42,337</td>
<td>25,159</td>
<td>−40.6%</td>
</tr>
</tbody>
</table>

Source: National Center for Education Statistics
Challenges of the boom-and-bust cycle

If something is unsustainable, it will stop.
—Economic maxim (Stein’s law)

• The boom-and-bust cycle is one of the hardest challenges that academic computer science has to overcome.

• When student demand rises, universities react initially by trying to increase capacity through faculty hiring. Unfortunately, there are many more faculty openings than applicants.

• When faculty searches fail, universities seek to restrict access to the major and to limit enrollment in these courses.

• Such limitations have a disastrous effect on diversity because women often have less experience with computers and feel less comfortable in a competitive milieu.
The capacity challenge today

Source: Computing Research Association Taulbee surveys
Jane Stout
Computing Research Association
jane@cra.org
Data Buddies
Research questions

• How do women feel in computing?
• Why are women leaving?
• Where are women going?
How do women feel in computing?

- Low belonging
- Low confidence
  — Computing GPA equal to men
Why are women leaving Intro CS?

I didn’t enjoy the professor’s teaching style
- Men: 20%
- Women: 45%

It was too challenging
- Men: 75%
- Women: 33%
Why are women leaving computing major?

Women are more likely than men say challenging environment

- “harsh”
- “overwhelming”
- “high pressure”
- “insufficient background”
Where are women going?

Women (n=19)
- 5% Engineering
- 16% Math / Statistics
- 16% Physical Sciences
- 11% Business
- 21% Humanities
- 32% Social Sciences

Men (n=19)
- 32% Engineering
- 26% Math / Statistics
- 11% Physical Sciences
- 16% Business
- 11% Humanities
- 5% Social Sciences
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STARS Computing Corps

Alliance of ~50 colleges & universities
Developing faculty & student leaders
who engage in outreach, research and service to
Broaden Participation in Computing
STARS Impact

Outreach to 135,000+ in K12
Beauty & Joy of Computing

An Advanced Placement CS Principles course. Students learn programming & global impacts of computing.

BJC has provided PD for 350+ high school teachers from 2012-2016.
50 STARS & 11 BJC locations
Nationally – high interest, high demand

- CS for all – Obama’s proposal to fund CS in K-12 schools
- BLS: 1.3M jobs by 2022
- Gallup poll:
  - 91% parents want CS in K-12 schools
  - <10% admins perceive high parent demand
  - <20% admins perceive high student demand
Demand rising at universities (courses & majors)

Colleges are not prepared for this demand!

Private schools can meet rising demands...
Public schools can’t: bust/boom cycles & pre-planned hiring

Crappy solutions (Lazowska, UW, 2014):
• Restrict the size of the major
• Exclude non-majors from upper-division courses
• Retreat to “the core” — turn over many of our courses to other departments
• Have enormous class sizes and/or enormous teaching loads
• Have a beer while the students use Coursera

Online is not ideal

Kristin Smith, CEO of Seattle’s Code Fellows:
“Learning to code on your own is frustrating & lonely.”
“Graduation rates from full online courses are in the single digits already”

Many university CS students get best jobs based on high-quality team-based project courses
Thank you

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