BOOMING ENROLLMENTS
SURVEY DATA
BOOMING ENROLLMENTS
SURVEY DATA

Tracy Camp, moderator
OUR ESTEEMED PANELISTS

Stu Zweben, The Ohio State University
Jane Stout, Computing Research Association
Duncan Buell, University of South Carolina
Who attended 2015 SIGCSE Panel on Booming Enrollments? Yes OR No
Quick Background

CRA Committee Formed
Included members from other groups

Questions for Students
Questions for Institutions

Two subgroups formed
→ CRA Institution Subgroup

CRA Student Subgroup
CRA COMMITTEE: INSTITUTION

Rick Adrion (UMass)
Betsy Bizot (CRA)
Tracy Camp (Mines)
Susan Davidson (Penn)
Mary Hall (Utah)
Susanne Hambrusch (Purdue)
Ellen Walker (Hiram)
Stu Zweben (Ohio State)
Lida Beninson/Jan Cuny (NSF)
Our Masterpiece (Survey)

- goal: measure, assess, and better understand enrollment trends and impact (on unit, on diversity, …)

- focus: computer science degree programs
Our Masterpiece (Survey)

A. Preliminary Questions
B. Unit Context
C. Declaration/Admission to CS Major
D. Computing Courses for Non-Majors
E. Changes in Demand
F. Impact of Demand Increases
G. Data on Enrollment Changes in CS Courses
H. Unit/Data Reports
I. Data Use Permission
J. Final Comments
The Pilots

Committee Members (2+)

Google CS Capacity Grantees
- Jeff Offut, George Mason
- Heather Pon-Barry, Mt. Holyoke
- John DeNero, UC Berkeley

Emily Grumbling (and others)

Anne Condon
CRA Taulbee

Enrollment Survey
- due date Feb 5th (extended)

~123 of 188 submitted useful data
~113 U.S. institutions
~10 Canadian institutions
Enrollment Survey
- due date Feb 19th (initial)

~70 submitted useful data so far

Extended due date 3 more weeks
Enrollment Survey
- due date Feb 19th (initial)

~70 submitted useful data so far

Extended due date 3 more weeks
CRA Institution Subgroup

⇒ CRA Student Subgroup
CRA COMMITTEE: STUDENTS

Duncan Buell (USC)
Tracy Camp (Mines)
Ed Lazowska (UW)
Leen-Kiat Soh (Nebraska)
Jodi Tims (Baldwin Wallace)
Jane Stout (CRA)
Lida Beninson/Jan Cuny (NSF)
Fall 2015 Student Survey
Due date: Jan 3rd, 2016
N = 2477 (taking intro to CS course)
Give CERP Student Survey?
NDC Institutions     Yes OR No
Give CERP Student Survey?

jane@cra.org  (CERP or boom survey)
Data Analysis
Goal: finish by Fall 2016
OUR ESTEEMED PANELISTS

Stu Zweben, The Ohio State University

Jane Stout, Computing Research Association

Duncan Buell, University of South Carolina

Prelim Results and Discussions
BOOMING ENROLLMENTS
INSTITUTIONAL SURVEY

Stu Zweben (OSU)
To understand what kind of ‘boom’ units offering CS programs are seeing, and how different types of institutions are responding to the boom.

- Intensity and Scope
- Unit Operations
  - Effects
  - Actions
  - Reductions
- Diversity
- Unit Context
TO WHAT EXTENT ARE INCREASING UG ENROLLMENTS IMPACTING YOUR UNIT?

- Having big impact with significant challenges to unit: 60.0%
- Beginning to impact unit: 30.0%
- Have seen increase, but have managed so far: 20.0%
- No noticeable increase: 10.0%
- Other: 0.0%

123 Doctoral depts; 2/3 public
70 Non-doctoral depts; 2/3 private
IN WHICH COURSES IS DEMAND INCREASING?

- Significantly incr
- Somewhat incr
- Stable
- Don't Know

INTRO

MID-LEVEL

UPPER-LEVEL

RQD

NOT RQD
WHAT OPERATIONS ARE MOST GREATLY AFFECTED?
(SIGNIF. INCR. PROBLEM AT 40% OF DEPARTMENTS OR MORE)

<table>
<thead>
<tr>
<th>Doctoral Departments</th>
<th>Non-doctoral Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom space (78%)</td>
<td>Sufficient faculty (44%)</td>
</tr>
<tr>
<td>Sufficient faculty (69%)</td>
<td>Faculty workload (42%)</td>
</tr>
<tr>
<td>Sufficient TAs (67%)</td>
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<tr>
<td>Faculty workload (61%)</td>
<td></td>
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<tr>
<td>Lab space (55%)</td>
<td></td>
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<tr>
<td>Office space (55%)</td>
<td></td>
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<tr>
<td>Advising/admin support (47%)</td>
<td></td>
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<tr>
<td>Non-majors access to rqd courses (44%)</td>
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</tbody>
</table>
MOST FREQUENT ACTIONS THAT HAVE BEEN TAKEN
(BY AT LEAST 40% OF DEPARTMENTS)

Doctoral Departments

• Increase class size and number of sections in academic year (>80%)
• Increase use of UG TAs (>70%); **Increase adjuncts/visiting faculty**, have grad students teach, increase teaching fac on continuing apt (>60%); increase use of grad TAs (>50%), increase T-T faculty (>40%)
• Reduce small enrollment classes (>50%); **limit enrollment in high demand courses**, restrict enrollment in upper division courses to majors/minors
• Reduce faculty advising load, **advise weaker students to other majors** (>40%)

Non-doctoral Departments

• Increase class size (>40%) and number of sections in academic year (>60%)
• Increase adjuncts/visiting faculty (>40%)
  **Note**: 42% would like to increase TT faculty, but cannot
• Limit enrollment in high demand courses (60%)
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• Advise weaker students to other majors (>40%)
Why can you not hire?
Admin says ‘no’ OR failed search
### MOST FREQUENT ACTIONS THAT HAVE BEEN TAKEN
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#### Doctoral Departments

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  **Note**: 42% would like to increase TT faculty, but cannot
- **Advise weaker students to other majors** (>40%)
- **Limit enrollment in high demand courses** (60%)
How is “weak” being defined?
GPA OR 1st CS course OR prior experience
<table>
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<tr>
<th>Doctoral Departments</th>
<th>Non-doctoral Departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced offering of low enrollment courses (48%)</td>
<td>Reduced faculty contribution to college core or first year activities (49%)</td>
</tr>
<tr>
<td>Reduced # of electives (45%)</td>
<td>Reduced # of electives (37%)</td>
</tr>
</tbody>
</table>
Lots of changes in enrollment
Diversity % up OR stable OR down?
HOW IS DIVERSITY BEING AFFECTED?

• No adverse effects on recruitment and retention so far (perception)

• Only 35-40% of unit explicitly consider the impact on diversity when choosing actions

• Diversity concerns have not nixed any enrollment-related actions taken
BOOMING ENROLLMENTS
STUDENT SURVEY

Jane Stout
Computing Research Association
The sample

- N = 2477
  - 98% enrolled in Intro CS
  - 2% was enrolled, but dropped

- Academic status
  - 51% First year
  - 24% Second year
  - 14% Third year
  - 6% Fourth year
  - 2% Fifth year or greater
  - 3% Missing

- Major
  - 72% computing major
  - 7% computer minor
  - 16% neither computing major nor computing minor
  - 5% undeclared major and undeclared minor

- Institution Type
  - 87% Ph.D. granting
  - 9% M.S. granting
  - 3% B.S. granting
The sample (cont...)

• Gender
  – 33% women
  – 61% men
  – 6% unidentified

• Ethnicity/Race
  – 1% Arab, Middle Eastern, or Persian
  – **28% Asian or Asian American**
  – 5% Black, African American
  – 8% Hispanic or Latina/o
  – <1% Native American
  – <1% Native Hawaiian or Other Pacific Islander
  – **42% White, Caucasian or European American**
  – 1% Other
  – <1% Mixed Asian + White
  – 6% Mixed Minority
  – 3% Mixed, unknown
  – 6% Missing
Why are students eager to take computing classes?

Students’ reasons for enrolling in Intro CS
Why did you enroll in an introductory computing class?

- **It was required for my major/minor**: 86%
- **Curiosity or interest in computers**: 39%
- **A teacher or other mentor encouraged me**: 9%
- **My parents encouraged me**: 6%

*N = 2,422*
Why are students dropping Intro CS courses?
Why did you **drop** your introductory computing course?

- It was too challenging: 46%
- I didn’t enjoy the professor’s teaching: 29%
- I’m no longer interested in computer: 26%
- It was not challenging enough: 16%
- I had a scheduling conflict: 15%
- It was no longer a requirement for my: 13%

N = 55
How will the current “boom” have an impact on diversity in an already demographically homogenous field?
Why did you drop your introductory computing course?

It was too challenging

- Men, n = 30: 33%
- Women, n = 20: 75%
- Asian/White, n = 34: 44%
- Minority, n = 14: 64%
Why did you drop your introductory computing course?

I didn’t enjoy the professor’s teaching style

- Men: 20% (n = 30)
- Women: 45% (n = 20)
- Asian/White: 27% (n = 34)
- Minority: 43% (n = 14)
Is this boom *different*?

Yes OR No OR No Idea
Is this boom *different*?  
(feels different, need data to convince)
IS THIS BOOM DIFFERENT?

Duncan Buell (USC)
Bureau of Labor Statistics

2014-2024 predictions
2012-2022 predictions
Etc.
Usually come out in December of the following odd year

Must compare with [Occupational Outlook Handbook](https://www.bls.gov/ooh) and with [O*NET Online](https://www.onetonline.org) to get explanation of occupation titles
What is “STEM”?  
Mathematics  
Physical, biological, and agricultural sciences  
Engineering and engineering technologies  
Computer/information sciences  

It is no longer true that the acronym STEM has to be “expanded” to be S T E M, and that works against us, so let’s not do it (😊)

(US DoEducation 2009-161, July 2009)
## The Good News 2014-2024

### Table 1.2 Employment by detailed occupation, 2014 and projected 2024 (Numbers in thousands)

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<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent distribution</td>
<td>Number</td>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td><strong>Total, all occupations</strong></td>
<td>00-0000</td>
<td>150,539.9</td>
<td>160,328.8</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Computer occupations</strong></td>
<td>15-1100</td>
<td>3,916.1</td>
<td>4,404.6</td>
<td>2.6</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>Computer and information research scientists</strong></td>
<td>15-1111</td>
<td>25.6</td>
<td>28.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Computer and information analysts</strong></td>
<td>15-1120</td>
<td>650.7</td>
<td>784.1</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Computer systems analysts</strong></td>
<td>15-1121</td>
<td>567.8</td>
<td>686.3</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Information security analysts</strong></td>
<td>15-1122</td>
<td>82.9</td>
<td>97.7</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Software developers and programmers</strong></td>
<td>15-1130</td>
<td>1,591.1</td>
<td>1,790.8</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Computer programers</strong></td>
<td>15-1131</td>
<td>328.6</td>
<td>302.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Software developers, applications</strong></td>
<td>15-1132</td>
<td>718.4</td>
<td>853.7</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Software developers, systems software</strong></td>
<td>15-1133</td>
<td>395.8</td>
<td>447.0</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Web developers</strong></td>
<td>15-1134</td>
<td>148.5</td>
<td>188.0</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Database and systems administrators and network architects</strong></td>
<td>15-1140</td>
<td>648.8</td>
<td>705.0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Database administrators</strong></td>
<td>15-1141</td>
<td>120.0</td>
<td>133.4</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Network and computer systems administrators</strong></td>
<td>15-1142</td>
<td>382.6</td>
<td>412.8</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td><strong>Computer network architects</strong></td>
<td>15-1143</td>
<td>146.2</td>
<td>158.9</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Computer support specialists</strong></td>
<td>15-1150</td>
<td>766.9</td>
<td>855.7</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Computer user support specialists</strong></td>
<td>15-1151</td>
<td>585.9</td>
<td>661.0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td><strong>Computer network support specialists</strong></td>
<td>15-1152</td>
<td>181.0</td>
<td>194.8</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Computer occupations, all other</strong></td>
<td>15-1199</td>
<td>233.0</td>
<td>240.8</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Engineers</strong></td>
<td>17-2000</td>
<td>1,636.2</td>
<td>1,701.2</td>
<td>1.1</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Life scientists</strong></td>
<td>19-1000</td>
<td>310.9</td>
<td>330.0</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td><strong>Physical scientists</strong></td>
<td>19-2000</td>
<td>296.8</td>
<td>316.6</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Good News: Total Openings

2014-2024
Good News: Job Growth

2014-2024

- Computer occupations (15-1100)
- Engineers (17-2000)
- Life scientists (19-1000)
- Physical scientists (19-2000)
- Social scientists and related workers (19-3000)
- Mathematical science occupations (15-2000)
The Bad News?

Numbers are going down
Media says “Projected computing jobs are disappearing!”

But wait …
Total growth 2014-2024 – 6.5%
Total growth 2012-2022 – 10.8%
Total growth 2010-2020 – 14.3%

Total growth 2000-2010 – 15.2%
Total Openings
Job Growth
OTHER MUSINGS

Tracy Camp (Mines)
STUDENTS 2005->2015

[Bar chart showing percentage increase from 2005 to 2015 across different categories: Majors, Intro (NR), Intro (RQD), Mid, Upper. The categories show a significant increase, with the 'Intro (RQD)' category having the highest increase.]
MAJORS VS NON-MAJORS

Enrollment majors booming

Enrollment non-majors (minors?) booming too!

At all levels of our courses
FACULTY AT PHD INSTITUTIONS

T/TT faculty up by 8.7% (2005-2015)

LOW compared to major/enrollment %
HANDLING THE BOOM

Restricting entrance to the major existed in previous boom (~75%) (guess)

Not a significant action today (~25%)
K-12 INTEREST

Way different today than previous boom

Has any K-12 subject in past gone through a boom … and then a bust?
We are only at the start of the analysis!
Stereotypes about CS people
Are they different today?
Yes OR No OR Don’t Know
ATTITUDE IS DIFFERENT

code.org

CS for All

Computer Science Principles
Student Employment: lots of jobs?
Yes OR No OR Same
Why is response rate on NDC low?
CS is booming …
Who is losing?
What’s next?
2016 Snowbird

Booming Enrollments: Understanding the Surge

Impact on Department Practices
  Susanne Hambrusch (Purdue)
  Stu Zweben (Ohio State)

Student Profiles/Motivations
  Tracy Camp (Mines)
  Mary Hall (Utah)

Programs for High Achieving Students
  Nancy Amato (Texas A&M)
National Academies Committee on Growth of CS Undergraduate Enrollments

Chairs:
Jared Leigh Cohon (CMU)
Susanne Hambrusch (Purdue)
M. Brian Blake (Drexel)
Tracy Camp (Mines)
David Culler (UC Berkeley)
Susan Davidson (Penn)
Brian Fitzgerald (BHEF - workforce)
Ann Quiroz Gates (Texas-El Paso)
Charles Isbell (GATech)
Clas Jacobson (United Tech Corp - workforce)
Michael McPherson (Spencer Foundation - economics)
Eric Roberts (Stanford)
Valerie Taylor (Texas A&M)
Jodi Tims (Baldwin Wallace)
Sarah Turner (UVA - economics)
Timeline

Meeting: March 22nd-23rd

Workshop: May or June

Goal: report done by end of year
EXTRA SLIDES FOR JANE
Why did you enroll in an introductory computing class?

**It was required for my major/minor**

- Major: 93%
- Minor: 78%
- Neither: 69%
- B.S. granting: 76%
- M.S. granting: 85%
- PhD granting: 87%
- Men: 90%
- Women: 85%
Why did you enroll in an introductory computing class?

Curiosity or interest in computers

- Major: 35%
- Minor: 49%
- Neither: 46%
- B.S. granting: 35%
- M.S. granting: 35%
- PhD granting: 39%
- Asian: 41%
- White: 42%
- Black: 24%
- Hispanic: 29%

* Black/Hispanic different from Asian/White
Why did you enroll in an introductory computing class?

A teacher or other mentor encouraged me

- B.S. granting: 18% *, n = 74
- M.S. granting: 10%, n = 187
- PhD granting: 8%, n = 2144
- Asian: 9%, n = 682
- White: 10%, n = 1014
- Black: 7%, n = 103
- Hispanic: 4%, n = 189

* Hispanic different from White
Why did you enroll in an introductory computing class?

My parents encouraged me

- Major: 5%
  - n = 1756
- Minor: 9%
  - n = 175
- Neither: 4%
  - n = 364
- Continuing: 6%
  - n = 11804
- First Gen: 2%
  - n = 324

* Indicates statistically significant value