Transforming K-12 CS
The Beauty and Joy of Computing

K-12 teachers please stand...

OVERVIEW

This is a description of how we’re moving the needle with our BJC course and professional development for high school teachers around the country!

bjc.berkeley.edu
Three big challenges for our future

The computing community in the U.S. faces three significant and interrelated challenges in maintaining a robust workforce.

1. Underproduction
2. Underrepresentation
3. Lack of a presence in K-12 education

– Source of next 7 slides: Jan Cuny, NSF Program Manager
Underproduction

United States: Number of Degrees Earned in CIS vs. Projected Average Annual Number of Computing Job Openings

- 144,500 Average Annual Openings
- 88,161 Annual Degrees Earned
  - 1,340 Doctoral
  - 17,312 Master’s
  - 39,701 Bachelor’s
  - 29,808 Associate’s

Underrepresentation: Women

- Gender % of HS Advanced Placement exams

<table>
<thead>
<tr>
<th>Subject</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>Statistics</td>
<td>49%</td>
<td>51%</td>
</tr>
<tr>
<td>Calculus</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>CS</td>
<td>19%</td>
<td>81%</td>
</tr>
</tbody>
</table>

—Credits: NCWIT & the College Board
Underrepresentation: Ethnic Minorities

We receive just:
10.6% of undergrad,
4.8% of masters, and
3.6% of Ph.D.
degrees in computing

(but are 28.5 % of US Population!)

— Taulbee Data, 2011
Consensus is to start in high school

- Things are really bad there.
- Without the HS piece, anything we do for middle school will be lost.
- Without the HS piece, anything we do at the college level will be insufficient

-- Jan Cuny, NSF

\[\text{STUCK IN THE SHALLOW END} \]
\[\text{Education, Race, and Computing} \]

JANE MARGOLIS
Rachel Estrella
Joanna Goode
Jennifer Jelison Holme
Kimberly Nuo
How can we get computing into K-12?

- **New Course:** “Computer Science : Principles”
  - Engaging, accessible, inspiring, rigorous
  - Focused on the fundamental concepts of computing (Computational Thinking)
  - An impetus for college curriculum reform
  - Available nationwide (IB as well)

- **SINGLE SOURCE OF NATIONAL LEVERAGE!**

[CollegeBoard](csprinciples.org)
The CS10K Project

Goal: get engaging, rigorous computing curricula into computing courses in 10,000 high schools, taught by 10,000 well-prepared teachers by 2016.
BJC curriculum and team leads

- Dan Garcia
  - Sr Lecturer SOE

- Tiffany Barnes
  - NC State

- Luke Segars
  - TA Grad Student (Now @ Google)

- Brian Harvey
  - Sr Lecturer SOE

- Colleen Lewis
  - TA Grad Student (Now Prof @ Harvey Mudd)

...many others @ Cal!
BJC Initial High School Collaborators

Ray Pedersen
- Albany HS

Sean Morris

Eugene Lemon
- Ralph Bunche HS

Josh Paley
- Gunn HS
What differentiates BJC?

- More programming-heavy
  - Recursion
  - Functions-as-data, \( \lambda \)
  - Concurrency, Distributed computing

- **Graphic language makes difficult coding concepts easier**

- **Unintended implications of computing technology**
  - Balanced optimism with pessimism
We started from Scratch, literally…

BYOB/Snap! add functions, generic lists, \( \lambda \)

- **BYOB (Build Your Own Blocks) \( \rightarrow \) Snap!**
  - developed by Jens Mönig w/design input and documentation from Brian Harvey & others @ Cal
  - Leverages awesomeness of Scratch (design, simplicity, multi-media, community of users)
  - Snap! is in Javascript, in-the-browser

Building a For Loop and calling it. What other languages make it this easy?

```
for i = start = 1 to end = 10 action!
```

```
for i = 1 to 10
for k = 3 to 5
    say join words i k for 1 secs
```
How we teach Recursion ... Vee
You can make a mobile app too!

Click on Alonzo fast to score points.

tinyurl.com/bjctapia
BJC Testimonials (x17)

- Justin Barnes (L) & Ian Birmingham (R)

The class itself was amazing… I had a really fun time… building our own projects was great… The lectures were really interesting…. I never really got into computing… but because of this class now I'm really interested in computing and being a possible major.

Anyone even remotely interested in computers should take it—

Justin

The class is incredibly engaging… The atmosphere is unlike anything I've ever taken here… I would recommend it to any friend… I'm a senior but honestly if I had taken this class earlier I would have considered it a major.

Anyone even remotely interested in computers should take it—

www.youtube.com/watch?v=6gUW_mEulx0
45% Women, ~57% of top 22 students!

Women GPA: 3.06
Men GPA: 2.87

2013Sp 50.5% women!
BJC in High School Testimonial

From Nathan Mattix (Piedmont HS)

“BJC totally rocks! We are having a blast this year and it is only going to get better from here. The students love it and their projects are amazing. This may be the best course ever invented. We have five times more girls than last year, and we smashed our enrollment record for girls. We retained all of the BJC girls. Girls almost always are one and done at PHS.”
We’re reaching 100+ teachers & profs!

Year 1: We come to them (> 20)
Year 2+: Bring them to us
BJC Future: CS Education Group @ Cal

- Dan Armendariz
  - Nonlinear edX lets you “test out” of units you know

- Omoju Miller
  - Culturally-relevant curricular unit on Big Data

- Zack MacHardy
  - Adaptive assessment

- Jon McKinsey
  - Remote Pair-Programming
BJC Future: edX SPOC

- **SPOC:** “Small Private Online Course”
  - Hybrid MOOC
  - Think of MOOC = ebook
  - Teacher signs up class, picks parts they want
  - The forum discussions are self-contained
  - Teacher gets analytics of only their students
  - Teacher feels in control
BJC Summary

- BJC has been transformational
- On giants’ shoulders...
  - AP CS: Principles Framework
  - Scratch
  - Blown to Bits
- Future: Bright!
  - Improvements to Snap!
  - edX driving our PD
  - edX MOOC SPOC