A Clean Slate Approach to High School CS

Jan Cuny
7/15/2009
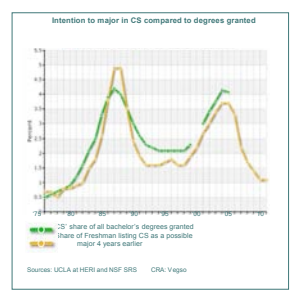

Where do we stand?

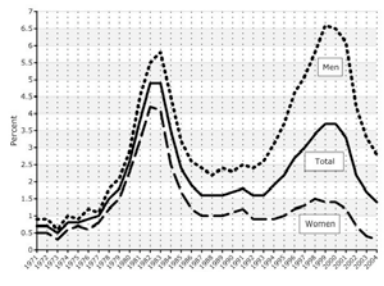# Plummeting CS Enrollments

Total Bachelor's Degrees Granted in CS & CE
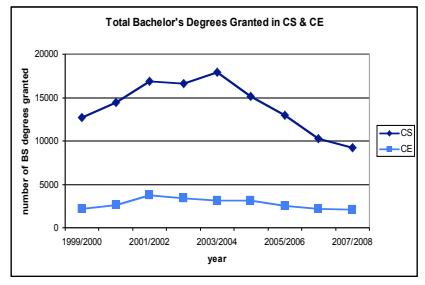
CRA Taulbee Survey, 2008

Future trend?

Intention to major in CS compared to degrees granted

CS' share of all bachelor's degrees granted
Share of Freshman listing CS as a possible major 4 years earlier

Sources: UCLA at HERI and NSF SRS   CRA: Vegso

Gender Gap

Men
Total
Women

CRA Taulbee Data, 2006

Missing 70%

2007 - 2008 CS & CE Degree Reciepant Demographics

BS
MS
PhD

Women | American Indian / Alaska Native | Asian | Black | White | Hispanic

CRA Taulbee Survey, 2007/2008

Percent Women by Field and Degree Level 2007 Degree Conferrals

CPST, 2008

Percent URM by Field and Degree Level 2007 Degree Conferrals

CPST, 2008

Why does it matter?

Degree Production vs. Projected Job Openings (2002-2012)

John Sargent, US Department of Commerce, 2004
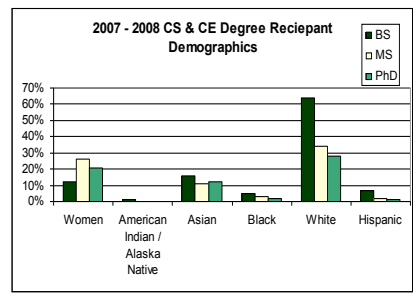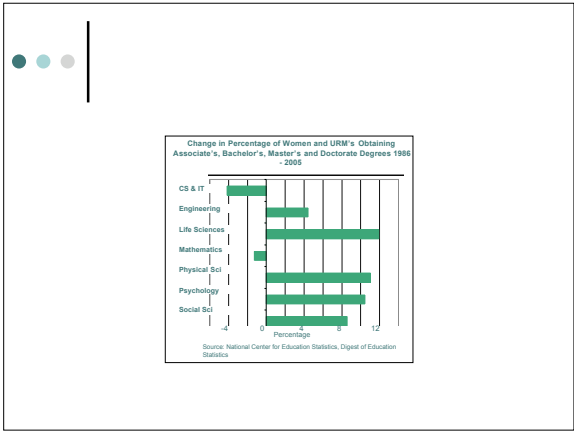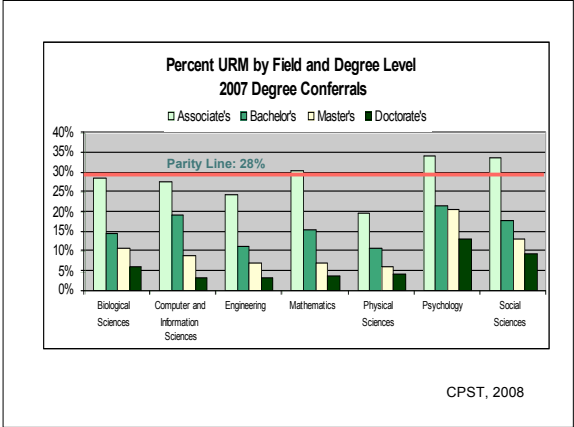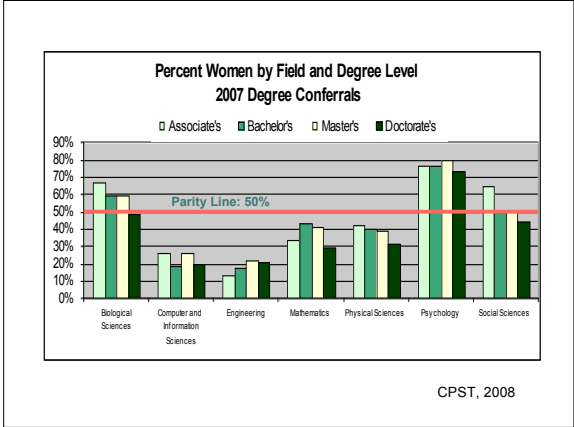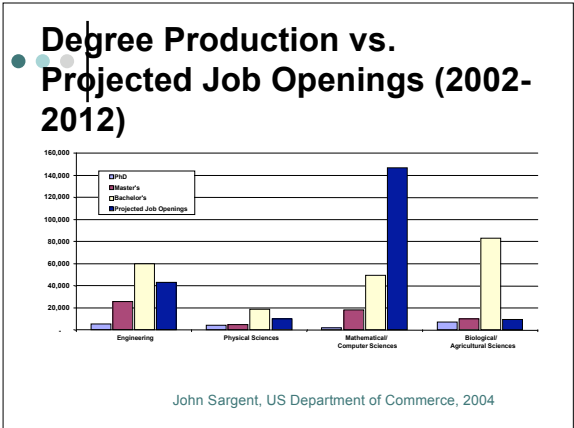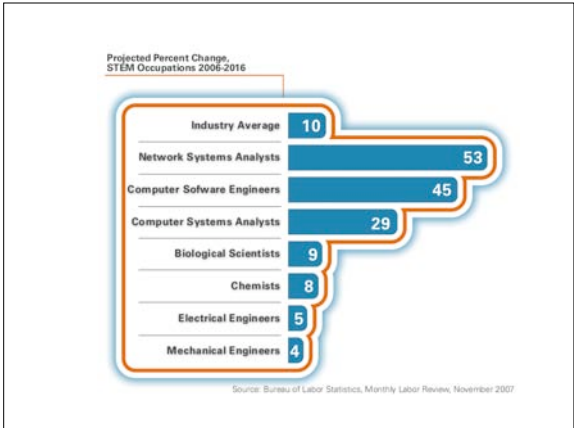
It's a Loss of

- Opportunity for individuals
- Talent for the workforce
- Creativity needed to maintain global competitiveness

…   If I bring you a batch of resumes where everybody's name is Smith, you're bound to ask me why I think only people named Smith can do the job. You're going to wonder, "Aren't there any Joneses out there?"

David Cornwell

David Cornwell, March 1988

Our profession is diminished and impoverished by a lack of diversity … the range of design options considered in a team lacking diversity will be smaller … It's that the product that serves a broader international customer base, or a segment of this nation's melting pot, or our handicapped, may not be found. It is that the most elegant solution may never be pursued.
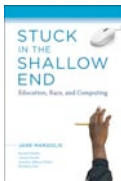
William Wulf, NAE, 1998

Why High School?

Why High School?

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

STUCK IN THE SHALLOW END
Education, Race, and Computing

Why focus on AP?   CollegeBoard

- Often the only CS course that carries college prep credit
- Attractive to students & schools
- 2,000 CB-audited teachers
- Single point of national leverage

What's wrong with the current AP course?

- Doesn't appeal to many students (particularly women and minorities)

AP test takers (2007)

- 14,529 students took AP CS A
  - 204,564 Calculus AB
  - 141,321 Bio
  - 96,282 Statistics
- AP CS had the worst gender balance of any of the AP tests
  - 18.3% CS A
  - 48.7% Calculus AB
  - 50.2% Statistics

What's wrong with the current AP course?

- Doesn't appeal to many students (particularly women and minorities)
- Inaccessible to students without previous experience
- Fails to introduce the fundamental concepts of CT
- Doesn't teach the breadth of application or "magic" of computing

Math and Science in U.S. High Schools (NRC, 2002)

- AP courses should
  - Reflect what we know about how students learn
  - Build students' transferable, conceptual understanding and inquiry skills
  - Convey the content and unifying concepts of a discipline
- AP courses should not be designed solely to replicate introductory college courses (which are not typically exemplary models)

Chemistry, Biology, Physics, and Environmental Science are leading the way. (ESI-0525575)

AP Commission:
Owen Astrachan,
Chris Stephenson,
Amy Briggs, …

AP Advisory Group:

Deepak Kumar (Bryn Mawr)
Tom Cortina (CMU)
Mark Guzdial (GA Tech)
Wanda Dann (Ithaca)
Larry Snyder (UW)
Eric Roberts (Stanford)
Gail Chapman
Rich Kick
Susanne Hambrusch (Purdue)
Michelle Hutton
Juan Gilbert (Auburn)
Stephen Edwards (VA Tech)
Duane Bailey (Williams College)
Richard Pattis (UC Irvine)
Cameron Wilson (ACM)

AP GSC's Big Ideas

95/5% Rule

1. Computing is a creative activity that draws on a wide variety of fields, such as natural sciences, mathematics, engineering, social sciences, business, and the arts.
2. Abstraction is a central problem-solving technique in computer science.
3. Algorithms are the essence of computational problem solving.

AP GSC's Big Ideas

95/5% Rule

4. Writing programs is an integral part of solving computational problems.
5. Theoretical and practical limitations affect what can be solved computationally.
6. Computing enables and empowers innovation, exploration, and creation of knowledge.
7. Computing drives and is driven by economics, culture, society, and ethics.

AP GSC

- Engaging, accessible, inspiring, rigorous
- Focused on the fundamental concepts of computing (CT)
- A target for K-9 course development
- An impetus for college curriculum reform
- Available nationwide (IB as well)

Getting it taught, well
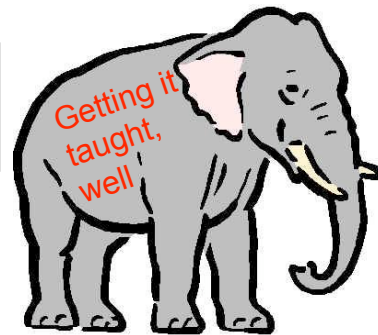
10,000 Teachers / 10,000 Schools

- In-service preparation
- Pre-service preparation
- Ongoing professional development
- Entrée into schools

In-Service Preparation

- Significant and intensive training (stipends)
- High quality on-line options
- Partnerships with universities: Beyond outreach (Recruiting, Courses, Classroom assistance)
- Build on state-wide infrastructure: Train the trainers, Master teachers, Community
- Collaborations with other STEM programs e.g. MSP

Pre-service preparation

- Partnerships between CS & Ed Schools
- Computing methods courses
- Teacher Residency Programs
- Traditional and alternative certification: UTEACH,TFA, MFA, Teaching Fellows, Transitions to Teaching (Troops to Teachers) …

On-going professional development

- CSTA
- National Writing Project-like, National Computing Project
- Coaching & mentoring for novice teachers (Teacher Residency Programs)
- In class assistance: GK-12, SLC-like Computing Corps, Retirees, Faculty (Adopt a Classroom)
- Collaborate with mathematics teachers associations

Entrée into the schools

- Hardware, Software, Connectivity, & Tech Support
- Extended hours & Out of school hours availability
- Help with teacher salaries / Stipends
- AP Incentives
- Manuever patchwork of state standards, credit issues, certification requirements, etc.

CS / 10K Project

Good News: We are gaining support among

•High school administrators and teachers

•University faculty

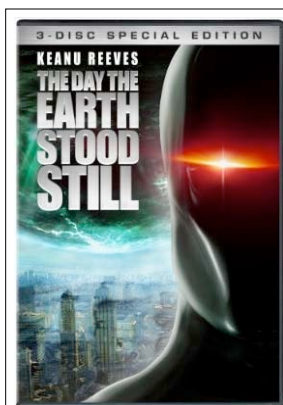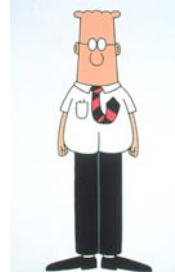•Industry

Clean slate …

but we can't blow it.

We need the computing community to step up.

What can you do?

○ Help us get the word out to students

Why not computing?

1. ~~Computer scientists are geeky nerds~~
2. ~~Programming is not cool.~~
3. ~~Computing doesn't benefit society.~~

...onic ignition, antilock brakes, and

...telephones, high-definition ...video, computer animation, and

...navigate without GPS, weather ...banks and merchants can't ...actory automation stops

Slide Credit: Ed Lazowska

Virtual Worlds

Change the storyline

- Computer scientists are geeky nerds. / creative people who like to solve problems.
- Programming is not cool. / hard to do really cool things.
- Computing doesn't benefit society / is changing our society in exciting ways.

What can you do?

- Help us get the word out to students
- Form a CSTA chapter
- Help with advocacy
- Volunteer to help with CS / 10K projects
- Send suggestions

Thanks!

jcuny@nsf.gov