



CS 10K Project: Transforming High School Computing for the 21st Century

Jan Cuny
January 30, 2012



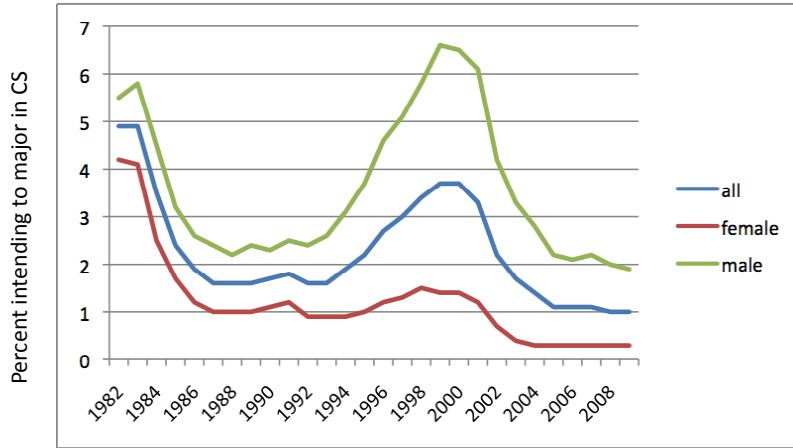
1

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

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

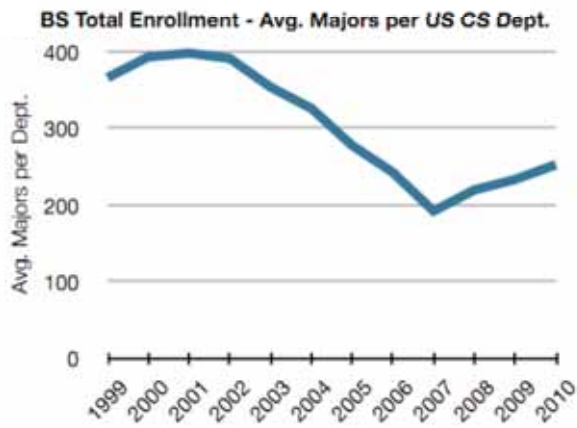
2

Yet student interest in computing is very low.



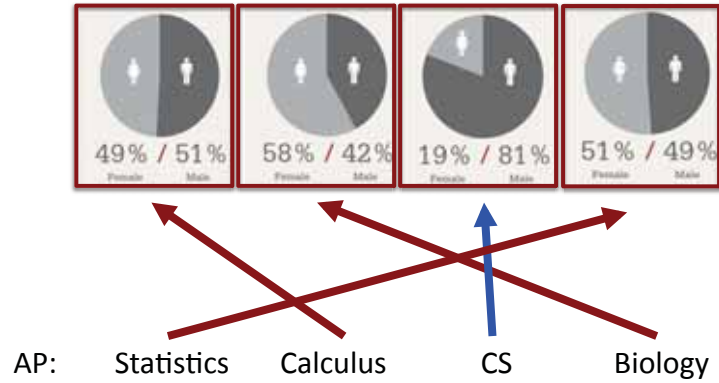
Data source: HERI, Slide: NCWIT

CS & CE Majors



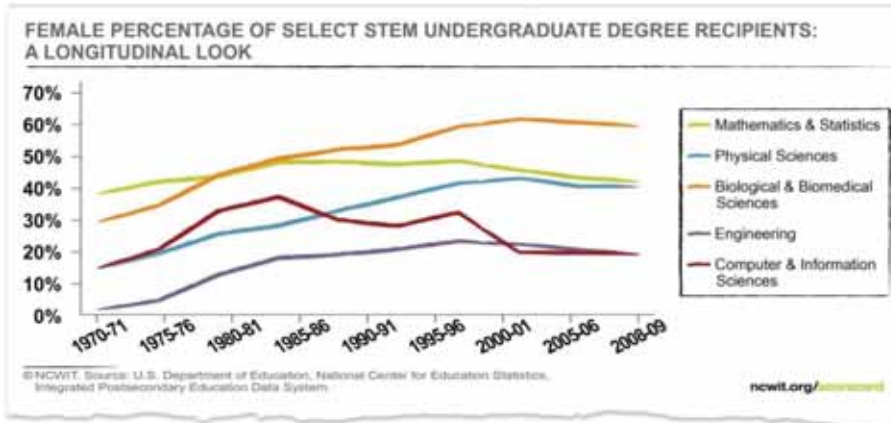
—CRA Taulbee Survey, 2011

Computing has a long standing, significant underrepresentation of women.



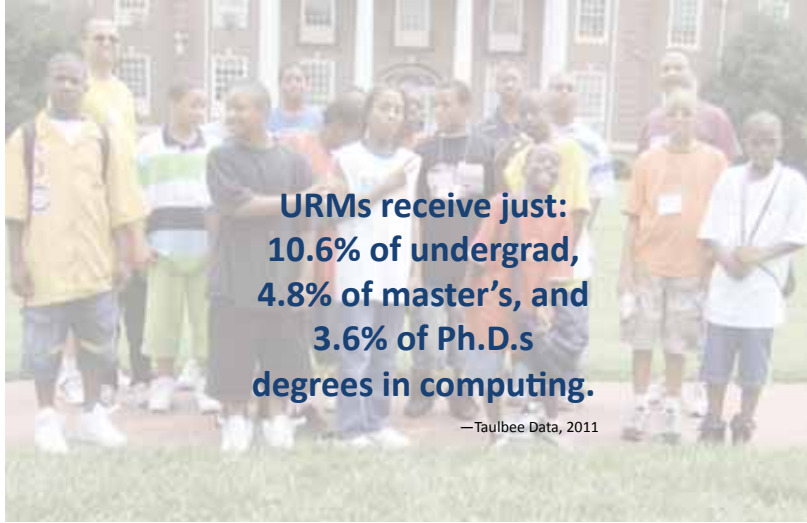
—Credits: Top NCWIT, Bottom College Board

The underrepresentation of women in computing continues through college.



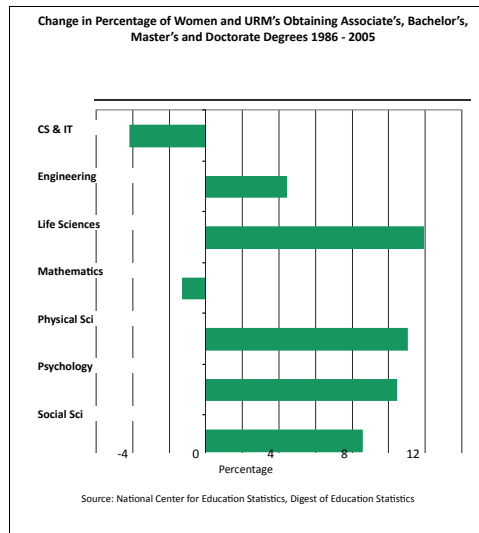
—Credits: Top NCWIT

And computing has a long standing underrepresentation of minorities.



9

The Trend



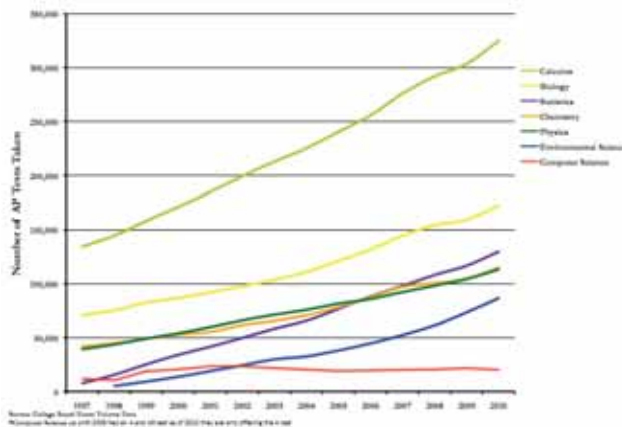
Computing does not have a presence in K-12.

The percentage of U.S. high school students taking STEM courses has increased over the last 20 years across all STEM disciplines *except* computer science where it dropped from 25% to 19%.

—2009 NAEP High School Transcript Study

The CS AP test has sustained the lowest participation in comparison with other STEM disciplines.

AP Test Taking in STEM, 1997-2010



In 2010, Senior participation:
 340,551 AP Calculus
 250,003 AP Biology
 142,910 AP Statistics
 22,176 AP CS A

—College Board

The President's Council of Advisors on Science and Technology believes the need for better computing education particularly in high schools is "urgent."

Computer-related courses should aim not just for ... a deeper understanding of the essential concepts, methods and wide-ranging applications of CS. Students should gain hands-on exposure to the process of algorithmic thinking and its realization in ... a computer program, to the use of computational techniques for real-world problem solving, and to ... pervasive computational themes as modeling and abstraction, modularity and reusability, computational efficiency, testing and debugging, and the management of complexity.

15

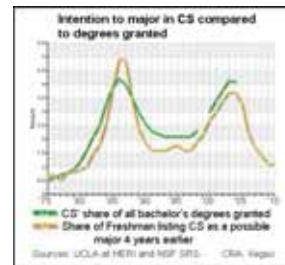
High school is key.



16

Why High School?

- We need to do *much* better 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.



The **CS 10K Project** aims to transform computing in high school.



The CS 10K Project is centered on an entirely new CS AP course, called *CS Principles*.

Why AP?

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

19

CS Principles



- Engaging, accessible, inspiring, rigorous
- Focused on the fundamental concepts of computing (CT)



Big Ideas

1. Computing is a creative activity.
2. Abstraction reduces information and detail to facilitate focus on relevant concepts.
3. Data and information facilitate the creation of knowledge.
4. Algorithms are used to develop and express solutions to computational problems.

95% Rule

Big Ideas (Cont.)

5. Programming enables problem solving, human expression, and creation of knowledge.
6. The Internet pervades modern computing.
7. Computing has global impacts.

23

Big Ideas, Key Concepts, Supporting Concepts

V. Programming enables problem solving, human expression, and creation of knowledge.

- B.** Programming is facilitated by appropriate abstractions.
1. Functions are re-usable programming abstractions.
 2. Parameterization can be used to generalize a specific solution.
 3. Data abstraction provides a means of separating behavior from implementation.
 4. Application Program Interfaces (APIs) and libraries simplify complex programming tasks.

24

Computational Thinking Practices

1. Analyzing effects of computation
2. Creating computational artifacts
3. Using abstractions and models
4. Analyzing problems and artifacts
5. Communicating processes and results
6. Work effectively in teams

csprinciples.org

2/7/12

CSPrinciples, Sigcse 2011

25

Computational Thinking Practices

1. Analyzing effects of computation
2. Creating computational artifacts
3. Using abstractions and models
4. Analyzing problems and artifacts
5. Communicating processes and results
6. Work effectively in teams

csprinciples.org

2/7/12

CSPrinciples, Sigcse 2011

26

The computing community supports the development of the CS Principles course, and has moved it past milestones.

2009-2010

✓ Course framework

2010-11

✓ Pilot I: Five colleges

✓ College Survey

✓ College attestation/support

2011-12

Pilot II: ~20 colleges, ~40 high schools

27

Pilots

2010-11,12

- Berkeley, Dan Garcia (BYOB Scratch)
- Metro State Denver, Jody Paul (Scratch)
- UC San Diego, Beth Simon (Alice)
- UNC Charlotte, Tiffany Barnes (BYOB Scratch, Games)
- University of Washington, Larry Snyder (Processing)

Beyond the AP Curriculum

- Additional course models
- Standards & assessments
- Teacher preparation
- Entrée into schools

Some schools will want a more introductory course such as Exploring Computer Science (ECS), which was developed for LA high schools.

- Piloted ECS 2008/2009
- This school year in ~25 LAUSD schools
- 2000 students, 40% female, 81% URM
- Complete, detailed curriculum & lessons plans on CSTA site (csta.org)
- College prep & CTE credit
- Also San Jose, Oakland, Chicago



32

ECS & CS Principles Pilot Sites 2011-12



To be successful, we'll need lots beyond the teacher training.

- New CS Standards
- Changes in teacher certification
- Changes in the crediting of CS courses
- CSTA Chapters
- Pre- and in-service teacher professional development
- Ongoing teacher support: Coaching, mentoring, communities of practice

NSF can catalyze the CS 10K Project but the project as a whole is outside of NSF's mission and resources.

Within NSF's mission and resources, develop

- Additional course curricula, materials, models
- Standards & assessments
- Teacher preparation
- Pilots

Beyond NSF's mission and resources

- Scale teacher preparation to 10,000
- Entrée into 10,000 schools

35

We'll need the entire computing community to get involved.

- High school teachers
- Academic departments at universities and community colleges
- Individuals: students, faculty, professionals
- Companies and Foundations



Thanks!

Jan Cuny, jcuny@nsf.gov

37