



Explorations in Computer Science for High School Teachers

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SIGCSE 2007, Covington KY







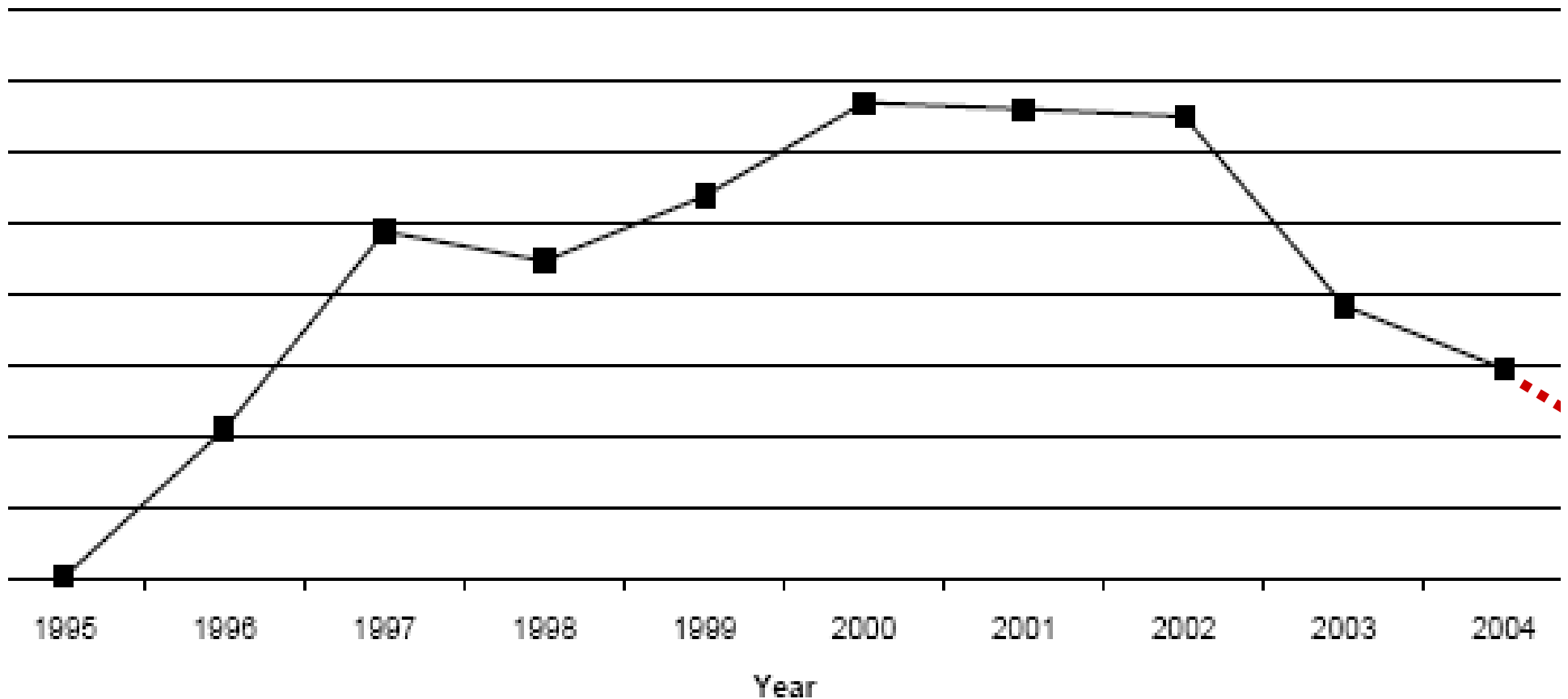
Explorations in Computer Science for High School Teachers

# Outline

- **Motivation and Pre-Survey** (Lenore)
- **Workshop Details** (Tom)
- **Evaluation & Future Work** (Tom)

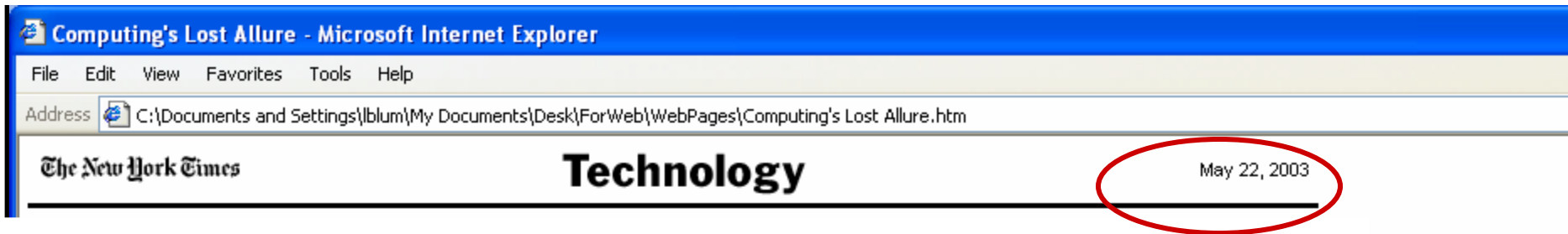
# Declining Enrollments

Figure 7. Newly Declared CS/CE Undergraduate Majors



# Declining Enrollments

- **2004-2005 CRA Taulbee survey**
  - ◆ The number of **new undergraduate CS majors** in the U.S. **has dropped** by more than 30% since 2001-2002.
- **Higher Education Research Institute/UCLA study**
  - ◆ The **percentage of incoming undergraduates... who would major in CS has declined 70%** between fall 2000 and 2005.
- **College Board statistics**
  - ◆ Enrollment in **AP courses** has increased in all disciplines except **CS which has seen declines** of 6% in 2004 and 7% in 2005.



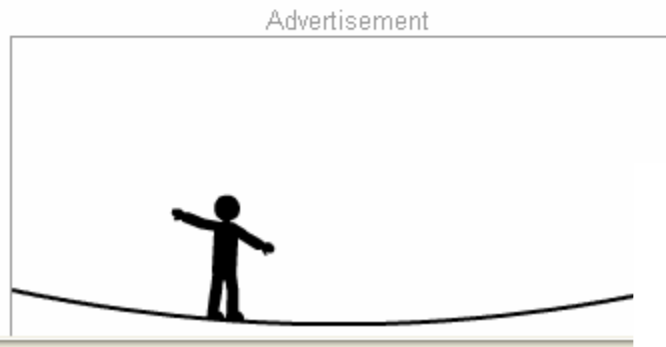
The media has been reporting this drop for some time...

## Computing's Lost Allure

By KATIE HAFNER

**B**ERKELEY, Calif. -- ON a sunny May afternoon, Brian Harvey's introductory computer science class at the University of California convened for the last time before the final exam. By the time Dr. Harvey was full tilt into his lecture, reviewing recursive functions and binary search trees, the cavernous hall was lightly peppered with about 100 students, backpacks at their sides, a few legs slung over the backs of empty seats.

Sparse attendance is, of course, an end-of-semester inevitability. Many students viewed the lecture by Webcast, if at all. But more significantly, just 350 students signed up for the course this spring, in



Kim Kulish for The New York Times

Eugene Chung, a computer science major at the University of California at Berkeley, is combining that focus with a major in business.

# Reasons?

• Do .Com Bus ?



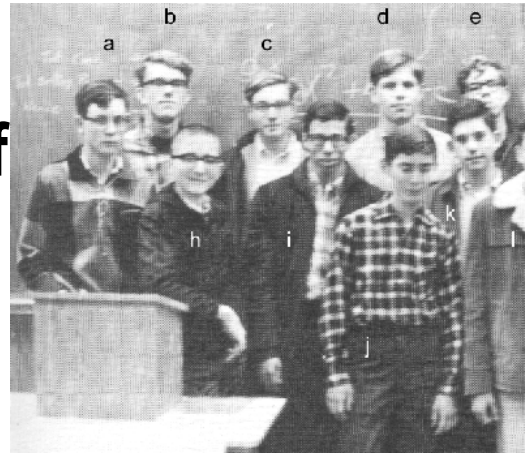
• Fears of Outsourcing ?



# More Fundamental Reasons

**IMAGE, IMAGE, IMAGE**

- **Narrow Image of who can do CS**



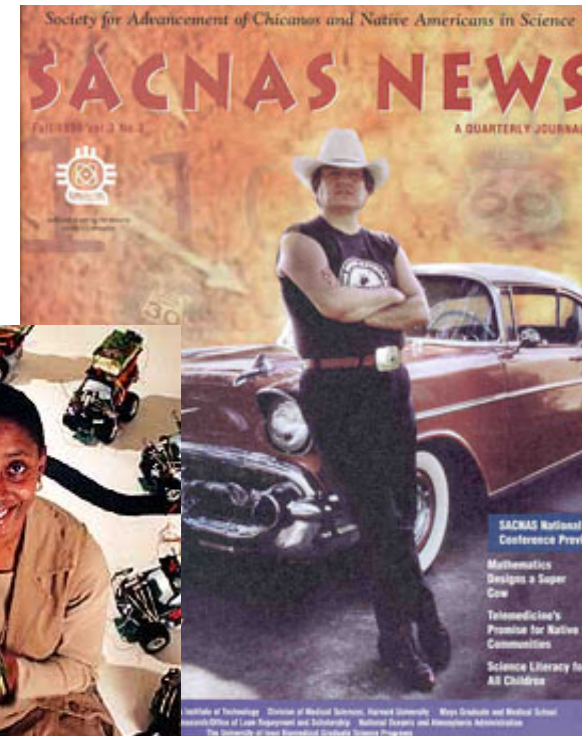
- **Narrow Image of the field of CS**

**AP** CS = Programming

# Solutions

IMAGE IMAGE, IMAGE

- Broaden Image of who can do CS



# Solutions

**IMAGE IMAGE, IMAGE**

- **Broaden Image of who can do CS**



# Solutions

IMAGE IMAGE, IMAGE

Education, Education, Education

• Broaden Image of who can do CS

• Broaden Image of the field of CS

Introduce Breadth and Depth of CS into the Curriculum

- Problem Solving
- Programming
- Biology + CS
- Neuroscience + CS
- Graphics + CS
- Human-Computer Interaction
- Game Technologies
- Artificial Intelligence + CS
- Robotics



CS 4 HS Home

Carnegie Mellon | SCHOOL OF COMPUTER SCIENCE

2006 HOME
OVERVIEW
<b>WORKSHOPS SCHEDULE</b>
PEOPLE
REGISTER
RESOURCES

2006  
**CS4HS SUMMER WORKSHOP**  
 Explorations in Computer Science for AP CS Teachers 2006



Friday, July 21 - Monday, July 24  
2006



### Workshop Schedule

#### FRIDAY, JULY 21

3:00-7:00	On-campus Housing Check-in - New House, Moorewood Avenue (Guests arriving after 7PM should go directly to Newell-Simon Hall Atrium)
5:00-7:00	Registration - Newell-Simon Hall Atrium
7:00-10:00	Dinner/Social

#### SATURDAY, JULY 22

8:00-9:00	Registration, Continental Breakfast, Pre-Workshop Survey
9:00-9:15	Welcome
9:15-10:00	Keynote Address: <b>Computational Thinking</b> - <b>Jeannette Wing</b> , Professor and Chair of Computer Science Dept., CMU
10:00-10:15	Break
10:15-12:30	Featured Topic: <b>CS Unplugged: Introducing CS to all Students</b> <b>Craig Nevill-Manning</b> , Google
12:30-2:00	Lunch

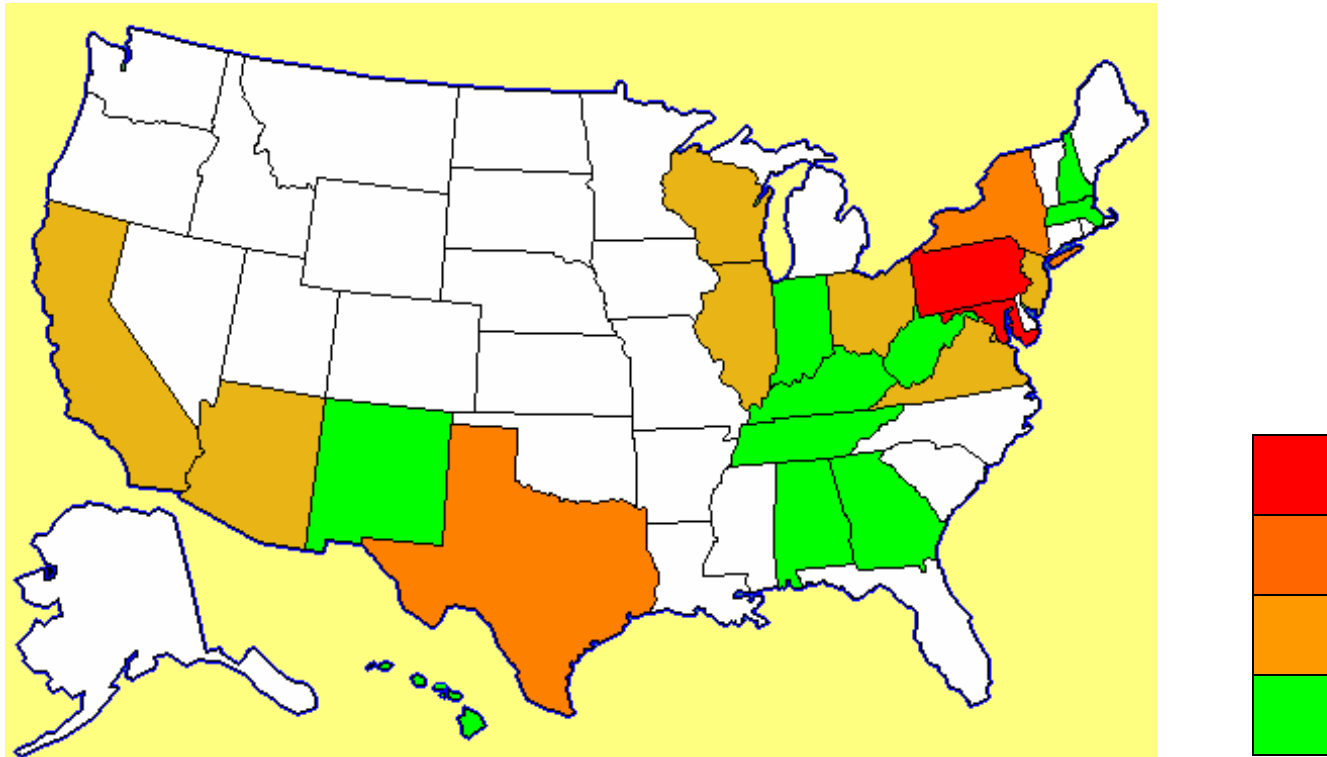
Carnegie Mellon 2006  
CS4HS SUMMER WORKSHOP  
Explorations in Computer Science for AP CS Teachers 2006

**Friday, July 21 - Monday, July 24, 2006**

- CS4HS is a new summer workshop designed to address this problem by providing resources and course material for high school teachers to bring back to their classrooms.
  - ◆ Small modules/exercises to be used within AP classes to show students the breadth of CS and how it relates to other disciplines and to their own lives.
  - ◆ Some material could be used after the AP exam in May before students leave for their summer break.

# Workshop Data

- 48 teachers attended the weekend workshop



- Presenters from Carnegie Mellon, Google, University of Maryland, Technion (Israel)

# Workshop Pre-survey

- **Distribution of teachers**
  - ◆ 7/8 of the attendees were high school teachers.
  - ◆ A majority of teachers taught in public schools.
  - ◆ Most taught at co-ed institutions.
- **In addition to a degree in Education, degrees earned included:**
  - ◆ Computer science or mathematics
  - ◆ Business and finance
  - ◆ Educational technology
  - ◆ Electrical and computer engineering
  - ◆ (9 reported no degree besides a degree in Education)

# Workshop Pre-survey

- **"In what department is your CS course taught?"**
  - ◆ Business (35%)
  - ◆ Math (25%)
  - ◆ Technology (19%)
  - ◆ Computer science (15%)
  - ◆ Science (2%)
- **"What certification do you have to teach CS?"**
  - ◆ Business
  - ◆ Math/Computer Science
  - ◆ None

# Workshop Pre-survey

- "What is the single greatest reason for the decline in enrollment in CS courses and programs at the high school level?"
  - ◆ outsourcing reports in the media
  - ◆ dot-com bubble burst, not enough high-paying careers
  - ◆ increased amount of required courses and tests
  - ◆ elective status, competition with many other electives
  - ◆ lack of understanding of CS by guidance counselors and administrators
  - ◆ difficulty of material, not "fun enough"
  - ◆ irrelevance to students
  - ◆ **male-dominated geeky discipline**
  - ◆ **lack of meaningful curriculum and standards**

# Workshop Pre-survey

- **"How would your students define CS?"**
  - ◆ Programming (26 teachers)
  - ◆ What computers can do/how computers work
  - ◆ How to use the internet
  - ◆ Playing/making games
  - ◆ Problem solving
- **Clearly there are problems:**

CS courses are disappearing at an alarming rate despite the fact that projections for job growth in the software and technology sector is very strong. **Even more, CS and computational thinking increasingly will be fundamental to 21<sup>st</sup> century developments in science, technology, commerce, .. – to our lives.**

# Workshop Events: Friday

- **Friday:**

- ◆ **Dinner Social**

- ◆ **Ice-breaker/group activity:**

- Form a big circle in birthday order (month and day only).
- Illustrates sorting techniques (radix sort was popular).
- Illustrates hashing collisions (we had a few).
- This can be done in your own classes to introduce computational thinking.
  - What is the quickest way to sort ourselves?
  - How likely are collisions?
  - What does this have to do with computer science?



# Workshop Events: Saturday

**Keynote Address  
by Jeannette Wing**



**Great Ideas in CS Using Food**



**CS Unplugged**  
featuring Craig Nevill-Manning  
from Google



**Human Computation**

# Workshop Events: Sunday

## Panels: Broadening Participation in CS and Careers & Social Responsibility



## Workshop Exercise Discussions



**Robotics in the Classroom**



**Algorithms in the Real World:  
Computational Biology**

# Monday: Group Presentations

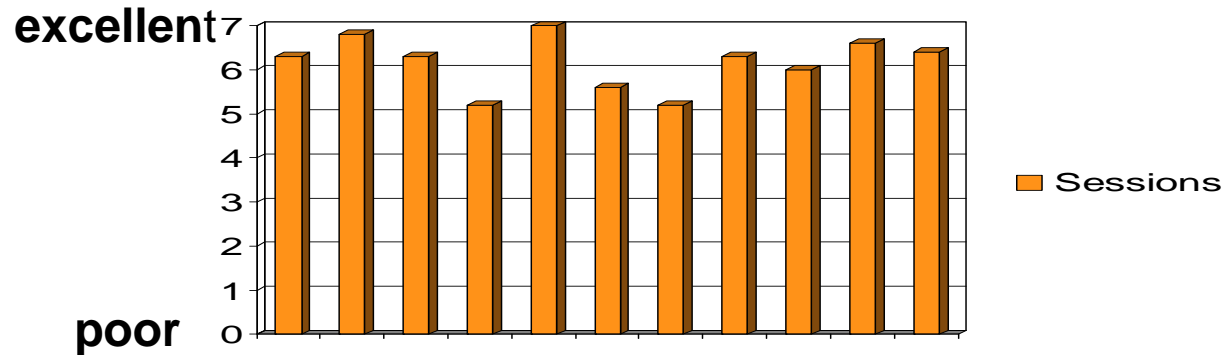
- Participants were grouped randomly on Sunday and asked to come up with their best 4 answers to an open-ended question about CS education.
- Each group received a different question.
- Groups presented their answers and began a discussion in the last session.
- Answers were posted on a wiki that is available for all participants for continued collaboration after the workshop ended.

# Sampling of Questions

- What 4 books would you recommend for your students to read to get them interested in the possibilities available to them as a computer scientist?
- Give an example of a topic you teach in an AP course in CS that can be applied to each of the following 4 high school areas: science, history, economics, and film/media.
- What are 4 concrete things you can do as a teacher to increase enrollment in CS courses given the current constraints you have as a teacher?

**More questions and all group responses are listed in our paper in the proceedings.**

# Workshop Evaluation



- Sessions with practical exercises and demonstrations received the highest ratings.
- Sessions that were more theoretical in nature received good ratings.
- Potential use of workshop material in their own classes for the next school year: 6.05 (average)

# Defining Computer Science

- **"How would you (as a teacher) define CS?"**
  - ◆ **Teachers were surveyed before and after the workshop.**
    - Most teachers saw CS as a field that was much bigger than computer programming.
    - Some saw connections between CS and other fields that they didn't see before.
    - More than half of the teachers wrote down a new definition of CS that incorporated some aspect of the workshop in its definition.
    - Several teachers removed the word "programming" from their original definitions.

# From an Enthusiastic Teacher

`"I am sitting here making sure all my t's are crossed and i's dotted for my Intro. to CS course this year. Looking back at my notes from previous years I realize how much the CS4HS meeting helped me change my thinking about what this course is all about. Previous courses have been 'jumps off the high dive right into programming syntax'. This year the first 8 weeks are shaping up to be much more about computational thinking, problem solving..."

# Future Work

- **End-of-School-Year Survey**
  - ◆ We will be sending our teachers an additional survey to see what topics made it into their classes.
  - ◆ We will also ask them about their views of CS a year later to see if their views have changed.
- **Development of Lesson Plans/Modules**
  - ◆ We will be working with several attendees from 2006 to disseminate their lesson plans for material presented at CS4HS to other teachers from last year's group and future attendees.



- Initiative sponsored by Google to expand the reach of CS4HS to as many teachers as possible.
- **2007 Summer Workshops:**
  - ◆ Carnegie Mellon University - July 13-16
    - National outreach, primarily AP CS teachers
  - ◆ University of Washington - July 20-22
    - State-wide outreach, high school math and science teachers
  - ◆ University of California, Los Angeles - July 11-13
    - Regional outreach, high school teachers in Southern California
- **Even more workshops for 2008**

# Acknowledgments

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- ◆ Center for Women and Information Technology at the University of Maryland, Baltimore Campus



- Additional support was provided by

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- ◆ Computer Science Teachers Association, TECS Program

tecs



- For more information, visit

<http://www.cs.cmu.edu/cs4hs>