

# *Must There Be So Few?*

## *Including Women in CS*

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J McGrath Cohoon  
University of Virginia

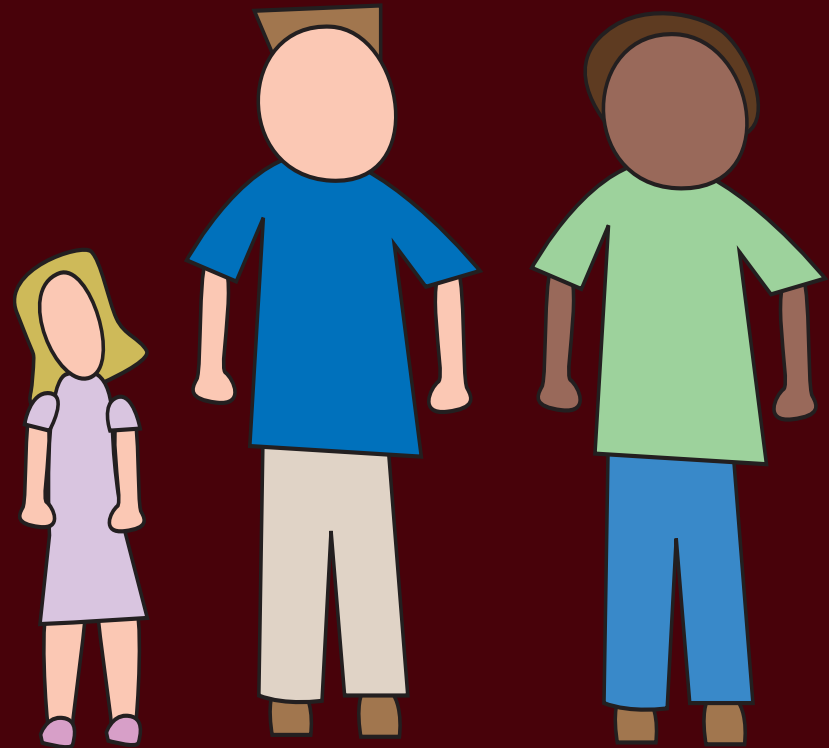


# Overview

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## ➤ Demonstrate the extent of women's under-representation

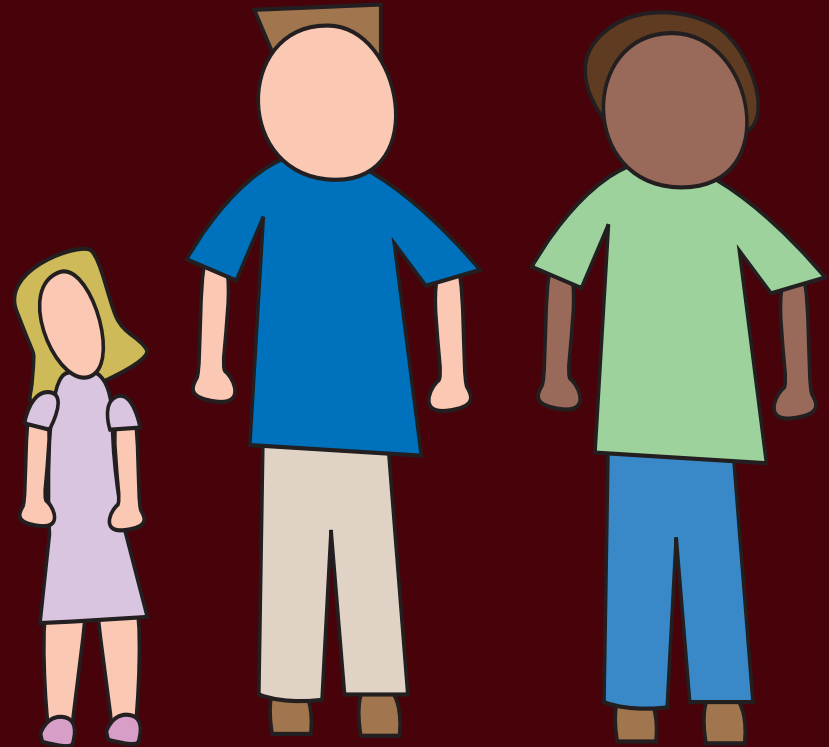
- Suggest why you might care
- Describe causes
- Identify effective interventions



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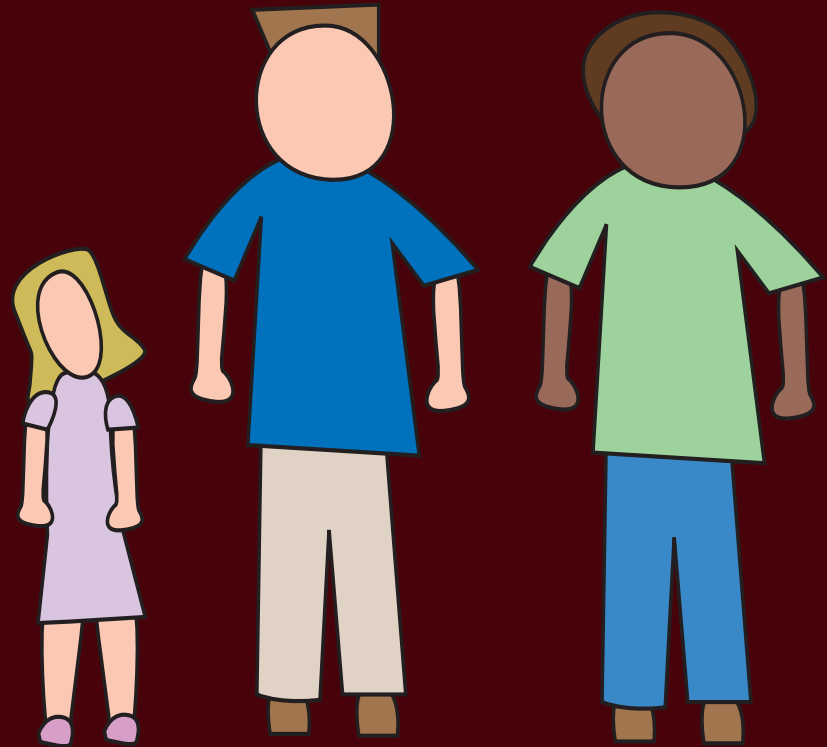
- Demonstrate the extent of women's under-representation
  - Industry
- Suggest why you might care
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# Overview

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- Demonstrate the extent of women's under-representation
  - Industry
  - Academia
- Suggest why you might care
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- Demonstrate the extent of women's under-representation
- **Suggest why you might care**
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- Demonstrate the extent of women's under-representation
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  - Diverse viewpoints
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- Demonstrate the extent of women's under-representation
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  - Gender equity
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  - Gender balance enrollment so women have peer support



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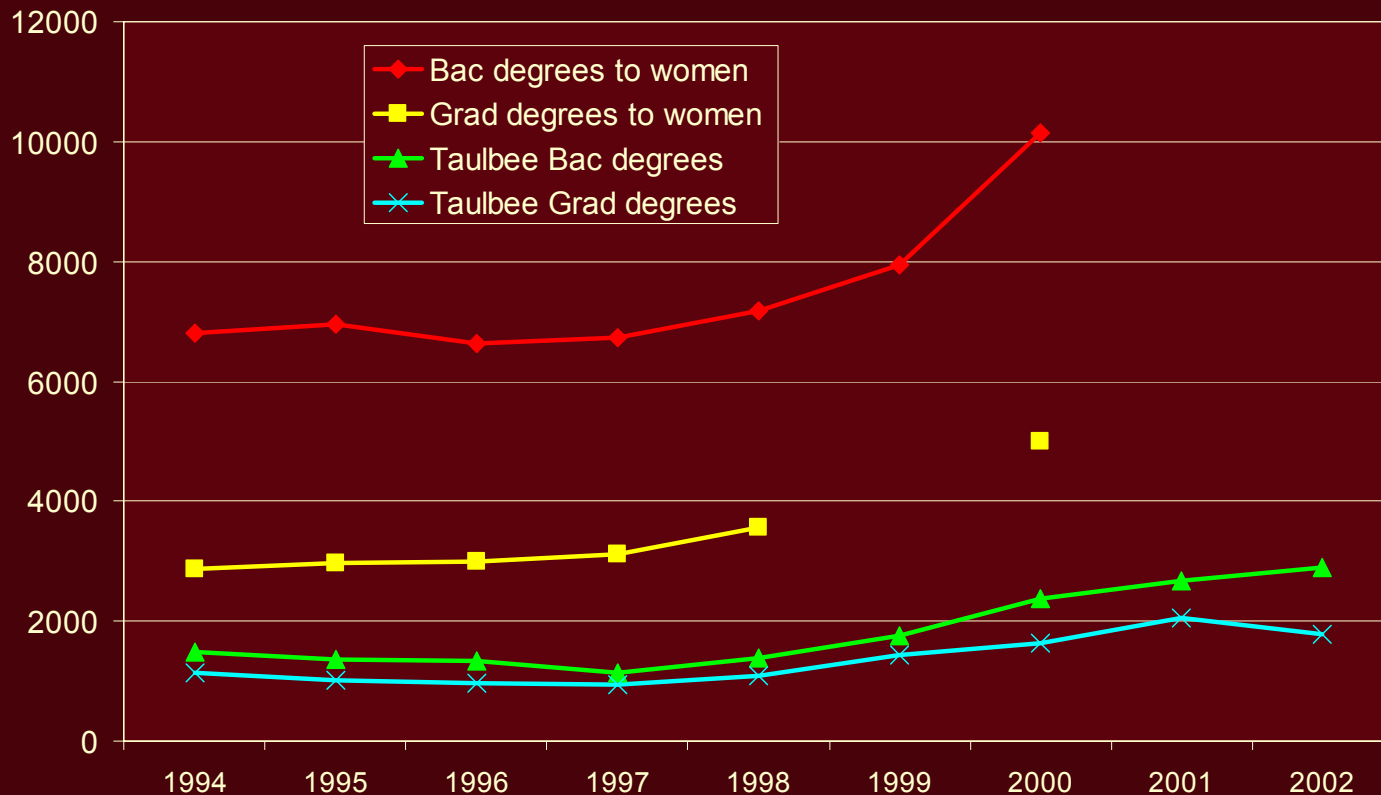
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  - Gender balance enrollment so women have peer support
  - Faculty support for enrolled students



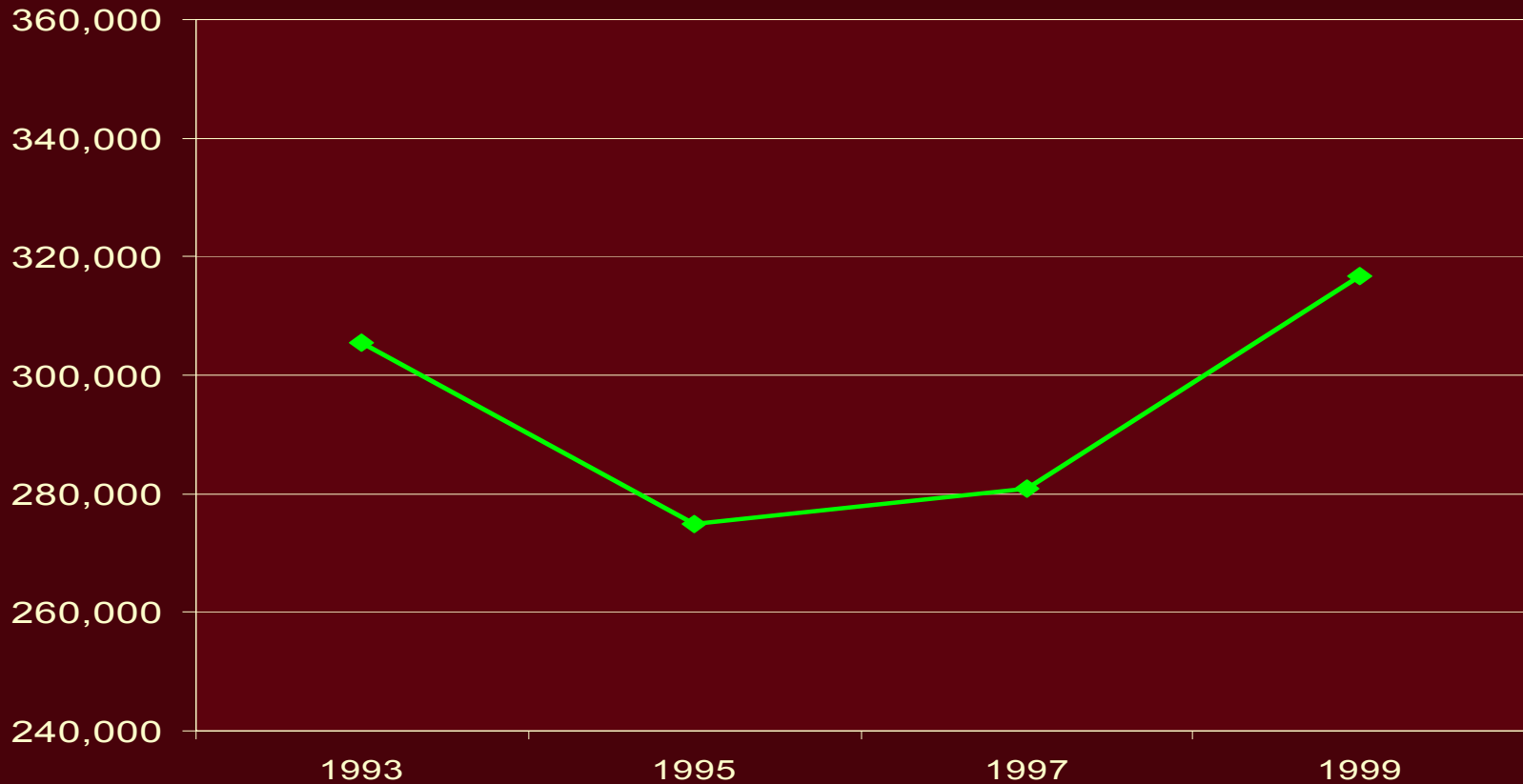
# Many Women with Degrees

Number of Women Earning CS Degrees U.S. 1994 - 2000



# *Many Women in Computing Occupations*

**Women Employed in U.S. Computer/Math Sciences**





# *Gender Composition of CS Occupations in U.S.*

Female Percent of Computer/Math Sciences Workforce



# *Gender Composition of CS Occupations Internationally*

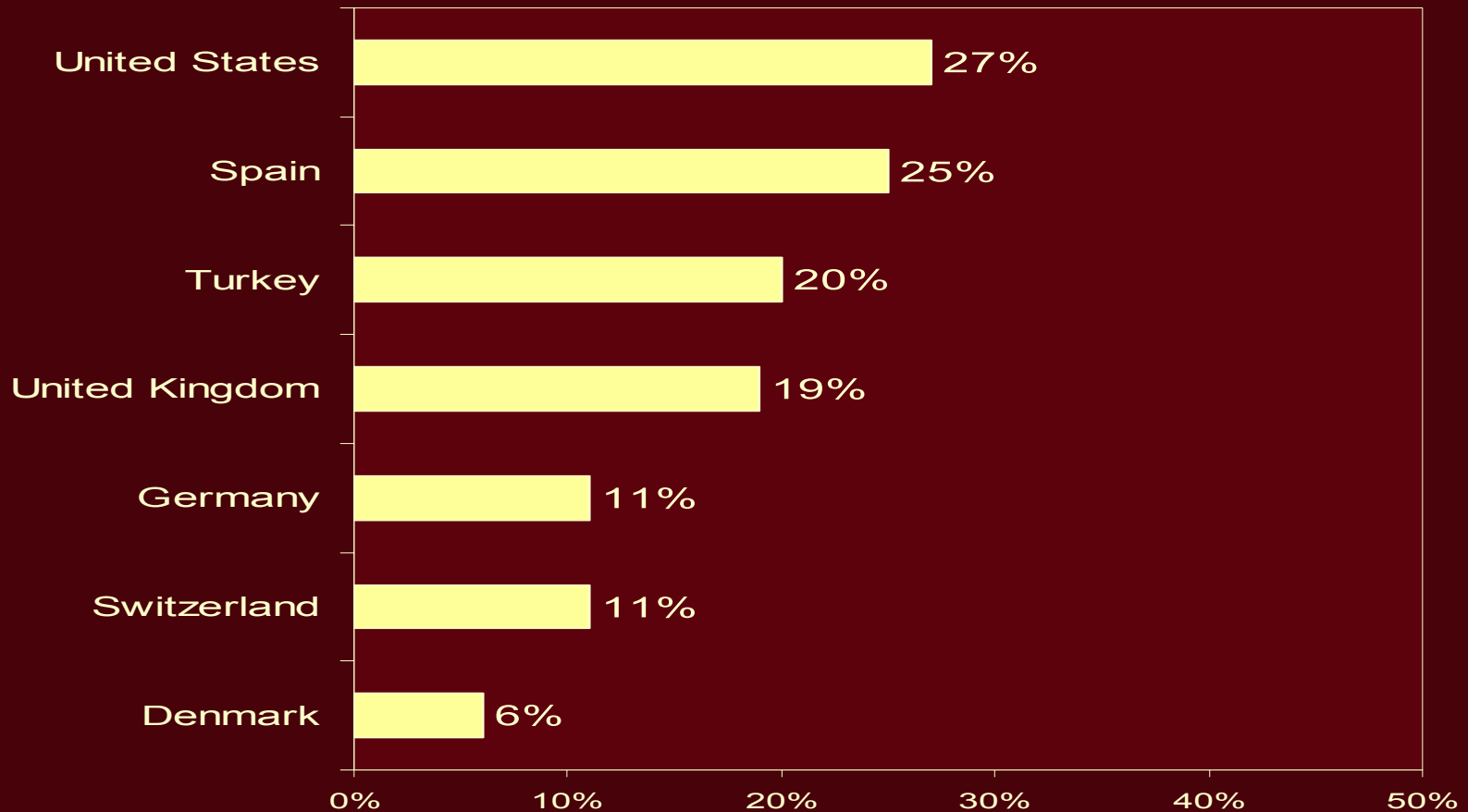
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- Women's representation varies internationally
  - Singapore
    - >50% of application/analyst programmers and system analyst/designers



# *Women's Proportion of CS Degrees Internationally*

## College Level

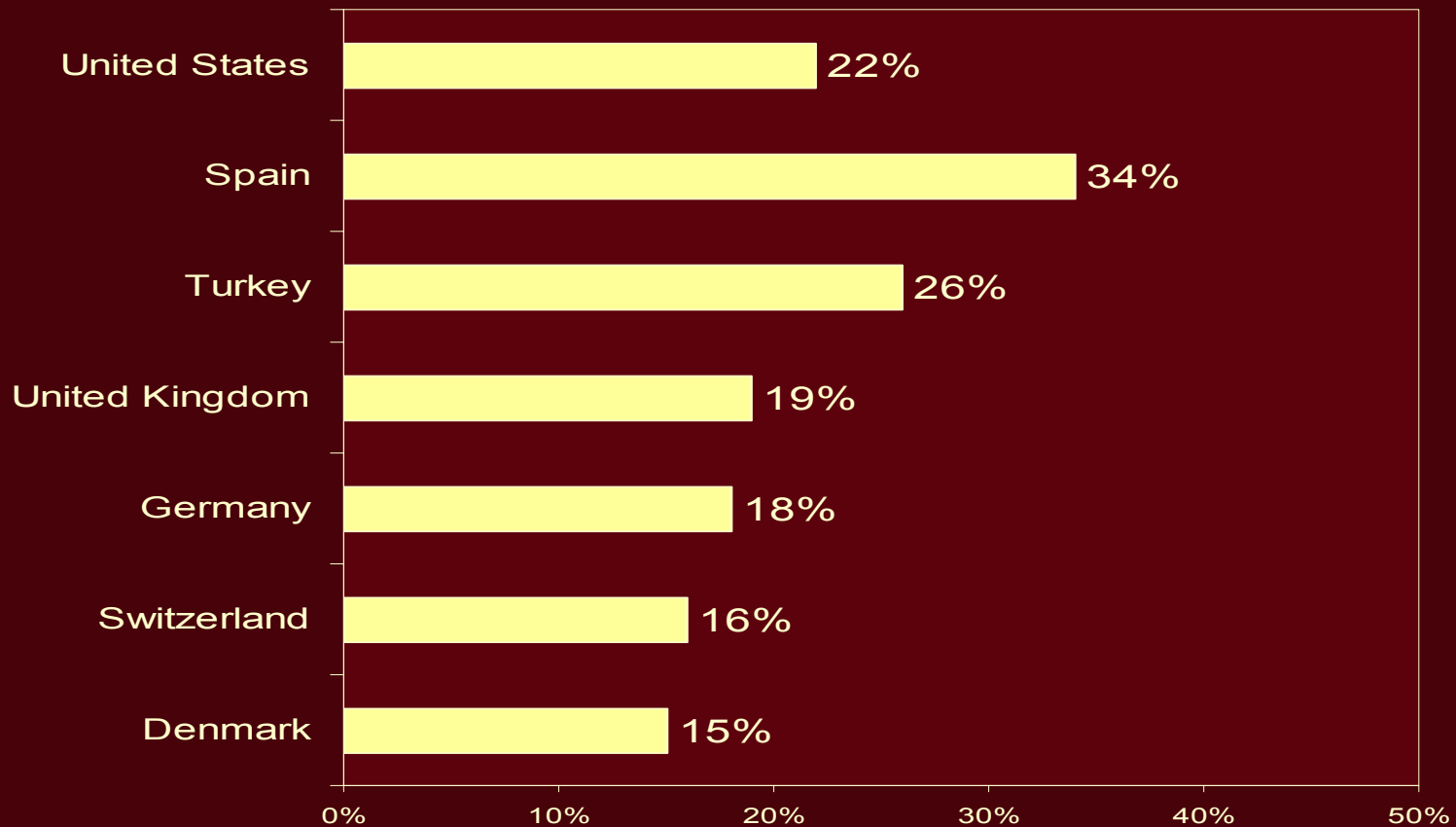


Departmental Factors in Gendered Attrition from Undergraduate IT Majors



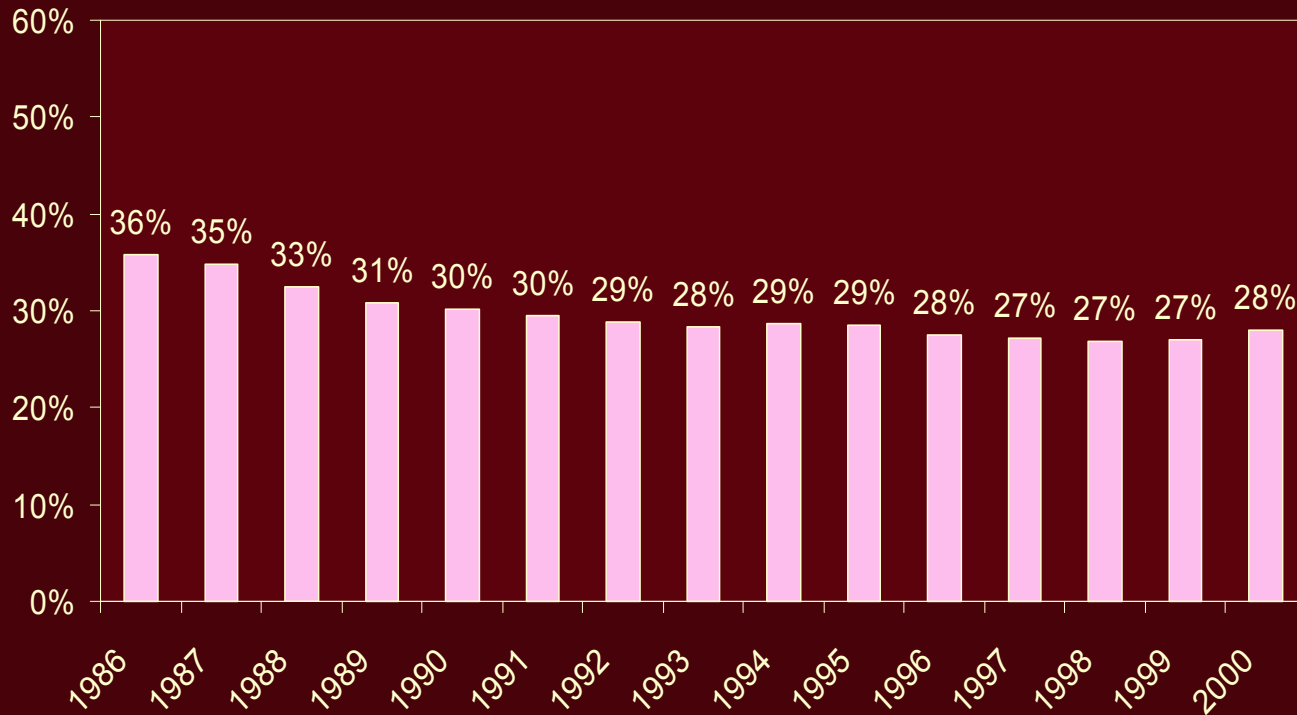
# *Women's Proportion of CS Ph.D.s Internationally*

## Math and CS Ph.D.s



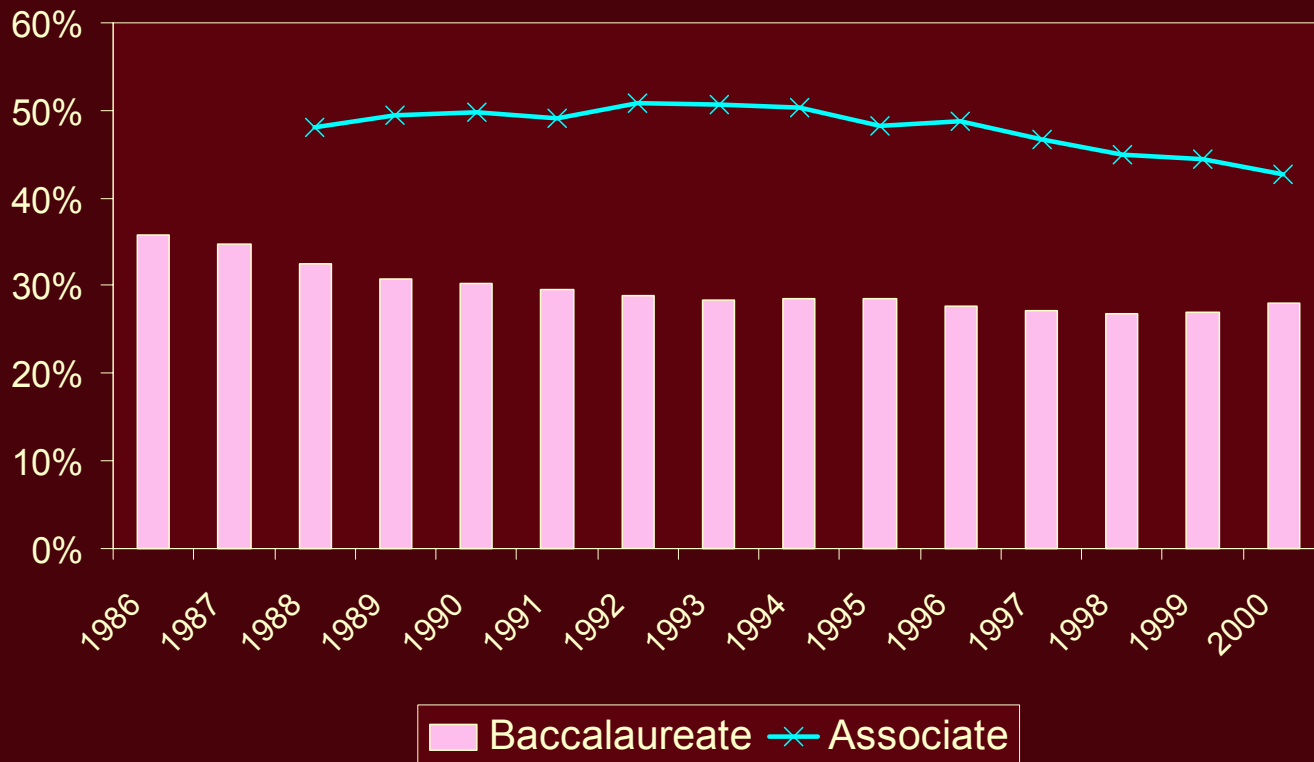
# *U.S. College-Level Declines*

**Women's Percent of CS Bachelor Degrees, U.S.  
1986-2000**



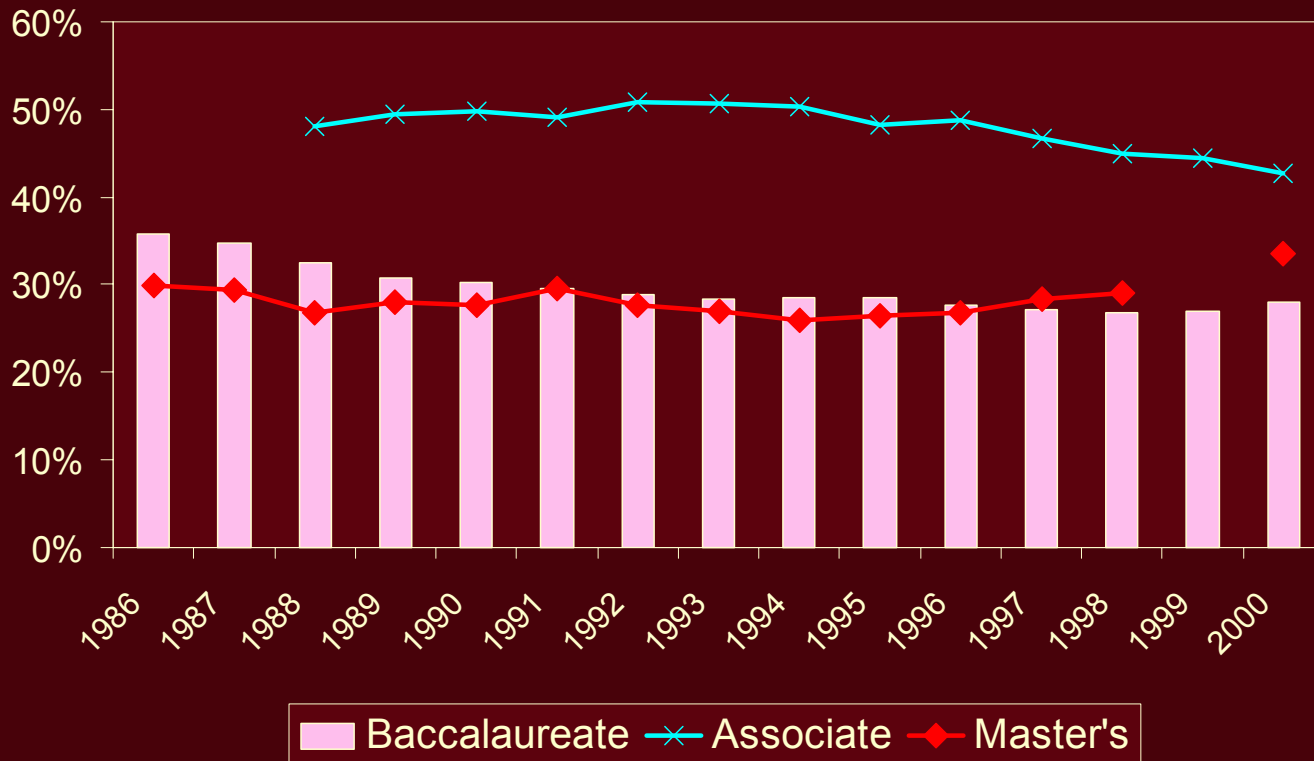
# *Relative to Other Degree Levels*

Women's Percent of CS Degrees, U.S. 1986-2000



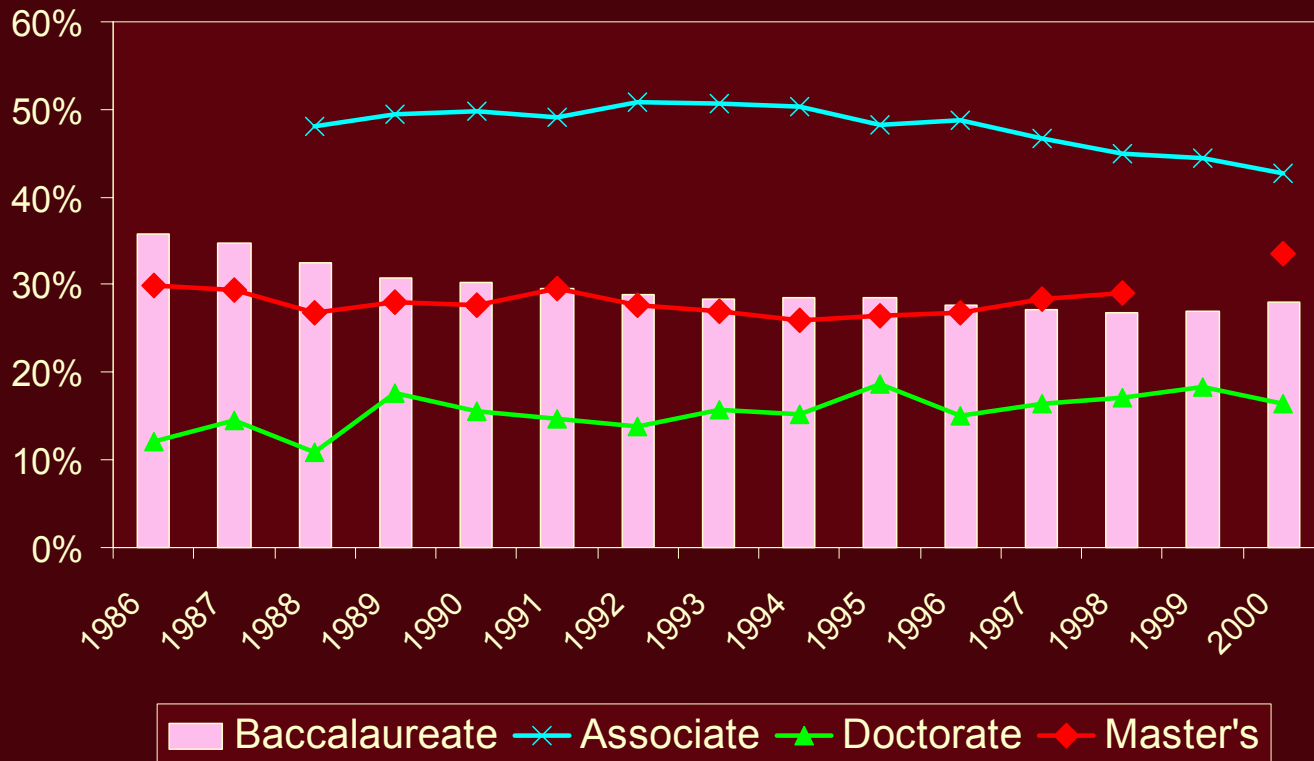
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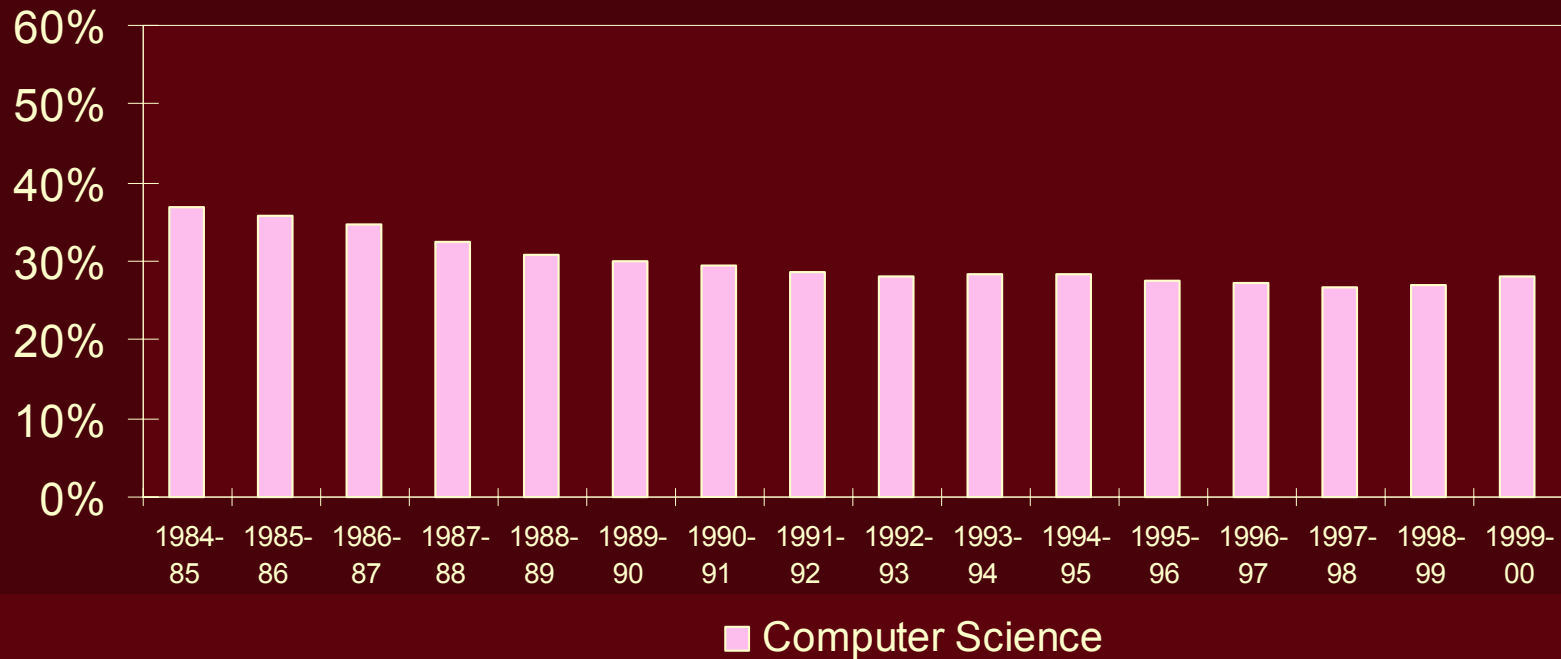
Women's Percent of CS Degrees, U.S. 1986-2000





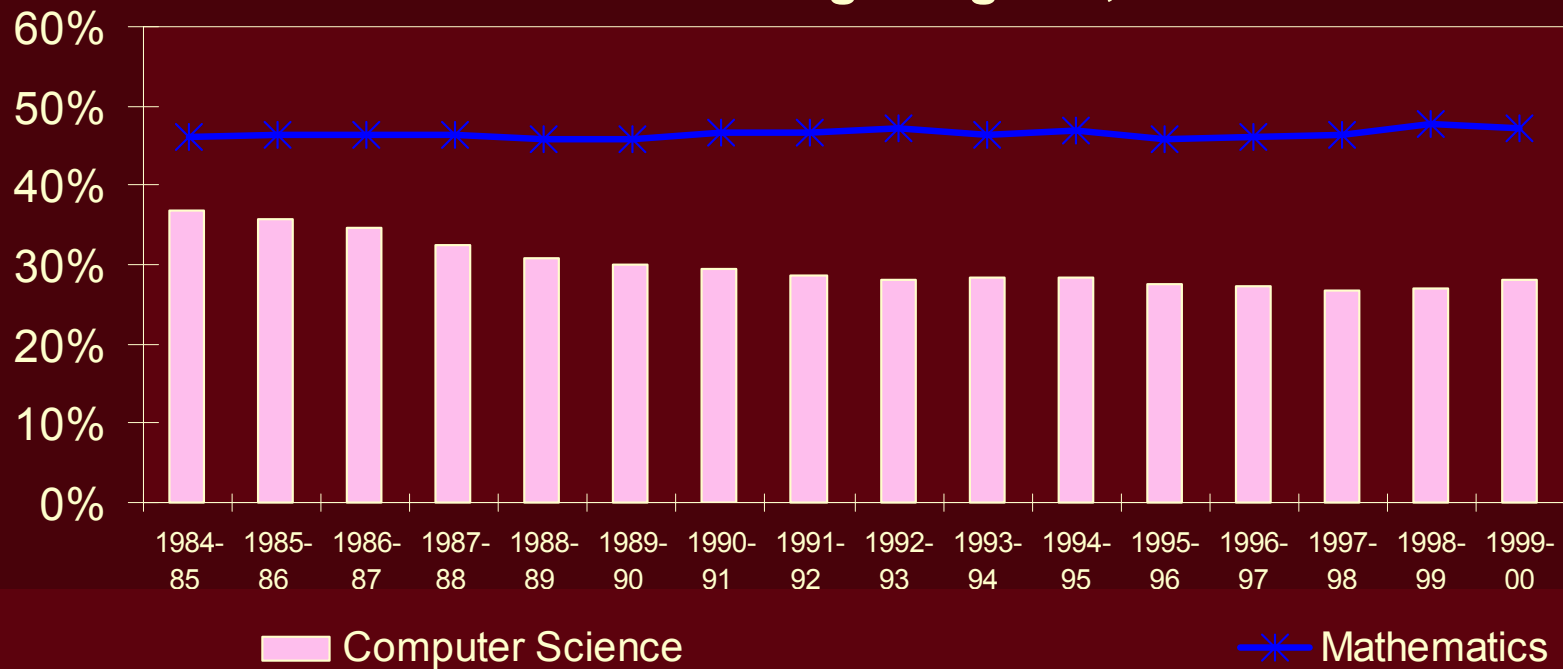
# *Relative to Other Disciplines*

## Women's Percent of College Degrees, 1985-2000



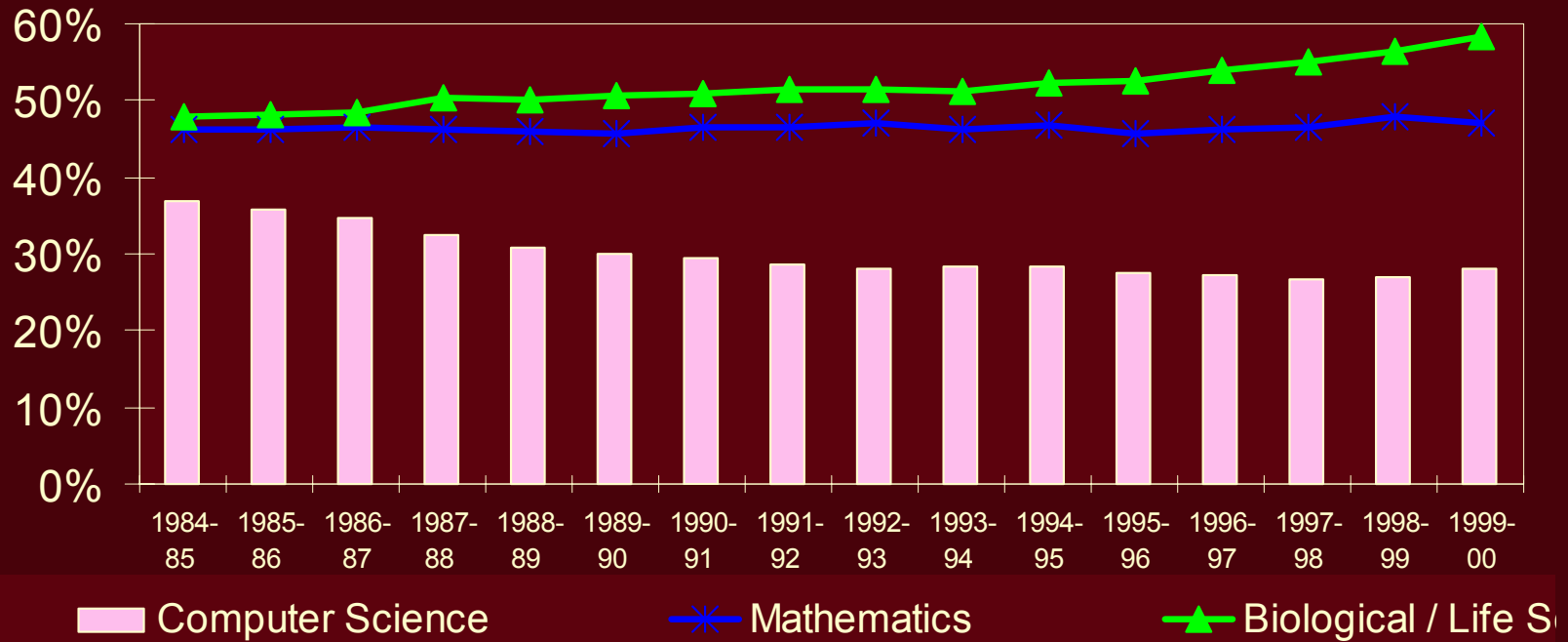
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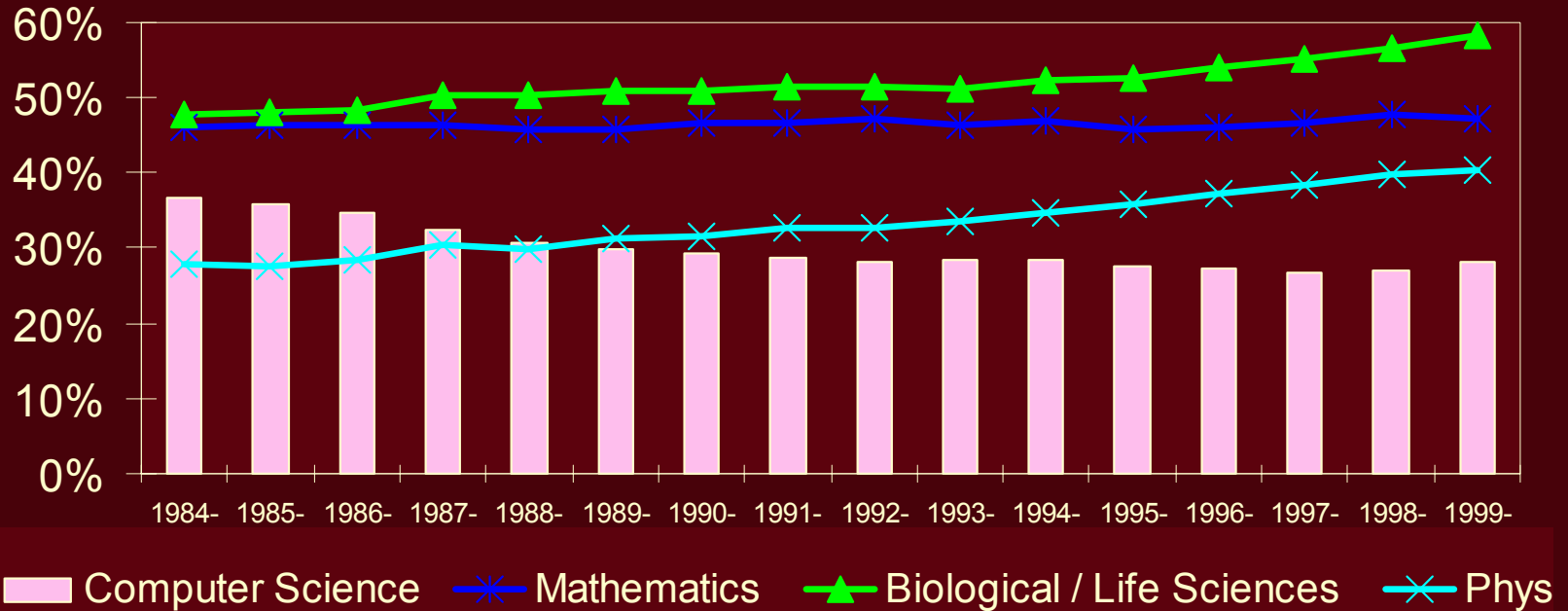
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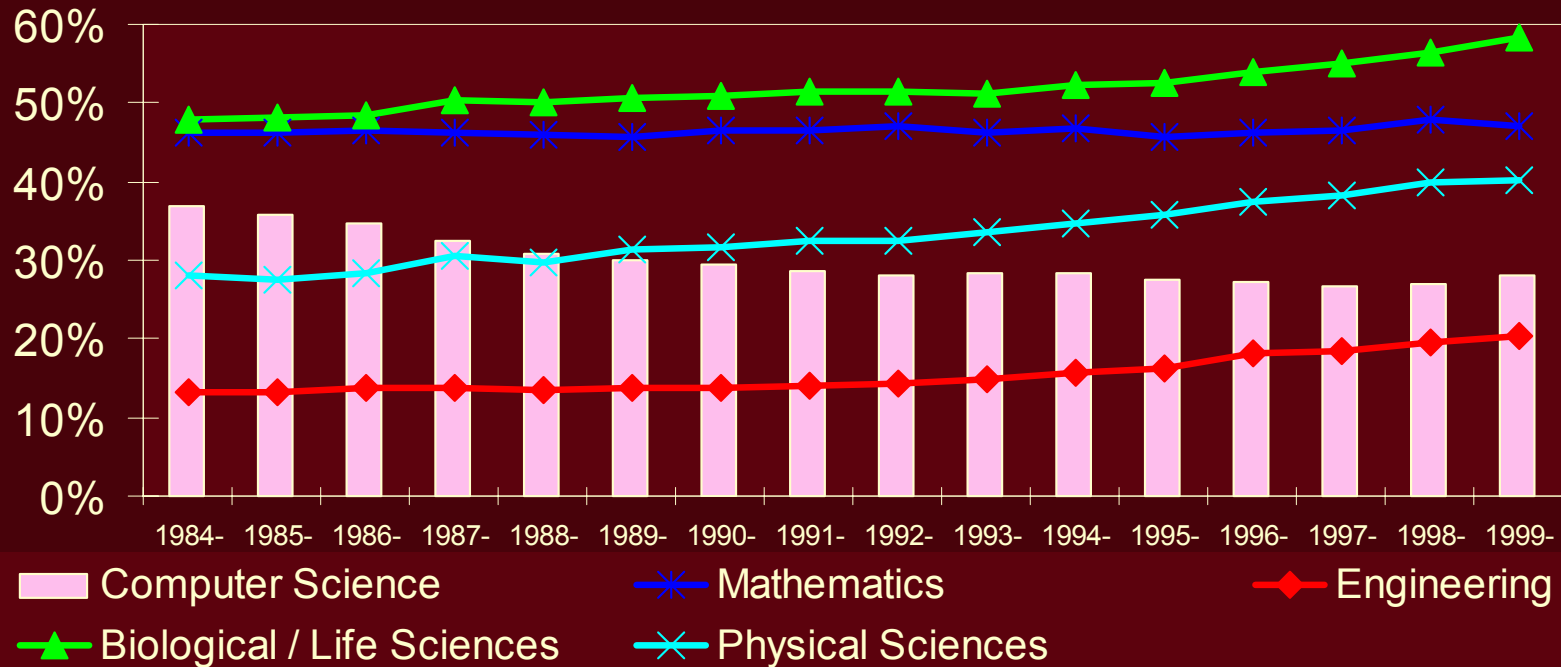
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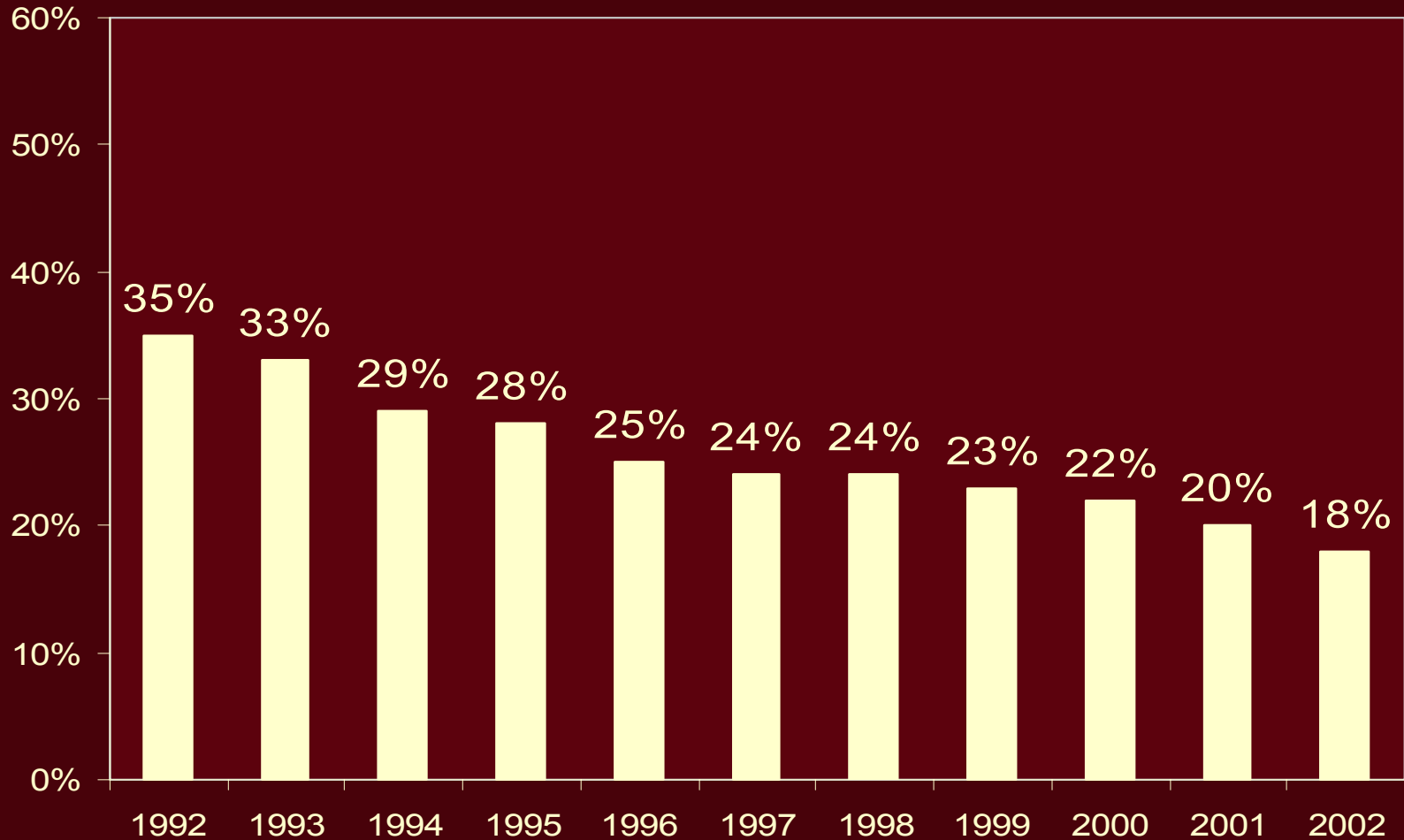


# *Relative to Other Disciplines*

## Women's Percent of College Degrees, 1985-2000



# *Female % of Intended CS Majors*

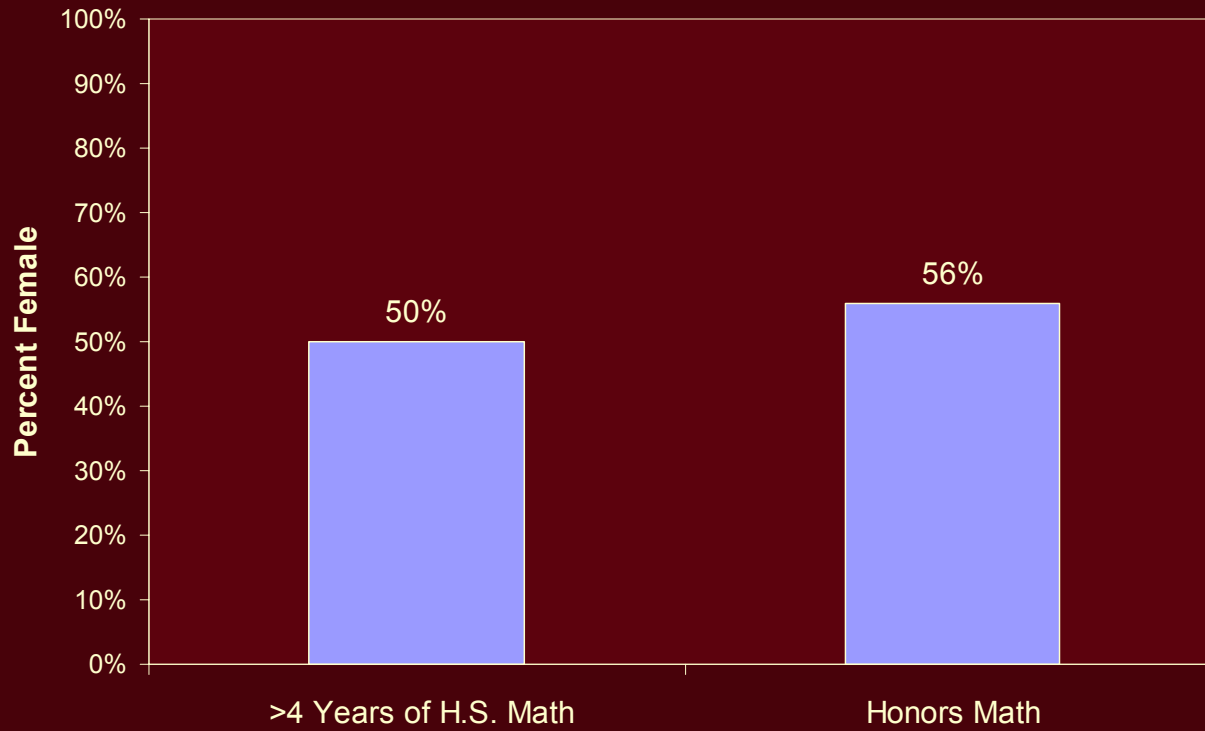


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# *Adequate H.S. Preparation*

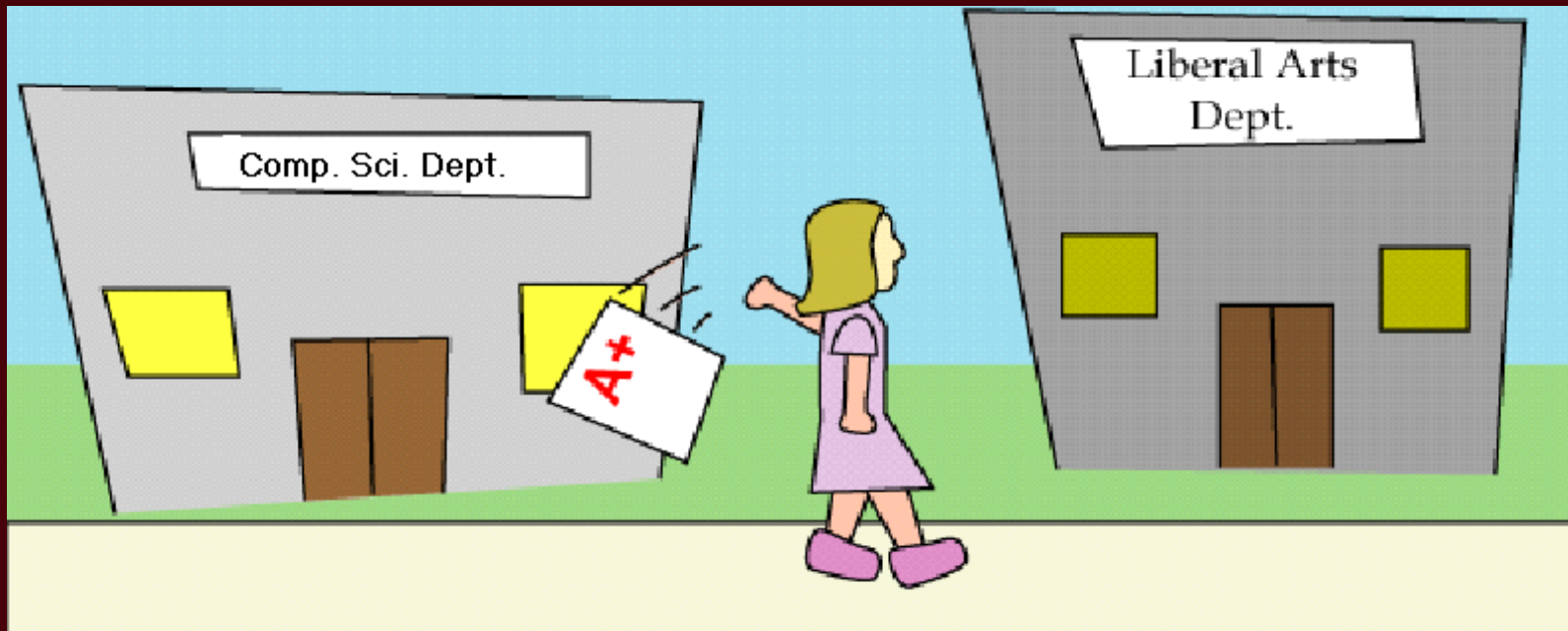
## 2002 SAT-Takers' Academic Preparation



# *Able Women Go Elsewhere*

- *She got an A in Computer Science [Intro] in the fall and an A+ in [Calculus I]. And do you know what she's taking this semester? English, Psychology, and Music.*

- CS Faculty Member, 2000





# Overview

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- Demonstrate the extent of women's under-representation
- **Suggest why you might care**
  - **Supply**
  - **Diverse viewpoints**
  - **Gender equity**
- Describe causes
- Identify effective interventions



## *So What?*

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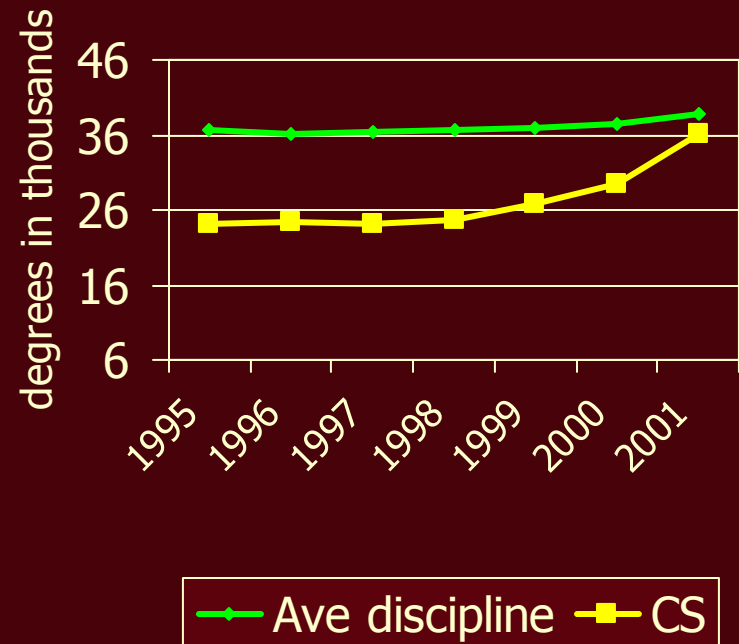
- Supply of students, teachers, professionals
- Diverse viewpoints
- Gender equity



# Supply of Students

- CS is approaching the size of the average discipline
- Number of new undergraduate majors declined

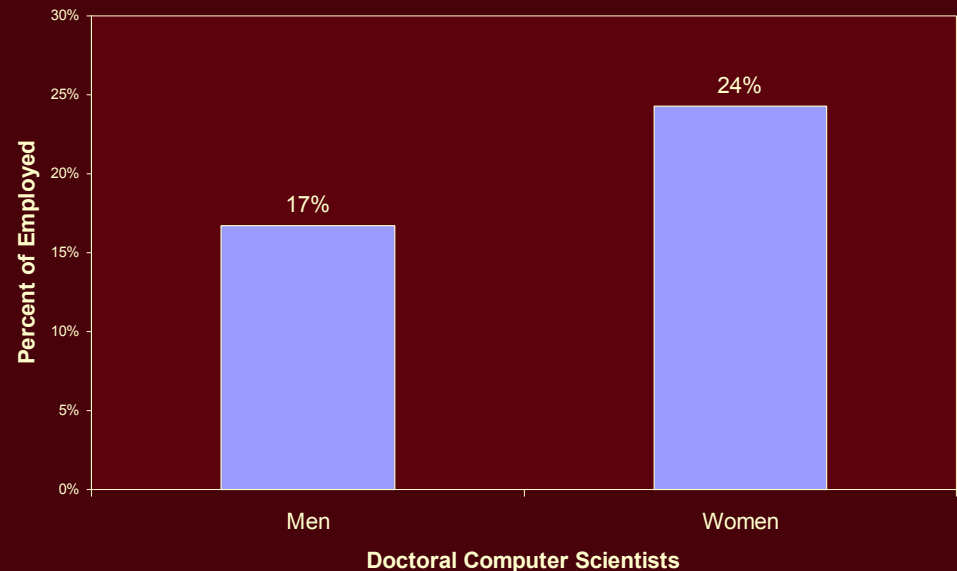
## Under-Graduate Degrees Awarded



# Supply of Professionals

- Unmet need for faculty
  - Concern about insufficient faculty
  - Estimated 20-33% of all openings go unfilled
- Workforce demand expected to continue

Employed in Universities and 4-Year Colleges



# *Diverse Viewpoints*

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- *Without diversity, we limit the set of life experiences that are applied, and as a result, we pay an opportunity cost – a cost in products not built, in designs not considered, in constraints not understood, and in processes not invented.*
  - William A. Wulf, President National Academy of Engineering



# *Gender Equity*

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- Participation in creative and financially rewarding careers
  - *Basically, I could do and go almost anywhere. And, of course, the money's not so bad either.* - Female CS Major, 2000



# *Overview*

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- Demonstrate the extent of women's under-representation
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- **Describe causes**
  - **Failure to attract**
  - **Failure to hold**
- Identify effective interventions



# *Failure to Attract Women*

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- Image
- Initial experiences
- Support





# *Image of CS as a Guy Thing*

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- Computing is a male-stereotype activity
  - *I guess life just isn't fair until women grow chest hair, spit, chew, bench press 250 pounds, and write a computer program ...* - Male Computer Consultant on ZDNN, 1998
  - *I'm clearly not a computer scientist. ... I'm not like the other ones .... They all think it's really fun to sit in the lab all weekend and program till the small hours of the night some stupid little program ... And I don't want to be like that, so I can't be a computer science major.* - CS Faculty Member's Conversation with Student, reported by colleague, 2000
  - *When people ask me, "Oh, what's your major?" ... They would never think I'm a CS major ... because I'm a female.* - Female CS major, 2000



# *Initial Experiences*

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- Boys often start younger
  - *When I was two I was given a computer to play around with. ... I had fun on it, so much fun. ... And I was just in love with it. And I think ever since then I've been really into computers.* - Male CS major, 2000
- Games generally target a male audience
  - *I wanted to get into making video games and stuff since I play a lot of video games.* - Male CS major, 2000



# Support

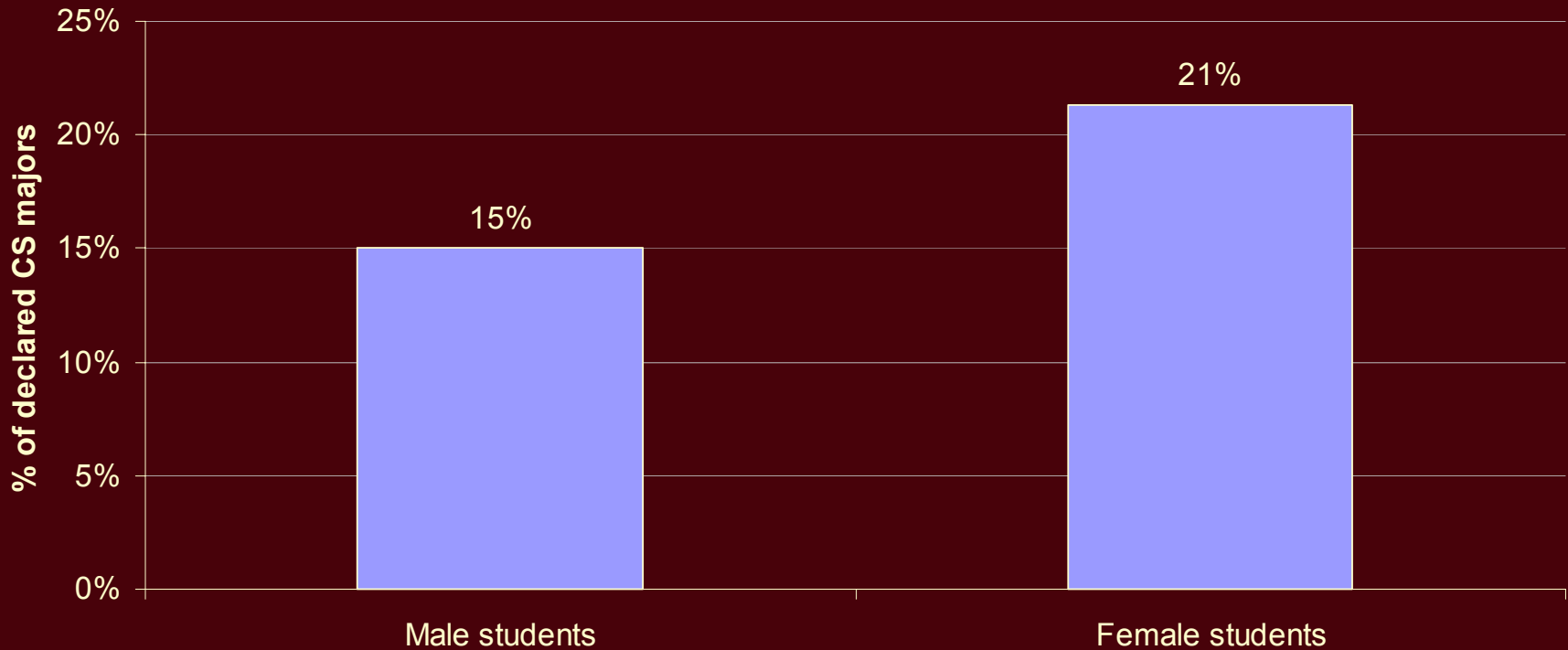
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- Family support
  - *My dad was really into computers and got me into it.* - Male CS Major, 2000
- Teacher support
  - *[In 10<sup>th</sup> grade, my CS teacher] said, "You seem to have a liking for Computer Science. Let me help you."* - Male CS Major, 2000



# *Failure to Hold*

**Average Annual Undergraduate Attrition 1994/95 - 1999/00**



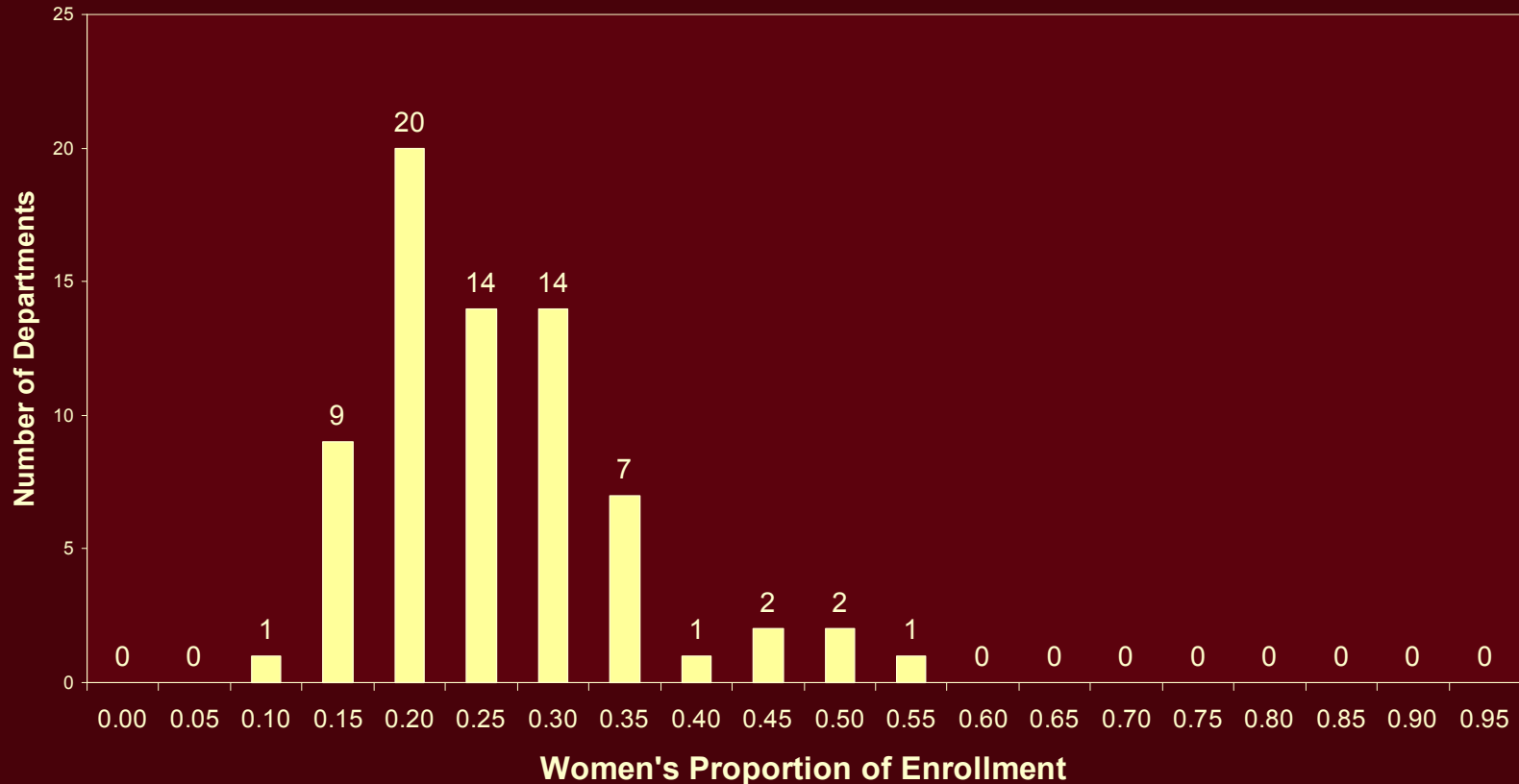
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- **Identify effective interventions**
  - **Gender balance enrollment so women have peer support**
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# *Departmental Variation in Gender Composition*



# *What Attracts Women to CS?*

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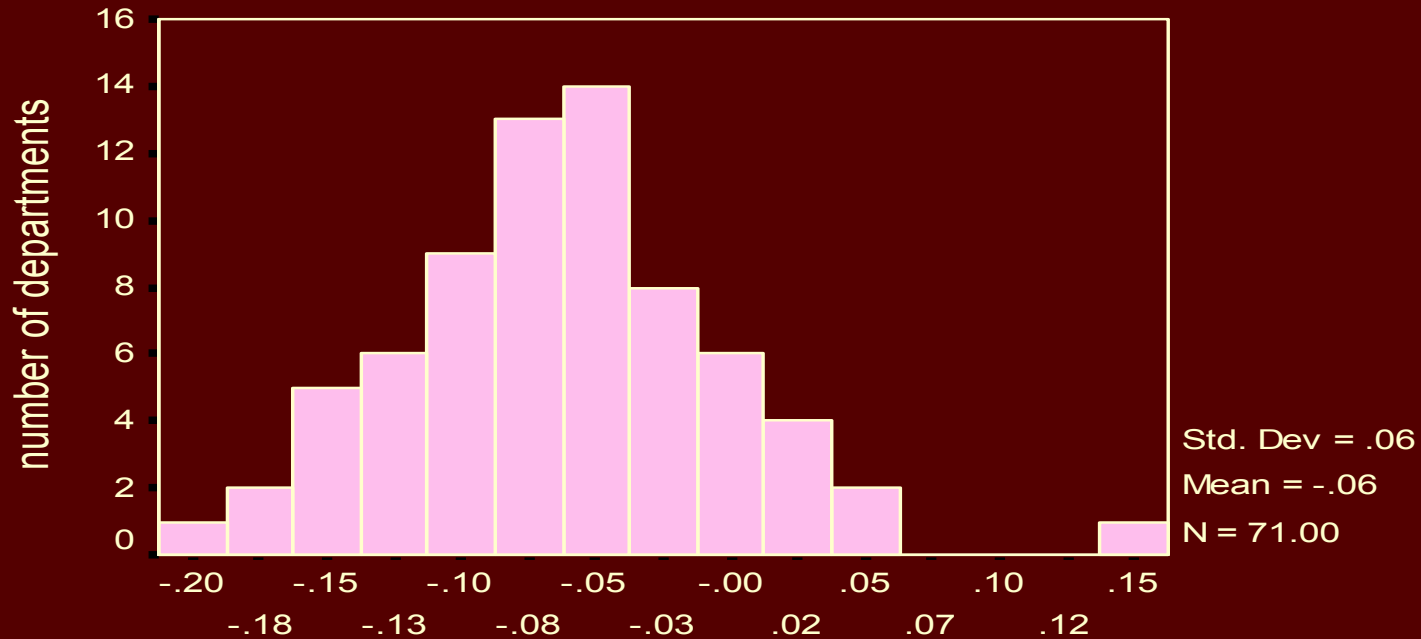
- Defiance
  - *Somebody told me I couldn't do it. They said that it wasn't the way that a girl thinks.* - Female undergraduate, 2000
- Communication
  - *It's basically you communicating with the machine instead of you communicating with the person, so it's like a foreign language.* - Female undergraduate, 2000
- Personal influence
  - *My brother had taken computer science and he said, "Oh, take it, you'll like it." I'm like, "I won't like it but I'll take it anyway."* - Female undergraduate, 2000



# *Departmental Variation in Gendered Attrition*

## Gendered Attrition from the CS Major

1994/95 - 1999/00



gender gap: male attrition rate - female attrition rate





# *What Retains Women?*

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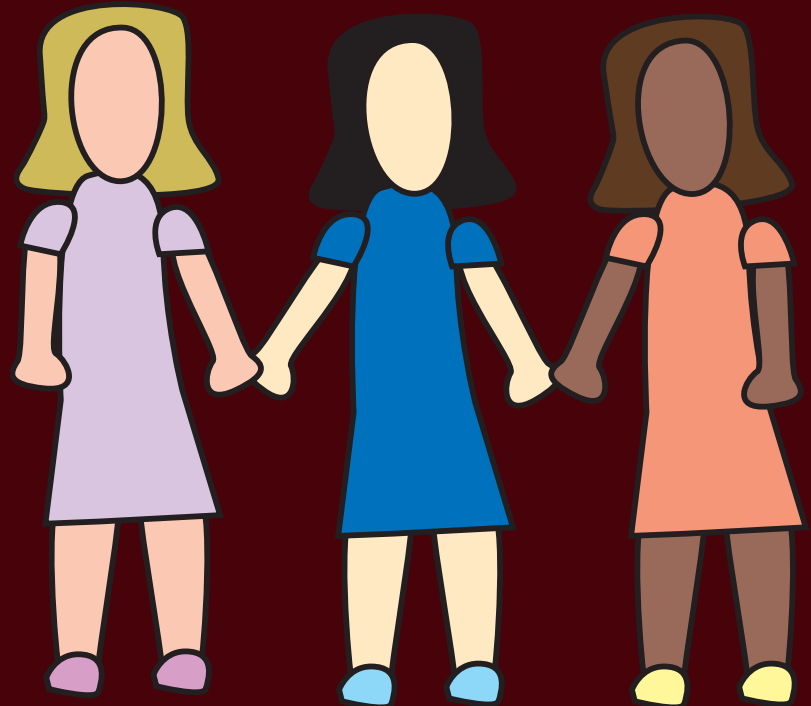
- Access to same-sex peer support
- Supportive faculty
  - Encourage students to persist
  - Mentor to overcome under-representation



# *Same-Sex Peers Retain Women*

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- Women help retain women



# *Importance of Peer Support*

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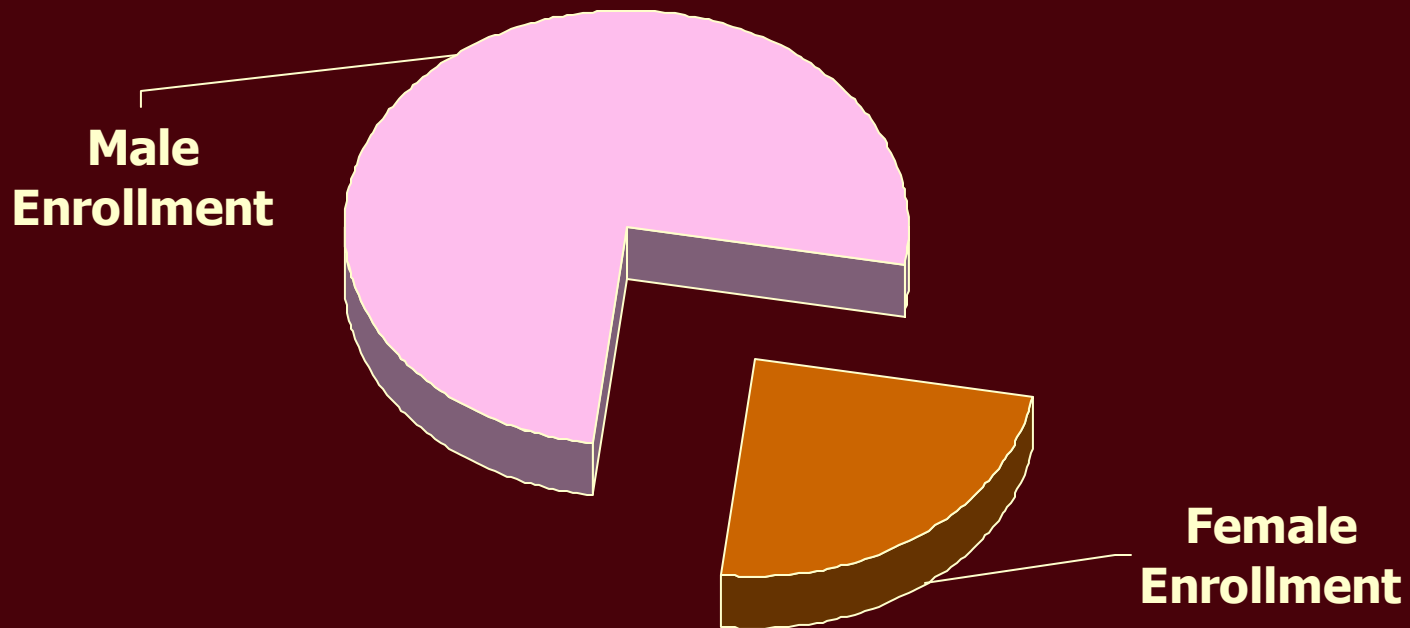
- Most effective method of coping
  - *If I didn't have people here that I could come to and say, "What does this mean?" I don't think I would have stayed at all. - Female CS Major, 2000*
  - *You don't need a professor who's going to be like, 'Don't you know this information? Didn't I teach it to you last week?' You need a friend who says, 'Don't worry. Together we'll work at it, and we'll learn it.' - Male CS Major, 2000*



# *Women Have Few Female Classmates*

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## **Gender Composition of Average Department**



# *Why Same Sex?*

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- Many women in CS comfortably rely on men
  - *Some of my best friends are male.* - Female CS major, 2000
  - *I've always, ever since I was tiny, had guys for friends. ... You know - I'm getting married; I can't seem to find any bridesmaids.* Another woman in the group nodded in agreement. In her case, she added, *My brother's my maid of honor.* - Female CS Majors, 2000



# *Why Same Sex?*

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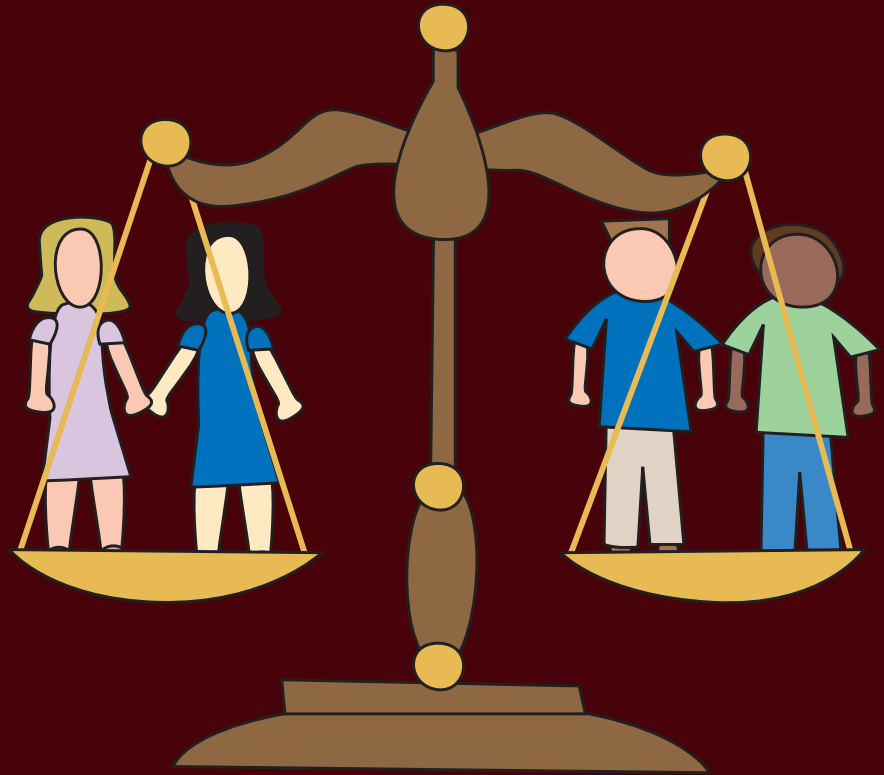
- Some women prefer to rely on women
  - Easier to approach
  - Less concern about image
  - Less opportunity for misinterpretation
- Classmate support
  - *I got a 4.0 in my first semester and I had at least three separate guys, upon hearing about it, ask me if I did special favors for the professors.* - Female CS major, 2000



# *Equal Access to Peer Support*

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- Gender balanced enrollments give women and men equal access to peer support



# *Supportive Faculty Retain Women*

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- Encouraging students
  - *It just takes me going to them and saying, "You do better than you think you do, so keep trying."* - Male CS Faculty Member, 2000
- Encouraging students to persist is effective
  - *In the beginning, I was having such a hard time ... with the class itself. And for me, [Professor X] was encouraging because she was, "Just keep at it. You can do it. We need more women in the field."* [Laughter from other members of the focus group.] *And, yeah. You're laughing, but it's true. It made me feel better.* - Female CS Major, 2000





# *Few Faculty Encourage Students*

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- Fewer than half encourage students to persist
  - *I would even counsel students who have come to me, [to switch majors] ... Most students even if they don't necessarily like particular teachers, or whatever, if they like the subject matter, they have a goal in mind, they will just lump it and get through it.* Female CS Faculty Member, 2000



# *Weeding Out*

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- Discouraging students is common
  - *He was trying to get me to change my major and stuff. Like making me feel like I couldn't do it or something.* - Female CS major, 2000
  - *It made me think, "Well, maybe I should consider something else."* - Female CS major, 2000



# *Motivated Mentoring Retains Women*

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- *Based on my enrollments in my classes, ... I bet I only have 20% women in that class. And that's typical over the last three years. We don't have a lot of women in computer science. - CS Faculty Member explaining why she makes special effort to mentor women, 2000.*



# *Mentoring Undergraduates*

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- Out-of-class relationship that includes
  - Involving individual students in professional activities
  - Offering personalized advice
  - Encouraging individual students
  - Helping students establish careers



# *Few Faculty Mentor to Retain Women*

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- Faculty in the average CS department mentor 3 hours/week
- 25% of faculty mentor to overcome under-representation
- 23% of faculty initiate mentoring



# *Impact of Mentoring*

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- *Throughout the entire time I was here, he would give me papers to read, keep my interest, to show me that there's so much more going on and open everything to what grad school is like and various aspects like that. So I already found the professors are incredibly approachable and you can see them about anything. And that was probably the biggest encouragement to stay here.*  
- Female CS Major, 2000



# *What Can You Do?*

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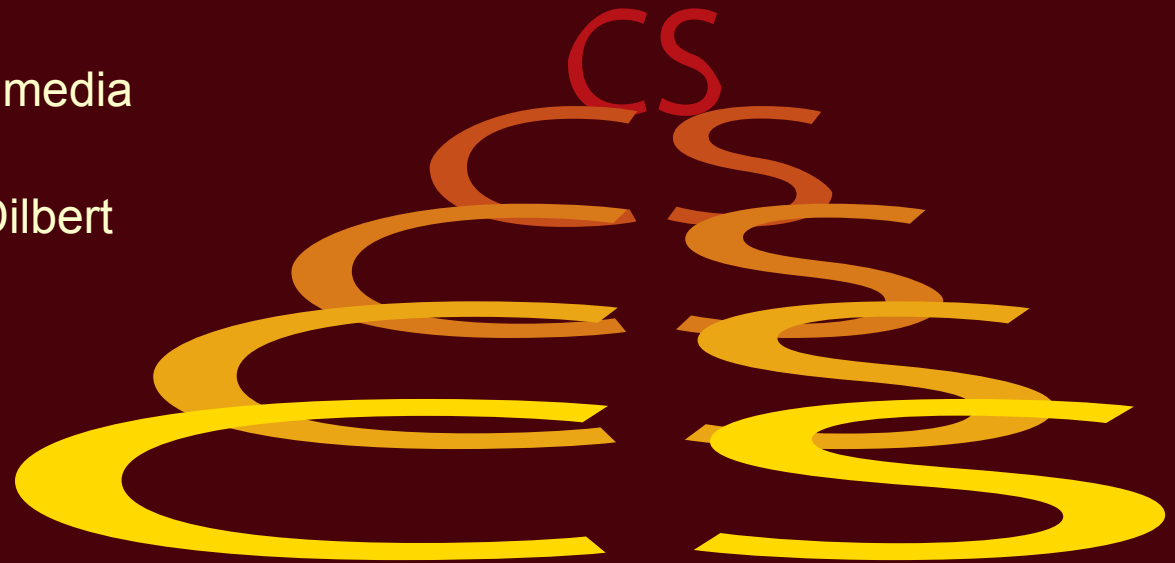
- Broaden Image
- Recruit Women
- Retain Through Mentoring and Encouragement



# *Broaden Image*

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- Individual effort
  - Language
  - Examples
  - Pictures
- Positive and inclusive media portrayals
  - Contrast 24 with Dilbert





# *Michelle Dessler*

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- Michelle Dessler
  - Capable
  - Intelligent
  - Attractive
  - An important character on the Fox TV show, 24.
- Employment
  - Computer expert
  - Challenging
  - Interesting
  - Exciting
  - Crucial to the well-being of her nation



# *Dilbert*

- Dilbert
  - Cartoon character
  - Loves technology more than he loves people
  - Unattractive
  - No social skills
- Employment
  - Dull
  - Frustrating
  - Pointless



# *Recruit Women*

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- Documented success at Carnegie Mellon University
  - 7% women in 1995
  - 39% women in 2000
  - Outreach to high school teachers
  - Broaden admission criteria
  - Curriculum changes



# *Mentor and Encourage Students*

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- Proven to be generally effective for retention
- Retention is equal in departments where
  - Average faculty member encourages students to persistor
  - 90% of faculty mentor to overcome under-representation



# *There Does Not Need to Be So Few*

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- Women's representation in CS can be increased
- The situation is in our hands



# *More Information*

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- <http://curry.edschool.virginia.edu/ITattrit>
- Acknowledgement and Disclaimer
  - This material is based upon work supported by the National Science Foundation under grant number EIA0089959. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation
  - Special thanks to all those who provided data for this study

