WHERE DID THE WOMEN GO?

Beatrice Zhang

Abstract: Though women were largely responsible for programming the early computers, few women work in the computer industry. This paper explores the decline of female representation in technology, the origins of the male "nerd" stereotype, and possible reasons why few girls enter computer science today. The paper examines methods used to increase the number of females studying computer science, in order to meet demand for skilled workers.

Science, technology, engineering, and math (STEM) fields are known for having low female representation. Computer science is the STEM field with the lowest representation of females worldwide. But what distinguishes computer science from other STEM fields is that many of the first computer science pioneers were women. Whereas other STEM fields have seen slow but steady increases in female representation in the last 50 years, female representation in computer science experienced rapid growth and peaked in the mid-1980s before starting to decline (National Center for Education Statistics, 2013). Although the computer industry initially offered great opportunities to the first women in the field, a cultural redefinition of the industry as masculine and "nerdy" brought about the low female representation evident today. In order to fulfill demand for more technology workers, the education system must work harder to debunk the "computer geek" stereotype and redesign classrooms to be more inclusive of all.

The First Computer Women

The history of women and computers dates back to even before the invention of the first electronic digital computers. Then, mechanical desk calculators were used to perform arithmetic. The workers who performed these calculations were called "computers," and were often women. (Abbate, 2012, p. 12). When the first digital computers were built during World War II, women made up a significant amount of the labor force. Women were encouraged to work on computers during World War II so more men could fight abroad. Although men built the hardware of early computers, women programmed their software. Women not only performed their tasks, but also innovated. Lieutenant Commander Grace Hopper, who was a member of the Navy WAVES – Women Accepted for Volunteer Emergency Service – was an example of innovation. She coined the term "bug" after discovering a moth causing problems in the Harvard Mark I computer. Grace Hopper went on to win the Data Processing Management Association's first "Man of the Year" award (Misa, 2010, p. 63). However, Grace Hopper was an exception because many women were not offered the opportunity to succeed. Most women simply

punched in the cards that contained instructions for the computer. The job of a keypunch operator involved work in noisy, stuffy, hot conditions with little hope of advancement (Misa, 2010, p. 53). Although hardware engineering was the exclusive work of men, women were able to work as computer operators and programmers during World War II since the jobs did not exist before the war, and thus were not stereotyped as masculine (Abbate, 2012, pp. 19, 20).
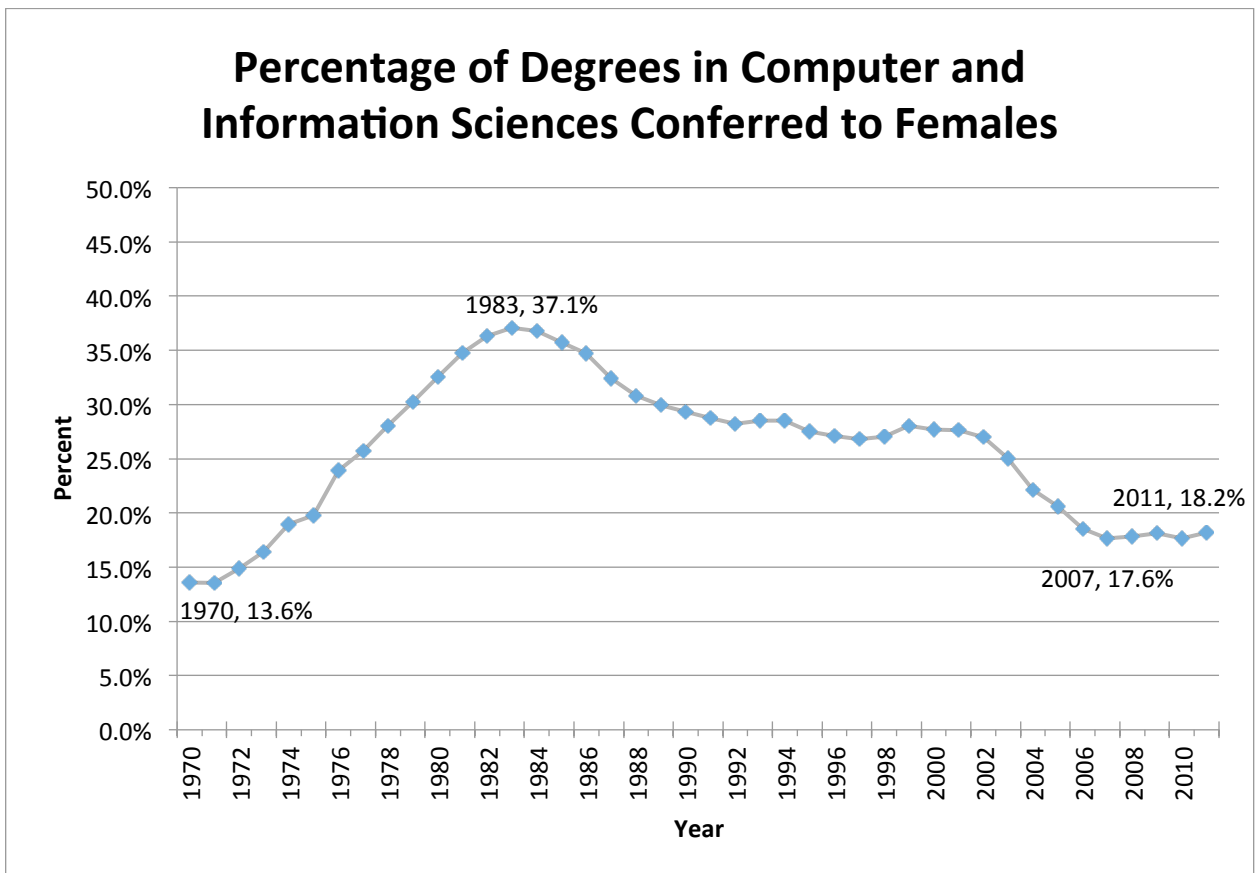
From Computer Girls to Computer Nerds

After World War II, the rapid growth of computing initially opened more opportunities for women. Linda Shafer, IEEE Computer Society Press Chair, who worked at NASA during the space race, recalled

> In 1966 there was already a "manpower" shortage of trained (or even untrained) programmers, operators, and software designers. The situation became a crisis when an estimated 50% more programmers would be needed by 1967…there were free-flowing funds in collecting the workers, and there were no barriers to race, religion, political leanings, or gender. Just about anyone who could pass an aptitude test, believed in the mission, and loved challenges in logical thinking was brought on board (Misa, 2010, p. ix).

The need for programmers was so great that the April 1967 issue of *Cosmopolitan* magazine featured an article titled "The Computer Girls," encouraging young women to explore the computer industry (Misa, 2010, p. 115). No prior education or experience was required. The only criteria was that they pass an aptitude test. Such aptitude tests proved to be a double-edged sword for aspiring "computer girls." Aptitude testing initially opened doors for many women, as testing was open to all, regardless of background. The first aptitude tests focused on pattern recognition, logical thinking, and mathematical ability. However, later aptitude tests included personality profiles. Psychologists for the System Development Corporation developed the first personality profile for the programming profession. They attributed mathematical inclinations and a "disinterest in people" to successful programmers.

Unfortunately, personality tests inherently selected for men, as few women at the time possessed

mathematical degrees, and antisocial characteristics are more common in males than females. The myth

of the "computer nerd" originated from such dubious personality tests (Misa, 2010, pp. 157-159). The

"computer girls" left the field.

Percentage of Degrees in Computer and Information Sciences Conferred to Females

1983, 37.1%

2011, 18.2%

1970, 13.6%

2007, 17.6%

Percent

Year

Computer Women Today

Women in computer science today are an endangered species. The percentage of bachelor's

degrees in computer science awarded to women peaked at 37.1% in the 1983-1984 academic year.

Today the percentage of bachelor's degrees in computer science awarded to women nationwide is 18.2%

(National Center for Education Statistics, 2013). Female enrollment in Northeastern's College of

Computer and Information Sciences (CCIS) is 19%, about the National Average (Sugie, 2014).

Researchers have many theories about why few females enter Computer Science. For example, two

researchers, Heather Tillberg and J. McGrath Cohoon, visited sixteen universities, and conducted 31 focus groups with 182 male and female undergraduate computer students to find answers. They found three prominent differences between men and women. First, fathers worked in the computer industry more often than mothers. Since one of the most important factors in a child's choice of career is the career of the same-gender parent, the absence of women in computer science discourages future women from entering. Second, the researchers found that males were more attracted to competitive aspects of computing, notably gaming, whereas females were more attracted to the creative aspects of computing, such as design. Gaming is emphasized in computer science curriculums more than design. Finally, the researchers reported "few men and no women wanted to work in isolation" (Tillberg & Cohoon, 2005). The perception of computing as a field dominated by antisocial male gamers deters women, and even some men, from studying computer science.

Recoding the Field

In the vast majority of college campuses, one would be hard-pressed to find a woman majoring in computer science. However, there is one university where women in computer science are not exceptions, but norms. The proportion of women entering Carnegie Mellon's undergraduate computer science program rose from 7 percent in 1995 to 42 percent in 2000. This coincided with an overall growth of the program from 96 to 130 students (Margolis & Fisher, 2002, p. 130) Carnegie Mellon achieved their results by deemphasizing computer experience in the admissions criteria, redesigning the curriculum, and reaching out to high schools. First, Carnegie Mellon eliminated the admissions preference for highly experienced students, and encouraged students with no prior experience to apply. Second, the school began assigning the best professors possible to the courses where women reported having the most difficulty. Third, the computer science program added courses that place technology in the context of real-world uses. Finally, the university built relationships with certain high schools through an outreach program, which resulted in enrollment from those schools doubling for both male

and female students (Margolis & Fisher, 2002, pp. 130-134). Carnegie Mellon's experience shows that despite preconceived notions about the nature of computing, women can sustain interest in computer science, and succeed in the field.

Conclusion

The first computers were born through the combined efforts of men and women working towards a common goal. Male engineers designed computer hardware while female programmers wrote instructions to keep computers running. Women such as Grace Hopper worked long hours in noisy, uncomfortable conditions in order to prove themselves capable of being in the workforce, and serving their country. Unfortunately, the first female computer pioneers were rarely recognized for their work, and left the field without women to replace them. However, women in computing today receive another chance to shine. Today's computers come in all shapes and sizes such as desktops, laptops, tablets, cell phones, medical devices, and much more. They are no longer built solely to perform complex mathematical equations, but also to communicate with others around the world. This shift in the role of computing requires a parallel shift in company culture, from the selection of intelligent, antisocial, mathematically-inclined "nerds," to the selection of social, innovative candidates from diverse backgrounds. Therefore universities must recognize the need for skilled computer workers of all backgrounds, debunk the "nerd" stereotype, recruit more students into their programs through outreach efforts, and teach students to design better programs for a better world.

Works Cited

Abbate, J. (2012). *Recoding Gender : Women's Changing Participation in Computing.* Cambridge, MA: MIT Press.

Margolis, J., & Fisher, A. (2002). *Unlocking the Clubhouse: Women in Computing.* Cambridge, MA: MIT Press.

Misa, T. J. (2010). *Gender Codes : Why Women Are Leaving Computing.* Hoboken, New Jersey: IEEE Computer Society.

National Center for Education Statistics. (2013, September). *Advance Release of Selected 2013 Digest Tables*. Retrieved from Digest of Education Statistics: http://nces.ed.gov/programs/digest/2013menu_tables.asp

Sugie, M. (2014, April 10). *Women in computer science call for more CISters*. Retrieved from The Huntington News: http://huntnewsnu.com/2014/04/women-in-computer-science-call-for-more-cisters/

Tillberg, H., & Cohoon, J. M. (2005). Attracting women to the CS major. *Frontiers*. Retrieved from http://ezproxy.neu.edu/login?url=http://search.proquest.com/docview/232347129?accountid=12826

CELEBRATING WOMEN IN COMPUTING!
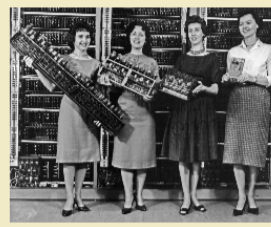
by Beatrice Zhang

The Pioneers

Before modern computers, key punch machines were used to perform calculations.

Workers who performed complex calculations, such as those for ballistic trajectories, were called "computers."

The women who programmed the ENIAC computer in WWII are widely celebrated as the world's first programmers.

Grace Hopper coined the term "bug" after discovering a moth in an early computer.

Computer Girls to Computer Nerds

The Computer Girls
BY LOIS MANDEL

A trainee gets $8,000 a year ...a girl "senior systems analyst" gets $20,000—and up! Maybe it's time to investigate....
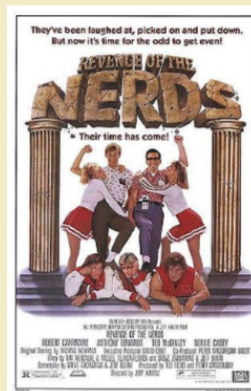
The April 1967 issue of Cosmopolitan magazine featured an article titled "The Computer Girls."

A severe shortage of programmers opened doors for smart young women.

In "Computer Girls," Grace Hopper compared programming to "planning a dinner."

The only requirement for becoming a programmer was to pass an aptitude test, at first.

Psychologists for the System Development Corporation developed the first personality profile for progammers.

Researchers used questionable methodology.

They attributed mathematical inclinations and a "disinterest in people" to successful programmers.

Selection for antisocial traits helped fuel the "nerd" stereotype.

"Revenge of the Nerds," a story of male computer science students, was released in 1984.

The Numbers Story

Percentage of Degrees in Computer and Information Sciences Conferred to Females, 1970-2012
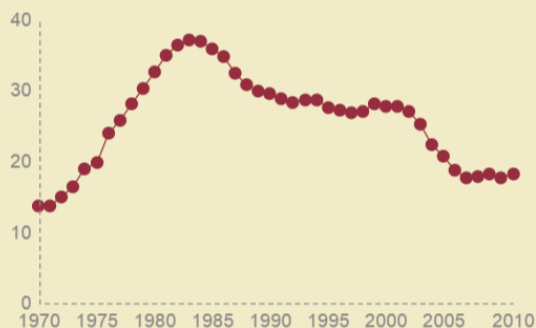
37.1% of computer science degrees were awarded to women in 1984, the highest in history.

Only 18.2% of computer science degrees were awarded to women in 2012.

Today, women are more underrepresented in Computer Science than in any other STEM field.

Today's Computer Women

by Beatrice Zhang

Recoding the System

A research study conducted at 16 universities showed a few important differences between male and female computer science students:

Women are less likely to have role models in computer science.

Women are usually more attracted to creative aspects of computing, than to competitive ones.

Few men, and no women, wished to work in isolation.

Carnegie Mellon recoded its computer science program, increasing female representation from 7% in 1995 to 42% in 2000

Prior computing experience was deemphasized in the admissions process.

Introductory courses were assigned the best professors possible. New courses placed technology in the context of real-world uses.

Outreach programs at select high schools doubled enrollment of both males and females from those schools.

Computing at Northeastern

Northeastern's College of Computer and Information Sciences (CCIS) offers majors in Computer Science, Information Science, and combined majors.

Northeastern University
College of Computer and Information Science

CCIS doubled enrollment of women in 5 years, from 8% to 19%.

Northeastern Women in Technology (nuWiT) is a club that supports students interested in computer and information science.

ANITA BORG INSTITUTE
GRACE HOPPER CELEBRATION
OF WOMEN IN COMPUTING

nuWiT organizes annual trips to the Grace Hopper Celebration, held once a year in memory of computer pioneer Grace Hopper.

Sources

Computer Girls - Gender Codes : Why Women Are Leaving Computing by Thomas Misa

Carnegie Mellon - Unlocking the Clubhouse : Women in Computing by J. Margolis and A. Fisher

Gender Differences - "Attracting Women to the CS Major" by H. Tillberg and J. M. Cohoon

Statistics - "Advance Release of Selected 2013 Digest Tables," National Center for Education Statistics

ccis.neu.edu

ccs.neu.edu/groups/CISters/

gracehopper.org

Images:
Ballistics calculations, ENIAC, Computer Girls - http://nursingclio.org/2014/10/14/women-in-tech-from-eniac-to-mom/ | Key punch machine, Revenge of the Nerds - Wikipedia
Grace Hopper - http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Hopper.html

Piktochart

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