Title

Women in Computer Science and Electrical Engineering: A Network of Our Own

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Women in Computer Science and Electrical Engineering: A Network of Our Own

by Sheila M. Humphreys

It just helped me feel more normal. Kathie Nichols, PhD 1984

WICSE presidents at the WICSE 40th Anniversary, March 2018, UC Berkeley Front row (left to right): Judith Hoffman (2012), Ginger Smith (2014), Katya Gonina (2009) Back row: Paula Hawthorn (1977), Gitanjali Swamy (1993), Megan Thomas (1998), Barbara Simons (1978), Hayley Iben (2002-03), Linda Kamas (1992), Chelsea Finn (2015), Alice Ye (2017), Chen-Nee Chuah (1997), Coline Devin (2017), Kim Keeton (1995)

Background

During the year 2020, the University of California celebrates the one hundred fiftieth anniversary of the admission in 1870 of women to Berkeley. Chronicling the history of women

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students is central to the 150W celebration. From the outset women student organizations have been change agents on campus. Thus, the story of the graduate women's student organization WICSE (Women in Computer Science and Electrical Engineering), in UC Berkeley's Department of Electrical Engineering and Computer Sciences (EECS), adds a timely dimension to the 150W History Project. Since the late 1970s, WICSE has pursued the goal of increasing the number of women in those disciplines and supporting their academic progress. WICSE has become a permanent force in EECS, and, indeed, is the first such group in an American university with a disciplinary focus on computer science or electrical engineering. Since then, women's groups have been created in most computing departments. The establishment of WICSE created peer support and a strong voice for women graduate students, and the faculty has relied on WICSE to monitor the climate for women ever since. Surely there is a connection between the remarkable number of EECS alumnae who are leaders in academia, industry and government, and their participation in WICSE as students.[1]

Since first enrolling at Berkeley, women students formed separate organizations in response to their exclusion from campus facilities like the gymnasium or the men's Senior Bench. Women were kept out of most student organizations and even some classes. By 1876 a Young Ladies Club had sprung up at a time when only forty-five women were enrolled. Seven years after the establishment of the coeducational Associated Students of the University of California (ASUC), women created their own Association of Women Students (AWS) in 1894, to represent their interests. AWS coordinated all-female extracurricular groups, such as *Sports and Pastimes,* drama, music and debate. Although women were not eligible for election to the ASUC Executive Committee, AWS had to contribute one quarter of their income to the ASUC. For thirty years AWS maintained its autonomy, until campus culture changed after World War I and women gained independence in the prosperous, peacetime "flapper era." The Association of Women Students did not merge with ASUC until 1923.

The oldest honor society for college women was created at Berkeley. In 1901 two Berkeley seniors, Agnes Frisius and Adele Lewis, founded the Prytanean Honor Society, composed of top student leaders drawn from all the women's groups, including the AWS, sororities, sports, and the YWCA. Prytanean's ideal was service to the university, a counterpart to the male-only Order of the Golden Bear, established a year earlier. The Prytanean Alumnae organization continues today to promote student leadership and the advancement of women faculty in their quest for tenure.[2]

After 1910, women began to challenge their unequal status on campus more directly. During the First World War, the enrollment of women increased to 53 percent, and they claimed leadership positions formerly held by men. Gaining the right to vote in 1920 was a step towards gender equity and presaged the optimism of the 1920s. Similarly, during World War II women

took over as President of ASUC, Editor in Chief of the Daily Cal newspaper and of the Blue and Gold Yearbook. In post war years, an influx of veterans returned to campus after 1945 under the GI Bill while women were encouraged to return to traditional roles. On campus and in the country, the "silent 1950s" were a decade of conservatism. But in the 1960s the women's liberation movement was gaining steam and everything changed.

The Free Speech Movement, civil rights and anti-war protests spurred campus women to organize in the next decade. In 1970 Professors Elizabeth Colson (anthropology) and Elizabeth Scott (statistics) were asked to write a report to the Academic Senate on the status of women. Colson, Scott and their committee demonstrated differential treatment of and discrimination against women at Berkeley at every level, from faculty hiring to admission of women graduate students. The *Report on the Subcommittee on the Status of Academic Women on the Berkeley Campus*[3] dramatically raised awareness and turned the tide in terms of hiring women. The next year Susan Graham was hired by the College of Letters and Science as the first woman computer science faculty member. She later became the first woman faculty member in the College of Engineering when CS merged with EECS in 1973. Graham remained the sole female faculty member in EECS from 1971 to 1988.

The Founding of WICSE

Women math and science students organized early at Berkeley. By 1900 women interested in advanced math organized the XYZ Club and women chemists started a group called the *Chemistry Fiends*. Since women students were a distinct minority and women faculty almost nonexistent in engineering, they felt isolated. In 1977 the few women graduate students in computer science began to meet informally for lunch in the seventh-floor lounge of Evans Hall. (Early participants were Susan Eggers, Paula Hawthorn, Linda Lawson, Jane McGrath, Marie-Anne Neimat, and Barbara Simons, often joined by Deborah Estrin, an undergraduate in the CS major.) The two leaders, Paula Hawthorn and Barbara Simons, were "older" returning students and single parents. Diane McEntyre, a doctoral student in the School of Education's SESAME program (the Graduate Group in Science and Mathematics Education), enthusiastically

Barbara Simons, PhD 1981

mentored the group. An outstanding teacher, McEntyre was an early proponent of teaching computer science in a way that was more welcoming to women.[4] The students adopted the name WICS (Women in Computer Science) but soon strategically added "E" for "engineering" in order to qualify for funding from the College of Engineering. None of the WICSE founders had majored in computer science prior to graduate school, and some had to struggle to gain admission. The graduate women were determined to attract more women to study computer science at both the undergraduate and graduate levels.

Deborah Estrin (BS CS 1980) discussed her experiences as a student when she was featured in an article in the Massachusetts Institute of Technology (MIT) alumni *Connector*: "Deborah Estrin also considers herself very fortunate to have met influential women mentors while she was an undergraduate at Berkeley." Among the women whom Estrin acknowledged was Barbara Simons. Inspired by WICSE and the spirit of Berkeley in the 1970s, Estrin is quoted as saying, "I left Berkeley not only with a desire to invent things but also with a lot of idealism and activism. I wanted to fix the world, not just solve technical problems."[5] A professor of computer science at Cornell University and winner of a MacArthur "genius grant," Estrin has become increasingly visible at Berkeley. In her commencement address to Berkeley's 2019 graduating class in computer science,[6] she reflected on her undergraduate education as well as the influence of WICSE. Estrin will serve on the external team conducting a once-a-decade academic review of the EECS Department in 2020.

The First Women PhDs in EE and CS

During the decade of the 1970s fourteen women earned doctoral degrees in EE or CS at Berkeley. Over half of them chose a career in academia: Dana Angluin, Barbara Grosz, Faye Duchin, Estela de Llinas, Rabab Kreidieh Ward, Ana Flora Pereira Humes, Anne-Louise Radimsky, and Patricia Daniels. Amazingly, at least four of these alumnae are still active in academic careers at the time of this writing: Dana Angluin, Barbara Grosz, Estella Llinas and Anne-Louise Radimsky.

Women Doctoral Graduates of the 1970s

Year	EE	CS
1972	Rabab Kreidieh Ward	Carol Ziegler
1973		Anne-Louise Radimsky, Faye Duchin
1974	Patricia Daniels	Anne Cottrell
1975		Nancy McDonald
1976	Ileanna Gross Krumme	Dana Angluin
1977	Estela Soria de Llinas	Barbara Grosz
1978	Ana Flora Humes, Karel Youssefi	
1979		Paula Hawthorn, Marie-Anne Neimat

Graduate Alumnae with Careers in Academia (1969-1979)

The first woman to earn a doctorate in electrical engineering at Berkeley was **Kawthar Zaki,** in 1969. Born in Egypt, Zaki studied under Professor Andrew Neureuther to earn her MS and PhD degrees. In 1970, she joined the Electrical Engineering Department at the University of Maryland at College Park, as the first woman hired in the College of Engineering; she is currently professor emerita of electrical and computer engineering there.[7]

Rabab Kreidieh Ward earned her PhD in electrical engineering in 1972 and was the first woman appointed in electrical and computer engineering at the University of British Columbia. A prolific researcher over four decades, Ward is co-author of more than 500 refereed research papers. Among her many scientific awards is election in 2020 as an international member to the National Academy of Engineering for her "innovative

applications of signal processing to industrial and bioengineering problems." In 1999 she became the first woman in electrical engineering to become a Fellow of the Royal Society of Canada.[8]

Anne-Louise Guichard Radimsky (1941-2020), a native of France, graduated in 1973 in computer science, and was hired at UC Davis, the first woman faculty in computer science. Radimsky worked in aeronautical engineering in France before earning a scholarship to study computer science at Berkeley. She still taught upper-division CS courses at California State University Sacramento when this article was first published.[9]

Faye Duchin, a psychology graduate from Cornell, also obtained her PhD in computer science in 1973 (Michael Stonebreaker was her advisor) writing a dissertation titled *Rents, Rent Control, and Non-Profit Rent Schedules: Analysis and Computer Simulation*. Duchin joined the Economics Department at Rensselaer Polytechnic Institute.[10]

 Patricia Daniels, both a Berkeley undergraduate and PhD (EE 1974) alumna, spent her academic career at the University of Washington and the University of Seattle, with time spent at the National Science Foundation(NSF) as Program Director for Undergraduate Education.[11]

Dana Angluin received her PhD in computer science in 1976, with Manuel Blum as her research advisor. She joined the Computer Science faculty at Yale University in 1979 and has remained there ever since. She was a math undergrad at Berkeley ('69) and took computing classes in community college as none was offered at Berkeley. She got her start doing undergraduate research with Butler Lampson. Professor Angluin is active and continues to teach computing to Yale undergraduates.[12]

Barbara Grosz (PhD CS 1977*),* Higgins Professor of Natural Sciences at Harvard University, came to Berkeley as a math graduate of Cornell. Grosz has been honored for her pioneering work in Artificial Intelligence and her leadership roles at Harvard as Dean of the Radcliffe Institute of Advanced Studies and Founder of the Center for the Study of Language and Information. While leading the Radcliffe Institute, she chaired a comprehensive study of women faculty in STEM at Harvard. Grosz is currently a leader at Harvard in the Embedded Ethics project to integrate ethical reasoning and philosophy into the computer science curriculum. One would never know that Grosz had difficulty finding a doctoral advisor, until Professor Martin Graham stepped in to help.[13]

Estela S. de Llinas (PhD EE 1977) traveled to Berkeley from Cordoba, Argentina. Already married, she completed an undergraduate degree in Physics at Berkeley. Llinas is still a professor of engineering and mathematics at the University of Pittsburgh and has returned to teach courses at Berkeley in the summer. Llinas noted that the women in the PhD program in her cohort were not from the US. By the time she completed her dissertation, she had two children, and has been a champion for women in the field throughout her career.[14]

Ana Flora Pereira de Castro Humes (EE MS 75, PhD 78) spent her career as professor of Applied Mathematics and Statistics at the University of Sao Paolo, Brazil.[15]

# Synergy with the UC Women's Center

A collaboration with the Center for the Continuing Education of Women (Women's Center, CCEW) figured in the early days of WICSE. The Center was established in October 1972 after ten years of discussion among faculty, faculty wives, and community members. In the 1960s, UCB sociologist Neil Smelser, along with prominent academic wives such as Frances Townes and Beatrice Bain joined by Prytanean alumnae, played a key role in convincing the university of the need to establish a center to support the educational goals of "older" women who wanted to return to higher education.[16] Bain was typical of many women scholars married to Berkeley faculty, thus barred from employment due to nepotism rules. The staff and Advisory Board of the Women's Center joined the women faculty and students in the 1970s to lobby for a women's studies program.

In 1977, graduate students Barbara Simons and Paula Hawthorn approached Dr. Margaret Wilkerson, director of the Women's Center (CCEW), to propose a set of workshops to expose women students to engineering and computer science, and present strategies for admission to the major and to graduate school. At this point, the programs of the Women's Center shifted from community women to enrolled women students. Wilkerson agreed to a new program focusing on women in science. She asked the author in her role as associate director of the Center, to work with STEM students to promote opportunities for women in computer science, math, physics, and engineering. Simons, Hawthorn, and other students led a series of workshops on strategies for getting into the computer science major and gave a rosy view of employment opportunities in the field. Growing synergy between the Women's Center and the engineering students resulted in a STEM speaker series featuring national leaders such as Naomi MacAfee, former national president of the Society of Women Engineers; Janet Welsh Brown, director of the Environmental Defense Fund; and Dr. Nancy Cummings of the National Institutes of Health. The Women's Center cosponsored the first conference for women in engineering in 1978, an event with far-reaching consequences.

Paula Hawthorn PhD CS 1979

First Women in Engineering Conference: Working in Computer Science and Engineering

Working in Engineering and Computer Science

A Conference for Women
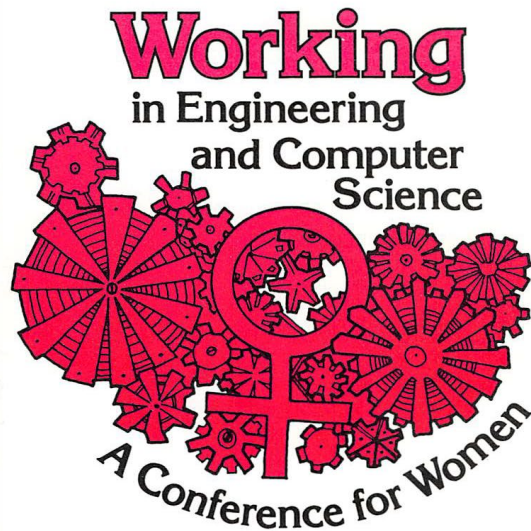
Saturday May 13, 1978
University of California, Berkeley
Wheeler Auditorium

Sponsors:

Bank of America
Ford Motor Company Fund
College of Engineering, UCB
Professional Development Program, UCB
CCEW Women's Center, UCB

The graduate women in WICSE decided to organize a major Bay Area conference for women to promote the study of computer science and engineering, and to examine barriers to women's entry into the field. The first ever conference held on the Berkeley campus for women in engineering proved to be a catalyst for women in the computer science community. *Working in Engineering and Computer Science* attracted more than six hundred participants on May 13, 1978, and resulted in a grassroots movement to recruit women more actively.

Simons and Hawthorn appealed to Provost George Maslach, explaining the difficulty faced by women wishing to enter the computer science major. As older, reentry students, they reflected the perspective of outsiders, writing "We would like to point out to you a problem we have encountered in our efforts to recruit women into the department. There is in this school a bias against the 'non-standard student.' We define 'standard' for undergraduates as straight out of high school, and for graduates, having immediately previously earned a BS."

The College of Engineering allocated $3,000 from a Ford Motor Company grant to support the women's conference. A very diverse group of women from campus units and student groups joined to plan and sponsor the daylong event. Staff from the Career Center, the Office of Admissions and Outreach, and representatives from industry, gave talks and workshops. Women scientists and students filled Wheeler Hall, the campus's largest lecture hall, and

generated a sense of possibility for all who attended. The most senior faculty member present, Elizabeth Scott (statistics), moderated a panel and played a prominent role. All five of the women then on the engineering faculty took part; three were ladder-rank faculty, and two were lecturers.[17] The College of Engineering had recently hired a second woman faculty member, in mechanical engineering (ME). During one panel, Barbara Simons joked that ME had increased the number of women faculty by 100 percent. In an intense atmosphere, the panelists told their stories, and the audience posed questions. Conference speakers shone a spotlight on the low enrollment of women in engineering and the barriers they faced. Scott forcefully challenged existing graduate admissions and financial aid policies that day and

Students at the Women in Engineering Conference, 1978

the next week expressed her concerns in a memo to Associate Dean David Pirtz of the College of Engineering:

Turning to women in graduate engineering, it seems to me that a problem which Engineering still faces is the tiny proportion of applicants who are women: my data show that only 3.4% of applicants are American white women; and they are 0.2% Black women. The data also indicate that American women are getting only one-third the University financial support they should be getting (in fact, I find only one such woman so the numbers could not be much smaller). . . . It seems to me important to attract strong women into your graduate program and to support them, which in itself will serve to attract more women.[18]

Thelma Estrin (1924–2014), professor of computer science, UCLA

The following week, Thelma Estrin, chair of the Institute of Electrical and Electronics Engineers (IEEE) Committee of Professional Opportunities for Women, and professor of computer science at the University of California, Los Angeles (UCLA), wrote an affirming congratulatory memo to the organizers. Estrin articulated to women students the possibilities that engineering offers for solving societal problems. She wrote "The definition of engineering which I like is 'a profession in which a knowledge of the mathematical and natural sciences is applied with judgment to utilize the materials and forces of nature for the benefit of mankind. To me, your conference was a confirmation of an opinion I have long had: The entry of women will improve both the practice of engineering and the image of the profession because women, as a group, rate high in communications skills and *people* orientation. I think we will improve the delivery of engineering benefits to mankind, and even find a non-sexist word to replace *mankind*."[19]

The engineering administration responded to the WICSE conference in three ways. First, undergraduate admissions policy was freshly scrutinized, bringing to light how standard criteria, such as prior computing experience, negatively affected female applicants. Engineering administrators gained a new awareness of the hurdles female applicants faced at both the undergraduate and graduate levels. Once the admissions policy changed, more women were admitted. Second, a reentry program in computer science was initiated to open the door to graduate study to talented women and underrepresented minorities who had high potential but lacked an undergraduate degree in the field (non-standard students as Hawthorn called them). The Computer Science Reentry Program thrived throughout the 1980s, and opened a path to graduate computer science degrees for a string of women who were successful in academia and industry.[20] Third, although it took several years, the College of Engineering under Dean Karl Pister created the first permanent staff position to advocate for women and minorities in engineering at the graduate level.

Students gained momentum from the conference and set the wheels in motion for progress in the next decade. The College of Engineering had two and the EECS Department just one tenure-track woman on the faculty, at the time of the conference. During the 1980s, WICSE students worked hard on graduate recruitment and lobbied for more women faculty. In that decade, twenty-three women earned doctoral degrees. Among the PhD graduates of the 1980s who became successful at universities and in industry were Barbara Simons (PhD CS 1981), Kathie

Nichols (PhD EE 1984), Audrey Viterbi (PhD EE 1985), Belle Wei (PhD EE 1987), Teresa Meng (PhD EE 1988), and Susan Eggers (PhD CS 1989). Hiring women *faculty* was a slower process; EECS did not hire a second woman professor until 1988, Avideh Zakhor, in electrical engineering. Computer scientist Katherine Yelick followed in 1991, and Connie Chang-Hasnain and Tsu-Jae King (both in electrical engineering) joined in 1996, increasing the number from one to six women faculty in twenty-five years.

WICSE students built support by holding annual receptions for women in engineering at the Women's Faculty Club. The students identified faculty who were particularly sympathetic to women, and explained that: "The reception has as its purpose to improve the quality of academic life for women students by offering professional role models and the chance to meet and form personal contacts with other engineering students." At the initial reception in 1979, Paula Hawthorn, the first president of WICSE, recognized Professor Elizabeth Scott and the support of two male allies, computer science Professor Manuel Blum[21] and EE alumnus Dr. Jean-Paul Jacob[22] of IBM Almaden Research Center.

Dr. Jean-Paul Jacob (1937-2019) receives WICSE award for "supportive male faculty," 1979

Subsequent annual WICSE receptions honored other engineers and scientists, such as well-known biochemist and mountaineer Dr. Arlene Blum,[23] who led the women's ascent of Annapurna, and Prof. Thelma Estrin of UCLA.

Thelma Estrin was herself a reentry student. She worked as a machinist and electronic technician during the war, after taking a three-month engineering class. At the University of Wisconsin, she earned a BS, MS and PhD in electrical engineering. In the 1950s, Thelma Estrin worked in Israel with her husband Gerald to build the first electronic computer in the Middle East. She also pioneered the use of informatics in medicine. At the time of the WICSE reception, Estrin had just received the 1981 Achievement Award of the Society of Women Engineers.[24] Estrin had been active in SWE since the 1950s when she wrote a letter to SWE objecting to their "selling pie tins and silk stockings and Monte Carlo parties in the name of advancing women in the engineering profession" and urged the Los Angeles SWE chapter to "form science circles" and talk to women and children "about engineering and scientific topics."[25] Estrin strongly supported the Computer Science Reentry Program and met with the student organizers whenever she came to Berkeley.

WICSE Lunch Meetings: "A Network of Our Own"

For me the biggest ongoing thing was being able to have lunch with other women every Friday. I was on the EE side and there were very few women. It just helped me feel more normal.   Kathie Nichols

In 1983 WICSE President Kathie Nichols and Vice-President Joan Plumstead wrote a letter to all the graduate women enrolled in EE and CS. They explained how joining WICSE could provide social support to counter the isolation women graduate students might feel in their classes and research groups and, equally important, an information network:

> *As a fellow woman EECS graduate student, I'm sure you've noticed that women are quite a small minority in our field. . . . The problems we encounter as we train and work in our profession are diverse; some are major and some are minor. We think that many of these problems can be solved, or at least mitigated, by a peer support group. This is WICSE's primary function: to provide the opportunity for exchange of ideas and information between women graduate students of varied experience. As women, we often end up outside the "informal information network," so we have established a network of our own.*

Kathie Nichols, WICSE president, 1983

Occurring regularly since 1978, WICSE's core activity has been a weekly lunch meeting. The predictability of the gatherings has built a continuous structure for guest speakers and changing groups of students as they move through their degree programs. Women students of the 1980s spoke of the value of the lunches, which created "a network of our own" and a forum for visiting scholars and alumnae. Marie desJardins, president of WICSE in 1989, put it this way: "Our weekly lunches were part of what kept me on track during the tough times!"[26]

Through the WICSE lunches, EECS students have continuously hosted a large number of prominent women computer scientists and electrical engineers, from senior MIT faculty members Mildred Dresselhaus and Sheila Widnall, to Maria Klawe (then a chair of computer science at University of British Columbia)[27] and alumna Barbara Grosz, then professor of computer science and dean of Harvard's Radcliffe Institute for Advanced Study. The lunches created a space for ongoing contact between Berkeley alumnae and enrolled women. This was especially helpful in the case of Leslie Field (PhD EE 1991), who called herself an "older woman" at age twenty-eight and who switched fields from chemistry to electrical engineering as a reentry doctoral student in the 1980s after seven years working at Chevron. She explained that the WICSE community offered needed support during that transition to graduate school:

> I started Grad School at Berkeley in 1985 in the group that would later become
> Berkeley Sensor and Actuator Center as part of a career change from the R&D work
> I'd been doing in Catalysis at Chevron for 7 years, to go into Electrical Engineering in
> order to be able to have a more entrepreneurial R&D impact. . . . As a kind of reentry

student changing fields, it was a difficult transition to go from working in an area in which I had established great competence into an area I had to learn from almost-scratch. It was incredibly exciting to be learning something new again, and to find that the entrepreneurial passion was shared by others. There were few women in the EECS department at Berkeley when I entered the PhD program, but compared especially to my experience at MIT in the mid-seventies, the acceptance by fellow students and professors was a vast improvement over some of what I'd encountered there, with far more women on the Berkeley campus in general, and CS reentry program and WICSE, which all made the transitions due to being a woman (and an older woman, aged 28), and due to changing fields, much easier than it might have been.[28]

"Half the People She Knew Were Women"

An unexpected outcome of the WICSE lunches was related by Dr. Dawn Tilbury (PhD EE 1994),[29] a former president of WICSE. Tilbury related the following anecdote from her student days about how attendance at WICSE lunches created a positive perception:

One of the first-year women grad students came up to me and said, "I'm having an argument with my office mate about the percentage of women in the Department. He thinks it is less than 10%, but I think it is more like 40–50%, isn't it?" I told her it's really about 15%. What she didn't realize was that because of the weekly WICSE lunches, she knew a large percentage of the women in the Department. In fact, half the people she knew were women. . . . The WICSE alumnae guest speakers who were successful in academia or industry and came back to tell us their stories helped us to feel connected. Bringing groups of smart and determined women together is always a good recipe for inspiration, support, and action.[30]

Left to right: Lisa Buckman, Dawn Tilbury, Ginger Ogle, Gitanjali Swamy, Sheila Humphreys, and Ruth Rosenholz (horizontal) at a WICSE lunch meeting

WICSE has given students a vehicle for developing leadership skills—from soliciting funding, to organizing conferences, to articulating publicly women's concerns. Dr. Myra Boenke (PhD EE 1988) explains the affirmation she felt giving back to peers:

> *Aside from the camaraderie and safe haven, WICSE helped me in yet another way. I found, and have since heard this repeated by psychologists, that to truly feel good about yourself, you have to be helping others. I found that lending the type of helping hand to other, newer women grad students that I so much needed and appreciated when I first arrived at Berkeley helped me resolve and heal some of the turmoil and stress I carried from my first days and semesters. So I became President of WICSE and helped organize the weekly gatherings for several years. I found it to be a healing balm.[31]*

Dr. Kathie Nichols chaired a second WICSE engineering conference for women in 1988. She related what she gained from the leadership experience:

The thing that had the biggest effect on me personally was working on the conference and making things come together and learning some things about what it takes to make something happen. Whenever I was involved with an event in later years I always remembered your advice the day of the conference that all the work was done and now I should just "act like it's a big party and you are the host." Wonderful advice. I put quarters in a speaker's parking meter, smiled a lot and had a good time.[32]

Myra Boenke (PhD EE 1988) in the clean fabrication lab, 1986

WICSE recruitment and mentoring activities initiated in the 1980s continue to the present. WICSE officers represent the collective voice of women students to the assembled faculty at the annual EECS Faculty Retreat. WICSE continues to play a major role in the recruitment of women students by contacting admitted women and hosting a brunch on the department Visit Day for admitted graduate women. Marie desJardins, WICSE president in 1988, initiated peer mentoring through a Big/Little Sister matching program in which first-year women are paired with more senior students—a system that continues to the present. Recruiters from industry have established collaborative relationships and funded WICSE since the late 1970s and expressed their appreciation of the efficiency of working with a single student organization to contact potential female employees, which was unusual at the time.
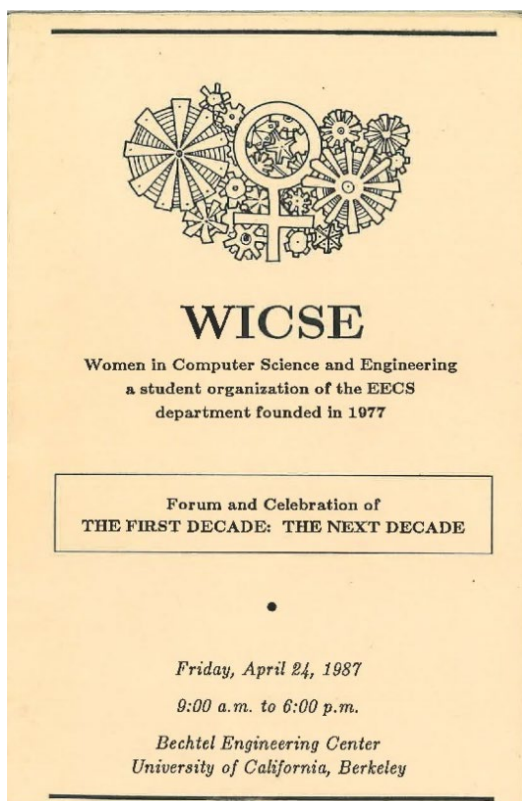
Amy Wendt giving a tour to Thelma Estrin at the 1987 Women in Engineering conference

Celebrating the History of WICSE

WICSE leadership has advocated for women in EECS for forty years and has celebrated a succession of anniversaries. Students marked the tenth, twentieth, twenty-fifth, thirtieth, and fortieth anniversaries of WICSE by organizing major gatherings of students and prominent alumnae, reflecting their evolving concerns through the decades. These celebrations have strengthened the ties between alumnae and students. In the 1980s and 90s recruiting more women students was combined with an urgent call for more women faculty, and accommodations for student parents. During the 90s, Linda Kamas (PhD EE 1996) led a group of graduate women who conducted their own research to examine the causes of higher doctoral attrition by women. They reported that of students who entered the EECS doctoral program at Berkeley in 1981-1986, 43% of the women but 61% of the men obtained a PhD. They summarized their findings with detailed recommendations to faculty for improving the "department atmosphere" and problematic relations between students and their advisors.[33] Based on student surveys, WICSE leaders make annual presentations to the faculty on issues they choose such as departmental climate, implicit bias, impostor syndrome, advising, inclusive pedagogy, safety, and measures of "belonging" at annual retreats.

Tenth and Twentieth Anniversaries: Commemorating the First Two Decades

At WICSE's tenth anniversary in 1987, Institute Professor Mildred Dresselhaus of MIT flew west overnight to lend her stature as keynote speaker. In her talk, Dresselhaus emphasized that even outstanding women students tend to underestimate themselves. She reported that, nevertheless, women doctoral students complete their degrees in about the same proportion and in the same number of years as men at MIT. She pointed out the higher percentage of women at MIT (38 percent in 1987) as compared with only 20 percent in engineering at Berkeley. The daylong program featured talks by Professor Thelma Estrin (UCLA); her daughter, Professor Deborah Estrin (University of Southern California); Professor Mary Lou Soffa (University of Pittsburgh); and alumna Dr. Audrey Viterbi (UC Irvine).

WICSE
Women in Computer Science and Engineering
a student organization of the EECS
department founded in 1977

Forum and Celebration of
THE FIRST DECADE: THE NEXT DECADE

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Friday, April 24, 1987
9:00 a.m. to 6:00 p.m.
Bechtel Engineering Center
University of California, Berkeley

Dr. Anita Borg, a researcher at Xerox Palo Alto Research Center (PARC), gave the keynote address at the twentieth WICSE anniversary in 1997. A visionary leader, Borg had founded the *Systers* virtual community of women in computer science a decade earlier.[34] Borg explained to Berkeley students why she created the *Systers* group: because she wanted to provide a space for women to discuss issues they experienced at work and share strategies.[35] *Systers* was a way to bring women together, a vast online network in which women in technology could connect with one another. Initially Borg conducted research about the *Systers* network while employed at Xerox PARC. She founded the Institute for Women in Technology in 1997 and served as its CEO until 2002. After Borg's early death from a brain tumor, the Institute was renamed in her honor. The Anita Borg Institute (ABI) sponsors the annual *Grace Murray Hopper Celebration of Women in Computing* conferences, attended each year by Berkeley students. A. Richard Newton, EECS professor and Berkeley's dean of engineering, developed a close relationship with Borg and the Institute during Borg's last years. While he was dean, Newton showed his deep commitment by both attending and personally paying from his own pocket for Berkeley Engineering to be a sponsor of the *Hopper* Conferences. Like Borg, Newton died early, in 2007. ABI created the *Educational Innovation Abie Award in honor of A. Richard Newton*; the award recognizes

educators for developing innovative teaching practices and approaches that attract female students to computing, engineering, and math in K–12 or undergraduate education.[36]

Twenty-Fifth Anniversary: Raising Issues and Consciousness

In 2002, the EECS Department's Excellence and Diversity Student Programs,[37] initiated by Chair Eugene Wong in 1986, gained national recognition. The Women in Engineering Proactive Network (WEPAN), gave EECS a Women in Engineering Programs (WIEP) award which "recognizes an outstanding program or project that serves as a model for other institutions, and demonstrates improvements in the educational environment for women in engineering." The influence of WICSE's activities beyond Berkeley was acknowledged.[38]

WICSE outreach event for middle school girls

That same year the Computer Research Association published an article describing the EECS diversity programs:

Twenty-five years ago a group of women students founded the graduate group WICSE (Women in Computer Science and Engineering), which continues to form the cornerstone of our programs for graduate women. The effectiveness of WICSE derives in part from its continuity, departmental support, and meaningful contact with CS alumnae and other prominent women in CS. The EECS Department provides WICSE with staff assistance, space, facilitation of conference travel, a guaranteed voice at the annual Faculty Retreat, and funding to support its activities.[39]

Randi Thomas, Katherine Yelick and Valerie Taylor at the 25th WICSE Anniversary, 2003

At the twenty-fifth anniversary of WICSE in 2003, former presidents and alumnae traveled to campus from as far away as Michigan and Wisconsin to participate. An afternoon research symposium featured WICSE alumnae who were faculty: Professors Amy Wendt (PhD EE 1988) at the University of Wisconsin–Madison, Dawn Tilbury (PhD EE 1994) at the University of Michigan, and Valerie Taylor (PhD EE 1991) at Texas A&M University. Tilbury and Wendt were among the eighteen former WICSE presidents who attended the celebration. Lisa Buckman Windover (PhD EE 1996), Agilent Labs, summed it up: "There were definitely some women who stood up at this reunion and said they were on the verge of quitting many times and that there is no way they would have finished if it weren't for the people in this group (WICSE)."[40]

A party following the symposium was enlivened by a loud salute from Cal's marching band. Mary Ann Mason, dean of Berkeley's Graduate Division, recognized WICSE's role as change agent: "You have raised issues and consciousness extending far beyond your starting point, helping change policies at Berkeley and across the nation. I consider it an honor indeed to congratulate WICSE and all who support it, not only for overcoming a variety of odds and surviving for a quarter-century, but for providing an extraordinary resource for many women at a critical point in their lives."[41]

WICSE's twenty-fifth anniversary, Soda Hall, UC Berkeley, 2003

Thirtieth Anniversary: A Shining Example

WICSE celebrated a thirtieth anniversary in 2008, at an event organized by WICSE President Lynn Wang (PhD EE 2009). Winner of the Turing Award, the most prestigious in computer science, IBM Fellow Frances E. Allen was the main speaker. Her award, the equivalent of a Nobel, symbolized a turning point for women computer scientists.[42] Allen gave a public lecture on her pioneering research, *The Challenge of the Multi-Cores: Think Sequential, Run Parallel*. Two decades earlier Fran Allen had interacted with women students when the campus named her a Regent's Lecturer in the Computer Science Division. For doctoral alumni who worked at IBM T.J. Watson Research, Allen was known to be a legendary mentor.

With Professor Teresa Meng, Stanford University, and Belle Wei , dean of engineering at San Jose State University, Allen engaged in highly candid *Conversation about Women Engineers* at the Women's Faculty Club. Meng made after-dinner remarks in which she recounted the challenges she overcame in founding a startup company after being turned down for venture capital: "My conclusion was that if this was going to happen, I had no other option but to start a company and do it myself." Meng, a member of the National Academy of Engineering, said she learned persistence from her startup experience and that she practiced "the three F's: Focus, Faith, and Fortitude."[43]

Left to right: Frances Allen, Belle Wei, Teresa Meng, and Susan Graham, WICSE's thirtieth anniversary, 2008

Andrew Szeri, Dean of UC Berkeley's Graduate Division, acknowledged WICSE's influence on the campus in his message to participants at the thirtieth WICSE celebration, "In my view, effective mentoring systems are key to supporting women through the pipeline, and for 30 years, WICSE has been a shining example of women sharing knowledge for personal support and collective advancement. Your accomplishments have helped change not only your lives and workplaces but the character and quality of UC Berkeley overall, and beyond."[44]

WICSE thirtieth anniversary, Women's Faculty Club, UC Berkeley, March 2008

Fortieth Anniversary: Filling the Pipeline with Qualified Women

Alumnae and current students celebrated the fortieth anniversary of WICSE on March 17, 2018, with a daylong program of research presentations and reflections. By the time of that anniversary, a woman was the chair of EECS, Tsu-Jae King Liu. Students created a website with biographies of the alumnae speakers and transcriptions of the talks.[45] Senior faculty King Liu, Katherine Yelick, Claire Tomlin and Marti Hearst participated as speakers and panelists. WICSE co-founder Barbara Simons opened the program by recalling the history of WICSE from a personal perspective, and how hard it was to return to school after nine years as a single mother with three young children. Motivated to help talented women without enough

credentials to qualify for graduate programs equal to Berkeley's, she and her "co-conspirator" Paula Hawthorn realized their vision by co-founding the Computer Science Reentry Program. Simons, who is internationally known for her work on the integrity of U.S. elections, then pivoted to share her deep worry about voter security, citing the disastrous results in the presidential election of 2000.

Dr, Marie-Ange Eyoum Tagne (Roku) and Prof. Farinaz Khoushanfar (UCSD)

Alumnae from each decade spoke. Berkeley EECS Professor Claire Tomlin (PhD EE 1998)[46] led a discussion about diversity, asking panelists to discuss the diversity programs they were implementing in their universities and companies. Tomlin cited the *Girls in Engineering*[47] camp for middle school girls she had started five years earlier. Graduate student Regina Eckert presented Bias Busters at Berkeley, a very active grassroots group of men and women students in EECS which offers workshops across campus to reduce bias.[48] Each speaker explained in why WICSE was important during their graduate days. Dr. Marie-Ange Eyoum-Tagne (PhD EE 2006) told of her ongoing involvement in outreach, from her grad student days in BGESS (Black Graduate Engineering and Science Students) and later at Intel: "It's very personal. I am always the only one, the only Black woman." Eyoum-Tagne mentors young women in Africa through TechWomen.[49] Professor Chen-Nee Chuah (PhD EE 2001) recalled the unusual ratio of women to men in her Berkeley lab when six out of seven graduate students were women. She made the point that presently *retaining* women is more critical than *recruiting women.* A senior faculty member at UC Davis, Chuah has purposefully worked on creating a culture in which

women feel a "sense of belonging." Often students get discouraged, she went on, by measuring themselves only against the "stars" rather than those who have followed a less direct but equally viable path.

During the afternoon, WICSE Co-presidents Coline Devin and Alice Ye saluted the most senior woman present, Professor Ruzena Bajcsy, for the wisdom and inspiration she has given generations of women in robotics and computer science.[50] Spontaneously, Bajcsy took the microphone to make two points. First, she declared, "We, meaning UC Berkeley, are filling the pipeline with highly qualified women." Second, she urged the students to ponder the consequences of the technology they are developing. "Technology is disruptive. I beg of you," she asked, "to think about the results and how the profits of the technology you develop should be shared," stating that all the profits need not go back to industry but could help social problems.

A "Fireside Chat" between Associate Provost Tsu-Jae King Liu and Diane Greene (MS CS 1988), former CEO of Google Cloud, concluded the program. Greene participated in the CS Reentry Program in the early 80s, which enabled her transition to graduate school in computer science at Cal. She traced her path from being a windsurfing champion, to earning a master's degree in computer science from Berkeley, to founding and then selling VMWare, a very successful company, and recently managing Google Cloud. Greene connected her ability to take risks to the independence she was given as a child sailing on the eastern shore of Maryland. Greene emphasized that she always tried to figure out what jobs would make her happy and went after

Diane Greene and Professor Tsu-Jae King Liu, WICSE fortieth reunion, 2018

them. Her advice to students was this: "Stay in touch with what it is that makes you happy. It is the hardest thing to figure out but it's the best thing."

Over the course of successive celebrations of WICSE anniversaries since the 1980s, Berkeley alumnae have made it clear that the WICSE community exerted a profoundly beneficial influence on their experience after leaving Berkeley. WICSE alumnae who are deans, chairs and managers across the country have instigated their own programs to promote women at their universities, companies and government agencies. Erin Summers (PhD EE 2012) co-created with her Facebook colleague an acclaimed online role model program Wogrammer in 2015. Wogrammer has reached 4 million people and has published 250 profiles of women.[51] Amy Wendt founded Women in Science and Engineering Leadership (WiSELi) at the University of Wisconsin. Nancy Amato (MS CS 1988), Marie desJardins (PhD CS 1992), Ming C. Lin (PhD CS 1993), Nina Amenta (PhD CS 1994), Andrea Goldsmith (PhD EE 1994), Janice Hudgings (PhD EE 1999), Valerie Taylor, and Belle Wei serve or have served as deans, department chairs and provost at top schools. Valerie Taylor and Dawn Tilbury head federal research agencies at Argonne National Laboratory and NSF, respectively.

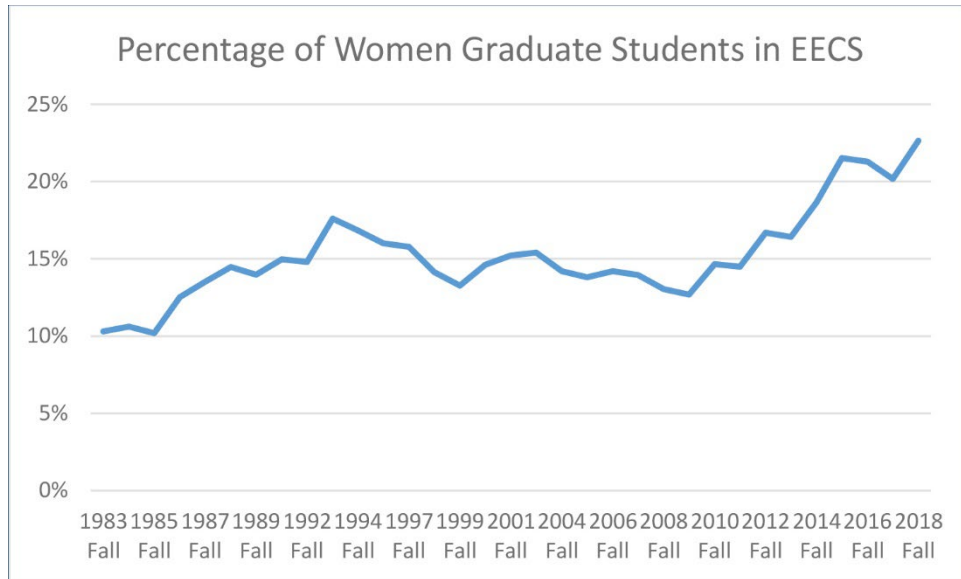# Is WICSE Still Relevant?
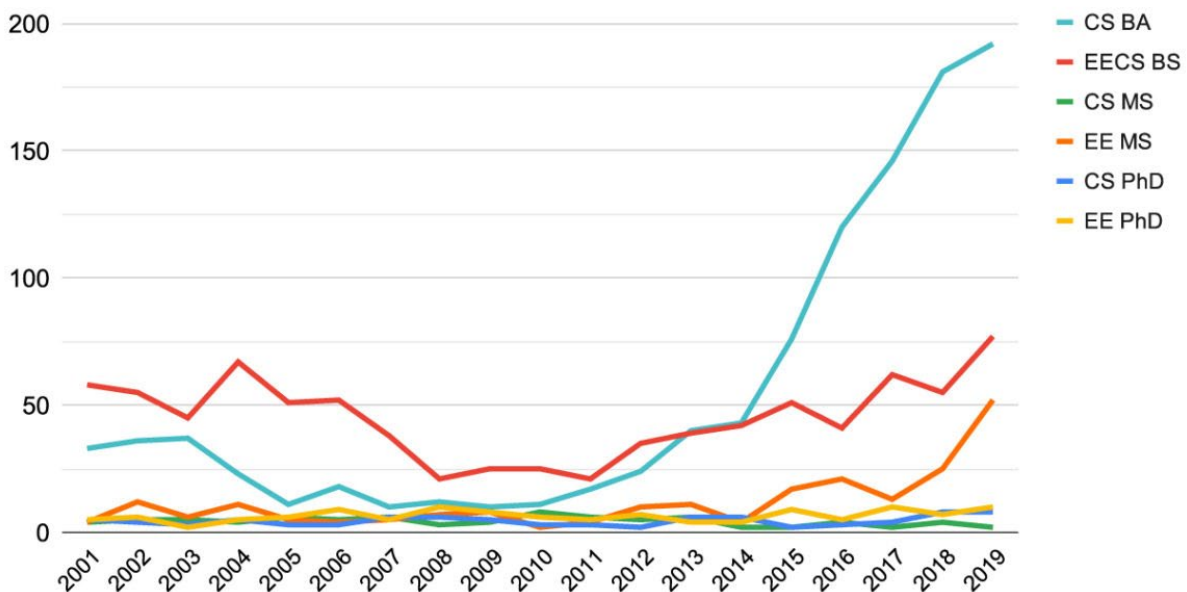
Source: CalAnswers

Berkeley's computer science population has increased dramatically in the past five years. Since 2009, the number of CS majors has almost tripled: from 1133 to 3172. With increased demand

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for computer science, the criteria for admission to the major have become much more selective. While the number of women majoring in computer science and the number of degrees earned have greatly increased, the percentage of women in the major is about where it was in the 1980s, despite successful academic intervention programs serving entering freshmen and transfer students. Progress has been slow.
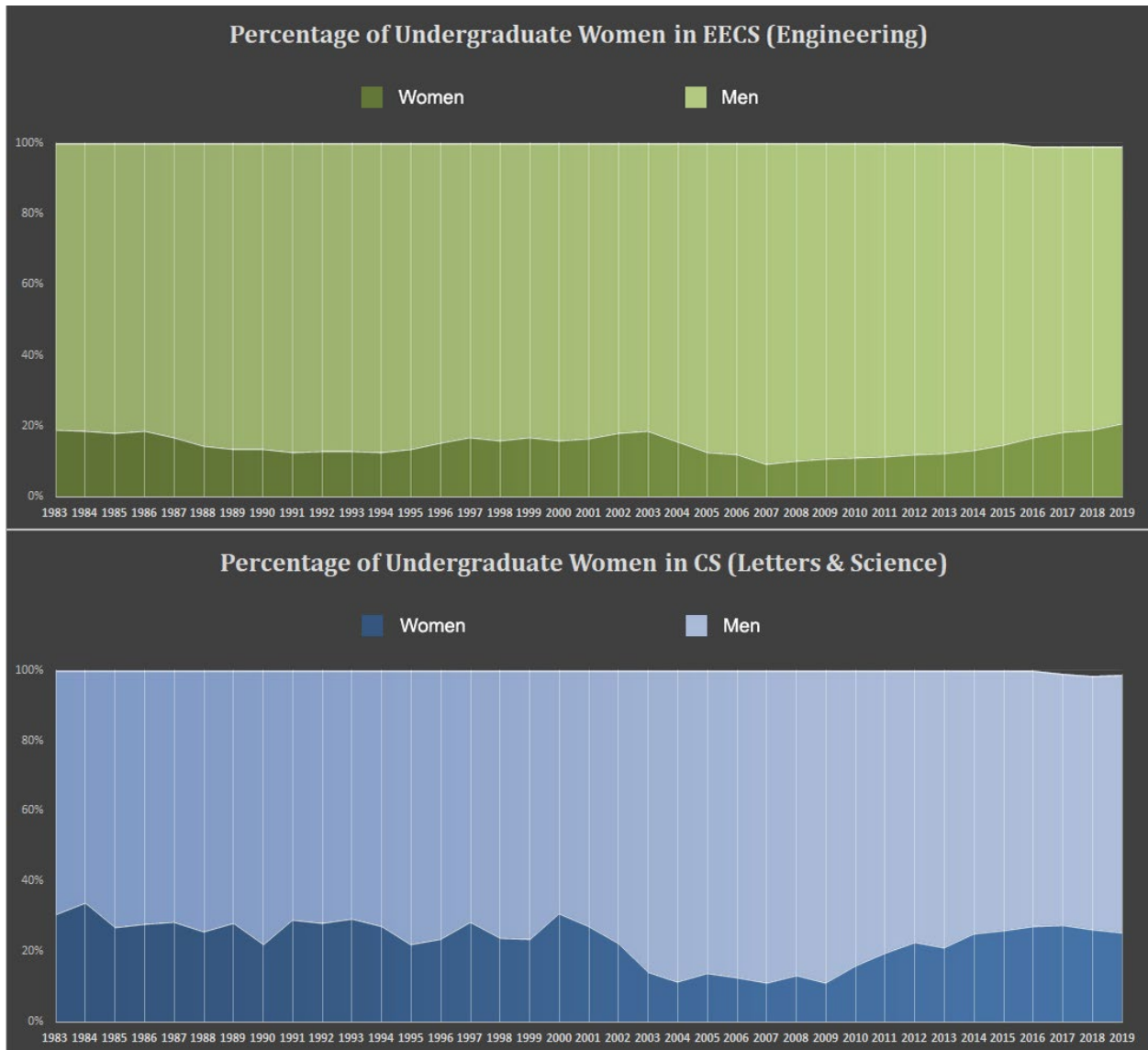
Source: EECS Center for Student Affairs

There are positive data points. An introductory course for computer science majors, CS 61A, experienced a 52% increase in women over the last four years, and now enrolls 1,145 women out of 2,774 students. An introductory course geared toward potential CS majors, the "Beauty and Joy of Computing," regularly enrolls more than 50% women.

Source: EECS Center for Student Affairs

Is WICSE still as relevant to women students as when the organization was founded over forty years ago? Both the chancellor of UC Berkeley and the dean of engineering are women. Twenty-three women[52] hold faculty appointments in the EECS Department, 17 percent of the total faculty, as of this writing. Women comprise 20 percent of graduate students and 19 percent of undergraduates (26% in Letters and Science CS). Yet, the issue of under-representation on the faculty and in the student body is not entirely solved. Gender bias, implicit rather than explicit, lingers in our society and sometimes even in the EECS department. WICSE provides community, continuing contact with alumnae, and a collective voice for women students. The 2019-20 co-president of WICSE, Utkarsha Agwan, points out how WICSE creates a climate in which women experience a sense of belonging: "As a woman in EECS, it is difficult for me to feel like I belong in a space which has very few women. Building a community in grad school is important, and WiCSE makes room for casual mentorship and discussions that many women would not have access to otherwise."[53] Regina Eckert, student leader and 2020 EE PhD, takes the position that "WICSE remains an important forum for women to be able to both build connections across the department and create a space where they can talk about their experiences with a supportive network."[54]

Comments welcome. All opinions are my own. Sheila Humphreys (shumphreys@berkeley.edu)

Footnotes

[1] EECS current and former alumnae leaders in **government**: Dawn Tilbury, asst. director, NSF Engineering Directorate; Valerie Taylor, director Division of Mathematics and Computer Science, Argonne national Laboratory; former head of the Department of Computer Science and Engineering; Texas A & M; In **academia**: Nina Amenta, former chair of computer science, UD Davis; Marie desJardins, dean of the College of Organizational, Computational, and Information Sciences, Business School, Simmons University; Andrea Goldsmith, dean of Engineering, Princeton; Barbara Grosz, former director, Radcliffe Institute; Janice Hudgings, former provost, Pomona College, former dean of the faculty, Mount Holyoke College; Ming C. Lin, chair, Computer Science, University of Maryland, College Park; Dana Randall, Georgia Institute of Technology; Belle Wei, former dean of School of Engineering, San Jose State, and former Provost, Chico State University; Amy Wendt, co-director of the Women in Science and Engineering Leadership Institute (WISELI) since 2007, co-chair of ECE from 2005 to 2009.

[2] Ruyle, Janet. "*The Early Prytaneans*." Ladies Blue and Gold. Special issue of the Chronicle of the University of California. Vol. 1, no. 2, 1998. Pp. 49–56. The entire volume of Ladies Blue and Gold essays about women at UC Berkeley is online:
https://cshe.berkeley.edu/publications/ladies-blue-and-gold

[3] Colson, E., Ervin-Tripp, S., Scott, E., "*Report on the Subcommittee on the Status of Academic Women on the Berkeley Campus*." Academic Senate, UC Berkeley, 1970.

[4] Diane McEntyre died in 1992. After her death, the Diane S. McEntyre annual teaching award was created by Berkeley's Computer Science Division.

[5] Barbara Simons (https://en.wikipedia.org/wiki/Barbara_Simons) "Dr. Barbara Simons was a graduate student there when Estrin was a freshman. Dr. Simons and Sheila Humphreys, then Associate Director of the Women's Center at UC Berkeley, had convened a group of women in computer science and invited Deborah Estrin to join them." (*Connector*, EECS, Department, MIT, 2013).

[6] Deborah Estrin delivered the Letters and Science Commencement Address, May 2019. https://www.youtube.com/watch?v=ZCw96OgcBW4

[7] "Dr. Kawthar Zaki Was the First Female Professor Hired Within the College of Engineering at the University of Maryland," A. James Clark School of Engineering, Department of Electrical and Computer Engineering, April 3, 2017, https://ece.umd.edu/news/story/dr-kawthar-zaki-was-the-firstnbspfemale-professor-hired-within-the-college-of-engineering-at-the.

[8] Rabab Kreidieh Wardis emerita professor of electrical and computer engineering at the University of British Columbia. Among her many firsts is the Norbert Wiener Award of IEEE. https://www.ece.ubc.ca/faculty/rabab-ward

[9] Anne-Louise Radimsky https://www.computer.org/publications/tech-news/research/anne-louise-guichard-radimsky-biography-first-women-phds-computer-science

[10] Anne-Louise Radimsky https://www.computer.org/publications/tech-news/research/anne-louise-guichard-radimsky-biography-first-women-phds-computer-science

[11] Patricia Daniels is Professor Emerita at Seattle University where she served as Professor and Chair of Electrical and Computer Engineering, and Associate Dean of Science and Engineering https://www.ece.uw.edu/people/patricia-d-daniels/

[12] Dana Angluin's PhD thesis was among the first work to apply computational complexity theory to the field of inductive inference. According to the website, her research on learning from positive data reversed a previous dismissal of that topic and established a flourishing line of research. Her work on learning with queries established the models and the foundational results for learning with membership queries. More recently, Angluin has focused on the areas of coping with errors in the answers to queries, map-learning by mobile robots, and fundamental questions in modeling the interaction of a teacher and a learner. https://cpsc.yale.edu/people/dana-angluin

[13] Barbara Grosz**, emerita professor of Computer Science at Harvard, https://grosz.seas.harvard.edu Grosz made foundational contributions to the fields of natural-language processing and multi-agent systems. She is a member of the National Academy of Engineering, Fellow of the American Academy of Arts and Sciences, and American Philosophical Society. Among her many awards are the 2009 ACM/AAAI Allen Newell Award, the 2015 IJCAI Award for Research Excellence and the 2017 Association for Computational Linguistics Lifetime Achievement Award.

[14] For more information on Estela Llinas, see Magdalene Crowley, "Alumni Spotlight: Estela Llinas" https://newsletter.eecs.berkeley.edu/2017/08/alumni-spotlight-estela-llinas/

[15] Anna Flores Pereira de Castro Humes was appointed to the faculty of Applied Mathematics at the University of Sao Paulo, Brazil. https://www.ime.usp.br/~anaflora/

[16] Sheila M. Humphreys, *Catalyst for Change at Berkeley: The University Women's Center*, UC Berkeley, Bulletin of the Institute of Governmental Studie*s*, vol. 22 (December 1981).

[17] Ladder faculty: Professors Susan Graham (CS), Alice Agogino and Gale McCarthy (ME); Lecturers: Elizabeth Deakin (Civil Eng), and Patricia Grosh (CS)

[18] Memo to Associate Dean David Pirtz from Professor Elizabeth Scott, May 1977.

[19] Memorandum, Thelma Estrin to Sheila Humphreys, Susan Graham, Paula Hawthorn, Nancy Kreinberg, Barbara Simons, and Susan Freitas, May 15, 1978.

[20] The history and outcomes of the Berkeley Reentry Program in Computer Science are documented in this article: Sheila M. Humphreys and Ellen Spertus. "*Leveraging an Alternative Source of Computer Scientists,*" ACM SIGSE Bulletin, Vol. 34, No. 2, 53-56, June 2002. https://people.eecs.berkeley.edu/~humphrys/pubs/reentry.pdf

[21] Chair of Computer Science, Professor Manuel Blum and his wife, Mills Professor of Computer Science Lenore Blum, were early influential supporters of the Computer Science Reentry Program.

[22] Dr. Jean-Paul Jacob conducted a research career over fifty years at IBM Research–Almaden. He received the EECS Department's Research Leader Award in 2003. He died in 2019. http://service-science.info/archives/5270

[23] Arlene Blum, *Annapurna: A Woman's Place*. San Francisco: Sierra Club Books, 1980.

[24] Professor Thelma Estrin (1924–2014) was a pioneer in computing and a strong advocate for women (https://senate.universityofcalifornia.edu/_files/inmemoriam/html/ThelmaEstrin.html). Thelma and Gerald Estrin were the parents of alumna Deborah Estrin, professor of computer science at Cornell and 2018 MacArthur Fellow: https://www.macfound.org/fellows/1009/.

[25] Letter from Thelma Estrin to LA Society of Women Engineers, September 15,1959, courtesy of Deborah Estrin.

[26] Marie desJardins is inaugural dean of the College of Organizational, Computational, and Information Sciences (COCIS) at Simmons University.

27 Professor Maria Klawe is currently president of Harvey Mudd College (HMC). HMC has succeeded in enrolling more than 50% women as computer science majors.

28 Dr. Leslie Field, personal communication, 2016. Field founded Ice911 (http://www.ice911.org) a nonprofit organization which has developed a novel engineering approach to restore reflective Artic ice, to slow climate change.

29 Dr. Dawn Tilbury currently serves as assistant director of National Science Foundation's Engineering Directorate, on leave from her professorship of mechanical engineering at the University of Michigan. https://me.engin.umich.edu/news-events/news/dawn-tilbury-heads-nsf-engineering-directorate

30 Quoted in WICSE fortieth anniversary brochure, EECS Department, Berkeley, 2018. https://wicsereunion.wordpress.com/

31 Dr. Myra Boenke, personal communication, 2016. Boenke manages the RF/mmWave & Silicon Photonic Corporate Application Engineering department at Globalfoundries, Burlington, Vt.

32 This was one of six conferences for women organized or co-organized by WICSE between 1978 and 2008.

33 Linda Kamas, Carol Paxson, Amy Wang and Ricki Blau, *"Ph.D. Attrition in the EECS Department at the University of California, Berkeley."* Department of Electrical Engineering and Computer Sciences, unpublished report. 1993.

34 In 1987, Borg founded the Systers online community with twelve other women technologists. To this day, Systers offers a closed-network, safe online community for women technologists. http://anitab.org/systers/

35 Dr. Anita Borg, "Why Systers?" https://anitab.org/systers/why-systers/.

36 The Educational Innovation Abie Award honors the life and career of A. Richard Newton (1951–2007) Alumnae Diane Greene, Coleen Lewis and Marie desJardins have won ABIE awards. (https://anitab.org/awards-grants/abie-awards/-richard-newton-educator-abie-award/). Newton was a professor of electrical engineering and dean of the College of Engineering at UC Berkeley, a pioneer in electronic design automation and integrated circuit design, and a visionary leader in the technology industry.

37 Computer scientist Eugene Wong, chair of EECS, created "Excellence and Diversity Student Programs" in 1986, which encompassed outreach and academic support for underrepresented students, an honors program and targeted recruitment for the Top Fifty admitted graduate students. Professor Wong was the first department chair to fund a staff position to create and oversee diversity programs. The program laid the foundation for the EECS Department's current diversity programs.

38 WEPAN is a national organization whose purpose is to increase women in engineering and to advance women in the field. Engineering dean Shankar Sastry nominated EECS Excellence and Diversity programs for the national WIEP Award. Suzanne Kauer, Director, Center for Student Affairs, accepted on behalf of EECS at the annual WEPAN meeting in Puerto Rico.

39 Sheila M. Humphreys, "Expanding the Pipeline: Award Validates Berkeley's Diversity Programs," *Computing Research News 14*, no. 5 (November 2002): 2, 7.

40 WICSE twenty-fifth anniversary web page with biographies of alumnae speakers and historical information: https://www2.eecs.berkeley.edu/Diversity/WICSE/25/wicse25th.htm.

41 Ibid.

[42] IBM Research Editorial Staff, Remembering Frances E. Allen. https://www.ibm.com/blogs/research/2020/08/remembering-frances-allen/

[43] Teresa Meng, professor emerita of electrical engineering, Stanford University, thirtieth anniversary brochure, UC Berkeley EECS Department, March 2008. https://www2.eecs.berkeley.edu/Diversity/WICSE/30/

[44] Andrew Szeri, dean of Graduate Division, UC Berkeley, WICSE thirtieth anniversary brochure, UC Berkeley EECS Department, March 2008.

[45] "WICSE Fortieth Anniversary," https://wicsereunion.wordpress.com/. The webite contains biographies of the speakers, a timeline of WICSE events, and list of WICSE presidents. The talks were recorded by the College of Engineering.

[46] Professor Claire Tomlin is a senior faculty member in electrical engineering at Berkeley, MacArthur "genius" and member of the National Academy of Engineering. (https://people.eecs.berkeley.edu/~tomlin/).

[47] "Girls in Engineering: Inspiring the Next Generation of Engineers," http://girlsinengineering.berkeley.edu/about/.

[48] "Bias Busters," https://callink.berkeley.edu/organization/biasbusters.

[49] "TechWomen," https://www.techwomen.org/.

[50] Ruzena Bajcsy," https://people.eecs.berkeley.edu/~bajcsy/

[51] Erin Summers (PhD EE 2012) co-founded Wogrammer, which has reached four million people and was acquired by Anitab.org in 2020. https://wogrammer.org/about

[52] List of Women faculty in EECS: https: //www2.eecs.berkeley.edu/Faculty/Lists/women.html

[53] Utkarsha Agwan, Personal communication, July 2020

[54] Regina Eckert, Personal communication, June, 2020