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Widening Participation

The Beauty and Joy of Research: New Pathways for Workforce Diversification

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Widening Access to the Beauty and Joy of Research

Computing is a profoundly creative profession, to paraphrase William Wulf[1], past president of the National Association of Engineering. The development of computing technology and services depends on the life experiences of the people who produce them. Sans 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, in processes not invented. Diversity is both individual (e.g., first generation to go to college, poor, or limited access to opportunities to engage in computing experiences) and systematic (women, underrepresented minorities, people with disabilities). The breadth of experiencing the world differently, both at the individual and system levels, fuels creativity in getting around first-impression design constraints or in serving diverse abilities and communities.

Technology Works Best for Those Who Create It

Computing technologies or services have become ubiquitous and indispensable to consumers, yet women, people from Black, Indigenous, and People of Color (BIPOC) communities, or people with disabilities are underrepresented creators of these technologies or services, and as a result, fail to meet the needs of consumers most in need of these computing technologies. To meet the needs of all consumers, we require a workforce with diverse experiences and needs. Academic programs with a critical mass of diversity have a proven track record of graduates with that characteristic.

For example, one might think that to enter medical school, you need to have a strong undergraduate education in the sciences. However, students can enter medical school from all walks of life. In many cases, students who elect to go into medicine do so not so much because of interest but because they see great need in their communities for medical care, and also because they see so few that look like them. Although Historically Black Colleges and Universities (HBCUs) only represent 3% of all degree granting institutions, yet 17% of all applicants to medical schools are from HCBUs. Similarly, in computing, many diverse students are drawn to the opportunity to do

[1] "The importance of diversity in Engineering," Keynote Speech, National Association of Engineering.

social good, especially women and people with disabilities[2]. Support for computing programs at minority-serving institutions[3] and special institutions for people with disabilities[4] can greatly increase the numbers of computing graduates through their critical mass of available resources including alumni for recruitment and retention of students in computing fields, and post-graduate network support for employment and retention.

The specific pathway we address is workforce diversification by encouraging and supporting students from underrepresented groups to pursue Master's degrees in computer science, even for students who did not study CS as undergrads. Once they are in a Master's program, students can decide if they want to pursue additional research opportunities and they can be encouraged to go on to Ph.D. programs. This provides an opportunity to reach the diversity of talent in the college-educated population, many of whom may now view computing much differently as they search for jobs in a tight market and find that the most lucrative ones are those that require computing expertise. By addressing gaps in foundational curriculum, support systems, and funding (both for the creation of such programs as well as funding for students), we can grow a diverse computing workforce. We identify the following interventions:

- Provide stipends to qualified students from underrepresented groups in graduate programs, including Master's programs. This may make potential advisors more enthusiastic about giving more students an opportunity in their labs. It may also give students a bit more autonomy/creativity in their work.
- Offer funding for online programs that prepare people with non-technical degrees to enter Master's programs in computer science -- provide for additional instructors, one-on-one counseling tutoring. Success flows students directly into MS programs with reduced costs. In addition to flowing students into MS, provide funding for the thesis research option of MS. The NYU Tandon Bridge online program, the Rochester Bridges to the Doctorate, and the CS-Align program at Northeastern University are great models that provide funding to make an MS degree accessible with no financial risk for students from under-represented groups, and provide local in-person support meetings. In the current COVID environment, virtual support meetings could be provided via a cohort model of peers using CAHSI's Affinity Research Group set of signature practices.
- Provide fellowships or stipend funding to Master's and Ph.D. students in computing programs with critical mass (>50%) in women, BIPOC, or students with disabilities, such as Scripps, Howard or Gallaudet respectively that are classified as at least R2. This should

[2] "Expanding the pipeline: Characteristics of Male and Female Prospective CS Students," L. Sax, CRA.
[3] "Minority Serving Institutions," Department of the Interior.
[4] "Special Institutions for people with disabilities," Office of Special Education and Rehabilitative Services.

be in addition to existing programs (such as GEM[5], GAANN[6], or the NSF Graduate Research Fellowship Program[7]) that often are limited to US PhD students.

- Provide a loan forgiveness program for students from underrepresented groups who complete an MS or a Ph.D.
- Provide supplements to research grants to support MS students, in a way similar to Research Experiences for Undergraduates (REU) supplements but for MS students. This will enable more domestic students to get into MS programs. By making these supplements to existing NSF grants, the students will not all go to top schools but will be allowed to stay in their own school or go to other places and be funded to work on research. Given the small numbers of US students going to graduate school, this will increase the pool of students who will consider a Ph.D. Students from underrepresented groups should be preferred.
- Create collaborations between advising faculty and MS students across academic institutions for "cross-pollination", both in nurturing a supportive (not competitive) environment where ideas can be vetted and shared, but also to encourage students to make connections outside their home institution in the hopes they might pursue a Ph.D. at another institution.
- Support students to go beyond the MS, work with programs that allow people to (re)enter computing research through postdoc or post-MS fellowships that catch them up".

All the suggested programs will have to be evaluated for:

- Student/program outcomes -- for students who get stipends or internships
- Program/student outcomes -- for institutions that enroll these students
- Company/internship outcomes -- for companies that hire these students for internships

Diversity Drives Innovation

Innovation happens at the intersections of different disciplines and experiences. Funding students as described herein has the promise of significantly broadening the spectrum of CS research, with notable interdisciplinary benefits. It would allow students to focus on research in areas they particularly care about. As noted earlier, many students who elect to go into computing do so not so much initially because of interest, but because they see great need in their communities for technology solutions that address the gaps they face. The proposed programs will give students the opportunity to do research that will have a direct positive impact on their community and in their chosen discipline.

This quadrennial paper is part of a series of papers compiled every four years by the Computing Research Association and members of the computing research community to inform

[5] GEM: https://www.gemfellowship.org/
[6] GAANN: https://www2.ed.gov/programs/gaann/index.html
[7] NSF GRFP: https://www.nsfgrfp.org/

policymakers, community members and the public on important research opportunities in areas of national priority. The topics chosen represent areas of mutual interest among the members spanning various subdisciplines of the computing research field. The papers attempt to portray a comprehensive picture of the computing research field detailing potential research directions, challenges, and recommendations.

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