Collaborative Research: CNS Core: Medium: How to Scale Up DNA Storage?
BPC Plan

Activity [1]: David Du, University of Minnesota

Recruiting and Retention of Under-Represented Minority and Female Students in Computer Science

1. Context

The University of Minnesota--Twin Cities is the state's public university and the only R1 institution in the state. Minnesota has a strong program of community colleges and K-12 school systems and ranks highly on many education and quality of life metrics in general; however, it also ranks as one of the worst states in terms of educational disparities and health disparities. The Twin Cities of Minneapolis and St. Paul are the population center for the state and home to diverse communities, including large Somali, Hmong, African American, and American Indian communities. Minnesota is home to 11 federally recognized tribal nations. The University itself resides on Dakota land ceded in the Treaties of 1837 and 1851, yet, American Indian and Alaskan Native students make up less than 1% of the UMN student population.

The Department of Computer Science and Engineering (CS&E) was founded in 1970 and is organized administratively within the College of Science and Engineering. CS&E offers multiple degree programs including a BS through the College of Science and Engineering, a BA through the College of Liberal Arts, and multiple interdisciplinary degrees in collaboration with other units. CS&E is the largest department in the College of Science and Engineering based on student enrollment data, with 59 faculty and 60 staff members serving more than 2,000 undergraduate students and more than 600 graduate students in its degree-granting programs in Spring 2020.

Demographic Data. By the numbers, CS&E's graduate and undergraduate programs both suffer from underrepresentation of BPC groups of interest. Women (regardless of race/ethnicity) make up ~19% of the undergraduate student body and ~32% of the graduate student body (including interdisciplinary programs in Cognitive Science, Computational Biology, Human Factors, Data Science, and Robotics). When examined by race/ethnicity, CS&E's domestic students from underrepresented groups make up only 6% of the undergraduate student population and just 5% of the graduate. The tables below aggregate all the degree granting programs affiliated with CS&E at the undergraduate and graduate levels and compare these to university- and college-level demographics.

Undergraduate Student Demographics (Spring 2020)

	Total	Women	Black or African American	Hispanic / Latinx	American Indians or Alaska Natives	Native Hawaiians & Pacific Islanders	Persons with Disabilities
University	35,165	53.6%	5.1%	4.4%	0.3%	0.1%	unknown
College	5,183	28.6%	1.6%	3.5%	0.1%	0.0%	unknown
CS&E	1,594	19.5%	2.9%	2.1%	0.8%	0.2%	unknown

Graduate and Professional Student Demographics (Spring 2020)

	Total	Women	Black or African American	Hispanic / Latinx	American Indians or Alaska Natives	Native Hawaiians & Pacific Islanders	Persons with Disabilities
University	15,392	55%	4%	3.7%	1.5%	0.2%	unknown

College	2,450	28.3%	1.5%	3.1%	0.1%	0.0%	unknown
CS&E	637	32.2%	1.1%	1.7%	1.6%	0.3%	unknown

Recruiting and Retention Data.
To focus effort where it is most impactful, it is important to understand how student progress through CS&E's programs (e.g., for undergraduates: applying, being admitted, matriculating, moving through intro courses, applying to the major, continuing to advanced courses, graduating). For example, CS&E faculty Gini and Watters discovered a high rate of non-passing grades within the introductory CSci-1133 course. Between Fall 2014 and Fall 2018, the "DFW rate" (Drop, Fail, or Withdraw) hovered around 30% (min 24%, high 40%). They developed a pilot intervention in Spring 2018, which reduced the rate to just over 9% and are now expanding the pilot with external support.

Dr. Du is currently supervising 8 Ph.D. students and one Post-Doc. Among them, two are female Ph.D. students and one female Post-Doc. He usually teaches networking courses (both undergraduate and graduate levels) and storage systems courses (graduate level). The female and under-represented minority students are around 10% in these classes.

2. Goals

The goals are:

1. Recruit and retain more female and under-represented minority students for both his research group as well as for the classes that he teaches.
2. Create an equitable and inclusive environment at all classes he teaches, as measured by bringing quantitative and qualitative experiences from members of underrepresented groups in line with the experiences of members of the majority.

The under-represented minority groups include:

- Women;
- People across the spectrums of gender and sexual identities and expressions, including lesbian, gay, bisexual, transgender, nonbinary, queer, intersex, asexual, genderfluid, gender-neutral, and gender nonconforming;
- African Americans;
- Hispanics;
- American Indians;
- Alaska Natives;
- Native Hawaiians;
- Native Pacific Islanders;
- Other Indigenous populations;
- Local and recent immigrant populations;
- People with both apparent and non-apparent disabilities;
- First-generation students;
- Students from economically disadvantaged backgrounds;
- Students who are parents;
- Others who might encounter barriers in our discipline based on their religious expression, age, marital status, origin (national or rural/urban), ethnicity, or veteran status.

3. Activities

Dr. Du plans to carry out the following activities to achieve the proposed goals:

a. He will participate the departmental student recruiting effort by visiting local colleges and universities with special attention to recruit American Indians from local tribes.
b. He will advertise his courses to female student groups to attract more female students.

c. For all his classes, he will form a mentoring group especially for the under-represented minority students to make sure that they will have a smooth learning process.
d. For the proposed project, there is a great possibility of attracting more female students from bio-tech side. He plans to put in a special effort to work with them to ensure their success of completing the proposed project.
e. He will participate in Summer NSF REU Site programs and host some students from these programs in his research group.
f. He will support and encourage his female students to participate annual MinneWIC and Grace Hopper activities.
g. He will recruit more under-graduate under-represented minority students to work in his research group.
h. He will assist his research collaborative companies including HPE, Seagate, Intel, IBM, etc. to recruit more female and under-represented minority students for summer internship.

4. Evaluation

The progress of these BPC activities will be evaluated annually to identify the activities that need to be further strengthened. The progress can be measured in the following ways:

a. Measure overall satisfaction with the activities, feelings of belonging, and similar metrics of climate and student experience using survey instrument; increase participation in surveys to make these measures more accurate.
b. Collect the outcomes of these activities by measuring the number of female and under-represented minority students increased in each type of activities.

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Activity [2] Li Ou, University of Minnesota
Encourage female students majoring in biological sciences to pursue computing degrees

1. Context & Goals

Context: According to the IPEDS data from https://bpcnet.org/statistics/, I investigated the women computing degree recipients in University of Minnesota among three degrees (including Bachelor's, Master's, and Doctoral degrees) along with state and national data as shown in the table below.

According to the table, the situation of women computing degree recipients in University of Minnesota is worse than the state wide and national wide among the bachelor's and master's degrees. One possible reason is the lack of interest and knowledge of computing science.

Gender	Race/ Ethnicity	Inst. Awards (N)	Inst. Awards (%)	State Awards (N)	State Awards (%)	National Awards (N)	National Awards (%)
Bachelor's degree							
men	all	1841	81.03	3876	81.34	140279	80.43
women	all	431	18.97	889	18.66	34137	19.57
Total	-	695	100	4765	100	174416	100
Master's degree							
men	all	427	76.94	505	73.29	45930	69.3
women	all	128	26.06	184	26.71	20899	30.7
Total	-	555	100	689	100	66829	100
Doctoral degree							
men	all	113	75.33	113	75.33	5737	79.75
women	all	37	24.67	37	24.67	1457	20.25
Total	-	150	100	150	100	7194	100

Goal: To increase the number of female students in computing degrees, I will encourage students in my laboratory to pursue computing degrees in the University of Minnesota and other institutions.

Activity Motivation: As a faculty member from the Department of Pediatrics, Medical School, I will not be able to directly increase the recruitment of women students in computing degrees. However, the student body majoring in medicine or biological sciences is relatively balanced in terms of gender. I will leverage my access to female students in the field of medical and biological sciences to help recruitment of female students for computing degrees.

I have been training undergraduates and will encourage female students to pursue an advanced degree in computing if they are interested. More importantly, I will keep female students involved in the proposed project and constantly expose them to latest breakthrough in the field of DNA data storage.

2. Intended Population

Activity Participants: All graduate and undergraduate students in my laboratory and the courses that I teach.

Participant Recruitment: I will invite my faculty colleagues in the Medical school to help, but the students are the intended participants.

3. Strategy

Activity Content: First, I will have at least two female students work on the proposed project if awarded. In this way, these students will be actively involved in computing and data science research. These students will also participate and present their results in the weekly project meetings hosted by Dr. David Du. In addition, I will encourage them to submit conference papers to the {USENIX}Workshop on Hot Topics in Storage and File Systems. If accepted, I will sponsor them to go to these meetings. In this way, they will be able to interact with the broader community of computer science.

Second, I will include discussions on DNA data storage in my weekly lab meetings. I will also invite female students (or alumni) from Dr. Du's group to introduce their academic and industrial experience in the field of computing and data science. These life examples and role models are expected to significantly inspire female students in my group to pursue a degree in computing. The computer science and data science jobs are usually high-paying, especially compared to jobs in biological sciences. This may help attract more students to pursue a degree in computing.

Activity Budget: It is cost-free.

Responsibilities of PIs: I will organize my lab meetings, and coordinate with Drs. Du and Li for project meetings. I will also seek support from my faculty colleagues in the Medical School.

4. Preparation

I have started to include discussions on DNA data storage in my weekly lab meeting. This will provide background knowledge and generate the academic atmosphere in my laboratory. Once awarded, we will be able to jump start the project and implement the BPC plan.

5. Evaluation

I will document relevant discussions in my lab meeting and the project meeting hosted by Dr. Du. The activity of female students on this project and their future positions (especially positioning in computing programs or jobs) will be documented. Evaluation results will be reported in each annual NSF report.

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Activity [3] Bingzhe Li, Oklahoma State University

Learn about Student Recruitment and Retention (NCWIT 101) and encourage female students majoring in biological sciences to pursue computing degrees

In year 1, the PI will lead the Co-PIs and graduate students funding on the project through a 16-hour self-paced course with 6 face-to-face meetings. This self-paced will guide the team to identify impactful recruitment and retention activities for their context. The team will pursue these activities in years 2, 3 and 4. Moreover, the PI will try to attract/recruit more female students involving in the computing community.

1. Context & Goals

Context: According to the IPEDS data from https://bpcnet.org/statistics/, I investigate the women computing degree recipients in Oklahoma State University among three degrees (including Bachelor's, Master's, and Doctoral degrees) along with state and national data as shown in the table below.

According to the table, the situation of women computing degree recipients in Oklahoma State University is worse than the state wide and national wide among the bachelor's and master's degrees.

Gender	Race/ Ethnicity	Inst. Awards (N)	Inst. Awards (%)	State Awards (N)	State Awards (%)	National Awards (N)	National Awards (%)
Bachelor's degree							
men	all	588	84.6	1782	79.91	141802	80.39
women	all	107	15.4	448	20.09	34600	19.61
Total	-	695	100	2230	100	176402	100
Master's degree							
men	all	281	73.37	372	72.51	45930	68.73
women	all	102	26.63	141	27.49	20899	31.27
Total	-	383	100	513	100	66829	100
Doctoral degree							
men	all	10	71.43	10	71.43	2041	80.45
women	all	4	28.57	4	28.57	496	19.55
Total	-	14	100	14	100	2537	100

Goal:
1. The self-paced course will help the project team, and colleagues in the department, understand how underrepresentation of certain groups in computing occurs, how to make both individual- and departmental-level changes to increase the representation of historically marginalized groups in computing and ensure the classrooms, labs, and overall department are welcoming and inclusive places. The project team will participate in the majority of meetings and will complete all "assignments" within the course.
2. Based on the course contents, the PIs will recruit more female students involving in the computing community.

Activity Motivation:
1. The project leadership for this activity does not have extensive prior BPC experience, but is interested in contributing to BPC. The NCWIT 101 course will provide the project team with the foundational knowledge they need to broaden participation in computing in their departments, within their sphere of influence.
2. The project is highly related to the biology area, which has relatively balanced in terms of gender. The project builds a good connection between biology and computing so it can provide an opportunity to attract female students involving into the computing community.

2. Intended Population

Activity Participants: All PIs and graduate students funded on the project.
Participant Recruitment: PIs will invite other departmental faculty and staff to participate, but the PIs and graduate students are the intended participants.

3. Strategy

Activity Content:
1. By the end of the first year, the participants will complete the self-paced 16-hour course "NCWIT 101: Introduction to Diversifying Undergraduate Computing Programs." The participants will meet 6 times during the year to discuss each module in the course. Modules all have "homework" (such as collecting enrollment data in the major by demographic) which will be distributed equally amongst the PIs and then discussed. Year 1 will include going through the modules as a team. Year 2 will include deciding on a focus for BPC activities that suit the project team's time availability and sphere of influence. Year 3 will be implementation of an agreed-upon intervention with basic evaluation of preliminary results.
2. From year 1 to year 4, the PIs will do presentations about the projects to different departments at Oklahoma State University (OSU) such as department of biology. Also, the PIs try to recruits female students who have both interests on biology and computing.
Activity Budget: Year 1 is cost-free. Years 2, 3 and 4 may have costs, depending on the goals and strategies the team decides upon. For example, if redesigning the departmental website is decided upon as a strategy, then a web designer may need to be hired. If faculty recruitment is chosen, then there may be costs associated with advertising in different places.
Responsibilities of PIs: The PI will coordinate all meetings and do presentations in different departments of OSU. The Co-PIs will participate fully and lead the discussion of an individual course module.

4. Preparation

The participants will be able to follow the structure of the course and meet regularly at a schedule that suits their team.

5. Evaluation

In Year 1, the PI will document attendance at each meeting and self-reports from participants, including reflections on the course and the completion of each module's tasks. The fifth module of the course provides a way to evaluate the BPC activities the team decides to do upon completion of the course. Thus evaluation activities such as departmental student data collection, surveys, observations, or interviews can take place in Years 2 and 3 and will assess the effectiveness of the BPC activities the team has chosen for their context. Participants will also complete the course evaluation to provide feedback to NCWIT. Moreover, the activity of female students on this project and their future positions (especially positioning in computing programs or jobs) will be documented. Evaluation results will be reported in each annual NSF report.