

# DIVERSIFYING CORNELL CS PH.D. ADMISSIONS

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## 1. INTRODUCTION

The goal of the Cornell Computer Science (CS) Ph.D. program is to train the next generation of research leaders in computing. While our students must be able to teach and to do well in our classes, our key admissions criterion is the potential to do innovative research. Each year we seek new student colleagues to work with the faculty and with each other to push our research in new directions. We want our Ph.D. class to be diverse along many axes; science is a team sport, and teams with diverse backgrounds produce better research<sup>1</sup>. But as with most CS programs in the US, our Ph.D. program does not reflect the gender or ethnic make-up of the population at large: our students are predominantly white or Asian men, many of whom graduated from a few major research universities. This year, we took some new steps to improve the diversity of our program. As a result, in 2018 we welcome the largest and most diverse Ph.D. class in the history of the department.

The admission process has three phases: soliciting applications, selecting who to admit, and recruiting the students to Cornell. We made changes in each phase to

- Encourage more students to apply;
- Evaluate their potential rather than prior opportunity; and
- Welcome the diversity of the class we admitted.

Our approach is not novel. We learned from other fields at Cornell, and adopted changes that worked for them. In this report, we pass on these ideas in the hopes that others might replicate our results.

In the next three sections, we outline the changes to how we solicit, select, and recruit applicants. We conclude with some observations on retention, mentoring, and future improvements. In the appendix, we provide demographic statistics on who applied and who was admitted.

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<sup>1</sup>See, e.g., Freeman and Huang in *J. Labor Econ.*, 33 (2015), DOI:10.1086/678973, and *Nature* 513 (2014), DOI:10.1038/513305a, as well as the review by Smith-Doerr, Alegria, and Sacco in *Engaging Science, Technology, and Society* 3 (2017), DOI:10.17351/ests2017.142.

## 2. SOLICITING APPLICATIONS

We cannot admit students who do not apply, and so we want to encourage students to send us applications. Students might not apply for a variety of reasons, sometimes unfounded. They fear that they are not good enough<sup>2</sup>, worry about the cost of standardized tests<sup>3</sup> and application fees<sup>4</sup>, or believe that a Ph.D. is not financially viable<sup>5</sup>. Such concerns may suppress application rates among underrepresented student groups. While we do not imply to students that admission is guaranteed, we must express personal enthusiasm to get some strong students to apply in the first place. Cornell’s College of Computing and Information Sciences (CIS) and the CS department have engaged in several initiatives to “prime the pipeline” and encourage Ph.D. applications from a diverse array of applicants. These include:

**Pre-Doctoral Research School:** Co-organized by Alvisi (Cornell), Bhattacharjee (UMCP), and Druschel (MPI), the [summer school](#) ran for the first time in August 2017. By design, there were 33 women among the audience of 81 undergraduates, who hailed primarily from European (but some U.S.) universities. Future versions of the school are planned; Alvisi will remain on the organizing committee, and two Cornell faculty per year will lecture. The summer school puts Cornell faculty in direct contact with leading undergraduates in Europe; it also gives us access to a list of prospective students for follow-up.

**FLIP Alliance:** Cornell is part of the recently-formed [FLIP Alliance](#) (Diversifying Future Leadership in the Professoriate) under a two-year grant awarded in September 2017. The FLIP goal is to recruit and retain URM doctoral students in computing at the FLIP universities, which produce most of the computer science faculty at major research universities. The FLIP Alliance advertised broadly to get students to apply to

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<sup>2</sup>In 1978, psychologists [Clance and Imes](#) introduced the name “imposter syndrome,” for the pattern where people doubt their own abilities and fear being exposed as a fraud. This is a common pattern among even very strong Ph.D. applicants.

<sup>3</sup>In Spring 2018, the CS faculty decided to no longer require GREs for graduate student applications, though they are still recommended at present.

<sup>4</sup>Cornell provides fee waivers for students applying through pipeline programs and for students without financial means.

<sup>5</sup>As in most fields of science and engineering, the CS department at Cornell guarantees financial support to Ph.D. students who remain in good standing. While our Ph.D. stipends are not competitive with CS industry salaries, they comfortably cover living expenses.

universities in the group, and Cornell participation in FLIP appears to have been a factor in the decisions of several admitted students to accept our offers.

**Grace Hopper Celebration:** The [Grace Hopper Celebration](#) is an annual meeting for women in technology, produced by [AnitaB.org](#) in partnership with the Association for Computing Machinery (ACM). Cornell CIS is a platinum sponsor of the Grace Hopper celebration, and Cornell CS has an ongoing commitment to send a different faculty member each year to attend the conference, along with a group of students. In 2017, we sent a large group from CS and IS, with five graduate and 23 undergraduate students; and we hosted a reception for undergraduates and alumni at the event. We also have access to resumé lists from the conference for recruiting.

**ACM Richard Tapia Celebration:** The [ACM Richard Tapia Celebration of Diversity in Computing](#) is an annual meeting to celebrate and promote diversity in computer science. As with the Grace Hopper Celebration, Cornell CS is committed to sending a different faculty member each year to attend the conference, along with a group of students; in 2017, CIS sent 29 students to the meeting. As with the Grace Hopper meeting, we also have access to resumé lists from the conference.

**McNair Scholars:** Created in 1986, the [Ronald E. McNair Post-baccalaureate Achievement Program](#) is one of the eight federal TRIO programs run by the US Department of Education. McNair grants are awarded to colleges and universities to prepare students from underrepresented backgrounds for doctoral work through research opportunities, summer internships, and seminars and other activities. At least two-thirds of the participants in each program must come from low-income backgrounds; these participants are often first-generation college students. Cornell has a [McNair Scholars program](#), as do [many other US institutions](#). In Fall 2017, we reached out by email to the McNair program coordinators at these institutions and encouraged them to have students contact us with questions about admission at Cornell.

**Black in AI:** The [Black in AI group](#), co-organized by Cornell grad student Rediet Abebe, is present on several social media platforms (Google Groups, Facebook, Twitter), and organized an inaugural workshop event at NIPS 2017. We explicitly reached out to this group to solicit applications.

**SoNIC Workshop:** Since 2011, Hakim Weatherspoon has run an annual one-week [SoNIC summer research workshop](#), originally designed in collaboration with Howard University. The workshop brings undergraduate minority students to Ithaca for talks by Cornell CS faculty and experience doing research with cutting-edge network equipment. In Summer 2017, there were sixteen participants.

In addition to outreach activities in CIS, we benefit from university-level outreach activities through the [Office of Academic Diversity Initiatives \(OADI\)](#), the [Office of Inclusion and Student Engagement \(OISE\)](#), and the [Diversity Programs in Engineering \(DPE\)](#). In particular, the director of recruitment for OISE, Anitra Douglas-McCarthy, emails Cornell Ph.D. admissions chairs with contact lists from conferences and feeder programs. Qualified participants in feeder programs, including several of those mentioned above, are eligible for application fee waivers<sup>6</sup>.

Apart from formal activities, our faculty and students also reached informally to former students and colleagues at other universities. These informal contacts helped us get a wide variety of applicants to apply and later helped us convince them to come to Cornell.

### 3. SELECTING STUDENTS

Our admission process is run by a committee of faculty and graduate students, who work together with the field to recruit, select, and matriculate these new students. The committee balances admissions decisions by area and by individual. No student is admitted unless several committee members agree that we should do so. As a department and a field, we pride ourselves on collegiality among both the faculty and the students, and we view it as a community decision to bring in a new student colleague. We want students with the CS background and strong research potential to excel in our program. Evidence for research potential can come in the form of reference letters from people who are themselves recognized researchers. Transcripts and personal statements may also show evidence that students took on challenges that have prepared them to enter our research environment. We also watch for “diamonds in the rough” who have done incredible things with limited opportunities.

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<sup>6</sup> A complete list of feeder programs for which Cornell offers fee waivers is at <https://gradschool.cornell.edu/admissions/apply/fees>.

Many applicants to our CS Ph.D. program already have published papers. While paper co-authorship is a useful signal of research potential, it equally signals that a student engaged in undergraduate research early, with an actively-publishing faculty member, in an area where the publication cycle is short and the barrier to entry is relatively low. Over-emphasis on papers disadvantages excellent students coming from institutions where they do not have well-established mentors, students working in areas in which advanced coursework is needed to engage seriously in research, and students in areas in which the publication cycle is relatively long. It also disadvantages students who may have valued breadth in their undergraduate training, and did not allocate a large part of their time to research. Simply counting papers is a poor way to judge faculty<sup>7</sup>; it is an even worse way to evaluate Ph.D. applicants.

**3.1. Review Criteria.** In the selection process, the committee and the field reviewed, sorted, and prioritized applications. For each applicant, reviewers answered five questions:

- (1) How do you rate the applicant on a five point scale (reject, weak reject, weak accept, accept, strong accept)?
- (2) What are your general evaluation comments?
- (3) How well has the applicant taken advantage of opportunities?
- (4) Does the applicant provide a unique perspective?
- (5) Who are the potential advisors?

It is easy to fall prey to the fallacy that within an area, there is one natural underlying quality ranking of applicants, and that such a ranking is revealed through prior achievements alone. Our program thrives when students have a mix of strengths and perspectives, and we want applicants with research potential more than records of prior achievement. Hence, we added the third and fourth questions as a new part of our review process this year. The questions were directly taken from a successful experiment run by the field of information science in the previous Ph.D. admissions cycle<sup>8</sup>. These questions are meant to help counteract bias earlier in the pipeline, but they made a significant difference in how we evaluated several prospective students — and not only women and underrepresented minorities.

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<sup>7</sup>See the [“CRA Best Practices Memo on Evaluating Scholarship in Hiring, Tenure, and Promotion.”](#)

<sup>8</sup>Like the CS department, the IS department has taken measures that significantly improved diversity of their Ph.D. class in the past two years. We learned about this review approach from Phoebe Sengers, who was the admissions chair for information science; in turn, she learned about the idea from a panel on diversity in graduate admissions from Fall 2016.

**3.2. Selection Process.** At the start of the selection process, the committee wrote reviews of each applicant. These reviews identified prospective advisors and additional reviewers who should comment on the applicant. While we allowed some applicants to be rejected with one review, we required that every woman or underrepresented minority in the pool be reviewed by at least two committee members.

After the initial round of reviews, we organized additional review work by area to cope with the scale of our applicant pool. Because many faculty and students span areas within computer science, the committee chair monitored the process to make sure applicants did not fall through cracks between areas. In most years, roughly a third of our offers are accepted, so the target number of applicants to admit is about three times the number of students we seek. Area chairs on the committee worked with the relevant faculty to identify slates of strong candidates in each area, organized into two lists: a conservative “must” list with no more than twice the target number of students in the area, and a more aggressive “please” list. The committee chair formed wild card “must” and “please” lists for candidates that did not fit neatly within an area and for those that enhanced diversity.

When the committee met to discuss the short lists, we accepted “must” students by default, and we discussed the case for each student on the “please” lists. These discussions were based on area demands (with particular attention to the needs of junior faculty), intellectual breadth (most students on more than one “please” list were admitted), and diversity along multiple dimensions. From these discussions, the committee chair proposed a list of students to accept and a short wait-list. After a few additional discussions with faculty in the field, this became the final list.

#### 4. RECRUITING ADMITTED STUDENTS

Once we admit prospective Ph.D. students, we must compete with peer institutions and with industry to get them to come to Cornell. Our approach to recruiting the admitted students is hands-on: before they even receive offer letters, faculty contacts reach out to the admitted students to congratulate them, answer their questions, and encourage them to come to visit day. Different students have different concerns, and so much of our recruiting effort involves conversations between the prospective students, current graduate students, and faculty members. Beside these efforts to engage the students personally, the centerpiece of our Ph.D. student recruiting is the prospective student visit days, in which we invite students to come to Ithaca and NYC to learn more

about the program and to meet with the faculty, the current graduate students, and each other. Our recruiting efforts this year were substantially the same as in previous years, but we did make a few changes to try to get ensure that the diversity of our admitted student pool was retained among the students who accepted.

**4.1. FLIP Networking.** After admission, we sent admitted under-represented minority students an email inviting them to participate in a Facebook networking group for students at FLIP Alliance universities; the email was jointly sent by the recruiting chair and by Hakim Weatherspoon, who is the local coordinator for the FLIP effort. Several students mentioned this outreach as a positive influence toward Cornell in their decisions.

**4.2. Visit Day.** The centerpiece of our recruiting is the student visit day. The visit day consists of 1-2 days in Ithaca, together with a visit to the Tech campus in NYC. Prospective students hear about the department from the chair, meet with faculty members during the day, meet over coffee with various campus groups, and have lunch, dinner, and an after-party with each other and with faculty and current graduate students. As in previous years, we included special coffee hours for women and for international students; this year, we added a coffee hour in which we invited campus support and diversity office representatives to give the message that Cornell is a welcoming place that is serious about recruiting a diverse student group<sup>9</sup>. Apart from meeting those already at Cornell, the prospective students also met each other, and this reinforced the message that we care about diversity.

## 5. REFLECTIONS AND CONCLUSIONS

We made it a priority to improve the diversity of our Ph.D. program, we made a concerted effort to achieve it, and our efforts yielded results. Of 59 students who accepted our offers, 22 were women and seven were US citizens coming from underrepresented minorities. Our approach was not innovative; we borrowed ideas from other Cornell departments that also undertook successful efforts to diversify their Ph.D. programs. We hope others will adopt these ideas, and we believe similar efforts will improve the diversity of the Ph.D. programs at our peer institutions.

Compared to previous years, we were able to recruit a more diverse applicant pool this year. In particular, we tripled the number

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<sup>9</sup>This idea was presented by Susan Daniel of Cornell's Department of Chemical and Biological Engineering (CBE) at a November 2017 panel on diversity in graduate admissions.

of African American applicants compared to last year<sup>10</sup>. But we were not uniformly successful; the number of Hispanic applicants went down slightly, for example. Moreover, the applicant pool remains imbalanced: women made up less than 20% of our applicant pool, and less than 2% of our pool came from under-represented minorities. Improving the diversity of the pool must be an ongoing process. Building connections to programs like the McNair scholars, to contacts at HBCUs, and to other organizations is critical, as is continued involvement at venues like Tapia and Grace Hopper. We are also making efforts to improve the diversity of our undergraduate program; our undergraduates today are the graduate students of tomorrow.

To better focus on research potential rather than prior achievement and academic pedigree, we modified our review criteria to highlight the unique perspectives of the students and how well they have taken advantage of opportunities. These changes affected the gender and racial diversity of our admitted students, but it affected our admission choices in other ways as well. While we still had to compete with our peers to recruit the students we admitted, we convinced many of them that Cornell is a collegial and exciting research environment that welcomes diversity. As a result, more than 40% of the students accepted our admissions offers, and the fraction of accepted offers was even higher among women and underrepresented minorities.

We are excited by the potential of these students, and we want them to succeed. Our challenge now is to support and mentor them. We borrowed ideas from our sister departments to attract these students, and we will continue to borrow good ideas as we seek not only to retain these students, but to help them thrive.

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<sup>10</sup>This includes applicants of mixed race; more details are in the appendix.

## APPENDIX A. DEMOGRAPHIC INFORMATION

In this appendix, we provide self-reported demographic information on applicants, admitted students, and students who accepted our offers for both the class admitted in 2017 and the class admitted in 2018. A useful point of comparison for these numbers is the [CRA Taulbee survey](#). Table 1 reports the breakdown by gender. Tables 2 and 3 report the breakdown by ethnicity, both with multiracial applicants counted several times and with them lumped under a single category. Nonresident aliens and applicants who did not care to report their ethnicity are listed under N/A. Table 4 lists how many applicants were Hispanic.

TABLE 1. Gender information.

	Applicants		Admits		Accepts	
	2018	2017	2018	2017	2018	2017
M	1044	696	102	107	37	35
F	255	148	45	27	22	6
N/A	0	2	0	0	0	0

TABLE 2. Ethnicity (multiracial counted repeatedly).

	Applicants		Admits		Accepts	
	2018	2017	2018	2017	2018	2017
N/A	976	636	85	83	32	23
White/Caucasian	212	140	42	34	20	12
Asian American	103	76	13	19	3	6
Black or African American	18	6	8	2	5	2
American Indian or Alaska Native	6	4	0	0	0	0
Native Hawaiian or Other Islander	2	0	1	0	1	0

TABLE 3. Ethnicity.

	Applicants		Admits		Accepts	
	2018	2017	2018	2017	2018	2017
N/A	976	636	85	83	32	23
White/Caucasian	196	126	40	30	18	10
Asian American	95	65	13	15	3	4
Multiracial	16	14	2	4	2	2
Black or African American	15	4	7	2	4	2
American Indian or Alaska Native	1	1	0	0	0	0

TABLE 4. Hispanic applicants.

	Applicants		Admits		Accepts	
	2018	2017	2018	2017	2018	2017
Non-hispanic	1284	829	144	131	59	41
Hispanic	15	17	3	3	2	0