A Guide to applying to US CS PhD programs for EngSci/ECE

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1 Why this guide?

This guide dedicated to Toronto Engineering Science (EngSci) and ECE undergraduates who wants to apply to CS PhD programs in the USA. While going through this process myself, I got substantial assistance from upper year students, the division, and the Engineering Communication Centre (Alan Chong in particular). Nowadays, I get asked about this application process several times a year, so instead of providing a low quality answer on a case-by-case basis, I will summarize the important things I've learned, and put them here. In response to demand, this guide will focus on the "top 4" CS PhD programs.

There are several excellent guides on applying to PhD programs in general, and CS PhD programs in specific, the ones I've used are included in the resources section. This guide tries to address some specifics if you are applying from UofT EngSci/ECE. The guide does not address why you would want to do a PhD in the first place, but simply assumes so.

2 EngSci vs. the competition

EngSci is a weird program. If you are interested in computer science/ECE, most of the courses you took in the first two years are not relevant. Third year covers some basic stuff that other people do in second year. So EngSci applicants are already weak in course experience. If like me, you wander around without a clear focus for a couple of years, then even our work experiences, and extra-curricular activities tend to lack focus. This is a major weakness when applying to top PhD programs.

I know very little about grad school in aerospace/biomedical/nanoengineering. People in those options are more successful at getting into good graduate schools than CS people. This is partly because they actually get good preparation from EngSci, in addition to a more limited supply of good students from elsewhere. CS PhD is a different game, almost every US school has a

CS program, not to mention the international competition. Many students are exposed to the profession at an early age by doing programming competitions and developing their own games. Undergrads who attended good CS schools often get a good amount of research experience and sometimes get published in the process. By the time we took our first serious CS class, others can already have years of experience doing it. Saying that you come from a unknown program that sounds a bit weird and took one course on quantum mechanics, fluid mechanics, or relativity really does not help. You have to convince the admission committee (filled with cynical older students and eccentric professors who think their discipline is the best) that you are actually better prepared than the competition, which is difficult. As a result, while renowned getting into top grad schools, EngScis usually cannot get admitted to top 4 CS graduate programs. While I think going to a top 20 school is as good a start as any, everyone who asks me this question wants to get into Stanford, MIT, CMU, Berkeley (i.e. the top 4). So here you have to play the game, and the randomness is high enough that many people have a chance, and almost no one has a sure shot. Ideally,

3 The obligatory master vs. PhD informational section

PhD programs in CS provides training in research, for people who want to be in academia or industry research labs. M.Sc. with a strong research component that continues to PhD program is basically the same as PhD programs (like the one at UofT). M.Eng (Toronto), and other course based master programs are completely different. The primary purpose there is to take more courses.

3.1 specifics

MIT EECS does not have a masters program; Stanford's CS master program is like MEng; Stanford's CS PhD program is basically separate from its CS master program with less than 3 people from the master program continuing into the PhD program every year; Stanford's EE PhD program is the same as its EE master program but with funding for the first year. Other things are typically somewhere in between.

In a research programs, one gets paid to do research (typically covers tuition, and a stipend for living expenses). In a course-based program, you pay tuition to take more courses. In a research program, you are basically labor, your job is to produce papers. In a course based program, you are a student, your job is to learn and to enhance (at least, not to mess up) the reputation of the school. The admission criteria reflect this difference and the second is usually easier to justify if you are willing and able to pay for it. This guide continues about research based programs. Some money numbers are provided in the section 3.2 and more discussions can be found in the other guides.

3.2 Money numbers

These numbers change year over year, I've never seen them falling and they should still give you an overall idea. **UofT:** M.Eng tuition is $9000+incidentals at UofT for domestic students, $24,000+incidentals for international students per year. M.Sc and PhD tuitions are $6400 incidentals for domestic students and 15000+incidentals for international students per year, these are usually covered.

Stanford: Stanford's grad tuition is about 9000 per quarter right now, living expense is roughly 7000 per quarter. Stipend is just over 8k at Stanford per quarter, with tuition covered. True for both research assistants and teaching assistants. CMU and MIT are basically comparable, except they are not on a quarter system. i.e. 2.5k per month, tuition covered.

4 The must-haves

You must have research experience, good grades (3.7+ GPA), and at least one good recommendation letter from a professor in the field.

4.1 Research experience

There are no successful applicant who has 0 research experience at the time of application, so no need to donate money to the top 4 if you are applying this year, and make sure you get them if you are applying in the future. My friend in the admission committee commented that 80% have at least 1 publication. If you get a strong recommendation from someone well-known and reputable in the field, it can go a long way, but a generic letter from big names probably does no good. There are several quite well-known faculties at UofT computer science that are doing very interesting things. Strangely, they are actually not as well-known within UofT and especially within EngSci as they are well-known internationally. Stanford undergrads will fight to work with people of that caliber, but EngScis are just busy getting their 4.0s and largely overlooking such opportunities. So take advantage of NSERC summer research funding, and the thesis project. I basically volunteered and did thesis full time in the summer before 4th year, and in hindsight, I had no chance if I did not do that. But I guess there are little one can do about these at the point of applying, which is often when people ask me about it, except for the personal statement.

5 The nice-to-haves

I think success in IOI, IMO, and college level programming/math competition still impresses people. I've heard of both professors and students talking about this. Internships at reputable software companies like Google, Microsoft, IBM still seem to help, particularly if there is a research

component to your job. Research experience in other fields of hard sciences also help, for computer scientists sometimes have science/math envy and are occasionally not that closed minded. But because we are still mostly closed minded, make sure you are clear on the statement that CS is more awesome than whatever research you did, and you now know better because you've tried both. These are things probably worth a mention on the personal statement, if you have them. A website might also to help: I had a tracker up on my website while applying, and I see people from the schools I applied to visiting it, where I provide additional information that does not fit in the application itself.

6 The do-not-haves

Do not mention that oh, UofT engsci/ECE grades are worth more than grades from Ryerson and US universities with severe grade inflation. I never thought this way, but after attending Stanford, I realize there is probably truth to it. Still do not mention it.

Do not spend more than 1 or 2 sentences advertising for EngSci/UofT, UofT is a good research institution and somewhat known, no need to feel like you have to advertise. The reason for not adversing EngSci is clear too. First, it sounds bad and snobby, it is like saying I am from MIT and I am better than the rest of you. This is bad enough for someone from MIT, but even worse if you replace MIT with something that people have not heard of. Even if you are such a good writer and you manage to sneak it in there without sounding bad, it is still hard to be convincing, for everyone thinks their institution is better than it is. Second, even if you can convince people that EngSci is good, that doesnt say much about where you fit. The average Stanford/MIT/Berkeley/CMU students also just have a tiny chance of getting into the top 4 PhD programs, and I doubt any of their strong candidates spend any time advertising for their schools.

Random hobbies in which you are not particularly accomplished in have no place in your personal statement. It is not the place to show that you have a life, unlike the rest of us. Basically everything else that is not strictly research, and not mentioned in the nice-to-have section is not worth including in the statement, which generally will be read very carefully if you otherwise have a strong application. Your goal is to say as much as possible in 2 pages on why you will succeed in research, and that means leave out random things that does not accomplish this goal. Though if you made the UofT varsity, or have an Olympic medal or something, then you should consider including it. Keep in mind their goal: they want someone who can sit in front of a computer for 5 years, produce good research, and further the reputation of the department. So your personal statement is to convince them why you can do it well, and not some super distracted cool dude whos ambition, coolness is above that.

7 Now the personal statement

So in the two previous sections I said what you should include and leave out the P.S., this section is about the meat of it. Remembering the goal is important, reiterating: you need to convince them, in limited space, why you are the person who they can trust to produce excellent research, be a faculty later, or start a company, or otherwise further the reputation of the department. They know that PhD is hard-work, not very glamorous, and many people drop out. While they do not mind people like Larry Page dropping out, it is mostly a loss for the department. So you should also keep in mind in your PS why you are not one of the likely dropout. Because there are students in the committee who do not think strictly in business terms, convincing them that you are really smart, hardworking, dedicated is a worthwhile goal as well.

Concretely, it should be roughly structured as follows: 1) why you want to apply, and whats your chosen area 2) what you've done 3) how what you have done/learned prepares you for good research in your chosen area and 4) what you want to do in the future, and why doing a PhD is necessary for it. Section 2) should constitute the bulk of the statement, with 3) possibly mixed in 2) to make the whole thing flow better and not just a boring list. For 3) you do not need to know exactly what you will be doing, but you need to convince them why you want to work on your chosen field, and not just lose interest in it after a year. The committee do not expect a detailed research plan, many of us still have not figured that out in our second year. Basically, the goal of 2) and 3) is to convince them why you are qualified, why you are smart, and that you are not totally clueless on what you want to work on, 1) and 4) are to convince them why you have the proper motivation to finish a PhD. One good reason is if you want to be a prof or work in industry research labs, among other legitimate reasons.

You should make sure that someone is actually working on the field you are interested in at the school. Qualified candidates can be declined because there is no good match for their interests. It is worth mentioning specific faculties in your PS, they will actually read it and pick you if they feel you are a good match to them. Besides the very few overloaded faculties, most faculties are happy to have more students working for them, so if your interest do match theirs, they might strongly advocate for you.

8 Contacting Professors

A commonly asked question is if you should email professors, the general answer is there is no need for top 4. I did not email anyone prior to acceptance. They all get a bunch of such emails, and some explicitly say on their site do not email. However, this has almost no chance of hurting you either (nor helping), so if you have time to burn, feel free to do it. The exception is if your advisor introduces you, or you otherwise know them personally, in which case you do no need to listen to some random guide right? A good way to get inside information is to email their grad

student instead.

9 Resources

- Philip Guo's Application guide: `http://www.pgbovine.net/grad-school-app-tips.htm`
- The CMU guide, Applying to Ph.D. Programs in Computer Science: `http://www.cs.cmu.edu/~harchol/gradschooltalk.pdf`