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Choosing A Ph.D. Program In Computer Science

by [Rachel Pottinger](#)

Applying to a Ph.D. program can be a very confusing and overwhelming process. I first learned this when I applied two years ago and was recently reminded as a member of my department's prospective students committee. To help others, I have put together an overview of the process. This reference is primarily for people interested in Ph.D. programs, and all costs are as of 1999.

The most useful advice for people *deciding* whether or not to go to grad school can be found in [Advice for undergraduates considering graduate school](#) by Phil Agre. It covers getting research experience and also deciding whether or not to go to grad school. I defer to it on these topics. My discussion focuses on the application process, but first I will discuss the basics of Ph.D. programs.

The Ph.D. Program, In Brief

(Note that this is geared towards programs in the United States; the process is different in other countries.)

It is important to realize that schools do not require you to have a Masters degree before applying to a Ph.D. program. Student's applying for a Masters degree rarely receive funding, while Ph.D. students often do. If you are planning on applying to a Ph.D. program eventually, you might as well apply to the Ph.D. program from the outset; you can always drop out if you change your mind.

On the other hand, the process of getting a Ph.D. almost always involves first getting a Masters degree. Even if you have a Masters degree from another university, you will

often be asked to show that you have sufficient breadth. Policies to demonstrate your breadth of knowledge vary from program to program. You will most likely have to join other students in taking classes or taking exams or both. Students are sometimes asked to do a project and presentation. The 'breadth' phase may last for a year or two. After that, you might be required to read a number of papers in your chosen field, write a synthesis paper and give a presentation on your conclusions. This generally occurs between your second and fourth year. Finally, you choose a Ph.D. dissertation topic, propose your topic, research it and present it. The whole program takes between four and eight years, on average. This varies widely from department to department.

Applying For Fellowships, And Other Monetary Issues

After you have decided to apply to grad school, the first set of applications you need to worry about are fellowship applications.

One of the biggest myths about computer science graduate school is that you have to go into debt to get a Ph.D. While it is true that many departments do not offer support to their Masters students, most support their Ph.D. students. Most schools pay for tuition and give students a stipend that averages around \$12,500 for 9 months. Most students receive funding through either a TA-ship (teaching assistantship), or a RA-ship (research assistantship). In general, first year students receive TA positions, and then they are funded by their advisors and given TA positions if there is no RA money.

Now that you know how funding *usually* works, you may wonder why it is necessary to start applying for fellowships so early. There are several reasons:

1. Many universities will supplement an outside fellowship with more money. Since you are not costing them as much, they can give you extra money.
2. Many fellowship applications are due before the graduate school applications. Most graduate school applications are due in late December or early January. Fellowship deadlines can be much earlier; the [National Science Foundation's Graduate Research Fellowship](#) application is due early in November, for example.
3. Sometimes the fellowship organizers will forward applicants' names to departments. When this happens, the departments may decide to send you application materials or even offer to waive your application fee (usually \$40-\$65). Departments might also extend their application deadline.
4. Some departments will not reject students until the NSF fellowships are awarded.

Consequently, you may get in departments based partly on your fellowship.

5. You can reapply for many fellowships, and the hard part about the statement of purpose (more on that later) is getting it written the first time. You should not think of the fellowship applications as a trial run for your graduate school applications, but if you write the essays for the fellowship applications, it will give you more time to think about what you want to say in your graduate school application.

Perhaps the most important reason to apply for a fellowship is as follows. A year or two into your program you need to choose an advisor. In addition to giving you advice, they are responsible for funding you. If you have your own funding, you can work with whomever you wish, irrespective of their funding. Also, if you want to switch advisors, having your own funding makes this easier. Along the same lines, if you decide to transfer, an outside fellowship will often follow you. Which means that you can change schools more easily since they will not be as concerned about your funding.

Now that you know *why* to apply for a fellowship, the next question is *how*. There are a number of resources you can use.

- Check with a faculty member in your department. Many departments keep lists of fellowships.
- Many departments will send you a list of fellowships to apply for when they send you your application.
- Keep your eyes peeled. Sometimes a fellowship may pop up at the last minute, and unless you pay attention you may miss it. Letting your department and friends know that you are interested in graduate school is another excellent way to do this; if something comes along, they may think of you and pass it on.

Applying To Graduate School

It is best to start thinking about this in your junior year, if not before. The considerations you will need to make are mainly about the [GREs](#), which might influence your choice of classes.

Deciding Where To Apply

There are a number of factors you might consider when choosing a department. These may include:

- department reputation & size
- available research opportunities
- your chances of getting in
- your chances of getting a job once you get out

The easiest way of finding general information about the departments is by reading their web pages. Note that a big difference in applying to graduate school is that you must look carefully at the *department* you are applying to, not just the university. Check out the web sites of the departments, and check out rankings, such as [US News and World Report's ranking of Computer Science Departments](#). Most importantly, talk to professors you know about the departments; the world of computer science is smaller than you think.

In choosing which departments to apply to, remember what you did when applying to your undergraduate institution. Apply to a few departments you are pretty sure you will get into, and then reach for others. Unlike undergraduate schools, it is a lot harder to judge which departments are reaches because the numbers of people applying are lower. Again, I would highly recommend talking to a faculty member who knows you well and is willing to tell you where they think that you can get in.

When you are looking into the departments, there are a number of factors to think about. Some factors to consider are:

- Big or small department? If you choose a small department, chances are good that you will get a lot of personal contact. However, a big department offers a greater variety of fields from which to choose.
- Specialty? For example, if you are certain that you only want to go into theory, make sure that the departments you are thinking of applying to have a strong presence in theory.
- Location? You are going to be there for 4 to 8 years, so this should be a consideration.

Getting The Applications

Most places have their applications ready by the end of September. Contact each department by the beginning of October. Keep a record so that you know which

departments you have contacted. Send them mail again if they have not replied to you by November. Some places have applications you can download off the web. Some places have a pre-application, so make sure you find this out early enough to get the real application from them. Most applications will be due in late December or early January, so plan accordingly.

The GREs

The GRE, Graduate Record Examination, actually consists of two different exams: a General Test, which tests your general knowledge, and a Subject Test in the field of Computer Science. The General Test is akin to the SAT I and the Subject Tests are like the SAT II (or the SAT and the Achievement Tests). Like the SAT, they are administered by the Educational Testing Service.

The general GRE, is similar to the SAT I except that instead of two basic sections there are three. The sections are verbal, quantitative and analytical. The verbal and quantitative sections are very similar to the verbal and math sections of the SAT. Like the SAT, calculus is not required, though the questions are more difficult on the GRE. The same goes for the verbal sections; it is the same type of questions, only with bigger words.

The analytic section is something that you are not likely to recognize; it involves a lot of logic questions. Some people have told me that it is much like what you would see on the LSAT. In general there are two types of questions: puzzles and arguments. The puzzles are listings of situations from which you are supposed to derive logical conclusions. For example, a question you might see is:

Irene, Jenny, Karen, Mary, and Nancy all want to room in the same hall. The hall has three rooms; two are doubles and one is a single. The single is located between the doubles. No one else will live on the hall. In addition:

Irene will not live with or next to Jenny

Nancy will not room with Irene

Karen and Mary want to live either in the same room or in adjacent rooms

Who must room with Nancy?

- (A) Irene
- (B) Jenny
- (C) Karen
- (D) Mary

(The answer is B)

Editor's Note: Thank you to all those who pointed out our typo in providing the answer!! I am embarrassed that we didn't catch this mistake. The answer above, B, is correct now. Thank you to Mike Menchaca, David Holmes, and Ronald Mobley who brought this to our attention.

Arguments check how well you can derive logical conclusions from a set of statements; it is much like figuring out what a politician is actually saying. An example is:

Winters are colder than summers, and summers tend to have more sun than winters. Based on the above, what has to be true?

- (A) Winters get more precipitation than summers
- (B) It's warmer out when it's sunny out
- (C) A winter day is more likely to be cloudy than a summer day
- (D) Winters are better than summers

(The answer is C)

Editor's Note: The author affirms that C is the correct answer and offers the following logic as proof:

Summers have more sunny days than winter (given). Sunny days have fewer clouds (common knowledge of the definition of sunny assumed here) therefore summer days have fewer cloudy days than winter days and winter days are more cloudy than summer days. You can't derive B, not to mention that it's false. Just look at a really, really cold winter day, they're usually clear because the clouds help to hold the heat in.

It used to be that taking the General Test meant going into a room for hours and taking the test with a paper and pencil. That is not the case any more. The GRE is only given on the computer at most sites, so it is really important to get used to the computer format. The subject test remains a pencil and paper ordeal. One advantage of the computer based test is that you get your scores right away; you still have to wait for up to a month for your Subject Test scores.

The computerized test is liable to be different from any test you have taken in the past. Unlike the SAT, where you had a mix of easy, medium, and hard questions, the GRE tries to target your score by giving you questions based upon how well you have done on previous questions. If you answer a question right, they give you a harder one, if you answer one wrong, they give you an easier one. What this means to you is that you will most likely be more challenged on the test than you normally are on a standardized test. It also means that the first few questions that you answer are very important; if you do poorly on the first few questions, you may never get to the hard questions that would show you know the best of your abilities. Thus you should take your time for the first few. Although you should answer every question on the exam, it is the first few that matter the most.

You can get one free copy of the general GRE by picking up a free booklet or [**downloading it online**](#). [**The Princeton Review**](#) now has a free full length computer based test online. I warmly recommend it.

In addition, many places sell books full of real or fake GREs. This can be a good method of trying to figure out what you need to learn. The only real GREs that you can get come directly from [**ETS**](#). Some books attempt to simulate computer-based exams by making you flip between pages based on your answers to questions. I do not advise this, as it was much too distracting to be useful.

Another option is computer software. I would strongly consider this option. ETS puts one out called [**Power Prep**](#). It offers a practice test and also some of their tips for taking the test.

Another option is [**The Princeton Review**](#). They have a number of GRE products. I would recommend going with "Inside the GRE, GMAT, and LSAT", which is software that both helps you study for the exams by giving you drills and has four full length exams that give you answers and reasons behind the answers.

Computer Science Subject GREs

The computer science GRE is an intensive exam designed to cover all of computer science. Your school's normal curriculum may not cover all of the topics involved, so you should definitely ask a professor at your school about which classes you should take before you take the GRE.

The exam is currently 70 questions long, but this may change without warning, so I strongly advise checking at the beginning and seeing how many questions are there so that you can pace yourself accordingly. The test is scored from a 200 to a 990, so looking at your scores may confuse you; it is more useful to look at the percentile that comes with it.

While the test is ideally only a test about computer science concepts and should not involve any specific programming language, it is difficult to ask questions that require no programming knowledge. If you do not know any C, C++ or Pascal, I would strongly advise learning at least a little bit of one of them.

The resources available for the computer science GRE are considerably more limited than for the regular test. The only reasonable one is Practicing to take the Computer Science Test by ETS. This book contained one actual exam which was quite helpful in figuring out what the test in general covered. Unfortunately, the rest of the books out there are dismal; I would buy one only if you are panicked. The best studying is to go through old tests and class notes. On the other hand, many graduate departments do not require the subject test. Check with the department to see if you need it.

Final Thoughts On Both Parts of the GRE

The GRE is an important part of your preparation, however you should *not* leap to the conclusion that you will be automatically rejected from a department even if your percentile is considerably lower than their recommended score. Strong grades, a well written statement of purpose and, most importantly, good letters of recommendation can go a long way for making up for bad GRE scores.

Filling Out Applications

The applications are a pain. You should start filling them out early, as often they will

ask for information which will surprise you (such as the books used in all of the classes you have taken). In addition, some schools consider applications on a rolling basis, so early applications will receive more attention. The application will probably consist of several pieces: basic information (name, school, GPA, etc), transcripts, GRE scores, and letters of recommendation. The part that will be the most work will probably be the statement of purpose. In your statement of purpose you are supposed to show them that you can write, you have done research, and that you have an interesting idea for what you would like to research in the future.

Statement Of Purpose

The statement of purpose is an extremely important segment of your application, and it is very different from anything that you have to fill out for undergraduate admissions. Because of this you should start to write it early. One issue that you should definitely be aware of is that people are going to really want to see you have a definite course of research in your statement of purpose. Unless you know what you want to do, pick two or three different topics that you are interested in and write up something short about each of them. Then let them sit for a day or two and see which one feels best to you. Definitely ask a professor to read over them for you if you have someone who would be willing to do so. If you do not feel comfortable asking a professor, ask other people to read them for you. Graduate students you know are a good choice; all of them have been through this process, and they remember how difficult it was.

If you know other people who are applying to graduate schools, even if they are not in your area, something that can really help is to sit down with them and read over each others' essays. This forces each of you to make sure that your statement is clear. Since you are doing each other favors, you may not wind up feeling unduly indebted to them.

Finally, as a general note, be very careful about how the universities want their materials sent in. Some schools will request that you have all of your supporting material in the same envelope that you send in your main application. This means that since most of them will be due during winter break you need to make sure to get transcripts and letters returned to you *before* break.

Letters Of Recommendation

Letters of recommendation are also important. Hopefully you have a number of people

who would be willing to write you recommendations, but make sure that you include everyone. If you are applying for grad school in AI, and you did some research for an AI person, even if it was long ago and you do not consider it to be relevant, get a recommendation from that person. It almost never hurts to have extra letters, and do not feel bad about asking people for letters; it is part of their job. On a similar note, do not have more than one letter of recommendation from industry, because unless they are researchers, their recommendations are not going to mean as much to those who are reading them. Remember that the field that you are going to work in is probably a small world (much smaller than you would think), and these people are all likely to know each other.

If you do not have any faculty members who know you really well, there are a number of ways that you can go about trying to change this. The earlier you start, the more options you have. The easiest option is to take an independent study with a professor. Another option is to do research at another university. Ask professors for internship programs that they know about.

Once you have chosen people to ask for recommendations, make sure to ask for them early. Also, if you are unsure what your references think of you, it is a good idea to ask them straight out what kind of recommendation they will write you. Professors have been known to write unfavorable recommendations, so if you have doubts, you are better off asking them rather than getting rejected on the basis of a bad recommendation. It is helpful to give them a general idea about what you have been up to, even if they know you very well. To that extent, you should give them a copy of your transcript, resume, and, if you have it, your statement of purpose.

The Acceptance/Rejection Process

In general, departments have an admissions process that works in the following manner: They receive all the applications and then figure out who their top choices are and admit those. After that, they pick a second group of people to admit. What happens after that differs from department to department. Some departments will decide to reject people who did not get in from the first two rounds. Others will wait for a time, sometimes to see if they get any early rejections, or to see if one of the candidates gets an outside fellowship and then possibly offer admission to others later. If you have been rejected from a department there is not much of a point in contacting that department to see if they can let you in anyway, but they may tell you *why* you were not admitted, and if it was close they may encourage you to reapply.

Departments will start sending acceptance letters in early February, and most acceptances will be out by the middle of March. If you know someone who was accepted, and you have not heard from the same program yet, do not assume that you have been rejected from it; this probably means that you have been moved to the second group of applicants, and they will decide on your application later. Also, some departments mail acceptances in small envelopes, so always open your mail before discarding it!

Visiting The Departments

This stage usually comes after you have been accepted to the departments and they are trying to convince you that you should go there. You can visit by yourself beforehand, but they almost certainly will not be willing to pay for your visit. That being said, here is what you should expect to happen on your visit.

All acceptances that I received included an invitation to come and visit the department at their expense (with reimbursement). Please note that most departments will not ask for students in foreign countries or Masters students to visit. Some departments offered to pay everything, while others put caps on the amount that they were willing to pay. Be very careful about this. In particular make sure that you have some reassurance about housing before you buy your tickets. Some departments may pay for you to visit only if you can come on the date that they are having the rest of their incoming students come and visit; be sure to check on this as well. You may be able to convince them to pay more, but do this before buying tickets, not after.

Also note that in general you have to buy the tickets and then they reimburse you. It can take departments up to two months to get reimbursements to you, so plan accordingly; an extra credit card can be very handy. You may be able to convince them to pay up front, but do not count on it.

Deciding Which Departments To Visit

Visit as many departments that you are admitted to and interested in as you can. It is bad form to take their money just to visit the department if you are not at all interested in them. However, visiting the departments can give you a good idea of what is going on in the field and can also help you make contacts for later. Also, check with your professors at the beginning of the semester to make sure that visiting the different departments is not going to cause any academic difficulty. You should try to

take a light course load; this decision is probably going to be a lot harder than you expected.

Preparing To Visit A Department

After you have decided to visit a department and have made all of the travel arrangements, you should start looking more carefully into the information you have about the department. What you should be looking at in particular is the research that you think you would be interested in, and the people who you think you would like to work with. It is not necessary to read all of the papers that the person you are interested in has written, but it is to your advantage to see what their general research topics are. The web is the easiest place to find this information. Picking out who to look at is more difficult. Often times a professor from the department will contact you as being interested in working with you. Unless you have a reason not to, this would probably be a good person's work to look at; you know that he/she is interested in working with you based on your application information. Another good resource is the people at your school. Ask the people at your school if there are any people they would recommend talking to. Most places will probably set up a schedule for you, but if they do not, knowing who you want to talk to is very important.

When you are packing, wear something either casual or a little fancier. As with any trip, bring along an extra set of essentials in case something goes really wrong, and bring along a credit card for unexpected expenses. You will not need to bring along anything for your visit day with the possible exception of a pen or pencil; they will give you a packet of stuff when you get there.

Most departments will have one or two dates on which they arrange for potential candidates to go visit. If you can go on those dates, it is a really good idea; then you get to meet the other students who might be entering with you. If you do go on another date, be aware that professors may not have as much time to talk with you, and you will probably have to set up your own meetings.

Actually Visiting The Department

When you visit the department, you are trying to gauge the general atmosphere of the department, whether there is research there that you want to do, whether there are professors you would like to work with, and, basically, whether you really want to go there. After your visit, make sure to write down what you thought about the

department and people as soon as possible; you would be surprised how much the places can run together in your mind.

If you go on the official visiting day, most likely your day will run something like this: a greeting from the department chair, a long talk about all of the department's research, meetings with the individual professors, watching demos, and talking to grad students. You will probably be served food anywhere from one to three times during this. Here is what you should expect out of each of these and what you should try to get out of them.

The intro speech is, perhaps, the least informative of these events. Other than learning more about what you will be doing for the rest of the day, there is really not a whole lot you can get out of it. Perhaps the most helpful thing that you can do is listen to what the speaker says and see if there is anything said that makes you feel either uncomfortable or as though you want to go to that department. If something like this does occur, write it down.

During the description of research performed at the department, one of two things can happen.

1. Each professor speaks for himself/herself. This method has several consequences. The first is that since everyone needs to talk, it can take a really long time, or people's research gets left out. If this is the case, try to pay attention to the projects that people are talking about, and also see if they sound like people that you would like to work with. Write down the names of people who you'd like to talk to. Even if you have a list of people to talk to and they are not on it, try to talk to them sometime, even if it is just during lunch.
2. One person talks about the research for everyone in their research group. This method can cause the meeting to run shorter, but will not let you hear people talk about their own research. If that happens, make sure that you pay careful attention to whose work they're talking about, otherwise you can have your judgment clouded by who is talking even if they have nothing to do with that research.

In any case, what you want to take out of this meeting is an idea of which research you find interesting. Make sure that if you find a particular project interesting you write down whose it is so that you can talk to them, or you will forget. Count on this part

running late!

Meeting with professors is the most important event. This is where you get to find out if a professor is someone you would actually be interested in working with. This will go smoother if you already have some idea of what their research is. When you are talking to professors, you are looking for two main things:

1. Would you like to work on the *area of research* that this professor studies?
2. Could you work *with* this person?

The advisor relationship is the most important one that you will form in graduate school, and you should think about it very carefully. Make sure to ask them questions; like all of us, they like talking about themselves.

Demos are probably the second least important of the events. You will get to see the cool stuff that is going on in the department, however, you can probably get a better idea by talking to the professors or grad students. While it can be fun, I would only go to the demos if you do not have anything else to do.

Talking with grad students is very important for several reasons. The graduate students will most likely tell you what is actually going on in the department. They can probably answer most of your questions or point you to the proper person to ask. Some questions you may want to ask are (in no particular order):

- how they like the department
- are they happy there
- can they live on their stipend
- what is the worst thing about the department
- how are the resources (building, computers, etc)
- if there is a specific professor who you would like to work with, find some of his/her students and ask them how they like working with the faculty member, how many students the professor has, how much interaction they have with him/her, etc.
- how many people who enter the program finish with a Ph.D.
- why did the people who do not finish leave
- what happens if you decide to leave the program (some schools are considering making you pay back all of the tuition if you leave)
- how many hours a week they spend at work

- what the classes are like
- how many classes they have to take, and can you place out of them
- if there are no classes, what do you have to do instead
- what hurdles (like preliminary exams) do you have to take, and what type are they (oral, written, etc)
- anything else that is important to you; for example, if you are female ask the female students how they are treated as females. This is important; don't feel silly for asking.

What To Do If You Cannot Visit

If you cannot visit, you can still find out useful information about the department. One method is to ask someone you know his/her impressions. This will probably tell you about what the people were like, but will not give you a very good view into what the professors who you want to research with are like. Send the professors email or give them a call. Most professors will be happy to tell you what they are up to. Make sure to get information about what the graduate community is like in addition to what the professors are like.

Making Your Decision

After you have gone to the schools and gotten your final lists of acceptances and rejections, you will have to make up your mind. Most schools will want to know by April 15. Besides making sure that you will have the decision by then, this also means one other thing: Pay your taxes early! If you wait until the last moment, not only will it make your decision harder, but you may discover that you are strapped for cash because you have been trying to pay off your bills from visiting all those schools.

If by this point you already know that there is exactly one place that would be the best for you to go to, congratulations! If you have not made up your mind yet, do not panic. There is still a lot that you can do to try to figure it out. Also, keep two things in mind. First, after a certain point, you cannot make a wrong decision. Chances are good that there is no one perfect place for you to go, and anywhere that you go will be fine. You are just trying to optimize. This may not make you feel a whole lot better, but keep it in mind; it really is true. Second, no decision that you make will make everyone happy. Someone will think that you have made the wrong decision no matter where you decide to go. Accept that and when the first person expresses that you have made the wrong choice, try not to let it bother you.

If you have not made up your mind, try to narrow it down to two or three based on general factors. Basically, just keep trying to make your list shorter, and if you do it long enough you will get down to one (it will not be fun, though). So how do you pick? Talk to people. If you are really undecided, try sending mail or calling the people you have talked to at other schools. If you look at web pages, you may be able to find people who have links to both communities and who would be able to give you good advice about the differences between the two. Talk to your professors again and ask them for advice. Ask the schools for information about where their graduates go after graduation; some schools may already have a list that they can just mail to you. The decision is going to be different for each person, but one method that works is to flip a coin. If the coin comes up for one school, and you are disappointed, then you know where you want to go.

I hope this helps, and good luck!

Biography

Rachel Pottinger is a second year Ph.D. student at the University of Washington. Rachel's undergraduate alma mater is Duke University. She would like to thank everyone who helped her when she was choosing her graduate school.

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