The PhD in CS: Getting There and Being Successful
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CRA-E
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Education
What is a Ph.D. in CS and Why Should I Consider It?

**Increase Knowledge & Hone Research Skills**
- Study advanced topics, increase your CS knowledge & train to be a successful researcher

**Advance the State-of-the-Art**
- Learn about and contribute to cutting edge CS research

**Pursue Your Interests**
- Opportunity to pursue your own professional and intellectual interests in CS
More Great Reasons to Pursue a Ph.D.

Gain Opportunities to Teach and Mentor

Pursuing a Ph.D. provides you with a unique opportunity to teach and mentor.

Satisfy Your Intellectual Curiosity

- Discover new things
- Identify new problems
- Develop creative solutions
- Push the boundary of knowledge
- Develop a habit of lifelong learning

Get Paid to Learn!

Many students don’t realize that most C.S. Ph.D. programs pay a comfortable stipend. But note, there are opportunity costs.
The CS Doctorate (Ph.D.) in a Nutshell

Timeline
• Variable; average 6-7 years from Bachelor’s
• Depending on school, starting with a Master’s degree may shorten timeline

Coursework
• Typically “next level” CS foundations and (more) advanced electives

Research
• Dissertation (aka Doctoral Thesis)
• Oral/Written Exam along the way (e.g., qualifying exam)

Tuition & Stipend (Get paid to learn!)
• Generally tuition is waived and you typically receive a stipend and health insurance from a teaching or research assistantship or fellowship

Career Paths
• Academia (e.g., a professor)
• Industrial, NPO, or government researcher or engineer
• Entrepreneur (e.g., a start-up)
• Higher-level development/leadership positions
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How a Ph.D. differs from an M.S. Degree

Academic Master’s Program
3-4 courses/term in first year.
1-2 courses/term with a research and MS thesis or project in second year.
Not always funded, but there is the potential to serve as a teaching assistant.

Professional Master's Program
3-4 courses/term for 1.5–2 years.
Geared towards industrial careers.
Typically not funded by the school, but could be funded by a company you work for.

Doctoral (Ph.D) Program
Similar to Academic Master’s in the first 2 years. In years 3+, primarily research.
Typically includes additional duties such as teaching assistant or research assistant.
Preparing a Strong Application
The Admissions Process
Smooth Transition: The First Few Years
The Research Apprenticeship
Beyond the Ph.D.
Preparing a Strong Application for Ph.D. Admission

How to set yourself up for success and make yourself an attractive applicant
General Preparation During Your Undergrad Years

Choose Courses Carefully
Take challenging courses (maybe even grad classes) and get broad foundations.

Seek Support to Excel in Class
Performance in advanced courses is important. Work hard, and get help when you need it.

Get Involved in Research
Undergraduate research is typically expected by admissions committees. Find a faculty member and ask to work with them.

Know Your Professors
Get to know your professors. Talk to them about your plans and interests. Build a relationship!
What Graduate Schools are Looking For...

Prior Research Experience

Potential for Becoming a Leader in the Field

Evidence of Creativity, Effort, & Persistence

Your Academic Choices and Performance
The Four Major Application Components

- Personal Statement(s)
- Letters of Recommendation
- Undergraduate Transcripts
- GRE Test Scores (for some programs)
Writing an Effective Personal Statement

• Describe your prior research experience
• Describe your future research interests
• Demonstrate that you have ideas for interesting and important problems to study
• Make it personal or unique to you!
• Personalize your statement with at least one paragraph about why the department interests you
• Have at least one faculty member give you feedback

• More guidelines:
  ○ Statement of Purpose Guidelines (MIT)
  ○ Writing the Statement of Purpose (UC Berkeley)
  ○ Statement of Purpose for Graduate School (Princeton Review)
Getting Strong Letters of Recommendation

3-4 Letters Typically Required
Have at least one letter from a faculty member with whom you did research. Focus on faculty who you have worked with recently.

At Least One Strong Letter
A letter that only says “this student did well in my class” is not very helpful. Faculty who know you well can write stronger letters.

Letters from Other Disciplines
Sometimes it can be hard to find 3-4 CS professors who know you well. It is okay to have letters from faculty in other related technical fields (e.g., EE, Math, etc.)

Internship Supervisors
A letter from a supervisor during a summer internship is fine. It is preferable if the internship is research focused.
Getting Strong Letters of Recommendation

For example...
“I’m applying to graduate school. Would you feel comfortable writing a positive letter for me? If so, I’d be grateful. If you are not able to do this for any reason, I’ll certainly understand.”

Give Them a Way to Say “No”
Neutral letters will not have much impact. Make sure such writers can decline your request.

Helps to Have Built a Relationship
Provide a resume and a transcript when asking. Ask which other materials they would like to see (e.g., a statement of purpose).

Additional tips for requesting letters:
https://gradschool.cornell.edu/diversity-inclusion/recruitment/prospective-students/requesting-letters-of-recommendation/
GRE Exam & Scores

Check if GRE Scores are required/accepted by the institutions to which you are applying

Investigate the expected GRE score ranges, and the scores’ importance to the application

Prepare for the exam! Taking practice tests can help immensely

You can retake the exam if you feel you could do better. However, the previous scores will still appear on your application

Resources:

- https://www.princetonreview.com/grad/gre-information
- http://www.ets.org/gre
The Admissions Process

How to decide where to apply and choose among your acceptances
Typical Admissions Timeline

**Junior Year**
- Take challenging CS courses
- Prepare for and take the GRE
- Continue doing research

**Summer after Junior Year**
- Decide which schools to apply to
- Narrow down list of professors for recommendation letters
- Update your resume
- Conduct summer research
- Draft personal statements

**Fall Senior Year**
- Ask letter writers
- Give them resume, personal statements & transcripts
- Finalize application materials and get feedback
- Submit applications
- Update your resume
- Conduct summer research
- Draft personal statements

**Spring Senior Year**
- Receive decisions
- Visit campuses
- Make the decision!
Five Factors to Consider When Applying

1) Strong researchers in areas of interest
2) Healthy student and academic culture
3) Financial support offered by the program
4) Location preferences
5) Department rankings
How many Applications to Submit?

Suggestion:
2 “Safe Schools”, 3 “Good Matches”, 3 “Slight Stretches”

• Why so many? Who gets accepted is unpredictable for many reasons beyond your control.

• The “top few” schools in your areas of interest should be considered stretches in almost every case.

• Talk to your advisor and other faculty in your research areas of interest with whom you feel comfortable.
Acceptances and Campus Visits (Winter/early Spring semester)

Go on Campus Visits!

- Find out about student and academic culture.
- Get answers to your questions.
- Visits are often paid for by the institution.
- If/when you get too many visit invitations, prioritize based on your factors, ask your advisor for guidance.

Sample Agenda

- Meet potential advisors and support staff.
- Meet current Ph.D. students and other prospective students.
- See the campus and surrounding neighborhoods.
- Learn how institution/dept can support your specific needs.
Knowing your Research Interests vs. Being Unsure

Knowing Your Area

- It is often helpful to have a research interest before enrolling.
- Larger departments may offer more flexibility in choosing a research area.
- Having research experience in any area can make a big difference.

Contacting Potential Advisors

- Some professors do not respond to emails until students are admitted.
- More likely to get a response to a thoughtful, personalized email.
- More likely to get responses from a smaller departments receiving fewer applications.
Financial Support Options

Teaching Assistantship

Requires up to 20 hours of work per week to help the course instructor develop and offer in course. Typical duties include grading and running lab/discussion sections.

Research Assistantship

RAs typically require working with your research advisor on a funded project. Having an RA typically requires that your advisor has research funding.

Fellowships

NSF Graduate Fellowship, DOE, DOD, DHS, industry and foundation fellowships as well as university designated fellowships. May be viewed as more prestigious and offer more research freedom.
Making a Smooth Transition into Grad School: The First Few Years

*Taking courses, getting involved in research*
Before Classes Start: Settling in & Learning the Ropes

Know Your Program Requirements

- What are the course requirements?
- What exams will you need to pass and when?
- Teaching requirements?
- By when do you need to find an advisor?
- What's the usual timeline? Are there other program or university deadlines?

Helpful Tips

- Get to know your peers and near peers
  - Create study groups
  - Establish hobbies and friendships outside the department
  - Find mentors
- Get to know your school environment and resources
- Create a comfortable studying and living environment for yourself
Taking Courses

- Ph.D. typically requires <10 courses
- Remember, focus during the Ph.D. is on research!
- Choose classes related to the potential research area
  - Ask your adviser for advice and recommendations. They may have expectations.
  - If you are interested in working with a particular faculty, take their course. Do very well. Possibly consider a course project as research.
  - Consider taking courses outside CS relevant to your research (e.g., Stat, Math, Psychology, Computational Linguistics)
Key Differences Between Courses and Research

- Class assignments have known answers. Research problems may not even have a solution.
- In classes, you are assigned problems. In research, you get to pick ones to work on.
- In classes, you can ask for help. In research, often no one knows more than you do.
- In classes, there is a clear separation between students and professors. In research, you work side by side with other research students, post-docs, and your advisor.
Get Involved in Research Early

- Getting involved in research early is the most important thing to do for overall success!
- The research process (finding an advisor, a research problem, obtaining initial results, getting these results published) takes time, so the sooner you start the better!
- The key is to have a professor to work with.

“Keep in mind that no one can give you a complete picture of what research is. The best way to learn what research is, and whether you like it, is simply to start doing it. The earlier the better!”

https://www.cs.cmu.edu/~harchol/gradschooltalk.pdf
Finding a Healthy Work/Life Balance

Graduate school does not have to be 9-5
Find the most productive hours for you and schedule ~8 working hours at that time

Make working time productive!
Research is much more about the quality of the output rather than the hours spent

Schedule personal time!
It is easy to keep working; however, time off is important

Set clear goals, get feedback and reward yourself
Talk regularly to your advisor; make sure goals and expectations are aligned

Banish the Guilt!
Take breaks to be able to produce your best work. Tap your support network!
The Research Apprenticeship

Finding an advisor that fits you; Conducting impactful research
How to Find an Advisor

- Choosing an advisor is one of the most important decisions to make in graduate school.
- Do your homework! Check the following information for a potential advisor’s Ph.D. students:
  - How many students and when they graduated?
  - How many papers (and where) students published with their advisor?
  - Where are those students now (academia, industry)?
  - What is the advisor's collaboration style?
  - Is the advisor an established or beginning researcher?
- Talk to faculty during office hours, attend their talks
- Ask to attend research meetings of a group you’re interested in
What are Advisors Looking For?

- It's important to understand what advisors are looking for:
  - Competency/interest in their area
  - Specific technical or research skills (e.g., systems building, ability to come up with proofs)
  - Writing and critical thinking skills

More advice/resources on finding an advisor:

Tips for Conducting a Successful Research Project

1) Identify an important problem you are passionate about

2) Devise a new solution or study – approach the problem from a new viewpoint

3) Create a plan for the work, and stick to it! – Expect setbacks, and work through them

4) Rigorously evaluate your solution or explain your findings
Tips for Conducting a Successful Research Project

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Beyond the Ph.D.

Choosing and pursuing a career path
Potential Career Paths

- Tenure track professor at a research university
- Teaching-focused professor at a research university
- Professor at a primarily undergraduate institution
- Industry or government researcher
In Summary: Why should you pursue a Ph.D. in C.S.?

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- **Advance the State-of-the-Art**: Learn about and contribute to cutting edge CS research.

- **Pursue Your Interests**: Opportunity to pursue your own professional and intellectual interests in CS.
Want More Info? Check Out Conquer!

A website specifically for undergraduate research and graduate school advice in CS

http://www.conquer.cra.org

Many departments/universities have grad school information sessions. Consider attending!
CRA-E’s mission is to address society’s need for a continuous supply of talented and well-educated computing researchers.

http://www.cra.org/crae