COMPUTER SCIENCE PH.D. HANDBOOK

2025-2026

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The purpose of this document is to describe the process and requirements involved in earning a Ph.D. degree in Computer Science (CS) from Northwestern University (NU). If anything is unclear, please consult your advisor for guidance.

Useful pointers

The following email addresses and websites are specific to the CS Ph.D. program:

- CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU is the initial point of contact for assistance related to the Ph.D. program. Messages sent here are received by CS staff, who will address your inquiry, or forward it to the appropriate person if needed.
- CS-DGS-PHD@NORTHWESTERN.EDU is the email for the director of graduate studies who oversees the Ph.D. program.
- The Ph.D. program maintains a site, HTTPS://WWW.MCCORMICK.NORTHWESTERN.EDU/COMPUTER-SCIENCE/RESOURCES/STUDENT/PHD.HTML, with resources catering to Ph.D. students, such as Ph.D. program handbooks, processes and documents for Qualifier and Thesis Prospectus exams, information on Conference Travel grants, Arrangements and Reimbursement, etc.
- PHD.CS.NORTHWESTERN.EDU is an internal website for the Ph.D. program. It includes numerous pointers.

Information resources external to CS are given in the appendices.

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1. General expectations and advice

The CS faculty has a set of general expectations and some general advice for all Ph.D. students.

1.1. Fulfillment and fun

You are learning how to be an effective researcher in some intellectual area, including by advancing that area through your own efforts. It is very important that you find fulfillment in your efforts, your area of endeavor, and your interactions with others in the area. Ideally, this should also be fun. Your Ph.D. training is the first step in a lifetime path. You may change directions over the arc of your life, but the one you are following now should be one you enjoy now and one that you see a future in.

1.2. Self-motivation

You are expected to be strongly self-motivated. Unlike undergraduate school or a master's program, Ph.D. level study involves extended periods where the primary driver is the student themself. The search for the thesis topic is the most critical of these periods. It is also common for research to encounter unforeseen issues, and sometimes a research project does not pan out, or you get scooped. These are obstacles that can be overcome, but you need to find the motivation within to do so.

1.3. Initiative

As you advance in the program, you are expected to take on greater initiative in your research. By the time you reach your thesis proposal—ideally earlier—you should feel comfortable suggesting research directions, disagreeing with the literature and your advisor, participating in others' projects, and running your own projects.

1.4. Reading

You are expected to be reading research papers that are relevant to your field. In some areas, this might also involve reading code. You need to develop something deeper than a textbook-level understanding of computer science and your field. Sometimes it is obvious where to start (your advisor might give you a reading list or you might take a graduate course with a reading list), but sometimes you may have to ask. Forward and backward chaining, where you follow citations made in a paper of interest, and citations of that paper, is also an effective way to find an intellectual stream.

1.5. Writing and presenting

No matter how good your research is, it will be judged through the lens of your writing and presentation skills. Likewise, how well you communicate your work influences how others perceive you as a researcher. These skills are not easy to master, but they are essential. It is also important to understand that the expectations of your research community about what constitutes a good paper, or a good talk may be quite different than what you learned previously. An effective way to learn is to read many papers and watch talks in your field, then reflect on their effectiveness and discuss your observations with your advisor.

If you are interested in the academic job market (as well as various kinds of research labs), you should pay close attention to job talks given in the department, even if they are unrelated to your area. Think about it: Attending job talks provides a valuable opportunity to observe candidates who have successfully secured interviews and to learn from their presentations. This experience allows you to gain insights into what contributes to a strong or less effective job talk. Additionally, you can discuss these observations with your advisor and others to better understand the factors that lead to success.

1.6. Networking

Knowing people in your area is important. You should take every opportunity to meet people in professional settings such as conferences, invited talks here, and other venues. You can ask your advisor or other faculty to introduce you. Think beyond just the conferences where you might be going because you have an accepted paper. If there is a relevant conference happening close by, you should go. If you can go to a remote conference by being a student volunteer or applying for student travel support offered by the conference, do it. In addition, the CS department and The Graduate School (TGS) offer a limited number of funds to partially support students who travel to conferences to present their work. If you can participate in a student meeting with a visitor, do it.

We suggest that you have a practice "elevator pitch." This is a brief description of who you are and what you do. If you share an elevator with a famous person in your field who talks to you, what do you say? That is your elevator pitch. As you progress through the program, this will become more focused.

1.7. Broadening what and who you know

While earning a Ph.D. involves becoming an expert (hopefully *the* expert) on an extremely specific question or topic, your future depends on being able to apply the skills and mindset you have learned on other topics. It is also the case that having a broad view of computer science (or even science/engineering in general) makes it possible for you to find and take advantage of connections that would not occur to someone who is overly focused. It also helps avoid your being surprised by "solving" a problem that has already been solved in a different field. Finally, when you are on the job market, you are likely to encounter people from a very wide range of areas, and you should be able to meaningfully talk to them about their work and your work.

For these reasons, you should strive to get a broader sense of fields beyond the one you are focusing on. You should also try to get a sense of the people and culture in other fields. One way to do this is to take advantage of the talks in the department. Even if the abstract is one you are not familiar with, you will at least learn something about the audience and their expectations and dynamics. Another way to get a sense of other fields is to attend community events run by the different groups in the department. Finally, talk to your fellow graduate students!

1.8. Goals

You should have written goals for the short, intermediate, and long term. Goals are not set in stone. You can always change them. What is important is to know what your goals are at any point in time

so that you can make meaningful decisions based on pursuing them. Your goals might include preparing for qualifying exams, working on your proposal, or seeking a summer internship. Your long-term goals should reflect what you intend to do next, after completing the Ph.D. If you can, also try to map out longer-term career goals.

It is a good idea to have a conversation with your advisor about your goals, especially when they change. Your advisor can help you shape what you are doing to increase the probability of achieving them.

Your five-year goals are, paradoxically, especially important when you are just starting the program. In essence, the question at that point is what kind of career you aspire to after the Ph.D.

1.9. Plans

Similar to goals, you should have written plans. These can always change, but the point is that at times you should be making decisions not just tactically, but also strategically. Your written plans are strategy.

We suggest you write and maintain a quarterly, yearly, and five-year plan. As for goals, we strongly suggest you have conversations with your advisor about your plans.

Your five-year plan is, paradoxically, especially important when you are just starting the program. The question here is what needs to be done over your time in the Ph.D. program to put you on the trajectory for the kind of career you aspire to after the Ph.D.—it is your plan for the most important five-year goal. The answer can vary a great deal.

You can also review the outcome of successful long-term Ph.D. plans, particularly of students looking at academia or a research lab. If you find someone in whose footsteps you would like to follow, just look at their CV, and work backward from their own graduation.

1.10. Important questions

Here are some high-level questions you should be able to answer starting sometime in your first year, and that you'll be continuously refining during your time here:

- What is my track?
- What is my specialization within that track?
- What is my research about?[1]
- What are my plans and goals for the next year?
- What are my plans and goals for the next five years?

[1] You should be prepared to answer this at different levels of detail. An important level of detail is the "elevator pitch" — If you're riding in an elevator with someone important in your field, and they ask you what your research is about, what is your answer? You have about a paragraph's worth of time in an elevator pitch.

2. Overall process and model

The target duration for the CS Ph.D. is five years. The reality is that the amount of time varies depending on the track, and, more importantly, on the qualifying exam and thesis processes. To earn a CS Ph.D., you need to demonstrate your ability to find, plan, execute, document, and defend original CS research that is recognized by some research community in CS as being of high quality.

Figure **1** illustrates the typical timeline of a Ph.D. student in CS. The **MILESTONE CHECKLIST** section provides a detailed list of all milestones.

2.1. Finding an advisor

The CS Ph.D. process follows an **apprenticeship model** in which **your advisor**[2] **is of critical importance**. When you arrive at Northwestern, you will be assigned an *initial advisor*, who will serve this role until you match with a thesis advisor, who will supervise your Ph.D. thesis (unless otherwise qualified, when we say *advisor* in the remainder of this document, we mean *thesis advisor*). Usually, the initial advisor is a faculty member who advocated for your admission and would like to start working with you right away. You are under no obligation to stick with your initial advisor, however.

The first thing that you should do after you arrive at NU is to start looking for an advisor (or deciding to stick with your initial advisor). Your advisor is of critical importance. He or she will guide you, help you, fund you, and advocate for you. How you learn to do research and your style and taste in problems will be largely formed by your advisor. Choose wisely. Although it is always possible to

[2] Or advisors, if you are co-advised.

change your advisor later, you can lose valuable time in doing so. Advisors have different styles, but it is common to have a one-to-one meeting each week with your advisor to talk about research.

In choosing an advisor, you should talk to any CS faculty member who interests you. Generally speaking, faculty who have a full or partial appointment within CS can advise you. Faculty with a courtesy appointment in CS can co-advise you along with another faculty member who has a full or partial appointment in CS. In your first quarter, you should also be enrolled in Introduction to Graduate Studies (IGS), which includes introductions to some of the faculty. However, you should take the initiative right away. If there is someone whose work interests you, make sure to reach out in person or by email.[3]

Generally, you should find an advisor by the end of the fall quarter (your first quarter). Strictly speaking, the hard deadline for matching (in which you and the faculty member agree to start an advising relationship) is the end of the third quarter of study. Once you match, the student-advisor pairing must be officially declared through **THE GRADUATE STUDENT TRACKING SYSTEM (GSTS)**: you must formally invite the faculty to serve as your Ph.D. advisor, and the faculty must formally accept the invitation through GSTS. For more information, see the section on **GSTS**.

2.2. Joining a track

A track in CS constitutes an overall area of shared interest among faculty that is also generally considered an area within CS as a whole. Our tracks are Theory, Systems, Artificial Intelligence, Interfaces, and Computer Engineering.

Your advisor will be part of one or more tracks and will recommend the one for you to follow. You will then be expected to follow the track's course requirements, qualifying exam structure, and thesis process. These will extend the general processes described here.

2.3. Research and courses

You should aim to get involved in research by the end of your first quarter or earlier. In your first year or two, you will also be taking classes, but doing research is *the* critical ingredient to your success as a graduate student. Section **COURSE REQUIREMENTS** describes general enrollment and course requirements in detail. The specific courses you need to take are described in your track's part of this manual.

Throughout your graduate student years, at least 50% of your time should be spent on research. The focus of a Ph.D. in CS is to become a good, independent researcher. The only way to learn how to do research is to do research under the guidance of your advisor and other faculty members. You would also want to determine very quickly whether doing research is what you intend to do professionally.

[3] Faculty are notoriously bad about responding to email. This does not mean they are uninterested. It means you should be persistent.

2.4. Community and service to the community

The CS department includes all the Ph.D. students, M.S. students, undergraduate students, postdocs, faculty, and staff. Students are expected to actively participate in the department's community. That includes joining community events, attending seminars, research group meetings, and other scholarly events, participating in student organizations, helping and mentoring other students, and teaching. Students are also expected to contribute to departmental and CS program service activities, such as assisting with student recruitment efforts, participating in orientation events for new students, and helping to organize seminars or workshops.

Finally, every person in our community is expected to treat others with common decency and respect.

2.5. M.S. degree backstop

We recommend that Ph.D. students apply for their M.S. degree as soon as they are able, which is usually at the end of the summer of the first year, or slightly later. Another option, which some tracks use, is to include it as part of the qualifying exam. Either way, the point of getting an M.S. degree on the way to the Ph.D. is to act as an indicator of progress, and as a backstop. Additionally, if you leave the program before completing your Ph.D., the M.S. degree will serve as formal recognition of your efforts.

A typical arc for a new Ph.D. student is to take 10 graded graduate courses and then two or more COMP_SCI 590 courses. This pattern matches *most* of the requirements for a project-based M.S. degree. The research that you are doing while starting your Ph.D. stands in for the M.S. project. In addition to the courses, the project-based M.S. degree also requires two CS faculty members to approve the outcome. Please review the M.S. degree requirements and procedures provided in the **CS MS MANUAL**.

2.6. Teaching Assistantship

You must serve as a Teaching Assistant (TA) at least once during your Ph.D. program, as mandated by TGS. Depending on funding and course needs, you may be asked to TA multiple times. The CS faculty recognizes the value of TAing and acknowledges that your research time may be reduced during the quarters in which you serve as a TA. TAships range from 5-hours-per-week to 20-hours-per-week positions (the latter are the majority) split across course support tasks such as attending lectures, running labs, grading, and hosting office hours. Examples of additional responsibilities include course management software development (e.g., autograding infrastructure), course development (e.g., new assignments; lecture topics; etc.), mentoring Peer Mentors (undergraduate TAs), and preparing and delivering guest lectures. Students seeking to gain teaching experience are encouraged to propose and take on progressively increasing responsibilities within their TA roles, and to connect to other teaching development opportunities listed in the **APPENDIX**.

Once you receive your TA assignment, you should reach out to the instructor of record prior to the beginning of the quarter to clarify goals for the quarter and get familiar with the course. Refer to our practical guides – **TA TIPS** and **OFFICE HOURS TIPS** – for helpful advice and best practices.

2.7. Qualifying exam

Ph.D. students must take their track's qualifying exam by the end of **their second year**[4]. The purpose of the qualifying exam is for a group of faculty in the track to assess whether the student is likely to successfully propose, execute, and defend a thesis. The specific requirements vary by track (see section **TRACK REQUIREMENTS**), but common criteria include: (1) successful completion of guided research, ideally at the level of paper submission to a quality venue, (2) a reasonable command of the research literature in the area, and (3) the ability to think and reason well.

Passing your qualifying exam advances you to "Ph.D. candidacy" within Northwestern. In the CS program, it indicates to you and your advisor that it is time to start working on your Ph.D. thesis, beginning with identifying a research topic.

2.7.1. Qualifying exam outcomes

After the exam, the committee members give one of the following grades:

- **Pass**. The student successfully completed the qualifying exam.
- **Conditional Pass**. While the student did well on most of the exam, the faculty have identified an area of weakness that must be addressed before a "pass" is reported. This letter will outline what actions must be taken to address the weakness.
- **Fail with Possibility of Retake**. The student failed the qualifying exam, but there is evidence that the student could pass, given a specific course of action. A letter will outline what needs to be done before the student may retake the exam.
- **Fail without Possibility of Retake**. The student did not pass the exam and either (1) this is their second and final attempt or (2) the committee determines there is no course of action likely to result in passing the qualifying exam prior to The Graduate School's deadline.

The qualifying exam can be retaken only once. A student cannot be admitted to candidacy without passing this exam.

Important note: After passing the qualifying exam, students must formally notify the CS program and TGS of the completion of this milestone. This is done by uploading in GSTS a document in which the qualifying exam committee members certify the student has successfully completed the qualifying exam. Uploading an email chain with each committee member's certification suffices.

2.8. Thesis process

The thesis process is the most critical and least certain part of your Ph.D. career. It is described in detail in **COMMON THESIS PROCESS REQUIREMENTS** and in your track's part of **TRACK REQUIREMENTS**.

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[4] More accurately, by the last day of the 8th quarter of study. Ph.D. students who joined the program before Fall 2025 must pass the qualifying exam by the end of their third year (last day of the 12th quarter of study).

3. Understanding funding

The cost of a Ph.D. student over their five or so years at Northwestern can range up to $400,000.[5] We acknowledge that you are making a very significant commitment[6] to be a Ph.D. student. In the following, we describe how funding works in the CS Ph.D. program. There are CS-adjacent programs that provide different dispensations. Talk to your advisor if you are in doubt.

In general, CS Ph.D. students are funded through the following sources:

- University fellowships: Northwestern supports you.
- External fellowships: An external entity supports you.
- Research assistantships (RA): A faculty member (typically your advisor) has a research grant and supports you from that grant. You need to be doing something relevant to the grant.
- Teaching assistantships (TA): Northwestern supports you, but you will be teaching, typically by TAing a course.
- Graduate assistanships (GA): The CS department funds you to support departmental activities or operations, instead of TAing. This is stopgap funding that is expected to be very rare.

Funding is guaranteed for the first five years, subject to satisfactory academic progress. The source of funding depends on the available funding sources, and is not at the discretion of the student.

In your first year at Northwestern, you are supported through a university fellowship, typically a Murphy or Cabell award. This gives you a great deal of freedom. We want you to use that freedom to hit the ground running, find an advisor, and start building your research career. Once you match with your advisor, funding generally is based on being an RA, a TA, a GA, or on being awarded an internal or external fellowship. University fellowships do exist for upper-year students, but they are much more rare and usually competitive. You should apply for them (and your advisor should tell you which ones are relevant), but these are uncommon cases for upper-year students.

External fellowships are awarded directly to students and provide the maximum flexibility. We **highly recommend** that students take the initiative in seeking external funding. An external fellowship is also usually quite prestigious.[7] The department maintains a list of fellowship opportunities that you and your advisor can consult. The University's fellowship office also provides lists and help.

The majority of funding for upper-year (Y2+) students in CS is via research assistantships (being an RA). Research assistantships are funding that is provided as part of a research grant, generally your advisor's grant, and generally a grant from the federal government. If you are funded as an RA, the expectation is that you will do, in part, research and development related to the grant, as determined

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[5] This number may seem surprising, but it is based on the five-year cost of a student on a federal grant. In addition to your stipend and benefits, the cost also involves tuition, some materials, some travel, and university overhead.

[6] Not just your time and effort, but also the opportunity cost.

[7] Of particular note are the NSF GRFP, DOD NDSEG, and DOE CSGF fellowships, which all students who are U.S. nationals and have matching research interests should apply for. Various companies like Meta, Microsoft, Google, IBM, also run highly prestigious fellowship programs that have no citizenship restrictions.

by your advisor. This is generally a very workable situation as you hopefully share at least some of your advisor's interests and those interests are partially reflected in the grant and its work. Many advisors are extremely happy when students take the initiative in suggesting work to be done while funded on an RAship. Students can begin to provide research assistance after their first quarter.

It is very important to understand that RA support can be limited and competitive. While grant funds may appear substantial, they must cover many costs. In the event of a funding shortfall, your advisor will explore alternative ways to provide support. If you have questions about your funding, please discuss them with your advisor.

Teaching assistantships can fund students through their fifth year at Northwestern. TA positions are allocated quarterly through a department-level competition, and require students to assist with a course. The time involved in full-time TAing a course (100% effort) is 20 hours a week. Half TAships (50% effort) have a time obligation of 10 hours a week, and 25% TAship assignments require 5 hours a week. These time commitments are averages across the entire quarter; time involvement during individual weeks may be variable. If you are TAing a course and find you work longer than anticipated, you should discuss the TA assignment with your advisor.

3.1. Summer funding

Summer funding differs slightly from other quarters. The school is not in session, so TA positions are typically not available during the summer quarter. Summer funding primarily comes from RA positions (supported by the student's advisor's grants), GA positions (supported by the department), internal or external fellowships, or internships.

Students are encouraged to explore summer opportunities such as internships at reputable research laboratories, national labs, and companies. Those interested in a summer internship should take the initiative in identifying suitable opportunities, ideally beginning their search early, with January being the recommended timeframe.

More information surrounding internships and internship policies is available at section **INTERNSHIPS**.

4. Evaluation and academic progress, issues

4.1. Annual evaluation of students

At the beginning of each academic year, all Ph.D. students, except first-year students, receive annual reviews. These reviews include feedback from the faculty and a numerical evaluation from 1 to 5 of the student's work over the previous academic year, where 1 signifies "Unsatisfactory," 2 "Needs Improvement," 3 "Meets Expectations," 4 "Exceeds Expectations," and 5 "Exceptional."

This annual evaluation of Ph.D. students takes place at the end of the spring quarter or the beginning of the summer quarter. This evaluation incorporates the following sources:

- The advisor fills out a detailed evaluation of the student in a standardized form.
- The student fills out a detailed evaluation of themselves in a standardized form.

- The program collects information from university systems that include RCR status, English testing status, and grades.

The advisor and student forms follow a similar structure, allowing faculty to directly compare the student and advisor perspectives and determine if they are on the same page.

The faculty reviews each student using this information and prepares a letter summarizing the evaluation. The letter indicates whether the student is making satisfactory progress (based on the range mandated by TGS), highlights accomplishments and challenges from the past year, and outlines goals for the upcoming year. It may also include deadlines for specific milestones. The faculty meets to review each letter, and the letter is sent to the student on behalf of the entire faculty. The letter is also shared with TGS.

Note that students found in violation of the **NORTHWESTERN CS ACADEMIC INTEGRITY POLICY** must receive an unsatisfactory review for the academic year in which the violation occurred.

4.2. Academic probation by the CS program (currently under TGS review)

The CS Ph.D. program places students in academic probation, with one quarter to remediate, if:

- The student receives an annual review evaluation of "***Unsatisfactory***."
- The student is on their **fourth quarter** of study or later, and does not have a thesis advisor.
- The student has not passed a qualifying exam within the first **two years**[8] of study.
- The student has not passed a Ph.D. thesis proposal within the first **four years** of study.
- The student has not defended the Ph.D. thesis within the first **seven years**[9] of study. While this milestone deadline provides some allowance for unforeseen delays toward Ph.D. degree completion, we expect such cases to be rare, and students to graduate within five years.

In particular, Ph.D. students are placed on academic probation effective the first day of the quarter following the quarter that triggered the probation (e.g., effective the first day of the quarter following the annual review, for students that received an "Unsatisfactory" evaluation; or the first day of the quarter following the quarter in which the student missed a milestone deadline; or the first day of the quarter following the quarter in which the student's advising relationship was dissolved). While on probation, the students may be required to report their progress to the Director of Graduate Studies (DGS) in regular intervals, to ensure progress is made toward remediation.

Despite its dire implications, probation is meant to be a strong motivation, rather than a punitive action. It is a formal, top-priority alert that you must take immediate corrective actions to continue in the CS Ph.D. program. While its purpose is to compel you to act to overcome current deficiencies, probation must not be taken lightly. It is the last lifeline offered to place the student back in good academic standing.

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[8] Ph.D. students who joined CS before Fall 2025 must pass the qualifying exam by the end of their third year.

[9] Ph.D. students who joined CS before Fall 2021 must defend their Ph.D. thesis by the end of their ninth year. Ph.D. students who joined CS in AY 2021-22 must defend their Ph.D. thesis by the end of their eighth year.

At the end of the probation period, a student is removed from probation if:

- For students that received an "Unsatisfactory" evaluation, if there is a notable improvement in performance, as determined by a committee formed by the DGS.
- For students without a Ph.D. advisor, if they have found a new advisor.
- For students that missed a milestone deadline, if the student has passed the milestone (i.e., qualifying exam, prospectus exam, or successfully defended their Ph.D. thesis).

If the student is not removed from probation, a committee formed by the DGS will make one of the following determinations:

- Dismiss the student from the Ph.D. program.
- Extend the probation period by one quarter (in exceptional cases).

Students dismissed from the Ph.D. program have the right to appeal this decision per TGS rules.

4.3. Academic probation by TGS

TGS also evaluates students every quarter to determine if they are making satisfactory academic progress as per TGS's general **REQUIREMENTS**. Examples of problems include your GPA dropping below the minimum required level, having three or more incomplete grades, and missing deadlines for milestones such as the qualifying exam ("admission to candidacy") and proposal ("prospectus"). If these problems occur, TGS will place you on probation. The purpose of probation is to compel you and your advisor to act, typically within 2 quarters, to fix the problem. If the problem is not fixed in the probationary timeframe, you risk dismissal. It is possible to petition to extend the deadline.

We refer students to The Graduate School's **ACADEMIC PROBATION** Policy for more information.

4.4. Annual evaluation of advisors

The annual evaluation of Ph.D. students is paired with an annual evaluation of advisors. In this evaluation, we integrate the following sources:

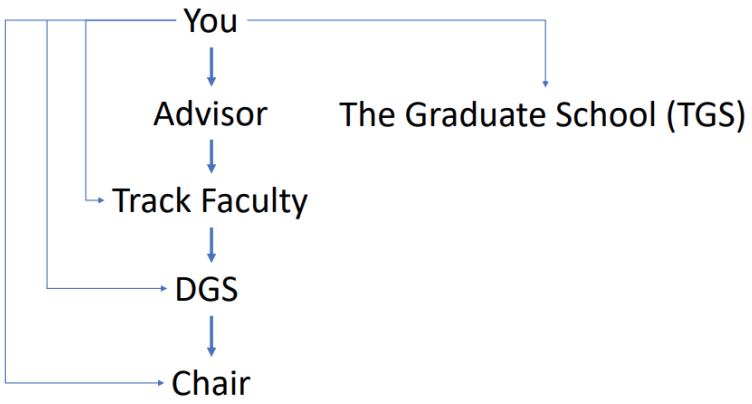
- The student fills out a detailed evaluation of their advisor in a standardized form. This information is only available to the DGS and chair.
- The DGS and chair summarize any issues that have come to their attention over the past year.
- The DGS and chair follow up with advisors if serious issues[10] are identified.

4.5. Reporting issues

If you are having a problem or issue, we encourage you to talk to us about it. The figure below shows the reporting path. Note that you can skip any step here. You can always approach TGS without involving anyone in the CS department or program. While we recommend that you talk to your

[10] Again, "serious issues" is defined here with respect to the intellectual relationship of advising, and more profound matters will be dealt with separately and swiftly.

advisor about an issue first, you are perfectly welcome to talk to other faculty on your track first instead. Also, note that there is an entire parallel reporting path in The Graduate School (TGS).



It is important to note that reporting profound matters such as harassment, intimidation, and the like has additional processes and paths in place, which are described in section **TITLE IX**. Everyone in our community must be treated with common decency and respect.

4.6. Leaves of absence

Northwestern allows for **LEAVES OF ABSENCE FOR MANY REASONS**, including medical, family, parental, and general reasons.[11] Please review the leave of absence details and impact on timelines for milestones.

5. On-campus presence, residency, and time off

5.1. On-campus presence policy

Graduate students in a paid TA, RA, or GA position, or a Northwestern fellowship, must maintain full-time on-campus presence, including summers, and active engagement in research, education, and departmental activities, as appropriate for their Northwestern appointment, including attending seminars, during the paid quarters to retain funding. Students may be allowed to conduct part of their research remotely, while still residing in the US, only with advisor approval in writing. Travel that is required for research or business purposes related to the student's Northwestern appointment, or Ph.D. thesis (conferences, research visits, etc.) is allowed with advisor approval. Students may not reside outside of the United States while working for Northwestern University.

Additional information can be found in the Northwestern Policy on Workplace Strategies, section X: **REMOTE WORK POLICIES/PROCEDURES**[12]. These policies apply to all employees, including staff, faculty, student, and non-student temporary workers.

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[11] **HTTPS://CATALOGS.NORTHWESTERN.EDU/TGS/ACADEMIC-POLICIES-PROCEDURES/LEAVES-ABSENCE/**

[12] **HTTPS://HR.NORTHWESTERN.EDU/ESSENTIALS/ALTERNATIVE-WORK-STRATEGIES/**

Important note: Students who receive funding from Northwestern (in any form, including internal or external fellowships or assistantships) during a quarter, including summer, or register for classes, including COMP_SCI 590 and TGS 500, are required to be in residence and available for on-campus academic activities by the first day of classes in that quarter. Exceptions may be granted in advance for students engaged in approved off-campus research or other academic activities authorized by their advisor and the CS program. Under no circumstances should students be in residence at the designated place of performance after the course add/drop deadline of the respective quarter. The registrar publishes these dates in the academic calendar.

Failure to arrive to the designated place of performance by the course add/drop deadline of the corresponding quarter may prevent the student from maintaining continuous full-time enrollment, may result in the academic program being discontinued due to "failure to enroll", and may have severe immigration repercussions, including the termination of the student's visa. This is the case even if the delay is due to unforeseen and extenuating circumstances, including travel abroad to renew a student visa, and exceedingly long visa processing delays preventing the student from returning to campus on time. Students who are unable to arrive to the designated place of performance by the course add/drop deadline must notify the CS program and the CS DGS as early as possible, and may be required to obtain a General Leave of Absence for the quarter.

5.2. Residency policy

Graduate students in a paid TA, RA, or GA position or fellowship residing outside Illinois require 60 days advance notice and review for tax implications and approval by the McC HR Business Partner. Students may not reside outside of the United States while working for Northwestern University.

5.3. Time off policy

Graduate students should consult with their advisor to request personal time off at least two weeks in advance. Graduate students should use best efforts to schedule personal time off during scheduled academic breaks. For incidental, temporary illnesses and exposures to infectious illness, graduate students may request time off from their advisor, and such requests shall not be unreasonably denied.

6. Enrollment, registration, and GPA requirements

While you are an active CS Ph.D. student, you must be registered, including during the summer.

Registration means signing up for 3–4 units (a class is typically a single unit) each quarter. Here is a general template for what you should be registering for:

- If you have not yet completed your 10 graded graduate courses, you should be signing up for actual courses that help with the intellectual requirements of your track and advisor. If you cannot find a relevant course, or you have already met the intellectual requirements, take COMP_SCI 499 (typically with your advisor, but not necessarily with them).

- If you are in a quarter where you need to take some graded graduate courses and/or 499s, but you don't need to fill all 3-4 slots to finish with the 10-course requirement, fill in the empty slots with COMP_SCI 590. This is a pass/fail "slot" for research that can be "mixed" with graded graduate classes.
- If you are in a quarter where you don't need any more graded graduate courses and/or 499s, and you receive funding, fill in the whole quarter with TGS 500. TGS 500 is a pass/fail "slot" for Ph.D. thesis research.

6.1. Internships and CRDV 510

Ph.D. students may benefit from internships in research laboratories and high-tech companies. You should discuss with your Ph.D. advisor whether applying for a summer internship is the right choice for you. Internship eligibility is determined by the student's Ph.D. advisor and the Director of Ph.D. Program Administration at the Northwestern School of Engineering. Students pursuing internships must follow the rules set by the McCormick School of Engineering:

- Ph.D. students pursuing a full-time internship opportunity must register for CRDV 510 *Crown Family Internship Program*. CRDV 510 is a 0-credit, no-tuition-bearing course that allows students to preserve their student status, allows health benefits to be maintained, and permits loans to be deferred.
- Ph.D. students may participate in up to three full-time internships (i.e., three CRDV 510 units) during their course of study, with no more than two quarters taken consecutively.
- Ph.D. students may take an internship only after passing their qualifying exams.
- Internship experiences cannot inhibit progress toward degree completion, and are not grounds for milestone extensions.
- Students may participate in part-time internships of 25% effort (i.e., 5 hours per week) or 50% effort (i.e., 10 hours per week) during the academic year (September through May), which will count as 0.25 units or 0.5 units of CRDV 510, respectively, toward the 3-unit CRDV 510 limit.
- Part-time internships must be directly related to the student's Ph.D. thesis topic, and allow the student to make uninterrupted progress toward Ph.D. degree completion.
- A student requesting to participate in a 25% (or 50%) effort part-time internship, will be offered a 75% (or 50%, respectively) Northwestern appointment as an RA, TA, or GA, or be supported by an internal or external fellowship. Work on the part-time internship must be performed while the student is on campus, in order for the student to satisfy their Northwestern appointment responsibilities.
- Ph.D. students pursuing a part-time internship opportunity should **not** register for CRDV 510 and should **not** complete a Graduate Student Permission to Work Request. Instead, they must reach out to the CS Director of Graduate Studies (DGS) to discuss the appropriate process for obtaining approval.

Additional policies on full-time and part-time internships may exist. Students interested in pursuing internship opportunities should discuss their plans with their advisor and the program, to ensure student eligibility and program compliance. For more information, see "**CROWN FAMILY GRADUATE INTERNSHIP**."

6.2. GPA requirement

You must have a cumulative grade point average of 3.0 ("B") or better. Your GPA is computed based only on your graded graduate courses.

7. Course requirements

The purpose of the Ph.D. process is to learn how to become an effective, independent researcher. You learn how to do research by doing research, initially with a lot of guidance, and, over time, with less and less guidance. This cannot be stressed enough: Y*ou are in a Ph.D. program to learn how to do research, and courses serve this goal*.

7.1. Intellectual versus accounting requirements

Courses serve three intellectual purposes. The first is to make you a well-grounded computer scientist with a feel for the breadth of CS, and perhaps beyond. The second is to give you depth within the track you are working in. The final purpose is to give you the tools to better pursue your research. These purposes create intellectual *requirements*, which should be your primary concern when it comes to selecting courses.

Your selection of courses also must meet *accounting requirements* in terms of the number and type of courses required for graduation, which are imposed by various parts of Northwestern. These are not onerous, and by meeting the intellectual requirements you will generally also be meeting the accounting requirements. It is important to keep an eye on them, however.

7.2. Your advisor and courses

The intellectual requirements that you can satisfy through courses are determined by your advisor, your track, and the CS program. The intellectual requirements are intended to be specific to your situation. It is important to talk to your advisor every quarter about courses. Your advisor knows your background, your track, your research, and your goals better than anyone else, and is thus best equipped to lead you in the right direction.

Your advisor should also know the accounting requirements, but if they do not, they can always reach out to **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** to ask. You can too.

7.3. Course requirement details

You must take a total of 10 graded[13] graduate[14] courses at Northwestern including COMP_SCI 401 *Introduction to Graduate Studies* (IGS). Let us consider the requirements in more detail:

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[13] "Quality graded", specifically, which means a letter grade that contributes to your GPA.

[14] "Graduate course" means approved for TGS credit, which is the case for most 300+ level courses in CS. If in doubt, ask or look on CAESAR (a graduate course will appear in "The Graduate School" "Course Career").

- **Enrollment requirements**
    - While you are in the program, you must be enrolled as a full-time student. You need to register for 3-4 units in each quarter, even if you are not taking formal classes anymore. At the beginning of your time in the program, this will typically be graded courses and COMP_SCI 499 *Independent Study* units. Later, it will progress to COMP_SCI 590 *Thesis Research*, TGS 500 *Funded Doctoral Study*, CRDV 510 *Crown Family Internship*, etc. If you are not registered for classes, you may be discontinued from the program, and it can negatively impact stipend funding. You must also maintain a 3.0 GPA. More information is in **GPA REQUIREMENT.**
- **University requirements**
    - RCR: You must complete the *Responsible Conduct of Research* (RCR) web training and course (e.g., GEN_ENG 519). You should do this as early as possible in your first year. *If you do not pass the RCR requirement, your means of support are extremely limited because you cannot be funded on a sponsored grant.*
    - English: If you are a foreign student, you must also pass Northwestern's English Language Proficiency tests (including taking courses if necessary) before you can TA. Since TAing is required for graduation, and is also an important source of funding, you should get this done as early as possible. You have a limited number of attempts.
- **The Graduate School (TGS) requirements**
    - You must complete 9 graded graduate courses.
    - At most half of the courses during your first three quarters can be 499s (more below).
    - "Teaching Experience" courses like GEN_ENG 545/546 do not count toward these requirements.
    - You must maintain a 3.0+ GPA.
- **CS Program requirements**
    - You must take COMP_SCI 401 *Introduction to Graduate Studies* (IGS). Ideally, you would take this in the first quarter of your first year. **IGS is *in addition* to the 9 TGS courses, so the total number of graded graduate courses is 10.**
- **Track requirements**
    - Here, you are expected to attain a certain level of breadth and depth. The track's description later in this document describes the intellectual requirements in detail and suggests courses to achieve those requirements. These courses will also help you meet the enrollment and TGS accounting requirements. Each track includes its specific requirements for courses as part of its description in Section **TRACK REQUIREMENTS**.
    - The courses suggested by the track are not the only ways to meet the intellectual goals of the track. Your advisor is tasked with helping you meet the intellectual goals of the

track through course suggestions, or in determining that you meet them without taking a course. The track's other faculty can help when things are not clear. If there remains a lack of clarity, your advisor can contact CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU.

- **Advisor requirements**
    - Your advisor may have additional intellectual expectations and course requirements given your specific circumstances.
- **Qualifying Exam Committee requirements**
    - Your intellectual background, including courses, is fair game during your qualifying exam. Your advisor is tasked with helping you prepare for it, including taking relevant courses.

7.4. Course waivers

Many students enter the program with substantial undergraduate or masters-level coursework and other experience. This might well obviate the need to meet an intellectual requirement of taking a course.

If you believe you have the intellectual background that is reflected in a course requirement, you should talk to your advisor. If you and your advisor agree that you already have the intellectual background of COMP_SCI NNN (and you can get help on making this determination by talking to the course coordinator of COMP_SCI NNN), then you can take a different course, or a COMP_SCI 499 instead. COMP_SCI 499 allows the student to have more graduate reading and research, while earning a course credit at the same time. We expect the student, advisor, and track faculty to determine when COMP SCI 499 is intellectually appropriate for the student.

It is important to note that courses with the same title may vary in content and rigor. As a result, some Ph.D. students may need to retake certain courses at Northwestern to ensure they cover the necessary intellectual foundation. Additionally, all Ph.D. students are encouraged to engage in guided research from the outset of their program, and COMP_SCI 499 often helps facilitate this goal.

Common scenarios to discuss include:

- **Filling gaps in intellectual background:** If a course is needed to strengthen your foundation, you should enroll in and complete the course for a grade.
- **Balancing research and coursework:** If you need to engage in graduate reading or research while also completing a graded course, you can register for COMP_SCI 499 with your advisor.
- **Prioritizing research:** If you already have sufficient graded coursework, you may register for COMP_SCI 590 with your advisor or TGS 500 if you are funded by The Graduate School.

The only strict limitation placed on COMP_SCI 499 is TGS's requirement that 499s must represent half or less of your courses during your first three quarters at Northwestern.

It is important to understand that having a course requirement waived affects the intellectual requirements of the program, but it does not affect the accounting requirements. You must satisfy the University, TGS, and CS program course accounting requirements: RCR, English, and 10 graded graduate courses (including IGS). What waiving does is allow you to substitute other graduate courses.

Students who transfer from the Northwestern M.S. program to the Ph.D. program may count their credits toward satisfying Ph.D. requirements if permitted by The Graduate School (TGS).

8. Common thesis process requirements

You complete this process by persuading your thesis committee—through a series of steps—that you have achieved this goal. Ultimately, the committee members endorse your work by attaching their names to the thesis and publicly affirming their confidence in it. The final product, the dissertation, becomes a permanent public record. It is the student's responsibility to form a committee and schedule both the proposal and final defenses. The general requirements outlined here apply to all CS tracks; Section **TRACK REQUIREMENTS** provides additional track-specific details.

8.1. Thesis committee

The thesis is evaluated by a committee selected by the student in consultation with his or her advisor. The committee is responsible for reviewing and providing feedback on the thesis proposal, attending the proposal defense, providing guidance and advice as the thesis work progresses, reading and commenting on the dissertation, and attending the thesis defense.

The thesis committee must include at least four members. Of these, at least three—including the committee chair— must be members of the Northwestern Graduate Faculty [15], and must also be non-courtesy members of the CS faculty [16]. The fourth member is recommended to be external to the CS department or Northwestern.[17] The committee must include the student's advisor, who generally serves as the chair of the committee.

These requirements represent the minimum composition; it is acceptable, for example, to have additional members, or to have courtesy faculty as members, provided these minimum requirements are met. Note that some tracks impose additional requirements. While changes to the committee composition are permitted, they are uncommon and generally discouraged.

8.2. Thesis prospectus (proposal)

The thesis proposal is a written description of the envisioned work that should lay out the research problem that will be addressed, the approach you plan to take to the problem, related work, your

[15] This is true of tenured/tenure-track faculty.

[16] They must have at least a partial appointment in CS, i.e., CS pays at least some of their salary.

[17] An external member provides several benefits to you. First, they provide an external sanity check for you and the rest of the committee. Second, they are a valuable networking opportunity for you that may be beneficial when you enter the job market.

prior work, and a work plan and schedule. The schedule must make your expected completion date clear. Once you and your advisor agree the document is ready, you will share it with the rest of the committee. The proposal does not need to be made publicly available online.

After the committee has had at least a week to review your thesis proposal, the next step is a thesis proposal defense. The talk is a summary of the thesis proposal and a defense of its ideas. This generally takes the form of a public talk followed by in-depth questions first from the committee and then from the other attendees. The student must schedule the defense, making sure all the committee members are there physically or via phone/video. There is no set time limit for a thesis proposal defense, tracks might imposed specific requirements.

Please contact **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** **no later than a week before** the proposal defense, so the CS program can formally announce it to the community. At the end of the thesis proposal defense, the committee will either approve or reject the thesis proposal and inform the student. This should be communicated to **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** who will record it within CS and inform TGS as well.

You should complete the thesis proposal and proposal defense no later than by the end of the fourth year of study (more specifically, by the last day of the 16th quarter of study). This deadline can be altered in case of an approved leave of absence.

Important note: After successfully defending the thesis prospectus, students must formally notify the CS program and TGS of the completion of this milestone. This is done by uploading in GSTS a document in which the thesis prospectus committee members certify the student has successfully passed. Uploading an email chain with each committee member's certification suffices.

8.3. Thesis defense and dissertation

The dissertation is a written, typically book-length work that describes your activity in addressing the problem you laid out in your proposal and gives the results. It is not uncommon for the dissertation to integrate publications (for example as chapters), but the dissertation must be able to stand on its own.[18] The dissertation should include an abstract, a statement of funding sources, and must include a list of your thesis committee members, and which one is the chair.

The thesis defense begins with a public, well-advertised talk in which you summarize your thesis work, dissertation, and main results. This is followed by questioning by the thesis committee and others. As with the thesis proposal defense, there is no set time limit for a thesis defense.

The student must schedule the defense, making sure all the committee members are there physically or via phone/video. The dissertation document must be complete, in draft form, before the thesis defense can take place.

At least two weeks before the thesis defense, you must submit a draft of your dissertation along with the CS Examination Request form signed by all members of the committee to **CS-PHD-STUDENT-**

[18] TGS provides formatting guidelines that you need to meet. The easiest way to meet them is to ask to borrow a template file from a graduated student or from your advisor.

HELP@NORTHWESTERN.EDU or in person at the CS grad office. This signifies that the committee is ready to hear your defense and that they will have at least a week to review the dissertation draft. Generally, the advisor will read and comment on the dissertation draft well before then.

At this time (**at least one week prior to the defense**), you must also email CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU with the following information, which will be used to create a formal public talk announcement, similar to a seminar talk announcement:

- The date, time, and location of your defense.
- The title and abstract of your talk, as well as your bio.
- The names of your thesis committee members, and their affiliations. The chair should be clearly designated.
- A link to your dissertation draft for interested parties.

Your talk will then be advertised widely in the department and at Northwestern.

At least 3 members of your thesis committee must be designated as readers (in most cases, the external committee member is not a reader). At least three days prior to the defense, your readers must prepare short reviews (at least 2–3 paragraphs) of the dissertation draft and send them to you and the rest of the committee. All other members of the CS department are welcome to submit their feedback as well. Before the defense, the thesis committee chair should prepare a draft summary of all reviews. The summary can be edited and updated by committee members before and during the defense.

The defense minimally consists of four components:

- **Public talk**: You will give your talk, presenting a summary of the thesis work and a defense of its ideas and results. Anyone may attend.
- **Public questioning**: Each member of the committee will ask you in-depth questions. Once the committee is finished, further questions are solicited from the audience.
- **Private questioning**: After public questions have been exhausted, the audience will leave, and the committee may ask further private questions or raise other private concerns.
- **Private discussion and decision**: You leave the room, and the thesis committee continues the discussion and determines whether you have passed or failed the thesis defense.

Immediately after the defense, the committee chair will inform you of their decision and provide you with a summary describing the results of the committee's deliberation and what required additional work, if any, is to be done.

If you pass, the thesis committee chair is responsible for seeing that the required changes are completed and verifying that the rest of the committee is also happy with them.

At this point, you need only to deliver the final version of your dissertation in order to graduate. It is done in two ways. First, you submit it to TGS, specifically (currently) ProQuest. TGS will identify any formatting issues that would need to be addressed. ProQuest makes the dissertation available via

the library. Second, you must create and publish a Northwestern CS technical report[19] of your dissertation to make the thesis work widely available to the public. The dissertation, in both forms, must include a page documenting the thesis committee members who approved it.

[19] This is intended to be straightforward. The technical report will essentially be your existing TGS-approved dissertation document prefaced with a technical report cover.

9. Milestone checklist

Here are a range of milestones you should be checking off as you go through the program:

- ☐ Found an advisor
- ☐ Found peers to talk to and hang out with
- ☐ Conducted research with your advisor and/or their group
- ☐ Had weekly one-on-one meetings with your advisor
- ☐ Completed your Responsible Conduct of Research (RCR) Training
- ☐ Completed all other mandatory training to-date (e.g., anti-bias, student code of conduct)
- ☐ Passed any necessary English language tests to be qualified to TA
- ☐ Finished your coursework
- ☐ Interned outside of Northwestern
- ☐ Provided service to your lab, group, the CS program, or the CS department
- ☐ Been a TA
- ☐ Mentored or co-mentored an undergraduate, REU, or M.S. student
- ☐ Submitted a paper to a competitive venue as a co-author
- ☐ Had a paper accepted at a competitive venue as a co-author
- ☐ Submitted a paper to a competitive venue as an equal contributor
- ☐ Had a paper accepted at a competitive venue as an equal contributor
- ☐ Submitted a paper to a competitive venue as the/a lead author
- ☐ Had a paper accepted at a competitive venue as the/a lead author
- ☐ Attended a research conference
- ☐ Gave a talk at a research conference
- ☐ Completed your master's degree
- ☐ Passed your qualifying exam
- ☐ Seen a research proposal or received mentoring about research proposals
- ☐ Passed your thesis proposal (“prospectus”)
- ☐ Defended your thesis successfully
- ☐ Completed your dissertation document and had it approved
- ☐ Completed job application materials (“job packet”) for an academic or research lab position
- ☐ Completed job application materials for an industry or other position
- ☐ Gotten a job offer
- ☐ Gotten a job offer you like

10. Track requirements

10.1. Track requirements: Theory Track

Theoretical Computer Science (TCS) looks at the fundamental questions of computation by creating formal models of computation and understanding the resources needed to solve general and specific algorithmic questions. TCS studies the design of efficient algorithms and the computational complexity of various computational tasks that arise in computer science, statistics, economics, and other sciences.

10.1.1. Members

The following faculty members are affiliated with the theory group, are members of The Faculty of The Graduate School, and can serve as primary Ph.D. research advisors: Edith Elkind, Jason Hartline, Samir Khuller, Konstantin Makarychev, Sidhanth Mohanty, Miklos Racz, Aravindan Vijayaraghavan, and Xiao Wang.

10.1.2. Course requirements

Theory courses

Each student in the theory group must earn at least an "A-" in 3 courses from the following list before their qualifying exam.

- COMP_SCI 396/496 – Algorithms for Collective Decision Making
- COMP_SCI 407 – Advanced Topics in Modern Cryptography
- COMP_SCI 432 – Mechanism Design
- COMP_SCI 437 – Approximation Algorithms
- COMP_SCI 462 – Foundations of Quantum Computing and Quantum Information
- COMP_SCI 496 – Algorithms for Big Data
- COMP_SCI 496 – Computational Complexity
- COMP_SCI 496 – Foundations of Data Economics
- COMP_SCI 436 – Graduate Algorithms
- COMP_SCI 496 – Learning in Networks
- COMP_SCI 496 – Learning, Information and Data
- COMP_SCI 496 – Modern Discrete Probability
- COMP_SCI 496 – Preference Aggregation for AI Alignment
- COMP_SCI 496 – The Expansion Phenomenon in Computer Science
- COMP_SCI 496 – Theoretical Foundations of Data Science
- COMP_SCI 496 – Theoretical Machine Learning
- COMP_SCI 496 – Topics in Algorithmic Statistics

The student may substitute one of these courses with a different graduate-level theory course with the permission of the qualifying exam committee.

Non-theory courses

All students should take at least two 300+ non-theory graduate courses before their thesis proposal. These courses can be non-theory CS courses and/or courses from other departments (e.g., math and economics). These courses must be approved by the student's advisor.

10.1.3. Internships

Students are encouraged to apply for summer internships at research labs if this is deemed to enrich their learning experience.

10.1.4. Qualifying exam

The purpose of the theory group's qualifying exam is to determine whether the student has the essential prerequisites for being a Ph.D. level researcher. The exam tests the following:

- If the student has acquired a sufficient breadth of knowledge in computing and algorithms.
- If the student has a depth of knowledge in his or her research area.
- If the student can present research well both in written and oral form.

The qualifying exam committee consists of three or four members. The student's advisor(s) must be on the committee. The other committee members should be faculty at the Northwestern CS department or, if approved by the advisor, faculty members or researchers from other departments, universities, or research labs.

The qualifying exam typically takes 2-3 hours in total. The first part of the exam is open to the public. The student should contact **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** **no later than a week before** the proposal defense, so the CS program can formally announce it to the community. In the first part, the student presents either (a) the results of research he or she has done (preferably already published in a conference or journal); or (b) an in-depth survey of a research topic assigned to the student by the advisor. The topic of the presentation should be discussed with the advisor. Also, fourteen days before the exam, the student should send the committee the paper or papers he or she is going to present.

The second part of the exam is closed to the public: Only the student and committee members can attend it. During the second part of the exam, committee members ask the student technical questions related to his or her research area, literature on the reading list, and the core courses the student has taken. The reading list should contain 10-15 papers and book chapters. It should be approved by the committee before the exam.

10.1.5. Thesis committee

There are no requirements beyond those specified by the CS program in **THESIS COMMITTEE** and imposed by The Graduate School.

10.1.6. Thesis prospectus (proposal)

The thesis prospectus defense is a talk open to the public and should last approximately 50 minutes. Following the thesis prospectus talk, the chair of the committee will write a formal letter to the

student describing the results and what additional work, if any, is to be done. The student should contact **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** **no later than a week before** the prospectus defense, so the CS program can formally announce it to the community. The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis prospectus of all tracks.

10.1.7. Thesis defense and dissertation

After a successful thesis defense, the committee will send comments on the dissertation draft to the student within 7 days. The student must then complete any additional work and make the necessary changes to the dissertation. The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis defense and dissertation of all tracks.

10.2. Track requirements: Systems Track

Computer systems research studies how to create reliable, secure, scalable, and usefully programmable computing, communication, and storage foundations that the world depends on. The scope of inquiry ranges from microarchitecture to interplanetary networking.

10.2.1. Members

The following faculty are affiliated with the systems group, are members of The Faculty of The Graduate School, and can serve as primary Ph.D. research advisors: Nivedita Arora, Fabian Bustamante, Simone Campanoni, Yan Chen, Alok Choudhary, Andrew Crotty, Christos Dimoulas, Peter Dinda, Robby Findler, Nikos Hardavellas, Russell Joseph, Aleksandar Kuzmanovic, Seda Ogrenci, Jennie Rogers, Kate Smith, Xinyu Xing, and Xiao Wang.

10.2.2. Timeline and general expectations

The target duration for the systems Ph.D. is 5 years, but it is not uncommon for it to take longer. Systems research often has a high overhead, which means the publication pipeline is long. It is therefore in your interests, especially if you want to pursue academic or research lab positions, to start focused research as early as possible. The independent research and success in coursework should ideally lead to a paper submission (and hopefully a publication) by the end of the 2nd year. By that point, we expect that you will have made significant research contributions that will also serve as a guide for the remainder of your time in the program. The time from thesis proposal to completion varies, but 12-18 months is common.

Students are **strongly encouraged** to apply for summer internships at research labs, and at companies that will challenge them intellectually. Academic year internships are also a reasonable choice. Systems research tends to be strengthened by ties to "real world" problems, and internships are a good way to find such ties. Quality internships can also help you financially. And, of course, interning helps you build personal ties that you can leverage later. For more information, see the section on **INTERNSHIPS**.

Systems research necessarily involves computers and networks, often many of them. This research infrastructure does not manage or configure itself, and the IT support group provides very limited support for research computing in systems. Systems students are expected to help in configuring, updating, and maintaining their lab's infrastructure and the shared infrastructure of the systems group.

Good systems researchers build systems; they don't just talk about or simulate them. You must be proficient in at least one low-level systems programming language such as C or C++. You must be proficient in at least one high-level application programming language such as Java, Perl, Python, Scheme, Lisp, ML, or Matlab. Proficiency implies having written programs of at least 1000 lines and contributing to multi-developer projects, as real-world system development is inherently collaborative. To better understand the expectations and standards of this field, you explore the websites of the research labs within the systems group. These will provide concrete examples of the depth and scale of programming you should be competent at doing.

10.2.3. Course requirements

Breadth in Computer Science

Systems students are expected to have familiarity with other essential areas of Computer Science, in particular each of Theory, Artificial Intelligence/Machine Learning, and Interfaces. Courses that satisfy this requirement are listed below.

- **Theory:** COMP_SCI 335 (Theory of Computation), 336 (Algorithms), 496 (Graduate Algorithms), COMP_ENG 356 (Formal Verification), 357 (VLSI Design Automation), 459 (VLSI Algorithmics). *Students should be familiar with algorithms at least to the level of COMP_SCI 336 (Algorithms).*
- **Artificial Intelligence:** COMP_SCI 325 (AI Programming), 337 (Natural Language Processing), 344 (Problem Solvers), 348 (Artificial Intelligence), 349 (Machine Learning). *Students should be familiar with core AI and machine-learning topics as described in COMP_SCI 348 (Artificial Intelligence) and COMP_SCI 349 (Machine Learning).*
- **Interfaces:** COMP_SCI 330 (Human Computer Interaction), 351-1 (Graphics), 351-2 (Advanced Graphics), 352 (Machine Perception of Music), 370 (Computer Game Design), ELEC_ENG 332 (Computer Vision).

The goal of this requirement is to have intellectual exposure to these areas and content, not to take these specific courses here at Northwestern. A quality undergraduate or M.S. program may have already provided this exposure, in which case other courses may be substituted. The systems faculty will make a judgment call on such substitutions.

Breadth in Computer Systems

Systems students are expected to have deep knowledge of systems beyond their own specific focus. To that end, the systems faculty expect that each student will take **six courses, selected from six of the following areas, with Operating Systems, Networking, and Programming Languages and Compilers being required areas.** Each area lists appropriate courses.

- **Operating Systems:** COMP_SCI 343 (Operating Systems), 441 (Virtualization), 443 (Advanced Operating Systems), 446 (Kernel Development)
- **Networking:** COMP_SCI 340 (Networking), 440 (Advanced Networking)
- **Programming Languages and Compilers:** COMP_SCI 321 (Programming Languages), 322 (Compilers), 323 (Code Analysis and Transformation)
- **Architecture:** COMP_ENG 361 (Architecture), 452 (Advanced Architecture), 453 (Parallel Architectures)
- **Databases:** COMP_SCI 339 (Database Systems)
- **Distributed Systems:** COMP_SCI 345 (Distributed Systems)
- **Parallel Systems:** COMP_SCI 358 (Parallel Computing), 368/468 (GPU Parallel Computing with CUDA)
- **Embedded Systems:** COMP_ENG 364/464 (Cyber-Physical), 365/465 (IoT), 366/466 (Embedded Systems)
- **Security:** COMP_SCI 354 (System Security), 355 (Forensics), 450 (Internet Security)
- **Performance Analysis:** COMP_SCI 442 (Dynamics)

The goal of this requirement is to have intellectual exposure to these areas and content, not to take these specific courses here at Northwestern. A quality undergraduate or M.S. program may have already provided this exposure, in which case other courses may be substituted. The advisor in consultation with the systems faculty will make a judgment call on such substitutions.

There are some courses that are particularly important to certain areas in systems. Students planning to do their Ph.D. thesis in these specific areas are expected to take these courses before the qualifying exams. Such courses are highlighted in italics in the corresponding area.

Depth in Computer Systems

Systems students may be required to take additional courses, beyond the required 9 track courses, in preparation for their Ph.D. thesis. Such additional requirements will be determined on a case-by-case basis and are at the discretion of the advisor.

10.2.4. Qualifying exam

The purpose of the systems qualifying exam is to determine whether you have the essential prerequisites of being a doctoral-level researcher, namely:

- Have you acquired a breadth of knowledge in computer science and computer systems?
- Do you have a depth of knowledge in your research area?
- Can you do research?
- Can you present your research well, both in written form and orally?
- Can you defend your research?
- Can you think and discuss research extemporaneously? In other words, can you think on your feet?

If you do not meet these prerequisites, you will not pass the exam. In some cases, such as if you fail due to insufficient breadth or depth, you may be able to retake the exam. The exam can be retaken only once.

You should ask your advisor if you are prepared to take the qualifying exam. If he or she agrees, you should form a committee consisting of your advisor and at least two other systems faculty members. Non-systems faculty are also appropriate in some situations: you should ask your advisor. It is your responsibility to schedule the exam and reserve a conference room for it. Exams have no set length, but past exams have taken from 2 to 6 hours. When scheduling the qualifying exam, please schedule it for at least 2 to 3 hours. Qualifying exams are private: only your committee and you are in the room.

The qualifying exam begins with your presentation of a significant piece of research that you have done. One week before the exam, you must supply the committee with a paper about the work. A conference or workshop talk/paper is ideal. The committee will ask you tough questions about the content of the presentation and the work. The purpose of this part of the exam is to determine whether you are capable of doing research, presenting it, and defending it well.

In the next stage of the qualifying exam, each of your committee members will have the opportunity to ask you questions. Any technical question related to computer science is fair; however, the focus will be on systems. Many faculty members prefer to start with a question designed to test your

breadth or depth of knowledge in computer science. The committee may follow up on such questions, probing to find out what you know and what you don't know. The committee is particularly interested in how you respond to questions in areas you don't know or that you don't know the answer to. This is a common situation in doing research and the committee wants to know how you respond to it. It is appropriate and encouraged to ask questions of the committee. The committee also wants to see how you respond in an intellectual dialog.

10.2.5. Thesis committee

The committee requirements are a superset of those described earlier. The committee must consist of at least three faculty members in the CS department who are also faculty in The Graduate School and must have at least one external committee member. In most cases, the faculty member should be drawn from the systems group, although exceptions can be made. The external committee member should be from outside Northwestern and should hold a Ph.D. Exceptions can be made in consultation with the student's advisor, but a member external to the CS department is required.

10.2.6. Thesis prospectus (proposal)

The thesis proposal is a document written by the student that describes the proposed thesis. The proposal is generally 10-15 pages long and prepared in consultation with the advisor. It must contain:

- Thesis statement. What is the specific research problem being addressed and what is the proposed solution?
- Related work. What have other people done in this area and why is the proposed solution new?
- Prior work. What work has the student done already that suggests that he is capable of addressing the problem?
- Work plan. What the student proposes to do. Of course, research often takes one in unplanned directions. The point of the work plan (and schedule) is to describe what path is currently expected.
- Expected contributions. What artifacts and results are expected?
- Schedule. When will the major elements of the work plan be completed? Notice that writing the dissertation is an important task.

Proposal defense

Generally, proposal presentations last about 50 minutes, although there is no set time. Only clarification questions are permitted during the talk. This part of the proposal defense is open to the public. The student should contact CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU **no later than a week before** the thesis proposal presentation, so the CS program can formally announce it to the community.

The open segment of the proposal defense is followed by a closed segment with only the committee and the student: after public questions have been exhausted, the audience will leave, and the

committee may ask further private questions or raise other private concerns. The student will then leave the room, and the committee will determine whether the student has passed or failed the proposal defense. The student will be informed whether he or she passed or failed on the day of the proposal defense. Given the multiple parts of the proposal defense, the exam should be scheduled for at least a 2-hour window.

10.2.7. Thesis defense and dissertation

The procedures for the thesis defense are similar to those of the proposal defense. Generally, a defense talk lasts about 50 minutes, although there is no set time. Only clarification questions are permitted during the talk. The student should contact **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** **no later than a week before** the thesis proposal presentation, so the CS program can formally announce it to the community. To allow time for the Ph.D. thesis committee to ask questions and confer, the thesis defense should be scheduled for at least a 2-hour window.

After a successful defense, the committee will, within 2 weeks, send comments on the dissertation draft to the student. The student will then complete any additional work and make the necessary changes to the dissertation.

10.3. Track requirements: Artificial Intelligence Track

Artificial Intelligence (AI) focuses on understanding how minds work, from a computational perspective, and creating systems for helping people learn better and perform better using principles of cognitive science, artificial intelligence and machine learning techniques, robotics, and more.

10.3.1. Members

The following faculty members are affiliated with the AI group, are members of The Faculty of The Graduate School, and can serve as primary Ph.D. research advisors : Brenna Argall, Larry Birnbaum, Doug Downey, Ken Forbus, Kristian Hammond, Ian Horswill, Jessica Hullman, Sam Kriegman, Manling Li, Han Liu, Bryan Pardo, Christopher Riesbeck, Michael Rubenstein, V.S. Subrahmanian, Haoqi Zhang, and Ruohan Zhang.

10.3.2. Timeline and general expectations

It is crucial to realize that, unlike undergraduate study, Ph.D. study is primarily about research, not courses. However, we expect you to really do well in your courses. We expect you to become involved in research starting in your first year. Independent study projects are a good way to explore what kind of work you want to become involved in or just to wrap your head around something different if you are already involved in a project. Instead of a master's thesis, we encourage students to publish research in conferences and journals, starting early in their graduate careers.

10.3.3. Course requirements

AI courses

While the following courses are not required, each student should be conversant with the material in these courses, as their content is assumed knowledge in the qualifying exam.

- COMP_SCI 325 - Artificial Intelligence Programming
- COMP_SCI 337 - Introduction to Semantic Information Processing
- COMP_SCI 338 - Practicum in Intelligent Information Systems
- COMP_SCI 344 - Design of Computer Problem Solvers
- COMP_SCI 348 - Introduction to Artificial Intelligence
- COMP_SCI 349 - Machine Learning
- COMP_SCI 371 - Knowledge Representation

Non-AI Courses

Coursework will vary depending on the exact interests and background of each student. Someone deeply interested in cognitive science might take a number of courses in psychology. Someone interested in creating new kinds of educational software might take some of their courses in the School of Education and Social Policy. Someone interested in more applied AI might take some of their courses in human-computer interaction and interface design.

10.3.4. Qualifying exam

The AI group's qualifying exam is a one-day written exam, traditionally the Monday or Tuesday after finals week of the spring quarter. The exam is open-book, open-notes, and graded anonymously.

10.3.5. Thesis committee

There are no requirements beyond those specified by the CS program in **THESIS COMMITTEE** and imposed by The Graduate School.

10.3.6. Thesis prospectus (proposal)

The written proposal must be approved by the thesis committee. After approval, the student gives a public formal presentation of the thesis proposal as one might give at a departmental colloquium. The expected format is 45 minutes for the presentation, with another 15–45 minutes for questions. The student should contact **CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU** **no later than a week before** the thesis proposal presentation, so the CS program can formally announce it to the community. The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis prospectus of all tracks.

10.3.7. Thesis defense and dissertation

After a successful thesis defense, your committee will send comments on the thesis draft to you. You will then complete any additional work and make the necessary changes to the thesis. The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis defense and dissertation of all tracks.

10.4. Track requirements: Interfaces Track

This track is used by those involved in several areas, including robotics, computational photography, computer vision, audio processing, human-computer interaction, human computation, and social computing.

10.4.1. Members

The following faculty members are affiliated with the interfaces group, are members of The Faculty of The Graduate School, and can serve as primary Ph.D. research advisors: Karan Ahuja, Emma Alexander, Brenna Argall, Nivedita Arora, Larry Birnbaum, Kristian Hammond, Michael Horn, Ian Horswill, Jessica Hullman, Maia Jacobs, Matthew Kay, Sam Kriegman, Eleanor O'Rourke, Bryan Pardo, Michael Rubenstein, Uri Wilensky, Marcelo Worsley, and Haoqi Zhang.

10.4.2. Course requirements

There are no specific courses required for Ph.D. students in this group. However, all are required to demonstrate proficiency in the areas listed below.

- Fundamentals of Programming: COMP_SCI 111+ COMP_SCI 211+ COMP_SCI 214. It is important to note that these courses are not graded graduate courses and thus *do not count* toward the CS degree's accounting requirements.
- Theory (1 course): COMP_SCI 335 (Theory of Computation), COMP_SCI 336 (Algorithms)
- Systems (2 courses): COMP_ENG 361 (Architecture), COMP_SCI 321 (Programming Languages), COMP_SCI 322 (Compilers), COMP_SCI 339 (Database Systems), COMP_SCI 340 (Networking), COMP_SCI 343 (Operating Systems)
- Graphics or media (1 course from any of the following categories)
    - Audio, visual or multimedia processing: COMP_SCI 351-1 (Graphics), COMP_SCI 351-2 (Advanced Graphics), COMP_SCI 352 (Machine Perception of Music)
    - Computer games: COMP_SCI 370 (Computer Game Design), COMP_SCI 396 (various)
- Cognitive and social systems (1 course from any of the following categories)
    - Artificial Intelligence: COMP_SCI 348 (Artificial Intelligence), COMP_SCI 349 (Machine Learning), COMP_SCI 371 (Knowledge Representation), COMP_SCI 474 (Probabilistic Graph Models)
    - Cognitive science: An advisor-approved cognitive science course
    - Social science: An advisor-approved social science course
    - Learning sciences: COMP_SCI 313 (Tangible Interaction Design and Learning)

Proficiency means showing knowledge comparable to getting an A in an undergraduate course on the topic at a peer institution. For programming knowledge, proficiency may, at the discretion of the advisor and the interfaces faculty, be demonstrated through significant work experience in the

software industry. Students entering the CS Ph.D. program with an undergraduate degree in computer science will likely satisfy most or all of the requirements through coursework on their undergraduate transcript.

Any requirements not satisfied through prior coursework should be resolved by taking the appropriate course at Northwestern. Students should consult with their advisors to identify appropriate courses to take. Course numbers shown are courses offered at Northwestern that would satisfy the requirement, but other courses may also apply.

It is the responsibility of the student to make a case for how each course taken at a prior institution satisfies a requirement. This may include providing their transcript, and/or the syllabus of each class in question. This case should be made to the student's advisor. Students entering with an undergraduate CS degree or similar should complete this work in their first year, while those with undergraduate degrees in other areas should complete this within two years.

10.4.3. Qualifying exam

The qualifying exam consists of presenting the results of a small-to-medium-sized, completed research project to an examination committee of three members of the Northwestern graduate faculty, at least two of which must have a primary, secondary, or courtesy appointment in CS. Although the project may be a component of a larger group project, the work reported on must be solely by the student, not joint work with other students.

The exam has two parts: the written component and the oral component. The written component consists of a mock (or real) conference paper on the project. Although the project need not be published work, the student should identify a conference in which the project could plausibly be published and write the paper to be consistent with the submission requirements (length, etc.) for that conference. The paper submitted to the committee should be a final version, approved by the student's advisor. The paper must be submitted to the committee at least one week before the presentation to allow time to read and critique it.

The oral component consists of a formal presentation of the project, as one might give at a departmental colloquium. It should be roughly 45 minutes in length, with another 15–45 minutes for questions. The purpose of the oral exam is to probe the student's analytical and research skills, although the committee may ask whatever questions it feels are appropriate.

10.4.4. Thesis committee

There are no requirements beyond those specified by the CS program in **THESIS COMMITTEE** and imposed by The Graduate School.

10.4.5. Thesis prospectus (proposal)

The thesis proposal document must specify the following:

- The topic to address.
- Why it's important.
- The relevant work that has been done before on the topic.

- How the student expects to improve upon existing relevant work.
- A schedule for the work to be done. This is intended as a planning tool for you to help ensure plans are practical.

A typical thesis proposal length is 15 to 20 pages, and a typical thesis proposal presentation is 45 minutes, with another 15–45 minutes for questions. The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis prospectus of all tracks.

10.4.6. Thesis defense and dissertation

The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis defense and dissertation of all tracks.

10.5. Track requirements: Computer Engineering Track

A Computer Science Ph.D. student following the Computer Engineering track is governed by the rules of the Computer Engineering Program for track requirements. The Computer Engineering Program has its own graduate handbook that outlines its rules. Please consult that handbook. The **COMMON THESIS PROCESS** requirements specified by the CS program apply to the thesis prospectus and thesis defense and dissertation of all tracks.

11. Nondiscrimination statement

Northwestern University prohibits discrimination on the basis of actual or perceived race, color, religion, creed, national origin, ethnicity, caste, sex, pregnancy, sexual orientation, gender identity, gender expression, parental status, marital status, age, disability, citizenship status, veteran status, genetic information, reproductive health decision making, height, weight, or any other class of individuals protected from discrimination under federal, state, or local law, regulation, or ordinance or any other classification protected by law in the matters of admissions, employment, housing or services or in the educational programs or activities it operates, as required by Title IX of the Education Amendments of 1972; Title III of the Americans with Disabilities Act of 1990, as amended in 2008; Section 504 of the Rehabilitation Act of 1973; Title VI and VII of the Civil Rights Act of 1964; the Age Discrimination Act of 1975; the Age Discrimination in Employment Act of 1967; and any other federal, state, or local laws, regulations, or ordinances that prohibit discrimination, harassment, and/or retaliation.

Any alleged violations of this policy or questions concerning nondiscrimination or reasonable accommodations should be directed to the Northwestern Office of Civil Rights & Title IX Compliance (**HTTPS://WWW.NORTHWESTERN.EDU/CIVIL-RIGHTS-OFFICE/**).

12. Title IX statement

It is the policy of Northwestern University to comply with Title IX of the Education Amendments of 1972, which prohibits discrimination (including sexual harassment and sexual violence) based on sex in the University's educational programs and activities. Title IX also prohibits retaliation for asserting or otherwise participating in claims of sex discrimination.

The Title IX coordinator and the deputy coordinators (listed under **OUR STAFF**) have been designated to oversee Northwestern's compliance with Title IX and to respond to reports of violations. For more information about Title IX, go to Northwestern's **TITLE IX WEBSITE**. A person may also file a complaint with the Department of Education's Office for Civil Rights regarding an alleged violation of Title IX by visiting **THE U.S. DEPARTMENT OF EDUCATION'S WEBSITE** or calling (800) 421-3481.

13. Northwestern CS academic integrity violation policy

The Computer Science department takes violations of Northwestern's academic and research integrity policies very seriously. Students found in violation of these policies, either by the Dean's Office or by the Office for Research, will receive an unsatisfactory annual review for the year in which the violation occurred. A second violation will result in dismissal from the Ph.D. program. Additionally, if a violation is deemed particularly serious by the student's advisor, the CS Director of Graduate Studies (DGS), or the Department Chair, then a committee formed by the DGS may dismiss the student from the program after a first violation. Furthermore, if a Ph.D. advisor ceases advising a Ph.D. student due to a violation of the integrity policy, the student will be placed on a one-quarter academic probation due to lack of advisor, effective at the start of the quarter following the violation.

14. Mandatory training

The University and the School may require that students complete training and attestations. Examples may include mandatory lab safety training, anti-bias training, attestation to abide by the University's Policy on Discrimination, Harassment, and Sexual Misconduct, and attestation to follow the Student Code of Conduct, or other University policies. Such mandatory training requests must be completed in a timely fashion. Failure to complete the training and attestations will prevent you from continuing your coursework and completing your degree, as the registrar may impose registration holds due to non-compliance. Failure to register full time may result in the academic program being discontinued, terminating your student affiliation with Northwestern, and can severely impact immigration status. Training requests may be issued at various times in a student's Ph.D. career, as policies change and expand. Please complete them at your earliest convenience.

15. CS resources

Computer Science resources and processes, including Travel; Purchasing, Procurement, and Vendor Payment; Expense Reimbursements; Department Operations and Facilities; and Student Resources, can be accessed at the following link:

- HTTPS://WWW.MCCORMICK.NORTHWESTERN.EDU/COMPUTER-SCIENCE/RESOURCES/

16. CS Ph.D. student-led organizations

16.1. CSPAC

The Computer Science Ph.D. Advisory Council (CSPAC) has the mission of promoting the well-being of CS Ph.D. students through advocacy and information-sharing. The council seeks to create and curate an accessible informational repository to connect CS Ph.D. students with the resources they need for a healthy and productive graduate experience. It strives to elevate the voice and power of CS Ph.D. students to address concerns that directly impact student life, including departmental policies and decisions. More information can be found in the following places:

- CSPAC website: HTTPS://CSPAC.CS.NORTHWESTERN.EDU/
- CSPAC Wiki: HTTPS://GITHUB.COM/NU-CSPAC/NU-CS/WIKI/
- CS Ph.D. Student Slack Workspace: HTTPS://NUCSPHD.SLACK.COM/
- CS Ph.D. Student WatsUp Site: HTTPS://WATSUP.CS.NORTHWESTERN.EDU/INDEX.HTML

16.2. CSSI

The Computer Science Social Initiative (CSSI) pushes community-building efforts forward. Through the planning of informal and low-key events, CSSI aims to be a vector for students to know each other. CSSI actively collaborates with CSPAC and the CS Department to make these events part of our department's life and culture. More information can be found on the WatsUp Site.

16.3. Other organizations

A range of other organizations or informal meetups can be found on the WatsUp Site. These include the AI Journal Club, the Databases and Security Reading Group, and the Graduate Women in Computer Science.

17. Organizations external to CS

17.1. McCormick School of Engineering and Applied Science (McC)

Computer Science is a department within the McCormick School of Engineering, and general Ph.D. information can be found on their website, including regarding admissions, school-wide student groups, and professional development:

- HTTPS://WWW.MCCORMICK.NORTHWESTERN.EDU/ACADEMICS/GRADUATE/

17.2. The Graduate School (TGS)

The Graduate School (TGS) (HTTPS://WWW.TGS.NORTHWESTERN.EDU/) works throughout the university to ensure uniformly high standards for all Ph.D. programs. TGS policies apply to all Ph.D. programs at Northwestern, and we typically require TGS approval on most of the official forms and actions. For example, successful quals results are reported to TGS, who also approves them.

It is important to remember that the CS Ph.D. requirements are a superset of the TGS Ph.D. requirements. If you are meeting CS's requirements, you are meeting TGS's requirements. That said, you can find TGS's specific requirements here:

- HTTP://WWW.TGS.NORTHWESTERN.EDU/ABOUT/POLICIES/PHD-DEGREE-REQUIREMENTS.HTML
- HTTPS://WWW.TGS.NORTHWESTERN.EDU/ACADEMIC-POLICIES-PROCEDURES/POLICIES/SATISFACTORY-ACADEMIC-PROGRESS.HTML

Northwestern Student Affairs (HTTPS://WWW.NORTHWESTERN.EDU/STUDENTAFFAIRS/) is involved in many other aspects of student life.

17.2.1. Graduate Student Tracking System (GSTS)

GSTS is a web system, available to students and advisors at HTTPS://GSTS.NORTHWESTERN.EDU/, that records and displays the student's progress through the graduate program. GSTS lists the TGS program milestones and deadlines, completed coursework and unofficial transcripts, course plans, advisor and committee members, some milestones, some components of annual evaluations, and more.

It is important to understand that GSTS covers *only* TGS milestones and activities. Students should use GSTS to formally invite faculty members to serve on the student's committee, submit (TGS) milestone forms, request M.S. degree completions, and request admission to Ph.D. candidacy and thesis examinations. If you are unsure about how to use GSTS for some purpose (or whether to use it), please reach out to CS-PHD-STUDENT-HELP@NORTHWESTERN.EDU.

17.3. Office of International Student and Scholar Services (OISS)

If you are an international student and are having issues or questions related to that status, you should talk to the Office of International Student and Scholar Services (OISS). You can find their website at HTTPS://WWW.NORTHWESTERN.EDU/INTERNATIONAL/. The OISS' two primary roles are:

- To provide guidance/advice for maintaining proper immigration status consistent with the laws of the United States;
- To ensure compliance with those laws and help the students with various forms, such as OPT (Optional Practical Training) and CPT (Curriculum Practical Training).[20]

The CS department cannot provide advice on immigration laws or related questions.

17.4. English Language Programs (ELP)

All graduate students must satisfy the English Proficiency Requirement to gain eligibility for any TGS-supplied funding such as TAships. International students will generally have to pass a test (HTTPS://WWW.ELP.NORTHWESTERN.EDU/ENGLISH-PROFICIENCY-TESTING/), which is generally TOEFL iBT, Versant, or SPEAK.

ELP (HTTPS://WWW.ELP.NORTHWESTERN.EDU) offers extensive assistance to Ph.D. students to ensure suitable proficiency in both spoken and written English for study, teaching, and research. These services include online software training, graduate student courses in English (e.g., LING_480), teaching demonstration assessments, group and individual tutoring, and assistance with editing written works. ELP also runs orientation programs for incoming international students.

18. Personal safety and health

18.1. Emergency or concerns

Northwestern and Evanston are generally safe environments, and we hope you will not encounter any issues. However, it is important to be aware of the following resources:

- **911 is the universal emergency number in the U.S.** You can dial this number from any phone to be connected to the closest emergency dispatcher (police, fire, ambulance, etc.).
- All the blue-light poles on campus hold a phone connected directly to the police.
- Northwestern Police (HTTPS://WWW.NORTHWESTERN.EDU/UP/INDEX.HTML) is located at 1200 Davis St. in Evanston. Their *non-emergency* help number is: 847-491-3456
- If you are uncomfortable walking somewhere on your own, you can use SafeWalk.

[20] In our experience, processing OPT applications can take months. Therefore, you should submit your OPT application 2–3 months before graduation.

- HTTPS://WWW.NORTHWESTERN.EDU/OFFCAMPUS/RESOURCES/GETTING-AROUND/WALKING-SAFETY.HTML

- You can ask for a safety escort via 847-491-3456 (Evanston, NU Police)
  - HTTPS://WWW.NORTHWESTERN.EDU/UP/COMMUNITY-SERVICES/SAFETY-ESCORTS.HTML

18.2. Medical and psychological help

For medical and psychological help use the following resources:

Infirmary: For medical assistance, call or visit the campus infirmary: 633 Emerson Street (Searle Building): HTTPS://WWW.NORTHWESTERN.EDU/HEALTHSERVICE-EVANSTON/.

In case of a medical emergency, call 847-491-8100.

CAPS: For support with personal crises, stress, counseling, a listening ear, or mental health assistance, you can contact Counseling and Psychological Services (CAPS) anytime, 24/7, at 847-491-2151. More information is available at:

- HTTPS://WWW.NORTHWESTERN.EDU/COUNSELING/

Health insurance: All CS Ph.D. students have health insurance coverage, either provided by CS and TGS (the common case) or obtained independently (less common). In either case, you should not hesitate to visit a doctor, clinic, or other healthcare provider as needed. For more information, see HTTPS://WWW.NORTHWESTERN.EDU/STUDENT-INSURANCE/

18.3. Other support resources

For assistance from NU authorities, contact the Dean on Call at 847-467-3022, available 24/7. For information on The Graduate School Legal Service, check

- HTTPS://WWW.TGS.NORTHWESTERN.EDU/SERVICES-SUPPORT/LEGAL-SERVICES/

A more comprehensive list of on-campus support services is available here:

- HTTPS://WWW.NORTHWESTERN.EDU/CARE/GET-HELP/GET-HELP-NOW/ARE-YOU-IN-CRISIS/INDEX.HTML

The phone number for RAINN: National Sexual Assault Hotline is 800-656-4673.

19. Appendix

19.1. Teaching development resources

Teaching assistantship and teaching can be a valuable component of your professional development, particularly if you are considering a career that includes instructional responsibilities. A number of resources are available within the department and across the university to support your growth as an educator. Please check the **DEPARTMENTAL WEBSITE** for the full list.