Abstract

This document describes the process and requirements for earning a Ph.D. in Computer Science from Northwestern University. It applies to students starting in Fall, 2021, and later.
Contents

1 Introduction 5

2 General expectations and advice 5

3 Overall process and model 8
   3.1 Finding an advisor 8
   3.2 Joining a track 9
   3.3 Research and courses 10
   3.4 Masters degree backstop 10
   3.5 TAing 10
   3.6 Qualifying exam 10
   3.7 Thesis process 11

4 Understanding funding 11

5 Evaluation and issues 13
   5.1 Annual evaluation of students 13
   5.2 Annual evaluation of advisors 14
   5.3 Reporting issues 14
   5.4 Probation 15
   5.5 Leaves of absence 15

6 Enrollment, registration, and GPA requirements 15

7 Course requirements 16
   7.1 Intellectual versus accounting requirements 16
   7.2 Your advisor and courses 16
   7.3 Nested requirements 17
   7.4 Reconciling intellectual and accounting requirements: the 499 19
   7.5 Track requirements 19
   7.6 Course waivers and “testing out” 19

8 Common thesis process requirements 20
   8.1 Thesis committee 20
   8.2 Thesis prospectus (proposal) 20
   8.3 Thesis defense and dissertation 21

9 Milestone checklist 22

10 Track requirements 24
   10.1 Theory 24
      10.1.1 Timeline and general expectations 24
      10.1.2 Course requirements 24
      10.1.3 Qualifying exam 25
10.1.4 Thesis committee ........................................ 26
10.1.5 Thesis prospectus (proposal) ........................... 26
10.1.6 Thesis defense and dissertation ........................ 26
10.2 Systems .................................................... 27
  10.2.1 Timeline and general expectations ..................... 27
  10.2.2 Course requirements .................................. 28
  10.2.3 Qualifying exam ...................................... 29
  10.2.4 Thesis committee ...................................... 31
  10.2.5 Thesis prospectus (proposal) .......................... 31
  10.2.6 Thesis defense and dissertation ....................... 32
10.3 Artificial Intelligence ..................................... 33
  10.3.1 Timeline and general expectations ..................... 33
  10.3.2 Course requirements .................................. 34
  10.3.3 Qualifying exam ...................................... 34
  10.3.4 Thesis committee ...................................... 35
  10.3.5 Thesis prospectus (proposal) .......................... 35
  10.3.6 Thesis defense and dissertation ....................... 35
10.4 Interfaces .................................................. 36
  10.4.1 Timeline and general expectations ..................... 36
  10.4.2 Course requirements .................................. 36
  10.4.3 Qualifying exam ...................................... 37
  10.4.4 Thesis committee ...................................... 38
  10.4.5 Thesis prospectus (proposal) .......................... 38
  10.4.6 Thesis defense and dissertation ....................... 39
10.5 Computer Engineering ..................................... 39

11 CS Ph.D. student-led organizations ................. 39

A Organizations external to CS .............................. 41
  A.1 McCormick School of Engineering ....................... 41
  A.2 The Graduate School (TGS) .............................. 41
    A.2.1 Graduate Student Tracking System (GSTS) ............ 41
  A.3 International Office (IO) ................................ 42
  A.4 English Language Programs (ELP) ......................... 42

B Personal safety and health ................................. 42
  B.1 Emergency or concerns .................................. 42
  B.2 Medical and psychological help .......................... 43
  B.3 Other help ................................................ 43

C Diversity statement ........................................ 43

D Nondiscrimination statement .............................. 43
List of Figures

1  Typical timeline. ....................................................... 9
2  A highly inaccurate model of how funding works. .................. 11
3  Who to talk to about problems. ........................................ 14
4  Nested course requirements ............................................ 17
1 Introduction

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), and to demystify elements of Ph.D. student life within the department. Please consult your advisor if you don’t understand anything here.

**Primacy of research** The purpose of a CS Ph.D. degree is to prepare you to become an effective, independent researcher. The primary way in which you learn how to be a researcher is by doing research. You should be spending 50% of your time working on research from the very start of your Ph.D. In addition to being the critical part of Ph.D. training, an early start on research also increases the chances that at graduation time you have a research portfolio (e.g., quality publications) that can effectively launch you into the next stage of your career.

**Useful pointers** The following email addresses and web sites are specific to the CS Ph.D. program.

- phd.cs.northwestern.edu is an internal web site for Ph.D. program that is under exclusive control of the CS faculty. It includes numerous pointers.
- phd-student-help@cs.northwestern.edu is the initial point of contact for getting help with regard to the Ph.D. program. This goes to CS staff. If there is an issue they cannot resolve, they will forward it to the relevant faculty.
- dgs-phd@cs.northwestern.edu is the email for the director of graduate studies who is responsible for the Ph.D. program.

Information resources external to CS are given in the appendices.

**Computer Engineering** A Computer Science Ph.D. student following the Computer Engineering track is governed by the rules of the Computer Engineering Program, which has its own graduate manual. Please consult that manual and not this one. We would like to encourage such students to take advantage of elements of the CS Ph.D. process, such as the Introduction to Graduate Studies (IGS) course, and making the thesis proposal, defense, and dissertation elements follow the CS model. Please talk to your advisor to see if this makes sense for you.

2 General expectations and advice

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

\footnote{It is important to understand that https://www.mccormick.northwestern.edu/computer-science/academics/graduate/phd is a marketing web site.}
Fullfilment 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 in your interactions with others in the area. Ideally, this is should also be fun. Your Ph.D. training is a 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.

Self-motivation  You are expected to be strongly self-motivated. Unlike undergraduate school or a masters program, Ph.D. level study involves long periods where the primary driver is the student himself. The search for the thesis topic is the most critical of these periods. It’s 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.

Initiative  You are expected to increasingly take the initiative in research as you progress in the program. By the thesis proposal, and ideally well before, you should feel comfortable suggesting research directions, disagreeing with literature and your advisor, participating in others’ projects, and running your own projects.

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 following citations made in a paper of interest, and citations of that paper, is also a good way to find an intellectual stream.

Writing and presenting  No matter how good your research is, it’s seen through the filter of your writing and presentation skills. You are also seen through that filter. These are not easy skills to master, but you need to do so. 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 very different than what you learned in some generic communication studies course. A good way to learn is to read lots of papers and watch lots of talks in your area, and then ask yourself and your advisor about whether they were good, and why.

If you are interested in the academic job market (as well as various kinds of research labs), you should really pay attention to job talks given in the department, even if they are unrelated to your area. Think about it: you get a chance here to see people who have successfully gotten an interview, and you get to see a job talk that either succeeds or fails. Plus you can get feedback from your advisor and others about why it succeeded or failed.

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 their student travel support, do it. If you can
participate in a student meeting with a visitor, do it.

We suggest that you have a practiced “elevator pitch”. This is a short 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’s your elevator pitch. As you progress through the
program, this will become more focused.

Broadening what and who you know While earning a Ph.D. involves becoming an
expert (hopefully the expert) on a very 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 exploit connections that would not occur to someone
who is overly focused. It also helps avoid your being blindsided 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 have to 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’re
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 in eine komische Mondsprache you can’t understand, 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!

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’s important is to know what your
goals at any point in time $t$ so that you can make meaningful decisions based on pursuing
them. Short term might mean the next quarter, or the next paper deadline. Intermediate
term goals might be qualifying exams or your proposal, or an internship. Your long term
goals should reflect what you intend to do next, after completing the Ph.D. If you can, also
try to paint out longer term career goals.

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

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

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

---

$^2$This is, of course, obvious advice, but it is very easy for people to forget it.
We suggest you write and maintain a quarterly, yearly, and five year plan. As with goals, we strongly suggest you have conversations with your advisor about your plans.

Your five year plan is, paradoxically, very important when you are just starting the program. In essence, 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’d like to follow, just look at their CV, and work backward from their own graduation.

Community  The CS department is a community that includes all the Ph.D. students, M.S. students, undergraduates, postdocs, faculty, and staff. We want you to part of that community. That includes joining community events, attending talks, participating in student organizations, helping other students, teaching, etc.

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

3 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. Section 9 includes a checklist of milestones.

3.1 Finding an advisor

The CS Ph.D. process follows an apprenticeship model in which your advisor 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 an advisor. Usually, the initial advisor is a faculty member who is excited to have you here 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 defend you. How you learn to do research and your style and taste in problems will be formed in large measure by your advisor. Choose wisely. Although it is always possible to 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.

---

3 This window has implications for your planning process. In particular, if you want to pursue an academic or research lab position, it is particularly important to ramp up your research right away.

4 Or advisors, if you are co-advised.
### OVERALL PROCESS AND MODEL

#### 3.2 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, and Interfaces.

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.

---

5Faculty are notoriously bad about responding to email. This does not mean they are uninterested. It means you should be persistent.
3.3 Research and courses

By at least the beginning of your second quarter, you should be starting to engage in research. 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. Sections 6 and 7 describe general enrollment and course requirements in detail. The specific courses you need to take are described in your track’s part of Section 10.

Throughout your graduate student years, at least 50% of your time should be spent on research. The whole point 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 also want to determine very quickly whether research is for you. Remember, you are not in graduate school to take classes.

3.4 Masters 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. If the Ph.D. does not work out, the M.S. acknowledges the effort that has been made.

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 MS degree. The research that you are doing while starting your Ph.D. stands in for the MS project. In addition to the courses, the project-based MS degree also requires two CS faculty members to approve the outcome.

3.5 TAing

You will be asked to TA at least once during your time in the Ph.D. program. Depending on funding and needs within courses, you may be asked to TA multiple times. The CS faculty recognizes the value of TAing and understands that research time may be diminished during a quarter during which you TA.

3.6 Qualifying exam

Typically, by the end of your second year, you will take your track’s qualifying exam. The purpose of the qualifying exam is for a group of faculty on your track to determine whether you are likely to successfully propose, execute and defend a thesis. What exactly this entails depends on the track (see Section 10), but some commonalities are (1) whether you have

---

6Two other alternatives are possible. In a course-based MS, you complete 12 graded graduate courses, none of which are 590s, and at most 2 are 499s. This might make sense if you are taking a lot of courses to fill in intellectual background. A thesis-based MS is similar to the project-based MS, but there is an oral defense. This might make sense if you are doing a quals process that already involves a paper and a presentation.
completed some guided research successfully, ideally at the level of a paper submission to a quality venue, (2) whether you have a reasonable command of your area’s research literature, and (3) whether you can think and reason well.

Passing your qualifying exam advances you to “Ph.D. candidacy” within Northwestern as a whole. Within CS, it signals you (and your advisor) that you should start the thesis process, in particular finding a thesis topic.

Failing your qualifying exam generally comes with a second chance. There is no third chance.

3.7 Thesis process
The thesis process is the most critical and least certain part of your Ph.D. career. It is described in detail in Section 8 and in your track’s part of Section 10.

4 Understanding funding
The cost of a Ph.D. student over their five or so years at Northwestern can range up to $400,000. We acknowledge that you are making a very significant commitment to be a Ph.D. student. You should also be aware of our commitment and how it works. Contrary to what you may have heard, CS does not, in fact, have a giant pot of money to support Ph.D. students. 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 need to spend a portion of your time supporting teaching, typically by TAing a course.

---

7This 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.

8Not just your time and effort, but also the opportunity cost.
Funding depends on adequate progress toward the Ph.D. and available funding sources. It is not guaranteed.

In your first year (4 quarters) 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.

After the first year, academic year\(^9\) funding generally is based on being an RA, a TA, or on being awarded an 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 the uncommon case 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.\(^{10}\) 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 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. New faculty members generally have some degree of student support as a part of their startup packages. From the point of view of students, these funds act just like RAships.

It is very important to understand that RA support is not built on top of a convenient big pot of money. The amount of work your advisor will put in to write a good grant proposal is similar to that put into producing a top-tier publication. The acceptance rate for a grant is similarly quite low (15% or so). The awarded funds may sometimes seem large, but keep in mind that your stipend and benefits are only a small part of the overall cost of a student. The uncertainty of grant funding likely keeps your advisor up at night. That uncertainty also affects you. If your advisor has a funding shortfall, they may need to try to support you through other means. You can help with this uncertainty by pursing external fellowships.

Teaching assistantships can fund students through their 5th year at Northwestern. TAs are distributed on quarterly basis according to a department-level competition and require that the student TA a course. While Northwestern does not provide the number of TAs we might expect given course enrollments, we have so far been able to cover students who need one. While all students are required to TA at least once, for Y2+ students, TAs mostly function as a backstop funding mechanism. Being asked to TA isn’t a bad thing—it’s

\(^9\)This means fall, winter, and spring quarters

\(^{10}\)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 Facebook, Microsoft, and Google also run highly prestigious fellowship programs that have no citizenship restrictions.
a sign your advisor is looking out for you and trying to decouple your progress from the vagaries of grant funding. The time involved in TAing a course should not exceed 20 hours a week on average.

**Summer funding for Y2+ students** There are no TAships during the summer quarter. Summer funding for Y2+ students derives almost entirely from RAship funding (your advisor’s grants) and external fellowships (your funding). As a consequence, it is not guaranteed. The expectation is that students funded during the summer will work full time on the research of the underlying grant.

Students are encouraged to seek out summer opportunities of their own in the form of internships at quality research laboratories and companies. Students who are interested in doing a summer internship must take the initiative in finding appropriate opportunities. Generally, this must be done starting early (January is good).

## 5 Evaluation and issues

In addition to checks such as courses, qualifying exams, and the thesis process, Ph.D. students are also evaluated on a yearly basis, as are advisors.

### 5.1 Annual evaluation of students

The annual evaluation of Ph.D. students currently happens at the tail end of the summer quarter, and leading into the fall quarter. In this evaluation, we integrate 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 department collects information from university systems that includes RCR status, English testing status, and grades.

The advisor and student forms run along parallel lines, and thus it is possible for the faculty to directly compare the student and advisor perspectives, to determine if they are on the same page.

The faculty then reviews each student, using this information, producing a letter to the student. The letter notes whether the student is making satisfactory progress or not (using the range mandated by TGS), notes the student’s accomplishments and issues over the past year, and lays out goals for the upcoming year. A letter may include deadlines by which certain milestones need to be met. The faculty meets to review each letter, agree on its contents, and then sends it as a whole to the student. The letter is also provided to TGS.

If there are serious issues\(^\text{11}\) the DGS will follow up with both the student and their advisor perspectives, large-scale advisor/student incompatibility, and things of a similar nature that can happen in an advising relationship. Any evidence of profound matters like harassment, intimidation, and the like will be dealt with swiftly and separately.

\(^{11}\)By “serious issues”, we mean total lack of student progress, major disconnect between student and advisor perspectives, large-scale advisor/student incompatibility, and things of a similar nature that can happen in an advising relationship. Any evidence of profound matters like harassment, intimidation, and the like will be dealt with swiftly and separately.
5 EVALUATION AND ISSUES

5.2 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 review this information, looking for serious issues. They will follow up with those advisors.

5.3 Reporting issues

If you are having a problem or issue, we encourage you to talk to us about it. Figure 3 shows the reporting path. Note that you can skip any step here. While we would prefer, for example, that you talk to your 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 have additional processes and paths in place, which are described in Section D. Everyone in our community must be treated with common decency and respect.

12 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.
5.4 Probation

TGS also evaluates students on a quarterly basis 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, 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 isn’t fixed in the probationary timeframe, you risk expulsion. It is possible to petition to extend a deadline.

5.5 Leaves of absence

Northwestern allows for leaves of absence for many reasons, including medical, family, parental, and general reasons. A leave of absence essentially stops the clock on all requirements for its duration.

6 Enrollment, registration, and GPA requirements

While you are a funded Ph.D. student, you must be registered. Unfunded students (e.g., ABD students) should also generally be registered. Finally, if you are on an internship, it is probably in your interests to register as well (this is particularly the case for international students). If you are in doubt about what to register for, talk to your advisor.

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).

- If you are in 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, fill in the whole quarter with TGS 500. TGS 500 is a pass/fail “slot” for research that is cheaper and thus helps your advisor stretch funding further.

- If you are a funded Y2+ student over the summer, you should sign up for TGS 500.

---

13 [http://www.tgs.northwestern.edu/about/policies/satisfactory-academic-progress.html](http://www.tgs.northwestern.edu/about/policies/satisfactory-academic-progress.html)

14 [https://www.tgs.northwestern.edu/academic-policies-procedures/policies/leaves-of-absence.html](https://www.tgs.northwestern.edu/academic-policies-procedures/policies/leaves-of-absence.html)

15 ABD = “All But Dissertation”, meaning a student in good standing who has paused their thesis work.
• If you are interning, you should strongly consider registering for CRDV 510 (“Crown Family Graduate Internship”). This is particularly the case for an internship during the academic year.\footnote{And for international students who need to maintain registration as part of their visa.}

• If you are not funded and are not interning, you should sign up for TGS 512.

**GPA requirement**  You must have a cumulative grade point average of 3.0 (“B”) or better. Your GPA is computed only based 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: you are not in a Ph.D. program to take courses; you are in a Ph.D. program to learn how to do research, and courses serve this end.

### 7.1 Intellectual versus accounting requirements

Courses serve three intellectual purposes. The first is 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*, 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 department, in that order. The intellectual requirements are intended to be specific to your situation. It is important to talk to your advisor on a quarterly basis 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 phd-student-help@cs to ask. You can too.

If you are a first year student, you have an initial advisor who should be filling this role. If you are an upper year student who has been between advisors for a significant period of time, you should already be talking to the DGS, who will fill this role.
Figure 4: Nested course requirements, both intellectual and accounting (shaded). Intellectual requirements can be satisfied within the context of the accounting requirements.

### 7.3 Nested requirements

The course requirements, both intellectual and accounting, nest, as is illustrated in Figure 4. The innermost three levels represent the accounting requirements, while the next four levels represent the intellectual requirements. A good way to think about this is that the accounting requirements determine the number of courses of different kinds you must take, while the intellectual requirements determine what the topics of those courses should be. It is possible for intellectual requirements to demand additional courses, however.

You must take a total of 10 graded\(^{17}\) graduate\(^{18}\) courses at Northwestern. One of these is department’s Introduction to Graduate Studies (IGS).

Now let’s consider the requirements, from the innermost out:

- **Enrollment**: 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 any more. At the beginning of your time in the program, this will typically be graded courses and COMP\_SCI 499s. Later, it will progress to COMP\_SCI 590, TGS 500, TGS 512, CRDV\_510, etc. **If you are not registered for classes, very bad things can happen, so pay attention to this.** You must also maintain a 3.0 GPA. More information is in Section 6.

- **University**

  - **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 grant.**

---

\(^{17}\)“Quality graded”, specifically, which means a letter grade that contributes to your GPA.

\(^{18}\)“Graduate course” means it’s approved for TGS credit, which is the case for most 300+ level courses in CS. If in doubt, look on CAESAR or ask. On CAESAR, a graduate course will appear in the “The Graduate School” “Course Career”. 
- 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)**
  - 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.

- **Department**
  - 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**
  - 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.
  - 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 phd-student-help@cs.

- **Advisor**
  - Your advisor may have additional intellectual expectations and course requirements given your specific circumstances.

- **Quals Committee**
  - 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 Reconciling intellectual and accounting requirements: the 499

Some Ph.D. students enter the program with minimal preparation, while others enter with a great deal of background, for example from a high quality undergraduate or masters program. The former set of students need to take a lot of courses to acquire intellectual background they should have. On the other hand, it would be nonsensical to have the latter set of students take courses that cover intellectual background they already have. It is also the case that not all courses in the world with the same name are equal. Some Ph.D. students may need to “repeat” courses here at Northwestern to make sure they do cover the relevant intellectual ground. Finally, all Ph.D. students need to have time to pursue guided research, from day one.

To summarize the above: At the start of their Ph.D. journeys, students require varying amounts of time for graduate reading and research. This needs to be reconciled with the graded course requirements (the 10 courses you are required to take). The graded course we use to do this is COMP_SCI 499. The only strict limitation placed on COMP_SCI 499 is TGS’s requirements that 499s must represent half or less of your courses during your first three quarters at Northwestern.

We expect the student, advisor, and track faculty to determine when COMP_SCI 499 is intellectually appropriate for the student. Here are some common scenarios, however: Do you need to take a course to cover some intellectual background you need? Take the course and get a grade. Do you need to do graduate reading and research and also need to have a graded course? Take COMP_SCI 499 with your advisor. Do you need to do graduate reading and research and you already have enough graded courses? Take COMP_SCI 590 with your advisor (or TGS 500 if they are funding you).

7.5 Track requirements

Each track includes its specific requirements for courses as part of its description in Section 10.

7.6 Course waivers and “testing out”

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 that 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 (i.e., have more graduate reading and research).

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. In all cases, you must satisfy the University, TGS, and departmental accounting requirements: RCR, English, and 10 graded graduate courses (including IGS). What waiving does is allow you to substitute other graduate courses.
8 Common thesis process requirements

The thesis process is the way you demonstrate that you are able to envision, plan, execute, document, and defend a substantial new research contribution in your field. You pass the thesis process by convincing your thesis committee of this via several steps. In the end, the members of your committee are lending their names to your thesis and confirming to the world that they are convinced. The written outcome of the process, the dissertation, is permanently and publicly visible. The following describes what is common across the various tracks in CS. Section 10 provides more detail about additional aspects on a track-by-track basis.

8.1 Thesis committee

Your thesis committee must consist of 4 or more people. At least 3 of these, including the committee chair, must be members of the Northwestern Graduate Faculty\(^\text{19}\) who are also non-courtesy\(^\text{20}\) members of the CS faculty. We recommend that the 4th member of the thesis committee be external to Northwestern, or at least external to the CS department, and that they have an earned Ph.D.\(^\text{21}\) Your advisor will typically be the chair of your thesis committee.

It is important to note that the committee requirements are a minimum. It is OK, for example, to have additional members, or to have courtesy faculty as members, as long as these minimum requirements are met. Note that some tracks add additional requirements.

You should form your thesis committee together with your advisor. You’ll be interacting with them for some time. It is possible to change the thesis committee’s composition over the course of the thesis work, but this is unusual and not recommended.

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 take to the problem, related work, your prior work, and a work plan and schedule. The schedule must make your expected completion date clear. Once you and your advisor feel the document is ready, you will share it with the rest of the committee.

After the committee has had at least a week to review your thesis proposal, the next step is a thesis proposal defense. This generally takes the form of a talk followed by questions from the committee and perhaps others. There is no set time limit for a thesis proposal defense. At the end of the thesis proposal defense, the committee will either approve or reject the thesis proposal. This will be communicated to phd-student-help@cs who will record it within CS and inform TGS as well.

\(^{19}\)This is true of tenured/tenure-track faculty.

\(^{20}\)This basically means they must have at least a partial appointment in CS—CS pays at least some of their salary.

\(^{21}\)An external member provides several benefits to you. First, they are a sanity check on both you and the rest of the committee. Second, they are a networking opportunity for you that may be beneficial on the job market.
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). This deadline can be altered in case of an approved leave of absence or parental accommodation.

### 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.\(^{22}\) The dissertation should include an abstract, 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.

At least one week prior to 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 `phd-student-help@cs` 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.

At this time (at least one week prior to the defense), you must also email `phd-student-help@cs` 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:

\(^{22}\)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.
• **Public talk:** You will give your talk, presenting a summary of the thesis work and its results. Anyone may attend.

• **Public questioning:** Each member of the committee can ask you in-depth questions. Once the committee is finished, further questions are solicited from the audience. Anyone may ask you questions.

• **Private questioning:** Everyone leaves the room except for the thesis committee and you. Further questions can be asked at this point.

• **Private discussion and decision:** You leave the room, and thesis committee continues the discussion and determines whether you have passed or failed the thesis defense.

Immediately after the defense, the committee will inform you of their decision, and provide you with a summary of reviews and required changes.

If you passed, 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 to make your final dissertation public. You will do so in two forms. First, you will submit it via TGS, specifically (currently) Proquest. TGS will identify any formatting issues. Proquest makes the dissertation visible in their database. Your second step will be to create and publish a Northwestern CS technical report of your dissertation.\(^{23}\) The purpose of the technical report version is to make sure the dissertation is readily publicly visible and searchable instead of disappearing behind a paywall or other high-friction system.

### 9 Milestone checklist

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 track am I in?

• What is my specialization within that track?

• What is my research about?\(^{24}\)

• What are my plan and goals for the next year?

• What are my plan and goals for the next five years?

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

\(^{23}\)This is intended to be straightforward. The technical report will essentially be your existing TGS-approved dissertation document prefaced with a technical report cover.

\(^{24}\)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.
☐ 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

☐ Passed any necessary English language tests to be qualified to TA

☐ Finished your coursework

☐ Interned outside of Northwestern

☐ Provided service to your lab or group

☐ Been a TA

☐ Mentored or co-mentored an undergrad, REU, or MS 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 masters 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
10 Track requirements

10.1 Theory

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.

Members The following faculty members are affiliated with the theory group: Benjamin Golub, Jason Hartline, Samir Khuller, Annie Liang, Konstantin Makarychev, Aravindan Vijayaraghavan, and Xiao Wang.

10.1.1 Timeline and general expectations

Students in the theory group are expected to finish their Ph.D. in 5 years. Students should make every effort to find an advisor no later than spring quarter of the first year. Students should engage in research as soon as possible, but the timing will depend on their academic background and should be decided in consultation with their advisors.

By the end of their 2nd or 3rd year, students will take the theory group’s qualifying exam. The next step after the qualifying exam has been passed is to find a thesis topic. A thesis prospectus (proposal) is presented after the student has done substantial work, and the potential research contributions can be envisioned and defended. The final step is to write a dissertation and defend the thesis.

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

10.1.2 Course requirements

Accounting Theory students must take a total of 10 graded graduate courses at Northwestern (including Introduction to Graduate Studies). These “slots” enable the student to cover the following intellectual requirements and more. It is possible for intellectual requirements to be waived, for example if a student has taken a relevant course previously. In such cases, an alternative course, including COMP.SCI 499, is substituted.

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 496 - Approximation Algorithms
• COMP_SCI 496 - Algorithms for Big Data
• COMP_SCI 496 - Computational Complexity
• COMP_SCI 496 - Graduate Algorithms
• COMP_SCI 496 - Graduate Cryptography
• COMP_SCI 496 – Mechanism Design
• COMP_SCI 496 – Theoretical Machine Learning
• COMP_SCI 496 – Theoretical Foundations of Data Science
• COMP_SCI 496 – Learning, Information and Data

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 Qualifying exam

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

- If the student has acquired 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 two hours in total. The first part of the exam is open to the public. 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.

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. A 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.

### 10.1.4 Thesis committee

There are no requirements beyond those specified by the CS department and The Graduate School.

### 10.1.5 Thesis prospectus (proposal)

The thesis committee should be formed as specified by the CS department and the Graduate School. The prospectus document (thesis proposal) should be submitted to the committee at least one week before the presentation to allow time to read and critique it.

The prospectus defense is a talk open to the members of the Northwestern community. The talk should last approximately 50 minutes. The student will be informed whether he or she has passed or failed on the day of the proposal defense. In either case, 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.

### 10.1.6 Thesis defense and dissertation

The dissertation draft should be submitted to the committee at least two weeks before the presentation to allow time to read and critique it. The thesis defense is open to the members of the Northwestern community. In the talk, the student should provide a summary of the thesis work and a defense of its ideas and results.

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 final version of dissertation must be
submitted to The Graduate School and also published as a CS technical report as described earlier.

10.2 Systems

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

Members The following faculty are affiliated with the systems group: Fabian Bustamante, Simone Campanoni, Yan Chen, Alok Choudhary, Christos Dimoulas, Peter Dinda, Robby Findler, Branden Ghena, Nikos Hardavellas, Josiah Hester, Russell Joseph, Aleksandar Kuzmanovic, Gokhan Memik, Seda Memik, Eleanor O’Rourke, Jennie Rogers, Vincent St-Amour, and Xiao Wang.

10.2.1 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 students must find an advisor by the spring quarter of the first year, but we strongly recommend that you find an advisor much earlier than this. 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.

Starting from the very beginning, you are expected to spend about 50% of your time engaged in research. In the first year and perhaps second year, this is combined with taking courses that fill in missing background or that are considered necessary given the research focus. These efforts will ideally lead to a paper submission (and hopefully a publication) by the end of the 2nd year. By the end of your second year, 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.

By the end of their 2nd (ideally) or (at least) 3rd year, you will take the systems group’s qualifying exam. The next step after the qualifying exam has been passed is to find a thesis topic. A thesis proposal follows, after you have done the work to support it, and your advisor feels it is ready. A successful thesis proposal defense is followed by executing the proposed research. The final step is to write a dissertation and defend the thesis. The time from 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.

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 know at least one low-level systems programming language such as C or C++. You must know at least one high-level application programming language such as Java, Perl, Python, Scheme, Lisp, ML, or Matlab. If you haven’t written a 1000+ line program in the language, you don’t know it. If you haven’t programmed on a multi-person project, you haven’t programmed. You should look at the websites of the various labs that comprise the systems group to get a sense of the level of programming you should be competent at doing.

10.2.2 Course requirements

Accounting A systems student must take 10 graded graduate courses at Northwestern (including Introduction to Graduate Studies). 9 of these courses cover the following intellectual requirements. It is possible for intellectual requirements to be waived, for example if a student has taken a relevant course previously. In such cases, an alternative course, including COMP\_SCI 499, is substituted.

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 MS program may have already provided this exposure, in which case other courses may be substituted. The systems faculty will make a judgement 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_ENG 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 MS 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 judgement 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.

**10.2.3 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. 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.

After the exam, the committee will deliberate. Four outcomes are possible:

• **Pass.** The student successfully completed of the qualifying exam.

• **Conditional Pass.** While the student did well on the majority of the exam, the faculty have identified an area of weakness that must be addressed before a “pass” is reported. A 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.

10.2.4 Thesis committee

The thesis is judged by a committee that is chosen by the student in consultation with the student’s advisor. The committee commits to reading and commenting on the thesis proposal, attending the thesis proposal defense, providing guidance and advice as the thesis work progresses, reading and commenting on the dissertation, and attending the thesis defense.

The committee requirements are a superset of those described earlier. The committee must consist of at least three faculty members in the CS Department that are also faculty in The Graduate School and must have at least one external committee member.

The committee must include the student’s advisor, who is generally the chair of the committee. 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.

It is the responsibility of the student to form the committee and to schedule it for the proposal and dissertation defenses.

10.2.5 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.
The document must be given to the members of the committee at least one week before the proposal defense. It is not necessary to make the proposal available online.

The proposal defense is an open, advertised, public talk, given in front of the committee and any members of the CS Department who care to attend. The open segment of the proposal defense is followed by a closed segment with only the committee and the student.

The student must schedule the defense, making sure all his/her committee members are there physically or via phone conference. The student must assure that the proposal defense is advertised to the CS Department at least one week before it occurs. It will specifically be posted as a thesis proposal talk. It should at least appear in the weekly news email.

The talk is a summary of the thesis proposal and a defense of its ideas. It’s the final sanity check before the thesis work begins and is very important.

Generally, proposal talks last about 50 minutes, although there is no set time. Only clarification questions are permitted during the talk. After the talk, each member of the committee, in an order determined by the chair, will ask in-depth questions. Once the committee is finished, further questions will be solicited from the audience.

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 they passed or failed on the day of the proposal defense.

If the student passes the thesis proposal defense, we will immediately inform The Graduate School that the student’s “thesis prospectus has been approved.”

10.2.6 Thesis defense and dissertation

The dissertation document must be complete, in draft form, before the thesis defense can take place. It must be provided to the members of the committee at least one week before the defense is to take place. Generally, the advisor will read and comment on the dissertation draft well before then.

The procedures for the thesis defense are similar to those of the proposal defense. The defense is an open, advertised, public talk, given in front of the committee and any members of the CS Department who care to attend. The open segment of the defense is followed by a closed segment with only the committee and the student.

The student must schedule the defense, making sure all the committee members are there physically or via phone/video. The student must assure that the defense is advertised to the CS Department at least one week before it occurs. It will specifically be posted as a thesis defense talk. It should at least appear in the weekly news email.

The defense talk is a summary of the thesis work and a defense of its ideas and results. Generally, a defense talk lasts about 50 minutes, although there is no set time. Only clarification questions are permitted during the talk. After the talk, each member of the committee, in an order determined by the chair, will ask in-depth questions. Once the committee is finished, further questions will be solicited from the audience. 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 dissertation defense. In either case, the chair of the committee will inform the student describing the results of the committee’s deliberation and what additional work, if any, is to be done.

If the student passes the thesis defense, we will report this to The Graduate School. At this point, the student needs only to deliver the final version of his/her dissertation in order to graduate.

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. First, the student must then deliver the final dissertation to The Graduate School. This will also result in it being made available via the library. Second, the student must publish the thesis as an CS Department technical report. The purpose of publishing the dissertation as a technical report is to make the thesis work widely available to the public. The disseration, in both forms, must include a page documenting the thesis committee members who approved it.

10.3 Artificial Intelligence

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

Members  The following faculty members are affiliated with the AI group: Brenna Ar-gall, Larry Birnbaum, Oliver Cossairt, Douglas Downey, Ken Forbus, Kristian Hammond, Thomas Hinrichs, Ian Horswill, Jessica Hullman, Han Liu, Bryan Pardo, Christopher Ries-beck, Michael Rubenstein, Sara Owsley Sood, and Haoqi Zhang.

10.3.1 Timeline and general expectations

It is crucial to realize that, unlike undergraduate study, Ph.D. study is primarily about research, not courses. We expect you to do well in your courses, naturally. However, 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 the graduate career.

Students should make every effort to find an advisor no later than spring quarter of the first year. By the end of their 2nd year, students are expected to take the qualifying exam. The next step after the qualifying exam has been passed is to find a thesis topic. A thesis prospectus (proposal) is presented after the student has done substantial work, and the potential research contributions can be envisioned and defended. The final step is to write a dissertation and defend the thesis.
10.3.2 Course requirements

**Accounting**  AI students must take a total of 10 graded graduate courses at Northwestern (including Introduction to Graduate Studies). These “slots” enable the student to cover the following intellectual requirements and more. It is possible for intellectual requirements to be waived, for example if a student has taken a relevant course previously. In such cases, an alternative course, including COMP_SCI 499, is substituted.

**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 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.

10.3.3 Qualifying exam

The AI group’s qualifying exam is a one-day written exam, traditionally the Monday or Tuesday after finals week of spring quarter. The exam is open-book, open-notes, and graded anonymously. Ph.D. students in the AI group must take the exam at the end of their second year.

Four outcomes are possible:

- **Pass.** The student successfully completed the qualifying exam.
- **Conditional Pass.** While the student did well on the majority of the exam, the faculty have identified an area of weakness that must be addressed before a “pass” is reported. A 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.

### 10.3.4 Thesis committee

The thesis is judged by a committee that is chosen by the student in consultation with the student’s advisor. The committee commits to reading and commenting on the thesis proposal, attending the thesis proposal defense, providing guidance and advice as the thesis work progresses, reading and commenting on the dissertation, and attending the thesis defense.

The requirements for the composition of the committee are described in Section 8.1.

### 10.3.5 Thesis prospectus (proposal)

All graduate students will write a thesis proposal before undertaking serious work on their PhD research. The written proposal must be approved by the thesis committee. The proposal document should be submitted to the committee at least one week before the presentation to allow time to read and critique it.

After approval, the student must give a public presentation of the thesis proposal. This oral component consists of a formal presentation of the proposed research to the thesis committee, as one might give at a departmental colloquium. You should plan the presentation for 45 minutes, with another 15–45 minutes for questions.

If the student passes the public presentation, we will immediately inform The Graduate School that the student’s “thesis prospectus has been approved.”

### 10.3.6 Thesis defense and dissertation

The dissertation should be submitted to the committee at least **two weeks** before the defense to allow time to read and critique it.

The procedures for the PhD thesis defense presentation are similar to those of the proposal defense. The defense is an open public talk, given in front of the committee and any members of the CS Department who choose to attend. The talk is a summary of the thesis work and a defense of its ideas and results.

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.

After a successful thesis defense, the student must then deliver the final dissertation to The Graduate School. This will also result in it being made available via the library. Second,
the student must publish the thesis as an CS Department technical report. The purpose of publishing the dissertation as a technical report is 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.

10.4 Interfaces

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

Members

The following faculty members are affiliated with the interfaces group: Brenna Argall, Larry Birnbaum, Jeremy Birnholtz, Oliver Cossairt, Nick Diakopoulou, Elizabeth Gerber, Darren Gergle, Kristian Hammond, Michael Horn, Ian Horswill, Jessica Hullman, Maia Jacobs, Matthew Kay, Eleanor O’Rourke, Bryan Pardo, Michael Rubenstein, Jack Tumblin, Uri Wilensky, Marcelo Worsley, and Haoqi Zhang.

10.4.1 Timeline and general expectations

Students are expected to finish their Ph.D. in 5 years. Students should make every effort to find an advisor no later than spring quarter of the first year. Students should engage in research as soon as possible, but the timing will depend on their academic background and should be decided in consultation with their advisors.

By the end of their 2nd or 3rd year, students will take the qualifying exam. The next step after the qualifying exam has been passed is to find a thesis topic. A thesis prospectus (proposal) is presented after the student has done substantial work, and the potential research contributions can be envisioned and defended. The final step is to write a dissertation and defend the thesis.

10.4.2 Course requirements

Accounting

Students must take a total of 10 graded graduate courses at Northwestern (including Introduction to Graduate Studies). These “slots” enable the student to cover the following intellectual requirements and more. It is possible for intellectual requirements to be waived, for example if a student has taken a relevant course previously. In such cases, an alternative course, including COMP_SCI 499, is substituted.

Courses

There are no specific required courses 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 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.
Exam components  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.

Exam timing  The expectation is that the qualifying exam will be completed prior to the start of the student’s third year in the program. In exceptional cases, this may happen later, subject to the limits described earlier.

Outcomes  After the exam, the committee will deliberate. Four outcomes are possible:

- **Pass.** The student successfully completed of the qualifying exam.

- **Conditional Pass.** While the student did well on the majority of the exam, the faculty have identified an area of weakness that must be addressed before a “pass” is reported. A 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.

10.4.4 Thesis committee

There are no requirements beyond the general requirements previously specified in this manual.

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.

The thesis proposal document must be submitted to the committee at least one week before the presentation to allow time to read and critique it. The oral component of the thesis proposal consists of a formal presentation of the proposed research to the thesis committee, as one might give at a departmental colloquium. You should plan the presentation for 45 minutes, with another 15–45 minutes for questions.

10.4.6 Thesis defense and dissertation

The dissertation should be submitted to the committee at least two weeks before the defense to allow time to read and critique it.

The procedures for the PhD thesis defense presentation are similar to those of the proposal defense. The defense is an open public talk, given in front of the committee and any members of the CS Department who choose to attend. The talk is a summary of the thesis work and a defense of its ideas and results.

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.

After a successful thesis defense, the student must then deliver the final dissertation to The Graduate School. This will also result in it being made available via the library. Second, the student must publish the thesis as an CS Department technical report. The purpose of publishing the dissertation as a technical report is 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.

10.5 Computer Engineering

A Computer Science Ph.D. student following the Computer Engineering track is governed by the rules of the Computer Engineering Program, which has its own graduate manual. Please consult that manual.

11 CS Ph.D. student-led organizations

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

**CSSI** The Computer Science Social Initiative (CSSI) pushes community building efforts forward. Through 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 life and culture. More information can be found on the Watsup Site.

**Others** 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.
A Organizations external to CS

A.1 McCormick School of Engineering

Computer Science is a department within the McCormick School of Engineering, and general Ph.D. information can be found on their web site, including regarding admissions, school-wide student groups, and professional development: https://www.mccormick.northwestern.edu/academics/graduate/

A.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, a successful quals results is reported to TGS, who also approve it.

It is important to remember that the CS Ph.D. requirements are 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
- http://www.tgs.northwestern.edu/about/policies/satisfactory-academic-progress.html

In addition to an advisor, each Ph.D. is also assigned a TGS counselor to monitor overall academic progress. The TGS counselor inspects the students’ coursework and GPA, enforces TGS policies for timely completion of degree requirements (milestones), and works to ensure compliance with all TGS standards.

Northwestern Student Affairs (https://www.northwestern.edu/studentaffairs/index.html/) is involved in many other aspects of student life.

A.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. We are currently trying to move away from a dependence on GSTS, using departmental information systems to populate GSTS as needed. However, at this point, students and advisors do need to use GSTS for some things.

Students should use GSTS to formally invite faculty members to serve in the student’s committee, submit (TGS) milestone forms, request MS degree completions, request admission to PhD candidacy and thesis examinations. If you are confused about how to use GSTS for some purpose (or whether to use it, please reach out to phd-student-help@cs.
A.3 International Office (IO)

If you’re an international student and are having issues related to that status, you should talk to the International Office (IO) (https://www.northwestern.edu/international/). The IO’s 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).

It is important to note that no one in the CS department itself is an expert on these matters. We will try to help, but going to the IO is in your best interests.

A.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, 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.

B Personal safety and health

B.1 Emergency or concerns

Northwestern and Evanston are generally very safe environments, and you are unlikely to encounter any issues. That said, there are several resources you should know about:

- **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

---

25In our experience, processing OPT applications can take months. Therefore, you should submit your OPT application 2–3 months before graduation.
• If you’re uncomfortable walking somewhere on your own, you can use SafeWalk. [https://www.northwestern.edu/offcampus/resources/getting-around/walking-safety.html](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](https://www.northwestern.edu/up/community-services/safety-escorts.html)

### B.2 Medical and psychological help

• **Infirmary:** For medical assistance, call or visit campus infirmary: 633 Emerson Street (Searle Building): [https://www.northwestern.edu/healthservice-evanston/](https://www.northwestern.edu/healthservice-evanston/). Medical Emergency? 847-491-8100

• **CAPS:** For personal crisis/stress help, counseling, an understanding listener, and/or mental health assistance: Counseling and Psychological Services (CAPS) call anytime, 24/7 (847-491-2151). [https://www.northwestern.edu/counseling/](https://www.northwestern.edu/counseling/)

• **Health insurance:** All CS Ph.D. students have health insurance coverage ([https://www.northwestern.edu/student-insurance/](https://www.northwestern.edu/student-insurance/)), either covered by CS and TGS (the common case), or on their own (uncommon). In either case, you should not hesitate to visit a doctor, clinic, etc, as needed.

### B.3 Other help

• For help from NU authorities – Dean on Call: 847-467-3022 call anytime, 24/7

• TGS Legal Service: [https://www.tgs.northwestern.edu/services-support/legal-services/](https://www.tgs.northwestern.edu/services-support/legal-services/)

• For a longer list of on-campus supports, check: [https://www.northwestern.edu/care/get-help/get-help-now/are-you-in-crisis/index.html](https://www.northwestern.edu/care/get-help/get-help-now/are-you-in-crisis/index.html)

• RAINN: National Sexual Assault Hotline: 800-656-4673

### C Diversity statement

A diverse student population is a key element of the educational experience of students in The Graduate School (TGS). Diversity presents itself in many different forms such as: socioeconomic status, race or ethnicity, religion, gender, sexual orientation, nationality or place of origin, disability, unique work or life experience, etc. It is the goal of TGS to cultivate an environment that values diverse backgrounds, approaches, and perspectives — all essential ingredients for true academic excellence.

### D Nondiscrimination statement

Northwestern University does not discriminate or permit discrimination by any member of its community against any individual on the basis of race, color, religion, national origin, sex,
pregnancy, sexual orientation, gender identity, gender expression, parental status, marital status, age, disability, citizenship status, veteran status, genetic information, reproductive health decision making, or any other classification protected by law in matters of admissions, employment, housing, or services or in the educational programs or activities it operates. Harassment, whether verbal, physical, or visual, that is based on any of these characteristics is a form of discrimination. Further prohibited by law is discrimination against any employee and/or job applicant who chooses to inquire about, discuss, or disclose their own compensation or the compensation of another employee or applicant.

Northwestern University complies with federal and state laws that prohibit discrimination based on the protected categories listed above, including Title IX of the Education Amendments of 1972. Title IX requires educational institutions, such as Northwestern, to prohibit discrimination based on sex (including sexual harassment) in the University’s educational programs and activities, including in matters of employment and admissions. In addition, Northwestern provides reasonable accommodations to qualified applicants, students, and employees with disabilities and to individuals who are pregnant.

Any alleged violations of this policy or questions with respect to nondiscrimination or reasonable accommodations should be directed to the Northwestern Office of Equity (https://www.northwestern.edu/equity/).

**Title IX** Questions specific to sex discrimination (including sexual misconduct and sexual harassment) should be directed to Northwestern’s Title IX Coordinator (https://www.northwestern.edu/sexual-misconduct/get-help/title-ix-coordinators/). 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 www2.ed.gov/about/offices/list/ocr/complaintintro.html or calling 800-421-3481. Inquiries about the application of Title IX to Northwestern may be referred to Northwestern’s Title IX Coordinator, the United States Department of Education’s Assistant Secretary for Civil Rights, or both.