

The Software Engineering Ph.D. Program at  
Carnegie Mellon

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## 1. Introduction

Software engineering is the branch of computer science that creates practical, cost-effective solutions to computing and information processing problems, preferentially by applying scientific knowledge, developing software systems in the service of mankind [1]. Carnegie Mellon’s Software Engineering Ph.D. program aims to produce well-educated researchers, teachers, and future leaders in Software Engineering. The Ph.D. degree is a certification by the faculty that the student has a broad education in Software Engineering and has performed original research in the area.

This document is an informal description of the Software Engineering Ph.D. program; herein “we” refers to all the faculty and staff involved in the Ph.D. program. Currently, the Institute Head is [William Scherlis](#), the Director of the Software Engineering Ph.D. program is [Jonathan Aldrich](#), and the Ph.D. Programs Manager is Connie Herold.

To complete the Ph.D. degree, we require that each student:

- Participate in *directed research*
- Pass 84 university units worth of *graduate courses*, with certain distribution requirements
- Serve as a *teaching assistant* at least twice
- Demonstrate oral and written *communication skills*
- Demonstrate, through an issue-focused oral presentation and written *practicum report*, an understanding of software engineering that is grounded in practice.
- Write and orally defend a *thesis*, a significant piece of original research in a specialized area of Computer Science

Our program is unique in that we encourage and expect students to engage in research from their first day in the Institute. We are also unique in our student community. Many of our students bring significant prior experience in industry that we value, and which they can leverage in their research—while other students may not have this experience themselves, but benefit from those who do.

To help students fulfill the requirements of our program, we provide these educational opportunities:

- An active research environment, with experienced and dedicated faculty advisors
- The *Immigration Course*, intended to give an overview of the research interests of the faculty and to familiarize new students with the people and facilities of the Institute

- A large number of *graduate courses* covering various topics within software engineering and related areas in computer science

The entire faculty meet twice a year to evaluate each student's progress. A student demonstrates progress by passing courses, doing directed research, teaching, fulfilling the skills and practicum requirements, and doing thesis work. While students are encouraged to shape an educational program to suit their needs, financial support and/or permission to continue in the Ph.D. program depends on satisfactory progress each semester along at least some of these categories.

## 2. Overview of the Program

Carnegie Mellon's Ph.D. in Software Engineering is, above all, a research degree. When the faculty award a Ph.D., they certify that the student has a broad foundation in software engineering, has advanced the field by performing significant original research, and has reported that work in a scholarly fashion.

Before embarking on original research, we expect students to acquire a body of technical knowledge that includes a familiarity with the breadth of software engineering as well as a deep understanding of a specialized area. The Immigration Course is the first step in this process, exposing the student to the many ongoing research activities and projects in the Institute and School. Next, through structured coursework the student gains a broad understanding of the fundamental research issues in software engineering and related disciplines, and has the opportunity to gain a deep understanding in the student's area of specialization. Finally, the thesis work itself guarantees that the student understands the area well enough to advance the state of knowledge in the field.

Below we sketch the progress of a typical student through the program. Since the program is flexible, the careers of some students depart from this script at one or more points.

Around the start of October of the first year, each student is matched with a suitable advisor, who helps the student pursue directed research in an area of mutual interest. If the student's research interests change, he or she is free to change advisors at any time.

During the first two years of the program, the student begins to gain the foundation of knowledge that will allow him or her to go on and become an expert researcher in software engineering, primarily through the following two ways:

- By mastering a body of graduate material, achieved by passing 84 university units worth of graduate courses. Eighty-four units is equivalent to seven full-time (12-unit) courses.
- By reflecting on the student's own software engineering experience, or carrying out an structured study of some aspect of software engineering practice, culminating in an oral presentation and written practicum report.

- By learning how to organize and begin to carry out original research, achieved by participating in directed research. What constitutes directed research is decided individually between the student and his or her advisor.

Twice, usually during the first three or four years, the student serves as a teaching assistant. While teaching or taking courses, we expect students to spend at least half their time doing directed research.

Our environment provides a myriad of opportunities for students to hone their writing and speaking abilities and to maintain their programming finesse. We expect students to satisfy their communications skills requirements within their first three years.

Each 12-unit course should require no more than a quarter of the student's time during any one semester. So, typically a student tries to complete all coursework and the practicum by the middle of the third year. At this point the student becomes involved in full-time research and starts thinking about research directions for a thesis. As the student's thesis research direction becomes clear, the student writes a thesis proposal and assembles a thesis committee with help from the student's advisor. The student then completes and defends the thesis, and graduates.

All requirements in the Ph.D. program must be fulfilled by work actually carried out at Carnegie Mellon University, with the exception of the dual degree program with several Portuguese universities. **Work done elsewhere cannot be accepted for satisfying the SE Ph.D. requirements; rare exceptions must be approved by the SE Ph.D. Program Director.**

The Ph.D. program provides each student with a periodic evaluation of his or her progress. Continuation in the Ph.D. program is contingent on making satisfactory progress.

### 3. The Immigration Course

The Immigration Course (IC) is intended to provide a common starting point for the entering Ph.D.-students. It is organized as a day-long session before the semester begins, together with a series of meetings with faculty during the first two weeks of the semester. The IC's goals are:

- To orient students new to the Institute, through introductions to people (faculty, staff, other students) and through social activities.
- To introduce students to various research and educational topics of current interest to the faculty.
- To give students an opportunity to find a suitable research advisor.
- To familiarize students with the computing facilities and environment at Carnegie Mellon.

These goals are fulfilled through a program of faculty and student presentations, group meetings with faculty, and tours of facilities. Students are also expected to

meet with faculty individually during this period in order to learn more about their research. Many faculty in other SCS departments give presentations in the ICs for their respective departments, and attending those presentations is encouraged for students with cross-disciplinary interests.

## 4. Advisors

Except during their first month in the program, each student has a faculty advisor charged with guiding the education and monitoring the progress of the student through the program. This personal student-advisor relationship ensures that every student receives the necessary faculty mentoring. Throughout the program, the advisor is responsible for guiding the student's research and education. Early in the program, the advisor guides the student along some research initiative and helps with strategic planning for courses and other educational activities. Later, the advisor helps to focus the student's research interests towards a thesis topic. Toward the end of the program, the advisor chairs the student's thesis committee, and helps to select the other members of the committee. The advisor also provides the student with career advice.

How are advisors initially chosen? After a little over a month at CMU, entering students are matched with faculty advisors by the "handshake" process. Students list faculty preferences and faculty list student preferences; the SE Ph.D. Program Director then matches each student with a faculty member, taking into consideration each of their preferences and other factors. Students typically base their faculty preferences on research interests. They can learn about an individual faculty member's research interests by attending the faculty's research presentation during the IC, by reading papers written by faculty members, and from meeting individually with different faculty members during their first month here.

There is flexibility in the kind of relationship a student has with his or her advisor. Some students work more closely with their advisors than any other faculty member, and some students work more closely with another faculty member on a particular research project. A few students have two co-advisors. While it must be approved by the SE Ph.D. Program Director, a request to switch advisors is routine and almost always granted for a student in good standing, especially during the early part of the degree program. It often results from an evolution of the student's research interests.

Any non-courtesy Tenure Track or Research Track faculty member in SCS may serve as a sole advisor or co-advisor. In addition, faculty in other tracks, or in other schools, can serve as advisors with permission of the SE Ph.D. Program Director.

## 5. Directed Research

During a student's first two years, he or she should be doing directed research at least half time; once all coursework is completed and before doing thesis research, full time (except when teaching). Different students, and different advisors, have different ideas of what directed research means and how progress can be demonstrated. It is the responsibility of both the student and his or her advisor to formulate for each semester a set of reasonable goals, plans, and criteria for success in conducting directed research.

At each semi-annual graduate student review meeting, the faculty assess the student's previous semester's research progress and the student's next semester's research plans to ensure that the student is making satisfactory progress. The evaluation of a student's progress in directed research often depends on the student having produced some tangible result; examples include the implementation of pieces of a software system, a written report on research explorations, an annotated bibliography in a major area, or, as part of preparation for doing research, a passing grade in a graduate course (beyond the 84 required units).

Advisors are individually responsible for adequately supervising this portion of the Ph.D. program.

## 6. Course Requirements

The purpose of completing 84 university units worth of graduate courses is to attain a broad understanding of software engineering and closely related fields, a core set of research skills, and a deep understanding of topics that lead into the student's thesis research. A *core course* provides an understanding of the Software Engineering field, including important ideas and the major research strategies in use. By taking a *star* course in each of four categories, students acquire breadth through exposure to fundamental knowledge, concepts, and skills in software engineering. Through the equivalent of two elective courses, students typically choose to gain more depth in the student's particular area of research. Some students use electives to gain more breadth by specialized exposure to an area outside of the student's core research area.

### 6.1. Software Engineering Research Course

The Software Engineering Research Course requirement is fulfilled by taking the 12-unit course 17-808: Software Engineering Research, typically in their first semester in the software engineering Ph.D. program. This course is taught jointly by the software engineering faculty, and is designed to prepare Ph.D. students to being research in software engineering. It introduces important ideas across the breadth of software engineering and the major research strategies of the field. Students will become familiar with the structure of the field; they will learn the seminal ideas and developments that led to current research questions;

they will learn to critique research papers to evaluate their claims and evidence; and they will also become familiar with the current research themes at CMU.

## 6.2. Four Area Star Courses

Each student must pass one star course from each of four categories:

- SYM: Symbolic mathematical modeling and analysis
- BEH: Human-focused empirical research
- ENG: Design and engineering of software systems
- SOC: The interaction of software with larger issues in society, business, or public policy.

These categories are chosen to ensure that students acquire breadth through exposure to fundamental knowledge, concepts, and skills in software engineering. Each category captures a particular set of knowledge and skills that every software engineering student should possess. At the same time, the choice of courses within the categories gives students the flexibility to customize their course selection to their individual needs.

Star courses differ from non-star courses in that:

- They are appropriate for Ph.D. study, but assume only an undergraduate background in the relevant area—no more and no less.
- They use multiple forms of evaluation, such as assignments, exams, projects, or term papers.

### 6.2.1. Star Course Categories and Approved Courses

The more detailed descriptions of the star course categories, together with the rationale for their selection and the currently-approved courses in each category, are as follows:

- SYM: A course whose primary focus is on symbolic mathematical modeling and analysis techniques that are applicable to software artifacts. Students taking a SYM course should engage in symbolic research methods that might include discrete models, proofs, state space exploration, or other software-relevant mathematical topics. Symbolic mathematical techniques are useful in many areas of software engineering research, and more broadly, many students have found them helpful in writing careful definitions and precisely distinguishing among related concepts. The courses currently approved in this category are:
  - 08-622 Intro to Network Science
  - 10-701 Machine Learning (Ph.D.-level)
  - 15-812 Programming Language Semantics
  - 15-814 Type Systems for Programming Languages
  - 15-819O Program Analysis



- 17-751 Models of Software Systems
- 80-610 Formal Logic
- ENG: A course with a primary focus on software systems design and engineering. Courses in this category must include (A) significant engagement with software design, (B) consideration of software artifacts at a significant scale and complexity, and (C) exposure to the tradeoffs (such as cost/benefit) at the core of the engineering discipline. The courses currently approved in this category are:
  - 05-830 Advanced User Interface Software
  - 15-712 Advanced Operating Systems and Distributed Systems
  - 15-821 Mobile and Pervasive Computing
  - 17-755 Architectures for Software Systems
  - 17-752 Methods: Deciding What to Design
  - 18-730 Introduction to Computer Security
  - 18-749 Fault-Tolerant Distributed Systems
  - 15-745 Optimizing Compilers for Modern Architectures
- SOC: A course with a primary focus on how software interacts with larger issues in society, business, or public policy. This requirement is intended to create breadth in the curriculum, pushing students out of a focus on the software system itself (which is what ENG does) to take a course that views software from the perspective of another discipline. The courses currently approved in this category are:
  - 05-820 Social Web
  - 08-731 Information Security and Privacy
  - 08-733 Privacy, Policy, Law and Technology
  - 90-802 Information Security: Comparison of US and European Policies
  - 90-880 Strategy and Management of Technological Innovation
  - 95-782 Global eBusiness Strategy
- BEH: A course that is primarily concerned with behavioral science research methods. The course must touch on one or more human-focused empirical research methods that may include case studies, interviews, surveys, human subjects experiments, or mining software repositories. These methods may involve working with subjects directly or inferring information about subjects based on artifacts they have left behind, as in mining software repository research. The course must require students to plan and prototype a sample project using at least one of these research methods in some depth. The courses currently approved in this category are:
  - 08-803 Empirical Methods for Socio-Technical Research
  - 05-899D Human Aspects of Software Development
  - 08-734 Usable Privacy and Security

- 05-821 Applied Research Methods - Qualitative WITH 05-822 Applied Research Methods - Quantitative (6-units each, therefore 2 must be taken)
- 36-743 Statistical Methods for the Behavioral and Social Sciences

### 6.2.2. Process for Requesting Approval for New Star Courses

The faculty have selected an initial set of approved courses in each category. These are subject to review from time to time to ensure that, if the course content changes, it remains consistent with the purpose of that star.

SE Ph.D. students may request that the faculty approve an additional course in one of the star categories. In general, if the request is approved, the course will be added to the list for other students to take for star credit. When a request is student-initiated, it is the student's responsibility to make a case supporting STAR status. Students should submit a request to the SE Ph.D. Program Director and the SE Ph.D. Program Administrator using the following template:

1. Your name
2. Name and number of the course
3. Course description or URL to course description
4. Which star requirement you want this course to satisfy
5. An indication of approval by your advisor.
6. Evidence, including quotes from the course description and syllabus with supporting links, to demonstrate that the course:
  - (a) Matches the topic and fulfills the particular requirements of the star course category you have requested
  - (b) Assumes an undergraduate background in the relevant area—no more and no less
  - (c) Uses multiple forms of evaluation (e.g. assignments, exams, projects, papers, ...)
  - (d) Is appropriate for Ph.D. study. For example, if a course is primarily designed for master's students, a justification should be given that the course is also an appropriate preparation for Ph.D. study. Sometimes a course that is missing engagement with research may be adapted for Ph.D. students through additional or replacement assignments that lead PhD students deeper into relevant research topics

Given sufficient information, requests received by the faculty should generally receive a response within 2 weeks, if the request is made during a regular academic semester. Star credit should generally be requested at least 2 weeks before the end of the semester before taking a course, and preferably 2 weeks before the beginning of the registration period. This ensures students can register for a course before it fills up, and avoid spending time on a course that is not in the end approved.

Courses will not, in general, be approved in two categories, but instead will be approved in the category that best fits the primary emphasis of the course (if

any). If any exception to this principle is made, the student must choose which category to apply the course to, and find a different course with which to fulfill the other requirement.

Course curricula may evolve over time, due to the advancing state of knowledge, the changing background and needs of students, or the strengths that a new instructor brings to bear on a course. Therefore, the faculty may re-examine star courses from time to time in order to verify the the course continues to fulfill the requirements for a star. If it does not, star status may be withdrawn for future offerings of the course.

### 6.3. Twenty-Four Elective Units

Students must also take 24 university units worth of elective courses, at least 12 of which are from graduate courses offered by the School of Computer Science; the other 12 may be from graduate courses offered by the rest of the University. In general, elective graduate courses must be level 700 or above; exceptions to this rule may be made with a note from the student's advisor to the SE Ph.D. Program Administrator.

There is no explicit breadth or depth requirement. Students may use electives to gain additional depth of knowledge in the student's research area, e.g., to complement their directed research or to prepare them for choosing a thesis topic. Students may also use electives to gain additional breadth of knowledge in an area outside of the student's research area.

We strongly advise students to choose electives in consultation with their advisor. The student and his or her advisor are both responsible for making sure that through these 24 elective units the student gains new knowledge, perhaps to fill gaps or to prepare for thesis research.

Students are free to take more than the required number of elective units.

Following is a sample of past electives taken:

- 05-830 Socio-Techn Ecosystm
- 05-899 Grt Rdgs Sftw Eng
- 15-816 Modal Logic
- 15-817 Rsrch Wrtg Sft Engr
- 15-819 Human Aspects Softwr
- 15-892 Emp Mthd Soc-Tch Rsr
- 17-654 Wrld/Wrtg Rsh of Writing
- 17-703 Emrg Prog Paradigms
- 17-711 Smr Soco Tehn Ecosy
- 17-714 Grt Rdgs Software Eng
- 17-732 Intro Model checking
- 17-758 Languae & Culture for eaching
- 17-762 Foundations of Electronic Marketplaces
- 17-807 Analysis of Software Artifacts
- 17-993 Word/Wright: The Right Rite of Writing
- 99-452 Program Analysis

## 6.4. Credit for Prior Courses Taken at Carnegie Mellon

Students who have taken Ph.D.-level courses at Carnegie Mellon prior to entering the Software Engineering Ph.D. Program may request credit for up to two courses.

If a master's-level course was previously taken, credit may be given under this policy if the student completes a supplementary project that exposes the student to software engineering research in the area of the course. The project must be supervised by a Carnegie Mellon faculty member with expertise in the course area, and should be roughly equivalent to a final project in a typical Ph.D.-level course.

## 7. Practicum Requirement

An integral part of ISR's software engineering research program is ongoing interaction with industrial-strength software development in a real (not just realistic) setting. Students are expected to have prior industrial experience, or are expected to acquire such experience, typically through internships, while in the program.

The purpose of the practicum, therefore, is to ground academic study in practice by reflecting on direct experience in software development and analyzing the experience in a scientific style. Each student will complete one practicum, which is expected to take effort equivalent to a 12-unit course. A practicum may take one of the following forms:

- An issue-focused reflection and analysis of a software engineering practical experience of the author
- An empirical study of (some aspect of) the software development process

A practicum of the first type should be potentially publishable as an experience report, but it is not merely a report of the author's experience. Rather, it is a critical reflection on that experience, focused on a well-defined issue or related set of issues. The practicum should be grounded in experience and careful observation, and possibly data as well. At the same time, it should draw out lessons that might be applied to other similar situations. The author's interpretations should be substantive and well-argued, but it is not always necessary to have sufficient data for statistical validity; the narrative should be clear about the strength of the evidence.

The second category of practicum is in the form of a scientific paper, potentially publishable at a peer-reviewed conference or workshop in the area of empirical software engineering.

### 7.1. Practicum Presentation, Writing, and Evaluation

The student must present the practicum orally to the Carnegie Mellon Software Engineering community, for example in the Software Research Seminar (SSSG).

In addition, the student must produce a self-contained report, written for an audience of entering software engineering PhD students or advanced undergraduates. The target length for the report is about 10-15 pages in a normal technical report format. The report should be written in a scientific style: it should have clear definitions, careful distinctions between observations and interpretation, and appropriate comparisons to the scientific literature.

The practicum report must be approved by two faculty members. Any faculty in the Institute for Software Research are eligible; other faculty may be approved by the SE Ph.D. Program Director.

## 7.2. Practicum Confidentiality

As with any report on practical experience, practicum papers may be sensitive. Practicum reports must be available to members of the Carnegie Mellon Software Engineering Community without restriction; however, they need not be public beyond the scope of that community. It is the student's responsibility to ensure compliance with any NDAs the student may have signed. As with other papers, it is acceptable to shield the identity of individuals and organizations, as well as details of data about the experience (for example, by removing units from graphs).

Prior practicum reports are available on the password-protected internal SE Ph.D. Program web page, along with informal pragmatic advice on writing the practicum document.

## 8. Teaching Requirement

The ability to teach is an important skill for all scientists, not only for those who plan to teach after completing their degrees. Teaching skills include the ability to communicate technical material ranging from elementary to advanced, and to communicate technical material to audiences ranging from general to specialized. Thus, we expect students to develop and exercise teaching skills as part of their graduate education.

Students have ample opportunities to present advanced material while working on research projects, by participating in research seminars and by giving practice conference talks. To gain experience in presenting material at an introductory or intermediate level, we require that all graduate students help teach two courses. The norm is for students to teach one course focused on introductory material in computer science or software engineering, and one course focused on mastery of material (typically an advanced undergraduate or master's course). Teaching assistants typically spend 15-20 hours per week.

It is important that **all** teaching that is to count towards the teaching requirement must be assigned and approved **in advance** by the TA coordinator (currently David Garlan). Students' preferences will be taken into account, but cannot always be honored. In order to receive credit for the teaching requirement, the student must obtain a filled out [teaching assistant](#)

[evaluation form](#) from the course instructor, and provide the SE Ph.D. Program Administrator with a copy of the evaluation.

We encourage students to teach more than twice. At the semi-annual evaluation of students the faculty give special recognition to those who do an outstanding job as a TA and to those who teach beyond the required load. The School of Computer Science offers a TA workshop which we encourage students to take advantage of.

## 9. Written and Oral Communication Skills

To be a well-rounded software engineer, each student should have not just basic knowledge, but also the abilities

- To communicate technical ideas clearly in writing
- To communicate technical ideas clearly orally

We also expect students to be able to program, but there is no formal checkpoint to certify programming skills. It is left up to the advisor and student to make sure the student has the necessary skills.

### 9.1. Writing Proficiency

To satisfy the writing proficiency requirement, each student must write a scholarly document, as either its sole author or its primary author (if coauthored), that is at least the quality of a Carnegie Mellon technical report. This document must be a scholarly paper with references to the literature that could be submitted for peer review. It may be a technical report, a paper published at or in preparation for a conference or journal, a document written to satisfy a course requirement (e.g. a course project report), or a comprehensive survey paper (e.g. suitable for submission to *ACM Computing Surveys*).

Annotated bibliographies, user manuals, and reference manuals do not qualify because they do not require the same kind of explication, organization, and summarization skills needed to write a conference- or journal-like publication. The paper may not be a practicum document, the thesis proposal, or the thesis.

The writing requirement is evaluated by at least two SCS tenure/research faculty members and one SCS Ph.D. graduate student. One of the reviewers must be a faculty member of ISR, and none of them should be a co-author of the paper being reviewed. These evaluators must read the document and provide written feedback using the [Writing Evaluation Form](#). If the initial draft is not satisfactory, the student must revise the document until the evaluators are willing to give their final approval by signing the form. The student then gives these three (or more) signed forms to the SE Ph.D. Program Administrator, who keeps copies in the student's file and indicates in the student's records that the requirement has been satisfied.

Students are responsible for asking the appropriate faculty members and Ph.D. student to help them with satisfying their writing requirement.

We expect students to be able to satisfy this requirement within their first three years, and prior to their thesis proposal.

Computer Science Ph.D.~students are welcome to enroll in the undergraduate communications course, required of undergraduate computer science majors, to enhance their writing skills; however, taking it does not serve to satisfy the written communication skills requirement.

## 9.2. Speaking Proficiency

All SE Ph.D. students are expected to practice their speaking skills by presenting 3 times per year in the weekly ISR Software Research Seminar. The requirement is reduced to twice per year for students who take advantage of the opportunity to present in other venues approved by their advisor, such as workshops, conferences, course lectures, or other CMU seminars. At the student evaluation meeting held each semester, the faculty make a judgment to pass students who have demonstrated high speaking proficiency through the presentation(s) they have given. We expect a standard of proficiency typical of good presentations at an academic conference, or of a respected instructor giving course lectures.

Students who have passed the proficiency requirement still benefit from honing their speaking skills, and thus remain subject to the presentation expectations described above. All students are expected to regularly attend and participate actively in the Software Research Seminar (rare exceptions, e.g. for course conflicts, must be approved by the advisor and SE Ph.D. Program Director).

## 10. The Thesis Process

The thesis must describe a significant piece of original research. It is evidence of proficiency, high attainment, and ability to do research in software engineering.

A more extensive checklist with specific information on the thesis proposal and thesis defense is available at <http://isri.cmu.edu/education/se-phd/docs/thesis-proposal-checklist.pdf>. Every student must read and adhere to these more detailed process rules.

### 10.1. Thesis Proposal

The student submits a written proposal to the faculty. The student also orally presents the thesis proposal to interested faculty and students in a public colloquium.

A thesis proposal should

- Explain the basic idea of the thesis topic (e.g., the problem to be solved and the approach to solving it)
- Argue why that topic is interesting (e.g., what contributions to the field would be made in carrying out the proposed work)

- State what kind of results are expected
- Argue that these results are obtainable within a reasonable amount of time
- Demonstrate the student's personal qualifications for doing the proposed work

The main purpose of the thesis proposal is to convince the faculty that the chosen thesis topic is significant and that the student's approach has a reasonable chance of success. A thesis proposal gives the faculty the opportunity to pass such judgment at the start of the work and not at the end. We want to minimize the chance that a thesis will be turned down when almost completed. We expect students to present their thesis proposals as early as possible, not halfway through writing the thesis. A thesis proposal should be short, about 15–20 pages, and the oral presentation should take about 40 minutes, not including questions.

A thesis proposal should *not* be

- A dry run for the thesis
- A summary or abstract of the thesis
- The first chapter or part of the thesis
- A technical report
- A survey of the field
- An annotated bibliography

Any included list of references or bibliography should serve the purpose of supporting the assessment of the state of the art and the student's personal qualifications.

To provide ample notice to the public, at least one week in advance of the oral presentation, students should provide the SE Ph.D. Program Administrator with an electronic copy or link to the thesis proposal, an electronic copy of the proposal's abstract, and a list of the thesis committee members, including the external member. The SE Ph.D. Programs Administrator posts the public announcement of the thesis proposal presentation.

Please remember that at least three thesis committee members (including the Chair) must be physically present for the thesis proposal, and the thesis proposal must be held at Carnegie Mellon. The only exception is for students in joint Ph.D. programs, in which case the thesis proposal may be held remotely, with one Carnegie Mellon member physically present, and the proposal session broadcast to a Carnegie Mellon room open to the public.

Upon completion of the thesis proposal the student must complete a Doctoral Candidate Contractual Agreement Form provided by the Graduate Programs Administrator.



## 10.2. Time to Degree Policy

Students who began in the PhD program prior to June 1, 2011 must complete all requirements for the PhD within a maximum of seven full academic years, unless terminated earlier by conferral of the degree or by academic or administrative action.

Students who began in the PhD program after June 1, 2011 must complete all requirements for the PhD within a maximum of ten years from original matriculation as a doctoral student, unless terminated earlier by conferral of the degree or by academic or administrative action.

Once this time-to-degree limit has lapsed, the person may resume work towards a doctoral degree only if newly admitted to a currently offered doctoral degree program under criteria determined by that program.

## 10.3. Residency Policy

Ph.D. students must register as full-time students for a minimum of 2 years total. Full-time students must be resident in Pittsburgh, or, with the approval of their advisor and the program head, at a collaborative site.

## 10.4. All But Dissertation (ABD) Policy

After the presentation of an acceptable thesis proposal, and satisfying all other requirements except for the dissertation and its oral defense, students are regarded as “all but dissertation.”

An ABD candidate may choose to continue as a regular student *In Residence*, or, if the residency requirement above is fulfilled, he or she may choose to be *In Absentia* (ABS).

*ABS - Off Campus:* Students who leave CMU but plan to continue working on the thesis will be classified as ABS. These students should not require substantial use of university resources, but are permitted use of the libraries and consultation with faculty or students as necessary. While a candidate is ABS, he or she is required to pay the university technology fee each semester. No formal enrollment or payment of tuition is required, with the exception of the academic semester in which the degree requirements are completed. A candidate who is ABS is required to enroll for a minimum of five units during the academic semester in which the degree requirements are completed. Charges for these units are the responsibility of the candidate.

Since an ABS candidate will not be certified by the University as a “student” for immigration purposes, non-resident alien students who become ABD should not choose to become ABS.

*ABD - On Campus:* Students who are self-supporting and are in ABD status may remain on campus to complete the thesis. They must register and pay for a minimum of five units each semester. However, students who receive a stipend predicated on their status as a graduate student and paid by or administered by

the university will be required to register for a minimum of 36 research units. Nearly every ABD student in ISR falls into this latter category.

For other important information regarding ABD and ABS status, please see the [University Doctoral Student Status Policy](#).

### 10.5. Thesis Committee

The student's advisor chairs the thesis committee. All other committee members, including the external member, should be agreed upon before the thesis proposal presentation. Members of the student's committee must accept the responsibility of meeting with the student regularly to ensure that the research is progressing in the right direction. The Thesis Committee must consist of at least one Institute for Software Research faculty member, two members of SCS faculty, and/or other faculty approved by the Institute Head, and an external committee member. All thesis committees are subject to departmental approval.

The list of other approved faculty currently consists of Anthony Tomasic and David Eckhardt.

Please remember that at least three thesis committee members (including the Chair) must be physically present for the thesis proposal and defense.

### 10.6. Thesis

The thesis must describe a piece of original research work and must describe it well. It is on this basis that the Institute certifies the qualifications of the new Ph.D. Furthermore, it is the most important basis on which the scientific community judges the initial achievement and potential of that individual.

### 10.7. Thesis Defense

The student's thesis committee decides whether to accept the thesis based on its content and the outcome of the *thesis defense*, which is a public presentation describing the contributions of the thesis. At least one week in advance of the oral presentation, students must provide the SE Ph.D. Program Administrator with an electronic copy of the abstract and a list of all thesis committee members. The SE Ph.D. Program Administrator posts the public announcement of the thesis defense.

Before the thesis defense, the entire thesis committee is expected to have read the entire thesis, to have given comments to the candidate, and to have given approval for scheduling the public defense. This means that a copy of the complete thesis document should be provided to the whole thesis committee a minimum six weeks in advance of any proposed date for the defense. Significant deviations from this rule must be approved by the SE Ph.D. Program Director. Committee members should meet briefly before the thesis presentation to discuss any issues.

The presentation by the candidate is normally about 45 minutes, followed by a question-and-answer period which may be as long as needed.

Please remember that at least three thesis committee members (including the Chair) must be physically present for the thesis defense. The only exception is for students in joint Ph.D. programs, in which case the thesis defense may be held remotely, with the Chair physically present, and the defense session broadcast to a Carnegie Mellon room open to the public.

The thesis committee chair (advisor) determines who may ask questions and in what order and brings the discussion to a close at the appropriate time. The question-and-answer period is followed by a closed-door session attended by only the members of the thesis committee and any interested faculty members. The options of the committee are:

- To approve without corrections
- To approve subject to minor changes, to be approved later by the thesis chair only
- To require a resubmission after major changes and reapproval of the entire committee
- Not to approve the thesis

All members of the committee are required to sign a Final Oral Examination card, indicating that the student has passed the thesis oral examination. In addition, the thesis committee chair, the Institute Head, and the Dean sign a final certification sheet when the student submits the final version of the thesis.

## 10.8. Graduation Certification

The SE Ph.D. Program Administrator maintains a checklist of procedures for scheduling the thesis oral presentation and completing the other requirements for graduation. The SE Ph.D. Program Administrator certifies fulfillment of requirements for graduation only when the final version of the thesis has been approved by the thesis committee, the Institute Head, and the Dean. Students are not allowed to participate in commencement exercises unless final certification has been made.

If the final copy of the thesis is not submitted within one year of the thesis defense, the faculty may require a second defense before making a final certification.

## 11. Community Spirit

Our sense of community is well-known as a distinguishing aspect of the School of Computer Science at Carnegie Mellon. It is one of the reasons many students choose to come here. The Institute for Software REsearch is proud of our strong community spirit, which we foster through close working relationships between

students and advisors, among faculty, and among students. Many working relationships turn into friendships for life.

Luckily, our community works. People volunteer their time, energy, intellect, talent, and other skills to do many of the things that keep our environment running smoothly. These efforts include organizing seminars, maintaining software packages, serving on departmental committees, grading for a graduate course, planning and running social activities, giving tours, and hosting visitors.

## **12. Masters Degrees**

We are happy to grant any student a Masters Degree once he or she has passed all 84 course units, completed the practicum, passed both communication skills requirements, and taught at least once. No Masters Degree will be granted if you have received a Masters Degree in another area of SCS. You must make your request in writing or via email to the SE Ph.D. Program Administrator.

## **13. Student Support**

### **13.1. Academic Year Support**

The Institute aims to allow students as much freedom as is possible in choosing research directions, subject to the interests and expertise of the faculty who are available to oversee the work. Thus, the Ph.D. program places the responsibility on the advisor to identify a source of funding to support his or her student. We also encourage students to seek their own external funding since often the award is prestigious (e.g., NSF or Hertz) or the source provides an opportunity to make professional connections (e.g., an industrial fellowship).

If a student receives an external fellowship/scholarship, they must notify the SE Ph.D. Program Administrator. The Institute supplements the stipends of students with an outside fellowship to meet (and usually exceed) the stipends of students with internal funding. To any student whose spouse or qualifying domestic partner earns less than \$200 per month, the Institute pays a dependency allowance that is 10% of the student's SCS monthly stipend per dependent.

### **13.2. Summer Support**

Advisors provide summer support for many students, particularly for those working on their dissertation. However, we believe it is also good for students to gain experience in industry for one or two summers during their career here at Carnegie Mellon. Faculty and staff will provide help in finding suitable summer employment.

### **13.3. Consulting and Outside Employment**

Consulting is a privilege, not a right. We grant this privilege for one of two

reasons:

- The consulting task is relevant to the student's thesis work or a Carnegie Mellon research project.
- The student has exceptional financial obligations.

Consulting is normally limited to a maximum of one day per week.

A student who wishes to consult should obtain permission from his or her advisor and the SE Ph.D. Program Director.

We may require that students limit outside employment in order to be in compliance with university and government rules.

## 14. Leave of Absence

Students who wish to leave the program temporarily may request a leave of absence by submitting a request to the SE Ph.D. Program Director.

Leaves are initially granted for a period of no more than one year, but an extension of up to one additional year may be granted under exceptional circumstances. When an extension is granted, the conditions for return must be negotiated with the advisor and the SE Ph.D. Program Director prior to returning to the program. Students must be in good standing in order to be granted a leave of absence.

Students on leave of absence should contact the SE Ph.D. Program Administrator two months prior to the end of the leave to indicate their plans. While a leave can in principle start at any time, university regulations allows students to return only at the beginning of a semester (usually late August or January).

## 15. Evaluation of Students' Progress

Evaluation and feedback on a student's progress are important both to the student and to the faculty. Students need information on their overall progress to make long-range plans. The faculty need to make evaluations to advise students, to make support decisions, and to write recommendations to potential employers.

The faculty meet at the end of each semester to make a formal evaluation of each student in the Ph.D. program. For historical reasons this meeting is called "Black Friday." The purpose of having all the faculty meet together to discuss all the students is to ensure uniformity and consistency in evaluating across all the different areas, by all the different advisors, throughout the years of the SE Ph.D. program as it inevitably changes.

The faculty measure each student's progress against the goal of completing the Ph.D. program in a reasonable period of time. The evaluation considers all components of the program using indicators and information sources described below. Through a Black Friday letter, the faculty inform students of the results

of this evaluation, which may include specific recommendations for future work or requirements that must be met for continued participation in the program.

### 15.1. Components and Indicators

In their evaluation, the faculty consider the following components, though naturally only some of these components will be applicable in any given semester; they are not equally important at every stage of a student's career.

- *Courses taken:* Evaluated by the course instructor—brief prose evaluation/summary grade.
- *Directed research:* Evaluated by research supervisor and other collaborating faculty.
- *Teaching:* Evaluated by the course instructor and two different teaching evaluation forms (one filled out by the course instructor and the other filled out by students, where appropriate).
- *Skills:* Writing and speaking, by relevant faculty and forms.
- *Thesis:* Status summarized by the thesis advisor and comment by members of the thesis committee.
- *Other:* Lectures given, papers written, etc. Evaluated by cognizant faculty.

The faculty's primary source of information about the student is the student's advisor. The advisor is responsible for assembling the above information and presenting it at the faculty meeting. The student should make sure the advisor is informed about participation in activities and research progress made during the semester. Each student is asked to submit a summary of this information to the advisor at the end of each semester—the *Student Statement for Black Friday* at <https://gsaudit.cs.cmu.edu>. This statement is used as student input to the evaluation process and as factual information on activities and becomes part of the internal student record. It is strongly recommended that the student and advisor meet prior to the faculty meeting to review the information provided in this statement.

### 15.2. Recommendations

Based on the above information, the faculty decide whether a student is making satisfactory progress in the Ph.D. program. If so, the faculty usually suggest goals for the student to achieve over the next semester. If not, the faculty make more rigid demands of the student; these may be long-term (e.g., finish your thesis within 1-1/2 years) or short-term (e.g., select and complete one or more specific courses next semester; prepare a thesis proposal by next Black Friday).

Ultimately, permission to continue in the Ph.D. program is contingent on whether or not the student continues to make satisfactory progress toward the

degree. If a student is not making satisfactory progress, the faculty may choose to drop the student from the program.

The faculty also decide whether support should be continued for each student. Termination of support does not always mean termination from the program.

### 15.3. Grades

Since the Ph.D. program is not based solely on conventional academic courses, it is difficult to associate grades with a student's accomplishments. Also, for students who complete the program, grades are largely irrelevant. However, passing grade for graduate courses is B- or better. Graduates are judged primarily on their professional achievements and the experience they have gained during the program, and on the basis of recommendations from members of the faculty.

Once the required coursework is completed, students register only for a blanket course (e.g., Reading and Research<sup>4</sup>) covering all their program activities for that semester, for which they receive a Pass/No Pass grade.

## 16. Problems?

### 16.1. Points of Contact

Students and advisors enjoy a close working relationship in our program. If students have problems, whether related to their research or not, they should feel free to speak to their advisors. If doing so is awkward or if students simply want a second opinion, they should feel free to discuss their problems with either the SE Ph.D. Program Director (currently Jonathan Aldrich) or the SE Ph.D. Program Administrator (currently Connie Herold).

### 16.2. The Ombudsperson

If a student feels that none of the above avenues are appropriate for hearing about his or her problem, the student can turn to the Ph.D. program's *ombudsperson*. The ombudsperson's role and responsibilities are:

- To meet with students and listen to their problems
- To give advice, perhaps suggesting someone else to talk to or suggesting the next step to take
- To keep conversations confidential

The ombudsperson is supposed to be friendly, approachable, mature, a good listener, in his or her third year or higher (i.e., should "know the ropes" so to speak), and reasonable (of course!).

Currently, the ombudsperson is **XXXXXXXX**.

## **17. University Policies**

All policies not explicitly covered in this document adhere to university policies as stated in the Graduate Student Handbook. These policies include the status of All But Dissertation (ABD) and In Absentia students, academic disciplinary actions, and grievance procedures.



## **18. Bibliography**

- [1] Mary Shaw (editor). Software engineering for the 21st century: A basis for rethinking the curriculum. Technical Report CMU-ISRI-05-108, Carnegie Mellon University, 2005.

## A. Time Estimates

The following table indicates estimates for approximately when students should have finished each requirement. Overall, we expect students to complete the program within 5–6 years, depending on background and dissertation research.

These figures are meant to be suggestive, not prescriptive. We present them so that all faculty and students can develop a shared image of the expectations of the program.

COMPONENT	INTENSITY	COMPLETION TIME
Practicum	1/4 time	by end of year 2
Course Requirements	each 1/4 time	by end of year 3
Writing Skills	variable	by end of year 3
Speaking Skills	SSSG	by end of year 4
Teaching	1/2 time	by end of year 4
Thesis Proposal	1/2 time	by end of year 4
Thesis	full time	by end of year 5 (or 6)

Students are expected to be working on research every semester with intensity at least 1/2 time throughout their time at CMU. In addition, it is expected that students volunteer within the department and school throughout their time at CMU.