Department *of* Computer Science

Graduate Handbook

Department of Computer Science
85 Engineer's Way
P.O. Box 400740
Charlottesville, VA.
22904-4740

Phone: 434-982-2200
Fax: 434-982-2214
http://www.cs.virginia.edu

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Chapter 1

Introduction

1.1 Computer Science Department

The University of Virginia's Computer Science graduate program aims to produce well-educated researchers, teachers, and future leaders in Computer Science. Graduate degrees are a certification by the faculty that the student has a broad education in Computer Science and has performed original research in the area.

Through the development of sophisticated computer systems, algorithms, and hardware, computer scientists have the opportunity to change society in ways unimagined several years ago. Our goal is the education and training of a diverse body of students who can lead this information technology revolution. To this end, our computing graduate program orients students toward advanced studies and groundbreaking research in multiple aspects of computer science. Computational thinking is rooted in solid mathematics and science, and grounding in these fundamentals is essential. Our laboratory environment exposes students to many research and commercial software tools and systems and introduces modern software development techniques. Our graduate training provides a capstone for computer science education and prepares students for the highest possible computing careers in industry and academia. Graduate students will participate in cutting-edge research with department faculty members. The knowledge and skills acquired from our graduate degree program will give students the ability to make contributions in their own field as well as to society at large.

1.2 Diversity Statement

The members of the department envision an environment where a diversity of capable, inspired individuals congregate, interact and collaborate, to learn and advance knowledge, without barriers. We embrace this vision because:

- We wish to be leaders and role models in reaping and sharing the benefits of diversity.

- We seek to improve the intellectual environment and creative potential of our department.
- We expect to produce happier, more capable and more broadly educated computer science graduates.
- We wish to contribute to social justice and economic well being for all citizens.

1.3 Degrees Offered

The Department of Computer Science offers three computing degrees available to graduate students in the School of Engineering and Applied Science.

- *Master of Computer Science (MCS)*. The MCS degree is a graduate professional degree with an emphasis on coursework. It enhances the professional instruction of an undergraduate program by providing students with greater knowledge and deeper understanding of computer science.
- *Master of Science (MS)*. The MS degree introduces students to research at the graduate level with a focus on a formal written thesis.
- *Doctor of Philosophy (PhD).* The PhD program prepares students for faculty careers at world-class universities and for research positions in leading government or industrial research labs. It is common, but not required, for PhD students to obtain an MCS or MS degree along the way.

Degree details and requirements are provided later in this document.

1.4 Department Organization

While every faculty and staff member of the department plays a part in the graduate experience, some roles have significant impact on graduate student life:

Position	Currently Serving
Department Chair	Kevin Skadron
Director of Graduate Studies	Westley Weimer
Graduate Ombudsman	Jack Davidson
Graduate Administrator	Kim Gregg

Each student also works closely with at least one research advisor and frequently interacts with several committees. Advisors are discussed in detail in Chapter 2.1 and Chapter 2.2, while committees are discussed in detail in Chapter 5.2, Chapter 6.2.1 and Chapter 6.3.1.

Department faculty members are divided into tenure-track (or research) faculty and general (or teaching) faculty. General faculty members are not directly involved in the graduate program and the term "faculty" refers to tenure-track faculty in this document unless otherwise noted.

1.5 Collegiality

The Computer Science department at the University of Virginia prides itself on its collegial and democratic atmosphere. Relationships between students, advisors and faculty are cordial and open. Part of this spirit is a strong sense of cooperation and volunteerism among the graduate students, exemplified by the *Computer Science Graduate Student Group*. The CSGSG is a student-run organization that works closely with the faculty, sends representatives to faculty meetings, identifies and advocates for student concerns, and takes leadership and planning roles in departmental activities. All graduate students are encouraged to participate, and more information can be found at `http://www.cs.virginia.edu/~csgsg/`.

1.6 Contact Information

The Computer Science department is located in Rice Hall.

Department of Computer Science
85 Engineer's Way
P.O. Box 400740
Charlottesville, VA.
22904-4740

Phone: 434-982-2200
Fax: 434-982-2214
`http://www.cs.virginia.edu`

Graduate students may use the department address for any school-related purposes. Mail sent to the P.O. Box listed above can be picked up at the front desk. Packages delivered by courier services other than the United States Postal Service (e.g., FedEx, UPS, etc.) should be given the physical address (85 Engineer's Way) rather than the P.O. Box, and may be claimed in the department's front office.

Chapter 2

Graduate Academic Program

The typical graduate student accomplishes the following milestones while working on the PhD degree:

1. Select a faculty research advisor;
2. Pass the two portions of the qualifying exam:
   - *Breadth*: take six courses spanning the CS curriculum;
   - *Depth*: propose and defend a 3-credit research project and demonstrate mastery of selected readings related to that project;
3. Propose PhD research through a written and oral outline of planned research activities; and
4. Defend a PhD dissertation, which is a written and oral report of the completed PhD research.

The qualifying examination can fulfill many of the requirements of the MCS Master's Degree (see Chapter 4) and most students opt to obtain that degree before the PhD proposal. Students also take additional courses and file administrative forms throughout the degree program. Details on each step, as well as steps taken by students working on the MCS and MS degrees, are outlined later in this document.

Unless otherwise noted, all timelines and dates given are for students entering with a bachelor's degree. Differences for students who have a master's degree are indicated separately as appropriate. Timing is expressed in terms of semesters. Only Fall and Spring semesters are counted, so for example the "third semester" of a student entering during the summer term is that student's second fall semester. Where specific numbers are given, these are requirements that can only be deferred with approval from the graduate program director.

This document details the necessary steps each graduate student must take, but students are encouraged to perform many other activities. For example, almost all successful graduate students publish multiple papers, but the department has no formal publication requirement. A graduate student's advisor will have more information about such elements of a successful graduate experience.

2.1 Temporary Advisor

During orientation (held right before each Fall semester), each student is assigned a temporary advisor to aid in the selection of their first semester courses. The temporary advisor also assists with educational and administrative issues that may arise during the student's first semester but typically does not provide research guidance.

For various reasons, some students do not obtain a temporary advisors during orientation. Such students should contact the graduate program director or the administrator as soon as possible to have one assigned.

2.2 Research Advisor

Research advisors provide oversight and mentoring of a student's entire graduate experience. A student's research advisor (or simply advisor) is selected during the matching process, which is part of the first-semester CS 6190 course. Near the end of the first semester, students are asked to supply a prioritized list of potential advisors with whom they have discussed research opportunities during the first semester. Similar prioritized lists of students are provided by faculty, and these preferences are used to match each student with a research advisor. In cases where it becomes necessary to change research advisors, the student should discuss this potential change with both their current advisor and their new advisor and communicate the final result to the front office so that the update is recorded properly.

An advisor's role is to guide the student through all phases of the graduate program. At times this includes helping the student through special circumstances not covered by official policies. Students who have concerns that cannot be resolved on their own should bring these concerns to their advisor, who will assist them in bringing the matter to a suitable conclusion. Students with concerns about their advisor should first contact the graduate program director and then, if desired, the ombudsman.

2.3 Student Evaluations

The entire faculty meet once a year to evaluate each student's progress. A student demonstrates progress by passing courses, completing the qualifying examination, doing directed research, teaching, 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 graduate program depends on satisfactory progress each semester along at least some of these categories. Ideally, this process should contain no surprises as students and advisors will discuss goals and progress throughout each year. The yearly evaluation process is sometimes referred to as "Bright Monday."

Students should complete the "Graduate Student Annual Report Form" and turn it in to the department administrator (see Chapter 8).

The outcome of the student evaluation process is a formal letter sent to each student representing the overall faculty evaluation of the student at that point in time. Students who do not receive this letter contact their advisor or the graduate administrator.

Chapter 3

Graduate Student Employment

The typical graduate student is employed by the department, either as a *teaching assistant (TA)* or as a *research assistant (RA)*. As university employees, TAs and RAs are expected to perform their duties in a prompt and proper manner. A student funded by the department may not also have outside employment without permission from the Computer Science Chair and the SEAS Graduate Dean. Full-time graduate students must also not unilaterally accept research internships without prior approval from their advisor.

All full-time graduate students *must* sign up for 12 credit hours per semester. Students commonly augment standard courses with research and teaching hours (e.g., CS 8897, CS 8999 or CS 9999) to reach the 12 credit hour minimum.

3.1 Teaching Assistant Responsibilities

TAs are important members of the department's professional teaching staff. Each TA is assigned to assist in the educational goals of one or more course sections. This assignment is typically given by the director of graduate studies early in the semester and is accompanied by an expected number of hours the TA will devote to each course. Because schedules and resources can change up to the beginning of classes each semester, TAs should not be surprised if course assignments are not made until after courses actually begin. TAs without an assignment by the second week of classes should contact the graduate program director.

Students should enroll in up to 3 credits of CS 8897 (CS 9897 for doctoral students) each semester in which they are employed as a TA. Students assigned to TA multiple courses should split the amounts among those courses at their discretion (e.g., 1 in Course A and 2 in Course B), noting that it is not possible to sign up for 1.5 credit hours.

Specific TA responsibilities for a particular course are assigned by the instructor. Common duties include grading, proctoring laboratory sections, holding office hours and help sessions, attending class, reading instructional materials, completing assignments, answering email or forum questions, and tutoring students in need of additional

help.

Additional duties directly related to a particular course may be assigned by an instructor. Students concerned that specific duties are inappropriate or off-topic may seek resolution through the instructor, their advisor, or the graduate ombudsman. A TA whose duties require significantly more or less time than than their assigned weekly hours should inform the course instructor so that a more appropriate set of duties can be assigned.

Each TA is responsible for obtaining a proper understanding of the course material. TAs without a firm grasp of course concepts should obtain guidance from the instructor or request a change in course assignments from the director of graduate studies when given the course assignment.

TAs are employees and representatives of the department and the university. As such, they should behave with professional courteously and politeness in all their official communications and activities. This includes handling student questions in a polite, constructive, and accurate manner.

The period of TA employment begins with the beginning of the semester and lasts until the final grades are submitted to the registrar. TAs should be reliable in all their duties. Non-emergency absences from scheduled duties within that time must be approved by the graduate program director.

UVa maintains a teaching resource center with published information helpful in guiding TA interactions with students. These publications are online at `http://trc.virginia.edu/Publications/`.

3.2 Research Assistant Responsibilities

Students receiving research funding are called research assistants. Each RA is assigned to a particular advisor and is given a number of hours each week to devote to that advisor's research program. The majority of a typical graduate student's academic tenure is spent as an RA.

RAs and advisors are colleagues in research and the employer-employee relationship is rarely visible as they work together to expand the frontiers of knowledge. However, there are elements of a research program that may not appeal to the RA but still need to be completed. While an RA is often officially a 20-hour position, success in graduate school and in industrial or academic research requires more than 20 hours per week. A student who is concerned that specific duties are inappropriate or off-topic may seek resolution with the advisor, the graduate ombudsman, or the director of graduate studies.

3.3 Summer Support

Summer support is available for many students, particularly those working on dissertations. In addition, the faculty believe that it is often beneficial for graduate students to gain direct experience with industrial or industrial research through summer internships. Graduate-level summer internships often lead to a publication, provide external

committee members (see Chapter 6.2.1 and Chapter 6.3.1), and help in the evaluation of possible careers. Research advisors will help in finding suitable summer employment.

3.4 Funding Adjustments

For those students who have been awarded financial aid, the following policy applies. Funding for master's degree students remains constant (except for possible cost-of-living increases). PhD students, however, are paid increasing amounts according to the following three-step scale:

1. Incoming students (regardless of previous degree)
2. Passed Qualifying Examination (see Chapter 5)
3. Passed Dissertation Proposal Examination (see Chapter 6.2)

Chapter 4

Master's Degrees

The CS department offers two Master's degrees: a Master of Science (MS) degree, which requires a thesis, and a Master of Computer Science (MCS) degree, which focuses on a project. Many students choose to complete an MS or MCS degree while working on a PhD, and some courses and activities can fulfill requirements in both. Although most students finish within two years, the time limit for degree completion after entering the Master's program is five years for the MS and seven years for the MCS. Degree requirements set by the School of Engineering and Applied Science (SEAS) are given in the SEAS Graduate Record (see Chapter 7) and are additional to the CS Graduate Program requirements.

In addition, there are special rules for students in a Master's-only program or students who are terminating their graduate studies with a Master's degree.

4.1 Course and Degree Requirements

All graduate degrees offered by the department require a combination of research and coursework. Each student is required to meet *both* the SEAS-defined minimum number of credits for a graduate degree *and* the department-defined breadth of instruction. These accountings are performed independently; for example, CS 6161 counts as a course towards the minimum to earn a degree and also satisfies the department's theory breadth requirement for passing the qualifying examination (see Chapter 5.3).

4.1.1 Minimum Credits

Students must have a minimum number of *graded*, *graduate-level* credits. A graduate-level class is any class numbered 5000 or above. No grade lower than a "C" will be accepted towards satisfying this requirement, and the average of all grades in courses uses to satisfy CS graduate degree requirements must be at least a "B".

In addition to graded courses, students are required to take some number of *research* credits for each degree. Students employed as TAs should also register for TA

credits (CS 8897 and CS 9897; see Chapter 3.1)); these do not count toward the requirements of any degree.

All students must take "Computer Science Perspectives" (CS 6190) during their first Fall semester.

The minimum number of credits depends on the particular degree sought.

Students are not permitted to earn both an MS and an MCS.

4.2 Common Master's Degree Approaches

This subsection describes the two most common Master's degree approaches supported by our department. The default is the coursework-based MCS (see Chapter 4.2.1), but students are welcomed and encouraged to pursue a research project with a faculty advisor.

4.2.1 Terminal Coursework-Based MCS Requirements

Students in a Master's-only program, or students who are terminating their graduate studies with a Master's degree (and thus *not* pursuing a Ph.D.), may elect to complete the MCS degree requirements entirely via coursework, skipping the project and the Ph.D. qualifying examination.

The terminal coursework-based MCS degree requires a minimum of 31 graduate-level credits, including

- "Computer Science Perspectives" (CS 6190)
  - can be waived by permission of the graduate program director
- "Theory of Computation" (CS 6160)
- "Design and Analysis of Algorithms" (CS 6161)
- "Computer Architecture" (CS 6354)
- "Operating Systems" (CS 6456)
- at least 18 credits of graded graduate-level coursework ("graduate electives"), containing
  - at least one graded graduate-level mathematics course (may be satisfied by transfer credit)
    - MATH and APMA courses are acceptable
    - "Introduction to Machine Learning and Data Mining" (CS 6501) is acceptable
    - other non-CS graduate courses with a significant mathematical component can also satisfy this requirement with the prior written approval of the graduate program director

  - no more than 6 credits from 5000-level courses, none of which are from the CS department.
  - no more than 6 transfer credits (see Chapter 7)

- A project presentation is *not* required for the terminal coursework-based MCS degree.
- Complete the "Engineering Design" and "Engineering Analysis" assessment forms with your instructor from CS 6161 or CS 6160. (Optionally, you may complete each assessment form with any other instructor from your graded, graduate-level CS classes.)
- Complete the "Plan of Study" assessment form with your CS advisor. (Optionally, you may complete this assessment with the graduate program director.)

There is no independent research project *requirement* for students completing a terminal coursework-based MCS degree. Terminal coursework-based MCS students may, however, choose to fulfill one of the electives via an MCS project.

4.2.2 Project-Based MCS Requirements

Most students working toward a Ph.D. degree complete a Master's degree along the way. Such students usually complete the project-based MCS degree requirements.

The project-based MCS degree requires a minimum of 31 graduate-level credits, including

- "Computer Science Perspectives" (CS 6190)
  - can be waived by permission of the graduate program director
- at least 3 credits of supervised project research (CS 7995), typically associated with the student's MCS and Qualifying Examination project
- at least 27 credits of graded graduate-level coursework, containing
  - at least one graded graduate-level mathematics course (may be satisfied by transfer credit)
    - MATH and APMA courses are acceptable
    - "Introduction to Machine Learning and Data Mining" (CS 6501) is acceptable
    - other non-CS graduate courses with a significant mathematical component can also satisfy this requirement with the prior written approval of the graduate program director
  - no more than 6 credits from 5000-level courses, none of which are from the CS department.
  - no more than 6 transfer credits (see Chapter 7)
- Completion of the Qualifying Examination (see Chapter 5)

  - The depth component of the Qualifying Examination also counts as an MCS project presentation

- Complete the "Engineering Design", "Engineering Analysis" and "Oral Communication" assessment forms. You should bring these forms to your MCS Project Presentation.

Students are encouraged to complete this project-based MCS degree on the way to the PhD degree.

4.3 Uncommon Master's Degree Approaches

This subsection describes uncommon Master's degree approaches supported by our department. Students should discuss plans with an advisor before attempting to complete any of these Master's degree approaches.

4.3.1 Terminal Project-Based MCS Requirements

Students in a Master's-only program, or students who are terminating their graduate studies with a Master's degree (and thus not pursuing a Ph.D.), may elect to complete the MCS degree requirements via a project and coursework, skipping the Ph.D. qualifying examination.

The default for terminal MCS students is to complete the terminal coursework-based MCS (see Chapter 4.2.1). However, students are welcomed and encouraged to pursue a project-based MCS with a faculty advisor.

The terminal project-based MCS degree requires a minimum of 31 graduate-level credits, including

- "Computer Science Perspectives" (CS 6190)
  - can be waived by permission of the graduate program director
- at least 3 credits of supervised project research (CS 7995) associated with the student's MCS Project
- at least 27 credits of graded graduate-level coursework, containing
  - at least one graded graduate-level mathematics course (may be satisfied by transfer credit)
    * MATH and APMA courses are acceptable
    * "Introduction to Machine Learning and Data Mining" (CS 6501) is acceptable
    * other non-CS graduate courses with a significant mathematical component can also satisfy this requirement with the prior written approval of the graduate program director
  - no more than 6 credits from 5000-level courses, none of which are from the CS department.

  - no more than 6 transfer credits (see Chapter 7)

- Completion of the MCS Project Presentation
  - a 30-minute publicly-announced presentation with your advisor and at least one other faculty member present
- Complete the "Engineering Design", "Engineering Analysis" and "Oral Communication" assessment forms. You should bring these forms to your MCS Project Presentation.

4.3.2 Terminal Thesis-Based MS Requirements

Students in a Master's-only program, or students who are terminating their graduate studies with a Master's degree (and thus not pursuing a Ph.D.), may elect to complete the MS degree requirements entirely via a thesis and coursework, skipping the Ph.D. qualifying examination.

The default for terminal Master's students is to complete a terminal coursework-based MCS (see Chapter 4.2.1). However, students are welcomed and encouraged to pursue a Thesis-based MS with a faculty advisor.

The terminal thesis-based MS degree requires a minimum of 31 graduate-level credits, including

- "Computer Science Perspectives" (CS 6190)
  - can be waived by permission of the graduate program director
- "Theory of Computation" (CS 6160)
- "Design and Analysis of Algorithms" (CS 6161)
- "Computer Architecture" (CS 6354)
- "Operating Systems" (CS 6456)
- at least 12 credits of graded graduate-level coursework ("graduate electives"), containing
  - at least one graded graduate-level mathematics course (may be satisfied by transfer credit)
    - MATH and APMA courses are acceptable
    - "Introduction to Machine Learning and Data Mining" (CS 6501) is acceptable
    - other non-CS graduate courses with a significant mathematical component can also satisfy this requirement with the prior written approval of the graduate program director
  - no more than 6 credits from 5000-level courses, none of which are from the CS department.

  - no more than 6 transfer credits (see Chapter 7)

- at least 6 credits of "Masters Thesis Research" (CS 8999)
- Acceptance of MS Thesis
- Complete the "Engineering Design", "Engineering Analysis" and "Oral Communication" assessment forms. These forms are completed as your MS Thesis is accepted.

4.3.3 Thesis-Based MS Requirements

Most students working toward a Ph.D. degree completing a Master's degree along the way. Students may elect to complete a thesis-based MS degree.

The default Master's degree for students pursuing a Ph.D. degree is the project-based MCS degree (see Chapter 4.2.2). However, students are welcomed and encouraged to pursue a Thesis-based MS degree with a faculty advisor.

The thesis-based MS degree requires a minimum of 31 graduate-level credits, including

- "Computer Science Perspectives" (CS 6190) (or permission of the graduate program director)
  - can be waived by permission of the graduate program director
- at least 6 credits of research (CS 8999)
- at least 24 credits of graded graduate-level coursework, containing
  - at least one graded graduate-level mathematics course (may be satisfied by transfer credit)
    * MATH and APMA courses are acceptable
    * "Introduction to Machine Learning and Data Mining" (CS 6501) is acceptable
    * other non-CS graduate courses with a significant mathematical component can also satisfy this requirement with the prior written approval of the graduate program director
  - no more than 9 credits from 5000-level courses, none of which are from the CS department.
  - no more than 6 transfer credits (see Chapter 7)
- Completion of the Qualifying Examination (see Chapter 5)
- Acceptance of MS Thesis
- Complete the "Engineering Design", "Engineering Analysis" and "Oral Communication" assessment forms. These forms are completed as your MS Thesis is accepted.

4.4 Master's Degree Forms

To receive a master's degree, students must file form "Application for Graduate Degree" (see Chapter 8) at the start of the semester during which they expect to graduate (i.e., no later than **1 October**, **1 February**, or **1 June**, respectively).

Student should double-check their completion of the requirements using the report offered by the Student Information System (SIS) website.

A PhD student who plans to continue on to the PhD program after a master's degree will need to fill out the "Request Program or Plan Change Form". This administrative form allows the student to temporarily be listed as a Master's student, receive the Master's degree, and then return to the PhD program. It is purely a temporary bookkeeping measure required by the UVA system and is not a punitive or permanent change in any way.

Chapter 5

Qualifying Examination

The *qualifying examination* is designed to evaluate a student's ability to pursue and to successfully complete graduate-level research. All graduate students, except those leaving with a terminal Master's degree, are required to pass all parts of the qualifying examination.

The qualifying examination consists of two parts: breadth and depth. The *breadth* portion of the exam requires coursework in four major research areas: computer systems, software systems, application systems, and theory. The *depth* portion of the exam focuses on the student's research potential and requires the student to propose and to complete a semester-long research project guided by their research advisor. The student then prepares a written report and oral defense for evaluation by a faculty committee. The student's committee is responsible for approving both the breadth and depth portions of the qualifying exam.

Each element of the qualifying process has an associated deadline. During periodic reviews of graduate students, the faculty will note any missed deadlines related to the qualifying examination and communicate them to the student in the official progress letter. In the worst case, students who do not complete the requirements in a timely manner will be asked to leave the program.

5.1 Qualifying Examination Timeline

All students completing the qualifying examination are required to adhere to the following timeline:

- **By October 15th of the student's third semester.** The committee must have *approved* the qualifying examination proposal including an updated plan of study (see Chapter 5.3), the reading list (see Chapter 5.4.2), and the project document proper (see Chapter 5.4.1).

- **By March 1st of the student's fourth semester.** The breadth and depth portions of the qualifying examination must be entirely completed (see Chapter 5.5).

- Any exceptions from these deadlines require a petition to the graduate program committee (see Chapter 1.4).
  - Many students match with an advisor in their second semester (instead of in their first semester). Such students should request a one-semester extension to the qualifying examination timeline.

Students are responsible for calibrating committee expectations with regards to these deadlines.

5.2 Qualifying Examination Committee

The student must form a *qualifying examination committee* by the first month of the student's second semester. The qualifying exam committee comprises the student's research advisor and three other CS faculty members. Alternative committee compositions may be approved by the graduate program director.

Form "Appointment of Final Examination Committee" should be filed after a student has formed a qualifying exam committee, selecting "Master of Science Final Exam" (see Chapter 8) even for students not electing to earn a Master's degree. Each committee should have an explicit *chair*, who directs meetings procedurally. Any member of the committee, including the advisor, may serve as the chair for the qualifying exam committee.

For a student entering with a master's degree, the committee should be formed within the first month the student is enrolled. The committee may be formed under a temporary advisor if a research advisor has not yet been selected.

The committee evaluates all aspects of the student's qualifying examination process. They approve the student's course selection for satisfying the breadth portion of the qualifying exam. The committee evaluates the student's qualifying proposal, including the reading list selection. The committee members read and evaluate the student's written report and attend the student's oral defense of qualifying research. Their objective is to gauge the student's research ability and likelihood of succeeding in the graduate program.

5.3 Qualifying Examination Breadth Requirement

To satisfy the breadth requirement of the PhD qualifying exam, each student must take the following courses within their first four semesters in the graduate program (three semesters for students entering the department with a master's degree):

- At least one 4000-level or higher course from each breadth area (see Chapter 5.3.1);
- At least two 5000-level or higher courses from any of the four breadth areas. (Note that the number of 5000-level credits accepted for a graduate degree is limited by SEAS.)

Each of these courses must be distinct, for a total of six courses. Each of these six courses must be passed with a minimum grade of a "B" (not "B−"), and with a cumulative GPA of at least 3.6. Individual breadth course requirements may be satisfied by transfer credit at the discretion of the student's curriculum committee (see also Chapter 7).

Note that while 4000-level courses may be used to satisfy some breadth requirements, they are not graduate-level courses and do not satisfy degree requirements that demand graduate-level courses.

Students entering with or earning a Master's degree prior to their PhD may fulfill the breadth requirement by transfer credits at the discretion of their committee; however, they are still required to take at least six credit hours of coursework beyond their Master's coursework.

5.3.1 Qualifying Examination Breadth Areas

The department distinguishes four major areas for research and coursework:

- Computer systems (architecture, operating systems, networks)
- Software systems (programming languages, compilers, software engineering)
- Application systems (graphics, databases, artificial intelligence, etc.)
- Theory (theory, algorithms, security)

Each graduate student is expected to be knowledgeable in all four areas.

Each course is assigned to one breadth area. The assignment of a *special topics* course to a breadth area depends on the topic of the course and is handled on a case-by-case basis by the student's committee. The committee will take into account the student's body of work as well as the instructor's classification of the course, if relevant. The mapping between courses and breadth areas can be found in Tables 5.1.

5.4 Qualifying Examination Depth Requirement

The depth component of the qualifying examination begins with a written proposal document and a meeting with the student's committee. Together, the document and meeting establish the project expectations. The student must provide the committee with the proposal document at least one week prior to the meeting. The meeting also allows discussion of the student's reading list. The student should prepare a 15-minute presentation to open the meeting with the committee. This meeting must take place by the end of the student's second semester.

5.4.1 Qualifying Examination Proposal Document

The student's proposal document should be sufficient for the committee to make a determination about the research quality of the project. It should be between two and five pages in length and contain the following elements:

Table 5.1: Breadth area of each CS course number. Courses marked "— n/a —" do not count toward breadth requirements.

Course	Computer Systems	Software Systems	Application Systems	Theory
4102				✓
4240		✓		
4330	✓			
4414	✓			
4434		✓		
4444	✓			
4457	✓			
4458	✓			
4501	(varies by section)			
4610		✓		
4620		✓		
4630				✓
4710			✓	
4750			✓	
4753			✓	
4810			✓	
4820			✓	
4840			✓	
5487	✓			
5501	(varies by section)			
5787				✓
5788				✓
6160				✓
6161				✓
6190		— n/a —		
6240		✓		
6250		✓		
6316			✓	
6354	✓			

Course	Computer Systems	Software Systems	Application Systems	Theory
6415	✓			
6444	✓			
6456	✓			
6501	(varies by section)			
6610		✓		
6620		✓		
6750			✓	
6840			✓	
6993	(varies by section)			
7457	✓			
7501	(varies by section)			
7620	✓			
7716			✓	
7882			✓	
7993		— n/a —		
7995		— n/a —		
8516				✓
8524		✓		
8535	✓			
8545	✓			
8561		✓		
8575			✓	
8584			✓	
8897		— n/a —		
8999		— n/a —		
9897		— n/a —		
9999		— n/a —		

Abstract An executive summary, no more than half a page long

Motivation What is the problem and why is it important? What is the hypothesis of this research?

Contributions What are the main ideas and why do they matter? In what way are these ideas novel?

Related work What is the relevant prior work and state-of-the-art in this area?

Detailed research plan What specific goals or milestones will be completed during the research project and how will they be implemented, designed, and evaluated? For projects with a significant implementation component, give enough details of the features to be implemented and the experimental setup involved for the committee to judge the feasibility of the proposed work. For projects with a significant formal component, give enough details of the formalisms used (e.g., proposed theorems, proof schemas, and logical frameworks) for the committee to judge the feasibility of the proposed work.

Summary A short summary of the above and potential future work.

The ordering of the sections above may vary depending on the committee's preferences. Many proposals also include a section devoted to the work completed by the student prior to the proposal.

The proposal document is not binding in either direction. However, students should discuss any major deviations with their committees. The proposal document is intended to assist the student in the formalization of the research project and to ensure that the student is not undertaking too much or too little work. If the committee is not satisfied with the proposal, it may request amendments or changes and set appropriate due dates. Typically, the committee will indicate weaknesses in the proposal that must be addressed in the final report and presentation for the student to pass the depth requirement. The committee will also indicate deadlines for any required revisions.

5.4.2 Qualifying Examination Reading List

The qualifying exam proposal should include a reading list that the oral examination may cover. The student and research advisor prepare an initial reading list, which should be included as an appendix in the proposal document. During the initial meeting, the committee may make changes or additions to the reading list. During the proposal presentation, the *selection* of materials for the reading list may be reviewed and amended. During the report presentation, the student may be questioned about the *content* of each work on that list.

The reading list consists of:

Focus papers A small number (typically two or three) papers representing the state of the art in the area. The student will be expected to know these papers in detail.

Background readings Typically a textbook and one or two book chapters or survey papers, or no textbooks and four or five book chapters or survey papers.

The student will be expected to have a firm command of the material covered in these readings, as shown through general understanding and an ability to place the work in context, but will not be questioned about them as closely as on the focus papers.

Related works The proposal (and later project report) bibliography comprises the rest of the reading list. The student should understand the main idea of each such paper, why that paper is cited, and its relevance to the proposed research.

5.5 Qualifying Examination Defense

The qualifying defense comprises a final project report written by the student and a public oral defense of the research. All students, even those with a previous Master's degree, must register for three credits of CS 7995 (or CS 8999) in the semester they give their qualifying defense.

5.5.1 Qualifying Examination Final Report

The report should convey the results of the project and include evidence and arguments that those results are valid. The report should be 10–12 pages long using a typical publication format from conferences in the topical field. The exact format and style of the report may vary somewhat across topics but in general will include the following elements:

- Presentation of the work's motivation, hypothesis and contributions.
- Placement of the work in the context of prior art.
- An explanation of how the proposed work was carried out. Where applicable, this should provide enough information for the reader to replicate the results.
- Conclusions drawn from the work and a discussion of future research directions that the project suggests.
- A copy of the final reading list should be included as an appendix in the final report.

The report should be self-contained and independent of the corresponding proposal. The report should provide enough context and detail so that a reader of the proposal can readily see how the work fulfills the promises in the proposal.

The report and all associated materials must be provided to the committee at least one week in advance of the defense meeting.

5.5.2 Qualifying Examination Oral Defense

The student's final presentation to the committee is open to the public. The student must provide the final report to the committee at least one week in advance. The student must also arrange for the department graduate administrator to publicize the time and date of the final presentation at least one week prior to the oral examination. The oral defense must be budgeted for *two* hours. This is the minimum time needed for the student presentation (25–30 minutes), questioning regarding the project (about 30 minutes), questioning regarding the reading material (about 30 minutes), and committee deliberations and form processing. The chair of the committee (see Chapter 5.2) is responsible for ensuring that there is time for both phases of questioning (i.e., questioning about the project and questioning about the reading material).

The oral examination begins with a 30-minute presentation by the student providing an overview of the research project undertaken by the student. The presentation is followed by questioning from the committee and the general audience. Exam questioning should cover the project itself as well as the material from the reading list.

In addition to questions about the student's work, the student should be prepared to answer questions about their depth area in general and their research project in particular. The student should be:

- able to explain the main idea, conclusions, and relevance of any paper in their report's bibliography. The student is not expected to be completely familiar with every detail of every paper.

- an expert on the focus papers from their reading lists. These papers represent the state-of-the-art in the area, and the student will be held to a higher standard for these papers. Deep questioning regarding them should be expected.

- familiar with the major concepts from the background readings in the reading lists. The student will be expected to demonstrate a firm command of the background readings, as shown through general understanding and an ability to place the work in context, but will not be questioned about them as closely as on the focus papers.

Student are encouraged to provide the committee members with copies of the slides used in the proposal presentation. Slides can be distributed in an electronic form a few days in advance of the presentation or printed out and distributed at the oral examination itself. Providing numbered slides is a courtesy that helps the committee follow the presentation and keep track of their comments.

Upon completion, the student should file (1) the "Report on PhD Exam" form and (2) the "Computer Science Qualifying Exam Assessment" (see Chapter 8).

5.5.3 Qualifying Examination Depth Outcomes

Based on the student's final project report and oral exam, the advisory committee will determine if the student passed the depth portion of the qualifying exam. If the student's performance is not acceptable, the committee may permit a second attempt, in which

case the exam must be re-taken within one month. If the university is on holiday during the next month (e.g., the student defends in December), the exam must be retaken within the first month of the next semester. A total of at most two attempts are allowed.

5.6 Qualifying Examination Overall Outcomes

Based on the student's performance on both the breadth and depth components of the qualifying exam, the advisory committee will decide if the student has passed the overall qualifying examination.

Chapter 6

PhD Degrees

The PhD degree culminates with the student writing and defending a dissertation based on the result of independent, original research that makes a significant contribution to the student's field of study. The work is expected to be of sufficient quality to merit multiple peer-reviewed academic publications.

6.1 PhD Requirements

The PhD degree requires 72 graduate-level credits, including

- at least 24 credits of graded graduate-level coursework, containing
  - one graded graduate-level mathematics course (may be satisfied by transfer credit)
    - MATH and APMA courses are acceptable
    - "Introduction to Machine Learning and Data Mining" (CS 6501) is acceptable
    - other non-CS graduate courses with a significant mathematical component can also satisfy this requirement with the prior written approval of the graduate program director
  - no more than 6 credits from 5000-level courses, none of which are from the CS department.
  - at least 6 credits of graded graduate-level coursework *in excess* of that required for the Master's degree (if possessing or obtaining a Master's degree)
- (The remaining 48 graduate-level credits are typically satisfied via graduate teaching and research hours such as CS 9999.)
- Completion of the Qualifying Examination (see Chapter 5)
- Completion of the PhD Proposal (see Chapter 6.2)

- Completion of the Oral Defense of the written Dissertation (see Chapter 6.3)

These requirements have significant overlap with the MCS and MS degree requirements; many students choose to earn one of those Master's degrees as part of their PhD studies.

SEAS does not limit PhD transfer credit, but all transfer credits must be approved by the student's PhD committee (see Chapter 6.2.1 or Chapter 6.3.1). Students should not assume that transfer courses will be accepted prior to curriculum committee approval. Students may take additional courses beyond those required for graduation.

6.2 PhD Proposal

Each PhD student must present a dissertation proposal, created under the guidance of the student's advisor. This proposal should be presented prior to performing extensive research, in order to receive early faculty approval of the suitability of the proposed research. The proposal should be completed by the end of the student's third year.

6.2.1 PhD Proposal Committee

In most cases, the PhD proposal committee is the same as the PhD defense committee (see Chapter 6.3.1). However, other committee compositions are possible provided the committee contains the student's research advisor, a chair, a minor representative (outside the student's department and major curriculum study area), and at least one other person.

There is no form to indicate the PhD Proposal Committee in advance. Instead, the committee is indicated on forms used the day of the PhD Proposal Oral Examination (see Chapter 6.2.3). Students must obtain verbal confirmation from their committee members before scheduling the proposal.

6.2.2 PhD Proposal Document

The student's proposal document should clearly and unambiguously convey the scope of the work and the criteria for success. Every proposal should include the following elements:

Abstract An executive summary, no more than half a page long;

Motivation What is the problem and why is it important? What is the hypothesis of this research?

Contributions What are the main ideas and why do they matter? In what way are they novel?

Related work What is the relevant prior work and state-of-the-art in this area? A comprehensive literature review may be included as an appendix, which is not subject to page limitations, although such an appendix is not a substitute for the related work section in the body of the proposal.

Detailed research plan What specifically will be completed during the course of the research and how will it be implemented, designed, and evaluated? For projects with a significant implementation component, give enough details of the features to be implemented and the experimental setup involved so that the committee can evaluate the feasibility of the project. Similarly, for projects with a significant theoretical component, give substantial details of the formalisms used (e.g., proposed theorems, proof schemas, and logical frameworks) for the committee to judge the feasibility of the proposed work.

Summary

Proposals can also include a section devoted to the work completed by the student thus far although this section is not formally required.

Proposal documents should not exceed 15 single-spaced pages (or 30 double-spaced pages). The bibliography and any appendices (appendices are not required to be read by the student's committee) are not included in this page limit. Proposals should favor brevity over exhaustiveness. Departures from these guidelines must be approved in advance by the student's proposal committee. The written proposal document must be submitted to the committee at least two weeks in advance of the proposal presentation.

Some faculty members have preferences on formatting details (e.g., double-spaced text). In the absence of any particular instruction, students should follow National Science Foundation (NSF) grant proposal formatting guidelines.

6.2.3 PhD Proposal Oral Presentation

The PhD Proposal Oral Presentation must be publicly announced two weeks (14 days) in advance via the graduate administrator.

As a rule of thumb, presentations should not exceed 30 minutes, but should be scheduled for at least 120 minutes to allow for questions and a post-presentation discussion by the committee. The student must bring forms (1) "Dissertation Proposal and Admission to Candidacy" and (2) "Engineering Dissertation Proposal Assessment" (see Chapter 8) to the PhD proposal presentation to be filled out by the committee and filed immediately afterwords.

Student are encouraged to provide the committee members with copies of the slides used in the proposal presentation. Slides can be distributed in an electronic form a few days in advance of the presentation or printed out and distributed at the presentation itself. Providing numbered slides is a courtesy that helps the committee follow the presentation and keep track of their comments.

6.2.4 PhD Proposal Outcomes

If the committee decides that the proposal is sufficient they will accept it without changes, communicating any feedback to the student personally. The committee may also decide that formal amendments to the written document are required before the proposal can be accepted. In such a case the committee chair will often "hold" the forms until all committee members have indicated their satisfaction with the updated material.

Once accepted, the proposal is a binding document on the committee. If the student competently carries out the work described therein, the committee will not reject the student's PhD dissertation on the grounds that too little has been done. It is not binding on the student, who is free to adjust the research plan. However, there is no guarantee that research other than that outlined in the proposal adjusted will be of sufficient depth and quantity to satisfy the PhD requirements: students adjusting research plans should thus confer with their committees.

In the event that a suitable proposal is not presented but the faculty believes the student has sufficient research potential, another research presentation will be scheduled within six months. If a suitable proposal is still not presented, the student is subject to dismissal from the program. One final outcome of the proposal presentation might be that the student does not have sufficient research potential to complete a dissertation in a timely fashion; in this case the student will be subject to dismissal from the program.

6.3 PhD Defense

Student should double-check their completion of the requirements using the report offered by the Student Information System (SIS) website.

To receive a graduate degree, students must file form "Application for Graduate Degree" (see Chapter 8) at the start of the semester during which they expect to graduate (i.e., no later than **1 October**, **1 February**, or **1 June**, respectively).

6.3.1 PhD Defense Committee

A PhD student's Final PhD Examining Committee (i.e., PhD Defense Committee) shall consist of a minimum of five members constituted according to the following rules. There must be at least three Computer Science faculty members, at least one UVa faculty member from outside the Computer Science department, and at least one other member with expertise in the research area. The Department recommends one of the committee members to be an expert from outside the University. The dissertation advisor must be a member of the Computer Science faculty. This committee evaluates the student's PhD dissertation and oral defense.

The student should file form "Appointment of Final Examination Committee", selecting "Ph.D. Final Exam", to officially create the committee (see Chapter 8).

6.3.2 PhD Dissertation

The dissertation should convey the research results and argue that those results are valid and correct. The exact form of the dissertation can vary across topics, but in general a dissertation will include the following elements.

- Presentation of the work's motivation, hypothesis, and contributions.
- Placement of the work in the context of prior art.
- An explanation of how the proposed work was carried out. Where applicable, this should provide enough information for the reader to replicate the results.

- Conclusions drawn from the work and a discussion of future research directions suggested by the project.

A dissertation should be a self-contained document. In particular, it should not assume that the reader has read the corresponding proposal, but it should provide enough context that a reader who has read the proposal can readily understand how the performed work fulfills the promises in the proposal.

The written dissertation document must be submitted to the committee at least two weeks (14 days) in advance of the oral defense. Additional formatting requirements are published by Printing and Copying Services (see Chapter 7).

6.3.3 PhD Oral Defense

The dissertation defense, which must be announced publicly two weeks (14 days) in advance via the department administrator, is an oral defense before the student's advisory committee as well as other faculty, students, and anyone else interested in the work. The written dissertation document must have been submitted to the committee at least two weeks (14 days) in advance of the oral defense. Generally, presentations should not exceed 45 minutes, but should be scheduled for at least 120 minutes to allow for audience questions and a post-presentation discussion by the committee.

The student should bring forms "Report on Dissertation or Thesis Final Examination" and "Engineering MS Thesis PhD Dissertation Assessment " to the defense so they may be filled out by the committee and submitted immediately afterwords (see Chapter 8). The student must also complete the "Survey of Earned Doctorates" at `https://sed.norc.org/doctorate/showRegister.do`.

Students are encouraged to provide the committee members with copies of the slides used in the oral defense. Slides can be distributed in an electronic form a few days in advance of the presentation or printed out and distributed at the defense itself. Providing numbered slides is a courtesy that helps the committee follow the presentation and keep track of their comments.

6.3.4 PhD Outcomes

Based on the student's dissertation document and oral exam, the advisory committee will either

- sign the forms indicating the student has earned a PhD degree,
- require formal amendments to the written dissertation and "hold" the forms until they are made,
- specify significant amendments to the dissertation to be followed by a new defense, or
- declare the work unsatisfactory and dismiss the student from the program.

Chapter 7

University Policies and Resources

The Department of Computer Science is part of the School of Engineering and Applied Science within the University of Virginia. All students are expected to comply with SEAS and UVa policies as defined and published by their respective governing bodies. For reference, information about some of those policies is listed here.

University Registrar
`http://www.virginia.edu/registrar/`

Academic Calendar
`http://www.virginia.edu/registrar/calendar.html`

Transfer Credit
Transfer classes will show as "Courses Not Approved for Graduate Engineering" until you complete the following form and bring or send it to the Graduate Office (A108 Thornton Hall). Once approved, such courses will appear as satisfying the departmental course credit requirements: `http://www.cs.virginia.edu/forms/FormRequestforApprovalofTransferCredits.pdf` and `http://www.seas.virginia.edu/advising/SEAS_grad_course_approval.pdf`

Enrollment and Degree Certification
`http://www.virginia.edu/registrar/status.html`

Family Educational Rights and Privacy Act (FERPA)
`http://www.virginia.edu/registrar/privacyact.html`

Student Information System (SIS)
`http://www.virginia.edu/sis/`

Transcripts
`http://www.virginia.edu/registrar/transcript.html`

Equal Opportunity

UVa is committed to equal opportunity and affirmative action. If students feel they have been subject to discriminatory practices they may seek redress through the resources outlined at http://www.virginia.edu/eop/

Graduate Record

Students at UVa are subject to the university's academic, financial, and non-academic rules and regulations, as outlined in the "Regulations" chapter of the graduate record. These include policies on tuition and fees; class registration, auditing, and attendance; grievances and redress; graduation and diplomas; military personnel, both veterans and those on active duty; parking and transportation on grounds; legal issues such as copyright, confidentiality, and harassment; and many other topics: http://records.ureg.virginia.edu/

Theses and Dissertations

All PhD dissertations and Master's theses are printed and bound by Printing and Copying Services. Submission guidelines are maintained online at http://www.virginia.edu/uvaprint/copy_dissertations.html. The CSGSG maintains links to student-generated LaTeX style files that satisfy these guidelines at http://www.cs.virginia.edu/~csgsg/links.php

Honor System

http://www.virginia.edu/honor/

SEAS Graduate Program Contact Information

The Associate Dean for Graduate Programs, Employment Services Specialist, Graduate Payroll/Financial Aid Administrator, and Graduate Admissions Office can all be useful to graduate students. Contact information for them is maintained at http://www.seas.virginia.edu/admin/gradprog.php

SEAS Graduate Student Payment Paperwork

SEAS handles the payment of those students with funding or employment within the department. Students are responsible for ensuring that all relevant paperwork has been filed with the Graduate Financial Aid Administrator. A list of documents that must be filed prior to being paid through the university, either as an employee or a grant recipient, may be found at http://www.seas.virginia.edu/admin/hr/grad/forms.php

SEAS Center for Diversity

SEAS maintains a center for diversity in engineering to assist students from underrepresented populations in science, technology, engineering, and mathematics. All students are welcome to utilize these services; more information may be found at http://www.seas.virginia.edu/admin/diversity/

Teaching Resource Center

http://trc.virginia.edu/Publications/

Chapter 8

Forms

The most relevant forms are collected on the department webpage:

`http://www.cs.virginia.edu/forms/index.html`

For your convenience, direct links to some common administrative forms are also provided here.

Appointment of Final Examination Committee
(replaces old form "G105")
`http://www.seas.virginia.edu/advising/Form%20Final%20Examination%20Committee.pdf`

Report on PhD Exam
"PhD Exam Report" (for Quals, replaces old form "G107")
`http://www.seas.virginia.edu/advising/Form%20PhD%20Exam%20Report.pdf`

Computer Science Qualifying Exam Assessment
(replaces old CS-specific form "G107")
`http://www.cs.virginia.edu/forms/CSqualexamassessment.pdf`

Dissertation Proposal and Admission to Candidacy
`http://www.seas.virginia.edu/advising/Form%20Dissertation_Proposal.pdf`

Engineering Dissertation Proposal Assessment
(replaces old G108-A)
`http://www.seas.virginia.edu/advising/Engineering_dissertation_proposal_Assessment.pdf`

Application for Graduate Degree
(replaces old form "G113")
`http://www.seas.virginia.edu/advising/Form%20Application%20for%20Graduate%20Degree.pdf`

Report on Dissertation or Thesis Final Examination

"Final Report on Final Examination" (replaces old form "G111")
http://www.seas.virginia.edu/advising/Form%20Report%20on%20Final%20Examination.pdf

Engineering MS Thesis PhD Dissertation Assessment

http://www.seas.virginia.edu/advising/Engineering_thesis_&_dissertation_Assessment.pdf

Graduate Student Annual Report Form

http://www.cs.virginia.edu/forms/GradAnnualReport.docx
or http://www.cs.virginia.edu/forms/GradAnnualReport.tex

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Enlighten the people generally, and tyranny and oppression of body and mind will vanish like evil spirits at the dawn of day . . . the diffusion of knowledge among the people is to be the instrument by which it is to be effected.

— Thomas Jefferson, 1816