Computer Science Graduate Degree Requirements*

Duke University
Department of Computer Science

1 Introduction

This document defines the requirements set forth by the Department of Computer Science for a student to earn a graduate degree in computer science, and to remain in good standing in the graduate program. These requirements are designed to allow students the flexibility to create programs of study that match their particular interests and needs, with the recognition that computer science is an evolving and interdisciplinary field. However, each student's program of study and progress toward the degree must meet these minimum requirements. The *Director of Graduate Studies* (*DGS*, `dgs@cs.duke.edu`) is responsible for monitoring satisfactory progress toward the degree and certifying completion of degree requirements to the Duke Graduate School as a representative of the Faculty of Computer Science.

Besides the requirements of the Department presented in this document, there are other requirements and regulations mandated by the Graduate School, many of which are not presented here. They include, for example, specific deadlines to file to receive a degree in a given semester, as well as rules governing language proficiency, minimum GPA, and minimum and maximum periods of residency at Duke. Students should consult the Graduate School website (`http://gradschool.duke.edu/`) for these policies and the *Duke University Graduate School Bulletin*, published annually by the Graduate School. In the event that any part of this document conflicts with Graduate School policies, then those policies shall apply at the discretion of the Dean of the Graduate School.

*Approved March 17, 2010; effective August 2010. Last revised June 9, 2014. The current and older versions of this document can be found at `http://www.cs.duke.edu/education/graduate/requirements/`.

2 PhD Program

2.1 Faculty Advisor

By the end of the second semester in the graduate program, every student must identify a faculty member who agrees to serve as an *advisor*. The advisor must be a *full member of the Graduate Faculty* (as defined in Appendix A) who holds a primary or secondary appointment in Computer Science. When naming an advisor, the student must submit a short description of research progress to date, and a one-page description of the research topic area in which the faculty member has agreed to advise the student.

Upon termination of an advising relationship, the student must name a new advisor within one semester, by following the procedure above.

2.2 Supervisory Committee

Each graduate student must nominate a set of members of the Graduate Faculty who agree to act as the student's *supervisory committee*. The supervisory committee is a standing committee chaired by the student's advisor, and must meet the additional requirements on composition and approval specified in Sections 2 and 3 for various degree milestones. Although the supervisory committee is a standing committee, the student must explicitly request that the committee be approved before each milestone, by filing the appropriate form with the DGS office.

Note: As one continues to develop and refine research ideas, additions or changes to the supervisory committee are permitted and sometimes expected. For example, PhD preliminary exam (Section 2.4) and dissertation defense (Section 2.5) require a larger committee than RIP (Section 2.3).

2.3 Research Initiation Project (RIP)

Each PhD student must complete a substantial *Research Initiation Project (RIP)* before the end of the second year. The student conducts the research under the supervision of a faculty advisor and a supervisory committee approved for RIP. The commit-

tee must include, besides the advisor, at least two other faculty members with appointments in Computer Science, or other members approved by the DGS. The DGS must approve the committee and any changes to it at least one week before a RIP milestone.

RIP has two required milestones:

1. A project proposal and public presentation are due by the end of the second semester. The committee provides guidance and feedback, and assesses the readiness of the student in carrying out the proposed research.

   Note: In case of scheduling difficulties, the public presentation may be deferred, upon approval by the DGS, up to the end of the second week of the third semester; however, the complete proposal document must be delivered to each committee member by the end of the second semester.

2. A final report and public defense of the completed work are due before the end of the second year. The committee evaluates whether the student is making good progress, and whether the student has demonstrated the ability to do novel research, which is the goal of the PhD program.

The committee may require, at its discretion, an additional milestone involving a written progress report and public presentation by the middle of the fourth semester.

Written documents for all RIP milestones must be delivered to each committee member at least two weeks prior to the respective presentation dates.

If the outcome of the committee evaluation at the second RIP milestone is negative, the student will be placed on one-semester departmental probation (Section 2.11).

2.4 Preliminary Exam

Each PhD student must pass a *preliminary exam*, which entails a public presentation before an approved committee on the research progress to date and a plan for subsequent years leading up to the dissertation defense. The preliminary exam assesses a student's preparation to continue in his or her chosen field, as well as the likelihood of successful completion of a dissertation. A preliminary exam report must be delivered to each committee member at least two weeks prior to the exam date.

The committee must include, besides the advisor, at least three other members of the Graduate Faculty. At least three of the committee members must have appointments in Computer Science. At least one of the committee members must be from outside Computer Science or hold an appointment in another department. The DGS and the Graduate School must approve the committee at least two months before the exam date. Any changes must be approved at least one week before the exam date.

A PhD student must pass the preliminary exam and file the committee-approved report with the DGS office before the end of the third year. An extension beyond the end of the third year requires petition to the DGS and approval of a dean. Failure to pass the preliminary exam and file the approved report before the end of the fourth year will result in termination from the PhD program.

Before the preliminary exam, the student must complete the qualification requirement (Section 2.6). Upon passing the preliminary exam, the student advances to *PhD candidacy*.

2.5 Dissertation

Each PhD candidate must complete a doctoral *dissertation* and defend it in a public presentation before an approved committee. The candidate must deliver the full dissertation to each committee member at least four weeks prior to the defense; minor modifications suggested by the committee may be incorporated within 30 days after the defense and by the semester deadline for the degree. The dissertation must be formatted and submitted for publication to the Graduate School in accordance with their regulations.

The requirements on committee composition and approval are the same as those for the preliminary exam (Section 2.4). In addition, the DGS and the Graduate School must approve the committee before the student can apply for graduation in ACES.

The dissertation defense should be completed within two calendar years of the preliminary exam. A dean must approve extensions beyond four calendar years.

2.6 Qualification Requirement

The PhD *qualification requirement* is intended to ensure that each PhD student has adequate knowledge and preparation for PhD-level studies in computer science. Every PhD student must earn *quals credits*.

The qual credits can be earned in the following two ways:

Core Credits. The student needs to obtain at least three qual credits by taking qualifying exams in *core*

Group	Quals Exam	Quals Course	Old Number (before Fall 2012)
I	Algorithms	CPS 532	*230*[1]
	Computational Complexity	CPS 534	*240*
II	Architecture	CPS 550	*220*
	Systems	CPS 510	*210*
III	Artificial Intelligence	CPS 570 or 571	*270* or *271*
	Numerical Analysis	CPS 520	*250*

Table 1: Quals exams and courses.

courses. The exams and their designated *core courses* are divided into three groups and listed in Table 1. *At least one quals credit must be earned from each group.* Quals credit for an exam may be earned by passing the exam or by taking a quals course designated for this exam and receiving a grade of B+ or better.

The quals exams measure basic knowledge across the breadth of computer science, i.e., materials the Department expects every PhD graduate to know. The level of knowledge required to pass quals exams does not exceed a solid undergraduate level of exposure to these materials. Materials covered by the quals courses often subsume or are more advanced than those tested in the corresponding quals exams.

Note: For some quals exams, students with insufficient background to pass them may consider taking or auditing appropriate undergraduate courses as exam preparation. Students should consult the published quals exam syllabus (see Appendix B) and the course instructors to determine if the preparation will be sufficient. Students are encouraged to take the designated quals courses instead if appropriate prerequisites are met.

Elective Credit. The student can obtain at most one qual credit by taking a designated *elective course*. This course can be any one from a set of courses that have been designated as electives for the purpose of the Qual requirement. The quals credit can be obtained by receiving a grade of B+ or better in the course. There is no qual exam associated with elective courses.

Students must earn all four quals credits by the end of their second year; failure to do so will result in termination from the PhD program.

A grade of *Incomplete* cannot be used to earn a quals credit, even if it is later replaced by a grade of B+ or better.

Only quals courses taken during one's enrollment in the Department's PhD program can be used to earn quals credits. Equivalent courses taken elsewhere or prior to the PhD program do not count.

[1]PhD students who took CPS *229* (now 430) in Spring 2012 may use it in place of CPS 532 as the algorithms quals course. However, starting Fall 2012, CPS 430 (formerly *229*) is no longer considered as an algorithms quals course alternative.

For additional requirements and guidelines on the administration of quals exams and courses, please refer to Appendix B.

2.7 Course Requirement

PhD students must satisfactorily complete (with B-grade or higher) eight *regular courses* (as defined in Appendix A). They must include six graduate courses in Computer Science. Three of the eight courses must be related to the student's primary research area, as deemed appropriate by the advisor. Undergraduate courses in Computer Science do not count towards this requirement. Students are free to take additional courses beyond the requirement.

For the purpose of this requirement, earning a quals credit by exam counts as satisfactorily completing one corresponding quals course (see Section 2.6).

Coursework may be completed at any point in the PhD program. However, to ensure steady progress, students are required to have satisfactorily completed at least five courses by the end of the second year; furthermore, the three courses related to the student's research area must be completed before the preliminary exam. Failure to make satisfactory progress toward the course requirement will result in termination from the PhD program.

The supervisory committee may require specific courses as part of and/or in addition to the course requirement above. Such requirements by the supervisory committee will be on file at the DGS office, and are checked at degree milestones and annual progress reviews. PhD students must consult their supervisory committees if they wish to take undergraduate courses or courses outside Computer Science for the purpose of satisfying the course requirement.

2.8 Teaching Requirement

PhD students are required to participate in the teaching mission of the Department for at least one semester during their first three semesters. This requirement can be met by satisfactorily serving as a *teaching assistant* or *instructor* for a Computer Science course. In either case, at the end of the semester, the faculty member supervising the course will submit feedback on the student's service. Based on this feedback and the evaluations by the students in the course, the Department's Teaching Excellence Committee assigns a rating of *excellent*, *satisfactory*, or *unsatisfactory* for the service. *Unsatisfactory* perfor-

mance must be made up with another term of service.

The Department will award a graduating PhD student a *Certificate of Distinction in Teaching* if the following conditions are met:

- The student has successfully served in the teaching mission of the Department for three semesters (or the equivalent in effort), where 1) at least one semester of service is for an undergraduate Computer Science course at the introductory level; and 2) at least one semester of service is as an instructor.
- The student is nominated for this distinction by at least one faculty member who has supervised the student on teaching.
- The student must submit a teaching portfolio and have it approved by the Teaching Excellence Committee. The portfolio should include a 2-page teaching statement and supporting documents such as sample instructional materials created by the student.

2.9 Progress Review

Every student is required to discuss research progress in a formal capacity with all the members of their supervisory committee at least annually. In a given year, this requirement can be met by a full committee meeting, or by a series of one-on-one meetings with each member of the committee.

The Department conducts an *annual progress review* of all graduate students. Each student is required to submit a set of written materials as input to the annual review (see Appendix D for deadlines and details). Faculty members provide written feedback on these materials. In the case when a student fails to make satisfactory progress, the Faculty may place the student on *departmental probation* (Section 2.11).

2.10 New Student Mentoring

All entering graduate students must attend and participate in the first offering of CPS 701S (formerly known as *300* before Fall 2012) after their matriculation. This "immigration course" clarifies the goals and requirements of the graduate programs and exposes the students to methods, best practices, and ethical and professional issues for research in computer science.

The Department's *Admissions Committee* and DGS pair each entering student with a member of the Faculty who will act as a *faculty mentor*, before an advisor is identified. The faculty mentor shall meet with the student early in each semester, and additionally as appropriate. The responsibility of the faculty mentor is to discuss the student's research interests and goals, and guide the student toward a suitable match with an advisor. The faculty mentor also reports on the student's progress as input to the annual progress review (Section 2.9), if the student has not yet identified an advisor.

2.11 Good Standing

Students maintain good standing in the graduate program by complying with the requirements and regulations set forth by the Department, the Graduate School, and the University. A student who is not in good standing can be placed on *departmental probation*, e.g., by the supervisory committee or Faculty for lack of progress, or by the DGS because for failure to meet degree requirements or violation of the Department's *House Rules*.

The terms of probation will specify a concrete set of goals for the student to accomplish within a deadline. The probation period gives the student a chance to address issues raised by the committee or the Faculty. Failure to meet the goals by the deadline will result in termination from the program.

Within 10 days of receiving a decision of departmental probation or termination from the program, students have the right of a formal appeal in writing to the Department Chair. The appeal will be heard by the Department's Graduate Curriculum Committee or a special committee appointed by the Chair.

3 MS Program

To obtain an MS degree, a student must (i) earn a minimum of thirty units of graduate credits, (ii) have been registered continuously, and (iii) take a master's exam.

Each student can choose one of the following three options: course-only, project, or thesis. Before the end of the second semester, the student must declare the option that she or he plans to pursue. If choosing the project or thesis option, the student must at the same time also:

1. identify a faculty member who agrees to serve as an advisor, and

2. submit a one-page description of the research topic on which the faculty member has agreed to advise the student.

The advisor must be a full member of the Graduate Faculty who holds a primary or secondary appointment in Computer Science. If choosing the course-only option, the student will be appointed an advisor.

A student can switch to a different option with the approval of her/his advisor and the DGS until four weeks before her/his master's exam.

Besides submitting progress reports for annual departmental reviews, each MS student is required to submit a progress report at the end of the 2nd semester. If a student fails to make satisfactory progress, he or she may be dismissed from the program or placed on departmental probation (see Section 2.11 under Ph.D. Program for details).

3.1 Course Requirement

Each MS student must earn a minimum of thirty graduate credits, the distribution of which depends on which of the three options the student chooses.

Course-only option: At least eighteen credits of graduate CS coursework; at least six credits of coursework outside CS, drawn from a field related to CS or to the student's area of concentration; at least six credits of approved course electives. At least six of the thirty credits must be earned by taking courses that have a significant course-project component (at least 30% of the total weight). All courses have to be regular courses; see Appendix A for details.

Project/Thesis option: At least twelve credits of graduate CS coursework; at least six credits of coursework outside CS, drawn from a field related to CS or to the student's research; at least six credits of approved course electives; at most six credits of (ungraded) research. All credits except the ungraded research must be regular courses; see Appendix A for details.

A student can earn at most six credits toward the MS degree using undergraduate courses, but no courses numbered below 200 may be used for credit toward the MS degree.

A student must earn a grade of B- or higher in a course for it to be counted toward the MS degree.

3.2 Master's Exam Requirements

Each student must pass a final exam administered by a committee. The nature of the exam and the committee depends on the option the student has chosen.

Course-only option: Each student will take an oral exam, typically 15-20 minutes long, administered by a three-person examining committee appointed by the Department Chair. The exam is based on a portfolio containing:

- All student papers, project reports, and slides from oral or written presentations, both from project-oriented and other courses. Material created by the student as a research or teaching assistant also may be included.
- If the student undertook an internship as part of his or her academic program, a written description of the project, including a discussion of how the experience relates to the student's field and a summary of what the student has learned, must be included.
- An updated resume.

Each student must submit an electronic copy of the portfolio at least two weeks prior to the final exam date. The examining committee will ask questions during the exam based on the portfolio.

Project/Thesis Option: Each student must complete a research project or thesis under the supervision of the faculty advisor and a supervisory committee. The student must prepare a written project report or thesis, as applicable, and defend the work in a public presentation before the committee. The committee votes to accept the work as a project if the student has chosen the project option, to accept the work as a thesis if the student has chosen the thesis option, or to fail the defense.

The thesis option also requires a written thesis document, which must be formatted and submitted for publication to the Graduate School in accordance with their regulations (http://gradschool.duke.edu/documents/policies_and_forms/paper_thesis_dissertation_guide.pdf).

The student must submit the project report or thesis to each committee member at least two weeks prior to the defense; modifications suggested by the committee must be incorporated both within thirty days after the defense and before the semester deadline for the degree.

The supervisory committee must include, besides the advisor, at least two other members of the Graduate Faculty. At least two committee members must have appointments in Computer Science. The supervisory committee, and any changes to it, must be approved by the DGS and the Graduate School at least two weeks before the MS exam. See Appendix C for additional details about the final exam.

Note: For a PhD student earning an MS degree en route, the MS defense can be combined with the RIP defense or the preliminary exam, if approved by the supervisory committee. The outcomes of the MS defense and the other milestone will be determined separately by the committee. In the case of combining with the RIP defense, the MS written report may serve as the RIP final report. In the case of combining with the preliminary exam, the MS written report may serve as part of the preliminary exam report; however, the full preliminary exam report must additionally contain a dissertation proposal component.

A Clarification of Terms

The Graduate School classifies *Graduate Faculty* into two categories: *full members* and *term members*. All tenure-track faculty members at Duke are full members of the Graduate Faculty; other cases of full membership require approval of the Dean. Faculty members who are not full members of the Graduate Faculty, as well as expert researchers outside Duke University, may serve as term members; such memberships must be nominated by the DGS and approved by the Graduate School.

Note: Inclusion of expert researchers outside Duke in supervisory committees is common, and is encouraged when appropriate. Students should notify the DGS office in advance so there is enough time to collect from external committee members information required for nominating them for membership in the Graduate Faculty.

The i-th semester (into a graduate program) refers to the i-th semester (Fall or Spring) since the student's date of matriculation into the program. Summer terms are not counted.

The n-th year (into a graduate program) refers to the n-th year since the student's date of matriculation into the program. The year starts from the first day of class in a Fall or Spring semester (depending on the semester of matriculation), and ends on the last day of the final examinations in the following Summer term or Fall semester (respectively).

Note: Unless pre-approved otherwise, a Leave of Absence *from the program does not stop the clock as far as the graduate requirements are concerned.*

Regular courses include those approved by the University for repeated periodic graded offerings. CPS 590 (formerly known as *296* before Fall 2012) offerings, if graded, are also considered regular courses. CPS 701S (formerly *300*), CPS 791 (formerly *391*), and formerly offered CPS *395* and *399* are not regular courses.

B Administration of PhD Quals Exams and Courses

1. A syllabus describing the exam scope must be finalized three months before the exam date, and the exam itself must be on file at the DGS office one week before the exam date. The exam syllabus should remain relatively fixed; changes from one offering to the next, other than minor ones, are strongly discouraged. All syllabi and contents of administered exams will be made accessible to students for three years.

2. The faculty member administering a quals exam must have the exam proofread and vetted by another faculty member or a PhD candidate in the same area, before it can be filed. In case that the exam is not administrated (e.g., because no students are taking it), the content of the exam shall remain private.

3. As stated in Section 2.6, the level of knowledge required to pass quals exams should not exceed a solid undergraduate level of exposure to these materials. This requirement should be reflected by the exam syllabi, and checked by the exam proofreaders.

4. A quals course must have a clearly defined grading scale published on the course website. At least 40% of the grade in the course should be due to in-class proctored exams that test mastery of material covered in the course.

5. A quals course should be offered according to a regular schedule, at least once every other year. For core courses, at least one course per group must be offered each year. We recommend that the qual exam for core courses be offered even in years when the course is not offered. Changes or deviations from the regular offering schedule must be approved by the Chair, and should be announced to the students one year in advance.

6. A qual course should not have another grad course as a prerequisite, and should not be a seminar course.

7. Each quals exam should be offered according to a regular schedule, at least once every other year, during the week before or in the first week of a semester when a corresponding quals course is also offered. The faculty member offering the course is responsible for preparing and administering the quals exam. Changes or deviations from the regular offering schedule must be approved by the Chair, and should be announced to the students one year in advance.

8. Changes to Table 1, including the designation of new quals courses, must be approved by the Faculty.

C Guidelines for Milestone Documents and Presentations

Table 2 gives the standard length guidelines for documents and presentations required by the various degree milestones. *These standard lengths are only guidelines.* Minor deviations are common and expected. Supervisory committees have discretion to request or permit significant deviations from the standard length guidelines, although these must be negotiated in advance.

Students should allow adequate time to incorporate review comments from the advisor before submitting a document to the committee, and adequate time to incorporate review comments from committee members before the document is due. The document for a milestone must be delivered to all committee members for final review well in advance of the public presentation, unless they agree to accept it later; see Sections 2 and 3 for the lead time required for various milestones. The approved final versions of all milestone documents must be filed at the DGS office.

Public presentations associated with degree milestones should proceed in three phases: 1) the student gives a prepared talk and answers questions from the supervisory committee and other attendees; 2) the student discusses the work with the committee in a private session; and 3) the committee discusses the work in a private session. Other faculty members may attend the private sessions with approval of the committee.

Students are responsible for negotiating with committee members to schedule and announce each public presentation and to file the necessary paperwork in conformance with published deadlines. The DGS office assists with this process.

Note: Students should begin the scheduling process early. Scheduling is often time-consuming and difficult toward the end of a semester, and the Graduate School requires the student to apply for graduation in ACES by a deadline well before the end of the semester in which a degree is received.

Additional guidelines on the documents and presentations for specific milestones are provided below. The supervisory committee has discretion to set standards for content of documents and presentations. It is critical that students discuss expectations with each committee member in advance. Students may provide additional material such as supplementary report text or publications for consideration by the committee.

PhD RIP It is expected that a successful RIP will lead to publishable work. Students are encouraged to publish RIP final reports externally, with approval of the committee.

PhD Preliminary Exam A preliminary exam report should 1) define a research problem suitable for dissertation research, 2) survey the literature in the area, 3) present the student's preliminary research in the area, and 4) outline objectives and plans for continuing research. The prepared talk should summarize the content of the report and may provide additional supporting detail in selected areas. The report and presentation together should provide sufficient detail for the committee to judge four criteria for a successful defense: 1) the proposed research is of suitable scope and scale for a PhD dissertation; 2) the candidate has mastered previous work in the area; 3) the candidate's preliminary research demonstrates sufficient aptitude and mastery of research methods and tools; and 4) the candidate meets standards of scholarship and presentation necessary to earn a doctoral degree.

Students may publish preliminary exam reports externally with approval of the committee.

PhD Dissertation and MS Thesis PhD dissertations and MS theses present research that makes a substantial contribution to knowledge. The supervisory committee has full discretion to define content standards for dissertations, theses, and their presentation.

The Graduate School publishes all dissertations and theses. Students must format these documents according to standards set by the Graduate School, and must submit a draft document to the Graduate School for a format check before a *Final Exam Card* required for the defense can be issued. See the Graduate School website for details.

Milestone	Document	Presentation
PhD RIP Proposal	5 pages	15-minute talk in a 30-minute slot
PhD RIP Progress	15 pages	25-minute talk in a 1-hour slot
PhD RIP Defense	30 pages	25-minute talk in a 1-hour slot
PhD Preliminary Exam	30 pages	50-minute talk in a 2-hour slot
PhD Dissertation	*See below*	50-minute talk in a 2-hour slot
MS Defense	*See below*	50-minute talk in a 2-hour slot

Table 2: Guidelines on lengths of milestone documents and presentations. Document lengths in this table assume the standard (double-spaced) thesis format defined by the Graduate School. However, there is no departmental requirement to use the standard thesis format for documents submitted to supervisory committees; some faculty members may prefer a single-spaced format with wide margins. Also, note that there are no standard length guidelines for MS theses/reports and PhD dissertations; individual circumstances vary widely.

In some situations, public access to dissertations and theses should be *embargoed* (i.e., restricted) for a period of time. Students must consult their supervisory committees for the appropriate embargo option.

Project-Based MS Students pursuing the project (non-thesis) option for their MS degree must request from their advisor a note to the Graduate School, at the time they apply for graduation in ACES, stating that they are ready to graduate.

The supervisory committee has full discretion to define content standards for the MS project reports and their presentation.

D Procedure for Annual Progress Review

The Department conducts an *annual progress review* of graduate students. The purpose of the review is to recognize and reward achievement, deliver constructive guidance to students, and assess the effectiveness of the graduate program. The DGS office gathers information from students and faculty and maintains records for each student as well as progress measures for the graduate program as a whole. The DGS and the Department's Graduate Curriculum Committee prepare this material for discussion during an annual progress review meeting of the faculty.

Students must submit written material as input to each annual review. These materials include 1) an updated curriculum vitae, 2) a brief (1- or 2-page) research summary with a bibliography of the student's publications and works-in-progress, and 3) a short (1-page) progress statement including a self-assessment of progress for the previous year, a statement of goals for the following year, and an updated schedule of planned milestone completions. This process of planning and documenting progress and accomplishments will be valuable for students, and it will facilitate more detailed feedback from the Faculty. Each year, the DGS office publishes deadlines and additional guidelines for submitting these materials.

Faculty mentors or advisors and supervisory committee members report on student progress at each annual review. Faculty advisors must provide written feedback for students on the materials submitted for review. Instructors of graduate courses should also provide feedback on students' course performance since the last annual progress review.

In a typical year, supporting materials from students will be due by the end of the fall semester, and reports from faculty advisors and supervisory committee members will be due within two weeks after the beginning of the spring semester. The Faculty will complete the annual progress review by mid-February.

An important function of the annual progress review is to identify students who are not making adequate progress in the judgment of the Faculty as a whole. As a result of the review, the Faculty may place at-risk students on departmental probation (Section 2.11), with a probation period of no less than eight weeks.