Graduate Group in Computer Science
University of California, Davis

Requirements for Degrees
APPROVED 5/1/2001

Introduction

This document describes requirements for the Master’s and Ph.D. degrees offered by the Graduate Group in Computer Science at UC Davis.

Computer Science Breadth Requirements

All students receiving degrees through the Graduate Group in Computer Science must satisfy the “breadth” requirements. These requirements include:

- Demonstrated proficiency at the undergraduate level in four fundamental areas of computer science, and in mathematics (see Appendix A)
- MS students must demonstrate proficiency at the graduate level in three breadth areas(See Appendix B)
- Ph.D. students must complete the Advanced Proficiency Requirements (See Appendix B)

MS Undergraduate Proficiency Requirements

A student satisfies the undergraduate proficiency requirements by demonstrating proficiency at the undergraduate level in the following areas:

- Computer Architecture
- Programming Languages
- Operating Systems
- Theoretical Foundations of Computer Science
- Mathematical Foundations

A student satisfies the above requirements in one of the following ways:

- Demonstration of proficiency in each area on the student’s previous undergraduate or graduate record. This is decided by a graduate advisor in consultation with the student.
• Demonstration of proficiency in each area by completion of an approved undergraduate course in the area with a grade of B or better. (See Appendix A for a list of "approved" courses for each area).

• Demonstration of proficiency in an area by completion of a graduate course, with a grade of B or better, equivalent to one of the approved undergraduate courses in the area, or approved by the graduate adviser.

• Demonstration of proficiency in an area by challenging one of the approved courses in the area, receiving a grade of B or better.

• Petitioning the Graduate Advisors Committee of the Graduate Group to have the requirement removed, or have an acceptable substitute course submitted in place of the requirement. It is expected that the student will complete the Undergraduate Proficiency Requirements by the end of the first academic year of residence. This deadline may be extended only by approval of the Graduate Advisors Committee of the Graduate Group.

**MS Graduate Breadth Requirements**

The breadth requirement of the Computer Science Graduate Group includes demonstrated proficiency in three of four areas of computer science at the graduate level: Theory, Systems, Architecture, and Applications. Courses are associated with the four areas as follows:

- **Architecture**
  - Computer Architecture (ECS 250A/B/C)

- **Systems**
  - Programming Languages (ECS 240, 242)
  - Operating Systems (ECS 251)
  - Software Engineering (ECS 260)

- **Theory**
  - Theory of Computation (ECS220)
  - Design and Analysis of Algorithms (ECS 222A/B)

- **Applications**
  - Artificial Intelligence (ECS 270)
  - Data Bases and Information Systems (ECS 265)
  - Visualization and Computer Graphics (ECS 275A/B, 276, 277, 278)
  - Networks (ECS 252, 256A/B)
  - Security (ECS 253)
  - Scientific Computation (ECS 230)

The student can satisfy the above requirements in one of the following ways:

- Completion of a course in three of the four areas
- Demonstration of a similar graduate course taken at another institution with a grade of B or better (A graduate advisor must approve this option.)
- Challenging a required course in the area (according to University of California procedures), receiving a grade of B or better
Requirements for the Master's Degree

Master's Degree Plan I (Thesis)

Students who wish to develop a thorough knowledge of the state of the art in a specific field of Computer Science may choose the master's thesis option.

Unit/Course Requirements

- Thirty-six (36) units of upper-division and graduate course work are required.
- At least six (6) graduate courses are required, excluding 290, 290C, 298, and 299.
- No more than nine (9) units of 299 may be counted toward the 36-unit requirement.
- At most six (6) units of undergraduate course work, completed to satisfy the breadth requirements, may be counted toward the 36-unit requirement.
- A grade of B or better must be obtained in all coursework used to satisfy degree requirements.

Procedures

A thesis must be approved by a committee of three members. The committee must be approved by the Graduate Studies (accomplished through the "aAdvancement to Candidacy" petition). The committee members are restricted by the requirements stated in Appendix C.

The Thesis

A Master’s thesis is usually based on six to nine units of laboratory research carried out under the 299-course number. The thesis should demonstrate the student’s proficiency in research methods and scientific analysis, and a thorough knowledge of the state of the art in the student’s chosen area. A Master’s thesis is a description of an original technical or research contribution of limited scope, or an advanced design project.

Academic Residence

A student must be in residence at the University for a minimum of three quarters.

Advancement to Candidacy

Every student must file an official application for Advancement to Candidacy after they have completed at least one-half the course requirements for the degree. Note that this
must be done at least one full quarter before completion of all degree requirements and before going on filing fee status.

**Normal Progress Requirements**

- It is expected that the student will complete the breadth requirements within the first four quarters of residence.
- It is expected that the student will complete the M.S. Degree by the end of the seventh (7th) quarter of residence at the university, including all course requirements and the approval of the thesis.
- These deadlines may be extended only by approval of the Graduate Advisors Committee of the Graduate Group

**Master's Degree Plan II (Examination)**

Students who wish to develop breadth at the graduate level in computer science may choose the Master's examination option.

**Unit/Course Requirements**

- Thirty-six (36) units of upper-division and graduate course work are required.
- At least eight (8) graduate courses are required, excluding 290, 290C, 298, and 299.
- No more than three (3) units of 299 may be used to fulfill the 36-unit requirement.
- At most six (6) units of undergraduate course work completed to satisfy the undergraduate breadth requirements may be counted toward the 36-unit requirement.
- A grade of B or better must be obtained in all coursework used to satisfy degree requirements.

**Comprehensive Examination**

The student is required to pass a comprehensive examination at the graduate level in three different areas of computer science. At least two of the areas must be taken from the following list:

- Computer Architecture
- Programming Languages
- Operating Systems
- Theory
The third area may be chosen from the list detailed in Appendix D, or include a third area from the above list.

These examinations may be oral, written or a combination of both and must be administered prior to the eighth week of the quarter in which the student plans to graduate. A student is allowed to repeat the Comprehensive Examination only once.

Program of Study

The student in conjunction with a graduate advisor develops the program of study for a student in Plan II. The Graduate Advisors Committee of the Graduate Group must approve the specific selection of courses used to satisfy the 36-unit requirement.

Normal Progress Requirements

- It is expected that the student will complete the breadth requirements within the first four (4) quarters of residence.
- It is expected that the student will complete all course work and examinations by the end of the sixth (6th) quarter of residence.
- These deadlines may be extended only by approval of the Graduate Advisors Committee of the Graduate Group.

Requirements for the Ph.D. Degree

The Ph.D. program is open to only the most qualified students, and is the most demanding in terms of research, examinations, and course work. The formal requirements for the Doctor of Philosophy are the satisfactory performance on the advanced proficiency requirements and qualifying examination, completion of an approved program of study, and production of a dissertation that is acceptable to the Graduate Group in Computer Science and the University of California at Davis.

Undergraduate Proficiency Requirements

A student satisfies the undergraduate breadth requirements by demonstrating proficiency at the undergraduate level in the following areas:

- Computer Architecture
- Programming Languages
- Operating Systems
- Theoretical Foundations of Computer Science
- Mathematical Foundations
A student satisfies the above requirements in one of the following ways:

- Demonstration of proficiency in each area on the student’s previous undergraduate or graduate record. This is decided by a graduate advisor in consultation with the student.

- Demonstration of proficiency in each area by completion of an approved undergraduate course in the area with a grade of B or better. (See Appendix A for a list of “approved” courses for each area).

- Demonstration of proficiency in an area by completion of a graduate course, with a grade of B or better, equivalent to one of the approved undergraduate courses in the area, or approved by the graduate adviser.

- Demonstration of proficiency in an area by challenging one of the approved courses in the area, receiving a grade of B or better.

- Petitioning the Graduate Advisors Committee of the Graduate Group to have the requirement removed, or have an acceptable substitute courses submitted in place of the requirement. It is expected that the student will complete the Undergraduate Proficiency Requirements by the end of the first academic year of residence. This deadline may be extended only by approval of the Graduate Advisors Committee of the Graduate Group.

**Advanced Proficiency Requirements**

All students who are in the Ph.D. program, or who expect to work toward a doctorate in computer science at UC Davis are required to complete the Advanced Proficiency Requirement. A student passes this requirement by a high level of achievement in graduate coursework and demonstrating “advanced” proficiency in the graduate breadth requirements.

**To pass this requirement, a student must**

- have a **3.5 GPA in graduate courses taken at UC Davis**,  
- demonstrate “advanced proficiency” in each of the four areas of the graduate breadth requirements by passing a “comprehensive examination” or by exhibiting a bypass course as a valid substitute for passing the examination.
- have at least a B+ in each of the four courses taken to satisfy the graduate breadth requirements.

**Comprehensive Examinations**

Students may demonstrate advanced proficiency in an area by passing a **two-hour written examination** in the area. A student is allowed to repeat the comprehensive examination in an area once.
Bypass Provisions

A student may demonstrate proficiency in an area by submitting a bypass course as a valid substitute for passing the comprehensive examination. To qualify for the bypass requirement, a course must be listed below and a grade of A- or better must be achieved.

<table>
<thead>
<tr>
<th>Area</th>
<th>Bypass Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>Computer Architecture (ECS 250A/B/C)</td>
</tr>
<tr>
<td>Systems</td>
<td>Programming Languages (ECS 240, 242) Operating Systems (ECS 251)</td>
</tr>
<tr>
<td></td>
<td>Software Engineering (ECS 260)</td>
</tr>
<tr>
<td>Theory</td>
<td>Theory of Computation (ECS220) Design and Analysis of Algorithms (ECS 222A/B)</td>
</tr>
<tr>
<td>Applications</td>
<td>Artificial Intelligence (ECS 270) Data Bases and Information Systems (ECS 265)</td>
</tr>
<tr>
<td></td>
<td>Visualization and Computer Graphics (ECS 275A/B, 276, 277, 278)</td>
</tr>
<tr>
<td></td>
<td>Networks (ECS 252, 256A/B) Security (ECS 253)</td>
</tr>
<tr>
<td></td>
<td>Scientific Computation (ECS 230)</td>
</tr>
</tbody>
</table>

Unit/Course Requirements

- A student's program of study must contain a minimum of 45 units of graduate and upper-division work.
- With the approval of the graduate advisor, up to 15 units of graduate course work taken as a student prior to attending UC Davis, may be used toward partial satisfaction of this 45-unit requirement.
- At least ten (10) graduate courses are required, exclusive of seminar (290, 290C, 298) and research (299) units. This may include all courses taken in the Master's program if applicable.
- No courses completed to satisfy the undergraduate breadth requirements may be counted toward the 45-unit requirement.
- A grade of B or better must be obtained in all coursework used to satisfy degree requirements.

Majors and Minors

The student must declare both a major and minor area of study. The major area must include at least thirty (30) units of course work, with at most six (6) units of 299, which form a consistent program of study in a research area of computer science. The minor
area must include at least fifteen (15) units of course work, including at least three graduate courses, and excludes any units of 299.

**Program of Study**

The student in conjunction with the faculty/dissertation advisor develops the program of study for a Ph.D. student. All programs of study must be approved by the Educational Policy Committee of the Graduate Group, which is the sole body with authorization to grant exceptions from the stated Ph.D. requirements.

No course with a grade less than a B will be accepted on the program of study.

**Ph.D. Dissertation Committee**

The Ph.D. dissertation committee consists of three members of the Graduate Group who will guide the student in research. Graduate Studies at UC Davis must approve this committee. Guidelines for choosing the members of the dissertation committee are given in Appendix C.

**Qualifying Examination**

To be eligible for the Qualifying Examination, the student must have satisfied all course requirements, have removed all deficiencies, and must have at least a 3.5 GPA in courses taken in the program of study.

The Qualifying Examination is administered by a faculty committee appointed by the Dean of Graduate Studies, in conjunction with the student's faculty advisor. Student input into the selection of the committee is sought and encouraged (see Appendix C).

The Qualifying Examination is a formal, oral examination to ascertain the student's readiness to conduct Ph.D. level research in the major area of study. Prior to the Qualifying Examination the student must prepare a paper containing a thorough discussion of a proposed thesis topic. This paper must be submitted to the Qualifying Examination Committee at least two weeks prior to the examination.

The examinations differ in structure, depending on the area of research and the members of the examining committee. In this examination the student will be asked to give a formal presentation of the thesis proposal. The committee will question the student on this proposal, and will question the student to determine the student's competence in both the major and minor areas of study.

The committee can issue the following grades for the examination:

- **Pass** – In this case student can apply to the Graduate Studies for Advancement to Candidacy for the degree. At this time a dissertation committee is officially selected to direct the student in the research, and to guide the student in the preparation of
the dissertation. The committee must be approved by Graduate Studies.

- Not Pass — In this case, the committee has two options:
  1. It can decide that the student's research proposal is not sufficient and ask that it be re-thought/re-written to better reflect a Ph.D.-level research project. In this case, the committee will ask the student to remedy the difficulties in the proposal and retake the examination within a specified time frame.

  2. It can decide that the student's knowledge within the major and minor areas is not sufficient for continued progress for the Ph.D. In this case, the committee can ask the student to take some additional course work and retake the examination within a specified time frame.

The committee can meet with the major advisor as part of its deliberations.

The student can only retake the qualifying examination once. If a passing grade is not achieved by the second attempt, the student cannot continue in the Ph.D. program.

**Dissertation**

The Ph.D. dissertation demonstrates the ability of the student to carry out an independent original research project of high quality. It reflects a level of attainment in research and not the fulfillment of a list of requirements. An acceptable Ph.D. dissertation is not only an original contribution to the field, but is generally characterized by a broad scope of universal applicability.

**Exit Seminar**

Each student is required to participate in an exit seminar, in which the candidate's research is presented to the UC Davis academic community. This seminar will be administered by the dissertation committee and will take place after all committee members have approved the dissertation, but before the dissertation has been filed with the Office of Graduate Studies.

**Teaching Requirement**

The Graduate Group requires all Ph.D. candidates demonstrate at least three quarters of college level teaching experience.

**Residency Requirement**

A student must be in residence a minimum of six (6) quarters.
Normal Progress

It is expected that the student will complete the breadth requirements within the first four quarters of study, the advanced proficiency requirements within the first four quarters of study, and the Qualifying Examination between the sixth and ninth quarters of study. Completion of all requirements is normally accomplished in fifteen quarters of study. The maximal time period allowed for completion of each requirement is as follows:

- A student's Program of Study must be submitted and approved by the end of four quarters of study.
- The student must complete the Advanced Proficiency Requirements by the end of the sixth quarter of study.
- The student must complete the Qualifying Examination by the end of the ninth quarter of study.
- The student should complete all requirements for the Ph.D. by the end of the 15th quarter of study.

Students, who fail to complete all the requirements within the "normal" time period, are referred to the Educational Policy Committee of the Graduate Group. The Committee considers the student’s entire record, including examination scores and letters of support, particularly from the student's major research advisor. The Committee exercises wide discretion: it may decide that no action is necessary (i.e., when a student has one or more quarters to complete the requirements); that the student should be allowed more time in which to complete the requirement; that certain of the requirements should be waived; that certain remedial actions should be taken; or that the student should be advised to leave the program.

The committee attaches great weight to the major research advisor's letter of support. It is therefore extremely important that students involve themselves in research under some faculty member very early in the program – preferably by the end of their third quarter.
Appendix A

Graduate Group in Computer Science
Undergraduate Proficiency Course Requirements

Computer Architecture

- ECS 154A – Computer Architecture

Operating Systems (one of the following)

- ECS 150 - Operating Systems and System Programming
- ECS 151A - Operating System Design

Programming Languages

- ECS 140A - Programming Languages

Theoretical Foundations of Computer Science (one of the following for MS; both required for Ph.D)

- ECS 120 - Introduction to the Theory of Computation
- ECS 122A - Algorithm Design and Analysis

Mathematical Proficiency

- Mathematics 131 - Methods of Mathematical Probability
  or
- Statistics 131A - Introduction to Probability Theory
- One additional mathematics course at the upper division level.
Appendix B

Graduate Group in Computer Science
MS Graduate Breadth Requirement
Ph.D. Advanced Proficiency Requirement

This appendix lists coursework that may be used to fulfill the MS Graduate Breadth Requirement and the Ph.D. Advanced Proficiency Requirements.

**MS Breadth Requirement:** MS students must complete one course from three of the following areas with a grade of B or better.

**Ph.D. Advanced Proficiency Requirement:** Students must complete one course from each of the following areas with a grade of B+ or better.

**Architecture**

- ECS 250A Advanced Computer Architecture
- ECS 250B High-Performance Uniprocessing
- ECS 250C Parallel Processing

**Systems**

- ECS 240 Programming Languages
- ECS 251 Operating Systems Models
- ECS 260 Software Engineering

**Theory**

- ECS 222A Design and Analysis of Algorithms
- ECS 222B Advanced Design and Analysis of Algorithms
- ECS 220 Theory of Computation

**Applications**

- ECS 270 Artificial Intelligence
- ECS 265 Distributed Database Systems
- ECS 275A Advanced Computer Graphics
- ECS 275B Advanced Computer Graphics
- ECS 276 Advanced Volume Visualization
- ECS 277 Computer Aided Geometric Design
- ECS 252 Local and Metropolitan Area Networks
- ECS 256A Analytic Methods for Computer Systems Design
- ECS 256B High Speed Networks
- ECS 253 Cryptography & Data Security
- ECS 230 Scientific Computation
Appendix C

Graduate Group in Computer Science
Guidelines for Committee Selection

Master's Thesis Committee

- The master's thesis committee will be composed of three members.
- A duly elected member of the Graduate Group in Computer Science may chair this committee.
- At least two members of this committee must be members of the Academic Senate of the University of California.
- At least two members of this committee must be members of the Graduate Group in Computer Science.

Qualifying Exam Committee

- The qualifying examination committee will be composed of five members.
- The primary dissertation adviser must be selected before the examination. This person can be on the qualifying exam committee but cannot be chair of the committee.
- The membership of the qualifying exam committee must satisfy the following conditions:
  - The chair of the committee must be a member of the Academic Senate of the University of California, Davis, and a member of the Graduate Group.
  - At least three members of the committee must be members of the Academic Senate of the University of California and members of the Graduate Group.
  - It is recommended (by the Academic Senate) that one member of the committee be a faculty member outside of the Graduate Group in Computer Science.

Ph.D. Dissertation Committee

- The Ph.D. dissertation committee will be composed of at least three members.
- At least two of these members must be members of the Academic Senate of the University of California.
- At least two of these members must be members of the Graduate Group in Computer Science.
- The Chair of this committee must be a member of the Graduate Group in Computer Science.

Proposed committee members that are not members of the Academic Senate of the University of California must be approved, first by the Educational Policy Committee of the Graduate Group in Computer Science, and then by Graduate Studies.
Appendix D

Graduate Group in Computer Science
Master's Comprehensive Examination
List of Examination Areas

This appendix lists the examination areas of the Master's Comprehensive Examination along with courses considered preparatory for this exam. Students must pass two examinations from the areas of Architecture, Programming Languages and Compilers, Theory, and Operating Systems. The third examination may be taken from any of the remaining areas.

Architecture

ECS 154 A, B  Computer Architecture
ECS 250A  Advanced Computer Architecture

Programming Languages

ECS 140A  Programming Languages
ECS 142  Compilers
ECS 240  Programming Languages

Operating Systems

ECS 150  Operating Systems
ECS 151A, B  Operating Systems Design
ECS 251  Operating Systems Models

Theory

ECS 122A  Algorithm Design and Analysis
ECS 120  Introduction to the Theory of Computation
ECS 222A  Design and Analysis of Algorithms
ECS 220  Theory of Computation

Software Engineering

ECS 160  Introduction to Software Engineering
ECS 260  Software Engineering

Data Base Systems

ECS 165A, B  Database Systems
ECS 265  Database Systems