Ph.D. Degree Requirements

The requirements for a Ph.D. in Computer Sciences include satisfying the general University residency and minor field requirements, passing the Department's qualifying, preliminary, and final oral examinations, and writing a dissertation. The student will be formally admitted to candidacy for the Ph.D. only when he or she has satisfied requirements I and II below. A student who has satisfied requirements I, II and III below, and has satisfied the Graduate School's residence requirement is officially a dissertator in Computer Sciences. Details of the Graduate School's requirements can be found in the *Graduate School Bulletin.*

I. Qualifying Examination

Each semester, the Department offers a four-hour *depth* exam and a two-hour *breadth* exam in each of the following areas:

- Artificial Intelligence
- Computer Architecture and VLSI
- Database Systems
- Mathematical Programming
- Modeling and Analysis of Computer Systems
- Numerical Analysis
- Operating Systems
- Programming Languages and Compilers
- Theory of Computing

Each exam is graded on a scale of P+ (high pass), P (pass), P− (low pass), or F (fail). There are two ways to pass the qualifying examination. One way is by taking the depth exam in one area and the breadth exams in two other areas. The second way is to pass the depth exams in the areas of mathematical programming and numerical analysis. In one area, the depth exam must be passed with a grade of P or better; competency in the other two areas is exhibited by passing their associated breadth exams, one with a grade of at least P and the other with a grade of at least P−. Students taking two depth exams in mathematical programming and numerical analysis must pass one with at least a P and the other with at least a P−.

A student is allowed at most two chances to pass each area (including any combination of depth and breadth exams in the area). If a student takes an exam twice, the second grade always supersedes the first.

The student must pass all exams by the end of the sixth semester. Students who received 8 or more Master's credits for courses taken before being admitted as a Master's degree candidate are allowed only five semesters to complete the exams, and only four semesters if 16 or more credits were received. Those entering with a Master's degree in Computer Science are allowed only four semesters. Students who believe their situation warrants additional time should consult with the GAC chair during the first semester after entry. After this time, the time limit can be changed only by a written appeal to GAC.

Students who do not register and are not on probation may resume their studies up to one year later without re-applying for admission. No additional time will be permitted for passing the qualifying examination process without written approval from the chair of GAC.

A syllabus is published in advance of the exams listing the topics to be covered in each exam. Depth exams are designed to test the preparation of students intending to do Ph.D. research in a given area. These exams cover topics included in courses as well as additional papers and publications. Breadth exams are intended to demonstrate a basic understanding of an area by students concentrating in another area. A student should be able to pass the breadth exam in any area after completing two courses in that area. In some areas the syllabus will simply list two

500-level courses or one 500-level and one 700-level course, with the understanding that a student who has thoroughly mastered the material in these courses should be able to complete the breadth exam. Other areas may structure their exams to allow a student a choice of two from among three or more courses.

Qualifying examinations are currently offered early in each regular semester. Students are required to register in advance for these exams. Registration deadlines and qualifying exam dates are announced in advance on the Department bulletin board. Registration dates are strictly enforced. Late registration is permitted only by a departmental vote of the faculty.

One of the breadth exams may be given in a "special area" instead of in one of the areas listed above. The "special area" may be either a specially prepared area for the individual student or an area approved by another department and the associated exam administered by that department. In either case, the area must be approved by the Examination Committee and two faculty members in the Computer Sciences Department. Under normal circumstances a student wishing to take a "special area" examination as part of the qualifying process must petition for this privilege before the end of the 12th week of the semester before the semester proposed for the examination. This petition must include: (1) letters of support from two Computer Sciences faculty members, one of whom asserts that he or she would be willing to be the Ph.D. advisor for the student if the qualifying process is successfully completed, and (2) a description of the student's overall program and goals together with a statement of the relevance of the "special area."

The committee administering a depth area exam may, at its discretion, recommend both depth and breadth grades for a student's performance on the depth exam. For example, the committee might recommend a grade of F for the depth exam, but offer the student the option of counting the sitting as a P− on the corresponding breadth exam. All such recommendations must be approved by the Examination Committee. If the recommendation is approved, the student may choose which grade is to be counted towards the completion of the qualifying process.

II. Preliminary Examination

To pass this oral examination, the student is expected to display depth of knowledge in the area of specialization in which research for the dissertation will be conducted. Students should plan for the examination, and determine when they are ready to take it, in consultation with the major professor. Students requiring longer than one year beyond the deadline for completing the qualifying exam must have a major professor certify that progress is being made toward the exam. In any case, the preliminary exam may not be taken more than two years after the deadline for completing the qualifying exam.

The preliminary examination committee consists of three members. The composition of the committee will be suggested by the student's major professor in consultation with the student and must be approved by the Chair of the Department. The student should approach each proposed member of the committee, secure agreement to serve, and then discuss a program for preparing for the examination. It is advisable for the student to do this about a semester before the examination is to be scheduled.

III. Minor Field

The Graduate School determines the requirements for fulfilling the minor field requirement for a Ph.D. There are two methods of fulfilling this requirement. One option (Option A) is to fulfill the minor field requirement as specified by another department other than Computer Sciences. Students should contact the individual department for details. Computer Sciences graduate students minoring in mathematics should note that special regulations apply to the use, for satisfying minor requirements, of courses cross-listed in both Computer Sciences and Mathematics.

A second option (Option B) is available under which the Computer Sciences Department can arrange special minors for Computer Sciences majors who require a program not covered by an

orthodox choice of courses in some other single department. This option is an interdepartmental minor for students whose program makes such a minor more desirable than the standard minor under the control of one particular department other than the student's major department. For Computer Sciences graduate majors the requirements for an Option B minor are:

1. Approval by the Department of the use of the Option B minor and of the content of the minor course program. This approval must occur no later than half-way through the minor course sequence.

2. Completion of at least 12 graduate credits in two or more departments other than Computer Sciences, in related courses selected for their relevance to a particular area of concentration, with an average grade no lower than B, and with no individual grade lower than BC. One course cross-listed with Computer Sciences may be included in this program if it is staffed by another department and is not applicable to requirements of the student's major program.

Students selecting Option B to satisfy their minor requirement should:

1. Consult with the major professor early in the degree program, and decide on a proposed Option B set of courses. Complete a form provided by the departmental office, and have it signed by the major professor and the Department Chair. This constitutes Departmental approval of the proposed courses for satisfying the minor requirement.

2. After completing the program, bring the preliminary examination warrant to the secretary in charge of student records in the departmental office. The warrant will then be signed by the Department Chair to certify completion of the minor program, and will be returned to the student.

Students who do not yet have a major professor and who want some preliminary advice on the kinds of programs likely to be approved may speak with the minor advisor or a member of GAC.

IV. Dissertation

The student must conduct a substantial piece of original research in computer science and report it in a dissertation meeting the highest standards of scholarship.

The initiative in selection of a research supervisor (major professor) is entirely with the student. A professor should be approached for this purpose at as early a stage in the student's graduate work as possible though usually not until after the student has taken some of the professor's courses or has worked for and demonstrated ability to the professor in some way.

V. Final Oral Examination

In a final oral examination, the student must explain and defend the contents of the dissertation and exhibit detailed knowledge of the general area in which the reported research falls.

The final oral examination and defense of the dissertation will take place before a committee of five, three of whom will constitute the reading subcommittee. The composition of the committee will be suggested by the student's major professor and approved by the Chair of the Department. At least one of the five members must have a faculty appointment in some department other than Computer Sciences.