Academic Requirements for PhD in Computer Science

A minimum of 48 semester hours of course work beyond the BS/BA degree is required of all students.

Admission to Candidacy

All students must demonstrate sufficient knowledge in the fundamentals of computer science, as well as the ability to carry out research in an area of computer science.

The student must maintain a minimum GPA of 3.500 among the six core courses satisfying the above course requirements and receive a grade of B or better in each of these courses. Students who have taken equivalent courses in other institutions may petition to be exempted from the course(s) (subject to the approval of the PhD committee). Each student may repeat a course once for no more than three out of the six courses if they do not receive a B or better in the course. Students with an MS in Computer Science may petition to the PhD committee for an exemption from these courses. Petition forms are available on the college website.

The fields listed do not necessarily represent areas of specialization or separate tracks within the PhD program. Rather, they attempt to delineate areas on which the student must be examined in order to measure his or her ability to complete the degree. Therefore, they may be adjusted in the future to reflect changes in the discipline of computer science and in faculty interests within the College of Computer and Information Science. Similarly, these fields do not represent the only areas in which a student may write his or her dissertation. They are, however, intended to serve as a basis for performing fundamental research in computer science.

Research/Survey Paper

To demonstrate research ability, the student is required to submit to the PhD committee a research or a survey paper in an area of specialty under the supervision of a faculty advisor. Normally, the length of the paper should not exceed fifteen pages. A submitted paper from a student is considered to have fulfilled the paper requirement if:

1. The paper has been submitted to a selective conference.
2. The student has made a substantial contribution to the paper.
3. The advisor has endorsed the paper with a written statement indicating the student’s contribution.
4. The PhD committee has voted on a positive recommendation.

Upon completion of the course and the research paper requirements, the student is admitted to candidacy for the PhD degree. It is highly recommended that the student complete the candidacy requirement by the end of his or her second year but no later than the third year.

Residency

One year of continuous full-time study is required after admission to the PhD candidacy. It is expected that during this period the student will make substantial progress in preparing for the comprehensive examination.

Comprehensive Examination

The examination is taken after the student has achieved sufficient depth in a field of study in order to prepare a prospectus for the PhD dissertation. This process should take place no later than the end of the fifth year in residence. Prior to taking the comprehensive examination, the student prepares a thesis proposal for the examination, which describes the proposed research, including the relevant background materials from the literature. The thesis proposal should clearly specify the research problems to be attacked, the techniques to be used, and a schedule of milestones toward completion. Normally, the thesis proposal should not exceed fifteen pages, excluding appendices and bibliography.

The examination is chaired by the PhD advisor. It is strongly recommended that the same members should serve on both the comprehensive and thesis committees. With the help of the advisor, a student selects the comprehensive committee, consisting of four members to be approved by the PhD committee. The four members must include the advisor, two other faculty members from the college, and an external examiner (optional for comprehensive committee).

To help the PhD committee to make an informed decision, a copy of the external examiner’s resumé should be submitted at the same time. Upon approval of the written proposal, the student has to present the proposed work orally in a public forum, followed by a closed-door oral examination from the comprehensive committee. The student may take the comprehensive examination twice, at most.

Doctoral Dissertation

Upon successful completion of solving the research proposed in the thesis proposal, the candidate has an opportunity to prepare the dissertation for approval by the doctoral committee. The dissertation must contain results of extensive research and make an original contribution to the field of computer science. The work should give evidence of the candidate’s ability to carry out independent research. It is expected that the dissertation should be of sufficient quality to merit publication in a reputable journal in computer science.

DOCTORAL COMMITTEE

If the thesis committee is the same as the comprehensive committee, no further approval is needed. If the thesis committee is changed in its composition, the approval process will follow that of the comprehensive committee.

DISSERTATION DEFENSE

The dissertation defense is held in accordance with the regulations of the University Graduate Council. It consists of a lecture given by the candidate on the subject matter of the dissertation. This is followed by questions from the doctoral committee and others in attendance concerning the results of the dissertation as well as any related matters. The examination is chaired by the PhD advisor.

TIME AND TIME LIMITATION

After the establishment of degree candidacy, a maximum of five years will be allowed for the completion of the degree requirements, unless an extension is granted by the college graduate committee.

Program Requirements

Complete all courses and requirements listed below unless otherwise indicated.

Milestones

Qualifying examination and area examination

Annual review

Dissertation proposal

Dissertation committee
**General Requirements**

**Programming**
- **CS 7400** Intensive Principles of Programming Languages 4

**Systems**
- **CS 7600** Intensive Computer Systems 4

**Algorithms**
- **CS 7800** Advanced Algorithms 4

**Computation**
- **CS 7805** Theory of Computation 4

**Specialization Courses**
Note: Please see specialization section below for full list of approved courses.

Complete 8 semester hours from the following:
- **CS 5100** to **CS 5850**
- **CS 6110** to **CS 6810**

**Open Electives**
Note: Consult faculty advisor for the other acceptable courses.

Complete 24 semester hours from the following:
- **CS 5100** to **CS 5850**
- **CS 6110** to **CS 6810**
- **CS 8982** Readings 1-8

**Dissertation**
Upon achieving PhD candidacy, complete the following two (repeatable) courses for two consecutive semesters:
- **CS 9990** Dissertation 2-4
- **CS 8982** Readings 1-8

For remaining semester(s), please complete:
- **CS 9996** Dissertation Continuation 0

**Specializations**
Complete 8 semester hours from the following:

**Artificial Intelligence**
- **CS 5100** Foundations of Artificial Intelligence
- **CS 5335** Robotic Science and Systems
- **CS 6110** Knowledge-Based Systems
- **CS 6120** Natural Language Processing
- **CS 6140** Machine Learning
- **CS 7140** Advanced Machine Learning
- **CS 7170** Seminar in Artificial Intelligence
- **CS 7180** Special Topics in Artificial Intelligence

**Computer-Human Interface**
- **CS 5340** Computer/Human Interaction
- **CS 5350** Applied Geometric Representation and Computation
- **CS 6350** Empirical Research Methods
- **CS 7140** Advanced Machine Learning

**Data Science**
- **CS 5200** Database Management Systems
- **CS 6140** Machine Learning
- **CS 6200** Information Retrieval

**Software Development**
- **CS 6220** Data Mining Techniques
- **CS 6240** Parallel Data Processing in MapReduce
- **CS 7270** Seminar in Database Systems
- **CS 7280** Special Topics in Database Management

**Graphics**
- **CS 5310** Computer Graphics
- **CS 5320** Digital Image Processing
- **CS 5330** Pattern Recognition and Computer Vision
- **CS 5520** Mobile Application Development
- **CS 6310** Computational Imaging
- **CS 7370** Seminar in Graphics/Image Processing
- **CS 7380** Special Topics in Graphics/Image Processing

**Information Security**
- **CS 5770** Software Vulnerabilities and Security
- **CS 6540** Foundations of Formal Methods and Software Analysis
- **CS 6740** Network Security
- **CS 6750** Cryptography and Communications Security
- **CS 6760** Privacy, Security, and Usability
- **CS 7580** Special Topics in Software Engineering

**Networks**
- **CS 5700** Fundamentals of Computer Networking
- **CS 5750** Social Computing
- **CS 6710** Wireless Network
- **CS 6740** Network Security
- **CS 6750** Cryptography and Communications Security
- **CS 6760** Privacy, Security, and Usability
- **CS 7770** Seminar in Computer Networks
- **CS 7775** Seminar in Computer Security
- **CS 7780** Special Topics in Networks

**Programming Languages**
- **CS 5400** Principles of Programming Language
- **CS 6410** Compilers
- **CS 6412** Semantics of Programming Language
- **CS 6510** Advanced Software Development
- **CS 6515** Software Development
- **CS 7470** Seminar in Programming Languages
- **CS 7480** Special Topics in Programming Language
- **CS 7570** Seminar in Software Development

**Software Engineering**
- **CS 5610** Web Development
- **CS 6510** Advanced Software Development
- **CS 6520** Methods of Software Development
- **CS 6530** Analysis of Software Artifacts
- **CS 6535** Engineering Reliable Software
- **CS 6540** Foundations of Formal Methods and Software Analysis
- **CS 7575** Seminar in Software Engineering
- **CS 7580** Special Topics in Software Engineering
### Systems
- CS 5620 Computer Architecture
- CS 5650 High Performance Computing
- CS 6610 Parallel Computing
- CS 6740 Network Security
- CS 7670 Seminar in Computer Systems
- CS 7680 Special Topics in Computer Systems

### Theory
- CS 6610 Parallel Computing
- CS 6750 Cryptography and Communications Security
- CS 6800 Application of Information Theory
- CS 6810 Distributed Algorithms
- CS 7805 Theory of Computation
- CS 7870 Seminar in Theoretical Computer Science
- CS 7880 Special Topics in Theories of Computer Science

### Game Design
- CS 5150 Game Artificial Intelligence
- CS 5310 Computer Graphics
- CS 5340 Computer/Human Interaction
- CS 5850 Building Game Engines
- CS 7140 Advanced Machine Learning

### Program Credit/GPA Requirements
48 total semester hours required
Students must maintain a minimum GPA of 3.500 among the four core courses and two area electives as well as earn a grade of B or better in each of these courses.

Minimum overall 3.000 GPA required

### Plan of Study

#### Sample Curriculum

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Total Hours: 48