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 grade-point average (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 a Master of Science 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 (CCIS). 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.

Paper Requirement

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. 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. The committee may require a presentation from the student before making a 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.

Teaching Requirement

All computer science PhD students must satisfy the teaching requirement in order to graduate. This requirement is fulfilled when the student works as a teaching assistant (TA) or instructor of record (IoR) for one semester and during this semester:

- Teaches at least 3 hours of classes
- Prepares at least one assignment, or quiz, or equivalent

PhD students are expected to satisfy the teaching requirement some time after completing their first year and at least one semester prior to scheduling their PhD defense.

Comprehensive Examination/Dissertation Proposal

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 15 pages, excluding appendices and bibliography.

The thesis proposal must be approved by the comprehensive committee. 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 résumé 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
Course requirements
Paper requirement
Comprehensive exam/dissertation proposal
Dissertation defense

Core Requirement
A grade of B or higher is required in each course. A cumulative 3.500 GPA is required for the core requirement.

Breadth Areas
Complete one course from four of the five following breadth areas:

Artificial Intelligence and Data Science
- CS 6140 Machine Learning
- CS XXXX (Applied Statistics)

Human-Centered Computing
- CS 5340 Computer/Human Interaction
- CS 7295 Special Topics in Data Visualization

Software
- CS 7400 Intensive Principles of Programming Languages
- CS 6410 Compilers

Systems
- CS 7600 Intensive Computer Systems

Theory
- CS 7800 Advanced Algorithms
- CS 7805 Theory of Computation

Specialization Courses
Complete 8 semester hours from the specialization course lists. (p. 2)

Electives
Complete 24 semester hours in the following:

Note: Consult faculty advisor for the other acceptable courses.
- CS 5100 to CS 5850
- CS 6110 to CS 6810
- CS 8982 Readings

Dissertation
Upon achieving PhD candidacy, complete the following (repeatable) courses for two consecutive semesters:
- CS 9990 Dissertation
- CS 8982 Readings
For remaining semester(s), complete the following (repeatable) course until graduation:
- CS 9996 Dissertation Continuation

Specialization Course Lists

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
- CS 6220 Data Mining Techniques
- CS 6240 Large-Scale Parallel Data Processing
- CS 7270 Seminar in Database Systems
- CS 7280 Special Topics in Database Management
- CS 7290 Special Topics in Data Science

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
### 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 7485: Special Topics in Formal Methods
- 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 6650: Building Scalable Distributed Systems
- 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 7485: Special Topics in Formal Methods
- 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

### Plan of Study

#### Sample Curriculum

**Year 1**

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**Year 2**

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**Year 6**

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**Total Hours: 48**

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### Program Credit/GPA Requirements

48 total semester hours required  
Minimum overall 3.00 GPA required