Computer Science, PhD

The PhD in Computer Science is designed to prepare students for careers in academia, industrial and national research labs, and technical leadership in industry and government. The rigorous curriculum provides a broad background in the fundamentals of computer science, advanced courses in a wide range of focus areas, and opportunity to make an impact at the forefront of computing. The program provides training in conducting research, publishing and presenting papers, developing systems, and establishing science and technology policy.

Coursework

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

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 of 3.500 among the six core courses 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 computer science curriculum 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 computer science curriculum 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 their 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 Khoury College of Computer Sciences. Similarly, these fields do not represent the only areas in which a student may write their 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 accepted by 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 computer science curriculum committee has voted on a positive recommendation. The committee may require a presentation from the student before making a recommendation.

Admission to Candidacy

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 their 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 or instructor of record for one semester and during this semester:

- Teaches at least three 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

After the student has achieved sufficient depth in a field of study, they prepare a proposal for the PhD dissertation. This process should take place no later than the end of the fifth year in residence. The student prepares a dissertation proposal, which describes the proposed research, including the relevant background materials from the literature. The proposal should clearly specify the research problems to be attacked, the techniques to be used, and a schedule of milestones toward completion.

The dissertation proposal must be approved by the dissertation committee. With the help of the advisor, a student selects the committee, consisting of at least four members, to be approved by the PhD computer science curriculum committee. The four members must include the advisor, two internal members, and an external member.

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 dissertation committee. The student may take the dissertation proposal examination twice, at most.

Doctoral Dissertation

Upon successful completion of solving the research proposed in the dissertation proposal, the candidate has an opportunity to prepare the dissertation for approval by the dissertation 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

With the help of the advisor, a student selects the committee, consisting of at least four members, to be approved by the PhD computer science curriculum committee. The four members must include the advisor, two internal members, and an external member.

Dissertation Defense

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

Coursework
Paper requirement
Admission to candidacy
Residency
Teaching requirement
Comprehensive examination/dissertation proposal
Doctoral dissertation
Doctoral committee
Dissertation defense

Course Area Requirements

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

Students should refer to the course numbering table for graduate course leveling (https://catalog.northeastern.edu/graduate/academic-policies-procedures/records-transcripts/).

Code	Title	Hours
Complete a total of six courses. Courses must cover at least four of the five areas, and a maximum of two courses may be at the 5000 level.		24
At least two courses must be 7000-level seminar courses.		
At least two courses must be 7000-level nonseminar courses.		
Artificial Intelligence and Data Science		
Seminar Courses		
CS 7170	Seminar in Artificial Intelligence	
CS 7270	Seminar in Database Systems	
Nonseminar Courses		
CS 7140	Advanced Machine Learning	
CS 7150	Deep Learning	
CS 7180	Special Topics in Artificial Intelligence	
CS 7200	Statistical Methods for Computer Science	
CS 7240	Principles of Scalable Data Management: Theory, Algorithms, and Database Systems	
CS 7280	Special Topics in Database Management	
CS 7290	Special Topics in Data Science	
CS 7380	Special Topics in Graphics/Image Processing	

Other Courses	
CS 5100	Foundations of Artificial Intelligence
CS 5150	Game Artificial Intelligence
CS 5170	Artificial Intelligence for Human-Computer Interaction
CS 5180	Reinforcement Learning and Sequential Decision Making
CS 5200	Database Management Systems
CS 5330	Pattern Recognition and Computer Vision
CS 5335	Robotic Science and Systems
CS 5850	Building Game Engines
CS 6120	Natural Language Processing
CS 6140	Machine Learning
CS 6200	Information Retrieval
CS 6220	Data Mining Techniques
CS 6240	Large-Scale Parallel Data Processing
CY 6720	Machine Learning in Cybersecurity and Privacy
DS 5110	Introduction to Data Management and Processing
DS 5220	Supervised Machine Learning and Learning Theory
DS 5230	Unsupervised Machine Learning and Data Mining
Human-Computer Interaction	
Nonseminar Courses	
CS 7250	Information Visualization: Theory and Applications
CS 7260	Visualization for Network Science
CS 7295	Special Topics in Data Visualization
CS 7300	Empirical Research Methods for Human Computer Interaction
CS 7340	Theory and Methods in Human Computer Interaction
CS 7390	Special Topics in Human-Centered Computing
Other Courses	
CS 5097	Mixed Reality
CS 5170	Artificial Intelligence for Human-Computer Interaction
CS 5340	Computer/Human Interaction
CS 6350	Empirical Research Methods
Software	
Seminar Courses	
CS 7470	Seminar in Programming Languages
CS 7575	Seminar in Software Engineering
Nonseminar Courses	
CS 7400	Intensive Principles of Programming Languages
CS 7430	Formal Specification, Verification, and Synthesis
CS 7480	Special Topics in Programming Language
CS 7485	Special Topics in Formal Methods
CS 7580	Special Topics in Software Engineering
Other Courses	
CS 5310	Computer Graphics
CS 5400	Principles of Programming Language
CS 5500	Foundations of Software Engineering
CS 5520	Mobile Application Development
CS 5610	Web Development
CS 6410	Compilers
CS 6510	Advanced Software Development
Systems and Security	
Seminar Courses	
CS 7670	Seminar in Computer Systems
CS 7770	Seminar in Computer Networks
CS 7775	Seminar in Computer Security

Nonseminar Courses	
CS 7600	Intensive Computer Systems
CS 7610	Foundations of Distributed Systems
CS 7680	Special Topics in Computer Systems
CY 7790	Special Topics in Security and Privacy
Other Courses	
CS 5600	Computer Systems
CS 5700	Fundamentals of Computer Networking
CS 6620	Fundamentals of Cloud Computing
CS 6650	Building Scalable Distributed Systems
CS 6710	Wireless Network
CS 6760	Privacy, Security, and Usability
CY 5130	Computer System Security
CY 5150	Network Security Practices
CY 5770	Software Vulnerabilities and Security
CY 6720	Machine Learning in Cybersecurity and Privacy
CY 6740	Network Security
Theory	
Seminar Courses	
CS 7870	Seminar in Theoretical Computer Science
NonSeminar Courses	
CS 7800	Advanced Algorithms
CS 7805	Complexity Theory
CS 7810	Foundations of Cryptography
CS 7880	Special Topics in Theoretical Computer Science
Other Courses	
CS 5800	Algorithms
CY 5120	Applied Cryptography

Electives

Code	Title	Hours
Complete 24 semester hours in the following:		24
Note: Consult faculty advisor for the other acceptable courses.		
CS 5100 to CS 5850, except CS 5340		
CS 6110 to CS 6810		
CS 7340	Theory and Methods in Human Computer Interaction	
CS 7930	Effective Scientific Writing in Computer Science	
CS 8982	Readings	

Dissertation

Code	Title	Hours
Upon achieving PhD candidacy, complete the following courses for two consecutive semesters:		
CS 9990	Dissertation Term 1	
CS 9991	Dissertation Term 2	
For remaining semester(s), complete the following (repeatable) course until graduation:		
CS 9996	Dissertation Continuation	

Program Credit/GPA Requirements

48 total semester hours required
Minimum overall 3.000 GPA required

Plan of Study

Sample Curriculum

Year 1			
Fall	**Hours**	**Spring**	**Hours**
Area course	4	Area course	4
Readings	4	Readings	4
	8		**8**
Year 2			
Fall	**Hours**	**Spring**	**Hours**
Area course	4	Area course	4
Readings	4	Readings	4
	8		**8**
Year 3			
Fall	**Hours**	**Spring**	**Hours**
Area course	4	Area course	4
Readings	4	Readings	4
	8		**8**
Year 4			
Fall	**Hours**	**Spring**	**Hours**
CS 9990	0	CS 9991	0
	0		**0**
Year 5			
Fall	**Hours**	**Spring**	**Hours**
CS 9996		CS 9996	
	0		**0**
Year 6			
Fall	**Hours**	**Spring**	**Hours**
CS 9996		CS 9996	
	0		**0**

Total Hours: 48

Advanced Entry Program Requirements

Coursework

Incoming PhD in Computer Science students who have already completed a Master of Science in Computer Science or an adjacent field may petition to the PhD in Computer Science program administration for advanced entry. Advanced entry petitions are reviewed by the program administration on a case-by-case basis. Please note that advanced standing does not waive by itself any part of the PhD coursework requirements.

As a degree conferral requirement, a minimum of 16 semester hours of coursework beyond the 32 semester hours of the master's degree is required of advanced entry PhD students (48 semester hours is required of standard entry PhD students). Students must maintain a minimum GPA of 3.500 as well as earn a grade of B or better in each course.

Paper Requirement

Refer to the Computer Science, PhD, overview (p. 1), for research/survey paper requirements.

Admission to Candidacy

Refer to the Computer Science, PhD, overview, (p. 1) for admission to candidacy requirements.

Residency

Refer to the Computer Science, PhD, overview, (p. 1) for residency requirements.

Teaching Requirement

Refer to the Computer Science, PhD, overview, (p. 1) for the teaching requirement.

Comprehensive Examination/Dissertation Proposal

Refer to the Computer Science, PhD, overview, (p. 1) for comprehensive examination requirements.

Complete all courses and requirements listed below unless otherwise indicated.

Milestones

Annual review
Course requirements
Paper requirement
Comprehensive exam
Teaching requirement
Doctoral candidacy
Dissertation committee
Dissertation proposal
Dissertation defense

Core Requirements

Students must maintain a minimum GPA of 3.500 as well as earn a grade of B or better in each course.

Code	Title	Hours
Consult your faculty advisor for acceptable courses.		16

Dissertation

Code	Title	Hours
Upon achieving PhD candidacy, complete the following courses for two consecutive semesters:		
CS 9990	Dissertation Term 1	
CS 9991	Dissertation Term 2	
For remaining semester(s), complete the following (repeatable) course until graduation:		
CS 9996	Dissertation Continuation	

Program Credit/GPA Requirements

16 total semester hours required
Minimum overall 3.500 GPA required