Network Science, PhD (Boston)

The PhD in Network Science program aims to enhance our understanding of networks arising from the interplay of human behavior, sociotechnical infrastructures, information diffusion, and biological agents. This is a multidisciplinary program, with members of the Northeastern University Network Science Institute (https://www.networkscienceinstitute.org/) representing a range of fields including computer science, information science, physics, complexity, sociology, communication, data visualization, organizational behavior, political science, population health, and epidemiology.

This doctoral program is a joint collaboration across five academic colleges. Students are admitted to the College of Social Sciences and Humanities and may choose to move to the home college of their dissertation advisor after they reach candidacy (once they pass their dissertation proposal/comprehensive exam). Students follow policies of their home college, including dissertation format and submission deadlines for graduation. Faculty supervisors may be from one of the following Northeastern academic colleges:

- College of Science
- College of Social Sciences and Humanities
- Khoury College of Computer Sciences
- Bouvé College of Health Sciences
- College of Arts, Media and Design

Required coursework includes 20 semester hours of core courses in network science, plus an additional 20 semester hours of elective courses relevant to the student's area of research. Electives should be discussed with the student's faculty advisor. A minimum of 40 semester hours of coursework is required, though the faculty advisor or program committee may recommend additional coursework based on student research skills.

Alternative Course Path
Students have the option to complete core coursework in their first year of study. This curriculum pathway is expected to be taken by students whose admitting advisor is located outside of the Boston campus and elsewhere in the Northeastern network.

Annual Review
A review of satisfactory progress will be ongoing and formally evaluated at the end of each academic year. Students must maintain a cumulative grade-point average of 3.000 or better in all coursework. Students are not allowed to retake courses. A student who does not maintain a 3.000 GPA, or is not making satisfactory progress on their dissertation research, may be recommended for dismissal by the graduate program committee.

As part of the annual review process, the students will be asked to submit a summary of completed and future courses and research. Students will submit to the program committee:

- A list of courses completed in the last academic year and course plan for the following year
- A short synopsis of their research progress and research plans for the next year

Qualifying Examination
The qualifying exam is an hour-long oral examination of the material covered in the core curriculum and consists of questions selected by network science faculty. One month prior to the exam., students receive between 50 to 80 study questions to prepare. Students will be asked to give a short presentation of their research plans, followed by an oral exam where the qualifying exam panel will ask a subset of the review questions.

Students must take the exam by the fall semester of their third year. If students fail the qualifying exam on their first attempt, they may retake the exam in the following semester. Students who do not pass the exam after two attempts will be asked to leave the program. [1]

Dissertation Committee
Students must confirm their dissertation advisor by the end of their second year. The dissertation advisor must be a full-time, tenured, tenure-track, research, or teaching faculty member of Northeastern. The advisor should be a network science doctoral program faculty member, unless the student receives approval by the network science program committee.

Students must confirm their dissertation committee prior to their comprehensive exam. The committee must consist of a minimum of four members:

1. A dissertation advisor
2. A core member of the Network Science Institute faculty
3. An additional tenured/tenure-track, research, or teaching faculty member from the Network Science Institute or other Northeastern faculty approved by the advisor and program committee
4. One member recognized as an expert in the specific topic of research, who can be external to Northeastern.

Dissertation Proposal (Comprehensive Examination)
The comprehensive exam should be completed in the student's fourth year of study. The exam consists of two parts: preparation of the dissertation proposal and oral presentation of the proposal. Students must prepare a written comprehensive research proposal describing the dissertation

research plan including review of relevant literature, research questions, motivation, methods, any preliminary results, and potential impact. The proposal must be shared with the doctoral committee members two weeks prior to the scheduled presentation.

Students will give a 30-minute oral presentation to their committee members that is open to the public. Following the presentation, the dissertation committee will assess the proposed research plan and provide feedback to the student. If the proposal and/or presentation do not meet the expectations of the committee, the student will be asked to revise their proposal and/or their presentation. The completion of the comprehensive exam is considered successful if the dissertation committee approves as satisfactory both the written proposal and the oral presentation. Students may repeat the comprehensive exam once. If they are unsuccessful in their second attempt, the program will ask the student to leave the program.

PhD Candidacy

A student is considered a doctoral candidate upon completion of the required coursework with a minimum cumulative GPA of 3.000, a passing score on the qualification exam, and satisfactory completion of the comprehensive exam.

Dissertation

A PhD student should aim to complete their dissertation in their fifth year of study. Upon successful completion of the research plan 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. The work should give evidence of the candidate's ability to carry out independent research. It is expected that the dissertation consists of one or more research studies of sufficient quality to merit publication in a reputable journal(s).

Dissertation Defense

Like the dissertation proposal, the dissertation defense consists of two parts: the written dissertation and the defense oral presentation. The PhD candidate should send the written dissertation to their dissertation committee at least one month prior to the dissertation defense.

The oral dissertation defense will be open to the public and will include a Q&A session. Following the presentation, the dissertation committee will communicate their assessment of whether they consider the candidate's dissertation requirement fulfilled. Once the dissertation requirement is fulfilled, the PhD candidate is ready to graduate. Students then apply to graduate and follow the formatting guidelines and deadlines of their home college.

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[1]*Students who have completed required coursework with a cumulative GPA of 3.000 or better may be eligible to receive an MS in Network Science degree. Note that no students will be admitted directly into the MS in Network Science to pursue a master's degree.*

Program Requirements

Complete all courses and requirements listed below unless otherwise indicated.

Milestones

Coursework
Annual reviews
Qualifying exam
Dissertation committee
Dissertation proposal (comprehensive examination)
Dissertation
Dissertation defense

Core Requirements

Code	Title	Hours
Students must complete all 20 semester hours of the core courses listed below, unless the program director approves changes to the student's course plan:		
NETS 5116	Network Science 1	4
NETS 6116	Network Science 2	4
NETS 7332	Machine Learning with Graphs	4
NETS 7334	Social Networks	4
NETS 7335	Dynamical Processes in Complex Networks	4

Electives

Code	Title	Hours
Complete 20 semester hours from the following elective course options.		20
The student's elective course plan should be discussed with, and approved by, their advisor. Students who seek to apply courses not on this list to fulfill program requirements must obtain written approval from their advisor and the program director. Elective options below are organized by domain areas. Students may take courses from one or more domain areas.		

Computational Social Science

CNET 5126	Spreading on Networks: From Epidemics to Memes
CNET 5314	Complexity in Social Systems
CNET 5411	Financial and Economic Networks
CNET 5901	Visualizing Complex Networks
CNET 5902	Communicating Network Data
NETS 7341	Network Economics
NETS 7350	Bayesian and Network Statistics
NETS 7360	Research Design for Social Networks
NETS 7370	Computational Urban Science
NETS 7976	Directed Study
NETS 7983	Topics
NETS 8941	Network Science Literature Review Seminar
PHYS 7332	Network Science Data 2

Computer Science

CNET 5901	Visualizing Complex Networks
CNET 5902	Communicating Network Data
CS 5800	Algorithms
CS 6120	Natural Language Processing
CS 6140	Machine Learning
CS 6220	Data Mining Techniques
CS 7180	Special Topics in Artificial Intelligence
CS 7260	Visualization for Network Science
CS 7295	Special Topics in Data Visualization
NETS 7976	Directed Study
NETS 7983	Topics
NETS 8941	Network Science Literature Review Seminar
PHYS 7332	Network Science Data 2

Epidemiology and Public Health

CNET 5126	Spreading on Networks: From Epidemics to Memes
CNET 5515	Complex Network Analysis for Biological Systems
CNET 5901	Visualizing Complex Networks
CNET 5902	Communicating Network Data
NETS 7370	Computational Urban Science
NETS 7976	Directed Study
NETS 7983	Topics
NETS 8941	Network Science Literature Review Seminar
PHTH 5202	Introduction to Epidemiology
PHTH 5210	Biostatistics in Public Health
PHTH 6202	Intermediate Epidemiology
PHTH 6400	Principles of Population Health 1
PHTH 6410	Principles of Population Health 2
PHTH 6800	Causal Inference in Public Health Research
PHYS 7332	Network Science Data 2

Mathematic and Physics

CNET 5901	Visualizing Complex Networks
CNET 6061	Analyzing Higher-Order Networks
CNET 6063	Probabilistic Mathematics of Networks
CS 5800	Algorithms
MATH 7233	Graph Theory
MATH 7243	Machine Learning and Statistical Learning Theory 1
NETS 7976	Directed Study
NETS 8941	Network Science Literature Review Seminar
PHYS 5211	Introduction to Scientific Computing

PHYS 7305	Statistical Physics
PHYS 7321	Computational Physics
PHYS 7332	Network Science Data 2

Dissertation

Code	Title	Hours
Precandidacy		
Students should register for NETS 8986 after passing the qualifying exam and before completing the comprehensive exam (proposal defense):		
NETS 8986	Research	
Dissertation		
After passing the comprehensive exam (reaching candidacy), students should register for NETS 9990 and NETS 9991, successively:		
NETS 9990	Dissertation Term 1	
NETS 9991	Dissertation Term 2	
Dissertation Continuation		
After completing both NETS 9990 and NETS 9991, students should register for NETS 9996 each semester until graduation:		
NETS 9996	Dissertation Continuation	

Program Credit/GPA Requirements

40 total semester hours required
Minimum 3.000 GPA required

Plan of Study
Typical Plan of Study

Year 1

Fall	Hours	Spring	Hours
PHYS 5116	4	NETS 6116	4
Elective course	4	NETS 7334	4
Elective course	4	One elective course	4
	12		**12**

Year 2

Fall	Hours	Spring	Hours
NETS 7332	4	NETS 7335	4
One elective course	4	One elective course	4
	8		**8**

Year 3

Fall	Hours	Spring	Hours
NETS 8986	0	NETS 8986	0
	0		**0**

Year 4

Fall	Hours	Spring	Hours
NETS 8986	0	NETS 9990	0
	0		**0**

Year 5

Fall	Hours	Spring	Hours
NETS 9991	0	NETS 9996	0
	0		**0**

Total Hours: 40

Alternate Plan of Study

Year 1

Fall	Hours	Spring	Hours
PHYS 5116	4	NETS 6116	4
NETS 7332	4	NETS 7334	4
One elective course	4	NETS 7335	4
	12		**12**

Year 2

Fall	Hours	Spring	Hours
Elective	4	Elective	4
Elective	4	Elective	4
	8		**8**

Year 3

Fall	Hours	Spring	Hours
NETS 8986	0	NETS 8986	0
	0		**0**

Year 4

Fall	Hours	Spring	Hours
NETS 8986	0	NETS 9990	0
	0		**0**

Year 5

Fall	Hours	Spring	Hours
NETS 9991	0	NETS 9996	0
	0		**0**

Total Hours: 40