Evaluation of the First US PhD Program in Network Science: Developing Twenty-First-Century Thinkers to Meet the Challenges of a Globalized Society

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1 Introduction

1.1 Purpose of the Program

As the world becomes more globally connected, it is increasingly defined by networks. Our ability to quantify underlying principles that drive network dynamics and evolution has vastly improved in the last decade. With roots in physical, information, and social sciences, network science provides a formal set of methods, tools, and theories to describe, prescribe, and predict network dynamics. Despite this formalization, there is still considerable debate over what constitutes the fundamental techniques, methods, and theories of network science. That is, how do we identify ourselves in a field of study that is by its very nature transdisciplinary and that has become so pervasive and is being taught across so many disciplines? Our PhD program attempts to establish, from the multitude of disciplinary methods and theory, a general framework that defines network science as a coherent field and will define the next generation of network scientists.

Dramatic improvements in information technology over the past 20 years, including increased storage capacity and computing power, have made it possible to archive and study multiple levels and multiple dimensions of biological and sociotechnical systems with unprecedented detail in areas such as communication, transportation, natural resources, infectious diseases, and political and cyber systems. Science and technology are growing exponentially, not only in terms of ideas and knowledge produced and spread but also in terms of the emerging applications that utilize this knowledge. The approaches and methods of network sci-

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ence have synergies across disciplines and pervade data science and data analytic methodologies. The latter are the core expertise sought after by many companies in their hiring plans. In the 2011 McKinsey Global Institute (MGI) study [1], it was predicted that by 2018 the United States alone could face a shortage of 140,000 to 190,000 people with this expertise. In a more recent analysis, the 2014 MGI study [2] suggests that understanding networked capabilities – both technically and behaviorally – will transform organizational practices and will drive two-thirds of the value creation opportunities afforded by social technologies. Further, a series of reports from the National Science Foundation, National Institutes of Health, National Research Council, and Institute of Medicine [3] have highlighted two fundamental directions for future scientific progress, complexity and transdisciplinarity, both of which are hallmarks of network science. Research on network connections among multiple types and levels of "actors" offers a powerful paradigm to understand the workings of complex systems across broad areas of science, including information and technology, biological systems, health and health care, local and global political and economic processes, and sociotechnical infrastructures and sustainability.

Adopting a "network view" requires novel evaluations of, reconfigurations in, and innovations for standard methods of theorizing, data collection, and analysis. However, the new techniques capable of evaluating, designing, and influencing these systems and their interdependencies developed in network science and other computational methodologies have not yet been systematically formalized into an educational curriculum. We do not yet have a workforce with the background to effectively capitalize on these new techniques. To meet new challenges arising from an increasingly interconnected globalized society, we have developed a doctoral program to grow a new kind of scholars with an interdisciplinary quantitative and social scientific training, tailored to leverage these new capabilities.

2 Program Description and Overview

The Northeastern University's Network Science PhD program couples fundamental network science methods with disciplinary knowledge, enabling theoretical and substantive understanding of the appropriate use of network scientific tools and techniques. Thus, the PhD program is built on the following standards:

- Rigorous training in mathematical, computational, and theoretical concepts, fundamental to network science. Students gain this knowledge in the first 2 years of coursework with the core classes.
- Exposure to key tools and techniques of network modeling across disciplines – including data collection strategies, computing languages, modeling approaches, and theoretical and problem-solving strategies. While we cannot expect trainees (or even faculty) to be expert, or even proficient, in these tools, the understanding

of and respect for their potential contributions to novel interdisciplinary approaches to network science is paramount. Students gain this expertise through considerable hands-on core coursework, as well as through selection of elective courses that allow them to become proficient in a set of capabilities appropriate to their interests and research area.

- Experience with applied knowledge in disciplinary fields of study and the ability to frame the major problems in these fields into a set of network-based problems. Students gain this knowledge primarily through mentored research, starting in their second year. Applicants to the program select one of four concentration areas: natural sciences (physics, biology, ecology); social sciences; health science (epidemiology); and computer and information sciences. Tracks loosely guide the student through their coursework and function to help students navigate the selection of electives and dissertation advisor.
- Foundational training in all aspects of network science (e.g., approaches, languages, problems), beginning in the first year of graduate training, as it is necessary in order to build an inherently interdisciplinary science and the next generation of researchers and projects.
- Deep dive and practice in matching theoretical and substantive questions with the appropriate use of network-based tools and techniques. This knowledge is the most complex and nuanced and the hardest to assess. Students gain these perspectives from weekly journal club discussions, in which mathematical, conceptual, and even philosophical notions of the field are explored. In addition, active speaker and workshop series offer students a great breadth of scientific excellence across fields.

Finally, the program relies on a team of research-active faculty members to provide mentorship and advising.

The interdisciplinary nature of the proposed program draws students who are interested in applying network science in different areas and disciplines. The program has attracted students who are not only technically strong but are also interested in major scientific challenges and the solution of real-world problems. The program provides a path for students to acquire experience and skills in networks while at the same time being knowledgeable in a specific application area.

2.1 Program Structure

The doctoral program is an interdisciplinary program, supported by multiple colleges and departments at Northeastern University. The Network Science Institute at Northeastern University serves as the primary research organization for doctoral students. The Institute is currently made up of ten core faculty collocated in a modern, largely open floor setup. Our core faculty and affiliated faculty members are from a range of academic departments, including physics, political science,

communication, computer science, health sciences, and business. Applicants to the doctoral program are evaluated on their academic readiness (e.g., GPA, exam scores), interest and understanding of network science (assessed by their personal statement), and, in some cases, research experience (while this is not required, exposure and success in research environments is weighed heavily). Successful applicants must show outstanding academic and intellectual capabilities as well as having interest in an area that is aligned with the Institute's projects. When students apply to the program, they must identify a focus area – political science, health science, computer science, or physics. We use these categorizations to help us create diverse cohorts and identify possible faculty mentors. Students invited into the program are offered fellowships for their first year, allowing them time to explore different areas of research and mentorship styles. By the end of the first semester of year 2, students will have selected a dissertation advisor from the core network science faculty or associated faculty.

2.2 Program Objectives

The purpose of the program is to build competence in network science through: (1) coursework, (2) research collaboration and exchange (through an extensive schedule of speakers, research visitors, workshops, and team meetings), and (3) independent (mentored) research on a range of large-scale projects that draw extensively from the multiple disciplines and tools offered by the field.

The key goals for the network science program are to:

- Develop interdisciplinary scientists who understand and appreciate the full scope of network science and who are poised to engage challenging questions across multiple disciplines
- Understand the diverse languages, foci, and tools of network research by introducing students early in their graduate training to both disciplinary and interdisciplinary orientations regarding the influence of interconnections in complex social, virtual, physical, and natural systems
- Acquire skills using relevant theories and advanced modeling methods
- Understand the range and value of different (qualitative and quantitative) data collection methods and analytic techniques
- Develop intellectual flexibility regarding approaches to network-based research
- Serve as a catalyst for a new generation of network research and the emerging field of network science
- Understand important issues in scientific careers, including challenges and opportunities (e.g., from the logistics of funding/publication to considerations of ethical, institutional, and societal challenges in scientific work)

We expect that the graduates from our PhD program will have acquired:

- Comprehension of the mathematics of networks, and their applications to biology, sociology, technology, and other fields, and their use in the research of real complex systems in nature and human-made systems
- Adequate knowledge on network modeling, on network data mining clustering, visualization techniques, statistical descriptors of networks and computational statistics, data acquisition and handling, measurement, and research design
- Ability to communicate network science concepts, processes, and results effectively, both verbally and in writing
- Preparation to enter many potential career paths including industrial research positions, government consulting positions, and postdoctoral or junior faculty positions in academic institutions

2.3 Admission Criteria and Process

Application materials include transcript(s), personal statement, three letters of reference, and the general GRE scores. Students are accepted with a bachelor's or higher degree in any field and should have either academic or work experience demonstrating a commitment to working in network science. Interest in the program has steadily increased with 13 applicants in 2014, 61 applicants in 2015, 71 applicants 2016, and 86 in 2017. Currently, the Institute is training 21 network science PhD students. Over the four admission cycles that have taken place, approximately 17% of the applicants have received an offer of admission. Successful applicants typically have an average undergraduate GPA of 3.61; verbal and quantitative GRE general scores at 85th and 86th percentile or higher, respectively; analytical GRE general score of 4.4; and a minimum TOEFL score of 100 (in the case of international applicants). Offers of admission are made based on the applicant's qualifications, the alignment of research goals with existing faculty, and space within the program. The students will obtain a PhD Degree in network science.

3 Characteristics of the PhD program

The PhD curriculum is designed to provide students with graduate-level understanding of foundational network science concepts. In addition to course evaluations, there are three assessments over the doctoral training: Qualifying Exam, Comprehensive Evaluation, and Dissertation Defense. The successful student will master the following fundamental skills:

- Comprehension of the mathematics of networks and their applications to biology, sociology, technology, and other fields.
- Statistical descriptors and biases of network data
- Measures and metrics of networks

- Network clustering techniques
- Network modeling
- Network data mining techniques from real-world datasets to networks
- Understanding process modeling on networks
- Network visualization
- Familiarity with the ongoing and current research in the field of network science
- Understanding of additional (non-network methods) that enable network research, including:
  - Computational statistics (e.g., inferential methods)
  - Data acquisition and handling
  - Measurement and research design

Graduates of the program should also be capable of leading and performing independent, new research projects related to network sciences. Students will need to show competency to communicate network science concepts, processes, and results effectively, both verbally and in writing. It is expected that graduates will be well-prepared to enter many potential career paths including industrial research positions, government consulting positions, postdoctoral researchers, or junior faculty positions in academic institutions.

4 Degree Requirements

Required coursework includes: (1) Three network science foundational courses (Complex Networks and Applications, Network Science Data I, and Dynamical Processes in Complex Networks); (2) data analytic courses (students select either Social Network Analysis or Data Mining Techniques); (3) three to four elective courses (twelve semester hours), defined by their specific track and research goals; and (4) two independent research courses with core faculty of the program. Electives are dependent on a student's area of concentration and subject to approval by their faculty advisor. The expected time to degree is 5 years. Below we give the description of the courses that our PhD students most usually take (required and elective). Additional information on the course syllabi can be found here: https://www.networkscienceinstitute.org/phd.

4.1 Required Core Courses

1. Complex Networks and Applications

Introduces network science and a set of analytical, numerical, and modeling tools used to understand complex networks in nature and technology. Focus is on the organizing principles that govern the emergence of real networks and the theo-

retical concepts necessary to characterize and model them, with examples coming from biology (metabolic, protein interaction networks), computer science (World Wide Web, Internet), and social systems (e-mail, friendship networks). Covers elements of graph theory, statistical physics, biology, and social science as they pertain to the understanding of complex systems.

2. Network Science Data I

An introductory course on programming for network and data scientists. Students learn the fundamentals of computer programming (e.g., control structures, data structures, algorithms) with particular focus on applications to network and data sciences, such as how to create a network and analyze its basic features using Python.

3. Dynamical Processes in Complex Networks

Immerses students in the modeling of dynamical processes in complex networks (contagion, diffusion, routing, consensus formation, etc.). Provides a rationale for understanding the emergence of tipping points and nonlinear properties that often underpin the most interesting characteristics of sociotechnical systems. The course reviews the recent progress in modeling dynamical processes that integrate the complex features and heterogeneities of real-world systems.

4. Data Analytic Courses

a. Social Networks

Offers an overview of social network analytic methods including topics such as how to characterize topology and visualize and analyze networks. Explores major social network research, covering seminal work from political science, sociology, economics, and physics including small-world literature and the spread of information and disease.

b. Data Mining Techniques

Covers various aspects of data mining, including classification, prediction, ensemble methods, association rules, sequence mining, and cluster analysis. The class project involves hands-on practice of mining useful knowledge from a large data set.

5. Independent Research

Offers advanced students an opportunity to work with an individual instructor on a topic related to current research. Instructor and student negotiate a written agreement as to what topics are covered and what written or laboratory work forms the basis for the grade. Viewed as a lead-in to dissertation research.

4.2 Concentration Elective Courses

1. Network Science Data II

Explores advanced topics of network analytical approaches and practical exercises in real network data. Students learn how to retrieve network data from the real world, analyze network structures and properties, study dynamical processes on top of the networks, and visualize networks. Covers topics such as centrality measures, network sampling and filtering, temporal networks, community detection, network visualization, multiplex networks, and big data network analysis.

2. Statistical Physics of Complex Networks

Covers applications of statistical physics to network science. Focuses on maximum-entropy ensembles of networks and on applicability of network models to real networks. Main topics covered include micro-canonical, canonical, and grand-canonical ensembles of networks, exponential random graphs, latent variable network models, graphons, random geometric graphs and other geometric network models, and statistical inference methods using these models. Covers applications of maximum-entropy geometric network models to efficient navigation in real networks, link prediction, and community structure inference.

3. Special Topics: Bayesian and Network Statistics

An introduction to advanced quantitative methods including maximum likelihood, hierarchical models, sampling, and network modeling. The course begins with a review of probability and then examines maximum likelihood methods for estimating regression models with continuous and categorical dependent variables, followed by examining a variety of procedures for sampling from posterior distributions. These methods are applied to hierarchical modeling and other simple probabilistic models. The course then takes a closer look at the statistical modeling of networks as it has been developed in the social sciences, beginning with the exponential random graph model (ERGM) and finishing with the temporal SIENA model.

4. Introduction to Computational Statistics

Introduces the fundamental techniques of quantitative data analysis, ranging from foundational skills to more advanced topics in statistics, machine learning, and network modeling. Emphasizes real-world data and applications using the R statistical computing language. Prepares students to apply a wide variety of analytic methods to data problems, present their results to non-experts, and progress to more advanced coursework.

5. Network Economics

Covers seminal work in the economics of information and networks. Progresses through concepts of information, its value, measurement, and uncertainty; two-sided (or multi-sided) network effects, organizational information processing, learn-

ing, and social networks; how rational actors use information for private advantage; and other micro- and macro-economic effects such as matching markets. Students are expected to produce a paper suitable for publication or inclusion in a thesis.

6. Graph Theory

Covers fundamental concepts to include adjacency and incidence matrices, distance in graphs, matchings and factors, connectivity, network flows, vertex colorings, Eulerian circuits and Hamiltonian cycles, planar graphs, and Ramsey theory.

7. Algorithms

Presents the mathematical techniques used for the design and analysis of computer algorithms. Focuses on algorithmic design paradigms and techniques for analyzing the correctness, time, and space complexity of algorithms. Topics may include asymptotic notation, recurrences, loop invariants, Hoare triples, sorting and searching, advanced data structures, lower bounds, hashing, greedy algorithms, dynamic programming, graph algorithms, and NP-completeness.

4.3 Student Requirements & Evaluations

- Credit Hours

A minimum of 32 credit hours of coursework is required, though the graduate program committee may recommend additional coursework based on student research interests. In principle, course requirements can be waived for students transferring from other programs upon the analysis of the transcript by the program director of the network science PhD program in consultation with the graduate program committee. Up to 9 credit hours can be transferred from regionally accredited US graduate programs, with approval of the program director.

- Minimum Academic Standards

Satisfactory progress in the program is ongoing and formally evaluated at the end of both the first and second years of the program. Students are expected to maintain a cumulative GPA of 3.0 or better in all coursework and to earn at least a 3.0 in the two core foundational and two core data analytic classes. A student who does not maintain the 3.0 GPA, or is not making satisfactory progress on their dissertation research, may be recommended for termination by the graduate program committee.

- Dissertation Advising

Each student has one primary research advisor from the network science doctoral program faculty. As part of the admission evaluation, an initial match is made between new incoming students and faculty members of the Institute. However,

during their first and second years in the program, students are expected to meet with their assigned advisor, as well as with other institute faculty members, to determine the best advisor-advisee match. Students must solidify the relationship with their selected research advisor by the end of the spring semester of their second year.

- Qualifying Examination

All students are required to take the qualifying exam in the fall semester of their 3rd year of the program. Students receive 50–80 potential questions one month before the exam, which consists of a set of questions provided by each one of the core faculty of the Institute. Students are asked a subset of these questions by the qualifying examination committee, to which they must be prepared to provide in-depth answers in an oral format. Students have up to 2 hours to show competency across the topics, after which the committee meets to evaluate the student's performance. The committee provides feedback immediately to the students, offering suggestions for growth and direction. Students who do not pass the qualifying exam on their first attempt are expected to retake the exam in the spring term. Students may take the qualifying exam no more than twice. Students who fail to complete the qualifying examination but who have completed all the PhD program's required coursework with a cumulative GPA of 3.0 or better will be awarded a terminal Master of Science in network science degree.

- Comprehensive Examination

PhD students must submit a written dissertation proposal to their dissertation committee. The dissertation committee consists of at least four members: the dissertation advisor (tenured/tenure-track Northeastern University faculty member), one additional network science doctoral program faculty member, one expert in the specific topic of research (who can be from outside the university), and one additional tenured/tenure-track faculty member from the concentration department. The proposal should identify relevant literature, define a research problem, outline a research plan, and describe its potential impact on the field. A presentation of the proposal shall be made in an open forum, and the students must successfully defend it before the dissertation committee. The comprehensive exam must precede the final dissertation defense by at least 1 year. Students may repeat the comprehensive examination once if they are unsuccessful in their first attempt.

- Degree Candidacy

A student is considered a PhD candidate upon completion of required coursework with a minimum cumulative GPA of 3.0, satisfactory completion of the qualification examination, and satisfactory completion of the comprehensive examination.

- Dissertation Defense

A PhD student must complete and defend a dissertation that involves original research in network science. The dissertation defense must adhere to the College of Science policies, as outlined in the Northeastern University Graduate Catalog.

4.4 Sample Course Outline

The curriculum is designed to provide PhD students with a strong foundation in network science. Below we present a sample course outline.

Year 1, Fall Semester	
Complex Networks and Applications	(4 credits)
Network Science Data I	(4 credits)
Year 1, Spring Semester	
Network Science Data II	(4 credits)
Concentration Elective	(3–4 credits)
Year 2, Fall Semester	
Dynamical Processes in Complex Networks	(4 credits)
Concentration Elective	(3–4 credits)
Research	(2 credits)
Year 2, Spring Semester	
Social Network Analysis	(4 credits)
or	
Data Mining	(4 credits)
Concentration Elective	(3–4 credits)
Research	(2 credits)
Dissertation (PhD Candidacy Achieved)	
Year 3 and Until Completion	
Dissertation Research	

5 PhD Program Progress & Evaluation

The PhD program in network science was launched in the fall of 2014. Now in its fourth year, our program has seven (7) students in year 1, six (6) students in year 2, five (5) students in year 3, and three (3) students in year 4. We have brought together promising young scientists from various backgrounds, who are eager to combine their thoughts and basic principles from the different scientific disciplines they come from. As the first US network science PhD program, other organizations and academic colleagues are looking toward our program for ideas about how to develop and structure a graduate level program in network science. Our team is dedicated to leveraging the existing momentum in the field by evaluating and modifying the program when needed. We rely on the input from and dialogue among the diverse core faculty, as well as the active engagement with the student body. The doctoral students have been exceptionally proactive in this endeavor, forming a student council to formally organize activities and assess all aspects of the program. As part of

this ongoing dialogue between the leadership and students, we implemented an anonymous online survey. We received fifteen[1] responses from the first three cohorts of the doctoral program.

5.1 Program Evaluation Survey

During the academic year 2016–2017, we sent all 15 students a 7-question survey. Students were asked about both the content and ordering of the courses; the process of selecting an advisor; and about how prepared they feel for the job market. Twelve students (80%) indicated that they would like additional classes to be offered in the program. They mentioned analysis and method courses that they would like to have had the opportunity to take in the first semester of the program, including Advanced Statistics (e.g., causal inference), Experimental Methodology, Linear Algebra, Calculus and Probability, and a few applied courses, most prominently, network neuroscience. Eight students (53.33%) said that they were happy with the sequence of courses, while three students (20%) were neutral, and four students (26.67%) would like some changes. For example, they mentioned that the network science Data course should be offered before or at the same time as the Complex Networks and Applications course. Eight students (53.33%) suggested that the Network Science Data course should be offered in the first semester or even be divided into two courses, introductory and advanced. Students were very positive when asked about some new activities in the program, including a graduate student speaker series. In terms of professional trajectory, eleven students (73.33%) indicated that they would consider positions in academia, ten students (66.67%) are interested to work in the business and corporate environments, while seven students (46.47%) said they would also consider government or nonprofit positions.

One of the most important insights from the survey arose from the widespread concern about how students who come from different fields are differentially prepared for the courses and research tasks. Students suggested a buddy system for incoming students and a weeklong program (Net Sci boot camp) to ensure that future cohorts will be at equivalent levels in basic coding, complex systems, and network theory. In the months following the survey, the students presented to the faculty a proposal for 5-day introductory session designed for the incoming doctoral student cohort and taught by the doctoral students in their second or third year of the program. The ability to both identify core topic areas necessary across disciplinary

[1] In the academic year 2016–2017, the cohorts of the first three years were fifteen (15). Specifically, the incoming students in that year were seven (7). All the fifteen students participated in the survey. However, one student of the year 2016–2017 had, for personal reasons, to restart the PhD program in the following academic year, 2017–2018. This is the reason that, in the end, there are six (6) students in year 2 and seven (7) students in year 1.

backgrounds and then to self-organize in such a way to competently teach those topics is a true signal of achievement for our program. Building common language and context represents the greatest challenge of interdisciplinary endeavors. Our students were able to discover this and design a solution in a matter of months, attesting to the power of interdisciplinary thinking and problem-solving.

5.2 Changes Introduced to the PhD Program

In the time between program launch in fall 2014 and 2017, there has been revision to the content and structure of the PhD program. These revisions have been based on continuous and ongoing evaluation of PhD program, to ensure that the educational, research, and professional objectives of the program have the best opportunity for success. The discussions between the faculty members, the instructors, the leaders and the students, as well as the survey results, led the leadership of the PhD program to introduce changes for the Academic Year 2017–2018. These changes are the following:

- There are two new concentration elective courses in the curriculum. One is the Statistical Physics of Complex Networks. The second elective was derived by splitting the original Network Science Data course into two. The Network Science Data I course will now be an introduction to use computational and algorithmic approaches to the analysis of network data and will be taught, as a core course, in the Fall Semester, in accordance with the theory course "Complex Networks and Applications" which the students take at the same time. The Network Science Data II will be offered in the Spring Semester, starting in 2018, and it will cover, as an elective course, more advanced numerical methods of analysis of networks (e.g., centrality measures, network sampling and filtering, temporal networks, community detection, network visualization, multiplex networks, big data network analysis).
- Due to the difference in the backgrounds of the incoming students, the PhD students are self-organized – with the support of program leadership – to carry out a 5-day boot camp series that took place 1 week before the official start of the semester. Each session was led by the older students on scientific principles and concepts required for the successful completion of the regular classes. Sessions included basic programming languages and computing tools, statistical analysis, linear algebra, whiteboarding, approximations and concepts used in physics (regimes, Taylor expansion, mean field, units, variable transformation, master equation), core algorithmic approaches, and origins of network science within the fields of complex systems and social network analysis.
- Beginning in the spring semester of 2017, we have been holding a weekly network science Literature Review Seminar led by a senior faculty member. Each week the group discusses seminal papers in network methods and theories.

5.3 Future Steps

The program has required significant improvisation, reflecting its newness and the interdisciplinary interests of the students. Critical to successful adaptation has been to listen to and work with doctoral students, and we anticipate ongoing evolution in future years. Building in feedback mechanisms, such as the survey, regular town halls with all of the students, and monthly meetings with the leadership of the students, is likely good practice for all doctoral programs but in this case was essential. We will continue to assess the introduction of the specific changes through additional surveys as well as more formal assessments of students performance through graded activities within the classroom and during the qualifying examination. In addition, as the first graduating cohort reaches the job market, we will be in a more suitable position to assess the program in total. At this phase, what we know is the importance of helping the students to overcome the difficulties that the interdisciplinary nature of the program itself creates. Focused on this target, we are waiting for the outcome of the changes made for the academic year 2017–2018, and we are ready to discuss with the students and consider their needs on a continuous basis.

We are encouraged that in addition to the PhD program offered at Northeastern University, there are new programs on network science being developed in the United States and in Europe. Such programs are the following:

- Network Science Certificate program at the Naval Postgraduate School (2013) [4]
- Undergraduate Minor in Network Science at the US Military Academy (2014) [5]
- PhD program in Network Science at the Central European University (2015) [6]
- Advanced Certificate program in Network Science at the Central European University (2015) [7]
- Network Science Traineeship program at UC Santa Barbara (NSF-IGERT, 2015) [8]
- Network Biology Traineeship at University of Maryland (NSF-NRT, 2017) [9]
- Complex Networks and Systems Traineeship at Indiana University (NSF-NRT, 2018) [10]
- Master of Science in Network Science at Queen Mary University, London, UK (2015) [11]
- Master in Complex Systems, “Physics, Computer Science, and Complex Networks,” at École Normale Supérieure (ENL), Lyon, France [12]

It is very promising that the scientific community has started to recognize the specific value of training in network science and specifically of creating young researchers educated as network scientists. As additional programs are established, we are optimistic that collaborations and exchange programs can thrive in the future.

In the spirit of building a student community, we organized a workshop for young scientists who are working on network science-based problems. We invited students from all backgrounds to participate in a one-day meeting to share research, discuss interdisciplinary challenges, explore career paths, and engage in dialogue with experts in the field. As part of this initiative, the students involved with the planning also officially formed the Society of Young Network Scientists (SYNS).

The vision for the society is to build a cohesive community among young network science scholars working across disciplines and within a diversity of research centers. The group currently has 40 students, with active social media profiles, consensus on the organizational structure, and plans to host annual meetings as well as smaller workshops throughout the year.

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