



Network Science Institute
at Northeastern University
London



Northeastern University London Fully Funded PhD Scholarship in Network Science

Reconstruction and Modeling of Higher-Order Interactions in Complex Systems

Northeastern University London > Network Science Institute

Deadline: 16 February 2025

Funded PhD Project (UK or International Students)

Funding provider: Northeastern University London (NU London)

Subject areas: Network Science

Project start date: April 2025 preferred, with possibility for October 2025

Supervisors (*lead):

- Giovanni Petri* (Network Science Institute, Northeastern University London)
- Gunnar Moeller (University of Kent)

Aligned programme of study: PhD in Network Science

Mode of study: Full-time

Northeastern University London

As part of a major investment, Northeastern University London (NU London) has multiple, fully-funded PhD studentships available to accelerate its interdisciplinary research in the humanities, social sciences, and computing, maths, engineering and natural sciences. Each scholarship is fully-funded for three and a half years (UKRI rates) and includes full course fees, an annual stipend (including an additional London allowance) and associated costs, such as training.

NU London is both a UK university governed by UK higher education regulations, and the European campus of Northeastern University – a large, top-tier research intensive, Boston-based institution. Founded in 1898, Northeastern University is known for its high-impact research, aimed at solving problems across the globe. Interdisciplinarity, experiential learning, and connection to partners beyond academia are at the heart of the Northeastern University ethos. Northeastern received \$230.7m of external research funding in 2022, and is the



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recognized leader in experience-driven lifelong learning. It has campuses across the United States and Canada (in Boston; Charlotte, North Carolina; Portland, Maine; Oakland, California; San Francisco; Seattle; Silicon Valley; Arlington, Virginia; the Massachusetts communities of Burlington and Nahant; Toronto and Vancouver). Whilst the PhD will be a UK qualification, students will have the opportunity to engage with and visit the Northeastern University network overseas as part of their London-based doctoral studies, providing a truly unique and highly sought-after dimension to their research training.

The Project

How do higher-order interactions (HOIs) shape the dynamics and emergent properties of neural and social systems? This is the central question driving this PhD project, part of the ERC Consolidator Grant “RUNES” (Reconstruction and Unification of Neural and Social Systems). The successful candidate will contribute to advancing our understanding of HOIs, tackling one of the frontiers in complex systems research by bridging the critical gap between theory and data.

The research program will begin with the development of theoretical models that leverage topological and information-theoretic approaches to describe HOIs. These models aim to uncover how interactions beyond simple pairwise relationships drive phenomena such as synergy, redundancy, and collective behavior in complex systems. Building on this foundation, the project will focus on inference and reconstruction methods, utilizing Bayesian and non-parametric methodologies to infer HOIs from incomplete or low-dimensional data. Computational experiments will explore how HOIs influence system dynamics, including synchronization, contagion, and critical transitions, while empirical applications will validate these models against real-world datasets from neuroscience (e.g., fMRI, EEG) and social systems.

This interdisciplinary project integrates theoretical, computational, and empirical approaches to tackle some of the most pressing questions in the study of complex systems. By exploring HOIs, the research promises to advance our understanding of neural and social systems, paving the way for innovations in modeling emergent behaviors and collective dynamics.

The successful candidates will:

- MSc (or equivalent) in Mathematics, Physics, Computer Science, or related fields.
- Strong computational and modeling skills.
- Experience in complex systems, network science, or statistical mechanics.
- Proficiency in programming (e.g., Python, Julia, C++, or similar).
- Excellent communication and collaboration skills. Have a proven, strong educational background in history or a related subject (see eligibility criteria)

The successful candidate will join the [Network Science Institute](#) within the [NPLab](#) (led by [Prof. G. Petri](#)), and is expected to interact with members of the group, as well as with postdocs, graduate and PhD students, and to work across a range of applications of network and topological data analysis, both within and outside of the lab.



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In addition, the successful candidates will benefit from a brand new campus on the banks of the River Thames next to Tower Bridge. This is an interdisciplinary, vibrant research environment with international collaboration and networking opportunities and dedicated research space. It will form the hub of a highly experienced, multi-institution supervisory team from NU London, Northeastern University and the University of Kent. In addition, successful candidates will benefit from the unique connection to the wider Northeastern University network in North America, providing a range of additional research opportunities and learning resources.

Shortlisted candidates will be interviewed at the end of February. Candidates are welcome to contact the NU London supervisor with informal enquiries before the application deadline: Giovanni Petri (giovanni.petri@nulondon.ac.uk)

Eligibility

- Bachelor's degree in a relevant subject - 2:1 or 1st (essential)
- Master's degree in a relevant subject (strongly recommended)

English Language requirements:

If applicable – IELTS 7 overall (with a score of at least 6.5 in each individual component) or equivalent.

Nationality

Applications are open to UK and international students. Please indicate if you are likely to require a visa on your application. We are unable to support visa costs

Funding

This scholarship covers the full cost of tuition fees, an annual stipend and an additional London allowance (set at UKRI rates) for 3.5 years.

International travel

This scholarship covers the full cost of tuition fees, an annual stipend and an additional London allowance (set at UKRI rates) for 3.5 years. For the 2024/2025 academic year the annual stipend is £21,237. Annual increments will be in line with UKRI rates.

How to Apply

Please submit a CV and a Covering Letter stating how you meet the requirements and why you are interested in the proposed research project by clicking on [this link](#). Please reference your application “**R131495**”