Sophia Danielle Kolak

Email Website Github

Education

Carnegie Mellon University, School of Computer Science, Pittsburgh PA — May 2026
PhD Candidate in Software Engineering

Columbia University, Columbia College, New York NY — May 2021
Computer Science: Intelligent Systems Track
Concentration in Mathematics

Relevant Courses: Machine Learning, Programming Languages & Translators, Advanced Software Engineering, Artificial Intelligence, Computation and the Brain, Senior thesis in Computer Science, Analysis of Algorithms, Modern Analysis, Quantum Computing, Computer Science Theory, Fundamentals of Computer Systems, Advanced Programming, Data Structures, Linear Algebra, Research in Computer Science I & II, Discrete Math, Multivariable Calculus

Research Experience

Columbia University - Performance Patterns — Research Assistant
Advisor: Baishakhi Ray — *Spring 2020-present*

Developed a method for predicting the performance of Python samples with deep learning. Scraped correct samples at different runtimes from leetcode algorithm challenges and used DeepWalk (an unsupervised DL technique) to embed their graph representations in Euclidean space, then classified them as high or low performing with 97% accuracy.

Carnegie Mellon University - Neuro-reuse — Research Assistant
Advisor: Claire Le Goues, David Garlan — *Summer 2020*

Proposed and implemented a method called "neuro-reuse", wherein a neural network planner leverages information from old ANNs to replan with evolutionary computation. Empirically evaluated this transfer learning method in our exemplar self-* system and found that neuro-reuse converged faster in the majority of trials and was more robust against drastic changes.

Carnegie Mellon University - ROS Ecosystem — Research Assistant
Advisor: Claire Le Goues, Michael Hilton, Chris Timperley — *Summer 2019*

Created a database of packages in the Robot Operating System (ROS) ecosystem and their dependencies, with the ability to create snapshots of the ecosystem over time. Examined all ROS packages on GitHub along with their dependencies, discovered over 200,000 applications that extend the ROS framework. Analyzed growth in the ROS ecosystem, identified a small set of working groups at the core of its collaboration structure.

Columbia University: Axel Laboratory - Cognitive Spatial Maps — Research Assistant
Advisor: Richard Axel, Walter Fischler — *Fall 2018-Spring 2019*

Assisted with an experiment that recorded place and time cell activity during a navigation task to examine how mice represent, recognize and employ sparse olfactory landmarks to form a cognitive spatial

map. Used machine learning techniques to identify place and time cells in high dimensionality neuron spiking data, and to correlate their activity with behavior.

Publications

[1] **It Takes a Village to Build a Robot: An Empirical Study of the ROS Ecosystem**, **Sophia Kolak**, Afsoon Afzal, Claire Le Goues, Michael Hilton, Chris Timperley, in Proceedings of the IEEE 36th annual international conference on software maintenance and evolution, ICSME 2020

[2] **Detecting Performance Patterns with Deep Learning**, **Sophia Kolak**, in Proceedings of the ACM SIGPLAN International Conference on Systems, Programming, Languages, and Applications: Software for Humanity, SPLASH Companion '20

[3] **Reusing 100% of The Brain: Neuro-reuse for Self-* Planning**, **Sophia Kolak**, Cody Kinneer, David Garlan, Claire Le Goues, *under review* for the Symposium on Software Engineering for Adaptive and Self-Managing Systems '21

[4] **SHIRLEE: A Sharp-edge Handheld Identifier and Remover in Low-gravity Extravehicular Environments**, Dada, Ganeshan, Groll, **Kolak**, Ravi, Stein, Wang in Proceedings of American Institute of Aeronautics and Astronautics AIAA SciTech Forum 2021

Presentations

It Takes a Village to Build a Robot, *ROScon 2019, Macau video slides*

Invited Robotics Software Quality Panelist, *ROS World, November 2020*, video

ICSME Talk - ROS Empirical Study, *ICSME, 2020*, video

ROS Developers Podcast - Featured Interview, January 2020, video

Quantum Computing and Independence-Friendly Logic, *Deconstructing Hintikka Summer course, Inter-University Centre, Dubrovnik program*

Awards

Third place, SPLASH Student Research Competition 2020

Finalist, CRA Outstanding Undergraduate Researcher Award 2021

Best paper, AIAA Student Research Competition 2020

Winning tool, Micro-G NExT NASA Challenge 2019

Leadership Activites & Teaching

Association for Women in Mathematics - President
2018-present
Responsible for organizing weekly events to help students navigate their technical courses and build community within the math department. Overseeing mentorship, outreach, events, and club publicity.

Computer Science Theory (COMS 3261) - Teaching Assistant
Semesters: Fall 2019, Spring 2020, Fall 2020

Responsible for holding office hours, grading assignments, managing piazza and holding recitation for Columbia's undergraduate course on automata theory and computational complexity.

Columbia Space Initiative - Computer Science Mission Co-Lead
2017-present
Led Columbia's team in the NASA-SUITS design competition. Our team created and demoed an augmented reality UI for next-generation spacesuits, which we presented to NASA and Microsoft.

AWM Machine Learning Reading Group - Lead
Fall/Spring 2020
Ran weekly discussions on various introductory topics in machine learning. As a result of the success of these groups, our club was awarded the 2020 AWM Student Chapter Award for Scientific Excellence.

Skills

Programming: Java, Python, C++, C, C#, R
Databases: MySQL, GraphQL, Neo4j
Frameworks/Libraries: ROS, PyTorch, TensorFlow, Scikit-Learn, Qiskit
Languages: Conversational in BCS (Bosnian/Croatian/Serbian)