

# Kara Schatz

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## EDUCATION

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### Doctorate of Philosophy in Computer Science

Expected Graduation May 2025

*North Carolina State University (NCSU), Raleigh, North Carolina*

College of Engineering — Department of Computer Science

GPA: 4.0

### Master of Science in Computer Science

May 2023

*North Carolina State University (NCSU), Raleigh, North Carolina*

College of Engineering — Department of Computer Science

GPA: 4.0

### Bachelor of Science in Mathematics and Computer Science, Minor in Statistics

May 2020

*Xavier University, Cincinnati, Ohio*

College of Arts and Sciences — Department of Mathematics and Department of Computer Science

University Scholar; Summa Cum Laude; GPA: 3.966

## SKILLS AND RELEVANT COURSEWORK

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**Programming Languages:** Python, Java, C++, C, SQL, Cypher, MIPS, Scheme, MATLAB, Golang

**Programming Tools:** Git, Neo4j, Pytorch, Google Cloud

**Graduate Courses:** Computational Logic, Design and Analysis of Algorithms, Databases, Artificial Intelligence, Graph Data Mining, Graph Theory, Technical Communication for Engineering Research, Algorithms on Strings, Human-Computer Interaction, Automated Learning and Data Analysis

**Undergraduate Courses:** Data Structures and Algorithms, Machine Organization, Programming Languages, Databases, Artificial Intelligence, Operating Systems, Networking, Security, Graph Theory, Data Mining

## TEACHING/MENTORING EXPERIENCE

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### Online Instructor

May 2023 – Present

*iD Tech*

- Conducted online private lessons for individual students. I have taught roughly 20 different students on a variety of topics, including Python, Java, C++, Machine Learning and Artificial Intelligence, Data Science, Algebra, and Pre-calculus.
- Taught Online Teen Academies on Machine Learning and Artificial Intelligence using Nvidia Jetson Nanos. Each session lasted two weeks, two hours per day and had 5-10 students.

### Department of Computer Science

June 2021 – December 2021

*North Carolina State University*

- Mentored a high school student in computer science research.
- Worked on a database curation project.

### The Engineering Place Teacher Team Lead

June 2021 – August 2021

*North Carolina State University*

- Led a Python programming camp for high schoolers.
- Taught the basics of Python through an application to Natural Language Processing and Sentiment Analysis.
- Adapted an existing curriculum for the camp.

### Office of Academic Support SI Leader

August 2018 – May 2020

*Xavier University*

- Held Supplemental Instruction sessions to help students in Computer Science II, which focuses on Java and object-oriented programming concepts.
- Provided debugging assistance and worksheets with practice questions and sample solutions.
- Worked side-by-side with the students to help them work through tough problems with guidance.
- Held Office Hours for students in Computer Science II and Foundations of Higher Math (Discrete Math).

### Math Tutoring Lab Tutor

August 2017 – May 2020

*Xavier University*

- Tutored students in various mathematics courses at Xavier with any related coursework/concepts.

### NOYCE Summer Program Camp Lead

June 2017 – August 2017

*Xavier University*

- Ran a STEM camp for elementary and middle schoolers.
- Created lessons about various STEM fields through the lens of The Martian/“Survival on Mars”.
- Assisted with the Xavier Summer ICE Camp, a camp to spark the interest of young girls in STEM fields.

## PUBLICATIONS

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Pei-Yu Hou, Jing Ao, **Kara Schatz**, Alexey Gulyuk, Yaroslava Yingling, Rada Chirkova. “Provenance-Aware Data Integration And Querying for Knowledge Graphs.” Manuscript accepted for publication in September 2023.

Jing Ao, **Kara Schatz**, and Rada Chirkova. “Trend Surfing: Effective and Efficient Retrieval of Unusual Temporal Trends.” Manuscript accepted for publication in May 2023.

**Schatz, Kara**, D. Korn, A. Tropsha, and R. Chirkova, “Workflow for Domain- and Task-Sensitive Curation of Knowledge Graphs, with Use Case of DRKG,” in *2022 IEEE International Conference on Big Data (Big Data)*, pp. 3692–3701, IEEE, 2022

**Schatz, Kara**, C. Melo-Filho, A. Tropsha, and R. Chirkova, “Explaining Drug-Discovery Hypotheses Using Knowledge-Graph Patterns,” in *2021 IEEE International Conference on Big Data (Big Data)*, pp. 3709–3716, IEEE, 2021

**Schatz, Kara**, E. Quintanilla, S. Vyas, and Y. S. Rawat, “A Recurrent Transformer Network for Novel View Action Synthesis,” in *Computer Vision–ECCV 2020: 16th European Conference, Glasgow, UK, August 23–28, 2020, Proceedings, Part XXVII 16*, pp. 410–426, Springer International Publishing, 2020

## MANUSCRIPTS

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Daniel Korn, Pei-Yu Hou, **Kara Schatz**, Jon-Michael Beasley, Rada Chirkova, and Alexander Tropsha. “Towards Improving the Efficiency of Drug Repurposing by Leveraging Node Promiscuity in Biomedical Knowledge Graphs.” Manuscript submitted for publication in May 2023.

**Kara Schatz**, Jon-Michael Beasley, Cleber Melo-Filho, Alexander Tropsha, and Rada Chirkova. “E3D2: Extracting and Evaluating Explanations for Drug-Discovery Hypotheses Using Biomedical Knowledge Graphs.” Manuscript submitted for publication in February 2023.

## PRESENTATIONS

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### NSF STEPS Science and Technologies Center Annual Site Visit Poster Session

May 31, 2023

*North Carolina State University*

- Poster session for NSF evaluators.
- Poster covered work done on the Convergence Informatics Project for STEPS.

### IEEE Big Data Conference

December 17 – 20, 2022

*Virtual*

- Virtual conference presentation for IEEE Big Data 2022 consisting of a video, a live presentation, and a Q&A session.
- **Schatz, Kara**, D. Korn, A. Tropsha, and R. Chirkova, “Workflow for Domain- and Task-Sensitive Curation of Knowledge Graphs, with Use Case of DRKG,” in *2022 IEEE Big Data*, pp. 3692–3701, IEEE, 2022

### NCSU Graduate Student Research Symposium

April 6, 2022

*North Carolina State University*

- Nominated by my department to present a poster at the 15th Annual Symposium to showcase NCSU’s graduate-level research.
- Poster covered an extension of my work from the paper “Explaining Drug-Discovery Hypotheses Using Knowledge-Graph Patterns.”

### IEEE Big Data Conference

December 15 – 18, 2021

*Virtual*

- Virtual conference presentation for IEEE Big Data 2021 consisting of a video, a live presentation, and a Q&A session.
- **Schatz, Kara**, C. Melo-Filho, A. Tropsha, and R. Chirkova, “Explaining Drug-Discovery Hypotheses Using Knowledge-Graph Patterns,” in *2021 IEEE Big Data*, pp. 3709–3716, IEEE, 2021

### ECCV Poster Session

August 23 – 28, 2020

*Virtual*

- Virtual poster session for ECCV 2020 consisting of videos and Q&A sessions.
- **Schatz, Kara**, E. Quintanilla, S. Vyas, and Y. S. Rawat, “A Recurrent Transformer Network for Novel View Action Synthesis,” in *ECCV 2020*, pp. 410–426, Springer International Publishing, 2020

### Pi Mu Epsilon Student Talks

September 21, 2018

*Miami University*

- Presented 2018 REU research on estimating bacterial recombination rates to students and faculty in the Ohio Theta Chapter of Pi Mu Epsilon as well as other guests.

### MathFest Student Paper Session

August 1 – 4, 2018

*Denver, Colorado*

- Presented 2018 REU research on estimating bacterial recombination rates to other undergraduate students and mathematicians at MathFest.

## RESEARCH EXPERIENCE

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### Department of Computer Science

August 2020 – Present

*North Carolina State University*

- **Provenance-Aware Data Integration Project:** Developed a domain-agnostic approach to integrate data across multiple granularity levels. The approach maintains provenance during integration to enable efficient and effective querying of both the data and provenance after integration. We have submitted a manuscript of this work for publication.
- **Knowledge Graph Reasoning Project:** Designed a domain-agnostic approach for extracting and evaluating explanations of hypotheses. The approach derives explanations via a backward-chaining approach using knowledge graph triples and inference rules to justify the truth of the hypotheses. The metrics offer a global evaluation of each explanation based on existing evidence in the knowledge graph. We published a paper in the *2021 IEEE International Conference on Big Data* entitled “Explaining Drug-Discovery Hypotheses Using Knowledge-Graph Patterns” on this work. I also presented this work at *IEEE Big Data 2021* and at the 15th Annual NCSU Graduate Student Research Symposium. We have submitted a second manuscript of this work for publication.
- **Knowledge Graph Refinement Project:** Refined and improved the “Drug Repurposing Knowledge Graph” released by AWS. Previously this knowledge graph consisted only of complex identifiers connected by relationships. Through web-scraping and database cross-referencing, we have refined all the triples to now include clear entity names, relationship types, and other attributes. Overall, this makes the knowledge graph more usable for experiments, and especially for domain users, since the triples can be understood. We published a paper in the *2022 IEEE International Conference on Big Data* entitled “Workflow for Domain- and Task-Sensitive Curation of Knowledge Graphs, with Use Case of DRKG” on this work. I also presented this work at *IEEE Big Data 2022*.
- **Knowledge Graph Promiscuity Project:** Worked on developing the notion of promiscuity in knowledge graphs, which is related to node degree and connectivity. Helped to devise an algorithm for finding least promiscuous paths in knowledge graphs, which have been found to be more interesting overall than promiscuous paths. We are preparing to submit a manuscript of this work for publication.
- **Identifying Outlier Trends Project:** Developed a heuristic method to efficiently and effectively identify outlier temporal trends in data sets. I specifically worked on the theoretical justification for our approach, which involved multiple time complexity proofs, as well as deriving a formula to estimate user efforts in searching for outlier trends. We have submitted a manuscript of this work for publication.

### Science and Technologies for Phosphorus Sustainability (STEPS)

August 2021 – August 2022

*North Carolina State University*

- **Convergence Informatics Project:** Designed a system for uniformly compiling all scales of STEPS data into a knowledge graph. I led the efforts to build the knowledge graph from scratch, and design its ontology and schema as well. I used Python and Neo4j to build the knowledge graph. Through close collaboration with STEPS domain experts, I have designed an appropriate ontology, as well as a useful, reasonable knowledge graph schema.

### Department of Computer Science

January 2020 – May 2020

*Xavier University*

- **Computer Science Thesis Project:** Developed an AI to play the popular phone and web game 2048. I developed a state space for the game and implemented AI search techniques with several different heuristics to determine the best strategy.

### Department of Mathematics

August 2019 – May 2020

*Xavier University*

- **Mathematics Senior Thesis Project:** Derived and proved original formulas for the linear bandwidth and linear bandwidth criticality of complete bipartite and complete tripartite graphs.

### Center for Research in Computer Vision

May 2019 – February 2020

*University of Central Florida*

- **Novel View Action Synthesis Project:** As part of a Research Experience for Undergraduates (REU) program, I developed a machine learning framework to solve the novel view action synthesis problem, which had little prior research. I implemented this framework in Python using the Pytorch library. I continued this research for several months after the REU ended, and published a paper in the *European Conference on Computer Vision (ECCV)* entitled “A recurrent transformer network for novel view action synthesis” about this work. I also presented this work at *ECCV 2020*.

### OurCS Research Workshop

October 26 – 28, 2018

*Indiana University*

- **Human Identification Project:** Explored machine learning and its applications by developing an approach to identify humans based on audio and video data.

### Department of Mathematics and Statistics and Department of Biology

May 2018 – July 2018

*University of North Carolina Greensboro*

- **Modeling Bacterial Recombination Rates Project:** Created mathematical models and computer simulations to estimate recombination rates in bacteria. This project involved deriving formulas for bacteria recombination rates using probability and combinatorics. I also programmed a simulation in Python to model bacterial recombination based on genetics principles. I presented this research at 2 conferences: the MathFest Student Paper Session and the Pi Mu Epsilon Student Talks.

## OTHER WORK EXPERIENCE

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### Mathematics Department Assistant

August 2017 – May 2020

*Xavier University*

- Graded homework assignments for various courses, e.g., Discrete Math, Languages and Automata, and Calculus II.

## PROFESSIONAL DEVELOPMENT

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### Teaching and Communication Certificate

August 2022 – Present

*North Carolina State University*

- A certificate program to hone teaching skills through a series of workshops and development series.

### Graduate Writing Certificate

May 2022 – June 2023

*North Carolina State University*

- A certificate program to hone academic and professional writing skills through a series of workshops and development series.

### Reflective Educational Design Inclusive Teaching Certificate

October 2022 – May 2023

*North Carolina State University*

- A certificate program focused on developing resources and skills for applying inclusive course pedagogical practices that support all learners.

## SERVICE ACTIVITIES

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### FLAMES@MSEN Outreach Program

October 2022 – Present

*Volunteer*

- An outreach enrichment program for high schoolers in which we taught module on game design and development.
- Mentored participants with any help they needed, e.g., ideation, technical and comprehension issues, and debugging.

### DiamondHacks

March 26 – 27, 2022

*Volunteer*

- Mentored Hack-a-thon participants with any help they needed, e.g., ideation, technical issues, and debugging.

### Xavier Xploratory

October 2017 – February 2020

*Volunteer*

- Created lesson plans in Origami, Cryptology, and Fractals.
- Taught to middle schoolers at 3 Saturday sessions each year.

## OTHER ACTIVITIES

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### NCSU STARS Computing Corps

August 2021 – Present

*Member*

- Outreach group focused on introducing computer science to elementary, middle, and high schoolers.

### NCSU Women in Computer Science

August 2020 – Present

*Member*

### Xavier University Math Club

August 2018 – May 2020

*President*

- Organized social events where members can bond with other students who share similar interests.
- Before August 2018, the Math Club at Xavier had not held a meeting in over 2 years. By 2020, we had more than 20 active members attending our events.

### Pi Mu Epsilon (Mathematical Honor Society)

Inducted November 2017

*Member of the Ohio Theta Chapter*

### Phi Beta Kappa (Academic Honor Society)

Inducted April 2020

*Member of the Pi of Ohio Chapter*

### Xavier University Women in Computing

August 2018 – May 2020

*Member*

### Xavier University Computer Science Club

August 2018 – May 2020

*Member*

## COMPETITIONS

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### William Lowell Putnam Mathematical Competition

December 1, 2018

*Participant*

- Annual mathematics competition for undergraduates in which students are given 6 hours to complete 12 problems of high theoretical caliber.

### ACM-ICPC

November 10, 2018

*Team Member*

- Association for Computing Machinery – International Collegiate Programming Contest
- Programming competition in which teams are given 5 hours to program solutions to 10 problems.

### COMAP ICM Contest

February 8 – 12, 2018

*Team Member*

- Worked on COMAP Problem D modeling a network for electric car chargers.
- Involved: mathematical modeling, data analysis

## AWARDS

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### **NCSU College of Engineering Graduate Enhancement Award**

April 2023

- Awarded to a small number of outstanding graduate students.
- Award amount: \$2,850

### **NCSU Department of Computer Science Outstanding Research Award Nomination**

February 2023

- Recognizes a doctoral student for outstanding research contributions in the previous calendar year.

### **NCSU Provost's Doctoral Fellowship**

August 2020 – July 2021

- Awarded to support outstanding doctoral students entering the program.
- Award amount: \$30,000

### **Clare Boothe Luce Scholarship Recipient**

May 2018 – May 2020

- Awarded to an undergraduate woman in a STEM field who embodies the characteristics of the Clare Boothe Luce legacy and plans to attend graduate school in her STEM field.

### **Kramer-Miller Mathematics Award**

April 2019 & April 2020

- Presented to a senior Mathematics Major for having achieved great distinction in the study of mathematics.

### **John F. Niehaus Award**

April 2020

- Given in memory of John F. Niehaus to an outstanding senior majoring in computer science.

### **COMAP Meritorious Award**

February 2018

- Received this award for my team's submission in the COMAP ICM contest.
- Scored in the top 11% of all submissions for this problem.