RIT

B. Thomas Golisano College of Computing and Information Sciences

DEPARTMENT OF COMPUTER SCIENCE

ANNUAL REPORT 2020

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WELCOME FROM THE CHAIR

It is my pleasure and privilege to write this message on behalf of the faculty, staff, students, and alumni of the Department of Computer Science at RIT (CS@RIT). The department of computer science offers an ABET accredited 5-year BS degree in computer science (CS) that includes one year of mandatory co-op while the MS program in computer science is the largest graduate program at RIT. CS@RIT's BS and MS programs are highly sought after by students across the US and the world, with more than 12% of all RIT applicants seeking Computer Science programs. Furthermore, CS@RIT attracts highly talented students despite the stiff competition from hundreds of computer science departments across the nation, including several in the Northeast region. The department also offers popular combined BS/MS programs, in collaboration with several other programs at RIT, and a graduate certificate course in big data analytics. Starting in 2020-21, we will be offering a graduate certificate course in artificial intelligence for computer science. Our PhD program is administered within the Golisano College of Computing and Information Sciences (GCCIS). RIT's experiential programs provide opportunities for research, professional experience, study abroad, and entrepreneurship. At any given time, the department is home to nearly 1400 students. During the last five years, BS and MS programs at CS@RIT have experienced significant increase in enrollment, persistence and graduations. Typically, a total of 275-300 students graduate from CS programs each year.

Our faculty, comprising 29 tenured/tenure-track and 14 lecturers, are committed to excellence in teaching and research. 11 tenure-track faculty and11 lecturers been hired in the last 7 years to boost our research profile and to provide a robust offering of courses across the discipline.

In recent years, at CS@RIT we have significantly enhanced our research presence while maintaining our commitment to excellence in teaching. Many of our faculty, established and new, are actively involved in seeking funding, publishing in quality venues, and supervising BS, MS, and PhD students. In recent years, one junior faculty member received the prestigious NSF Career Award while two other junior faculty members have received NSF's CISE Research Initiation Initiative grant (CRII). Faculty coauthored more than 120 peer-reviewed journal and conference articles in 2020. Faculty are engaged in ongoing research activities in computing education, data science, distributed systems, graphics and visualization, artificial intelligence and pattern recognition, networking, pervasive and mobile computing, programming languages, security, and theory. The department is proud to have 4 winners of the Eisenhart Award for Outstanding Teaching and one winner of the Outstanding Teaching Award for non-tenure track faculty.

Computer Science staff, including academic advisors contribute significantly to student success. The CS Alumni network is expansive and engaged, providing the department with invaluable feedback, and sup-

port on many fronts. The department's advisory board comprises members from Amazon, Apple, Cisco, Google, IBM, Intel, Microsoft, and other leading companies.

Employment rate of our BS and MS graduates exceeds 98% while our PhD graduates have made meaningful contributions in their respective areas, and secured positions in industry and academia. As computer science continues to be the most attractive field of study to major and minor in, growth in enrollments poses challenges and opportunities.

We are proud of our achievements and excited by new opportunities as we aspire to be among the top computer science departments in the U.S. At CS@RIT, our vision is to make dreams come true. We endeavor to provide the right environment for students, staff and faculty to flourish.

Mohan Kumar
Professor and Chair
Computer Science Department
Rochester Institute of Technology

ABOUT THE DEPARTMENT

Overview of our Programs

BS in Computer Science

RIT established one of the first undergraduate schools of computer science and technology in the nation in 1972. The program was initiated while the department was in the Institute College (later changed to the College of Applied Science and Technology). The program has been ABET (https://www.abet.org) accredited since 1989. Currently, the BS in computer science is the largest undergraduate program at RIT. This program receives over 2750 applications each year; more than 12% of all applications to the undergraduate programs at RIT. The BS is a 5-year comprehensive and rigorous program that includes one year of mandatory co-op. The employment rate of our graduates is more than 98%.

Fall 2020	
BS students	1044
Fulltime equivalent	900
Credit hours	10,788

BS Student Outcomes

To allow our BS graduates to meet our long-term program educational objectives, the department has developed seven student outcomes, which describe what our students are expected to know and be able to do by graduation. Students graduating from our BS program are able to:

1. Apply the theory and principles of computer science;
2. Demonstrate fluency in high-level programming languages, environments, and tools for computing;
3. Demonstrate knowledge of the principles of computer organization, operating systems, and networks;
4. Apply computing skills and work effectively in teams in industry or research;
5. Demonstrate advanced knowledge of a selected area within the computer science discipline;
6. Prepare technical documents and make effective oral presentations; and
7. Comprehend and analyze both legal and ethical issues involving the use of computing in society.

MS in Computer Science

The MS in Computer Science is by far the most successful graduate program at RIT, attracting 800-1000 applications each year – this is nearly 18% of all applications to graduate programs at RIT. The MS graduation rate is more than 98% with 150-200 graduations each year. The MS program is preceded by a set of bridge courses, and includes an optional co-op of up to 1 year.

Fall 2020	
MS students	374
Fulltime equivalent	322
Credit hours	3179

BS/MS in Computer Science

Students have the ability to complete a joint BS/MS degree in computer science. The degree program, including 1-year mandatory co-op, can be completed in 6 to 6.5 years. We also offer joint BS/MS programs with computer security, software engineering. and computer engineering technology.

Program Educational Objectives

Our program educational objectives are broad statements that describe what graduates are expected to attain within a few years of graduation. Our graduates will be able to:

1. Pursue advanced study in computing or participate in modern software development;
2. Collaborate successfully with colleagues and clients;
3. Work as ethical and responsible members of the computing profession and society.

Industrial Advisory Board

The computer science industrial advisory board (IAB) consists of leaders from industry and government sectors who help the department ensure that “real-world” concerns are incorporated into our programs. One of the primary goals of the board is to help the department to create curricula that continue to meet the changing needs of industry. The IAB convenes annually with department members to share information about computer science curricula and the skills and training needed to advance the computing industries.

CS Industrial Advisory Board Members

Bridget Beamon - Robertson Senior Professional Engineer The Johns Hopkins University Applied Physics Laboratory	**Sal Ceravolo** Strategic Planning and Research Manage REDCOM Laboratories	**David Cok** Senior Principal Consultant
David Doerman Professor University at Buffalo	**Erik Haddad** UX Engineer Google	**Tad Hunt** Product Manager Google
James Janicki Business Unit Director Sparton Corporation	**Sean Janis** Engineering Manager, Mobile Shopping Amazon	**Michael Kirby** Vice President, Embedded Hardware/Software for Controller Product Development Xerox
Juli Klie President Veritor	**Mike Kurdziel** Communications Systems L3Harris Technologies	**John Marshall** Distinguised Engineer Cisco Systems
Paul Monette Director of Quality Engineering CloudCheckr	**Craig Paton** Global Head of Investments Technology Citibank	**Aaron Rallo** CEO TSO Logic
Laura Weime Game Developer Relations Engineer Intel	**Aaron Robinson** Senior Software Engineer Microsoft	**Anoop Thomas** Senior Graphics Programmer Rockstar Games

Co-operative Education

A co-op is a full-time paid work experience directly related to a student's course of study and career interests. The goals of cooperative education for computer science students include the application of theory to real-world situations and the opportunity to work with others in a professional environment. The co-op program prepares students for software development and provides background in communication skills, professional responsibilities, and ethical behavior mandated by today's team-oriented work environment.

BS students are required to complete a minimum of three co-op work assignments. One assignment occurs during summer and two assignments take place during semesters. MS degree students optionally complete up to 12 months of co-op work assignments.

The employment outcomes for computer science students and graduates remain bright. RIT sponsors and supports university-wide career fairs where employers and students connect. The Winter and Spring career fairs each draw around 250 employers and approximately 4000 students, leading to an average of 1500 interviews on the following day.

The average co-op wages are $21.50/hr for BS students and $26.78/hr for MS students. Organizations hiring Computer Science students include Amazon, Apple Inc., Cisco Systems, Citigroup, Datto Inc, Facebook, Factset Research Systems, Fidelity Investments, General Electric, Google, Harris Corporation, IBM, Intel, Intuit, Lockheed Martin, Microsoft, National Security Agency, Oracle, Ortho-Clinical Diagnostics, Paychex, Rochester Software Associates, Square, Thomson Reuters, Vanguard, Windstream, and Xamarin.

For more information, see https://www.rit.edu/emcs/oce/student/intro-to-co-op.

News

The following items are presented as they appeared on the Computer Science Department website during the 2020 Academic year.

Andrew Searns receives Honorable Mention for CRA 2020 Outstanding Undergraduate Researcher Award

Andrew Searns, a computer science BS/MS student, has received an Honorable Mention for the Computing Research Association's (CRA) 2020 Outstanding Undergraduate Researcher Award, which recognizes top undergraduate research students across North America.

Andrew's research is within the field of multiagent systems, a subfield of artificial intelligence (AI) that deals with reasoning and computation for deciding how to achieve fairness in resource allocation problems. He has also done research in counting problems, particularly on counting various types of cuts in graphs. Searns' research is at the intersection of theory and AI and has been advised by Hadi Hosseini and Ivona Bezakova; both faculty members in RIT's Computer Science department.

Alexander Ororbia to Work in Collaboration with Google Research

For this project Alexander Ororbia will work in collaboration with Google Research will focus on developing a backprop-free method for training neural language architectures. Specifically, he is interested in adapting some of his more recently proposed procedures for representation learning in natural language processing (NLP), with a focus on unsupervised and semi-supervised learning (of useful distributed representations of constructs such as documents). Given the expense involved in creating labeled data, especially when working with text data, an effective alternative to backprop would be of interest to Google in terms of annotation cost reduction and, furthermore, to exploit the underlying parallelism when large-scale computational resources are available, i.e., massive clusters of GPUs, CPUs, and/or TPUs.

Co-op stories: Facebook

Konce Quispe, from Queens, N.Y., says her dream is to "connect the world and give all people equal access to technology." Doing a co-op at Facebook, a company built with the intention of connecting people, was the perfect opportunity for her.
Last summer, the third-year computer science student worked as a software engineer intern at Facebook in Menlo Park, Calif. Her main projects involved making the website more accessible by developing and expanding options for keyboard shortcuts.
"RIT's student body is composed of many students with disabilities, which has given me insight into how differently abled people interact with technology in personal,

educational, and professional settings. This contributed greatly to the decisions I made regarding the user interface for my project," said Quispe, explaining how her time at RIT helped increase her knowledge of accessible design practices.

Spending time on the Facebook campus gave Quispe a lot of experience in decision making and communicating ideas. However, her most memorable experience from her co-op didn't involve her professional work.

"Once I literally ran into Sheryl Sandberg in a micro kitchen and almost knocked her over," she said, explaining an embarrassing encounter with the chief operating officer of Facebook. "I guess even the COO of a billion-dollar company needs a snack sometimes."

'U.S. News' rankings highlight RIT graduate programs

RIT graduate programs are among the best in the nation, according to the U.S. News annual statistical survey of graduate programs.

RIT master's degree programs in engineering, business and fine arts feature in the U.S. News & World Report 2021 edition of Best Graduate Schools, released in March, including the first specialty ranking of the university's business analytics master's program. This year, RIT:

- Tied for 72nd in the nation for the best graduate engineering programs, offered by Kate Gleason College of Engineering;
- Tied for 89th for the full-time MBA program, offered by Saunders College of Business, and ranked 29th in business analytics programs; and
- Tied for 23rd among fine arts programs and tied for sixth in photography, offered in the College of Art and Design.

U.S. News measures the quality of professional school programs in business, education, engineering, law, medicine and nursing. Rankings are based on statistical and reputational surveys about the school's faculty, research and students.

Beyond the six disciplines listed annually, U.S. News also periodically ranks programs in science, social sciences and humanities, fine arts, health and other areas based on academic reputation surveys. These RIT programs remain ranked by U.S. News as follows:

- Tied for 68th among computer science graduate programs, offered in Golisano College of Computing and Information Sciences;
- Tied for 69th among physics graduate programs, offered in the College of Science; and
- Tied 108th among master's degree programs in physician assistant, offered by the College of Health Sciences and Technology.

RIT faculty receive NSF award to develop a data science curriculum for non-computing majors

Computer Science faculty members, Xumin Liu and Rajendra Raj, have been awarded an NSF grant that supports them to create Data Science coursework and make it both hands-on and accessible to

non-computing students, regardless of their programming background.

Data Science is intrinsically used within a variety of application domains and ramped up the demand for data science education outside computing and mathematical disciplines. However, it is challenging for non-computing students to take data science courses due to the long chain of prerequisite courses, especially in programming, data structures, and introductory databases, as well as relevant mathematics/statistics. To address this challenge, this project aims to develop a hands-on data science curriculum will make learning more readily-accessible to non-computing majors.

This funded project will lead to a Data Science Principles (CSP) course that will be available for students outside GCCIS, who have taken CSCI 101 or ISCH 110. It was also provide data science components to strengthen Computer Science Principles (CSP) courses offered at the high-school AP and college levels

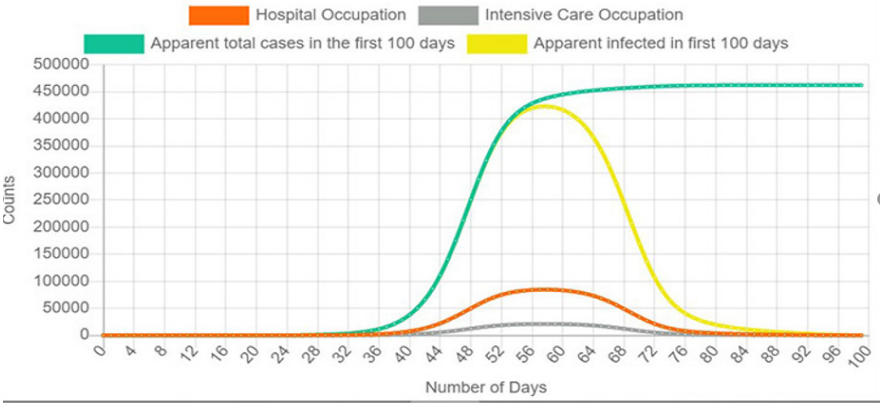
Undergraduate computer science program ranked #52 out of 481 in first US News & World Report CS rankings

RIT's computer science (CS) program is ranked #52 out of 481 undergraduate programs in the United States in recent rankings from US News & World Report. These are the first ever computer science-specific rankings by the publication, and RIT was the highest ranked program in Upstate and Western New York.

The CS program is housed in the Golisano College of Computing and Information Sciences (GCCIS), one of the most comprehensive computing colleges in the nation. CS at RIT has long been recognized by peer institutions and industry as a leading program as a result of a solid foundational courses and strong research base in areas like artificial intelligence, computer graphics and visualization, distributed systems, and theory, as well as a co-op program that places students at leading tech companies like Google, Amazon, and Facebook.

Alumni of the program include John Resig '05, inventor of jQuery, and graduates of the program go on to work at the biggest names in tech, start their own companies, or pursue doctoral work. The GCCIS doctoral program in Computer Science is ranked 68th in the US World & News Report graduate rankings. For more information visit the Computer Science department page.

Visualizations help make COVID-19 spread models more accessible



Computer science researchers at RIT want to make it easier for people to understand how COVID-19 can spread. The researchers have turned complicated predictive COVID-19 models into interactive visualizations for the general public. The visualizations show how COVID-19 can spread based on multiple factors, including the number of people in a bubble, how strictly people abide by mask wearing and social distancing policies, and the availability of a vaccine.
Thomas Kinsman, senior lecturer of computer science, and Mugdha Varpe, a computer science graduate student, noticed that many of the existing mathematical models used to predict COVID spread were only available using complicated spreadsheets. They wanted to visualize a model in a way that was accessible to anyone — not just mathematicians.

Kinsman and Varpe created an interactive visualization last fall and used it in Kinsman's course on Social Network Analysis and Data Visualization.
The Exponential Spread visualization prototype simulates exponential spreading and how it can be affected by two parameters.

"You can use a visualization like this to predict what's going to happen in the future and make informed decisions," said Kinsman. "For example, our work shows the importance of both wearing a mask and social distancing. If either masking or social distancing is missing, the virus becomes more contagious."
Users can adjust the slider bars to set their parameters, including how often people wear face masks and the average number of contacts per week. Small manipulations in behavioral parameters can drastically change the resulting graph. Due to the probabilistic nature of the model, each time users hit the "Re-run Simulation" button, they may see different results because of parameters out of their control — just like in real life.

Varpe decided to take the work a step further and develop more complicated visualizations for her capstone project.

Varpe's desktop web application includes additional parameters and graphs. Her visualization uses data from a mathematical model based on the spread of COVID-19 in New York City, throughout spring 2020.

She hopes her visualizations can be used by decision makers to help compare different cases. For example, decision makers could compare how quickly a spike can be controlled, based on how many vaccines doses are available and the number of active cases.
Varpe said that managing the slider bar functionality on the backend of the web application was a challenging aspect of her work. In order to make the graphs interactive, she had to make sure users receive

instant feedback when they move a slider bar.
“This data is important and we need to make sure people can understand it,” said Varpe, who is from India. “If we can save some lives by helping people better understand these models, that would make me very happy.”

Ph.D. student uses computing to help solve 90-year-old math problem

A Rochester Institute of Technology Ph.D. student was part of a team of researchers that settled a 90-year-old math problem called Keller’s conjecture.
student David Narvaez.

David Narváez, a computing and information sciences Ph.D. student, who helped resolve Keller’s conjecture

David Narváez, a computing and information sciences Ph.D. student, used his expertise in symmetry-breaking to help a cluster of computers solve the problem in just 30 minutes. He also brought in techniques that make the proof verifiable, meaning that mathematical computer programs can confirm the answer is correct.

“I enjoy using computer science to help solve problems that mathematicians are stuck with,” said Narváez, who is from Panama.

Keller’s conjecture is a tiling problem about how certain shapes can cover a space. It was posed by Ott-Heinrich Keller in 1930.

The conjecture asserts that if you cover an n-dimensional space with n-dimensional identical hypercubes, at least two of the hypercubes must share a face. For example, if you’re trying to completely cover a cube with matching square bricks, there should always be at least one pair of bricks that meet exactly face-to-face. The conjecture makes the same prediction for spaces of every dimension.

Throughout the past 90 years, mathematicians have explored the conjecture. It was proven true for dimensions one through six. It was then proven false in eight dimensions and higher. The last mystery was if the conjecture was true in seventh-dimensional spaces.

In fall 2019, Narváez joined Joshua Brakensiek of Stanford University and Marijn Heule and John Mackey of Carnegie Mellon University to put the unresolved question to bed. Narváez, who enjoys solving combinatorial problems using constraint satisfaction techniques, was invited to help solve the problem after collaborating with the researchers on a previous project. The team recently published a paper on their work.

The team was using an automated reasoning approach that would allow high-powered computers to systematically check all possibilities to see if Keller's conjecture was true for seventh-dimensional spaces. However, the researchers said that it would take the world's fastest computers until the end of time before they'd exhausted all the possibilities.

"The problem with these kinds of mathematical objects is they're highly structured, with many similarities," said Narváez. "There are a lot of calculations that can be avoided if you take into account those symmetries. But the computer logic doesn't know that, so it repeats a lot of work."

Narváez essentially taught the computer about what symmetries could be avoided, helping to discard big chunks of the problem and save time.

"Without symmetry breaking, the automated approach is unable to solve the conjecture," said Heule, who is an associate professor at Carnegie Mellon. "Implementing symmetry breaking is hard and we had to be sure that no mistakes were made."

An important part of Narváez's symmetry-breaking argument is that his technique also turned it into a machine-checkable proof, giving the researchers confidence in the correctness of the implementation. The technique produced an enormous proof of roughly 200 gigabytes. However, the answer that comes out of the computer is often too complicated to be understood by human beings, so it needs to be verifiable by a mathematical computer program.

Courses of Study

- Principles of Data Mining
- Intro to Big Data
- Database Systems Implementation
- Data Security and Privacy
- Big Data Analytics
- Data Cleaning and Preparation

Opportunities

- Analytics Manager
- Database Administrator
- Data Scientist

What students are saying

- All about data storing, querying, processing and application both in theory and practical implementation. - Zizhun Guo
- There is enough diversity in the courses. It helps to know where my interest lies and what courses align with that interest. - Sapan Singh
- Very well-designed coursework if you are looking to dig deeper into data analytics and databases. - Aniket Giriyalkar

The data sciences cluster studies the foundational data management and knowledge discovery challenges prevalent in design, analysis and organization of data. The courses cover general database issues, including database design, database theory, data management and data mining.

Artificial Intelligence

Courses of Study

- Intro to Computer Vision
- Intelligent Security Measurement
- Foundations of Intelligent Systems
- Mobile Robot Programming
- Image Understanding
- Neural Networks and Machine Learning
- Pattern Recognition

Opportunities

- AI Developer
- AI Engineer
- Azure/AWS Scientist
- Data Scientist
- ML Data Developer

What students are saying

- Provides mathematical foundations for the higher-level AI concepts that everyone talks about. Now, you're one of the people who can actually work with it, not just talk about it. - Dylan P. Jackson
- The artificial intelligence cluster has helped me demystify machine learning. This cluster exposes you to cool concepts and projects that you can easily apply to real world problems. - Yancarlos Diaz
- Artificial intelligence has great scope in almost all the possible fields(-finance, space, health, etc) you can think of and also a lot of potential for research as it is continuously growing. - Karan Manghi

Artificial intelligence encompasses the study of algorithms and architectures that enable effective decision making in complex environments. Artificial Intelligence aims to create technology that allows computers and machines to function in an intelligent manner. The ability of your computer to make decisions about how to solve problems without insight from users makes this discipline one of the most in demand for both research and careers-oriented students.

Courses of Study

- Aspect Oriented Programming
- Design Patterns & C#/.Net
- Functional Programming
- Efficient Design in Modern C++
- Software Development Tools
- Compiler Construction

Opportunities

- Apple
- Microsoft
- Oracle
- Facebook
- Google

What students are saying

- It is a fantastic way to learn about languages. - Robert Svetlichniy

The languages and tools cluster focuses on language design and implementation. Students will learn how languages are specialized to solve particular problems as well as how those languages and the software written in them is architected. Students will gain a broader understanding of compiler construction, language parsing and tools used in a language. Students specializing in this cluster gain a broad understanding of theoretical and applied knowledge.

Security

Courses of Study

- Data Comm & Networks
- Data Security & Privacy
- Machine Learning
- Secure Coding

Opportunities

- NSA
- Google
- L3 Harris
- Northrup Grumman
- Lockheed Martin

What students are saying

- It helps you understand the implications of seemingly simple decisions when designing systems. - Nathaniel Heitsch

The security area spans topics from networking to cryptography to secure databases. By choosing different domains in which to study security students can gain a broad understanding of both theoretical and applied knowledge.

Courses of Study

- Intro to Computer Graphics
- Foundations of Computer Graphics
- Global Illumination
- Computer Animation
- Scientific Visualization
- Computational Geometry

Opportunities

- Disney
- Pixar
- Dreamworks
- Electronic Arts
- Apple

What students are saying

- This cluster deals with computer graphics and how modern day game engines, computer animations and various other computer graphics related things work - Manan Joshi
- Lots of fun with using math and physics to make images and animation! - Caleb Adrian
- It's awesome. Being able to create images and renderings is exciting. - Boyuan Li

The graphics and visualization cluster provides the technical foundations for studies in computer graphics and image understanding. Areas for further study include graphics programming, rendering and image synthesis, computer animation and virtual reality, image processing and analysis, and data visualization.

Distributed Systems

Courses of Study

- Data Comm & Networks
- Distributed Systems
- Parallel Computing
- Cryptography
- Cloud Computing
- Network Security

Opportunities

- General Dynamics
- PayPal
- Cloudflare
- Dropbox
- Raytheon

What students are saying

- Distributed nature of things has always fascinated me to a point of becoming an addiction and RIT has provided me with an ideal platform to nurture my passion for distributed systems. - Moiz Arif
- RIT's High-Performance Distributed Systems Laboratory has been instrumental in fostering my passion for bridging the gap between high performance computing and Big Data analytics. - Avinash Maurya
- Distributed systems allow me to understand life better. It is the interpretation of how every domain has evolved in the World, and my daily interactions with such systems provide valuable insights on how to improve efficiency. - Kevin Assogba

This area studies systems formed from multiple cooperating computers. This includes the analysis, design, and implementation of distributed systems, distributed middleware, and computer networking protocols, including security.

Courses of Study

- Advanced Algorithms
- XTreme Theory
- Cryptography
- Complexity
- Computational Geometry
- Programming Language Theory

Opportunities

- Security
- Cryptography
- Internet Algorithms
- Algorithmic Game Theory
- Geometric Algorithms

The theory area studies the fundamentals of computation. These fundamentals include complexity theory to determine the inherent limits of computation and communication and cryptography and the design and analysis of algorithms to obtain optimal solutions within those limits.

Staff Spotlight

Susan Quatro

Where is your degree from (and in what)?
BS from RIT - School of Individualized Study (concentrations in communications and business management) MS from RIT - Communication and Media Technology

Where did you grow up?
Rochester, New York

What did you do before RIT?
I was a paralegal for about 15 years, then worked at the Rochester Christian School in office administration, raised my daughters and a few dogs.

What are your professional interests?
I would like to teach and will get my first opportunity this Spring teaching Communication 253 here at RIT.

What are your personal interests?
I love to spend time with my daughters, be near any body of water, I also love to hike, play board games, cards, garden and play with my dog, Lucy. I am involved in an amazing church and my faith remains important very important to me.

Describe a particularly rewarding RIT-related experience (i.e., student interaction, classroom)?
Part of my role as Manager of Student Services allows me to meet over a hundred prospective students and families each year. I have incorporated having our CS Ambassadors come to these meetings which has made the entire experience so much more rewarding and fun for both sides. I love meeting these new and interested families and watching the CS Ambassadors shine.

What is daily working life like for you during pandemic?
I am at home 3 days a week and on campus 2 days a week. I truly enjoy the convenience of working from home, but I miss reviewing things with the staff and faculty in person. I am also dreadfully close to my refrigerator! I love working in my athletic pants but will be happy when we have a full campus of students again. Pluses and minuses, just like most folks.

Is there anything else you would like to say?
I am coming up on my 10-year anniversary here in CS and I am often overwhelmed by the generosity and care of our faculty and staff. I think our department, although being the largest on campus, stays tightly knit and consistently cares for one another. It is a huge blessing in my life.

UNDERGRADUATE STUDIES

First Year Computer Science

The undergraduate first year curriculum at RIT is a challenging yet rewarding experience. Students learn Python, Java, object-oriented programming, data structures, algorithms, and other core topics of Computer Science through a unique problem-solving approach to teaching.

Each week begins with a new problem to solve, and the pedagogical goals of the course are introduced as potential solutions. This approach encourages students to thoughtfully consider which algorithms and data structures they should use, as opposed to simply translating notes on a board into source code.

Imagine being given a set of railcars encircling a board. The goal is to make the rail lines as long as possible to the center of the board or to a power station on the edge of the board. The player with the total of the longest route wins. This is the type of problem that students will solve in the introduction sequence at RIT.

Students develop solutions by working in small teams of three to four people, with pen and paper before taking the solutions to a computer. This problem-solving approach teaches students how to adapt their knowledge to a variety of applications and domains. Students, by the end of their program, will have the ability to continue to learn and adapt to new situations by applying the problem-solving skills learned in their first year. Lab time is also provided for students to implement weekly labs with the assistance of their instructor and student assistants. TAs provide weekly recitations so that students can get additional reinforcement of the material after the two-hour lecture. In addition to the time spent in the classroom, the department provides a tutoring center where students can get additional assistance for topics they may be struggling with.

Each of the introductory courses culminates in a project that utilizes many of the concepts they have learned throughout the semester. Some projects have included a competition with other students in a rousing game of Cable Car, where students compete against each other to form the longest path possible without intersecting their opponents' paths; while other projects have involved data analytics, network programming, text processing and significant aspects of program design.

Undergraduate Research

Reynold Bailey, Professor of Computer Science and Associate Undergraduate Program Coordinator, recently completed a 3-year National Science Foundation Research Experience for Undergraduates (REU) Site award, “Computational Sensing,” on which he served as co-PI, alongside PI Cecilia Ovesdotter Alm, Associate Professor of in the College of Liberal Arts. The goal of this REU Site project is to give students experience with fundamental research in acquisition and fusion of multisource sensing data related to human beings. Students are challenged to make sense of human behaviors and cognitive processes with hardware, software, and complex thinking, exploring the nexus of computational science, scientific practice, and the human experience. Traditionally, sensors have been understood narrowly, often as physiological measurements. This project envisions sensing in broader, new ways, as time-evolving measurable data directly linked to individuals and, by extension, to their communities. With this understanding, sensing data may involve language, social network and environment signals, or emotional-creative reactions.

“REU Site: Extremal Graph Theory and Dynamical Systems” is a competitive NSF award to create research experiences for undergraduates hosted by RIT during summers. Professor Narayan from the School of Mathematical Sciences (SMS) is the PI of his project, and Professor Radziszowski from CS is a co-PI, as the only member on the project’s team not from the School of Mathematical Sciences. The current award of $287,556 is funding 10 students (selected from about 150 applicants from across the US) for each of three summers to work with mentors on research projects during an 8-week residence workshop on the RIT campus. The students working with Professor Radziszowski focus on the computational aspects of Ramsey theory. This project award has been renewed three times, and has been running at RIT since 2007. The typical outcomes of each summer are student presentations at the annual Young Mathematicians Conference and at the Joint AMS Meetings, and papers published in conference proceedings and specialized journals.

Study Abroad

The Computer Science Department has created multiple opportunities for students to continue their studies while experiencing the world from a different perspective. Although there are many study-abroad options available to students at RIT, the CS Department programs are unique in that all participating students take computer-science-based coursework while abroad. We encourage undergraduate students to explore the options that the department offers, and encourage all students to check out additional study abroad opportunities offered by RIT.

Osnabrück,Germany

We offer a semester study abroad program in Osnabrück, Germany (in affiliation with SUNY Oswego). Students attend the University of Osnabrück and carry a minimum of 12 credit hours per semester in the Cognitive Science Program and focus on artificial intelligence, functional programming, neural networks, and German language and culture. This program kicks off in the beginning of April and runs through mid-July every year. This program is open to all computing students.

Staff Spotlight

Mark Stamer

I first started working at RIT in 1997 exclusively for the Computer Science Department which was then part of CAST. In 2002 GCCIS was formed and I became one of two hardware technicians supporting the entire college. My job is mainly to repair computers, printers, and other devices. It is not uncommon to see me in the many buildings or on different floors of GCCIS working in the ceiling or crawling under tables and desks. Along with these duties I'm also responsible for Lenel swipe access to labs.

Prior to my RIT life I worked as a Field Service Engineer for Decision One, a nationwide hardware support company. My clients included Sun Micro Systems, American Airlines, and Sabre Travel Systems. My territory was from Milwaukie WI to Philadelphia PA, and up to Boston MA with all points in between. American Airlines might have been the most interesting because I worked in restricted areas of airports the public does not get to see. There is nothing like going out on the tarmac to fix a printer or computer which is covered in jet fuel residue while a plane does an engine test!

When I'm home I step away from technology as much as possible. I enjoy woodworking, cooking, and hiking with my rescue dog Princess (aka: Girlfriend). I've converted my garage into a shop where I enjoy building shop grade items such as cabinets, bookshelves, and benches. I also enjoy restoring furniture and old cast iron tools. I'm a huge foodie and just about every weekend I'm cooking a new dish or smoking/grilling on my Kamado Joe. Smoked lasagna and smoked stuffed peppers, I'm told, are my signature dishes.

Honors & Awards

The Richard T. Cheng Endowed Scholarship

- **Carson Bloomingdale**
- **Aleksei Bingham**
- **Alexis Holler**

Established in November of 1997 by Dr. Richard T. Cheng, current President of ECI Systems & Engineering, and former Chair of Computer Science at RIT from 1973 to1976. Applicants must be majoring in Computer Science, be in at least their second year of study, demonstrate academic achievement (at least a 3.0 overall GPA and a 3.2 GPA in computer science courses), and financial need.

Kenneth and Margaret Reek Scholarship

- **Michael Vogt**

Established in 1999 by Ken and Margaret Reek, both alumni of RIT's Computer Science Program and former faculty members in the Department. The scholarship was established to assist students who might not otherwise be able to attend RIT. Applicants must be majoring in computer science, demonstrate academic achievement (at least a 3.0 overall GPA and 3.2 GPA in Computer Science courses), and financial need.

Carl Reynolds Computer Science Scholarship

- **Bin Qui**

Established in 2008 in memory of Carl Reynolds, who was a member of the faculty of RIT's Computer Science Department from the fall of 2004 un l his death in the spring of 2008. Applicants must be majoring in computer science and in their first year of study. The award recognizes students who demonstrates academic achievement (at least a 3.0 GPA overall and a 3.2 GPA in computer science courses) and who combines academic accomplishments with a willingness to help and mentor fellow students.

Outstanding First Year Student Scholarship

- **Benjamin Piro**

The outstanding first-year student scholarship recognizes a first year computer science major who maintains high academic standards while also contributing positively to the culture within the department. The award is given annually to an undergraduate student majoring in computer science in their first year who has earned an overall GPA 3.5 or better.

Outstanding Fifth Year Student Award

- **Yancarlos Diaz**

The outstanding fifth-year student award recognizes a fifth year computer science student for maintaining high academic standards during his or her studies at RIT and has made significant contributions to the department. The award is given annually to a student who has maintained a 3.0 GPA or better average during his or her five years of study.

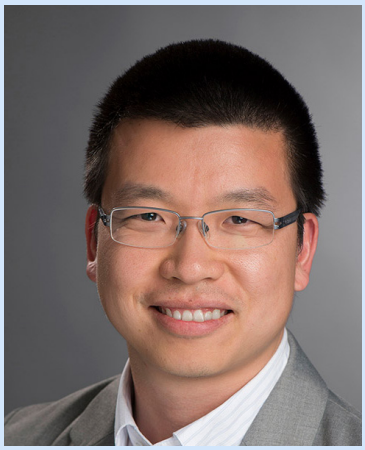
Alumni Scholarship

- **Fatima Umar**

The Alumni Scholarship recognizes a computer science BS student for maintaining high academic standards (at least a 3.5 overall GPA) during their studies at RIT and who have made significant contributions to the Department. The award is made possible by generous donations from computer science alumni.

Faculty Spotlight

Peizhao Hu



Where is your degree from (and in what)?
BS in computer science, University of Wales, Swansea
PhD in computer science, University of Queensland

Where did you grow up?
I grew up in GuangDong, China. After finishing my high school, I decided to go abroad to advance my study.

What did you do before RIT?
I was a senior research engineer at the National ICT Australia (it is now called Data61 within the CSIRO), a federated and state funded research organization focusing on use-inspired research.

What are your professional interests?
My research interests are applied cryptography for privacy-preserving computing such as machine learning and distributed systems topics including blockchain, mobile computing, networking.

What are your personal interests?
Sport such as table tennis and badminton. I also learn to fly a plane.

Describe a particularly rewarding RIT-related experience (i.e., student interaction, classroom)?
Student interactions on technical discussions inside and outside the classroom is fruitful experience which keeps me working hard to improve my teaching.

Class of 2020 (BS)

Adylova, Ayana
Angelo, Tyler
Arcaro, Anthony
Atwater, Tanner
Azhar, Talha
Barnes, Drew
Barrow, Jake
Bastian Perez, Kevin
Belle, Michael
Bendlin, Theodora
Bires-Navel, Brandon
Bitler, Christopher
Blyth, Kyle
Bohara, Akshayjain
Bowald, Dylan
Brice, Michael
Brown, Alexander
Brunwasser, Dan
Burrows, Cody
Byrne, John
Caffrey, Tanner
Camp, Bryan
Cardinali, Natalie
Carenzo, Michael
Carlson, Colin
Carlton, Scott
Carpenter, Shaun
Carr, Jason
Carroll, Zephram
Carver, William
Castaneda, John
Chacon, Oscar
Chambers, David
Chan, Ka
Charles, Martin
Christie, John
Cinibulk, Peter
Comly, William
Conn, Bryan
Cook, Ian
Coombs, James
Corrigan, Laura
Crocco, Mat
Cutler, Kyle
Davies, Trevor
Davis, Sam
De La Hoz, Omar
Dennis, Corey
Diller, Kyle
Dinman, Michaela
Ditullio, Richard
Doyle, Michael
Doyle, Peter
Eager, Joel
Ehrenreich, Patrick
Elgin, Michael
Feng, Xian
Festa, Andrew
Flam, Michael
Flores-Hernandez, Fernando
Fomchenko, Sarah
Francis, Sean
Frey, Austin
Galatic, Paul
Ganung, Nicole
Giannone, Andrew
Golden, Joseph
Goldobin, Sergey
Grace, Chris
Greene, Stephen
Grullon, Dyangelo
Gruskin, Michael
Gupta, Harshvardhan
Haqq, Qadir
Harbison, Angel
Hart, Zachary

Robin Avenoso

Why did you choose computer science as your major?
My first experience with programming goes back to middle school where I was on the Lego Robotics team. This is where I first learned how much I liked programming and since then I have been the lead programmer for my FIRST Robotics team in high school and taught myself several programming languages. I love being able to solve problems in creative and efficient ways and that is what lead me to Computer Science.

Please describe your experience as a computer science major.
Entering the Computer Science major, I had experience with programming but very little formal education. I was not sure which area interested me and I had no idea that I would later get into research. My first taste of research was an independent study where I prototyped a system to take python code written on white boards and make it executable.

Are you engaged in any groups or activities within Computer Science? If so, please explain.
I have been very involved within computer science since my first year on campus. I was a Student Lab Instructor for 3 semesters, a Grader for several courses, as well as now a TA for the intro sequence courses. I am a Computer Science department ambassador where I help with prospective student events and meetings. Additionally, I am a member of Women in Computing as the director of sponsorship for WiCHacks.

Are you engaged in any groups or activities outside of computer science? If so, please explain.
I am the present of Club Café, the coffee and tea enthusiast club on campus. I have held an Eboard position in this club since my first year. Additionally, through my years on campus, I have been involved with several clubs and organizations including Women's Frisbee Club, No Voice Zone, Tangent, and Labrys.

Please describe an accomplishment you are proud of.
While I was on Co-op at Collins Aerospace, I brought the Pride (LGBTQ) Employee Resource group to the office. I started during Pride Month and got the office to fly the pride flag for the month, organized and hosted pride events and talks. While leading the Pride ERG I got Gender Neutral Bathrooms in the office that previously only had gendered Bathrooms. I got to attend a workplace equality conference that the company sponsored but no one from our office had ever attended to bring back information to improve our office, and since I left that Co-op the Pride ERG continued under new leadership and continues to do events.

Is there someone who inspired you to go into computer science? If so, who and why.
I do not think there is a single person that inspired me to go into computer science, instead, it was a collection of many people in my life. The teachers in charge of the several robotics teams I was on. My brother, Mario, who helped me learn some programming early on. Also, two of my high school teachers, Mrs. Montleon and Mr. Spiegel that helped nature my interest in problem-solving and support me in my computer science endeavors.

What is your dream job?
Having had a lot of teacher experience through my time in college, I learned that my dream goal is to eventually become a professor and be able to teach students all the interesting things they will need to solve new problems. Before I become a professor, I would like to continue my work in handwriting recognition in industry and maybe find my next problem I would like to solve.

Describe any positive impacts of the actions you have been forced to take with the recent outbreak.
Due to the pandemic, club meetings were forced to move to video calls. This semester Club Café hosted weekly meetings on Friday night where we would gather and unwind after stressful weeks. Holding Game nights and chatting with members. We had several first-year members and the club gave them a social group so they did not feel alone during this time.

Is there anything else you would like to say?
Something I have learned through my years in college is to not let your self-worth be defined by your grades. The grades you earn only tell a part of the story and it is more important that you learn as you go through class than it is that you always get an A. There might be a class that you stumble through more than others and it is important that you don't let that stop you from what you want to do.

Hartman, Eric
Hartog, Abby
Haywood, James
Heary, Luke
Heitsch, Nathaniel
Heller, John
Hiemenz, Kevin
Hirsh, Evan
Hopkins, Michael
Hsiao, John
Huang, Alexander
Hughes, Ethan
Hunley, Jennifer
Hurlbutt, Michael
Incardona, Michael
Jackson, Chloe
Joerger, Richard
Johansen, Michael
Jones, Zach
Kanani, Krunal
Keller, Alex
Kerstetter, Carter
Kessler, Lucas
Kleinfeld, Jonathan
Knight, Cameron
Krasinski, Amelia
Kuchipudi, Nikita
Kuhn, Lillian
Kuzio, Samuel
Landau, Steven
Larsen, Grant
Latoy, Jeffrey
Lederman, Emily
Lefurge, Jeremy
Leo, Tory
Lim, Christopher
Lin, Alvin
Liu, Jennifer
Lowry, Oscar
Ly, Patrick
Madlem, Jacob
Mande, Rohan
Manning, Tristan
Mays, Amy
Mcauliffe, Connor
Mccall, William
Meisenzahl, Casey
Menezes, Jason
Miehle, Abigail
Milligan, Connor
Milton, Samuel
Missel, Ryan
Mok, Analia
Morgan, Zach
Morrissey, Ryan
Muszynski, Mason
Naple, Ian
Netti, Joseph
Nijssen, Tessa
Nyar, Kyaw
Osvath Londono, Daniel
Patten, Jonathan
Powers, Trevor
Quach, David
Quesnel, Tyler
Quinn, Shannon
Reed, Nathan
Reid, Chris
Reilly, Colin
Ricciarelli, Nicholas
Richards, Austin
Rivenburgh, Kyle
Roy Barman, Daniel
Rozenshteyn, Georgiy
Rozeski, Edwin
Rubenstein, Aidan
Rudenkyy, Dmytro
Ruffell, Justin

Sanchez, Shon
Sapp, Cody
Scanlon, John
Scholl, Evan
Schrope, Nathaniel
Schwenk, Kay
Seiders, Trevor
Serrano-Berthet, Sebastian
Shah, Arpan
Shaner, Benjamin
Shannon, James
Sheehan, Hank
Singh, Rohandeep
Spann, James
Sultan, Juasheem
Svetlichniy, Robert
Taylor, Dominick
Tervay, Justin
Thorsen, Connor
Tice-Carroll, Dylan
Tokarchuk, Nazariy
Townsend, Sam
Uddin, Shihab
Van Lenten, Tyler
Vannozzi, Laura
Vaughan, Christian
Wagner, Dylan
Waheibi, Danny
Wakabayashi, Luke
Whitehurst, Tyler
Wohl, Michael
Wong, Jonathan
Woodside, Asia
York, Connor
York, William
Zhang, Lijing

GRADUATE STUDIES

Graduate Research

Students in the RIT computer science master's program are required to finish a master's project or thesis to complete their degree. Faculty in the department carry out research in a wide variety of Computer Science areas (see the *Research Areas* section near the back of the report).

MS projects may be implementation-based, or a narrowly-focused research effort. Project students are required to take the Master's Project Colloquium (CSCI-788), in which students study technical writing, presentation skills, strategies for research programming, experimental design, and analysis of results. Projects culminate with a poster presentation session and final report submitted to their advisor.

A **master's thesis** is a research-based undertaking, normally requiring 2-3 semesters to complete. A thesis culminates with an oral presentation and defense of the thesis document to a committee of three faculty members. Successfully defended theses are archived by RIT. Often, thesis students also complete an independent study with their advisor, to obtain sufficient time for studying background literature and identifying a research problem of interest. Master's students wishing to pursue a PhD or research-related positions in academia or industry are well-served by the additional time and technical depth that a thesis requires. A list of master's theses completed in 2018 may be found in the *Publications* section.

A number of our MS project and theses students have published research papers, provided tools for research, and contributed to educational activities and exhibitions.

Master's Project Best Poster and Report Awards (2020)

Each semester at the master's project poster session, up to three posters are selected for the Best Poster Award. In addition, one report was selected for the Best Report Award in Spring 2018. All award recipients traditionally receive a gift card and book by Prof. Bischof, the master's program coordinator.

Spring 2020

Best MS Project Poster Award

Arpit J Vora: Colluded Application Attack and Its Detection Using Machine Learning
Advisor: Dr. Leon Reznik

Summer 2020

Best MS Project Poster Award

1st Place Poster: Coleman Link: Integrating Kubernetes and RDMA
Advisor: Dr. Minseok Kwon

Fall 2020

Best MS Project Poster Award

1st Place Poster: Xuan Huang: A Mechanized Formalization of the WebAssembly Specification in Coq
Advisor: Dr. Matthew Fluet

2nd Place Poster: Sudhish Surendran Thazhakasseril: Road Pothole Classification and Reporting with Data Quality Estimates
Advisor: Dr. Leon Reznik

3rd Place Poster: Bharath Suresh Modhipalli: Detecting Phishing using CT Logs and Website similarity
Advisor: Dr. Taejoong Chung

Honors & Awards

Outstanding Graduate Student Award

- **Ajeeta Rajkumar Khatri**

The outstanding graduate student award recognizes a computer science graduate student for maintaining high academic standards (at least a 3.5 overall GPA) and for making significant contributions to the Department and the Computer Science Graduate Program.

Student Spotlight

Cyril Weerasooriya

Why did you choose computer science as your major?
I've been into CS ever since I was little, building my own PC from those Intel and Windows 95 days to now building models to build them.

Please describe your experience as a computer science major.
My experience has been unique to applying Computer Science to solve problems in Social Sciences. I do learn take classes on learning the basic principles but at the same time I get the chance to apply them to real world problems. Right now, we are working on a core problem of machine learning, predicting human disagreements during annotation. Think to the disagreements on a social media post, now imagine how you'd teach a machine learning algorithm to predict it.

Are you engaged in any groups or activities outside of computer science ? If so, please explain.
Yes, I'm the vice-president of the Doctoral Students Association of RIT.

Please describe an accomplishment you are proud of.
I love DevOps side of things (building systems) and I was fortunate enough to get the experience of building my own machine learning pipelines for my research. I had the opportunity of setting up CUDA (it isn't an easy thing to do!) to use with any Python package that relies on a GPU. I feel accomplished knowing how to assemble a PC, designing experiments to use it, and finally building the pipeline to utilize it.

Is there someone who inspired you to go into computer science? If so, who and why.
My father. He was the person who brought home a computer and that started it all. I learned to use it practically.

What is your dream job?
Researcher.

Describe any positive impacts of the actions you have been forced to take with the recent outbreak.
It kicked us out of our comfort zones to do what we haven't done before. I know it took a hit in teaching and delivery, but in terms of communication between peers and students, it got us thinking out of the box. I know things aren't the way we want it to be, but something is better than nothing. It's been a year living under the pandemic, and we are slowly getting used to the new norm and when we go back to in-person class days life before, we will appreciate it more. But at the same time, we mastered on how to handle classes, do research, and socialize while being at home.

Is there anything else you would like to say?
I also got the opportunity to teach a class over the summer and it was the first time I handled an entire class on my own. I learned a lot from the experience. One of the most important things I learned was to appreciate our teachers on the effort they put into teaching and how much a single mark can impact the life of a person.

Class of 2020 (MS)

Acharya, Gourav
Aggarwal, Sonali
Ahluwalia, Sukraat
Ajmera, Sahil
Assogba, Kevin
Bangalore Ranganath, Srishan
Bendlin, Theodora
Bharadwaj, Abhiram Ravi
Bhattacharya, Ritaban
Bhatwadekar, Advait
Bheda, Pranshu Nitin
Borkar, Paritosh Pandurang
Bowald, Dylan
Bulchandani, Vishal
Carr, Jason
Carver, William
Chakraborty, Rahul
Chambers, David
Chandanshive, Pallavi Vilasrao
Chaudhari, Viraj Vilas
Chiu, Carmen
Cinibulk, Peter
Cutler, Kyle
Desai, Akash Rakeshbhai
Desai, Neel D
Desai, Paren Nikunj
Deshpande, Ketan
Dmello, Abishai
Duong, William
Dwivedi, Priyanka
Fernandes, Cliffton
Festa, Andrew
Gaikar, Aakshaye Mahindra
Gaikwad, Amol Shamrao
Galatic, Paul
Gandhi, Jeet Jesal
Gandhi, Sahaj
Gangadhara, Kantha Girish
Garg, Sudheeksha
Gaur, Gaurav
Giriyalkar, Aniket Ashok
Goldobin, Sergey
Govilkar, Sayali Ramesh
Govindapla Ravi, Gagan
Gummuluri, Sashank
Gund, Manasi Bharat
Gupta, Arjun
Haqq, Qadir
Hartman, Eric
Huang, Xuan
Iyengar, Satyanarayan
James, Jainey Elsa
Jayanti, Aditya Kalyan
Joerger, Richard
Joshi, Manan
Kapuganti, Rasmi Mukula
Karki, Akshay
Kate, Sanyukta Sanjay
Keswaney, Nikhil Haresh
Keswani, Rohit
Khanna, Sagar
Khatri, Ajeeta Rajkumar
Khot, Sagar Nitin
Kota, Vidhathri
Koul, Vipul
Krishnan, Maha Krishnan
Kukreja, Sagar
Kulkarni, Ruta
Kumar, Neelabh
Kumar, Videet
Lad, Justin
Lakhani, Vrishabh Ajay
Lakshminarayan, Srikant
Ligade, Ninad
Liu, Zhuo

Lokare, Hanmant
Mahajan, Shivangi Dilip
Menezes, Jason
Modhipalli, Bharath Suresh
Mulwani, Kunal
Nagaraja, Parinitha
Nagavara Ravindra, Sahana
Nair, Nitinraj Rajan
Nair, Vignesh Vijaykumar
Nakte, Jyotsna Namdeo
Nayyar, Kunal
Nema, Saransh
Nill, Robert
Nishizawa, Gavin
Pandey, Nikhil
Panwar, Abhishek Singh
Paralkar, Ashish
Patel, Chintal Ashok Kumar
Patel, Dhvani Dineshbhai
Patil, Abhishek Sanjay
Patil, Gourang Sandesh
Patil, Priyanka Nagesh
Patil, Shubham Bharat
Pawar, Akhil Dilip
Pethe, Sahil
Pillai, Rajkumar Lenin
Pradhani, Keerthi Nagappa
Rane, Pranav Mohan
Ranjan, Nalin
Ravishankar, Rohit
Roy Barman, Daniel
Rudroju, Shashank
Sasmal, Soumyabhusan Mrityunjoy
Saurav, Samir
Sen, Sarah
Shah, Arpan
Shah, Brij Ketan
Shah, Ishan
Shah, Vaibhav Bipinbhai
Shanavas, Abdul Hakim
Sharma, Anika
Shembekar, Parikshit Prashant
Shen, Haohua
Sheng, Haoran
Shiroor, Rohan
Shukla, Aniruddha
Singh, Sapan
Smith, Jack
Sorte, Suyash
Sun, Leilei
Sun, Xu
Sun, Yifei
Swati, Swati
Tapo, Allahsera
Thakker, Ishaan
Thorat, Rasika Rajeev
Thormann, Rachael
Tikam, Jairaj Prashant
Tribhuvan, Nikita
Turakhia, Shachi Amitkumar
Vane, Anuja Sambhaji
Vidhate, Indrajeet Avinash
Vijayanarasimha, Mrudula
Wanjara, Kunal Shirish
Xie, Ted
Yang, Tao
Yao, Shuo
Zeng, Wei

Faculty Spotlight

Thomas Kinsman

Dr. Thomas B. Kinsman uses every conceivable method to incentivize students into wanting to learn. Online lecturing is difficult because the students are distracted by everything on their computer. Dr. Kinsman uses illusions, humor, science tricks, riddles, puzzles, origami, and even sound effects to capture student attention.

The effects must relate to the lessons at hand. Do you know how to discover if an egg is hard-boiled or raw by spinning it? In that case, the state of the egg is an example of a latent variable – something that is hidden. Other demonstrations show seemingly impossible balancing acts to convey that the center of mass of data is pulled off by outliers. Or, putty which changes shape is used to demonstrate the relative size of eigenvalues for principal components analysis. He terms his mixture of education and entertainment, “edu-tainment.”

An ideal lecture starts off with a motivating problem to intrigue students, then progresses through a theater of the mind until the students arrive at their own explanation. He is unafraid to make mistakes so that the students can correct him, and in doing so, feel good about themselves.

With a wave of his hand in front of the camera, his shirt changes color. Out of student sight, under the desk of his home studio are foot switches which control red and blue lights. This is a demonstration of the importance of the light for computer vision.

While his methods can be unorthodox, he is dead serious about his teaching. The topics he covers are profoundly relevant to life and activities. Anything he can do to help them remember is worth the trouble. Dr. Kinsman teaches at RIT – “Education at the intersection of technology, the arts, and design.”

Kinsman was nominated for a technical award for a demonstration of illumination changes. He has been nominated for the Outstanding Non-tenure track teaching award, four times. Kinsman was once a professional magician.

Dr. Kinsman demonstrates how different lighting geometries produce different effects using fluorescence. This sparks the imagination, and helps students remember. Dr. Kinsman has been known to use a “Where’s Waldo” or a “Luke Skywalker” costume to discuss context sensitivity and conditional probability.

PhD Program

The Golisano Computing College PhD program began in Fall 2006. Since that time, the program has grown from a handful of students to over 100. Our PhD students carry out research in both fundamental and applied Computer Science.

Our program is research-focused. Admitted PhD students have chosen their advisor prior to admission. During the first year of the program, in addition to coursework students complete their research potential assessment, which requires writing, presenting, and defending a mock conference paper to the PhD faculty from across the Golisano Computing College. This requires our students to engage directly in research when they enter the program. To complete the program, they must also write and defend a thesis proposal and their final dissertation.

The Computing and Information Sciences PhD graduates advised by CS faculty have gone on to successful careers in industry and academia, including faculty positions at the Stevens Institute of Technology and The College of the Holy Cross, postdoctoral positions (e.g., at University at Buffalo), and senior positions at corporations including Google and Appnexus.

PhD Students Advised by CS Faculty

Asma Alnemari

Cybersecurity and Privacy

Advisors: Rajendra Raj and Carol Romanowski

Asma Aloufi

Information Security and Applied Cryptography

Advisor: Peizhao Hu

Moiz Arif

Next-Generation Data Centers for Emerging Distributed and Parallel Workloads

Advisor: M. Mustafa Rafique

Angelina Brilliantova

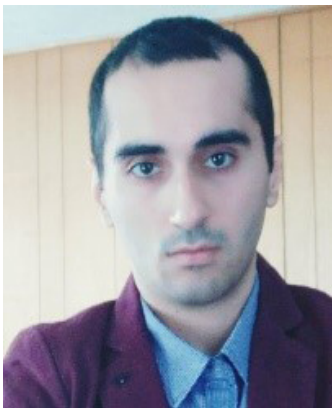
Multi-agent Systems

Advisor: Hadi Hosseini

Maheen Contractor

TBD

Advisor: Matthew Fluet



Garegin Grigoryan

Computer Networking, Routing Scalability and Programmable Data Planes

Advisor: Minseok Kwon

Sahil Gupta

Securing the Internet of Things Networks

Advisor: Minseok Kwon

Igor Khokhlov

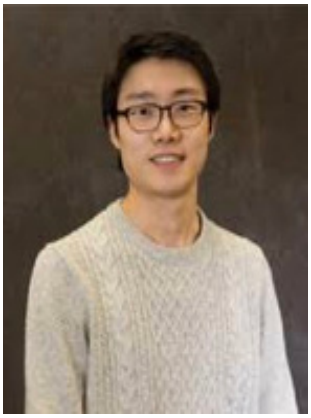
Data Quality and Security, Artificial Intelligence, Android OS

Advisor: Leon Reznik

Eduardo Lima

Statistical Learning of Service Features

Advisor: Xumin Liu



Tong Liu

Crowdsourcing and Human Computation, Natural Language Processing and Machine Learning

Advisor: Christopher M. Homan

Mahshad Madhavi

(Imaging Science)

Recognizing Handwritten and Typeset Math Formulas

Advisor: Richard Zanibbi

Behrooz Mansouri

Information Retrieval, Machine Learning

Advisor: Richard Zanibbi

Avinash Maurya

Exploiting Multikernels to Accelerate High-Performance Data Analytics Platforms

Advisor: M. Mustafa Rafique

Hannah Miller

TBD

Advisors: Edith Hemaspaandra, Ivona Bezáková

Justin Namba

TBD

Advisor: Michael Mior

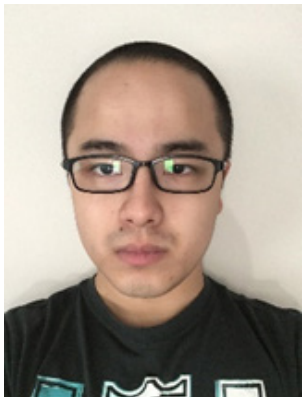
David E. Narváez

Constraint Satisfaction Techniques for Combinatorial Problems

Advisors: E. Hemaspaandra and S. Radziszowski

Nibesh Shrestha
Byzantine Fault Tolerant Protocols

Advisor: Mohan Kumar



Wenbo Sun

Sampling Graph Structures Related to Chordal Graphs

Advisor: Ivona Bezáková

Tharindu Cyril Weerasooriya
TBD
Advisor: Christopher M. Homan

Sawyer Welden
Multi-agent Systems, Algorithmic Economics
Advisor: Hadi Hosseini

Zhizhuo Yang
Data-driven Framework for Realistic Self-Organized Virtual Humans

Advisors: Reynold Bailey, Alexander Orobia

Timothy Zee

Interpretability of Neural Models

Advisors: Ifeoma Nwogu, Alexander Orobia

Wei Zhong
Structrual and Semantic Similarity Search for Documents Containing Math Formulas

Advisor: Richard Zanibbi

CS ALUMNI

Lane Lawley

When did you graduate? What degree(s) did you earn?
I graduated in 2015 with B.S. in computer science.

What do you currently do for a living?
I'm a CS PhD candidate at the University of Rochester.

What are your professional interests?
Logico-symbolic artificial intelligence, schema-based learning, and story understanding.

What are your personal interests?
Bouldering (rock climbing), pub trivia, algorithmic art, guitar, banjo, and Minecraft.

Describe a particularly rewarding RIT-related experience (i.e., student interaction, classroom)?
Studying abroad in Croatia with Professor Ivona Bezakova. We learned so much about CS and the region from her, both inside and outside of the classroom, and it was a beautiful country! I'll treasure those memories forever.

Is there any one thing you wished you had known as a student that you could share with current students? If so what?
It's possible to go to industry and then quit to go to graduate school! More than one professor told me people don't tend to come back from industry, but I think if you're really meant to do something, you'll still find a way.

What is daily working life like for you during pandemic?

I organize experiments and write papers from home. It's a bit lonely, but our research group still meets over Zoom twice a week.

Saurabh Sampatrao Gaikwad

When did you graduate? What degree(s) did you earn?

I graduated in December 2020 with a Master's degree in computer science and an advanced certification in big data analytics.

What do you currently do for a living?

I work at Amazon (Seattle) as a Software Development Engineer.

What are your professional interests?

I like developing applications and working with new technology which helps us connect the world.

What are your personal interests?

My personal interest includes working out, playing soccer, cricket and many other sports. My new interest is skiing.

Describe a particularly rewarding RIT-related experience (i.e., student interaction, classroom)?

At RIT I got many opportunities to prove myself. The different clusters and bridge courses are very helpful. I was able to crack many interviews, where my concepts were tested. All this because of the bridge courses.

Is there any one thing you wished you had known as a student that you could share with current students? If so what?

To share with current students, I would like to tell them that being a RIT graduate you don't have to worry about further challenges in your life. RIT prepares you to face all the challenges.

What is daily working life like for you during pandemic?

As the pandemic struck I started working as an intern at Amazon and further I worked on my capstone project and two other courses, which on a daily basis would take 3-4 hours of my day. Other than that, I did home workout and celebrated all the festivals to be sane. Now after graduating, I started working from home again, I hope this pandemic gets over soon.

CS FACULTY AND STAFF

Faculty

Dr. Reynold Bailey
Professor and Associate Undergraduate Program Coordinator

Dr. Ivona Bezáková
Professor

Dr. Hans-Peter Bischof
Professor and Graduate Program Director

T.J. Borrelli
Principal Lecturer

Jeremy Brown
Lecturer

Dr. Zack Butler
Associate Chair, Professor and Associate Graduate Coordinator

Ting Cao
Lecturer

Warren R. Carithers
Associate Professor

Maria Jose Cepeda Garcia
Lecturer

Dr. Aaron Deever
Senior Lecturer and Undergraduate Program Coordinator

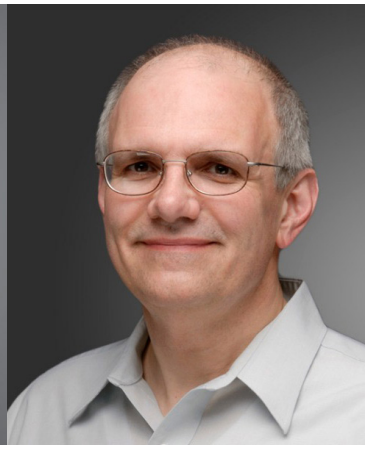
Razieh Fathi
Visiting Lecturer

Dr. Matthew Fluet
Associate Professor

Timothy Fossum
Lecturer

Dr. Joe Geigel
Professor

Susan Haller
Lecturer

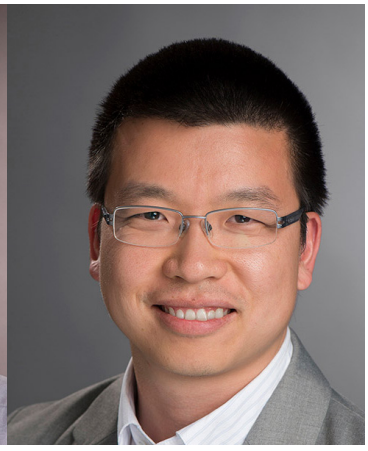


Dr. James Heliotis
Professor

Dr. Edith Hemaspaandra
Professor

Dr. Hossein Hojjat
Assistant Professor

Dr. Chris Homan
Associate Professor



Dr. Peizhao Hu
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Scott Johnson
Lecturer

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Lecturer

Dr. Mohan Kumar
Professor and Chair

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Associate Professor

Dr. Xumin Liu
Associate Professor

Dr. Michael Mior
Assistant Professor

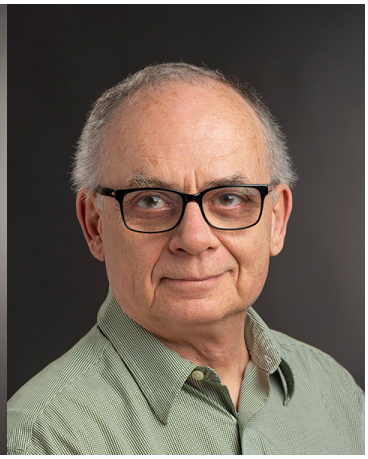
Dr. Arthur Nunes-Harwitt
Lecturer

Dr. Ifeoma Nwogu
Assistant Professor

Dr. Jansen Orfan
Lecturer

Dr. Alex Ororbia
Assistant Professor

Dr. Monika Polak
Lecturer



Dr. Stanisław Radziszowski
Professor

Dr. M. Mustafa Rafique
Assistant Professor

Dr. Rajendra K. Raj
Professor

Dr. Leon Reznik
Professor

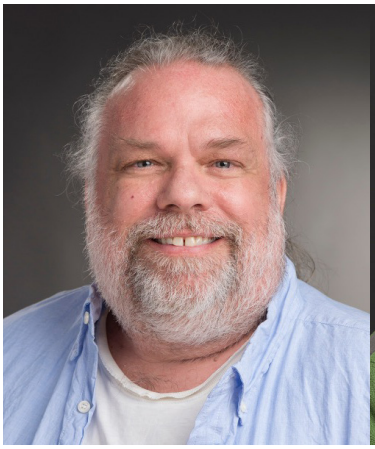
Dr. Carlos Rivero
Assistant Professor

Dr. Carol Romanowski
Professor

Ben K. Steele
Senior Lecturer

Sean Strout
Principal Lecturer

Paul Tymann
Professor



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Dr. Richard Zanibbi
Professor

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Manager of Technical Services

Lucieann Condino Stollery
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Jason Harrison
Staff Assistant

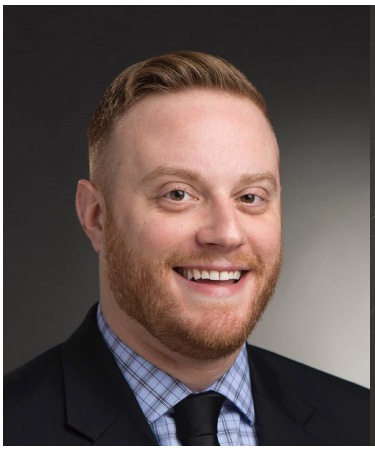
Jordan Gates
Sr. Staff Assistant

Susan Quatro
Manager of Student Services

Arnela Stupac-Catello
Systems Administration

Sam Waters
System Administrator

Advisors



Don Denz
Academic Advisor

Betty Hillman
Academic Advisor

Rebecca O'Connor
Academic Advisor

Christina Rohr
Senior Academic Advisor

Cindy Wolfer
Academic Advisor

Adjunct Professors

Jake Brandt
Matthew Hosking
Nelson Powell
William Childs
Mike Kirby
Laura Reznikov
Sam Fryer
Michael Kurdziel

Research Areas

Below is an alphabetical list of research areas that our faculty engage in, along with the specific faculty that teach and supervise student projects in each area.

Artificial Intelligence

Artificial intelligence encompasses the study of algorithms and architectures that enable effective decision making in complex environments. Faculty and students work on projects in computer vision, robotics, sensor networks, data mining, document recognition, information retrieval, and the theoretical foundations of decision-making.

- Zack Butler
- T.J. Borrelli
- Edith Hemaspaandra
- Chris Homan
- Thomas Kinsman
- Ifeoma Nwogu
- Alex Ororbia
- Leon Reznik
- Linwei Wang
- Richard Zanibbi

Computer Graphics and Visualization

Computer graphics and visualization provides the technical foundations for studies in computer graphics. Areas for advanced study include advanced graphics programming, image synthesis, computer animation, virtual reality, and data visualization.

- Joe Geigel
- Reynold Bailey
- Hans-Peter Bischof
- Warren Carithers
- Ifeoma Nwogu
- Sean Strout

Computer Science Education

Computer science education explores the pedagogy of computer science focusing on new methods and paradigms for the teaching of the CS curriculum.

- Ivona Bezáková
- T.J. Borrelli
- Jeremy Brown
- Zack Butler
- Joe Geigel
- James Heliotis
- Hadi Hosseini
- Scott Johnson
- Xumin Liu
- Arthur Nunes-Harwitt
- Rajendra Raj
- Ben Steele
- Sean Strout
- Paul Tymann

Data Science

Data science studies the foundational data management and knowledge discovery challenges prevalent in design, analysis and organization of data. This area can be applied in a variety of domains including data management in resource constrained environments, enterprise and multimedia databases, active and secure databases, and knowledge discovery algorithms.

- Xumin Liu
- Jeremy Brown
- Scott Johnson
- Thomas Kinsman
- Michael Mior
- M. Mustafa Rafique
- Rajendra Raj
- Prof Carlos Rivero
- Carol Romanowski
- Leon Reznik

Distributed Systems

Distributed systems studies systems formed from multiple cooperating computers. This includes the analysis, design, and implementation of distributed systems, distributed middleware, and computer networking protocols, including security.

- Hans-Peter Bischof
- Jeremy Brown
- James Heliotis
- Peizhao Hu
- Mohan Kumar
- Minseok Kwon
- Michael Mior
- M. Mustafa Rafique
- Leon Reznik

Languages and Tools

Languages and tools studies language design and implementation together with architecture and use of software development tools.

- Hans-Peter Bischof
- Jeremy Brown
- Matthew Fluet
- James E. Heliotis
- Hossein Hojjat
- Scott Johnson
- Arthur Nunes-Harwitt
- Rajendra K. Raj

Security

Security spans topics from networking to cryptography to secure databases. By choosing different domains in which to study security, students can gain a broad understanding of both theoretical and applied knowledge.

- Edith Hemaspaandra
- Ivona Bezáková
- T.J. Borrelli
- Aaron Deever
- Chris Homan
- Monika Polak
- Stanisław P. Radziszowski

Theory

Theory studies the fundamentals of computation which include complexity theory to determine the inherent limits of computation and communication, the design and analysis of algorithms to obtain optimal solutions within those limits, and theoretical foundations of cryptography.

- Edith Hemaspaandra
- Ivona Bezáková
- T.J. Borrelli
- Aaron Deever
- Chris Homan
- Stanisław P. Radziszowski

Yancarlos Diaz

Why did you choose computer science as your major?
I think I had a bit of a different experience choosing computer science. I hadn't really had any experience programming or anything related like many people who come into CS at RIT. For me, it was a huge leap of faith. I knew Computer Science was growing, and I knew that I'd be having a pretty significant impact on people's life, one way or another. I just kind of said, "you know what? let's do it."

Please describe your experience as a computer science major.
Given that I didn't know what I was getting myself into, it was no surprise that I struggled a lot my first year. It felt as though everyone around me was 10 steps ahead, but I wasn't going to let that stop me. I took advantage of every resource I could get my hands on and powered through the intro sequence.

Since then, I've come across so many opportunities that I could have never expected. I got the opportunity to do research and work for two different labs in the CS department. I supported the intro courses as a Student Lab Instructor, a Supplemental Instruction Leader, and now as a Teaching Assistant. I also had the chance to work for 4 different companies in my 6 years at RIT.

Are you engaged in any groups or activities outside of computer science? If so, please explain.
Outside the classroom, volleyball is my biggest passion. I've been an active member of the Men's Volleyball Club since my first semester at RIT and I've been the secretary of the club since my second year. I think volleyball will always be a part of my life, and I happy I got to pay competitively at RIT.

Please describe an accomplishment you are proud of.
I'm particularly proud of getting the Outstanding Fifth Year Student Award last year. This was the first and only award I've applied to at RIT. Up until that point, I didn't think I was good enough. After meeting and working with so many great people, I decided that I'd finally give it a try. Getting the award meant a lot to me because it made me see how much I had grown in my five years at RIT. I still remember how clueless I was at my first computer science class. Looking back sometimes makes me shed a tear. Who's cutting onions?

Is there someone who inspired you to go into computer science? If so, who and why.
I didn't really have someone who inspired me to go into computer science.

What is your dream job?
I certainly want to work in industry for a while. But I have always had a passion for teaching, and I think that's where I'll end up eventually. I see myself teaching computer science at a high school where I can also coach volleyball. My senior year of high school was such a pivotal point in my life where I had awesome people that helped me go down the right path. I want to be that person for someone else.

Describe any positive impacts of the actions you have been forced to take with the recent outbreak.
The pandemic brought tremendous change to everyone's life. To cope with our new way of life, I had to learn to take better care of myself both physically and mentally. I learned more about sleep and mindfulness, and I think I'll be taking those things with me for the rest of my life.

Is there anything else you would like to say?
People often ask me if I would have gone to a different school or program given what I know now. Being completely honest, I wouldn't change a thing. I've grown tremendously and had so many great opportunities as a CS major at RIT. I'm happy where I am, and I wouldn't trade that easily.

RESEARCH AND SCHOLARSHIP

Publications

Below is a list of publications by faculty and students from the Department of Computer Science that appeared in 2020. In computer science, many of the most prestigious publication venues are conferences rather than journals due to the rapid development in new technologies. For the same reason, technical reports are cited frequently, particularly those appearing in the arXiv.org collection maintained at Cornell University.

[1] Cecilia Ovesdotter Alm and Reynold Bailey. "Transitioning from Teaching to Mentoring: Supporting Students to Adopt Mentee Roles". In: *Journal for STEM Education Research* (Dec. 2020). ISSN: 2520-8713. DOI: 10.1007/s41979-020-00045-9. URL: https://doi.org/10.1007/s41979-020-00045-9.

[2] Asma Mohammed Alnemari. "Interactive Range Queries under Differential Privacy". PhD thesis. Rochester Institute of Technology, June 2020. URL: https://scholarworks.rit.edu/theses/10455.

[3] Asma Aloufi, Peizhao Hu, Hang Liu, Sherman S.M. Chow, and Kim-Kwang Raymond Choo. "Toward Robust and Privacy-Preserving Location Referencing and Geospatial Query". In: *Elsevier Journal of Computers & Security, Cryptology ePrint Archive: Report 2019/820* (Dec. 2020).

[4] Asma Aloufi, Peizhao Hu, Yongsoo Song, and Kristin Lauter. *Computing Blindfolded on Data Homomorphically Encrypted under Multiple Keys: An Extended Survey*. Revisied for ACM Computing Survey. Preprint version https://arxiv.org/abs/2007.09270. July 2020.

[5] Hussein Alrubaye, Mohamed Wiem Mkaouer, Igor Khokhlov, Leon Reznik, Ali Ouni, and Jason Mcgoff. "Learning to recommend third-party library migration opportunities at the API level". In: *Applied Soft Computing* 90 (2020), p. 106140.

[6] Moayad Alshangiti, Weishi Shi, Xumin Liu, and Qi Yu. "A Bayesian learning model for design-phase service mashup popularity prediction". In: *Expert Syst. Appl.* 149 (2020), p. 113231. URL: https://doi.org/10.1016/j.eswa.2020.113231.

[7] Tejaswini Ananthanarayana. "Sign Language Translation using Deep Learning". In: *34th AAAI Conference on Artificial Intelligence, Doctoral Symposium*. AAAI Press, 2020.

[8] Martina Anto-Ocrah, Nick Maxwell, Jeremy Cushman, Emmanuel Acheampong, Ruth-Sally Kodam, Christopher Homan, and Timmy Li. "Public knowledge and attitudes towards bystander cardiopulmonary resuscitation (CPR) in Ghana, West Africa". In: *International Journal of Emergency Medicine* 13.1 (2020), pp. 1–12.

[9] Moiz Arif, M. Mustafa Rafique, Seung-Hwan Lim, and Zaki Malik. "Infrastructure-Aware TensorFlow for Heterogeneous Datacenters". In: *2020 28th International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems (MASCOTS)*. 2020, pp. 1–8. DOI: 10.1109/MASCOTS50786.2020.9285969.

[10] Iti Bansal. "Analyzing the Impact of Negative Sampling on Fact-Prediction Algorithms". MA thesis. Rochester Institute of Technology, Nov. 2020. URL: https://scholarworks.rit.edu/theses/10610/.

[11] Iti Bansal, Sudhanshu Tiwari, and Carlos R. Rivero. "The Impact of Negative Triple Generation Strategies and Anomalies on Knowledge Graph Completion". In: *Proceedings of the 29th ACM International Conference on Information and Knowledge Management, CIKM*. 2020, pp. 45–54. DOI: 10.1145/3340531.3412023. URL: https://doi.org/10.1145/3340531.3412023.

[12] Ivona Bezáková, Antonio Blanca, Zongchen Chen, Daniel Štefankovič, and Eric Vigoda. “Lower Bounds for Testing Graphical Models: Colorings and Antiferromagnetic Ising Models”. In: *Journal of Machine Learning Research* 21 (2020), 25:1–25:62. URL: http://jmlr.org/papers/v21/19-580.html.

[13] Ivona Bezáková, Radu Curticapean, Holger Dell, and Fedor V. Fomin. “Finding Detours is Fixed-Parameter Tractable”. In: *SIAM Journal on Discrete Mathematics (SIDMA)* 33.4 (2019), pp. 2326–2345. DOI: 10.1137/17M1148566. URL: https://doi.org/10.1137/17M1148566.

[14] Ivona Bezáková, Kimberly Fluet, Edith Hemaspaandra, Hannah Miller, and David E. Narváez. “Witness Feedback for Introductory CS Theory Assignments”. In: *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education (SIGCSE), Poster Abstract*. To appear. 2021.

[15] Ivona Bezáková, Andreas Galanis, Leslie Ann Goldberg, and Daniel Štefankovič. “Inapproximability of the Independent Set Polynomial in the Complex Plane”. In: *SIAM Journal of Compututing (SICOMP)* 49.5 (2020). DOI: 10.1137/18M1184485. URL: https://doi.org/10.1137/18M1184485.

[16] Ivona Bezáková, Edith Hemaspaandra, Aryeh Lieberman, Hannah Miller, and David E. Narváez. “Prototype of an Automated Feedback Tool for Intro CS Theory”. In: *SIGCSE ’20: The 51st ACM Technical Symposium on Computer Science Education, Portland, OR, USA, March 11-14, 2020*. Ed. by Jian Zhang, Mark Sherriff, Sarah Heckman, Pamela A. Cutter, and Alvaro E. Monge. ACM, 2020, p. 1311.

[17] Ivona Bezáková, Edith Hemaspaandra, Aryeh Lieberman, Hannah Miller, and David E. Narváez. “Prototype of an Automated Feedback Tool for Intro CS Theory”. In: *Proceedings of the 51st ACM Technical Symposium on Computer Science Education (SIGCSE)*. ACM, 2020, p. 1311. DOI: 10.1145/3328778.3372598. URL: https://doi.org/10.1145/3328778.3372598.

[18] Ivona Bezáková and Wenbo Sun. “Mixing of Markov Chains for Independent Sets on Chordal Graphs with Bounded Separators”. In: *Proceedings of the 26th International Conference on Computing and Combinatorics (COCOON)*. Vol. 12273. Lecture Notes in Computer Science. Springer, 2020, pp. 664–676. DOI: 10.1007/978-3-030-58150-3_54. URL: https://doi.org/10.1007/978-3-030-58150-3%5C_54.

[19] Ivona Bezákovaá, Kimberly Fluet, Edith Hemaspaandra, Hannah Miller, and David E. Narváez. “Witness Feedback for Introductory CS Theory Assignments”. In: *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education (SIGCSE 2021), Poster Abstract*. To appear. 2021.

[20] Jean R. S. Blair, Christa M. Chewar, Rajendra K. Raj, and Edward Sobiesk. “Infusing Principles and Practices for Secure Computing Throughout an Undergraduate Computer Science Curriculum”. In: ITiCSE ’20. Trondheim, Norway: Association for Computing Machinery, 2020, pp. 82–88. ISBN: 9781450368742. DOI: 10.1145/3341525.3387426. URL: https://doi.org/10.1145/3341525.3387426.

[21] Heather Bort, David P. Bunde, Zac Butler, Christopher L. Hovey, Jaime Spacco, and Cynthia Taylor. “CONVERSATIONS

Conversation with a Prominent Propagator: Leo Porter”. In: *ACM Inroads* 11.1 (Feb. 2020), pp. 12–15. ISSN: 2153-2184. DOI: 10.1145/3381023. URL: https://doi.org/10.1145/3381023.

[22] Dylan Bowald. “AR Comic Chat”. MA thesis. Rochester Institute of Technology, May 2020.

[23] Joshua Brakensiek, Marijn Heule, John Mackey, and David E. Narváez. “The Resolution of Keller’s Conjecture”. In: *10th International Joint Conference on Automated Reasoning*. Springer, July 2020, pp. 48–65.

[24] David P. Bunde, Zack Butler, Christopher L. Hovey, and Cynthia Taylor. “CONVERSATIONS: Conversation with a Prominent Propagator: Sushil Prasad”. In: *ACM Inroads* 11.3 (Aug. 2020), pp. 22–24. ISSN: 2153-2184. DOI: 10.1145/3410472. URL: https://doi.org/10.1145/3410472.

[25] David P. Bunde, Zack Butler, Christopher L. Hovey, and Cynthia Taylor. “CONVERSATIONS

Conversation with a Prominent Propagator: Michael KöLling”. In: *ACM Inroads* 11.4 (Nov. 2020), pp. 6–8. ISSN: 2153-2184. DOI: 10.1145/3428677. URL: https://doi.org/10.1145/3428677.

[26] Zack Butler, Ivona Bezáková, and Kimberly Fluet. “Puzzles in Many Places: Closing the Loop on Propagation”. In: *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education (SIGCSE), Poster Abstract*. To appear. 2021.

[27] William Carver and Ifeoma Nwogu. “Facial Expression Neutralization with StoicNet”. In: *In Proceedings of the WACV Workshop on Generation of Human Behavior (GHB)*. IEEE Computer Society, 2020.

[28] J. Chen, K. Shitut, J. Geigel, D. Munnell, and M. Schweppe. “Building the Virtual Stage: A System for Enabling Mixed Reality Theatre”. In: *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*. 2020, pp. 708–709. DOI: 10.1109/VRW50115.2020.00205.

[29] S. Chuprov, I. Viksnin, I. Kim, L. Reznik, and I. Khokhlov. “Reputation and Trust Models with Data Quality Metrics for Improving Autonomous Vehicles Traffic Security and Safety”. In: *2020 IEEE Systems Security Symposium (SSS)*. July 2020, pp. 1–8. DOI: 10.1109/SSS47320.2020.9174269.

[30] Sergey Chuprov, Egor Marinenkov, Ilya Viksnin, Leon Reznik, and Igor Khokhlov. “Image Processing in Autonomous Vehicle Model Positioning and Movement Control”. In: *2020 IEEE World Forum on Internet of Things*. IEEE. 2020. DOI: 10.1109/WF-IoT48130.2020.9221258.

[31] Adrienne Decker, Peter DePasquale, Rajendra K. Raj, and Matt Jadud. “Bringing Industry into the University Experience”. In: 35.8 (Apr. 2020), pp. 254–255. ISSN: 1937-4771.

[32] Juilee Decker, Amanda Doherty, Joe Geigel, and Gary D. Jacobs. “Blending Disciplines for a Blended Reality: Virtual Guides for a Living History Museum”. In: *Journal of Interactive Technology & Pedagogy* 1.17 (May 2020). URL: https://jitp.commons.gc.cuny.edu/blending-disciplines-for-a-blended-reality-virtual-guides-for-a-living-history-museum.

[33] Travis Desell, AbdElRahman ElSaid, and Alexander G Ororbia. “An empirical exploration of deep recurrent connections using neuro-evolution”. In: *International Conference on the Applications of Evolutionary Computation (Part of EvoStar)*. Springer. 2020, pp. 546–561.

[34] A. Dining and J. Geigel. “Farewell to Dawn: A Virtual Theatre Production”. In: *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*. 2020, pp. 859–859. DOI: 10.1109/VRW50115.2020.00283.

[35] AbdElRahman ElSaid, Joshua Karnas, Zimeng Lyu, Daniel Krutz, Alexander G Ororbia, and Travis Desell. “Neuro-Evolutionary Transfer Learning Through Structural Adaptation”. In: *International Conference on the Applications of Evolutionary Computation (Part of EvoStar)*. Springer. 2020, pp. 610–625.

[36] AbdElRahman ElSaid, Joshua Karns, Zimeng Lyu, Daniel Krutz, Alexander Ororbia, and Travis Desell. “Improving neuroevolutionary transfer learning of deep recurrent neural networks through network-aware adaptation”. In: *Proceedings of the 2020 Genetic and Evolutionary Computation Conference*. 2020, pp. 315–323.

[37] AbdElRahman ElSaid, Alexander G Ororbia, and Travis J Desell. “Ant-based Neural Topology Search (ANTS) for Optimizing Recurrent Networks”. In: *International Conference on the Applications of Evolutionary Computation (Part of EvoStar)*. Springer. 2020, pp. 626–641.

[38] Zack Fitzsimmons and Edith Hemaspaandra. “Election Score Can Be Harder than Winner”. In: *ECAI 2020 - 24th European Conference on Artificial Intelligence, 29 August-8 September 2020, Santiago de Compostela, Spain, August 29 - September 8, 2020 - Including 10th Conference on Prestigious Applications of Artificial Intelligence (PAIS 2020)*. Ed. by Giuseppe De Giacomo, Alejandro Catalá, Bistra Dilkina, Michela Milano, Senén Barro, Alberto Bugarín, and Jérôme Lang. Vol. 325. Frontiers in Artificial Intelligence and Applications. IOS Press, 2020, pp. 83–90.

[39] Zack Fitzsimmons, Edith Hemaspaandra, and Lane A. Hemaspaandra. “Control in the presence of manipulators: cooperative and competitive cases”. In: *Journal of Autonomous Agents and Multi-Agent Systems* 34.2 (2020), p. 52.

[40] Fabian Frei, Edith Hemaspaandra, and Jörg Rothe. “Complexity of Stability”. In: *31st International Symposium on Algorithms and Computation, ISAAC 2020, December 14-18, 2020, Hong Kong, China (Virtual Conference)*. Ed. by Yixin Cao, Siu-Wing Cheng, and Minming Li. Vol. 181. LIPIcs. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, 2020, 19:1–19:14.

[41] Dan Garcia, Ivona Bezáková, Adam Blank, and Neal Terrell. “Teaching Computer Science with Abstract Strategy Games”. In: *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education (SIGCSE), Panel Session Abstract*. To appear. 2021.

[42] Joe Geigel, Kunal Shailesh Shitut, Juilee Decker, Amanda Doherty, and Gary Jacobs. “The Digital Docent: XR Storytelling for a Living History Museum”. In: *26th ACM Symposium on Virtual Reality Software and Technology*. VRST ’20. Virtual Event, Canada: Association for Computing Machinery, 2020. ISBN: 9781450376198. DOI: 10.1145/3385956.3422090. URL: https://doi-org.ezproxy.rit.edu/10.1145/3385956.3422090.

[43] Abraham Glasser, Bonnie Jacob, Emily Lederman, and Stanisław Radziszowski. “Failed Power Domination on Graphs”. In: *Australasian Journal of Combinatorics* 76(2) (2020), pp. 232–247.

[44] Anand Gopalakrishnan, Ankur Mali, Dan Kifer, Lee Giles, and Alexander G Ororbia. “A neural temporal model for human motion prediction”. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2019, pp. 12116–12125.

[45] G. Grigoryan, Y. Liu, and M. Kwon. “PFCA: A Programmable FIB Caching Architecture”. In: *IEEE/ACM Transactions on Networking* 28.04 (July 2020), pp. 1872–1884. ISSN: 1558-2566. DOI: 10.1109/TNET.2020.3001904.

[46] Garegin Grigoryan, Minseok Kwon, and M. Mustafa Rafique. “Extending the Control Plane of Container Orchestrators for I/O Virtualization”. In: *2020 2nd International Workshop on Containers and New Orchestration Paradigms for Isolated Environments in HPC (CANOPIE-HPC)*. 2020, pp. 1–7. DOI: 10.1109/CANOPIEHPC51917.2020.00006.

[47] Garegin Grigoryan, Minseok Kwon, and M. Mustafa Rafique. “Extending the Control-Plane of Container Orchestrators for I/O Virtualization”. In: *CANOPIE HPC Workshop 2020 (in conjunction with SC20)*. 2020.

[48] Garegin Grigoryan, Yaoqing Liu, and Minseok Kwon. “Boosting FIB Caching Performance with Aggregation”. In: *Proceedings of the 29th International Symposium on High-Performance Parallel and Distributed Computing*. HPDC ’20. Stockholm, Sweden: Association for Computing Machinery, 2020, pp. 221–232. ISBN: 9781450370523. DOI: 10.1145/3369583.3392682. URL: https://doi.org/10.1145/3369583.3392682.

[49] Manasi Gund, Abhiram Ravi, and Ifeoma Nwogu. “Interpretable Emotion Classification Using Temporal Convolutional Models”. In: *Proceedings of the 25th International Conference Conference on Pattern Recognition, ICPR*. 2020.

[50] Jingoo Han, M. Mustafa Rafique, Luna Xu, Ali R. Butt, Seung-Hwan Lim, and Sudharshan S. Vazhkudai. “MARBLE: A Multi-GPU Aware Job Scheduler for Deep Learning on HPC Systems”. In: *2020 20th IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing (CCGRID)*. 2020, pp. 272–281. DOI: 10.1109/CCGrid49817.2020.00-66.

[51] Benjamin Heald. “Nereus: A Proposal for Implementing Anti-phishing Software Using Corporate Branding Color Matching”. MA thesis. Rochester Institute of Technology, Dec. 2020. URL: https://scholarworks.rit.edu/theses/10644.

[52] Edith Hemaspaandra, Lane A. Hemaspaandra, and Curtis Menton. “Search versus Decision for Election Manipulation Problems”. In: *ACM Transactions on Computation Theory* 12.1 (2020), 3:1–3:42.

[53] Edith Hemaspaandra, Lane A. Hemaspaandra, Holger Spakowski, and Osamu Watanabe. “The Robustness of LWPP and WPP, with an Application to Graph Reconstruction”. In: *Computational Complexity* 29.2 (2020), p. 7.

[54] Christopher Michael Homan, J Nicolas Schrading, Raymond W Ptucha, Catherine Cerulli, and Cecilia Ovesdotter Alm. “Quantitative methods for analyzing intimate partner violence in microblogs: observational study”. In: *Journal of medical internet research* 22.11 (2020), e15347.

[55] Peizhao Hu, Asma Aloufi, Adam Caulfield, Kim Laine, and Kristen Lauter. “SparkFHE: Distributed Dataflow Framework with Fully Homomorphic Encryption”. In: *PPML-PriML workshop collocated with NeurIPS 2020*. Dec. 2020.

[56] Anam Javaid, Asma Rafiq, Maaz Rehan, M. Mustafa Rafique, M. Kamran, and Ehsan Ullah Munir. “Clustering-cum-Handover Management Scheme for improved Internet access in high-density mobile wireless environments”. In: *Sustainable Computing: Informatics and Systems* 30 (2021), p. 100483. ISSN: 2210-5379. DOI: https://doi.org/10.1016/j.suscom.2020.100483.

[57] Chula Jayawardene, David Narváez, and Stanisław Radziszowski. “Star-critical Ramsey Numbers for Cycles Versus K_4”. In: *Discussiones Mathematicae Graph Theory* 41 (2021), pp. 381–390.

[58] Ajeeta Khatri. “Interaction Recognition in a Paired Egocentric Video”. MA thesis. Rochester Institute of Technology, Nov. 2020. URL: https://scholarworks.rit.edu/theses/10484/.

[59] Ajeeta Khatri. “Interaction Recognition in a Paired Egocentric Video”. MA thesis. Rochester Institute of Technology, Dec. 2020.

[60] Igor Khokhlov, Ligade Ninad, and Leon Reznik. “Recurrent Neural Networks for Colluded Applications Attack Detection in Android OS Devices”. In: *IEEE World Congress on Computational Intelligence (WCCI) 2020*. IEEE. 2020. DOI: 10.1109/IJCNN48605.2020.9207339.

[61] Igor Khokhlov and Leon Reznik. *From Data Communication to Delivery of Quality Data*. 2020. URL: https://drive.google.com/drive/folders/1_rzzcVMv0jBGtZ8kvaelrXSZhOk4xgIz (visited on 09/09/2020).

[62] Igor Khokhlov and Leon Reznik. “Knowledge Graph in Data Quality Evaluation for IoT Applications”. In: *2020 IEEE World Forum on Internet of Things*. IEEE. 2020. DOI: 10.1109/WF-IoT48130.2020.9221091.

[63] Igor Khokhlov and Leon Reznik. “What is the Value of Data Value in Practical Security Applications”. In: *IEEE/NDIA/INCOSE Systems Security Symposium 2020*. IEEE. 2020. DOI: 10.1109/SSS47320.2020.9174457.

[64] Igor Khokhlov, Leon Reznik, and Sahil Ajmera. “Sensors in Mobile Devices Knowledge Base”. In: *IEEE Sensors Letters* 4.3 (2020), pp. 1–4. DOI: 10.1109/LSENS.2020.2975161.

[65] Igor Khokhlov, Leon Reznik, and Sergey Chuprov. “Framework for Integral Data Quality and Security Evaluation in Smartphones”. In: *IEEE Systems Journal* (2020). DOI: 10.1109/JSYST.2020.2985343.

[66] Vidathri Kota, Geeta Madhav Gali, and Ifeoma Nwogu. “A Computational View of the Emotional Regulation of Disgust using Multimodal Sensors”. In: *15th IEEE International Conference on Automatic Face & Gesture Recognition, FG 2020*. IEEE Computer Society, 2020, pp. 915–919.

[67] Rakshit Kothari, Zhizhuo Yang, Christopher Kanan, Reynold Bailey, Jeff B. Pelz, and Gabriel J. Diaz. “Gaze-in-wild: A dataset for studying eye and head coordination in everyday activities”. In: *Scientific Reports* 10.1 (Feb. 2020), p. 2539. ISSN: 2045-2322. DOI: 10.1038/s41598-020-59251-5. URL: https://doi.org/10.1038/s41598-020-59251-5.

[68] Jonathan Kvist, Philip Ekholm, Preethi Vaidyanathan, Reynold Bailey, and Cecilia Alm. “Dynamic Visualization System for Gaze and Dialogue Data”. In: *Proceedings of the 15th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications - Volume 2: HUCAPP,* INSTICC. SciTePress, Jan. 2020, pp. 138–145. ISBN: 978-989-758-402-2. DOI: 10.5220/0008953201380145.

[69] M. Kwon, K. P. Neupane, J. Marshall, and M. M. Rafique. “CuVPP: Filter-based Longest Prefix Matching in Software Data Planes”. In: *2020 IEEE International Conference on Cluster Computing (CLUSTER)*. 2020, pp. 12–22. DOI: 10.1109/CLUSTER49012.2020.00012.

[70] Minseok Kwon, Krishna Prasad Neupane, John Marshall, and M. Mustafa Rafique. “CuVPP: Filter-based Longest Prefix Matching in Software Data Planes”. In: *2020 IEEE International Conference on Cluster Computing (CLUSTER)*. 2020, pp. 12–22. DOI: 10.1109/CLUSTER49012.2020.00012.

[71] Michael Leventhal, Allahsera Tapo, Sarah Luger, Marcos Zampieri, and Christopher M Homan. “Assessing Human Translations from French to Bambara for Machine Learning: a Pilot Study”. In: *1st AfricaNLP Workshop Proceedings*. arXiv:2004.00068. 2020.

[72] Jessica Li, Matt Luettgen, Matt Huenerfauth, Sedeeq Al-Khazraji, Reynold Bailey, and Cecilia O. Alm. “Gaze guidance for captioned videos for DHH users”. In: *Journal on Technology and Persons with Disabilities* (2020), pp. 69–81.

[73] Sarah Luger, Martina Anto-Ocrah, Tapo Allashera, Christopher M. Homan, Marcos Zampieri, and Michael Leventhal. “Health Care Misinformation: An artificial intelligence challenge for low-resource languages”. In: *Proceedings of the AI for Social Good 2020 AAAI Fall Symposium*.

[74] Sarah Luger, Allashera Auguste Tapo, Christopher M Homan, Marcos Zampieri, and Michael Leventhal. “Towards a crowdsourcing platform for low resource languages–a semi-supervised approach”. In: *Proceedings of the Eighth International AAAI Conference on Human Computation (HCOMP)*. https://www.humancomputation.com/assets/2020/wip_demos/HCOMP_2020_paper_95.pdf. 2020.

[75] Mahshad Mahdavi. “Query-Driven Global Graph Attention Model for Visual Parsing: Recognizing Handwritten and Typeset Math Formulas”. PhD thesis. Rochester Institute of Technology, Aug. 2020.

[76] Mahshad Mahdavi, Leilei Sun, and Richard Zanibbi. “Visual Parsing with Query-Driven Global Graph Attention (QD-GGA): Preliminary Results for Handwritten Math Formula Recognition”. In: *Proc. CVPR Workshop on Text and Documents in the Deep Learning Era*. 2020, pp. 2429–2438. DOI: 10.1109/CVPRW50498.2020.00293.

[77] Ankur Mali, Alexander Ororbia, and C Lee Giles. “The Neural State Pushdown Automata”. In: *arXiv preprint arXiv:1909.05233* (2019).

[78] Ankur Mali, Alexander G Ororbia, and C Lee Giles. “The Sibling Neural Estimator: Improving Iterative Image Decoding with Gradient Communication”. In: *2020 Data Compression Conference (DCC)*. IEEE. 2020, pp. 23–32.

[79] Parag Mali, Puneeth Kukkadapu, Mahshad Mahdavi, and Richard Zanibbi. “ScanSSD: Scanning Single Shot Detector for Mathematical Formulas in PDF Document Images”. In: *CoRR* abs/2003.08005 (2020). URL: https://arxiv.org/abs/2003.08005.

[80] S. A. Mamun, A. Ganguly, P. P. Markopoulos, A. Kwasinski, and M. Kwon. “Security Vulnerabilities of Server-Centric Wireless Datacenters”. In: *2020 IEEE Conference on Communications and Network Security (CNS)*. 2020, pp. 1–9. DOI: 10.1109/CNS48642.2020.9162233.

[81] S. A. Mamun, A. Ganguly, P. P. Markopoulos, A. Kwasinski, and M. Kwon. “What Can Ail Thee: New and Old Security Vulnerabilities of Wireless Datacenters”. In: *IEEE GLOBECOM*. 2020.

[82] Behrooz Mansouri, Anurag Agarwal, Douglas W. Oard, and Richard Zanibbi. “Finding Old Answers to New Math Questions: The ARQMath Lab at CLEF 2020”. In: *Proc. ECIR*. 2020, pp. 564–571. DOI: 10.1007/978-3-030-45442-5_73.

[83] Behrooz Mansouri, Douglas W. Oard, and Richard Zanibbi. “DPRL Systems in the CLEF 2020 ARQMath Lab”. In: *CLEF 2020 Working Notes*. 2020. URL: http://ceur-ws.org/Vol-2696/paper_223.pdf.

[84] Victor J. Marin, Iti Bansal, and Carlos R. Rivero. “Towards summarizing program statements in source code search”. In: *Proceedings of the 35th ACM/SIGAPP Symposium on Applied Computing, SAC*. 2020, pp. 118–120. DOI: 10.1145/3341105.3374055. URL: https://doi.org/10.1145/3341105.3374055.

[85] Avinash Maurya, Bogdan Nicolae, Ishan. Guliani, and M. Mustafa Rafique. “CoSim: A Simulator for Co-Scheduling of Batch and On-Demand Jobs in HPC Datacenters”. In: *2020 IEEE/ACM 24th International Symposium on Distributed Simulation and Real Time Applications (DS-RT)*. 2020, pp. 1–8. DOI: 10.1109/DS-RT50469.2020.9213578.

[86] Natalie Maus, Dalton Rutledge, Sedeeq Al-Khazraji, Reynold Bailey, Cecilia Ovesdotter Alm, and Kristen Shinohara. “Gaze-Guided Magnification for Individuals with Vision Impairments”. In: *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*. CHI EA ’20. Honolulu, HI, USA: Association for Computing Machinery, 2020, pp. 1–8. ISBN: 9781450368193. DOI: 10.1145/3334480.3382995. URL: https://doi.org/10.1145/3334480.3382995.

[87] Hannah Miller and David E. Narváez. “Toward Determining NFA Equivalence via QBFs”. In: *AAAI-21 Student Abstract*. To appear. 2021.

[88] M. J. Mior and K. Q. Pu. “Semantic Data Understanding with Character Level Learning”. In: *International Conference on Information Reuse and Integration for Data Science (IRI)*. IEEE, Aug. 2020, pp. 253–258.

[89] M. J. Mior and K. Salem. “ReSpark: Automatic Caching for Iterative Applications in Apache Spark”. In: *International Conference on Big Data BigData*. IEEE, Dec. 2020.

[90] Michael J. Mior and Alexander G. Ororbia II. “Column2Vec: Structural Understanding via Distributed Representations of Database Schemas”. In: *CoRR* abs/1903.08621 (2019). arXiv: 1903.08621. URL: http://arxiv.org/abs/1903.08621.

[91] Nitinraj Nair, Rakshit Kothari, Aayush K. Chaudhary, Zhizhuo Yang, Gabriel J. Diaz, Jeff B. Pelz, and Reynold J. Bailey. “RIT-Eyes: Rendering of near-Eye Images for Eye-Tracking Applications”. In: *ACM Symposium on Applied Perception 2020*. SAP ’20. Virtual Event, USA: Association for Computing Machinery, 2020. ISBN: 9781450376181. DOI: 10.1145/3385955.3407935. URL: https://doi.org/10.1145/3385955.3407935.

[92] Nitinraj Rajan Nair. “Realistic eye image and video generation for eye tracking applications”. MA thesis. Rochester Institute of Technology, Aug. 2020.

[93] David E. Narváez. “A QSAT Benchmark Based on Vertex-Folkman Problems”. In: *34th AAAI Conference on Artificial Intelligence (Student Abstracts)*. AAAI Press, 2020, pp. 13881–13882.

[94] David E. Narváez. “Constraint Satisfaction Techniques for Combinatorial Problems”. PhD thesis. Rochester Institute of Technology, Dec. 2020.

[95] Gavin Nishizawa. “Visual Structure Editing of Math Formulas”. MA thesis. Rochester Institute of Technology, August.

[96] Gavin Nishizawa, Jennifer Liu, Yancarlos Diaz, Abishai Dmello, Wei Zhong, and Richard Zanibbi. “MathSeer: A Math-Aware Search Interface with Intuitive Formula Editing, Reuse, and Lookup”. In: *Proc. ECIR*. 2020, 470–475 (demo paper). DOI: 10.1007/978-3-030-45442-5_60.

[97] J. Nordhaus, M. Campanelli, J. Bochner, T. Warfield, H. -P. Bischof, and J. Noel-Storr. *AstroDance: Engaging Deaf and Hard-of-Hearing Students in Astrophysics via Multimedia Performances*. 2020. arXiv: 2006.10543 [physics.ed-ph].

[98] Srinath Obla, Xinghan Gong, Asma Aloufi, Peizhao Hu, and Daniel Takabi. “Effective Activation Functions for Homomorphic Evaluation of Deep Neural Networks”. In: *IEEE ACCESS*. Aug. 2020.

[99] Alexander Ororbia. “Spiking Neural Predictive Coding for Continual Learning from Data Streams”. In: *arXiv preprint arXiv:1908.08655* (2019).

[100] Alexander Ororbia and Daniel Kifer. “The Neural Coding Framework for Learning Generative Models”. In: *arXiv preprint arXiv:2012.03405* (2020).

[101] Alexander Ororbia, Ankur Mali, Matthew Kelly, and David Reitter. “Like a baby: Visually situated neural language acquisition”. In: *Proceedings of the 57th Annual Meeting of the Association for Computational Linguistics*. 2019, pp. 5127–5136.

[102] Alexander Ororbia, Ankur Mali, Daniel Kifer, and C Lee Giles. “Large-Scale Gradient-Free Deep Learning with Recursive Local Representation Alignment”. In: *arXiv preprint arXiv:2002.03911* (2020).

[103] Alexander Ororbia, Ankur Mali, Daniel Kifer, and C Lee Giles. “Lifelong Neural Predictive Coding: Sparsity Yields Less Forgetting when Learning Cumulatively”. In: *arXiv preprint arXiv:1905.10696* (2019).

[104] Alexander G Ororbia, Ankur Mali, Jian Wu, Scott O’Connell, William Dreese, David Miller, and C Lee Giles. “Learned Neural Iterative Decoding for Lossy Image Compression Systems”. In: *2019 Data Compression Conference (DCC)*. IEEE. 2019, pp. 3–12.

[105] Gahyun Park, Minseok Kwon, Ramprasad Tamilselvan, and Seungjoon Lee. “Two-Way Trees: A Distributed Algorithm for Efficient Replica Search and Placement”. In: *Symposium on Algorithmic Principles of Computer Systems (APOCS)*, pp. 133–146. DOI: 10.1137/1.9781611976021.10. eprint: https://locus.siam.org/doi/pdf/10.1137/1.9781611976021.10. URL: https://locus.siam.org/doi/abs/10.1137/1.9781611976021.10.

[106] Rajendra K. Raj, Carol J. Romanowski, Sherif G. Aly, Brett A. Becker, Juan Chen, Sheikh Ghafoor, Nasser Giacaman, Steven I. Gordon, Cruz Izu, Shahram Rahimi, Michael P. Robson, and Neena Thota. “Toward High Performance Computing Education”. In: *Proceedings of the 2020 ACM Conference on Innovation and Technology in Computer Science Education*. ITiCSE ’20. Trondheim, Norway: Association for Computing Machinery, 2020, pp. 504–505. ISBN: 9781450368742. DOI: 10.1145/3341525.3394989. URL: https://doi.org/10.1145/3341525.3394989.

[107] Rajendra K. Raj, Carol J. Romanowski, John Impagliazzo, Sherif G. Aly, Brett A. Becker, Juan Chen, Sheikh Ghafoor, Nasser Giacaman, Steven I. Gordon, Cruz Izu, Shahram Rahimi, Michael P. Robson, and Neena Thota. “High Performance Computing Education: Current Challenges and Future Directions”. In: ITiCSE-WGR ’20. Trondheim, Norway: Association for Computing Machinery, 2020, pp. 51–74. ISBN: 9781450382939. DOI: 10.1145/3437800.3439203. URL: https://doi.org/10.1145/3437800.3439203.

[108] Carlos R. Rivero and David Ruiz. “Selecting suitable configurations for automated link discovery”. In: *Proceedings of the 35th ACM/SIGAPP Symposium on Applied Computing, SAC*. 2020, pp. 907–914. DOI: 10.1145/3341105.3373882. URL: https://doi.org/10.1145/3341105.3373882.

[109] Mihaela Sabin, Stuart Zweben, Barry Lunt, and Rajendra K. Raj. “Evaluating Student Participation in Undergraduate Information Technology Programs in the U.S.” In: *Proceedings of the 21st Annual Conference on Information Technology Education*. SIGITE ’20. Virtual Event, USA: Association for Computing Machinery, 2020, pp. 93–99. ISBN: 9781450370455. DOI: 10.1145/3368308.3415396. URL: https://doi.org/10.1145/3368308.3415396.

[110] Mike Schaekermann, Christopher M. Homan, Lora Aroyo, Praveen Paritosh, Kurt Bollacker, and Chris Welty. “Will Machine Learning Outgrow Human Labeling?, AI Bookie Column, Interactive AI Magazine”. In: (2020). https://interactiveaimag.org/columns/will-machine-learning-outgrow-human-labeling/.

[111] Parikshit Shembekar. “Anomaly Detection in Videos through Deep Unsupervised Techniques”. MA thesis. Rochester Institute of Technology, Nov. 2020. URL: https://scholarworks.rit.edu/theses/10572/.

[112] Pablo Suárez-Otero, Michael J. Mior, Maria José Suárez-Cabal, and Javier Tuya. “Maintaining NoSQL Database Quality During Conceptual Model Evolution”. In: *International Workshop to Improve Big Data Science Project Team Processes (IEEE BigData workshop)*. Dec. 2020.

[113] Wenbo Sun and Ivona Bezáková. “Sampling Partial Acyclic Orientations in Chordal Graphs by the Lovász Local Lemma (Student Abstract)”. In: *Proceedings of the 35th AAAI Conference on Artificial Intelligence (AAAI)*. To appear. AAAI Press, 2021.

[114] Wenbo Sun and Ivona Bezáková. “Sampling Random Chordal Graphs by MCMC (Student Abstract)”. In: *Proceedings of the 34th AAAI Conference on Artificial Intelligence (AAAI)*. AAAI Press, 2020, pp. 13929–13930. URL: https://aaai.org/ojs/index.php/AAAI/article/view/7237.

[115] Allahsera Auguste Tapo, Bakary Coulibaly, Sébastien Diarra, Christopher Homan, Julia Kreutzer, Sarah Luger, Arthur Nagashima, Marcos Zampieri, and Michael Leventhal. “Neural Machine Translation for Extremely Low-Resource African Languages: A Case Study on Bambara”. In: *Proceedings of the 3rd Workshop on Technologies for MT of Low Resource Languages (LoRes)*. arXiv:2011.05284. 2020, pp. 23–32.

[116] Juan Troncoso-Pastoriza, David Froelicher, Peizhao Hu, Asma Aloufi, and Jean-Pierre Hubaux. “Privacy-preserving data sharing and computation across multiple data providers with Homomorphic Encryption”. In: *Proceedings of Homomorphic Encryption workshop @ Microsoft Research*. Springer, Dec. 2020.

[117] Leo Ureel, James Heliotis, Megan Lutz, Mireilla Bikanga, Mohsen Dorodchi, Victoria Eisele, and Ethel Tshukudu. “Directing Incoming CS Students to an Appropriate Introductory Computer Science Course”. In: *2020 IEEE Conference on Frontiers in Education*. IEEE. 2020.

[118] Tharindu Cyril Weerasooriya, Tong Liu, and Christopher M Homan. “Neighborhood-based Pooling for Population-level Label Distribution Learning”. In: *Proceedings of the European Conference on Artificial Intelligence (ECAI)*. arXiv:2003.07406, https://doi.org/10.3233/FAIA200130. 2020, pp. 490–497.

[119] Nicholas Wilkins, Max Cordes Galbraith, and Ifeoma Nwogu. “Modeling Global Body Configurations in American Sign Language”. In: *Interspeech 2020, 21st Annual Conference of the International Speech Communication Association*. 2020, pp. 671–675. DOI: 10.21437/Interspeech.2020-2873. URL: https://doi.org/10.21437/Interspeech.2020-2873.

[120] Nicholas Wilkins and Ifeoma Nwogu. “Analyzing the Extent of Rapport in Groups of Triads Via Interactional Synchrony”. In: *IEEE International Conference on Systems, Man, and Cybernetics, SMC 2020*. IEEE, 2020, pp. 234–240. DOI: 10.1109/SMC42975.2020.9283474. URL: https://doi.org/10.1109/SMC42975.2020.9283474.

[121] Xiaodong Xu, Meilian Liang, and Stanisław Radziszowski. “Chromatic Vertex Folkman Numbers”. In: *Electronic Journal of Combinatorics* 27(3) (2020), #P3.53, 12 pages.

[122] Wei Yin, Peizhao Hu, Jadwiga Indulska, Marius Portmann, and Ying Mao. “MAC-Layer Rate Control for 802.11 Networks: Lesson Learned and Looking Forward”. In: *Springer Journal on Wireless Networks* (Feb. 2020).

[123] Wei Yin, Peizhao Hu, Wenbo Wang, Jiahui Wen, and Hongjian Zhou. “FASUS: A Fast Association Mechanism for 802.11ah Networks”. In: *Elsevier Journal of Computer Networks* (Apr. 2020).

[124] Wei Yin, Peizhao Hu, Jiahui Wen, and Hongjian Zhou. “ACK Spoofing on MAC-layer Rate Control: Attacks and Defenses”. In: *Elsevier Journal of Computer Networks* (Jan. 2020).

[125] Richard Zanibbi, Behrooz Mansouri, Anurag Agarwal, and Douglas W. Oard. “ARQMath: A New Benchmark for Math-Aware CQA and Math Formula Retrieval”. In: *SIGIR Forum*. ACM SIGIR, Dec. 2020.

[126] Richard Zanibbi, Douglas W. Oard, Anurag Agarwal, and Behrooz Mansouri. “Overview of ARQMath 2020 (Updated Working Notes Version): CLEF Lab on Answer Retrieval for Questions on Math”. In: *CLEF 2020 Working Notes*. 2020. URL: http://ceur-ws.org/Vol-2696/paper_271.pdf.

[127] Richard Zanibbi, Douglas W. Oard, Anurag Agarwal, and Behrooz Mansouri. “Overview of ARQMath 2020: CLEF Lab on Answer Retrieval for Questions on Math”. In: *Proc. CLEF 2020*. Vol. 12260. LNCS. Springer, 2020, pp. 169–193. DOI: 10.1007/978-3-030-58219-7_15.

[128] Wei Zhong and Richard Zanibbi. “Accelerating Substructure Similarity Search for Formula Retrieval”. In: *Proc. ECIR*. 2020, pp. 714–727. DOI: 10.1007/978-3-030-45439-5_47.

Funding

Research and academic grants that were active or newly awarded in 2020 to Computer Science faculty are listed below. The total amount of funds exceeds $11 million, with the majority of funding coming from external grants.

Investigators	Sponsor	Project Title	Duration	Funds
Alm, Cecilia, Reynold Bailey	NSF	REU Site: Computational Sensing for Human-Centered AI. Research Experiences for Undergraduates(REU)	4/2019–3/2022	$359,926
Alm, Cecilia, Reynold Bailey	NSF	Supplemental Funding Request to Enhance 2020 and 2021 REU Student Stipends	4/2019–3/2022	$20,000
Bezakova Ivona, Edith-Hemaspaandra	NSF	Automated Feedback in Computing Theory	10/2018–09/2021	$299,417
Butler Zack, Ivona Bezakova	NSF	Pencil Puzzles as an Inclusive Domain for Learning Computer Science	10/2018–09/2021	$474,064
Diaz, Gabriel, Reynold Bailey	Facebook Reality Labs	Improved Semantic Segmentation with Natural Gaze Dynamics	7/2020–7/2021	$278,214
Diaz, Gabriel, Alexander Ororbia	RIT D-RIG Seed Funding	Machine Learning for Visually Guided Action Through Active Inference	1/2021–12/2021	$15,000
Fluet Matthew	NSF	Automatic Locality Management for Dynamically Scheduled Parallelism	6/2014–5/2020	$236,744
Fluet Matthew	NSF	Positioning MLton for Next-Generation Programming Languages Research	8/2014–7/2020	$224,329
Frank, Mark G., Ifeoma Nwogu	NSF	Deceit and Interactional Synchrony In Different Social Constellations	5/2017–4/2020	$318,526
Geigel, Joe	Vicarious Visions / Activision	Unrestricted. corporate gift	2020	$15,000
Geigel, Joe, M. Schweppe	Epic Games	AI-Pollo - Augmented Reality Theatre. Epic Mega-grant	2020-21 Academic Year	$25,000 + 4 MAGIC Leap devices
Hu, Peizhao	REDCOM Labs	Zero-knowledge based authentication method	7/2019–2/2020	$57,745

Investigators	Sponsor	Project Title	Duration	Funds
Kwon, Minseok	NSF	A New Approach to Federated Network Security: REU Supplement	6/2020–8/2020	$16,000
Kwon, Minseok	NSF	A New Approach to Federated Network Security	1/2020–8/2020 (extended)	$167,450
Kwon, Minseok, Warren Carithers	Cisco University Research Program	End-to-End Traffic Control with Virtual Switches for Containerized Applications	1/2020–8/2020 (extended)	$57,541
Liu, Xumin, Rajendra K. Raj	NSF	Developing a Hands-on Data Science Curriculum for Non-Computing Majors	10/2020–9/2023	$299,878
Lukowiak Marcin, Peter Bajorski, Stanislaw Radziszowski	L3Harris Technologies	Bit Stream Obfuscation for Securing IP on FPGAs	2019–2021	$69,411
Lukowiak Marcin, Peter Bajorski, Stanislaw Radziszowski	L3Harris Technologies	Enhanced Security for the MK-3 Crypto Algorithm	2020–2021, 2020	$40,000
Mior, Michael	RIT Provost's Learning Innovations Grants	An Interactive Exploration of Relational Database Query Processing	Summer 2019–Fall 2020	$4,960
Mior, Michael	RIT Seed Funding	Benchmarking Integration of Relational and Non-Relational Data Systems	5/2019–6/2021	$4,960
Rafique, Mustafa M.	Department of Energy	Optimizing Asynchronous Data Movement for Deep Memory Hierarchies	9/2020–8/2021	$69,511
Narayan, Darren, Jobby Jacob, Nishant Malik, Laura Munoz, Stanislaw Radziszowski	NSF	REU Site: Extremal Graph Theory and Dynamical Systems. REU Mathematics Program	2020–2023	$323,995
Nwogu, Ifeoma	NSF	CAREER:A Computational Approach to the Study of Behavior and Social Interactions	2/2019–1/2024	$524,692

Investigators	Sponsor	Project Title	Duration	Funds
Reznik, Leon	NSF	Data quality and security evaluation framework for mobile devices platform	9/2016–8/2021	$250,052
Reznik, Leon	US Military Academy/DoD	Self-learning capabilities for a mission-oriented data quality and security assurance in military IoT systems	9/2020– 9/2021	$85,936
Rivero, Carlos, Zack Butler	NSF	IUSE: EHR: Using Program Dependence Graphs to Propagate Feedback to Students and Promote Responsive Teaching in Programming Assignments. Improving Undergraduate STEM Education	10/2019–9/2022	$298,728
Yuan, Bo, Andrew Meenely, Rajandra K. Raj	NSF	Cybersecurity as a Diverse Discipline	1/2015–12/2020	$4,117,669
Yuan, Bo, Andrew Meenely, Rajandra K. Raj	NSF	Renewal: Cybersecurity as a Diverse Discipline	8/2019–7/2024	$5,515,422
Zanibbi, Richard, Anurag Agarwal	NSF	Improving Technical Paper Database Search through Math- Aware Search Engines	12/2017–11/2021	$498,928
Zanibbi, Richard, Lee Giles	Digital Information Technology Program Grant. Alfred P. Sloan Foundation	Improving Discovery of Scientific and Scholarly Information through Math-Aware Search	7/2017–6/2021	$470,458

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