

RIT

B. Thomas Golisano College of Computing and Information Sciences

DEPARTMENT OF COMPUTER SCIENCE

**ANNUAL REPORT
2019**

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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 1300 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. 9 tenure-track faculty and 9 lecturers have joined our department in the last 5 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 2019, 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

2019. 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 support 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 2019	
BS Students	905
Fulltime Equivalent	740
Credit Hours	8166

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 2019	
MS Students	375
Fulltime Equivalent	314
Credit Hours	3018

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	John Marshall Distinguished 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 2019 Academic year.

RIT research helps artificial intelligence be more accurate, fair and inclusive

Rochester Institute of Technology has received a grant from the National Science Foundation to help make artificial intelligence smarter and more inclusive.



The three-year, \$359,927 grant creates the [Research Experiences for Undergraduates \(REU\) Site in Computational Sensing for Human-centered AI](#). It will allow a total of 30 undergraduate students from across the country - mostly from computing disciplines - to spend 10 weeks at RIT. The [first cohort](#) of 10 students will arrive later this month and will stay on campus through the beginning of August, when they will present at the RIT [Undergraduate Research Symposium](#).

Cecilia Ovesdotter Alm, principal investigator and an associate professor in the College of Liberal Arts, said it is important to broaden participation of underrepresented groups in scientific research. At least half of the students in the program will be women and recruiting efforts will also focus on underrepresented minorities, including Native American and Latino/a American students.

The research will attend to fairness and critical thinking in data collection and development of AI so that systems are more accurate.

“The program aims to ensure that the next generation of researchers are mindful of the importance of inclusion and that all voices are represented in computational artificial intelligence research,” Alm said.

[Research projects](#) this summer will include measuring engagement with eye tracking in mixed reality applications, developing accessible captioning techniques for deaf and hard-of-hearing individuals, and improving automatic screen magnification for individuals with low vision.

“We consider human sensing in a variety of contexts,” said Reynold Bailey, co-principal investigator and professor in the Department of Computer Science.

“Human activity generates data - your speech, facial expressions, eye movements, pulse, skin conductance, emotional reactions - it’s all data,” Alm said. “The projects will advance computational approaches to sense and model this data.”

Two additional students from Malmö University in Sweden will join the research on campus. Their visit is sponsored by Malmö University and RIT Global.

“We’re thankful for how this partnership exposes all students to global issues and provides mutual intercultural exchange,” Bailey said.

Five additional faculty members - Ammina Kothari from RIT’s College of Liberal Arts; Ray Ptucha from Kate Gleason College of Engineering; and Joe Geigel, Kristin Shinohara and Matt Huenerfauth from B. Thomas Golisano College of Computing and Information Sciences - will also mentor the students during their stay in Rochester.

“It’s really important to make it a team experience,” Bailey said. “The mentors will continue to support the students and guide them as they disseminate their team’s work in research publications or apply to graduate school.”

RIT student develops tool to visualize molecular dynamics of proteins in virtual reality

A Rochester Institute of Technology student developed a tool that can help scientists visualize molecular motion and dynamics of proteins using virtual reality headsets.

Kyle Diller, a fifth-year computer science student from East Windsor, N.J., developed a plug-in application for the molecular visualization program UCSF ChimeraX. The application is currently under development at the University of California at San Francisco, where they are developing new visual capabilities in more life-like multidirectional shadowing and virtual reality. Diller’s plug-in allows users to display an atomic structure as if it were a movie so they can manipulate how the view looks and see how the protein or structure changes.

“Molecular dynamics is becoming a big field within bioinformatics and this can help you see how physics plays out at the atomic level,” said Diller. “Chimera X is a fairly new visualizer but it previously didn’t have this capability. I hope that this helps people with their molecular dynamics simulations.”

Diller created the tool in the spring semester as a project for his bioinformatics languages class taught by Gregory Babbitt, an associate professor in the Thomas H. Gosnell School of Life Sciences.



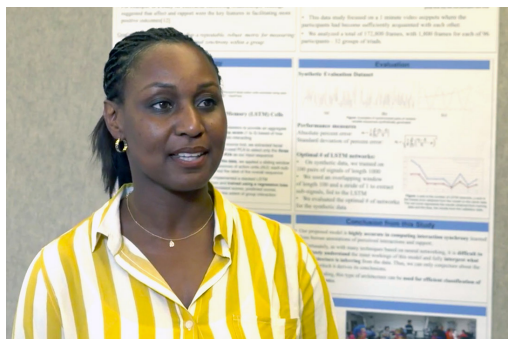
“With Kyle’s project, we wanted to incorporate these features into our current software for visualizing comparative protein motions,” said Babbitt. “He did such a nice job extending ChimeraX that I suggested that he offer his viewer as a plug-in for their user community. I think it is a perfect example of how a student can take an open-ended class project and develop it into something that can help the broader scientific community.”

The plug-in Diller developed, MolecularDynamicsViewer, is available to download from the [UCSF ChimeraX toolshed](#) or [GitHub](#).

RIT faculty earns NSF CAREER award to study human behavior using machine learning

A Rochester Institute of Technology professor has earned a prestigious National Science Foundation award to use computers to better understand human behavior and social interaction.

Ifeoma Nwogu, an assistant professor of computer science, received an NSF Faculty Early Career Development (CAREER) award and grant for her five-year project.



She aims to study human behavior in a new way, by using machine learning techniques to analyze and find patterns in the many signals that individuals display during social interactions. Her work will specifically look at groups working in science, technology, engineering and math (STEM), with the aim of supporting underrepresented groups in STEM.

“In a conversation, people are constantly displaying and processing different non-verbal signals, such as how fast someone is talking or the facial expressions they are making,” said Nwogu. “I wanted to use computers to analyze all of these signals in new ways and help us gain a better understanding of social intelligence and our emotions.”

Working with a team of student researchers, Nwogu will observe and collect data generated in small face-to-face group meetings. Some of the non-verbal communication data she will collect include galvanic skin response information, facial expressions, gestures, self-observed data and speech prosody—which includes intonation, tone, stress and rhythm of speech.

The sequence of data is essentially time series signals, and the real challenge is extracting meaningful statistics and analyzing patterns in that data, Nwogu explained. Using Bayesian trained neural networks, she plans to develop a computational framework for analyzing individuals’ behavior and interactions.

“Deep learning is good at analyzing large data sets and finding hidden patterns, layers or clusters, but it can’t tell you why there are patterns,” Nwogu said. “We can then create probabilistic models to help gain a better understanding of collective behaviors in a group, such as why people with a certain perceived-personality type might speak at a specific volume or pace.”

For example, Nwogu could use the models to predict if people in a group have rapport or not. Speech volume or certain facial expressions could be indicators used for making that prediction.

For the project, Nwogu is partnering with RIT’s [**Center for Advancing STEM Teaching, Learning and Evaluation \(CASTLE\)**](#), which is a network of faculty, projects and programs engaged in scholarship surrounding STEM education.

Nwogu will observe and collect signal data from student and faculty mentoring or peer-to-peer groups that the center offers. She hopes to better understand everything that happens, to find ways to improve teaching in STEM. For example, the study may observe what happens when a

student becomes flustered by a difficult topic or when an instructor becomes frustrated teaching a specific concept.

“Ifeoma’s work has the potential to truly revolutionize how we study student learning,” said Scott Franklin, director of CASTLE and a professor of physics. “Social and group interactions are critical to learning, which is why activity-based classrooms are so successful, but research on human dynamics, which are incredibly subtle, has always been extremely labor-intensive. Machine-learning can automate procedures that reliably identify complicated group dynamics, exponentially increasing our ability to acquire and analyze important data on how students work together to construct knowledge and learn content.”



As part of outreach for her research, Nwogu recently taught a computer vision course at the African Institute of Mathematical Sciences (AIMS) in Rwanda.

As part of outreach for the study, Nwogu has partnered with RIT’s African Center for Excellence in Teaching and Learning Mathematics and Science to teach a course at the African Institute of Mathematical Sciences (AIMS) in Rwanda. She also plans to bring research students to Rwanda and continue the NSF project, observing if social interaction patterns change across different cultures.

The CAREER program is an NSF-wide activity that offers awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

“Congratulations to Ifeoma on this tremendous achievement,” said Anne Haake, dean of RIT’s Golisano College of Computing and Information Sciences. “NSF CAREER awards like this are a testament to the increasing strength of computing research by our faculty at RIT.”

RIT hosts elite universities for regional International Collegiate Programming Contest

RIT is hosted the **Northeast North American Regional Final of the International Collegiate Programming Contest (ICPC)**, Nov. 9 in the Golisano College of Computing and Information Sciences. The top regional team advanced to the World Finals in Moscow.

In the contest, each team of three students attempted to solve a set of 10 complex, real-world problems. More than 50,000 students from 3,000 universities around the world compete in the annual programming contest.

RIT’s Department of Computer Science has organized the regional contest for almost two decades. This year’s sponsor is M&T Bank. For the contest, RIT faculty get to design the algorithmic problem sets and create the corresponding implementation and data sets. As a chief judge, RIT Professor Zack Butler also sets up the judging software to go along with the problems.

“Needless to say, organizing the contest involves an extraordinary amount of work, which is all done via volunteers,” said Ivona Bezakova, professor of computer science and director of the

regional contest. “As a reward, we get to interact with the best students in the region (and the world) and show them what a great place RIT is.”

Student teams from RIT and 19 other colleges and universities took part in the 2019 regional competition, including Brandeis University, Brown University, University at Buffalo, Concordia University, Harvard University, Massachusetts Institute of Technology, McGill University, Mount Allison University, Northeastern University and University of Rochester.

RIT’s team included Ayana Adylova, a fifth-year computer science student from Almaty, Kazakhstan; Steven Landau, a fifth-year computer science student from Rye Brook, N.Y.; and Andrew Searns, a BS/MS computer science student from East Amherst, N.Y.

“I like to participate in programming contests because I am a pretty competitive person and therefore find the ICPC environment very helpful in preparing for coding interviews, rather than just solving problems on my own without any real time pressure,” said Adylova.

A possible problem in the event could look at airline schedules. For example, students must find an optimal route from place A to place B, within given constraints, such as a desired layover time. Teams need to design and implement an algorithm that will produce the desired output for any possible input.

When they are done with implementation, they submit it to a judging software that runs their implementation against a set of hidden test cases and gives them a good or bad response. Teams are scored by the number of problems solved.

“However, the catch is that they are not given the test case – so they need to do extensive testing by creating their own test cases,” said Bezakova. “This is a very useful skill for students to have when they graduate, whether they choose to work in industry or do research.”

Three Theory Lab Student Abstracts accepted to AAAI-20

Three papers written by students involved with the Theory lab located in the Golisano College of Computing and Information Sciences were recently accepted to the Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI-20) Student Abstract and Poster Program.

David E. Narváez’s paper “A QSAT Benchmark Based on Vertex-Folkman Problems”

Andrew Searns’s paper “Fairness Does Not Imply Satisfaction”.

Wenbo Sun’s paper “Sampling Random Chordal Graphs by MCMC”.

Link to conference: <https://aaai.org/Conferences/AAAI-20/>

International Collegiate Programming Contest

Several teams from the Department of Computer Science have spent the past month participating in the International Collegiate Programming Competition. The first stage in this journey was a qualifying competition at RIT among seven teams. The top four teams moved on to the regional qualifying competition at Hamilton College on October 26th. RIT took positions one, two, four, and nine with the top team solving all problems with more than an hour to spare!

This team, consisting of RIT students Ayana Adylova, Steven Landau, Andrew Searns, and coached by professors Michael Mior and Alexander G. Ororbia II, continued to the Northeast North America regional contest hosted at RIT on November 9th. The team achieved an impressive seventh place behind teams from MIT, Harvard, and other top schools. Unfortunately the team will not be moving on the next round of the competition, but these students should be congratulated for their impressive performance!



4th Annual Frameless Symposium 2019

The 4th Annual Frameless Symposium, an exciting 2 days of virtual, augmented, and mixed reality, was held November 21-22 at the Magic Spell Studios

Highlights included:

- Interactive workshops on Virtual Sculpting, Media Literacy, Spark AR, and Snapchat Lens Studio on Thursday (pre-registration recommended)
- Keynote presentation by Luis Cataldi, Global Education Evangelist at Epic Games
- A full day of talks on a variety of XR topics including VR/AR in Advertising, Digital Storytelling, XR in Education, Imaging and Optics, Creating XR Experiences, and Wellbeing and Awareness on Friday
- Interactive Demo session and Reception (RSVP on Web site for complementary beverage ticket)
- Encore performance of Fragile Corridors performed by BIODANCE with visuals by W. Michele Harris, first seen at the 2019 Rochester Fringe Festival.

All events were free and open to the public.

Full schedule can be found at <http://framelesslabs.rit.edu/symposium-2019/>

Faculty Spotlight

Warren Carithers

Where is your degree from (and in what)?

I have an MS in Computer Science from the University of Kansas. My MS thesis was entitled "Static Evaluation Functions and the Game of Othello".

Where did you grow up?

I was born in Indianapolis, Indiana, but moved to Topeka, Kansas at age 7 and grew up there. Between those places we also lived in Glenview, Illinois and Kirkwood, Missouri for a few years.

What did you do before RIT?

I was a student at KU. While there, I worked at the Kansas Geological Survey as a programmer for several years as an undergraduate, and did some software development for the Menninger Foundation in Topeka, KS. I began teaching during the last semester of my senior year, and taught throughout graduate school, including teaching both undergraduate and graduate classes.

I did spend a Summer working in industry in 1979, writing COBOL compiler test programs (!) for NCR Corporation in Wichita, KS. That was enough to convince me that I really was much more interested in teaching than in programming as a nine-to-five activity.

What are your professional interests?

My primary interest has always been in computer architecture and organization, along with operating systems and system software in general. I have also had a long-time interest in programming language design and features; my interest in computer graphics dates back to the late 1990s.

Tell us about a high point thus far in your career.

Receiving the Eisenhart Outstanding Teaching award in 1993 was a "high point." I was the first person in CS to receive it; at the time, CS was in CAST, and I was only the second person in CAST to receive it.

A few years after I received it, Margaret Reek received it, followed by Ken Reek, then Edith Hemaspaandra, then Ivona Bezakova, and Zack Butler. Being a member of that group is absolutely something I'm proud of.

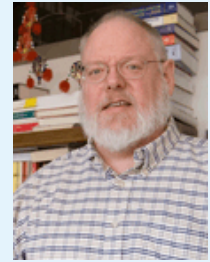
What are your personal interests?

I have always been a "reader," primarily of science fiction, mystery, and detective fiction. I also enjoy choral singing, and in recent years have taken up music composition and arranging.

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

One of the most rewarding things about this job is the feedback I receive from former students who have gone on to successful careers after graduation. Many of them tell me that it was a particular course (or even just a topic within a course) they took from me that caught their interest and eventually led to the work they are involved in.

The idea that something I might say in class could have a profound influence on someone else's future is at the same time astonishing, frightening, and profoundly satisfying. It sounds pretty sentimental (almost schmaltzy), but this is what has kept me in this profession over the years - the idea that my interest in passing on what I've learned might help inspire someone else and spur them on to bigger and better things.



AREAS OF STUDY

Students are required to complete a set of core classes covering programming and CS theory. After those courses are completed, students select a specialization area or *cluster* for their remaining courses. Master's students must complete a project or thesis in their cluster. The combination of coursework and research found in our program provides students with the skills to both engineer and advance modern computing systems.

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 Giriyaalkar

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.

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.

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. Areas for further study include graphics programming, rendering and image synthesis, computer animation and virtual reality, image processing and analysis, and data visualization.

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

- XTreme Theory
- Cryptography
- Computational Geometry
- Programming Language Theory

Opportunities

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



THEORY

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.

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 this 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.

Student Spotlight

Andrew Searns

I've always known that I have a deep love for math and logical thinking. In high school, I took nearly every computer science and engineering course that was offered. The decision was very close, but ultimately, I decided on Computer Science because it mixes the logic of mathematics with the power of modern technology. As a CS major here at RIT, I've had a lot of opportunities to develop and give back, from personal projects to tutoring.

Within CS, I'm very involved with the theory group. I've attended Theory Canal talks since my freshman year, and I even presented three of my own talks. I've worked on independent research now with both Dr. Bezakova and Dr. Hosseini. I presented my research on Planar Graph Data Structures with Dr. Bezakova at ISAAC 2018 in Taiwan last December, and my student abstract regarding Fair Division with Dr. Hosseini was recently accepted into AAAI 2020.

There were many people who inspired me to go into Computer Science, but the person who first inspired me towards theoretical Computer Science was Professor Mongan at Drexel University. During a high school summer camp, Professor Mongan introduced me to Markov Chain methods for text prediction, and I've been hooked with Computer Science ever since.

Outside of CS, I am the treasurer of RIT's Tango Club and the Social Media Director of RIT's Juggling Club. My dream is to push the boundaries of scientific knowledge, so I'd like to continue in research either in academia or in industry.



Honors & Awards

ECI Systems & Engineering Scholarship

- Paula Register
- Cody Burrows
- Daniel Osváth Londoño

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 1973-1976. 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

- Chinonso Akujuobi

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

- Fatima Umar

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 until 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

- Sri Kamal Chillarage

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

- Qadir Haqq

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

- Emily Wesson

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.

Staff Spotlight

Arnela Stupac-Catello

Where is your degree from (and in what)?

SUNY Alfred State - Network Administration, BS.

Where did you grow up?

Bosnia/Turkey/Rochester NY

What did you do before RIT?

I worked as Sr Security Analyst at Frontier (Business Analyst, Exchange Admin, AD Admin and various other roles).

What are your professional interests?

Network security.

What are your personal interests?

Running, knitting.

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

There have been plenty of weird and strange problems to figure out, but I think my most rewarding experience was working with the CS main office staff and figuring out all the little things they do and touch to make a student successful within Computer Science. This was quite the challenge during my initial discovery phase but I can say that my appreciation only grew stronger.

Describe a particularly challenging RIT-related experience?

Working with other individuals from different departments, with each department having their own set of goals is quite the challenge. It is key to understand where each puzzle piece fits.

Is there anything else you would like to say?

I think RIT is a wonderful place for students, faculty and staff. I have felt accepted and part of, what I like to call, extended family. I enjoy the challenges presented to us as it keeps things very new and exciting.



Class of 2019 (BS)

Ahmad, Saad
Aleksic, Stefan
Barandiaran, Thomas
Beagley, Starbuck
Belisle, Melissa
Bertonica, Andrew
Bicking, Josh
Bodzas, Austin
Bohde, Tommy
Both, Corie
Brown, Rebecca
Campbell, Kemoy
Carmosino, Robert
Cassata, Nathan
Cerbone, Stephen
Cheung, Ka
Chowdhury, Tousif
Clay, Casper
Clow, Corey
Coval, Connor
Crespo, Aaron
Crisanti, Giovanni
Davis, Quinn
Deichmann, Josh
DeSain, Jeffrey
DeVizia, Josiah
Dimoff, Dara
Dodds, Raymond
Dudley, Eric
Durek, Jason
Farrell, Nathan
Ferris, James
Flinchum, Jonathan
Forcier, James
Gibson, Matthew
Glasser, Abraham
Glynn, George
Goh, Gregory
Graham, Matthew
Haller, James
Hartz, Jacob
Hedges, Alex
Henry, Samuel

Herzig, Daniel
Hobson, Samuel
James, Brandon
Javaid, Zahir
Johnson, Christopher
Karthigeyan, Ganesh
Katcher, Christopher
Kelly, Eero
Kilgus, Samuel
Kim, Stephen
Kliot, Elijah
Kopinski, Brandon
Kroll, Juliana
Ku, Matthew
Kushalnagar, Kesavan
Lemelin, Christopher
Lentner, Christopher
Lewis, Kevin
Liao, Hmwe
Ling, Christian
Link, Coleman
Lista, Jacob
Lucas, Elizabeth
Lydic, Christopher
Lynaugh, Benjamin
Mainali, Bikash
Maloney, Matthew
Martinez, Connor
Masley, Steven
McMullen, Maximillian
Miller, Charissa
Mirabito, Steven
Mitchell, Benjamin
Miu, Jodie
Moreyn, Joseph
Muller, Liam
Ni, Lisa
Olivera, Stuart
Perweiler, Laurel
Pitt, Gavin
Porillo, Nicholas
Prescott, Emma
Promokhov, Gleb

Pyne, Eddie
 Ridley, Jumoke
 Robbins, Joshua
 Rock, Adam
 Rogers, Cole
 Ross, Robert
 Saran, Jesse
 Schenk, Jonathan
 Sgorbati, Noah
 Shea, Jordan
 Shores, Vincent
 Shpuntoff, Samuel
 Singh, Pushpinder
 Steed, Daniel
 Steinberg, Cara

Steinberg, Thomas
 Sterling, James
 Thompson, Colin
 Thompson, Zachary
 Thompson, William
 Tria, Scott
 Urena, Jean Luis
 Wallace, Brandon
 Wellman, Todd
 Wong, Colin
 Xhagolli, Orens
 Zamora, Daniel
 Zenie, Paul
 Zerner, Ariel
 Zujko, Peter

Student Spotlight

Garegin Grigoryan

From the early years, I was excited about how Internet technologies can connect me to people from different parts of the world. For example, when I was a kid, I had a website and enjoyed studying its statistics on a daily basis. Later, I became curious about how computer networking works on lower layers, specifically, IP and transport layers. This led me to choosing computer networking as my primary field of study.

I have a Master's Degree in computer science. Currently, I am a Phd. candidate. My research interests focus on different areas of computer networking, specifically, routing scalability in the context of IP and BGP protocols, verification of forwarding correctness of a router and in a private network, programmability of routers' control and data planes for designing more dynamic, application-driven networks, and remote direct access memory data transfer for minimizing the CPU overhead when processing network packets at end-hosts. Throughout the years of graduate studies, I have co-authored six full conference papers at venues such as IEEE INFOCOM, ICC, and NCA, ACM ANCS, 2 US Patents and 4 poster papers at IEEE ICNP and ACM ANCS.

My typical weekday starts with doing exercises at the Weidman fitness center of RIT. I also enjoy playing badminton and other sports. In addition, I am an amateur musician. I played two mini-shows at the Rochester Fringe Festival, and I am a member of a music band that occasionally plays at different open mic shows.

I am glad for several accomplishments I have had so far, however, I would like to be proud of something more than that. Within the computer science field, those accomplishments were positive feedback from students of classes where I had been an instructor or a teaching assistant, and papers accepted at top conferences like IEEE INFOCOM and ACM ANCS.

I am inspired by people who make a positive change in the lives of others, and those people are not necessarily from the computer science field. They can be musicians, entrepreneurs, social activists or software engineers. As for myself, I find that the studies in computer science advance me towards the goal of having a positive impact on society.

My dream job is a job that has a positive impact on society. It can be a computer science professor's job, to educate younger generations. It might be a software engineer job, to develop products that will make the Internet faster, safer, reachable and accessible.



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 (2019)

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 2019

Best MS Project Poster Award

Arpit J Vora: Colluded Application Attack and Its Detection Using Machine Learning

Advisor: Dr. Leon Reznik

Summer 2019

Best MS Project Poster Award

1st Place Poster: Coleman Link: Integrating Kubernetes and RDMA

Advisor: Dr. Minseok Kwon

Fall 2019

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

- **Bharath Suresh Modhipalli**

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.

TSO Logic - An Amazon Web Services Company Scholarship

- **Srinath Obla**
- **Leilei Sun**
- **Puneeth Kukkadapu**
- **Jainey Elsa James**
- **Mansha Malik**

Selection for this scholarship was based on the recipient's matriculation in a degree-granting program in RIT's B. Thomas Golisano College of Computing and Information Sciences. Preference is given to second-year graduate students enrolled in computer science. Recipients should demonstrate an area of interest in edge computing and/or big data analytics as evidenced by coursework and research topics and be in good academic standing.

Faculty Spotlight

Monika Polak

I grew up in Poland and since I remember I loved mathematics. I earned a doctoral degree with honors in Mathematics from the University of Maria Curie Skłodowska in Lublin, Poland, in 2016. My dissertation was in algebraic graph theory, cryptography and coding Theory titled "On the applications of Algebraic Graph Theory to Coding" under excellent supervision of Prof. Vasyl Ustimenko. My main research interests are in extremal graph theory, algebra, cryptography and coding theory. I embraced in a transition from Mathematics to Computer Science even as a student. Now my focus is in applications of Mathematics in Computer Science. I worked as assistant professor at the University of Information Science and Technology "St Paul the Apostle" in Ohrid, North Macedonia, 2017, where I taught cryptography and modeling and simulations. Being a faculty member was my dream job since the first semester as a student. I think it is very important to do work that you love because it is the only way to be really good.



I have been a lecturer at RIT since Fall 2018. I really enjoy teaching and seeing my students engaged during my lectures. At RIT I teach Introduction to Computer Science, Introduction to Computer Science Theory and Introduction to Cryptography. The latter is my favorite course in great part because I can teach students what I do for my research.

I am involved in Women in Computing (WiC) at RIT. I was excited when the Director of WiC asked me to prepare a curriculum for the Python Coding Camp for Girls organized by WiC and funded by a grant from AT&T. Summer Camp 2019 was very successful and we received great feedback from students. I would like to see more and more female students in my classroom. In the Fall semester I led special office hours targeting mainly freshmen female students. In 2019 I received funds from the STARTS Ignite Program to take a group of female students to the ACM Richard Tapia Celebration of Diversity in Computing where they presented a poster "Just press Run Girl". I was awarded a Grace Hopper Celebration 2019 Faculty Scholarship and I served as a judge for undergraduate student's poster competition during the celebration.

Personally, I love summer time, sea, good coffee, and traveling. During summer I visit Poland and Albania to spend time with family and friends. I really enjoy great food and beautiful nature there.

Class of 2019 (MS)

Abraham, Japheth Adhavan
 Agarwal, Sanket
 Ajmera, Tappan
 Ao, Xiang
 Belisle, Melissa
 Bhavsar, Komal
 Bhide, Saylee
 Bhuta, Bhavin
 Binu, Thomas
 Bongale, Pratik Sanjay
 Bostian, Dylan
 Both, Corie
 Caceci, Caroline
 Carcano, Damian
 Ceesay, Isza
 Chaudhary, Sandeep Shivbhagwan
 Chen, Jietong
 Chheda, Anuj
 Crisanti, Giovanni
 Dabholkar, Shardul
 Dixit, Utsav
 Dodeja, Rashmi
 Dodoo, Emmanuel
 Dolas, Kashmira
 Dourado, Renzil Anthony
 Francis, Michael
 Frey, William
 Fulwariya, Jitesh
 Furman, Scott
 Gambogi, Matt
 Gaydhani, Prajakta
 Gevaria, Harnisha
 Gevaria, Kushal
 Govindarajan Chandraketu, Gokul
 Gupta, Atit
 Guthinabail, Prajwal
 Harjani, Sunny
 Hedges, Alex
 Hedin, Samuel
 Hingu, Dharmendra Pravin
 Hounyo, Wilfried
 Huang, Tongtong
 Immel, Poppy
 Indukuri, Srivardhana Reddy
 Iyer, Ravi Sreelalan

Iyer, Tushar Mahesh
 Jaisinghani, Amit Shyam
 Jariwala, Karan Kishorkumar
 Jheeta, Maninder Singh
 Jin, Guangze
 Job, Joe Tom
 Jones, Michael
 Joshi, Ketan
 Joshi, Harsh
 Kalbhor, Akshay Balvant
 Kamalaskar, Manali
 Kanase, Chirag
 Kaur, Manpreet
 Kavathe, Darshan
 Kayarat Jayasankar, Savitha
 Khasbag, Sourabh
 Khatwani, Sanjay
 Kole, Vishal Vijay
 Kothari, Naman
 Kukkadapu, Puneeth
 Kuppusamy, Aravindh
 Lewis, Mica
 Li, Qiaoran
 Link, Coleman
 Logan, Thomas
 Lucas, Elizabeth
 Lunn, Susan
 Made, Prajakta
 Magar, Amit
 Malhotra, Trisha
 Mali, Parag Shrikrishna
 Maller, Amit
 Mantri, Varun Rajiv
 McGlynn, Kyle
 Meher, Pranit Sudhakar
 Miller, Charissa
 Mishra, Antara Anilesh Kumar
 Mudaliar, Rohit Anbalagan
 Munson, Richard
 Murali, Sandhya
 Murthy, Sahana
 Nagda, Vaibhav
 Nair, Parvathi
 Pachori, Bhaarat
 Pandey, Mayank

Parekh, Saurabh
Parekh, Virtee
Parmar, Viral
Pawar, Sameer
Perez, Michael
Pinto, Darryl Cyprian
Poon, Mitchell
Prabhakar, Shashank
Pudage, Akshay
Raman, Vishwanath
Ramesh, Chandini
Randolph, Joshua
Rao, Venkata Chinna Sai Praneeth
Raut, Tanvi
Rewaskar, Saurabh
Rinos, Michael
Robbins, Joshua
Rodriguez Sosa, Ana
Rudraraju, Sanjay Varma
Saha, Anindo Ashim
Sajan, Richie
Saran, Jesse
Sasuri, Ruzan
Sathish, Meghana
Schenk, Jonathan
Seshadri, Sanchitha
Shah, Eshaan
Shah, Hiteshi
Shah, Jinesh
Shah, Bhavin Navin
Shah, Jinal Sunil
Shakwala, Abhishek
Sharma, Tushar

Sharma, Akshay Chandramouli
Sharma, Deepak
Shaw, Aziel
Sheth, Sanket
Sheth, Mitul
Singh, Alankar Dingsh
Singh, Ashwini Rajesh
Singh, Chinmay
Sodergren, Erikson
Soni, Yashowardhan
Srivastava, Paridhi
St George, Jason
Su, Hao
Thote, Gitanjali Shitalnath
Tippur Gururaj, Krishna
Upadhyay, Jay
Upadhyay, Neha
Vaghela, Maitri
VanScoy, Jake
Venkatachalam, Akash
Vora, Arpit
Warner, Adam
Wilkins, Nicholas
Wilson, Erik
Xhagolli, Orens
Xu, Ruiyang
Yadav, Shristika
Yadav, Sheshans
Yin, Haonan
Young, Alexander
Zerner, Ariel
Zhao, Junan

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.

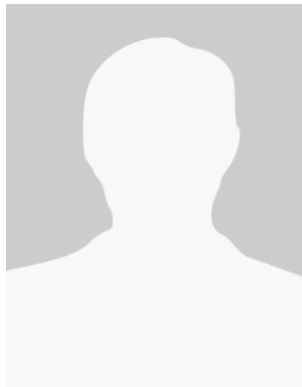
Our program is research-focused. Admitted PhD students have chosen their advisor prior to admission. During the first year of the program, in addition to coursework students complete their research potential assessment, which requires writing, presenting, and defending a mock conference paper to the 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



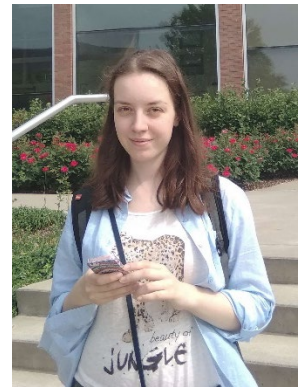
Asma Alnemari
Cybersecurity and Privacy
Advisors: Rajendra Raj and Carol Romanowski



Asma Aloufi
Information Security and Applied Cryptography
Advisor: Peizhao Hu



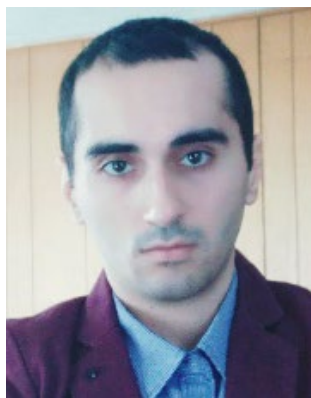
Moiz Arif
Next-Generation Data Centers for Emerging Distributed and Parallel Workloads
Advisor: M. Mustafa Rafique



Angelina Brilliantova
Multi-agent Systems
Advisor: Hadi Hosseini



Maheen Contractor
TBD
Advisor: Matthew Fluett



Garegin Grigoryan
*Computer Networking,
Routing Scalability and
Programmable Data Planes*
Advisor: Minseok Kwon



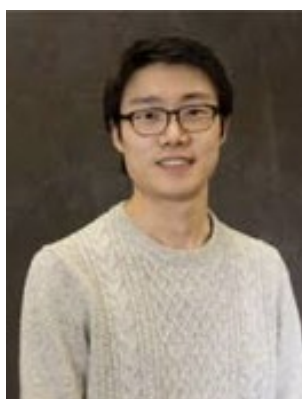
Sahil Gupta
*Securing the Internet of
Things Networks*
Advisor: Minseok Kwon



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



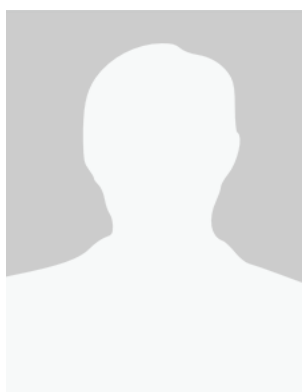
Mahshad Madhavi
*(Imaging Science)
Recognizing Handwritten and
Typeset Math Formulas*
Advisor: Richard Zanibbi



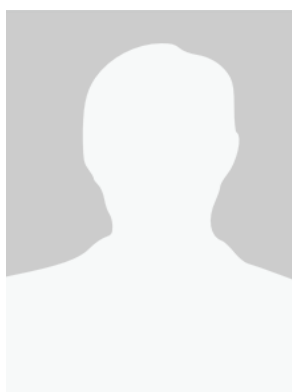
Behrooz Mansouri
*Information Retrieval,
Machine Learning*
Advisor: Richard Zanibbi



Avinash Maurya
*Exploiting Multikernels to
Accelerate High-
Performance Data Analytics
Platforms*
Advisor: M. Mustafa Rafique



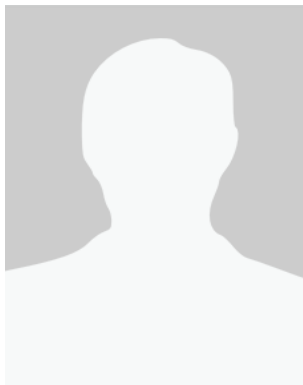
Hannah Miller
TBD
Advisors: Edith
Hemaspaandra, Ivona
Bezáková



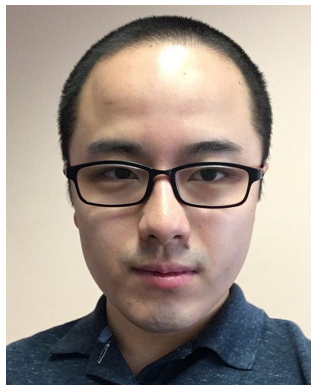
Justin Namba
TBD
Advisor: Michael Mior



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

Kenny Davilla

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

I graduated in 2013 with an M.Sc. in Computer Science, and in 2017 I received my Ph.D. in Computer and Information Sciences. Prior to RIT, I received my B.Sc. in Computing Systems Engineering in 2009 from Universidad Tecnologica Centroamericana (Tegucigalpa, Honduras).



What do you currently do for a living?

I am working on research as a Post-Doctoral Associate at University at Buffalo.

What are your professional interests?

Despite being difficult and frustrating at times, I love working on scientific research. I want to keep working on difficult problems where solutions can be used for practical applications that would benefit many. In particular, I love the potential that AI has in education, especially in helping to connect those who want to learn something new with the resources they need. In the long term, I see myself following a career in academia, where I can share my findings with the community through many more academic publications.

What are your personal interests?

My personal interests often overlap my professional ones. For example, I really love programming. I have always loved video games, earlier I loved making them, and now I still enjoy playing them. I also like visiting new places, and academic conferences are a perfect excuse for traveling around the world. Rock concerts are also another good excuse for me to travel around the country.

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

I am from a country where innovative ideas are quite often dismissed as absurd, crazy, or just impractical. One of my bosses told me once that developing our own handwriting recognition system was basically an impossible task. When I came to RIT, I took Pattern Recognition taught by Dr. Zanibbi, which led to my first publication; a system for recognizing handwritten mathematical symbols. Four years later, a paper based on my dissertation at RIT received the “best paper award” at the same leading conference in handwriting recognition (ICFHR). This proved to me that sometimes the boundaries of what is possible is just in our minds.

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

Hard work can help you succeed in many things, but smart work makes you more effective. Often, spending more time thinking and learning about a task will help you to get it done faster and with less effort. I wish I had known how to work smarter during my earlier years as a student.

Is there anything else you would like to say?

I am really thankful for everything I learned during my time as a student at RIT.

Pooja Ketan Shah

After completing my Undergraduate Degree in Information Technology, I worked in TCS, India for 2 years. My hunger for knowledge brought me to the USA. I completed my Master of Science in Computer Science in December 2017. I also earned the Big Data Analytics Advanced Certificate during my time at RIT. Along with my studies I completed two summer internships at Skyscape Medpresso Inc in Boston and PayPal in San Jose. My second internship at PayPal earned me a full time offer, where I then worked for fifteen months. Currently, I work as a Full Stack Engineer at Intuit, San Jose.



I personally take interest in learning new technologies and keeping myself up to date with emerging trends. Apart from my technical interest, I enjoy traveling, hiking and exploring new places.

There were many challenges when I began working, as everything was new including a diverse culture, technology, attending remote meetings, etc. However, I applied technical skills that I learned at RIT and it helped me grow into a confident and independent individual. I try to understand our customer's problems, and incorporate new features for the products we develop. Customer satisfaction is an utmost priority, and I have received a spotlight award for the work I have done within this area.

It was a very difficult decision to study in a different country because of my hearing disability. After many hours researching, I decided to study at RIT because of the amazing support services, such as captioning and speech therapy, which helped me understand what professors were teaching in the classroom. I would like to thank RIT for making it easier for me to study and for providing me with a strong foundation in computer science. I am also thankful to all the RIT professors for being

accessible at all times, and for ensuring students are understanding the material taught in the classroom through their assignments. Lastly, I would like to say, "Never be afraid of challenges, as they make you grow stronger".

Laurel Perwieler

When did you graduate?

May 2019

What degree(s) did you earn?

Bachelor of Science in Computer Science

What do you currently do for a living?

I am a full-time graduate student in the Higher Education program at the University of Denver. I work 30 hours a week as a Graduate Assistant in the Office of Student Engagement where I plan all social, professional, and wellness events for 8000 graduate students.

What are your professional interests?

Student affairs, and incorporating technology into this work to better support students (If you've heard of CampusGroups at RIT, I was part of the team that started that project and I am working on implementing this tool at my grad institution!)

What are your personal interests?

Aerial arts, traveling to see the Jonas Brothers, and hanging with my cat while watching Disney+!

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

Honestly, my entire RIT experience was incredibly rewarding. However, without my time as a Computer Science Ambassador and working for New Student Orientation, I would not have been able to see how engagement outside-of-the-classroom helped me grow both professionally and personally. (Plus seeing students, I gave tours to as a CS Ambassador actually enroll was really awesome!)

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

Please, please, please do not be afraid to approach the faculty and staff around you - whether that is within the department or another resource around campus. I do not think I would have gotten



through the program without all of the support I got from professional staff members. They are there to listen to you and more than likely will be willing to work with you!

Is there anything else you would like to say?

I will forever be grateful for the entire Computer Science Department. Everyone I interacted with over the course of five years wanted the best for me and helped me get there. Despite not working directly in the field, I know everything that I learned will guide me in whatever position I do hold after graduation pt. 2!

Mike Kirby

When did you graduate?

I graduated in 1991 and 1994

What degree(s) did you earn?

Bachelor of Science in Computer Science and a Bachelor of Science in Software Development and Management

What do you currently do for a living?

Vice President, Office Engineering for Xerox

What are your professional interests?

I enjoy new technology and understanding how it impacts how people interact with technology. Machine intelligence, user experience, and real-time embedded systems for “Internet of Things” applications.

What are your personal interests?

Hiking, skiing and baseball

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

The ability to interact with really smart people in the context of new and innovative technology. When you leave RIT and go into industry, you find a mix of skills and capabilities. Only at RIT will you be among the best of the best for so long.

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

First year GPA! So many kids slack off in the 1st year, and then can never recover when their GPA goes south.

Is there anything else you would like to say?

RIT is a sea of opportunity, but no one makes you take advantage of it. If there is an opportunity in front of you, seize it!

Swati Mehla

I have always been intrigued by how computers interface with every life aspect. While I was in high school, I was given the opportunity to take an introductory course in creating basic programs. Upon taking this class, I became very excited about learning the basic computer language. I began writing small programs on my computer. My best program was writing a library management software for my undergraduate college.



The ability to create tools that make day to day processes simple amazes me. Choosing computer science as a major gave me a path to realize the vision of simplifying people's lives. Moreover, an undergraduate degree in computer science built my problem solving and analytical skills, and prepared me to pursue this major for master's as well. I had worked in insurance domain in India where I worked with outdated technologies. While working in London I came across some AI and ML projects which motivated me to learn new technologies. Computer science major was the best way to enhance skill sets.

My CS Major experience at RIT has been amazing. CS at RIT not only built a strong foundation for me but also guided me to get a job in the career path of my choice. The bridge courses were a great revision for all programming languages, data structures, and algorithms. On top of that, the challenging homework assignments and projects shaped me well to handle complex problems effectively. The co-op program is also commendable. Moreover, the career fair is one of the best among all technology schools in the states. Getting a chance to interact with top-tier organizations was made easier through this. To sum up, I feel studying CS in RIT is one of the best decisions I have taken and I am extremely thankful to the amazing faculty, advisors and HOD.

I have been a graduate teaching assistant and tutor as a part of which I help undergrad CS students with assignments and projects. I am a part of WiC and have participated in WiC hackathons during my time here at RIT. Currently, I am a grader for both big data analytics courses and a lab assistant as well. Moreover, I have attended talks from various accomplished professors. For example, recently I attended a talk and was part of lunch with Prof. Vincent Poor.

Since I was trying to finish my masters as soon as possible. I was not able to participate in group activities outside CS. However, I enjoyed occasional folk dance practice at RIT Bhangra group. I judge my accomplishments by how I am doing on the goals I have set for myself. I feel there is this series of events which lead to a feeling of accomplishment. Coming from an organization which was working on outdated technologies, the first semester was very challenging and gave me the most learning. I have always maintained an A grade which gave me a chance to interview for the Graduate teaching assistantship. When I got the position, it was an amazing experience for me both in sense of learning and getting help with tuition fees by gaining 75% scholarship. My short-term goals included getting summer internships in the field of interest. I interned in Blue cross blue shield and ZS associates. Now as I am in the last semester I have 4 job offers with me in data science in EY, ZS Associates, Blue Cross Blue Shield and Cognizant.

As I am the first girl to get out of my hometown, away from family to work towards the career of my choice, everyone back home now looks up to me and feels motivated. My parents are proud and this journey has been a great accomplishment. I am the first person/generation from my extended family to have a career in computer science. It was my interest that drove me towards this. However, I would like to mention that listening to my achievements and journey motivated other kids in the family. I have three cousins who are studying computer science.

My dream job is to be a partner/CTO in one of the top 3 tech consulting firms such as McKinsey, BCG etc. Once I achieve that I plan to retire as a professor to sculpt new minds and give back to the society by opening a women's education foundation which will help underprivileged kids and women to acquire knowledge in the area of their interest.

CS FACULTY AND STAFF

Faculty



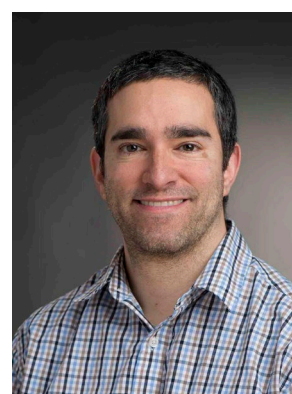
Dr. Reynold Bailey
Professor and Associate
Undergraduate Program
Coordinator



Dr. Ivona Bezáková
Professor



Dr. Hans-Peter Bischof
Professor and Graduate
Program Director



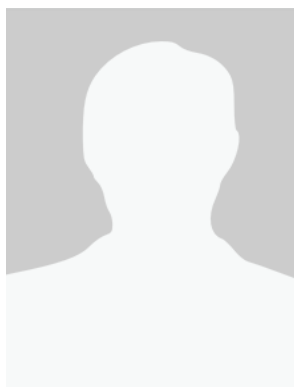
T.J. Borrelli
Senior Lecturer



Jeremy Brown
Lecturer



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



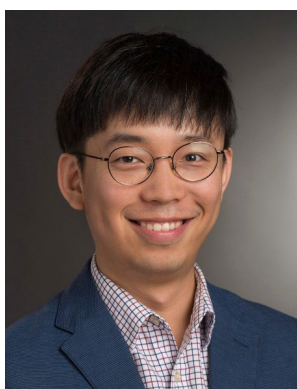
Ting Cao
Lecturer



Warren R. Carithers
Associate Professor



Maria Jose Cepeda
Garcia
Lecturer



Dr. Taejoong "Tijay"
Chung
Assistant Professor



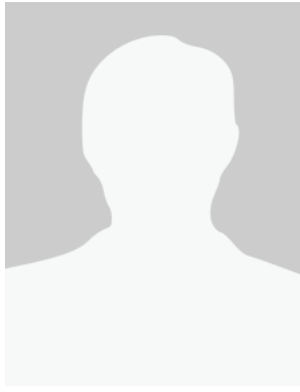
Dr. Aaron Deever
Senior Lecturer and
Undergraduate Program
Coordinator



Razieh Fathi
Visiting Lecturer



Dr. Matthew Fluet
Associate Professor



Timothy Fossum
Lecturer



Dr. Joe Geigel
Professor



Susan Haller
Lecturer



Dr. James Heliotis
Professor



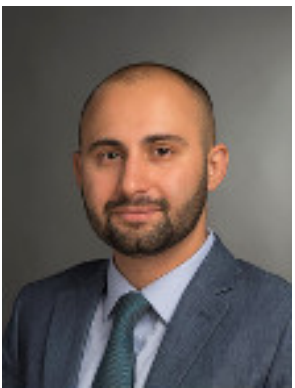
Dr. Edith Hemaspaandra
Professor



Dr. Hossein Hojjat
Assistant Professor



Dr. Chris Homan
Associate Professor



Dr. Hadi Hosseini
Assistant Professor



Dr. Peizhao Hu
Assistant Professor



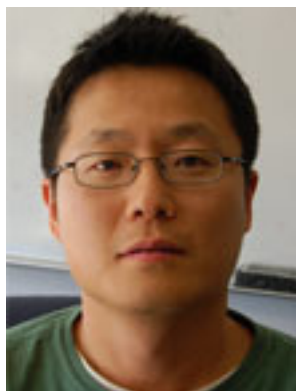
Scott Johnson
Lecturer



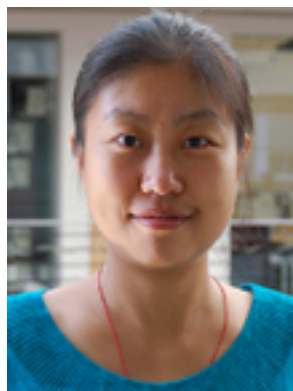
Dr. Thomas Kinsman
Lecturer



Dr. Mohan Kumar
Professor and Chair



Dr. Minseok Kwon
Associate Professor



Dr. Xumin Liu
Associate Professor



Dr. Michael Mior
Assistant Professor



Dr. Arthur Nunes-Harwitt
Lecturer



Dr. Ifeoma Nwogu
Assistant Professor



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



Niyazi Sorkunlu
Visiting Lecturer



Ben K. Steele
Senior Lecturer



Sean Strout
Principal Lecturer



Paul Tymann
Professor



Phil White
Senior Lecturer



Dr. Richard Zanibbi
Professor

Staff



Jennifer Burt
Senior Staff Assistant &
Assistant to the Chair



James "Linus" Craig
Manager of Technical
Services



Lucieann Condino
Stollery
Staff Assistant



Donald Denz
Academic Advisor



Jordan Gates
Sr. Staff Assistant



Jason Harrison
Staff Assistant



Betty Hillman
Academic Advisor



Rebecca O'Connor
Academic Advisor



Mina Pulcini
Senior Academic Advisor



Susan Quatro
Manager of Student
Services



Christina Rohr
Senior Academic Advisor



Mark Stamer
Technician



Arnela Stupac-Catello
Systems Administration



Sam Waters
System Administrator



Cindy Wolfer
Academic Advisor

Adjunct Professors

Jake Brandt

William Childs

Sam Fryer

Matthew Hosking

Mike Kirby

Michael Kurdziel

Laura Reznikov

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
- Hadi Hosseini
- Chris Homan
- Thomas Kinsman
- Ifeoma Nwogu
- Alex Ororbias
- 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 Sciences

Data Sciences 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
- Fereydoun Kazemian
- 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.

- Hans-Peter Bischof
- T.J. Borrelli
- Warren R. Carithers
- Taejoong Chung
- Chris Homan
- Peizhou Hu
- Alan Kaminsky
- James Minseok Kwon
- Monika Polak
- Stanisław P. Radziszowski
- Rajendra K. Raj
- Leon Reznik

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
- Hadi Hosseini
- Stanisław P. Radziszowski

New Faculty

Ting Cao

Ting Cao joined the Computer Science department of RIT as a lecturer this January. Before joining, she was a lecturer in Computer Science at Xi'an Jiaotong-Liverpool University (PRC) and University of Liverpool (UK). Before that, she worked for Oracle as Applications Engineer, for The GenieLab (UK) as Web Developer, and for the University of Aberdeen (UK) as Teaching Fellow and Software Developer. She did her MSc in Computer Science at the University of Edinburgh (UK). She has expertise in a plethora of modern software development skills. She has taught a variety of computer science courses around software development in UK and China to both undergraduate and postgraduate level.

Maria Jose Cepeda Garcia

Maria Cepeda joined the Computer Science department of RIT as a lecturer in August. She received her master's degree in Computer Science at the Rochester Institute of Technology in 2017. After finishing her master's, she worked at Cognivue Co. as a software engineer. Before that, she worked as a research assistant for the computer science department at the University of Idaho, and for the largest electricity company in Spain as a software developer. Her interests include programming languages, databases, and computer graphics.

RESEARCH AND SCHOLARSHIP

Publications

Below is a list of publications by faculty and students from the Department of Computer Science that appeared in 2019. 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.

Master's Theses

Bhide, Saylee. **Experimental analysis of spatial sound for storytelling in virtual reality**. Master's thesis, Rochester Institute of Technology, May 2019.

Carr, Jason. **Formally verified space-safety for program transformations**. Master's thesis, Rochester Institute of Technology, December 2019.

Dmello, Abishai. **Representing Mathematical Concepts Associated with Formulas using Math Entity Cards**. Rochester Institute of Technology, October 2019.

Logan, Thomas. **A mechanized theory of communication analysis in cml**. Master's thesis, Rochester Institute of Technology, March 2019.

Lucas, Elizabeth. **Understanding prediction of low-quality comments in online science discourse**. Master's thesis, Rochester Institute of Technology, May 2019.

Mali, Parag. **Scanning Single Shot Detector for Math in Document Images**. Master's Thesis. Rochester Institute of Technology, August 2019.

Pawar, Akhil. **A uml class diagram generator for the alloy modeling language**. Master's thesis, Rochester Institute of Technology, December 2019.

Ramesh, Chandini. **A comparative study of the effects of norms in wasserstein generative adversarial networks**. Master's thesis, Rochester Institute of Technology, May 2019.

Saha, Anindo. **A generic framework for workflow definition and execution**. Master's thesis, Rochester Institute of Technology, May 2019.

Sharma, Deepak. **Exploring deep neural network models for classification of high-resolution panoramas**. Master's thesis, Rochester Institute of Technology, August 2019.

Journal Papers

Aloufi, Asma, Peizhao Hu, Harry W. H. Wong, and Sherman S. M. Chow. **Blindfolded evaluation of random forests with multi-key homomorphic encryption**. In *IEEE Transactions on Dependable and Secure Computing (TDSC)*, Sept 2019.

Beshaj, Lubjana and Monika Polak. **On hyperelliptic curves of genus 3**. In *Contemporary Mathematics*, volume 724, Ohio State University, Columbus, OH, 2019.

- Bezáková, Ivon, Radu Curticapean, Holger Dell, and Fedor V. Fomin. Finding detours is fixed-parameter tractable. *SIAM Journal on Discrete Mathematics (SIDMA)*, 2020. To appear.
- Bezáková, Ivona, Andreas Galanis, Leslie Ann Goldberg, Heng Guo, and Daniel Štefankovič. **Approximation via correlation decay when strong spatial mixing fails.** *SIAM Journal of Computing (SICOMP)*, 48(2):279-349, 2019.
- Dongre, Siddharth, Sumita Mishra, Carol Romanowski, and Manan Buddhadev. **Quantifying the costs of data breaches.** In Jason Staggs and Sujeet Sheno, editors, *Critical Infrastructure Protection XIII*, pages 3-16, Cham, 2019. Springer International Publishing.
- Doucette, John A, Alan Tsang, Hadi Hosseini, Kate Larson, and Robin Cohen. **Inferring true voting outcomes in homophilic social networks.** *Autonomous Agents and Multi-Agent Systems*, 33(3):298-329, 2019.
- Fitzsimmons, Zack and Edith Hemaspaandra. **High-multiplicity election problems.** *Journal of Autonomous Agents and Multi-Agent Systems*, 33(4):383-402, 2019.
- Glasser, Abraham, Bonnie Jacob, Emily Lederman, and Stanislaw Radziszowski. **Failed power domination on graphs.** *Australasian Journal of Combinatorics*, 2020. To appear.
- Hashmi, K. H. Aljafer, Z. Malik and M. Mustafa Rafique. **Profit maximization in long-term e-service agreements.** *International Journal of Business Information Systems (IJBIS)*, 0(0):10, 2019. To Appear.
- Hart, Maxwell and Hadi Hosseini. **Exploration: From the Players Point of View.** In Alison James and Chrissi Nerantzi, editors, *The Power of Play in Higher Education*, pages 263-271. Palgrave Macmillan, 2019.
- Hemaspaandra, Edith and Lane A. Hemaspaandra. Credimus. In J.-F. Laslier, H. Moulin, R. Sanver, and W. Zwicker, editors, *The Future of Economic Design*, pages 141-152. Springer, 2019.
- Hemaspaandra, Edith, Lane A. Hemaspaandra, and Curtis Menton. **Search versus decision for election manipulation problems.** *ACM Transactions on Computation Theory*. To appear.
- Hernández, Inma, Carlos R. Rivero, and David Ruiz. **Deep web crawling: a survey.** *World Wide Web*, 22(4):1577-1610, 2019.
- Hosseini, Hadi, Maxwell Hart, and Mehrnaz Mostafapour. **Learning IS Child's Play: Game-Based Learning in Computer Science Education.** *ACM Transactions on Computing Education (TOCE)*, 19(3):22:1-22:18, 2019.
- Jayawardene, Chula, David Narváez, and Stanislaw Radziszowski. **Star-critical Ramsey numbers for cycles versus K_4 .** *Discussiones Mathematicae Graph Theory*, 2020. To appear.
- Kaufmann, Jenny, Henry Wickus, and Stanislaw Radziszowski. **On some edge Folkman numbers large and small.** *Involve, a Journal of Mathematics*, 12:813-822, 2019.
- Lima, Eduardo, Weishi Shi, Xumin Liu, and Qi Yu. **Integrating multi-level tag recommendation with external knowledge bases for automatic question answering.** *ACM Trans. Internet Techn.*, 19(3):34:1- 34:22, 2019.
- K. Hashmi, M. Mustafa Rafique, Malik, E. Najmi and A. Rezgui. **Product weighted taxonomy extraction using twitter.** *International Journal of Business Information Systems (IJBIS)*, 0(0):10, 2019. To Appear.
- Mior, Michael J. and Alexander G. Ororbia II. Column2vec: **Structural understanding via**

distributed representations of database schemas. *CoRR*, abs/1903.08621, 2019.

Müller, Moritz, Taejoong Chung, Alan Mislove, and Roland van Rijswijk-Deij. **Rolling with confidence: Managing the complexity of dnssec operations.** *IEEE Transactions on Network and Service Management*.

Ororbia, Alexander, Ahmed Ahmed ElSaid, and Travis Desell. **Investigating recurrent neural network memory structures using neuro-evolution.** *CoRR*, 2019.

Sobel, Ann, Allen Parrish, and Rajendra K. Raj. **Curricular foundations of cybersecurity.** *Computer*, 52(3):14-17, March 2019.

Xu, Xiaodong, Meilian Liang, and Stanisław Radziszowski. **A note on upper bounds for some generalized Folkman numbers.** *Discussiones Mathematicae Graph Theory*, 39:939-950, 2019.

Xu, Xiaodong, Meilian Liang, and Stanisław Radziszowski. **On a diagonal conjecture for classical Ramsey numbers.** *Discrete Applied Mathematics*, 267:195-200, 2019.

Xu, Xiaodong, Meilian Liang, and Stanisław Radziszowski. **Chromatic vertex Folkman numbers.** *Electronic Journal of Combinatorics*, 2020. To appear.

Conference Papers

Alnemari, A., R. K. Raj, C. Romanowski, and S. Mishra. **Protecting personally identifiable information (pii) in critical infrastructure data using differential privacy.** In *2019 IEEE International Symposium on Technologies for Homeland Security (HST)*, pages 1-7, Nov 2019.

Aloufi, Asma and Peizhao Hu. **Collaborative homomorphic computation on data encrypted under multiple keys.** In *International Workshop on Privacy Engineering (IWPE), collocated with IEEE S&P2019*, SAN FRANCISCO, CA, May 2019.

Alshangiti, Moayad, Hitesh Sapkota, Pradeep K. Murukannaiah, Xumin Liu, and Qi Yu. **Why is developing machine learning applications challenging? A study on stack overflow posts.** In *2019 ACM/IEEE International Symposium on Empirical Software Engineering and Measurement, ESEM 2019, Porto de Galinhas, Recife, Brazil, September 19-20, 2019*, pages 1-11, 2019.

Ayala, Daniel, Agustín Borrego, Inma Hernández, Carlos R. Rivero, and David Ruiz. **AYNEC: All you need for evaluating completion techniques in knowledge graphs.** In *The Semantic Web - 16th International Conference, ESWC, Proceedings*, pages 397-411, 2019.

Bendline, Theodora and Hadi Hosseini. **Partners in Crime: Manipulating the Deferred Acceptance Algorithm through an Accomplice.** In *Proceedings of the Thirty-Third AAAI Conference on Artificial Intelligence (AAAI-19)*, pages 9917-9918, 2019.

Bezáková, Ivona, Antonio Blanca, Zongchen Chen, Daniel Štefankovič, and Eric Vigoda. **Lower bounds for testing graphical models: colorings and antiferromagnetic ising models.** In *Conference on Learning Theory (COLT)*, volume 99 of *Proceedings of Machine Learning Research*, pages 283-298. PMLR, 2019.

Bezáková, Ivona, Andreas Galanis, Leslie Ann Goldberg, and Daniel Štefankovič. **The complexity of approximating the matching polynomial in the complex plane.** In *Proceedings of the 46th International Colloquium on Automata, Languages, and Programming (ICALP)*, volume 132 of *LIPICs*, pages 22:1-22:13. Schloss Dagstuhl - Leibniz-Zentrum fuer Informatik, 2019.

Bhide, Saylee, Elizabeth Goins, and Joe Geigel. **Experimental analysis of spatial sound for storytelling in virtual reality.** In Rogelio E. Cardona-Rivera, Anne Sullivan, and R. Michael Young,

editors, *Interactive Storytelling*, pages 3-7, Cham, 2019. Springer International Publishing.

Bischof, Hans-Peter, Jason St. George. **Music style transformer**. In *International Conference on Artificial Intelligence (ICAI 2019)*, ICAI 2019, 2019.

Bohlin, Gustaf, Kristoffer Linderman, Cecilia Ovesdotter Alm, and Reynold Bailey. **Considerations for face-based data estimates: Affect reactions to videos**. In *Proceedings of the 14th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications - Volume 2: HUCAPP*, pages 188-194. INSTICC, SciTePress, 2019.

Borrego, Agustín, Daniel Ayala, Inma Hernández, Carlos R. Rivero, and David Ruiz. **Generating rules to filter candidate triples for their correctness checking by knowledge graph completion techniques**. In *Proceedings of the 10th International Conference on Knowledge Capture, K-CAP*, pages 115-122, 2019.

Bort, Heather, David Bunde, Zack Butler, Christopher Lynnly Hovey, and Cynthia Taylor. **Propagating educational innovations**. In *SIGCSE Special Session*. ACM, 2019.

Brilliantova, Angelina, Anton Pletenev, and Hadi Hosseini. **The Rise and Fall of Complex Family Structures: Coalition Formation, Stability, and Power Struggle**. In *Proceedings of the 18th International Conference on Autonomous Agents and MultiAgent Systems*, pages 1847-1849. International Foundation for Autonomous Agents and Multiagent Systems, 2019.

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Aloufi, Asma and Peizhao Hu. **How to homomorphically compute on data encrypted under different keys?** In *IEEE Symposium on Security and Privacy (S&P) Poster*, SAN FRANCISCO, CA, May 2019.

Bezáková, Ivona, 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 2020), Poster Abstract*, 2020. To appear.

Link C., J. Saran, G. Grigoryan, M. Kwon, and M. M. Rafique. **Container Orchestration by Kubernetes for RDMA Networking.** In *IEEE ICNP*, 2019. Poster.

Funding

Research and academic grants that were active or newly awarded in 2019 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, and Reynold Bailey	NSF	REU Site: Computational Sensing. Research Experiences for Undergraduates (REU)	4/2016 - 5/2019	\$359,866
Alm, Cecilia, and Reynold Bailey	NSF	Computational Sensing for Human-Centered AI. Research Experiences for Undergraduates (REU)	4/2019 - 5/2022	\$359,926
Alm, Cecilia, and Reynold Bailey	NSF	Supplemental Funding Request to Enhance 2020 and 2021 REU Student Stipends. Research Experiences for Undergraduates (REU)	4/2019 - 5/2022	\$20,000
Bailey, Reynold	GCCIS	Data-Driven Framework for Realistic Self-Organized Virtual Humans	1/2018 - 12/2019	\$10,200
Bezáková, Ivona, and Edith Hemaspaandra	NSF	Automated Feedback in Computing Theory	10/2018 - 9/2021	\$299,417
Bezáková, Ivona	GCCIS	Sampling and Counting Independent Sets in Low Average Degree Graphs	1/2018 - 12/2019	\$10,000
Butler, Zack, and Ivona Bezáková	NSF	Pencil Puzzles as an Inclusive Domain for Learning Computer Science	9/2018 - 8/2021	\$464,064
Chung, Taejoong	NSF	Measuring and Improving the Management of Resource Public Key Infrastructure	10/2019 - 9/2021	\$166,561
Chung, Taejoong, Dave Levin, Alan Mislove, Bryan Parno, Chisto Wilson and Bruce Maggs	NSF	Large: Collaborative Research: Towards an Evolvable Public Key Infrastructure	6/1/2019 - 5/2022	\$300,000
Coüasnon, Bertrand, Yann Ricquebourg, and Richard Zanibbi	FMHE	Interactive Combination of Deep Learning and Syntactical Methods for Contextual Segmentation and Structure Learning in Document Recognition	9/2016 - 8/2019	€90,000
Frank, Mark G. and Ifeoma Nwogu	NSF	Deceit and Interactional Synchrony In Different Social Constellations	5/2017 - 4/2020	\$318,526

Investigators	Sponsor	Project Title	Duration	Funds
Fluet, Matthew	NSF	Automatic Locality Management for Dynamically Scheduled Parallelism	6/2014 - 5/2019	\$236,744
Fluet, Matthew	NSF	Positioning MLton for Next-Generation Programming Languages Research	8/2014 - 7/2019	\$224,329
Geigel, Joe	RIT Seed	SIGGRAPH 2019/Symposium for Applied Perception (SAP 2019)	7/2019 - 5/2020	\$3,000
Hartpence, Bruce, and Minseok Kwon	RIT	Applying Active Learning to New Courses on Software Based Networking	1/2018 - 8/2019	\$5,000
Hemaspaandra, Edith	GCCIS	Constraint Satisfaction Problems in Noninterference	1/2018 - 12/2019	\$22,500
Hemaspaandra, Edith	Alexander von Humboldt Foundation	Renewed Research Stay	10/2018 - 3/2019	€16,150
Homan, Christopher M. and Cecilia Alm	RIT	Label Distribution Learning for Qualitative Coding	9/2019 - 8/2020	\$10,000
Hosseini, Hadi	NSF	Fair, Efficient, and Truthful Resource Allocation in Dynamic Environments. CRII: Robust Intelligence	9/2019 - 9/2021	\$173,656
Hosseini, Hadi	RIT	An Interactive Online Platform for Artificial Intelligence Education	5/2018 - 8/2019	\$4,864
Hosseini, Hadi	RIT	Modeling Malicious Agents in Cyber Systems	1/2019 - 1/2020	\$75,000
Hu, Peizhao	Microsoft	Private AI/Homomorphic Encryption Research Collaboration	8/2019	\$55,000
Hu, Peizhao	The L Foundation	Smart and Secure Wearable Device	1/2019 - 12/2021	\$60,000
Hu, Peizhao	REDCOM Labs	Zero-knowledge based authentication method	7/2019 - 2/2020	\$57,745
Joshua Faber, Hans-Peter Bischof, Richard O'Shaughnessy	NSF	NSF REU Grant for a Site on Multi Messenger Astrophysics	9/2016 - 8/2019	\$384,866

Investigators	Sponsor	Project Title	Duration	Funds
Kwon, Minseok	NSF	A New Approach to Federated Network Security	1/2019 - 12/2019	\$167,450
Kwon, Minseok, and Warren Carithers	Cisco	End-to-End Traffic Control with Virtual Switches for Containerized Applications	1/2019 - 12/2019	\$57,541
Kwon, Minseok, Hossein Hojjat, and Matthew Wright	RIT	Real-Time Validation of BGP Route Updates in Programmable Control Planes	1/2018 - 8/2019	\$12,960
Łukowiak, Marcin, Peter Bajorski, and Stanisław Radziszowski	L3 Harris	Bit Stream Obfuscation for Securing IP on FPGAs	1/2019 - 12/2020	\$49,411
Łukowiak, Marcin, Peter Bajorski, Alan Kaminsky, and Stanisław Radziszowski	Harris RF	A Prototype Cross Domain Solution Using Functional Cryptography	11/2018 - 6/2019	\$36,000
Mior, Michael	RIT	Benchmarking Integration of Relational and Non-Relational Data Systems	5/2019 - 8/2020	\$4,960
Mior, Michael	RIT	An Interactive Exploration of Relational Database Query Processing	6/2019 - 6/2020	\$4,960
Mior, Michael and M. Mustafa Rafique	Harris	EVA and Device Management Database	9/2019 - 12/2020	\$20,000
Narayan, Darren, Elizabeth Cherry, Jobby Jacob, Laura Muñoz, Stanisław Radziszowski, and Paul Wenger	NSF	Extremal Graph Theory and Dynamical Systems. REU Mathematics Program	1/2017 - 12/2020	\$287,556
Ororbia, Alexander	RIT	Neurocognitively-Motivated Conversational Assistants Based on Distributed Representations	5/2019 - 8/2020	\$4,960
Nwogu, Ifeoma	NSF	CAREER: A Computational Approach to the Study of Behavior and Social Interactions	2/2019 - 1/2024	\$524,692

Raj, Rajendra K., Daniel Krutz, Rob Olson, and Ben Steele	NSA	GenCyber@RIT: Secure Web and Mobile Computing. GenCyber	4/2018 - 5/2019	\$130,908
Reznik, Leon and Justin Cappos	NSF	Data Quality and Security Evaluation Framework for Mobile Devices Platform	9/2016 - 8/2019	\$499,919
Rivero, Carlos, Hadi Hosseini and Zack Butler	NSF	Using Program Dependence Graphs to Propagate Feedback to Students on Programming Assignments and Promote Responsive Teaching	9/2019 - 9/2022	\$292,868
Rivero, Carlos	GCCIS	Clustering Student Solutions to Programming Assignments Using Program Dependence Graphs	12/2018 - 12/2019	\$10,000
Rivero, Carlos	RIT	GRAV: A visual tool for helping students understand graph algorithms	2/2019 - 12/2020	\$4,800
Rivero, Carlos	RIT	Why Am I Getting This? Helping Students Understand Unexpected Results in Big Data Databases	2/2018 - 12/2019	\$4,800
Yuan, Bo, Andrew Meneely, and Rajendra K. Raj	NSF	Cybersecurity as a Diverse Discipline	8/2019 - 7/2024	\$5,515,422
Zanibbi, Richard, and Anurag Agarwal	NSF	Improving Technical Paper Database Search Through Math-Aware Search Engine	12/2017 - 11/2020	\$498,928
Zanibbi, Richard, and Lee Giles	Sloan	Improving Discovery of Scientific and Scholarly Information Through Math-Aware Search	7/2017 - 6/2020	\$470,458

FMHE - The French Ministry of Higher Education; **NSF** - National Science Foundation; **NSA** - National Security Agency

NIH/UR - National Institute of Health/University of Rochester Medical Centers; **GCCIS** - RIT Golisano College of Computing and Information Sciences

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