2021

DIMACS

DIMACS Operating Status

Rutgers returned to campus this fall, and DIMACS did too. Throughout the fall semester, DIMACS staff began returning to the office, but most of our events continued to be online. We are planning a full slate of in-person events for the spring and summer of 2022. These include several exciting workshops, the 12th DIMACS Implementation Challenge, Reconnect, and more. Check our calendar to see if there's an event for you!

LET US KNOW

Did a DIMACS workshop or program lead to a new result, collaboration, course, or student project? Did DIMACS help your career, your research, or that of your students? If so, please let us know:

editor@dimacs.rutgers.edu

Simons Postdoctoral Leadership Initiative at DIMACS

DIMACS is delighted to have received an award from the Simons Foundation to establish a new Simons Postdoctoral Leadership Initiative at DIMACS. The new initiative funds four postdocs over the next three years and provides them with budget to enhance their research through activities of their own design. These activities can include organizing workshops, working groups, or seminars, hosting visitors at DIMACS, traveling to conferences or to corporate or international research experiences, or engaging in other opportunities that may arise. Also part of the grant is a Hot Topics Fund to support larger events that the postdocs and their mentors envision on themes that are relevant to their research and strategically important to DIMACS.

This award is our first from the Simons Foundation. It comes to us through the Targeted Grants to Institutes program of the Mathematics and Physical Sciences division to support established research institutes in selected fields by providing funds that help to extend and enhance their missions.

In September of 2021, Nicole Wein became the inaugural Simons postdoc at DIMACS after completing her Ph.D. in CS at MIT. With broad interests in CS theory, two themes reflected in her work are understanding distances in graphs and developing algorithms for graphs that change over time. Relating to these themes, she has developed a sizable body of work on graph diameter and has studied dynamic algorithms for graph problems that include, not only graph diameter, but also maximal independent set, graph coloring, single-source shortest paths, and graph spanners. She will spend two years at DIMACS and is currently working with Rutgers CS faculty members Sepehr Assadi, Aaron Bernstein, and Martin Farach-Colton.

Review of applications to become the next Simons Postdoctoral Leader begins in January of 2022.

RUTGERS

At the Center of Security Research

Did you know that DIMACS has been at the forefront of homeland security research for twenty years? It's true!

Over the past twenty years, DIMACS has engaged in what might be described as a "significant side business" in security—both cyber and physical. Security themes are reflected in special focus topics, past projects on nuclear detection and port-of-entry inspection, and most notably, the two Department of Homeland Security (DHS) Centers of Excellence (COEs)—DyDAn and CCICADA—that DIMACS has led.

Now, following an eight-month competition among the nation's largest universities, DIMACS will become part of a third DHS COE. In November of 2021, DHS announced that a team led by Northeastern will receive a $36 million contract to form a new COE to address the challenges of protecting myriad civilian targets, such as stadiums, schools, and places of worship. The newly minted COE, called SENTRY, includes a Rutgers team guided by DIMACS Director Emeritus Fred Roberts and Education Director Midge Cozzens.

SENTRY combines the strengths of three "emeritus" COEs that have each worked with DHS for more than a decade—ALERT (led by Northeastern), CCICADA, and CREATE (led by USC). SENTRY builds on ALERT's use of advanced sensor technologies and signature analysis algorithms for threat detection, CREATE's powerful methods for risk assessment, and CCICADA's extensive work securing stadiums and transportation facilities.

The Rutgers team will lead both research and education projects for SENTRY. Research projects will explore the interplay between architectural design and human behavior.

The team will experiment with a state-of-the-art physical digital twin facility at the Rutgers Richard Weeks School of Engineering testbed. Through this testbed, they will collect data, build models, and conduct analyses to ferret out ways to reengineer existing public spaces to make them more resilient. SENTRY will also take advantage of the Rutgers "Living Lab", which provides access to campus spaces to observe the interaction of buildings and people. The Living Lab facilities include a football stadium that seats over 50,000 fans, a smaller soccer stadium, a basketball arena, hospital facilities, dining halls, dormitories, an extensive bus system, and other contextually relevant environments that will allow researchers to test new ideas.

Midge Cozzens will direct two of SENTRY's education programs. The first will develop instructional modules that bring security topics and techniques into community college and undergraduate classrooms in a way that emphasizes the methods and tools of mathematics and computing. The second will hold Reconnect workshops on themes that are relevant to SENTRY.
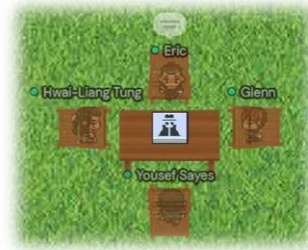
REU is online again in 2021

The DIMACS REU program was held online in 2021 for the second consecutive year. The 2021 REU involved 31 students, including four from Charles University in the Czech Republic. Centered on themes in computer science and discrete math, the program drew mentors from nine Rutgers departments, as well as Princeton University and IBM.

Research activity thrived during the program, and in many cases, beyond. We anticipate several resulting publications, such as the one (right) from REU in 2020.

DIMACS REU students also engage in a variety of activities to complement their research. These include seminars, a data science boot camp, a panel on applying to graduate school, and discussion of ethics in research.

New for 2021 was AI Day!. This half-day event featured three engaging research talks illustrating the use of AI for social good, a virtual tour of the Rutgers robotics lab, and an industry panel discussing AI at two DIMACS partner institutions—IBM and Nokia Bell Labs.

The entry to the virtual venue for AI Day! was an outdoor "garden party" space rather than a more traditional lobby. The garden included tables with games, such as codewords, tetris, pictionary, and poker, for students to play together during breaks, as well as before and after the presentations.

Workshop on Forecasting: From Forecasts to Decisions

Held online March 17 - 19, 2021.

Speakers at the workshop on Forecasting represented a variety of backgrounds—statistics, economics, business, operations, and psychology—with years of research and experience developing and improving forecasts. They explored methods to improve forecasts by forming teams of different types of forecasters; compared models versus markets (and methods that combine both) for predicting uncertain outcomes, examined peer prediction and other methods for eliciting truthful forecasts with no ground truth, and looked at

applications that included forecasting elections and clinical trials. A common theme emerged that teams of human forecasters still outperform machine-learning based forecasts in a variety of domains, including healthcare. Videos of workshop presentations are available on YouTube. We hope to hold in-person follow-on workshop in early 2023.

Research Highlight

- Then-UCLA graduate student Aayush Jain visited the Simons Institute for the spring semester of 2020 with support from the DIMACS SF on Cryptography. In groundbreaking research, Jain and collaborators Huijia Lin (U Washington) and Amit Sahai (UCLA) were able to show how to build indistinguishability obfuscation (iO) using only well-studied security assumptions—a challenge that has stood as a central problem in cryptography since iO was introduced in 2001. The existence of indistinguishability obfuscators enables a wide range of cryptographic tasks, including public-key encryption, digital signatures, homomorphic encryption, and deniable encryption. But until now, there was considerable skepticism about the existence of iO because all previous iO constructions relied on relatively untested assumptions that could often be broken when closely scrutinized. Jain and his colleagues construct iO from four well founded and widely accepted assumptions, effectively quelling doubts about the existence of iO. Their paper, "Indistinguishability Obfuscation from Well-Founded Assumptions," was selected as a Best Paper at *STOC 2021* and was featured in *Quanta Magazine* in November 2020.

Upcoming Events

- ### 12th DIMACS Implementation Challenge on Vehicle Routing Problems
  Competition Leaders: Claudia Archetti (ESSEC Business School), Nicholas Kullman (Amazon), Jorge Mendoza (HEC Montréal), Eduardo Uchoa (Universidade Federal Fluminense), and Thibaut Vidal (Polytechnique Montréal).
  Date: The competition is underway and will conclude with a workshop on April 6–8, 2022.

- ### Workshop on Meta-Complexity, Barriers, and Derandomization
  Organizers: Eric Allender (Rutgers), Antonina Kolokolova (Memorial University of Newfoundland), Periklis Papakonstantinou (Rutgers), Rahul Santhanam (Oxford)
  Date: April 23-25, 2022

- ### Mixed Integer Programming Workshop 2022
  Details: After two years online, DIMACS will be local host for the 19th edition of MIP, which will include a day celebrating MIP founder, Dan Bienstock, a lively student poster session, and an new computational competition.
  Date: May 23-26, 2022.

- ### DIMACS/SENTRY Reconnect 2022: Optimization
  Primary Lecturers: Robert Bosch (Oberlin College) & Robert Vanderbei (Princeton)
  Date: June 12-17, 2022.

  COVID-19 continues to impact the scheduling of DIMACS events.

DIMACS