FY21 ANNUAL REPORT

ECOSYSTEMS OF CONVERGENCE IN DATA & COMPUTING

Boston University Rafik B. Hariri Institute for
Computing and Computational Science & Engineering

BOSTON UNIVERSITY

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$20 MILLION

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5 YEARS

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Data Privacy Collaborative and
Open Research Cloud Initiative

FY21 EVENTS

98 TOTAL EVENTS HELD

1,500+ TOTAL ATTENDEES FROM

40 COUNTRIES

LETTER FROM THE DIRECTOR

I started as Director of the Hariri Institute last year, with a vision that we become in the coming years a national leader in convergent research at the nexus of the computational and data sciences. I never expected to serve my first year as Director largely at home (with my cats, rather than my colleagues!) during a global pandemic. But it is my belief that the lessons we learned from a year in a virtual setting will make our community more adaptable and resilient in the face of change and challenges.

In pursuit of our vision for the Hariri Institute, we leveraged a diverse set of mechanisms and resources over the past year including Focused Research Programs, virtual event platforms, software and data science development capacities, computational infrastructures, thematic research centers and initiatives, and staff support. We worked to further the societal and real-world impact of our research endeavors by engaging not only with members from across the Boston University (BU) academic community, but also with industry collaborators and partners from the public and private sectors.

Fostering Convergent Ecosystems

Even virtually, the Hariri Institute succeeded in fostering convergent ecosystems across a broad set of disciplines. The ***Machine Learning for Chemistry & Materials Science Focused Research Program*** brought together nine faculty members across five departments to improve models of atomic-level interactions in biological, pharmaceutical and energy materials using machine learning. The ***Leveraging AI to Examine Disparities and Bias in Health Care Focused Research Program*** brought together 25 faculty members across 13 departments from both the BU Charles River and Medical Campuses to determine the role of social determinants in health and the presence of racial, ethnic, gender, or other forms of bias in health care.

BU researchers also converged virtually at the Hariri Institute through events like our ***BU Knowledge Transfer Series***, where faculty working on a variety of aspects relating to data science and sustainability shared ideas and started to build collaborative, interdisciplinary relationships. Other researchers, including students, came together over our ***Did You Know You Could...?*** lunch and learn series to network and learn skills that either enable or are enabled by computing and data science.

Despite the physical distance between community members, the Hariri Institute leveraged the virtual world created by the COVID-19 pandemic to reach communities of people that we might not otherwise connect with. For example, the inaugural Hariri Institute Distinguished Speaker Series, entitled ***Artificial Intelligence (AI) & Inequalities - Creating Change***, brought together 700 attendees from 30 countries to hear talks from three leading innovators making inroads against AI bias towards a more fair, ethical, and democratized AI landscape.

Responding to COVID-19

Many of our researchers directly tackled COVID-19 research questions.

Elaine Nsoesie, a Hariri Institute Junior Faculty Fellow and Assistant Professor in the BU School of Public Health, found that the myth that 5G technology is related to COVID-19 spread as rapidly as the novel coronavirus itself. Nsoesie worked to help stop the spread of misinformation during the COVID-19 pandemic by consistently and clearly correcting common misconceptions through online articles, talks, and publications.

Researchers from the Center for Reliable Information and Cyber Security, including Ran Canetti, Ari Trachtenberg, and Mayank Varia, made significant contributions to cell phone-based, privacy preserving automated COVID-19 exposure notification technology that was adopted around the world. The technology notifies people who have been in close proximity to infected individuals of their potential exposure to the novel coronavirus -- without revealing their private data.

Jonathan Huggins, a Hariri Institute Junior Faculty Fellow and Assistant Professor in the Department of Mathematics & Statistics, built a model that explores the effectiveness of different forms of contact tracing. Huggins found that bidirectional contact tracing -- tracking positive COVID-19 cases both to newly infected individuals and back to their original source -- can be twice as effective as current contact tracing methods for stopping transmission.

In his spare time, Huggins also developed and maintained a website he created with his wife, Diana Rastegayeva, to help Massachusetts residents sign up for COVID-19 vaccinations. The goal of Massachusetts COVID Vaccination Help was to secure appointments for eligible residents without the time or capacity to book appointments themselves. Huggins recruited a team of volunteers to book over 25,000 vaccination appointments for the eldery, people without internet access, folks that don't speak English, and more.

At the onset of the pandemic, I coordinated the team that developed and now maintains operation of the university's computer simulation of COVID-19 across its campuses and community. I then worked with a team of Boston University researchers to assess the effectiveness of our COVID-19 control and surveillance efforts. Software developed by IS&T to propagate testing, symptom attestation, residence, and classroom information into a data-driven dashboard allowed BU's leadership and Community Health Oversight Group to do fairly quick interventions as infections sprung up on campus. Computing and data science provided us with actionable insights into BU's community behavior, minimizing campus-based transmission of the novel coronavirus.

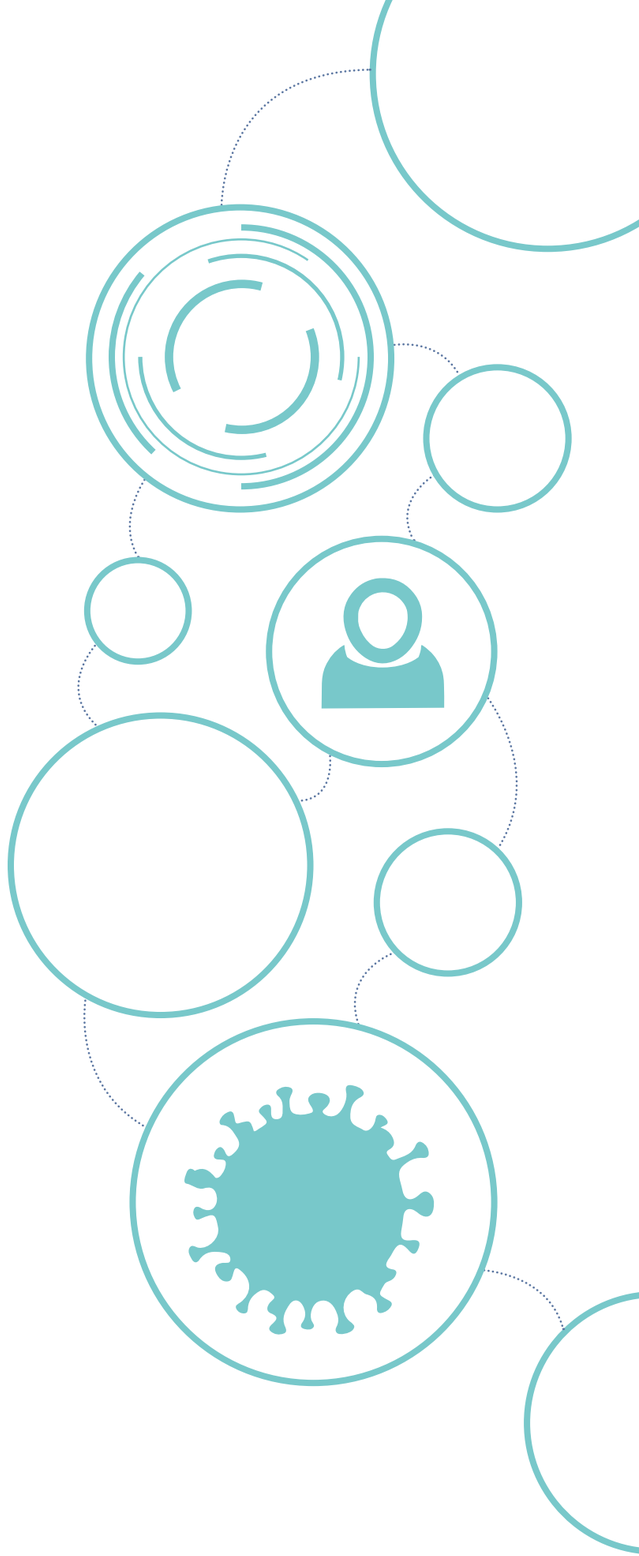
Diversity, Equity, and Inclusion

The research convergence we enable at the Hariri Institute emerges from the communities we build. We value and are stronger for the diversity, equity, and inclusion in those communities. To do better in this space, I engaged an Advisory Committee on Diversity, Equity, and Inclusion (DEI) during the 2020-21 academic year to review and assess the Hariri Institute's structure and processes and the programs and partnerships that those support with a DEI lens.

The committee conducted an anonymous survey in early February 2021 of the Hariri Institute's community members. The results show that the Hariri Institute is internally very well perceived overall, but much work remains to be done to improve diversity and a sense of community. Within the Institute, I am currently working with administrative staff members to improve diversity and foster a more inclusive community by incorporating DEI into the Hariri Institute's strategic plan, developing DEI as core values within the Hariri Institute, implement strategies to support diversity within the Hariri Institute's staff employees, and evaluating the Hariri Institute's progress in meeting DEI objectives annually.

More broadly, we continue to actively seek out and engage with various partners in ways that leverage the tremendous computing and data science expertise and resources of our Hariri Institute community in furthering diversity, equity, and inclusion through research. Within BU, such partnerships include working with the Black Women's Health Study to responsibly broaden access to their unique data resources, and collaborating with the Boston University School of Medicine to assemble and analyze over 30 years of data on their Early Medical School Selection Program, to quantify their impact in bringing diversity to the physician workforce. Externally, we continue to work with the Boston Women's Workforce Council (BWWC), to close the gender wage gap in the region, and with the Pacesetters program in the Greater Boston Chamber of Commerce, to close the racial wealth gap through increased spending with businesses of color.

We look forward to coming together in person next year and furthering our mission to positively impact society through diverse computing and data science research endeavors



YEAR IN REVIEW

1,118 Twitter Followers

2,945 YouTube Video Views

4,091 Social Media Engagements

162% Increase in LinkedIn Followers

7,097,874 Individuals Reached on Social Media

*Social engagement statistics from December 2020 onwards

PROGRAMS FUNDED

$556,584
Total Awarded to BU Faculty & Graduate Students

$391,584
Awarded Across 3 Focused Research Programs

$50,000
Research Incubation

$70,000
Awarded to 7 Junior Faculty Fellows

$45,000
Awarded to 9 Graduate Student Fellows

AWARDS AND ACHIEVEMENTS

15 NEW GRANTS

$29 MILLION

HARIRI-LED AND ENABLED FUNDING

including funds from the National Science Foundation (NSF), US Department of Energy (DOE), US Department of Health and Human Services, and American Heart Association.

2020 ACM Fellows

RISCS Researchers Adam Smith, Professor, Computer Science, CAS & Ran Canetti, Professor, Computer Science, CAS

NIH/NIDCD F31 Predoctoral Fellowship

Awarded to Graduate Student Fellow Defne Abur, Ph.D Student, Health and Rehabilitation Sciences, SAR

NSF CAREER Award

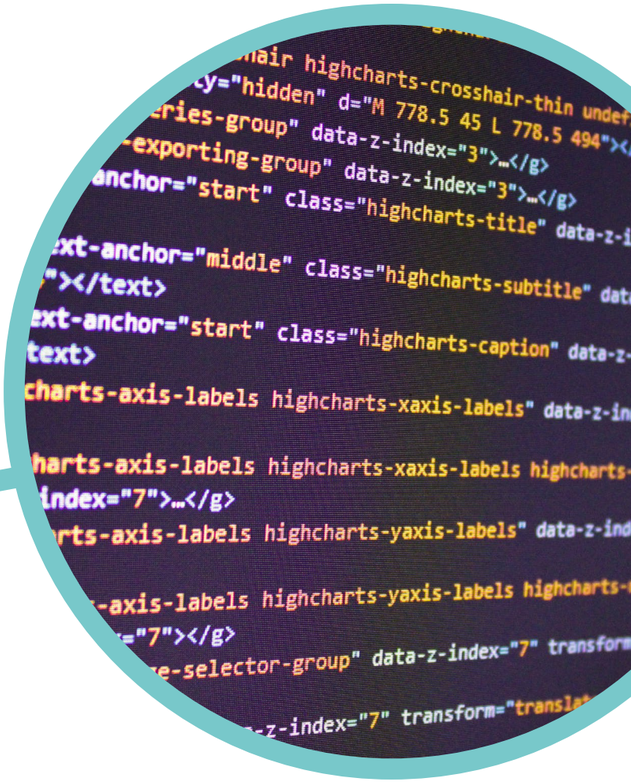
Awarded to Research Fellow Francesco Orabona, Professor, Electrical & Computer Engineering, ENG

Lei Guo, Professor, Emerging Media Studies, COM, Prakash Ishwar, Professor, Electrical and Computer Engineering, ENG, Derry Wijaya, Professor, Computer Science, CAS and Co-director of AIR Initiative Margrit Betke. The Artificial Intelligence and Emerging Media (AIEM) research group explores and creates techniques to interpret emerging media, their role in mass and interpersonal commnication, and understand the human and automated processes by which emerging media are developed, marketed, shaped and reshaped by users.

MISSION STATEMENT

An incubator and convergence accelerator in a university setting, the Rafik B. Hariri Institute for Computing and Computational Science & Engineering initiates research convergence and accelerates integrated initiatives with social impact at the nexus of the computational and data sciences.

It achieves this mission by promoting discovery and innovations across a broad set of disciplines, inspired by challenges in engineering; social, health and management sciences; and the arts. Through the use of computational and data-driven approaches, diverse groups of faculty, students, and staff work together to develop innovative methodologies and transformational research products.



ACCELERATING IMPACT

Expanding the Red Hat Collaboratory

Boston University (BU) and Red Hat announced a $20 million renewal and expansion of their partnership at Red Hat Summit 2021 to drive new talent, processes, and innovations for the open hybrid cloud. Over the next five years, the Red Hat Collaboratory, housed within BU's Hariri Institute for Computing, will lead integrated initiatives in open-source development through its commitment to research, education, and technological advancement.

Red Hat's continued support is positioning the Hariri Institute as an incubator of academic, government, non-profit, and industry partnerships in cloud computing. Red Hat is also providing the Collaboratory with generous software subscriptions to help grow a series of interrelated projects that form a new Hariri Institute-hosted open research cloud initiative. This initiative will enable close collaboration between production operations, systems research, and developers in the open source community. It is the first regional node in a broader open cloud being developed under the umbrella of OpenInfra Labs.

The Red Hat Collaboratory has established lasting relationships between BU researchers and Red Hat engineers and advanced research in open-source technologies to help scale the open hybrid cloud during the first five years of the partnership. Over the next five years, the Red Hat Collaboratory will build on these advancements and pursue areas of emerging translational research, like AI-supported operations, to discover new technologies, processes, and products for the open-hybrid cloud.

Researchers outside of BU will also reap the benefits of this expanded partnership through a new open research cloud initiative. This initiative will make available cloud resources to a broad community of researchers, with a focus on academic partner institutes of the Massachusetts Green High Performance Computing Center (MGHPCC), including BU, Harvard University, Massachusetts Institute of Technology, Northeastern University, and the University of Massachusetts.

Additionally, the Red Hat Collaboratory will expand its support of BU students and interns that work with Red Hat engineers to scale the open hybrid cloud. During the 2019-2020 academic year, BU students made up 14% of all Red Hat Summer interns and this number is expected to grow with the expansion of the partnership.

Expansive, open partnerships, like the one forged between BU and Red Hat, are critical to the advancement of research. Science and technology can grow rapidly when researchers work together to solve problems, recently exemplified by the swift development of coronavirus vaccines. What impacts one part of the globe can impact everyone else, and leveraging the world's openness through an open-source model can lead researchers to discover new technologies and knowledge across disciplines.

The Red Hat Collaboratory's experiential learning opportunities prepare BU students for industry research. Oindrilla Chatterjee (pictured above) was an intern at Red Hat in 2019, and transitioned to a full-time data scientist role within the office of the Chief Technology Officer at Red Hat after the internship ended. As a student, Chatterjee took advantage of some of the courses offered at BU and gained insight into how industry professionals apply coursework to the real world. As an intern, the support that Chatterjee received from her Red Hat mentors helped her feel confident in her abilities as a researcher.

Launching Industry Collaboratives

The Hariri Institute's new Industry Collaborative model brings together organizations interested in working with Hariri Institute researchers on transformative projects that address real-world applications for social impact. Membership in the collaboratives is open to public and private institutions, and provides access to peer institutions and university researchers. Members will have the opportunity to shape the direction of the Collaborative. The first Collaborative, the Data Privacy Collaborative, launched Spring 2021 under the leadership of Mayank Varia, Research Associate Professor, Computer Science, CAS.

DATA PRIVACY COLLABORATIVE

MISSION

Analyzing sensitive data without revealing private information is crucial for extracting valuable insights on workplace inequalities, transportation policies, health care outcomes, and more.

Researchers at the Hariri Institute are harnessing the power of big data while maintaining privacy protection, through secure multiparty computation (MPC), which allows collaborative data analysis without revealing private data in the process.

The Data Privacy Collaborative at the Hariri Institute, led by Mayank Varia, aims to foster cooperation among the Institute, industry, other nonprofits, and government entities to further the development of open-source platforms and to deploy at-scale software pilots that demonstrate and promote the responsible use of private data assets in real-world applications.

Members with interest in secure MPC and related privacy-enhancing technologies can join forces and work together toward the modernization and maintenance of privacy-preserving technologies. Members will meet twice annually to discuss common goals, shape research questions, and share in the communication of research results.

CURRENT MEMBERS

DATAVANT

MASSACHUSETTS TECHNOLOGY COLLABORATIVE

Red Hat

Enabling Focused Research Programs (FRPs)

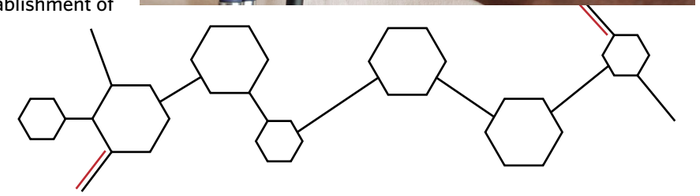
FY22 FRPs

Continuous Analysis of Mobile Health Data among Medically Vulnerable Populations

The goal of the ***Continuous Analysis of Mobile Health Data among Medically Vulnerable Populations FRP*** is to leverage mobile health data sources for developing dynamic models privately in the cloud that predict diseases and anticipate changes in physiology or behavior in large cohort studies and clinical trials among underserved populations.

Simulation Modeling for Population Health

The goal of the ***Simulation Modeling for Population Health FRP*** is to foster a multidisciplinary environment of faculty with interests in the application of simulation modeling to population health research and the development of methods used to design, build, validate, and ethically evaluate such models. This program addresses the key challenges faced in applying simulation modeling to population health through strategic partnerships, interdisciplinary collaborations, and the establishment of best practices in simulation modeling.



FY21 FRPs

Leveraging AI to Examine Disparities and Bias in Health Care

The ***Leveraging AI to Examine Disparities and Bias in Health Care FRP*** explored the application of machine learning and artificial intelligence (AI) in health care. AI experts from the Charles River Campus converged with faculty from the Medical Campus and leveraged AI to determine the role of social determinants in health and the presence of racial, ethnic, gender, or other forms of bias in health care. In addition, the FRP identified and analyzed the role of misinformation in public health. The FRP's objective was not only to discover how biases affect health and healthcare, but also how AI can help mitigate their effects.

On March 12, 2021, the Hariri Institute hosted the workshop, "AI in Health – Bias, Misinformation, and Social Determinants of Health." This workshop brought together four FRP researchers from across BU's Charles River and Medical campuses to discuss topics of bias in systems and networks, the THRIVE program at Boston Medical Center (BMC), missed care opportunities, and the spread of health misinformation online, especially on social media sites.

Machine Learning for Chemistry and Materials Science

The ***Machine Learning for Chemistry & Materials Science FRP*** sought to advance the design and synthesis of small molecules and materials through machine learning. Faculty from Mathematics and Statistics, Engineering, and Chemistry used machine learning to improve models of atomic-level interactions in biological, pharmaceutical and energy materials. This included figuring out how to add ab initio level details in larger scale models of point of contact between surfaces." to be "This included figuring out how to add ab initio level details in larger scale models of the point of contact between surfaces. In addition, the FRP examined how machine learning can be used to enhance our understanding of chemical reactions and provide information that could help scientists predict the outcome of reactions.

On June 14, 2021, The Hariri Institute hosted the Advancing Chemical and Materials Science Through Machine Learning symposium, which was co-sponsored by the BU College of Engineering, the BU College of Arts & Sciences, the BU Department of Materials Science & Engineering, and the BU Department of Chemistry. The event had 394 attendees from 33 countries, and our live Tweets reached over 30K unique individuals

Partnering with NASA JPL

Researchers from Boston University's (BU) Hariri Institute for Computing and Center for Remote Sensing have teamed up with scientists at NASA's Jet Propulsion Laboratory (JPL) to create an accessible cloud-based system for storing and analyzing very large and complex land cover data sets. The BU Hariri Institute for Computing recently granted Mark Friedl and Luis Carvalho funding to support their collaboration with NASA JPL's Thomas Huang and Dave Schimel.

Earth observation satellites, like NASA's Surface Biology and Geology Mission, provide researchers with petabytes of sophisticated data on Earth's land and its properties. These satellites not only capture information about different types of land cover, they also measure changes in critical environmental properties such as the density of forests, the amount of nitrogen in forest canopies, the different types of plants on the ground, and even the composition of the rocks.

The information collected by satellites through a process known as remote sensing helps researchers study the local effects of climate change on ecosystems all over the world. Researchers can use remote sensing data to model how much carbon terrestrial ecosystems can sequester and how much carbon is being released into the atmosphere as greenhouse gases.

Cloud computing, or using very large networks of remote servers hosted on the internet for data management and analysis, provides plentiful storage space and computing power for researchers to analyze remote sensing data. To support this effort, the BU Hariri Institute for Computing and NASA JPL teams instsalled an open-source Science Data Analytics Platform (SDAP) on the Mass Open Cloud. The researchers also stored land cover datasets and developed algorithms for land cover analyses on the SDAP, leveraging storage available through the Northeast Storage Exchange (NESE).

The cloud computing platform will catalyze global change research by providing a cost-effective way for scientists to run custom land cover analysis algorithms. The researchers hope to scale up their platform to eventually run land cover analyses across the globe. "The more we can get good tools into the hands of good scientists, the more we can remove barriers to them doing their science," said Friedl, "Our ultimate goal is to provide the best possible science to inform public policy."

CENTERS AND INITIATIVES

Boston Women's Workforce Council

Cyber Alliance

Center for Computational Science

Open Research Cloud Initiative

Red Hat Collaboratory

Center for Reliable Information Systems and Cyber Security

Digital Health Initiative

AI Research Initiative

Software & Application Innovation Lab

ARTIFICIAL INTELLIGENCE RESEARCH INITIATIVE (AIR)

The Artificial Intelligence Research (AIR) initiative at BU is a cross-disciplinary research initiative focused on machine intelligence. It brings together researchers whose work aims to create intelligent systems that reliably make decisions, reason about data, and communicate with humans. The primary research focus is on new computational models aimed at general artificial intelligence (AI), i.e. agents that exhibit the skills and learning capacity close to human ability.

This year, AIR tackled questions of bias and inequalities in technology and AI through their research and events. AIR Affiliate Derry Wijaya created an algorithm for translating low-resource languages automatically -- including Gujarati, Somali and Kazakh -- to help provide people that come from other countries that don't speak English access to online knowledge. The algorithm can be implemented easily and considers the cost of using the required computing power, based on the average salaries of people in countries that speak the low-resource languages. Co-Director Kate Saenko was invited by International Conference on Learning Representations (ICLR) 2021 to present her work on fighting dataset bias, which happens when the training data is not representative of future test data. Every dataset is biased in some way, so ML models often fail to perform well in the real world. For example, a pedestrian detector trained mostly on pictures of people in the sidewalk could fail on jaywalkers. Saenko's research develops techniques for domain adaptation, semi-supervised learning and generative modeling to attack this problem.

30+

PUBLICATIONS

From AIR Faculty

OVER

$1 MILLION

New AI Funding

BOSTON WOMEN'S WORKFORCE COUNCIL (BWWC)

250+

Boston-area employers

have signed the 100% Talent Compact, committing to take action to close the gender/racial wage gap in Boston

12 NEW

100% Talent Compact Signers:

Arbella Insurance (Anchor Signer), Barr Foundation, Cabot Properties, Inc. Combined Jewish Philanthropies/The Miriam Fund, Dough, Health Care For All, MediaHub, MomUp, MullenLowe, Rian Immigrant Center, Teak Media + Communication, YMCA Cambridge

The Boston Women's Workforce Council (BWWC) is a public-private partnership between the Mayor's Office and the Greater Boston business community that, in collaboration with BU, aims to eliminate the gender/racial wage gap and remove barriers to women's advancement.

A record number of 100% Talent Compact Signers anonymously participated in the BWWC's 2021 Gender/Racial Wage Gap Measurement. The employee data collected is based on gender, race, job category, tenure, and ethnicity. To ensure the privacy of Signer employees, BWWC has partnered with the Hariri Institute to use the cryptographic method of Multi-Party Computation (MPC) to complete their analysis. MPC is a secure way for researchers to analyze and convert data into code to obtain the information they need without requiring participants to reveal private information. The Software & Application Innovation Lab (SAIL) provides critical software support to these research efforts. Using computational and data-driven approaches, the BWWC can determine where Boston stands in terms of pay equity as well as how Boston's workforce has been impacted by the pandemic.

CENTER FOR COMPUTATIONAL SCIENCE (CCS)

The Center for Computational Science (CCS) serves as a conduit for collaborations between experimental researchers who are synthesizing and collecting real-world data and computational researchers with expertise in model building, simulation, and analysis.

This year, CCS-affiliated researchers participated in a Focused Research Program (FRP) on Machine Learning for Applications in Chemistry and Material Science. Led by Emily Ryan, Associate Professor in Mechanical Engineering, and Aaron Beeler, Associate Professor in Chemistry, this FRP funded four doctoral students and led to multiple new collaborations, both within and outside of BU.

New collaborations formed between the research groups of Boston University faculty members Emily Ryan, Sahar Sharifzadeh and Brian Kulis. Together, their teams are studying the use of machine learning techniques to inform multi-scale modeling of complex interfaces. A larger group of CCS-affiliated faculty, including Björn Reinhard, Keith Brown, David Coker, John Straub, and Arturo Vegas, worked together to develop a proposal for the NSF's "Designing materials to revolutionize and engineer our future" (DMREF) program titled "DMREF: Informatics Driven Design of Virus Mimicking Metamaterials as Reversible Nanocontainers". While the project was not funded, the effort opened new collaborative directions at the interface of materials science and machine learning. The FRP also inspired a collaboration between the research group of Boston University Professor Qiang Cui and researchers at the University of Wisconsin. The teams are exploring the integration of deep mutation experiments and machine learning models for identifying important structural and sequence features that define allostery hotspots in proteins.

5 NEW Publications

From the CCS and Department of Energy's Collaborative project *Control of Energy Transport and Transduction in Photosynthetic Down Conversion*

CENTER FOR RELIABLE INFORMATION SYSTEMS AND CYBER SECURITY (RISCS)

MULTIPLE

GROUNDBREAKING PAPERS

Published by our researchers in the field of quantum and post-quantum cryptography and security in conjunction with the Boston University Physics department

The Center for Reliable Information and Cyber Security promotes and coordinates research and education in system reliability and information security.

Data privacy experts provided coordinated assistance to the United States (US) Census Bureau in designing a privacy-centric release of the 2020 Census information. Differential privacy, first proposed in a 2006 paper co-authored by RISCS researcher Adam Smith and researchers at Harvard University, Materialize, Inc., and Georgetown University, controls the amount of individual-level information disclosed by computations.

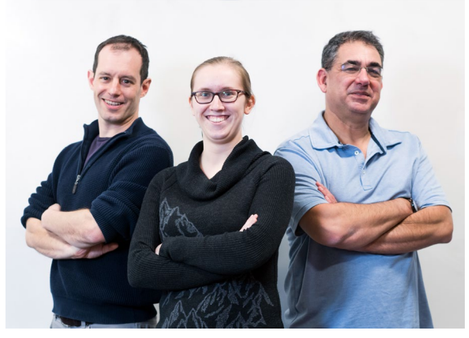
RISCS researchers leveraged their expertise to explain the impact of differential privacy in the 2020 Census on political issues like redistricting through numerous publications and interviews. Aloni Cohen, Ran Canetti, and Adam Smith, in collaboration with researchers from across the nation, filed an amicus brief supporting the use of differential privacy in the 2020 Census after Alabama filed a lawsuit against the US Census Bureau.

CYBER ALLIANCE

The Cyber Alliance is a collaboration between computer science, law, business, and social science researchers that aims to leverage BU's disciplinary breadth to create opportunities for cross-disciplinary debate, research, and activities that position BU as a leader in the burgeoning global discussion on cybersecurity.

Cyber Alliance researchers Mayank Varia and Sarah Scheffler used mathematical proofs to examine the foregone conclusion doctrine in the Fifth Amendment of the U.S. Constitution as it relates to encrypted, or password protected, devices. The researchers found that the government can demand the decryption of devices under the foregone conclusion doctrine if they're able to obtain the information they're requesting from someone or somewhere else. But the government needs to provide sufficient evidence that they can obtain the information they're requesting elsewhere.

These findings were detailed in a paper accepted for the 2021 USENIX Security Symposium and can help researchers, lawyers, and policymakers understand what information the government can compel people to produce from their phones or computers in a court of law. The team is now consulting with legal experts to detail recommendations on how the courts should apply the foregone conclusion doctrine to compelled decryption.



RISCS researchers Adam Smith, Professor, Computer Science, CAS, Sarah Scheffler, Ph.D student, Computer Science, CAS, Ran Canetti, Professor, Computer Science, CAS

DIGITAL HEALTH INITIATIVE (DHI)

4 NEW PAPERS

WRITTEN WITH

5 EXTERNAL COLLABORATORS

The Digital Health Initiative (DHI) supports research that leverages technologies and methodologies from computing and data sciences to tackle a range of applications related to healthcare systems, from medical informatics to healthcare delivery and administration.

This past year, DHI supported 11 projects led by researchers across Boston University working to apply machine learning, data science, and digital technologies to healthcare. Seven of these projects were awarded additional funding for their work, including grants from the National Institutes of Health (NIH), the National Institute on Aging (NIA), and Johnson & Johnson.

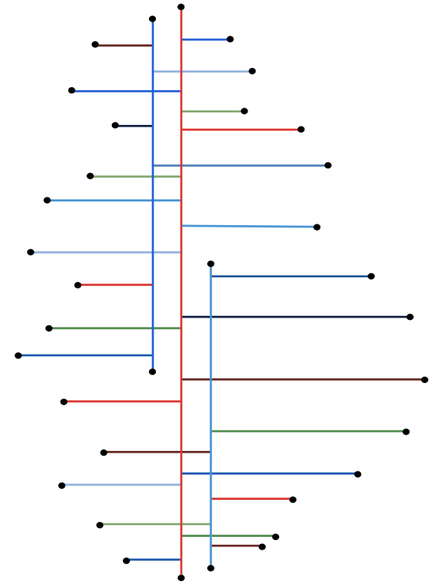
DHI also awarded new funding to two research teams conducting transdisciplinary research in the digital health domain. A team of faculty led by Alice Cronin-Golomb, a Professor in Psychological & Brain Sciences at College of Arts and Sciences, will study the relationship between visual hallucinations in patients with Parkinson's disease and disordered mood, sleep, and cognition using smartphone ecological momentary assessment technology. Another team of faculty led by Ashita Gurnani, a Research Assistant Professor in Neurology at the School of Medicine, will use cognitive tests on smartphones to assess the impact of COVID-19 on cognitive function in older adults who have been infected with the novel coronavirus.

OPEN RESEARCH CLOUD INITIATIVE

In the Spring, the Hariri Institute launched the Open Research Cloud Initiative (ORCI) -- the first, founding region in what is envisioned to become a network of production clouds connecting open source projects to production. The ORCI enables close collaboration between production operations, systems research, and developers in the open source community by providing a regional structure, centered around The Massachusetts Green High Performance Computing Center (MGHPCC).

Red Hat provided generous software subscriptions to help grow a series of interrelated projects within the academic community, in particular the five partner institutions of the MGHPCC: Boston University, Harvard University, Massachusetts Institute of Technology (MIT), Northeastern University, and the University of Massachusetts (UMass). The projects focus on production cloud services, facilitating research in the cloud, and enabling cloud development.

The goal of the ORCI is to create an open production cloud that provides domain researchers with predictable low cost resources and facilitator support while enabling academic researchers and developers in the open source community to participate in the kind of close interactions between research, development, and production operations that has resulted in so much innovation in today's public clouds.



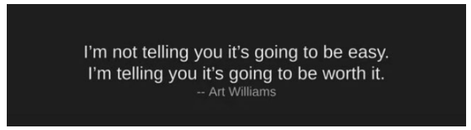
RED HAT COLLABORATORY

11 BOSTON UNIVERSITY PROFESSORS

Engaged with Red Hat engineers on research projects

11+ GRADUATE STUDENTS

Worked directly with Red Hat engineers on research projects



The Red Hat Collaboratory is a partnership between Red Hat and Boston University that connects BU faculty and students with industry practitioners working in open-source software communities. The Collaboratory aims to advance research focused on emerging technologies in a number of areas including operating systems, cloud computing services, machine learning and automation, and big data platforms.

Nearly 100 researchers from both Red Hat and Boston University came together on April 29, 2021 to hear the lead architect and co-creator of the Ceph open source distributed storage system, Sage Weil, discuss his leave of absence from Red Hat in 2020. While away Weil worked for VoteAmerica, a national get-out-the-vote organization with a focus on voter registration, voter turnout, and voter protection. Weil discussed how he used his technical skills and resources to help increase voter turnout in the 2020 election. The event spurred conversations from students and faculty, alike, around computing-enabled career paths with societal impact and the lasting effects of data science on the world.

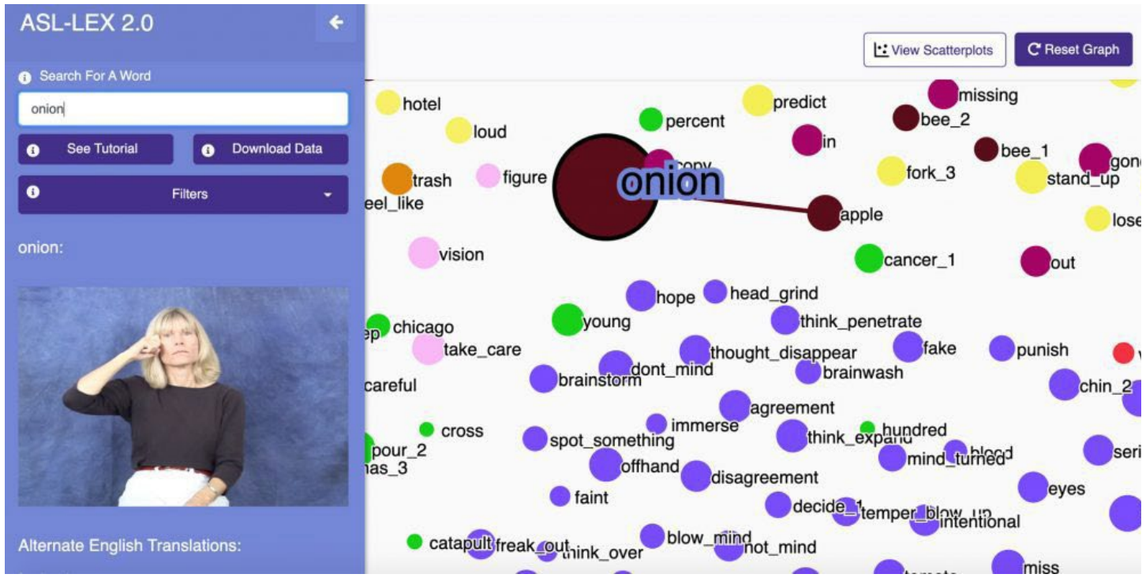
Image from Sage Weil's Red Hat Collaboratory talk

SOFTWARE APPLICATION AND INNOVATION LAB (SAIL)

The Software & Application Innovation Lab (SAIL) is where academia meets application at Boston University. A professional software development lab, SAIL builds software and applications for computational and data-driven research efforts across Boston University.

SAIL's professional software engineers allowed BU researchers to reimagine their research methodologies to work in an all remote, all internet based reality. Naomi Caselli of BU's Deaf Studies program and her collaborators have been working with the deaf community to understand the lexical relationships of signs in American Sign Language (ASL) for decades. Their database of findings, called ASL-LEX, launched in 2016 with a visualization of 1,000 signs. Six years ago, Dr. Caselli and her collaborators, Zed Sevcikova Sehyr and Karen Emmorey of San Diego State University, and Ariel Cohen-Goldberg of Tufts University, came to SAIL with their vision for the future of the project. Now armed with 2,723 ASL signs and many more complicated relationships between the signs, SAIL worked with the ASL-LEX team to design a new visualization capable of displaying these relationships. This year ASL-LEX 2.0, the updated visualization, launched in tandem with the publication of the research findings. Along with the additional signs and updated visualizations, each sign in ASL-LEX 2.0 includes videos of the sign and users can learn more about signs such as the average age that people learn that sign. The visualization and data can be viewed at https://asl-lex.org/visualization/ and has already inspired a spin-off for Israeli Sign Language, also developed at SAIL. These projects are only the start of the collaboration.

The team has been granted funding from the National Science Foundation and the National Institutes of Health to build ASL-LEX 3.0, a research platform that will make speech-based technologies more accessible to ASL speakers. Because of the work SAIL has done to make a scalable, web first interface, the ASL-LEX team has applied for a supplemental NIH grant to make ASL-LEX 3.0 configurable and available to sign language researchers around the world.



Signs are grouped together if they look similar to each other, like "onion" and "apple," since they share the same hand shape and movement. Each sign comes with other visual information, including a video demonstration. Image courtesy of The Brink

Junior Faculty Fellow Elaine Nsoesie, Professor, Global Health, SPH. Nsoesie applies data science methodologies to global health problems, using digital data and technology to improve health, particularly in the realm of surveillance of chronic and infectious diseases.

WHO WE ARE — Leadership

Eric Kolaczyk, Director, Hariri Institute for Computing

Mayank Varia, Co-Director, Center for Reliable Information Systems & Cyber Security

Kate Saenko, Co-Director, Artificial Intelligence Research Initiative

Ran Canetti Co-Director, Center for Reliable Information Systems & Cyber Security

Margrit Betke, Co-Director, Artificial Intelligence Research Initiative

Kim Borman, Executive Director, Boston Women's Workforce Council

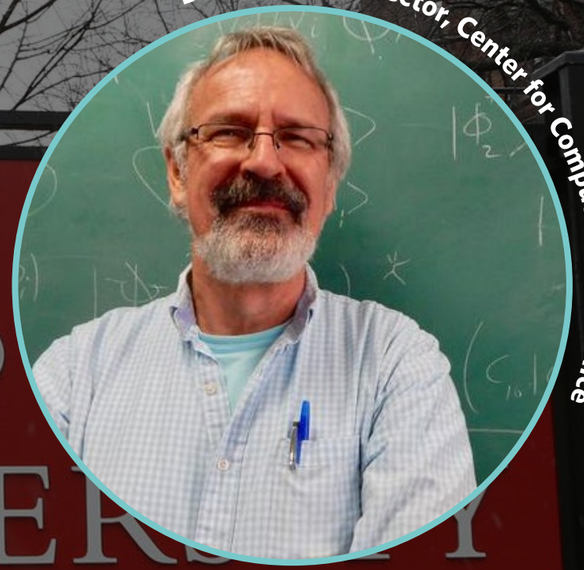
WHO WE ARE — Leadership (contd.)

Belinda Borrelli, Director, Digital Health Initiative

Orran Krieger, Co-Director, Red Hat Collaboratory

Hugh Brock, Co-Director, Red Hat Collaboratory

Jeff Simeon, Assistant Director of Operations, Software & Application Innovation Lab



David Coker, Director, Center for Computational Science

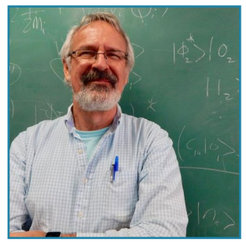
STEERING COMMITTEE

Members of the Institute's Steering Committee are appointed by the Office of Research to assist the Director with overall strategic planning and management of the Institute's operations. Members assist in reviewing ongoing activities, identifying and evaluating opportunities for investment of resources, developing proposals for new programs or initiatives, communicating the Institute's vision, and promoting its goals to the constituents they represent.

Bill Adams
Professor, Pediatrics, MED

Margrit Betke
Professor, Computer Science, CAS

Hugh Brock
Co-Director, Red Hat Collaboratory



David Coker
Professor, Chemsitry, CAS

Rhoda Au
Professor, Anatomy & Neurobiology, MED

Kim Borman
Executive Director, Boston Women's Workforce Council

Ran Canetti
Professor, Computer Science, CAS

Ziba Cranmer
Director, BU SPARK!

Michael Dietze
Professor, Earth and Environment, CAS

Orran Krieger
Professor, Electrical & Computer Engineering, ENG

Heather Schoenfeld
Associate Professor, Sociology, CAS

Wesley Wildman
Professor, Philosophy, Theology, and Ethics, STH

Stacey Dogan
Professor, School of Law, LAW

Cathie Jo Martin
Professor, Political Science, CAS

Evimaria Terzi
Professor, Computer Science, CAS

Jonathan Woodson
Professor in Management and Professor of the Practice; Markets, Public Policy, and Law, QST

Evan Johnson
Associate Professor, Medicine and Biostatistics, MED

Emily Ryan
Associate Professor, Mechanical Engineering, ENG

Mayank Varia
Professor, Computer Science, CAS

Muhammad Zaman
Professor, Biomedical Engineering, ENG

Swathi Kiran
Professor, Speech, Language, and Hearing Sciences, SAR

Kate Saenko
Professor, Computer Science, CAS

Laura White
Associate Professor, Biostatistics, SPH

Giorgos Zervas
Associate Professor, Marketing, QST

ADMINISTRATIVE STAFF

The Hariri Institute has assembled a team of talented and dedicated professionals to help researchers make connections, identify additional support resources, and lift the burden of administrative support, so that more research is accomplished with far fewer barriers.

The Institute's administrative staff provide program and project management, grant administration, event planning, communications support, and more.

Stephen Brown
Director of Finance and Administration

Korinne Dizon
Financial Manager

Katherine D'Angelo
Program and Events Manager

Marion Flanagan
Administrative Coordinator

Emily Johnson
Grants and Operations Manager

Gina Mantica
Marketing Communications Specialist

RESEARCH FELLOWS

Faculty who are part of project teams awarded support by the Hariri Institute through one of our funding mechanisms.

Rhoda Au
Professor, Anatomy & Neurobiology, MED

Andrew Bell
Assistant Professor, Earth & Environment, CAS

David Boas
Professor, Biomedical Engineering, ENG

Christos Cassandras
Professor, Electrical and Computer Engineering and Systems Engineering, ENG

Tracy Battaglia
Associate Professor, Medicine, MED; Epidemiology, SPH

Emelia Benjamin
Professor, Medicine, MED; Epidemiology, SPH

Belinda Borrelli
Professor, Professor, Health Policy & Health Services Research, School of Dental Medicine

Dino Christenson
Associate Professor, Political Science, CAS

Jennifer Beane-Ebel
Assistant Professor, Computational Biomedicine, MED

Margrit Betke
Professor, Computer Science, CAS

Luis Carvalho
Assustant Professor, Mathematics & Statistics, CAS

Ayse Coskun
Professor, Electrical & Computer Engineering, ENG

RESEARCH FELLOWS - (CONTD.)

Alice Cronin-Golomb
Professor, Psychology, CAS

Manuel Egele
Associate Professor, Electrical & Computer Engineering, ENG

Mark Friedl
Professor, Earth & Environment, CAS

Neha Gondal
Assistant Professor, Sociology, CAS

Nicholas Crossland
Assistant Professor, Pathology & Laboratory Medicine, MED

Patricia Fabian
Associate Professor, Environmental Health, SPH

Daniel Fulford
Assistant Professor, Occupational Therapy, SAR

Jaimie Gradus
Associate Professor, Epidemiology, SPH

Mark Crovella
Professor, Computer Science, CAS

Matthew Fox
Professor, Epidemiology, SPH

Sandro Galea
Professor, Family Medicine, SPH

Ashita Gurnani
Research Assistant Professor, Neurology, MED

Nafisa Halim
Research Assistant Professor, Global Health, SPH

Phillip Hwang
Postdoctoral Associate, Anatomy & Neurobiology, MED

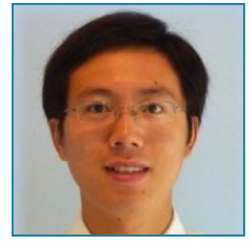
Swathi Kiran
Professor, Speech, Language, and Hearing Sciences, SAR

John Liagouris
Adjunct Assistant Professor, Computer Science, CAS

Brenda Heaton
Associate Professor, Health Policy & Health Services Research, SDM

Prakash Ishwar
Professor, Electrical and Computer Engineering, ENG

Orran Krieger
Professor, Electrical & Computer Engineering, ENG



Honghuang Lin
Associate Professor, Medicine, MED

Martin Herbordt
Professor, Electrical & Computer Engineering, ENG

Jonathan Jay
Assistant Professor, Community Health Sciences, SPH

Brian Kulis
Assistant Professor, Electrical & Computer Engineering, ENG

Benjamin Linas
Associate Professor, Medicine, MED; Epidemiology, SPH

Lucy Hutyra
Professor, Earth & Environment, CAS

Vasiliki Kalavri
Assistant Professor, Computer Science, CAS

Dan Li
Assistant Professor, Earth & Environment, CAS

Rebecca Lobb
Assistant Director of Community Engagement, Clinical Translational Science Institute, School of Medicine

RESEARCH FELLOWS - (CONTD.)

Abraham Matta
Professor, Computer Science, CAS

Joanne Murabito
Professor, Medicine, MED

Ioannis Paschalidis
Professor, Electrical & Computer Engineering, ENG

Marie-Helene Saint-Hilaire
Professor, Neurology, MED

Pankaj Mehta
Assistant Professor, Physics, CAS

Eleanor Murray
Assistant Professor, Epidemiology, SPH

Lisa Quintiliani
Associate Professor, Medicine, MED

Mickey Salins
Assistant Professor, Mathematics & Statistics, CAS

Rebecca Mishuris
Assistant Professor, Medicine, MED

Michael Paasche-Orlow
Professor, Medicine, MED

Emily Ryan
Associate Professor, Mechanical Engineering, ENG

Kaija Schilde
Associate Professor, International Relations, CAS

Abraham Seidmann
Professor, Information Systems, QST

David Starobinski
Professor, Electrical & Computer Engineering and Systems Engineering, ENG

Gianluca Stringhini
Assistant Professor, Electrical & Computer Engineering, ENG

Ludovic Trinquart
Associate Professor, Biostatistics, SPH

Allyson Sgro
Assistant Professor, Biomedical Engineering, ENG

Devin Steenkamp
Assistant Professor, Medicine, MED

Richard Stuebi
Lectureer, Strategy and Innovation, QST

Mayank Varia
Research Associate Professor, Computer Science, CAS

Sahar Sharifzadeh
Associate Professor, Electrical & Computer Engineering, ENG

Cara Stepp
Associate Professor, Speech, Language & Hearing Sciences, SAR

Kia Teymourian
Assistant Professor, Computer Science, MET

Laura White
Associate Professor, Biostatistics, SPH

Nicole Spartano
Research Assistant Professor, Medicine, MED

Jessica Stern
Professor, Pardee School of Global Studies, CAS

Lauren Tracy
Assistant Professor, Otolaryngology, MED

Wesley Wildman
Professor, Philosophy, Theology, and Ethics, STH

RESEARCH FELLOWS - (CONTD.)

David Zepeda
Clinical Associate Professor, Health Law, Policy & Management, SPH

Guanglan Zhang
Associate Professor, Computer Science, MET

JUNIOR FACULTY FELLOWS

Our Junior Faculty Fellows program aims to both recognize outstanding early-career computing and data-driven researchers at Boston University and support their continued development by connecting them with one another and with the Institute community at large through various mechanisms and activities. Junior Faculty Fellows are early-career faculty researchers who are selected for a three-year appointment.

Gerdus Benade
Assistant Professor, Information Systems, QST

Joshua Campbell
Assistant Professor, Bioinformatics, MED

James Feigenbaum
Assistant Professor, Economics, CAS

Ana Fiszbein
Assistant Professor, Biology, CAS

Andrey Fradkin
Assistant Professor, Marketing, QST

Garrett Johnson
Assistant Professor, Marketing, QST

Sanaz Mobasseri
Assistant Professor, Management & Organizations, QST

Allyson Sgro
Assistant Professor, Biomedical Engineering, ENG

Scott Hirst
Assistant Professor, Law, LAW

Emma Lejeune
Assistant Professor, Mechanical Engineering,

Elaine Nsoesie
Assistant Professor, Global Health, SPH

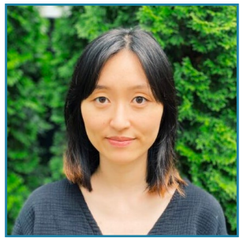
Gianluca Stringhini
Assistant Professor, Electrical & Computer Engineering, ENG

Jonathan Huggins
Assistant Professor, Mathematics & Statistics, CAS

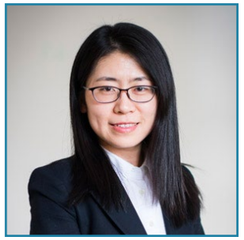
Laura Lewis
Assistant Professor, Biomedical Engineering, ENG

Eshed Ohn-Bar
Assistant Professor, Electrical & Computer Engineering, ENG

Chris Wells
Assistant Professor, Emerging Media Studies, COM



Jihye Jeon
Assistant Professor, Economics, CAS



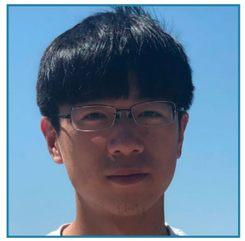
Wen Li
Assistant Professor, Astronomy, CAS

Prasad Patil
Assistant Professor, Biostatistics, SPH

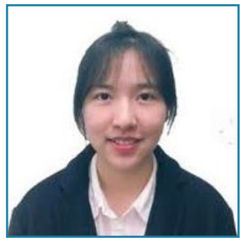
GRADUATE STUDENT FELLOWS

Our Graduate Student Fellows program recognizes outstanding PhD students who are pursuing computing and data-driven research at Boston University. These fellows have a a three-year appointment.

Afra Feyza Akyurek
Ph.D Student, Computer Science, CAS



Sheng Huang
Ph.D Student, Astronomy, CAS



Yunzhe Li
Ph.D Student, Electrical and Computer Engineering, ENG

Luca Morreale
Ph.D Student, Earth & Environment, CAS

Alex Best
Ph.D Student, Mathematics & Statistics, CAS

Mona Jalal
Ph.D Student, Computer Science, CAS

Chen Ling
Ph.D Student, Computer Engineering, ENG

Devlin Moyer
Ph.D Student, Interdisciplinary Programs, Bioinformatics

Munib Hasnain
Ph.D Student, Biomedical Engineering, ENG

Anil Kag
Ph.D Student, Electrical and Computer Engineering, ENG

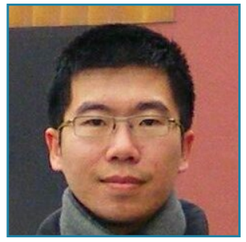
Hilary Miller
Ph.D Student, Speech, Language & Hearing Sciences, SAR

Adam Samuels
Ph.D Student, Astronomy, CAS

Beverly Setzer
Ph.D Student, Computational Neuroscience, CAS

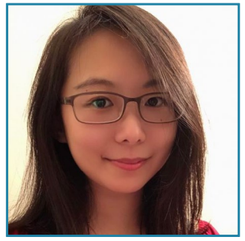
Hao Wang
Ph.D Student, Electrical and Computer Engineering, ENG

Hasini Weerathunge
Ph.D Student, Biomedical Engineering, ENG



Li Zhang
Ph.D Student, Emerging Media Studies, COM

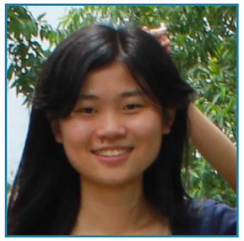
Adrianna Spindle-Jackson
Ph.D Student, Social Work, SSW



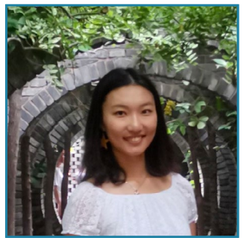
Jianing Wang
Ph.D Student, Interdisciplinary Programs, Biostatistics

Si Wu
Ph.D Student, Political Science, CAS

Marika Swanberg
Ph.D Student, Computer Science, CAS



Liang Wang
Ph.D Student, Earth & Environment, CAS

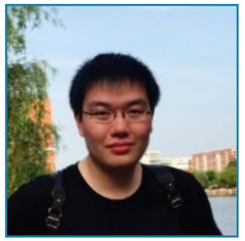


Kexin Zhang
Ph.D Student, Economics, CAS

POSTDOCS

Postdoctoral Research Associates have recently earned a PhD from Boston University or other institutions. They are currently collaborating with faculty researchers and other PhD students on projects at the Hariri Institute.

Aloni Cohen
Postdoctoral Associate, RISCS



Mingrui Liu
Postdoctoral Associate, AIR

Nicholas Spooner
Postdoctoral Associate, RISCS

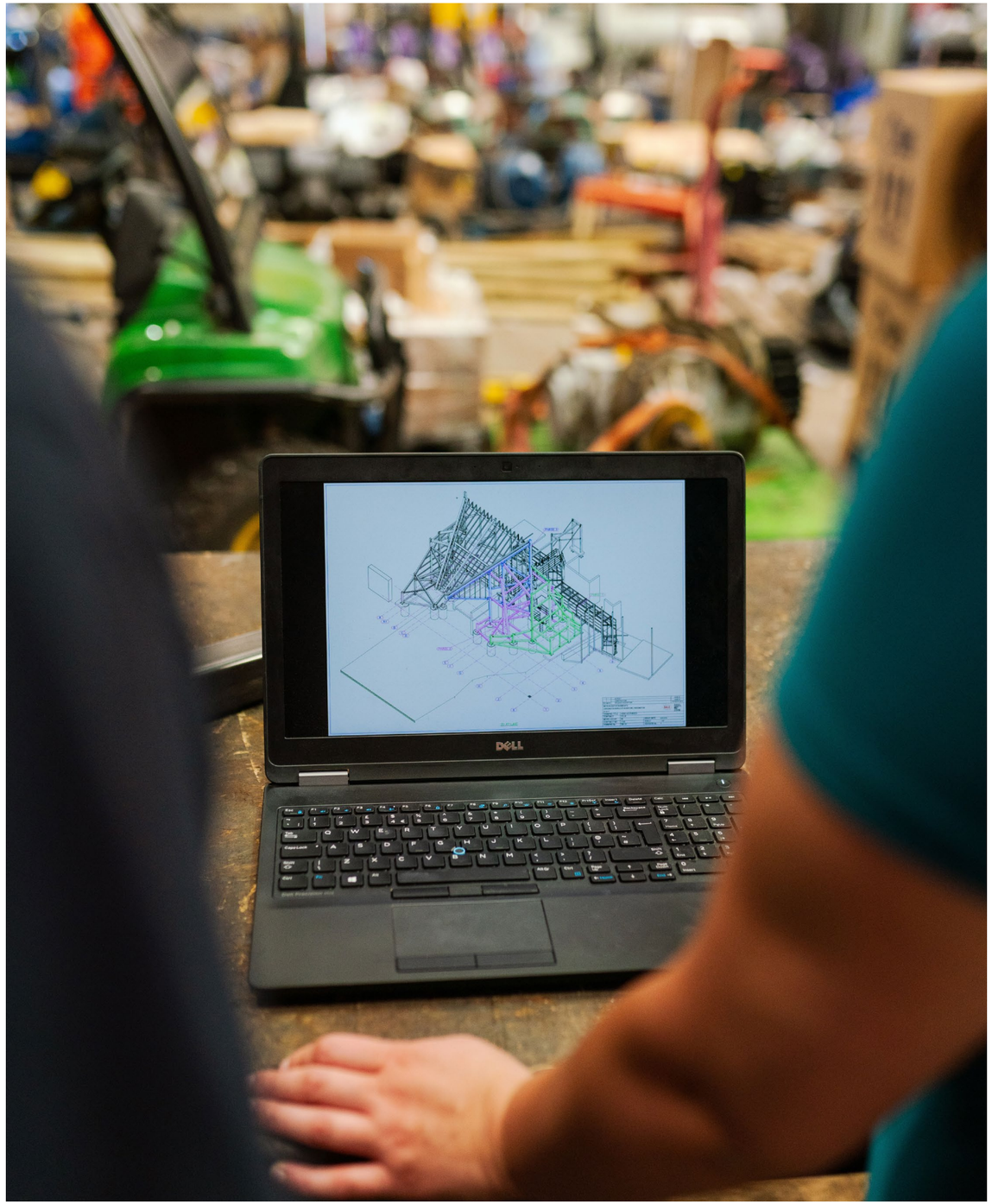
VISITING SCHOLARS

Visiting Scholars are scholars from other institutions spending time at the Hariri Institute in collaborative research endeavors.

Bandan Das
Engineer in Residence, Red Hat Collaboratory

Peter Desnoyers
Associate Professor, Computer Science, Northeastern University

Larry Rudolph
Principal Research Scientist, Computer Science and Artificial Intelligence Laboratory, MIT



LOOKING FORWARD

AI in Education

The Hariri Institute plans to support a new initiative at the interface of artificial intelligence (AI) and education, jointly sponsored by BU's Wheelock College of Education & Human Development. The goal of the AI in Education Initiative is to pursue collaborative research opportunities at the nexus of AI and education, marking the beginning of a new frontier in applications of AI research.

Sustainability & Computing

The Hariri Institute continues to promote sustainability through many different mechanisms. Through the Hariri Institute's Knowledge Transfer Series, co-sponsored by BU's Institute for Sustainable Energy (ISE), researchers across different fields at BU converged to discuss the interplay of data science and sustainability. The series focused on issues of sustainability, environmental justice, how data and systems can be used to amplify research, and how computationals perspectives are necessary for research into climate change. The Hariri Institute is proud to support a new Research Incubation Award that arose out of discussions from the Knowledge Transfer Series: "Exploring Sustainability via Data Center-Grid Integration Across Different Geographies", led by Ayse Coskun (ECE), Yannis Paschalidis (ECE/SE/CDS), and Richard Stuebi (QST).

Graaduate Student Fellow Luca Morreale, Ph.D Student, Earth & Environment, CAS, executing fieldwork

Diversity, Equity, & Inclusion

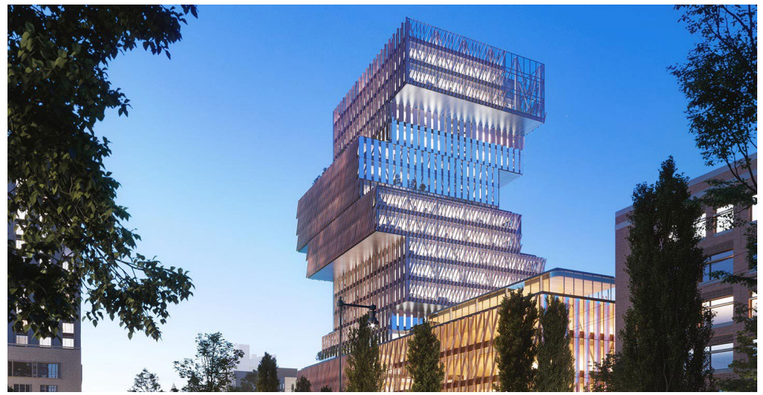
The Hariri Institute engaged an Advisory Committee on Diversity, Equity, and Inclusion (DEI) during the 2020-21 academic year to review and assess the Hariri Institute's structure and processes and the programs and partnerships that those support with a DEI lens. The committee conducted an anonymous survey in early February 2021 of the Institute's community members. The results show that the Institute is internally very well perceived overall, but much work remains to be done to improve diversity and a sense of community.

The Hariri Institute will work to improve diversity and foster an inclusive community by:
- Incorporating DEI into the Hariri Institute's Strategic Plan
- Developing DEI as core values within the Institute
- Implementing strategies to support diversity within the Institute's staff
- Partnering with internal and external groups to leverage the expertise of the Hariri Institute community around antiracist technology and data science
- Evaluating the Institute's progress in meeting DEI objectives annually

The Hariri Institute also plans to continue to support and develop research around DEI issues like algorithmic fairness, innovative data collection methods that respect anonymity, or methodologies for estimating and closing gender and racial wage gaps. Additionally, the Software & Application Innovation Lab (SAIL) is working to support BU researchers in the Black Women's Health Study.

The BU Center for Computing & Data Sciences Building

The Hariri Institute and the new Faculty of Computing and Data Sciences (FCDS) unit will be neighbors in the BU Center for Computing and Data Science building. Set to open in 2022, the new space will distinguish the Hariri Institute as an accelerator of convergent computational research at BU while supporting FCDS as an interface between traditional academic departments and faculty and students interested in data science.



Mock-up of the new Center for Computing & Data Sciences, which will house the Hariri Insititute for Computing

CONNECT WITH US

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Hariri Institute for Computing, Boston University

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@BU_Computing

COMING SOON

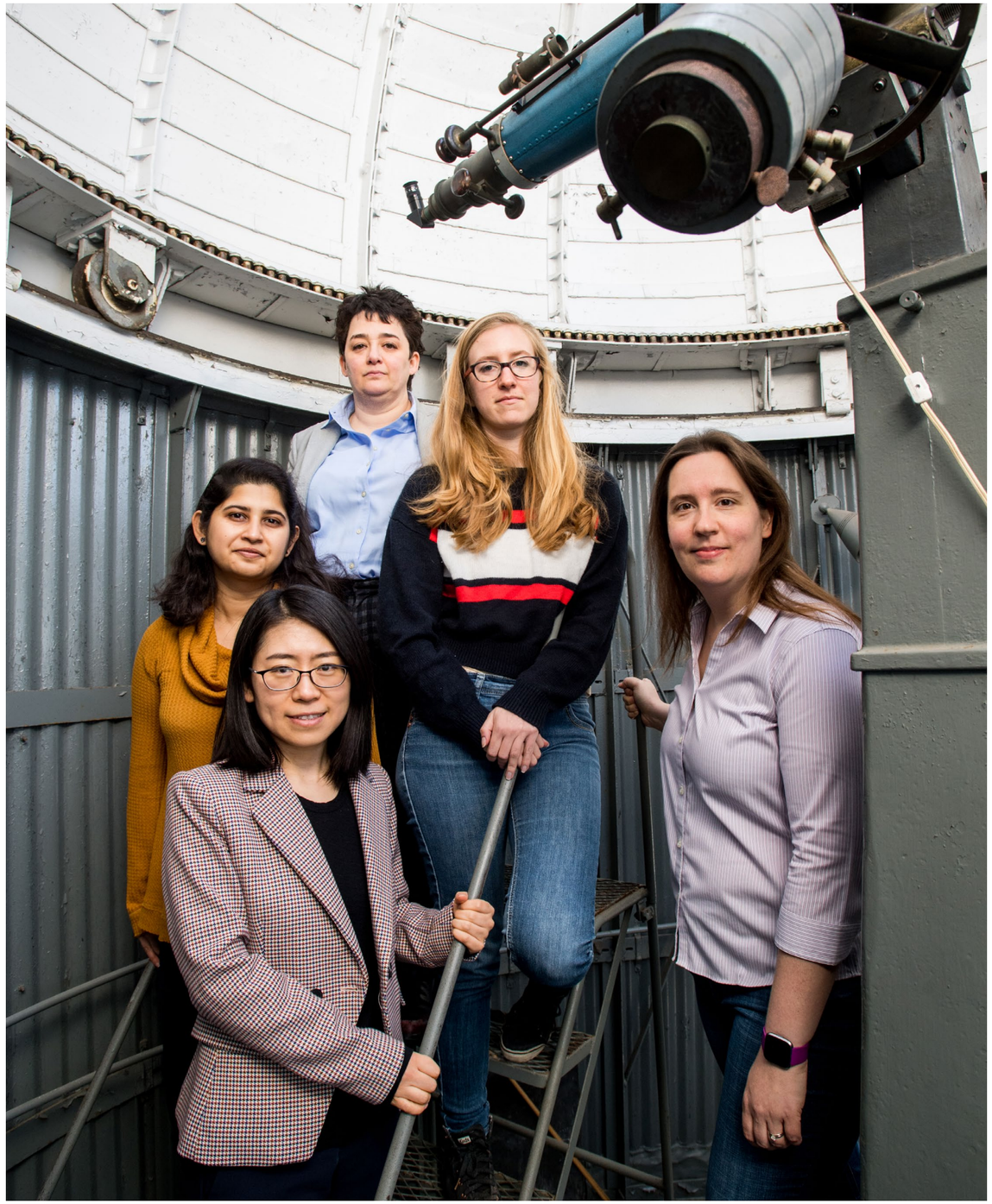
INSTAGRAM

@BU_Computing

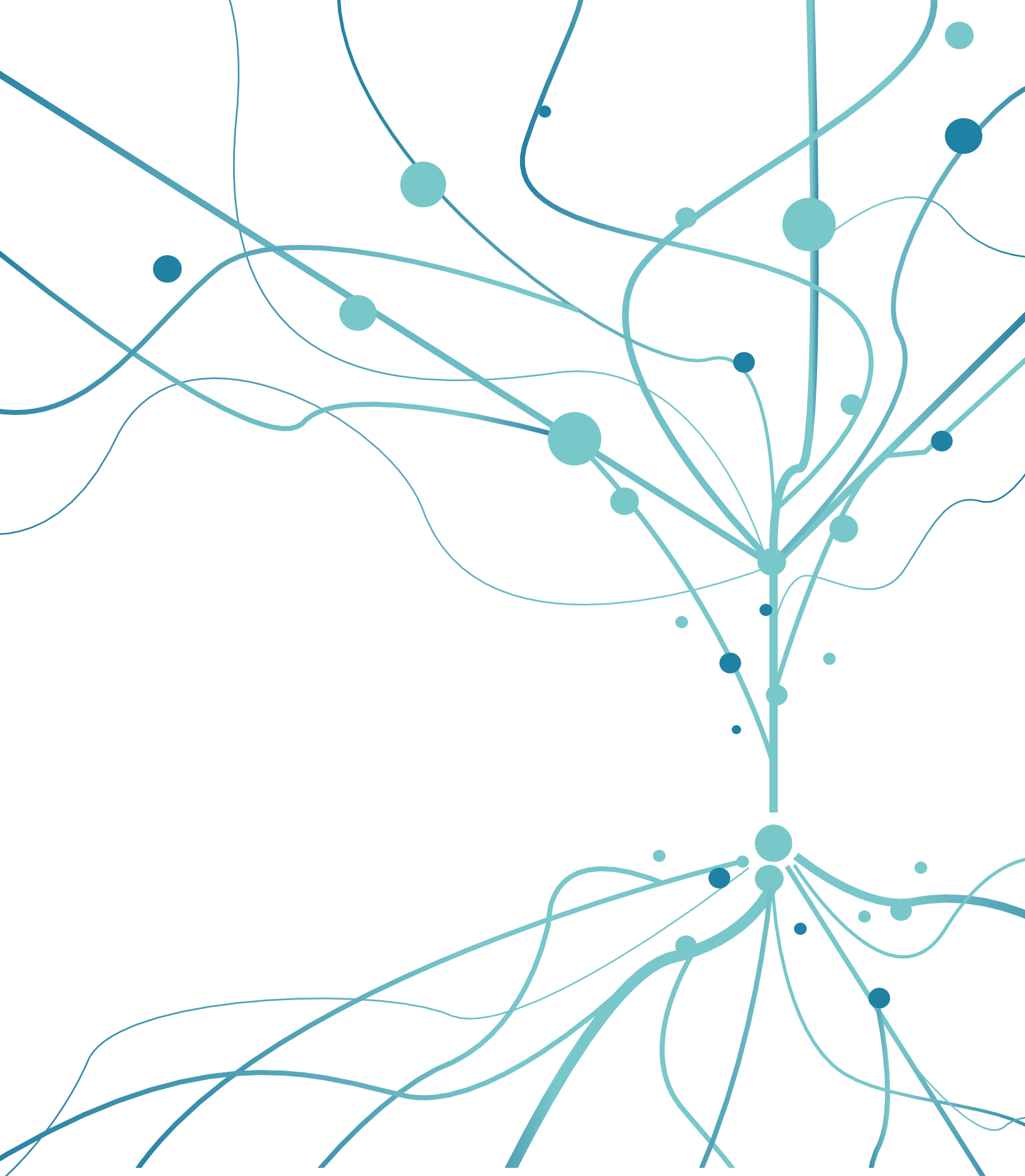
FACEBOOK

Hariri Institute for Computing, Boston University

If interested in joining any of our collaborative initiatives please visit our website for more information at https://www.bu.edu/hic/



Junior Faculty Fellow Wen Li, Professor, Astronomy, CAS, and research team at BU Astronomy Lab. Li uses computational models to simulate energetic particle dynamics due to wave-particle interactions and applies machine learning techniques to specify and predict the state of the space environment by taking advantage of various satellite data.



BU Rafik B. Hariri Institute for Computing
and Computational Science & Engineering

111 Cummington Mall, Boston, MA 02215
https://www.bu.edu/hic/