

Hariri Institute for Computing and Computational Science & Engineering

ANNUAL REPORT

2016

Contents

By the Numbers.....3

Institute Mission: An Incubator in a University Setting.....4

The Crossroads of BU Computational Research.....5

People.....6

Incubated Research.....8

Extramural Sponsored Research.....9

 Massachusetts Open Cloud (MOC).....12

 Modular Approach to Cloud Security (MACS) Project.....14

 SCOPE Big-Data for Smart Cities Project.....16

Centers, Initiatives & Collaborations Updates.....18

Development.....20

Resources.....22

 Software & Application Innovation Lab (SAIL).....22

 Platforms for Education & Training.....24

 Community Building Events.....26

 Space, Administrative & Research Support.....27

In the News.....28

Looking Forward.....29

Appendices.....30

BY THE NUMBERS

\$1M annual operating budget

53% as direct research support

30:1 ROI for 2016*

\$60M funding secured since inception

\$18.3M for Institute-led projects

\$30M FY16 research expenditures (BU Computing Community)

\$4.8M for Institute-supported projects

\$20M direct & in-kind industrial support since inception

170 faculty affiliates from

43 departments in

11 schools and colleges, including

42 fellows involved directly with Institute projects

\$181,250 in awards given to support incubated research on **7** new projects representing collaborations between **18** PIs and Co-PIs from **9** departments across **5** schools & colleges (awards were made from **16** proposals submitted by faculty from **12** different departments)

34 proposals submitted for **\$16.2M** in extramural funding, including **20** Institute-led proposals for **\$6.3M** and **14** Institute-enabled proposals for **\$9.9M**

20 media mentions

54 institute-produced news posts

32 outreach activities, both on and off campus

70+ public events and

250 group meetings attended by

1,100+ distinct participants

SAIL 

worked with **48** investigators from **12** departments; developed **16** projects with over **\$300K** of funding, including **13** externally funded projects; and provided **9** student internships

All figures reflect FY16 data, unless otherwise noted.
 *ROI calculation reflects ratio of BU Computing Community research expenditures to Institute FY16 operating budget

An Incubator in a University Setting

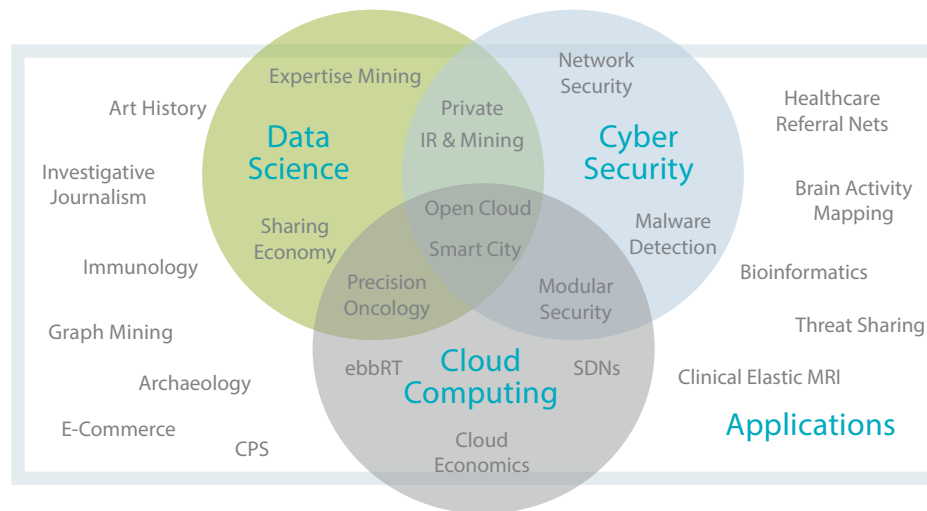
The mission of the Hariri Institute is to initiate, catalyze, and propel collaborative research for a better society by (a) promoting discovery and innovation through the use of computational and data-driven approaches, and by (b) advancing computing sciences, inspired by challenges in diverse application domains from arts and sciences to engineering and professional disciplines.

The Rafik B. Hariri Institute for Computing and Computational Science & Engineering at Boston University is an “incubator” through which new initiatives are envisioned, resourced, and launched, with the expectation that these initiatives will be self-sustaining within a relatively short period of time.

Given its unique position at the nexus of data science, cloud computing, and cyber security, the Institute marshals intellectual capital to establish Boston University’s leadership position in these three, intersecting fields as well as the application domains they enable.

The Institute strives to lead a cultural transformation, seeding collaborations that revolutionize entire fields and industries – from business to precision medicine, and from smart cities to journalism – bringing together the best minds to solve problems that cut across traditional disciplines.

The Institute’s goal is to leverage its resources of seed funding, office and lab space, state-of-the-art conference facilities, local and national partnerships, and staff support, to create and sustain a community of scholars who believe in the transformative potential of computational perspectives in research and education.



leveraging the computational perspective in a data-driven world

“The Hariri Institute for Computing moves with a nimbleness that belies its academic roots. It operates with a start-up mentality, swiftly seizing data-driven research and partnership opportunities and producing results in months rather than years. This receptivity to innovation and responsiveness are two of many reasons they are a sought-after partner.”

- Katherine Lusk, Executive Director, BU Initiative on Cities

The Crossroads of BU Computational Research

The Hariri Institute for Computing, a federated entity since 2014, includes several centers and initiatives within the University. The federation stimulates a broadened set of interdisciplinary research projects to secure funding and tackle challenges that span the fields of data science, cyber security, and cloud computing. For example, the Cloud Computing Initiative’s (CCI) Massachusetts Open Cloud (MOC) project benefits from innovative cloud security solutions created by researchers on the Modular Approach to Cloud Security (MACS) project, housed in the Center for Reliable Information Systems and Cyber Security (RISCS). Similarly, the Institute’s Smart-city Cloud-based Open Platform and Ecosystem (SCOPE) Project is enabled by the open cloud plug-and-play architecture being developed through the MOC.

CENTER FOR COMPUTATIONAL SCIENCE (CCS)

Director: David Coker (Chemistry, CAS)
 CCS was founded in 1990 and supports collaborations across departments and colleges by connecting computational scientists from different areas. Enabling the cross fertilization of new computational ideas and methodologies, 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. For more information, see page 19.

CENTER FOR RELIABLE INFORMATION SYSTEMS AND CYBER SECURITY (RISCS)

Director: Ran Canetti (Computer Science, CAS)
 RISCS promotes and coordinates research and education in system reliability and information security by emphasizing a multidisciplinary approach from fields such as reliable and secure computations, engineering, economics, ethics, and law. The Center draws on the expertise of 29 faculty and over 100 graduate students from the College of Arts & Sciences, College of Engineering, Questrom School of Business, and Metropolitan College. It provides opportunities for faculty and students from diverse fields to collaborate on interdisciplinary research problems and develop innovative, multidisciplinary curricula.

Through RISCS, BU is recognized as a National Center of Academic Excellence

in Information Assurance Education and Research. For more information, see page 19.

CLOUD COMPUTING INITIATIVE (CCI)

Director: Orran Krieger (Computer Science, CAS & Hariri Institute for Computing)
 Cloud computing is transforming all areas of computation. The mission of the CCI, incubated at the Institute in 2012, is to lead integrated initiatives in research, education, and technology development by targeting all layers of the cloud computing ecosystem.

DATA SCIENCE INITIATIVE (DSI)

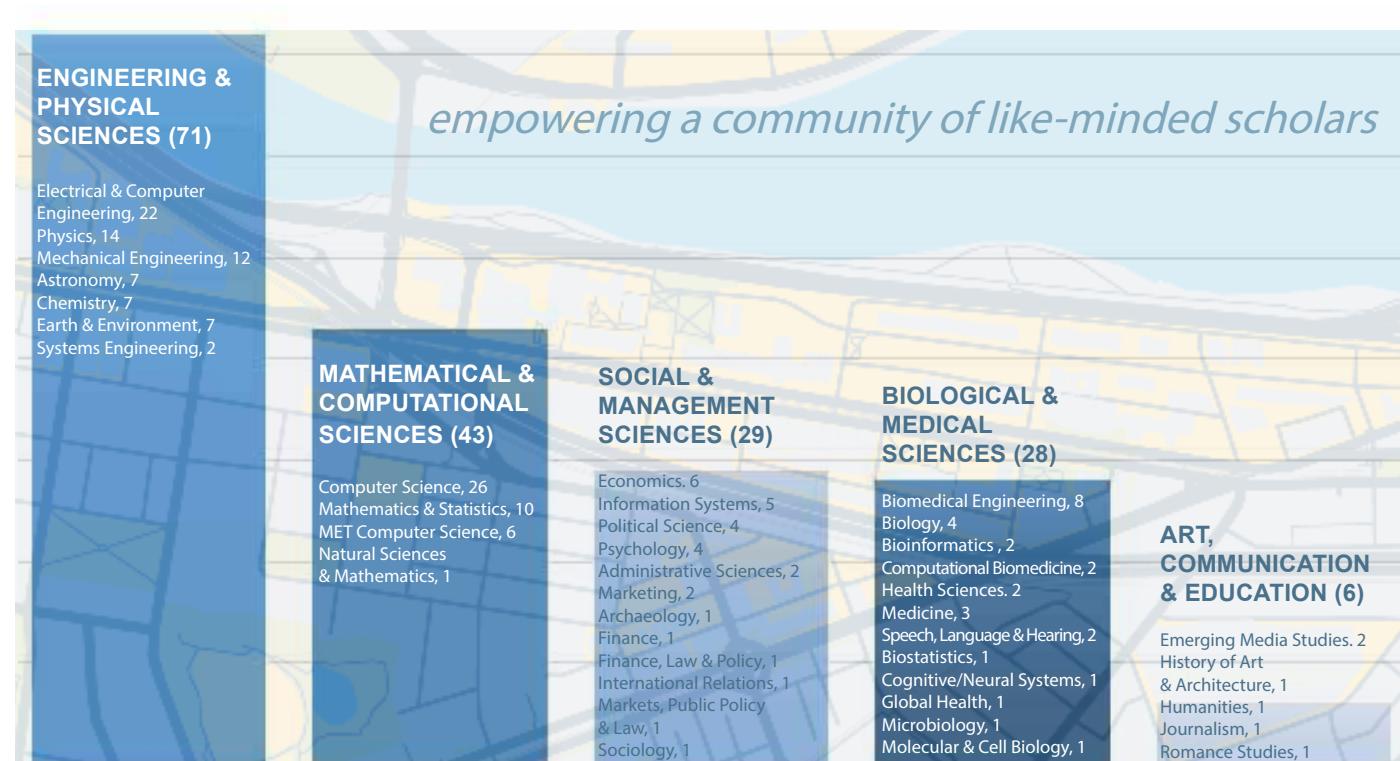
Data is the currency of discovery and innovation in almost every scientific and professional endeavor. Established in 2014, charged by the Provost, Jean Morrison, and under the leadership of Institute Director, Azer Bestavros, the DSI has been tasked with expanding BU’s data science footprint, including the recruitment of faculty to augment the existing base of talented researchers in data science-related fields. Additionally, the DSI is looking beyond faculty hiring to develop new models for data science programs, tracks and initiatives at BU. For more information, see page 18.

DIGITAL LEARNING INITIATIVE (DLI)

Director: Romy Ruukel
 The DLI addresses challenges and harnesses opportunities associated with the transformation of the higher education landscape brought forth by digital learning technologies.

The Initiative operates in an agile, start-up mode to foster and support strategic learning activities. DLI’s mission is to spearhead the University’s most innovative projects in online learning, uninhibited by pre-existing culture and structures. Among other activities, the DLI serves as BU’s liaison with the edX platform; acts as the hub of BU’s MOOC production; facilitates campus-wide digital learning innovation via CETLI/DLI grants program; follows developments in the digital learning space and proactively formulates and pursues key digital learning strategic initiatives. Incubated at the Institute for the past three years, the success of the DLI has led to the initiative moving out of the Institute federation to join with additional entities as part of the University’s Digital Learning and Innovation group, beginning next year.





People

“The Institute facilitates connections between faculty from various disciplines who identify new problems, bridge fields, and spark new directions for research.” - Doug Densmore, Hariri Faculty Fellow & Associate Professor, Electrical & Computer Engineering

The core work of the Hariri Institute for Computing focuses on empowering a community of scholars -- enabled by rapid advances in computational and data-driven techniques -- to advance our collective knowledge. The Institute community spans 43 departments and 11 schools and colleges. Such diversity highlights the importance of computing in nearly every field, and underscores the critical role of the Institute in catalyzing research through the development of computational and data-driven techniques.

AFFILIATES

The Institute community consists of 170 faculty affiliates from 43 units, including most departments in the College of Arts & Sciences, College of Engineering, Questrom School of Business, College of Communication, and Sargent College.

INSTITUTE FACULTY FELLOWS

Faculty Fellows include both faculty whose research projects are funded by the Institute and faculty who have distinguished themselves in contributions to the computational work of the Institute. Currently, 42 Faculty Fellows are involved directly in Institute-led research and projects.

“The Institute has been extraordinarily generous in embracing – with great enthusiasm – COM and the interdisciplinary work we are all trying to do. The new triangulated model of journalism, computer science, and statistics is the future – journalytics.”
– Maggie Mulvihill, Hariri Faculty Fellow and Clinical Professor of Journalism

JUNIOR FACULTY FELLOWS

The Junior Faculty Fellows program strengthens the BU-wide research community by recognizing achievements and accelerating the careers of outstanding junior faculty. Since 2011, 29 Hariri Junior Fellows have been selected for this honor, with a new cohort chosen through a competitive annual process. The program aims to connect these promising young faculty with one another and the Institute community at large. It does so by bringing together faculty members to partake in intellectual exchanges and integrative activities, and to probe the possibilities of cross-disciplinary collaborations. The Fall 2015 cohort consisted of six junior faculty members from the physics; computer science; psychological & brain sciences; markets, public policy, and law; sociology; and electrical and computer engineering departments.

“Being a Junior Fellow has exposed me to broader research related to social computing that is going on outside of my own school (Questrom); I’ve been able to access direct research support and pursue multiple opportunities for collaborations both within BU and with external organizations.”
– Dylan Walker, Junior Faculty Fellow, Assistant Professor of Information Systems

GRADUATE STUDENT FELLOWS

The Graduate Student Fellows program, newly established in 2016, provides resources to help outstanding PhD students flourish in their research careers. The inaugural cohort of eight Graduate Fellows includes scholars from the College of Arts & Sciences, College of Engineering, Questrom School of Business, and Sargent College of Health & Rehabilitation Sciences.

“This program will be a tremendous help as we try to recruit [exceptional graduate students to Boston University]”
– Alice White, Chair, Mechanical Engineering

INSTITUTE STAFF

The Institute’s administrative, research, and technical staff are instrumental in advancing the mission of propelling collaborative research. Over the past year, the team has invested resources in crafting systems and processes to support the growing depth and breadth of Institute initiatives, projects, and programs.

In order to support this growth, the Institute brought on several new staff members over the past year. The new associate director for communications and outreach has been working to increase and improve efforts to showcase ongoing research, create efficiencies in internal communication, and support a growing number of community-building events.

The technical and research support team has also grown, adding a dedicated director of research development and two additional software engineers for the Software Application and Innovation Lab. Additionally, the Institute hired an associate director for the Massachusetts Open Cloud (MOC), to support the expansion of the project, which continues to attract new industry, academic, and nonprofit partnerships.

LEADERSHIP

The Steering Committee meets once a semester to guide and support the development of the Institute. Reflective of the Institute’s focus on empowering a diverse community of scholars, the Steering Committee consists of 15 senior faculty members from 9 departments, representing the College of Arts & Sciences, College of Engineering, School of Law, School of Medicine, and Questrom School of Business. The Steering Committee acts as a think tank, creating a vision for how the Institute can engage researchers and students to enhance BU’s position as a world-class institution for research and learning.

“Steering Committee meetings are especially interesting and enlivening, as one gets to hear perspectives from a broad range of disciplinary experts and weigh in on topics ranging from strategic directions for the Institute, to the merits of supporting individual faculty members’ research proposals, to sponsorship of outstanding doctoral students engaging in interdisciplinary research.”
– John Byers, Steering Committee Member and Professor, Computer Science

Incubated Research

seeding collaborations that extend research horizons

A sample of active projects includes:

James Galagan (BME & MED Microbiology) is developing predictive computational models of regulatory and metabolic networks of the Tuberculosis Mycobacterium to accelerate discovery of potential drug targets, effectors of host-pathogen interactions, and pathogenesis regulators.

Jacob Bor (SPH Global Health), in collaboration with George Kollios (CS) and Lorenzo Orecchia (CS), is using graph algorithms to infer probabilistic linkage and network structures underlying chronic diseases in a dataset of 35 million records from South Africa's National Health Labs.

Rich West (CS), in collaboration with Cara Lewis (Sargent Physical Therapy) and Sheryl Grace (Mechanical Engineering), is developing a real-time bio-kinematic data acquisition system to be embedded in helmets of skaters to enable data-driven sports injury research.

Lucy Hutyra, Dan Li, and Mark Friedl (Earth & Environment) are mining cellular network data to build high-resolution spatio-temporal CO2 emissions models that enable research (and inform public policy) targeting coupled human-natural dynamics in urban heat islands.

Cathie Jo Martin (Political Science) is applying computational linguistics to British and Danish coming-of-age novels and poems to evaluate the cultural origins of diverse models of education reform and implications for socioeconomic inequality.

Jacob Groshek and Lei Guo (COM Emerging Media), in collaboration with Manuel Egele (ECE), Prakash Ishwar (ECE), Margrit Betke (CS), and Dino Christenson (Political Science), are developing robust collection, storage, and analysis capabilities to enable the use of Twitter feeds in emerging media research, including analysis of social media influence on the U.S. 2016 elections.

To support ambitious, high-risk, high-reward research, the Institute invests in its fellows and affiliates by selectively seed-funding new collaborations that cross typical disciplinary boundaries. Since its inception, the Institute has invested nearly \$1M in funding to 46 faculty members from across 23 departments. The Institute has 19 active Research Award projects, including seven new projects that were awarded over the past year from 16 project proposals (\$181,250 in FY16 funding).

This past year more than ever, the quality of proposals and the collaborative nature of proposed projects increased tremendously. Faculty members now routinely consult with Hariri staff to develop ideas and assemble cross-disciplinary research teams. In part, these results can be attributed to the Institute team's effort to continuously improve outreach activities and internal work flows.

	# of Awards	Total Funding
FY12	5	\$144,560
FY13	8	\$215,309
FY14	4	\$110,900
FY15	9	\$195,767
FY16	7	\$181,250
To Date	33	\$847,786

Extramural Sponsored Research

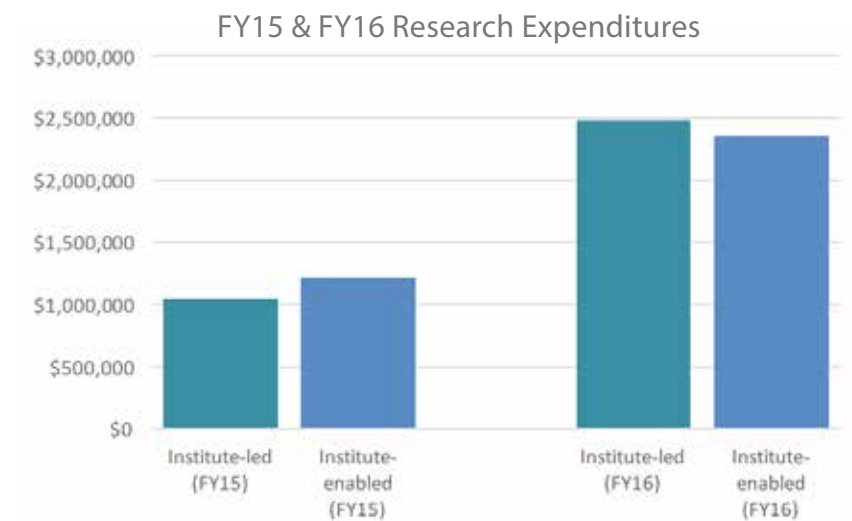
incubating transformative projects for a better society

Imagine a world where digital communication is secure, privacy is guaranteed, and information is beyond the reach of hackers and rogue agents. Imagine a world where smart-city sensors stream information into a cloud, enabling a huge marketplace of applications that are available to citizens and businesses alike. Imagine a world where physicians are able to diagnose a problem with a fetus instantly by harnessing the computational power of 10K CPU cores for one second to process high-throughput MRI imaging. Imagine a world where an art historian can instantly identify all influences of an artist by mining digital humanities artifacts. Imagine a world where personalized educational content and fully-automated, personalized one-on-one assistance is provided to students studying algebra online all over the world.

While seemingly unrelated, these opportunities, all of which are associated with on-going Institute projects, are at the nexus of cyber security, cloud computing, and big data research. These areas are synergistic: tackling big-data problems requires on-demand, high-performance computing at a scale offered only by cloud systems, operating on massive data in the cloud requires sophisticated approaches for cyber security and information assurance; and making real progress in cyber security has become, in part, a big data problem.

In addition to seeding incubated research and spearheading large, multi-collaborator projects, the Institute serves as an amplifier for the work of the entire BU computing community. The past year has seen considerable growth in community-wide activities, with FY16 research expenditures up by more than \$4M. Additionally, FY16 expenditures for Institute-led* and Institute-enabled** projects have significantly increased from FY15.

BU Computing Community Research Expenditures	
FY15	\$25,838,705
FY16	\$29,957,750



*Institute-led projects include all research submissions that were submitted by the Institute and for which the Institute serves as the funding award base.
 ** Institute-enabled projects include all projects for which the Institute provided some amount of research or support for the project but does not serve as the funding award base. These projects would not be possible without the support of the Institute.

extramural sponsored research research proposals

Working with affiliates and external collaborators to develop new research ideas and bring together diverse collaborators, the Institute devotes critical resources to proposal development and submission. Over the past year, the Institute supported 34 proposals towards a total of \$16.2M in extramural funding, both leading and enabling efforts with BU's College of Arts & Sciences, Questrom School of Business, College of Engineering, School of Public Health, School of Education, Sargent College, Bioinformatics Interdisciplinary Program, and Center for Integrated Life Sciences & Engineering (CILSE). A full list of FY16 proposals can be found on page 50.

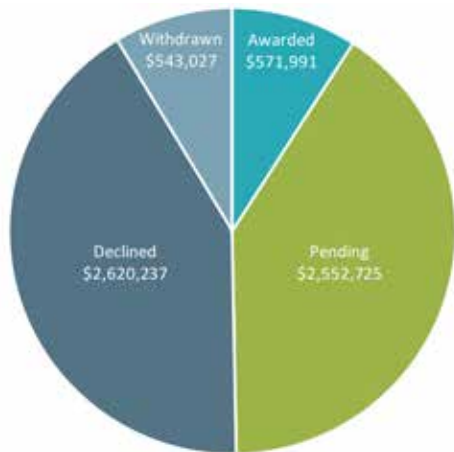
The Institute strives to leverage ongoing, state-of-the-art research, such as the SCOPE project's multi-party computation platform and the Massachusetts Open Cloud exchange, to support new inquiry and strengthen the BU research community's ability to attract major funding. Acting as a facilitator, the Institute draws on a wide network of faculty affiliates and external partners to make connections that enable this research, including serving as the gateway to the Massachusetts Green High Performance Computing Center (MGHPCC).

These proposals often entail complexities related to coordination among many collaborators and institutions. The demands of cross-disciplinary and multi-institutional efforts are often a barrier for individual departments and PIs; therefore, the Institute's ability to bring together the right people and leverage unique resources is essential to the pursuit of these complex research endeavors.

Institute-led Sponsored Research Submissions Total: \$6.3M

Institute-led proposals include all research submissions that were submitted by the Institute and for which the Institute serves as the funding award base. PIs leading these proposals are typically Institute leadership and Faculty Fellows closely engaged with key research thrusts of the Institute. In FY16, the Institute saw a 25% success rate, with an additional 30% of submissions still pending. Over the past year, the Institute led proposal submission for 17 different PIs and Co-PIs from computer science, electrical & computer engineering, physics, mechanical engineering, as well as RISCS, CCS, and IS&T.

Award Status Breakdown (Institute-led proposals)



Award Status	# of Awards	Funding
Awarded	5	\$571,991
Pending	6	\$2,552,725
Withdrawn	2	\$543,027
Declined	7	\$2,620,237
Total	20	\$6,287,980

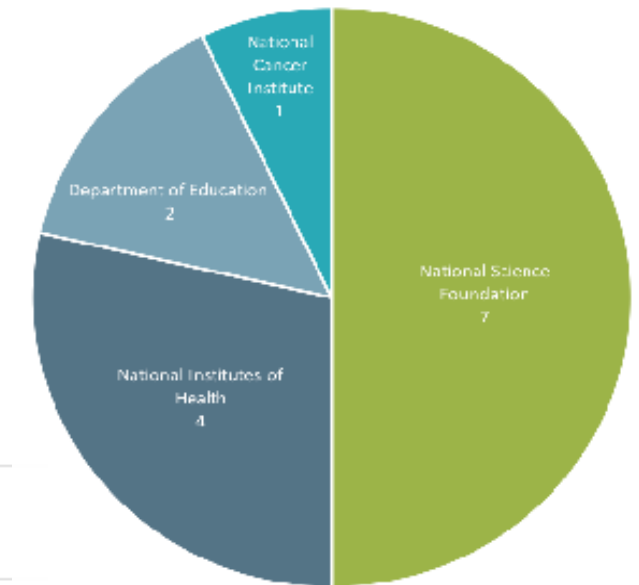
Institute-enabled Sponsored Research Submissions Total: \$9.9M

Institute-enabled proposals include all projects for which the Institute provided some amount of research support during the proposal process, but does not serve as the funding award base. The role of the Institute varies with these projects, and often includes letters of support and consulting services regarding both research activity and software development. Additionally, the Institute's software engineering staff (SAIL) offer design, prototyping, and implementation support for many of the Institute-enabled projects.

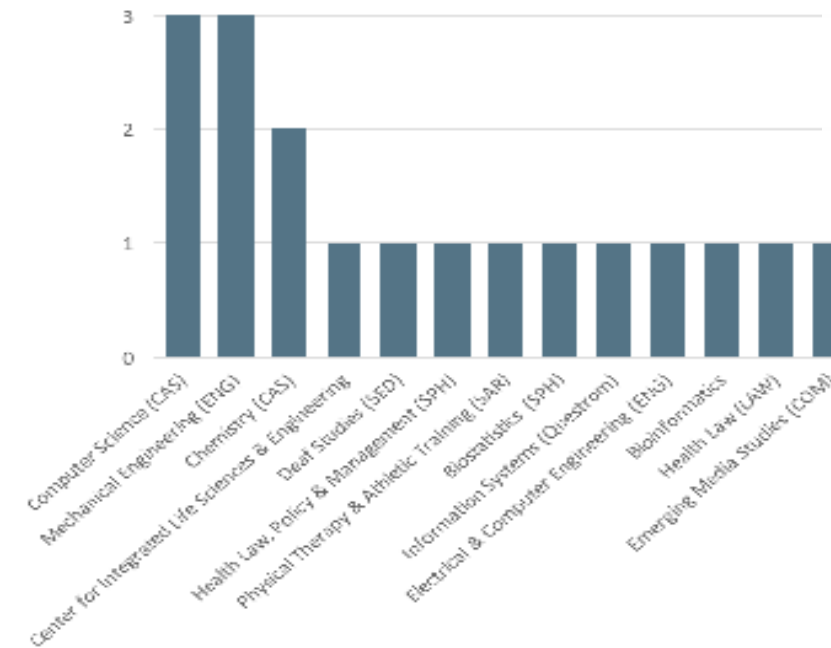
These project proposals would not be possible without the support of the Institute. Over the past year, the Institute enabled 14 projects, led by 18 different PIs and Co-PIs from 13 departments across the University.

Funding Sources (Institute-enabled proposals)

Award Status	# of Awards	Funding
Pending	7	\$6,142,909
Declined	7	\$3,785,786
Total	14	\$9,928,695



PI & Co-PI Departments (Institute-enabled proposals)



extramural sponsored research

The Massachusetts Open Cloud (MOC)

Built upon a unique academic, industry, and government partnership, the [MOC](#) is comprised of deeply interconnected projects all with the same goal: to develop an open, production-quality cloud computing system that enables research and provides leading-edge services for scientific computing. To date, the MOC has secured \$3M of funding from the Commonwealth of Massachusetts, and over \$20M of hardware, software, and direct funding from several industry leaders. The MOC team includes lead PI Orran Krieger, a director of engineering, five software and infrastructure engineers, one postdoctoral researcher, several interns, and an administrator. Beyond BU, the project includes dozens of contributors from partnering institutions and companies.

2015-2016 ACCOMPLISHMENTS

Over the past year, the MOC has made major advances on all dimensions of the project, with highlights including the successful launch of a production-quality OpenStack service that will be available as an experimental service through BU IT departments and select academic partners in the coming months. Since launch, the project team has engaged over 100 system users, and the service is expected to gain 300 additional users once completing the federation with MIT's Computer Science and Artificial Intelligence Lab (CSAIL). Additionally, the MOC facilitated the second run of the popular BU Cloud Computing course, which enrolled more than 70 students (Spring 2016).

“Massachusetts is proud to be a ‘first-mover’ in this paradigm-changing platform. This marriage of market leaders with an interdisciplinary team of researchers, working at the frontiers of innovation in open cloud computing, demonstrates the significance of Massachusetts’ position in global cloud computing markets and technologies.” - Pat Larkin, Director of Innovation, MassTech Collaborative

In addition to the highlights described above, the MOC team has engaged in critical research and project development activities. Additional accomplishments from the past year include:

PARTNERSHIP DEVELOPMENT

The MOC has exceeded expectations regarding partnerships by signing Intel, CISCO, Red Hat, Lenovo, Brocade, Two Sigma, and the U.S. Air Force as core project partners and attracting numerous additional industry contributors. These partners have committed significant financial and in-kind resources to the MOC, putting it on a sound financial footing moving forward. MOC leadership have worked extensively with one core partner to design and fund an incubation lab at BU that would advance research and learning objectives. Committed

revenue from core-partner membership fees has more than covered the project's third year revenue projection of \$600,000.

OUTREACH & ENGAGEMENT

Over the past year, the MOC has made significant progress in outreach and communications. The first annual MOC workshop drew participation from a broad community of researchers, as well as academic and industry partners. The event, and subsequent face-to-face meeting with all MOC key partners, provided important feedback for further acceleration of the project. Since then, the MOC has created a project Academic Advisory Board, initiated quarterly virtual meetings with MOC executive sponsors, and launched a project website.



INSTITUTE RESEARCH LINKAGES

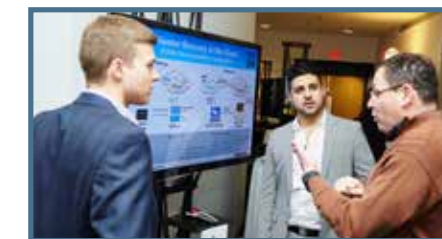
Housed within the Cloud Computing Initiative (CCI), the MOC provides a structure and testbed for the MACS and SCOPE projects.

Additionally, project lead Orran Krieger was invited to give the keynote address at the NSF Workshop on Software-defined Infrastructure and Software-defined Exchanges, which focused on “looking beyond the internet” and exploring research opportunities in wireless, network, and cloud technology. Krieger also presented at [Intel Cloud Day 2016](#), providing a vision for the MOC project at the core partner's annual event for announcing new technologies, investments, and industry collaborations.

MOC WORKSHOP

On November 19th, 2015, the Hariri Institute for Computing hosted the inaugural MOC Workshop, which brought together more than 100 participants, including students, faculty, research IT staff, and

representatives from industry partners.



MOC Workshop participants included students, researchers, and industry representatives.

The workshop celebrated the first year of the project with a combination of micro talks, networking opportunities, and a poster session that highlighted the project's key technical developments. MOC PI, Orran Krieger, Institute Founding Director, Azer Bestavros, and more than 20 BU faculty, students, postdocs, and

members of the MOC technical team gave presentations.

LOOKING FORWARD

Over the next year, the MOC development team will work to cultivate the system's user community by providing differentiated services for sharing and analyzing massive data sets as well as hosting a growing set of applications. Additionally, project contributors will continue to help BU researchers leverage the MOC in new research proposals, thereby expanding the project's role as a community resource. Project leadership will also deepen existing partnerships as well as develop new relationships in support of research and teaching objects in an effort to establish the MOC as a self-sustaining system.

extramural sponsored research

The Modular Approach to Cloud Security (MACS) Project

Funded by a \$10M five-year NSF Frontier grant, [MACS](#) is a multi-institution, multi-disciplinary project focused on the security of cloud computing. Led by BU, the project involves six faculty members from BU, five from MIT, and one each from Northeastern University and UCONN. Together, they are designing, developing, and intelligently integrating technologies that protect the privacy and integrity of cloud computing and data storage at all layers of the computing stack: hardware, networking, operating systems, applications, and data.

2015-2016 ACCOMPLISHMENTS

This year alone, researchers authored more than [40 academic publications](#) and a half-dozen software packages. Additionally, MACS hosted a two-day hackathon on Universal Composability, providing an opportunity for hands-on application to a broad audience of 40 faculty, students, and postdocs with interests in cryptography, networking, OS design, and systems security. Through two PI meetings, hosted in October (2015) and March (2016), project collaborators were able to discuss research progress and strategies, which have organically led to new, unplanned collaborations. In June (2016), MACS co-hosted a Cryptography Workshop that enabled project contributors to disseminate research findings to over 75 attendees and provided a common space for MACS affiliates to develop new research ideas with the greater academic community.

The success of the MACS project rests on many contributors working on individual projects that are synced across several research thrusts. A sample of research highlights achieved over the past year includes:

HARDWARE

Professor Orran Krieger spearheaded the design of a Hardware Isolation Layer (HIL) for the cloud. Whereas most cloud data centers use virtualization to isolate cloud tenants from each other, HIL securely isolates groups of computing, storage, and networking resources to enable faster, more dynamic, and more flexible user-level provisioning of resources.

OPERATING SYSTEMS

Professor Jonathan Appavoo developed the elastic build block runtime (EbbRT), an open-source, modular operating system designed for the cloud. Whereas today's cloud predominantly uses operating systems that were built for desktop environments (in which one computer runs many programs), EbbRT is a lightweight operating system built for the cloud that allows one program to execute on many computers.

NETWORKING

Professor Sharon Goldberg rigorously analyzed and improved the security of the Network Time Protocol (NTP), the mechanism by which computers on the internet learn and synchronize their

MACS research efforts are guided by lead PI Ran Canetti's theory of Universal Composability, which specifies that security mechanisms at different layers of the computing process combine to provide top to bottom security guarantees; in other words, that the sum of individual security measures is greater than its parts.



INSTITUTE RESEARCH LINKAGES

Housed within the Center for Reliable Information Systems and Cyber Security (RISCS), the MACS project contributes security features to the MOC and leverages the platform as a testbed for research implementation.

notion of time. Many applications and security mechanisms rely on the accuracy of timestamps and validity intervals. Goldberg's work addressed a serious vulnerability that could have allowed attackers to compromise encryption schemes, for example, those that protect e-commerce.

APPLICATIONS

In collaboration with the SCOPE project, Professor Azer Bestavros designed a secure computing platform that enables many organizations to leverage the cloud's centralization, availability, and computing power without needing to entrust the cloud to view their data. Additionally, Professor Ran Canetti designed several innovative cryptographic protocols that permit a cloud server to execute tenants' programs both without learning what it is being asked to perform and in a manner that ensures outcome integrity.

DATA

Professor Kollios designed secure database systems that enable cloud tenants to encrypt all data before uploading it to the cloud while still permitting the cloud server to perform certain types of searches over the encrypted data. Additionally, he has formally modelled and quantified the inherent tug-of-war between performance and privacy for these systems; this work can be leveraged in the future to design optimal systems.

PROJECT LINKAGES

MACS focuses significant efforts on developing linkages between individual research outcomes. Below are examples of these integrations, which are strongly enhanced through collaboration with the MOC:

From Theory to Practice: Project contributors have transitioned the hardware and operating systems technologies described above into the MOC. In future years, this can be leveraged to integrate technologies developed at higher layers of the computing stack into the MOC's open cloud marketplace.

From Practice to Theory: Due to close collaboration with the MOC, researchers have been able to observe several security-oriented challenges in the development of a cloud datacenter, which has led to the formation of new research ideas. For instance, project contributors plan to design secure mechanisms that enable the MOC to share data with cloud researchers and potential customers without revealing information about current tenants' computations and data. Additionally, researchers are beginning to investigate the security properties of cloud-specific software packages like OpenStack.

extramural sponsored research

The SCOPE Big-Data for Smart Cities Project

The Smart-city Cloud-based Open Platform and Ecosystem ([SCOPE](#)) project is creating a multisided marketplace for smart-city services in which stakeholders compete and cooperate within the same infrastructure. SCOPE is a National Science Foundation Partnerships for Innovation (NSF PFI) project, supported by over \$1M in funding from NSF and industry partners.

SCOPE's goals are to a) enable urban stakeholders to harness, learn, innovate, and monetize big data assets; b) spur a generation of new public and commercial goods; c) innovate with state-of-the-art technology, sensor-based information, and plug-and-play architectures; d) create new spaces for data-driven public policy debate; and e) enhance and innovate the quality and equity of services. Collaborators from city, regional, and state agencies are working to improve policies and practices through the SCOPE platform and engage in purposeful and transparent data-sharing to address issues that transcend agencies as well as require new rules and protocols on data use and applications.

2015-2016 ACCOMPLISHMENTS

A key accomplishment from the past year includes enhancing SCOPE's Multi-Party Computation (MPC) platform. The research team, led by Project PI Azer Bestavros and including contributors from SAIL and the Initiative on Cities, implemented a web-based version of the application and deployed it for use by 70 Boston Women's Compact (BWC) signatories to securely compute major pay equity aggregate statistics for 2016.

“[We] spent more than a year brainstorming with global experts in fruitless pursuit of a data-gathering method that would ensure employers’ confidentiality. It proved impossible to find a solution—until we were introduced to Professor Bestavros [and the SCOPE platform, which was] absolutely vital to our work. We owe our progress on this innovative and ground breaking project [to them].” – Christina Knowles, Executive Director, Boston Women’s Workforce Council

Contributors also developed innovative curricula that integrates smart-city work into two courses, the newly developed [Data Mechanics for Pervasive Systems and Urban Applications](#) course and the second run of the [Cloud Computing](#) Course. This was augmented by efforts to expose students to the intersection of policy and technology for smart cities through opportunities such as the November 2015 [Transportation Nudges Conference](#) and a Schneider Electric-funded student internship that focuses on creating value from transportation data. These accomplishments have also served to deepen existing project partnerships, a result of which can be seen in the Institute's ability to leverage the SCOPE partner network in its submission of a multi-institution NSF proposal to track air pollution in the Northeast.



INSTITUTE RESEARCH LINKAGES

Housed within the Institute, the SCOPE project interacts with RISCs and CCI by leveraging MACS project developments and utilizing the MOC eXchange model.

The success of the SCOPE project relies on many contributors working on individual projects that are synced across several research thrusts. A sample of research highlights achieved over the past year includes:

END-USER SERVICES Data Driven Traffic Analysis and Control

Co-PI Christos Cassandras and his research team spent the past year improving adaptive traffic light controllers to improve overall system performance under various traffic conditions and tested these results in simulated urban settings.

Smart City Mobile Apps

Cassandras's team has also identified opportunities to use optimal flow methods and Connected Automated Vehicles (CAVs) to improve traffic conditions by guiding vehicles to use socially optimal flows.

CROSS-CUTTING SERVICES

Traffic Management for Sustainability

Co-PI Lucy Hutyra led a team that included a collaborator from the Boston Metropolitan Planning Organization to develop a roadway-scale model of vehicle emissions for the greater Boston metropolitan area. This work identified “emissions hot spots” and traffic corridors where congestion produces excessive pollution levels.

Data-driven Public Safety Applications

Co-PI Evimaria Terzi and SAIL Engineer Frederick Jansens are developing a route recommendation platform that factors in distance and route safety to improve user experience.

Coordination of Crowdsourced Resources

Project PI Azer Bestavros expanded the development of incentive compatible route coordination mechanisms that enable application interfaces to support Geo Presence as a Service (GPaaS) and monetize geo presence tagging for users.

Participatory Planning and Organization

Senior Personnel Katherine Lusk and Paul McManus, along with SAIL collaborators Andrei Lapets and Frederick Jansen, engaged with City of Boston and MassDOT stakeholders to unlock city data and allow students from the Data Mechanics course to solve urban mobility challenges and incorporate over 30 public datasets into the SCOPE prototype platform.

APPLICATION PROGRAMMING INTERFACES

Mobility Index Analytics

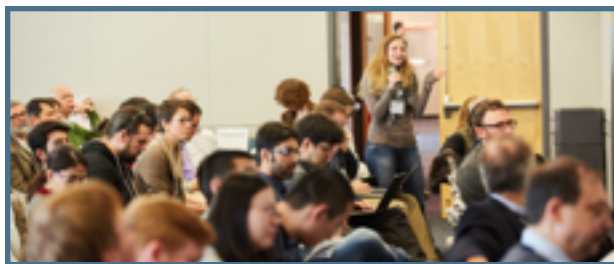
In pursuit of a comprehensive mobility index that takes into account climate, sustainability, affordability, and safety attributes, SCOPE researchers expanded their data collection to include social networking sites from additional cities (San Francisco and Austin) to distinguish between resident and visitor mobility trends.

Centers, Initiatives & Collaborations

While the major research accomplishments of the Institute's centers and initiatives have been highlighted, several of the federated entities have engaged in additional activities, designed to build research capacities, engage new faculty and students, and connect the BU community to globally-renowned research leaders.

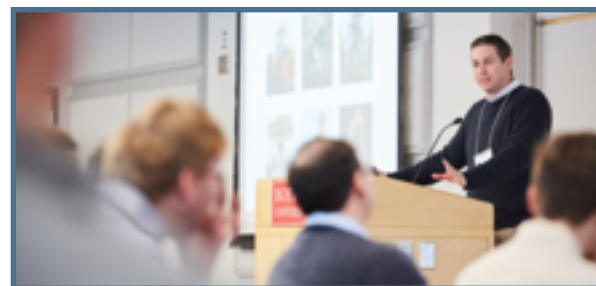
DATA SCIENCE INITIATIVE EXPANDS SCOPE

Throughout the University, researchers are mining mountains of data and growing technological and methodological tools to transform professional fields from health care and business to design and communications. The DSI provides significant resources for data scientists across BU, including the use of high-performance computing platforms through the Massachusetts Green High-Performance Computing Center, storage and infrastructure support, unique BU data sets, and access to Institute facilities, staff support, seed funding, and grant administration. The DSI hosted three Distinguished Lectures, bringing in prominent scholars to discuss exciting advances in big-data-driven research.



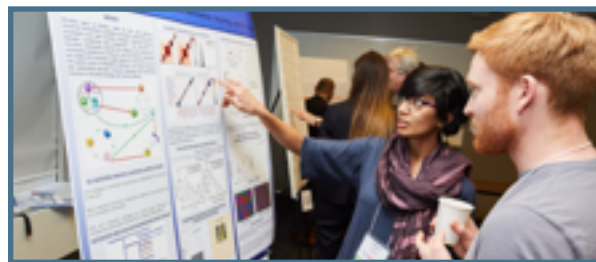
"[BUDS was a] very worthwhile effort to bring together different strains of data science, and to help foster new connections." – Faculty Attendee

In an effort to strengthen the vibrant ecosystem of researchers in incredibly diverse fields, the Institute hosted the inaugural [BU Data Science \(BUDS\) Day](#) in January, co-chaired by Institute fellows Dino Christenson (Political Science) and Prakash Ishwar (Electrical & Computer Engineering). The event featured talks from researchers across BU – from social sciences, humanities, law, business and medicine, to engineering, computer science, and statistics – as well as two keynote speakers, Alessandro Vespignani from Northeastern University and Jennifer Listgarten from Microsoft Research Lab. Additionally, the event featured a poster session to celebrate the work of BU students.



"How can we use biological big data to inform and influence how patients are treated in the clinic?" – W. Evan Johnson, Medicine and Biostatistics

Attended by more than 250 faculty, staff, and students, the symposium brought together a multi-disciplinary audience and initiated a dialogue about how the data science community can leverage the DSI to strengthen BU's research. Following the success of the inaugural event, planning efforts are already underway for BUDS 2017.



"Working with data allows me to find patterns in political and social phenomena that otherwise would be hidden." – Abi Hassan, doctoral candidate in political science & poster presenter

RISCS SUPPORTS FACULTY & STUDENT LEARNING

In addition to its support of the MACS project, RISCS hosts the [BU Security Group \(BUSec\)](#), which pursues research in cryptography and network security. Over the past year, RISCS supported 19 BUSec Seminars, a summer seminar series on Topics in Practical Security, and several high profile MACS events, including a Universal Composability Hackathon, a three-day Crypto in the RAM Model workshop, and cosponsorship of the Spring 2016 New England Security Day. This past spring (2016), RISCS sponsored a new course, titled Symmetric Cryptography: Design & Practice, and led by MACS Director and RISCS Co-Director, Mayank Varia.



The two-day UC Hackathon included a day of lectures about the universal composability framework followed by "hackathon style" sessions of UC security analysis related to computer algorithms.

CCS LAUNCHES SEMINAR SERIES & VISITING PROFESSORSHIP

Over the past year, the center hosted the CCS Lecture Series, which included four high-profile lectures that featured broad, widely accessible presentations by world-leading scientists. By focusing on fewer but broader topics, rather than competing with the proliferation of focused sub-discipline seminars, the series was much more effective in bringing together different communities, and each lecture was attended by lively groups of 30+ participants.

Additionally, CCS hosted its first Visiting Research Professor, Gerhard Stock, from the Institute of Physics at the Albert Ludwigs University of Freiburg in Germany. The

idea behind this new CCS program is to identify an area where BU has world leading expertise in computational science; identify visitors with strong, complementary research programs; and invite them for a visiting professorship to develop new collaborative projects. The focus area will rotate annually to provide growth opportunities in different areas of computational science.

For the first year, CCS focused on computational biophysical chemistry and selected Professor Stock due to the strong complementarity between his research and the research interests of BU faculty members, John Straub, David Coker, and Ksenia Bravaya. During his two month professorship at BU, Professor Stock gave a CCS Lecture Series presentation, lectured as part of the [Greater Boston Area Theoretical Chemistry Lecture Series](#), and taught a special CCS graduate student seminar titled "*Data driven Langevin modelling of biomolecular dynamics.*"

Finally, in continuing its strong record in hosting international conferences, CCS has engaged in a comprehensive planning process in preparation for hosting the [2017 American Conference on Theoretical Chemistry \(ACTC2017\)](#). An estimated 300 participants from the U.S. and abroad are expected to attend the July 2017 conference.

BU/MIT LINCOLN LAB COLLABORATION INCREASES ACTIVITIES

The Hariri Institute for Computing and MIT Lincoln Laboratory (MIT LL) have a multi-faceted research collaboration that brings together BU faculty and students with MIT Lincoln Lab technical leaders. Research topics of interest include verifiable security models, security as a service, moving target defense, secure cloud computing and others. A key component of the collaboration, the BU/MIT LL Cyber security Workshop Series hosted a one-day workshop focused on cyber security applications of big data. The workshop series are open to the public, and seek to bring together researchers from a diverse array of backgrounds, from industry and academia, in order to report on research findings, opportuni-

ties and challenges in the burgeoning field of cyber security. Additionally, the Institute, led by faculty member Manuel Egele (ENG), hosted a bi-weekly seminar series that addressed issues of network and cyber security.

"Having industry leaders join forces with the five MGHPC founding universities positions the MOC as a great example of the kind of academic, industry, and state government collaboration that we hoped to see when the MGHPC consortium was founded"
– John Goodhue, Executive Director, MGHPC

MASSACHUSETTS GREEN HIGH-PERFORMANCE COMPUTING CENTER (MGHPCC)

The Institute continues to act as the connector between the BU community of faculty and students and the [MGHPCC](#) activities, and Institute Director Azer Bestavros co-leads the Research, Education, and Outreach working group of the MGHPC. Additionally, Institute affiliates continue to be involved in proposal development that leverages this resource, including the Institute's recent PETALS proposal for NSF funding. The MGHPC continues to develop as a central resource for both the MOC and MACS projects. For example, several of the key outreach activities for the MACS projects are coordinated and implemented through the MGHPC, such as the project's 2016 summer workshop.

Development

priming the research pipeline

The Institute's success in securing extramural funding relies on its ability to develop high-risk, high-reward research ideas, leverage experience working with multi-sector stakeholders, and utilize unique Institute resources. Current development activities include cultivating key relationships, organizing faculty discussions, engaging with congressional and agency representatives regarding funding and policy, and assembling teams and writing proposals.

A sample of efforts to seed the Institute's future research portfolio are highlighted below.

Institute faculty and leadership, along with University administrators, are consulting with NSF's Global Environment for Network Innovations (GENI) Project Office to identify synergies that would allow BU to play a role in activating the GENI research and development community. Discussions have addressed how current positioning of the GENI community in leading future NSF cyber infrastructure initiatives aligns with prospective projects at BU. These cultivation efforts included a presentation by BU senior management to NSF's Computer & Information Science Engineering (CISE) and Computer and Network Systems (CNS) divisions in Washington, D.C. (June 2016). Institute affiliates involved in this work include faculty members from the departments of computer science and electrical & computer engineering as well as researchers from BU's Information Services & Technology unit.

Springing from Smart-city Cloud-based Open Platform and Ecosystem (SCOPE) and Massachusetts Open Cloud (MOC) project outcomes as well as deepening relationships with the Initiative on Cities and Institute for Sustainable Energy at BU, the Institute continues to convene key stakeholders and cultivate relationships for unique, multi-sector research collaborations. This past year, the Institute was able to leverage these relationships, assembling a team of 65 collaborators and leading the proposal submission for a NSF Big Data Regional Innovation Hub and Spoke project that would enable communities in the Northeast to measure, manage, and mitigate the impacts of air-polluting gases produced by transportation and energy systems. This was an exemplary demonstration of the Institute's ability to construct complex, collaborative, multi-institution proposals as well as establish BU as a national leader in data science research. These partnership development efforts have fostered collaborations among cities (Boston, MA; Holyoke, MA; Pittsburgh, PA, and Providence, RI), numerous public sector and nonprofit entities (MassTech Collaborative, ISO New England, the Massachusetts Green High Performance Computing Center, US Ignite, the Boston Area Research Initiative, and MetroLab Network), and several private companies (Arup, Cisco Systems, International Data Corporation, Live Traffic Data LLC, Red Hat, Intel, and more).

Aiming to establish BU as a national leader, Azer Bestavros and Institute Fellows, Ran Canetti, Sharon Goldberg, Leonid Reyzin, and Mayank Varia, are developing a tighter connection between RISCs cybersecurity researchers and the School of Law to position BU in the burgeoning global discussion of legal cybersecurity issues. Through conversations with Professor Stacey Dogan (LAW), RISCs has established a 'brown bag lunch' series to explore the interaction between cybersecurity technology, law, and policy. Working with BU's Director of Foundation Relations, Institute leadership has also begun to collaborate with the Hewlett Foundation Cyber Initiative on a joint cyber-law program. Additional outreach efforts, such as Professor Sharon Goldberg's congressional cyber security briefing (June 2016), continue to grow the credentials of the Institute in this research area.

As part of an effort to establish MOC project sustainability, Institute leadership continues to invest in the partnership with the U.S. Air Force to drive cutting edge research at the intersection of cloud computing, security, and cyberinfrastructure, as well as confirm new commitments with industry partners that will propel research and teaching and provide onsite resources. Expanding the breadth and depth of collaborations remains a critical component of the MOC's ability to serve as a new model for driving nimble, technology-focused, cross-sector research and innovation.

Following the highly-touted success of a real-world deployment of the SCOPE project's Multi-Party Computation (MPC) platform with the City of Boston's pay equity initiative, the Institute continues to leverage this novel algorithm in support of new research. In November, the Institute submitted a follow-up proposal, seeking funding to deploy MPC at scale and develop an operational software solution. Additionally, Institute leadership has connected with the Sloan Foundation to develop opportunities to apply MPC toward economics and finance issues, including computing bank stress tests over private transaction data and collecting diversity statistics at financial institutions, as required by the Dodd-Frank bill.

Staff from the Institute's [Software & Application Innovation Lab \(SAIL\)](#) have participated extensively in the assembly phase of a new affinity research collaborative (pre-ARC), which aims to develop a scientific vision and strategy for digital health at BU. To date, SAIL's contributions have included a formal presentation about Institute resources; technical consultations related to the development of web services mobile applications, and data-driven research projects; and development support for the strategic vision for the ARC's research focus, proposal content, and organizational structure. Numerous other SAIL-supported proposals have been submitted, including collaborations with faculty from the College of Arts & Sciences, College of Engineering, and School of Medicine.

Institute leadership met with the Army Research Lab to map their security needs with potential BU research efforts, including follow-up with Institute affiliates from departments such as computer science, electrical engineering, communications, business, and more. The Institute also hosted Steve Dennis, Data Analytics Engine Director for the Department of Homeland Security Advanced Research Project Agency, for a discussion with Hariri faculty affiliates about DHS priorities and opportunities for sponsored research in data science and cyber security.



Resources

leveraging unique resources to create community-wide benefits

In support of its goal to incubate ambitious, innovative research collaborations, the Institute invests in the development of resources that can be leveraged by the entire community to improve research proposals and outcomes. By providing professional-grade software development, the Institute bridges theoretical research with actionable solutions. Through the development of experiential learning platforms, researchers are able to test and implement new ideas, while simultaneously providing exclusive opportunities to BU students. By conceptualizing and hosting community events, the Institute creates space for intellectual collisions that will spur unpredictable collaborations and research pursuits.

Software & Application Innovation Lab (SAIL)

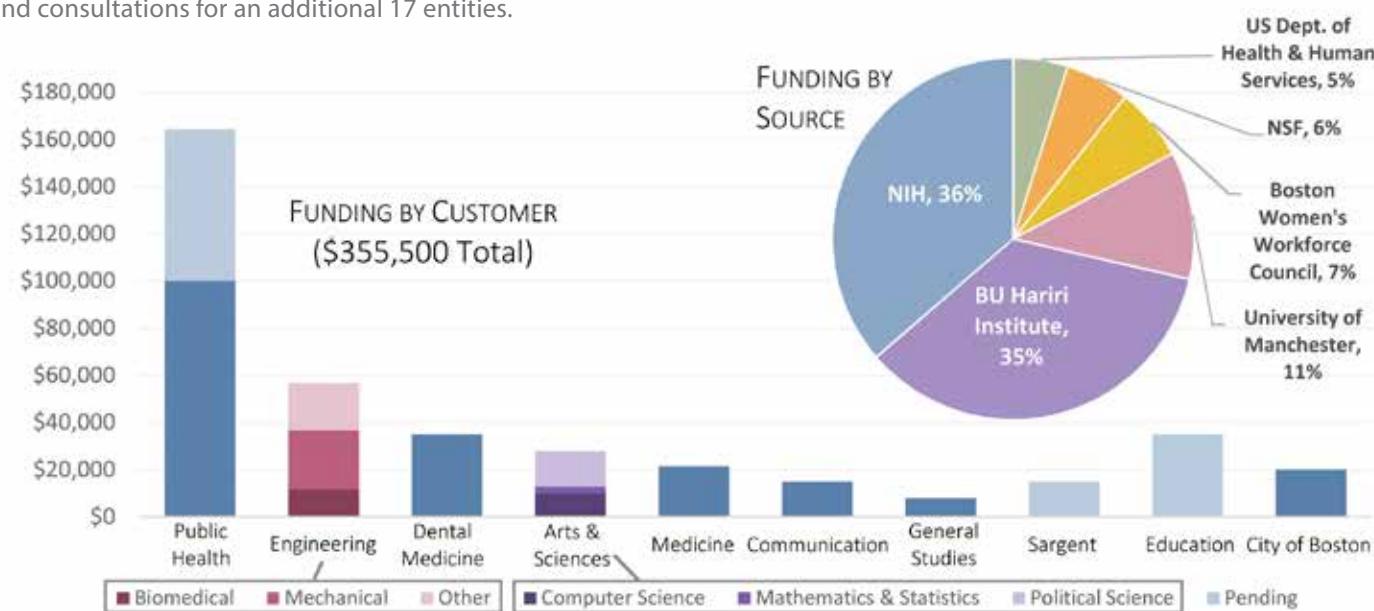
providing software expertise in support of innovative research and education

Recognizing that both the quality and potential impact of research are highly dependent on the development of high-grade software artifacts, the Institute launched [SAIL](#) in 2014 to provide researchers with professional software development capacity in support of computational and data-driven projects that require cutting-edge solutions.

SAIL's success in FY16 has been remarkable, with accomplishments including the development of 16 software and application projects with over \$300K of funding, including 13 that were externally funded. Additionally, SAIL employed nine student interns and expanded community outreach efforts to include two workshops, participation in a pre-ARC, and presentations and consultations for an additional 17 entities.

Depending on a project's nature and scale, the extent of SAIL involvement may range from a few consultations, to assembly of project plans and budgets for an external funding proposal, to months of development work. In the past year, the SAIL team has worked directly with 31 faculty and researchers on 18 projects, including:

- Developing DASH for Health, a cross-platform mobile application for nutrition and exercise habits.
- Creating a secure and user-friendly data analytics service to advance salary equity among Boston companies.
- Applying machine learning techniques to enable the study of cultural differences in British and Danish literature.



CROSS-DISCIPLINARY RESOURCE FOR SOFTWARE & DATA EXPERTISE

Dietary Approaches to Stopping Hypertension (DASH) for Health App
SAIL worked with BU Medical Campus IT to design and build a cross-platform mobile application for Devin Mann, Associate Professor of Medicine at BU and an Associate Chief Medical Information Officer at Boston Medical Center. The app enables users to track their food consumption by tapping tiles that correspond to the eight components of a healthy diet. The app connects via Bluetooth to a blood pressure monitor, scale, and pedometer; it also allows users to connect with health coaches through a messaging function. This work demonstrates how a resource like SAIL can enable a successful and sustained mobile health research ecosystem at BU.

“For us it’s about figuring out how to deliver this non-pharma intervention and package it so it contributes to overall health care workflow.” –Devin Mann, former Associate Professor of Medicine and Chief Medical Information Officer, Boston Medical Center

Secure Compensation Analytics for the City of Boston

In support of the SCOPE project's collaboration with the Boston Women's Workforce Council, SAIL developers built a secure web application that allows statistical data pertaining to compensation levels across genders and demographics to be collected, without requiring any organization to reveal its confidential data. This platform is unique in that it allows real-world organizations to use what is still largely studied as a theoretical technique, enabling analyses that would otherwise be impossible to do while preserving the confidentiality of participants.

Natural Language Processing for Political Science

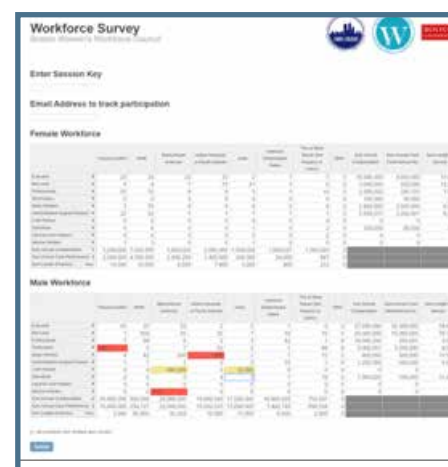
SAIL developers are helping Cathie Jo Martin, Professor of Political Science at Boston University, collect natural language data sets consisting of Danish and British fiction literature from third party sources and services as well as identify and apply appropriate machine learning techniques to these corpora. This work supports Professor Martin's goal of understanding deep cultural differences in views toward education as they can be observed in coming-of-age novels in Britain and Denmark.



SAIL staff and interns review code for an NIH-funded project.

SAIL TEAM & COMMUNITY ENGAGEMENT

SAIL consists of a small team of professional software architects, developers, and student interns who work directly with faculty and researchers on specific software and application development projects. SAIL's model allows the team to provide much-needed professional software



development expertise to researchers as well as provide opportunities for students to gain valuable software development experience.

“I’m interested in analytics, research and startups [...], so I felt that working for one that covered all three fit me best.” –Aditi Dass, CAS '17, 2016 SAIL Intern

Since its inception a little over a year ago, SAIL has employed two full-time software developers and is in the process of hiring a third.

LOOKING FORWARD

SAIL is poised to become an essential university resource that enables researchers to innovate using data and computational sciences. Already, the unit has enabled research outcomes that would have been unattainable without SAIL software solutions. By maintaining a shared community of researchers and students that accumulate expertise for future research efforts, SAIL will promote innovation throughout the university. SAIL's successful engagement with the community so far demonstrates the demand for such a resource, from the School of Medicine to the Digital Humanities Initiative and beyond.

Platforms for Education & Training

developing opportunities for experiential learning and innovative training

Through the development of experiential learning platforms, researchers are able to test and implement new ideas, while simultaneously providing exclusive opportunities to BU students. During past year, the Institute hosted the second edition of its popular Cloud Computing course as well as developed and ran two successful new courses, Data Mechanics and Symmetric Cryptography. Furthermore, the Institute engaged in a developing a variety of training platforms and opportunities for the BU research community.

CLOUD COMPUTING COURSE (SPRING, 2016)

In the 2016 spring semester, 72 students (undergraduate, master, and PhD level) developed agile development and cloud computing skills in the second edition of the [Cloud Computing course](#). This course was developed and co-taught by Orran Krieger (Boston University) and Peter Desnoyers (Northeastern University). Through a post-course survey, students reported feeling more prepared to enter the workforce and apply for cloud computing positions. In fact, 23 students reported that the course directly led to interviews and/or employment offers.



Over 70 students participated in the Cloud Computing Course, developing crucial skills for future careers. Photo credit: Fiona Whittington.

STUDENT ASSESSMENT OF CLOUD COMPUTING AND GENERAL SOFTWARE ENGINEERING KNOWLEDGE BEFORE AND AFTER THE CLASS:

34% OF STUDENTS FELT THEY WERE MORE PREPARED TO ENTER THE INDUSTRY AFTER TAKING THE COURSE.

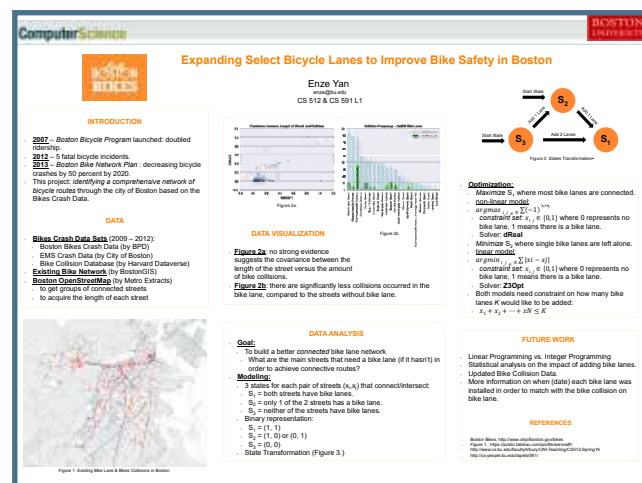
THE PERCENTAGE OF STUDENTS THAT FELT THEY WERE UNPREPARED WENT FROM 23% AT THE START OF THE CLASS TO 0% BY THE END OF THE CLASS.

AFTER THE COURSE, 94% OF STUDENTS FELT THAT THEY COULD ARTICULATE KEY CLOUD COMPUTING SKILLS, VERSUS 19% AT THE START OF THE COURSE.

BY THE END OF THE COURSE, 87% OF STUDENTS FELT THAT THEY COULD APPLY FOR A CLOUD COMPUTING POSITION, WHILE ONLY 16% THOUGHT THEY COULD BEFORE THE COURSE STARTED.

DATA MECHANICS COURSE (SPRING, 2016)

In a newly-developed computer science course, [Data Mechanics for Pervasive Systems and Urban Applications](#), CS Lecturer and Hariri Institute Director of Research Development, Andrei Lapets, worked with students to apply various techniques and methods to retrieve and derive data sets, implement optimization algorithms, perform analyses, and create visualizations for a variety of challenges facing urban environments.



Enze Yan's project, *Improving Bicycle Route Safety* explores which main streets need a bike lane to achieve a better connected bike lane network.

In total, 29 students produced 18 different projects, each closely linked to the work of the Smart-city Cloud-based Open Platform and Ecosystem (SCOPE). 30 data sets were provided by the City of Boston Data Portal, MBTA Developer Portal, and 10 other sources. Due to the high demand from students, the course will run again during the fall 2016 semester.



Steven Jarvis and Cristina Estupinan present project results to BU Initiative on Cities (IOC) Executive Director, Katherine Lusk, and Marketing & Communications Specialist, Conor LeBlanc.

SYMMETRIC CRYPTOGRAPHY: DESIGN & PRACTICE COURSE (SPRING, 2016)

Another newly developed course, led by MACS Director and RISCs Acting Director, Mayank Varia, offered students the opportunity to study techniques in the theory, design, and cryptanalysis of symmetric cryptography primitives. Employing a hands-on approach, students created original symmetric cryptography primitives to optimize a specific security goal or support a targeted environment. Student projects described cryptosystems designed for lightweight CPUs, network security, SIMD support, stronger nonlinearity, and applicability toward secure multi-party computation.

STORYTELLING WITH DATA WORKSHOPS

Founded and directed by Maggie Mulvihill, Hariri Faculty Fellow and journalism professor, the [Storytelling with Data Workshop series](#) is now in its second year. Co-sponsored by the Hariri Institute, the week-long course teaches working professionals from law, government, science, higher education, sales, finance, health care, and human resources how to leverage data to more effectively persuade an audience, tap into funding sources, edge out the competition, and inform and educate employees, clients, customers and shareholders. Over the past year, more than 90 participants attended three week-long workshops, including a new workshop designed specifically for political data storytellers.



DIGITAL HUMANITIES

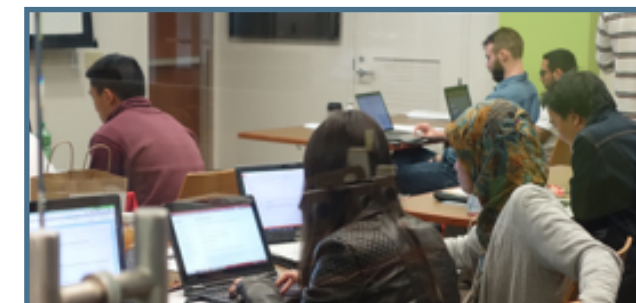
In an effort to advance the [digital humanities](#) by making computational techniques more accessible to researchers in the social sciences, the Institute has partnered with the BU Center for Humanities to develop innovative educational platforms and funding opportunities. Events such as the Data & Humanities Datathon and the 3D Visualization of Digitalized Landscapes workshops - led by Institute Steering Committee member Andrea Berlin - have opened new doors for social scientists at BU. Additionally, the Institute is co-sponsoring a Digital Humanities Seminar in the fall 2016 semester; the course is devoted to learning about and developing digital humanities project proposals and will be available to faculty, BU-affiliated post-docs, and graduate students.

GENI WORKSHOP & BOOTCAMP

Led by Insitute Fellow Abraham Matta (CS), the Institute hosted a valuable [GENI \(Global Environment for Network Innovations\)](#) workshop in May, 2016. GENI provides a virtual laboratory for networking and distributed systems research and education, and is well suited for exploring networks at scale, thereby promoting innovations in network science, security, services and applications. The workshop provided hands-on exposure to GENI test beds and tools and incubated ideas about how

“The GENI workshop and camp, hosted by the Hariri Institute, helped us introduce GENI to new researchers and educators, who will share their knowledge by publishing experimental findings, giving lectures, and leading hands-on tutorials in future workshops and camps.” –Abraham Matta, Professor of Computer Science

GENI can be used in research and education. Workshop and camp participants included both students and faculty, predominately from universities and companies in the Northeast. This included attendees from UMass Amherst, Brown, Northeastern, BU, Tufts, and Raytheon BBN, as well as schools outside the Northeast, such as the University of Utah, Georgia Tech, and Iowa State University.



GENI workshop attendees collaborate on advanced software defined and network function virtualization experiments. Photo credit: Sreeja Keesara.

Community Building Events

creating opportunities for intellectual collisions and new collaborations

The Institute's modus operandi is that innovation happens when people mix and when conversations go beyond disciplinary silos. Creating these opportunities for faculty, researchers, and students to connect is a critical function of the Institute and a true catalyst of its success. From weekly BU Security Group meetings to an annual data science symposium, the Institute hosts and sponsors a variety of workshops, round-tables, seminars, poster sessions, conferences and more.

In 2015-2016, the Institute sponsored and hosted over 70 public events and 250 group meetings with more than 1,100 distinct participants. Serving more than 60 staff, faculty, and student event organizers, the Institute provided support to 25 different BU departments, offices, and student organizations seeking event support. Institute staff assist with event planning, branding and promotion, logistics, and day-of support.

"I would really like to highlight [the Institute's] continuous and detailed support in the process of organizing the conference. [It] was invaluable, and really made this conference a hit. This kind of conference will help promote BU, [especially the] computational and data-oriented work that the Hariri Institute does." –Gustavo Schwenkler, Assistant Professor of Finance

Seminars and workshops focused on emerging areas such as "Computational Immunology" and "Story-telling with Data," as well as informal gatherings, including Wednesdays@Hariri "Meet our Fellows," "I got a data problem," and "I got a data hammer" talks designed to stimulate interdisciplinary exchanges.

The inaugural [BU Data Science \(BUDS\) Day](#) was a smashing success, gathering more than 250 participants from over 60 departments to energize the BU data science research community.



Prof. Plamen Ch. Ivanov presents on big data and network physiology during BUDS Day (January, 2016). Photo credit: Dave Green.

The Institute brought together internal and external experts for roundtable discussions on broad or deep topics in computational and data-driven research, such as "smart-city data platforms" and "precision oncology research."

Boot camps on computational platforms such OpenStack, Amazon AWS, Microsoft Azure, NSF GENI/XSEDE test beds offered participants an opportunity to master cutting-edge computational tools. Forums, datathons, and hackathons

focused on development of entrepreneurship among student groups, such as the BU Global App Initiative.

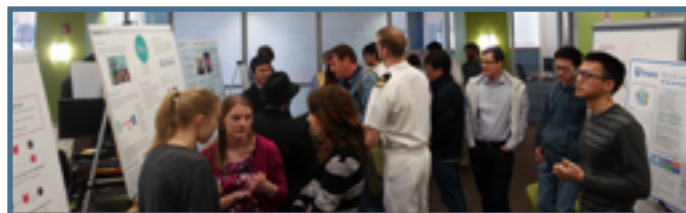
The Institute hosted eight different groups for recurrent meetings, including bi-weekly meetings of the BU/MIT Lincoln Lab Reading Group, led by Institute Fellow Manuel Egele. The BU/Lincoln Lab collaboration also hosted the Cybersecurity Applications of Big Data Workshop, attended by more than 50 BU and external participants.



Dr. Christina Nita-Rotaru presents during the January 2016 BU/MIT Lincoln Lab Workshop on Cybersecurity Applications of Big Data.

Acting as a regional hub, the Institute hosted meetings such as "[Charles River Crypto Days](#)" and "[New-England Networking & Systems Symposia](#)" to strengthen and build collaborative partnerships.

The Institute hosted five student poster sessions, providing BU students opportunities to present research projects to peers, faculty members and industry guests.



Students in Institute Fellow John Byers' CS 591 course present projects on network security.

The MACS project hosted a Universal Composability Hackathon, hosting 40 participants for a two-day workshop that included one day of lecturing by MACS lead PI Ran Canetti, followed by one day allotted for students to design and prove UC security for protocols of their choice in a hackathon-style rapid development process.

Space

Investing in physical improvements to better serve BU's research community

Providing accessible, functional spaces for faculty and students is essential to facilitating the intellectual "collisions" that spur new research ideas. The Institute offers state-of-the-art seminar and conference rooms in addition to comfortable common-area working spaces for affiliates and students.

"The goal of the Computational Fluid Dynamics talking group is to foster cross- and interdepartmental conversations between graduate students who may have similar challenges related to different applications. Hosting the discussions at the Institute was perfect because participants could easily share slides about their research and challenges and the group could sit together with laptops testing various algorithms and helpful resources." –Sheryl Grace, Associate Professor, Mechanical Engineering



In early 2016 the Institute underwent significant renovations, adding a small conferencing facility, accommodating new administrative and technical staff, and creating working spaces for fellows and researchers associated with centers and initiatives federated under the Institute.

Administrative & Research Support

leveraging Institute resources to support faculty research efforts

In addition to offering software development support and providing access to multi-use spaces, the team of administrative and technical staff at the Institute provide a range of support services to faculty across the University.

PROPOSAL DEVELOPMENT

The process for exploring and developing seeded research projects encourages investigators to involve the Institute in refining research ideas, suggesting potential collaborators, identifying additional or alternative sources of funding, and finding other creative ways to help support the project. Additionally, the Founding Director, Director for Research Development, SAIL engineers, and administrative staff provide critical support during the development process for Institute-led and Institute-supported extramural funding proposals.

PROPOSAL SUBMISSION & GRANT ADMINISTRATION

For proposals and grants led by the Institute, staff manage both the proposal submission and grant administration processes. Over the past year, the Institute supported 34 proposals for a total of \$16.2M in extramural funding. This includes 20 proposals for \$6.3M in funding for Institute-led projects, including 3 that are led by other institutions (\$659,986), as well as enabling 14 additional proposals for \$9.9M in funding in collaboration with other BU schools and departments. Additionally, Institute staff managed grant administration responsibilities for 11 active extramural awards over the past year.

EVENT PLANNING & EXECUTION

Aiding faculty affiliates along with hosting Institute-led events, the administrative team assists in all phases of event planning and management, including agenda development, speaker identification, program structure, student participation, communications, and all aspects of logistics execution.

In the News

Institute representatives engaged in a variety of outreach activities over the past year, including congressional briefings, National Academies workshops, and discussions with officials from the National Science Foundation, Department of Defense, and Department of Homeland Security. Additionally, the work of Institute Fellows has been featured in preeminent media outlets. Here are a few of the notable achievements from the past year:

Hariri Junior Faculty Fellow **Cara Stepp** (Speech, Language and Hearing Sciences and Biomedical Engineering) won the NSF Faculty Early Career Development (CAREER) award, which was given in recognition of her outstanding research and teaching capabilities and comes with a \$1 million grant to fund her research and educational goals.

Barbara Shinn-Cunningham, Hariri Institute Steering Committee member (Biomedical Engineering), was elected to the prestigious American Institute for Medical and Biological Engineering (AIMBE) College of Fellows, which is comprised of the top two percent of medical and biomedical engineers in the country.

Hariri Fellow **Doug Densmore** (Electrical and Computer Engineering) received a \$10 million NSF "Expeditions in Computing" grant to develop the Living Computing Project, a comprehensive effort to use computing engineering to develop a toolbox of biological parts that can be used to engineer organisms. This project, and the work of Densmore's forthcoming DAMP (Design, Automatics, Manufacturing, and Prototyping) Lab bridges biomedical and computer engineering and provides significant contributions to the field of synthetic biology. Additionally, Densmore launched the Nona Research Foundation to create a repository of open source software solutions for the synthetic biology community.

Media was abuzz on October 21, 2015, when Hariri Faculty Fellow **Sharon Goldberg** (Computer Science) uncovered and suggested a fix for a serious vulnerability in the Network Time Protocol one of the most critical protocols supporting Internet commerce. Over 15 major media outlets reported on the story at the time. Goldberg was the featured speaker at a BU-sponsored US Congressional briefing in June 2016 where she discussed "internet insecurities;" her video introduction on the subject was featured by the NSF and on Science360.gov.



*Photo credit: AOB Photo

Institute Director **Azer Bestavros** (Computer Science) briefed Department of Defense (DOD) and Homeland Security (DHS) officials on several BU cyber security projects, including the Modular Approach to Cloud Security and the Massachusetts Open Cloud. Bestavros' work with SCOPE and City of Boston enabled the first-ever, large scale gender pay equity analysis, which garnered significant local and national attention.

Former Institute Junior Faculty Fellow **Mark Kramer** (Mathematical Neuroscience) won an NSF CAREER award for his work in better understanding the brain mechanisms that drive seizures in people with epilepsy. Kramer hopes his research will lead to novel and effective approaches in the management of epilepsy.

Research by Hariri Faculty Fellow **Giorgos Zervas** (Marketing) and Hariri Graduate Fellow **Davide Proserpio** (Computer Science) on the sharing economy and on data-driven approaches in marketing was cited by the Wall Street Journal as evidence that Harvard Business School "is Behind in Tech" and that it needs to "hit refresh" and rethink its curriculum. Proserpio obtained his PhD in 2016 and was snatched by USC Marshall School of Business for a tenure-track assistant professorship.

Research seeded by the Institute and conducted by former Hariri Visiting Fellow **Mark Reynolds** has led to a successful U.S. patent application for an innovative software inspection system.

A complete list of outreach activities and media mentions can be found in the Appendices.

Looking Forward

Entering its sixth year, the Hariri Institute for Computing continues to establish BU's position as leading institution for cutting-edge research and innovation.

Using the Data Science Initiative model of broad University engagement to establish a better base of BU scholarship, the Institute will look to also develop strategic roadmaps for the critical research areas of cyber security and cloud computing.

Building on the existing Fellows programs, the Institute will expand engagement with faculty and students to further opportunities and collaborations for innovative research, training, and educational initiatives.

Additionally, the Institute will seek to increase visibility of Institute projects and programs, faculty achievements, and research outcomes. By showcasing these opportunities and accomplishments, the Institute aims to both better connect the BU research community and provide researchers and administrators with resources that can be leveraged to secure new funding and attract talented students and faculty.

The success of the MOC, MACS, and SCOPE projects, in connection with ever-deepening partnerships, positions the Institute to convene high-quality collaborations, attract new funding, and address complex, real-world challenges. Looking forward, the Institute will continue to pursue large-scale solicitations by strategically leveraging these projects along with new opportunities for growth.

Appendices

People.....	31
Leadership.....	31
Steering Committee.....	32
Faculty Fellows.....	33
Visiting Fellows.....	35
Junior Faculty Fellows.....	36
Postdoctoral Fellows.....	37
Graduate Student Fellows.....	38
Faculty Affiliates.....	39
Staff.....	44
Students.....	44
Incubated Research (Active Award Projects).....	46
Extramural Sponsored Research Proposals.....	50
Outreach & Communications.....	52
Meetings & Events.....	52
Communications.....	54
Outreach.....	57
Software & Application Innovation Lab (SAIL).....	59
People.....	59
Projects.....	59
Outreach.....	62

People

Leadership



Azer Bestavros [2011–present]
 Founding Director, Hariri Institute for Computing
 Professor, Computer Science (CAS)
 Cyber-physical and real-time systems; internet & cloud computing; economics-inspired computing



Ran Canetti [2013–present]
 Director, Center for Reliable Information Systems & Cyber Security (RISCS)
 Professor, Computer Science (CAS)
 Cryptography; cyber security; composable security; theoretical computer science



David Coker [2012–present]
 Director, Center for Computational Science (CCS)
 Professor, Chemistry (CAS)
 Computational molecular chemistry; computational atomistic modelling; computational material science



Chris Dellarocas [2011–present]
 Associate Provost for Digital Learning and Innovation
 Professor, Information Systems (Questrom)
 Online reputation systems; social networks; collective intelligence; economics of media industry



Orran Krieger [2012–present]
 Director, Cloud Computing Initiative (CCI)
 Professor of the Practice, Electrical & Computing Engineering (ENG)
 Operating systems and virtualization; software systems; cloud computing



Leonid Reyzin [2014–2015]
 Acting Director, Center for Reliable Information Systems & Cyber Security (RISCS)
 Professor, Computer Science (CAS)
 Security; cryptography; theory of computation



Mayank Varia [2016]
 Acting Director, Center for Reliable Information Systems & Cyber security (RISCS)
 Research Director, NSF Frontier MACS Project
 Cryptography; obfuscation; information theory; data provenance; privacy-preserving databases

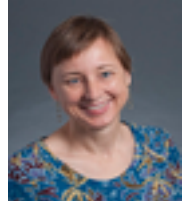
Steering Committee Members



Andrea Berlin [2015–present]
Professor, Archaeology (CAS)
Archaeology and history of the Achaemenid; Hellenistic, and Roman East, ceramic studies; second-temple Judaism; archaeology of Israel; digital humanities



Thomas Kepler [2012–present]
Professor, Microbiology (MED)
Computational and comparative immunology; evolution of multilevel systems; biostatistics; bioinformatics



Margrit Betke [2011–present]
Professor, Computer Science (CAS)
HCI for people with disabilities; medical and cellular imaging; visual analysis of bat behavior



Yannis Paschalidis [2015–present]
Professor, Electrical and Computer Engineering (ENG)
Systems and control; networking; applied probability; optimization; operations research; computational biology; bioinformatics



John Byers [2015–present]
Professor, Computer Science (CAS)
Designing algorithms; conducting measurements and building systems in networking; electronic commerce; large-scale data management



Barbara Shinn-Cunningham [2011–present]
Professor, Biomedical Engineering (ENG)
Computational cognitive and neuroscience for cross-modal integration; neural coding and perception



Roscoe Giles [2011–present]
Professor, Electrical & Computing Engineering (ENG)
Advanced computer architectures; high-performance distributed and parallel computing; computational science



Strom Thacker [2012–2016]
Professor, International Relations and Political Science (CAS),
Associate Dean of the Faculty, Social Sciences (CAS)
International and comparative political economy, governance and development; Latin American studies; Mexican political economy and politics



Cornelius Hurley [2012–present]
Professor of the Practice of Banking Law (LAW)
Director, Center for Finance, Law & Policy
Banking; financial law; public policy; economic modelling; investment management

Institute Faculty Fellows

All Center and Initiative Directors and Steering Committee Members are also Faculty Fellows



Paul Barbone
Professor, Mechanical Engineering (ENG)
Theoretical & computation biomechanics and bio acoustics; medical imaging; inverse problems; finite element methods; scattering; multiple scales



Douglas Densmore
Associate Professor, Computer Engineering (ENG)
Computer architecture; embedded systems; logic synthesis; digital logic design; system level design; synthetic biology



Jason Bohland
Assistant Professor, Human Physiology (SAR)
Cognitive & neural systems; Computational neuroscience; Speech and language



Mark Friedl
Professor, Earth and Environmental Science (CAS)
Remote sensing; biogeophysical patterns and processes of the earth's surface



Jacob Bor
Assistant Professor, Global Health (SPH)
Public health economics; population health; global health; epidemiology



James Galagan
Associate Professor, Biomedical Engineering and Microbiology (ENG)
Systems biology; infectious diseases; tuberculosis; computational biology; genomics; microbiology



Michael Caramanis
Professor, Mechanical Engineering (ENG)
Power markets; microgrid cyber capabilities; complex stochastic production systems



Sharon Goldberg
Associate Professor, Computer Science (CAS)
Network security; cryptography; game theory; algorithms; telecommunications systems



Luis Carvalho
Associate Professor, Mathematics and Statistics (CAS)
Bayesian statistic; computational biology; statistical inference; networks; remote sensing; transportation engineering



Lei Guo
Assistant Professor, Emerging Media Studies (COM)
Media effects theories; international communication



Dino Christenson
Associate Professor, Political Science (CAS)
Electoral behavior; public opinion; political psychology; quantitative methods; data science



Jacob Groshek
Assistant Professor, Emerging Media Studies (COM)
Communication technologies; visualization social media content



Jodi Cranston
Professor, History of Art & Architecture (CAS)
Cryptography; obfuscation; information theory; data provenance; privacy-preserving databases



Lucy Hutyra
Associate Professor, Earth & Environmental Science (CAS)
Ecosystem carbon exchange; forest ecology; urban carbon and nitrogen cycling; land use change impact; environmental biology

Institute Faculty Fellows

(continued)



Prakash Ishwar

Associate Professor, Electrical & Computer Engineering (ENG)

Network information theory; information-theoretic security; statistical signal processing; machine learning



Ajay Joshi

Assistant Professor, Electrical & Computer Engineering (ENG)

VLSI design; computer architecture; silicon photonics; neuromorphic systems



Leonid Levin

Professor, Computer Science (CAS)

Computation theory; computation randomness; algorithmic complexity and intractability; fault-tolerance; symmetry breaking; adversarial computations



Cara Lewis

Associate Professor, Health & Rehabilitation Sciences (SAR)

Musculoskeletal causes of hip pain; biomechanical analysis of human movement



Dan Li

Assistant Professor, Earth and Environmental Sciences (CAS)

Hydraulic engineering; geophysical fluid dynamics



Catherine Jo Martin

Professor, Political Science (CAS)

Comparative politics; political economy; comparative public policy



Stefano Monti

Associate Professor, Computational Biology & Genomics (MED)

Computational biology; cancer genomics; statistics; machine learning



Maggie Mulvihill

Professor, Journalism (COM)

Data-driven methods of investigative journalism



Emma Previato

Professor, Mathematics and Statistics (CAS)

Algebraic geometry; partial differential equations



Pablo Ruiz

Research Associate Professor, Mechanical Engineering (ENG)

Power and energy markets and systems; transmission topology control



Emily Ryan

Assistant Professor, Mechanical Engineering and Materials Science and Engineering (ENG)

Energy systems; fuel cells; thermodynamics; fluid mechanics; electrochemistry



David Somers

Professor, Psychological & Brain Sciences (CAS)

Functional MRI; psychophysics; visual perception and cognition



Eugene Stanley

Professor, Biomedical Engineering & Physics (ENG, CAS)

Statistical physics; neuroscience; econophysics; physical and social networks; physiology and medicine



Cara Stepp

Assistant Professor, Biomedical Engineering & Language and Hearing Science (ENG & SAR)

Sensorimotor function; neurotechnology; speech

Institute Faculty Fellows

(continued)



Evimaria Terzi

Associate Professor, Computer Science (CAS)

Algorithmic data mining; social network analysis; urban informatics



Dylan Walker

Assistant Professor, Information Systems (Questrom)

Social networks; network systems; statistical physics; large-scale empirical studies; computational social science; business; economics



Richard West

Associate Professor, Computer Science (CAS)

Real-time and embedded systems; multicore systems; resource management; hardware-software interaction; machine virtualization



Georgios Zervas

Assistant Professor, Marketing (Questrom)

Marketing; computer science; economics; internet markets; crowd-sourcing; online advertising

Visiting Fellows



Peter Chin [2013–present]

Chief Scientist, Decision Systems Group, Charles Stark Draper Laboratory
Professor, Computer Science (CAS)

Compressive sensing; data fusion; external graph theory; game theory



Hamed Okhravi [2014–present]

Research Staff, Cyber Systems and Technology Group

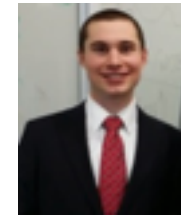
Cyber security; cyber trust; security metrics; operating systems; virtualization



Marten van Dijk [2012–present]

Chief Scientist, Riverbed
Associate Professor, Electrical and Computer Engineering, UCONN

Computer architecture; data center infrastructure; cryptography; machine learning



Richard Skowrya [2014–present]

Technical Staff, MIT Lincoln Laboratory

Cyber security; software-defined networks; networking; formal logic and verification; domain-specific languages; theory of disturbed systems



Vatche Ishakian [2015–present]

Research Staff Member, IBM

Cloud computing; resource management; application-level scheduling; network optimization and economics; data placement; network architecture



Nikolaos Triandopoulos

Assistant Professor, Computer Science (CAS)

Cloud security; Identity management; enterprise security



Andras Kornai [2013–present]

Professor, Budapest Institute of Technology

Natural language processing; speech recognition; OCR; mathematical linguistics

Junior Faculty Fellows

**Leila Agha [2015–2016]**

Assistant Professor, Markets, Public Policy & Law (Questrom)
Public economics; health economics; economics of technology and innovation

**Samuel Bazzi [2014–2017]**

Assistant Professor, Economics (CAS)
Labor mobility; economic development; access to finance; political decentralization

**Taylor Boas [2013–2016]**

Assistant Professor, Political Science (CAS)
Electoral politics; political communication; voting behavior; religion & politics

**Ksenia Bravaya [2014–2017]**

Assistant Professor, Chemistry (CAS)
Theoretical & computational quantum chemistry; multiple electronic states; open-shell species in magnetic fields; metastable systems

**Francesco Decarolis [2013–2016]**

Assistant Professor, Economics (CAS)
Firm behavior; industrial organization; market design; health economics; auction and procurement systems

**Manuel Egele [2015–2018]**

Assistant Professor, Computer Engineering (ENG)
Systems security; privacy; malicious code analysis

**Neha Gondal [2015–2018]**

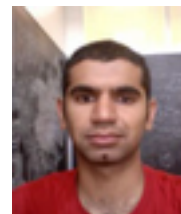
Assistant Professor, Sociology (CAS/GRS)
Culture & stratification; social networks; macro-level network structures

**Kirill Korolev [2015–2018]**

Assistant Professor, Physics (CAS)
Evolution & population dynamics; microbial spatial organization; cancer tumor evolution; complex systems transitions

**Sam Ling [2015–2018]**

Assistant Professor, Psychology & Brain Sciences (CAS)
Human visual system; transcranial magnetic stimulation; functional magnetic resonance imaging

**Pankaj Mehta [2013–2016]**

Assistant Professor, Physics (CAS)
Biological physics; single cells & cellular populations; sophisticated cell computation

**Lorenzo Orecchia [2015–2018]**

Assistant Professor, Computer Science (CAS)
Iterative algorithms; convex optimization; numerical analysis; machine learning

**Emily Ryan [2014–2017]**

Assistant Professor, Mechanical Engineering (ENG)
Computational modelling of energy systems; fuel cells; thermodynamics; fluid mechanics; electrochemistry; multi-scale modelling

**Gustavo Schwenkler [2014–2017]**

Assistant Professor, Finance (Questrom)
Financial econometrics; credit risk; systemic risk; asset pricing; mathematical finance; statistical methods; computational methods

**Konstantinos Spiliopoulos [2013–2016]**

Assistant Professor, Mathematics and Statistics (CAS)
Stochastic processes; multi-scale methods; financial mathematics; applied mathematics and probability; asymptotic problems

Junior Faculty Fellows

(continued)

**Cara Stepp [2014–2017]**

Assistant Professor, Biomedical Engineering & Language and Hearing Science (ENG & SAR)
Sensorimotor function; neurotechnology; speech

**Dylan Walker [2013–2016]**

Assistant Professor, Information Systems (Questrom)
Social networks; network systems; statistical physics; large-scale empirical studies; computational social science; business; economics

**Georgios Zervas [2013–2016]**

Assistant Professor, Marketing (Questrom)
Marketing; computer science; economics; internet markets; crowd-sourcing; online advertising

Postdoctoral Fellows

**Ronen Adato**

Optical Characterization and Nanophotonics Lab, Photonics Center
Nanophotonic tools; biological systems; semiconductor devices and integrated circuits

**Foteini Baldimtsi**

BU Security Group (RISCS)
Cryptography; security; data privacy; electronic cash; blockchain technologies; private authentication techniques

**Yossi Gilad**

Research Staff Member, IBM
Postdoctoral Researcher, Computer Science Department & MACS Project
Cloud computing; resource management; application-level scheduling; network optimization and economics; data placement; network architecture

**Jason Hennessey**

Cloud Computing Initiative (CCI)
Implementation of large, multi-tenant, multi-provider cloud including scheduling, security, privacy, and cost assessment models

**Alessandra Scafuro**

Postdoctoral Researcher, Boston University and Northeastern University
Cyber security; software-defined networks; formal logic and verification; domain-specific languages; theory of disturbed systems

**Ata Turk**

Postdoctoral Researcher, Boston University
Information retrieval; cloud computing systems; energy efficiency; mobile computing; big data

Graduate Student Fellows



François Guay

PhD Candidate, Economics (CAS)
Financial econometrics; asset pricing, computational methods



Jonathan Hersh

PhD Candidate, Economics (CAS)
Development; international economics, applied microeconomics



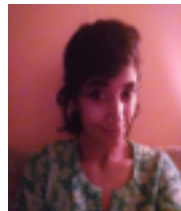
Rawane Issa

PhD Candidate, Computer Science (CAS)
Software engineering; computational biology



Jared Koller

PhD Candidate, Archaeology (CAS)
Archaeoacoustics; 3D visualizations; culture contact; Indian Ocean trade; East & Southeast Asian history; religious migration; landscape archaeology; GIS



Rajita Menon

PhD Candidate, Physics (CAS)
Quantitative biology; evolutionary game theory; non-equilibrium statistical physics; differential abundance analysis



Elizabeth Murray

PhD Candidate, Speech, Language, and Hearing Sciences (SAR)
Voice disorders; pediatric voice disorders; vocal hyperfunction



Davide Proserpio

PhD Candidate, Computer Science (CAS)
Marketing; econometrics; digital influence on markets and industries



Yicheng Song

PhD Candidate, Information Systems (Questrom)
Consumer's path to purchase; recommender system; dynamics within online community



Shahrooz Zarbafian

PhD Candidate, Operation and Technology Management
Computational protein docking; drug discovery; optimization and machine learning frameworks



Sarah Zheng

PhD Candidate, Operation and Technology Management (Questrom)
Healthcare operations; process management; healthcare policy; econometric analysis; business analytics; machine learning

Institute Faculty Affiliates

Leila Agha, Markets, Public Policy, & Law (Questrom)
Karen Allen, Chemistry (CAS)
Salomon Amar, Molecular & Cell Biology (MED)
Jonathan Appavoo, Computer Science (CAS)
Rama Bansil, Physics (CAS)
Paul Barbone, Mechanical Engineering (ENG)
Marianne Baxter, Economics (CAS)
Samuel Bazzi, Economics (CAS)
Enrico Bellotti, Electrical & Computer Engineering (ENG), Systems Engineering (ENG)
Gary Benson, Biology and Computer Science (CAS)
Andrea Berlin, Archaeology (CAS)
Azer Bestavros, Computer Science (CAS)
Margrit Betke, Computer Science (CAS)
Thomas Bifano, Mechanical Engineering (ENG)
Taylor Boas, Political Science (CAS)
Jason Bohland, Health Sciences (SAR)
Jacob Bor, Global Health (SPH)
Tereasa Brainerd, Astronomy (CAS)
Ksenia Bravaya, Chemistry (CAS)
Richard Brower, Electrical & Computer Engineering (ENG)
Peter Buston, Biology (CAS)
John Byers, Computer Science (CAS)
David Campbell, Physics (CAS)
Ran Canetti, Computer Science (CAS)
Michael Caramanis, Mechanical Engineering (ENG)
Luis Carvalho, Mathematics & Statistics (CAS)
Christos Cassandras, Electrical & Computer Engineering (ENG), Systems Engineering (ENG)
David Castanon, Electrical & Computer Engineering (ENG)
Christophe Chamley, Economics (CAS)
Claudio Chamon, Physics (CAS)
Peter Chin, Computer Science (CAS)
Lou Chitkushev, Computer Science (MET)
Dino Christenson, Political Science (CAS)
Andrew Cohen, Physics (CAS)
Michael Cohen, Computer Science (CAS)
David Coker, Chemistry (CAS)
Sheila Corder, Humanities (CGS)
Ayse Coskun, Electrical & Computer Engineering (ENG)
Jodi Cranston, History of Art & Architecture (CAS)
Mark Crovella, Computer Science (CAS)
Francesco Decarolis, Economics (CAS)
Charles DeLisi, Bioinformatics
Chrysanthos Dellarocas, Information Systems (Questrom)
Douglas Densmore, Electrical & Computer Engineering (ENG)
Robert Devaney, Mathematics & Statistics (CAS)
Dan Dill, Chemistry (CAS)
Manuel Egele, Electrical & Computer Engineering (ENG)
Howard Eichenbaum, Psychology (CAS)
William Eldred, Biology (CAS)
Sergio Fagherazzi, Earth & Environment (CAS)
Mark Friedl, Earth & Environment (CAS)
Robert Friedman, Medicine (MED)
Joyce Friedman, Computer Science (CAS)
Peter Gacs, Computer Science (CAS)

Institute Faculty Affiliates

(continued)

James Galagan, Biomedical Engineering (ENG)
 John Gerring, Political Science (CAS)
 Roscoe Giles, Electrical & Computing Engineering (ENG)
 Sharon Goldberg, Computer Science (CAS)
 Neha Gondal, Sociology (CAS)
 Sheryl Grace, Mechanical Engineering (ENG)
 Jacob Groshek, Emerging Media Studies (COM)
 Stephen Grossberg, Cognitive & Neural Systems (CAS)
 Paolo Guasoni, Mathematics & Statistics (CAS)
 Lei Guo, Emerging Media Studies (COM)
 Paul Hall, Earth & Environment (CAS)
 Abdelsalam Heddaya, Computer Science (CAS)
 Martin Herbordt, Electrical & Computer Engineering (ENG)
 Raquell Holmes, Physics (CAS)
 Steve Homer, Computer Science (CAS)
 Jian-Qiang Hu, Mechanical Engineering (ENG)
 Allyn E. Hubbard, Electrical & Computer Engineering (ENG)
 W. Jeffrey Hughes, Astronomy (CAS)
 Cornelius Hurley, Finance, Law & Policy (LAW)
 Lucy Hutyra, Earth & Environment (CAS)
 Samuel Isaacson, Mathematics & Statistics (CAS)
 Prakash Ishwar, Electrical & Computer Engineering (ENG)
 Gregg Jaeger, Natural Sciences and Mathematics (CGS)
 W. Evan Johnson, Medicine & Biostatistics (MED)
 Ajay Joshi, Electrical & Computer Engineering (ENG)
 Suresh Kalathur, Computer Science (MET)
 Vijay Kanabar, Computer Science and Administrative Sciences (MET)
 Mark Karpovsky, Electrical & Computer Engineering (ENG)
 Simon Kasif, Biomedical Engineering (ENG)
 Thomas Kepler, Microbiology (MED)
 Thomas Keyes, Chemistry (CAS)
 Assaf Kfoury, Computer Science (CAS)
 Kirill Korolev, Physics (CAS)
 William Klein, Physics (CAS)
 Eric D. Kolaczyk, Mathematics & Statistics (CAS)
 George Kollios, Computer Science (CAS)
 Mark Kon, Mathematics & Statistics (CAS)
 P. Robert Kotiuga, Electrical & Computer Engineering (ENG)
 Mark Kramer, Mathematics & Statistics (CAS)
 Orran Krieger, Computer Science (CAS)
 Henry Lam, Mathematics & Statistics (CAS)
 Marc Lenburg, Computational Biomedicine (MED)
 Leonid A. Levin, Computer Science (CAS)
 Lev Levitin, Electrical & Computer Engineering (ENG)
 Cara Lewis, Health Sciences (SAR)
 Dan Li, Earth & Environment (CAS)
 Xi Lin, Mechanical Engineering (ENG)
 Sam Ling, Psychology (CAS)
 Thomas D.C. Little, Electrical & Computer Engineering (ENG)
 Benjamin Lubin, Information Systems (Questrom)
 Alan Marscher, Astronomy (CAS)
 Cathie Jo Martin, Political Science (CAS)
 Abraham Ibrahim Matta, Computer Science (CAS)
 J. Gregory McDaniel, Mechanical Engineering (ENG)

Institute Faculty Affiliates

(continued)

Pankaj Mehta, Physics (CAS)
 Ennio Mingolla, Psychology (CAS)
 Suzanne Mitchell, Family Medicine (MED)
 Stefano Monti, Computational Biomedicine (MED)
 Maggie Mulvihill, Journalism (COM)
 Carol Neidle, Romance Studies (CAS)
 Merav Opher, Astronomy (CAS)
 Meers Oppenheim, Astronomy (CAS)
 Lorenzo Orecchia, Computer Science (CAS)
 Harold Park, Mechanical Engineering (ENG)
 Ioannis Paschalidis, Electrical & Computer Engineering (ENG)
 James Perkins, Mechanical Engineering (ENG)
 Nathan Phillips, Earth & Environment (CAS)
 Anatoli Polkovnikov, Physics (CAS)
 Emma Previato, Mathematics & Statistics (CAS)
 Zhongjun Qu, Economics (CAS)
 Claudio Rebbi, Physics (CAS)
 Sidney Redner, Physics (CAS)
 Leonid Reyzin, Computer Science (CAS)
 Jason Ritt, Biomedical Engineering (ENG)
 Pablo Ruiz, Mechanical Engineering (ENG)
 Emily Ryan, Mechanical Engineering (ENG)
 Marc Rysman, Economics (CAS)
 Nachiketa Sahoo, Information Systems (Questrom)
 Venkatesh Saligrama, Electrical & Computer Engineering (ENG)
 Anders Sandvik, Physics (CAS)
 Eric Schwartz, Electrical & Computer Engineering (ENG)
 Gustavo Schwenkler, Finance (Questrom)
 Stan Sclaroff, Computer Science (CAS)
 Daniel Segre, Biomedical Engineering (ENG), Bioinformatics, Biology (CAS)
 Kamal Sen, Biomedical, Engineering (ENG)
 Sahar Sharifzadeh, Electrical & Computer Engineering (ENG)
 Barbara Shinn-Cunningham, Biomedical Engineering (ENG)
 David Somers, Psychology (CAS)
 Harlan E. Spence, Astronomy (CAS)
 Konstantinos Spiliopoulos, Mathematics & Statistics (CAS)
 Shuba Srinivasan, Marketing (Questrom)
 H. Eugene Stanley, Physics (CAS)
 David Starobinski, Electrical & Computer Engineering (ENG)
 Cara Stepp, Speech, Language & Hearing Sciences (SAR), Biomedical Engineering (ENG)
 Alan Strahler, Geography and Environment (CAS)
 John Straub, Chemistry (CAS)
 Anatoly Temkin, Computer Science (MET)
 Evimaria Terzi, Computer Science (CAS)
 Strom Thacker, International Relations and Political Science (CAS)
 Ari Trachtenberg, Electrical & Computer Engineering (ENG)
 Nikos Triandopoulos, Computer Science (CAS)
 Selim Unlu, Electrical & Computer Engineering (ENG)
 Sandor Vajda, Biomolecular Engineering Research Center (ENG)
 Pirooz Vakili, Mechanical Engineering (ENG)
 Marshall Van Alstyne, Information Systems (Questrom)
 Irena Vodenska, Administrative Sciences (MET)
 Dylan Walker, Information Systems (Questrom)
 Feng Wang, Chemistry (CAS)

Institute Faculty Affiliates

(continued)

Gloria Waters, Speech, Language & Hearing Sciences (SAR)
 Richard West, Computer Science (CAS)
 Paul Withers, Astronomy (CAS)
 Hongwei Xi, Computer Science (CAS)
 Saul Youssef, Physics (CAS)
 Muhammad Zaman, Biomedical Engineering (ENG)
 Georgios Zervas, Marketing (Questrom)
 Yuting Zhang, Computer Science (MET)
 Tanya Zlateva, Computer Science (MET)

Institute Faculty Affiliates with CCS Affiliation

Enrico Bellotti, Electrical & Computer Engineering (ENG), Systems Engineering (ENG)
 Azer Bestavros, Computer Science (CAS)
 Thomas Bifano, Mechanical Engineering (ENG)
 Tereasa Brainerd, Astronomy (CAS)
 Ksenia Bravaya, Chemistry (CAS)
 Glenn Bresnahan, Information Services & Technology
 Richard Brower, Electrical & Computer Engineering (ENG)
 David Campbell, Physics (CAS)
 Michael Caramanis, Mechanical Engineering (ENG)
 Christos Cassandras, Electrical & Computer Engineering (ENG), Systems Engineering (ENG)
 David Castanon, Electrical & Computer Engineering (ENG)
 Claudio Chamon, Physics (CAS)
 Andrew Cohen, Physics (CAS)
 Michael Cohen, Computer Science (CAS)
 David Coker, Chemistry (CAS)
 Ayse Coskun, Electrical & Computer Engineering (ENG)
 Charles DeLisi, Bioinformatics
 Robert Devaney, Mathematics & Statistics (CAS)
 Dan Dill, Chemistry (CAS)
 Sergio Fagherazzi, Earth & Environment (CAS)
 Joyce Friedman, Computer Science (CAS)
 Roscoe Giles, Electrical & Computing Engineering (ENG)
 Paolo Guasoni, Mathematics & Statistics (CAS)
 Paul Hall, Earth & Environment (CAS)
 Abdelsalam Heddaya, Computer Science (CAS)
 Martin Herbordt, Electrical & Computer Engineering (ENG)
 Robert Hohlfeld, Computer Science (CAS)
 Raquell Holmes, Physics (CAS)
 Jian-Qiang Hu, Mechanical Engineering (ENG)
 Allyn E. Hubbard, Electrical & Computer Engineering (ENG)
 Thomas Keyes, Chemistry (CAS)
 William Klein, Physics (CAS)
 Eric D. Kolaczyk, Mathematics & Statistics (CAS)
 P. Robert Kotiuga, Electrical & Computer Engineering (ENG)
 Lev Levitin, Electrical & Computer Engineering (ENG)
 Thomas D.C. Little, Electrical & Computer Engineering (ENG)
 J. Gregory McDaniel, Mechanical Engineering (ENG)
 Meers Oppenheim, Astronomy (CAS)
 Ioannis Paschalidis, Electrical & Computer Engineering (ENG)
 James Perkins, Mechanical Engineering (ENG)
 Anatoli Polkovnikov, Physics (CAS)

Institute Faculty Affiliates with CCS Affiliation

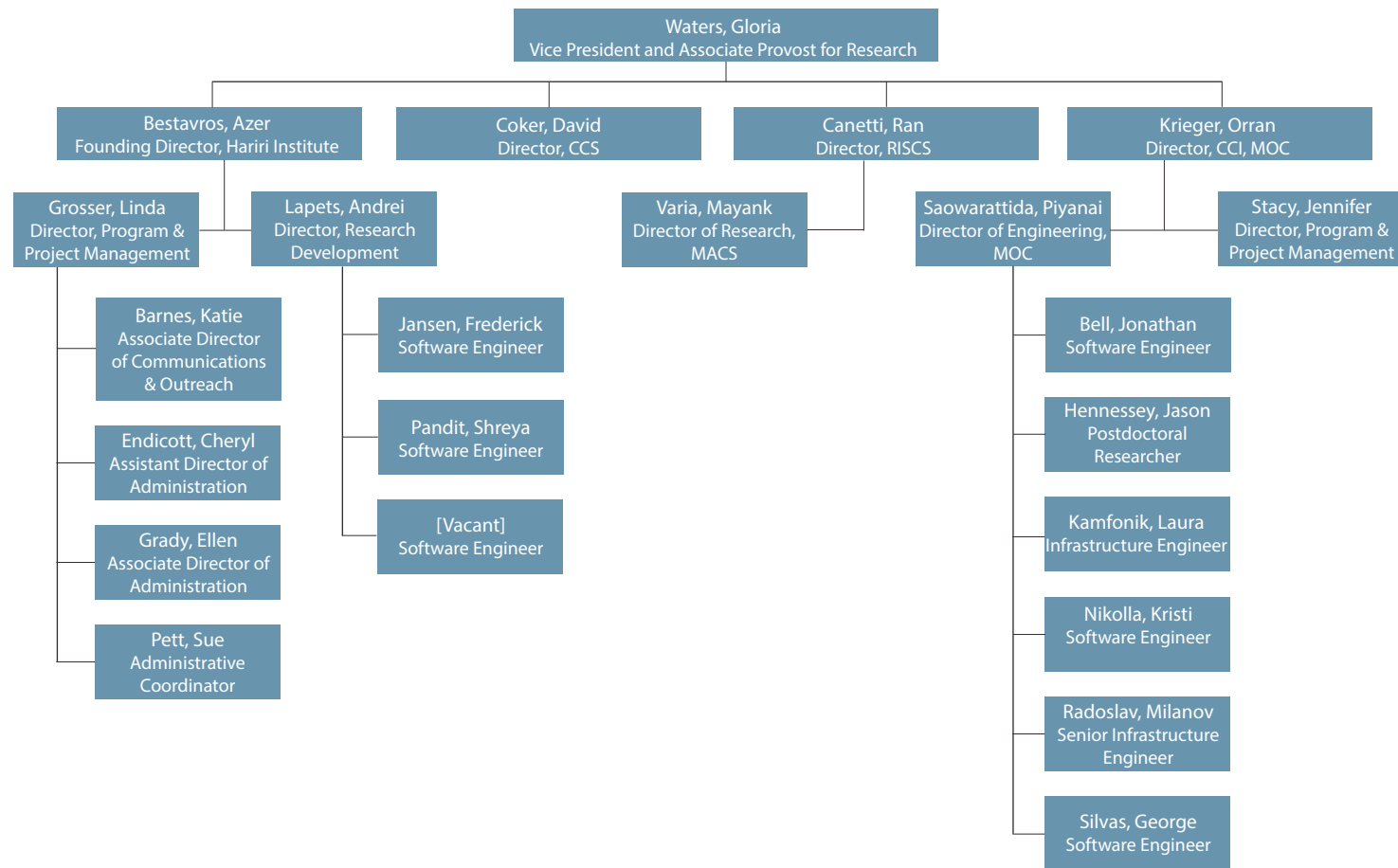
(continued)

Claudio Rebbi, Physics (CAS)
 Sidney Redner, Physics (CAS)
 Emily Ryan, Mechanical Engineering (ENG)
 Anders Sandvik, Physics (CAS)
 Sahar Sharifzadeh, Electrical & Computer Engineering (ENG)
 Harlan E. Spence, Astronomy (CAS)
 H. Eugene Stanley, Physics (CAS)
 Alan Strahler, Geography and Environment (CAS)
 John Straub, Chemistry (CAS)
 Ari Trachtenberg, Electrical & Computer Engineering (ENG)
 Selim Unlu, Electrical & Computer Engineering (ENG)
 Sandor Vajda, Biomolecular Engineering Research Center (ENG)
 Pirooz Vakili, Mechanical Engineering (ENG)
 Saul Youssef, Physics (CAS)

Institute Faculty Affiliates with RISCS Affiliation

Jonathan Appavoo, Computer Science (CAS)
 Azer Bestavros, Computer Science (CAS)
 Margrit Betke, Computer Science (CAS)
 Ran Canetti, Computer Science (CAS)
 Lou Chitkushev, Computer Science (MET)
 Mark Crovella, Computer Science (CAS)
 Peter Gacs, Computer Science (CAS)
 Sharon Goldberg, Computer Science (CAS)
 Martin Herbordt, Electrical & Computer Engineering (ENG)
 Steve Homer, Computer Science (CAS)
 Suresh Kalathur, Computer Science (MET)
 Vijay Kanabar, Computer Science and Administrative Sciences (MET)
 Mark Karpovsky, Electrical & Computer Engineering (ENG)
 Assaf Kfoury, Computer Science (CAS)
 George Kollios, Computer Science (CAS)
 Orran Krieger, Computer Science (CAS)
 Leonid A. Levin, Computer Science (CAS)
 Abraham Ibrahim Matta, Computer Science (CAS)
 Leonid Reyzin, Computer Science (CAS)
 David Starobinski, Electrical & Computer Engineering (ENG)
 Anatoly Temkin, Computer Science (MET)
 Evimaria Terzi, Computer Science (CAS)
 Ari Trachtenberg, Electrical & Computer Engineering (ENG)
 Nikos Triandopoulos, Computer Science (CAS)
 Marshall Van Alstyne, Information Systems (Questrom)
 Mayank Varia, Hariri Institute for Computing
 Hongwei Xi, Computer Science (CAS)
 Yuting Zhang, Computer Science (MET)
 Tanya Zlateva, Computer Science (MET)

Organizational Chart



Undergraduate Research Opportunities Program (UROP) Student Awardees

2016 UROP Awardees

Students received their awards in May 2016 and will complete project work in summer 2016 and present research in fall 2016.

Lawrence Luo, "The American Sign Language STEM Concept Learning Resource: Development of a Web-Based Educational Resource in the Fields of Science, Technology, Engineering, and Mathematics (STEM) for Deaf and Hard-of-Hearing students"
Mentor: Robert Homman, Department of Deaf Studies

Matin Sakib, "Simulation of Aftershocks in the Olami-Feder-Christensen (OFC) earthquake model to find Omori's Law's critical exponent"
Mentor: William Klein, Department of Physics

Trishita Tiwari, "Integration of the Datacenter Physical Layer into the MOC Monitoring System"
Mentor: Ayse Coskun, Department of Electrical & Computer Engineering

2015 UROP Awardees

Students received their awards in May 2015; project work was completed in summer 2015 and presented in fall 2015.

Zachary Chapasko, "Phoenix Computational Tool"
Mentor: Douglas Densmore, Department of Electrical & Computer Engineering

Joseph Cho, "Interactive Neuroanatomy Course for Clinical Neuroscience Students"
Mentor: James Otis, Department of Computer Science

Raymond Mead, "Fast Iterative Methods for Approximation Algorithms"
Mentor: Lorenzo Orecchia, Department of Computer Science

Nevin Zheng, "Memory Management for Multi-Core Processors"
Mentor: Tali Moreshet, Department of Electrical & Computer Engineering

Software & Application Innovation Lab (SAIL) Student Interns

Benjamin Lawson, Computer Science (CAS'17)
2015 Summer Supervisee
Projects: SCOPE

Aditi Dass, Computer Science (CAS'17)
2016 Summer Intern
Projects: Spinal Cord Injury Functional Index (SCI-FI)

Fan Feng, Computer Science & Mathematics (CAS'16)
2015 Fall Intern
Projects: MPC/MapReduce

Anna Goncharova, Computer Science (CAS'18)
2015 Fall Intern
Projects: SAIL Website

Chang Gao, Computer Science & Mathematics (CAS'17)
2015 Fall & 2016 Summer Intern
Projects: MPC/MapReduce, Data Mechanics

Ben Getchell, Computer Science (GRS'17)
2016 Summer Intern
Projects: Imagine All the People: The Origins of Education Reform and the Life Trajectories of Low-Skill Youth (POL-NLP)

Ekaterina Prokopenko, Computer Science (CAS'17)
2016 Summer Intern
Projects: Spinal Cord Injury Functional Index (SCI-FI)

David Wang, Computer Science (CAS'17)
2016 Summer Intern
Projects: Spinal Cord Injury Functional Index (SCI-FI)

Jacqueline You, Computer Science (CAS'16, MED'20)
2016 Summer Intern
Projects: IM-WELL Smoking Cessation Mobile Application, Spinal Cord Injury Functional Index (SCI-FI)

Incubated Research

Active Research Award Projects (Incubated Research)

New awards made in FY 2016

Graph-Based Approaches to Record Linkage in Large Datasets

PI: Jacob Bor (Global Health, SPH); Collaborators: George Kollios (Computer Science, CAS), Katia Oleinik (IS&T), Lorenzo Orcchia (Computer Science, CAS)

Award: \$31,500

This project will develop, implement, validate, and publish graph-based methods for probabilistic record linkage. Researchers will investigate different approaches to integrating information contained in the network structure of the data and assess their performance using a real world dataset: 35 million laboratory records from South Africa's National Health Laboratory Service. Record linkage presents a challenge in large populations where unique patient identifiers do not exist and identifying information is limited. This project aims to address the challenges presented by this scenario, which are common in many developing countries faced with a growing burden of chronic disease.

Enabling High Fidelity Imaging and Quantification of Tissue Mechanical Properties in Vivo through Access to Sophisticated Inverse Problem Solvers

PI: Paul Barbone (Mechanical Engineering, ENG)

Award: \$10,000

This project aims to bring new imaging capabilities, enabled by high-performance computing, to a wide cadre of biomedical researchers through a Biomechanical Imaging Science Gateway (BIG@BU) web portal. The BIG@BU Gateway will provide public access to advanced software to solve inverse problems in Biomechanical Imaging. The project will focus on two aspects: (A) To create a web-enabled user interface that simplifies access for novice users; (B) To enhance the functionality of software to reach a much broader audience of potential users than could be currently served.

An Ongoing Streaming Sample Twitter Collection and Analysis Toolkit

PI: Jacob Groshek (Emerging Media Studies, COM); Collaborators: Manuel Egele (Electrical & Computer Engineering, ENG)

Award: \$31,500

This project seeks to develop alternative and robust collection, storage, and analysis capabilities to perform research based on communications sent via Twitter. Twitter is one of the most popular and frequently used online social networks (OSNs), and the vast majority of user-generated content is public by default. The analysis of these communications can provide scholars with novel insights into how the use of Twitter as a pivotal OSN can influence sociopolitical movements (e.g. Ferguson, #occupy, and the Arab Spring), or how individuals may misuse OSNs for ill-intentioned purposes (e.g. rumor mongering or stock market drops after false news alerts). However, to undertake such research endeavors requires a data collection and analysis tool that is far superior to Twitter's search function, which is limited in time and in the amount of data that can be returned (i.e. aggressive rate limiting).

Imagine All the People: The Origins of Education Reform and the Life Trajectories of Low-Skill Youth

PI: Cathie Jo Martin (Political Science, CAS)

Award: \$25,000

This project uses computational linguistics to evaluate the cultural origins of diverse models of education reform – standards-setting versus social investment – and their implications for socioeconomic inequality. National standards to ensure uniform educational opportunities, in fact, increase the drop-out rates of low-skill youth. Conversely, educational pluralism (strong vocational tracks, local variation, and teacher autonomy) increase educational investments in and performance of low-skill youth, because teachers can educate according to the varying learning styles of their student population. The project will use computational tools to analyze the frequency and temporal changes of words in British and Danish coming-of-age novels and poems, which reveal profoundly different cultural assumptions about the two educational models in question.

Statistically Principled and Scalable Computational Tools for Transforming Research

PI: Lei Guo (Emerging Media Studies, COM); Co-PIs: Prakash Ishwar (Electrical & Computer Engineering, ENG), Margrit Betke (Computer Science, CAS); Collaborators: Jacob Groshek (Emerging Media Studies, COM), Dino Christenson (Political Science, CAS)

Award: \$26,500

This research is part of an ongoing project that is exploring reliable and valid methods to analyze large-scale social data in the context of communication research. Specifically, the study seeks to examine the efficacy and validity of using machine learning techniques for detecting topics in tweets and YouTube videos to be collected during the upcoming 2016 U.S. presidential election. Researchers aim to develop a comprehensive and replicable data-analytics framework that provides a timely analysis of the social media conversation about the 2016 election, which is believed by many to be the most important election of our lifetime.

Interdisciplinary Development of a Biokinematic Data Acquisition System

PI: Richard West (Computer Science, CAS); Collaborators: Cara Lewis (Health Sciences, SAR), Sheryl Grace (Mechanical Engineering, ENG)

Award: \$30,000

This project is developing an on-body, biokinematic data acquisition and analysis tool that tracks the body position of ice hockey skaters during stride production. This research aims to inform future inquiries in the following areas: physical therapy research that investigates in lab versus in community scenarios; mechanical engineering research that looks at the control of multi-unit systems such as unmanned air vehicles; and computer science research that focuses on optimization of scheduling and timing as well as the development of operating systems for other microprocessing platforms.

Coupled Human-Natural Dynamics in Urban Heat Islands: From Big Data to Local Policies

PI: Lucy Hutyra (Earth & Environment, CAS); Collaborators: Dan Li (Earth & Environment, CAS), Mark Friedl (Earth & Environment, CAS)

Award: \$26,750

This project is mining cell data for high-resolution spatio-temporal CO2 emissions models to produce a multidecadal assessment of trends, drivers, and scaling relationships. In order to inform the design of urban heat stress mitigation strategies through urban surface modification, the project uses geophysical modelling and data-analytic tools to assess how coupling and feedbacks between land use and land cover change and urban ecosystem services affect spatio-temporal dynamics of urban heat islands across Boston. The project will explore difference scenarios of energy use, urban land use, and vegetation cover by assimilating satellite data products into a high-resolution urban climate model.

Awards made in previous fiscal years with ongoing research

Web Repository for Research on Mentoring: A Global Resource

PI: Emma Previato (Mathematics & Statistics, CAS)

Award: \$6,267

Researchers are creating a global network for research on mentoring, which will offer a sophisticated, transforming resource intended to spur new collaborations and research directions. The first facility of its kind, users will include institutions, federal agencies, companies, and communities, while stakeholders include scholars, publishers, teachers, and the public. As academic mentoring continues to grow, this research intends to harness the power of these efforts, assess their efficacy, and recommend best practices through the use of big data, virtual communities and additional new technologies.

Identifying Novel Electrolytes for Lithium Batteries with Materials Informatics

PI: Emily Ryan (Mechanical Engineering, ENG)

Award: \$25,000

This research focuses on identifying novel electrolyte solutions for Lithium (Li) batteries to improve their performance and durability. Researchers are using materials informatics approaches to identify promising liquid electrolytes to address the issue of dendrite growth at the anode-electrolyte interface. Materials informatics, an emerging data-drive field that combines computational, statistical, and mathematical approaches, dramatically compresses the discovery time for new materials. The research aims to develop a powerful materials discovery tool that can be applied to other materials applications and scaled for use in other areas of engineering.

NinjaGame: Optimizing Neuroplasticity Through Speech-Driven Gameplay

PI: Cara Stepp (Speech, Language, and Hearing Sciences, SAR)

Award: \$20,000

This project is developing an immersive gaming environment that is designed to assist children with speech motor disorders with online feedback to modify their speech nasalization and intelligibility. The current collaboration with the Institute's Software and Application Innovation Lab (SAIL) is working to improve software compatibility, securely save subject data to the cloud, and increase the motivation and immersion of gameplay.

Power Networks Topology Control Software

PI: Pablo Ruiz (Mechanical Engineering, ENG); Collaborators: Michael Caramanis (Mechanical Engineering, ENG)

Award: \$35,000

This project is working to address electric power system congestion and reliability. Using their topology control algorithms (TCA), researchers are developing control policies whose solution times are practical for deployment on the largest power market and system operator in the U.S. Successful implementation of TCA would lead to a more reliable grid that is more resistant to potential disruptions from failure, natural disasters, or attack. Additionally, TCA can reduce the cost of congestion by 25-50% (\$1-4 billion in annual cost savings) and enable an increased use of wind and solar power, resulting in a substantial decrease in carbon dioxide emissions.

Active Research Award Projects (Incubated Research)

(continued)

Identifying the Causal Impact of Network Structure: A Randomized Experiment on Twitter

PI: Dylan Walker (Information Systems, Questrom)

Award: \$25,000

This research is the first experiment of its kind to examine the causal impact of network structural changes in vivo, in a real global social network, Twitter. Researchers are working to create platform research tools for conducting experimental research on social networks that can circumvent the large costs of low likelihood of success associated with direct collaborations with social network firms and platform owners. The project is specifically developing dedicated software and computational architecture to longitudinally collect, store, and process Twitter data.

Participation and Learning in the Sharing Economy: An Empirical Study of Early Adopters

PI: Georgios Zervas (Information Systems, Questrom)

Award: \$25,000

This research is an empirical study of the mechanisms underlying consumer engagement in the sharing economy. As decentralized peer-to-peer markets continue to emerge as plausible alternative suppliers of goods and services, researchers seek to answer the following questions through data analysis: a) what drives participation in the sharing economy, b) what marketing and sales strategies are learned and employed by early adopters, and c) are there spillover effects within and across segments of the sharing economy?

Computational Neuroimaging Analysis of Language and Cognitive Control Networks: Mining the Human Connectome Project Data Set

PI: Jason Bohland (Health Sciences, SAR); Collaborators: David Somers (Psychology & Brain Sciences, CAS)

Award: \$37,600

This research focuses on mapping two sets of wide-ranging and complementary brain networks: those supporting language and those supporting attention and cognitive control. This high-resolution mapping technique can be used for diagnostic purposes in individual patients to assay brain networks, provide intermediate phenotype measures for genetics studies, and inform individualized treatments, creating a roadmap to investigating a vast array of neurological disorders.

Big Data Network Genomics: Network Inference and Perturbation to Study Chemical-Mediated Cancer Induction

PI: Stefano Monti (Computational Biomedicine, MED)

Award: \$10,250

This project is looking to transform the field of computational toxicology and the study of chemically-driven tumor initiation. By integrating multiple genomic data types through “cell painting,” researchers are developing predictive models of chemical carcinogenicity based on network reconstruction and differential analysis approaches, toward the identification of a chemical’s mechanism(s) of cancer induction.

Statistical Models and Computational Methods for Community Detection in Large Networks

PI: Luis Carvalho (Mathematics & Statistics, CAS); Collaborators: Dino Christenson (Political Science, CAS)

Award: \$30,750

This project is working to investigate a novel statistical methodology that detects communities within large networks and under a variety of network data. Researchers are focusing on Amicus Curiae networks and brain functional networks, two important applications in political science and neuroscience, respectively. From a political science standpoint, this research aims to identify interest group communities and explain their behavior in terms of coalitions built on common ideological motivation. For neuroscience, researchers are looking to infer coupled neural activity between distinct brain regions and assess community structure among regions, which is believed to play an essential role in brain function and disease.

Computational Synthetic and Biological Microfluidics

PI: Douglas Densmore (Electrical & Computer Engineering, ENG)

Award: \$32,300

This project is working to create a controlled micro-fluidic design environment with automated design software that is able to explore numerous computational paradigms using engineered bacteria. The goal of this synthetic biology research is to use engineering principles to forward engineer novel biological systems with applications in bio-materials, bio-energy, bio-remediation, and bio-therapeutics. A potential long-term impact of this research would be the ability to develop a personal medical diagnostic chip that contains individual bio markers.

Active Research Award Projects (Incubated Research)

(continued)

Mapping the City in the Digital Humanities: First Stop Kyoto

PI: Sarah Frederick (Modern Languages & Comparative Literature; Collaborators: Alice Tseng)

Award: \$2,958

This project is a navigable and interactive online guide and database that was useful for undergraduate teaching and for the broader research community on the city of Kyoto that maps references in literature, film, art, fashion, and cinema to specific urban spaces, architecture, and events. The project was kicked off with mapping Nobel prize laureate Kawabata Yasunari’s 1962 novel Old Capital, a fictional work that takes the reader on a tour of the major cultural sites and festivals of Kyoto through the four seasons of one single calendar year; we designed an interactive, multi-media “map” of Kawabata’s postwar Kyoto based on the geographical and temporal structure laid out in his book.

Lost Worlds and Found Words

PI: Maurice Lee (English, CAS)

Award: \$5,500

This project used the digital humanities tool Voyant to track keyword frequencies across a corpus of American and British adventure novels from 1800-1920. The goal was to determine how the spread of quantitative methods influenced the use of numerical terminology and calculative concepts in novelistic traditions that, at least superficially, attempt to escape from modernity. This project advanced our understanding of the relationship between science and literature in the nineteenth century (an era that witnessed crucial divisions between both domains). It also told a deep history of the digital humanities by recovering the nineteenth-century relationship between numbers and literature.

Literary Lab: Allusions to Greco-Roman Classics in Irish Literature

PI: Meg Tyler (Humanities, CAS)

Award: \$8,000

This research aims to create an extensive database that provides contextualization for references to the Classics in (mostly modern) Irish Literature. The only collection of its kind, the database accepts entries from scholars the world over. It also allows for a scholarly discussion and debate to grow around each instance of allusion. As the database grows, it acts as an online repository for researchers and teachers in various literary and historical fields. Students can craft digital projects around its use; professors can use it as a teaching instrument.

CLIO World Tables: A Global Historical Database

PI: John Gerring (Political Science, CAS)

Award: \$10,000

Evidence about the past is scattered across archives, published works, and web sites, and often embedded in original-language sources. Consequently, those who wish to tackle historical subjects on a global scale are faced with the daunting prospect of assembling their own data, more or less from scratch – a laborious process, and one rarely undertaken. This research is working to build efficient infrastructure for researchers by creating a new database that draws on a wide variety of sources: published and unpublished, hard copy and digital, archival and non-archival, English and foreign language.

Extramural Research

Institute-led Sponsored Research Submissions (Total: \$6.3M)

Institute-led proposals include all research submissions that were submitted by the Institute and for which the Institute serves as the funding award base.

PI	Co-PIs	Unit	Source	Project Title	Amount	Status
Orran Krieger	N/A	ENG/ECE	Mass Dev.	Secure Multi-tenancy in the Cloud	\$150,000	Awarded
Abraham Matta	N/A	CAS/CS	NSF	Broadening Participation in Teaching and Research in GENI: A Regional Workshop in May 2016	\$49,935	Awarded
Saul Youssef	Glenn Bresnahan (IS&T), David Coker (CAS/Physics)	CAS/Physics	Harvard University/NSF	CIF21 DiBBs:El:North Eastern Storage Exchange	\$200,661	Awarded
Abraham Matta	N/A	CAS/CS	NSF/BBN	GENI Going Forward	\$130,689	Awarded
Ran Canetti	N/A	CAS/CS	NSF	WC:TTP Option: Frontier: Collaborative: MACS: A Modular Approach to Cloud Security Supplement	\$40,706	Awarded
Abraham Matta	N/A	CAS/CS	NSF	Collaborative Proposal: Broadening Participation in GENI	\$334,035	Pending
John Byers	N/A	CAS/CS	NSF	US:Ignite:Collaborative Research: Focus Area2: Virtualized Transport Services for Realtime Social Camera Applications	\$359,494	Pending
Richard West	Sheryl Grace (ENG/ME), Roberto Tron (ENG/ME)	CAS/CS	NSF	CPS:Synergy: A System for Mission-Critical Processing and Control of Smart Devices	\$999,781	Pending
Azer Bestavros	Andrei Lapets (Hariri Institute)	CAS/CS	NSF	Collaborative Research: CICI: Regional: Developing Secure and Robust Services to Support the MGHPCC Research Community	\$99,831	Pending
Emily Ryan	N/A	ENG/ME	NSF	A New Paradigm for the Combined Computational and Experimental Design of Porous Heterogeneous Hierarchical Materials to Optimize Reactive Transport Processes	\$599,695	Pending
Robert Hohlfeld	N/A	CCS	NSF	Collaborative Research: Galactic Accretion Flows and Instabilities	\$159,889	Pending
Azer Bestavros	N/A	CAS/CS	NSF	BD Spokes: SPOKE: NORTHEAST: Collaborative: PETALS -- Partnership for Emission Tracking and Analytics at Locally-relevant Scales	\$749,959	Declined
Azer Bestavros	Assaf Kfoury (CAS/CS), Michael Caramanis (ENG/ME), Pablo Ruiz (ENG/ME)	CAS/CS	NSF	Compositional Analysis and Optimization Algorithms for Operating Software-Defined Federated Power Systems	\$799,427	Declined
Azer Bestavros	Paul Trunfio (CAS/Physics)	CAS/CS	NSF	Smart and Connected Communities Supplement	\$151,479	Declined
Azer Bestavros	N/A	CAS/CS	NSF/CIS	CSR: SMALL: Enabling Privacy-Performance Trade-offs for Multi-Party Analytics in the Cloud	\$499,949	Declined
Richard Brower	N/A	CCS	NSF	Exploring Higgs Compositness Mechanism in the Era of the 14 TeV LHC	\$20,000	Declined
Mayank Varia	N/A	RISCS	NSF	CIF:Medium:Collaborative Research: Privacy and Utility in the Age of Inference	\$99,923	Declined
Andras Kornai	N/A	Hariri Institute	NSF	Between Vital and Endangered: Building the Computational Linguistic Infrastructure	\$299,500	Declined
Abraham Matta	N/A	CAS/CS	NSF	Collaborative Research: Broadening Participation in Teaching/Research in GENI through Regional Workshops	\$107,139	Withdrawn
Richard Brower	N/A	CCS	NSF	Quantum Finite Elements: Multi-scale Algorithms and Software	\$435,888	Withdrawn

Institute-enabled Sponsored Research Submissions (Total: \$9.9M)

Institute-enabled proposals include all projects for which the Institute provided some amount of research or support during the proposal process, but does not serve as the funding award base. These project proposals would not be possible without the support of the Institute.

PI	Co-PIs	Unit	Source	Project Title	Amount	Status
Chantal Stern	N/A	CILSE	NIH	High-Performance Computational Infrastructure for Cognitive and Systems Neuroimaging Research	\$557,580	Pending
Gerald Denis	Ran Canetti (CAS/CS)	CAS/CS	NCI	Creating an India Regional Metabolic Inflammation and Cancer Translational Center	\$606,303	Pending
Naomi Caselli	N/A	SED	NIH	American Sign Language Vocabulary Acquisition (*affiliation pending)	\$326,718	Pending
Naomi Caselli	N/A	SED	NIH	Phonological Distinctiveness Across Sign Languages	\$60,736	Pending
Lewis Kazis	N/A	SPH	Dept. of Education	Working After Burn Injuries: Development of a Computer Adaptive Test (CAT)	\$1,842,079	Pending
Julie Keysor	N/A	SAR	Dept. of Education	The Stay Working Program for People with Arthritis and Related Conditions: Moving Evidence to Practice	\$1,550,458	Pending
Qiong Yang	N/A	SPH	NIH	New methods and software for rare variant and haplotype association and omics integration analyses using TOP (*affiliation pending)	\$1,199,035	Pending
Dylan Walker	James Katz (COM/EMS), Kevin Outterson (LAW)	Questrom/IS	NSF	IBSS-L: Randomized Controlled Trials of Human Behavior Using Real-Time Social Interactions	\$970,764	Declined
Sheryl Grace	N/A	ENG/ME	NSF	Lagrangian, Mesh-Free Method for Accurate Cavitation Prediction	\$349,901	Declined
Glynn Holt	N/A	ENG/ME	NSF	Ultrasonic Defoaming: Physical Mechanisms and Computational Model	\$384,313	Declined
Emily Ryan	N/A	ENG/ME	NSF	Performance of High Energy Density Li Battery	\$236,679	Declined
Gary Benson	N/A	Informatics	NSF	REU Site: Bioinformatics Research and Interdisciplinary Training Experience	\$288,000	Declined
David Starobinski	Azer Bestavros (CAS/CS)	ENG/ECE	NSF	CSR:NeTS: Small: Analyzing Strategic Behavior in Advance Reservation Services	\$500,000	Declined
Björn Reinhard	David Coker (CAS/CH)	CAS/CH	NSF	DMREF-Collaborative Research: New Materials for Plasmonic Catalysis	\$1,056,129	Declined

Outreach & Communications

Meetings & Events

The Institute hosted over 250 group meetings and 70 public events, seminars, and workshops.

Wednesdays@Hariri

*Indicates "Meet Our Fellow" talks

Kirill Korolev*	The Tug of War between Beneficial and Deleterious Mutations in Cancer	9/30/2015
Lei Guo	The "Big Data" Challenge in Communication Research	11/4/2015
Emily Ryan*	Modeling the Physics and Performance Issues in Advanced Battery Technologies	12/2/2015
Lorenzo Orrechia*	Efficient Algorithms and Intractable Problems Through the Lens of Convex Optimization	1/27/2016
Manuel Egele*	Where's the Money in Cyber-crime?	2/10/2016
Leila Agha*	Big Names or Big Ideas: Do Peer Review Committees Select the Best Science Proposals?	3/16/2016
Neha Gondal*	Who Does Academic Inequality Hurt More? An Examination of Academic Hiring Networks by Professorial Rank, Gender, and Discipline	4/6/2016
Sam Ling*	The Formation and Flexibility of Visual Perception	4/20/2016

DSI Distinguished Lectures

Hosted as part of the Data Science Initiative

George Karypis	Big Data Research: Methods, Systems, and Applications	9/25/2015
John Lafferty	Statistical Learning in High Dimensions	11/6/2015
Rene Vidal	Teaching Machines to See	5/2/2016

BUsec Seminars

The BUsec group, sponsored by RISCS and the Hariri Institute for Computing hosted 19 seminars

Jeremiah Blocki	Towards Usable and Secure Human Authentication	9/16/2015
Katerina Mitrokotsa	Authentication in Constrained Settings: challenges and directions	9/23/2015
Alexander Pretschner	How I know you printed my email	9/30/2015
George Kellaris	Practical Differential Privacy	10/14/2015
Yilei Chen	On the Correlation Intractability of Obfuscated Pseudorandom Functions	10/21/2015
Ittay Eyal	Challenges in Blockchain Protocols	10/28/2015
Silas Richelson	Topology-Hiding Computation	11/4/2015
Avichai Cohen	Jumpstarting Interdomain Routing Security	11/11/2015
Oxana Poburinnaya	Optimal-Rate Non-Committing Encryption in a CRS Model	12/2/2015
Sophia Yakubov	Modular Cryptographic Accumulators	12/9/2015
Yossi Gilad	Cryptography in the Application Layer: Establishing an Affordable DDoS Defense over Untrusted Clouds	2/3/2016
Kobbi Nissim, Alex Wood	Do computer science definitions of privacy satisfy legal definitions of privacy? The case of FERPA and differential privacy	2/10/2016
Aanchal Malhotra	Attacking the Network Time Protocol	2/17/2016
Omer Paneth	On the Cryptographic Hardness of Finding a Nash Equilibrium	3/2/2016
Cristina Nita-Rotaru	On the trade-offs between performance and security in network protocols design	3/23/2016
Zakir Durumeric	Uncovering Cryptographic Failures with Internet-Wide Measurement	3/30/2016
Matt Green	Applied cryptography for the post-prohibition era	4/6/2016
Bryan Ford	Collective Authorities: Securely Decentralizing Trust at Scale	4/13/2016
Prabhanjan Ananth	Patchable Indistinguishability Obfuscation: iO for Evolving Software	4/27/2016

Meetings & Events

(continued)

RISCS Seminars on Practical Security

Sixth annual Seminar on Practical Security; an additional nine seminar talks are scheduled as part of the 2016 series and will take place in FY17.

Eugene Kolodenker & Will Koch	A Proactive Defense System Against Cryptographic Ransomware	6/3/2016
Prof. Tali Moreshet; Aanchal Malhotra	Spider Goat: Transactional Memory for Security; Attacking the Network Time Protocol	6/10/2016
Prof. Ari Trachtenberg; Jeffrey Stewart	Ad Injection: The Next Frontier for Legalized Ad Theft; SoK: Privacy on Mobile Devices – It's Complicated	6/17/2016
Prof. Yuting Zhang	Smartphone Sensing: Security Risks and Solutions	6/24/2016

CCS Seminars

David Hutchinson	Modelling Quantum Systems – Highlights from the Dodd-Walls Centre, New Zealand's New National Centre of Research Excellence	8/5/2015
Marcia Barbosa	Superflow of Nanoconfined Water	4/12/2016
Gerhard Stock	Energy and Signal Flow in Biomolecules	5/4/2016

Student Poster Sessions

CS 558 - Network Security	Prof. Sharon Goldberg	11/3/2015
CS 558 - Network Security	Prof. John Byers	12/11/2015
CS 591- Topics in Data Mechanics and Symmetric Cryptography	Lecturers Andrei Lapets & Mayank Varia	4/26/2016
CS 591 - Cloud Computing	Prof. Orran Krieger	4/29/2016

Reading Groups & Student Organization Meetings

(Recurrent meetings hosted by the Institute)

IVC Reading Group
 BU/Lincoln Lab Systems Security Reading Group
 Machine Learning Reading Group
 Deep Learning Reading Group
 Global App Initiative
 Women in Computer Science
 XIA Networking Group
 Computational Fluid Dynamics Talking Group

Additional Events

Keio Conference	Mathematics & Statistics	Conference	9/8/2015
Statistical & Mathematical Neuroscience Conference	Mathematics & Statistics	Conference	10/15/2015
BU Data Science Day	DSI	Conference	1/22/2016
New England Security Day Spring 2016	RISCS	Conference	4/28/2016
Universal Composability Hackathon (2 days)	MACS	Hackathon	3/18/2016
Davide Proserpio Dissertation Defense	Computer Science	Dissertation Defense	4/8/2016
Visiting Computer Science Collaborator, Dr. Alex Pogel, New Mexico State University	Hariri Institute	Roundtable/Meeting	7/22/2015
PhD Thesis Proposal: A Differential Geometric Approach to Classification	Computer Science	Roundtable/Meeting	10/27/2015
Geddes Staff Annual Retreat	CAS Language Center	Roundtable/Meeting	1/6/2016
An Optical Turing Machine for Network Processing	Computer Science	Roundtable/Meeting	3/16/2016
MACs PI Meeting	MACS	Roundtable/Meeting	3/17/2016
MOC Forum (Virtual Meeting)	MOC	Roundtable/Meeting	3/23/2016
Roundtable: Regional Interests in Data Science (NE Big Data Hub Rene Baston Visit)	Hariri Institute	Roundtable/Meeting	5/24/2016
BU Global Meeting	BU Global	Roundtable/Meeting	5/26/2016
Danna Gurari - PhD Defense	Computer Science	Seminar/Talk	7/23/2015

Meetings & Events

(continued)

Additional Events (continued)

Distinguished CS Alum talk	Computer Science	Seminar/Talk	9/17/2015
Steve Homer Theory Seminar	Computer Science	Seminar/Talk	10/19/2015
HIC/DLI Seminar - Gloria Alexandron	DLI	Seminar/Talk	10/26/2015
BU/Brown PDE Seminar	Mathematics & Statistics	Seminar/Talk	11/17/2015
CS Colloquium & Faculty Lunch w/ Dan Roth	DSI	Seminar/Talk	1/14/2016
Jianming Zhang Thesis Proposal	Computer Science	Seminar/Talk	1/28/2016
Technical Talk with Google for Women in Computer Science Students	Computer Science	Seminar/Talk	2/23/2016
Joe Touch Talk	Computer Science	Seminar/Talk	3/16/2016
Multipath Routing Talk	Computer Science	Seminar/Talk	4/1/2016
Formal Methods for Nonlinear Control	Computer Science	Seminar/Talk	4/7/2016
CS Lecturer Candidate Talks	Computer Science	Seminar/Talk	4/25/2016
CS Lecturer Search Seminar	Computer Science	Seminar/Talk	6/9/2016
BU/NU 3D Visualization Workshop	Hariri Institute Exclusive	Workshop	12/7/2015
Storytelling with Data (multi-day)	COM	Workshop	1/8/2016
BU/MIT LL Cybersecurity Workshop	Hariri Institute Exclusive	Workshop	1/29/2016
Concur Training	Computer Science	Workshop	2/11/2016
AZURE Workshop	Hariri Institute Exclusive	Workshop	3/25/2016
Cloud Computing Course	MOC	Workshop	4/28/2016
GENI Regional Workshop	Computer Science	Workshop	5/23/2016
GENI Summer Camp (4 days)	Computer Science	Workshop	5/24/2016
Storytelling with Data (5 days)	COM	Workshop	6/6/2016
DIMACS/MACS Workshop (3 days)	MACS	Workshop	6/8/2016
XSEDE's HPC Summer Bootcamp (4 days)	IS&T	Workshop	6/14/2016

Communications

Institute News (all news stories housed on [Institute website](#))

Hariri Institute Director Azer Bestavros Confers with Federal Officials on Cyber security, 7/23/2015
 CSS Seminar Features David Hutchinson, "Modelling Quantum Systems – Highlights from the Dodd- Walls Centre, New Zealand's new national Centre of Research Excellence," 7/31/2015
 Problematic Border Gateway Protocol (BGP) Finally Gets Attention, 8/10/2015
 On the Future of the Massachusetts Green High Performance Computer Center (MGHPCC), 9/4/2015
 DSI Distinguished Lecture by George Karypis on Big Data Methods, Systems, and Applications, 9/9/2015
 Hariri Institute Co-sponsors BU Digital Humanities 2015 Symposium, 9/16/2015
 Hariri Institute Sponsors and Hosts 2nd New England Networking and Systems Day, 9/22/2015
 Institute Announces 2015 Junior Faculty Fellows, 9/28/2015
 Giora Alexandron Gives Data Science Seminar Oct 26, Joining with Digital Learning and Hariri Institute, 10/14/2015
 Nov 6, DSI Distinguished Lecture: John Lafferty, University of Chicago, 10/20/2015
 Azer Bestavros featured in Boston Globe: "Acting Classes Give Scientists Tools to Pitch Their Work," 10/21/2015
 Sharon Goldberg, Institute Fellow, Discovers Flaw in Computers' Timekeeping, 10/25/2015
 Institute Establishes Core Industry Partnerships for Massachusetts Open Cloud (MOC), 10/27/2015
 January 2016 Storytelling with Data at Boston University, 10/27/2015
 Nov 19, 2015 MOC Annual Workshop Hosted by the Hariri Institute for Computing, 11/12/2015
 Dec 7, 2015 Digitized Landscapes and 3D Visualization Workshop Co- hosted by the Institute, 11/16/2015
 Inaugural BU Data Science (BUDS) Day – January 22, 2016, 11/17/2015
 Hariri Hosts First Annual Massachusetts Open Cloud (MOC) Workshop, 11/23/2015
 Hariri Institute Hosts Student Poster Session for E- Commerce and Network Security Courses, 12/16/2015
 Cara Stepp, Junior Faculty Fellow, Receives NSF CAREER Award, 1/14/2016
 Sharon Goldberg's Undergraduate Students Win CRA Research Awards, 1/18/2016

Communications

(continued)

Institute News (continued)

Inaugural BU Data Science Day Draws Cross- Disciplinary Crowd, 2/12/2016
 Barbara Shinn-Cunningham, Hariri Institute Steering Committee Member, Elected to AIMBE College of Fellows 2/12/2016
 Past Junior Fellow, Douglas Densmore, Aims to Advance Synthetic Biology, 2/15/2016
 Hariri Institute Director, Azer Bestavros, and Faculty Fellow, Sharon Goldberg, on President Obama's Cyber security Budget Proposals, 3/1/2016
 Hariri Institute Hosts Joe Touch for Talk: An Optical Turning Machine for Network Processing, 3/1/2016
 Hariri Fellow Sharon Goldberg Weigh in on Apple Cyber security Case, 3/4/2016
 Teaching the Next Generation – Hacking with Holyoke Codes, 3/14/2016
 Institute to Host Universal Composability Hackathon, 3/14/2015
 Professor Chrysanthos Dellarocas Appointed Associate Provost for Digital Learning and Innovation, 3/14/2016
 Computer Science, an Expectation in Boston Public Schools 3/14/2016
 Hariri Fellow to Participate in Cyber security Panel, 3/30/2016
 Hariri Institute Helps to Make Equal Pay a Reality for the Boston Women's Workforce Council, 3/31/2016
 Hariri Graduate Fellow, Davide Proserpio to give Doctoral Dissertation defense, 4/4/2016
 BU's Own Crowdfunding Platform: Getting Started Workshop - April 13, 2016, 4/7/2016
 GENI Regional Workshop and Summer Camp 2016, 4/15/2016
 May 2, 2016 DSI Distinguished Lecture: René Vidal, Johns Hopkins University, 4/19/2015
 Student Poster Session: Data Mechanics and Symmetric Cryptography, 4/21/2016
 DIMACS/MACS to host 3 day- workshop on Cryptography, June 8-10, 2016, 4/21/2016
 Institute to host XSEDE Summer Boot Camp, June 14-17, 4/22/2016
 Gerhard Stock to give May 4 CCS Seminar, "Energy and Signal Flow in Biomolecules," 5/2/2016
 BUsec Summer Weekly Seminar Series, 5/24/2016
 Institute Hosts Roundtables on Regional Interests in Big Data and the Northeast Big Data Innovation Hub, 5/31/2016
 2016 Undergraduate Research Opportunities Program (UROP) Award Recipients Announced, 6/1/2016
 Institute Announces Seven Hariri Research Awards, 6/10/2016
 BUsec Seminar – Prof. Tai Moreshet & Aanchal Malhotra, 6/10/2016
 Institute Announces 2016 Hariri Graduate Fellows, 6/14/2016
 Faculty Fellow Sharon Goldberg Briefs Congressional Cyber security Caucus, 6/16/2016
 CS Students Use Data Mechanics to Solve Urban Problems, 6/17/2016
 Institute, MACS, and MOC Co-Sponsor Online Computer Security Competition, 6/23/2016
 Institute Hosts GENI Workshop for Researchers, 6/25/2016
 SAIL Works with MED Campus Researchers to Create DASH App for e-Health, 6/30/2016
 Inaugural BU Data Science Day Draws Cross- Disciplinary Crowd, 2/12/2016
 Barbara Shinn-Cunningham, Hariri Institute Steering Committee Member, Elected to AIMBE College of Fellows 2/12/2016
 Past Junior Fellow, Douglas Densmore, Aims to Advance Synthetic Biology, 2/15/2016
 Hariri Institute Director, Azer Bestavros, and Faculty Fellow, Sharon Goldberg, on President Obama's Cyber security Budget Proposals, 3/1/2016
 Hariri Institute Hosts Joe Touch for Talk: An Optical Turning Machine for Network Processing, 3/1/2016
 Hariri Fellow Sharon Goldberg Weigh in on Apple Cyber security Case, 3/4/2016
 Teaching the Next Generation – Hacking with Holyoke Codes, 3/14/2016
 Institute to Host Universal Composability Hackathon, 3/14/2015
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 Gerhard Stock to give May 4 CCS Seminar, "Energy and Signal Flow in Biomolecules," 5/2/2016

Communications

(continued)

Institute News (continued)

BUsec Summer Weekly Seminar Series, 5/24/2016
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 2016 Undergraduate Research Opportunities Program (UROP) Award Recipients Announced, 6/1/2016
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 Institute, MACS, and MOC Co-Sponsor Online Computer Security Competition, 6/23/2016
 Institute Hosts GENI Workshop for Researchers, 6/25/2016
 SAIL Works with MED Campus Researchers to Create DASH App for e-Health, 6/30/2016

Hariri Institute in the News (media mentions)

BU Computer Expert Confabs with Feds on Cyber security, BU Today, 07/23/2015
<http://www.bu.edu/today/2015/bu-computer-expert-confabs-with-feds-on-cybersecurity/>
 Problematic protocol that directs all Web traffic finally gets attention, Christian Science Monitor, 08/7/2015
<http://www.csmonitor.com/World/Passcode/2015/0807/Problematic-protocol-that-directs-all-Web-traffic-finally-gets-attention>
 Acting classes give scientists tools to pitch their work, Boston Globe, 10/20/2015
<https://www.bostonglobe.com/news/nation/2015/10/19/boston-university-scientists-take-acting-classes-learn-how-pitch-their-work-program-founded-alan-alda/raz4o3SgPbUip8GUehLK3K/story.html>
 New attacks on Network Time Protocol can defeat HTTPS and create chaos, Arstechnica, 10/21/2015
<http://arstechnica.com/security/2015/10/new-attacks-on-network-time-protocol-can-defeat-https-and-create-chaos/>
 CAS Team Finds Flaw in Computers' Timekeeping, BU Today, 10/22/2015
<http://www.bu.edu/today/2015/hacking-network-time-protocol/>
 Network Time Protocol flaws defy HTTPS, cause network chaos, Zdnet, 10/22/2015
<http://www.zdnet.com/article/network-time-protocol-flaws-defy-https-cause-network-chaos/>
 Summit explores way to improve urban mobility, The Daily Free Press, 12/8/2015
<http://dailyfreepress.com/2015/12/08/summit-explores-way-to-improve-urban-mobility/>
 Hacking with Holyoke Codes, MGHPCC, 1/5/2016
<http://www.mghpcc.org/hacking-with-holyoke-codes/>
 Cara Stepp, Junior Faculty Fellow, Receives NSF CAREER Award, 1/14/2016
http://www.bu.edu/mse/2016/01/13/holmes-stepp-receive-nsf-career-award/?utm_source=MSE+Colloquium+for+2%2F12%2F16&utm_campaign=MSE+Colloquium&utm_medium=email
 First BU Data Science Day to highlight prominence of data in all scientific fields, The Daily Free Press, 1/18/2016
<http://dailyfreepress.com/2016/01/18/bu-data-science/>
 Outstanding Undergraduate Researches, Computing Research Association
<http://cra.org/about/awards/outstanding-undergraduate-researcher-award/>
 Show Me the Data, BU Research, 2/10/2016
<http://www.bu.edu/research/articles/bu-data-science-day/>
 Show Me the Data, BU Today, 2/17/2016
<http://www.bu.edu/today/2016/bu-data-science-day/>
 Zhang, Damiano, Shinn-Cunningham Elected to AIMBE College of Fellows, BU College of Engineering
<http://www.bu.edu/eng/2016/01/26/zhang-damiano-shinn-cunningham-aimbe/>
 Project to Engineer Cells That Compute Awarded \$10M NSF Grant, BU College of Engineering
<http://www.bu.edu/eng/2016/01/08/project-to-engineer-cells-that-compute-awarded-10m-nsf-grant-2/>
 BU Researchers Welcome Obama's Final Budget Proposals, BU Today, 3/1/2016
<http://www.bu.edu/today/2016/bu-researchers-welcome-obamas-final-budget-proposals/>
 Will Unlocking Apple's iPhone Also Unlock a Pandora's Box?, BU Research, 3/3/2016
<http://www.bu.edu/research/articles/unlocking-terrorist-iphone-cybersecurity/>
 Appointment of Professor Chrysanthos Dellarocas as Associate Provost for Digital Learning and Innovation, BU Office of the Provost, 3/14/2016
<http://www.bu.edu/provost/2016/03/14/appointment-of-professor-chrysanthos-dellarocas-as-associate-provost-for-digital-learning-and-innovation/>

Communications

(continued)

Hariri Institute in the News (continued)

More Boston businesses join drive to end gender wage gap, Boston Globe, 3/27/2016
<https://www.bostonglobe.com/business/2016/03/27/more-boston-businesses-join-drive-end-gender-wage-gap/MTgBGKMgxMfhHvseVYukUI/story.html>
 Will Data Help Close the Gender Pay Gap?, WBUR On Point, 3/30/2016
<http://www.wbur.org/onpoint/2016/03/30/gender-gap-pay-gap-boston-amazon>
 Computational Thinking Breaks a Logjam, BU Today, 3/31/2016
<http://www.bu.edu/today/2015/computational-thinking-breaks-a-logjam/>
 Calculating Gender Pay Equity, Arts & Sciences, 5/22/2015
<http://www.bu.edu/cas/magazine/spring16/calculating-gender-pay-equity/>
 GENI Regional Workshop and Summer Camp at Boston University, GENI
<http://sites.bu.edu/geni/>
 XSEDE HPC Workshop: Summer Boot Camp, Pittsburgh Supercomputing Center
<http://www.psc.edu/index.php/training-category-list/2264-xse-de-hpc-workshop-june-14-17-2016-summer-boot-camp>
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<http://www.bu.edu/federal/cyberbriefing/>

Outreach

Institute Outreach with BU Federal Relations

July 2015

Institute Director Azer Bestavros met with the Department of Defense and the Department of Homeland Security

September 2015

Institute Director Azer Bestavros met with Rep. Katherine Clark (D-MA) regarding the Boston pay-equity algorithm project, the Army Research Lab, and the Department of Defense

May 2016

MACS Director Mayank Varia attended a workshop on cyber security at the National Academies

June 2016

Institute Director Azer Bestavros and Computer Science Professor Abraham Matta attended a meeting with Rep. Katherine Clark (D-MA)

June 2016

Institute Director Azer Bestavros and Computer Science Professor Abraham Matta attended a meeting at NSF

June 2016

Computer Science Associate Professor Sharon Goldberg met with Reps. Katherine Clark (D-MA) and Jim Langevin (D-RI), and then presented at a Congressional lunchtime briefing on cyber security

Institute Outreach on Campus

Transportation Nudges Conference (December 2015)

SCOPE researchers presented at the Transportation Nudges conference, hosted by BU's Initiative of Cities, laying the groundwork for growing the institute's portfolio in the smart and connected communities field.

Deans Presentation (March 2016)

Institute Director Azer Bestavros presented to Vice President and Associate Provost for Research Gloria Waters, Dean Freeman (Questrom), and Dean Lutchen (ENG) regarding Institute model and activities

CAS & ENG Leadership Presentation (April 2016)

Institute Director Azer Bestavros presented to CAS and ENG leadership (associate deans) and University center directors to develop closer

SAIL Workshops, Collaborations, and Presentations

Data & the Humanities Workshop (11/03/2015)

Together with Jody Cranston (History of Art & Architecture, CAS), SAIL helped plan and participated in a "datathon" organized around the topic of manual data retrieval and entry into an online system ("Mapping Titian").

Digitized Landscapes 3D Visualization Workshop (12/07/2015)

SAIL participated in a panel during a workshop on using 3D visualization technologies in archaeology and social sciences.

Outreach

(continued)

SAIL Workshops, Collaborations, and Presentations (continued)

[Mobile Health & Informatics Pre-ARC \(03/14/2016 – present\)](#)

SAIL is participating in a pre-ARC organized around the goal of supporting and promoting mHealth and eHealth research efforts.

[Center for Global Health and Development \(03/30/2016\)](#)

SAIL staff gave a presentation during a department meeting to explain what resources are available at the Hariri Institute and within SAIL.

This presentation led to at least one Hariri Research Award, and may lead to additional proposals.

[SAIL Consultations and Proposal Assembly Assistance](#)

SAIL staff provides consultations to faculty and researchers in preparation for potential SAIL projects, Hariri Award proposals, and external funding proposals. In addition to consulting and proposal assembly assistance provided for all the projects listed under Projects and Community Outreach: Workshops, Collaborations, and Presentations above, SAIL also provided nine (9) additional consultations, as well as technical content and/or letters of support for seven (7) additional external funding proposals to the NSF, NIH, NEH, and other entities.

[SAIL Engagement with Student & University Groups](#)

In addition to the software engineer internship program, SAIL has also engaged with student groups such as the Global App Initiative and BUILDS by reaching out to members and attending meetings. SAIL has also established working relationships or lines of communication with resources such as BUMC.

Educational Outreach Activities

[“Hacking with Holyoke Codes” \(12/12/2016\)](#)

RISCS researchers hosted a free, hands-on cyber security workshop at the MGHPC in conjunction with Computer Science Education Week [Cyber Security Mentorship](#)

BU researchers Mayank Varia, Jason Hennessey, and Kyle Hogan jointly mentored two high school students as part of the MIT PRIMES program. The high school students are studying the threat of network-based side channel attacks in a cloud datacenter.

[Artemis Program Curriculum Development \(Spring 2016\)](#)

As part of the recurring Artemis program teaching 9th grade girls about computer science, plus the new follow-on Codebreakers program teaching 10th grade girls about cyber security specifically associate professor Sharon Goldberg (CS); assistant professor Manuel Egele (ECE), and MACS director Mayank Varia assisted with curriculum development for the July 2016 program edition.

[Phillips Academy Capture the Flag \(PACTF\) Competition \(Spring 2016\)](#)

The Hariri Institute for Computing, along with the MOC and MACS projects, sponsored a multi-round online computer security competition for middle and high school students at Phillips Academy (Andover, MA). PACTF had over 1000 teams participat in the cyber security competition where teams “hack, decrypt, reverse, and do whatever it takes to solve increasingly challenging security puzzles.”

Public, Nonprofit, Private Sector Outreach

[A list of the public, non-profit, and private sector organizations with whom the Institute collaborated this past year](#)

Advanced Cyber Security Center	Intel	New Media Consulting
U.S. Air Force	International Data Corporation (IDC)	New York Hall of Science
Arup	ISO New England	Northeast Big Data Innovation Hub
AT&T	Jackpine Technologies	Northeastern University
Boston Area Research Initiative	Juniper Networks	Peter Cowing
Brocade	Lenovo	Philips
Brown University	Live Traffic Data LLC	Plexxi Inc.
CISCO Systems Inc.	Massachusetts Green High Performance	Red Hat
City of Boston	Computing Center	RSA Laboratories
City of Holyoke	Massachusetts Military Asset and Security	Rutgers University
City of Pittsburgh	Strategy Task Force	Samsung
City of Providence	Massachusetts Technology Collaborative	Schneider Electric
Commonwealth of Massachusetts	MassDOT	SDI Architecture and Pathfinding
Cyberinfrastructure for Network Science Center	MassTech Collaborative	Traffic21
Dell	MathWorks	Two Sigma
DIMACS	Mellanox	University at Buffalo, SUNY
Education Development Center	Metro21	University of Connecticut
EMC	MetroLab Network	University of Massachusetts
ePosterboards	Mirantis	US-Ignite
Fujitsu	MIT	Western Pennsylvania Regional Data Center
Harvard University	MIT Lincoln Labs	Wingbrace
IBM	Museum of Science	Wyle Aerospace
IDC Corp	Network Science Institute	York University
INRIX		

Software & Application Innovation Lab

SAIL data is incorporated throughout the previous appendices of this report. This section provides a comprehensive overview of SAIL operations and information presented here may be duplicative of previous report sections.

SAIL Staff

Andrei Lapets

Research Fellow & Director of Research Development,
Hariri Institute for Computing
Acting Director, Software & Application Innovation Lab
Computer Science Lecturer & Professor

Frederick Jansen

Software Engineer (Lead), SAIL

Shreya Pandit

Software Engineer, SAIL

San Tran

Project Analyst & Coordinator, SAIL

SAIL Student Interns

Benjamin Lawson, Computer Science (CAS'17)

2015 Summer Supervisee

Projects: SCOPE

Aditi Dass, Computer Science (CAS'17)

2016 Summer Intern

Projects: Spinal Cord Injury Functional Index (SCI-FI)

Fan Feng, Computer Science & Mathematics (CAS'16)

2015 Fall Intern

Projects: MPC/MapReduce

Anna Goncharova, Computer Science (CAS'18)

2015 Fall Intern

Projects: SAIL Website

Chang Gao, Computer Science & Mathematics (CAS'17)

2015 Fall & 2016 Summer Intern

Projects: MPC/MapReduce, Data Mechanics

Ben Getchell, Computer Science (GRS'17)

2016 Summer Intern

Projects: Imagine All the People: The Origins of Education Reform and the Life Trajectories of Low-Skill Youth (POL-NLP)

Ekaterina Prokopeva, Computer Science (CAS'17)

2016 Summer Intern

Projects: Spinal Cord Injury Functional Index (SCI-FI)

David Wang, Computer Science (CAS'17)

2016 Summer Intern

Projects: Spinal Cord Injury Functional Index (SCI-FI)

Jacqueline You, Computer Science (CAS'16, MED'20)

2016 Summer Intern

Projects: IM-WELL Smoking Cessation Mobile Application, Spinal Cord Injury Functional Index (SCI-FI)

SAIL Projects (18)

Completed & Ongoing Projects- External Funding Support (6)

Dietary Approaches to Stopping Hypertension (DASH) for Health App

PI: [Devin Mann \(Medicine, MED\)](#)

SAIL worked with BU Medical Campus IT to design and build a cross-platform mobile application that enables users to track their food consumption by tapping tiles that correspond to the eight components of a healthy diet. The app connects via Bluetooth to a blood pressure monitor, scale, and pedometer; it also allows users to connect with health coaches through a messaging function. This work demonstrates how a resource like SAIL can enable a successful and sustained mobile health research ecosystem at BU.

Completed & Ongoing Projects - External Funding Support (continued)

Secure Compensation Analytics for the City of Boston

Project Director: [MaryRose Mazzola \(Boston Women's Workforce Council\)](#)

In support of the Boston Women's Workforce Council and its mission to advance salary equity among Boston employers as part of the 100% Talent Compact, SAIL staff and student developers built a secure multi-party computation web application that allows statistical data pertaining to compensation levels across genders and demographics to be collected from approximately 70 participating employer organizations, such as State Street Corporation and Putnam Investments, without requiring any organization to reveal its confidential data. This platform is unique in that it allows real-world organizations to use what is still largely studied as a theoretical technique, enabling analyses that would have been otherwise impossible to do while preserving the confidentiality of the participants.

IM-WELL Smoking Cessation Mobile Application

PI: [Belinda Borelli \(Health Policy & Health Services Research, SDM\)](#)

SAIL is designing and building a mobile application to enable a behavioral intervention study on smoking cessation. The application must have a user-friendly interface and design, must run on multiple platforms, and must provide appropriate data collection and reporting capabilities to be used by researchers. SAIL is providing both planning and design services, including diagramming and specification of user workflows.

Spinal Cord Injury Functional Index (SCI-FI)

PI: [Mary Slavin \(Health Law, Policy & Management, SPH\)](#)

SAIL is developing a web-based service and client-side application that delivers a computerized adaptive test (CAT) that assesses function in persons with Spinal Cord Injury. In the computerized adaptive testing approach, questions are selected from a calibrated question bank based on the person's response to previous questions. An iterative process is used to provide an estimate of a person's function. Developing a web-based version of this CAT will allow the measure to be widely used nationally and internationally.

SafeNav

PI: [Evimaria Terzi \(Computer Science, CAS\)](#)

SAIL built an interactive routing application for finding safe routes between destinations. The front-end component consisted of a client-side interactive map interface (via integration with OpenStreetMap), and the back-end component consisted of a server that housed data and efficiently ran an optimal graph routing algorithm developed by the PI that used crime incidence data to suggest safe routes.

Data Mechanics

PI: [Andrei Lapets \(Computer Science, CAS\)](#)

SAIL software engineers and interns are helping develop a data repository and platform that supports urban data science applications. The platform can retrieve real-world data sets from services such as the City of Boston Data Portal and the MBTA Developer Portal, and provides interfaces and APIs that allow third parties to build applications that utilize these various data sets in concert to solve optimization and analysis problems. This platform is being used in a graduate-level Computer Science Department course on urban data science.

Completed & Ongoing Projects - Hariri Award Support (5)

Additional information on these projects cant be found in the "Active Research Award Projects" section.

Imagine All the People: The Origins of Education Reform and the Life Trajectories of Low-Skill Youth

PI: [Cathie Jo Martin \(Political Science, CAS\)](#)

SAIL staff and student developers are collecting natural language data sets consisting of Danish and British literature from third party sources and services to identify and apply appropriate machine learning techniques to these corpora. This work supports Professor Martin's goal of understanding deep cultural differences in views toward educational models as they can be observed in coming-of-age novels and poems in Britain and Denmark. Furthermore, this work represents a part of a broader effort to advance the digital humanities by making computational techniques more accessible to researchers in the social sciences.

NinjaGame: Optimizing Neuroplasticity Through Speech-Driven Gameplay

PI: [Cara Stepp \(Speech, Language, and Hearing Sciences, SAR\)](#)

This project involved developing an immersive gaming environment that is designed to assist children with speech motor disorders with online feedback to modify their speech nasalization and intelligibility. SAIL worked to improve software compatibility, securely save subject data to the cloud, and increase the motivation and immersion of gameplay.

Completed & Ongoing Projects - Hariri Award Support (continued)

Power Grid Optimization

PIs: [Pablo Ruiz \(Mechanical Engineering, ENG\)](#), [Michael Caramanis \(Mechanical Engineering, ENG\)](#)

SAIL helped translate and extend a research prototype implementation of an optimal transmission topology control algorithm that addresses important needs in the power grid, and more broadly in the utilities industry. SAIL developers helped transform existing MATLAB code into a more modular and structured production-grade version application (the implementation of which follows software engineering best practices). SAIL developers provided extensive oversight, guidance, and instruction on software engineering principles and practices. SAIL also developed an open source library for implementing algorithms in parallel as part of this work.

Materials Database

PI: [Emily Ryan \(Mechanical Engineering, ENG\)](#)

SAIL developed an automated collection tool to extract ionic liquid materials data from various online resources. This tool will be part of a larger framework to discover new applications for materials.

Global Mentor Resource

PI: [Emma Previato \(Mathematics & Statistics, CAS\)](#)

SAIL developers helped assemble a web presence for an effort that aims to build a community of researchers focused on the subject of mentoring.

Upcoming Projects - External Funding Support (3)

SAIL provided consulting services in preparation for an upcoming project.

Working after Burn Injuries: Development of a Computer Adaptive Test

PI: [Lewis Kazis \(Health Law, Policy & Management, SPH\)](#)

Signbank: Enabling CorpusBased Sign Language Typology ASL Vocabulary Acquisition

PI: [Naomi Caselli \(Language and Literacy Education, SED\)](#)

Data Manipulation for Eye-Tracking Data Sets

PI: [Sudha Arunachalam \(Speech, Language, and Hearing Sciences, SAR\)](#)

Upcoming Projects - Hariri Award Support (4)

For which funding has been allocated, but development has not commenced. Additional information on these projects cant be found in the "Active Research Award Projects" section.

Statistically Principled and Scalable Computational Tools for Transforming Research

PI: [Lei Guo \(Emerging Media Studies, COM\)](#)

An Ongoing Streaming Sample Twitter Collection and Analysis Toolkit

PI: [Jacob Groshek \(Emerging Media Studies, COM\)](#)

Enabling High Fidelity Imaging and Quantification of Tissue Mechanical Properties in Vivo through Access to Sophisticated Inverse Problem Solvers

PI: [Paul Barbone \(Mechanical Engineering, ENG\)](#)

Graph-Based Approaches to Record Linkage in Large Datasets

PI: [Jacob Bor \(Global Health, SPH\)](#)

SAIL Outreach & Engagement

Faculty Engagement (31)

Paul Barbone, Professor, Mechanical Engineering (ENG)
Samuel Bazzi, Assistant Professor, Economics (CAS)
Andrea Berlin, Professor, Archaeology (CAS)
Jacob Bor, Assistant Professor, Global Health (SPH)
Belinda Borrelli, Professor, Health Policy & Health Services Research (SDM); Director, Behavioral Science Research (SDM)
Michael Caramanis, Professor, Mechanical Engineering (ENG)
Naomi Caselli, Lecturer, Language & Literacy Education (SED)
Jodi Cranston, Professor, History of Art & Architecture (CAS)
Chris Dellarocas, Professor, Information Systems (Questrom); Associate Provost for Digital Learning and Innovation
Lei Guo, Assistant Professor, Emerging Media Studies (COM)
Jacob Groshek, Assistant Professor, Emerging Media Studies (COM)
Lewis Kazis, Professor, Health Law, Policy & Management (SPH); Director, Center for the Assessment of Pharmaceutical Practices (SPH)
Julie Keysor, Associate Professor, Physical Therapy & Athletic Training (SAR); Director, Center for Enhancing Activity and Participation among Persons with Arthritis (SAR)
Xiaoguang Li, Research Fellow, Mechanical Engineering (ENG)
Honghuang Lin, Assistant Professor, Medicine (MED)
Devin Mann, Associate Professor, Medicine (MED); Associate Chief Medical Information Officer for Innovation and Population Health (BUMC)
Cathie Jo Martin, Professor, Political Science (CAS)
Tibor Palfai, Professor, Psychological & Brain Sciences (CAS)
Emma Previato, Professor, Mathematics & Statistics (CAS)
Pablo Ruiz, Research Associate Professor, Mechanical Engineering (ENG)
Emily Ryan, Assistant Professor, Mechanical Engineering and the Division of Materials Science and Engineering (ENG)
Stephen Scully, Assistant Professor, Classical Studies (CAS)
Mary Slavin, Research Assistant Professor, Health Law, Policy & Management (SPH)
Konstantinos Spiliopoulos, Assistant Professor, Mathematics & Statistics (CAS)
Cara Stepp, Assistant Professor, Biomedical Engineering (ENG); Speech, Language and Hearing Sciences (SAR)
Judith Swanson, Associate Professor, Political Science (CAS)
Evimaria Terzi, Assistant Professor, Computer Science (CAS)
Donald Thea, Professor, Global Health (SPH); Director, Center for Global Health & Development (SPH)
Robert Weintraub, Research Professor, Educational Leadership & Policy Studies (SED)
Qiong Yang, Associate Professor, Biostatistics (SPH)
Sudha Arunachalam, Assistant Professor, Speech, Language, and Hearing Sciences (SAR); Director, Child Language Lab

Engagement with Other Entities (38)

Schools and Colleges (12)

College of Arts & Sciences
 College of Communication
 College of Engineering
 College of General Studies
 Frederick S. Pardee School of Global Studies
 Henry M. Goldman School of Dental Medicine
 Questrom School of Business
 College of Health & Rehabilitation Sciences: Sargent College
 School of Education
 School of Law
 School of Medicine
 School of Public Health

Engagement with Other Entities (continued)

Departments (11)

Archaeology
 Biomedical Engineering
 Classical Studies
 Computer Science
 Economics
 History of Art & Architecture
 Mathematics & Statistics
 Mechanical Engineering
 Modern Languages & Comparative Literature
 Political Science
 Psychological & Brain Sciences

Centers (4)

Center for Enhancing Activity & Participation among Persons with Arthritis (ENACT)
 Center for Global Health & Development
 Center for the Study of Asia
 International Center for East Asian Archaeology & Cultural History

Initiatives (3)

Digital Learning Initiative
 Initiative on Cities
 Mobile Health & Informatics Pre-ARC

Labs (3)

Digital Learning Initiative
 Initiative on Cities
 Mobile Health & Informatics Pre-ARC

External Entities (5)

City of Boston, Boston Women's Workforce Council
 City of Boston, Department of Innovation & Technology
 Massachusetts Department of Transportation
 Simmons College
 University of Manchester

Community Outreach

SAIL Workshops, Collaborations, and Presentations

[Data & the Humanities Workshop \(11/03/2015\)](#)
 Together with Jody Cranston (History of Art & Architecture, CAS), SAIL helped plan and participated in a “datathon” organized around the topic of manual data retrieval and entry into an online system (“Mapping Titian”).
[Digitized Landscapes 3D Visualization Workshop \(12/07/2015\)](#)
 SAIL participated in a panel during a workshop on using 3D visualization technologies in archaeology and social sciences.
[Mobile Health & Informatics Pre-ARC \(/03/14/2016 – present\)](#)
 SAIL is participating in a pre-ARC organized around the goal of supporting and promoting mHealth and eHealth research efforts.
[Center for Global Health and Development \(03/30/2016\)](#)
 SAIL staff gave a presentation during a department meeting to explain what resources are available at the Hariri Institute and within SAIL. This presentation led to at least one Hariri Research Award, and may lead to additional proposals.

Community Outreach (continued)

Consultations and Proposal Assembly Assistance

SAIL staff provides consultations to faculty and researchers in preparation for potential SAIL projects, Hariri Award proposals, and external funding proposals. In addition to consulting and proposal assembly assistance provided for all the projects listed under Projects and Community Outreach: Workshops, Collaborations, and Presentations above, SAIL also provided nine (9) additional consultations, as well as technical content and/or letters of support for seven (7) additional external funding proposals to the NSF, NIH, NEH, and other entities.

Engagement with Other Student and University Organizations

In addition to the software engineer internship program, SAIL has also engaged with student groups such as the Global App Initiative and BUILDS by reaching out to members and attending meetings. SAIL has also established working relationships or lines of communication with resources such as BUMC.



Hariri Institute for Computing and Computational Science & Engineering
Boston University
111 Cummington Mall
Boston, MA 02215
Tel: 617-358-6692
bu.edu/hic