# Edge.Discovery

RESEARCH CONNECTIVITY - COLLABORATION - PARTNERSHIPS

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CELEBRATING 20 YEARS OF COLLABORATION

**20** YEARS

VISION TO VALUE

# CONTENTS

# Edge.Discovery

RESEARCH CONNECTIVITY - COLLABORATION - PARTNERSHIPS

Through EdgeDiscovery, Edge has made a significant commitment to supporting the research community. We are working diligently to connect with the researchers across the region to learn about the research projects, identify how we can support the requirements of the projects, and potential collaboration opportunities among researchers. An important part of this process has been raising awareness and enabling access to the available local, regional, and national resources. Our goal is to make sure that we provide value to our members leveraging the core competencies of EdgeDiscovery, including high performance network connectivity, access to advanced computing resources and expertise, and advancing big-data education and discovery especially in support of data-intensive data science programs.

We could not be more grateful to our members, allies, and partners, who are working tirelessly with us to improve both on-premise and cloud access to advanced computing capability and services through innovation and leadership, especially for the smaller, less-resourced institutions.

We have been thinking extensively about the impact of the pandemic on research. There have been so many COVID-19 challenges, yet a silver lining has been seeing the research and collaborations emerge at the front of this virus; finding new medications to treat the virus, discovering potential vaccines, innovating new testing methodologies, setting guidelines for reducing the spread of the virus, and so much more. The pandemic has required us to flex our leadership muscle fast and effectively by developing clear priorities, staying in close contact with our members, and managing our resources to accomplish our goals.

From a priority perspective, commitment to supporting research and discovery has never been more important. We feel it is imperative to stay in closer contact with our membership and to increase our services for the research community. We have been prioritizing regular communications with VPRs and CIOs of our member institutions through listening tour conversations and regular participation in local, regional, and national research communities.

As a result of integrating with the broader research community, we have established the EdgeDiscovery Advisory Council, comprised of distinguished experts from the research and education community representing the sectors that Edge serves, and will be instrumental in guiding the strategic direction for EdgeDiscovery and serving as ambassadors to connecting EdgeDiscovery to a greater constituency. The EdgeXchange Research community was launched as part of the effort to create a community among the researchers and research computing professionals.

We invite you to join us at the EdgeCon 2021 January 6-8. The research track at EdgeCon 2021 and the EdgeDiscovery magazine serve as a way for us to share with the broader community the great work that the research community is doing.

— **FOROUGH GHAHRAMANI, EdD**
Associate Vice President for Research, Innovation, and Sponsored Programs, Edge

# BUILDING A
## COLLABORATIVE
## COMMUNITY
# TO DRIVE
## DATA SCIENCE
## INNOVATION

**FLORENCE D. HUDSON**
Executive Director of Northeast
Big Data Innovation Hub

Florence D. Hudson, Executive Director of the Northeast Big Data Innovation Hub (Northeast Hub), has always been involved in academia and lived at the leading edge of technology. Hudson received her Bachelor of Science in Engineering from Princeton University and has attended executive education at Columbia University and Harvard Business School. With a distinguished career including designing the sample return mission from the Galilean satellites around Jupiter, Hudson continues to make an impressive impact in the world of research and education. Trained as an Aerospace and Mechanical Engineer, Hudson began her career at Grumman Aerospace Corporation and NASA, followed by a career in Information and Communications Technology, including roles as IBM Vice President

and Chief Technology Officer, and Internet2 Senior Vice President and Chief Innovation Officer.

Hudson adores inspiring future generations in STEM fields and consults with industry, government, research, and academia leaders in advanced technology innovations, diversity, and inclusion. "In research and education, you're surrounded by brilliant people who share, collaborate, and inspire each other. Plus, you have the exciting opportunity to be the wind beneath the wings of students," says Hudson. "These individuals are going to help solve real-world problems and be the minds who design our future." Building connections and increasing data science talent are among the core goals of the Northeast Hub, which was created to help accelerate innovation in the national big data ecosystem.

### A Hub for Collaboration and Innovation

The Northeast Hub is a collaboration network that is designed to fuel data science innovation by building partnerships within a diverse and inclusive community. As the Executive Director of the Northeast Hub, Hudson brings her over thirty years of experience in advanced technologies to help strengthen partnerships across industry, government, and academia. The Northeast Hub is one of four Big Data Hubs forming a national big data innovation ecosystem. "The Northeast Hub leadership team has chosen four focus areas that are important to our region, have a national impact, and allow us to lead new collaborations," shares Hudson. "Our main initiatives are in health, education and data literacy, responsible data science,

"In research and education, you're surrounded by brilliant people who share, collaborate, and inspire each other. Plus, you have the exciting opportunity to be the wind beneath the wings of students," says Hudson. "These individuals are going to help solve real-world problems and be the minds who design our future."

and urban to rural communities. These areas allow us to engage the community, identify the challenges, and celebrate the opportunities. We love to share success stories on our website to further amplify accomplishments of the community and help encourage collaboration."

### Leveraging Big Data
When Hudson served as Senior Vice President & Chief Innovation Officer of Internet2, she would often speak to different universities and meet with CIOs, network engineers, security officers, domain scientists, data scientists, and people within the research, education, and computing community. "While at Internet2, I began to see a broader group of domain scientists who were interested in understanding how to leverage

valuable tools like a big data network, and this interest continues to grow," says Hudson. "More scientists want to leverage artificial intelligence and machine learning; they want to bring in petabytes of data and figure out what to do with them, and how to gain new insights to solve scientific and societal challenges. I think there is a real opportunity for us to engage with the science community and help researchers connect with the infrastructures, the computing and networking capabilities, and the storage they need to leverage data to drive innovation."

As a special advisor for the National Science Foundation (NSF) Cybersecurity Center of Excellence at Indiana University, Hudson is part of a team working to support the mission of protecting national research endeavors, from developing a comprehensive cybersecurity framework to bringing new cybersecurity research to operational use. With beginnings in the security and defense culture, she continues to help organizations with cybersecurity research transition to practice programs. "While at Internet2, as Principal Investigator on an NSF grant, I worked with researchers who were funded by the NSF to help them transition their research into operational use and pinpointed ways to deploy their findings; asking how do we get the research out into the world?" explains Hudson. She continued those efforts working with the NSF Cybersecurity Center of Excellence.

Hudson also serves on the program committee for the annual Computational Approaches for Cancer workshops at SuperComputing conferences, led by the U.S. National Cancer Institute (NCI) and the National Institutes of Health (NIH). "Every year, the conference gets better and better," shares Hudson. "Data scientists join forces with doctors, biomedical researchers, and bioinformaticists; they learn from each other and become closely integrated. This collaboration is helping transform how

the domain scientists are looking at their data and these partnerships are opening new doors to fresh insights and information."

### The Changing World of Higher Education
COVID-19 has had a widespread impact across many industries, with the world of education being possibly changed forever. "The pandemic has brought about so many challenges," says Hudson. "I'm already working with the COVID Rapid Response Research (RAPID) researchers through the NSF." Due to the spread of coronavirus disease, the NSF is accepting proposals to conduct non-medical, non-clinical-care research that can be used immediately to explore how to model and understand the spread of COVID-19. "The goal is to harness the energy and intellect of researchers to focus on this critical problem," continues Hudson. "The Northeast Hub led the creation of the COVID Information Commons (CIC) at covidinfocommons.net to serve as an open resource to explore NSF-funded research addressing the pandemic, in collaboration with the Midwest, South, and West Big Data Hubs." The CIC serves as a resource for researchers, decision-makers, and students from academia, not-for-profits, and government to identify collaboration opportunities related to COVID-19 research.

Moving forward, Hudson says institutions face the challenge and opportunity of trying to leverage today's technology to continue to provide a rich learning experience and create a collaborative, nurturing environment. "Campuses are no longer just a physical center, but a technology center too that enables advanced collaboration," says Hudson. "There are opportunities we don't have time to think about right now because of COVID-19, but researchers can continue to look toward tomorrow. We have to work as a team to keep thinking about the good we can do for our future generations."

> "The leadership team has chosen four focus areas that are important to our region, have a national impact, and allow us to lead new collaborations." shares Hudson.
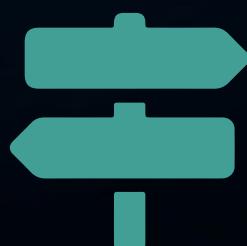
**HEALTH**

**EDUCATION + DATA LITERACY**

**RESPONSIBLE DATA SCIENCE: SECURITY + PRIVACY + ETHICS**

**URBAN TO RURAL COMMUNITIES**

## Engaging the Community

The Northeast Hub will continue to drive their initiatives forward and engage the community. "One of my favorite sayings is by Oliver Wendell Holmes, 'It is the province of knowledge to speak, and it is the privilege of wisdom to listen,'" shares Hudson. "When you listen, you learn, so when I work with students and the community, I listen to the challenges and ideas they have to explore the societal challenges we face, like COVID-19. By doing so, you can identify new ways to help. As a community convener, collaboration hub, and catalyst, the Northeast Hub will keep encouraging the community to get involved and create opportunities to join together."

Hudson is a longstanding friend and colleague of Edge and has worked with the organization and member institutions for a number of years. "Edge is excellent at identifying member needs and has often reached out to me to see if I can help offer solutions or insight," shares Hudson. "I'm very excited as Edge expands their involvement into the research community." Edge is dedicated to enhancing economic development in the state of New Jersey through regional growth and expansion of a resilient high-performance network, technology products, and professional services. EdgeDiscovery offers member institutions a way to expand their

research capabilities through advanced computing access, community engagement, and comprehensive expertise and support. "I'm eager to look at what we can do together and how I can help their member community in new ways," continues Hudson. "Especially by leveraging advanced technology, cybersecurity, and data science, particularly in our four focus areas."

## Developing Security and Safety Standards

Hudson is currently a member of the IEEE Engineering in Medicine and Biology Society Technical Committee on Standards, and Chairs a collaborative IEEE and Underwriters Laboratories (UL) standards working group: IEEE/UL P2933 - Clinical Internet of Things (IoT) Data and Device Interoperability with TIPPSS - Trust, Identity, Privacy, Protection, Safety, Security. "We have over 220 people in the working group, and this is the first time in history that IEEE and UL have ever created a standard together from the beginning," shares Hudson. "I recently suggested a responsible data science workshop which includes security, privacy, and ethics from the Hub perspective—specifically focused on the clinical IoT in connected healthcare. Eighteen people from the IEEE and UL P2933 working group offered to be on the program committee. We will explore questions

"Edge is excellent at identifying member needs and has often reached out to me to see if I can help offer solutions or insight," shares Hudson. 'I'm very excited as Edge expands their involvement into the research community.'"

like, how do you keep the data secure, how do you keep the device secure, how do you protect the humans from hacking of these devices? We will also discuss the type of framework we can create and the ethics around how we use the data and devices. My goal is to create a larger community, so people can work with each other and help each other to move the ball forward "

Students are invited to participate in this working group and Hudson says one student at the University of Buffalo received a 3-credit class for working with the pre-standards team in this effort, contributing to a published paper on IEEE pre-standards work on clinical IoT data and device validation and interoperability. "We engage students across the globe through their professors and researchers," says Hudson. "The IEEE and UL working group is a very engagement-oriented crowd and we invite students and members of the education, industry, government and not-for-profit community to get involved."

Keeping Pace with a Changing World
In August 2020, the Northeast Hub announced their Seed Fund program which is designed to promote collaboration in data science. The Seed Fund will encourage the sharing of data, ideas, and tools across disciplines and community sectors. "Leveraging technology for the educational experience is becoming more and

more important," says Hudson. "Technology has taken a seat at the head of the class and is enabling the new hybrid and virtual education environment. There are new advanced technologies coming out all the time, and with that, rising cybersecurity risks. We are trying to help students leverage advanced technology and manage the risks associated with these advancements. Whether these opportunities are in their life or in their career, we can empower students by teaching them data science, artificial intelligence and machine learning and identifying internship opportunities for them to apply what they learn."

As an aerospace engineer, Hudson says discovery and innovation is all about the data. "When I was working on our future missions around Jupiter, we did not have a lot of data, so we often had to speculate and look at the metrics from the Chemical Rubber Company (CRC) handbook to assess the potential attributes of the surface of Jupiter's Galilean satellites. We created hypotheses based on certain types of information and then tested these theories, but what we've found is that people need to be taught how to use the data correctly. This is critical to ensure

sound outcomes based on the data, whether you're in medicine, engineering, science, or any discipline. You need to use the data correctly, ethically, with validated provenance, which is key for responsible data science."

The 4th Industrial Revolution is certainly ushering in a new world, with big data, augmented reality, IoT, artificial intelligence, and automation becoming a regular part of our day to day work and lives. Even with the COVID-19 challenges we are currently facing, Hudson says we must recognize the existing infrastructure that touches many of our homes, communities, libraries, and institutions. "So much is changing to break down the digital divide and offer remote education. Advanced technologies are enabling the future and artificial intelligence and machine learning are becoming more prominent. There is an opportunity in the higher education community to continue to leverage technology for good and encourage collaboration and mutual success in data science endeavors. Through these partnerships, we can find new solutions to societal problems and further spur economic development and innovation."

Edge is committed to aligning with the best and brightest researchers and research innovators. To learn more about our partnerships and how you can get involved in fostering research community engagement, visit njedge.net/edge-discovery.

# Edge.Discovery

RESEARCH CONNECTIVITY - COLLABORATION - PARTNERSHIPS

# ADVISORY COUNCIL 2020-2021

### About EdgeDiscovery

EgeDiscovery is a technology-based research and discovery framework designed to provide access to leading-edge technology, advanced computing resources, and training for the research community. EdgeDiscovery facilitates multi-campus collaborations and partnerships to advance the frontiers of research and innovation, providing the ability for transformative impact on the research communities in both small and large institutions across New Jersey and the region.

### The Mission of EdgeDiscovery

The mission is to provide support for a diverse set of science drivers and emergent technology-based research and educational opportunities and facilitate access to a broad range of collaborative multi-institutional local, regional, and national advanced technology resources, both on-premise and in the cloud. Through learning networks and communities of practice, EdgeDiscovery fosters information sharing, collaborations, learning pathways, and the ability to form affinity groups based on research interests.

### Role of the Advisory Council

The EdgeDiscovery Advisory Council is comprised of distinguished experts of the research and education community representing the sectors that Edge serves. The Advisory Council members provide strategic direction and guidance for EdgeDiscovery, and provide input and feedback on specific research engagement initiatives. The specialized expertise of the Advisory Council members augments the expertise at Edge. The Advisory Council members serve as ambassadors to the EdgeDiscovery community and connect EdgeDiscovery to a greater constituency.

The EdgeDiscovery Research Engagement Advisory Council members meet two times per year, including one virtual meeting and one in-person meeting at the EdgeCon Annual Conference.

**For additional information on Edge's research activities, contact
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# BUILDING WORLD-CLASS
## COMPUTING, NETWORKING, AND DATA SCIENCE RESEARCH
# INFRASTRUCTURE

**DR. JACK BRASSIL**
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The technological changes affecting the academic science community are happening at a rapid pace, causing the roles of advanced cyberinfrastructure and big data to evolve on a global scale. As the Senior Director of Advanced CyberInfrastructure, Office of the Vice President for Information Technology, and Senior Research Scholar, Department of Computer Science at Princeton University, Dr. Jack Brassil is witnessing this extraordinary shift in scientific research. "The cyberinfrastructure and collaboration that researchers need to conduct their work is an important driver of this change. The role of commercial cloud technologies is growing. Work that is conducted at a relatively modest scale in laboratories or in campus research facilities is shifting to include larger collaborations between many universities with increased reliance on shared infrastructure and access to massive datasets." The transition from an older model of scientific research to a new model is occurring across the academic community, including Princeton, with many opportunities arising to leverage the Cloud to advance innovation and discovery.

## Expanding the Reach of IT

Princeton is home to world-class facilities that are available to researchers across many departments and disciplines. Throughout his career, Brassil has worked at many top-notch institutions and says his role at Princeton is both an honor and a privilege. "Princeton has a commitment to excellence and advancing teaching and research. My position is unique to this institution in that the role bridges both Advanced CyberInfrastructure and the Department of Computer Science. I'm able to expand the reach of the IT organization deeper into the departments and elevate the boundaries of the service that is normally provided. Through this hybrid role, I'm embedded within various departments as they explore new programs, research infrastructures, and instruments."

Brassil says closing the gap between an IT organization and academic units is vitally important to an institution. His dual-role at Princeton allows him to see university operations from both vantage points and helps him gain a better understanding of university-wide thinking, including how that aligns with the institution's goals and objectives. Brassil spent 25 years in industrial research, primarily working with universities and start-ups, and came to Princeton three years ago from the National Science Foundation (NSF). "This experience was instrumental in preparing me for the kind of innovative work I'm doing at Princeton," shares Brassil. "I was able to learn more about the overall national and international research enterprise and the inner workings, including policy development and fundraising associated with science research. This experience gave me a greater understanding of not just a single university, but the vast differences between universities. Now at Princeton, I'm helping the University meet the growing needs for complicated infrastructure and instruments that academics are increasingly calling for to complete their research."

## The Future of Cloud Technology

With extensive knowledge of cloud technology and the future of cloud-based research facilities, Brassil was approached by NSF to conduct

a workshop at Princeton. The NSF-1934704, *Workshop on Next Generation Cloud Research Infrastructure*, brought together members of the academic community and industry from around the country to investigate the future of cloud computing research infrastructure. Academic members of the workshop use clouds to conduct their research, publish papers, and study datasets. The group also included service providers and cloud platform developers.

"Cloud research platforms have multiple uses, but the underlying intent is to allow researchers to think about how we build clouds and guide the development of future commercial clouds," explains Brassil. "Existing commercial clouds, like Microsoft® Azure or Amazon Web Services (AWS), are designed to provide services to enterprises who want to expand their offsite computing needs. They do a great job at this, but they are not perfect vehicles for academic research. Institutions need sandboxes to determine what future commercial cloud technology should look like and try to pinpoint the specific services that are required of an academic cloud."

An additional project Brassil is involved in is NSF-1923692, *CloudJoin: Migrating CISE Computing Research Infrastructure to the Cloud*, which investigates the integration of novel architectures into campus research computing and commercial cloud platforms. Like the

"Edge created a community that facilitated collaboration and helped New Jersey create a top-tier statewide network. GigaPOP is a tremendous opportunity to consolidate resources in the state, which in the long run, will lead to better economic development and help facilitate more collaboration between universities and community colleges and the State."

workshop, this project focuses on how to build cloud computing infrastructure that is tailored to academic scientific research. "Academic research institutions host a central IT research computing organization to provide researchers with the campus tools, storage, and computing requirements they need to do their job," says Brassil. "Those services struggle to meet the demands of today, especially with the need for massive computing jobs and datasets."

"Academics are at a place of transition," Brassil continues, "Moving from using extensive, local equipment on campus to shared instruments, shared computing, and commercial cloud resources." *CloudJoin* is exploring hybrid clouds, which integrates on campus computing resources with commercial cloud resources. "A hybrid model provides researchers with the comfort of working with familiar, local tools, combined with the scale, reach, and collaboration opportunities of a commercial cloud."
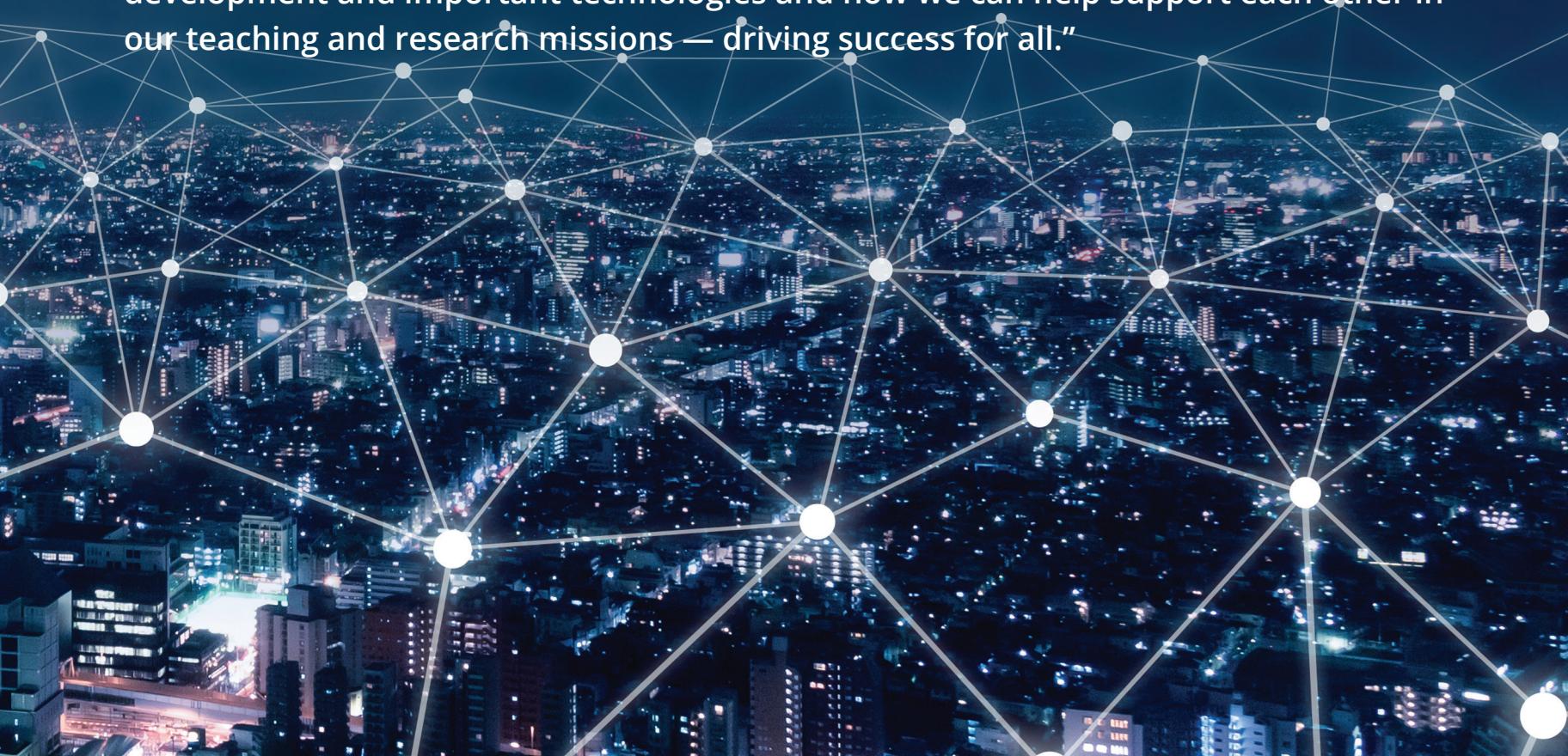
## Supporting Education and Innovation

Princeton, in conjunction with Edge and Rutgers University, created New Jersey's first Internet2 GigaPOP access point earlier this year. Internet2 is the nation's premier backbone for conducting research that supports education and innovation. The Internet2 GigaPOP is the first in-state connection to the national and global research infrastructure. "Edge created a community that facilitated collaboration and helped New Jersey create a top-tier statewide network," shares Brassil. "GigaPOP

is a tremendous opportunity to consolidate resources in the state, which in the long run, will lead to better economic development and help facilitate more collaboration between universities and community colleges and the State."

With the creation of this access point, Princeton, a long-time Edge member, is now connected to an advanced technology community. "This opportunity ties back to Princeton's desire to be fully connected and engaged in local communities," says Brassil. "As seen in other regional networks in the country, I think the potential impact on both workforce and economic development is fantastic and will help further drive innovation and discovery. This collaborative environment also creates a center

"My hat is off to Dr. Forough Ghahramani for having the vision and insight to bring together people from different institutions to lead collaborations between universities and the State. Edge taking a leadership role is terrific, council members will help inform each other of what's going on at the different institutions in New Jersey. By doing so, we'll gain a collective understanding of group economic development and important technologies and how we can help support each other in our teaching and research missions — driving success for all."

of knowledge for institutions to call upon for support as they develop new cyberinfrastructure."

Princeton, Rutgers, and Edge are also key participants in a NSF-funded network research infrastructure called FABRIC. The four-year project is intended to support exploratory research in computer networking, distributed computing systems, and next-generation applications. FABRIC involves network elements that are equipped with large amounts of compute and storage that are interconnected by high speed, dedicated optical links. Connecting several testbeds and high-performance computing facilities, FABRIC provides access to cutting-edge network technologies and aims to advance cybersecurity, integrate machine

learning and artificial intelligence, and help train the next generation of computer science researchers.

### EdgeDiscovery Advisory Council
Edge is dedicated to forging pathways for innovation and engagement among researchers and other stakeholders in the scientific discovery domain. Through EdgeDiscovery, members can pursue their research goals by accessing the advanced computing, support, training, and community engagement they need for success. The EdgeDiscovery Advisory Council was created to bring together fellow forward-thinkers and visionaries and provide a forum for supportive and informative collaboration. "Edge taking a leadership role is terrific. My hat is off to Dr. Forough Ghahramani for having the vision and insight to bring together

people from different institutions to lead collaborations between universities and the State," says Brassil. "Council members will help inform each other of what's going on at the different institutions in New Jersey. By doing so, we'll gain a collective understanding of group economic development and important technologies and how we can help support each other in our teaching and research missions — driving success for all."

To learn more about EdgeDiscovery and tapping into the power of research collaboration and connectivity, visit NJEdge.net/edge-discovery.

# REGIONAL OPTICAL FIBER NETWORK

**MAJOR NODES**

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**ROUTES**

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--- PLANNED

**SECONDARY NODES**

🔴 RUTGERS UNIVERSITY 1

🟠 RUTGERS UNIVERSITY 2

🟠 PRINCETON UNIVERSITY 1

🟡 PRINCETON UNIVERSITY 2

🟢 ROWAN UNIVERSITY

🟣 MONTCLAIR UNIVERSITY

🔵 POMONA

## The Edge Network Technology

As one of the nation's advanced research and education networks, the Edge network serves to support a diverse range of users and services from standard IP transit services to ultra-high capacity data transport capability. Edge has built a dual layer network able to integrate these service demands across a single core structure. The two layers include the Transmission Layer and Packet Layer.

## Transmission Layer

The transmission layer is built on the dark fiber core of the network, either on Edge points of presence (PoPs) or on leased wavelengths from national research and education networking organizations. Edge combines industry-leading Cisco ONS 15454 and EKINOPS 360 Transport Platform to light the fiber, the platform delivers rates from 100Mbps to 200G today and can scale to 400G. Edge has employed Cisco ONS 15454 ONS integrated optical amplifiers to drive the fiber backbone. The Cisco and EKINOPS equipment is used to deliver Lambda services to Edge members and IP trunks between the Edge Core routers.

## Packet Layer

The packet layer is a converged layer that supports both Layer2 and Layer3 services. This design means that Edge can offer both Ethernet connections and IP services on this layer. Edge implements the packet layer with Cisco ASR9K Series equipment using the Cisco IOS® XR operating system. The ASR9K and NCS55X Series equipment is a carrier grade router which supports MPLS and other services. The Edge network currently delivers its Layer 2 services using Multiprotocol Label Switching (MPLS) technology.

## High Performance Network Segment Dedicated for Research

Through EdgeDiscovery, Edge provides a high performance segmented network for research. The dedicated research network segment is a portion of the network that is built at or near the campus or laboratory's local network perimeter and is designed to optimize configuration and security policies for high-performance scientific applications. This model addresses the common network performance issues often encountered at research institutions due to the high volume of data and the network architecture easily adapts to incorporate high performance and advanced technologies.

ME

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Azure, Akamai

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Azure, Akamai

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NEWARK

PA

INTERNET 2

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Epsilon

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ADVANCING THE
**FRONTIERS OF RESEARCH**
THROUGH
**COLLABORATION**
AND **CONNECTIVITY**

The Eastern Regional Network (ERN) is a consortium of network providers, universities, and industry partners who are dedicated to advancing data and compute intensive research. Led by a coalition of the willing, which includes Rutgers, The State University of New Jersey (Rutgers), the ERN aims to provide layered and transparent access to shared data and computing facilities to a broader research community. This regional research and education platform allows each campus to benefit from collaborative multi-institutional resources, providing their students and faculty with new and exciting opportunities and helping to further advance research initiatives.

The ERN had a virtual meeting in June with over 170 attendees, where representatives from 28 colleges, nine regional network providers, and five industries came together to discuss regional cyberinfrastructure and how to achieve the consortium's mission. "During our meeting, we learned that two ERN-related proposals that we submitted to the National Science Foundation (NSF) had been funded, which was really exciting," says Dr. James Barr von Oehsen, Associate Vice President of the Office of Advanced Research Computing (OARC) at Rutgers. "One proposal focused on creating a cyberinfrastructure team that provides support to schools across the region and helps educate those interested in getting access to cyberinfrastructure."

The other proposal submitted to the NSF is a planning grant that collects information from research and education groups located at partner campuses about the challenges faced when sharing resources and data within multi-institution collaborative projects. "This grant will allow us to formalize seven different working groups focused on various parts of the ERN and tie them together to give us a clearer direction," shares von Oehsen. "As a collaborative group, we can lay a foundation for where we want to go and how we can better support the research community."

### Identifying the Challenges

The ERN will continue to have conversations with key stakeholders within the community to learn about the challenges they are facing when conducting collaborative research. Based on this knowledge, the consortium will build services and capabilities that help solves these problems. "The planning grant includes talking to researchers, CIOs, Vice Presidents of Research, provosts, deans, chairs of departments, and IT organizations," says von Oehsen. "We will run a series of workshops that conduct a deeper dive into topics that resulted from the all-hands meeting, collect information, pull together

position papers and lessons learned, and create action items to share with the community. Once we gather all this information, we can create several grant proposals that we plan to submit for future funding of the ERN."

One working group, Broadening the Reach, includes researchers, educators, regional network providers, and senior administrators from under-resourced campuses, including MSIs, HSIs, HBCUs, and EPSCoR institutions. This NSF-funded project aims to learn directly from this community on how best to support their research and education needs through access to research computing and data, core facilities, and expertise. "There are well over 2,000 colleges and universities in the northeast, and most of them are under-resourced," shares von Oehsen. "Broadening the Reach is focused on gaining a better understanding of these institutions and what resources their students need access to in order for them to become more competitive within the workforce. The goal of the group is to bring people together from both the administrative and the research and education side of the university along with members of the ERN community and exchange experience and insight. Even amid the challenges brought on by COVID, we're finding virtual meetings are allowing more of the community to attend and interact, helping in fact, to broaden the reach to a greater number of institutions."

### Gathering Input and Insight

As the ERN further expands distributed federated services that span multiple campuses, an understanding of data sharing policies is essential. Among the ERN working groups is one focused on campus policies and agreements. "This group makes us stand out from other organizations because policy is often an afterthought," says von Oehsen. "We're inviting people from the community to share with us the policies they have in place. We meet with those who are responsible for writing these agreements and use this

"Edge's commitment to advancing research and education is clear, especially with Dr. Forough Ghahramani joining the team. Not many RENs have a person dedicated to research in the community. Dr. Ghahramani coming on board was perfect timing for all of us, since so much is changing across the industry. Having somebody on the team from a research background is so beneficial and she has been a wonderful partner in facilitating conversations across the state. Other RENs have reached out to Edge to better understand her role and how they can replicate these responsibilities, because many are realizing they have been more focused on education than on research."

**DR. JAMES (BARR) von OEHSEN**
Vice President for Office of Advanced
Research Computing, Rutgers University

"Even amid the challenges brought on by COVID, we're finding virtual meetings are allowing more of the community to attend and interact, helping in fact, to broaden the reach to a greater number of institutions."

information as we build out services to connect our campuses."

Among the working groups, one committee concentrates on architecture and federation and collecting information from all the other working groups. They then use this compiled information to create a design of what the ERN infrastructure will look like going forward. "This process is a very daunting task, but the group of highly intelligent, technical people is successfully working through the details," says von Oehsen. "We have made a lot of headway on the design and building our workflow diagrams of how certain systems will be connected."

Above all else, von Oehsen says the people using the environment are the most important part of further advancing the ERN and creating a next-generation platform. "Three of our working groups are focused on research and education including structural biology, materials discovery, and computer science. We felt that if we understood the challenges related to these areas, we could develop solutions that have the broadest impact in helping researchers be more productive in conducting their research by offering a collaborative environment that benefits the greater community."

The computer science working group will lead experimentation and cutting-edge innovation, helping the ERN build effective and transformative test beds within their environment. The structural biology and materials discovery working groups will learn from these research communities on challenges they face with collaborative research, including accessing core facilities and research computing and data services. "These groups generate incredible amounts of data and they are a very well-connected community," says von Oehsen. "They struggle with how to share their data, both nationally and internationally, and giving other researchers access to their instruments. We believe if the ERN can create solutions for these three research communities, all disciplines across the community will benefit."

The seventh working group advocates for diversity, equity, and inclusion in the research community and attracting a wider group of individuals to STEM fields. "We are looking at how different universities are promoting diversity and inclusion on their campuses and using that as a foundation to build upon in our own community," shares von Oehsen. "We also want to educate and excite students about STEM and

the career paths available to them. This group will have a huge impact on the future of the ERN and we're excited to see the positive change that we can accomplish as a larger community."

### Expanding Network Connectivity

The ERN leverages the special relationship between researchers and the people who build and support research cyberinfrastructure in the region that it serves. Within the ERN, ten research and education networks (REN) play an important role in connecting institutions across the region. "The RENs are on the frontline and are vital to helping us connect to our region's schools," explains von Oehsen. "By leveraging the relationships that RENs have with many of the colleges and universities, especially the under-resourced institutions, the ERN can better understand how to interact with non-R1 research institutions within our area."

As the ERN moves forward, the consortium is exploring ways to improve connectivity between RENs to build a faster network layer that expands to other areas of the country. On board with helping achieve this mission, Edge is dedicated to creating

access to advanced computing resources and expanding research connectivity to institutions in the area and beyond. "Edge's commitment to advancing research and education is clear, especially with Dr. Forough Ghahramani joining the team," says von Oehsen. "Not many RENs have a person dedicated to research in the community. Dr. Ghahramani coming on board was perfect timing for all of us, since so much is changing across the industry. Having somebody on the team from a research background is so beneficial and she has been a wonderful partner in facilitating conversations across the state. Other RENs have reached out to Edge to better understand her role and how they can replicate these responsibilities, because many are realizing they have been more focused on education than on research."

### Enabling Cutting-Edge Discovery

After meeting Jack Brassil from Princeton University at a conference, von Oehsen kept in touch with him as they developed research platforms at their individual campuses and discussed how they could connect their two test bed environments to create a New Jersey-wide advanced networking and edge test bed. "The test bed we

"With Edge as a central piece, tying together Rutgers and Princeton's research networks will be much easier and we can ensure the enterprise network on our campuses is kept separate from the research network—allowing more cutting-edge discovery and innovation."

built at Rutgers is a 100-gigabit, fully programmable network that spans all our campuses, we now have advanced networking that extends down to Camden, Piscataway, and New Brunswick, and up to Newark," explains von Oehsen. "With Princeton and Rutgers both being partnered with Edge, this collaboration allows us to find a way forward in connecting our experimental research network and edge testbeds at our two universities and have this network span more of the state."

Both Princeton and Rutgers are partners in a newly-funded project, FABRIC, to help create a nationwide research infrastructure that enables the computer science and networking community to develop and test novel architectures. "Rutgers campuses connect through a mix of Rutgers-owned fiber and Edge fiber, with Princeton having the same set-up," says von Oehsen. "With Edge as a central piece, tying together Rutgers and Princeton's research networks will be much easier and we can ensure the enterprise network on our campuses is kept separate from the research network—allowing more cutting-edge discovery and innovation."

### Finding New Opportunities

Similar to countless industries around the globe, the research community has been greatly affected by COVID-19

and the constraints the pandemic has put on their day-to-day activities. "Our workload at Rutgers has tripled as we try to help our researchers maintain the momentum of their projects prior to the pandemic," shares von Oehsen. "Our faculty members who tend to conduct experimental research were not allowed access to their labs to run experiments, so we helped them transition from experimental research to using mathematical modeling and simulation in order to continue with their research activities. This was challenging for both the researchers and the OARC team and required a lot of training and education on how best to use our research computing and data resources."

As campuses closed, many students were also struggling to access computers and the software needed to complete their coursework. "We received close to a thousand student requests for accounts on our high-performance computing resource," says von Oehsen. "The system was designed for research, not education, so this was a real clash between services; the students trying to do their homework were taking away from the people conducting research. Finding a solution that served both communities was a huge undertaking, plus students required training as well to understand the environment."
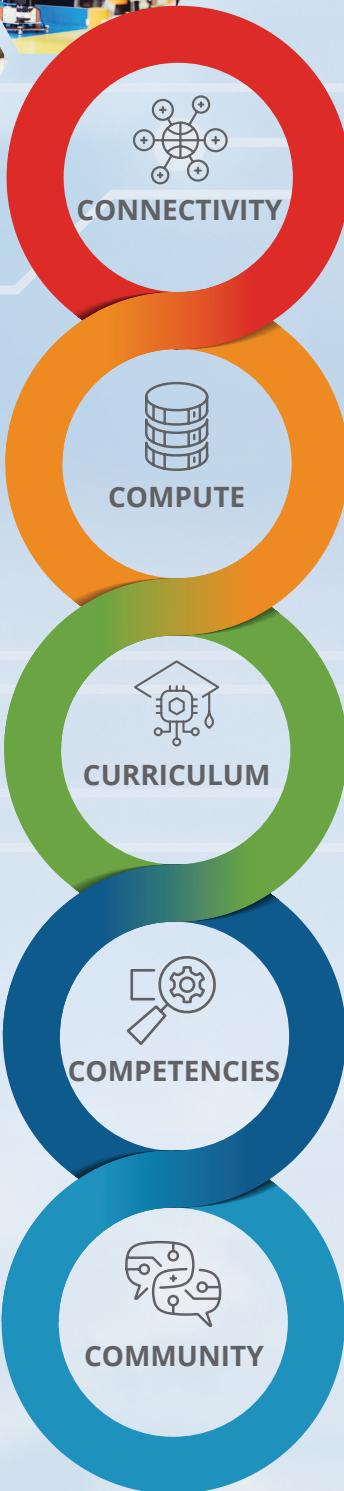
Like many campuses, Rutgers moved to virtual learning and had to quickly adapt the network and infrastructure to accommodate increased activity. "As the University moved to remote classes, our faculty members moved much of their classwork into our compute environment and because they liked the virtual desktop environment that we created for the research community. Unfortunately, this environment was not designed for a classroom," explains van Oehsen. "We've had to quickly streamline our processes to meet these new demands. Working through such a stressful situation is difficult, but communication and transparency between all of our teams and the education community was key to meeting the challenge. Sometimes a crisis forces change. The question is, do we give up or do we see this challenge as an opportunity? Our institution has chosen to view this time as a chance to positively change how we do things and discover new ways to better serve and support our students, faculty, and researchers in the months and years ahead."

**To learn more about network connectivity and collaboration that can help fuel the future of research and innovation at your institution, visit njedge.net/edge-discovery.**

# Edge.Discovery

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# OPTIMIZING VALUE FROM DATA AND ANALYTICS:
## NOW AND IN THE FUTURE

Dr. David Belanger's background in research runs deep, with extensive experience building and maintaining exceptional research organizations. For 15 years, Belanger was Vice President of Information, Software, and Systems Research at AT&T Labs. As Chief Scientist, he led research in computer science, data management, and analysis and visualization of data. Belanger's career also includes 17 years at Bell Labs and 10 as head of research in software systems and engineering. This impressive experience has helped Belanger in his current role as Senior Lecturer at Stevens Institute of Technology and has allowed him to make a significant impact in helping Stevens grow a very small data analytic organization into a first-class program.

Throughout his career, Belanger has also explored applications among the areas of fraud, service/network operations, marketing, and mobility, and uses these insights to enrich the program at Stevens. One aspect that has most defined Belanger's career, both industrially and at Stevens, is scale. "The research we conducted in software engineering at Bell Labs was about large-scale software and how to do that in a better way," shares Belanger. "The research conducted in software systems and information was determining how to deal with very large-scale data and obtaining the maximum value of that information.

The primary course I teach at Stevens, called Big Data Technologies, is chiefly about the various aspects of dealing with large amounts of data and creating a process that works day in and day out."

From his many years in the research industry, Belanger has recognized the significant importance of data. "Currently, I am trying to put together a very complete set of data that students can use from the time they enter Stevens, through the time they leave. This early availability of data will give students a complete feeling of how you collect and use data, from acquiring, cleaning, integrating, and managing this information, as well as incorporating artificial intelligence (AI),

"Edge has provided access to real data that comes from a real network in close to real time," explains Belanger. "Through this opportunity, we are able to expose students to this data and show them how to use streaming data. We're showing students how to understand what data is actually saying before applying several powerful algorithms. Secondly, student teams will spend their graduate school career looking at this data and see what information they can draw through analysis. This server access will be an incredible resource for both academics and research."

**DR. DAVID BELANGER**
Senior Lecturer,
Stevens Institute of Technology

machine learning, and putting data into production. Data goes beyond learning the algorithms. The real insight lies in understanding the entire data pipeline and lifecycle and creating value from data."

### Creating More Value from Data

While at AT&T Labs, Belanger created the AT&T Research InfoLab, with a mission of creating more value from data and interactively analyzing and visualizing AT&T's communication networks and services. "In 1995, the company concluded we had immense amounts of data and that data could be used to gain value in a variety of ways, not only in managing the network and the various services we had, but in looking at fraud, security,

and marketing," explains Belanger. "Two of the key learnings from this mission are the importance of solving the right problems and gathering a broad array of data. In many ways, our early exploration in the InfoLab was a precursor to what much of the data world looks like today."

Belanger's rich research experience has also revealed the importance of having the right thought process. "Both my training as a mathematician and my experience as an industrial researcher have taught me a certain type of thought process: sitting down and determining how you should think about a problem before actually diving in. This approach has served me well and I try to pass this advice on to my

students." In addition to technical skills, Belanger emphasizes that soft skills are equally essential for students entering the workforce. "Organizations hiring graduates not only expect data analytic skills, but are looking for how these individuals interact in teams, work with management, and are involved in the governance of data. I know the abilities that I have liked to see in the people I hired, so I try to instill those skills in my students."

### Promoting Student Engagement

Through state-of-the-art laboratories, world-renowned faculty, and cutting-edge research programs, Stevens offers a hands-on learning environment for the next generation of innovators. Belanger says

students who intend to become data researchers, analysts, or engineers must first love the process of data analysis and the life cycle. "Since they will be fully immersed in this field for several years, students need to enjoy the data process and be inquisitive about the cycle and how to improve this process. I try to engage students in as many actual experiences as possible. Most courses will include extra-long team projects where students work on either a problem that has been introduced to us by a company, perhaps with data from that organization, or using other real-world data to solve problems. This provides the most realistic view of the data cycle from beginning to end."

Stevens also provides students access to facilities that are close to real-life situations that they will encounter in the workforce. Over the last several years, Belanger's courses have incorporated using cloud facilities, specifically AWS Educate, to give students access to the Cloud. "Students can access the latest in modern software systems and hardware systems for use with clusters of computers, for instance," shares Belanger. "They are not only expected to use these resources, but most importantly, look at high-performance computing with a critical eye and measure performance under various conditions and scales."

Due to new advances in data and analytics, the financial industry is quickly changing, with fintech becoming an exploding field. The Hanlon Financial Systems Center at Stevens is helping researchers and students explore the complex global financial system and conduct calculations, modeling, and future-oriented research that can provide real-world applications in business. The technology within the Hanlon lab facilities gives students hands-on experience with the tools that will continue to drive change in the world of finance.

Through Edge, Stevens has access to a server with Edge network flow data—providing a test bed for Belanger and his students. "Edge has provided access to real data that comes from a real network in close to real time," explains Belanger. "Through this opportunity, we are able to expose students to this data and show them how to use streaming data. We're showing students how to understand what data is actually saying before applying several powerful algorithms. Secondly, student teams will spend their graduate school career looking at this data and see what information they can draw through analysis. This server access will be an incredible resource for both academics and research."

## Diving into the Framework

The rapid pace of technological advancement has sent a ripple effect across many industries, causing the world of research and innovation to significantly grow and transform. "As technology evolves, the tools you might learn in school may not be the tools you're using a decade later," says Belanger. "Because of this evolving dynamic, we teach our students four things: (1) learn how to use the best of current technology, (2) learn the framework of why that technology is the way it is, how the technology was developed, and what the limitations might be, (3) learn management of the data ecosystem, including the

> "We need to look at new tools and technologies with a mindset of whether they can allow us to accomplish things that we never thought possible."
>
> — Dr. David Belanger

software system that goes around all of these technologies and tools, and (4) understand theory and the evolution of technology in this area."

Belanger says we are in a time where there are many new tools and technologies constantly entering the market, where some will become market leaders and others will disappear or become niches. "For students, the real skill is not learning a list of fifty tools that roughly do the same thing; the key is to be able to put together a framework that understands how these tools fit into what you ultimately need to do to create value and try to understand whether these tools will be crucial in this space going forward."

Keeping an open mind about a new tool is also essential, even if there are features or capabilities that may seem unnecessary at the time. For instance, in regards to Big Data, Belanger tells his students that this area is all about doing things that people previously thought were either too hard, too expensive, or just plain impossible. "We need to look at new tools and technologies with a mindset of whether they can allow us to accomplish things that we never thought possible."

## Giving a Voice to Computing and Engineering

Belanger is co-chair of the IEEE Big Data Community and leads the IEEE DataPort project. The IEEE is the world's largest technical professional organization for the advancement of technology and aims to be a trusted global voice for computing, engineering, and technology information. "The IEEE DataPort project comes from my belief in the central role of data and the need for researchers and engineers to have more quality data that would be beneficial not only in analytics, but is helpful to society," says Belanger. "IEEE is the leading technical professional society in the world, with a global reach. To support the exchange of technical knowledge and information, IEEE Dataport is connected to over 100 IEEE technical journals and the IEEE DataPort platform provides a way for researchers and data analysts to retain, manage, and share valuable research data."

The IEEE DataPort platform currently has over 500,000 global users and over 1,600 datasets, offering free uploads of any dataset up to 2TB. "A crucial advantage of this platform is that the IEEE DataPort allows research reproducibility, where researchers can test and possibly extend the research of another person," shares Belanger. "Another unique advantage is we have an editor in charge of the metadata for the IEEE DataPort who ensures the quality of the metadata being contributed is consistent with what would go into a technical journal. We're treating data much like a publication, so if you put a dataset on the IEEE DataPort, you will receive a digital object identifier (DOI), giving you credit for producing papers and quality data and providing you with global exposure."

Stevens Institute of Technology, IEEE, Edge, and Belanger are all members of the New Jersey Big Data Alliance (NJBDA) which helps foster collaboration among state academia, industry, and government and aims to advance computing and data analytics capabilities and expertise. "Edge and NJBDA have very deep roots in the various technical communities of New Jersey, with Edge providing the network services and parts of the infrastructure," says Belanger. "In parallel, IEEE has both global reach and local chapters in New Jersey. All NJBDA members want to expand the range and access of technology and offer more career opportunities to a wider variety of people, both in New Jersey and beyond." Belanger currently leads NJBDA's entrepreneurial section activity to identify how the alliance can help support entrepreneurs and startups within the New Jersey area. "Edge is an important part of this mission, with Dr. Forough Ghahramani being very active in this entrepreneurial activity," says Belanger.

## Increasing the Momentum of Technology

As an active member of the EdgeDiscovery Advisory Council, Belanger helps to increase the momentum of technology by promoting collaboration and inspiring excitement in New Jersey's technical community. "Since the Council is able to be very close to the grassroots, the group has the ability to be a crucial social force in engaging more of our population," says Belanger. "New Jersey is a reasonably large state and the impact of this group is broad enough to have critical mass, but also focused enough to actually change things on the ground, which is very exciting. This movement will help more people from underrepresented communities become involved in technology, help increase entrepreneurial activity within the state, and create a more informed, highly-skilled population in New Jersey."

**Looking to drive innovation forward through research connectivity and access to advanced computing resources? Explore EdgeDiscovery at NJEdge.net/edge-discovery.**

# EdgeDiscovery:
# Bridging the Gap Between Researchers and Resources

### Joining Forces to Advance Institutional Research

Computing is an essential component of research and education across a variety of fields, especially those involving data-intensive science. Many small, mid-sized, and under-resourced campuses have compelling science research and education activities that would benefit from better access to advanced cyberinfrastructure (the combination of advanced computing and data storage systems with knowledgeable people, all connected by fast networks). However, they lack the necessary in-house expertise to make use of it. Without this expertise, researchers at these institutions must navigate a complex and daunting set of choices and decisions without guidance, particularly when the required resources are outside of their campus environments.

Networks and regional collaborations, such as the Eastern Regional Network (ERN), aim to simplify multi-campus collaborations and partnerships that help advance the frontiers of research and innovation. Through a partnership of educational institutions, research facilities, regional network providers, and Internet2, the ERN is committed to providing layered and transparent access to shared data and computing facilities. "Regional network providers play a significant role as facilitators and user support for the smaller institutions," says Dr. Forough Ghahramani, Associate Vice President for Research, Innovation, and Sponsored Programs, Edge. "For example, Edge uses a collaborative network to enable conversations across member institutions to leverage existing relevant shared resources to support researchers and help identify joint funding opportunities."

### Helping to Bridge the Gap for Research Computing Expertise

As researchers become more reliant on the use of massive amounts of data and sophisticated computing techniques such as artificial intelligence and machine learning, the demand for experts who can wield these tools effectively has grown considerably. "The Cyberteam to Advance Research and Education in Eastern Regional Schools (CAREERS) program, led by Yale University, is a National Science Foundation (NSF) grant for approximately $1.4 million that is convening seven institutions around initiatives to strengthen the research computing career pipeline," shares Ghahramani. "The goal is to increase the availability of Research Computing Facilitators (RCFs) who can collaborate with researchers and provide this support to underserved institutions."

> "Our hope is to find ways for schools, both large and small, to access the kind of computing expertise they need, without having to invest in full-time positions. I think this is an important model for the future and allows for more institutions to leverage facilitators to meet a broad and diverse research need."

**DR. ANDREW SHERMAN**
Senior Research Scientist and the Director of Arts & Sciences Computational Research Support, Yale Center for Research Computing

RCFs play an important role in the research community and are critical to the successful utilization of cyberinfrastructure. Equipped with expert knowledge and experience, RCFs help improve the performance of scientific workflows, assist projects that require large scale computer systems, and offer guidance to researchers who are adopting new software tools. Unfortunately, RCFs are in short supply. Programs like CAREERS are trying to solve this problem, while also raising awareness and interest regarding this rewarding career path.

Dr. Andrew H. Sherman serves as the lead Principal Investigator for CAREERS and works with researchers to address their computing needs. "As an RCF, I help bridge the gap between computing resources and tools and the scientists conducting the research," says Sherman, Senior Research Scientist and the Director of Arts &

Sciences Computational Research Support at the Yale Center for Research Computing (YCRC). "My group helps researchers in a variety of disciplines, including physical and social sciences, engineering, and forestry. A significant challenge for high-performance computing (HPC) on a national and international scale is the lack of facilitators. Often, researchers who are excellent theoreticians or laboratory scientists may lack the computing expertise that would allow them to take full advantage of advanced cyberinfrastructure to accelerate their research."

Along with Yale, CAREER's anchor institutions include the Massachusetts Green High Performance Computing Center (MGHPCC), Penn State University, Rensselaer Polytechnic Institute, Rutgers University, University of Delaware, and University of Rhode Island. "The genesis of this program

was to identify ways to not only increase the number of RCFs, but address diversity and inclusion," shares Sherman. "CAREERS aims to promote the field as a potential career to students with an interest in both computers and the sciences, particularly focusing on finding potential RCFs at small-to-medium sized schools, where there hasn't been as much exposure to advanced research computing."

**Advancing Computing Education**

The CAREERS Cyberteam is collaborating closely with the Northeast Cyberteam. Launched in 2017 with NSF funding, the Northeast Cyberteam aims to make advanced computing more accessible to researchers at smaller institutions in Northern New England that do not have critical mass to support these resources on campus. Both the Northeast and CAREERS Cyberteams are addressing the need

"We wanted to expand our portal to support groups like CAREERS, and simultaneously grow the network of mentors that were registered in the portal," says Ma. "As a result, the Northeast Cyberteam also invited other cyberteams from the NSF-funded Campus Cyberinfrastructure (CC*) program to use the platform as a management tool for their related programs."

**JULIE MA**
Program Manager, Northeast and CAREERS Cyberteams

for qualified support staff by building a pool of RCFs and a process by which they can be shared across institutional boundaries. "The regional networks—for example Edge in New Jersey—can advance the missions of programs such as the Northeast and CAREERS Cyberteams in at least two ways. First, they can raise awareness among their member institutions of local, regional, and national research computing resources, including not only high performance computing centers, but also organizations like the Cyberteams that provide training, mentoring, and consultation. And, second, they can help identify research projects at smaller, less research- oriented institutions that may benefit from the Cyberteams' activities," explains Sherman.

Anchored by MGHPCC, University of New Hampshire, University of Maine, and University of Vermont, the Northeast Cyberteam is working to advance academic research and create new opportunities for students and faculty. "When we started to make computing resources available to research and education programs outside of the MHGPCC consortium, we quickly found that a key ingredient for success was the research computing facilitators who bridge the space between the scientists and the

technology. The Northeast Cyberteam has proven to be a very effective way to meet that need," shared John Goodhue, the Principal Investigator for the Northeast Cyberteam and Executive Director of MGHPCC. The MGHPCC is a data center and consortium that serves more than 20,000 researchers, students, and educators at Boston University, Harvard University, MIT, Northeastern University, the University of Massachusetts, and other institutions in the Northeast. "The Northeast Cyberteam launched forty-two projects over the last three years at small and medium sized institutions in northern New England," shares Julie Ma, Program Manager, Northeast and CAREERS Cyberteams. "For each of these projects, we found a student facilitator to pair with a researcher that had a problem that needed to be solved. Students do not necessarily need to be versed in the particular domain. Instead, a mentor with domain expertise is paired with the student to provide subject matter expertise and also model how to be an effective facilitator. We want students to be able to jump between domains and learn how to use their computational expertise to help move the science forward." Through this process, the student will learn to be an advisor to help the researcher understand what computational resources are available

and how to use these tools on their project.

"Students can train to be a facilitator at a small institution, but pair with a mentor at one of the MGHPCC or anchor institutions," says Ma. "The mentor will help the student learn about the domain science, as well as teach them the skills needed in the RCF profession. Like CAREERS, our mission also included an emphasis on increasing diversity, equity, and inclusion, by recruiting students with diverse backgrounds." Leveraging the Northeast Cyberteam's model for giving students hands-on RCF experience, CAREERS is pairing RCFs with students to offer guidance in effectively working and communicating with their researchers. "In the beginning, student facilitators do not have all the information they need," says Sherman. "The mentor role brings in people who are professional RCFs from the anchor institutions and pairs them with students working on research projects. The students not only help the researcher advance their research projects, but they also learn about advanced computing and hopefully get excited about the field— later becoming RCFs themselves."

Along with the Northeast Cyberteam, CAREERS is working to develop a network of RCFs of varying specialties

throughout universities in the region, creating a comprehensive and cost-effective RCF program for a large network of institutions. "Our hope is to find ways for schools, both large and small, to access the kind of computing expertise they need, without having to invest in full-time positions," says Sherman. "I think this is an important model for the future and allows for more institutions to leverage facilitators to meet a broad and diverse research need."

### Increasing Access to Cyberinfrastructure Resources

As part of their operations, the Northeast Cyberteam built the Cyberteam Portal to help keep track of project workflows, and all the facilitators and their associated expertise and skillset. In spring 2020, the Northeast Cyberteam Steering Committee came to a realization that the portal could be a useful tool to connect other groups with similar goals. "We wanted to expand our portal to support groups like CAREERS, and simultaneously grow the network of mentors that were registered in the portal," says Ma. "As a result, the Northeast Cyberteam also invited other cyberteams from the NSF-funded Campus Cyberinfrastructure (CC*) program to use the platform as a management tool for their related programs. In July 2020, we rolled

out a pilot program where seven cyberteams, each with a personalized view into the database, began to explore the use of the portal to manage their workflows, while building a common network of mentors that stretches across the country. We recently added the Campus Champions community of practice to the mix, and added features to support affinity groups which connect individuals throughout the community with common goals and objectives."

Moving forward, the Northeast Cyberteam is working to make the expanded portal, now dubbed Connect.Cyberinfrastructure.org, available to other members of the research computing community.

### Supporting Inclusion and Equity

Building upon the success of the NSF-funded Internet2 Broadening the Reach: A Cyberinfrastructure Program for Non-Research-Intensive and Established Program to Stimulate Competitive Research (EPSCoR) Institutions, the ERN has formed a Broadening the Reach (BTR) working group, co-led by Forough Ghahramani and John Hicks, Network Research Engineer at Internet2. "This group is focused on learning from the community about the challenges faced by institutions and to identify the necessary support needed," shares

Ghahramani. "An ERN BTR workshop scheduled for later this fall will bring together representatives from the small, mid-sized, and under-resourced schools in the Northeast, including Minority Serving Institutions (MSI), Hispanic-serving institutions (HSI), and Historically Black Colleges and Universities (HBCU), along with regional and national cyberinfrastructure experts. The goal is to improve the ERN's understanding of how best to support under-resourced academic institutions in the region." The ERN BTR workshop is one of several workshops planned as part of the ERN's NSF-sponsored CC* CI-Research Alignment (CRIA).

As the complexity of societal challenges continues to grow, the need for advanced cyberinfrastructure and collaboration will increase as well. Finding new opportunities to support the people, resources, networks, and data that make up the connective cyberinfrastructure fabric will be essential to keeping innovation and discovery in motion. Through a unified commitment across the education community to help each other learn and grow, future generations are given the strong foundation they need to enter the workforce and drive positive change throughout the world.

# Edge.

PROVIDING
## EDGE-TO-EDGE SUPPORT
### TO THE NETWORKED ACADEMIC ENTERPRISE

## Two Decades of Commitment to Digital Transformation

When Edge was originally conceived in 1997, the genesis of the organization's formation was based on the burgeoning concept of broadband connectivity as a critical utility essential to advancing the missions of the higher education community in New Jersey. Back then, Chief Information Officers almost fully comprised Edge's membership base. As the technology needs of the higher education community expanded over the past 20 years, so too did Edge's membership, with nearly all of an institution's key roles finding benefit

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IT Directors

Students

in the services and solutions provided by Edge. Finding engagement at all levels of the institutional environment is not uncommon. Levels often include Presidents, Chief Information Officers, Chief Financial Officers, Chief Enrollment Officers, Chief Information Security Officers, Procurement Officers, Library Staff, Chief Academic Officers, Enterprise Information Technology (IT) Professionals, and IT Support Staff — to name a few.

Edge's member organizations now rely on Edge in constantly evolving ways to achieve success in today's digital world by transforming how technology serves as enabler and differentiator in the 21st century.



**Academic Technology Specialists**

**Library Staff**

**Instructional Designers**

## Edge Evolves to Meet the Needs of Sectors and Markets Beyond Higher Education

In addition to the digital transformations Edge has recently witnessed in education, government, and healthcare, digital transformation is now occurring in all vertical market segments, and is bringing about alignment of core functions with how the world now works. In an age of mobile computing, extreme connectivity, secure access, and social business, Edge continues to demonstrate a unique value proposition to member institutions and beyond through secure high-performance optical infrastructure, network services, technology solutions, and economic advantage.

Today's Edge member road map aptly depicts the fact that the Edge team is not one to sit still. The team's collective desire to create and innovate pushes Edge to provide optimal technology solutions. As Edge heads into its third decade of progress, the sky's the limit for members seeking solutions to their most complex technology dilemmas.

## Edge Proudly Supports the Following Industry Sectors

### Higher Education
Dating back to 1997, Edge's mission has been, and continues to be, to support New Jersey's institutions of higher education in their pursuit of excellence in teaching and learning.

### K – 12 Education
To educate tomorrow's learners one must consider the level of sophistication these students have with technology. Services are specifically tailored to address the needs and demands of this constantly evolving segment.

### Healthcare Industry
The healthcare industry demands precision technology in medical services and infrastructure to ensure secure support for hospitals and medical facilities.

### Libraries and Museums
Our experienced team understands that libraries and museums share common financial resources with other institutions yet have unique needs, requiring an expert approach to identifying funding channels and executing applications to ensure optimal results.
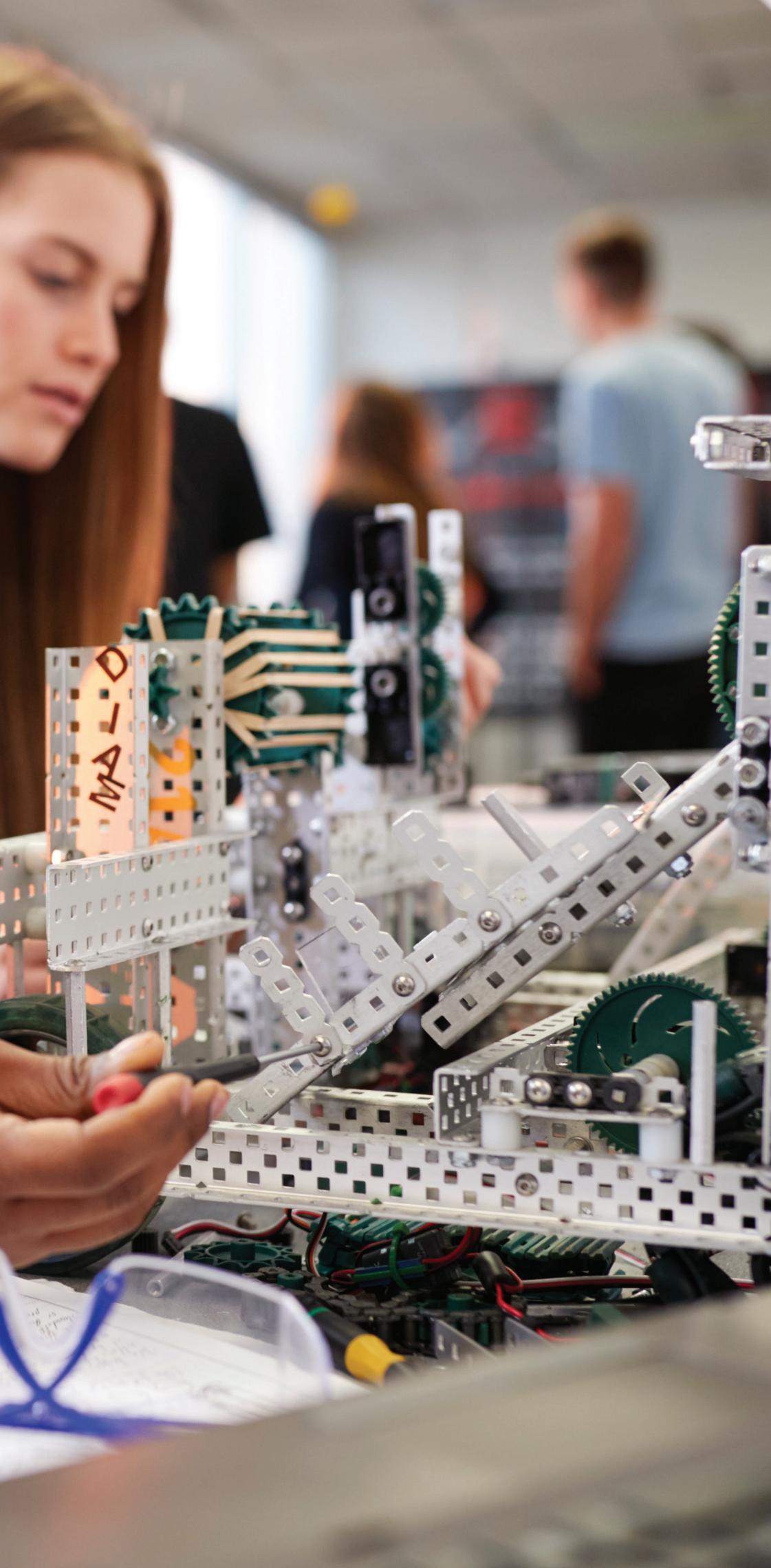
### Local, County & State Government
By deploying high-bandwidth services, our dynamic solutions enable government and public safety organizations to operate with improved efficiency and achieve lower operational costs with secured resources.

### Research
Accelerating the time to discovery by delivering the next generation of research technology to enable high performance and collaboration at even the smallest research institutions.

# INSPIRING
THE
## NEXT GENERATION
OF
## STEM INNOVATORS

Growing up in New Jersey, Lora Billings always had a passion for math and physics, viewing the subject matter as fun puzzles to solve. She carried that interest into her higher education and was the first in her family to go to graduate school, and then later receiving her Ph.D. in Applied Mathematics. "I studied chaos theory and dynamical systems," shares Billings, Dean of the College of Science and Mathematics, and Professor of Applied Mathematics, Montclair State University. "These disciplines gave me the foundation to develop new mathematical tools and modeling complex systems that helped me understand and predict real world questions."

Billings later became a National Science Foundation (NSF) Program Director where she gained a deeper knowledge of grants and best practices from other institutions. "The NSF is a unique and fantastic place to work," says Billings. "The organization is filled with brilliant people dedicated to advancing the sciences. I was immersed in a consensus-building culture that identifies areas with high impact potential and choosing the most promising people to conduct research." Through her NSF experience, Billings received a crash course in administration, specifically in the areas of policies, transparency, and ethics. "As a leader of any institution, these three areas are essential. While at the NSF, I learned how to manage people, budgets, and challenging workloads with short deadlines. That

> We recruit a diverse student population, including first-generation, economically disadvantaged, and urban students. These graduates can help enrich the faculty pipeline and later serve as role models and mentors for other students.

**LORA BILLINGS**
Dean of the College of Science and Mathematics,
and Professor of Applied Mathematics,
Montclair State University

experience helped me later build a fantastic team at Montclair State with the same determination to do right by the University and support our mission of empowering students and faculty. Since Montclair State is growing in research status, we are continuing to build the necessary infrastructure to fully realize our potential. My experience at the NSF gave me the perspective of how to accomplish the impossible and identifying the potential in people who can help you get there."

### Paving the Way

As the first woman to hold the position as Dean of the College of Science and Mathematics in Montclair State's 110-year history, Billings says she has always worked to remove the stereotypes surrounding mathematicians and scientists. "We need increased professional development in academia and improved infrastructure. I am truly inspired by our University president, Dr. Susan Cole. Especially in the last six months, she has demonstrated how important providing steady confidence and informed decision-making is for leaders. She has shown us that we will persevere and emerge from this pandemic a bit different, but we will be stronger. While some people like Dr. Cole are natural leaders, others may need a push.

Studies have shown women often need that extra encouragement to step into a leadership role." Billings says organizations need to create a supportive and inclusive environment for all leaders where confidence and vision are built into academica. "We must move beyond gender and promote people from a variety of backgrounds and experiences; I am proud that Montclair State has broken these barriers and allows people, no matter their demographics, to come together and accomplish great things."

As a proud partner of the NSF Program, the Louis Stokes Alliance for Minority Participation (LSAMP), Montclair State has long been a promoter of diversity in STEM and advocating on behalf of underserved populations. "The University has a history of prioritizing access to education and was recently designated as a Hispanic-Serving Institution (HSI)," shares Billings. "We recruit a diverse student population, including first-generation, economically disadvantaged, and urban students. These graduates can help enrich the faculty pipeline and later serve as role models and mentors for other students."

### Promoting STEM

Helping students succeed by guiding their trajectories is a core part of

Montclair State's mission. Along with faculty members, both undergraduate and graduate students conduct groundbreaking research across multiple disciplines. "Since math is a universal language, I've had the privilege of working with students from a variety of backgrounds," shares Billings. "Along with math majors, I've worked with physicists and biology students. One of my most successful students started as a high school math teacher. He returned to Montclair State to earn his master's degree and worked with me on my first epidemiology research in collaboration with Johns Hopkins University. He was able to explore mathematical biology and how data can impact real-world modeling. This student later received his Ph.D. from the University of Arizona and now works for the Critical Path Institute's C-Path quantitative medicine team to streamline research to produce new and improved vaccines and treatments for rare diseases."

Two years ago, Billings was invited to the U.S. Embassy in Brazil to speak to mathematical biologists and promote STEM. During this trip, she toured universities and the cities of Rio, São Paulo, and Recife to encourage underrepresented youth to attend graduate school and become scientific leaders and innovators. "I am dedicated to increasing the

involvement of students from all walks of life in STEM research," says Billings. "These future generations will continue to make life-changing discoveries and propel research forward."

Billings' most recent research focuses on modeling stochastic complex systems in ecology and epidemiology and studying uncertainty in systems that can cause unexpected or rare events. "My colleague, Eric Forgoston, who is in the Applied Math and Statistics department, is currently working with me in ecology," says Billings. "We have an NSF grant through the Division of Mathematical Sciences' Mathematical Biology Program. Our joint project includes colleagues from the British Antarctic Survey in Cambridge, and we are looking at extensions in ecology and population extinctions, which is a confluence of events where things can die out in an unexpected way. The research measures the robustness of a model system that has unexpected change."

In her current research, Billings hopes to create a way for scientists to predict the risk of of a major event and get the word out to society, similar to an early warning system. "Just a prediction is not enough, we need to carefully communicate and understand how people accept this type of information," explains Billings. "The goal is to understand the risk of unexpected events, like climate change for example, and the interconnectedness of certain environments and species. If we predict how a species can either die out or conversely, invade another population and thrive; society must then be willing to act in a way to change that pathway of that food web."

**Advocates for Science and Research**
Collaboration in academia and research is a key force behind actionable science and determining how to translate theoretical results into achievable actions. "Partnering with other institutions, both inside

and outside our industry, helps us identify what problems we're facing, what the needs are outside of academia, and how academia can help provide needed solutions," says Billings. "Like my fellow members of the EdgeDiscovery Advisory Council, I hope to serve as an ambassador in advancing EdgeDiscovery initiatives by bringing my own experience and insight to the group and helping create a community where we can learn and grow together."

From providing educational tools for researchers and students to offering access to advanced computing resources, EdgeDiscovery is delivering the next generation of research technology to empower institutions both large and small. "Colleges and universities can create programs to train students in the skillsets that are most needed in the workforce," says Billings. "In academia, we need to help guide students to their careers and make these opportunities known." EdgeDiscovery offers testbeds for experimentation and training and shows member institutions how to integrate technology, like virtual labs, into their curriculum—preparing the next generation of researchers. "We need to find a better way to communicate research initiatives and the importance of science to the greater community," says Billings. "The Advisory Council is providing a platform to get the word out and not only creating an impact among students and researchers, but allowing our voices to be heard across the state; helping us influence positive change on a grander scale."

**Whether your institution needs advanced computing resources, a high performance research network, or connectivity to national research platforms, EdgeDiscovery can help you reach new heights. Learn more at njedge.net/edge-discovery.**

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# CULTIVATING RESEARCH COMPUTING COMMUNITY ENGAGEMENT WITH

## Edge.Xchange

This past spring, Edge launched EdgeXchange, a state-of-the-art online member community where members can engage with one another, deepen relationships, discover insight on improvements, and explore the latest product and service offerings. This community focuses on connecting members and giving them a more dynamic way to engage one another and take advantage of their most valuable resource: each other.

The EdgeXchange Research Computing Community brings together researchers and research computing experts to help navigate the complicated, diverse, and rapidly changing research computing landscape. The community of professionals work together to advocate for, and help make sense of the available resources and service offerings across the research IT ecosystem for compute and data intensive research and education. In addition to identifying research collaboration opportunities, and opportunities for sharing best practices with the broader network of experts, EdgeXchange Research Computing Community provides professional development opportunities for the professionals associated with supporting and enabling technologies for compute and data intensive research.

**Building a Network of Peers**

Edge believes all members, no matter their role in an organization, deserve a supportive environment that helps provide valuable networking opportunities, fosters the sharing of great ideas, and focuses on the gratification that comes from exchange of knowledge. Edge members have been pleased with the ease of use and peer collaboration opportunities EdgeXchange has provided. The most recent EdgeXchange community is the Research Computing Community. Chief Information Officers in the NJ-CIO Forum Community, the Librarians within the VALE community, Chief Information Security Officers in the Security Community of Practice, and Education Technologists in the Ed Tech Community of Practice are among some of the members who have enjoyed sharing knowledge, experience, and ideas with a network of peers through EdgeXchange.

# ABOUT EDGEXCHANGE

**Connecting on Key Issues**
Ambassadors and discussion moderators keep the content and discussions engaging and members are encouraged to contribute their own thoughts and guidance on the topic introduced to the community. The situations and deep discussions are relevant to members across the industry and members can look to one another for insight and advice on real issues they are trying to solve. Typically, individuals have to sift through a vast amount of discussions and information in search of the answers or user reviews they need; now with EdgeXchange, the answers and information are in one, concise location and are provided by trusted peers.

EdgeXchange allows members to browse dynamic discussion groups and join a conversation with like- minded people who are enthusiastic about what they do. All interactions are in real time, so when one person posts a question or asks for a recommendation, other members are ready to share a vetted solution or offer resources and tools they found useful. Additionally, members can explore the extensive research library to find content and media on industry best practices, sample documents, spreadsheets, pictures, and videos.

**Extending the Community**
EdgeXchange will continue to expand the reach of this virtual community to more Communities of Practice and create an interwoven web of relationships between Edge members worldwide. Edge anticipates rolling out virtual Communities of Practice for Women Leaders in Technology, Chief Information Officers, Procurement Managers, and Edge's Board of Directors. EdgeXchange helps members form real relationships and when they connect at industry events, the camaraderie and conversation can continue in person. A network of passionate people is a powerful resource and EdgeXchange is dedicated to providing members with the partnerships and knowledge they need to be successful.

**Join the conversation with Edge's community of research thought leaders via research@njedge.net.**

# RESEARCH TRACK TOPICS

**PREDICTIVE ANALYTICS USING AMAZON WEB SERVICES**
**Sanjay Padhi, Ph.D.,** Head of AWS Research, US Education, Worldwide Public Sector

Predictive analytics is a set of techniques that are fundamental to large organizations like Amazon. Methods such as Machine Learning are used in many aspects of life, including healthcare, education, and financial modeling. This talk will provide a range of studies using predictive analytics including a detailed overview of methods such as Machine Learning (ML) and Deep Learning using AWS. Fully managed Artificial Intelligence services to help researchers build, train and deploy ML models in various domains including Computer Vision and Natural Language Processing will also be outlined. Supervised, unsupervised and reinforcement learning based frameworks and their implications in the fields of scientific computing, medical imaging, cancer detection, diabetic retinopathy, and voice-enabled solutions to improve management of chronic diseases will be discussed. Advancements in Quantum Computing technologies fostering innovations will also be highlighted. The AWS Research Initiatives with funding agencies such as the National Science Foundation and National Institutes of Health in scientific and biomedical sectors, as well as the AWS research credit program will be outlined.

**TRANSFORMING THE WORLD THROUGH DATA SCIENCE FOR GOOD**
**Florence D. Hudson,** Executive Director of Northeast Big Data Innovation

The Northeast Big Data Innovation Hub is a community convener, collaboration hub, and catalyst for data science innovation in the Northeast Region of the U.S. Our mission is to build and strengthen partnerships across industry, academia, nonprofits, and government to address societal and scientific challenges, spur economic development, and accelerate innovation in the national big data ecosystem. Join us (nebigdatahub.org/about) to learn about the exciting initiatives you can participate in across our four focus areas of Health, Responsible Data Science including security + privacy + ethics, Education and Data Literacy, and Urban to Rural Communities. We will present projects such as the COVID Information Commons (covidinfocommons.net), the Connected Healthcare Cybersecurity Workshop in collaboration with IEEE and Underwriters Laboratories, the Northeast Student Data Corps, and more, inviting you to join in the efforts and share your data science related insights and projects so together we may transform the world through data science for good.

**DRIVING INNOVATION AND EDUCATION THROUGH ADVANCED CYBERINFRASTRUCTURE**
**Jack Brassil, Ph.D.,** Director for Advanced Cyberinfrastructure at Princeton University
**James Barr von Oehsen, Ph.D.,** Vice President for Office of Advanced Research Computing at Rutgers University
**Forough Ghahramani, ,** Associate Vice President for Research, Innovation, and Sponsored Programs at Edge

This panel will explore how New Jersey institutions are supporting education and research through advanced cyberinfrastructure and cloud computing, impacting workforce and economic development, and helping to drive innovation and discovery. The significance of a top-tier state-wide network providing connectivity to the national and global research infrastructure, and the role of collaborations facilitated by organizations such as the Eastern Regional Network (ERN) for enabling resource sharing to advance research and education will be discussed.

## HIGH PERFORMANCE DATA ANALYTICS

**David Bader, Ph.D.,** Distinguished Professor, New Jersey Institute of Technology

Data science aims to solve grand global challenges such as: detecting and preventing disease in human populations; revealing community structure in large social networks; protecting our elections from cyber-threats, and improving the resilience of the electric power grid. Unlike traditional applications in computational science and engineering, solving these social problems at scale often raises new challenges because of the sparsity and lack of locality in the data, the need for research on scalable algorithms and architectures, and development of frameworks for solving these real-world problems on high performance computers, and for improved models that capture the noise and bias inherent in the torrential data streams. In this talk, Bader will discuss the opportunities and challenges in massive data science for applications in social sciences, physical sciences, and engineering.

## FEDERATED IDENTITY, INCOMMON, AND ENABLING FEDERATED ACCESS TO RESEARCH SERVICES

**Ann West,** AVP for Trust & Identity at Internet2 and Executive Director of the InCommon Federation
**Jim Basney, Ph.D.,** Senior Research Scientist, National Center for Supercomputer Applications
**Tom Barton,** Senior Consultant for Cybersecurity & Data Privacy, UChicago & Internet2

The panel will review the concepts of federated identities, authentication, and the role attributes play in managing access to services. They'll further describe how the InCommon Federation and eduGAIN enable academic collaboration across local, regional, national, and international scales, discuss technical alternatives for participation in InCommon, and delve a bit into how research communities and research cyberinfrastructures manage federated access to their services.

## SCIENCE WITHOUT PHILOSOPHY? CRITICAL COMPONENTS OF HUMAN INTELLIGENCE AND ARTIFICIAL INTELLIGENCE INTERACTION

**Jim Samuel, Ph.D.,** Associate Professor, Director, Analytics, IS & Applied AI, School of Business, University of Charleston
**Myles Garvey, Ph.D.,** Assistant Teaching Professor, D'Amore-McKim School of Business, Northeastern University

This session will provide perspectives on the critical components of human intelligence and artificial intelligence interaction. It will provide an overview and an abstraction of current scientific progress in human intelligence and artificial intelligence interaction. The arguments presented will critically and uniquely address the absence of philosophical foundations, and the consequences of the same. The session will conclude with a call for development of ontologically unified-concepts founded upon sound philosophizing.

## COVID IN A FULL-FIBRE ISLAND

**Tony Moretta,** CEO, Digital Jersey

The presentation will focus on how Jersey Channel Islands have delivered a full-fibre network to the premise for every home and business on the island - now boasting the world's third fastest internet speeds. The island experience of managing lockdown, bridging the digital divide and network neutrality. Lastly, how the island plans to go from a 1gig to 10 gig to each premise.

## RESOURCES AND COMMUNITIES OF PRACTICE FACILITATING COMPUTING AND DATA-INTENSIVE RESEARCH AND EDUCATION

**Dana Brunson,** Executive Director, Research Engagement, Internet2
**Forough Ghahramani,** Associate Vice President for Research, Innovation, and Sponsored Programs, Edge
**Julie Ma,** Program Manager, Northeast Cyberteam Initiative, Program Manager, CAREERS Cyberteam, Campus Champions Leadership Team, Massachusetts Green High Performance Computing Center (MGHPCC), Harvard University
**Andrew Sherman, Ph.D.** Senior Research Scientist and the Director of Arts & Sciences Computational Research Support, Center for Research Computing Yale University

This session will provide information about research support resources and communities available at the local, regional, and national level, bridging researchers with the resources and collaborations. Topics will include national Cyberinfrastructure (CI) resources, such as XSEDE and Open Science Grid (OSG), Campus Research Computing Consortium (CaRCC), the Campus Champions network, regional communities and resources including the Eastern Regional Network's (ERN) Broadening the Reach initiatives supporting less-resourced institutions, the NSF sponsored Cyberteams projects for advancing research and education in Eastern Regional Schools, and EdgeDiscovery enabling research and Innovation. As researchers become more reliant on the use of big data and sophisticated computing techniques such as artificial intelligence and machine learning, the demand for experts who can wield these tools effectively has grown considerably, the NSF CAREERS Cyberteam project strengthens the research computing career pipeline, increases the availability of research computing experts who can collaborate with researchers, and provide this support to underserved institutions. Northeast Cyberteam is addressing the challenges faced by smaller, mid-sized and under-resourced campuses by building a pool of research computing facilitators that can be shared across institutional boundaries. The regional networks have a significant role, such as Edge through EdgeDiscovery, in serving as facilitator and user support for the smaller institutions in advancing research and discovery.

## THE FUTURE OF WORK: WHAT'S NEXT STARTS NOW

**Jennifer Fischer,** Executive Director, Center for Innovation and Professional Studies, Felician University

This presentation will cover three areas of content to improve attendees' knowledge of and attitudes toward Future of Work trends and technology innovation. To provide a high value experience for this audience, the presentation will be tailored for Education, Government and Healthcare sectors. First, we will review how emerging technologies, such as AI and intelligent automation, are reshaping the ways in which work gets done, and what the anticipated impacts of this transformation will be. Second, we will examine strategies for the optimization of work, workforce, and workplace; and illustrate the positive effects that such changes can bring. Third, we will discuss a blueprint for action to assist leaders in creating the organizational support structures, including learning modalities and university partnerships, which are pathways to success with Future of Work initiatives. The goal is to provide attendees with a pragmatic approach to the opportunities and challenges ahead and empower them with an actionable plan to benefit from the enormous potential of these technological innovations.

# NJIT

# INSTITUTE FOR DATA SCIENCE

## THE 2020-21 DATA SCIENCE SEMINAR SERIES
## CONFIRMED SPEAKERS INCLUDE:

**SENJUTI BASU ROY**, NJIT

**YIFAN HU**, Yahoo Research Labs

**ADAM MCLAUGHLIN**, D.E. Shaw Research

**MICHAEL MAHONEY**, University of California Berkeley

**SRINIVAS ALURU**, Georgia Institute of Technology

**FRANCINE BERMAN**, Rensselaer Polytechnic Institute

**VIPIN KUMAR**, University of Minnesota

**JON KLEINBERG,** Cornell University

**MANISH PARASHAR**, NSF & Rutgers,
The State University of New Jersey

**RICK STEVENS**, Argonne National Laboratory

**VIKTOR PRASANNA**, University of Southern California

**LEMAN AKOGLU**, Carnegie Mellon University

**NARAYAN SRINIVASA**, Intel Labs

**HELEN BERMAN,** Rutgers,
The State University of New Jersey

**CHANDRA BAJAJ,** The University of Texas at Austin

**STEVEN SKIENA**, Stony Brook University, SUNY

**JEANNETTE WING**, Columbia University

The New Jersey Institute of Technology (NJIT) Institute for Data Science is pleased to invite you to the 2020-21 Data Science Seminar Series. The speakers are thought leaders in academia and industry addressing emerging trends in data science. The seminars will be held virtually using Zoom every Wednesday from 4:00 pm - 5:00 pm Eastern.

**For additional information about the Data Science Seminar Series:**
datascience.njit.edu/contact-us

# NJIT
### New Jersey's Science & Technology University

**DAVID A. BADER**
Distinguished Professor, Computer Science,
Director, Institute for Data Science

# Edge.Discovery
RESEARCH CONNECTIVITY · COLLABORATION · PARTNERSHIPS

**For information about EdgeDiscovery:**
research@njedge.net

# IMAGINE THE POSSIBILITIES

Combining the Network Power of **Edge.net**

with the Research Opportunities of **Edge.Discovery**

RESEARCH CONNECTIVITY · COLLABORATION · PARTNERSHIPS

Esports has exploded into the higher education market, with hundreds of institutions now sustaining varsity teams, clubs, on-campus competitions, or a combination of all three.

For institutions looking to differentiate themselves from the competition, a thriving esports program can serve as an opportunity to generate revenue, bolster recruitment, and develop a reputation as a leader in an emerging field.

Esports has grown exponentially in recent years, it is a phenomenon that is both digital and global, and the topic becomes increasingly relevant in academic research. Despite its tremendous popularity and commercial support, esports is not widely understood. To understand esports it is necessary to research the phenomenon of competitive gaming with regard to health and performance, in-depth research of the social impact, the evolution of esports as well as the current and future role of esports in society, resulting in a better understanding of esports and guiding its development as a credible, competitive entity.

**Are you ready to step onto the playing field
as your next laboratory?**

**Engage with the EdgeDiscovery team via
Research@Edge.net.**

# WE INVITE YOU TO JOIN US
# ON OUR JOURNEY AT **NJEdge.net**

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## THE REGION'S NONPROFIT TECHNOLOGY PARTNER

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