

FACULTY OF COMPUTER SCIENCE 2025

RESEARCH REPORT



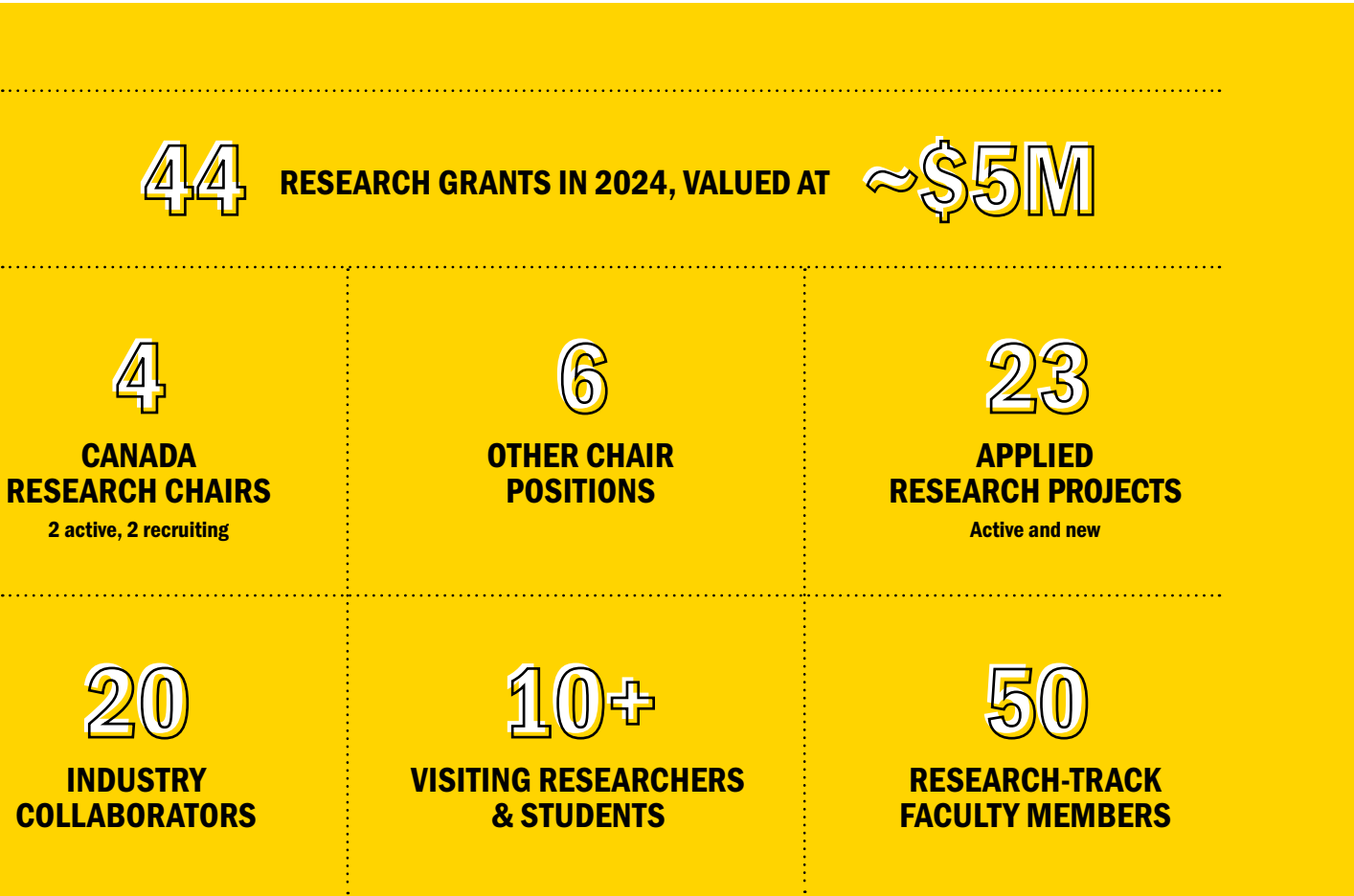
DALHOUSIE
UNIVERSITY

RESEARCH CLUSTERS

OVERVIEW

Our research strengths intersect across disciplines from oceans and agriculture to healthcare and the arts. We organize our faculty’s research by cluster:

- Artificial Intelligence, Big Data Analytics & Machine Learning
- Systems
- Algorithms & Bioinformatics
- Human-Computer Interaction, Visualization & Graphics
- Computer Science Education



Andrew Rau-Chaplin

Dean of Computer Science



We in Computer Science are at an incredible inflection point in our field; the expanding capacity of artificial intelligence to transform knowledge work across sectors is as exciting as it is fascinating. Large language models are driving research projects across our Faculty, from

cybersecurity to health data transformation and human-computer interaction. New opportunities abound, and our researchers are at the forefront of exploring new and innovative applications of machine learning across subdisciplines.

2024 was a banner year for Computer Science at Dal. We hired seven new researchers who bring even more diversity to the Faculty, both in terms of representation and research breadth. Translational and applied research within our Faculty covers everything from the depths of the ocean to the depths of space, and has real-world impacts on health, law, ocean health, and myriad other sectors. With successes such as the NSERC CREATE cybersecurity training program launching in October, and Dr. Rita Orji’s groundbreaking research earning her the prestigious Arthur B. McDonald Fellowship, our researchers are doing interesting and crucial work right here at Dal.

This report provides a snapshot of that work, and I think you’ll agree that our future is bright. I am excited to see where this momentum takes us.

Nur Zincir-Heywood

Distinguished Research Professor and Associate Dean, Research



At Dalhousie’s Faculty of Computer Science, we’re dedicated to training generations to come with a diverse and inclusive approach at the forefront of our research.

The spectrum of early-career and established faculty members continues

to strengthen and evolve, successfully covering the breadth and depth of computer science as a discipline. These include not only Research Chair-ships awarded, grants funded, and governmental, non-governmental, and industrial partnerships established, but also the recognition FCS researchers have received at the university, provincial, national, and international levels. Hats off to FCS!

Robert Beiko

Professor, Acting Associate Dean, Research, 2024



Our mission in FCS is to do exceptional research at the leading edge of a rapidly shifting technological landscape while never losing sight of the fundamentals. The disciplines we cover – some of which didn’t even exist ten years ago! – enable partnerships that

produce economic impact and social good, and create a world of new opportunities for our students. The next few pages showcase a subset of the exceptional projects and people we are proud to support.



Researchers in this cluster tackle important problems and develop real-life applications, harnessing technologies to extract insights and use data in a way made possible through dramatic advances in computing. With expertise in sectors including oceans, defense, aerospace and healthcare, areas of research focus include AI, text data, data mining, knowledge management, natural language processing, and deep learning.

FEATURED RESEARCHER

Carlos Hernandez Castillo

Dr. Carlos Hernandez Castillo thinks the human brain is the most amazing computational device in our world. In his lab, researchers develop and apply artificial intelligence techniques to understand brain function and to help in the diagnosis of neurological disorders. His specialties include neuroimaging, movement disorders, neuroscience, and computer vision.

Castillo led a [recent study](#) examining the occurrence of neurological effects — or “brain fog” — experienced by some people who suffered serious COVID-19 infections. His team uses magnetic resonance imaging (MRI) to see the anatomy and functionality of the brains of participants and apply cognitive tests to see how they perform on a wide variety of different tasks. Preliminary data shows approximately 15% of survivors might go on to develop cognitive or neurological deficits.



FEATURED RESEARCH PROJECT

Mooanalytica



Dr. Suresh Neethirajan can tell how farm animals are feeling. His research focuses on developing leading-edge, innovative technological solutions that improve the digitization of farm animals’ health and welfare. He is developing a mobile app, called [Mooanalytica](#), that allows farmers to monitor the overall health and emotional wellbeing of their cows, chickens, horses, and pigs.

He collects biological data first (such as cortisol levels, temperature, heart rate) and then pairs it with audio and visual recordings of animal vocalizations and movements, making sure to contextualize everything in terms of good experiences (food) and negative ones (sudden noises). He then uses natural language processing to process the data, including a deep learning model that performs facial recognition and gait analysis in livestock.

Neethirajan and his team are also collaborating with local Mi’kmaw knowledge keepers to harmonize western and Indigenous wisdom to fully understand the farm animal experience.

AWARDS



FRANK RUDZICZ,
*Killam Memorial Chair
Established Leader
CIFAR Chair in AI, Faculty
Affiliate, Vector Institute
for AI*

Killam Memorial Chairs are awarded to academics of the highest distinction at Dalhousie. Rudzicz’s pioneering research is in AI’s intersection with healthcare.



SAGEEV OORE
*Faculty Affiliate,
Vector Institute for AI*
Sageev studies machine learning as it relates to music, audio, text, and images, studying

everything from its use to identify signs of depression in voice recordings to generating sheet music.



Whether it’s emerging wireless technologies, cybersecurity, blockchain, data privacy, software engineering, or cloud computing, researchers in the Systems cluster take an interdisciplinary approach in using technology to explore the real-world problems, and sometimes threats, faced by organizations and individuals in the ever-evolving technological landscape.

FEATURED RESEARCHER

Yujie Tang

Dr. Yujie Tang’s research focuses on advancing smart and sustainable transportation through the Internet of Vehicles (IoV). IoV enables vehicles to communicate with each other and with infrastructure to improve road safety, optimize traffic flow, and reduce energy consumption. Tang also explores technologies such as connected and autonomous vehicles and energy-efficient electric vehicle charging systems.

While much of Tang’s work focuses on advanced technologies like autonomous vehicles and Internet of Things (IoT) systems, a significant emphasis is on reducing energy consumption and designing systems that align with environmental goals. For instance, one of her ongoing projects focuses on reducing the energy consumed by vehicle communications, a key step toward creating environmentally friendly cities.

Ultimately, Tang’s goal is to design technologies that make our future cities not only smarter but also safer and greener, bringing together cutting-edge innovation and sustainability.



FEATURED RESEARCH PROJECT

Green AI



Dr. Tushar Sharma’s research focuses on sustainable AI and software engineering. He ensures the source code that builds and runs AI models is as clean and efficient as possible. When it’s not, he identifies the problem and fixes it.

Sharma’s **SMART Lab** recently published a study detailing how to measure an AI model’s energy consumption on a granular level by identifying which parts of the code are the most power hungry. In another study, his lab sifted through dozens of layers of code within AI models to “prune” tokens that were no longer relevant, useful, or effective.

The idea is to train the models more efficiently, so the electrical draw and subsequent emissions are reduced. “The ideal scenario is that we are reducing the energy required to train or operate these systems without sacrificing the benefits.”

AWARDS



SRINI SAMPALLI and **NUR ZINCIR-HEYWOOD** are leading a team of researchers who were recently awarded a **\$1.6M NSERC CREATE grant** to

fund cybersecurity research. Over the next six years, the program—called “A Multi-disciplinary Approach to Research, Education and Training in Cybersecurity for Emerging Technologies”—will collaborate with industry partners Calian and Field Effect to train highly qualified personnel at all levels of study.



SRINI SAMPALLI was awarded Digital Nova Scotia’s 2024 “**Thinking Forward Award**,” which is provincial recognition for an individual who

dedicates considerable time to mentorship and supporting the future talent pipeline.



ISRAAT HAQUE was recognized by her alma mater, the University of Alberta, with a **2024 Alumni Honour Award**.

Haque, a cybersecurity expert and systems developer, earned the award through a combination of her in-lab mentorship and her academic research on systems and security.

ALGORITHMS & BIOINFORMATICS

CLUSTER HEAD: ROB BEIKO



Algorithms and bioinformatics researchers develop tools that address real-world problems in medicine, the environment, industry, and beyond. Research in the cluster has supported government agencies such as the Public Health Agency of Canada and the Department of Fisheries and Oceans, as well as other FCS clusters. Several cluster members are affiliated with the Dalhousie Institute for Comparative Genomics.

FEATURED RESEARCHER Norbert Zeh



Dr. Norbert Zeh’s research is in algorithms and data structures, primarily on fixed-parameter tractability, or the idea that not all inputs are created equal. Traditional algorithms research aims to develop algorithms whose running

time grows slowly as inputs get bigger. But Zeh asserts that, for a wide range of problems, that’s not possible, and it’s not because of the size of the input — it’s the input’s structure.

To that end, Zeh is interested in the ideas behind algorithms; what sets one apart from another and

why authors used certain approaches over others. For Zeh, it’s not about an abstract measurement of “better,” but showing how to exploit the structure of the problem and offer novel ways to obtain solutions.

“Those who think that computer science is all about writing code may be surprised that, with a few notable exceptions, if you want to do anything interesting with computers, it is all non-trivial and beautiful math under the hood,” he says.

Zeh says attracting students interested in algorithms research can be difficult, but he’s pleased to see the field diversifying, especially among women, who make up half of the students who have expressed interest in studying with him for summer 2025.

FEATURED RESEARCH PROJECT MicroScape



Cluster members are involved in the Institute for Comparative Genomics MicroScape program, which provides genomics education and outreach to P-12 students through workshops, public events, and other activities, with a focus on the unseen world of microorganisms.

PhD student David Mahoney and cluster member Dr. Rob Beiko participated in two biodiversity-themed days at the Discovery Centre in Halifax. Mahoney introduced visitors to the importance of bacteria and their genomes to plant health, while Beiko showed how DNA sampled from the environment can tell us about an unseen world of biodiversity in every habitat on Earth.

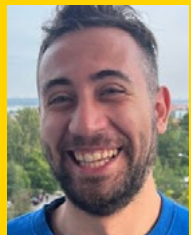


AWARDS



DR. FINLAY MAGUIRE, assistant professor cross-appointed with the Faculty of Medicine, won the 2024 Discovery Award for Emerging Professional for his research into

applying data-intensive methods to tackle critical health challenges, particularly using DNA data to improve infection diagnosis, treatment, and prevention.



NICOLA COTUMACCIO, a PhD student co-supervised by cluster member Travis Gagie, Professor Nicola Prezza from Ca’ Foscari University of Venice, and

Professor Catia Trubiani at the Gran Sasso Science Institute, won the **Best Italian PhD Theses in Theoretical Computer Science** award for 2024.

HUMAN-COMPUTER INTERACTION, VISUALIZATION & GRAPHICS

CLUSTER HEAD: DEREK REILLY



From healthcare to new media, researchers in this cluster connect computer science with human-centered disciplines, including psychology, health, sociology, anthropology, art and design, and develop technologies that advance the interfaces between humans and computers, making technology more useful, effective and enjoyable.

FEATURED RESEARCHER

Mayra Donaji Barrera Machuca



Mayra Donaji Barrera Machuca is an assistant professor in Dal's Faculty of Computer Science and leader of the VERTEX Lab, which focuses on understanding how people think when working in a 3-D virtual environment.

The lab's current projects

involve designing new 3-D user interfaces for 3-D sketching, understanding perception issues in virtual environments, and studying skills transfer between virtual reality and real life, and vice versa.

In her research lab, Machuca and her team design and develop novel multimodal user interfaces for 3-D sketching. Their work aims to reduce user error while drawing without affecting the user experience.



FEATURED RESEARCH PROJECT

Graphics Interface 2024

Graphics Interface (GI) is an annual international conference devoted to computer graphics and human-computer interaction (HCI), held in June 2024 in Halifax and chaired by FCS's Derek Reilly, and supported by many other cluster members.

GI is the longest-running conference in the field (the first conference was held in 1969), consistently attracting high-quality submissions from graphics, HCI, as well as visualization. The 2024 conference included programming about expressive facial modelling and animation, tangible and haptic interaction, mobile and persuasive technologies, and data rendering, among other topics.

All paper submissions to GI are rigorously peer-reviewed by at least three members of the international program committee, ensuring high-quality research. Awards are also given out each year, highlighting the best of student papers, doctoral dissertations, and research achievements. GI 2025 will be held in Kelowna, B.C.



AWARDS



DR. RITA ORJI was one of 10 national recipients of the **2024 Arthur B. McDonald Fellowship**, NSERC'S most prestigious award for early-career researchers. The

fellowship recognizes Orji's groundbreaking work in novel personalized and adaptive digital interventions powered by artificial intelligence and machine learning and is accompanied by a research grant of \$250K over the next two years.

COMPUTER SCIENCE EDUCATION

CLUSTER HEAD: ERIC POITRAS



Researchers and instructors in the Computer Science Education cluster develop, implement, and evaluate innovative teaching solutions and effective tools to support CS instruction. Collaborating with other clusters, they conduct empirical research in areas such as data mining and analytics to improve teaching and learning, instructional methods for enhancing learning, and studying the underrepresented student experience to identify opportunities for improvement, among other areas of study.

FEATURED RESEARCHER Angela Siegel



As Assistant Dean (Academic Outreach), Dr. Angela Siegel leads initiatives designed to bridge gaps between the university, industry, and communities. One of her key initiatives focuses on providing youth with opportunities to explore computer science through programs like Nova Scotia's High Skills Major program, which sees high school students earn a certificate of recognition by completing computer science-related courses and engaging in career exploration and community-based learning.

Siegel's research complements her outreach efforts by focusing on diversifying pathways into computer science and improving the learning experience. Siegel's current work includes exploring the factors influencing students' decisions to pursue or not pursue computer science. Her broader research portfolio explores foundational values in K-12 computing education, how AI coding assistants and learning analytics enhance student engagement and skill acquisition in programming courses, the transformative impact of the COVID-19 pandemic on computer science education and the lessons learned that support future resilience in teaching, and strategies for supporting students' transition to higher education in computer science.

FEATURED RESEARCH PROJECT Scholarship of Teaching and Learning in Computing Education

Dr. Raghav Sampangi, Gabriella Mosquera, and Dr. Eric Poitras are exploring the sense of belonging in computing education, focusing on the challenges first-year undergraduates face when transitioning from high school to university. Their research employs a survey to study how students' perceived challenges evolve over the semester, paired with thematic and quantitative analysis to uncover patterns and insights.

The study includes BCS and BACS students, examining links between these challenges, academic outcomes, and their overall sense of belonging. By contextualizing student feedback, the research aims to enhance instructor awareness and foster inclusive, supportive computing classrooms that empower students in their academic journeys.



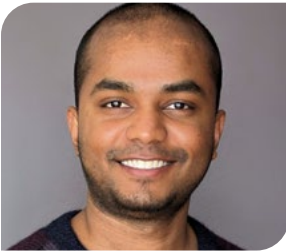
AWARDS



GABRIELLA MOSQUERA was awarded the 2024 Dal Legacy Award for Teaching Excellence in Online/Blended Course Development, Design, and Delivery. This award celebrates her exceptional contributions to the design and delivery of online and blended courses. Mosquera is known for her course designs that adhere to the Core Principles of effective teaching, which include accessibility and inclusivity, flexibility, interactivity, clear communication, instructor presence, and comprehensive support for students.

NEW FACULTY MEMBERS

In 2024, our faculty welcomed seven new faculty members from across the country and around the world, bringing their premier research and teaching experience to Halifax.



JANARTHANAN RAJENDRAN
Assistant Professor
Reinforcement Learning, Deep Learning



GABRIEL SPADON
Assistant Professor
Data Mining, Geoinformatics, Network Science



MARTA KRYVEN
Assistant Professor
Cognitive Psychology, Computational Models of Behaviour



F. E. BORDELEAU
Assistant Professor
Management of Information, Data Analytics



OLADAPO OYEBODE
Assistant Professor
Human-Centred AI, Digital Health, Persuasive Tech



NILS WILDE
Assistant Professor
Robotics, Autonomous Systems



HANIEH SHAKERI
Assistant Professor
Ubiquitous Computing, Design Research

RESEARCH CHAIRS

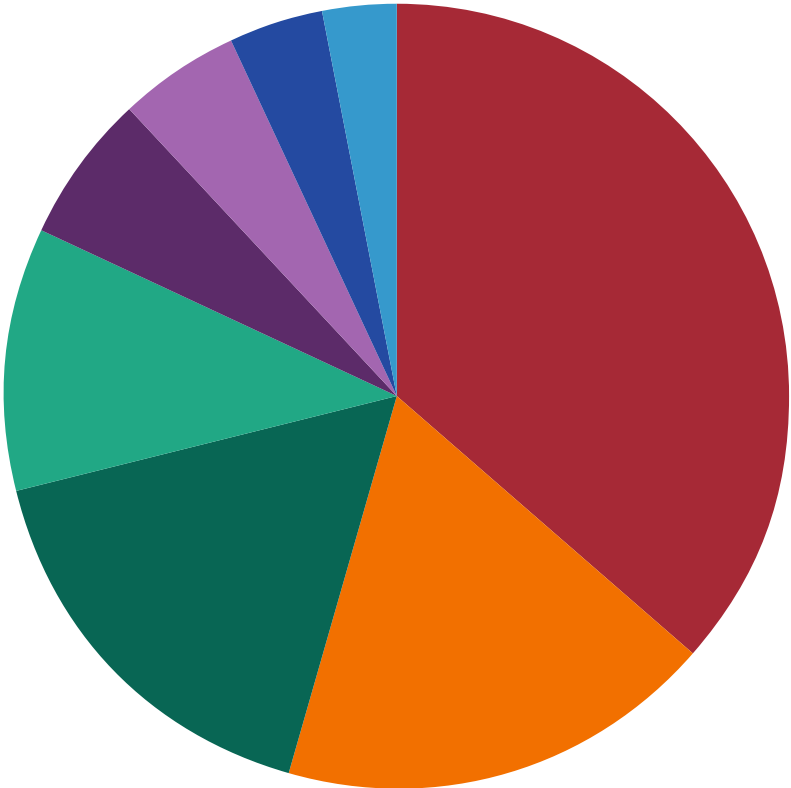
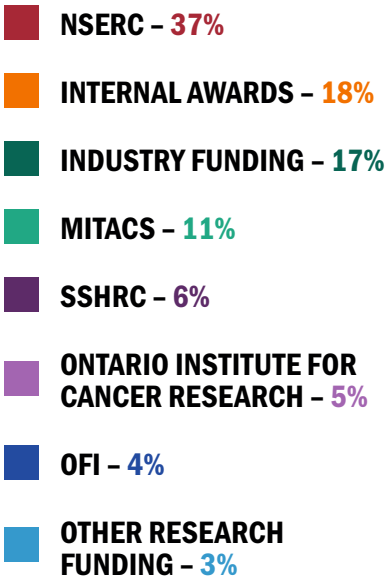
The Faculty of Computer Science currently has two active Canada Research Chairs, Carlos Hernandez Castillo (Tier 2 CRC in Artificial Intelligence for Health) and Rita Orji (Tier 2 CRC in Persuasive Technology), two nominees, and we are recruiting for two more. The CRC program supports excellence and leadership in research, with the Tier 2 level focused on exceptional early-career researchers.

OTHER CHAIR POSITIONS

- Suresh Neethirajan**
University Research Chair – Established Scholar
- Samer Lahoud**
University Research Chair – Established Scholar
- Chris Whidden**
DeepSense/Cove Digital Ocean Research Chair

- Janarthanan Rajendran**
Sexton Chair in Reinforcement Learning
- Manuel Mattheisen**
University Research Chair – Established Scholar
- Frank Rudzicz** – Canada CIFAR Chair in AI
– Killam Memorial Chair, Established Leader

TYPES OF RESEARCH FUNDING



GROUPS AFFILIATED WITH THE FACULTY OF COMPUTER SCIENCE

- | | | |
|--|---|---|
| CANSSI Atlantic (Canadian Statistical Sciences Institute) | College of Digital Innovation | Institute for Comparative Sustainable Software |
| Centre for Cyber Resiliency | DeepSense | ShiftKey |
| Clean Technologies Research Institute | Genomics | |
| | Institute for Big Data Analytics | |



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If you're interested in further information about the research happening in FCS, please reach out.

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