# University of Toronto
# Research Expertise

## *Artificial Intelligence/Machine Learning*



**Mar 2023**

# U of T Global Rankings

| #1 in Canada  \|  #18 worldwide | #1 in Canada  \|  #34 worldwide |
|---|---|
| THE World University Rankings (2021-2022) | QS World University Rankings (2021-2022) |

## A POWERHOUSE FOR INNOVATION & ENTREPRENEURSHIP

### 600 Startups

More than **$2.5B** in investment secured by **600+** startups over the past decade.

### 350+ Private Sector Partners

U of T's global reputation as a top research university and its vibrant innovation and entrepreneurship culture attracts industry partners from across Canada and worldwide.

### 1000+ Patent Applications

U of T is a leader among North American universities for research-based startups, inventions, licenses and options.

## U of T EXPERTISE IS SOUGHT BY GLOBAL GIANTS

U of T Faculty and Alumni are hired by some of the most influential tech companies worldwide
*(This graphic depicts engagements over the past several years, but may not reflect current status in all cases.)*
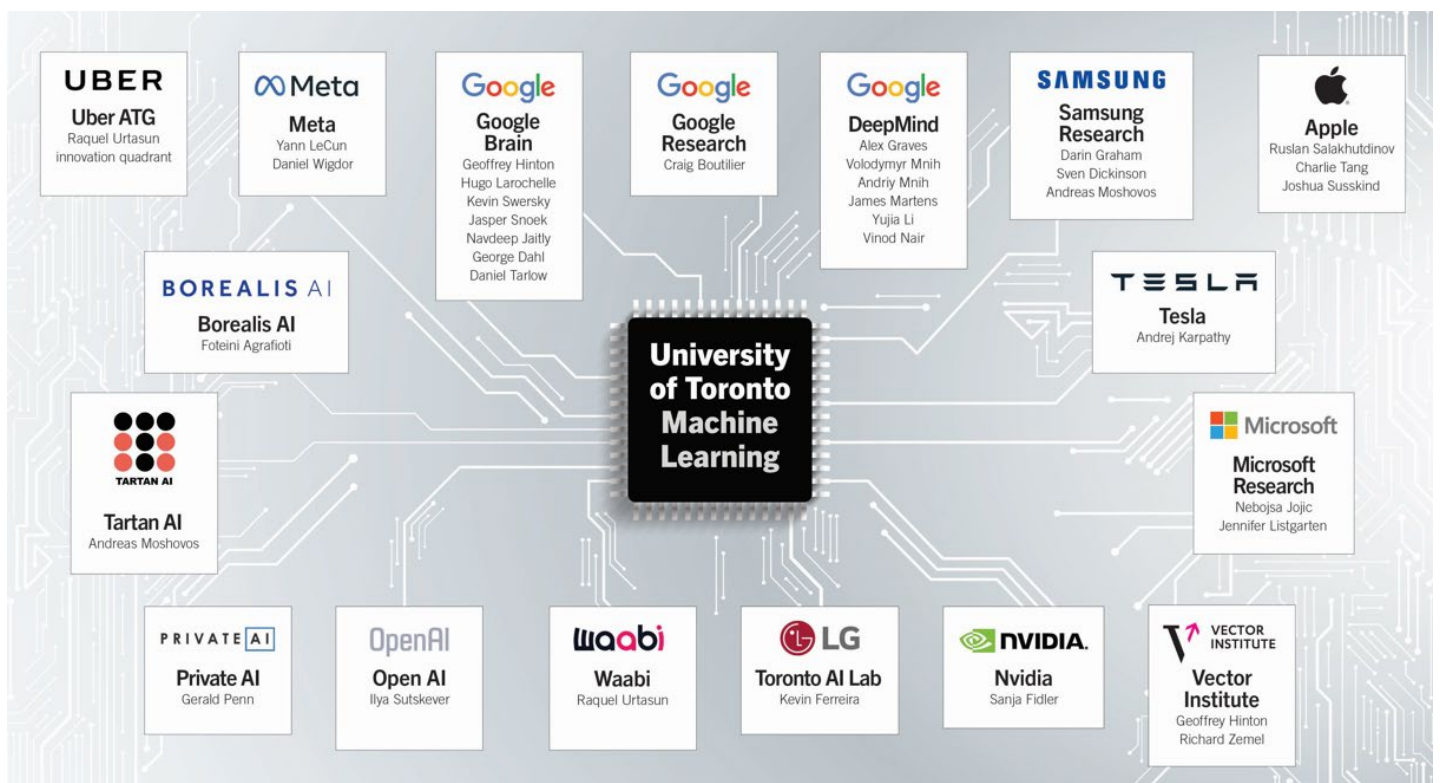
# Impact Stories



[U of T scientists use AI to fast-track drug formulation development](#)

Jan 11, 2023



[Researchers use AI-powered database to design potential cancer drug in 30 days](#)
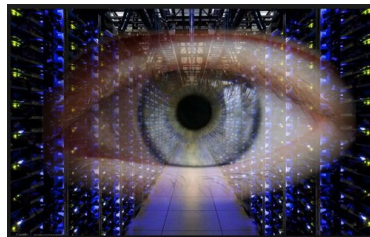
Jan 19, 2023



[U of T's Alán Aspuru-Guzik on self-driving laboratories that use robotics, AI to automate routine parts of experiments](#)
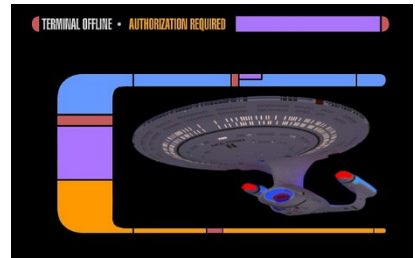
Oct 9, 2020



[U of T expert helps lead consultations with Canadians on digital and data transformation](#)
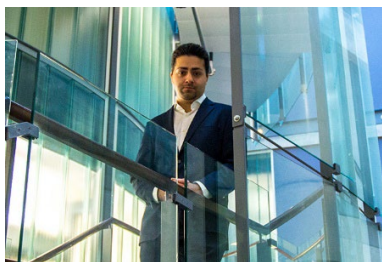
Aug 20, 2018



[Researchers at U of T and LG develop 'explainable' artificial intelligence algorithm](#)

Mar 31, 2021



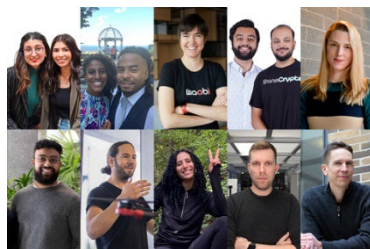[Tea, Earl Grey, hot! U of T researchers examine how Alexa, Siri stack up against Star Trek](#)
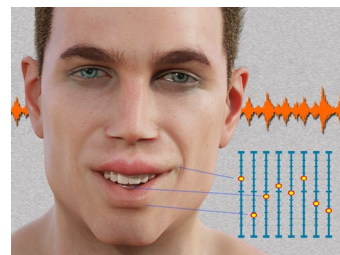
Mar 23, 2021



[U of T researcher launches group to help detect hidden biases in AI systems](#)

Jul 5, 2021



[U of T Entrepreneurship Week 2023: Top 10 startups to watch](#)

Mar 2, 2023



[U of T startup draws on AI, linguistics to power facial animation in video games](#)

Apr 30, 2021

# Table of Contents

# INITIATIVES – KEY RESEARCH CENTRES AND INFRASTRUCTURE

With internationally recognized strengths across a wide breadth and depth of disciplines, the University of Toronto is one of the few global institutions able to implement innovative strategic initiatives that span fields and faculties.

Institutional Initiatives are large-scale, cross-divisional research centres supporting interdisciplinary teams of University of Toronto researchers and partners, addressing grand challenges and pursuing bold ideas that require true collaboration and the integration of various disciplinary research approaches.

These are just some of the collaborative initiatives we are supporting.

## Schwartz-Reisman Institute for Technology and Society
https://srinstitute.utoronto.ca/

The Schwartz Reisman Institute draws on U of T's signature strengths in the sciences, humanities and social sciences to explore the benefits and challenges that AI, biotechnology and other technological advances present for our economy, our society and our day-to-day lives.

## Centre for Analytics and Artificial Intelligence Engineering (CARTE)
https://www.engineering.utoronto.ca/carte/

The **Centre for Analytics and Artificial Intelligence Engineering (CARTE)** brings together more than 30 professors with expertise in optimization, analytics and AI, as well as diverse domains such as energy, transportation and life sciences.  Artificial intelligence (AI) is increasingly part of our daily lives, with applications from voice-activated assistants to self-driving cars — and its influence continues to grow. This multidisciplinary research centre leverages the power of AI to address challenges in a wide range of fields, including human health, sustainability and advanced manufacturing.

## University of Toronto Data Sciences Institute
https://datasciences.utoronto.ca

The **Data Sciences Institute (DSI)** is a multi-divisional tri-campus multidisciplinary hub for data science activity at the University of Toronto. DSI facilitates research connections, fosters innovation, and enhances teaching and learning in data sciences, including in emerging data-driven disciplines with a highly collaborative, inclusive approach.  It unites researchers and trainees from within U of T and its affiliated research institutes, industry, and beyond, to facilitate data sciences research, innovation, collaboration, and training; all to translate promising ideas into real-world solutions and to advance the data sciences.  It is ideally placed to capitalize on U of T's data science leadership in a city renowned for its digital expertise.

## Acceleration Consortium
https://acceleration.utoronto.ca

The **Acceleration Consortium** is leading a paradigm shift in scientific discovery through the development of self-driving artificial intelligence-guided robotic labs that accelerate the discovery of advanced materials and small molecules, from decades to years.  The consortium addresses fundamental topics, such as deep learning algorithms, materials modelling, and robotics and applied challenges, such as discovering materials for a wide range of commercial applications.  The Acceleration Consortium supports a commercialization-focused ecosystem that aims to translate materials discoveries through start-ups and industry partnerships.

## A3MD
https://light.utoronto.ca/a3md/

The **Alliance for AI-Accelerated Materials Discovery** (**A3MD**) seeks to leverage the power of artificial intelligence to design the next generation of high-performance materials. Uniting recent advances in machine learning and high-throughput experimentation, the team seeks to accelerate the discovery and commercialization of new, efficient catalysts and consumer electronic materials. A3MD brings together world-leading researchers from the University of Toronto, McMaster University and the National Research Council of Canada, as well as industrial partners LG and Total.

## University of Toronto Robotics Institute
https://robotics.utoronto.ca

The **University of Toronto Robotics Institute** is home to the largest and most diversified robotics research program in Canada. We unite, grow, and catalyze collaborations among the many exceptional robotics research clusters at the University. Serving as the headquarters for robotics collaboration at U of T, we unite leading robotics experts from across the University around three research pillars: Autonomous Field Robotics; Healthcare Robotics; Advanced Manufacturing.

## UofT Transportation Research Institute (UTTRI)
https://uttri.utoronto.ca/

Faculty members at the **University of Toronto Transportation Research Institute (UTTRI)** specialize in systems analysis and policy evaluation, and are leaders in building and applying cutting-edge computer simulation models to the analysis and design of complex transportation systems.  U of T  has an internationally recognized critical mass of researchers with extensive experience in the analysis, planning and design of urban transportation systems,  covering roads, transit, freight and active transport modes (walk and bike) across a range of perspectives – travel behaviour, system performance, economics and environmental impacts.  We have extensive experience with comprehensive, system-wide, evidence-based policy analysis and decision support, leading to successful transportation facilities implementation and operations.

## Centre for Quantum Information and Quantum Control (CQIQC)
https://cqiqc.physics.utoronto.ca/

The **Centre for Quantum Information and Quantum Control (CQIQC)** is tasked with promoting research collaborations in the rapidly evolving interdisciplinary fields of quantum information and quantum control. CQIQC's activities at the University of Toronto encompass the Departments of Chemistry, Physics, Mathematics, Computer Science, Electrical Engineering, and Materials Science. CQIQC members are involved in a variety of theoretical and experimental activities, including coherent control, quantum optics, quantum cryptography, quantum decoherence-control, and quantum algorithms.

## School of Cities
https://www.schoolofcities.utoronto.ca/

The **University of Toronto School of Cities** convenes urban-focused researchers, educators, students, practitioners and the general public to explore and address complex urban challenges. The interdisciplinary research is conducted with the aim of making cities and urban regions more sustainable, prosperous, inclusive and just.

## School of the Environment
https://environment.utoronto.ca/
The **School of the Environment** serves as an interdisciplinary hub for education and scholarship on the environment and sustainability. We create new knowledge; train future leaders; engage and forge partnerships with the wider community; and contribute to positive environmental and social change from the local to the global scale.


## Climate Positive Energy
https://cpe.utoronto.ca/
The Climate Positive Energy Initiative reflects the University of Toronto's response to Canada's formal commitment to achieving Net-Zero Greenhouse Gas emissions by 2050. It currently includes more than 100 faculty members from a wide range of fields, from anthropology to electrical engineering to public policy, developing clean-energy solutions that are mindful of political, human, and societal considerations.


## University of Toronto Electric Vehicle Research Centre (UTEV)
https://utev.utoronto.ca/
**The University of Toronto Electric Vehicle (UTEV) Research Centre** is a game-changing university-industry partnership, focused on next generation of EV technologies. Research is focused in a state-of-the-art battery and power electronics lab, with multi-disciplinary collaborations alongside leading professors from Electrical and Computer Engineering, as well as from other engineering units.  In partnership with Industry and Government partners, UTEV researchers study Energy Management and Storage, Advanced Power Modules, Next-generation powertrain, Ubiquitous Charging, and generally new opportunities for EVs.

The UTEV Centre will also be linked to the nascent **University of Toronto Electrification Hub,** bringing together Engineering, Public Health, Urban Planning, Cybersecurity, and Anthropology experts to contribute to the electrification revolution with multidisciplinary research and innovations on material discovery, batteries, chargers, and stationary energy storage, in collaboration with Canada's fast-growing e-mobility sector.

# U of T RESEARCHERS

*This is not intended as an exhaustive list of our faculty members in this field, but highlights some of our relevant researchers. Appearance on this list should not be interpreted as indicative of any individual's availability for a specific external engagement*

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## Alán Aspuru-Guzik



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| **University Affiliations:**<br>Computer Science<br>Chemistry<br>CQIQC<br>Chemical Physics Theory Group<br>Vector Institute<br>Acceleration Consortium | |
| **Website:**  Alán Aspuru-Guzik | |
| **Keywords:**<br>AI/ML<br>Quantum Computing algorithms<br>High-performance computing<br>Robotics<br>Self-Driving laboratories<br>Molecular materials discovery<br>Energy & functional materials | |

Alán Aspuru-Guzik researches the interfaces of quantum information, chemistry, machine learning and physics. He was a pioneer in the development of algorithms and experimental implementations of quantum computers and quantum simulators dedicated to chemical systems. He has studied the role of quantum coherence in the transfer of excitonic energy in photosynthetic complexes, accelerating the discovery by calculating organic semiconductors, organic photovoltaic energy, organic batteries and organic light-emitting diodes.

Professor Aspuru-Guzik is currently the **Canada 150 Research Chair in Quantum Chemistry** as well as a **CIFAR AI Chair at the Vector Institute**. He is a **CIFAR Lebovic Fellow** in the **Biologically Inspired Solar Energy** program, and also holds a **Google Industrial Research Chair in Quantum Computing**.  He is the **Director** of the **Acceleration Consortium**, using AI in pre-competitive discovery research.

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## Gary Bader

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| | **University Affiliations:**<br>Computer Science<br>Molecular Genetics<br>Donnelly Centre for Cellular & Biomolecular Research<br>Data Sciences Institute |
| | **Website:** Gary Bader |
| | **Keywords:**<br>Computational Biology<br>Big Data |

Gary Bader and his team study the organization and evolution of biological systems using computational biology and bioinformatics, using comprehensive genomics data such as gene sequences and transcript profiles. In lay terms, they use AI to track and analyze the millions of molecular interactions within cells to assist in determining how the individual relationships fit as part of the larger structures and processes used by healthy living cells. This produces huge datasets; understanding how these systems work will make it easier to determine where the breakdowns occur in disease situations, and how to prevent/cure them.

Professor Bader is the **Associate Director, Data Management . Research software, Advanced Research Computing** at the UofT **Data Sciences Institute (DSI)**.  In addition to his work at UofT, he is associated with the **Princess Margaret Cancer Centre**, and the **Lunenfeld-Tanenbaum Research Institute** at **Mount Sinai Hospital**.

## Timothy Barfoot

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| | **University Affiliations:**<br>U of T Institute for Aerospace Studies<br>Autonomous Space Robotics Lab<br>U of T Robotics Institute<br>CARTE<br>Vector Institute (Affiliate Member) |
| | **Website:** Tim Barfoot |
| | **Keywords:**<br>AI/ML<br>Robotics<br>Computer vision<br>Autonomous systems |

Tim Barfoot pioneered a visual navigation stack for autonomous robots called "Visual Teach & Repeat," enabling robots to navigate long paths (kilometers) using a single sensor under a variety of conditions.  First developed for planetary rovers, it has applications for autonomous vehicles in a terrestrial setting, now also using machine learning to simplify the task. His research can also be applied in warehouse, office, and military settings.

Professor Barfoot is also **Associate Director of the University of Toronto Robotics Institute.** He has recently been elected a **Fellow** of the **IEEE Robotics and Automation Society** for his contributions.

## Timothy Chan

| University Affiliations: |
| --- |
| Mechanical & Industrial Engineering<br>Centre for Healthcare Engineering<br>CARTE<br>Data Sciences Institute |
| **Website:** Tim Chan |
| **Keywords:**<br>Operations Research<br>Applied Optimization<br>AI/ML<br>Healthcare |

Tim Chan's primary research interests are in optimization under uncertainty and the application of optimization methods to problems in healthcare, medicine, global engineering, sustainability, and sports. He has advised leading global companies in the fields of medical device technology, travel and hospitality, telecommunications, and energy on issues of strategy, organization, technology and operations.

Professor Chan holds the **Canada Research Chair in Novel Optimization and Analytics in Health**. Until recently, he was **Director** of both the **Centre for Healthcare Engineering** and **CARTE**, and **Associate Director, Research and Thematic Programming** for the **UofT Data Sciences Institute**. He has recently been appointed **Associate Vice-President and Vice-Provost, Strategic Initiatives**.

## Sanja Fidler

| University Affiliations: |
| --- |
| Computer Science<br>Vector Institute<br>NVIDIA – VP of AI Research |
| **Website:** Sanja Fidler |
| **Keywords:**<br>AI/ML<br>Computer Vision<br>Autonomous systems<br>Robotics |

Sanja Fidler conducts her research in the realm of Computer Vision and Machine Learning, where her research interests are 2D and 3D object detection, with particular attention to scalable multi-class detection, object segmentation, image labelling, and comprehension of 3D scenes. She is also interested in the intersection of language and vision; having computers generate sentential descriptions of complex scenes. Also, using text descriptions for better scene parsing (as with describing and contextualizing human/robot interactions).

Professor Fidler was also founding **Director of AI** for **NVIDIA's Toronto AI Lab**, a position she held since 2018. In addition to her university post, she is currently **VP of AI Research** for NVIDIA.

## Mark S. Fox

| | **University Affiliations:**<br>Mechanical & Industrial Engineering<br>Computer Science<br>School of Cities<br>UTTRI<br>CARTE |
|---|---|
| | **Website:** Mark S. Fox |
| | **Keywords:**<br>Smart Cities<br>Sustainability<br>AI/ML<br>Urban Infrastructure |

Mark Fox is Distinguished Professor of Urban Systems Engineering and Professor of Industrial Engineering and Computer Science. He is also the Founding Director of the Centre for Social Services Engineering and the U of T Enterprise Integration Laboratory. His current research applies artificial intelligence to smart cities, and he has developed ontologies for the representation of city information and knowledge which are being adopted by cities around the world. Professor Fox is currently leading the Connaught-funded Urban Genome Project, a multidisciplinary initiative focused on understanding urban growth.

Professor Fox has extensive experience in the private sector. In 1984 he co-founded Carnegie Group Inc., one of the first companies to apply artificial intelligence to solving engineering, manufacturing, and telecommunications problems.

Professor Fox is a **Fellow** of the **American Association for Artificial Intelligence (AAAI)** and the **Engineering Institute of Canada**.

## Jonathan Kelly

| | **University Affiliations:**<br>U of T Institute for Aerospace Studies<br>Computer Science<br>CARTE<br>Vector Institute (Affiliate Member) |
|---|---|
| | **Website:** Jonathan Kelly |
| | **Keywords:**<br>AI/ML<br>Robotics<br>Computer vision<br>Autonomous systems |

Jonathan Kelly's research is focussed on developing robust autonomous systems able to operate independently over long durations in challenging environments: for example, in space and on remote planetary surfaces. His team carries out research at the nexus of sensing, planning, and control, with an emphasis on the study of fundamental problems related to perception, representation, and understanding of the world. Current research topics include: power-on-and-go sensor systems, energy-aware path planning for planetary rovers, and deep learning methods for reliable navigation under challenging conditions. Professor Kelly is also interested in 'bringing space robotics down to Earth,' by leveraging opportunities for technology transfer from space systems to terrestrial robots and autonomous systems. His research group seeks to develop robots that are Pervasive (deployed widely), Persistent (reliable over long duration), and Perceptive (aware of their environment).

Professor Kelly currently holds the **Canada Research Chair (Tier 2) in Collaborative Robotics**.

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## Ashish Khisti

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|  | **University Affiliations:**<br>Electrical & Computer Eng'rg<br>Communications Group |
| | **Website:** Ashish Khisti |
| | **Keywords:**<br>Computer Communications<br>Computer Security<br>AI/ML |

Ashish Khisti's current active research areas include communication systems, information theoretic security and machine learning. He directs the Signals, Multimedia and Security Laboratory – this research group targets applications in real-time streaming communication systems and physical layer security, with a focus on developing fundamental limits of algorithms and architectures for various applications. Security issues include such non-intuitive items as smart-meter privacy: inadvertently supplying utility providers with sensitive information about individual device usage through power consumption levels.

Prior to its recent expiry, Professor Khisti held the **Canada Research Chair in Network Information Theory**. He has served as editor on several **IEEE** journals
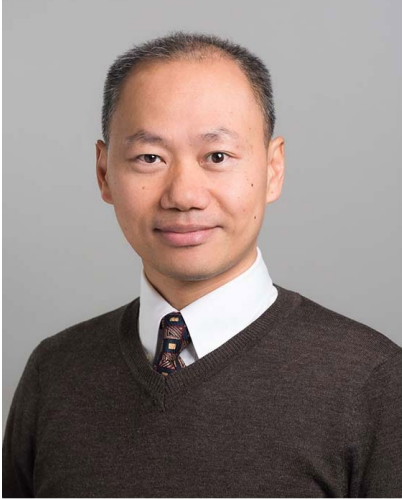
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## Chi-Guhn Lee

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|  | **University Affiliations:**<br>Mechanical & Industrial Engineering<br>Centre for Healthcare Engineering |
| | **Website:** Chi-Guhn Lee |
| | **Keywords:**<br>Operations Research<br>AI/ML<br>Healthcare |

Chi-Guhn Lee studies various problems in logistics; sequential decision making theories; financial theories applied in manufacturing and service sectors; market-driven conflict resolution; optimal pricing; marketing; information system control and design.  He has done both theoretical and applied research in dynamic optimization under uncertainty. His theoretical works involve accelerated value iteration algorithm for Markov decision processes, progressive basis-function approximation for value function space, multi-variate Bayesian control chart optimization, and optimal learning using Multi-armed Bandit Model. His interest in application is diverse from supply chain optimization to financial engineering, to dynamic pricing and to healthcare optimization.  He has recently integrated machine learning algorithms into his research: reinforcement learning, inverse reinforcement learning, and deep reinforcement learning.

Professor Lee holds positions as Associate Editor – **Enterprise Information System** and **International Journal of Industrial Engineering** and serves on other editorial boards.

## Ben Liang

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|  | **University Affiliations:**<br>Electrical & Computer Eng'rg<br>Communications Group |
| | **Website:** Ben Liang |
| | **Keywords:**<br>Computer Communications<br>Wireless Networks<br>Cloud Computing<br>Edge Computing<br>AI/ML<br>5G |

Ben Liang researches network systems and mobile communications. His current research looks into Resource management and optimization in wireless networks, fair resource scheduling in large-scale networked systems, and heterogeneous data communication for mobile cloud computing. He also conducts research into advanced machine learning techniques for network traffic classification, and distributed machine learning with mobile edge computing.

Professor Liang is a **Fellow of the IEEE** and a member of **ACM.**

## Andreas Moshovos

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|  | **University Affiliations:**<br>Electrical & Computer Eng'rg<br>Computer Engineering Group<br>Vector Institute (Affiliate Member)<br>CARTE |
| | **Website:** Andreas Moshovos |
| | **Keywords:**<br>Silicon Computing<br>High-performance computing<br>System Design<br>AI/ML<br>Computer Hardware |

Andreas Moshovos and his team investigate optimal design for computer processor and memory architecture, in terms of power, cost, complexity, and other parameters.  His designs for high-performance computers have influenced commercial designs of such chips. Currently, his focus is on optimizing hardware infrastructure as a platform to facilitate artificial intelligence software, specifically Machine Learning and Deep Learning. He leads COHESA, a Canada-wide strategic network researching Machine Learning hardware acceleration.

Professor Moshovos is a **Fellow of the ACM**, and has served as **Program Chair** for the **ACM/IEEE International Symposia** on both **Microarchitecture** and **Performance Analysis of Systems and Software**.

# Kostas Plataniotis

| | University Affiliations:<br>Electrical & Computer Eng'rg<br>Communications Group<br>CARTE<br>Multimedia Laboratory |
| --- | --- |
| | **Website:** [Kostas Plataniotis](#) |
| | Keywords:<br>Computer Communications<br>AI/ML<br>Human-Computer Interaction |

Kostas Plataniotis conducts research in the areas of image/signal processing, machine learning and adaptive learning systems, visual data analysis, multimedia and knowledge media, and affective computing. He focuses on human/machine interactions and user interface technologies, and is the director of the Multimedia lab.

Professor Plataniotis is a **Fellow** of **IEEE**, a **Fellow** of the **Engineering Institute of Canada**. He serves as the **General Co-Chair** of the **2021 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2021)**.

# Scott Sanner

| | University Affiliations:<br> Mechanical & Industrial Engineering<br>School of Cities<br>CARTE<br>UTTRI<br>Vector Institute (Affiliate Member) |
| --- | --- |
| | **Website:** [Scott Sanner](#) |
| | Keywords:<br>AI/ML<br>Big Data<br>Information Engineering<br>Smart Cities<br>Smart Home |

Scott Sanner's research spans a broad range of topics from the data-driven fields of Machine Learning and Information Retrieval to the decision-driven fields of Artificial Intelligence and Operations Research. He has applied the analytic and algorithmic tools from these fields to diverse application areas such as recommender systems, interactive text visualization, and Smart Cities applications including transport optimization. His Data-Driven Decision-Making Lab (D3M) re-envisions urban and consumer informatics from a data-driven decision-making perspective to forge sustainable, smarter cities and more efficient, consumer-responsive businesses.

Professor Sanner is a member of the Editorial Board for both the **Artificial Intelligence Journal (AIJ)** and **the Machine Learning Journal (MLJ)**, and Electronic Editor for the **Journal of Artificial Intelligence Research (JAIR)**.

## Lisa Strug

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|  | **University Affiliations:**<br>Statistical Sciences<br>Computer Science<br>Dalla Lana School of Public Health<br>Data Sciences Institute |
| | **Website:** Lisa Strug |
| | **Keywords:**<br>Biostatistics<br>Genetics<br>Big Data |

Lisa Strug focuses on statistical sciences, developing novel methodology to unravel the complex underpinnings of genetic diseases. Specifically, her work seeks to identify the genes contributing to Cystic Fibrosis, and then identifying novel therapeutic targets; ultimately leading to diagnostic and predictive models for early intervention. Professor Strug also is a Senior Scientist at the Hospital for Sick Children.

Professor Strug holds the **Canada Research Chair in Genome Data Science**, and serves as **Director** of the **Canadian Statistical Sciences Institute (CANSSI)** for Ontario Region. She is also the **Associate Director** of the **Centre for Applied Genomics**. She is the inaugural **Director** of the **UofT Data Sciences Institute (DSI)**.

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## Raquel Urtasun

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|  | **University Affiliations:**<br>Computer Science<br>Vector Institute<br>Waabi |
| | **Website:** Raquel Urtasun |
| | **Keywords:**<br>AI/ML<br>Computer Vision<br>Autonomous systems<br>Robotics |

Raquel Urtasun is a world leading expert in AI for self-driving cars. In 2017, she became Uber ATG Chief Scientist and the Head of Uber ATG Toronto. Her research interests include machine learning, computer vision, robotics, AI and remote sensing.

Professor Urtasun was a **co-founder** of the **Vector Institute** for AI/ML. After officially leaving Uber ATG, in 2021 she founded AI start-up Waabi, raising $100M in initial financing in record time. Her vision for Waabi is to leverage AI that can process the multiple inputs of urban driving situations, to expedite the development of self-driving vehicles. This research has progressed to both advanced training simulation and real-world testing on inter-city transport trucks.

Until accepting the external position with Uber, Professor Urtasun held the **Canada Research Chair in Machine Learning and Computer Vision**.

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## Nathan Wiebe

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|  | **University Affiliations:**<br>Computer Science<br>CQIQC |
| | **Website:** Nathan Wiebe |
| | **Keywords:**<br>Quantum Computing<br>Quantum Algorithms<br>AI/ML<br>Quantum Simulation |

Nathan Wiebe's research focuses on quantum algorithm development, in particular on quantum methods for machine learning and simulation of physical systems. He has developed the first quantum algorithms for deep learning, and pioneered the use of particle filters for characterizing quantum devices. This research blends the growing field of quantum computing algorithms with UofT's global leadership in the field of AI and Machine Learning.

Professor Wiebe has recently joined UofT's faculty, in the Department of Computer Science; and is aligned with CQIQC, the centre of quantum studies at the university.

# SELECT TECHNOLOGY OPPORTUNITIES

U of T has flexible IP terms available to sponsoring partners.  U of T's interest in IP developed through this research is "Inventors' Choice" where the inventors have the option to manage IP themselves, or to transfer IP to the university for management/commercialization (via the Innovations & Partnerships Office).

For all U of T technologies currently available for licensing, visit http://uoft.me/tech-opps


## Infera AI: Platform for Digital Twins and Better Decision Making
https://research.utoronto.ca/technology-opportunities/db/infera-ai-platform-digital-twins-and-better-decision-making
A software platform that leverages statistical inference and machine learning to make more informed decisions. Through a novel combination of deep Bayesian learning and Bayesian analytics, the platform delivers accurate prediction statistics for robust, quantifiable, and interpretable analytics to scenarios that were previously too expensive or too slow.


## Automatic Learning Filters to Improve the Accuracy of Sensing Algorithms
https://research.utoronto.ca/technology-opportunities/db/automatic-learning-filters-improve-accuracy-sensing-algorithms
The technology combines novel filters and a convolutional neural network model to automatically learn what kind of data will make an algorithm produce inaccurate results. While the idea of rejecting certain data is not new, existing filters are manually-developed and rely on assumptions about what causes the algorithm to be unreliable.  The approach applies machine learning methods to automatically learn when sensor processing algorithms will be reliable or unreliable and discards unreliable data, making the overall system more accurate.


## Deep Learning Performance and Energy Optimization Techniques
https://research.utoronto.ca/technology-opportunities/db/deep-learning-performance-and-energy-optimization-techniques
While algorithmic improvements will allow Deep Learning to evolve, much hinges on hardware's ability to keep delivering ever higher performance and data processing storage and processing capability.
This invention is a set of techniques that are valued-based methods for reducing the number of computations that need to be performed when executing Deep Learning Algorithms and do not require intervention from the Machine Learning expert.
By exploiting ineffectual computations, weight sparsity, precision variability, and bit content, the accelerator designs transparently reduce the amount of work that needs to be performed by neural networks. The methods lead to the design of performance-, energy-, and/or cost-optimized computing engines for various applications domains.
All work with out-of-the-box Deep Learning networks and rely on value properties exhibited by typical models such as value- and bit-sparsity and data type need variability, and reward model optimizations.


## Toronto Annotation Suite: AI-Powered Data Annotation
https://research.utoronto.ca/technology-opportunities/db/toronto-annotation-suite-ai-powered-data-annotation
We have developed algorithms that significantly speed up standard annotations for Computer Vision through human-in-the-loop AI models.  Using recurrent and convolutional neural networks, the algorithms assist human annotators through both annotation creation and editing, while simultaneously learning to continuously improve from human assistance.  These state-of-the-art algorithms are fully integrated in the Toronto Annotation Suite (TORAS), a web-based application that allows for larger, more efficient, and more accurate data annotation projects.

# SELECT AI/ML COMPANIES IN THE UofT COMMUNITY

**AfterData.ai**
https://www.afterdata.ai/
AfterData.ai is a software platform that uses Metadata Intelligence to help organizations create, maintain and distribute knowledge about data assets available for analytics.

**Black.AI**
https://www.black.ai/
Black is developing a distributed 3D perception stack to enable cashier-less shopping experiences for brick and mortar retail environments. Using Black's technology, retailers can monitor each visitor's movements and interactions, detecting the items a person picks up or puts down without the need to scan individualized SKUs at a level of granularity suitable for autonomy.

**Blue J Legal**
https://www.bluej.com/ca
Blue J Legal is on a mission to bring absolute clarity to the law, everywhere and on-demand. Its AI-powered platforms accurately predict court outcomes and allow practitioners to find relevant cases faster than ever before.

**Cohere**
https://cohere.ai/
The Cohere API provides access to models that read billions of web pages and learn to understand the meaning, sentiment, and intent of the words we use.

**DarwinAI**
https://darwinai.com/
DarwinAI has developed an engine that automatically generates highly optimized deep neural networks that are orders of magnitude smaller than comparable solutions, and with an 'explainable' ability to understand why a network makes decisions. The company's technology can achieve compacting ratios as high as 520:1 for specific network architectures without sacrificing functional accuracy.

**Datalogue**
https://www.datalogue.io/
Datalogue is tackling data preparation by combining computer vision and natural language processing techniques. Datalogue standardizes data, map ontologies, and join datasets. Using Datalogue, customers can unlock the full potential of data scientists, analysts, and developers by shifting their work to value-added tasks as opposed to data janitorial ones.

**Fleetops**
https://www.fleetops.ai/
Fleetops has created a marketplace that utilizes sensor data and artificial intelligence to match shipments with truck drivers who can deliver them. Through its partners, Fleet Ops has access to proprietary data about drivers and shipments, allowing for more matches and faster deliveries.

## Fluent.ai
https://www.fluent.ai/

Fluent.ai is pioneering disruptive machine-learning for multilingual voice interfaces. Fluent.ai's systems can provide high-recognition accuracy in any language, offline on-device speech recognition, and the ability to learn directly from the end user. The team has achieved this by developing a speech-recognition system that can directly map an incoming utterance to a user's intended action, without going through text.

## Galaxy.AI
https://www.galaxy.ai/

Galaxy.AI has built an AI solution that analyzes images and text data. Galaxy.ai provides real-time vehicle damage recognition for claims processing. Their solution offers clients such as insurance companies speed and scalability to process claims.

## JALI Research
https://jaliresearch.com/

JALI provides software and services for the complete automation of high end lip sync and facial animation with the option for ultimate animator directorial control. This system delivers the fastest and simplest animation curves providing higher quality and greater efficiency.

## Penfield.ai
https://www.penfield.ai/

Penfield is the industry's first human-machine intelligence platform, modelling Cybersecurity Analysts actions and processes in real time. The platform augments their workflows to improve speed, accuracy, knowledge sharing and automation of manual processes.

## Quantum Bridge Technologies
https://qubridge.io/

This technology includes a state-of-the-art encryption solution that leverages quantum technologies: Quantum Key Infrastructure (QKI). Distributed Symmetric Key Exchange (DSKE) is the industry's first scalable symmetric key technology, combining the scalability of PKI, the security of quantum key distribution (QKD) and the simplicity of pre-shared keys.

## Quantum Capture
https://www.quantumcapture.com/

Quantum Capture creates AI-powered virtual humans that enhance customer service, employee training, marketing, and entertainment applications.

## Untether AI
https://www.untether.ai/

Untether is tackling online content moderation using computer vision and AI to identify and track harmful images and videos. Aiming to make video as understandable to computers as text is right now, Unitary will allow content platforms to prevent the uploading and distribution of harmful content.

## Waabi
https://waabi.ai/

Waabi operates as a self-driving technology start-up, founded by the former head of Uber ATG, taking a new approach to multi-sensor, self-driving vehicles.