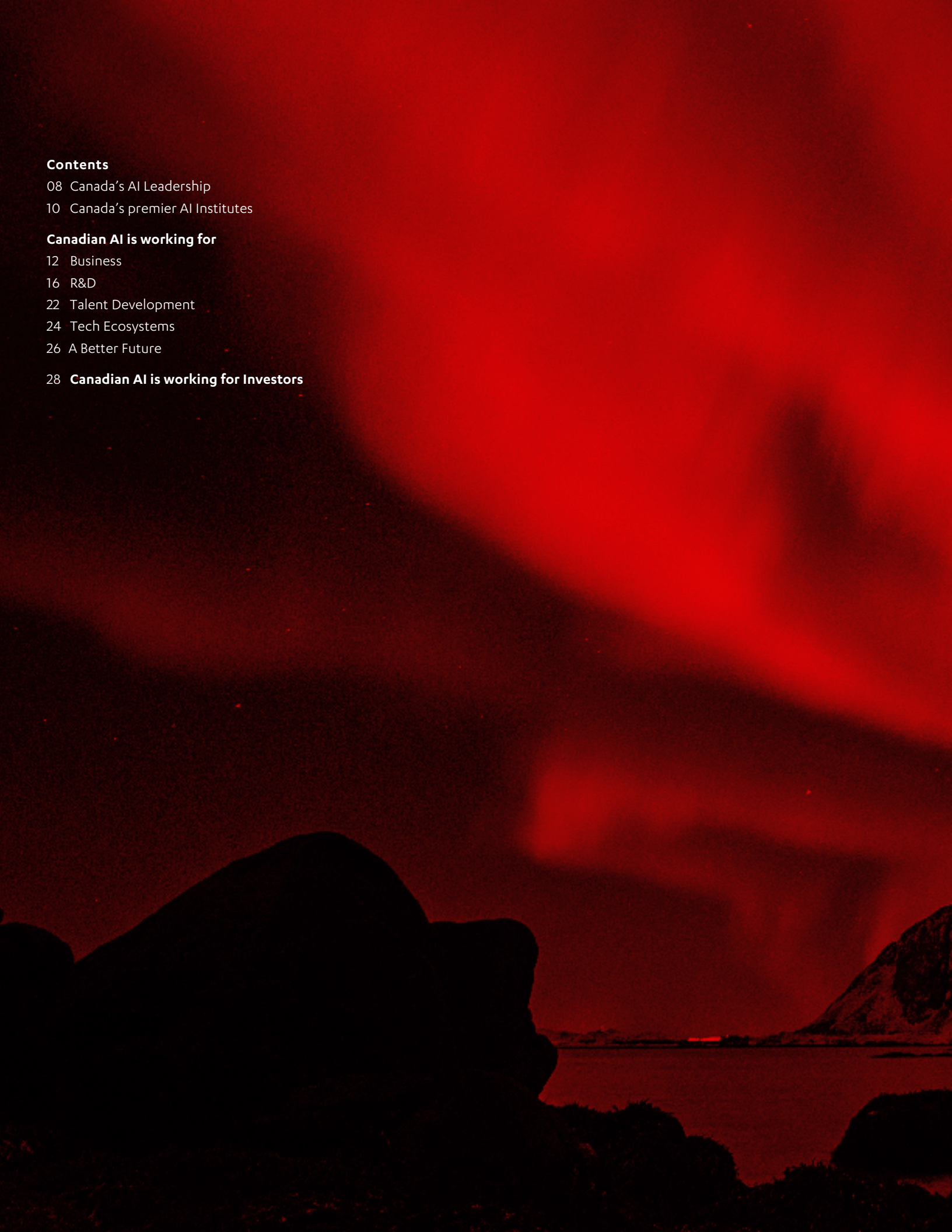
Canadian AI is working

# CANADAI



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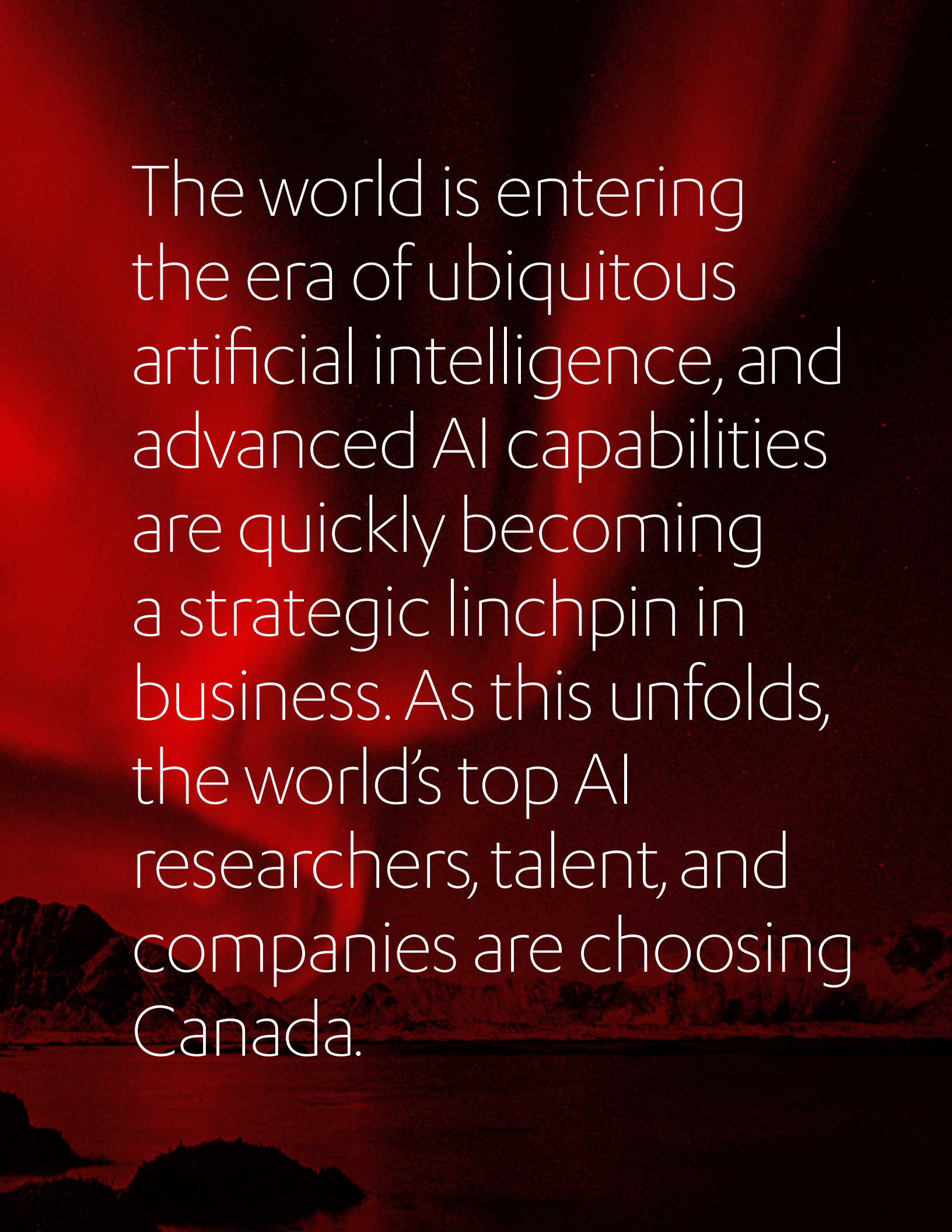

The world is entering the era of ubiquitous artificial intelligence, and advanced AI capabilities are quickly becoming a strategic linchpin in business. As this unfolds, the world's top AI researchers, talent, and companies are choosing Canada.

Canadian AI is working for

# business

Canadian AI is working for

# R&D

Canadian AI is working for

# talent development

Canadian AI is working for

# tech ecosystems

Canadian AI is working for

# a better future

AI is working for

# Canada

# Canada's AI leadership

Canada's role in AI's ascent as a key technology is well-known. Three Canadian AI hubs—the Toronto Region, Montreal, and Edmonton—are the sites of historic breakthroughs in artificial intelligence. The AI pioneers responsible for those breakthroughs—Geoffrey Hinton, Yoshua Bengio, and Richard Sutton—and their equally skillful students and colleagues call these places home. Today, the labs, campuses, and offices in these hubs, along with those in Vancouver and Waterloo, hum with leading AI research, education, and investment.

# The world's brightest minds and companies are choosing Canada

**The Pan-Canadian AI Strategy**
The Pan-Canadian AI Strategy—a $125 million, five-year plan announced in 2017 and the world's first national AI strategy—recognized the convergence of Canada's unique aptitude in AI and the technology's emergence as the new cornerstone of competitiveness. The Strategy, led by Canadian research institute CIFAR, aims to align Canadian resources, organizations, and AI scientists to make Canada the world's nexus of AI development, talent, and commercialization.

The Strategy set four goals that would contribute to a virtuous cycle of talent, capital, and company attraction in our cities and across Canada. These goals are:

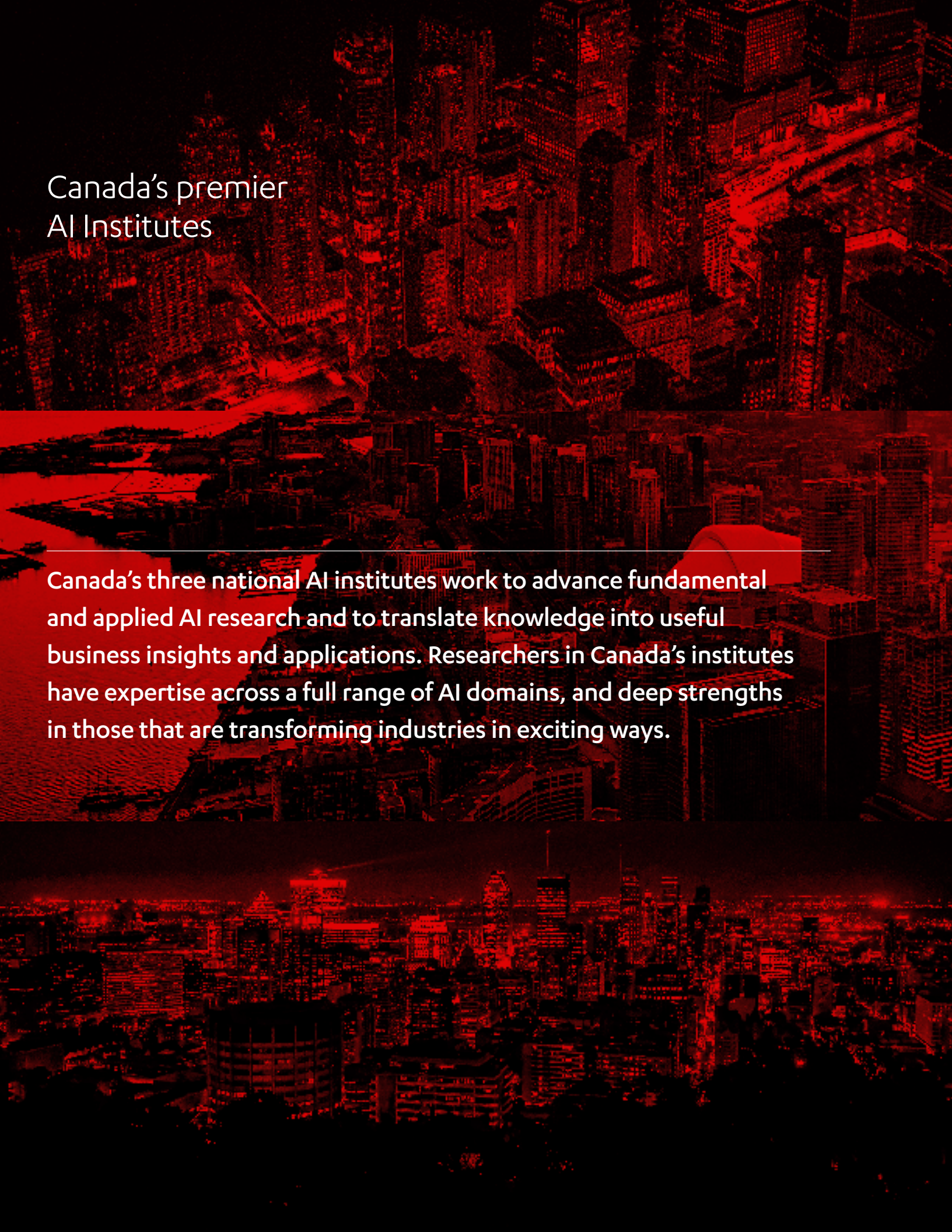
- to increase the number of outstanding AI researchers and graduates;
- to establish three institutes of AI excellence;
- to lead the world's understanding of AI science and societal impact; and
- to support a national AI research community.

The combination of this national vision with our quality and quantity of AI practitioners has made Canada an inimitable destination for the world's brightest minds and companies.

The results of the Strategy speak for themselves:

- The world's most talented graduate students are competing for places in Canada's AI institutes and universities;
- Canadian researchers are driving AI research and applications forward;
- Innovative technology companies, large and small, are establishing labs and commercializing AI in Canadian cities; and
- Canadian universities are expanding and developing new AI programs to create a pipeline of new experts.

Canadian AI is working. The companies, investors, entrepreneurs, and researchers that join Canada's AI community will enjoy the intellectual and economic benefits that come from being connected to the very best AI talent, organizations, and research.



# Canada's premier AI Institutes

**Canada's three national AI institutes work to advance fundamental and applied AI research and to translate knowledge into useful business insights and applications. Researchers in Canada's institutes have expertise across a full range of AI domains, and deep strengths in those that are transforming industries in exciting ways.**

Combined, the institutes represent a Canada-wide community of over 600 researchers, including 60 faculty.

600+
Researchers

60
Faculty

**Amii**
With close affiliation to the University of Alberta, Edmonton-based Alberta Machine Intelligence Institute (Amii) supports researchers and students, fosters the use of AI applications in enterprises and startups, helps attract and establish corporate AI labs, and works to upskill Alberta's workforce through AI-related training and mentorship. The combined work of Amii and the University of Alberta make Edmonton the foremost destination for academic and commercial interest in reinforcement learning.

**Mila**
Mila is closely affiliated with McGill University and the University of Montreal. The institute advances fundamental research in deep learning and reinforcement learning, attracts and retains outstanding AI talent, transfers AI expertise and capabilities from Quebec's labs to its businesses, and fosters thinking about socially responsible AI. Mila is recognized as one of the world's leading organizations pursuing advances in deep learning and machine learning more broadly.

**Vector**
The Vector Institute is an independent entity dedicated to AI research, and one of the world's top destinations for deep learning research. Established in 2017 to build on deep learning strengths at the University of Toronto, Vector has grown to include researchers in universities and institutions across Canada. Vector works with industry, institutions, startups, incubators, and accelerators throughout the country to advance AI research and drive its adoption and commercialization.

Artificial intelligence is an incredible technological lever for companies that can apply it effectively. The most forward-looking companies from Canada and abroad understand the compounding competitive advantage that applied AI can provide. That's why they're investing heavily in Canadian cities to get access to the deepest and highest quality pool of AI talent.

Canadian AI is working for

# business

**"At Uber, we recognize Canada's commitment to innovation and the vibrancy of Toronto's tech ecosystem."**

Dara Khosrowshahi
Uber's Chief Executive Officer [1]

**"It was a big decision for us to open our first non-UK research lab, and the fact we're doing so in Edmonton is a sign of the deep admiration and respect we have for the Canadian research community."**

DeepMind blog post [2]

Artificial intelligence is the new cornerstone of competitiveness in business. To build their AI capabilities, companies need to attract the best talent. Canadian cities have emerged as the places the world's scarce AI talent wants to be, and leading companies are taking notice.

Here is a sample of the companies that have invested in our AI communities.

**Uber chooses Toronto to develop self-driving vehicles**
Uber, a Vector industry founding sponsor, announced plans in 2017 to set up its Advanced Technology Group in Toronto in order to have noted University of Toronto Associate Professor and Vector co-founder Raquel Urtasun lead the company's research on self-driving cars. This year, Uber committed another $200 million to expand their lab and hire an additional 300 people to bring their workforce in Toronto up to 500 people.

**DeepMind expands to Edmonton**
DeepMind—the AI company acquired by Google and famous for creating AlphaGo—chose to open its first international AI research office in Edmonton. It's no wonder. Reinforcement learning enabled AlphaGo to beat the human world Go champion, and the person who literally wrote the book on the field—Richard Sutton—lives and teaches at the University of Alberta. DeepMind tapped Sutton to lead the lab, along with UAlberta colleagues Michael Bowling, Patrick Pilarski, and Adam White.

**Samsung launches two labs in Canada**
Samsung doubled down on Canada in 2018. In May, Samsung Research America opened the Samsung AI Centre in Toronto's MaRS Discovery District to "tap into and contribute to the flourishing AI industry growing in Canada's largest city." [3] In October, the company opened a lab in Montreal to develop AI for voice and image recognition, translation, autonomous driving, and robots. The reasoning behind the decision: "the availability of key AI talent, including leading AI researchers at McGill University and the University of Montreal." [4]

**NVIDIA triples capacity for Canadian talent**
NVIDIA, another founding industry sposonsor of Vector, announced the establishment of a new lab to accommodate a tripling of their AI and deep learning researchers in Toronto. The company hired Sanja Fidler—a Vector co-founder and University of Toronto Professor—to become NVIDIA's Director of AI.

**Microsoft expands their Montreal AI team**
In 2018, Microsoft announced plans to expand its research lab in Montreal by doubling its team to up to 75 technical experts. New members will build on the team's advances in machine reading comprehension. The announcement came a year after Microsoft established its AI presence in Canada by acquiring Canadian AI company Maluuba.

**"Greater Montreal has emerged as a powerhouse in AI research."**

Samsung Newsroom [5]

**"Toronto and the [Greater Toronto Area] are epi-centres of machine learning and one of the world's foremost hubs for AI research and development. Home to not only world-class talent, but also some of the most innovative start-ups in the artificial intelligence field."**

Dr. Larry Heck
Samsung's Co-Head of Global Artificial Intelligence Research [6]

**Facebook: Two years, two big Montreal AI investments**

In 2017, Facebook opened an AI research lab in Montreal (dubbed FAIR Montreal), tapped McGill University Computer Science Professor Joëlle Pineau to lead it, and expressed its intent to invest an additional $7 million in Montreal-based research and students. In 2018, Facebook announced plans to expand its space to accommodate 60 people, up from approximately 20.

**Borealis AI spreads labs across Canada**

The Royal Bank of Canada's AI lab—Borealis AI—is employing AI talent in multiple Canadian provinces. After originally setting up labs in Toronto and Edmonton, Borealis expanded to Montreal in 2017 to work closely with Mila. In 2018, Borealis expanded to Vancouver—a global hub in visual computing and graphics—to establish a centre focused on computer vision. RBC is also a founding industry sponsor of Vector.

**Investments have also been made in our cities by Accenture, Coveo, Deloitte Omnia, DiDi Labs, Etsy, GM, Google Brain, IBM, Intel, LG Electronics, Pixomondo, Thales, Thomson Reuters, among many others.**

Major Canadian companies are experiencing the benefits of belonging to Canada's AI community. Through affiliation with our institutes and proximity to a stream of the most qualified talent, companies like Linamar, Shopify, and Canada's biggest banks are reaping the rewards of AI implementation.

**At Linamar, AI means increased market share, a larger workforce, and higher wages**

Linamar is a Canadian diversified manufacturing company that produces transportation, infrastructure, and agricultural parts and equipment. The company—which earned $6.5 billion in 2017—is one of Vector's founding industry sponsors. Linamar is applying machine learning to advanced robotics, equipment data analysis, prediction, vision systems, and 3D printing. The widespread use of AI in Linamar has contributed to the company's double-digit revenue and profit growth, and—contrary to common concerns—has supported a trend toward a larger workforce with higher wages due to the company's increased competitiveness.

**"The [AI] talent here is incredible,"**

**"Canada is gifted to have one of the world's most important resources today."**

Jensen Huang
CEO of NVIDIA [7]

**"Toronto is a thriving hub for AI."**

Gavriel State
NVIDIA's Senior Director of System Engineering [8]

**"Montreal is really one of the most exciting places in AI right now."**

Jennifer Chayes
Managing Director of
Microsoft Research New England,
New York City and Montreal [9]

**At Shopify, AI personalizes services for 600,000 merchants**

Shopify—the Canadian e-commerce platform with over 600,000 merchant stores—is a founding industry sponsor of the Vector Institute and was an early AI adopter. E-commerce produces enormous volumes of data that can be analyzed to enhance personalization, increase sales conversions, and decrease churn. Three AI use cases at the company include:

- improving recommendations in its app stores to enhance merchant business;
- improving fraud detection; and
- automating credit risk assessments and customizing credit services for merchants in its Merchant Cash Advance program.

**At Canadian banks, AI augments consumer protection**

Toronto is one of the world's most important financial centres. The city is home to the second highest concentration of large bank headquarters in the world and financial institutions in the region account for $1.5 trillion in institutional investor capital. [10] Through the Banks Project—driven by Vector—Canada's largest financial institutions are collaborating and employing AI to reduce consumer costs by better tackling financial crimes and improving protection for their millions of combined customers.

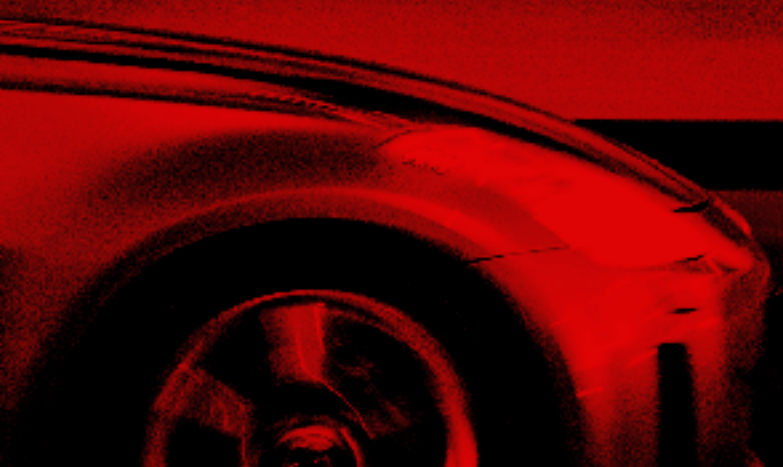
**Since the launch of the Pan-Canadian AI Strategy less than two years ago, the Vector Institute has been among a series of catalysts for over $1 billion of announced AI and tech-related investments, which will result in the creation of 25,000 jobs across Canada. Over a five-year period, this will help generate more than $20 billion in Canadian GDP, providing more than a ten-fold return on the governments' investments.**

1. Uber Announces Significant Jobs Investment in Canada. News release. 2018.
2. DeepMind expands to Canada with new research office in Edmonton, Alberta. DeepMind.com. 2017
3. Samsung Launches AI Centre in Toronto. Samsung.com. 2018.
4. Samsung Electronics Opens Another AI Center in Montreal and Expands AI Research Presence in North America. Samsung.com. 2018.
5. Ibid.
6. Samsung Launches AI Centre in Toronto. Samsung.com. 2018.
7. Nvidia CEO Jensen Huang calls Canada's AI talent 'incredible,' a key resource. UofT News. 2018.
8. NVIDIA Opening AI Research Lab in Toronto, Following Move in Seattle. NVIDIA.com. 2018.
9. Microsoft announces significant expansion of Montreal research lab, new director. Microsoft.com. 2018.
10. Tech North: Building Canada's first technology Supercluster. McKinsey & Company. 2016.

The quality and quantity of AI researchers in our cities has made Canada an inimitable destination for the world's brightest minds and leading companies. Breakthroughs by researchers in Canada lifted AI to its prominence today, and now their work is transforming industries, from transportation to finance to heath care and more.

Canadian AI is working for

# R&D



**Researchers affiliated with the Canadian AI institutes are at the forefront of their fields, and their work is being applied across the economy.**

Researchers affiliated with the Canadian AI institutes are at the forefront of their fields, and their work is increasingly being applied across the economy. The appointment of Canada CIFAR AI Chairs, a key element of the Pan-Canadian AI Strategy, will ensure top researchers have the funding they need to pursue their projects in Canadian institutions.

Here is a sampling of the leading researchers in Canada.

### Deep Learning

The enhanced data pattern recognition and classification that deep learning enables will transform every sector that generates vast amounts of data, including finance, retail, health care, and manufacturing.

#### PROMINENT DEEP LEARNING RESEARCHERS

**Yoshua Bengio**

University of Montreal; Mila co-founder & scientific director; Canada Research Chair in Statistical Learning Algorithms; Co-Director CIFAR Learning in Machines & Brains program

Yoshua is considered a pioneer of deep learning. His research focuses on its foundational principles and on ensuring that everyone shares in the benefits of AI. He is also the co-founder of Element AI, a leading AI-as-a-service company with the largest private AI lab in Canada.

**Geoffrey Hinton**

Google VP and Engineering Fellow; Vector Institute Chief Scientific Advisor; University of Toronto

Geoffrey is a world-renowned pioneer in deep learning research. He and his teams have achieved numerous breakthroughs in the field. His research involves designing machine learning algorithms, and a major aim of his is to discover a learning procedure that is efficient at finding complex structure in large, multi-dimensional datasets.

### Reinforcement Learning

Reinforcement learning's value in business is spreading rapidly. It is increasingly being applied to improve web systems configuration, chemistry, personalized recommendations, games, paid media bidding, robotics, and traffic control.

#### PROMINENT REINFORCEMENT LEARNING RESEARCHERS

**Michael Bowling**

University of Alberta; Amii Fellow

Michael's research uses games to understand and predict how multiple actors learn and act to achieve goals within a shared environment that is ambiguous or changing.

Top: Yoshua Bengio
Bottom: Geoffrey Hinton

**Amir-massoud Farahmand**
Vector Faculty Member

Amir-massoud researches the design of reinforcement learning agents (i.e., robots or software) to solve industrial problems, such as the optimization of air conditioning systems and hybrid vehicle operation.

**Doina Precup**
McGill University; Mila member; Montreal DeepMind Research Team Lead; CIFAR Senior Fellow

Doina's research in reinforcement learning focuses on reasoning and planning under conditions of uncertainty to address real-world problems.

**Richard Sutton**
University of Alberta; Amii Fellow; DeepMind Alberta co-lead; CIFAR Senior Fellow

Richard, an acclaimed pioneer of reinforcement learning, wrote the foundational text on the field: Reinforcement Learning: An Introduction. Richard was DeepMind's first advisor, and his research team is responsible in part for the academic origins of DeepMind's AlphaGo.

### Natural Language Processing (NLP)

NLP algorithms interpret and understand spoken and written language, and are being used in many customer service and health care applications.

#### PROMINENT NATURAL LANGUAGE PROCESSING (NLP) RESEARCHERS

**Jackie Cheung**
McGill University; Mila member

Jackie currently applies his research interests in NLP, computational semantics, natural language generation, and automatic summarization to projects that summarize fiction, extract information from texts, and adapt language across genres.

**Alona Fyshe**
University of Alberta; Amii Fellow

Alona combines research in computational linguistics, machine learning, and neuroscience to enable algorithms to truly learn and understand language.

**Randy Goebel**
University of Alberta; Amii Fellow

Randy researches the logic of machine learning with a current focus on interpretability. His work has been applied in the legal field to enable the efficient extraction of information from legal documents.

**Frank Rudzicz**
St Michael's Hospital; University of Toronto; Vector Faculty Member.

Frank researches the use of NLP and machine learning in health care, which includes applying learning algorithms to detect early signs of dementia.

### Computer Vision

Algorithms that can understand and identify objects in images or videos are driving progress in security, self-serve retail environments, health care, and autonomous vehicles.

#### PROMINENT COMPUTER VISION RESEARCHERS

**Aaron Courville**
University of Montreal; Mila member; CIFAR Fellow

Aaron's research focuses on computer vision applications, NLP, audio signal processing, and speech understanding. His work has been applied to end-to-end speech analysis and visual object discovery.

**Sanja Fidler**
University of Toronto; Director of AI at NVIDIA; Vector Faculty Member

Sanja conducts leading research on creating systems that understand the world the way humans do, particularly through vision and language. She researches 2D and 3D object detection (scalable multi-class detection, object segmentation and image labeling, and 3D scene understanding in particular) and the interplay between language and vision.

Top: Richard Sutton
Bottom: Sanja Fidler

### David Fleet

University of Toronto Scarborough; Vector Faculty Member; CIFAR Senior Fellow

David's research in computer vision, machine learning, image processing, and visual neuroscience enables visual motion analysis, tracking, human pose and motion estimation, video classification and captioning, and 3D reconstruction for electron cryo-microscopy.

### Christopher Pal

Polytechnique Montréal; Mila member

Christopher's research in computer vision and computational photography is being applied to human-computer interaction that includes, among other things, emotion recognition in facial analysis.

## Robotics

Research in robotics is enabling robotic systems to see, understand, learn, and act effectively and autonomously within complex environments.

#### PROMINENT ROBOTICS RESEARCHERS

### Gregory Dudek

McGill University; Samsung AI Centre Head

Gregory researches autonomous navigation, robots that learn, mobile robotics, machine learning, robot localization, and computer vision. He is also the founder and President of Independent Robotics, a company that designs, manufactures, and sells underwater robot vehicles and related technologies.

### Joëlle Pineau

McGill University; Montreal Facebook AI Research Lab Head, Mila member; CIFAR Senior Fellow

Joëlle researches efficient algorithm development to address complex challenges in robotics, health care, games, and conversational agents. This work includes the SmartWheeler Project, an intelligent robotic wheelchair designed to improve mobility for patients with severe impairments.

### Angela Schoellig

University of Toronto; Centre for Aerial Robotics Research and Education; Canada Research Chair in Machine Learning for Robotics; Vector Faculty Affiliate

Angela's research aims to enhance autonomous learning in robots to improve performance, safety, and autonomy. She has specific expertise in aerial vehicles and has been listed in MIT Technology Review's 35 Innovators Under 35.

## Time Series

AI application in time series is enabling more efficient forecasting in a range of fields, from finance to weather.

#### PROMINENT TIME SERIES RESEARCHERS

### David Duvenaud

University of Toronto; Vector co-founder; Canada Research Chair in Generative Models

David's research focuses on creating models for prediction, interpretation, and design. He is also the co-founder of Invenia, an energy forecasting and trading company.

### Graham Taylor

University of Guelph; NextAI Academic Director; Vector Faculty Member; CIFAR Azrieli Global Scholar

Graham's research in deep learning architecture is being applied to improve understanding of human and animal behaviour, climate and agricultural data, audio, and financial time series.

Top: Raquel Urtasun, Photo: Jonathan Lung
Bottom: Doina Precup, Photo: Owen Egan

Researchers in Canada are also focusing on AI in specific domains.

**Financial services**
AI is parsing the reams of data being generated by financial institutions and improving fraud detection, enhancing service personalization, and determining credit risk with incredible efficiency.

**Pascal Poupart**
University of Waterloo; Borealis AI; Vector Faculty Member

Pascal researches algorithms that reason under uncertainty. His work is being applied in the Royal Bank of Canada's AI lab, Borealis AI. He also leads research into chatbots, video analysis, and data driven management of telecommunication networks.

**Materials science**
AI is expediting and lowering the cost of new material discovery and optimization, which allows substantial enhancements to be made to conventional objects.

**Alán Aspuru-Guzik**
University of Toronto; Vector Faculty Member; Canada 150 Research Chair in Theoretical & Quantum Chemistry; CIFAR Senior Fellow

Alán's research sits at the intersection of computer science, chemistry, and physics. His research involves the integration of robotics, machine learning, and quantum chemistry, with specific application to clean energy and optoelectronic materials.

**Transportation**
Apart from being key to self-driving cars, AI is enhancing traffic management, automated incident detection, and energy optimization in traffic infrastructure.

**Andrea Lodi**
Polytechnique Montréal; Canada Excellence Research Chair in Data Science for Real-Time Decision-Making; Mila member.

Andrea is a leading researcher in mixed linear and nonlinear programming. His work involves developing new tools and methods to process and analyze enormous volumes of data from multiple sources to uncover insights and automate decision-making.

**Raquel Urtasun**
University of Toronto; Vector Institute co-founder; Canada Research Chair in Machine Learning and Computer Vision; Uber ATG Chief Scientist & Head of Uber ATG Toronto.

Raquel is among the world's top experts in the application of machine perception to self-driving vehicles.

**Privacy & Fairness**
A body of research is growing to address questions related to fairness, bias, privacy, and interpretability in machine learning and artificial intelligence.

**Toni Pitassi**
University of Toronto; Vector Faculty Affiliate; Bell Canada Chair in Information Systems.

Toni develops highly efficient algorithms that are low cost in terms of time, space, and randomness. She is highly respected in theoretical computer science and an expert in differential privacy, the application of AI to enable accurate predictions using aggregated data without compromising individual privacy.

**Or Sheffet**
University of Alberta; Amii Fellow

Or's work on differential privacy involves quantifying the trade-off between privacy and utility to enable accurate population-level statistics and predictions without compromising individual privacy.

**Richard Zemel**
University of Toronto; Vector Institute Research Director; Co-chief, Machine Learning at the Creative Destruction Lab; CIFAR Senior Fellow

Richard has performed foundational work on methods for learning to rank and recommend items, machine learning systems for automatic captioning and answering questions about images, and unsupervised systems that learn useful representations of data. Rich is an expert on fairness in artificial intelligence.

## Health

**AI in health is increasing efficiency, uncovering health trends, and ushering in the era of personalized medicine.**

### APPLYING AI TO HEALTH IN CANADA

Canada's AI institutes are driving innovation in health care.

In Ontario, Vector has partnered with the Institute for Clinical Evaluative Sciences on the Risk Dashboard program, which brings world-class machine learning expertise to bear on data that covers the entire population of Ontario. This is just one of several initiatives in Vector's Health Strategy that Anna Goldenberg (Associate Research Director, Health) and Vector health faculty Brendan Frey, Marzyeh Ghassemi, Quaid Morris, Frank Rudzicz, and Bo Wang are working on to address real-world health problems and opportunities.

In Alberta, Amii scientists in the Adaptive Prosthetics Program are developing intelligent artificial limbs that can increase patients' control over their medical devices, contributing to improved quality of life. The program is led by Patrick M. Pilarski, with important contributions from Richard Sutton.

### Prominent health & AI researchers

**Ismail Ben Ayed**
École de Technologie Supérieure; Research Chair on Artificial Intelligence in Medical Imaging

Ismail develops learning algorithms that help surgeons and radiologists improve decisions. Examples include an algorithm that can evaluate heart function and another that can annotate the bones of the spinal column.

**Marzyeh Ghassemi**
University of Toronto; Vector Faculty Member

Marzyeh's research interests include clinical risk prediction, optimal treatment discovery, and non-invasive patient monitoring. She has been listed on MIT Technology Review's 35 Innovators Under 35.

**Russ Greiner**
University of Alberta, Amii Fellow

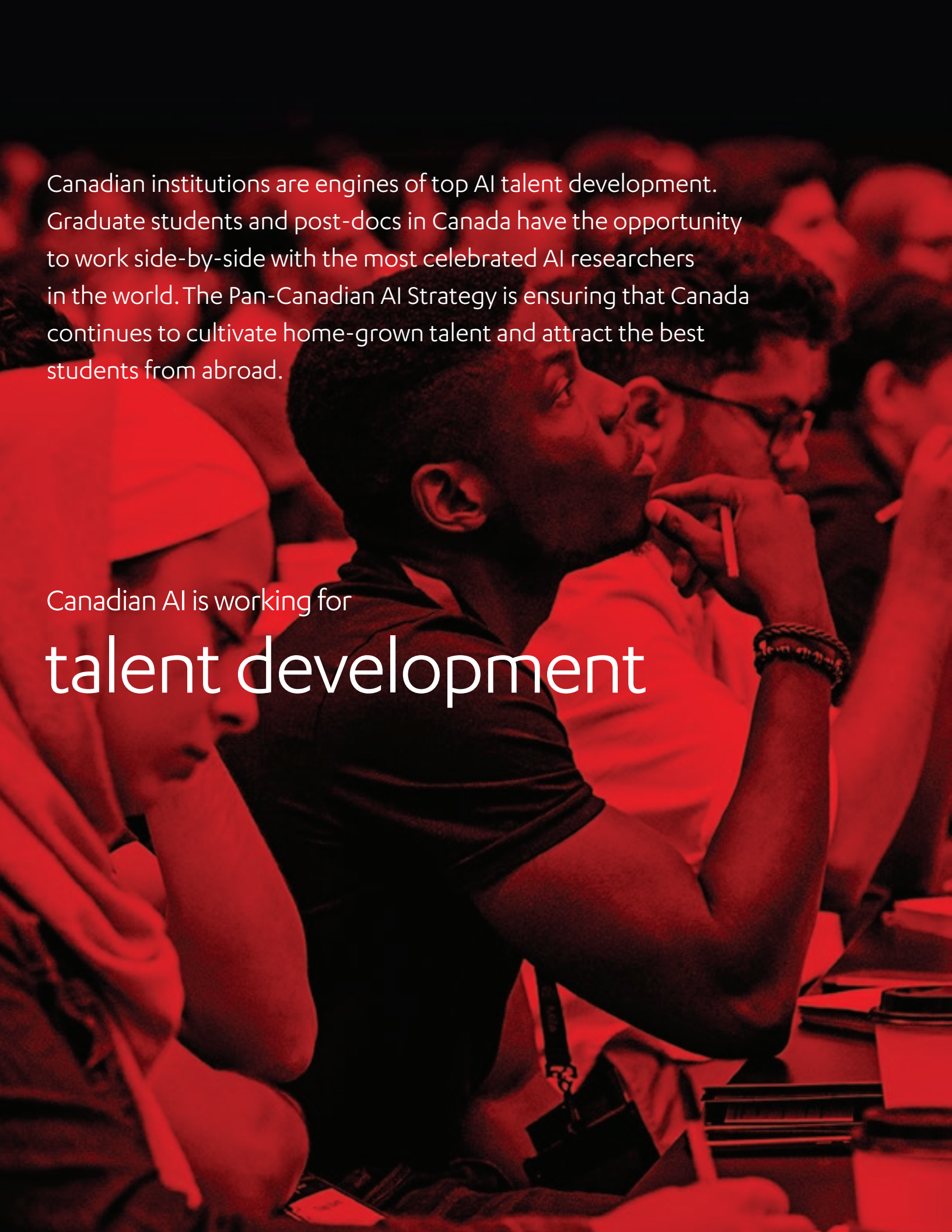
Russ' machine learning and bioinformatics research applications include psychiatric disorder diagnosis, diabetes management, and better understanding of brain tumors from MRI scans.

**Patrick M. Pilarski**
University of Alberta; Canada Research Chair in Machine Intelligence for Rehabilitation; Amii Fellow

Patrick's research in real-time data management and interpretation enables computers to operate in complex environments. He leads the development of intelligent artificial limbs in Amii's Adaptive Prosthetics Program.

**Bo Wang**
University of Toronto; Vector Faculty Member; Lead AI Scientist at the Peter Munk Cardiac Centre (PMCC) and the Techna Institute at the University Health Network (UHN)

Bo's research areas include machine learning, computational biology, and computer vision. Bo has a particular interest in predictive models and decision support for clinical and genomic personalized medicine.



Canadian institutions are engines of top AI talent development. Graduate students and post-docs in Canada have the opportunity to work side-by-side with the most celebrated AI researchers in the world. The Pan-Canadian AI Strategy is ensuring that Canada continues to cultivate home-grown talent and attract the best students from abroad.

Canadian AI is working for

# talent development

DLSS & RLSS attracted over 1200 applications from individuals in 60 countries for 250 openings.

1200
applications

60
countries

250
openings

**Training the next generation**
Through research and programs, Canada is training the next generation of AI talent to solve meaningful problems in industry and academia. Here's how we're giving students the world's highest-quality AI training:

AI INTERNSHIPS
Mila, Amii, and Vector provide internship programs that give AI students access to interesting problems, voluminous data, and supervision by experts and teams that can provide guidance and networks within industry.

DEEP LEARNING & REINFORCEMENT LEARNING SUMMER SCHOOL (DLSS & RLSS)
The 2018 DLSS and RLSS brought graduate students, post-docs, and professionals together to cover the foundational research, new developments, and real-world applications of deep learning and reinforcement learning. Participants learn directly from world-renowned deep learning and reinforcement learning lecturers.

VECTOR SCHOLARSHIPS IN ARTIFICIAL INTELLIGENCE
Vector Scholarships are $17,500 awards that recognize and support highly-qualified AI students, and help universities recruit top AI applicants. The Vector Institute announced the first 66 scholarship recipients for the 2018-19 academic year in fall 2018.

MACHINE LEARNING TECHNICIAN COURSE
These machine learning courses for Alberta's STEM grads aim to train individuals that may otherwise be impacted by the downturn in the oil industry.

**Upskilling professionals: access to top researchers & the latest AI insights**
All three AI Institutes are helping Canada's workforce adapt to rapid change by ensuring industry professionals have AI skills and are familiar with AI business cases. Here's how we're doing it:

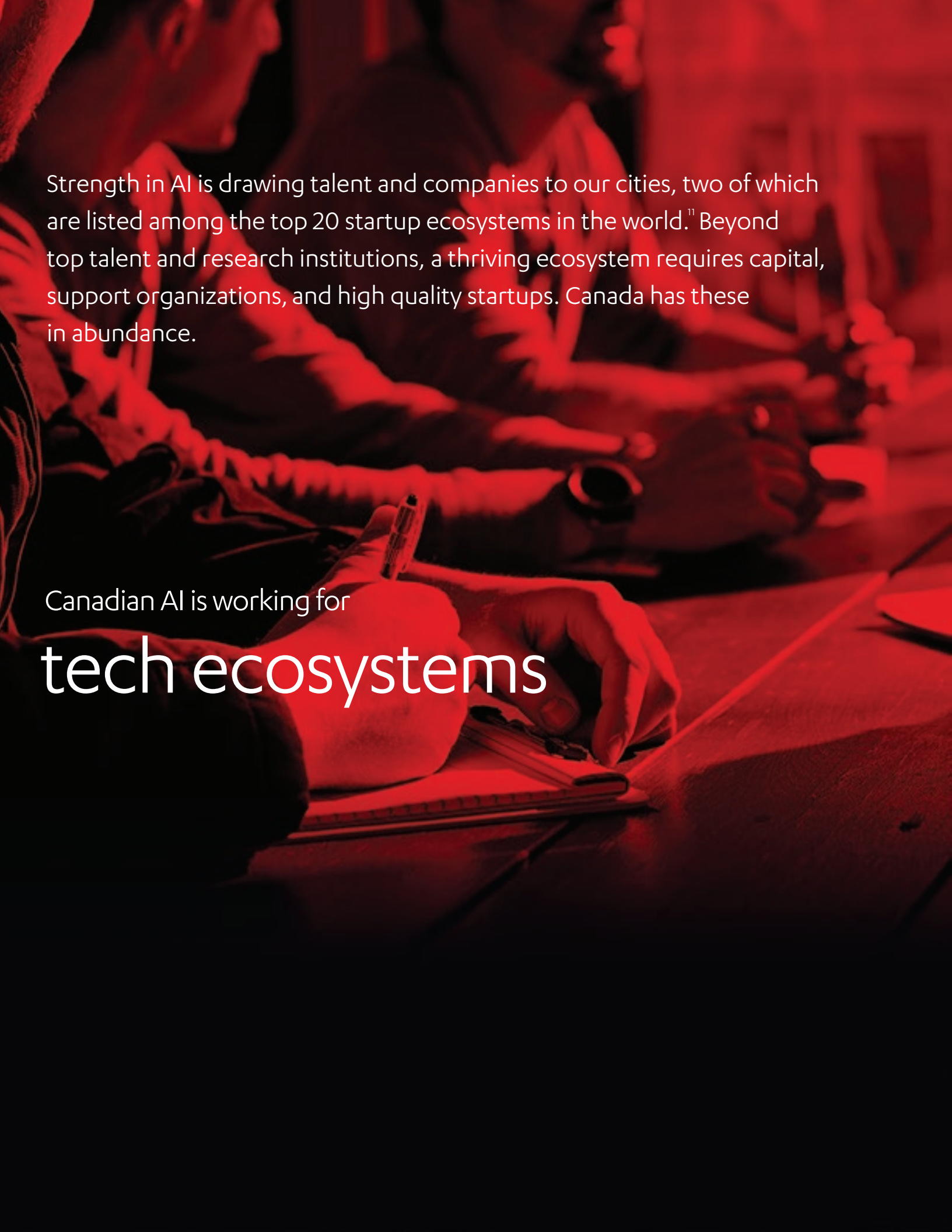
ENDLESS SUMMER SCHOOL (ESS)
ESS lectures for Vector industry sponsors are delivered by prominent AI researchers who cover the latest in algorithms, vision techniques, privacy, machine learning and health, and robotics, among other topics.

AI FOR EXECS
This program presents an opportunity for the senior management of Vector's industry sponsors to explore the latest AI business use cases and implementation practices throughout industry.

ALBERTA BUSINESS SEMINARS
These seminars provide use case and implementation guidance for the technical and senior leadership teams of Alberta-based companies.

MILA TECHNOLOGY TRANSFER
The team helps organizations by leading, managing, or contributing to AI projects and providing AI training.

IVADO MILA DEEP LEARNING SCHOOL
The School educates Montreal-based industry professionals, researchers, and science & engineering graduate students on deep learning techniques.



Strength in AI is drawing talent and companies to our cities, two of which are listed among the top 20 startup ecosystems in the world.[11] Beyond top talent and research institutions, a thriving ecosystem requires capital, support organizations, and high quality startups. Canada has these in abundance.

Canadian AI is working for

# tech ecosystems

# $252M

2017 saw US$252 million of venture capital flow into Canadian AI companies

# 460%

460% year-over-year increase

Canadian AI ecosystems have all the elements that are crucial for successful AI commercialization and startup generation.

**Access to capital**
Investment in Canadian AI startups is on the rise. 2017 saw US$252 million of venture capital flow into Canadian AI companies, representing a 460% year-over-year increase.[12] Numerous international venture capital funds have set up offices in Canada with the intent of getting in early on promising AI startups.

**Support programs and institutions**
Startup support programs exist across the country, providing entrepreneurs with investment, mentorship, and community. Here are some examples:

- The Creative Destruction Lab (CDL) is a seed-stage program with offices across Canada that provide mentorship for scalable science-based companies. CDL is the world's largest accelerator for AI-enabled startups.
- Innovation centres like MaRS in Toronto and Communitech in Waterloo Region provide spaces for entrepreneurs, assistance with access to capital, talent, and markets, and a network of mentors that give startups the resources and roadmap to start, grow, and scale.
- Ontario Centres of Excellence (OCE) partner with industry to invest in and help commercialize innovation from publicly funded post-secondary institutions and research hospitals.
- Techstars Montreal AI Accelerator is part of the renowned global Techstars accelerator network and provides mentorship and funding to companies applying and developing AI for industry.
- Startup Edmonton provides mentorship, programs, workspace, and community to the city's technology ecosystem, supporting and connecting entrepreneurs, developers, students, founders, mentors, and investors.
- NEXT Canada delivers entrepreneurial programming, including the Next AI program delivered in Montreal and Toronto to accelerate early stage AI startups.
- Corporate innovation hubs, like the AI Hub at Durham College, provide established companies with the expertise and facilities required to apply AI and develop new AI-related projects.

**Successful startups**
An impressive array of grown-in-Canada AI startups have emerged in our cities. Significant AI company exits—including TD Group's 2018 acquisition of Toronto-based Layer 6 AI and Microsoft's 2017 acquisition of Montreal-based Maluuba—highlight the outstanding companies that our ecosystems are producing.

Here are some of the most exciting Canadian AI startups today:

**Element AI:** Co-founded by Yoshua Bengio, Montreal-based Element AI provides AI-as-a-service, creating AI software tailored to clients' specific needs. Element AI operates the largest private AI research lab in Canada, and raised C$137.5 million in 2017, marking the world's largest AI startup Series A round to date.

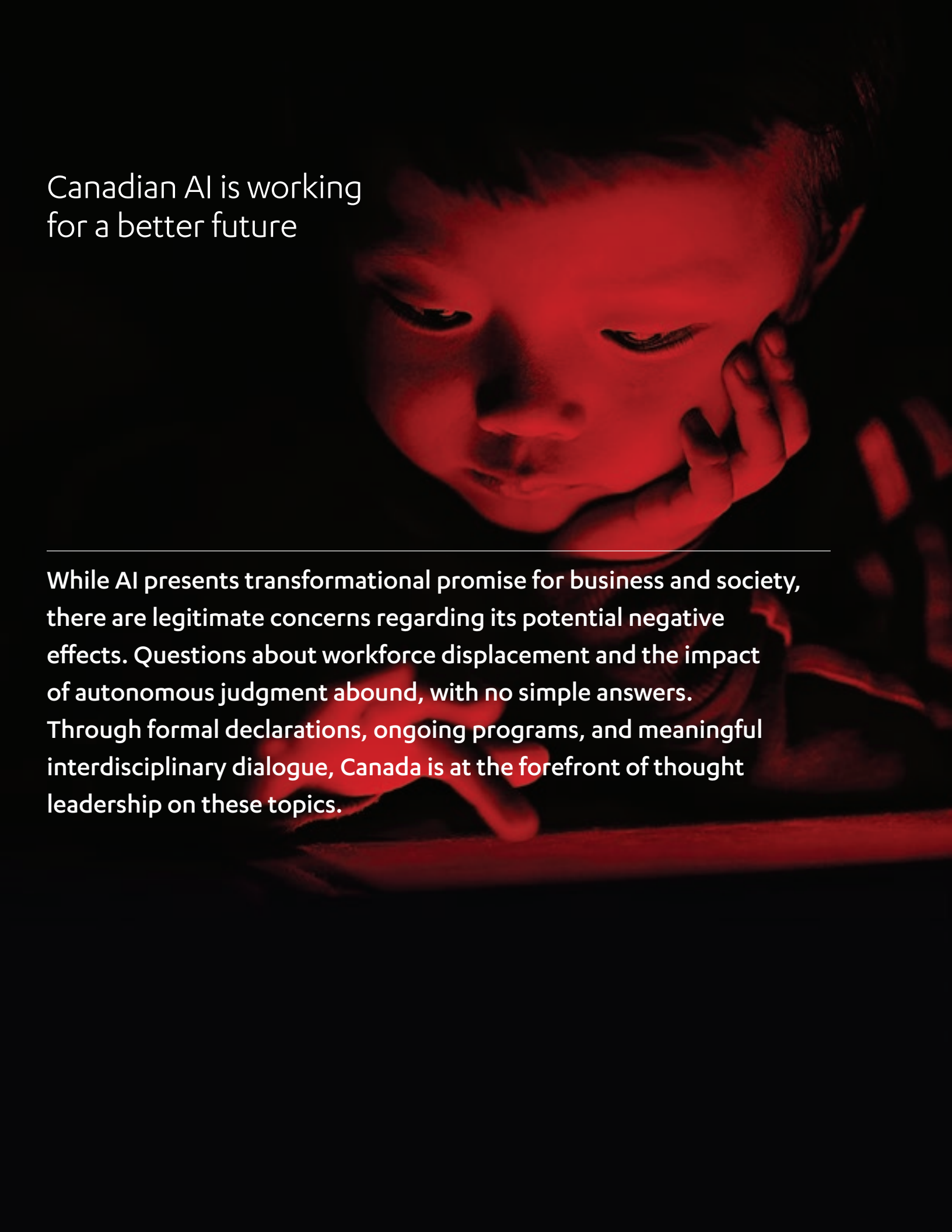
**integrate.ai:** Toronto-based integrate.ai, a Vector founding industry sponsor, provides an AI platform that enables consumer enterprises to create more natural and valuable customer interactions that result in increased customer acquisition, cross-selling opportunities, and customer lifetime value. The company raised US$30 million in a Series A round in 2018.

**Stradigi AI:** Montreal-based Stradigi AI helps enterprises quickly transform their businesses through AI-powered solutions from their configurable, scalable, and secure platform. They are powered by one of Canada's largest applied research labs, and are a Vector & Mila partner.

**Other significant AI startups across Canada include Testfire Labs, Finn.ai, Dessa, and ROSS Intelligence, among many others.**

11. Global Startup Ecosystem Report 2017. Startup Genome. 2017.

12. MoneyTreeTM Canada report 2017. PwC Canada & CB Insights. 2018.



# Canadian AI is working for a better future

**While AI presents transformational promise for business and society, there are legitimate concerns regarding its potential negative effects. Questions about workforce displacement and the impact of autonomous judgment abound, with no simple answers. Through formal declarations, ongoing programs, and meaningful interdisciplinary dialogue, Canada is at the forefront of thought leadership on these topics.**

## Canadian institutions are working to ensure the era of widespread artificial intelligence is guided by the right ethics and values.

Canadian institutions are working to ensure the era of widespread artificial intelligence is guided by the right ethics and values. Here's how:

**The Montreal Declaration of Responsible AI**
The Montreal Declaration of Responsible AI recognizes that the world has the opportunity to create autonomous and intelligent machines that can make decisions according to ethical principles, so that "AI will make our societies better, in the best interest of, and with respect for, everyone." The declaration includes principles related to well-being, autonomy, justice, privacy, knowledge, democracy, and responsibility.

**The Toronto Declaration: Protecting the rights to equality and non-discrimination in machine learning systems**
The Toronto Declaration, created in 2018 by Amnesty International and Access Now, emphasizes the need to ensure AI is designed and deployed in a manner consistent with equality and non-discrimination. The Declaration includes obligations and measures that enable companies and nations to ensure human rights are respected and emphasized in machine learning's development.

**CIFAR AI & Society**
CIFAR's AI & Society program explores the new uncertainties that AI presents with regard to the economy, ethics, policymaking, and the law. The program's Canada-wide series of policy workshops provides opportunities for people across disciplines to develop solutions to complex issues such as algorithmic bias, transparency, governance, and inclusion.

# Canadian AI is working for Investors

**MARCH 31, 2017**
Google bets on AI in Canada, launches Google Brain Toronto.

**APRIL 20, 2017**
IBM to open an AI lab in Montreal to better collaborate with MILA.

**MAY 8, 2017**
Uber launches new Advanced Technologies Group (ATG) in Toronto, led by Raquel Urtasun.

**JULY 5, 2017**
DeepMind expands to Canada with new research office in Edmonton, Alberta.

**AUGUST 15, 2017**
Accenture launches Liquid Studio in Toronto. Will hire 1,000 people in Canada.

**SEPTEMBER 15, 2017**
Facebook launches artificial intelligence research lab (FAIR) in Montreal. Hiring 10 researchers to start, aiming to triple in the coming year.

**OCTOBER 6, 2017**
DeepMind opening laboratory in Greater Montreal. Bets on strong research community.

**OCTOBER 10, 2017**
Thales launches Centre of Research and Technology in Artificial Intelligence eXpertise (cortAIx), creating 50 new world class jobs for AI researchers and developers.

**OCTOBER 11, 2017**
Thomson Reuters celebrates its Toronto Technology Centre's First Anniversary with $100MM expansion. New site will accommodate up to 1500 staff.

**NOVEMBER 21, 2017**
Borealis AI (RBC Institute for Research) to open new artificial intelligence lab in Montreal.

**JANUARY 19, 2018**
GM Canada opens new Canadian Technical Centre (CTC) in Markham, Canada's largest new automotive and mobility software centre with more than 700 staff. Announces GM Canada STEM Fund.

**JANUARY 23, 2018**
Microsoft expands its Montreal research lab (Laboratoire de recherche Microsoft). Doubles staff to 75.

**MAY 17, 2018**
Etsy opens machine learning center in Toronto.

**MAY 24, 2018**
Havas Group creates AI innovation centre in Montreal. Will employ 60 specialists in AI, data science, customer experience design and programming by 2020.

**MAY 24, 2018**
Samsung launches AI Centre in Toronto. Will increase R&D staff in Canada to 200.

**JUNE 15, 2018**
NVIDIA opens AI Research Lab in Toronto. Plans to triple number of AI and deep learning researchers by year end.

**AUGUST 1, 2018**
LG to establish an AI research lab in Toronto and hire several dozen employees.

**AUGUST 28, 2018**
Jumio launches AI lab in Montreal to hone ID verification, hiring 30 engineers and specialists by the end of next year.

**SEPTEMBER 11, 2018**
Microsoft announces new Canadian headquarters in downtown Toronto, growing staff by more than 500.

**SEPTEMBER 11, 2018**
Varian Medical Systems creates center of innovation in Greater Montreal, triples staff count to 60.

**SEPTEMBER 12, 2018**
Intel to open graphics-chip engineering lab in Toronto creating a home for dozens, if not hundreds, of engineers working on the chips.

**SEPTEMBER 13, 2018**
Uber opening an engineering hub in early 2019 and expanding its Advanced Technologies Group (ATG) Research & Development Centre in Toronto, investing more than C$200 million over five years. Overall headcount in Toronto will exceed 500 employees.

**SEPTEMBER 13, 2018**
Deloitte hiring hundreds of artificial-intelligence professionals across Canada, tripling its newly launched AI practice to approx. 1,000 people.

**SEPTEMBER 20, 2018**
Facebook expanding its Montreal AI lab to double the number of researchers. New facility to accommodate up to 60 people.

**SEPTEMBER 28, 2018**
Shopify will invest up to $500 million in new Toronto office.

**OCTOBER 9, 2018**
Samsung opens second AI Center in Montreal.

**NOVEMBER 13, 2018**
Coveo expands Montreal office to 300 employees.

**NOVEMBER 14, 2018**
Pixomondo plans Montreal expansion, increasing staff to 180.

**NOVEMBER 19, 2018**
DiDi launches labs in Toronto, expanding global research network to Canada.

**NOVEMBER 26, 2018**
IBM's Client Innovation Centre in Montreal expands mission with Artificial Intelligence and Salesforce focus creating 100 jobs in 2019.

**NOVEMBER 27, 2018**
Accenture opens Canada Innovation Hub in Toronto, adding 800 new highly skilled technology jobs.

**DECEMBER 4, 2018**
QuantumBlack announces new AI office opening in Montreal, adding up to 30 deep learning specialists and highly qualified data engineers.

**DECEMBER 4, 2018**
WinningMinds open AI office in Montreal.

**DECEMBER 4, 2018**
BIOS open AI office in Montreal.

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Canada

CIFAR

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Ontario

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