NWFC

Artificial Intelligence Public Politics

Pan-Canadian Artificial Intelligence Strategy

April 12, 2017

Walter Farah Calderón

Presentación

Las relaciones y conexiones son muchas, el progreso es permanente y las aplicaciones prácticas aumentan. Es necesario, por razones metodológicas, repensar el uso de la información para dar continuidad a la investigación y respiro al análisis. Los libros de trabajo actuales representan mi propio proceso de estudio.

Presentation

Relationships and connections are many, progress is permanent and practical applications increase. It is necessary, for methodological reasons, to rethink the use of information to give continuity to the research and breathe the analysis. The present Workbooks represent my own process of study.

Walter Farah Calderón.
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Serie: Cuadernos de Trabajo

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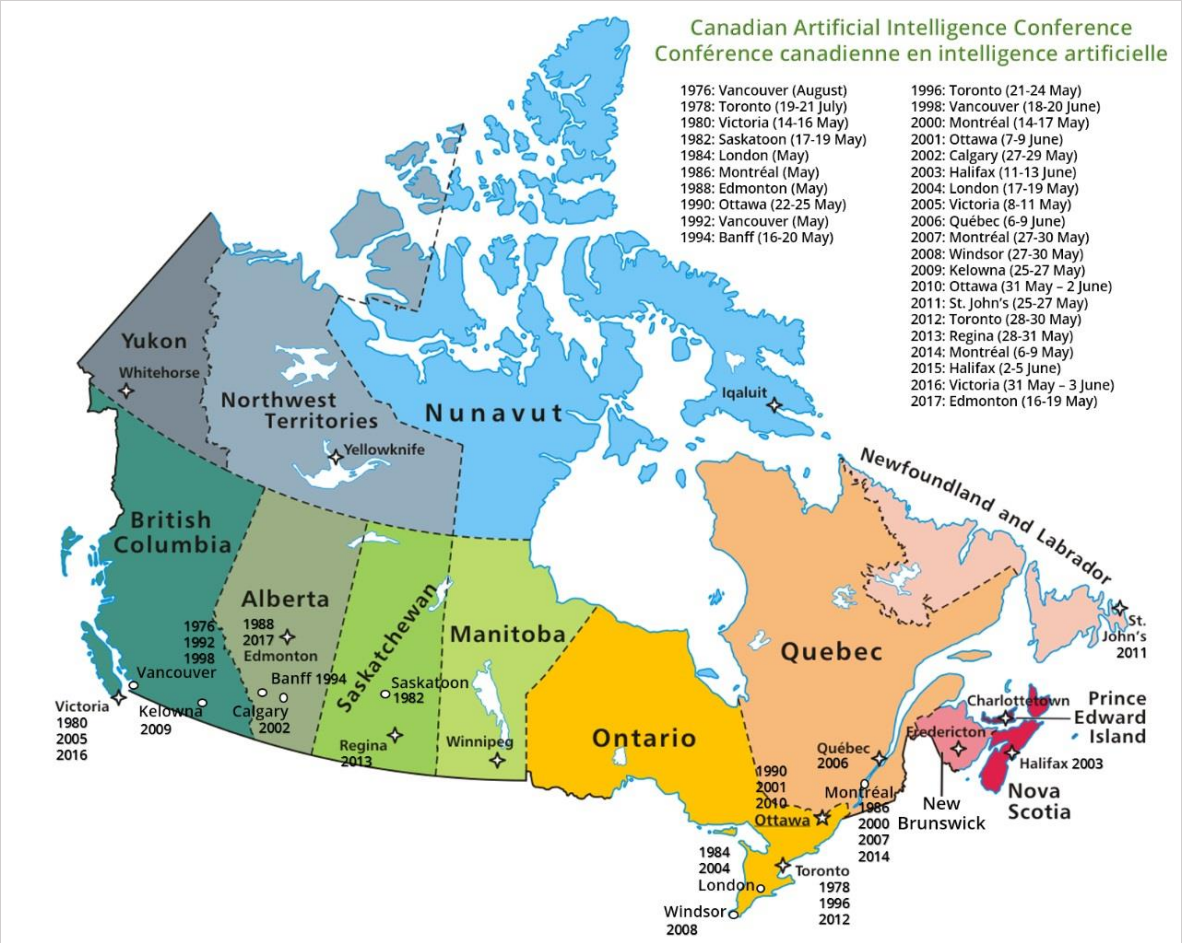
Canada
Artificial-Intelligence Public Politics

Contents

30th Canadian Conference on AI

The 30th Canadian Conference on Artificial Intelligence will take place in Edmonton, Alberta, May 16 to May 19, 2017. The event is collocated with the Canadian Graphics Interface and the Computer and Robot Vision conferences. These events (AI·GI·CRV 2017) will bring together hundreds of leaders in research, industry, and government, as well as Canada's most accomplished students. They showcase Canada's ingenuity, innovation and leadership in intelligent systems and advanced information and communications technology. Edmonton, Alberta, May 16 to May 19, 2017.



Map 1Cities that have hosted the CCAI (CCAI, 2017)

Itinerary for the PM Justin Trudeau, for Thursday, March 30, 2017

Brampton, Ontario 2:00 p.m. The *Prime Minister will highlight Budget 2017 investments in AI research. A media availability will follow. Magna International Inc. 2550 Steeles Avenue East Brampton, Ontario* (Trudeau, J. Prime Minister of Canada, 2017)

PM Justin Trudeau delivers remarks on scientific research and investment in artificial intelligence

March 30, 2017. Prime Minister Justin Trudeau delivers remarks on scientific research and investment in artificial intelligence (AI) while visiting a Magna International Inc. facility in Brampton, Ontario.

Video 1Prime Minister Trudeau delivers remarks (Trudeau J P. , 2017)

...Our government is proud to invest in Canadian innovation, be it in the automotive or aerospace industry, artificial intelligence or green technologies. And we're proud to invest in the creation and retention of good jobs for the people who work hard... (Trudeau J P. , 2017)

Video 2 Prime Minister Trudeau announces an investment at the Ford Essex Engine Plant in Windsor, Ontario (Trudeau J P. , 2017)

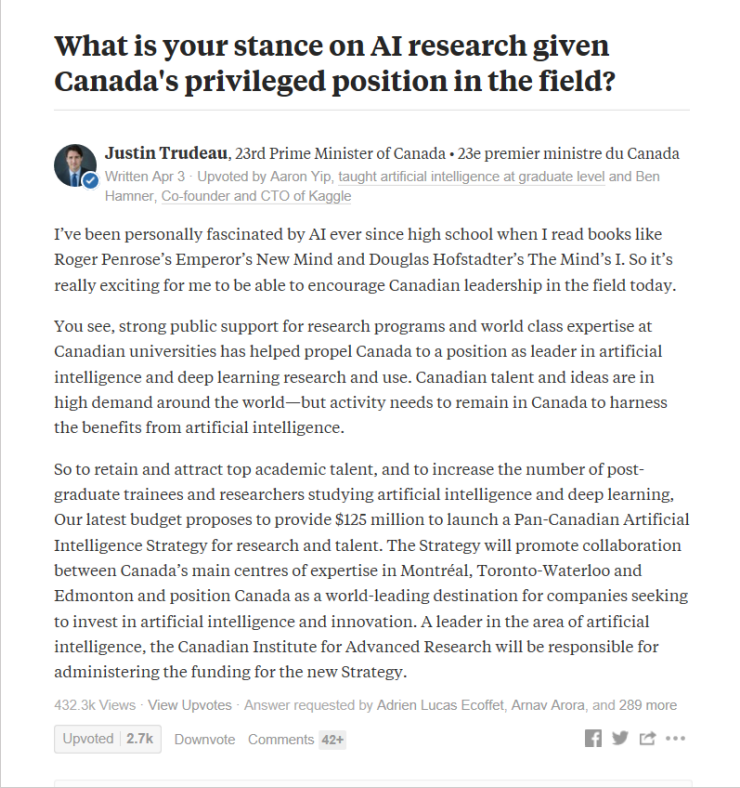
What is your stance on AI research given Canada's privileged position in the field?

I've been personally fascinated by AI ever since high school when I read books like Roger Penrose's Emperor's New Mind and Douglas Hofstadter's The Mind's I. So it's really exciting for me to be able to encourage Canadian leadership in the field today.

You see, strong public support for research programs and world class expertise at Canadian universities has helped propel Canada to a position as leader in artificial intelligence and deep learning research and use. Canadian talent and ideas are in high demand around the world—but activity needs to remain in Canada to harness the benefits from artificial intelligence.

So to retain and attract top academic talent, and to increase the number of post-graduate trainees and researchers studying artificial intelligence and deep learning, Our latest budget proposes to provide $125 million to launch a Pan-Canadian Artificial Intelligence Strategy for research and talent. The Strategy will promote collaboration between Canada's main centres of expertise in Montréal, Toronto-Waterloo and Edmonton and position Canada as a world-leading destination for companies seeking to invest in artificial intelligence and innovation. A leader in the area of artificial intelligence, the Canadian Institute for Advanced Research will be responsible for administering the funding for the new Strategy.

(Trudeau, J. Primer Ministe of Canada, 2017)



What is your stance on AI research given Canada's privileged position in the field?

Justin Trudeau, 23rd Prime Minister of Canada • 23e premier ministre du Canada
Written Apr 3 · Upvoted by Aaron Yip, taught artificial intelligence at graduate level and Ben Hamner, Co-founder and CTO of Kaggle

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432.3k Views · View Upvotes · Answer requested by Adrien Lucas Ecoffet, Arnav Arora, and 289 more

Upvoted 2.7k Downvote Comments 42+

Canada's Digital Future

The world is increasingly connected—it is expected that by 2021 over 4.5 billion people will have access to the Internet. This is just one of the effects of a worldwide shift toward a new digital reality, one that by 2020 includes over 25 billion devices embedded with Internet-based systems, sees a million minutes of video content cross the network every second, and delivers an estimated $6.6 trillion in economic opportunities each year in the G20.

For Canadians, this digital shift is all around us. Many already live in "smart homes" where lighting, temperature, security and appliances are interconnected, and the promise of self-driving cars grows closer every day.

In our communities, Internet-connected devices help to shape our daily commutes, with "smart" traffic lights that measure and adapt timing to improve traffic flows. In connected cities, electricity is now distributed across dispersed energy storage systems, sending energy derived from remote solar, wind and geothermal generating stations to wherever power is needed. Underground, connected sewer systems will detect leaks and monitor real-time water flow, and on our roads and highways, our transportation systems will show real-time information on rail traffic, transport capacity and port loading times, making supply chains faster and more reliable.

At the same time, these world-changing opportunities present challenges for Canada's middle class and those working hard to join it. As more and more industries embrace the digital future, Canadian workers will need new tools and new skills in order to stay competitive.

Some Canadians also face barriers to full participation in the digital economy. Addressing these digital divides means ensuring all Canadians have the digital skills and opportunities to participate online. Budget 2017 is making important investments to address these challenges, including through affordable Internet, skills training for older workers, coding education for kids and improved online accessibility for individuals with disabilities.
To help Canadian companies succeed in this new world, the Government is placing a priority on providing support to Canada's digital innovation.

Investments made in Budget 2016 and Budget 2017 set the stage for a new plan for Canada's digital future, one that will:

- **Make Canada an advanced, digital environment**, home to more "smart cities" and connected communities, where cutting-edge research and technology drive business growth and create good, well-paying middle class jobs.

- **Deliver high-speed Internet access**, so that all Canadians—urban and rural—can be part of the digital economy.

- **Give all Canadians a real opportunity to participate in the digital economy**, especially those for whom evolving technology can deliver life-changing help but who may encounter barriers to accessing it, such as low-income Canadians, adult learners, and Canadians living with disabilities.

- **Support an open and transparent Internet** that emphasizes the freedom to innovate, discuss and disrupt, including how we address issues of net neutrality, media and the creation of Canadian content.

(Departament of Finance Canada, Budget 2017. Chapter 1. Part 3 Canada's Innovaton Economy: Clean Technology, Digital Industries and Agri-Food. Canada Digital Future, 2017)

Artificial Intelligence, Made in Canada

Video 3 Artificial Intelligence, Made in Canada (Pineau, 2016)

Investment in a Pan-Canadian Artificial Intelligence Strategy

CAD$125 million investment in a Pan-Canadian Artificial Intelligence Strategy, designed to support and link together three particularly strong and emerging clusters in the Canadian cities of Montréal, Toronto and Edmonton"

March 22, 2017

Budget 2017 will: "…*Position Canada at the leading edge of a changing economy, by helping to ensure Canadians are able to access the jobs of the future. Budget 2017 helps connect companies on a global scale, takes an innovative and collaborative approach to solving modern challenges, and helps businesses get what they need to grow* (Departament of Finance Canada, Budget 2017. Chapter 1. Canada's Innovation and Skills Plan, 2017)
In this budget, we are making investments in six economic sectors where Canada will lead the way: digital, clean technology, agri-food, advanced manufacturing, bio-sciences, and clean resources. Mr. Speaker, in the realm of digital technology, I know two things to be true. One: Canada can be a world leader in digital innovation. And two: we can't afford not to be. ***That's why we will launch a Pan-Canadian Artificial Intelligence Strategy, and bring together Canada's main centres of AI expertise to drive investment and job creation across the country***. Budget 2017. Remarks by the Honorable Bill Morneau (Morneau, 2017)

To retain and attract top academic talent, and to increase the number of post-graduate trainees and researchers studying artificial intelligence and deep learning, ***Budget 2017 proposes to provide $125 million to launch a Pan-Canadian Artificial Intelligence Strategy for research and talent. The Strategy will promote collaboration between Canada's main centres of expertise in Montréal, Toronto-Waterloo and Edmonton and position Canada as a world-leading destination for companies seeking to invest in artificial intelligence and innovation.*** *Expanding the pipeline of Canadian talent for artificial intelligence will benefit businesses that wish to develop and submit a proposal for an artificial intelligence supercluster. A leader in the area of artificial intelligence, the Canadian Institute for Advanced Research (CIFAR) will be responsible for administering the funding for the new Strategy.* (Departament of Finance Canada, Budget 2017. Chapter 1. Part 3. Canada Digital Future. Growing Canada's Advantage in Artificial Intelligence, 2017)

Budget 2017

Video 4 The Minister of Finance tables #Budget2017 (Finance Canada, 2017)

Budget 2017 Chapter 1—Skills, Innovation and Middle Class Jobs

Part 1—Equipping Canadians With the Skills They Need to Get Good Jobs
Part 2—A Nation of Innovators
Part 3—Canada's Innovation Economy: Clean Technology, Digital Industries and Agri-Food

Canada's Clean Technology Advantage

Access to Financing for Cleantech Firms
Promoting the Demonstration of Clean Technologies
Investing in Research and Development for Clean Energy and Transportation
Encouraging Clean Technology in the Natural Resources Sectors
Expanding Tax Support for Clean Energy
Capitalizing on International Business Development for Clean Technology
Establishing a Clean Technology Data Strategy and the Clean Growth Hub

Canada's Digital Future

Canada as an Advanced Digital Environment
Growing Canada's Advantage in Artificial Intelligence
Supporting Innovation in Financial Services
Canadian Digital Services
Growing the Economy Through Agri-Food Innovation
Developing the Next Agricultural Policy Framework
Advancing Agricultural Science and Innovation

<u>Budget 2017</u>

Budget 2017. Chapter 1—Skills, Innovation and Middle Class Jobs

The Innovation and Skills Plan—Helping Canadians Succeed in the New Economy

Research, Technology, Commercialization	World-Leading Discovery and Innovation
Canada's governments and postsecondary institutions invest significantly in science, research and development, but Canada's business community tends to underinvest in these areas. As a result, Canadian discoveries and innovations often find greater success—and create good, well-paying jobs—in other countries. To better support job growth in Canada, the Innovation and Skills Plan must encourage greater business investment in research and help bridge the commercialization gap.	… Reinforce world class research strengths at post-secondary institutions in areas such as quantum computing, stem cells and **artificial intelligence**. …

Table 1. World-Leading Discovery and Innovation Adaptation Table 1.1
(Departament of Finance Canada, Budget 2017. Chapter 1. Canada's Innovation and Skills Plan, 2017)

What Success Will Look Like

• *Canada will have one of the most skilled, talented, creative and diverse workforces in the world, with more opportunities for all Canadians to get the education, skills and work experience they need to participate fully in the workforce of today, as they—and their children—prepare for the jobs of tomorrow.*
• *Canadian businesses will be strong, growing and globally competitive—capable of becoming world leaders in their fields, leading to greater investment and more job creation in Canada.*
• *Canada will be on the leading edge of discovery and innovation, with more ground-breaking research being done here at home, and more world class researchers choosing to do their work at Canadian institutions.*
• ***Canadian academic and research leadership in artificial intelligence will be translated into a more innovative economy, increased economic growth, and improved quality of life for Canadians.***

(Departament of Finance Canada, Budget 2017. Chapter 1. Canada's Innovation and Skills Plan, 2017)

International Research Collaborations

Canadian Institute for Advanced Research (CIFAR) connects Canadian researchers with collaborative research networks led by eminent Canadian and international researchers on topics that touch all humanity. Past collaborations facilitated by CIFAR are credited with fostering Canada's leadership in artificial intelligence and deep learning. Budget 2017 proposes to provide renewed and enhanced funding of $35 million over five years, starting in 2017–18 (Departament of Finance Canada, Budget 2017. Chapter 1. Part 2. A Nation of Innovations, 2017)

Table 1.3
Skills, Innovation and Middle Class Jobs
millions of dollars

	2016–2017	2017–2018	2018–2019	2019–2020	2020–2021	2021–2022	Total
Canada's Innovation Economy: Clean Technology, Digital Industries and Agri-Food							
Access to Financing for Cleantech Firms	0	51	51	51	26	26	207
Promoting the Demonstration of Clean Technologies	0	25	70	90	90	125	400
Investing in Research and Development for Clean Energy and Transportation	0	0	57	57	57	57	229
Encouraging Clean Technology in the Natural Resources Sectors	0	13	65	66	56	0	200
Expanding Tax Support for Clean Energy	0	2	3	2	1	1	9
Capitalizing on International Business Development for Clean Technology	0	3	4	4	4	0	15
Establishing a Clean Technology Data Strategy and the Clean Growth Hub	0	6	6	7	7	0	27
Growing Canada's Advantage in Artificial Intelligence	125	0	0	0	0	0	125
Advancing Agricultural Science and Innovation	0	4	9	16	16	15	60
Subtotal—Canada's Innovation Economy: Clean Technology, Digital Industries and Agri-Food	**125**	**104**	**266**	**294**	**257**	**225**	**1,271**

Table 2 Budget 2017 IA.
(Departament of Finance Canada, Budget 2017. Chapter 1. Part 3 Canada's Innovaton Economy: Clean Technology, Digital Industries and Agri-Food. Canada Digital Future, 2017)

Growing Canada's Advantage in Artificial Intelligence

From smartphone applications that can understand human speech to self-driving cars, artificial intelligence is changing the way that people interact with each other and our world. It has the potential to drive strong economic growth, by improving the way we produce goods, deliver services and tackle challenges like climate change. Artificial intelligence opens up possibilities across many sectors, from agriculture to financial services, creating opportunities for companies of all sizes, whether technology start-ups or Canada's largest financial institutions.

Strong public support for research programs and world class expertise at Canadian universities has helped propel Canada to a position as leader in artificial intelligence and deep learning research and use. Canadian talent and ideas are in high demand around the world—but activity needs to remain in Canada to harness the benefits from artificial intelligence.

To retain and attract top academic talent, and to increase the number of post-graduate trainees and researchers studying artificial intelligence and deep learning, Budget 2017 proposes to provide $125 million to launch a Pan-Canadian Artificial Intelligence Strategy for research and talent. The Strategy will promote collaboration between Canada's main centres of expertise in Montréal, Toronto-Waterloo and Edmonton and position Canada as a world-leading destination for companies seeking to invest in artificial intelligence and innovation. Expanding the pipeline of Canadian talent for artificial intelligence will benefit businesses that wish to develop and submit a proposal for an artificial intelligence supercluster.

A leader in the area of artificial intelligence, the Canadian Institute for Advanced Research (CIFAR) will be responsible for administering the funding for the new Strategy.

> *Canada a Pioneer in Deep Learning in Machines and Brains*
> *CIFAR's Learning in Machines & Brains program has shaken up the field of artificial intelligence by pioneering a technique called "deep learning," a computer technique inspired by the human brain and neural networks, which is now routinely used by the likes of Google and Facebook. The program brings together computer scientists, biologists, neuroscientists, psychologists and others, and the result is rich collaborations that have propelled artificial intelligence research forward. The program is co-directed by one of Canada's foremost experts in artificial intelligence, the Université de Montréal's Yoshua Bengio, and for his many contributions to the program, the University of Toronto's Geoffrey Hinton, another Canadian leader in this field, was awarded the title of Distinguished Fellow by CIFAR in 2014.*

(Departament of Finance Canada, Budget 2017. Chapter 1. Part 3. Canada Digital Future. Growing Canada's Advantage in Artificial Intelligence, 2017)

Pan-Canadian Artificial Intelligence Strategy

In Budget 2017, the Government of Canada announced funding for a Pan-Canadian Artificial Intelligence Strategy to be developed and implemented through CIFAR, the Canadian Institute for Advanced Research*. The strategy will attract and retain top academic talent, increase graduate and undergraduate training in AI, and support research into social and economic questions around AI.*

The strategy has five major goals:

- *Build a critical mass of talent within existing geographic areas of research excellence*
- *Increase the number of outstanding faculty in deep artificial intelligence nationwide*
- *Dramatically increase the number of Canadian graduate and undergraduate students being trained in deep AI*
- *Create national programs that build a pan-Canadian artificial intelligence community*
- *Position Canada as a scientific leaders in artificial intelligence research, and build on this science to ensure continuing prosperity and progress for all Canadians*

The CIFAR Pan-Canadian AI Research strategy includes:
Three AI institutes*. The strategy will fund AI institutes in Canada's three major centres for artificial intelligence research – the Vector Institute in Toronto, as well as institutes in Edmonton and Montreal. These three institutes will provide a critical mass of research and innovation excellence, and would work with researchers and industry across Canada.*

Academic chairs. *Canada CIFAR Chairs in Artificial Intelligence will be funded at universities in Canada. International competition for artificial intelligence researchers is intense. Funding for the chairs will help Canada retain and recruit top academic researchers, and allow them the freedom to carry out research, train students, and interact with industry.*

A national training program*. The program will recruit and train young researchers, including both graduate and undergraduate students. It will include funding for graduate students who will work with the Canada CIFAR chairs, as well as training for students at the three institutes and across Canada.*

Research into economic and social impacts of AI*. Development of artificial intelligence will have profound implications for the economy, government and society. The strategy will fund work into the potential changes that will be created by AI, as well as policy recommendations on how best to manage them.*

(CIFAR, Government announces CIFAR Pan-Canadian Artificial Intelligence Strategy, 2017)

…They want to build on the tenacity of veteran researchers…

Long before Google started working on cars that drive themselves and Amazon was creating home appliances that talk, a handful of researchers in —backed by the Canadian government and universities —were laying the groundwork for today's boom in artificial intelligence. But the center of the commercial gold rush has been a long way away, in Silicon Valley. In recent years, many of Canada's young A.I. scientists, lured by lucrative paydays from Google, Facebook, Apple and other companies, have departed. Canada is producing a growing number of A.I start-ups, but they often head to California, where venture capital, business skills and optimism are abundant.

"Canada is not really reaping the benefits from this A.I. technical leadership and decades of investment by the Canadian government," said Tiff Macklem, former senior deputy governor of the Bank of Canada, who is dean of the Rotman School of Management at the University of Toronto Now bringing A.I. home is a priority for the Canadian government, companies, universities and technologists. The goal, they say, is to build a business environment around the country's expertise and to keep the experts its universities create in the country.

And they want to build on the tenacity of veteran researchers like Geoffrey Hinton, Richard Sutton*, and* Yoshua Bengio *who developed techniques that opened the door to remarkable improvements in an A.I. technology called machine learning, even as many computer scientists and the tech industry considered their work to be an unpromising backwater. There are encouraging signs, including new government funding, big company investments, programs to nurture start-ups, and the changing habits of homegrown entrepreneurs and American venture capitalists.* (Lohr, 2017)

Edmonton

Background

The University of Alberta is an unlikely international hub for artificial intelligence (AI) research, but some of its brightest minds are going south of the border. The U of A's science faculty dean Jonathan Schaeffer hopes new funding from the federal government will help change that.

"With all this activity in artificial intelligence, it's exciting, but the side effect is these people are in high demand and the U.S. has been grabbing as many of them as they possibly can," Schaeffer said. "Google, Amazon, Facebook, IBM, these are all companies that have a huge thirst for artificial intelligence related research, and many of our students have been siphoned south of the border to work for these American companies."

Schaeffer and his team have their hands in a staggering range of AI projects, including developing self-driving cars that can navigate winter roads, image processing to better pinpoint the location of brain tumours, and using Netflix data to better predict what movies someone will want to watch in the future.

He said the number of companies knocking on the U of A's door is "huge."

"The point about artificial intelligence is it's here, it's used – you probably used it several times today and didn't even know it – but it can be used to improve many applications today," he said.

"But the real magic of artificial intelligence is the new things that it's going to enable, like a self-driving car, like personalized medicine. Those things are going to have a transformative effect on today's society."

Schaeffer, who joined the U of A as an AI researcher in 1984, said Edmonton has been recruiting since the 1970s and first gained prominence as an AI leader in developing computer programs that can play checkers, chess and poker.

Edmonton consistently ranks second in the world in AI and machine learning on CSRankings.org, only behind Carnegie Mellon in Pittsburgh. Schaeffer said students and researchers often choose the U of A over schools like Harvard, Stanford and MIT.

"It's absolutely amazing that we've been able to build such an incredible group, and retain this incredible group, for such a long period of time, given the obvious disadvantages of where we are compared to our major competitors," he said.

Schaeffer said the federal grant will not only help the U of A attract and retain more students and professors, but also build its capacity to work with industry and generate economic

return for numerous industries. University of Alberta faculty of science dean Jonathan Schaeffer. (Maimann, 2017)

Video 5 President David Turpin reacts to the Government of Canada's federal budget, which was tabled on March (University of Alberta, President David Turpin reacts to the Government of Canada's federal budget, which was tabled on March, 2017)

University of Alberta

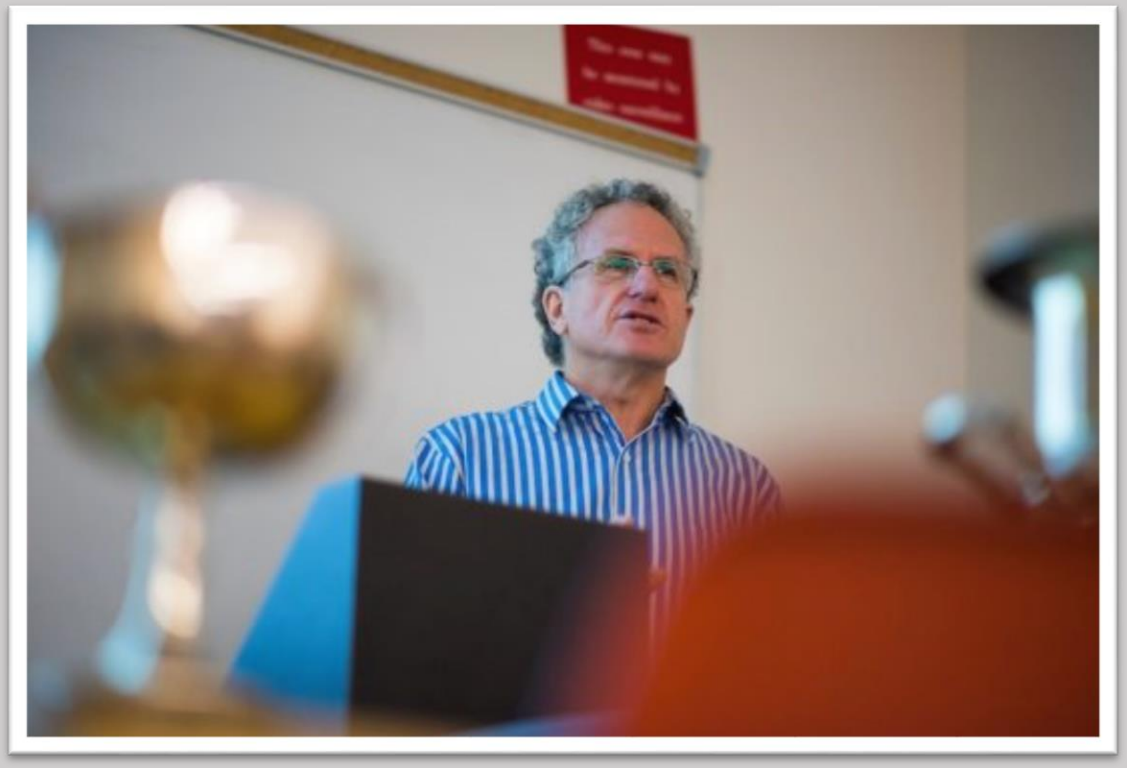


Photo 1University of Alberta faculty of science dean Jonathan Schaeffer (Maimann, 2017)

The University is Alberta is already ranked Canada's top player for AI and deep learning, according to the Computer Science Rankings, reaching eighth on the annual survey's global list. The university is host to robots winning at complicated board games, as well as the Alberta Innovates Centre for Machine Learning *and the* Reinforcement Learning and Artificial Intelligence*. It's also paving the way with research into self-driving cars, which got their own shout-out from Ottawa on Wednesday.* (Toronto Metro News, 2017)

"I'm very pleased the federal government has recognized our expertise in this area as it invests in this absolutely critical area for the future of all Canadians," said University of Alberta president David Turpin. "Our University of Alberta researchers have been world leaders in artificial intelligence for decades' thanks in large part to long-standing support from the Government of Alberta. Now, working together with both the federal and provincial governments, we have the opportunity to take this to the next level." Artificial intelligence research at the University of Alberta, which ranks second in the world, has been largely funded by the provincial government, primarily through its Alberta Innovates program, for more than a decade.

"This province has developed a strong foundation in artificial intelligence and machine learning through the Government of Alberta's investment of over $40 million and the ongoing efforts of the University of Alberta," said Marlin Schmidt, Minister of Advanced Education. "Our funding attracts talent and further investment, helps diversify our economy,

and makes life better for all Albertans. We are pleased the federal government recognizes the strength of AI in Edmonton and is providing funding to complement our ongoing support in these important areas."

Over the years, UAlberta AI researchers have created many applications from their research including prosthetics that improve the quality of life for amputees, and predictive medicine that could help doctors prevent cancer, Alzheimer's and diabetes before they start. With these applications and many others, including self-driving cars...A key component of the pan-Canadian AI strategy is to foster commercialization of AI-driven start-ups and work closely with industry to improve their operations. Some of the recent industry collaborations at the University of Alberta include research partnerships with large companies like RBC, and project-based ones, such as optimizing water treatment control systems with Edmonton-based ISL Engineering. "There is some truly fascinating AI research coming out of Canada," said Richard Sutton, a UAlberta computing scientist who is world-renowned for his boundary pushing research in reinforcement learning. "Canada is punching above its weight in the field, and we're thrilled the federal government is committed to building on this strong base. We've only scratched the surface of what AI can do and are excited to unleash even greater possibilities in deep reinforcement learning." (University of Alberta, UAlberta to play prominent role in pan-Canadian AI strategy, 2017).

Canadians—working in Canadian universities—are responsible for major discoveries in artificial intelligence and machine learning. At the University of Alberta, we are home to Richard Sutton, the world's foremost expert in reinforcement learning (a subfield of machine learning), and to Jonathan Schaeffer, Michael Bowling and their teams, which are well-known for creating the AI systems that solved checkers and out-played human professionals in heads-up no-limit Texas hold'em poker.

The potential application of their research is serious business. No-limit Texas hold'em poker involves decision-making with imperfect or hidden information. Consider the potential of future applications in areas such as planning medical treatments or negotiating complex contracts where decision-making also occurs in the context of incomplete information. Other U of A machine learning research is leading to new applications in healthcare such as the development of intelligent artificial limbs and a highly accurate, low-cost tool for diagnosing tuberculosis.

The U of A's Csaba Szepesvári is collaborating with Edmonton's ISL Engineering on Drayton Valley's water treatment facility. With the application of reinforcement learning, which uses algorithms that adapt to the control process in real time, water filtration is being optimized and energy consumption minimized, without sacrificing water quality.

Thanks to 15 years of sustained investment amounting to more than $40 million by the Alberta government, our artificial intelligence and machine learning research groups have been steadily growing in influence and impact. Today, our department of computing science is ranked second in the world for artificial intelligence, machine learning, and data mining, and its Alberta Machine Intelligence Institute (formerly Alberta Innovates Centre for Machine Learning) is Canada's leading centre in the field of machine intelligence…

Here in Alberta, RBC announced in January a partnership with our Alberta Machine Intelligence Institute. They plan to open an office in Edmonton, creating high-quality R&D jobs—and economic spin-off benefits in the millions. Brad Ferguson of Edmonton Economic

Development Corporation reports that, in the last 12 months, he has received more inquiries about Edmonton's emerging AI sector than any other opportunity. (Turpin, 2017)

Artificial intelligence program at U of A gets major boost. The University of Alberta is a leader in artificial intelligence research. In Wednesday's federal budget, a big funding boost was announced for that work. Vinesh Pratap takes a look at what's being done on campus and what it could mean when it comes to jobs of the future.

Following recent investments in artificial intelligence (AI) and machine learning, RBC announced Dr. Richard S. Sutton, one of the modern day pioneers of AI, as head academic advisor to RBC Research in machine learning. RBC Research will establish a new lab and plan to work with the Alberta Machine Intelligence Institute (Amii), based at the University of Alberta, to identify and pursue further research collaboration opportunities on an ongoing basis. "We are thrilled to be opening a lab in Edmonton and to collaborate with world-class scientists like Dr. Sutton and the other researchers at Amii," said Dr. Foteini Agrafioti, head of RBC Research. "RBC Research has built strong capabilities in deep-learning, and with this expansion, we are well poised to play a major role in advancing research in AI and impact the future of banking."…'The collaboration between RBC Research and Amii will help support the development of an AI ecosystem in Canada that will push the boundaries of academic knowledge,' said Dr. Sutton. 'With RBC's continued support, we will cultivate the next generation of computer scientists who will develop innovative solutions to the toughest challenges facing Canada and beyond. We've only scratched the surface of what reinforcement learning can do in finance and are excited to unleash even greater possibilities with this collaboration between RBC Research and Amii"…RBC Research is also collaborating with the University of Alberta to provide opportunities like internships, academic collaborations and exchanges with the Toronto-based research team to students and researchers. Dr. Eirene Seiradaki, academic partnerships lead at RBC, will be the key contact between RBC Research and professors, researchers and students interested in using machine learning to drive innovation in banking. With almost 20 years of experience in academics, Dr. Seiradaki joined RBC in 2016 and brings a strong commitment to fostering innovation and supporting the academic community. (RBC, RBC, 2017)

Alberta Machine Intelligence Institute

Amii is the Alberta Machine Intelligence Institute, a research lab at the University of Alberta previously known as the Alberta Innovates Centre for Machine Learning (AICML). We work to enhance understanding and innovation in a number of subfields of machine intelligence. Amii is the Alberta Machine Intelligence Institute, a research lab at the University of Alberta previously known as the Alberta Innovates Centre for Machine Learning (AICML). Amii, the Alberta Machine Intelligence Institute, conducts leading-edge research in the fields of artificial intelligence and machine learning, together called machine intelligence. Funded by the Ministry of Economic Development and Trade at the Government of Alberta and based out of the Department of Computing Science in the Faculty of Science at the University of Alberta, Amii's eleven researchers push the bounds of academic knowledge and forge collaborations both locally and internationally to develop innovative, adaptive solutions for some of the toughest challenges facing Alberta and beyond. (AMII, 2017)

Video 6 Amii Overview (Amii Intelligence, 2017)

Reinforcement Learning and Artificial Intelligence

The objectives of the RLAI research program are to create new methods for reinforcement learning that remove some of the limitations on its widespread application and to develop reinforcement learning as a model of intelligence that could approach human abilities. These objectives are pursued through mathematics, through computational experiments, through the development of robotic systems, and through the development and testing of computational models of natural learning processes. (University of Alberta, Reinforcement Learning and Artificial Intelligence, 2017)

Ontario

Video 7 Ontario Opens World-Leading Artificial Intelligence Institute (Premier of Ontario, 2017)

Background

- Advancing innovation in Ontario with IBM Watson. *IBM's Bluemix Garage, in partnership with Ryerson University's DMZ, combines IBM's cloud platform, Bluemix, with DMZ's strong network of international partners and in-house expertise.* IBM and Hamilton Health Sciences (HHS). *Located in Hamilton, HHS is an innovation space that provides healthcare providers, researchers, innovators, and entrepreneurs with advanced technology tools and expertise to improve healthcare outcomes. With access to an array of Watson cognitive and analytics software, expertise in cloud computing and high-performance computing infrastructure, and a network of global collaborators, the centre will offer programs and projects aimed at specialty care for people throughout the entire lifecycle – from prenatal to old age. How accessible is IBM Watson to researchers and entrepreneurs based in Ontario? IBM's commitment to R&D in Canada can be traced back to the 1930's, but more recently IBM technology can be found everywhere from mobile banking apps and the system powering Apple Pay transactions to speeding up drug discovery for Parkinson's disease at the Ontario Brain Institute. In fact, IBM can be linked to some of the most recent innovations of Toronto's beloved NBA basketball team, the Raptors. "IBM Watson, cloud and services expertise are behind the use of cognitive and advanced analytics designed to transform the Raptors' talent evaluation processes," says Horgan.* (Invest in Ontario, Advancing innovation in Ontario with IBM Watson, 2017). More IBM and Raptors

- *Few outside the research community may realize Ontario's deep roots in the field and its role in nurturing some of AI's foremost talent. In the early 2000's, modern AI was pioneered within the walls of the University of Toronto from what came to be known as deep learning, an approach that was all but discarded decades ago. Deep learning, a subfield of machine learning that involves many layers of processing, structured to mimic the brain's function and used to form predictions from big data, was created in Professor Geoffrey Hinton's lab at the University of Toronto, and announced to the world in 2012 when his group won the International ImageNet competition. Since then, global tech giants have been competing for the region's top AI research talent with alumni of the University of Toronto's Machine Learning program filling top roles at Apple, Facebook, OpenAI and Google Brain, as well as Microsoft and Google DeepMind, among others* (Invest in Ontario, Vector Institute to be world-leading Artificial Intelligence R&D Hub, 2017).

- *Ontario-based tech firms to watch at CES 2017. Kiwi Wearable Technologies @ CES 2017. Kiwi is working with large and well-established players to solve problems using artificial intelligence (AI). The company develops software for sensor-based products that is capable of interpreting raw data*. (Invest in Ontario, Ontario-based tech firms to watch at CES 2017, 2017)

- *Top Canadian technology companies represent innovative ideas ranging from fintech, data analytics and artificial intelligence applications to the latest in nanotechnology. Here is the full list of this year's top 20 Canadian tech companies: Blue J Legal, Toronto. Supported by IBM Watson, Blue J Legal is harnessing the power of artificial intelligence and machine learning to change the future of legal research...Finn.ai, Vancouver Finn.ai is an artificial intelligence-powered virtual banking assistant, able to help customers through a full suite of services.* (Ontario, 2016)

- *GM favours Ontario's talent over Silicon Valley. "My first reaction was 'this is just awesome.' Then I discovered that Ontario has the highest concentration of STEM (science, technology, engineering and mathematics), artificial intelligence and IT grads of pretty well any other jurisdiction. I was sold." Convinced that Ontario offered the critical software developers the company needed to drive the next revolution in the auto industry, Carlisle invited Mark Reuss, GM's Executive Vice President, Global Product Development, Purchasing and Supply Chain, to Waterloo. Reuss was equally impressed – to the point where he observed to Wall Street analysts that GM, unlike its competitors, would be giving Silicon Valley a pass in favour of Ontario. "There are seven universities between Windsor-Detroit and Oshawa, each with its own automotive expertise we can tap," explains Carlisle.* (Invest in Ontario, GM chooses Ontario to develop its autonomous car technology of the future, 2016)

- *Najah Ayadi, President of Bluewrist Inc., a provider of industrial automation solutions and products based in Richmond Hill, Ontario, believes it's a technology that makes good business sense. "This new generation of safe robots can deliver a return on*

investment within one year on average." But it's not just dollars and cents. Collaborative robots, along with robotics and autonomous systems in general, can help manufacturers improve quality, accuracy and most importantly, worker safety. And because they can work more closely with humans, they take up less floor space. Ayadi adds that the innovation he is seeing involves a lot of players, from engineers and systems integrators to colleges and universities, and government and standards bodies. Bluewrist's own product development relies on its relationships with local colleges and universities, co-op programs and other manufacturers within the region. Perhaps one of the main attractions is the fact that collaborative robots can quickly make smaller businesses more competitive. They are both affordable and more user-friendly than they used to be, explains Chris Claringbold, CEO of KUKA Robotics Canada Ltd, a robotics systems manufacturer based in Mississauga, Ontario. (Invest in Ontario, Collaborative robots in manufacturing environments, 2016).

- *In fact, robotics has gone through its own evolution, says Peter Fitzgerald, general manager for Ontario-based Fanuc Canada. According to Fitzgerald, the first robots in the 1950s had numerical controls that allow robots to perform simple, repeatable, reliable motions. "Robotics 2.0" arrived in 1980. At that point, integration allowed them to do more wide-ranging functions, like welding or painting cars on an assembly line, cutting metal, or picking and packing*. (Invest in Ontario, Industry 4.0: the digitization of manufacturing, 2016).

- *"Technology that monitors your fuel-efficiency rate in real-time can help drivers save gas and generate fewer greenhouse gas emissions," Lixar founder and CEO Bill Syrros said during a recent tour of the company's sprawling new design and development facility in Ottawa. "But the skills of the individual driving that particular vehicle also affect fuel consumption and emissions. The technology needs to take those factors into account.". Lixar software is built into a wide range of successful new automotive technologies that have won CNET, CES and Edison awards. The company's clients include industry leaders such as GM, QNX and Delphi. Lixar is involved with every stage of new technology development, from proof-of-concept through design and architecture to deployment. "Our clients give us a seat at their innovation table," said Syrros. Two years ago, Lixar started a data science group to explore how a better understanding of machine learning, neural networks and artificial intelligence could help drivers, even with something as seemingly straightforward as improving fuel efficiency. "Today, technology enables people to learn more about their cars," Syrros observed. "By 2020, your car will learn more about who you are."* (Invest in Ontario, New automotive technologies explore the frontiers of human-machine interaction, 2016)

- IBM and SOSCIP developing 'made in Canada' disruptive technologies. SOSCIP offers access to advanced computing platforms, technical expertise and funding for postdoctoral fellows and grad students.

IBM has a more than one hundred year history in Canada, and is one of the country's top ten private R&D investors, having devoted more than half a billion dollars over the past ten years alone. IBM Canada Ltd's President, Dino Trevisani, believes that one of the best ways to boost innovation is through improving collaboration between academia, industry and government. A big part of IBM's efforts toward this end is the Southern Ontario Smart Computing Innovation Platform (SOCIP), which focuses on developing made in Canada disruptive technologies. Since the program began in 2012, SOSCIP has launched more than 60 projects, engaging or creating 38 businesses while establishing more than $2 billion in revenue for new or growing businesses. (Invest in Ontario, IBM and SOSCIP developing 'made in Canada' disruptive technologies, 2015)

- *Canada's most innovative technology companies are from Toronto-Waterloo technology corridor in Ontario.*
  Among the 12 most innovative Canadian technology companies from Ontario, all are from the Toronto-Waterloo technology corridor. They include the following:… Beagle. Beagle of Kitchener-Waterloo helps its clients avoid the pains of dealing with contracts. Its solution offers automatic contract analysis, together with real-time collaboration that uses artificial intelligence to learn from each experience, providing personalized results (Invest in Ontario, Twelve of the 20 top Canadian companies in tech are from Ontario's Toronto-Waterloo corridor, 2015)

Notes

- *Ontario's investment in the Vector Institute will help: Encourage more investment, research and development, and create jobs Retain, train and attract talent, with the aim of producing the most masters, applied masters, PhDs and post-doctoral graduates in deep learning and machine learning AI Provide businesses with made-in-Ontario AI tools, talent and research Promote exports of homegrown products and services enabled through AI. Staying on the cutting edge of technology and leading global innovation is part of Ontario's plan to create jobs, grow our economy and help people in their everyday lives.*

- *Ontario's tech sector employs approximately 430,000 people. Investing in the Vector Institute supports the province's Highly Skilled Workforce Strategy by building on the strength of our education system to help prepare people for tomorrow's jobs in this important technology- and knowledge-based sector.*

- *The Vector Institute will focus on deep learning, a technology that uses software and algorithms to simulate the neural circuits of the human brain to compute massive amounts of data.*

- *The Vector Institute will collaborate with industry partners from sectors such as health care, banking, accounting, insurance, retail, telecommunications, manufacturing, technology, transportation, mining, construction and logistics to commercialize AI across industries.*

(Government of Ontario, 2017)

Ontario: from driverless cars to precision medicine, researchers and entrepreneurs are leveraging deep learning...

From driverless cars to precision medicine, Ontario researchers and entrepreneurs are leveraging deep learning, a powerful subfield of machine learning, to inspire and create the technologies that will dramatically change the world we live in.

Retailers will use deep learning to predict customer behaviour
Tomi Poutanen is co-CEO of Layer 6 AI, a company that employs deep learning to enable companies to personalize their services and unlock value from their data. According to Poutanen, a bank powered by his company's insights would be able to better service its customers based on previous interactions and knowledge of the customer profile and where they live. Meanwhile, a clothing retailer would be able to serve recommendations based on the colour and style of clothing drawn from the pictures of previously purchased items.

Deep learning is paving the way for autonomous vehicles
"By 2025, self-driving cars will be a reality, and soon after, the majority of vehicles on the road will be autonomous," says Associate Professor, Department of Computer Science at the University of Toronto, Raquel Urtasun. Urtasun is currently working with a consortium of companies to create cost efficient methods of mapping terrain for autonomous vehicles. "The model of owning a car will also be largely replaced by resource sharing and new, more flexible ways of public transportation," she says.
Deep learning will transform medicine through pharmaceuticals and personalized medicine

"AI technologies will be changing almost all aspects of society by 2025," says Brendan Frey, co-Founder and CEO of Deep Genomics. Frey's company is leveraging artificial intelligence to transform medicine through pharmaceuticals and personalized medicine, a field that promises to make even today's most modern treatments seem primitive.
Deep learning will create new jobs that do not yet exist.
Professor Geoffrey Hinton, VP Engineering Fellow at Google and University Professor Emeritus at the University of Toronto, says there will be definite changes to the job landscape. "In five to ten years, deep learning is going to do better than some professions, because it's going to get a lot more experience." However, there will also be incredible opportunities as AI will create jobs in positions that do not yet exist.
(Invest in Ontario, Top deep learning experts make bold predictions for an AI-enabled world, 2017)

Video 8 What has led to the rise of AI? (Invest in Ontario, What has led to the rise of AI?, 2017)

Video 9 Why is Ontario the ideal location for an AI R&D hub? (Invest in Ontario, Why is Ontario the ideal location for an AI R&D hub?, 2017)

University of Toronto

Special thanks to the University of Toronto for assistance in the start-up of the Vector Institute. (Vector Institute AI, Vector Intitute AI, 2017)

A team of globally renowned researchers at the University of Toronto is driving the planning of a new institute staking Toronto's and Canada's claim as the global leader in AI. Geoffrey Hinton, a University Professor Emeritus in computer science at U of T and vice-president engineering fellow at Google, will serve as the chief scientific adviser of the newly created Vector Institute based in downtown Toronto. "The University of Toronto has long been considered a global leader in artificial intelligence research," said U of T President Meric Gertler. "It's wonderful to see that expertise act as an anchor to bring together researchers, government and private sector actors through the Vector Institute, enabling them to aim even higher in leading advancements in this fast-growing, critical field".
After decades of being on the "lunatic fringe" pursuing an area of artificial intelligence known as neural networks, Hinton, his colleagues and former students are experiencing an abrupt and transformative reversal in fortune. They are now part of an incredibly in demand "lunatic core." Everyone is vying for their talents, from fellow universities to AI startups to the giants of Silicon Valley. Statistics show 100 per cent of graduates from U of T's master's in applied computing program find employment. Virtually all PhD grads are leaving Canada. South of the border, U of T alumni and former faculty can also be found leading AI divisions at Google, Apple, OpenAI and Facebook. Here at home, they're also creating their own startups like Layer6 AI, WinterLight Labs and Deep Genomics, fuelling local demand for the same talent pool. Hence the need for the Vector Institute. "If we don't create this now, basically we're going to miss the boat in the revolution of AI. It's actually critical for this to [have] started yesterday," says U of T computer science associate professor Raquel Urtasun, the Canada Research Chair in Machine Learning and Computer Vision.The goal, the researchers say, is to have Vector serve as both beacon and magnet – to attract and retain talent to fill the needs of local businesses, support AI startups and show Toronto is serious about capitalizing on its reputation as a global leader in deep learning to push the science towards the next made-in-Canada breakthrough. In particular, Vector funding will help train a huge new contingent of PhD students – some say the most of any institution anywhere – to fill booming demand. Vector's formation is a dream come true for the U of T machine-learning group, says U of T Computer Science Professor Richard Zemel, who is also the institute's research director. "It's the right time to capitalize on that [group's expertise] and grow," said Zemel. "There's a lot of research that goes on here that is a seed for the new wave that's going to come in. . . . My strong feeling is that if we hire more people, then we're going to be able to grow and lead that new wave of research." Brendan Frey, a U of T professor in electrical and computer engineering, and founder of AI startup Deep Genomics, agreed (University of Toronto, Vector Institute points to Toronto as the global hot spot for AI research, 2017)

Video 10 University of Toronto: Introducing the Vector Institute for AI research (University of Toronto, University of Toronto: Introducing the Vector Institute for AI research, 2017)

RBC announced two new initiatives in collaboration with the University of Toronto designed to ensure Canada remains a leading centre of development in machine learning and artificial intelligence. RBC Research in Machine Learning will be a state-of-the-art research practice working to push the boundaries of the science around machine learning. RBC is also partnering with the Creative Destruction Lab at the University of Toronto's Rotman School of Management, becoming a Founding Partner of the Lab's Machine Learning Initiative focused on artificial intelligence-enabled companies. "RBC Research in Machine Learning is part of our commitment to the advancement of machine learning and artificial intelligence in Canada," says Gabriel Woo, vice-president of innovation at RBC. "We are not only building our own capabilities, we're also big believers in creating jobs in this space to retain the amazing talent we have in Canada. We're working with leading universities across Canada like the University of Toronto to partner with the best, brightest and boldest minds in the country." RBC Research in Machine Learning will be housed at the Banting Institute at the University of Toronto, and will be headed up by successful inventor and entrepreneur (RBC, RBC invests in machine learning through partnership with the University of Toronto, 2016)

RBC Research supports RBC's innovation strategy through fundamental scientific study and exploration in machine learning theory and applications. Royal Bank of Canada /RBC) is Canada's largest bank, and one of the largest banks in the world, based on market capitalization

Quotes

"*Artificial intelligence and deep learning are, in fact, all about people. We will harness these cutting-edge technologies to improve everyday life in Ontario, while also attracting the world's best talent to our province. These investments strengthen our position as a global leader in the innovation economy, which is critical to creating more well-paying jobs and shared prosperity for the people of Ontario."* Kathleen Wynne Premier of Ontario (Wynne, 2017)

*"Ontario is, and will remain, a leader in the innovation and knowledge economy, and by accelerating artificial intelligence development and research our government is demonstrating our continued commitment to improving the lives of all Ontarians. The Vector Institute will help Ontario shape homegrown solutions and stay at the forefront of AI innovation, making improvements from food safety to how we teach our children or better care for our loved ones when they are sick."*Reza Moridi, Ontario Minister of Research, Innovation and Science (Government of Ontario, 2017)

"The Vector Institute is a great example of how we're partnering with the private sector and academic institutions to make sure Ontario is driving innovation. It's more important than ever that we take steps to stay ahead when it comes to R&D and commercialization in a highly competitive knowledge-based economy. Investments like these will help diversify our economy and create jobs of the future that will be increasingly in demand." Brad Duguid Ontario Minister of Economic Growth and Development. (Government of Ontario, 2017)

Minister of Economic Growth and Development. "The opportunities for new discoveries in the field of deep learning are very exciting, and the applications are endless. Now is the time for us to lead the research and shape the future of this field, putting neural network technologies to work in ways that will improve health care, strengthen our economy and unlock new fields of scientific advancement. And with the Vector Institute collaborating with institutes in Montreal and Edmonton we can do that here in Canada." Dr. Geoffrey Hinton Chief Scientific Advisor, Vector Institute (Government of Ontario, 2017)

Vector Institute

Video 11 Huge A.I. investment announcement for Ontario (Saltzman, 2017)

Vector Institute is an independent, not-for-profit corporation governed by a highly accomplished volunteer Board of Directors drawn from the private sector, public sector, academic and research communities (Vector Institute AI, About, 2017)

On Thursday, March 30, Finance Minister Bill Morneau will join Ontario Premier Kathleen Wynne and Toronto Mayor John Tory to discuss the Government of Canada's commitment to growing Canada's advantage in Artificial Intelligence (AI) at the launch of the Vector Institute. (Government of Canada, 2017)

A new institute for artificial intelligence research opened Thursday in Toronto with funding from the federal and Ontario governments and the private sector. The Vector Institute will specialize in the fields of machine learning and deep learning, which uses software and algorithms to simulate the neural circuits of the human brain. Ottawa is putting up to $50 million into the institute, Ontario is investing $50 million and more than 30 private-sector companies are set to invest $80 million. The announcement comes the week after Finance Minister Bill Morneau unveiled a budget with a focus on innovation, including $125 million to launch a new artificial intelligence strategy. (CTV News Ca, 2017)
Finance Minister Bill Morneau joined Ontario Premier Kathleen Wynne and Toronto Mayor John Tory at the launch of the Vector Institute, a new independent research facility for artificial intelligence (AI) located in downtown Toronto. Speaking at the MaRS Discovery District, the Minister highlighted the government's focus on supporting key sectors of the new economy where Canada will lead the way, including strong support for the digital sector

and AI, which opens up possibilities across many sectors—from agriculture to financial services. As highlighted by the Prime Minister earlier today, Budget 2017 proposes to provide $125 million to launch the Pan-Canadian Artificial Intelligence Strategy, delivered through the Canadian Institute for Advanced Research... CIFAR will work with the Vector Institute to support its core activities, including the Canada CIFAR Chairs in AI Science, graduate training, and the participation of the Chairs and trainees in national AI activities. (Departament of Finance Canada, Growing Canada's Advantage in Artificial Intelligence, 2017).

As part of the Government of Canada's Pan-Canadian Artificial Intelligence Strategy, Vector will share $125 million in federal funding with fellow institutes in Montreal and Edmonton. All three will conduct research and secure talent to cement Canada's position as a world leader in AI. In addition, Vector is expected to receive funding from the Province of Ontario and more than 30 top Canadian and global companies eager to tap this pool of talent to grow their businesses. The institute will also work closely with other Ontario universities with AI talent.Funded by the Government of Canada and the Government of Ontario (Vector Institute AI, About, 2017)

Ontario is investing $50 million in the Vector Institute, which will also be supported by the federal government. In addition, more than 30 companies in the private sector are anticipated to invest $80 million. (Government of Ontario, 2017).

In addition to $50 million in provincial support, Vector will also receive $40 million to $50 million as part of the Government of Canada's Pan-Canadian Artificial Intelligence Strategy, federal Finance Minister Bill Morneau said. The $125-million strategy is also supporting similar institutes in Montreal and Edmonton (University of Toronto, Toronto's Vector Institute officially launched, 2017).

CIFAR President & CEO Dr. Alan Bernstein congratulated the Vector Institute and the governments of Canada and Ontario for the investments in artificial intelligence research that were announced today. The investments will keep Canada at the forefront of an exciting and transformative area of science, and will help Canada build a leading edge innovation ecosystem, Dr. Bernstein said.

"Canadian successes in artificial intelligence clearly demonstrate how the support for fundamental research can lead to big dividends in scientific, technological and business innovation," said Dr. Bernstein. "The investments announced today build on much earlier support by CIFAR and others in deep learning and advanced AI research. They will keep home-grown talent in Canada, and attract the scientific talent and capital we need to spur innovative economic growth."

"These new investments will serve as a magnet to help retain and attract top research talent that will position Canada as a global player in AI. It will also help ensure that Canada builds a 21st century innovation ecosystem that will drive advances in everything from agriculture to transportation to healthcare," Bernstein said. (CIFAR, Congratulates Vector Institute, governments of Canada and Ontario on artificial intelligence investments., 2017)

Presentation

The Vector Institute is an independent, non-profit research institution dedicated to the transformative field of artificial intelligence, excelling in deep learning and machine learning – an area of scientific, academic, and commercial endeavour that will shape our world over the next generation.

Collaborating with Ontario's academic institutions, other institutes across Canada and companies in every sector of the economy, we will conduct research and drive the adoption and commercialization of AI technologies across Canada. Our goals are to: 1) be a world-leading centre for AI research; 2) graduate the most machine-learning PhDs and masters students in deep learning and machine learning globally; and 3) become the engine for an AI super cluster that drives the economy of Toronto, Ontario and Canada.

Launched in March 2017 with generous support from the Government of Canada, Government of Ontario, the University of Toronto and private industry, Vector represents an unprecedented answer to an unprecedented opportunity: the transformative potential of AI in fields as diverse as finance, education, environment and clean tech, retail, advanced manufacturing, transportation and health care.

We are building on a well-established and respected foundation of globally recognized talent and learning that exists today in Toronto. For researchers looking to establish academic careers, students seeking educations in deep learning and machine learning or companies building and looking to staff AI labs, invest in new businesses, or adapt and grow their existing businesses, Vector is the place to come, to be and to stay.

(Vector Institute AI, Vector Intitute AI, 2017)

Inaugural Partners

- Government of Canada and Government of Ontario
  Canadian Institute for Research and Institut Canadien de Recherchers Avancées
- Platinum ($5 million commitment) com: Accenture, BMO Financial Group, Google, Loblaws, Magna, NVIDIA, RBC, Scotiabank, Shopify, TD Bank, Thomson Reuters
- Gold ($2.5 million commitment): Air Canada, CIBC, Deloitte, EY, Georgian Partners, Intac Financial, KPMG, Manulife, PWC Canada, Sun Life, TELUS
- Silver ($500.000commitment): EllisDon, Linamar
- Bronze ($20.000/year commitment): Chan Zuckerberg Initiative, Clearpath, Deep Genomics, FreshBooks, Helpful, Integrate ai, Layer 6AI, Thalmiclabs

(Vector Institute AI, Partners, 2017) and (Vector Institutte AI, 2017)

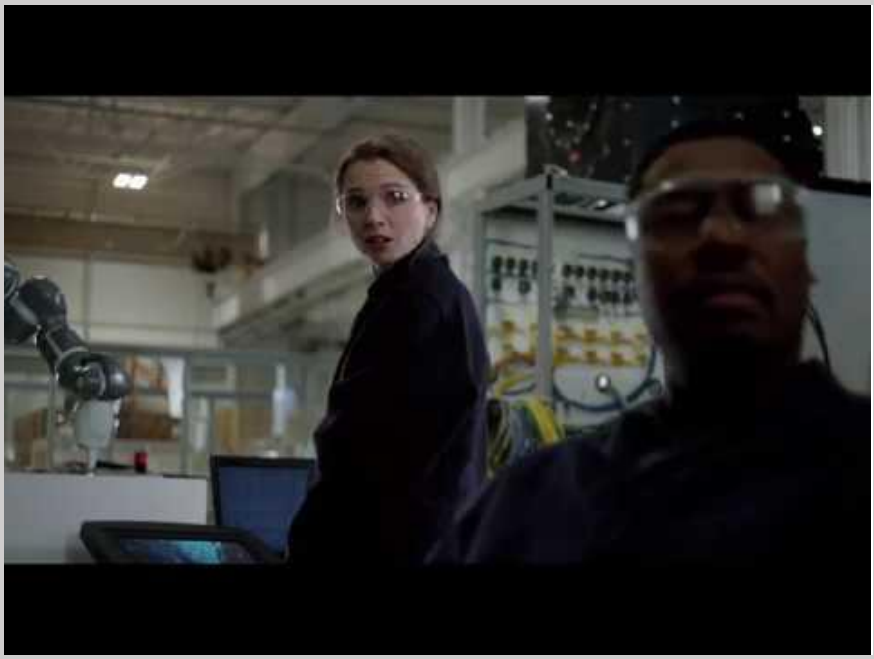
Video 12 Accenture Becomes Founding Sponsor of Vector Institute for Artificial Intelligence in Toronto (Canadian Press Images, 2017)

The Vector Institute launch was led by Ontario Premier Kathleen Wynne, federal Minister of Finance, Bill Morneau, Ed Clark, Chair of the Vector Institute, and Chief Scientific Advisor Geoffrey Hinton. An Accenture demonstration showcased the latest in AI technology, featuring the IPsoft Amelia AI platform and virtual assistant, as well as a DAQRI Smart Helmet and Microsoft HoloLens.

"We are excited to work with the Vector Institute on this unprecedented collaboration in Canada, to explore how business, government, academia and innovators can continue to master AI – which increasingly is becoming the predominant way to create new business, economic and social value," said Bill Morris, senior managing director and Canada president of Accenture. "Accenture is focused on helping our Canadian corporate and government clients better understand how to apply AI to help reinvent business models, unlock the trapped value of data, and improve the way we live and work as a society." Nicola Morini, global managing director of artificial intelligence at Accenture, said, "Accenture believes that businesses require strong partnerships across industry, governments, centers for higher learning, and research and development organizations, to take advantage of a new era in which artificial intelligence will open up new sources of valuable growth. The Vector Institute in Toronto is well-positioned to be a leader in AI and our new relationship reflects Accenture's commitment to help our clients transform their businesses and improve the outcomes they achieve." (Canadian Press Images, 2017)

Quebec

Quebec Budget 2017



Video 13 Le Plan économique du Québec 2017, c'est notre plan (Ministère des Finances du Québec, 2017)

2017-2018 Expenditure Budget On March 28, 2017, Pierre Moreau, Minister responsible for Government Administration and Ongoing Program Review and Chair of the Conseil du trésor, tabled before the National Assembly, the 2017-2018 Expenditure Budget of the Gouvernement du Québec for the current fiscal year.

(Secrétariat du Conseil du Tresor, 2017)

The March 2017 Québec Economic Plan *will stimulate the economy in all spheres of activity and in all regions through, in particular, business innovation and investment. The new initiatives announced today will help to position Québec as one of the most innovative and enterprising economies, open to foreign markets and able to attract the best talent.*
Over $830 million to stimulate research and innovation
To stimulate research and innovation in several cutting-edge activity sectors, the government is announcing additional initiatives totalling over $830 million by 2021-2022, in particular:
$305 million to encourage innovation and the next generation of scientists;
$180 million to encourage research and innovation in higher education institutions;
$118 million to implement the life sciences strategy;
***$100 million to create an artificial intelligence super-cluster**;*
$46 million to stimulate innovation in the forest sector

(CNW Telbec, 2017)

TABLE B.33

Financial impact of measures to stimulate research and innovation
(millions of dollars)

	2016-2017[1]	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	Total
Encourage research and innovation in higher education establishments	—	−20.0	−40.0	−40.0	−40.0	−40.0	−180.0
Encourage innovation and a new generation of scientists	−115.0	−20.0	−30.0	−40.0	−50.0	−50.0	−305.0
$100 million to create an artificial intelligence super-cluster	−50.0	—	—	−15.0	−15.0	−20.0	−100.0
Implement life sciences strategy	−2.0	−15.5	−25.0	−25.0	−25.0	−25.0	−117.5
Promote research by encouraging access to data	—	—	—	—	—	—	—
Promote the development of the innovative manufacturing sector	—	−3.5	−10.0	−15.0	−12.5	−7.5	−48.5
Stimulate innovation in the forest industry	−19.0	−3.5	−6.0	−6.0	−6.0	−5.0	−45.5
Promote maritime research	−6.8	−3.0	−3.0	−3.0	−3.0	−3.0	−21.8
Support mining research	−6.0	—	—	—	—	—	−6.0
Promote public policy research	—	−4.3	−0.8	−1.4	−1.4	−1.4	−9.3
TOTAL	**−198.8**	**−69.8**	**−114.8**	**−145.4**	**−152.9**	**−151.9**	**−833.6**

(1) The subsidies granted in 2016-2017 support the funding of new initiatives.

Table 3 Québec Financial Impact AI (Goverment of Québec, 2017)

6.3 $100 million to create an artificial intelligence super-cluster

There is currently a boom in activities involving the development of artificial intelligence technologies. Major technology companies invest considerable funds to develop applications used in various activity sectors, including health, energy, transportation, business and finance.
To support growth in this sector, the Québec Economic Plan provides an investment of $100 million for the creation of an artificial intelligence super-cluster. (Goverment of Québec, 2017).

Make Montréal an internationally recognized hub for artificial intelligence

Thanks to the presence of numerous highly qualified researchers and specialized research centres, Montréal is recognized internationally for its artificial intelligence expertise.
— Leading companies such as Google and Microsoft opted to open labs in Montréal as a result of this expertise.
— In addition, this expertise was recognized by the Canada First Research Excellence Fund, which recently announced an investment of nearly $94 million in the Institute for data valorisation (IVADO), a Montréal AI research centre.
The creation of a super-cluster will make Montréal a leading economic and scientific hub for research, training, technology transfer, and the creation of value-added products and solutions, employment and businesses specialized in the use and analysis of big data to facilitate decision-making (Goverment of Québec, 2017)

Montréal: a leader in artificial intelligence

By its economic and educational vitality, the Montréal region can attract the best researchers in the world in several areas, including artificial intelligence.
The field of artificial intelligence alone includes several hundreds of researchers. In addition to making advances in data science, several of these researchers collaborate with many private sector partners.
This position is due to:
– advantageous taxation in Québec for information and communication technologies (ICT);
– significant availability of venture capital, with $835 million invested in Montréal in 2016;
– university funding that enables the Montréal region to rank first in Canada in this area, thanks to 11 universities and hundreds of researchers.
Leading software companies such as Google and Microsoft have decided to open labs in Montréal. Because of this synergy, several start-ups opt for the Montréal region, intending to use this technology in concrete applications.
– The Greater Montréal area boasts some 91 000 ICT specialists in approximately 5 000 firms.
The creation of an artificial intelligence super-cluster in Montréal will consolidate the investments and expertise in place, in addition to making Québec an artificial intelligence economic and scientific centre.

Five target areas
The following five areas will be prioritized as part of the work performed by the super-cluster:
— attracting and retaining talent in a context where demand for capabilities in deep learning is strong;
— maintaining a critical mass of high-calibre researchers in artificial intelligence in Québec to incite young researchers to establish their career here and to attract the interest of industry leaders;
— creating a business environment that fosters the development and marketing of scientific advances in products and solutions;
— helping businesses get started and gain access to risk capital in the field of artificial intelligence in Québec, as well as getting artificial intelligence graduate students interested in business start-ups in this field;
— increasing the acceptability and social impact of artificial intelligence to ensure that the issues it raises, namely with regard to confidentiality, are discussed with both experts and citizens.

A collaborative approach
The Université de Montréal will initially be responsible for hosting a steering committee that will guide the development of the super-cluster, in partnership with the key industry actors, including other higher education establishments active in artificial intelligence.
In particular, the committee will be tasked with maximizing the leverage of the government investment, namely through canvassing of private firms that are likely to invest in the super-cluster or artificial intelligence projects.

In this regard, several business stakeholders have already indicated their interest in getting involved financially to help Québec stand out in this leading-edge sector.
Drawing on the expertise developed by IVADO, the super-cluster, which will be implemented in Montréal, will help:
— provide the resources needed for artificial intelligence and the innovation associated with its use;
— form partnerships, including between higher education establishments and the private sector, thus ensuring the financing of its actions and allow it to carry out its work;
— address the challenges associated with the data science, including in terms of confidentiality and ethics.

A number of stakeholders involved in research and innovation will benefit from additional investments, namely universities active in artificial intelligence, industrial research sectoral groups and CCTT.

In addition to the investment of $50 million in 2016-2017, additional appropriations totalling $15 million in 2019-2020 and 2020-2021 and $20 million in 2021-2022 will be allocated to the Ministère de l'Économie, de la Science et de l'Innovation to create the artificial intelligence super-cluster.

(Goverment of Québec, 2017)

Quotations

"It is essential to support research and innovation and foster investment in order to support our businesses in their development and continue our economic growth."
"A boom is currently underway in the artificial intelligence sector. We confirm Québec's place in this cutting-edge sector and we salute the international recognition of its know-how."
"Québec's future also depends on the economic development of all our regions. Thanks to the clarifications made today with regard to the Fonds d'appui au rayonnement des régions, we confirm our support for the economic development of the regions."

Carlos Leitão, Minister of Finance of Québec (CNW Telbec, 2017)

Several labs at the Montreal Neurological Institute are already using deep learning and related AI techniques to conduct research, and the Montreal Neurological Institute's McConnell Brain Imaging Centre is training the next generation of neuroscientists and brain imagers to use these new methods. In January of 2017, the BIC sponsored two hands-on educational sessions focusing on deep-learning for neuroimaging. The event was attended by 80 of the centre's students and staff scientists.
"AI techniques are changing the game of how we do science. We want our research staff and trainees to be aware of and well prepared for this revolution," says Sylvain Baillet, a McGill professor and director of the BIC. "We are fortunate that Montreal is emerging as an international hub for AI research and industry. To remain leaders in our field, we must embrace AI methods like deep learning together with building and using large neurodata repositories, and invest both human and technical resources to exploit the unique features of these powerful tools." (University Mc Gill , 2017)

Montreal Institute for Learning Algorithm at the Université de Montréal

Mission:

- *Federate researchers in the area of deep learning and machine learning for AI*
- *Provide a platform for collaboration and co-supervision*
- *Share human resources as well as infrastructures and computer networks*
- *Provide a unique access to the state-of-the-art to a pool of companies which can benefit from the opportunities opened up by machine learning* (MILA, 2017)

Researchers from MILA have pioneered the field of deep learning and deep neural networks (both discriminative and generative) and their applications to vision, speech and language. MILA is world-renowned for many breakthroughs in developing novel deep learning algorithms and applying them to various domains. They include neural language modelling, neural machine translation, object recognition, structured output generative modelling and neural speech recognition.

The machine learning laboratory at the University of Montreal is led by seven professors, Prof. Yoshua Bengio, Prof. Aaron Courville, Prof. Pascal Vincent, Prof. Roland Memisevic, Prof. Christopher Pal, Prof. Laurent Charlin, and Prof. Simon Lacoste-Julien, all of whom are leading world experts in machine learning, especially in the rapidly growing field of deep learning.

The MILA consists of a large number of researchers in addition to the faculty: at the beginning of 2016, there were 6 post-doctoral researchers, 42 doctoral students, 22 master's students as well as 6 scientific staff members working full time (one executive director, one chief of software development and 4 specialist programmers in deep learning), making it one of the largest academic labs focusing fully on deep neural networks and their applications. (MILA, 2017).

Artificial Intelligence Industry in Montreal

The light bulb flickers inside the old elevator that creaks as it takes you to the eighth floor of the 1960s-era building, tucked away in a corner of Mile End that was Montreal's garment industry a half century ago. Walk down the dank corridor and into the office of Landr's. The contrast is striking: White, shiny and minimalist, the space embodies the new economy. There's a pinball machine next to the kitchen, and pop art on the walls. Its 70 employees are young, educated and casually dressed. The juxtaposition of the office space housing the four-year-old audio technology firm inside the aging building is an easy metaphor for how the Quebec government hopes to inject new life into its economy by kick-starting the artificial intelligence (AI) industry…

As a Quebecer, Landr CEO Pascal Pilon never thought about leaving Montreal. His family is here, but he also believes this is where the fledgling AI industry will flourish. Landr makes software that masters audio files. Pilon's eyes glimmer with pride as he describes how artificial intelligence detects the genre of music that's being uploaded — instantly balancing the sound to make a more fulsome, rich recording. Until now, if you wanted to master audio, you had to hire a sound engineer. That made it prohibitively expensive for most musicians. Landr's product can do the job for a fraction of the price. Pilon says the AI community in Montreal has grown exponentially over the last few years. "It's definitely flourishing. When we started the company back in 2013, it was something people were talking about every now and then, but now everybody's talking about it," he said. The goal of scientists, business people and government alike is to leverage the AI talent that's here to create a worldwide hub of industry, competitive with places like New York and Silicon Valley, that the province could profit from for years to come.

Montreal's burgeoning AI community emerged organically, largely thanks to the work of Université de Montréal's Yoshua Bengio. Bengio runs the world-renowned laboratory, the Montreal Institute for Learning Algorithm. He's considered a trailblazer in the field of AI called deep learning. Instead of having to be programmed, deep learning gives computers the ability to "learn" to solve complex problems. It's used by companies such as Facebook and Google. Indeed, Google has pledged $4.5 million to support the lab's research and open an AI research group at its Montreal office. Microsoft has also invested. Bengio enthusiastically lobbied the government to notice Quebec's critical mass of AI researchers, who now number about 150 in Montreal. He's delighted with the funding announcement. "[AI] might be the most important economic revolution coming to us," said Bengio.

But to be competitive, Bengio said Montreal needs to capitalize on its advantage now — before other jurisdictions catch up. "Of course, it's a race. It's always a race when you're talking about innovation," said Dominique Anglade, Quebec's minister of economy, science and innovation. To Pilon, the magic formula includes having available capital and local people to hire."The faster you can develop the actual product, [the faster] you can go to market and make it a success," Pilon concurs.

A smaller Montreal startup, Fuzzy AI, is hoping to grow from five employees to 25 over the next year. Fuzzy AI creates AI agents that work like shopkeepers for businesses hoping to sell products online. Chatbots use the information you've given them to determine and present products a consumer might want. The government's investment is a cause for celebration and optimism, says Fuzzy AI CEO Evan Prodromou. "This kind of investment could be the seed that starts a billion-dollar industry," said Prodromou. "It could be something that really kick-starts a process for Canada and puts us at the forefront of the world in AI. I think that's a really exciting thing for us."

(McKenna, 2017)

Video 14 A conversation with Yoshua Bengio and Microsoft's Harry Shum (Microsof Reseach, 2017)

Microsoft announced a donation of 7 million $ to support research at MILA. The funds will be distributed over five years, with 6 M$ going to Université de Montréal and 1 M$ going to McGill researcher. They also announced their plan to double the size of the Montreal research team at Maluuba, which Microsoft recently acquired, with a focus on natural language processing. We have agreed to acquire Maluuba, a Montreal-based company with one of the world's most impressive deep learning research labs for natural language understanding.

Maluuba's expertise in deep learning and reinforcement learning for question-answering and decision-making systems will help us advance our strategy to democratize AI and to make it accessible and valuable to everyone — consumers, businesses and developers. We've recently set new milestones for speech and image recognition using deep learning techniques, and with this acquisition we are, as Wayne Gretzky would say, skating to where the puck will be next — machine reading and writing. Sam Pasupalak and his Maluuba co-

founder, Kaheer Suleman, have created a very strong engineering and research team that will become part of our Artificial Intelligence and Research organization.

We believe that together, we can achieve greater scale for Maluuba's groundbreaking work and accelerate our ability to develop software so computers can read, write and converse naturally. Additionally, Yoshua Bengio, one of the world's foremost experts in deep learning, head of the Montreal Institute for Learning Algorithms and an advisor to Maluuba, will also be advising Microsoft and interacting directly with me (Shum, 2017).

A new grant from Google for the Montreal Institute for Learning Algorithms (MILA) will fund seven faculty across a number of Montreal institutions and will help tackle some of the biggest challenges in machine learning and AI, including applications in the realm of systems that can understand and generate natural language. In other words, better understand a fan's enthusiasm for Les Canadien. Google is expanding its academic support of deep learning at MILA, renewing Yoshua Bengio's Focused Research Award and offering Focused Research Awards to MILA faculty at University of Montreal and McGill University: Pascal Vincent, Aaron Courville, Christopher Pal, Doina Precup, Joelle Pineau, Simon Lacoste-Julien, and Laurent Charlin. These awards taken together, for a period of 3 years, bring Google's total donation to MILA (bridging University of Montreal and McGill) to a total of $4.5 million ($3.375M USD)
In addition to this grant, Google is opening a deep learning and AI research group here in our Montreal office, linked to the Google Brain team in Mountain View, California. It will be led by Hugo Larochelle, a leader within the deep learning community who is returning from Boston to Montreal. This kind of corporate investment paired with a burgeoning AI start-up community and substantial government funding to the IVADO hub for data science, deep learning and operations research has turned Montreal into a global machine intelligence powerhouse. University of Montreal and McGill together now count more than 150 researchers (including students) in deep learning, the greatest academic concentration in the world. In collaboration with academic partners such as Google, incubators and start-ups, MILA and IVADO are making Montreal a hub for AI and technological innovation. (Mourad, 2016).

Bibliography

AMII. (2017, Mar 23). *Alberta Innovates Centre for Machine Learning*. Retrieved Apr 11, 2017, from AMII: http://www.amii.ca/blog/2017/3/23/media-release-canada-bolsters-funding-for-artificial-intelligence-recruitment-training

Amii Intelligence. (2017, Mar 9). *Spencer Murray describes how the Alberta Machine Intelligence Institute*. Retrieved Apr 12, 2017, from YouTube: https://youtu.be/VSkXPW6sJuY

Canadian Press Images. (2017, Mar 31). *Accenture Becomes Founding Sponsor of Vector Institute for Artificial Intelligence in Toronto*. Retrieved Apr 11, 2017, from YouTube: https://youtu.be/H4_TV5ZmRBc

CCAI. (2017, 2017). *Welcome to AI 2017!* Retrieved Apr 11, 2017, from 30 Canadian Conference On Artificial Intelligence: https://www.caiac.ca/en/conferences/canadianai-2017/home

CIFAR. (2017, Mar 22). *Canada funds $125 million Pan-Canadian Artificial Intelligence Strategy*. Retrieved Apr 9, 2017, from News Wire: http://www.newswire.ca/news-releases/canada-funds-125-million-pan-canadian-artificial-intelligence-strategy-616876434.html

CIFAR. (2017, Mar 30). *Congratulates Vector Institute, governments of Canada and Ontario on artificial intelligence investments.* Retrieved Apr 11, 2017, from Canadian Institute for Advanced Research: https://www.cifar.ca/assets/cifar-congratulates-vector-institute-governments-of-canada-and-ontario-on-artificial-intelligence-investments/

CIFAR. (2017, Mar 30). *Government announces CIFAR Pan-Canadian Artificial Intelligence Strategy*. Retrieved Apr 11, 2017, from Canadian Institute for Advanced Research: https://www.cifar.ca/assets/government-announces-cifar-pan-canadian-artificial-intelligence-strategy/

CNW Telbec. (2017, Mar 28). *Budget 2017-2018 - Press release no. 5 of 5 - The Québec Economic Plan - March 2017 - A Forward-Looking Economy for All Regions of Québec*. Retrieved Apr 11, 2017, from Quebec Portal: http://www.fil-information.gouv.qc.ca/Pages/Article.aspx?lang=en&motsCles=Artificial%20Intelligence&listeThe=&listeReg=&listeDiff=&type=&dateDebut=2016-10-11&dateFin=2017-04-11&afficherResultats=oui&idArticle=2503283859

CTV News Ca. (2017, Mar 31). *Ottawa and Ontario invest up to $100M in artificial intelligence institute*. Retrieved from http://www.ctvnews.ca/politics/ottawa-and-ontario-invest-up-to-100m-in-artificial-intelligence-institute-1.3348852?

Departament of Finance Canada. (2017, Mar 22). *Budget 2017. Chapter 1. Canada's Innovation and Skills Plan.* Departament of Finance Canada. Retrieved Apr 7, 2017, from Goverment of Canada: http://www.fin.gc.ca/n17/17-017-eng.asp

Departament of Finance Canada. (2017). *Budget 2017. Chapter 1. Part 2. A Nation of Innovations.* Departament of Finance Canada.

Departament of Finance Canada. (2017, Mar 22). *Budget 2017. Chapter 1. Part 3 Canada's Innovaton Economy: Clean Technology, Digital Industries and Agri-Food. Canada Digital Future*. Retrieved Mar 7, 2017, from Goverment of Canada: http://www.budget.gc.ca/2017/docs/plan/chap-01-en.html#Toc477707367

Departament of Finance Canada. (2017). *Budget 2017. Chapter 1. Part 3. Canada Digital Future.* marzo.

Departament of Finance Canada. (2017, Mar 22). *Budget 2017. Chapter 1. Part 3. Canada Digital Future. Growing Canada's Advantage in Artificial Intelligence*. Retrieved Mar 7, 2017, from Goverment of Canada: http://www.budget.gc.ca/2017/docs/plan/chap-01-en.html#Toc477707369

Departament of Finance Canada. (2017, Mar 30). *Growing Canada's Advantage in Artificial Intelligence*. Retrieved Apr 7, 2017, from http://www.fin.gc.ca/n17/17-026-eng.asp

Department of Finance Canada. (2017). *Budget 2017*. Retrieved Apr 7, 2017, from Department of Finance Canada: http://www.fin.gc.ca/fin-eng.asp

Finance Canada. (2017, Mar 22). *The Minister of Finance tables #Budget2017*. Retrieved Apr 12, 2017, from YouTube: https://youtu.be/1MJK3MFXAw8

Futurism. (2017). *Here's What Elon Musk Thinks About Brain Implants, AI, And Basic Income*. Retrieved from Futurism: https://futurism.com/elon-musk-automation-will-force-governments-to-introduce-universal-basic-income/

Gholam, R. (2017, march 28). *Canadian government, businesses back $150 million artificial intelligence institute*. Retrieved march 29, 2017, from Gholamreza: http://gholamrezaghanepoor1976.blogspot.com/2017/03/canadian-government-businesses-back-150.html

Gouvernement , F. (2017). *France Intelligence Artificielle. Rapport de Synthèse.* Paris: France Intelligence Artificielle. Rapport de Synthèse.

Gov Cn. (2017, mar 12). *Govt Work Report turns 'artificial intelligence' into buzzword*. Retrieved march 28, 2017, from GOV CN: http://english.gov.cn/premier/news/2017/03/12/content_281475592727661.htm

Goverment of Québec. (2017). *The Québec Economic Plan.* Retrieved Apr 11, 2017, from Bugget Finances Gouv Québec: http://www.budget.finances.gouv.qc.ca/budget/2017-2018/en/documents/EconomicPlan_March2017.pdf

Government of Canada. (2017, Mar 30). *Minister Morneau to Highlight the Federal Government's Support for Artificial Intelligence Initiatives*. Retrieved from Goverment of Canada: https://www.canada.ca/en/department-finance/news/2017/03/minister_morneautohighlightthefederalgovernmentssupportforartifi.html

Government of Ontario. (2017, Mar 17). *Ontario Opens World-Leading Artificial Intelligence Institute*. Retrieved Mar 7, 2017, from Government of Ontario: https://news.ontario.ca/opo/en/2017/03/ontario-opens-world-leading-artificial-intelligence-institute.html

Invest in Ontario. (2015, Oct 23). *IBM and SOSCIP developing 'made in Canada' disruptive technologies*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/ibm-and-soscip-developing-made-canada-disruptive-technologies

Invest in Ontario. (2015, Oct 30). *Twelve of the 20 top Canadian companies in tech are from Ontario's Toronto-Waterloo corridor*. Retrieved Apr 8, 2017, from https://www.investinontario.com/spotlights/twelve-20-top-canadian-companies-tech-are-ontarios-toronto-waterloo-corridor.

Invest in Ontario. (2016, Apr 29). *Collaborative robots in manufacturing environments*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/collaborative-robots-manufacturing-environments

Invest in Ontario. (2016, Oct 11). *GM chooses Ontario to develop its autonomous car technology of the future*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/success-stories/gm-chooses-ontario-develop-its-autonomous-car-technology-future

Invest in Ontario. (2016, Apr 20). *Industry 4.0: the digitization of manufacturing*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/industry-40-digitization-manufacturing

Invest in Ontario. (2016, Feb 16). *New automotive technologies explore the frontiers of human-machine interaction*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/new-automotive-technologies-explore-frontiers-human-machine-interaction

Invest in Ontario. (2017, Jan 17). *Advancing innovation in Ontario with IBM Watson*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/advancing-innovation-ontario-ibm-watson

Invest in Ontario. (2017, Jan 6). *Ontario-based tech firms to watch at CES 2017*. Retrieved Apr 4, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/ontario-based-tech-firms-watch-ces-2017

Invest in Ontario. (2017, Mar 29). *Top deep learning experts make bold predictions for an AI-enabled world*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/top-deep-learning-experts-make-bold-predictions-ai-enabled-world#request-conversation

Invest in Ontario. (2017, Mar 30). *Vector Institute to be world-leading Artificial Intelligence R&D Hub*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/ontario-leads-ai-revolution

Invest in Ontario. (2017, Mar 30). *What has led to the rise of AI?* Retrieved Apr 8, 2017, from YouTube: https://youtu.be/ugsysVqift0

Invest in Ontario. (2017, Mar 17). *Why is Ontario the ideal location for an AI R&D hub?* Retrieved Apr 8, 2017, from YouTube: https://youtu.be/zZGrwFCC8QI

Jing, M. (2017, March 12). *Beijing to release national artificial intelligence development plan*. Retrieved March 28, 2017, from Scmp: http://www.scmp.com/tech/article/2078209/beijing-release-national-artificial-intelligence-development-plan

Lohr, S. (2017, Apr 9). Retrieved Apr 11, 2017, from New York Times: https://www.nytimes.com/2017/04/09/technology/canada-artificial-intelligence.html?_r=0

Maimann, K. (2017, Apr 6). *University of Alberta gets real money for artificial intelligence*. Retrieved Apr 12, 2017, from Metro News:

http://www.metronews.ca/news/edmonton/2017/04/06/university-of-alberta-gets-funds-for-artificial-intelligence.html

McKenna, K. (2017, Apr 4). *Montreal's fledgling AI community foresees billion dollar industry on horizon*. Retrieved Apr 12, 2017, from CBC Canada: http://www.cbc.ca/news/canada/montreal/ai-quebec-100-million-1.4054430

Microsof Reseach. (2017, Apr 6). *A conversation with Yoshua Bengio and Microsoft's Harry Shum*. Retrieved from YouTube: https://youtu.be/2RSzkFw4LFs

MILA. (2017). *https://mila.umontreal.ca/en/mila/*. Retrieved Apr 11, 2017, from Montreal Institute for Learning Algorithms: https://mila.umontreal.ca/en/mila/

Ministère des Finances du Québec. (2017, Mar 12). *Le Plan économique du Québec 2017, c'est notre plan*. Retrieved from YouTube: https://youtu.be/NV0QXw_BPBE

Morneau, B. (2017, Mar 22). *Budget 2017—Building a Strong Middle Class Remarks by the Honourable Bill Morneau, P.C., M.P.* Retrieved Apr 7, 2017, from http://www.budget.gc.ca/2017/docs/speech-discours/2017-03-22-en.html

Mourad, S. (2016, Nov 21). *Google invests $4.5 Million in Montreal AI Research*. Retrieved Apr 11, 2017, from Canada Google Blog: https://canada.googleblog.com/2016/11/google-invests-45-million-in-montreal.html

Oitzman, M. (2017, Mar 23). *AI Rules Are Necessary, Say European Regulators*. Retrieved march 30, 2017, from Robotics Busines: https://www.roboticsbusinessreview.com/consumer/ai-rules-necessary-say-european-regulators/

Ontario, I. i. (2016, Oct 21). *Canada's top tech companies have one thing in common*. Retrieved Apr 8, 2017, from Invest in Ontario: https://www.investinontario.com/spotlights/canadas-top-tech-companies-have-one-thing-common

Pineau, J. (2016, Nov 11). *Artificial Intelligence, Made in Canada*. Retrieved Apr 12, 2017, from YouTube/McGill University: https://youtu.be/MYfp9-kZxzI

Premier of Ontario. (2017, Apr 4). *Ontario Opens World-Leading Artificial Intelligence Institute*. Retrieved Apr 12, 2017, from YouTube: https://youtu.be/xfRMFnw22n8

RBC. (2016, Oct 20). *RBC invests in machine learning through partnership with the University of Toronto*. Retrieved Apr 10, 2017, from RBC: http://www.rbc.com/newsroom/news/2016/20161020-machine-learning.html

RBC. (2017, Jan 18). *RBC*. Retrieved Apr 10, 2017, from RBC: http://www.rbc.com/newsroom/news/2017/20170118-rbcresearch-amii.html

Roos, G., & Yeh, A. (2017, mars 26). *Meta Media Fr.* Retrieved march 28, 2017, from L'IA, en route vers la quatrième révolution industrielle ?: http://www.meta-media.fr/2017/03/26/lia-en-route-vers-la-quatrieme-revolution-industrielle.html

Saltzman, M. (2017, Mar 30). *Huge A.I. investment announcement for Ontario*. Retrieved Apr 12, 2017, from YouTube: https://youtu.be/hqEXdlTC91o

Secrétariat du Conseil du Tresor. (2017). *https://www.tresor.gouv.qc.ca/en/expenditure-budget/2017-2018-expenditure-budget/*. Retrieved from Secrétariat du Conseil du Tresor: https://www.tresor.gouv.qc.ca/en/expenditure-budget/2017-2018-expenditure-budget/

Shum, H. (2017, Jan 13). *Microsoft acquires deep learning startup Maluuba; AI pioneer Yoshua Bengio to have advisory role*. Retrieved from Official Microsoft Blog: https://blogs.microsoft.com/blog/2017/01/13/microsoft-acquires-deep-learning-startup-maluuba-ai-pioneer-yoshua-bengio-advisory-role/#sm.0001kl4e4k1d08df3pygj0uxfv0gp

Toronto Metro News. (2017, Mar 22). *Edmonton to share feds' artificial intelligence $125M budget boost*. Retrieved Apr 10, 2017, from Metro News Canada: http://www.metronews.ca/news/edmonton/2017/03/22/edmonton-nets-artificial-intelligence-boost-in-2017-budget.html

Trudeau J, P. (2017, Apr 3). *Prime Minister Trudeau announces an investment at the Ford Essex Engine Plant in Windsor, Ontario*. Retrieved from Jutin Trudeu, Prim MInister of Canada.

Trudeau J, P. (2017, Apr 3). *Prime Minister Trudeau announces an investment at the Ford Essex Engine Plant in Windsor, Ontario*. Retrieved from YouTube: https://youtu.be/7s-PrMKLpa4

Trudeau J, P. (2017, Mar 30). *Prime Minister Trudeau delivers remarks at a Magna International facility in Brampton, Ontario*. Retrieved from Youtube: https://youtu.be/ISDTWQ1DfYQ

Trudeau, J. Prime Minister of Canada. (2017, Mar 30). *Itinerary for Thursday, March 30, 2017*. Retrieved Apr 12, 2017, from Trudeau, J, Prime Minister of Canada: http://pm.gc.ca/eng/news/2017/03/29/itinerary-thursday-march-30-2017

Trudeau, J. Primer Ministe of Canada. (2017, Apr 3). *What is your stance on AI research given Canada's privileged position in the field?* Retrieved Apr 12, 2017, from Quora: https://www.quora.com/What-is-your-stance-on-AI-research-given-Canadas-privileged-position-in-the-field/answer/Justin-Trudeau

Turpin, D. (2017, Apr 1). *Alberta and Canada well placed to seize AI opportunity*. Retrieved Apr 10, 2017, from Edmonton Journal: http://edmontonjournal.com/opinion/columnists/opinion-smart-for-edmonton-to-seize-ai-opportunity

University Mc Gill . (2017, Mar 20). *Deep learning transforming neuroscience research*. Retrieved Apr 12, 2017, from University Mc Gill C: http://www.mcgill.ca/newsroom/channels/news/dr-computer-266572

University of Alberta. (2017, Mar 22). *President David Turpin reacts to the Government of Canada's federal budget, which was tabled on March*. Retrieved Apr 12, 2017, from YouTube: https://youtu.be/qh1SE1N8Bg8

University of Alberta. (2017). *Reinforcement Learning and Artificial Intelligence*. Retrieved Apr 11, 2017, from RLAI: http://spaces.facsci.ualberta.ca/rlai/

University of Alberta. (2017, Mar 30). *UAlberta to play prominent role in pan-Canadian AI strategy*. Retrieved Apr 10, 2017, from University of Alberta: https://www.ualberta.ca/news-and-events/newsarticles/2017/march/ualberta-to-play-prominent-role-in-pan-canadian-ai-strategy

University of Toronto. (2017, Mar 30). *Toronto's Vector Institute officially launched*. Retrieved Apr 8, 2017, from University of Toronto: https://www.utoronto.ca/news/toronto-s-vector-institute-officially-launched

University of Toronto. (2017, Mar 31). *University of Toronto: Introducing the Vector Institute for AI research*. Retrieved Apr 8, 2017, from YouTube: https://youtu.be/-2QiezKfTH0

University of Toronto. (2017, Mar 17). *Vector Institute points to Toronto as the global hot spot for AI research*. Retrieved Apr 9, 2017, from University of Toronto: https://www.utoronto.ca/news/vector-institute-points-toronto-global-hot-spot-ai-research

Vector Institute AI. (2017, Apr 10). *About*. Retrieved from Vector Institute: http://vectorinstitute.ai/#about

Vector Institute AI. (2017). *Partners*. Retrieved Apr 10, 2017, from Vector Institute: http://vectorinstitute.ai/#partners

Vector Institute AI. (2017). *Vector Intitute AI*. Retrieved Apr 8, 2017, from Vector Institute AI: http://vectorinstitute.ai/

Vector Institutte AI. (2017, Mar 30). *New Artificial Intelligence Research*. Retrieved from Press Release.

Wynne, K. (2017, Mar 17). *Ontario Opens World-Leading Artificial Intelligence Institute*. Retrieved Mar 7, 2017, from Goverment of Ontario: https://news.ontario.ca/opo/en/2017/03/ontario-opens-world-leading-artificial-intelligence-institute.html

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