Introduction to AI

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Chief Commercialization Officer & VP, Industry Innovation
May 3, 2019
Agenda

• AI in Canada
• Vector Overview
• What is AI
• Opportunities for AI
AI in Canada
National AI Strategy Partners

https://ro.wikipedia.org/wiki/Fișier:Canada-provinces_layout.png
Funders - Public

Ontario

Ministry of Economic Development, Job Creation and Trade

Government of Canada  Gouvernement du Canada

Innovation, Science and Economic Development Canada
Funders - Sponsors

FOUNDING PARTNERS
PLATINUM

FOUNDING PARTNERS
GOLD

FOUNDING PARTNERS
SILVER

FOUNDING PARTNERS
BRONZE

2018 PARTNERS
BRONZE
Canada Global Leader in AI

Photo: Amii

GRAHAM HUGHES / THE CANADIAN PRESS
Canada Global Leader in AI

FRED LUM/THE GLOBE AND MAIL
Geoff Hinton – Godfather of Deep Learning

- Turing Award – 2019
- Co-Founder & Chief Scientific Advisor, Vector Institute
- Vice President and Google Fellow
- Bloomberg 50 Most Influential People – 2017
- Wired 100 list of global influencers – 2016
- Fellow: AAAI, Royal Society of Canada
- Awards
  - David E. Rumelhart prize
  - Killam prize for Engineering
  - NSERC Herzberg Gold Medal
  - IEEE James Clerk Maxwell Gold Medal
Geoff Hinton – Godfather of Deep Learning

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Awards

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- NSERC Herzberg Gold Medal
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Vector Institute for Artificial Intelligence
Foster AI education and Canadian economic growth with AI

Work with Canadian industry and public institutions to ensure that they have the AI people, skills, and resources

Lead Ontario’s efforts for AI-based innovation and productivity in Canada

Drive Knowledge, Development, and the Use of AI
The 4th Industrial Revolution

1st: Mechanization, water power, steam power
2nd: Mass production, assembly line, electricity
3rd: Computer and automation
4th: Cyber Physical Systems

https://www.weforum.org/agenda/2017/07/robots-have-been-taking-our-jobs-for-50-years-so-why-are-we-worried-now/
Requirements for AI

http://www.multihog.co.uk/products/drainage/high-volume-water-pump-product.html
Requirements for AI

https://www.huffingtonpost.com/minube/latin-americas-top-advent_b_3559612.html
What do computers do well?

follow instructions

forward 50
right 90
forward 50
right 90
forward 50
right 90
forward 50
right 90
Why Learning?
What is AI?
What is AI?
What is AI?

- deep learning
- supervised
- unsupervised
- content extraction
- classification
- machine translation
- question answering
- text generation
- natural language processing (NLP)
- expert systems
- image recognition
- machine vision
- speech to text
- text to speech
- vision
- speech
- planning
- robotics

https://mse238blog.stanford.edu/2017/08/jgokani/the-evolution-of-banking-ai/
What is ML?

Deep Learning

http://uc-r.github.io/feedforward_DNN
What is AI

Learn from Experience & Adapt to Environment
Predicting Biosignals

For EMG signals after ten minutes of online learning ($\gamma=0.97$).

**ANTICIPATION RESULTS**

**VALIDATION RESULTS**

Pilarski et al., IEEE RAM, 2013
How Did We Get Here?
What is AI?

https://upload.wikimedia.org/wikipedia/commons/a/ab/Scheme_ICC.svg

Wikipedia

https://upload.wikimedia.org/wikipedia/commons/f/f2/Cromwell_Bridge_Road_scenic_area.jpg

https://upload.wikimedia.org/wikipedia/commons/thumbnail/Multiple_Car_Accident_-_Rabindra_Sadan_Area_-_Kolkata_2012-06-13_01320.jpg/1280px-Multiple_Car_Accident_-_Rabindra_Sadan_Area_-_Kolkata_2012-06-13_01320.jpg

https://upload.wikimedia.org/wikipedia/commons/7/72/Digital_Compass_sensor_and_Arduino_Uno.jpg

https://upload.wikimedia.org/wikipedia/commons/0/0f/Multiple_Car_Accident_-_Rabindra_Sadan_Area_-_Kolkata_2012-06-13_01320.jpg/1280px-Multiple_Car_Accident_-_Rabindra_Sadan_Area_-_Kolkata_2012-06-13_01320.jpg
Every Day AI

https://upload.wikimedia.org/wikipedia/commons/0/08/Netflix_2015_logo.svg


https://upload.wikimedia.org/wikipedia/commons/7/70/Amazon_logo_plain.svg
AI Applied

- All Mail
- Spam
- Trash
- Categories
How Did We Get Here?
AI is Still Difficult
THIS IS YOUR MACHINE LEARNING SYSTEM?

YUP! YOU POUR THE DATA INTO THIS BIG PILE OF LINEAR ALGEBRA, THEN COLLECT THE ANSWERS ON THE OTHER SIDE.

WHAT IF THE ANSWERS ARE WRONG?

JUST STIR THE PILE UNTIL THEY START LOOKING RIGHT.
“In 1966, Minsky hired a first-year undergraduate student and assigned him a problem to solve over the summer: connect a television camera to a computer and get the machine to describe what it sees.”
Crevier 1993, pg. 88
Challenge with Data that lead to poor quality

- Not enough examples
- Not enough variety
- Not enough detail
- Too many irrelevant details
- About the wrong features of the data
- ...

https://en.wikipedia.org/wiki/Blind_men_and_an_elephant
The Take Home Message

Because AI/ML can digest disparate data and automatically adjust to new information, it can deliver business value for organizations.
What do computers do well?

follow instructions

forward 50
right 90
forward 50
right 90
forward 50
right 90
forward 50
right 90
What do humans do well?

abstract & synthesize learning
What does Machine Learning do well?

Learning from experience instead of hard-coded programming rules:

- More flexible than instructions
- Learns more general patterns

∴ Algorithms!

Source: https://www.youtube.com/watch?v=_kX09i4fds
General Tools & Specific Applications
Opportunities for AI
Expected Benefits for Manufacturing

Reasons: Reducing or Improving the Development Cycle

- Improving process efficiency
- Preventing faults
- Reducing inventory costs
- Increasing revenue
Industrial AI Use Cases

Optimize
- Process planning
- Job shop scheduling
- Yield management
- Supply chain
- Demand forecasting
- Warehouse operations optimization (picking)
- Production coordination
- Fleet logistics
- Product design
- Search ordering

Control
- Robotics
- Wind Turbine Control
- HVAC
- Autonomous vehicles
- Factory automation
- Smart grids
- Machine Tuning

Monitor & Maintain
- Quality control
- Fault detection & isolation
- Predictive maintenance
- Inventory monitoring
- Supply chain risk management

AI Can Create Value in 4 Areas

These areas are being explored or are already deployed in business today:

• Enabling companies to **project & forecast** to anticipate demand, optimize R&D, and improve sourcing

• Increasing companies’ ability to **produce** goods and services at lower cost and higher quality

• Helping **promote** offerings at the right price, with the right message, and to the right target customers

• Allowing them to provide rich, **personal**, and convenient user experience
AI Can Create Value in 4 Areas – Project

Accurately forecast demand, optimize supply, and shape future offerings to:

• Gain competitive advantage
• Design better offerings
• Use sales trends to guide orders for soon-to-be-popular items
• Use demand to only stock needed quantities of products and minimize waste
• Identify reliable supply chains

AI Can Create Value in 4 Areas – Project

Benefits of forecasting demand, optimize supply, and shape future offerings:

• Reduce forecasting errors from conventional approaches by 30-50%
• Reduce lost sales due to product unavailability by up to 65%
• Decrease costs of transportation, warehousing, and supply chain administration by 5-10% and 25-40%
• Overall inventory reductions of 20-50%

Maximize the time that systems run, while minimizing maintenance and repairs:

- Products: manufacturing, health care, power or consumer goods distribution
- Condition-based maintenance run by AI rather than scheduled maintenance
- Prevent decommissioning of assets before their useful lives have ended
- Enabling more frequent remote inspection and maintenance
Maximize the time that systems run, while minimizing maintenance and repairs:

Do your current solutions focus on monitoring & notification? → Downtime

European power distribution company reduced its cash costs by 30% over 5 years by changing its maintenance patterns based on remote analysis of 20 variables to determine the overall health of power transformers.
AI Can Create Value in 4 Areas – Promote

The right price & the right message to the right audience

With phones, AI can help optimize, update, and tailor sales to each shopper in real time:

- Retailers can send mobile coupons to shoppers
- Discount & merchandise based on previous purchases, age, address, web browsing...etc
- Personalized promotions, optimized assortment & tailored displays can increase sales by 1-5%.
- Online, there is a focus on the most valuable customers, this combined with dynamic pricing, can lead to a 30% growth in sales
AI Can Create Value in 4 Areas – Personalize

Give customers a rich, personalized, and convenient experience

- Supermarket shopper **recommendations in real-time based** on current item being purchased

- Athletes based on app data: A runner using an athletic company’s app to monitor her activity would receive **footwear recommendations tailored to her running paths**
Breaking Down AI Solutions – Fry Manufacturing

Issue/Problem: Food Imperfections Cause Waste

- French fry manufacturing – challenge to deliver a consistent product due to natural variation in size and shape of potatoes.

- The machine will make the same product regardless of the shape and size of the potato. This leads to waste as fries are too short or too thin and unappealing to consumers.


https://www.vegrecipesofindia.com/french-fries-navratri-recipe/
Breaking Down AI Solutions – Fry Manufacturing

**AI Solution: Sort Food Prior to Cutting**

- Machine identifies and separates potatoes most suitable for French fries, potato wedges or crisps
- More efficient production line
- Happier, more satisfied consumer enjoying the final product

“It is about capturing the essence of this consumer thinking and putting that intelligence into a machine. The ultimate goal for food sorting and processing is for a machine to view food in the same way that consumers do; the ability to control a natural variable and apply a degree of intelligence [are] hugely powerful tools to ...industry in general.”

Pieter Willems, technical director at TOMRA Sorting Food

Requirements for AI

- What data do you have?
- What is ground truth?
- What result do I want?
- What actions can I take?
Opportunities for AI

- What processes are automated?
- Where do we use data to make decisions?
- Where and or how do you currently use prediction? (i.e. credit default, life time value of a customer, etc.)
Questions That May Lead to AI Insights

**Personalization**
- How do we create a flexible production environment that supports mass customization?

**Quality Expectations**
- How do we reduce process variability?

**Operational Complexity**
- How do we minimize costs and ensure consistently high quality?
- How do we optimize use of resources and balance production constraints?

**Supply Chain Execution**
- How can we synchronize sales orders, purchases, and production?

https://www.slideshare.net/OracleAnalytics/optimizing-manufacturing-operations-using-big-data-and-analytics
Is AI Going to Replace Me?
How Did We Get Here?
Is AI Going to Replace Me?

1/3 of all jobs today did not exist 30 years ago - McKinsey
Even with all of the resources of a great machine learning expert, most of the gains come from great features, not great machine learning algorithms.

Thank you
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Data’s Potential

Blind men and an elephant

- Features
- More data
- How you get value

https://en.wikipedia.org/wiki/Blind_men_and_an_elephant
Industries Ripe for Disruption

• Any with lots of data in computer readable format
• Banking & Finance
• Capital Markets
• Insurance
• Accounting & Audit
• Legal
• ...

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