

The Future of Work and Learning: Focus on Artificial Intelligence

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**2018 Leaders and Innovators
Conference**

Outline

- Introductions – Why are you here?
- What is artificial intelligence (AI)?
- How AI is impacting work and learning
- What is machine learning (ML)?
- Using ML for solving real problems
- Hands-on exercise
- Questions and answers

Introductions

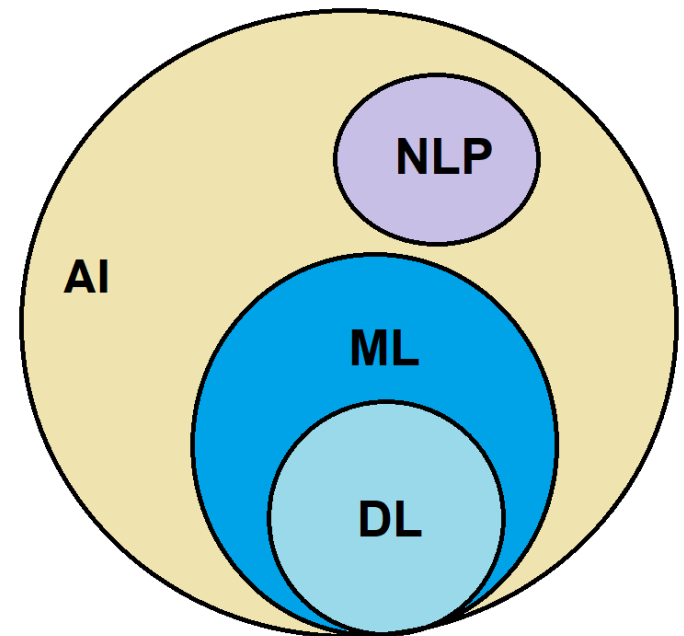
**Why are you interested in this session?
How much do you know about AI?**



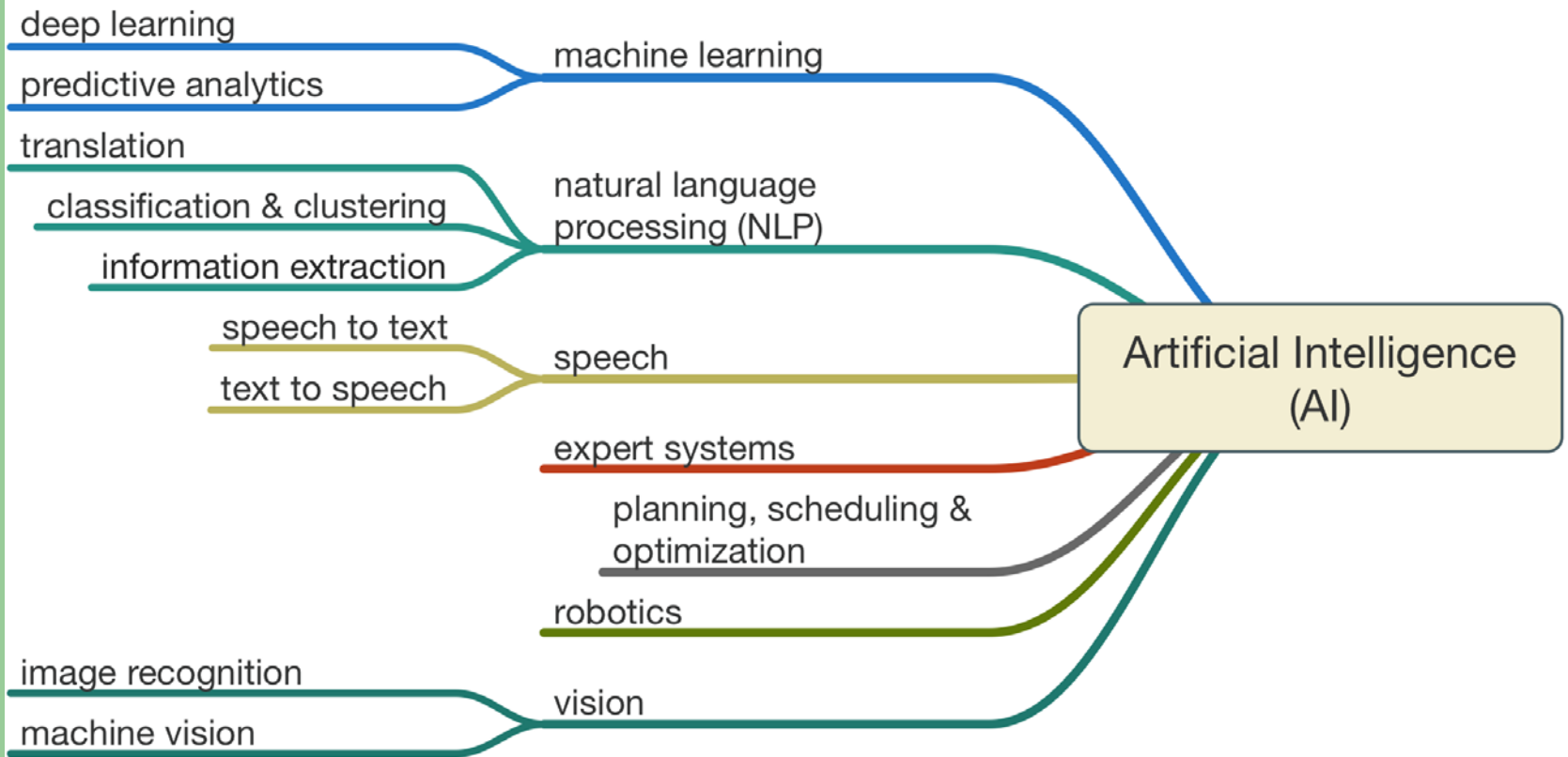
Overview of AI

Artificial Intelligence

- **AI:** “enterprise of **constructing an intelligent artifact**”, something like vision, voice, making assumptions, playing a game, etc. [Matt Ginsberg, Essentials of Artificial Intelligence].
- **ML:** subfield of AI that “allows computers to **learn from data without being explicitly programmed**”.
- **Deep Learning (DL):** subfield of machine learning that uses **deep artificial neural networks** which are neural networks with multiple hidden layers – mimicking human neurons.
- **Natural Language Processing:** subfield of AI that deals with building systems that can **understand** natural language
 - Combined with machine learning, NLP can be used **to understand** a natural language.



Subfields of AI



Outlook 2021 for ICT in Canada

- **Key Information & Communications Technologies**
 - **AI**
 - **Virtual and Augmented Reality**
 - **5G Mobile**
 - **Blockchain**
 - **3D Printing**
- **Canada is a leader in AI** and wants to sustain this advantage through innovation and entrepreneurship.

https://www.ictc-ctic.ca/wp-content/uploads/2017/04/ICTC_Outlook-2021.pdf

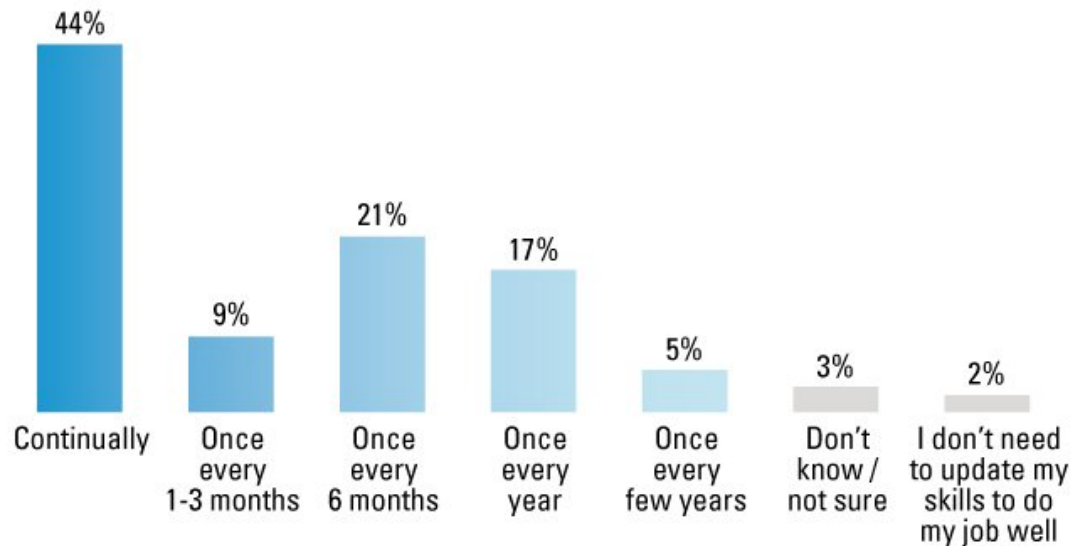
<https://www.theglobeandmail.com/report-on-business/rob-commentary/artificial-intelligence-is-the-future-and-canada-must-seize-it/article33532668/>

Demands of Digital Environment

More than 90% of respondents say they need to update their skills at least yearly to work effectively in a digital world.

Rectangular Snip

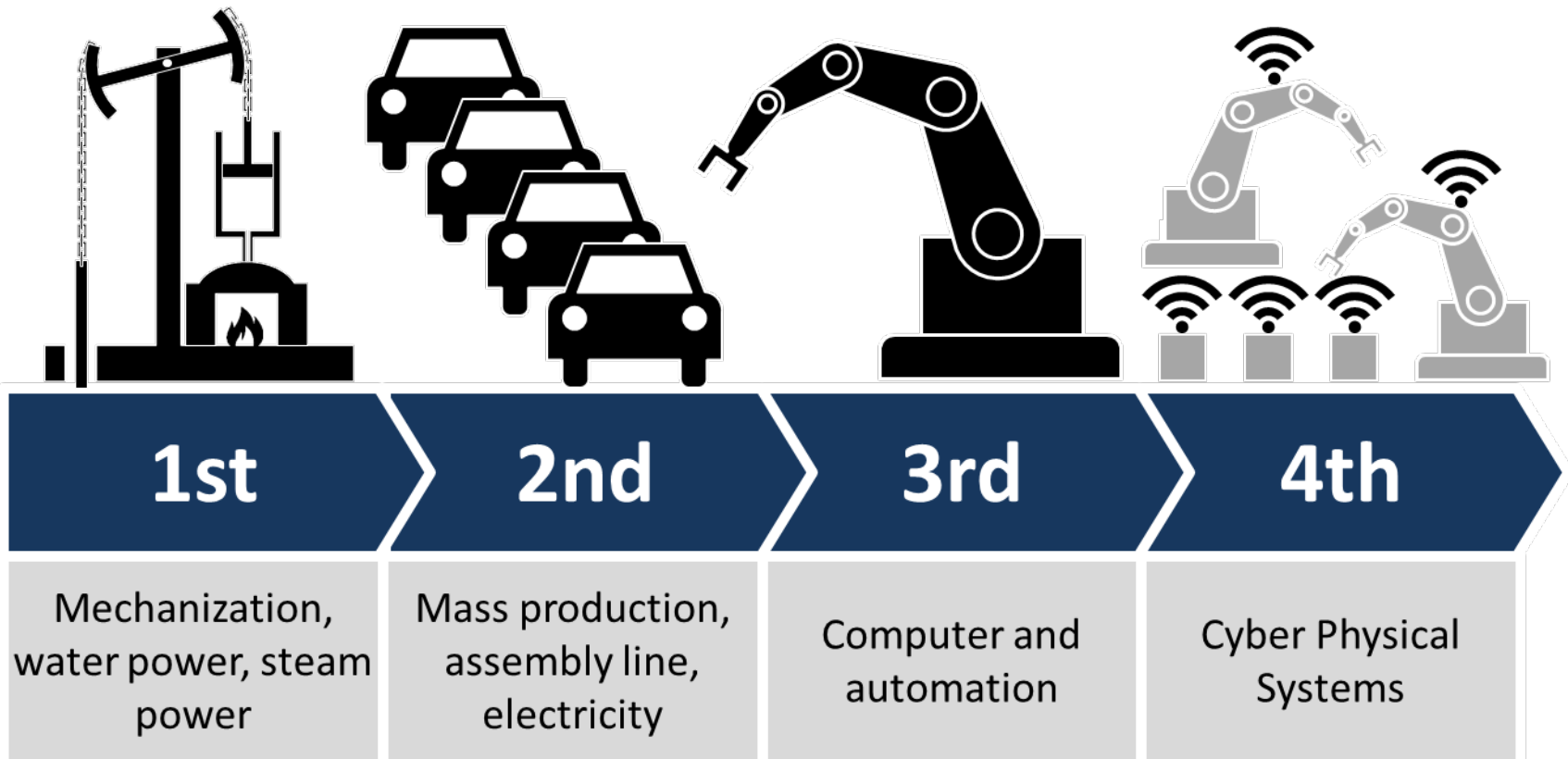
How often do you need to update your skills to do your job effectively in a digital environment?



Percentages do not total 100 due to rounding.



Impact on Work and Learning



Source:

https://en.wikipedia.org/wiki/Industry_4.0#/media/File:Industry_4.0.png

Intelligent Machines

Watson Goes to Work in the Hospital

Technology like that inside the *Jeopardy!* champ is being used to identify when babies are acquiring an infection.

by Tom Simonite April 13, 2011

Source:

<https://www.technologyreview.com/s/423636/watson-goes-to-work-in-the-hospital/>



Source: <https://singularityhub.com/wp-content/uploads/2015/08/autistic-neural-network-3.jpg>

The Mind to Market Award celebrates the best OCE-supported research collaboration between the business and research communities, resulting in effective commercialization of leading-edge ideas and solutions.

Award recipients exemplify the innovation that is possible when the brightest minds in industry and research collaborate to address today's most critical issues. The winner will serve as inspiration to others to adopt a collaborative approach to research, commercialization and, ultimately, building a more vibrant society and competitive economy for Ontario.

2017 FINALISTS

APX Building + Onsite Data Solutions

in collaboration with
University of Ottawa

Wireless Heterogeneous Sensor Networks in the e-Society was a five-year research and development project established in 2008 with a grant from Ontario's Ministry of Economic Development and Growth. As lead institution, the University of Ottawa

Korah Limited

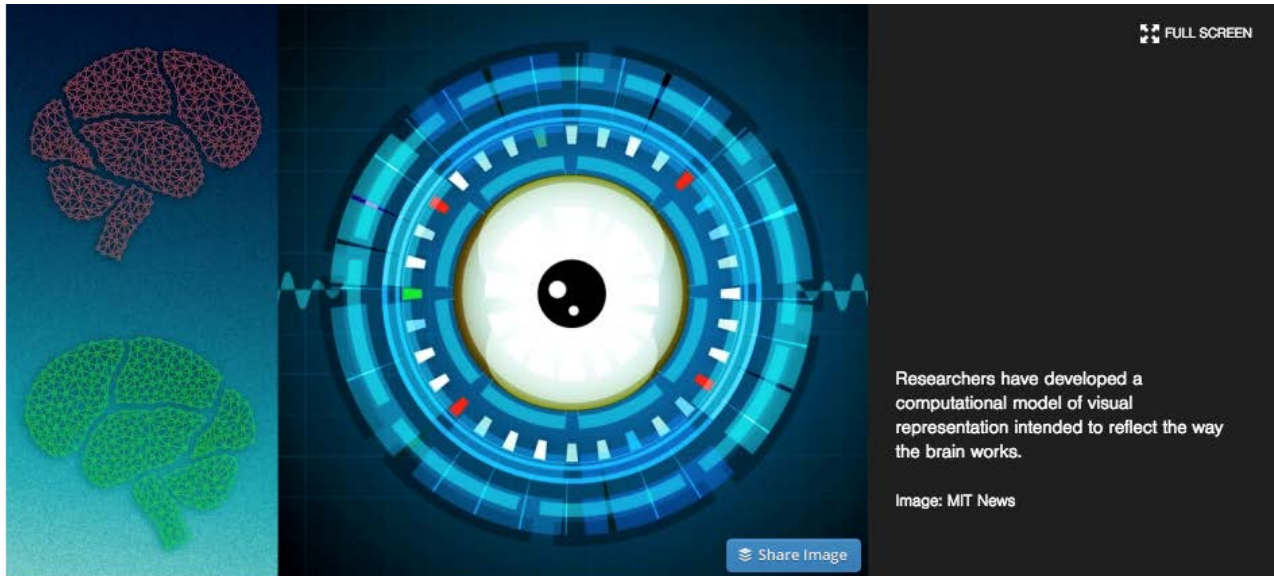
in collaboration with
Centennial College

ccRobot is a platform that uses the latest advances in natural language processing and machine learning to intelligently communicate to users and provide them an intuitive interface to interact with organizations through natural language. Designed as a customer service robot to automate the handling of

OTTO Motors

in collaboration with
University of Waterloo

OTTO™ Motors manufactures and operates self-driving vehicles to automate material movement inside busy factories and warehouses. Using self-driving technology much like the Google Car, the easy-to-use OTTO vehicles move inventory in a safe and flexible manner throughout the



Machines that learn like people

Algorithms could learn to recognize objects from a few examples, not millions; may better model human cognition.

Artificial Intelligence

- **AI's global economic impact** is expected to reach \$7.1 - \$13.1 trillion by 2025.
- AI is moving towards becoming **a core component of modern applications**.
- Artificial Intelligence is all set to become **the new database for the next generation applications**.
- Modern applications are **consuming AI Application Programming Interfaces (APIs)**.

https://www.ictc-ctic.ca/wp-content/uploads/2017/04/ICTC_Outlook-2021.pdf

<https://www.forbes.com/sites/janakirammsv/2017/06/12/3-steps-to-embedding-artificial-intelligence-in-enterprise-applications/#41e72e8b3cf4>

AI in the Past

- The earlier implementations of AI included **expert systems** used in decision-making.
- Such implementations used **strict if-then logic to mimic human expertise** and **did not learn from data** to improve over time.
- The problem with this approach is that it is **impossible to write a program for each task** because there may not be human expertise how to write it.

Identifying Spam E-mail

Imagine it is the early days of the Internet.
What rules would you use to determine if an incoming e-mail was spam?

Spam Email Example

- We want to automatically **classify spam email from legitimate email.**
- There are **no ideal rules to follow** for writing a program that will identify spam email.

Note: The email has an Unknown 'Aston' Email Address

Tip: Check the 'Global address list' in Microsoft Outlook to verify if the account exists

From: WEBMAIL SUPPORT TEAM (mailto:support-team@aston.ac.uk)
Sent: 18 June 2008 04:08
Subject: THE ASTON WEBMAIL SUPPORT TEAM

Dear ASTON Webmail User,

To complete your Plus webmail account, you must reply to this email immediately and enter the following informations below;

Name:
Password:

Failure to do this will immediately render your email address deactivated from our database.

You can also confirm your email address by logging into your Plus webmail account at <https://webmail.aston.ac.uk/webmail/login.php>

We apologise for any inconveniences, but trust you understand that our primary concern is for our customers to be totally secure.

THE ASTON WEBMAIL SUPPORT TEAM.

Note: A Request for personal information

Tip: Aston University IT Services will never request personal information

Flagging Spam Email Using ML

- Instead, we use a **large dataset of email examples** that are correctly classified by humans as **spam** and **legitimate** emails.
- Then, we use machine learning algorithms (such as Naïve Bayes) to “**create the program**” which will be able to classify new examples with sufficient accuracy.

word	count	category
have	1	spam
pleasurable	1	spam
stay	1	spam
get	2	spam
off	1	spam
flat	2	spam
cashback	2	spam
oyo	1	spam
room	1	spam
bookings	1	spam
done	1	spam
via	1	spam
paytm	1	spam
lets	1	spam
talk	1	spam
fashion	1	spam
backpacks	1	spam
watches	1	spam
perfumes	1	spam
sunglasses	1	spam
more	1	spam
opportunity	1	ham
product	1	ham
firm	1	ham
fullstack	2	ham
backend	1	ham
frontend	1	ham
bangalore	2	ham
javascript	1	ham
developer	2	ham
urgent	1	ham
requirement	1	ham



Overview of ML

Applications of Machine Learning

- Predicting how a viewer will rate a movie
- Predicting the stock price for tomorrow
- Finding out if an email is spam
- Detecting if a picture is a cat or a dog
- Recommending a product
- Credit approval
- Detecting handwritten characters (CAPTCHA, OCR)
- Detecting faces (Facebook Tagging)
- Weather forecasting

Basic Principle of Machine Learning

- **Learning:** Using a set of observations (**data**) to uncover an underlying process
 - Supervised Learning
 - Unsupervised Learning
- **Predicting:** A set of algorithms (learners) that can automatically detect/classify/predict

Current Advantages and Limitations

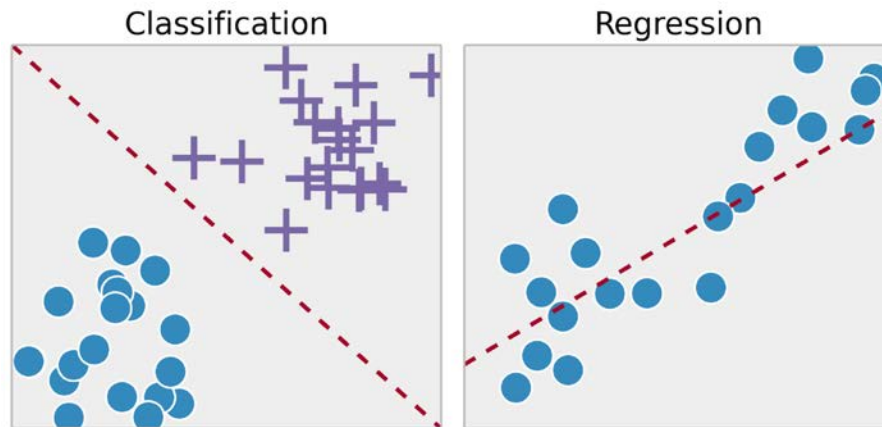
Advantages	Current Limitations
Can process lots of data and fast	Needs lots of data and they can be biased
Can automate many processes/tasks	Can automate many processes/tasks
Can solve very difficult problems for humans	Explainability

Preparing to Benefit from ML

Discussion: What data sets do you have at your College?

Supervised Learning

- **Examples:**
 1. **Regression** – predict house price based on numbers of rooms, bathrooms, square footage, etc.
 2. **Classification** – credit approval, hand-written digit recognition, etc.



Credit Approval Example - classification

Age	Marital status	Salary	Credit Rating	Outstanding debts	Approved /Not Approved
34	true	57,000	700	10,000	Yes
45	false	42,000	500	20,000	No
...

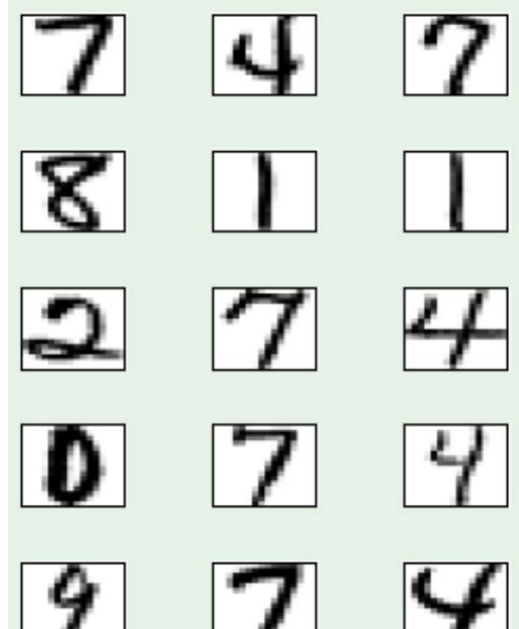
- Learn a classification model to predict the classes of future examples

Age	Marital status	Salary	Credit Rating	Outstanding debts	Approved /Not Approved
29	false	45,000	500	5,000	?

Digit recognition - classification

- Hand-written digit recognition task

some *'supervisor'* has taken the trouble to look at each **input**, in this case an image, and determine the correct **output**, in this case one of the ten categories {0, 1, 2,3,4,5, 6, 7,8, 9}

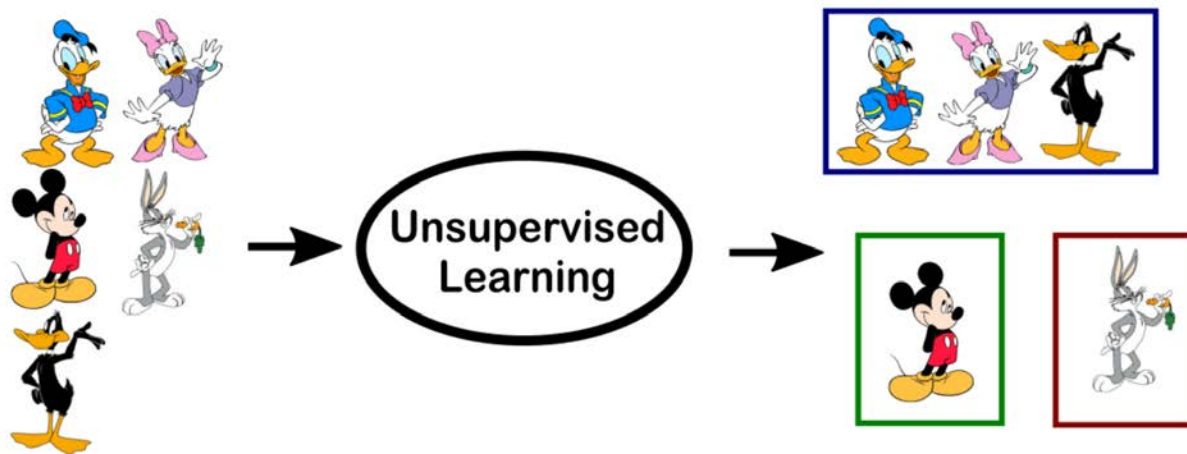


Prediction Retention - classification

- Machine learning can be used in educational institutions to predict student retention
 - Our application predicts the student retention based on **historical institutional data**, such as **academic** and **demographic** records of students, and other available institutional information.
 - The **ensemble classifiers** which combine the results of several machine learning algorithms, produced a **better accuracy** of prediction, approximately 80%.

UnSupervised Learning - Clustering

- **Clustering** – groups data that are similar in a cluster and data that are different from each other in different clusters
- Example: **segment** students/customers according to their similarities.



Strong AI

- Some researchers believe there is a 50% chance of AI outperforming humans in all tasks in 45 years.
- With more computing power than ever, internet, large datasets, quantum computing close to becoming a reality, and increasing interest in many areas of business and life, many believe that AI will allow the creation of systems that can do whatever humans do, something known as '**strong AI**'.



Hands-On Exercise with ML

Example: First Train, then Test

Contains patterns



Data

Finds patterns



Train Algorithm

Recognizes patterns



Build Model



New Data



Use Model
(prediction function)



Predictions

Supervised Learning Exercise

- Image Painting

- https://cs.stanford.edu/people/karpathy/convnetjs/demo/image_regression.html

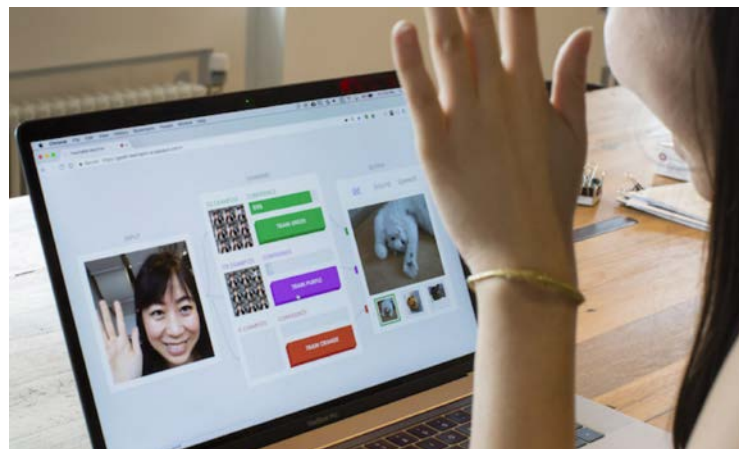
- <https://emojiscavengerhunt.withgoogle.com/>

- Here's how to play: Emoji Scavenger Hunt will present you with an emoji — say, a watch or a newspaper — and ask you to **look for the real-life version of that object as a timer counts down.**

Supervised Learning Exercise

- **Teachable Machine:**

- built using the deeplearn.js library
- Teaches a machine using your camera live in the browser
- You train a neural network locally in your device without sending any images to a server
- The machine learns fast and responds quickly



<https://teachablemachine.withgoogle.com/>

References

- Y. S. Abu-Mostafa, M. Magdon-Lsmail, and H. Lin, “Learning from data” ISBN 10:1-60049-006-9, AMLbook, 2012.
- <https://js.tensorflow.org/>



Question and Answers