

COMP47590

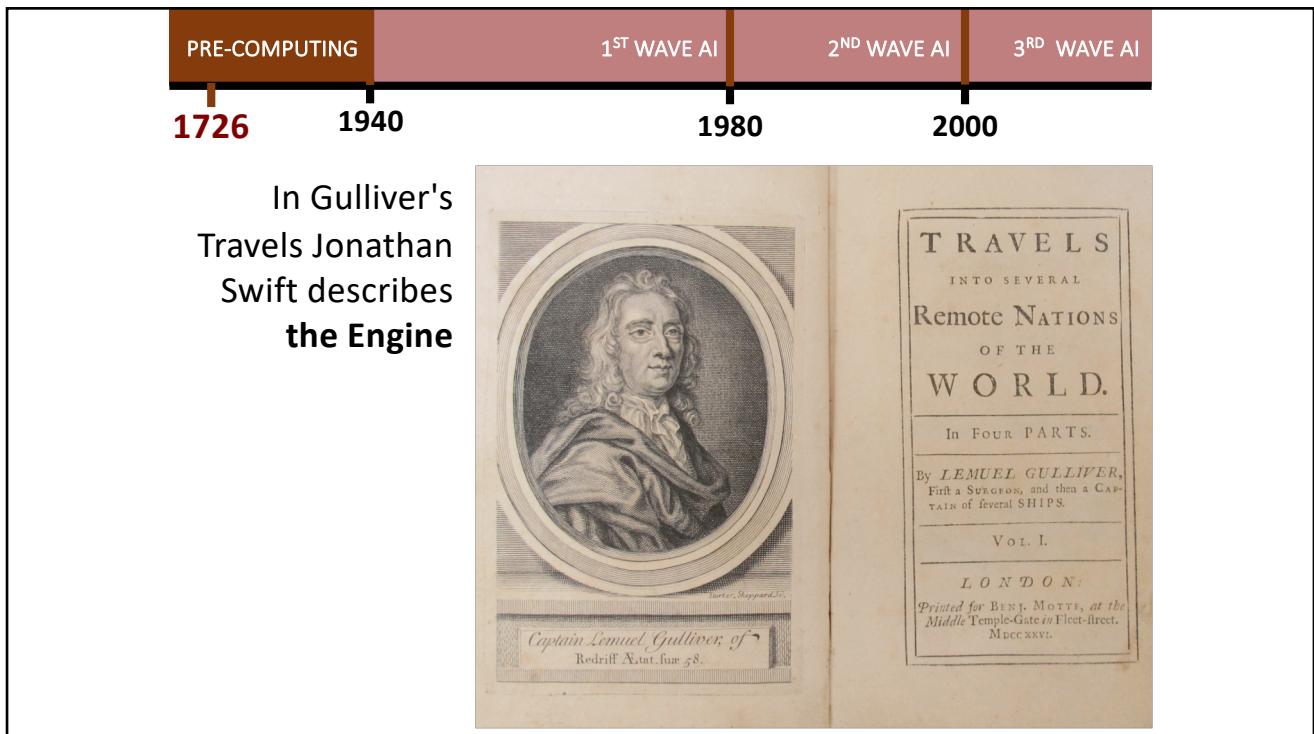
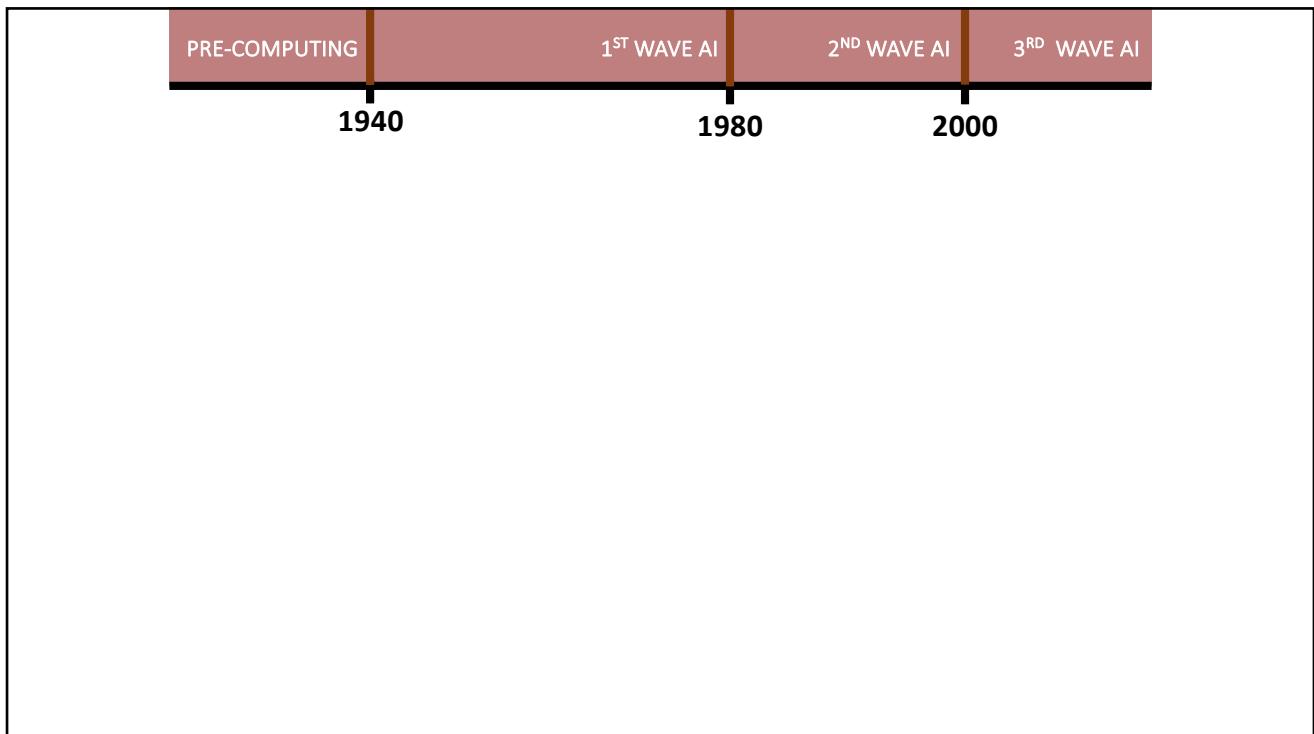
ADVANCED MACHINE LEARNING

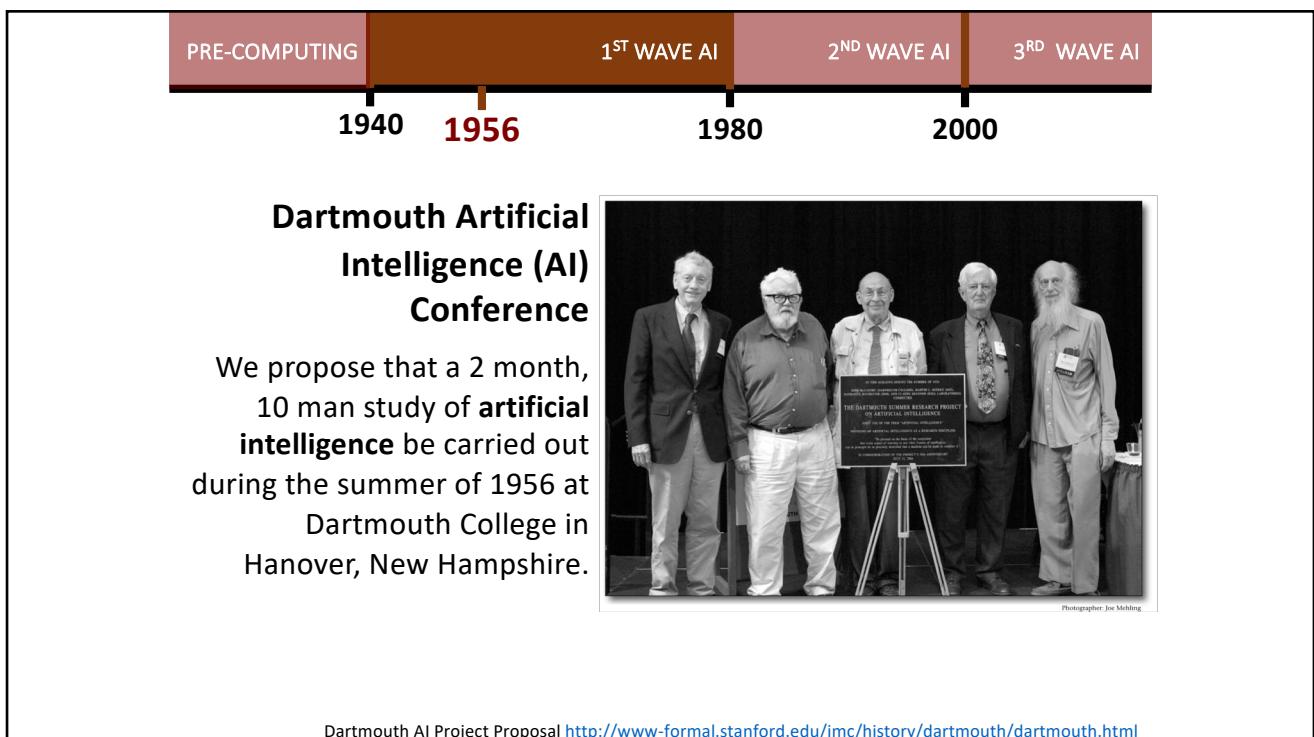
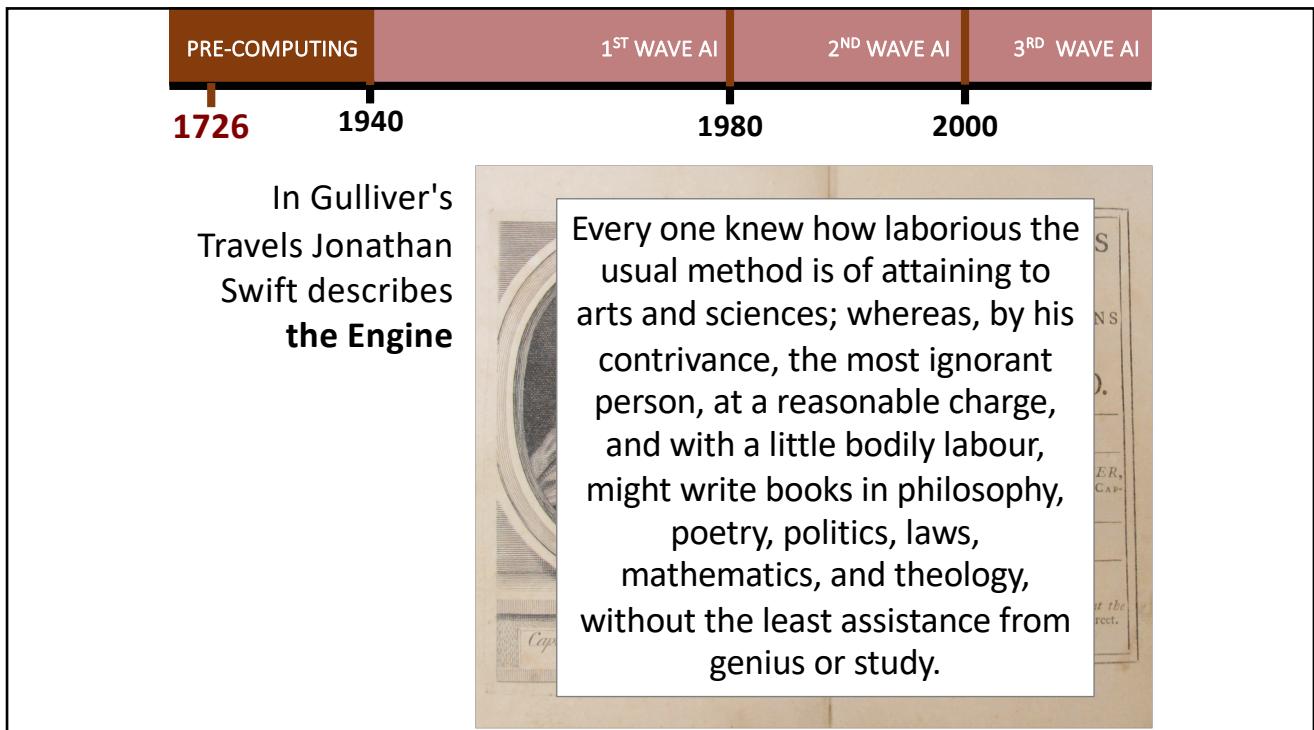
INTRODUCTION

Dr. Brian Mac Namee

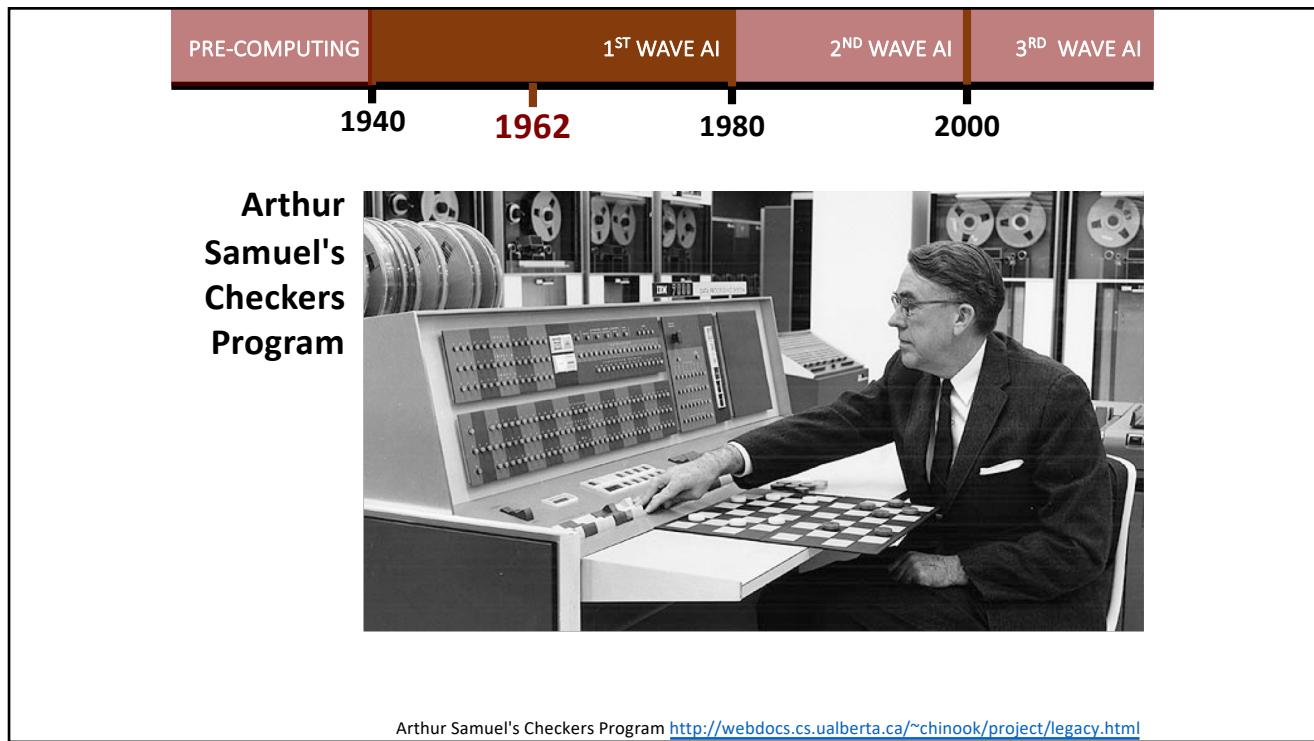
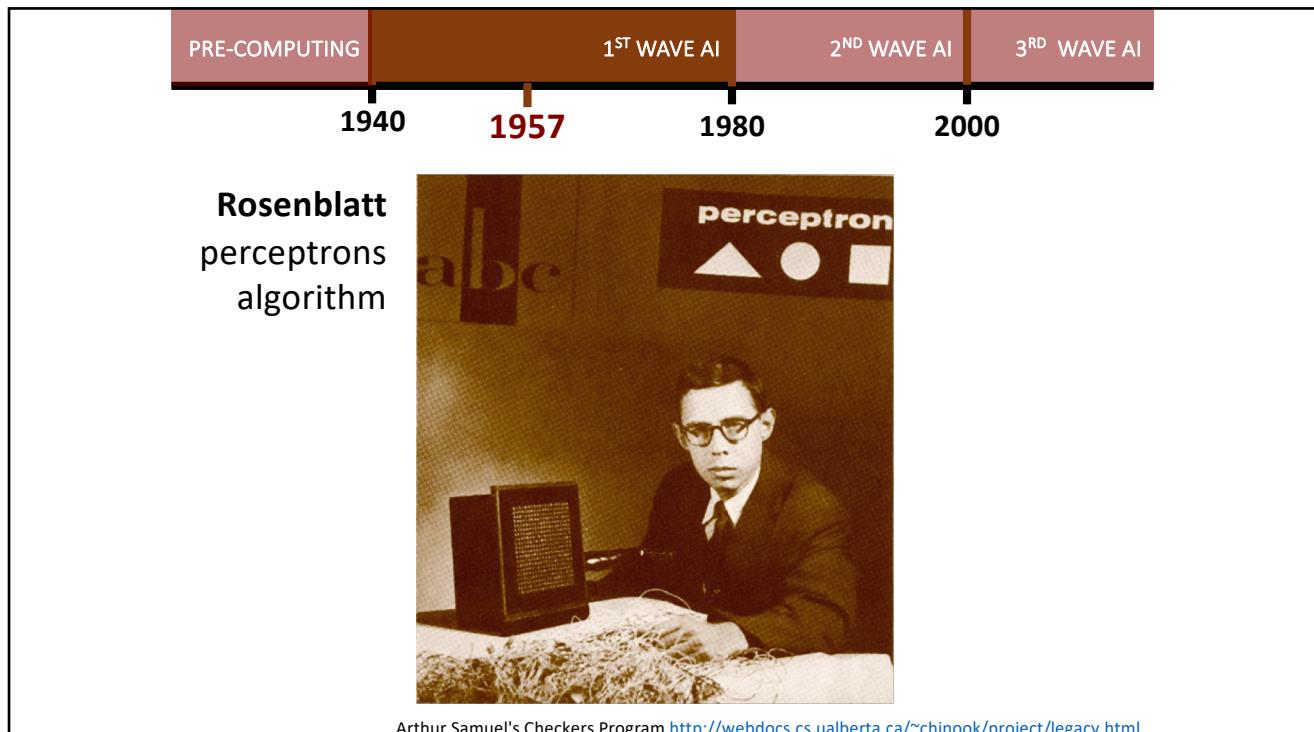


INTRODUCTION



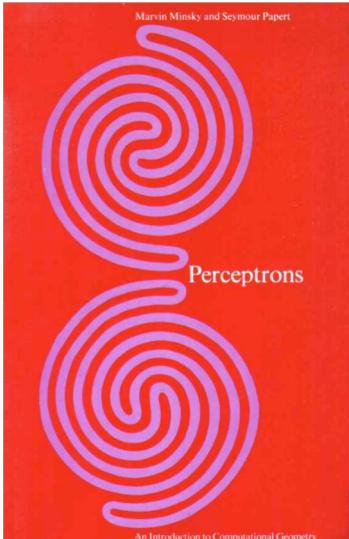


Dartmouth AI Project Proposal <http://www-formal.stanford.edu/jmc/history/dartmouth/dartmouth.html>



PRE-COMPUTING	1 ST WAVE AI	2 ND WAVE AI	3 RD WAVE AI
1940	1969	1980	2000

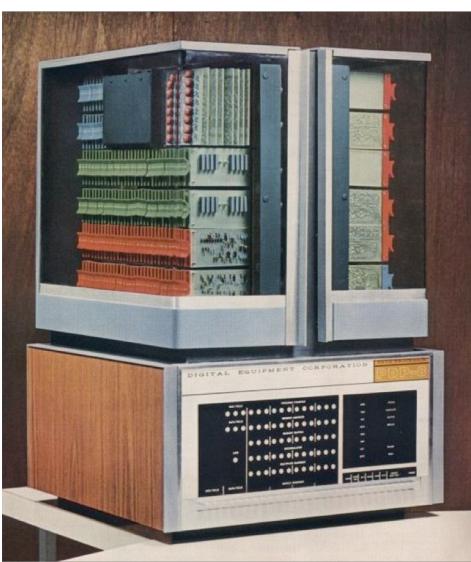
Minsky & Papert publish the book **Perceptrons** which pours cold water on perceptrons

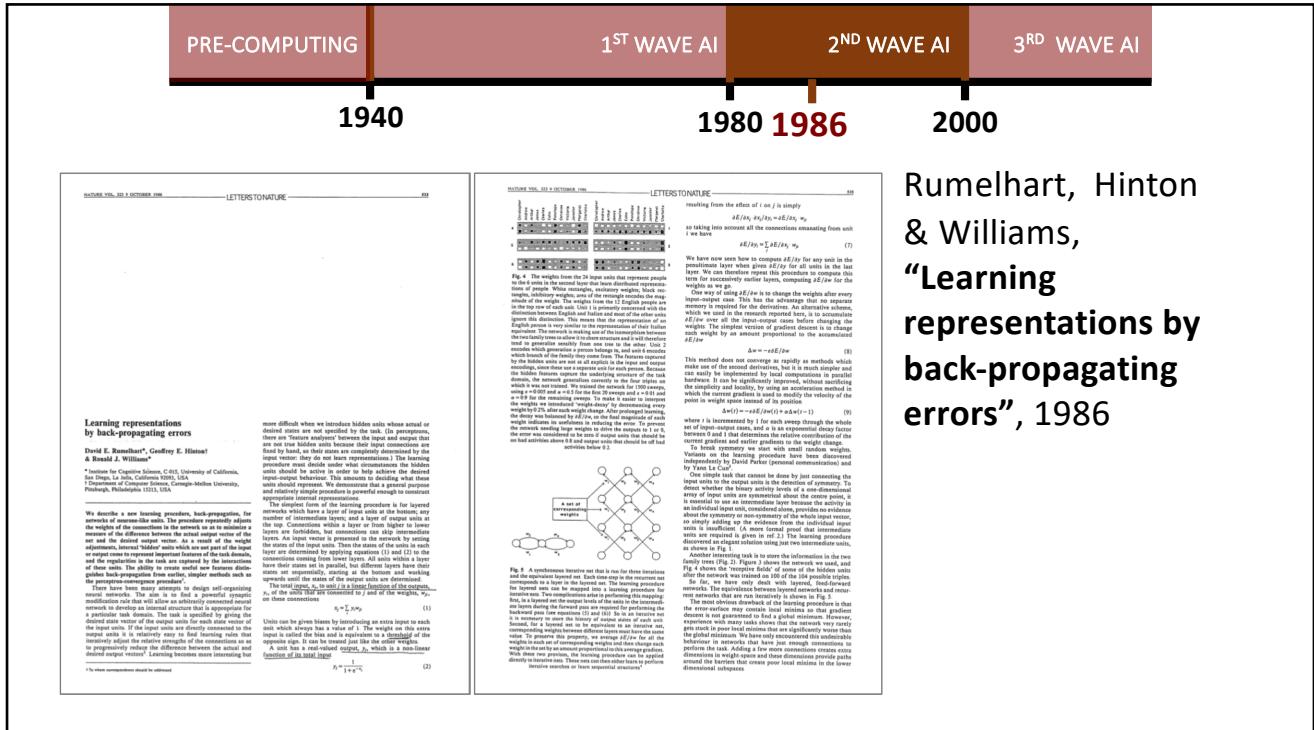


An Introduction to Computational Geometry

PRE-COMPUTING	1 ST WAVE AI	2 ND WAVE AI	3 RD WAVE AI
1940	1980	1985	2000

The RI expert system for order configuration used at Digital Equipment Corporation saves the company \$40m per year

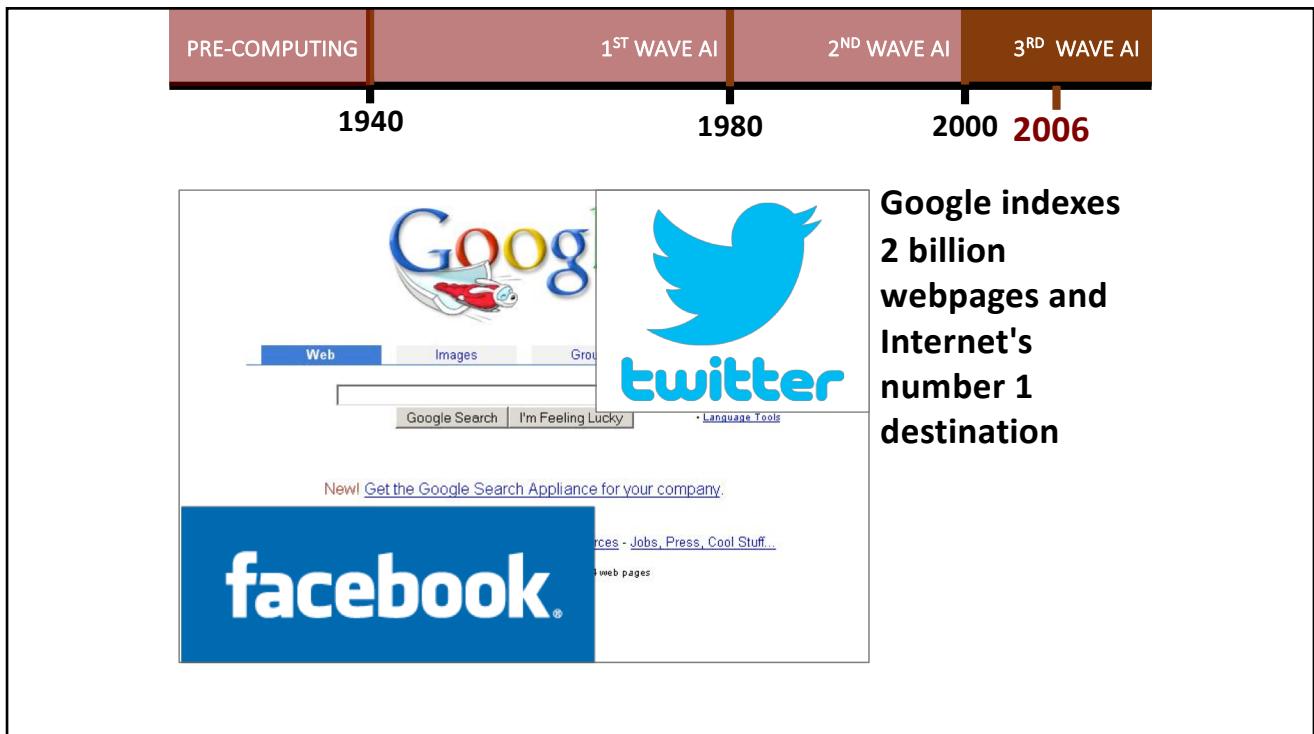
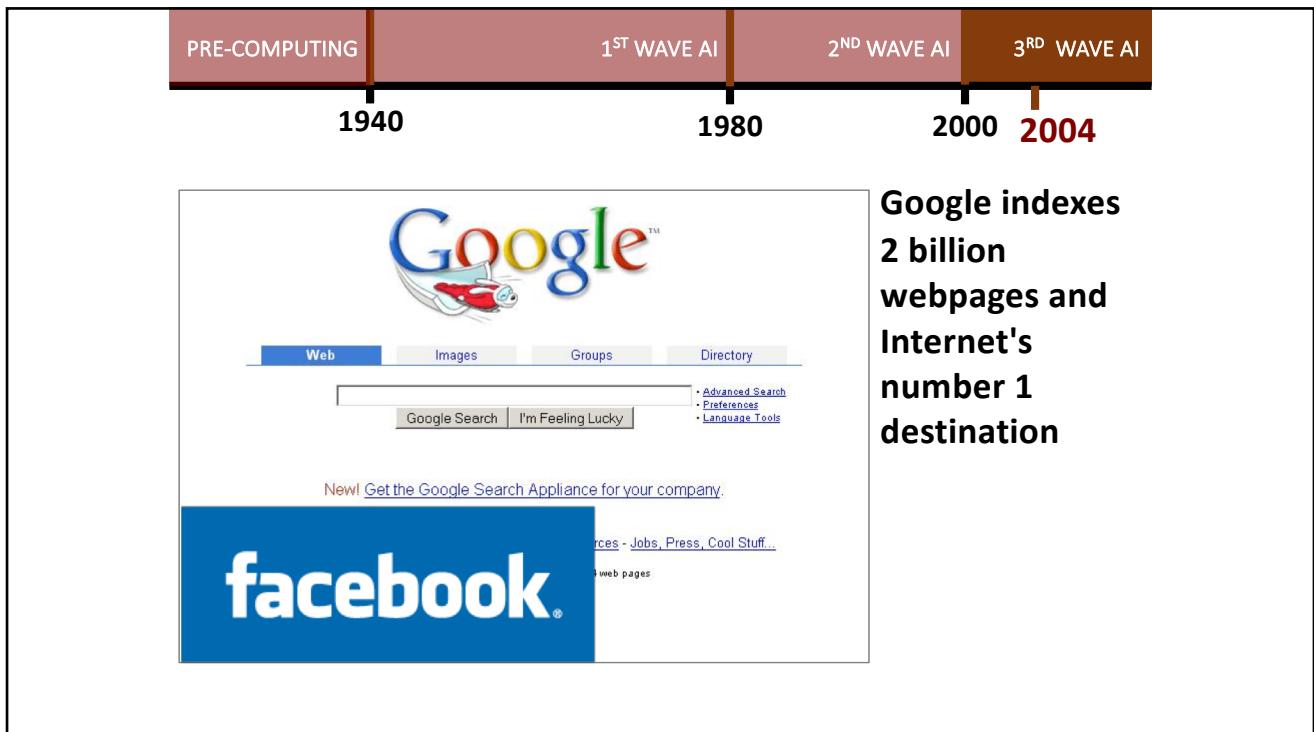


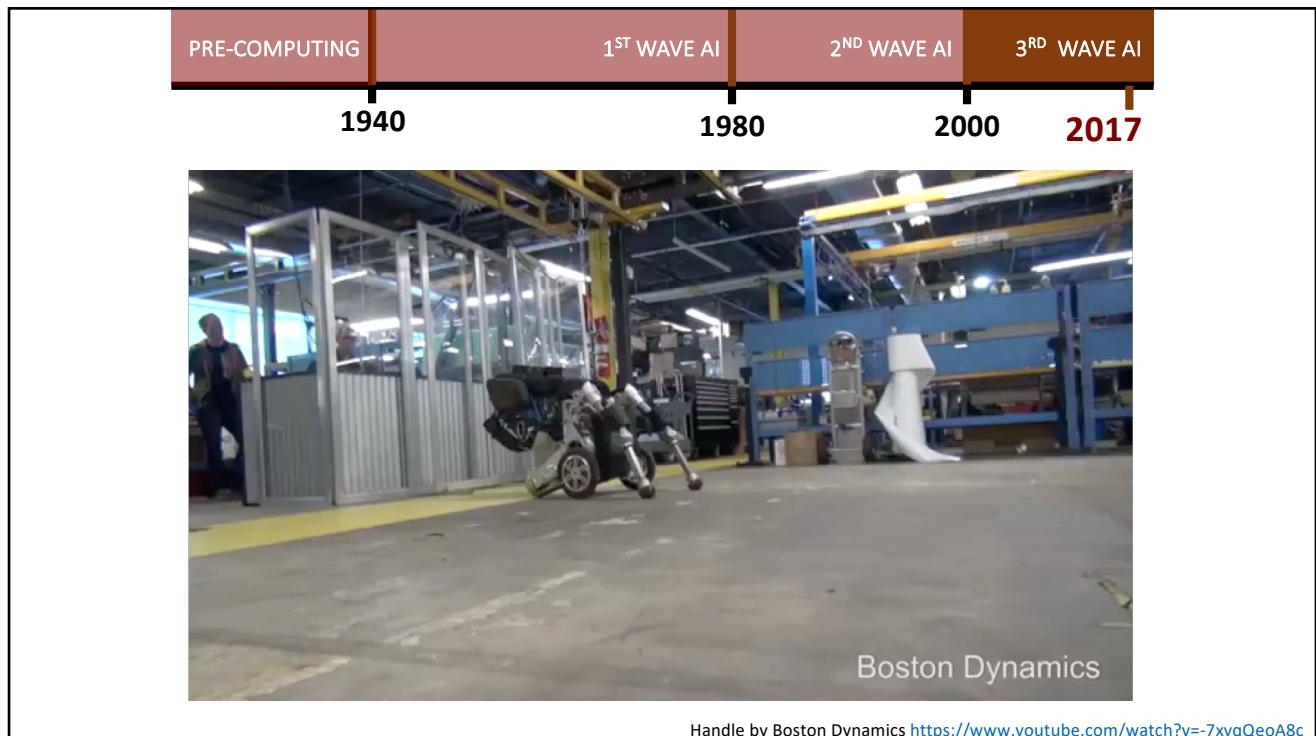


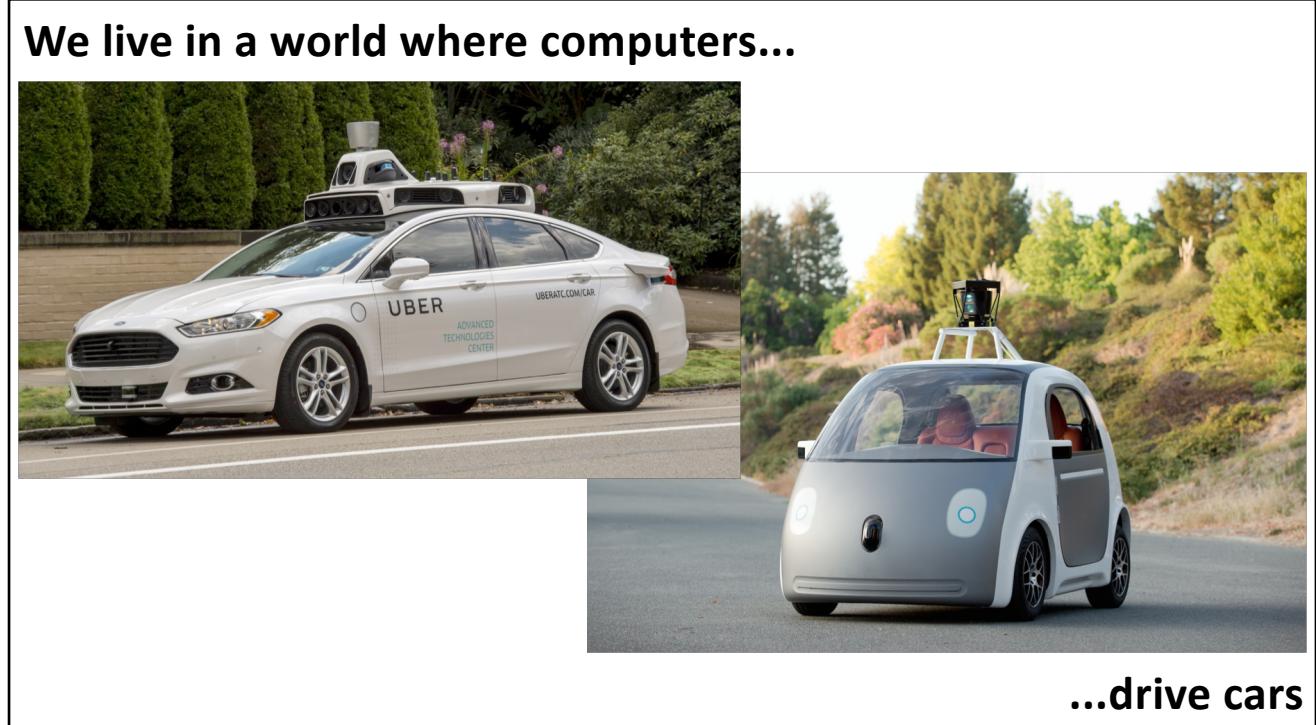
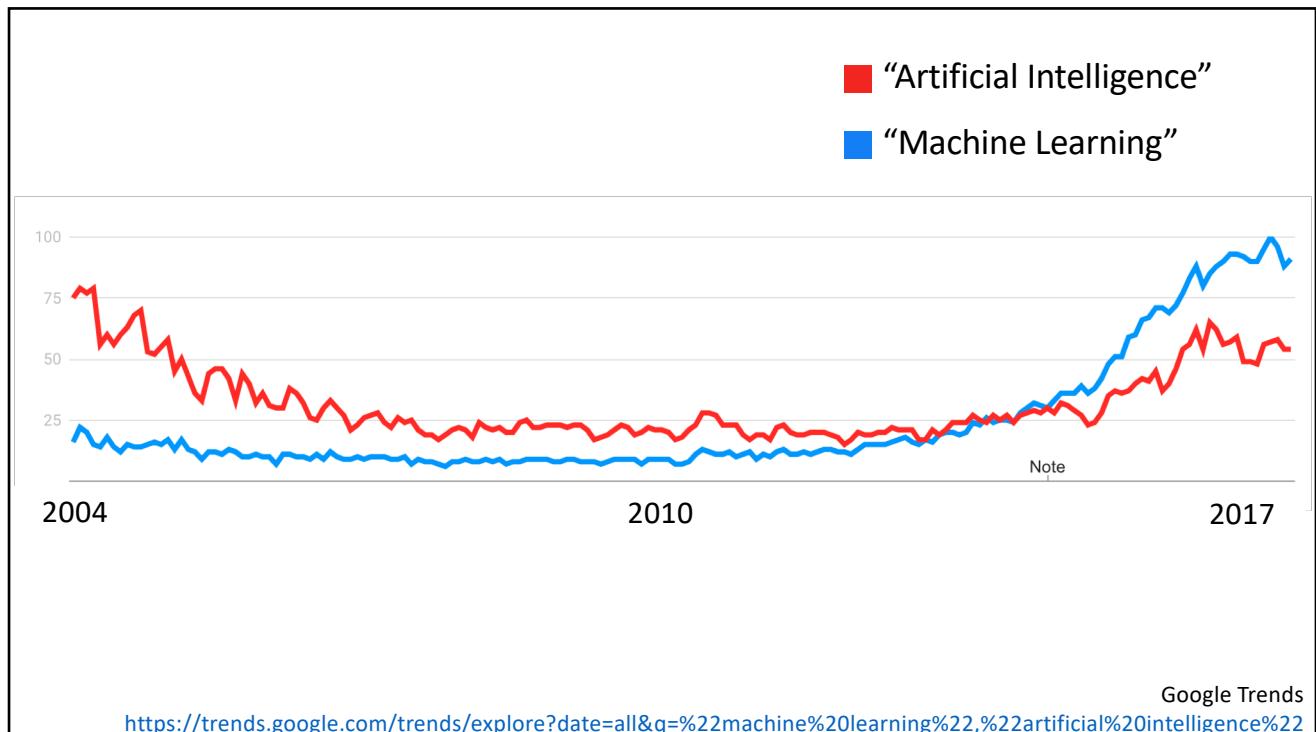
PRE-COMPUTING	1 ST WAVE AI	2 ND WAVE AI	3 RD WAVE AI
	1940	1980	1998 2000
LeCun et al's work on the MNIST dataset 			

Y. LeCun, L. Bottou, Y. Bengio and P. Haffner, Gradient-Based Learning Applied to Document Recognition <http://yann.lecun.com/exdb/publis/pdf/lecun-98.pdf>

PRE-COMPUTING	1 ST WAVE AI	2 ND WAVE AI	3 RD WAVE AI
	1940	1980	2000 2002
			Google indexes 2 billion webpages and Internet's number 1 destination







We live in a world where computers...



...are champions at many games

We live in a world where computers...

Apple Inc (AAPL) on Tuesday reported fiscal first-quarter net income of \$18.02bn.

The Cupertino, California-based company said it had profit of \$3.06 per share.

The results surpassed Wall Street expectations. The maker of iPhones, iPads and other products posted revenue of \$74.6bn in the period, also exceeding Street forecasts. Analysts expected \$67.38bn..."

Automated Insights



...write news articles, poems and movies

We live in a world where computers...



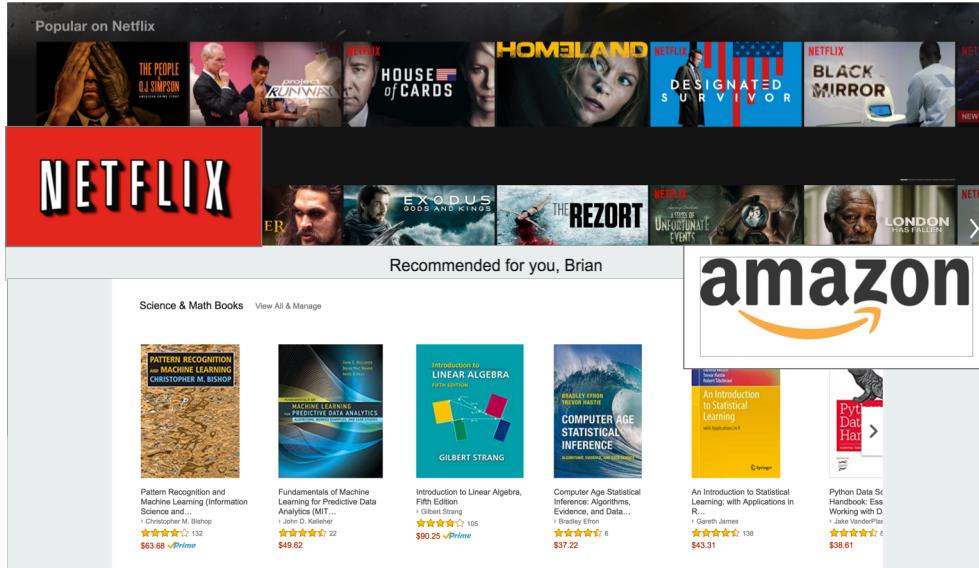
...run our homes, hospitals, and factories

We live in a world where computers...



...can hold a (passable) conversation

We live in a world where computers...



...decide what we read, watch, buy, and do

Elon Musk Worth reading Superintelligence by Bostrom. We need to be super careful with AI. Potentially more dangerous than nukes.

What's the difference between deep learning and machine learning?

Stephen Hawking warns artificial intelligence could end mankind

A Comparative Roundup: Artificial Intelligence vs. Machine Learning vs. Deep Learning

The Economist Artificial Intelligence

WIRED 'DEEP LEARNING' WILL SOON GIVE US SUPER-SMART ROBOTS

MacGyver

DEFINITIONS

Poll

Course Moodle link:

- csmoodle.ucd.ie/moodle/course/view.php?id=663
- **UCDAdvML2017**

Poll short link: <http://bit.ly/2DC6uRx>

[Machine learning is the] Field of study that gives computers the ability to learn without being explicitly programmed.

- Arthur Samuel

The field of machine learning is concerned with the question of how to construct computer programs that automatically improve with experience.

- Tom Mitchell

Tom Mitchell
<http://www.cs.cmu.edu/~tom/>

A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T , as measured by P , improves with experience E .

- Tom Mitchell

Tom Mitchell

<http://www.cs.cmu.edu/~tom/>

Machine learning is the science of getting computers to act without being explicitly programmed.

- Andrew Ng

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

- Expert Systems
(Google's first answer!)

What is Machine Learning?

<http://www.expertsystem.com/machine-learning-definition/>

Machine Learning is the science of getting computers to learn and act like humans do, and improve their learning over time in autonomous fashion, by feeding them data and information in the form of observations and real-world interactions.

- TechEmergence

What is Machine Learning?

<https://www.techemergence.com/what-is-machine-learning/>

Machine Learning at its most basic is the practice of using algorithms to parse data, learn from it, and then make a determination or prediction about something in the world.

- Nvidia

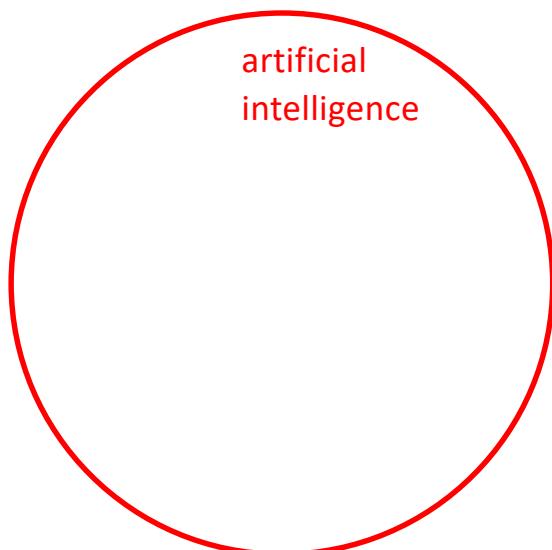
What's the Difference Between Artificial Intelligence, Machine Learning, and Deep Learning?
<https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/>

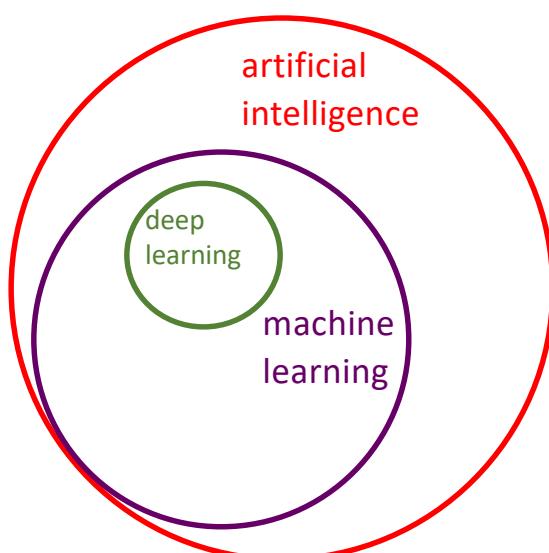
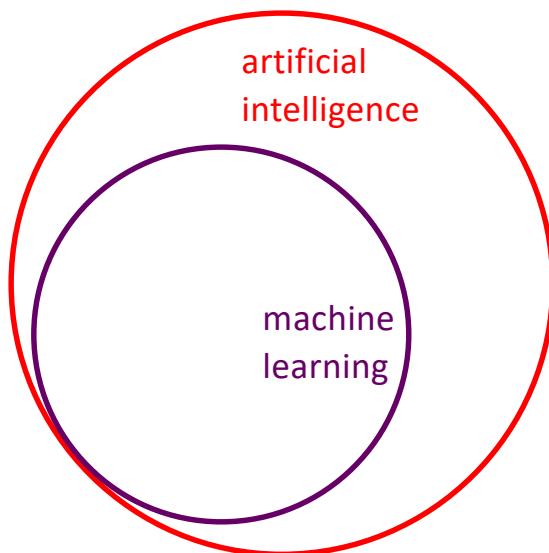
Machine learning research is part of research on artificial intelligence, seeking to provide knowledge to computers through data, observations and interacting with the world. That acquired knowledge allows computers to correctly generalize to new settings.

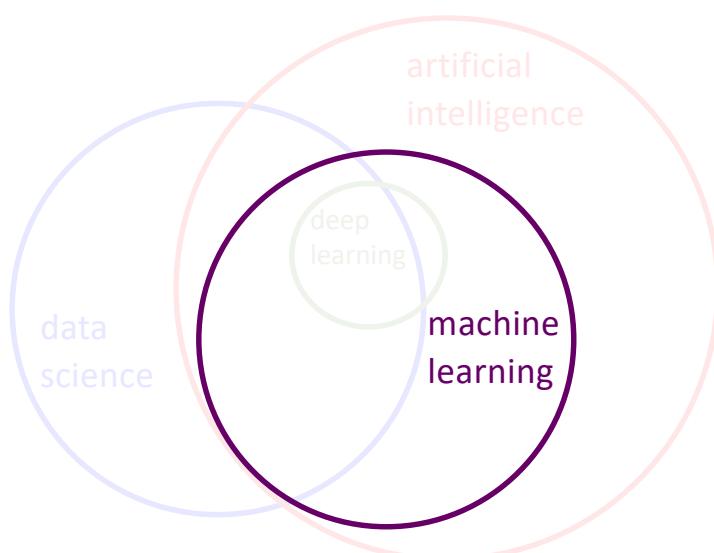
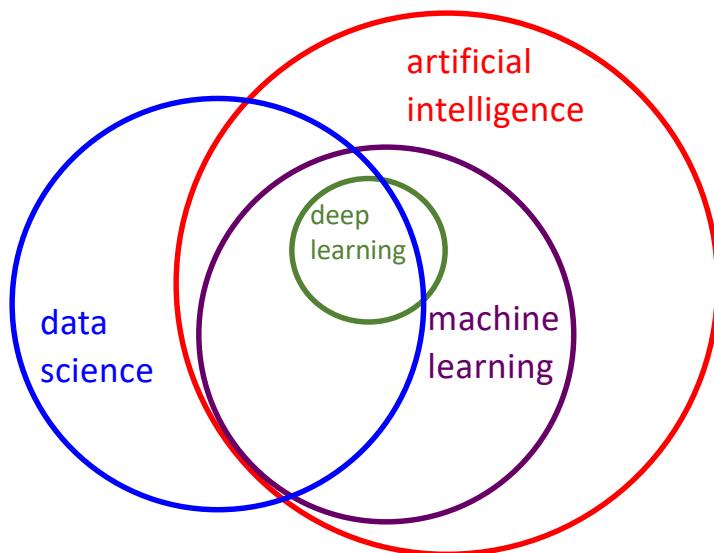
- Yoshua Bengio

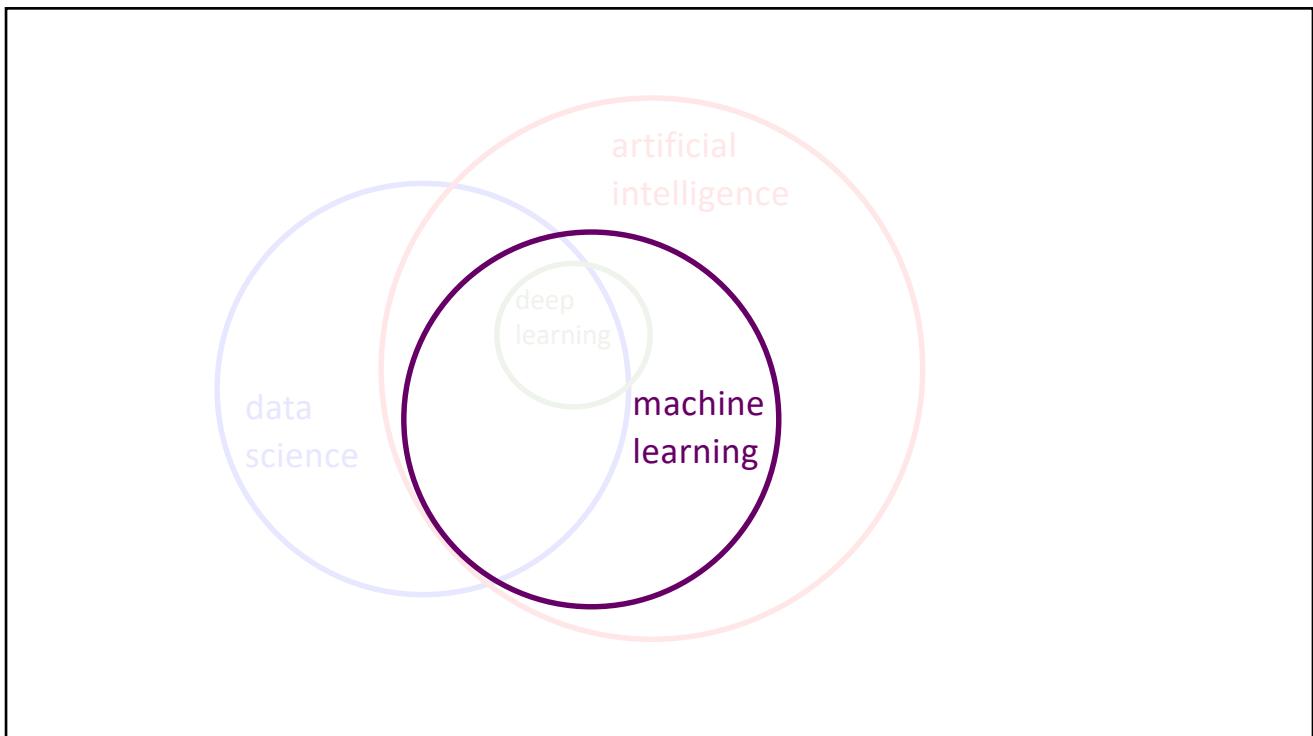
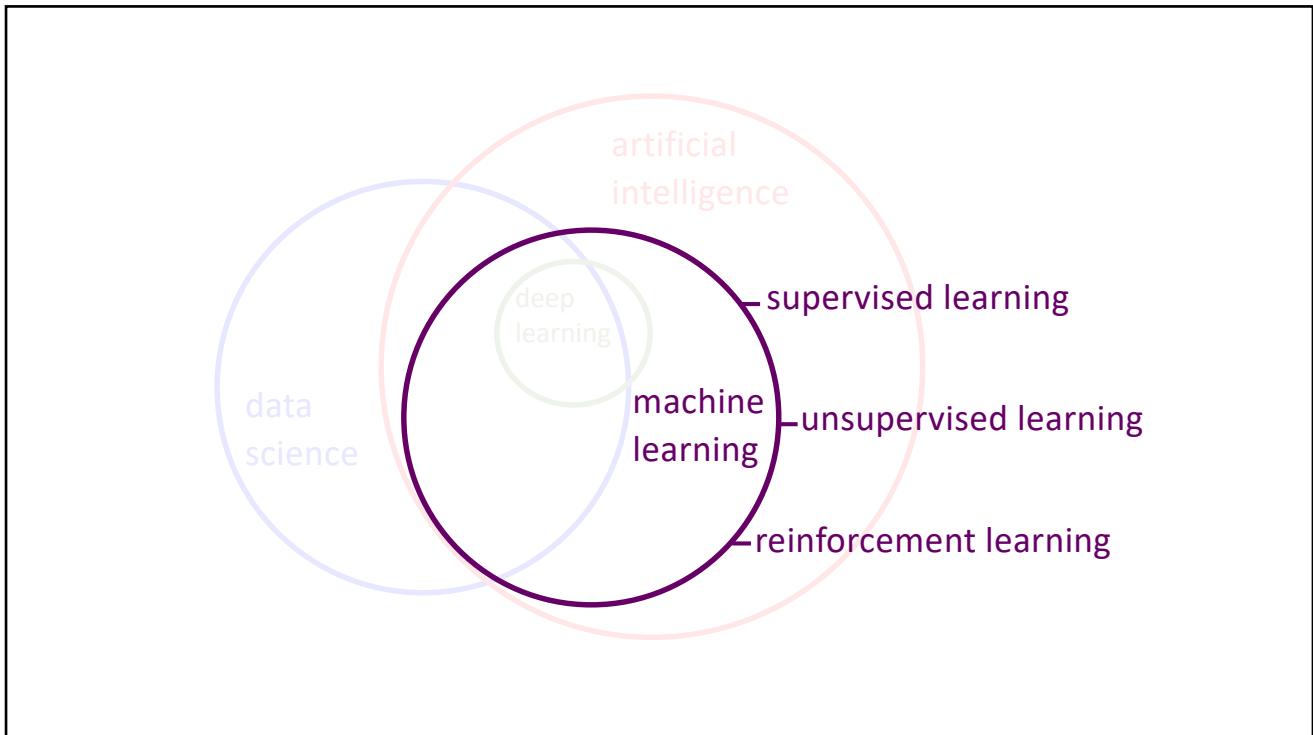
What is Machine Learning?
<https://www.techmergence.com/what-is-machine-learning/>

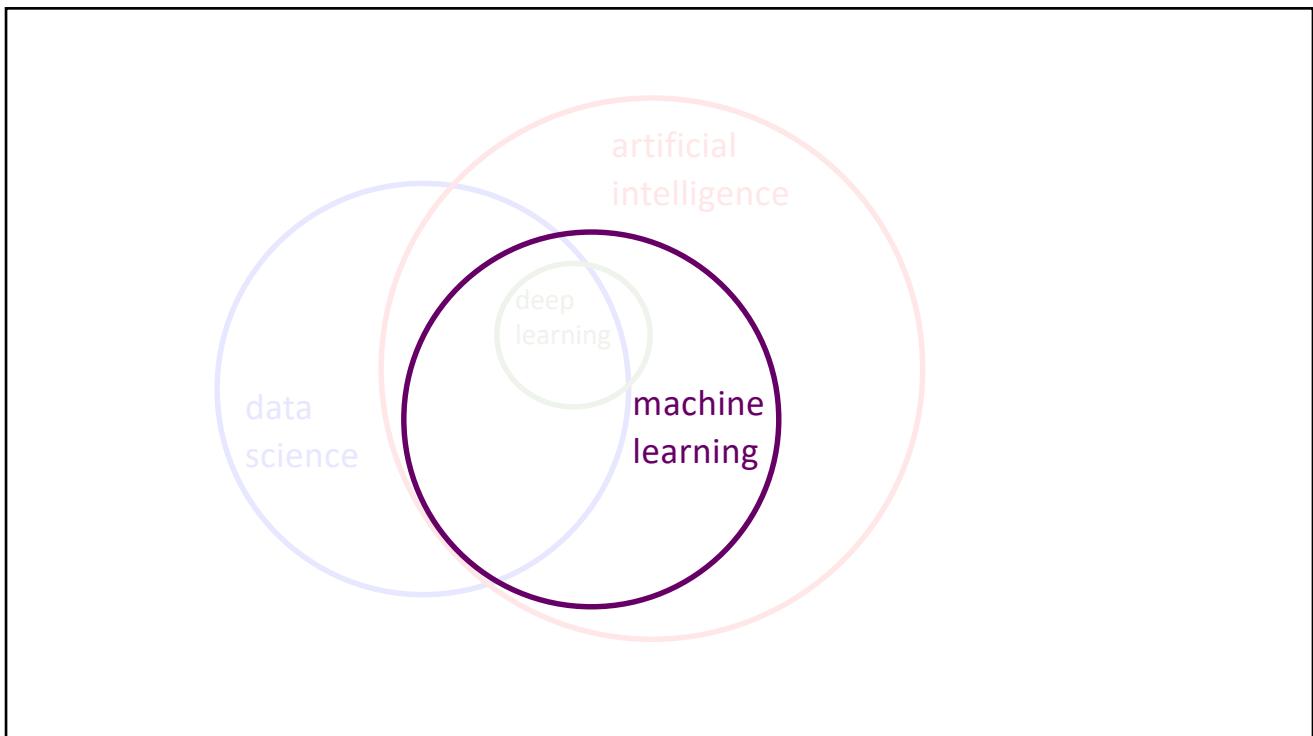
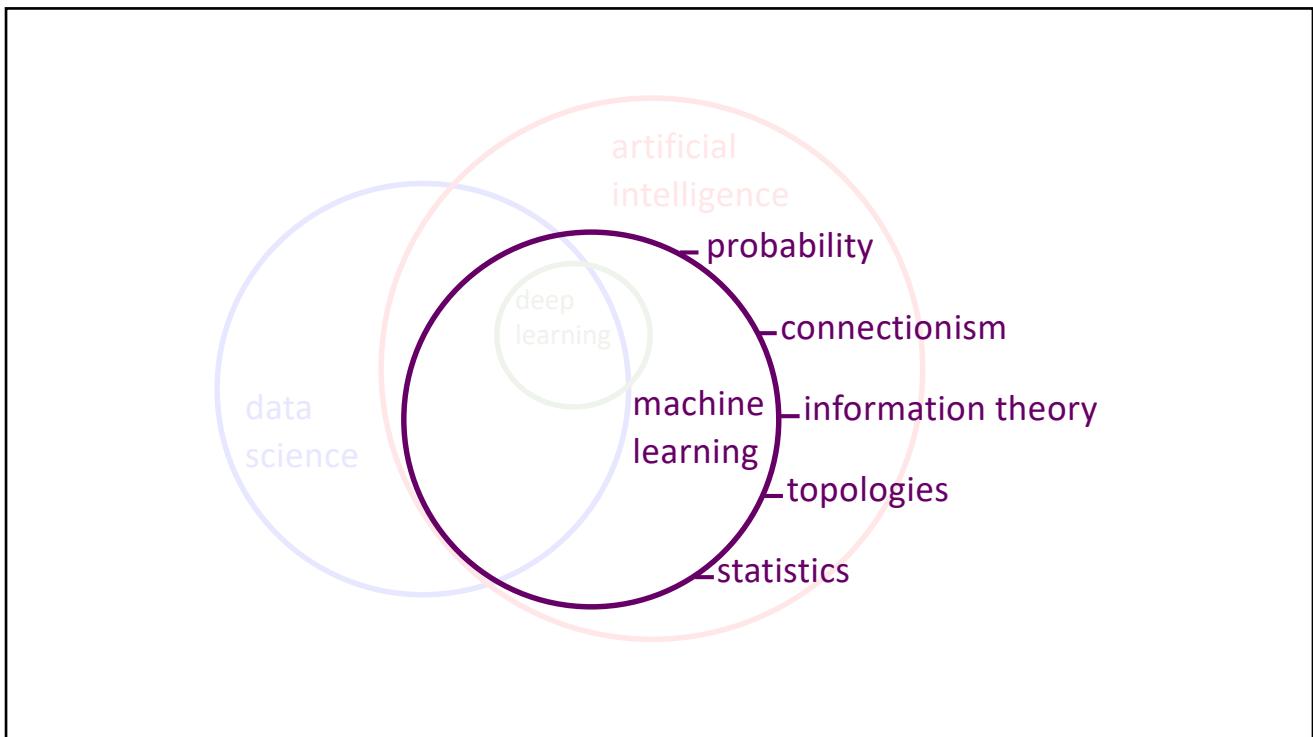
CATEGORISATIONS

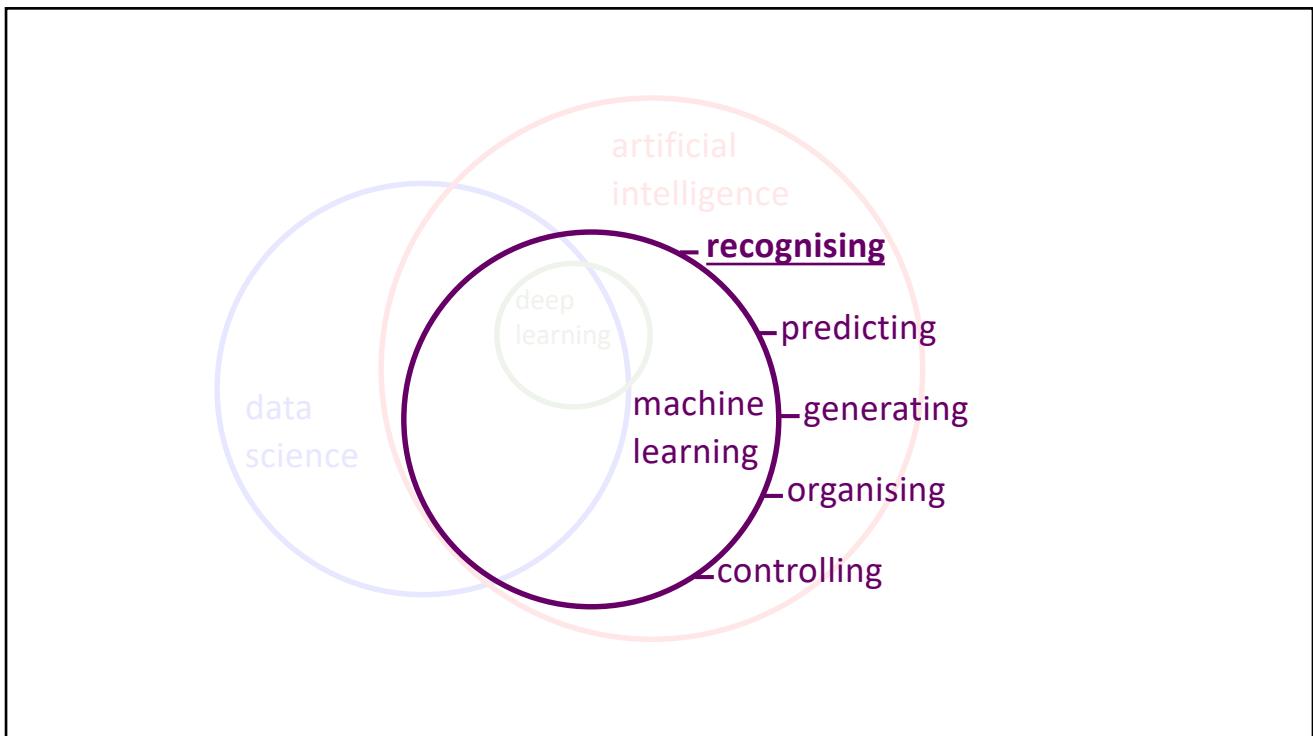
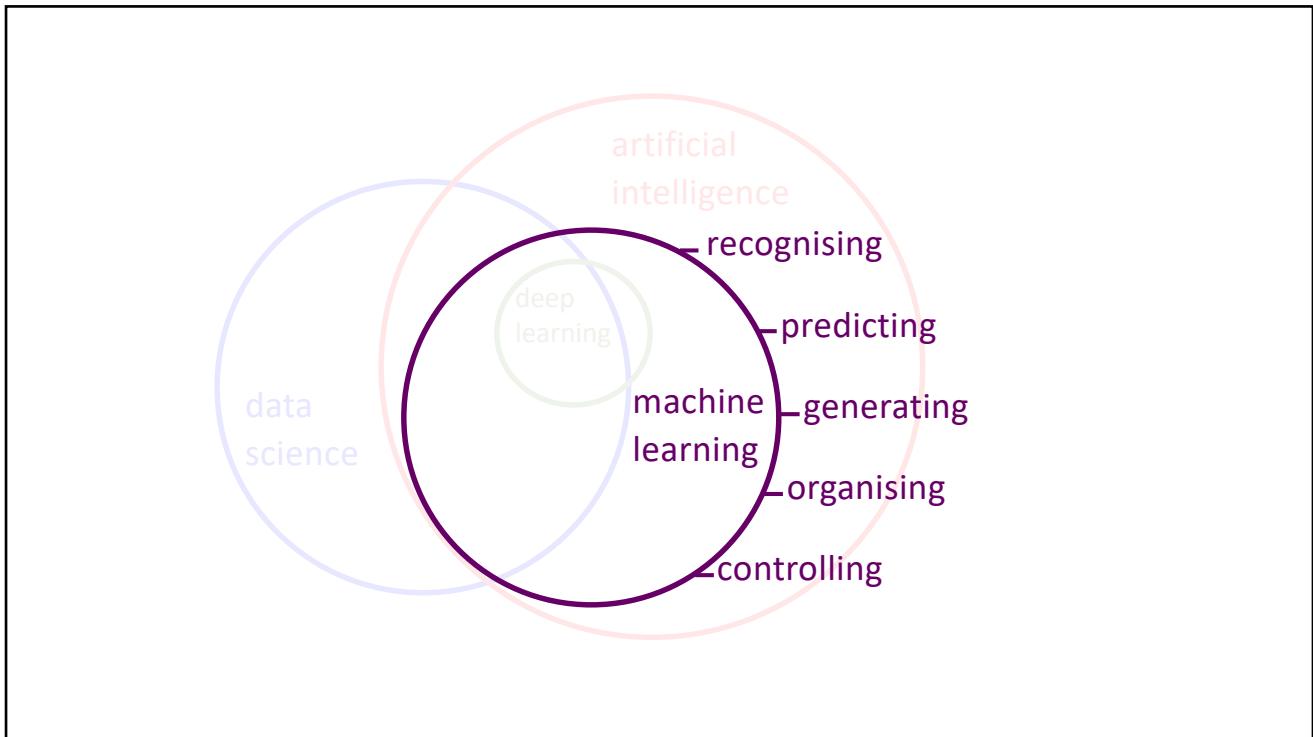














Kaggle dogs versus cats contest
<https://www.kaggle.com/c/dogs-vs-cats>

Spot...



...the difference



Spot...



This is a Cardigan Corgi, one of two types of Welsh Corgi. Slightly larger and heavier-boned than the Pembroke Corgi.

Economist.com

...the difference



This is a Pembroke Corgi, the more common of the two types of Welsh Corgi and the one favoured by the queen.

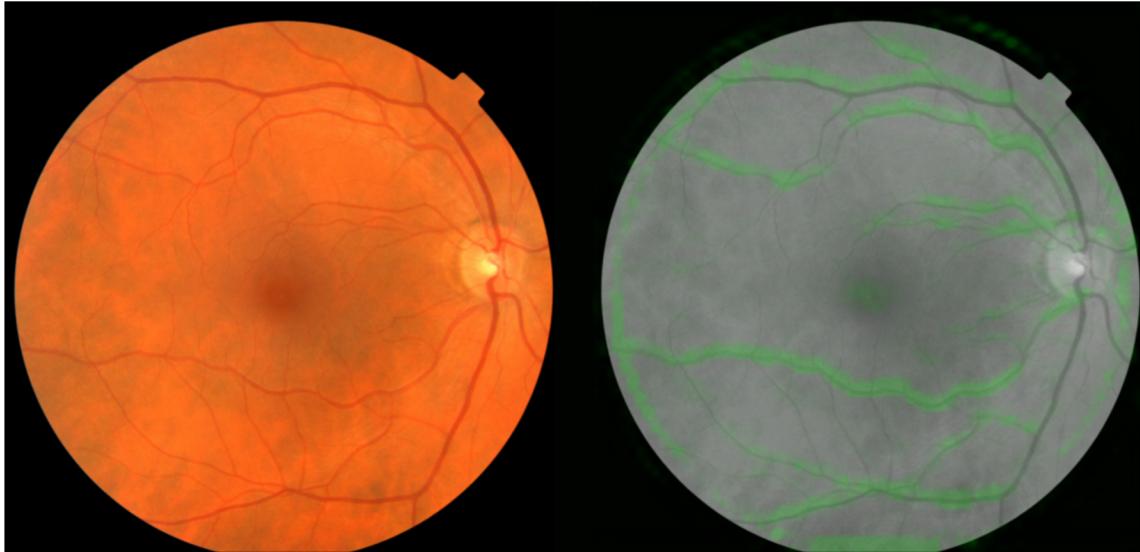
Economist.com

On Welsh Corgis, Computer Vision, and the Power of Deep Learning, Microsoft Research, 2014

<http://research.microsoft.com/en-us/news/features/dnnvision-071414.aspx>

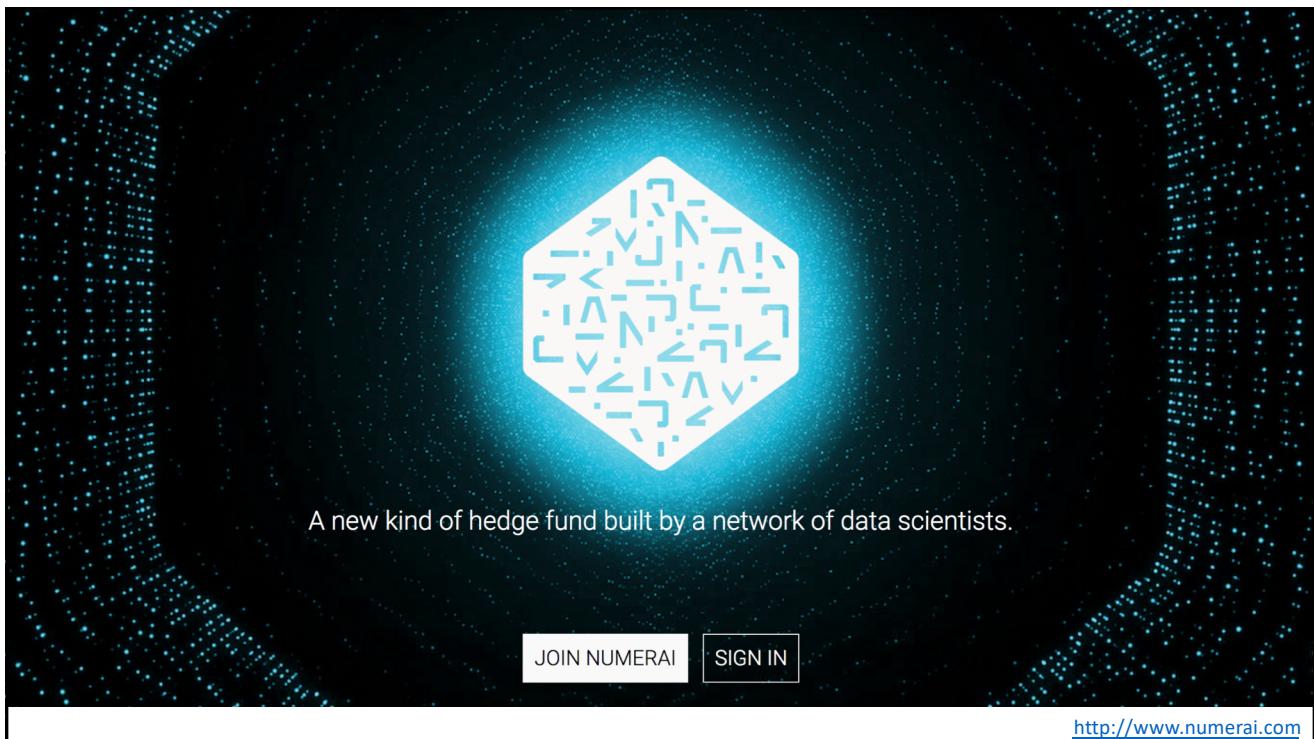
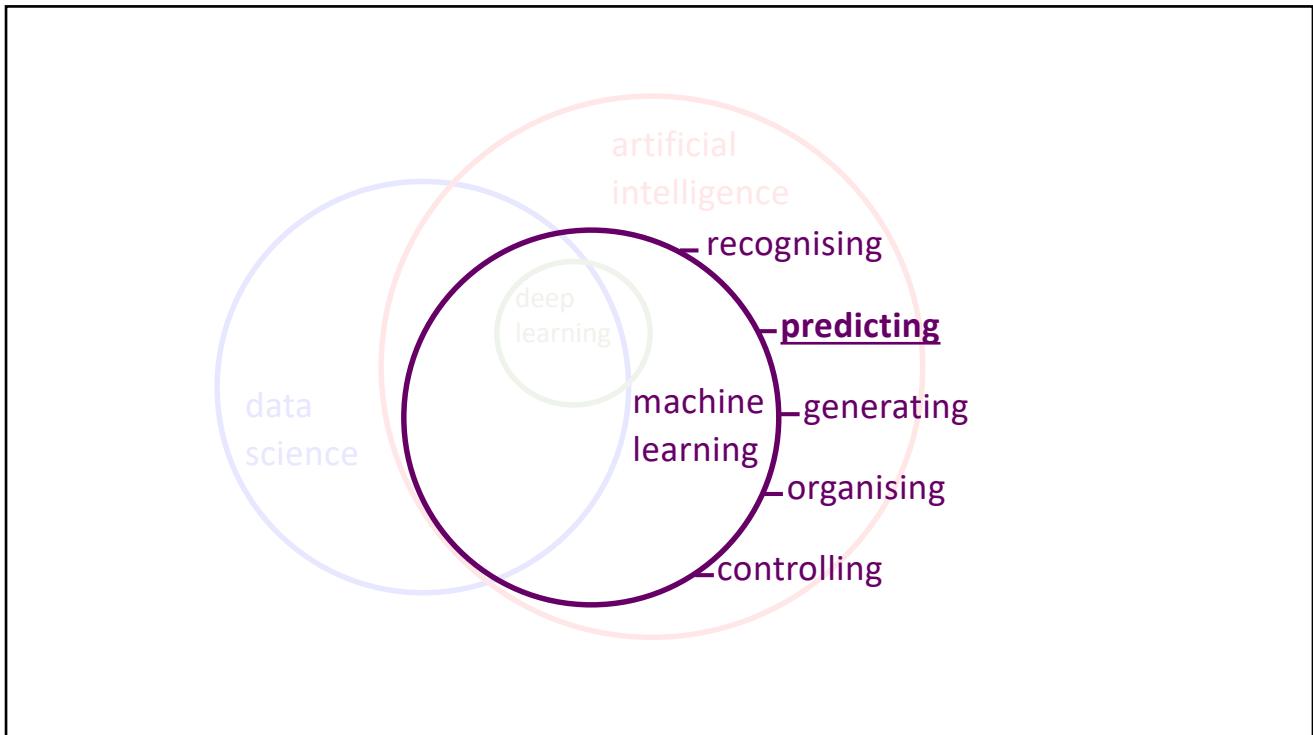
Rise of the machines, The Economist, 2015

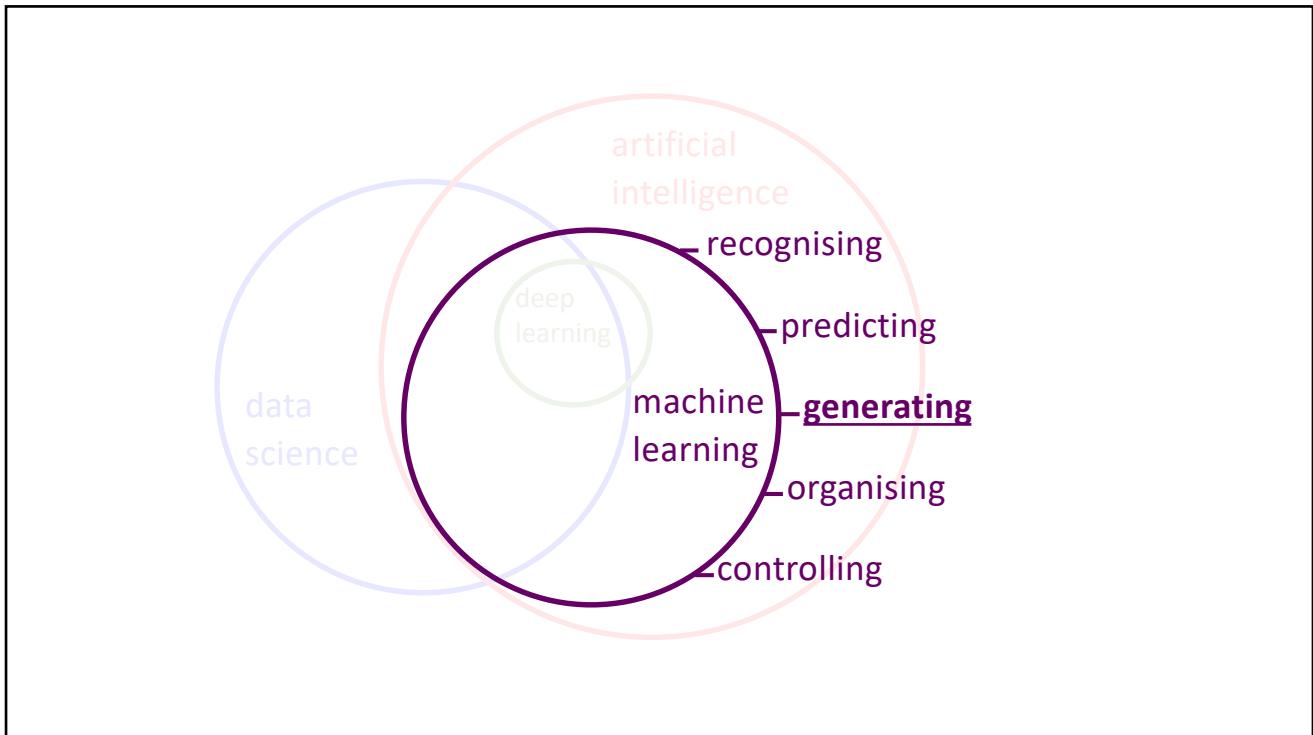
<http://www.economist.com/news/briefing/21650526-artificial-intelligence-scares-peopleexcessively-so-rise-machines>



Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning, Poplin et al, 2018

<http://pub-tools-public-publication-data.storage.googleapis.com/pdf/a79654ba4743b72dda1d64045518be1bc127a9dd.pdf>





Describes without errors	Describes with minor errors	Somewhat related to the image	Unrelated to the image
A person riding a motorcycle on a dirt road.	Two dogs play in the grass.	A skateboarder does a trick on a ramp.	A dog is jumping to catch a frisbee.
A group of young people playing a game of frisbee.	Two hockey players are fighting over the puck.	A little girl in a pink hat is blowing bubbles.	A refrigerator filled with lots of food and drinks.
A herd of elephants walking across a dry grass field.	A close up of a cat laying on a couch.	A red motorcycle parked on the side of the road.	A yellow school bus parked in a parking lot.

Show and Tell: A Neural Image Caption Generator, Oriol Vinyals, Alexander Toshev, Samy Bengio, Dumitru Erhan
<http://arxiv.org/abs/1411.4555>



“Deep Photo Style Transfer”, Fujun Luan, Sylvain Paris, Eli Shechtman, Kavita Bala

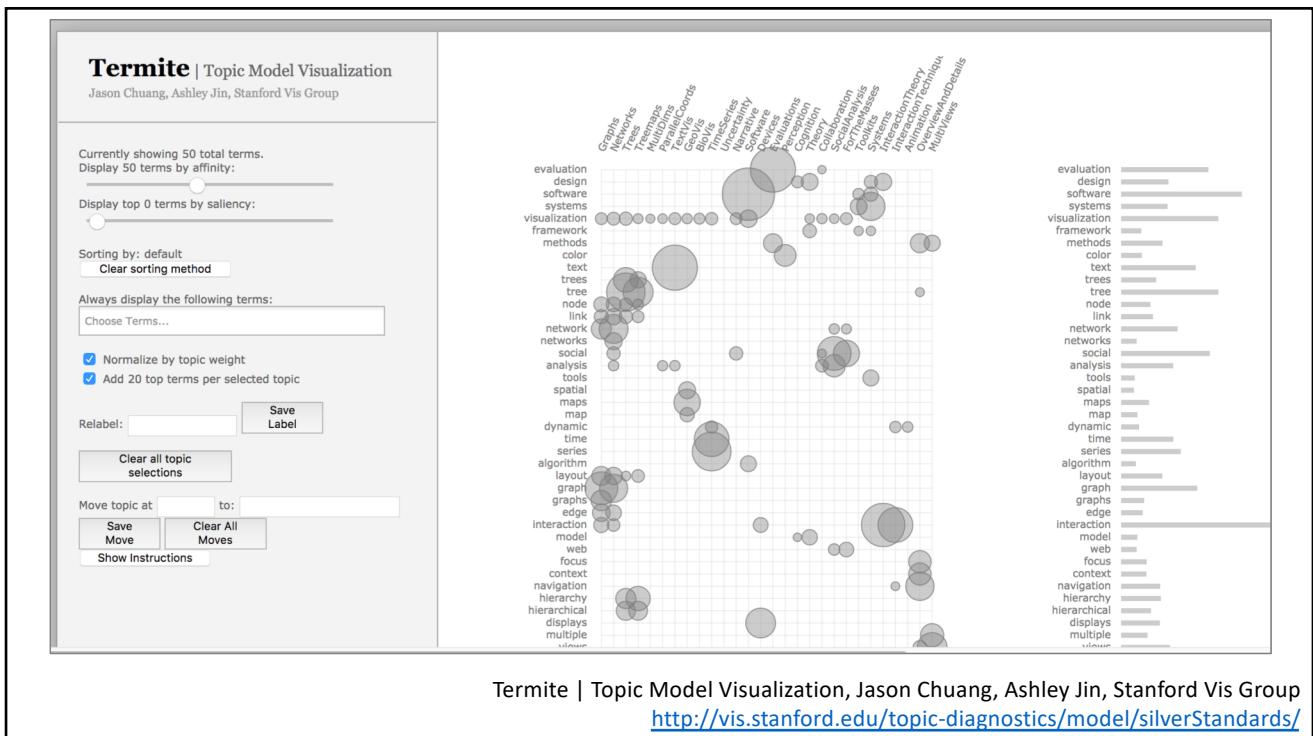
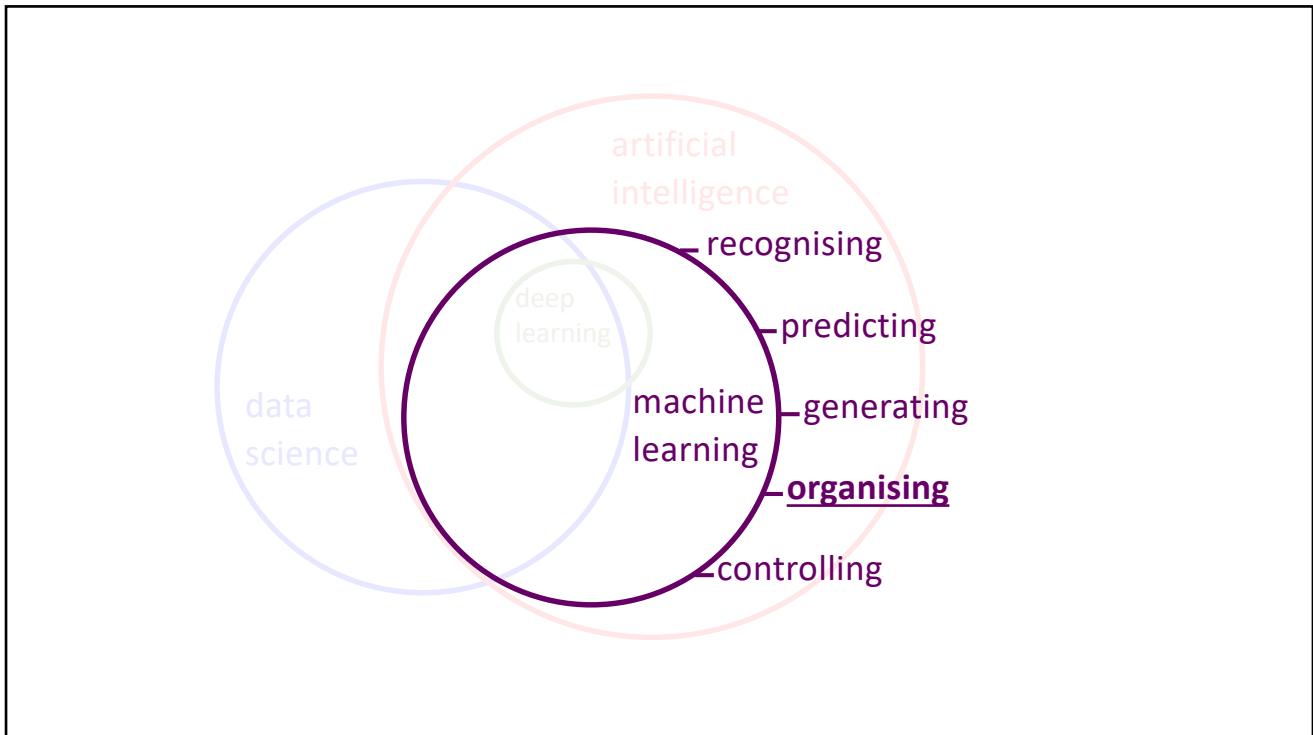
<https://arxiv.org/abs/1703.07511>

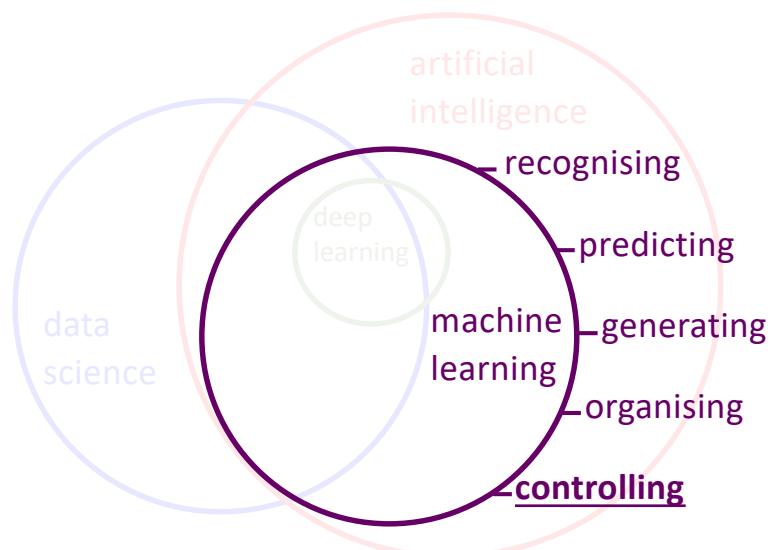
<https://github.com/luanfujun/deep-photo-styletransfer>



“Progressive Growing of GANs for Improved Quality, Stability, and Variation”, Karras et al, 2018

https://research.nvidia.com/publication/2017-10_Progressive-Growing-of

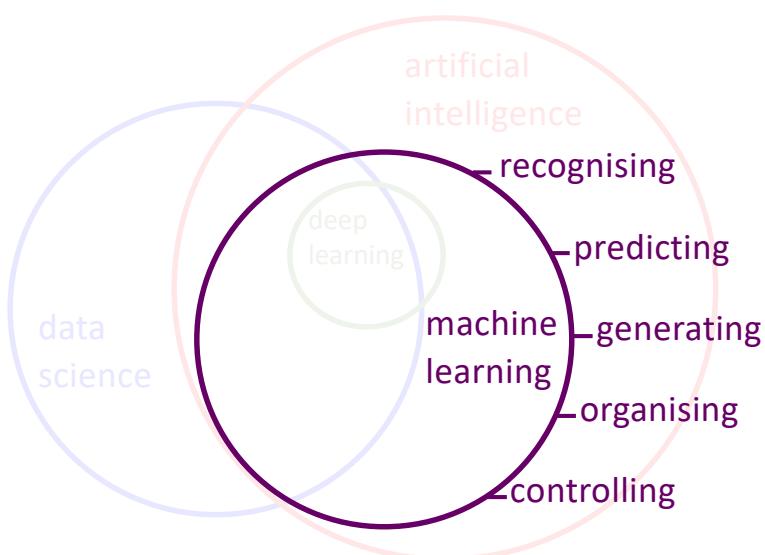




<https://www.youtube.com/watch?v=V1eYniJ0Rnk>



<https://www.youtube.com/watch?v=V1eYniJORnk>



MODULE LOGISTICS

Module Content

The main topics covered in this module will be:

- Ensemble techniques
- Unsupervised and semi-supervised learning
- Neural networks & deep learning
- Generative models
- Reinforcement learning
- Other assorted topics (evaluation, data representations, interpreting ML models, human in the loop ML, ...)

Module Practical Content

The practical content of the module will involve:

- Using machine learning implementations from popular ML APIs
- Implementing machine learning algorithms
- Developing machine learning solutions to problems
- Evaluating machine learning solutions



python™

**WE ASSUME YOU CAN
PROGRAMME IN PYTHON!!**

Information

Email: Brian.MacNamee@ucd.ie

Course Materials: All material posted on moodle
Enrolment key **UCDAdvML2019**

Classes

Monday 15:00 - 15:50 (B004 CSI)
(Lecture)

Wednesday 13:00 - 13:50 (B004 CSI)
(Lecture/Lab)

Thursday 15:00 - 15:50 (B004 CSI)
(Lecture/Lab)

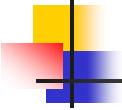
Assessment

Exam (50%)

- End of semester exam
- Details later in the semester

Continuous assessment (50%)

- In semester assignments
 - Developing machine learning algorithms
 - Using advanced machine learning algorithms



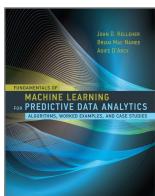
Plagiarism & UCD Computer Science

- **Plagiarism is a serious academic offence**
 - [Student Code, sections 6.2 & 6.3] or [UCD Registry Plagiarism Policy]
or [CS Plagiarism policy and procedures]
- Our staff and demonstrators are **proactive** in looking for possible plagiarism in all submitted work
- Suspected plagiarism is investigated by the CS Plagiarism subcommittee
 - Usually includes an interview with student(s) involved
 - 1st offence: **usually** 0 or NG in the affected components
 - 2nd offence: may be referred to the **University disciplinary committee**
- Student who enables plagiarism is equally responsible

<http://www.ucd.ie/students/guide/academicregs.html>

<http://libguides.ucd.ie/academicintegrity>

Books

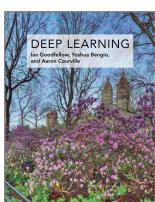


Fundamentals of Machine Learning for Predictive Data Analytics

Algorithms, Worked Examples, and Case Studies

By John D. Kelleher, Brian Mac Namee and Aoife D'Arcy

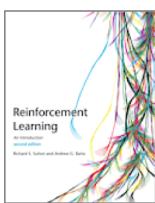
<https://mitpress.mit.edu/books/fundamentals-machine-learning-predictive-data-analytics>



Deep Learning

Ian Goodfellow and Yoshua Bengio and Aaron Courville

<https://www.deeplearningbook.org/>



Reinforcement Learning: An Introduction

Richard S. Sutton and Andrew G. Barto

<http://incompleteideas.net/book/the-book.html>

Questions

