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SCC361: Artificial Intelligence

Week 1: Introduction to Artificial Intelligence and Machine Learning

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SCC361: Artificial Intelligence

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- Lectures, Materials and Expectations
- Introduction to the Module
- Overview of Artificial Intelligence
- Overview of Machine Learning

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Playing this Video

- This version is unedited
- In general, it might be slow for some people
- Vary the playback speed to suit you preferred pace
- In live sessions, you can **ask questions at any stage**, but the **Questions?** slides will give you a specific opportunity to ask questions
- While watching, use the **Questions?** slides as stop points for coffee breaks, notes etc

Accessibility

- All our content is expected to meet the UK accessibility requirements
- We have done our best to ensure that that is the case with these course materials
- However, if any course material or part of its content is inaccessible in anyway to any individual or group, kindly let us know.

Attendance Check-in

Be sure to check in to all timetabled sessions using Attendance Check-in

To check in:

- Check the **Attendance Hub** in iLancaster
- Click **Check In**
- Wait for the “You are checked in” confirmation page
- Here is a the demo

Please DO NOT leave a timetabled session without your attendance being registered

Online Sessions on Teams

Before the session:

- Follow the Moodle link to join the lecture
- Ensure that your speakers, headsets are **connected** and **working**

Online Sessions on Teams

During the lectures:

- Turn your webcam **off**
- Turn your microphone **off**

Online Sessions on Teams

During the lectures:

- Use chat appropriately. Not closely monitored during lectures.

For live Q&A sessions:

- **Raise your hand** to ask questions. **Lower it** afterwards.
- When called, turn on your **mic** (and **cam** if you wish). Remember to turn them off afterwards.

Post additional questions on the SCC361 Moodle Forum

Online Sessions on Teams

After the lectures:

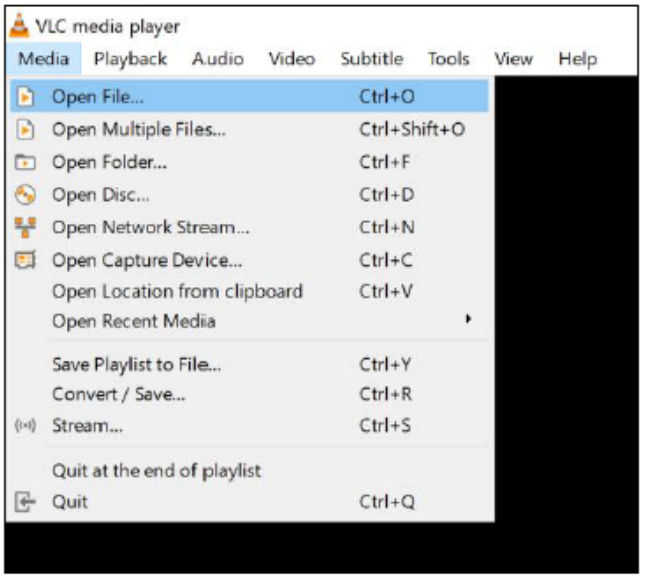
- The recorded content of the live sessions will be made available after the session on the Moodle Space

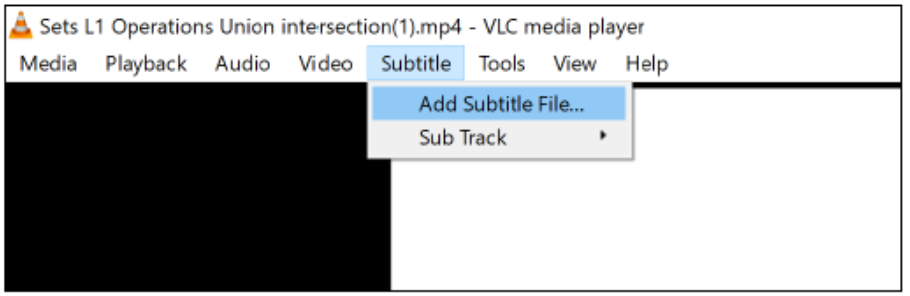
Using Materials Offline

The lectures can be watched on the Moodle space.

If you are struggling to watch the videos on Moodle:

- Download the video and caption file (*.vtt) from Moodle
- Download the free, open source VLC Media player: https://www.videolan.org/vlc/index.en-GB.html
- Open video file in VLC and add caption file





Note:

All learning materials: slides, videos and caption files are @Lancaster University copyright and are **not to be shared or distributed**.

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Plagiarism

Passing off someone else's work as your own, including:

- Colluding with a classmate or someone else to do your work
  - Submitting code written by someone else
  - Paying for someone else to do your work
  - Adapting code by someone else with only a minor modification
- Course work is submitted on Moodle and will be checked automatically for plagiarism!

Online Learning Expectations

- Online tools will be used to facilitate some aspects of learning e.g. Moodle, Teams, etc.
- The use of these is governed by existing policies that you are all currently bound by and have agreed to
- Academic malpractice and plagiarism still applies online
- Direct sharing of code, sharing solutions and/or partial solutions with other students, either privately or in an open chat, is **not acceptable**

Online Learning Expectations

- Don’t forget, these are your fellow students and staff, not some anonymous person on the Internet
- If you’re not sure if you should post or share something, please ask first
- If you see content or a post that you don’t like, in the first instance, message or email the course tutor to alert them to it
- We want these tools to be used; they will give you the best online experience!
- However, we are asking that you use them sensibly and with respect

What do we expect from you?

Attendance:

- Lectures, labs etc., be punctual

Active learning:

- Read around (explore) the subject
- Use recommended books and available online resources
- Ask questions, try things yourself, keep notes
- Have a study plan, get a study partner

Integrity:

- Honesty, no plagiarism/ result manipulation

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How can we help?

- Lecture slides and videos will be available on Moodle
- Provide references to follow up
- TAs will be available to ensure that the labs are running smoothly
- Arrange extra support if you are struggling and let us know on time
- Provide prompt feedback on formative coursework
- In extreme cases, respond to coursework questions outside the labs
  - We encourage you to maximise the use of lab sessions for all coursework related questions

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How to get help

- Use the labs to ask TAs/Tutors for help
- Use the course forum on Moodle
- Check other available (online) resources
- Drop me an email/ ask on Teams chat
  - There might be delays in replying

Questions?

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In this video

- Expected Learning Outcomes
- Teaching Staff
- Lecture Plan
- Teaching Structure
- Assessment

Expected Learning Outcomes

We will to be able to:

- understand AI concepts, applications and trends
- understand machine learning terms
- train machine learning models for specific tasks
- learn implement simple AI-based systems
- learn how to evaluate the performance of AI systems

Teaching Staff

Dr Bryan M. Williams

Weeks 1-5

Dr Hossein Rahmani

Weeks 6-10

Module Convenor

Teaching Assistants	Group 1	Group 2	Group 3	Group 4	Group 5
Mona Alghamdi			■		
Somayeh Bazin	■	■	■	■	■
Piotr Daniszewski		■		■	
Oishi Deb		■		■	
Ovini Gunasekera	■		■		■
Yuri Tavares dos Passos	■				■

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Lecture Plan

Weeks 1-5

1. Introduction to Artificial Intelligence and Machine Learning
2. Features in Machine Learning and Feature Extraction
3. Computer Vision and Natura Language Processing
4. Clustering and Classification
5. Artificial Neural Networks

Weeks 6-10:

6. Genetic Algorithms
7. Naïve Bayesian Classifier
8. Decision Tree Classifier
9. Introduction to Deep Neural Networks
10. Introduction to Convolutional Neural Networks

Teaching Structure

Lectures:

- Weeks 1-10
- Online only
- Mondays: **14.00-15.00**
- Tuesdays: **17.00-18.00**

Labs:

- Weeks 1-10
- Blended: **in-person and online**
- Wednesdays: **11.00-13.00**
- Thursdays: **10.00-12.00**
- Thursdays: **16.00-18.00**
- Fridays: **11.00-13.00**
- Fridays: **16.00-18.00**

Teaching Structure

Labs:

Group	Day	Time	Room
SCC361/P01/01	Wednesday	11:00-13:00	FST B076
SCC361/P01/02	Thursday	16:00-18:00	FST B076
SCC361/P01/03	Friday	16:00-18:00 (Weeks 1-4, 6, 8, 10) 14:00-16:00 (Weeks 5, 7, 9)	FST B070 (Weeks 1-4) FST B074 (Weeks 5, 7, 9) FST B080 (Weeks 6, 8, 10)
SCC361/P01/04	Thursday	10:00-12:00	FST B070
SCC361/P01/05	Friday	11:00-13:00	FST B080

Assessment

2 Courseworks: 40%

- CW1 (20marks):
  - Submission: On Moodle
  - Deadline: **5pm Friday 12th November, 2021**
- CW2 (20marks):
  - Details: to be confirmed

Exam: 60%

- Next semester in 2021
- Date: To be confirmed

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Questions?

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- Lectures, Materials and Expectations
- Introduction to the Module
- **Overview of Artificial Intelligence**
- Overview of Machine Learning

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Welcome to SCC361

Part 1 (Weeks 1 – 5):

- Wk1: Intro to Artificial Intelligence & Machine Learning
- Wk2: What are features and how to extract features from texts, images, etc.
- Wk3: Computer Vision and Natural Language Processing
- Wk4: Clustering & Classification
- Wk5: Intro to Artificial Neural Networks & Review of Previous Lectures

Part 2 (Weeks 6 – 10):

- Dr Hossein Rahmani (GAs, NBCs, DTCs, DNNs, CNNs)

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This Week's Lectures

Artificial Intelligence: An Overview

- Application, history, foundations of AI
- Definition of AI
- Goals of AI
- AI and the Society
  - Benefits
  - Risk and Challenges
  - Ethical Issues

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This Week's Lectures

Overview of Machine Learning

- AI and ML, Definitions of ML, How to learn

Types of Machine Learning

- Supervised, unsupervised, semi supervised

Supervised Learning

- Classification and regression

Unsupervised Learning

- Clustering and association

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Recommended Reading

- Artificial Intelligence: Foundations of Computational Agents 2ed. Poole & Mackworth 2017
- Artificial Intelligence A Modern Approach, Russell & Norvig, 2016 (chapters 1,2,5,6)
- Deep Learning, Goodfellow et al. , 2016
- Deep Learning with PyTorch, Stevens et al, 2020.
- Machine Learning, T. M. Mitchell, 1997
- Artificial Intelligence on Wikipedia
- Many online resources

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Artificial Intelligence

- AI Overview
- Definition of AI
- Goals of AI
- AI and Society

Introduction to Machine Learning

- Machine Learning Overview
- Types of Machine Learning
- Supervised Learning
- Unsupervised Learning

AI in Real Life

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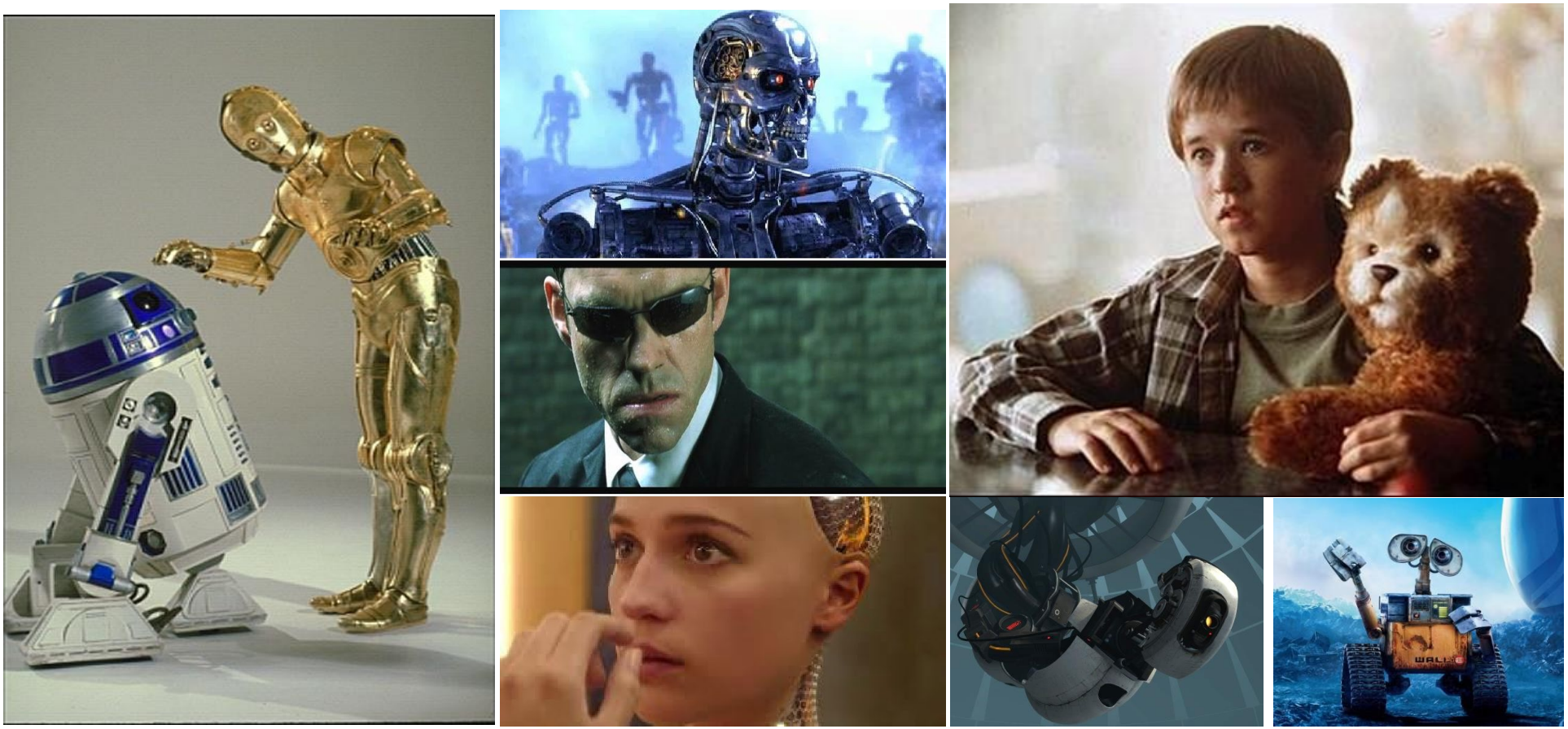
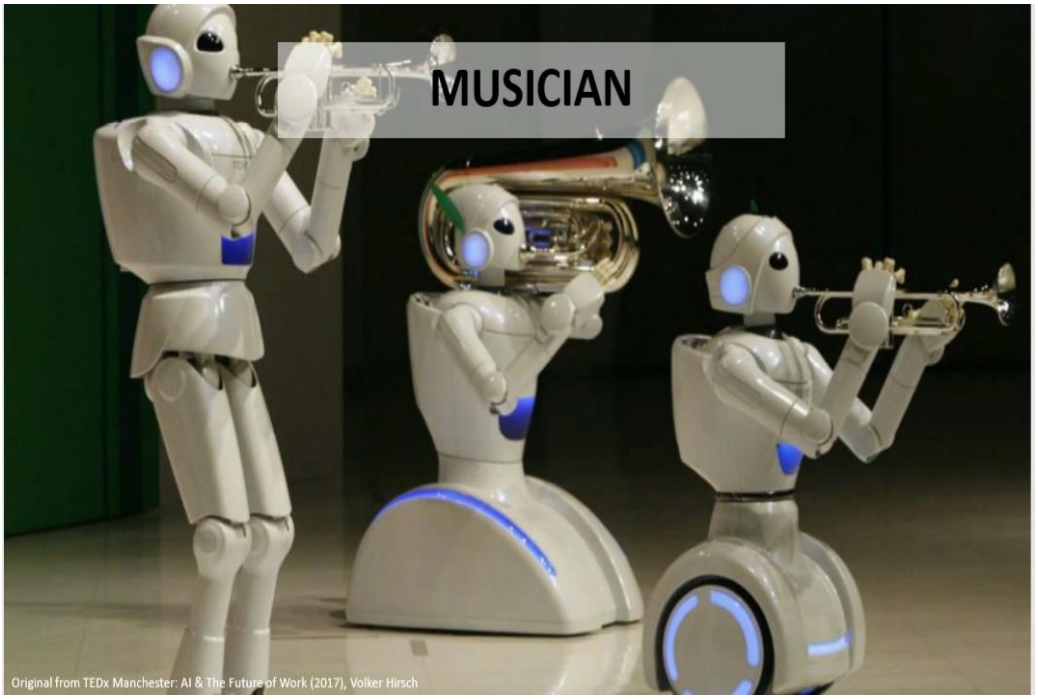
AI in Science Fiction Movies



AI in Science Fiction Movies

AI in Music


MUSICIAN
Original from TEDx Manchester: AI & The Future of Work (2017), Volker Hirsch

AI in Agriculture

AI in Delivery Services

AI in Self-Driving Vehicles

AI in Medicine

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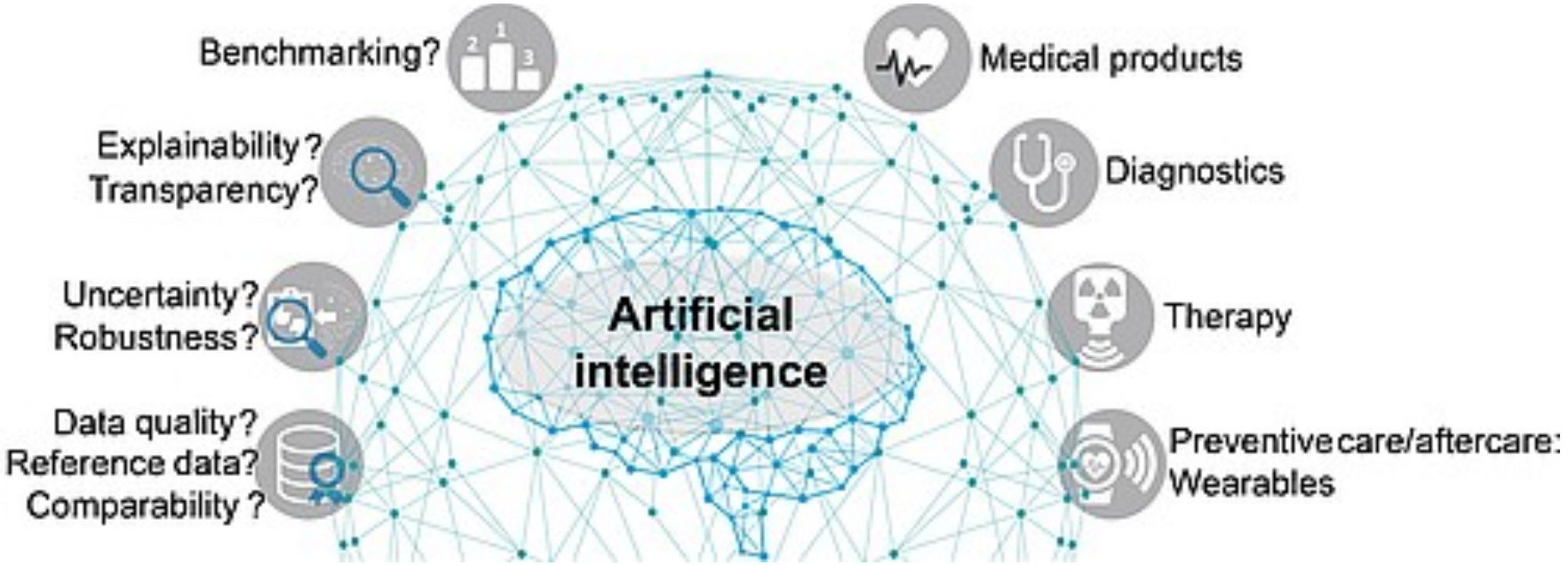
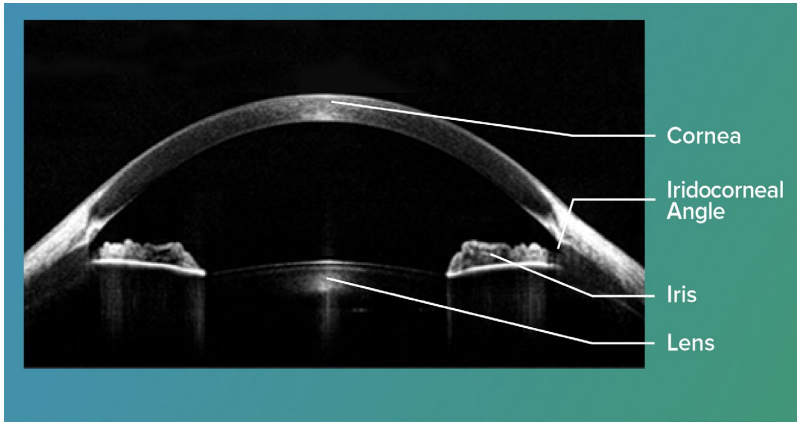
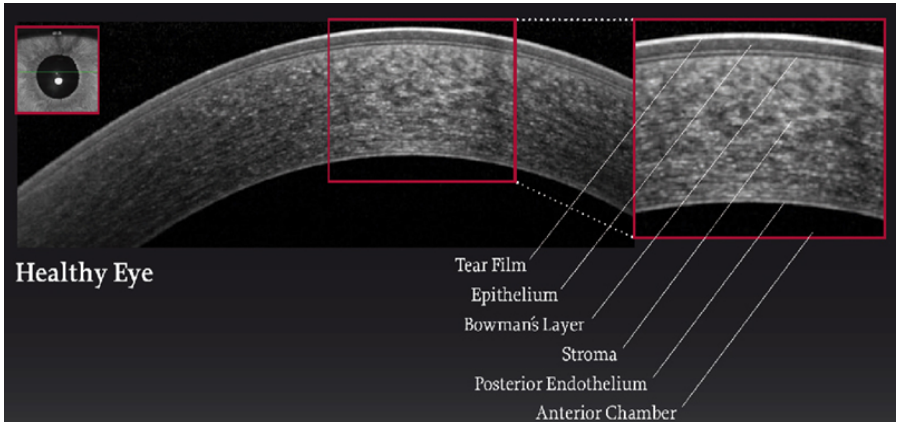
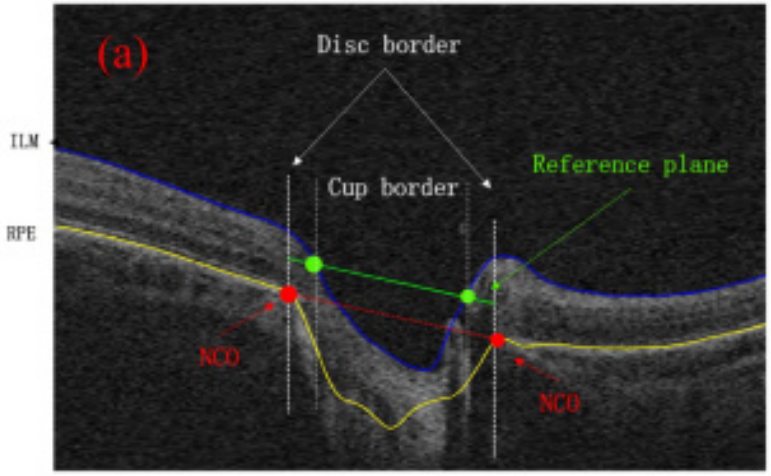
AI in Medicine

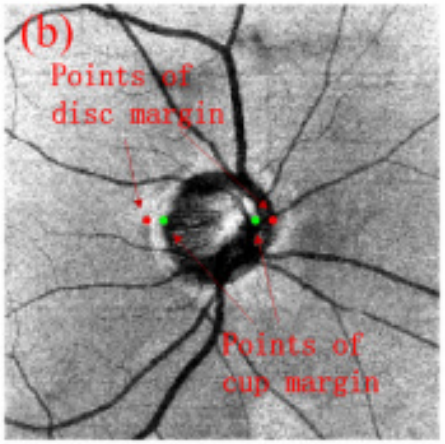


AI in Medicine

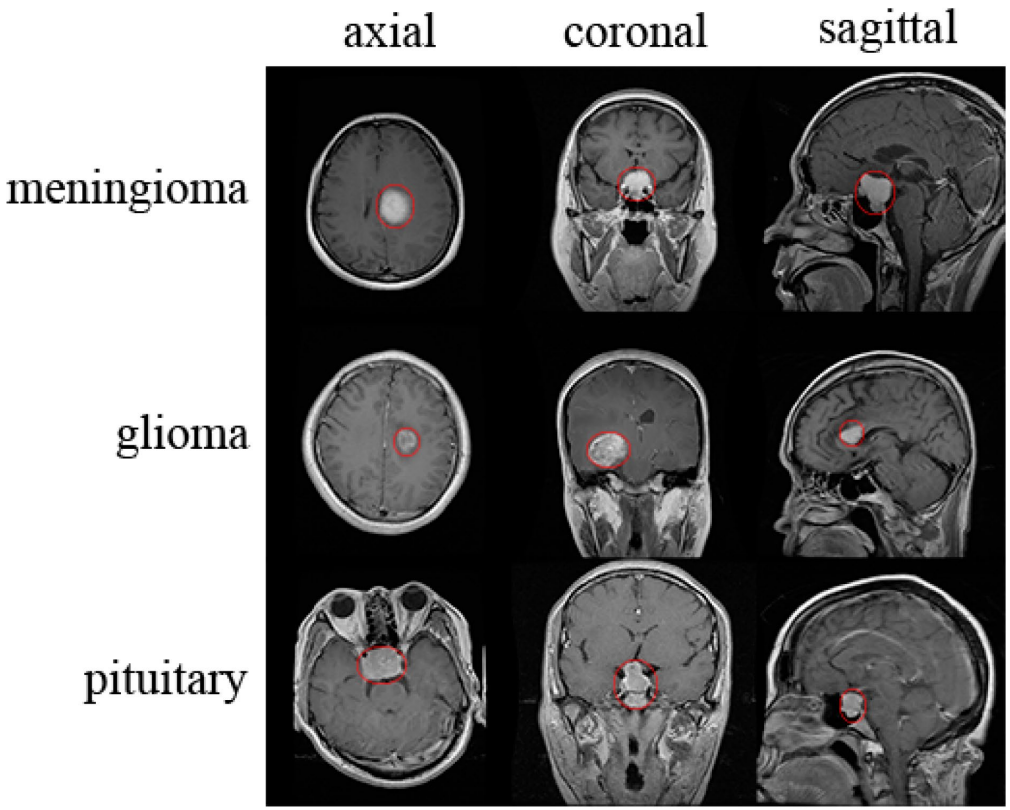


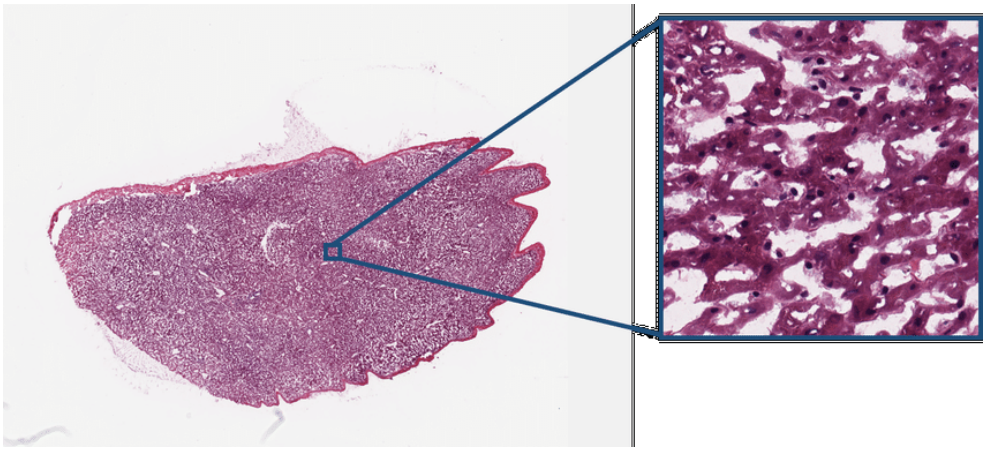


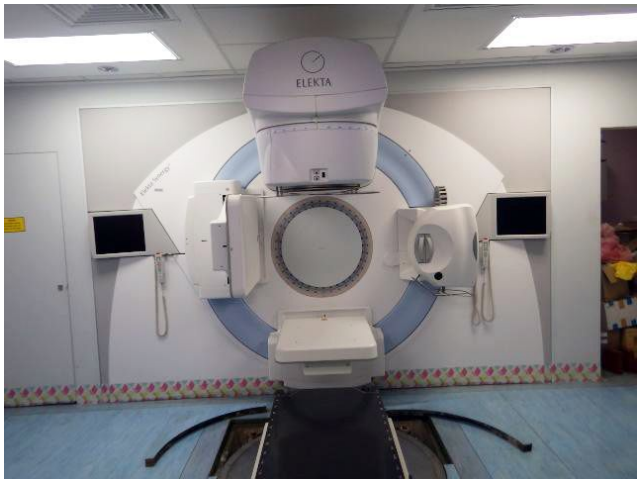




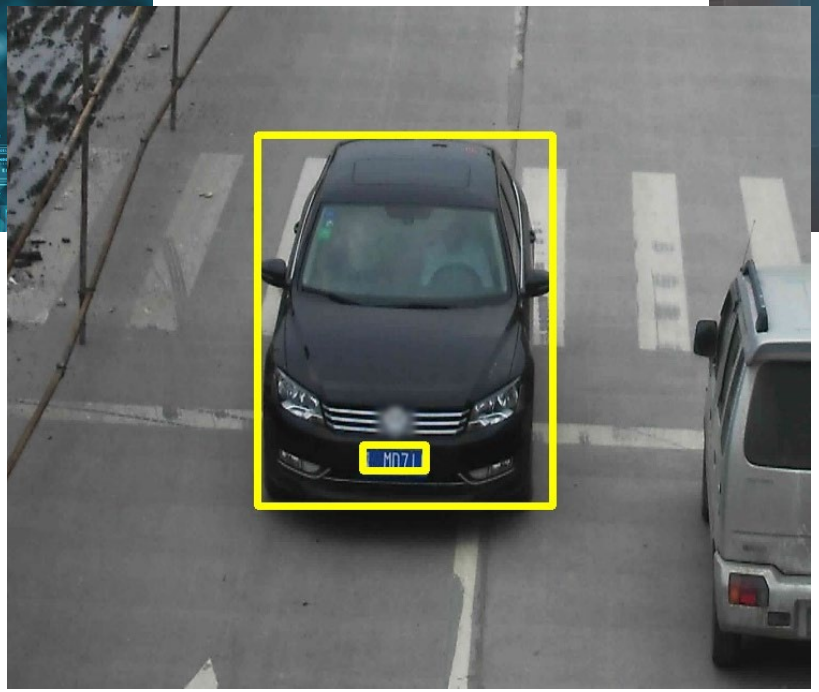
AI in Medicine







AI in Security



AI in Forensic Identification

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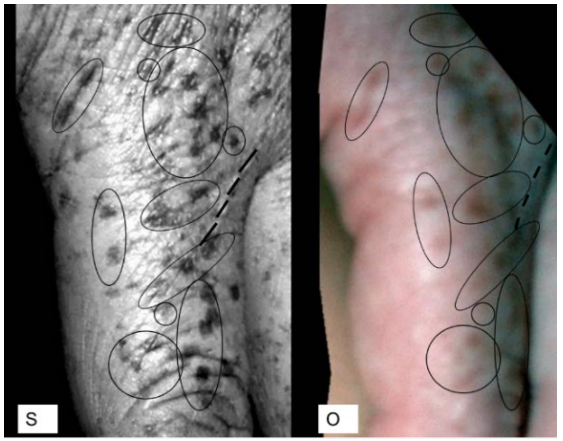
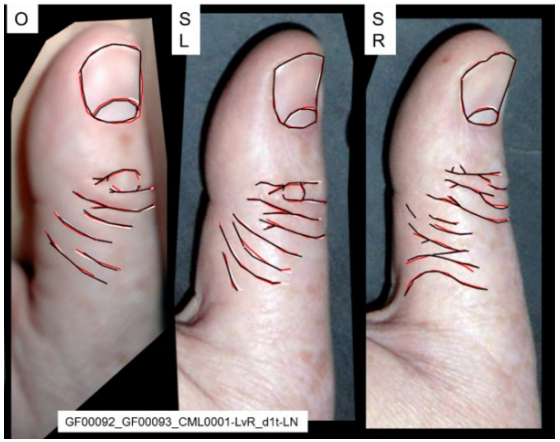


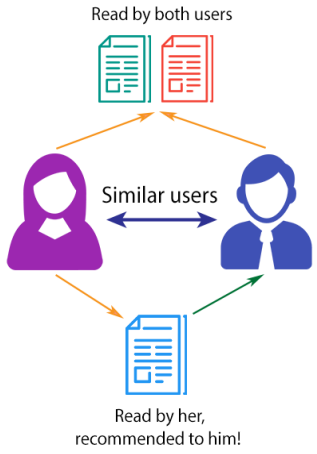


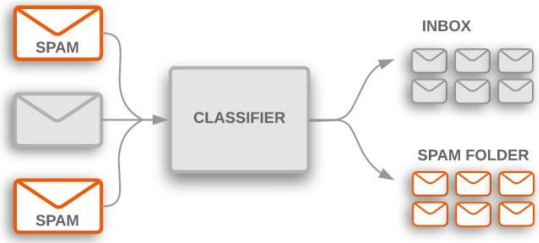
H-Unique

https://h-unique.lancaster.ac.uk/

AI in Natural Language Processing

- Web search engines
- Text classification: sentiment, topic
- Spam filtering etc
- Machine translation
- Question answering
- Recommender Systems





AI in Natural Language Processing

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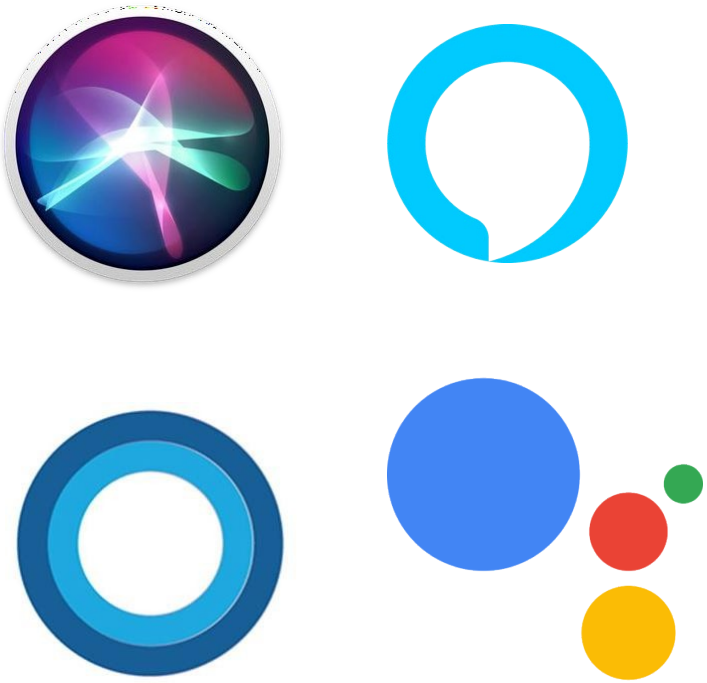
Speech Technologies

- Siri, Alexa, Cortana, Google Assistant
- Automatic Speech Recognition
- Dialogue systems



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Brief History of AI

1940-1950: Early Days

- 1943: McCulloch & Pitts: **Boolean Circuit Model of Brain**
- 1950: Turing's "**Computing Machinery and Intelligence**"

1950-1970: Excitement

- 1950s: Early AI programs: **Samuel's checkers program**, **Newell & Simon's Logic Theorist**, **Gelernter's Geometry Engine**
- 1956: Dartmouth meeting: "**Artificial Intelligence**" adopted
- 1965: Robinson's **complete algorithm for logical reasoning**

1970-1990: Knowledge-based approaches

- 1969-79: Early development of **knowledge-based systems**
- 1980-88: **Expert systems** industry booms
- 1988-93: Expert systems industry busts: "**AI Winter**"

Lesson Notes from Nikita Kitaev, University of California, Berkeley

Brief History of AI

1990 – 2012:
Statistical approaches
+ subfield expertise:

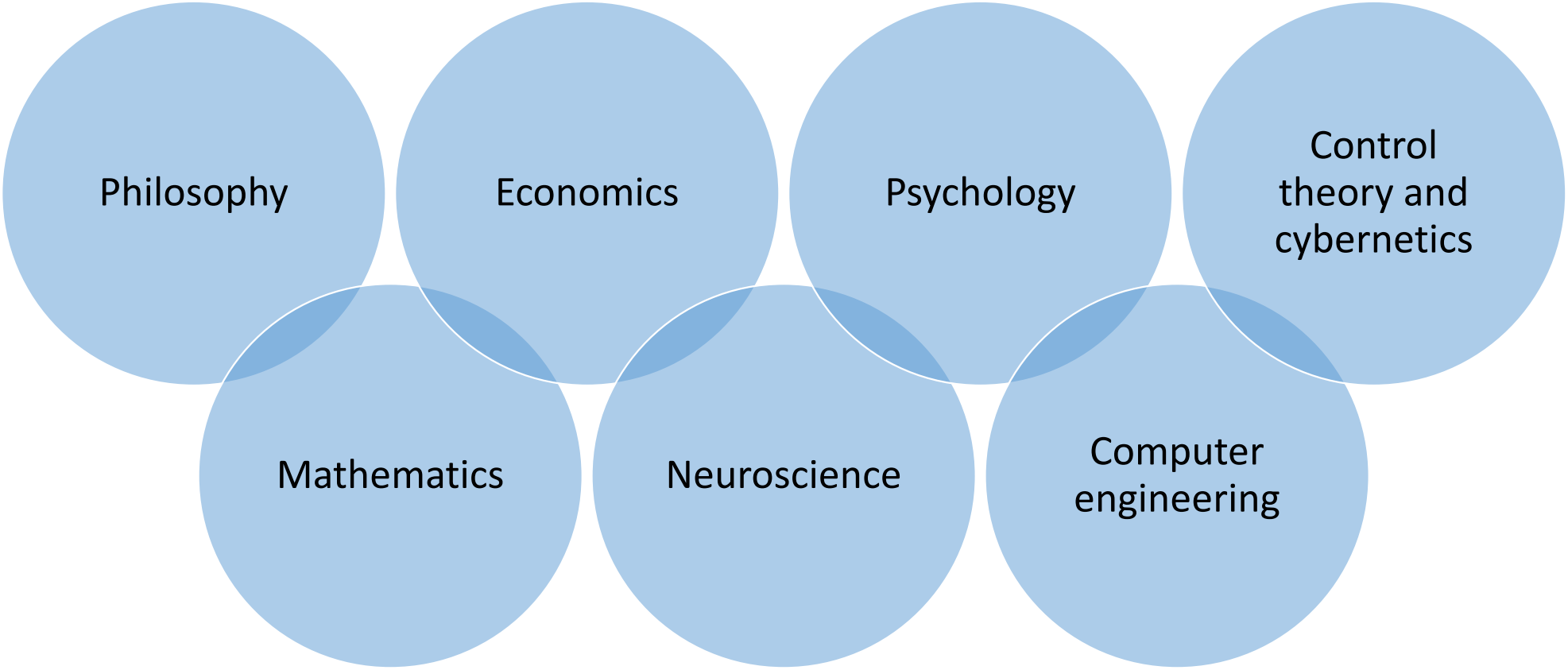
- Resurgence of probability, focus on uncertainty
- General increase in technical depth
- Agents and machine learning systems… “AI Spring”?

2012 – now:
Excitement:

- Big data, big compute, deep neural networks
- Some re-unification of subfields
- AI used in many industries

Lesson Notes from Nikita Kitaev, University of California, Berkeley

Foundations of Artificial Intelligence



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Questions?

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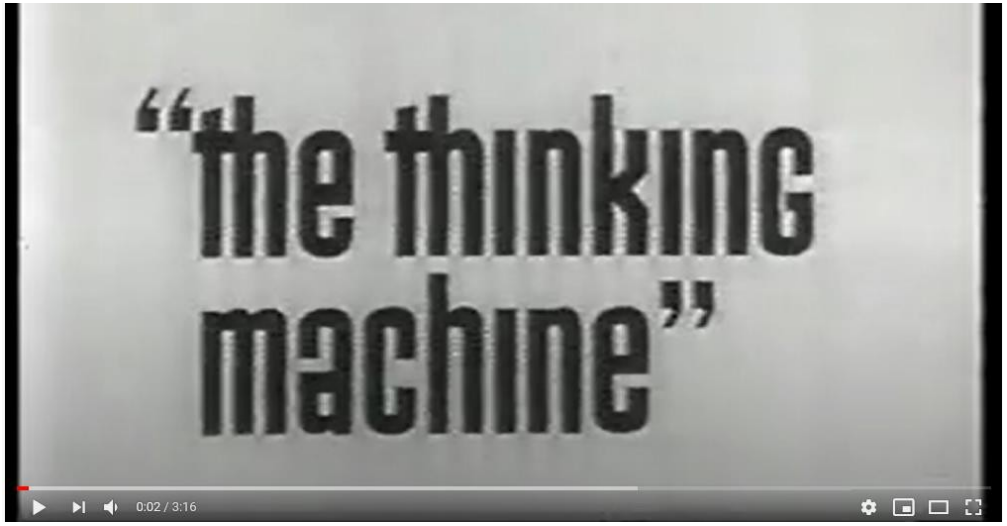
The Thinking Machine

- Can machines really think?
- Interviews by some of the AI pioneers in the 1960s:
  - Jerome Wiesner,
  - Oliver Selfridge,
  - Claude Shannon
- Can a robot marry my daughter?
- Can AI translate write poetry?



Human Intelligence

Learning

Reasoning

Perceiving

Understanding of Language

Feeling

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What is Artificial Intelligence?

Approach 1: Thinking Humanly

- "The exciting new effort to make computers think ...machines with minds, in the full and literal sense." (Haugeland, 1985)
- "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ..." (Bellman, 1978)

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

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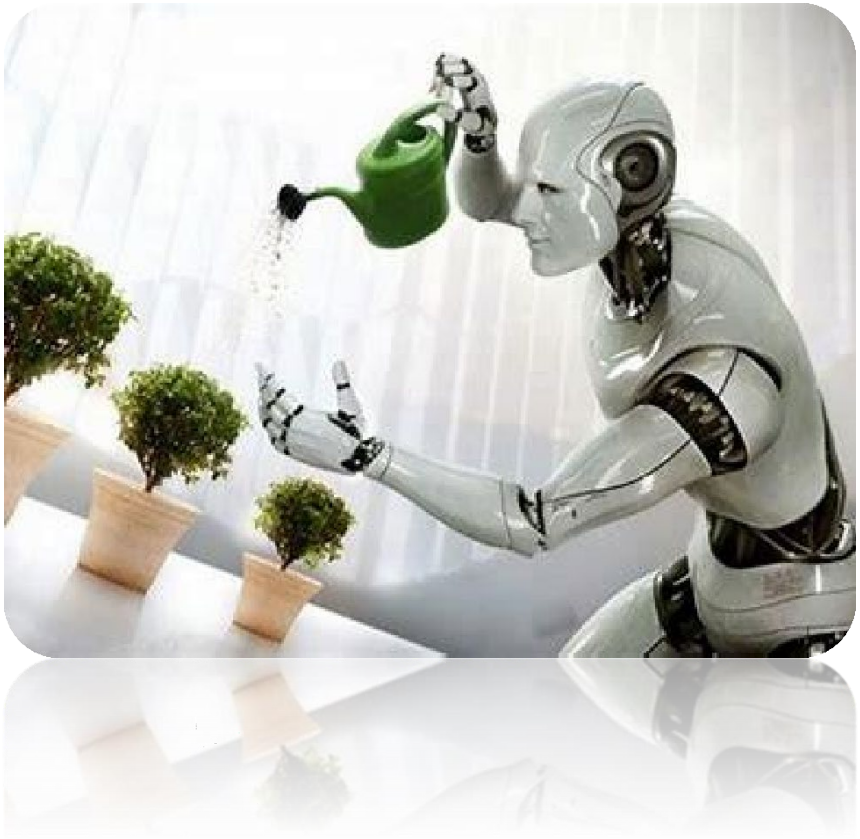
What is Artificial Intelligence?

Approach 2: Acting Humanly

- "The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)
- "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)



Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

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What is Artificial Intelligence?

Approach 3: Thinking Rationally

- "The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)
- "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

What is Artificial Intelligence?

Approach 4: Acting Rationally

- "Computational Intelligence is the study of the design of intelligent agents." (Poole et al., 1998)
- "AI ... is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

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Approaches to defining AI

	Human	Rational
Thinking	**Systems that think like humans**	**Systems that think rationally**
Acting	**Systems that act like humans**	**Systems that act rationally**

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Approaches to defining AI

	Human	Rational
Thinking	**Systems that think like humans** • Cognitive modelling approach • Introspection, psychological experiments, brain imaging • Cognitive Science	Systems that think rationally
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Approaches to defining AI

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Acting	**Systems that act like humans** • The (total) Turing Test • Requires the 6 disciplines • NLP, KR, Reasoning, ML, Computer vision, Robotics	Systems that act rationally

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Approaches to defining AI

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Acting	**Systems that act like humans** • The (total) Turing Test • Requires the 6 disciplines • NLP, KR, Reasoning, ML, Computer vision, Robotics	**Systems that act rationally** • The rational agent approach • Autonomous, perceptive, persistent, adapts to change • Creates and pursues goals

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

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Approaches to defining AI

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Thinking	**Systems that think like humans** • Cognitive modelling approach • Introspection, psychological experiments, brain imaging • Cognitive Science	**Systems that think rationally** • Laws of thought approach • "Logicist" tradition • Mostly rule-based • Logic
Acting	**Systems that act like humans** • The (total) Turing Test • Requires the 6 disciplines • NLP, KR, Reasoning, ML, Computer vision, Robotics	**Systems that act rationally** • The rational agent approach • Autonomous, perceptive, persistent, adapts to change • Creates and pursues goals

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

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What is an Agent?

An **agent** ‘acts’ (does something) within an **environment**

- e.g. worms, dogs, thermostats, airplanes, robots, humans, companies, and countries.

An agent acts **intelligently** if:

- action is appropriate for circumstances and goals
- flexible to changes in environment and goals
- learns from experience
- makes appropriate choices given perceptual and computational limitations

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Computational Agent

A **computational agent** is:

- An agent whose decisions and actions can be explained in terms of computation.
- Decision can be broken down into primitive operations that can be implemented in a physical device.
- Computations can take many forms
  - The human brain ("wetware")
  - Computers ("hardware")
- Non computational agents:
  - wind, rain, etc.

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Rational Agent

- **Rational agent** acts to 'achieve the best outcome or, when there is uncertainty, the best expected outcome.'
- AI focuses on build the *general principles* of **rational agent** and *components* for constructing them
- Two key advantages of the **rational-agent** over others:
  - Amenable to scientific development than approaches on human thoughts and behaviour
  - It is more general than the "laws of thought" approach
- Also deals with **limited rationality** – acting appropriately with limited computations

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig

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Intelligence

- AI is the field that studies the *synthesis* and *analysis* of **computational agents** that **act intelligently** - *Poole & Markworth*

- An agent acts **intelligently** if:
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Intelligence

- AI is the field that studies the *synthesis* and *analysis* of **computational agents** that **act intelligently** - *Poole & Markworth*

- An agent acts **intelligently** if:
  - action is appropriate for circumstances and goals
  - flexible to changes in environment and goals
  - learns from experience
  - makes appropriate choices given perceptual and computational limitations

it is 'rational'

Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth

Definition of AI

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Artificial intelligence, or **AI** is the field that studies the *synthesis and analysis of* ***computational agents*** *that* ***act rationally***

Artificial Intelligence: A Modern Approach, 2016, Russell & Norvig
Artificial Intelligence: Foundations of Computational Agents, 2017, Poole & Markworth

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Questions?

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Goals of AI

Two types of goals: **Scientific** and Engineering

- **Scientific goal** – understand the principles of intelligent behaviour:
  - Analysis of natural and artificial agents
  - Formulating and testing hypothesis
  - Designing, building and experimenting with computational agents
- Uses a general scientific approach
- Focuses on building **empirical systems**
- And **not** on the final **applications** that could be deployed to use

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Goals of AI

Two types of goals: Scientific and **Engineering**

- **Engineering goal** – concerned with constructing intelligent agents
- Focuses on the **design** and **synthesis** of useful, intelligent artefacts.
- Builds agents that act intelligently
- Agents that are useful in many real-world applications

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Business Benefits of AI

- Workflow/Process automation
  - Use of bots for routine, repetitive tasks
- Enhance creative tasks
  - More time and tools to explore creative functions
- Increased accuracy
  - Human errors can be reduced
- Better predictions & improved decision making
  - Predictions of risks, performance targets, tailored product offerings etc

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Social benefits of AI

- Healthcare
  - There is a huge effort in mobilizing AI for health.
- Smart cities, transportation, security
  - Maps, navigation systems, unmanned vehicles, route planning, security
- Forecasts and predictions
  - Weather, natural disasters, earthquakes, hurricanes, stock prices, economic
- Agriculture
  - Real-time data analytics help farmers to maximise their crop yields and profits
- Overall lifestyle

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Risks and Challenges of AI

- Safety and security
  - Driverless cars can be hacked
  - Failed Facebook AI chatbot experiment
  - Racist hijack of Microsoft AI Tweeter feed
- Trust and social manipulation
  - Facebook-Cambridge Analytica Scandal
- Explainable (or Interpretable) AI (XAI)
  - Deep neural models are naturally opaque
- Possible job losses
  - “AI will replace more than 75 million jobs by 2022” – World Economic Forum

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Ethical Concerns of AI

- Accountability
  - If AI violates ethical rules, who will be responsible?
- Accuracy, bias, privacy and inequality
- AI learns from data provided by humans which may encode human biases and prejudices
  - Facial recognition to ‘predict criminals’ sparks row over AI bias – BBC
  - IBM abandons “biased” facial recognition tech – BBC
- Technological social responsibility (TSR)
  - a conscious alignment between short- and medium-term business goals and longer-term societal ones – McKinsey Quarterly, August, 2019

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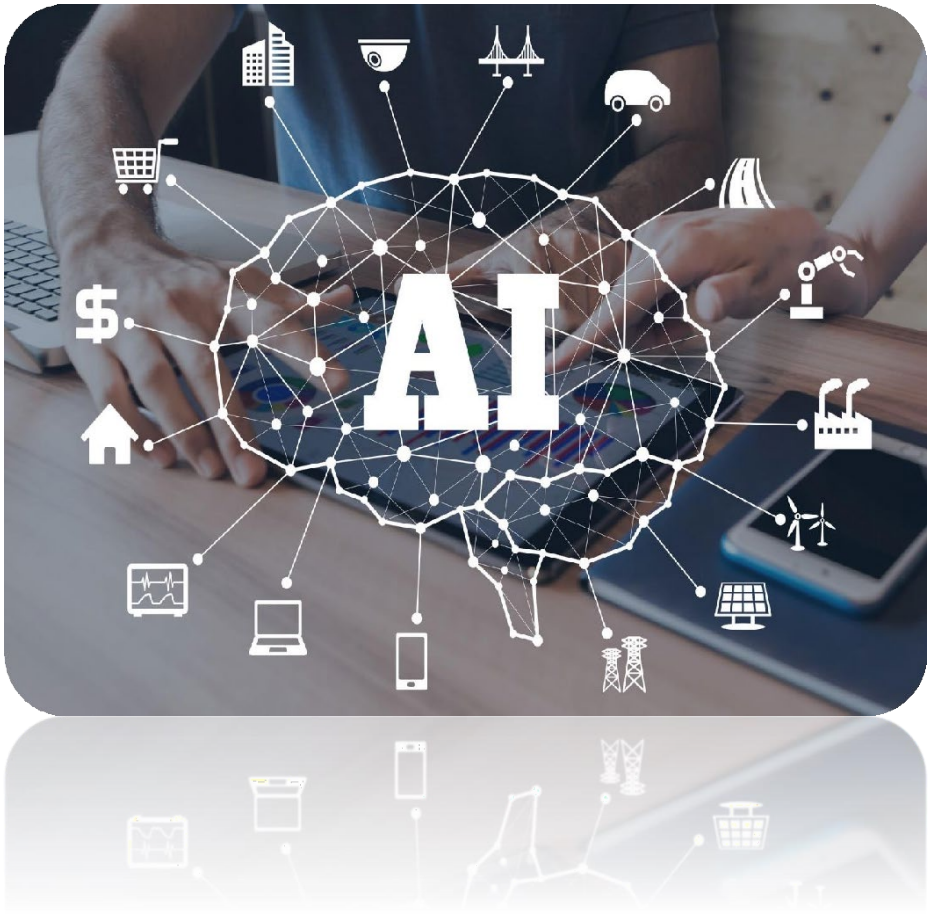
AI Summary

- Artificial Intelligence: An overview
  - Application, history, foundations of AI
- Definition of AI
- Goals of AI
- AI and the Society
  - Benefits
  - Risk and Challenges
  - Ethical Issues



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Questions?

SCC361: Artificial Intelligence

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- Lectures, Materials and Expectations
- Introduction to the Module
- Overview of Artificial Intelligence
- Overview of Machine Learning

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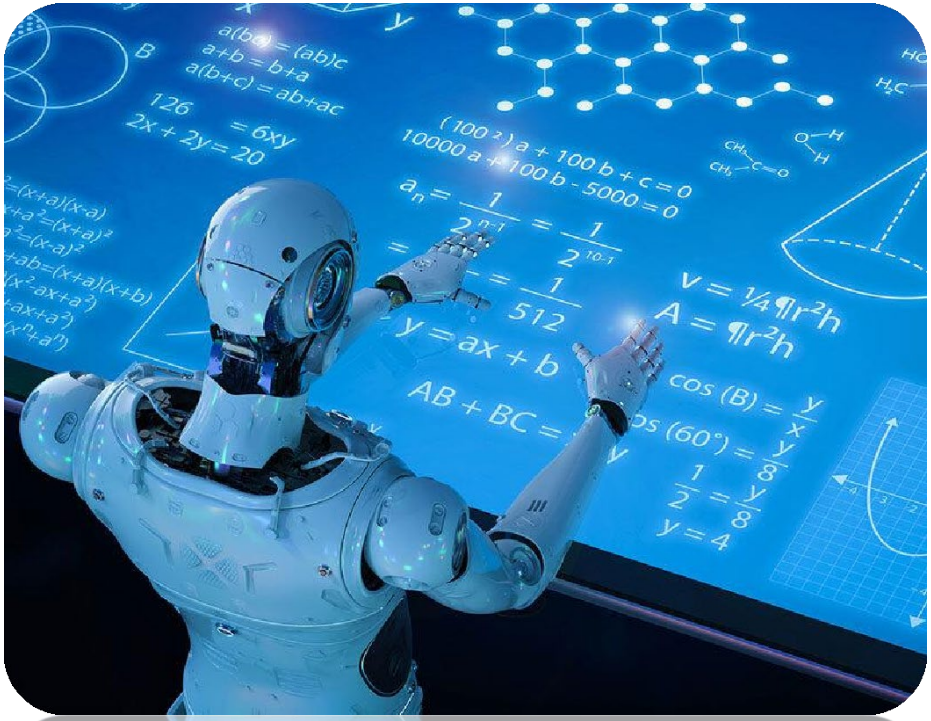
Introduction to Machine Learning

- Overview of Machine Learning
  - AI and ML, Definitions of ML, How to learn
- Types of Machine Learning
  - Supervised, unsupervised, semi supervised
- Supervised Learning
  - Classification and regression
- Unsupervised Learning
  - Clustering and association



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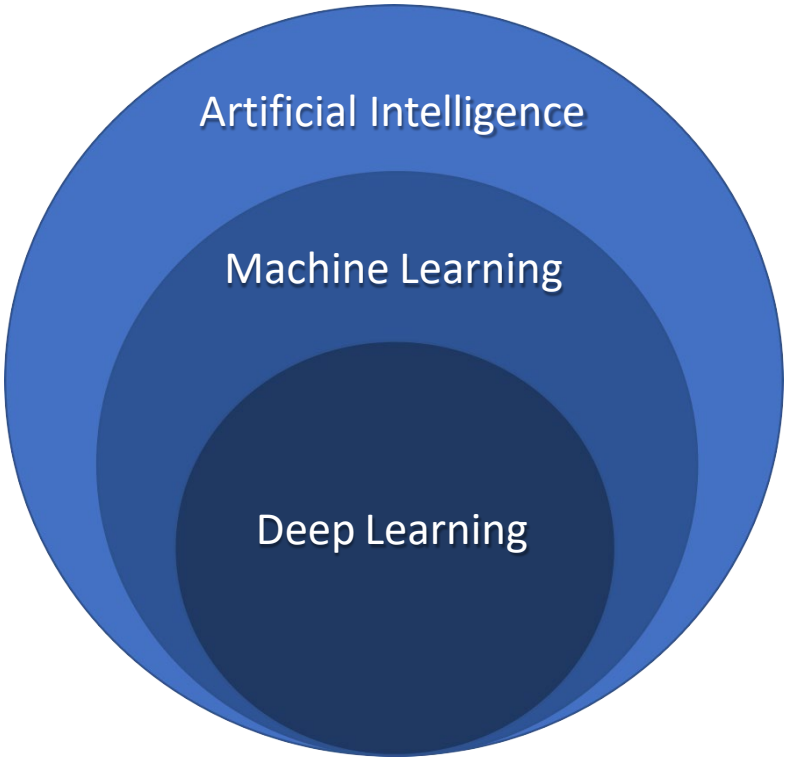
AI and Machine Learning

- AI systems were mostly **rule-based**
  - i.e. depended on hand-crafted rules
- Machine learning drives AI
  - Learning algorithms create a logical mapping from data to output
- Deep learning:
  - a subset of ML with additional layers to learn deeper representations data



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What is Machine Learning?

Early definition of machine learning

"Field of study that gives computers the ability to learn without being explicitly programmed"

– Arthur Samuel (1959)

- ML pioneer that built first "self-learning" program that played checkers by learning from experience
- Inverted alpha-beta pruning widely used in decision tree searching

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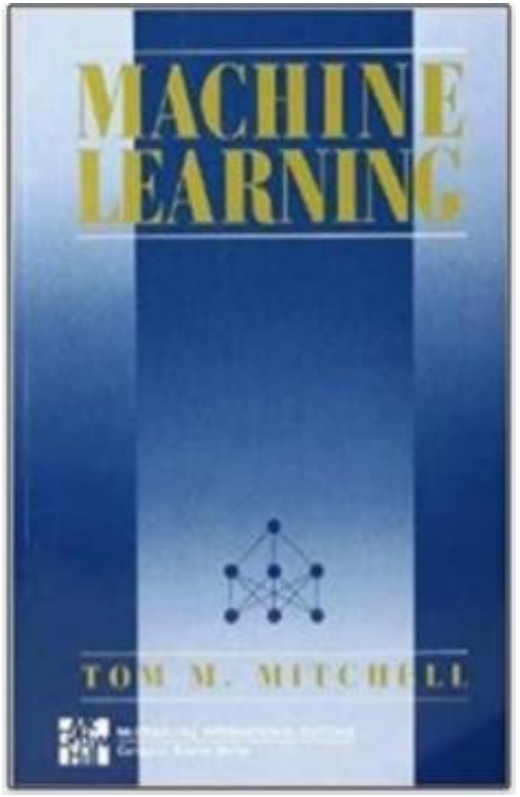
What is Machine Learning?

Another popular definition:

*"A computer is said to **learn** from experience **E** with respect to task **T** and some performance measure **P**, if its performance on **T**, as measured by **P**, improved with experience **E**"*

– Tom Mitchell (1997)



- Again, the key is learning from experience
- Not explicitly programmed

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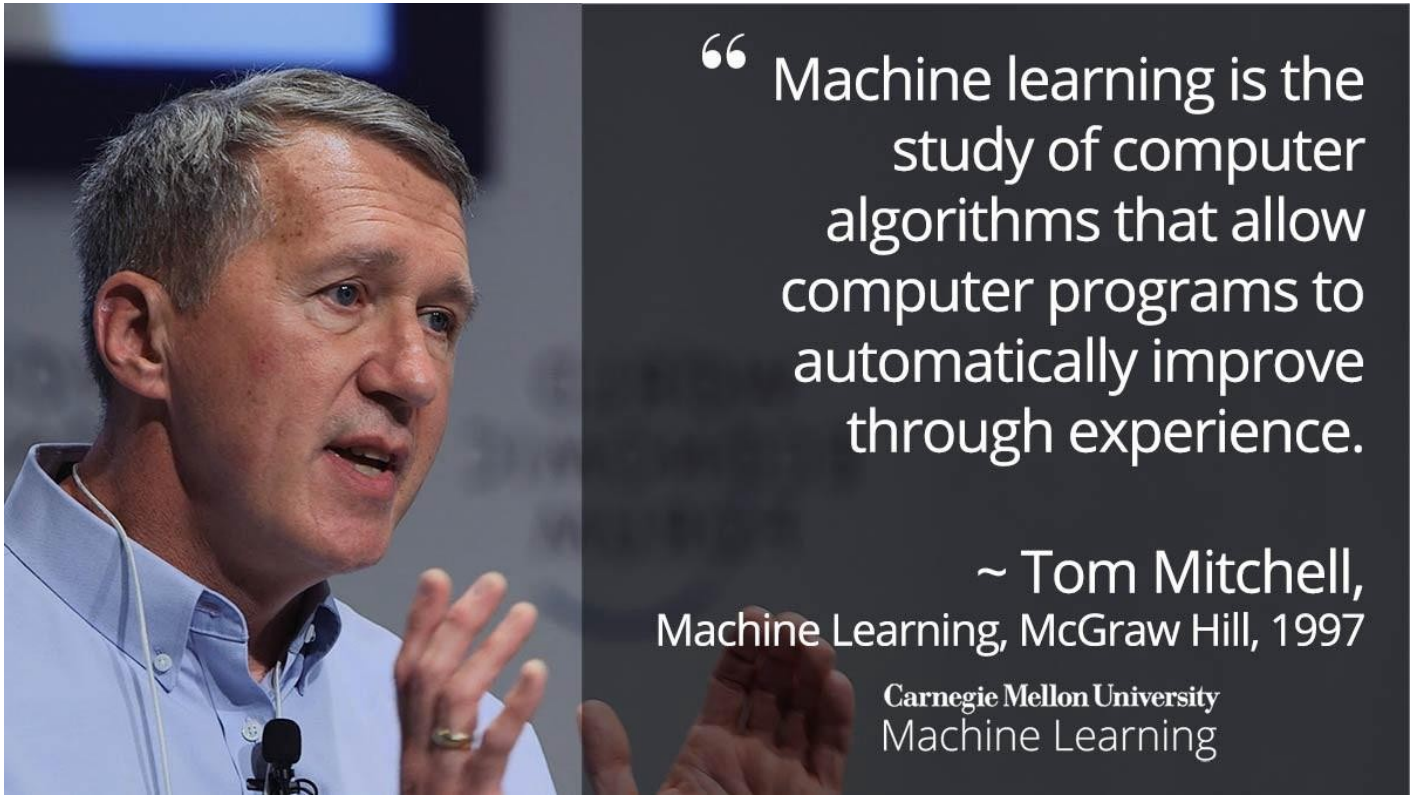
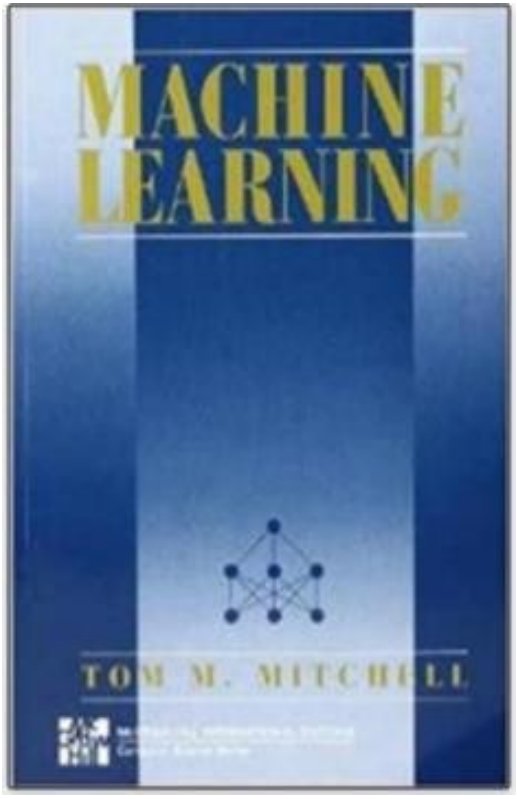
What is Machine Learning?





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Spam or not SPAM

Given this definition:

*"A computer is said to **learn** from experience **E** with respect to task **T** and some performance measure **P**, if its performance on **T**, as measured by **P**, improved with experience **E**"*

My email program watches me mark some emails as spam, and improves on filtering spams. What is the T, E and P in the setting?

a. Watching me label emails as spam

b. Classifying emails as spam or not spam

c. The fraction of emails correctly classified as spam or not

d. None of the above – this is not a machine learning problem

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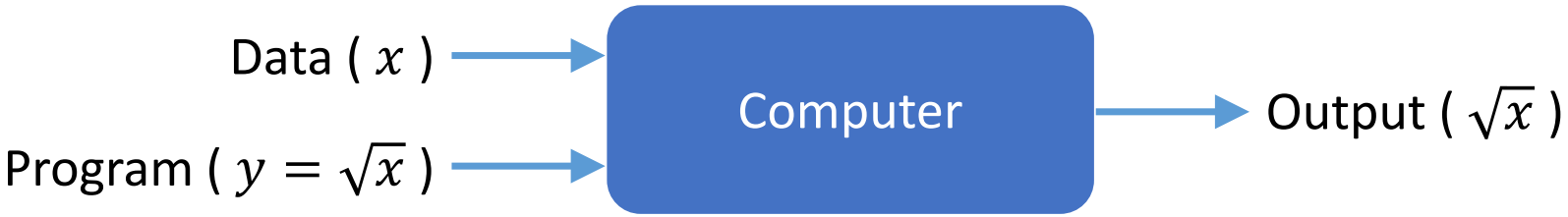
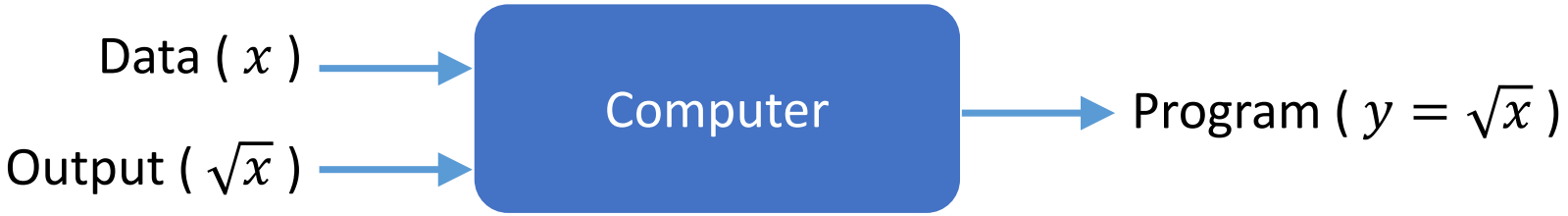
What is Machine Learning?

- Consider the function $y = f(x)$ (e.g. $f(x) = \sqrt{x}$)
- Traditional Programming (Software 1.0)



- Machine Learning (Software 2.0)



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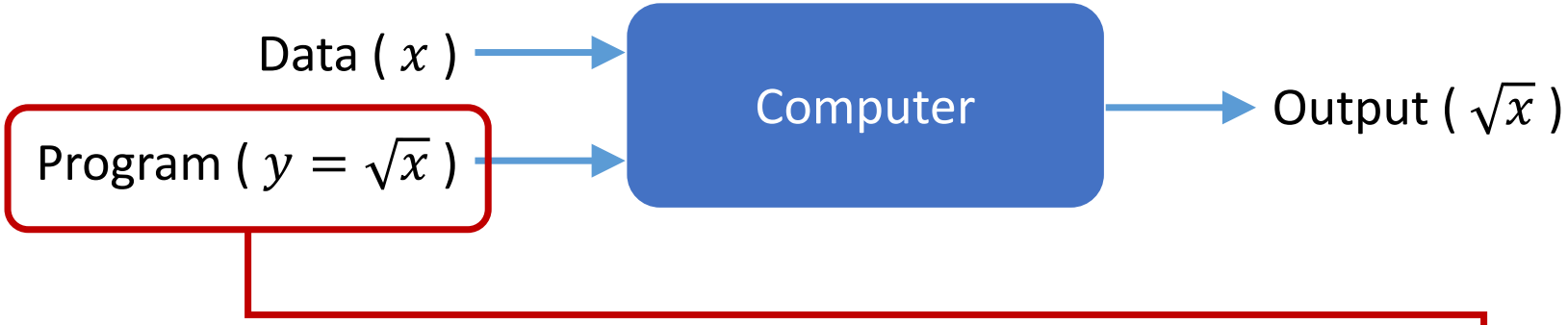

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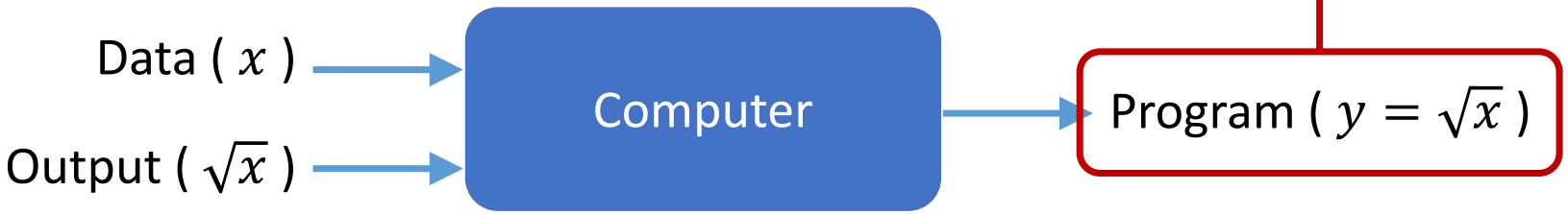

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How things are learned

- Memorization
  - Accumulation of individual facts
  - Limited by
    - Time to observe facts
    - Memory to store facts

Declarative knowledge

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How things are learned

- Memorization
  - Accumulation of individual facts
  - Limited by
    - Time to observe facts
    - Memory to store facts
- Generalization
  - Deduce new facts from old facts
  - Limited by accuracy of deduction process
    - Essentially a predictive activity
    - Assumes that the past predicts the future

Declarative knowledge

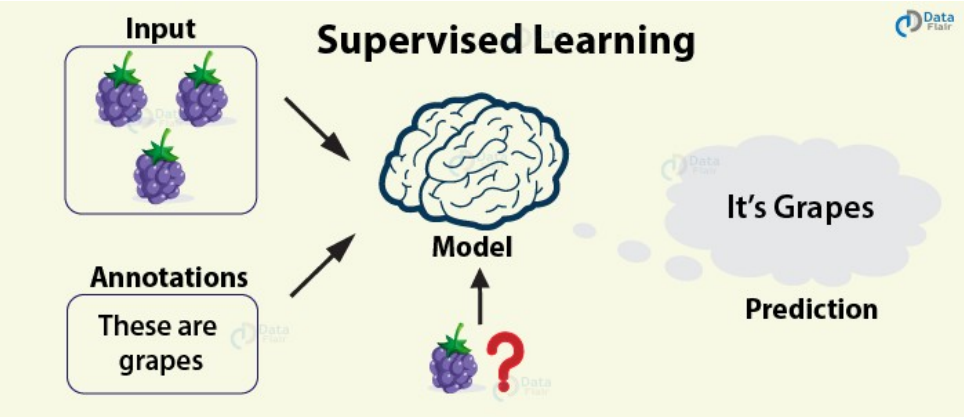
Better

Imperative knowledge

Types of Machine Learning

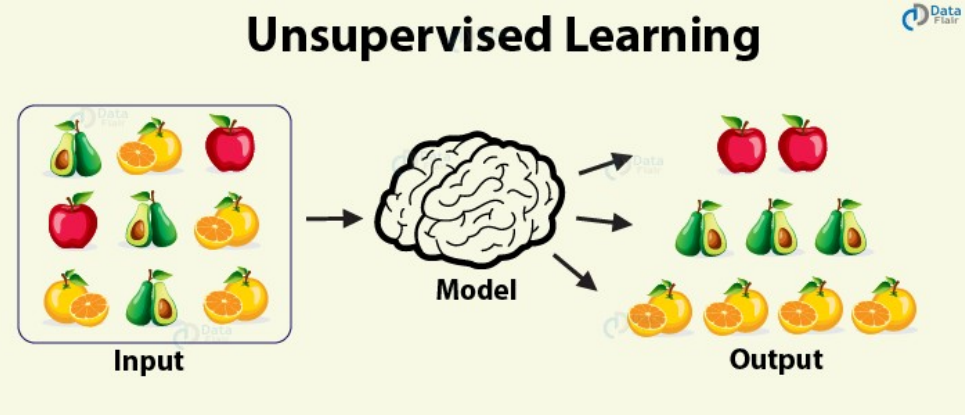
Supervised Learning

- Classification
- Regression



Unsupervised Learning

- Clustering
- Association



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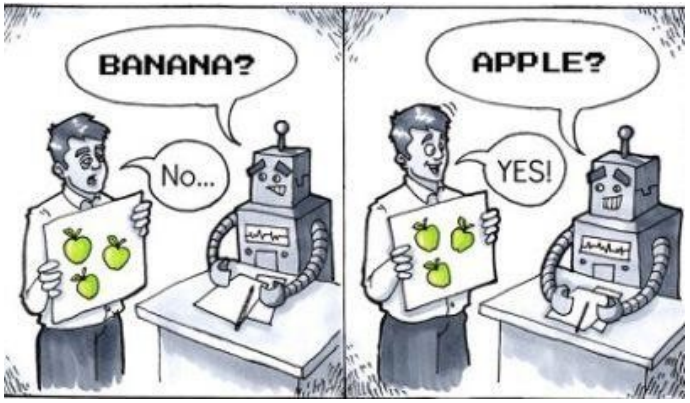
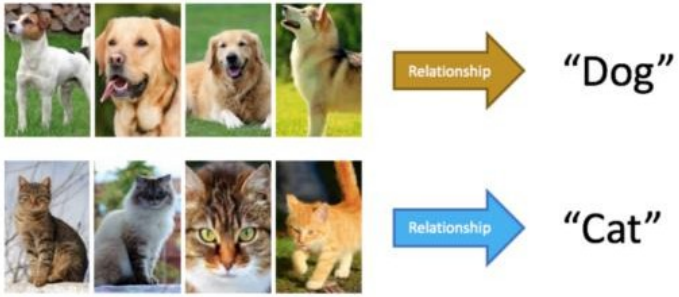
Supervised Learning

- The algorithm learns to map an **input** to a **particular output**.
- Instances of data are presented along with their **correctly labelled** output
- Similar to a **teacher-student** scenario
- The algorithm learns from **experience** to predict new unseen data
- Two broad categories:
  - Regression
  - Classification





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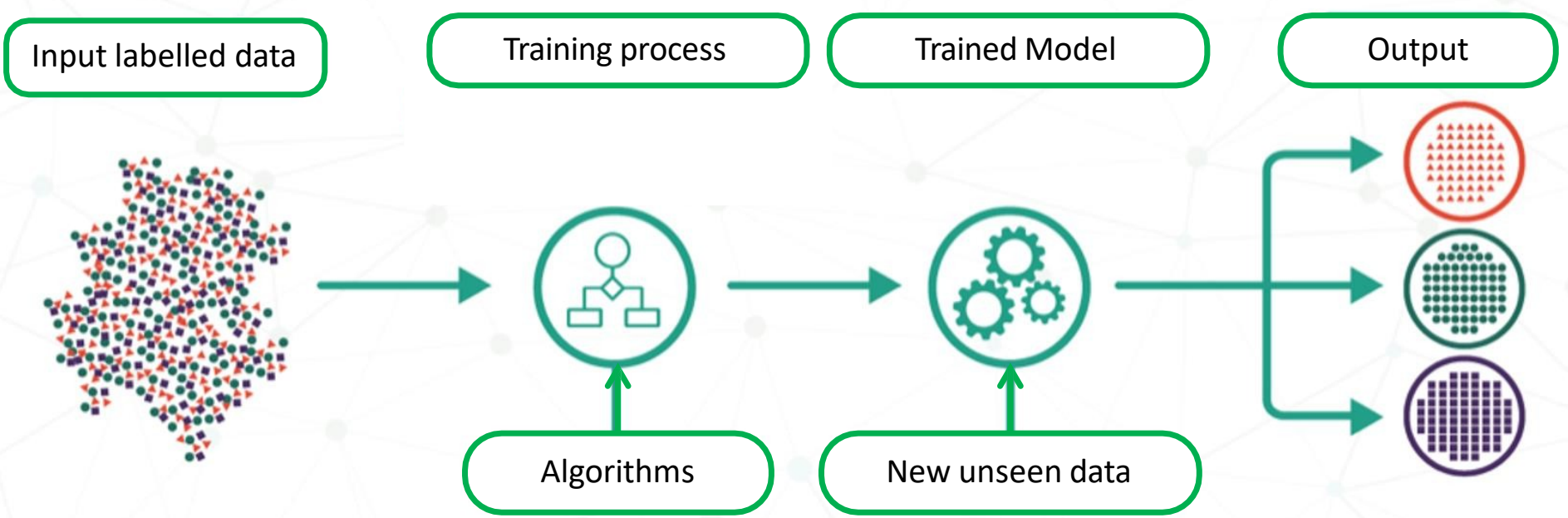
Supervised Learning



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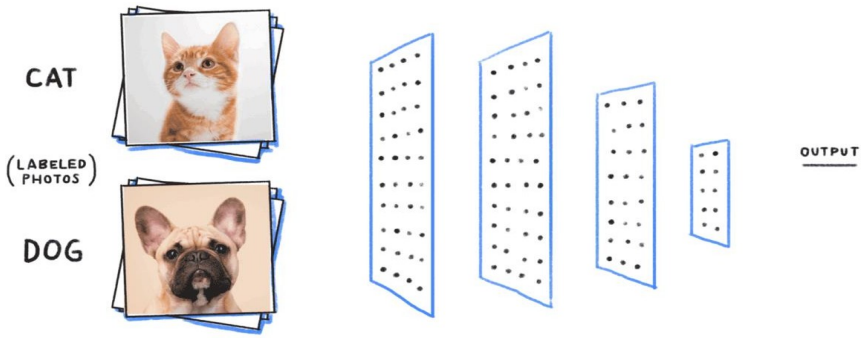
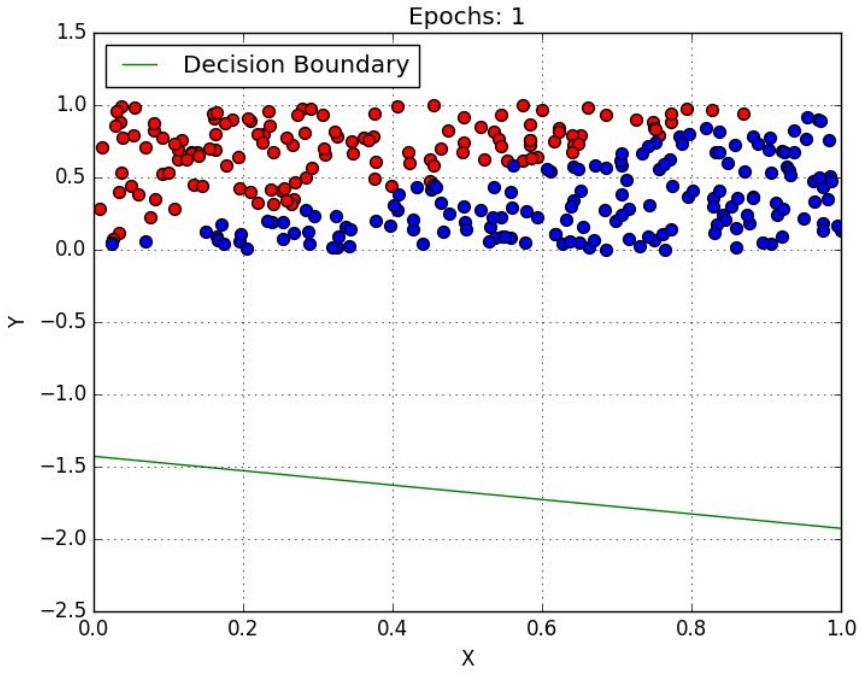
Classification

- Learns from labelled data (supervised)
- Predicts a **category** or a **class**
  - Cats|Dogs
  - Spam|Ham
  - Cancer|Not Cancer
- Attempts to separate the data into specific categories (or classes or labels)





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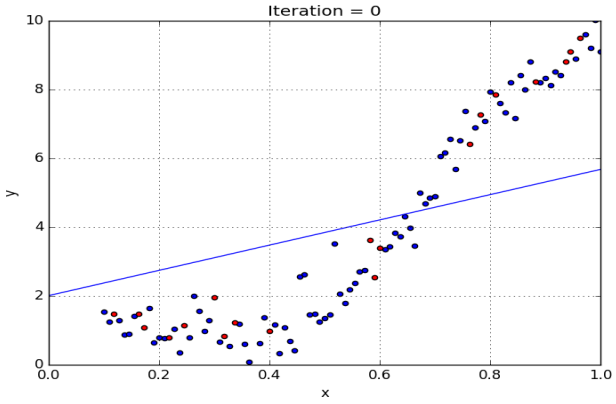
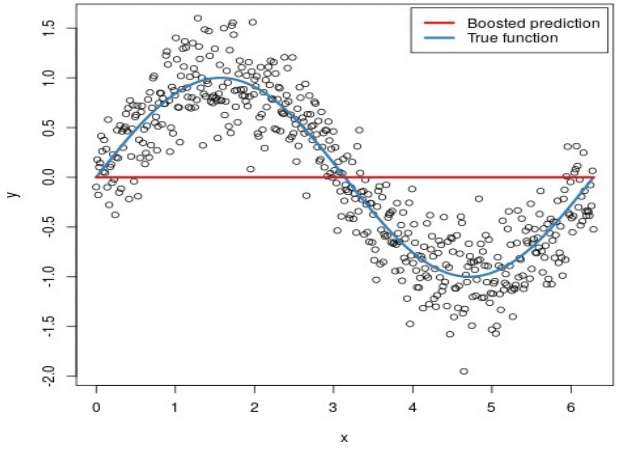
Regression

- Learns from labelled data (supervised)
- Predicts a **continuous-valued output**
  - height, price, duration etc.
- Consider a function $y = f(x)$
  - we want our model to predict y_i given x_i
  - x_i not seen during training
- Typically fits some linear or quadratic curve of the data plot
- Linear or logistic regression algorithms are often used





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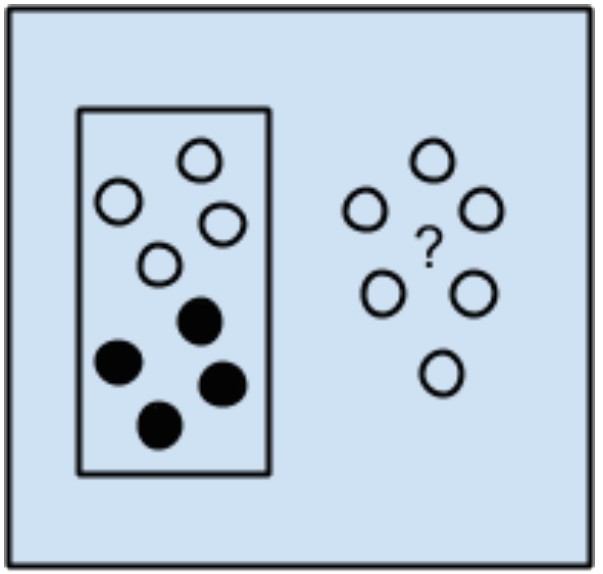
Supervised Learning Algorithms

- Input data = training data
  - with labels e.g. spam/ham or stock price at t
- In training
  - the model makes a prediction and is corrected if the prediction is wrong
- Training process continues until a desired accuracy is achieved
- Problem types: Classification and Regression
- **Algorithms**:
  - Logistic Regression
  - Back Propagation Neural Network.



Supervised Learning Algorithms

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Quiz: Classification vs Regression

- If we wish to learn models to address the following
  1. Predict how many students will enrol in this module in the next 3 years given the past enrolment data
  2. Predict whether a student will pass the module given previous years records
- How should we proceed
  a. Both are regression problems
  b. Both are classification problems
  c. Problem 1 is regression while Problem 2 is classification
  d. Problem 2 is regression while Problem 1 is classification

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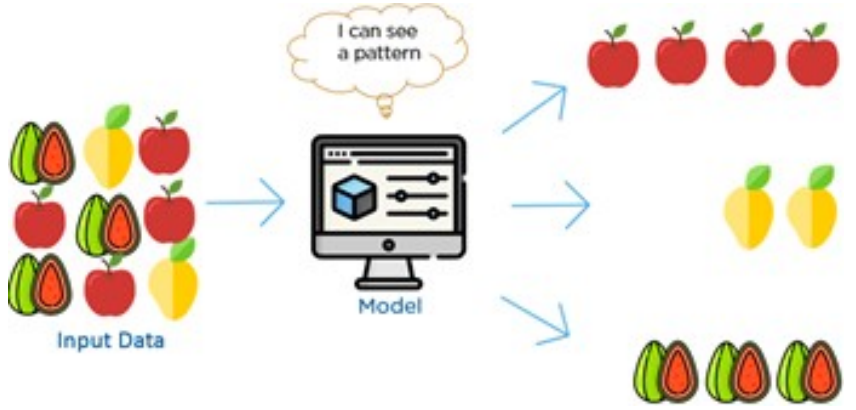
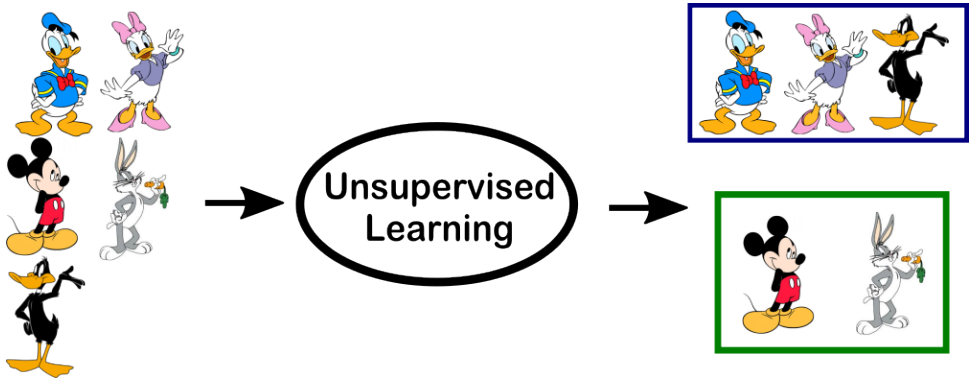
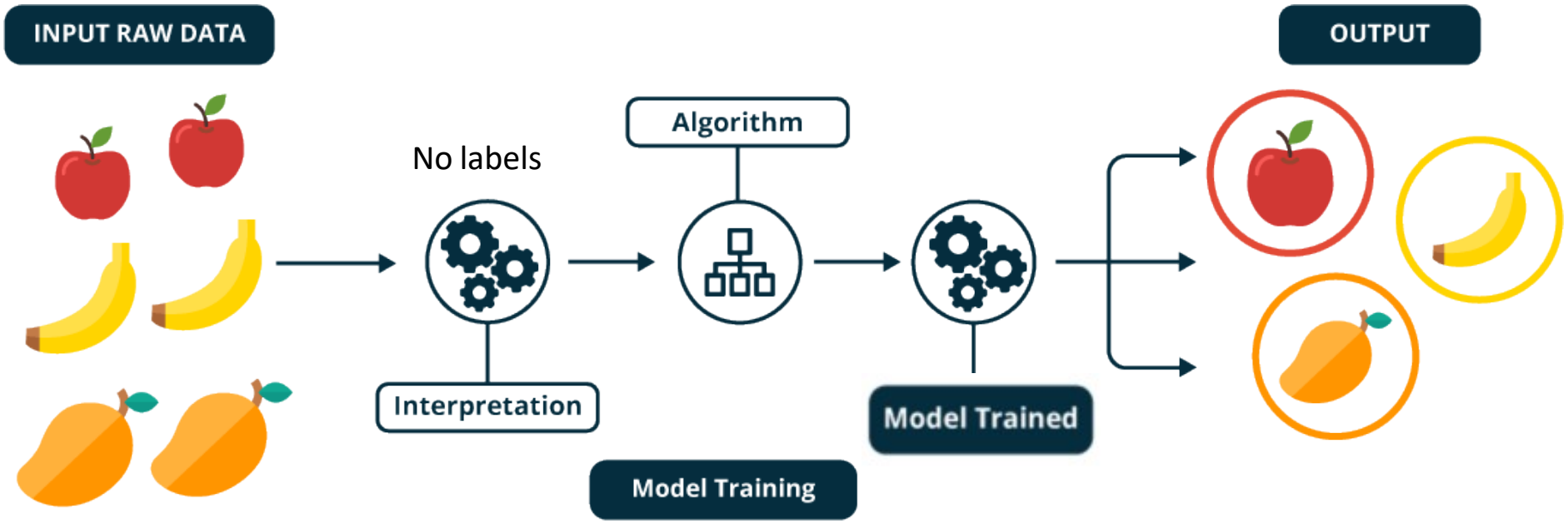
Unsupervised Learning

- Remember the function $y = f(x)$
- With unsupervised learning, only the input data, x, is available
- There are no corresponding labels (classes or categories) i.e. no output variable, y
- Aims at modelling the underlying structure of the data
- Two main categories
  - Clustering
  - Association





Unsupervised Learning



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Clustering and Association

- In a clustering problem, we want to discover the inherent groupings in the data:
  - Eg: grouping customers by purchasing behaviour.
- In an association rule learning problem, we want to discover rules that describe large portions of your data
  - E.g. people that buy $\boldsymbol{X}$ also tend to buy $\boldsymbol{Y}$

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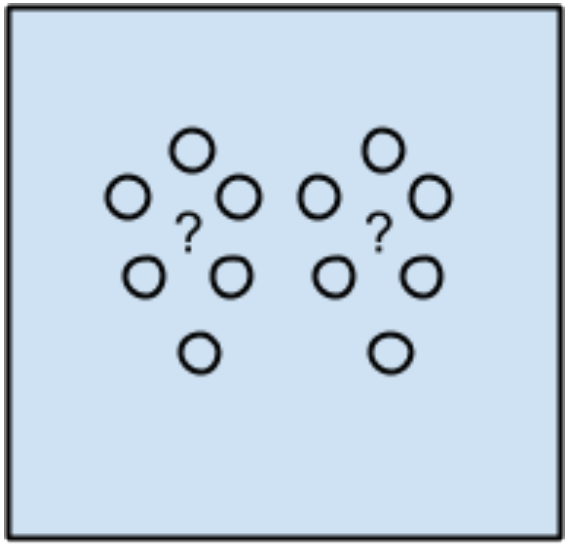
Unsupervised Learning Algorithms

- Input data in not labelled
  - Output not known
- In training
  - Deduces structures present in the input data
  - Extracting general rules, reducing redundancy or organise data by similarity
- Problem types: clustering, dimensionality reduction and association rule learning
- Algorithms:
  - K-Means algorithm
  - Apriori algorithm.



Unsupervised Learning Algorithms

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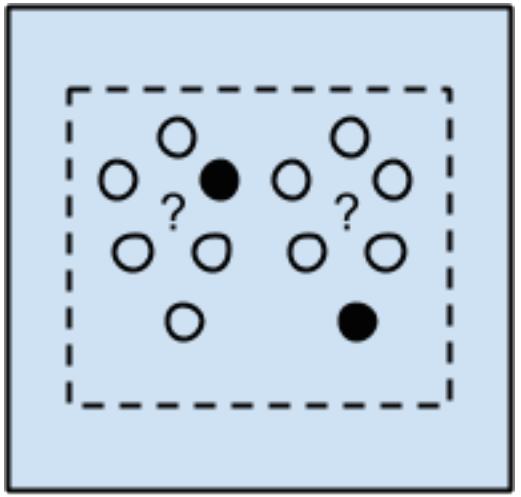
Semi-supervised Learning

- Semi-supervised learning approach refers to:
  - when we have a large amount of input data (X) but **only some** of the data is labelled (Y)
  - e.g. a photo archive where only some of the images are labelled, (e.g. *dog, cat, person*) and the majority are unlabelled.
- Many real world problems adopt this method
  - It can be expensive or time-consuming to label data
  - A hybrid design often helps to bridge the gaps
- Algorithms:
  - A flexible combination of supervised and unsupervised algorithms



Semi-supervised Learning Algorithms

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Machine Learning Summary

Today's Lecture

- Overview of Machine Learning
  - AI and ML, Definitions of ML, How to learn
- Types of Machine Learning
  - Supervised, unsupervised, semi-supervised
- Supervised Learning
  - Classification and regression
- Unsupervised Learning
  - Clustering and association

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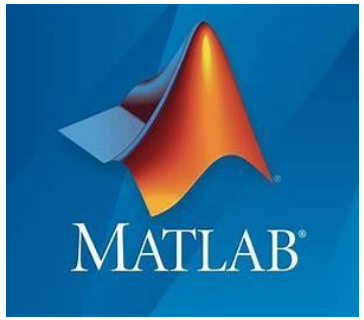
Coming up…

Labs: Introduction to Matlab

- Materials on Moodle / Teams Files

Group	Day	Time	Room
SCC361/P01/01	Wednesday	11:00-13:00	FST B076
SCC361/P01/02	Thursday	16:00-18:00	FST B076
SCC361/P01/03	Friday	16:00-18:00	FST B070
SCC361/P01/04	Thursday	10:00-12:00	FST B070
SCC361/P01/05	Friday	11:00-13:00	FST B080



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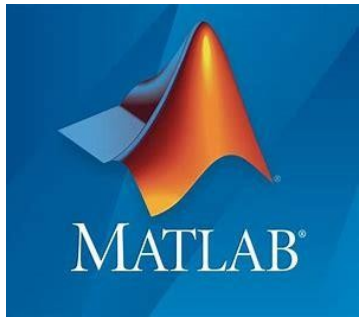

Week 2 Lectures: Features in Machine Learning and Feature Extraction

- What are features?
- How to extract/represent features from text, images

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Questions?