

# Introduction to AI/ML

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# Lecture Content

- ▶ What is Artificial Intelligence (AI)?
- ▶ What is Machine Learning (ML)?
- ▶ References

# What is Artificial Intelligence? (AI)

A quick overview

# What is AI?

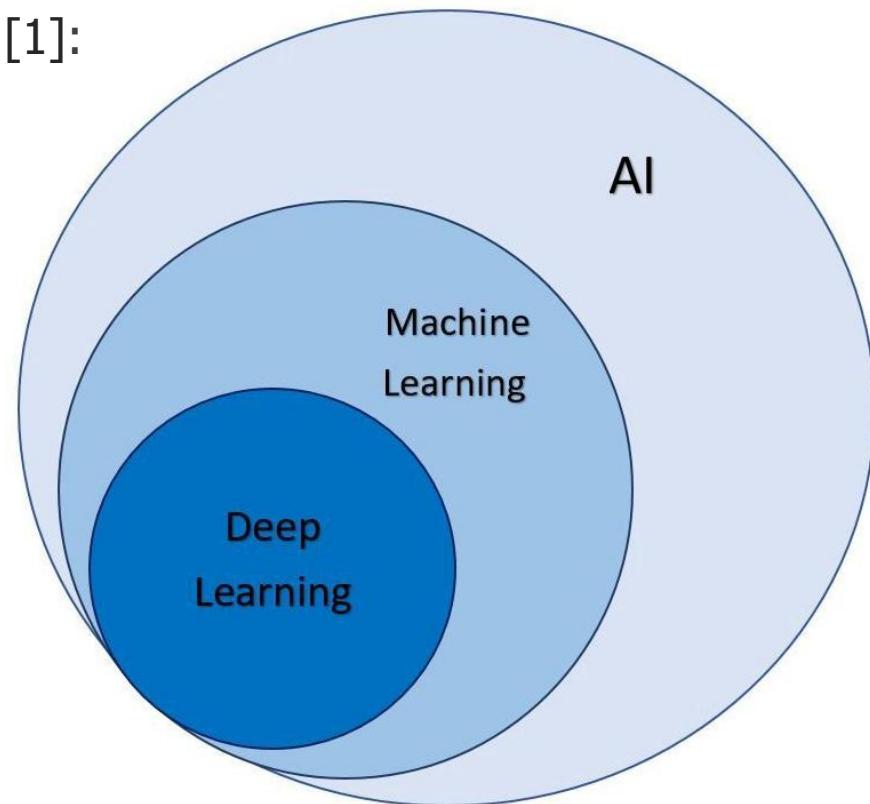
- ▶ Different **experts** define AI differently but with similar concept.
- ▶ Systems that think and act **like humans?**
  - ▶ "...activities such as decision-making, problem solving, learning..." (Bellman, 1978)
- ▶ Systems that think and act **rationally?**
  - ▶ "The study of computations that make it possible to perceive, reason, and act" (Winston, 1992)
- ▶ "Intelligent behaviour involves perception, reasoning, learning, communicating, and action in a complex environment" (Nilsson, 1998)
- ▶ What **common themes** are there to these ideas?

# What is AI?

- ▶ Oxford University Press (OUP) defines AI as “the theory and development of **computer systems** able to perform tasks that normally require **human intelligence**, such as **visual perception**, **speech recognition**, **decision-making**, and **translation between languages**.”
- ▶ Wikipedia defines AI as “the capability of **computational systems** to perform tasks typically associated with **human intelligence**, such as **learning**, **reasoning**, **problem-solving**, **perception**, and **decision-making**. ”

# What is AI?

- ▶ The **six disciplines** that compose **most of AI** [1]:
  - Knowledge representation
  - Automated reasoning
  - Machine learning
  - Natural language processing
  - Computer vision
  - Robotics



[1]. S. Russell and P. Norvig, 'Artificial Intelligence: A Modern Approach, 4th Edition', Pearson Series, 2021.

# What is AI?

- ▶ Computational Intelligence (CI) is a branch of AI.
- ▶ “The **three** main pillars of CI have been **neural networks**, **fuzzy systems**, and **evolutionary computation**” (IEEE Computational Intelligence Society).
  - **Neural networks:** inspired by how information is sent around the brain.
  - **Fuzzy systems** (systems based on **fuzzy logic**): inspired by human reasoning.
  - **Evolutionary computation:** mimics processes from evolution, e.g. genetic algorithm (GA).
- ▶ Hence, **fuzzy systems** and **evolutionary computation** are also part of AI.

# What is AI?

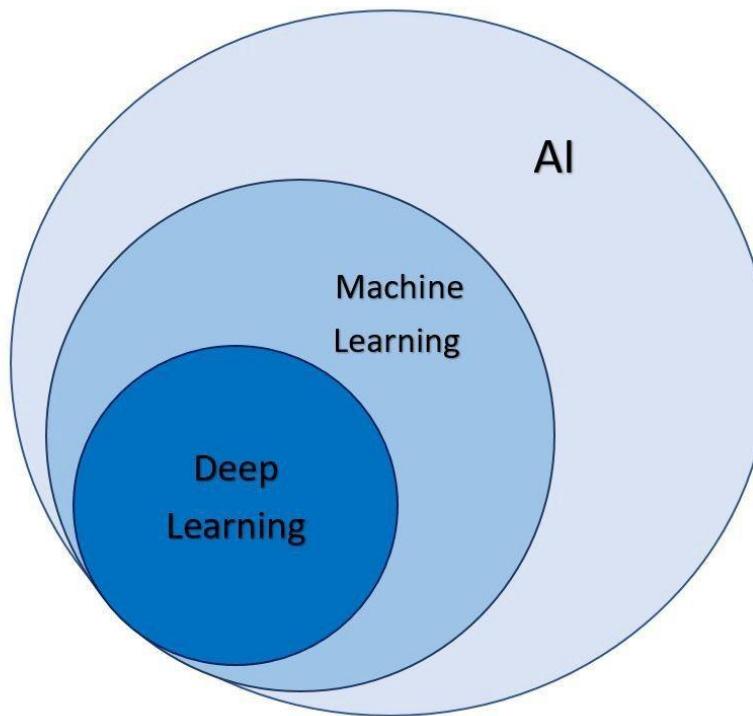
- ▶ 'Hard' computing vs 'Soft' computing:
  - **'Hard' computing** uses traditional mathematical methods, such as algorithms and mathematical models, to solve problems. These algorithms find **provably correct** and **optimal solutions** to problems.
    - Logic and facts.
    - Optimised for **certainty** and **precision**.
  - **Soft computing** is a set of algorithms, including neural networks, fuzzy logic, and evolutionary algorithms. These algorithms are tolerant of **imprecision, uncertainty, partial truth** and **approximation**.
    - **CI** is a form of soft computing.

# What is Machine Learning (ML)?

A quick overview

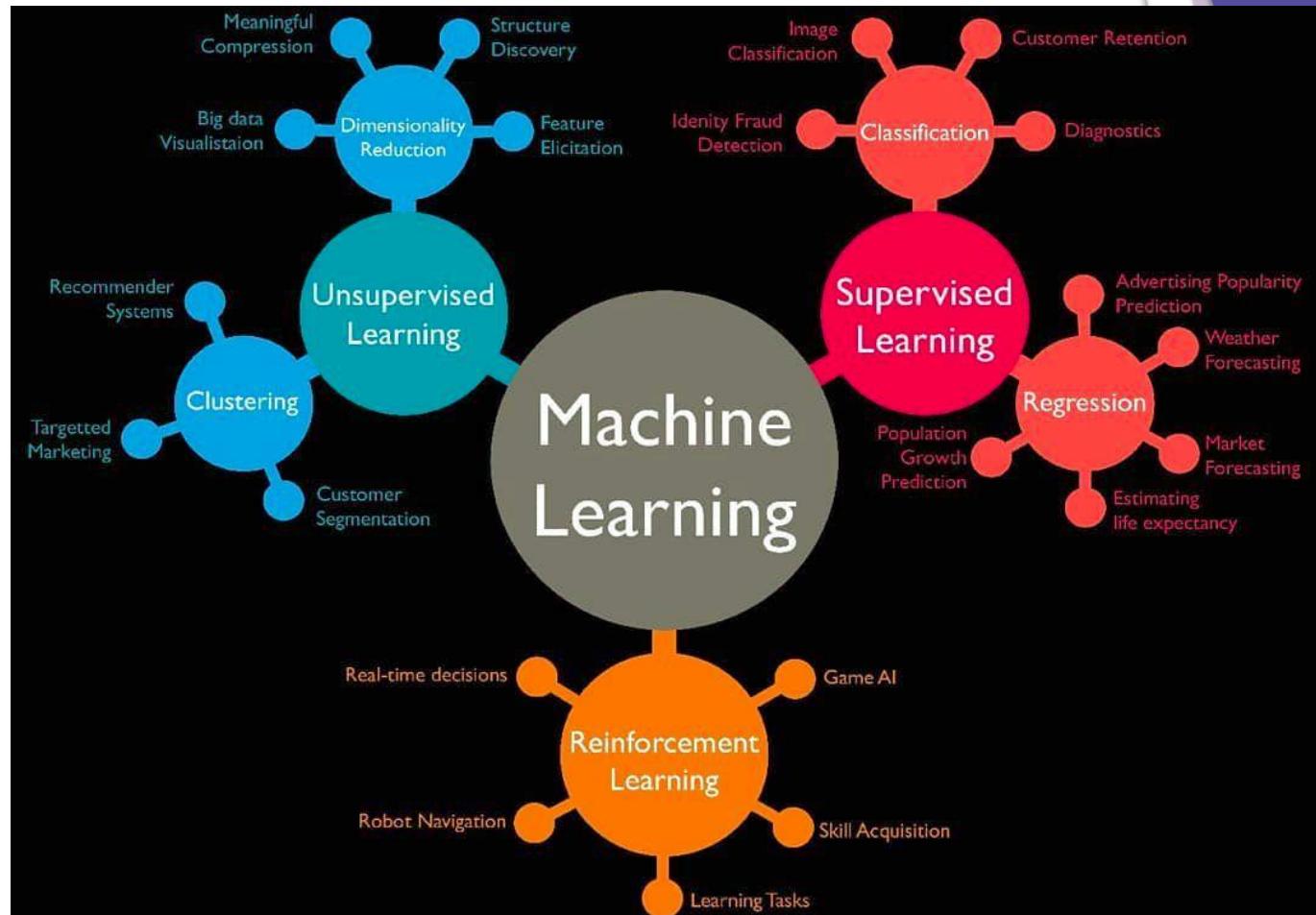
# What is ML?

- ▶ Machine learning (ML) is a core subfield of AI.
- ▶ ML is a study of algorithms that enable systems to **learn and improve** from **experience** without being explicitly programmed.



# What is ML?

- ▶ ML has 3 main branches for different applications:



# What is ML?

- ▶ **Supervised learning:** learns a **model** from a **labelled training data**.
  - Labelled training data: for each input sample data  $x_i$ , there is label  $y_i$ .
  - **Regression** – predicts **continuous** valued output. E.g. linear regression, non-linear regression, etc.
  - **Classification** - predicts **discrete** valued output. E.g. logistic regression, perceptron, neural networks, decision trees, SVM, etc.
- ▶ **Unsupervised learning:** Unlabelled training data.
  - Discovers **hidden patterns** in unlabelled data i.e. knowledge discovery. E.g. k-means clustering, principal component analysis (PCA), etc.
- ▶ **Reinforcement learning:** No training data.
  - Learns through **trial and error**. It learns from its **mistakes**. It uses **input** from the environment. E.g. Q-learning, Temporal Difference (TD) learning, etc.

# References

- ▶ S. Russell and P. Norvig, 'Artificial Intelligence: A Modern Approach, 4th Edition', Pearson Series, 2021.
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