UCCD2063

Artificial Intelligence Techniques

Unit 1:

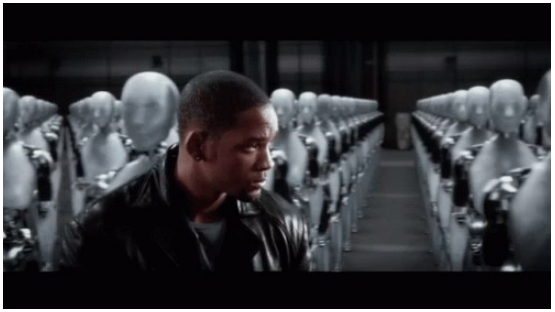
Introduction to Artificial Intelligence (AI)

Outline

- **Introduction**
  - **What is AI**
  - **History of AI**
  - **Applications of AI**
  - **Limitations of AI**
  - **Course Outlines**

What is AI?

Sci-Fi AI



What is AI?

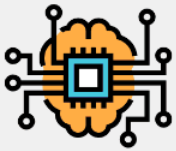
" **Artificial intelligence (AI)** is the science and engineering of making intelligent machines, especially intelligent computer programs."

[John McCarthy, father of AI]

What is AI?

(https://www.youtube.com/watch?v=uMzUB89uSxU)

Three Types of AI



A.I.

"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"

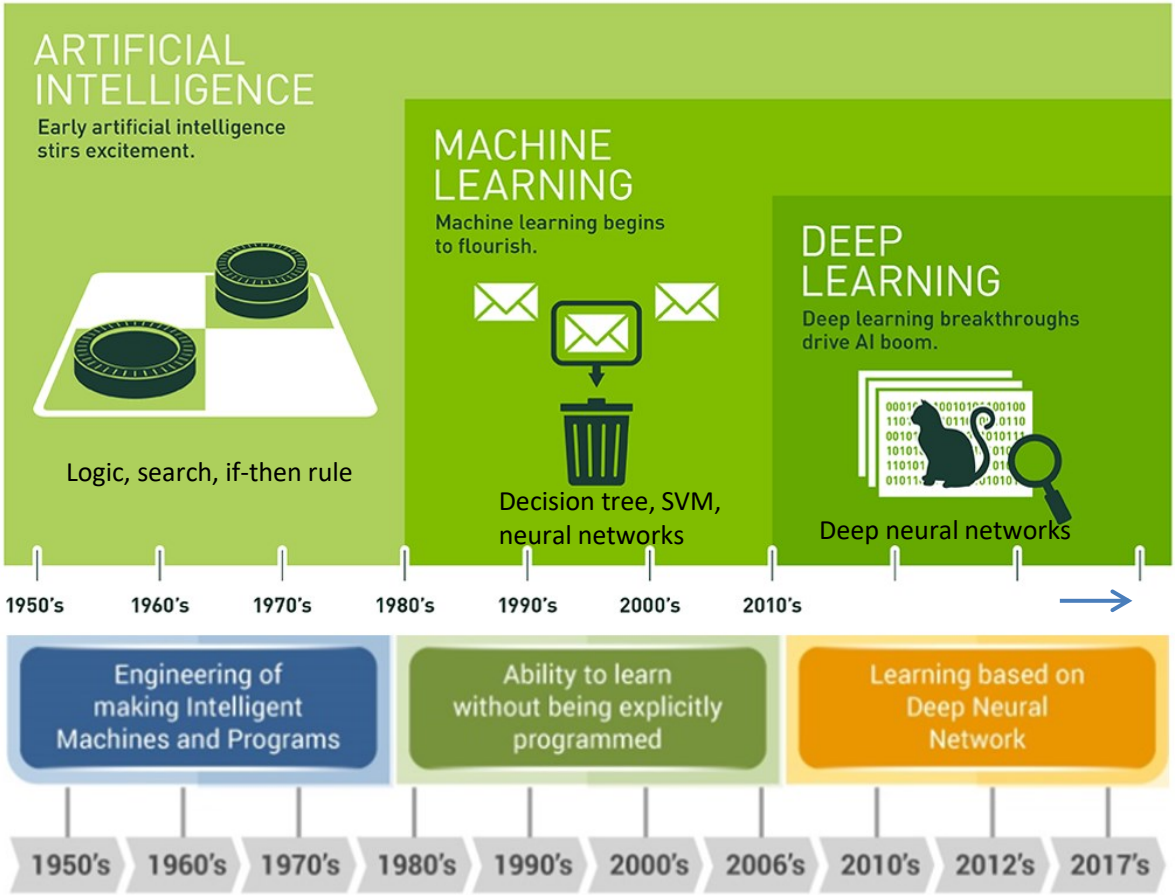
OED

AI Stages	Artificial Narrow Intelligence (ANI)	Artificial General Intelligence (AGI)	Artificial Super Intelligence (ASI)
	Execute specific focused tasks, without ability to self-expand functionality	Perform broad tasks, reason, and improve capabilities comparable to humans	Demonstrate intelligence beyond human capabilities
Timing	Today	About 2040?	Soon after AGI
Implications	Outperform humans in specific repetitive functions, such as driving, medical diagnosis and financial advice	Compete with humans across all endeavors, such as earning university degrees and convincing humans that it is human	Outperform humans, helping to achieve societal objectives or threatening human race
	Jobs enhanced	Jobs at risk	Humanity at risk
	Machine Learning	**Machine Intelligence**	**Machine Consciousness**

History of AI

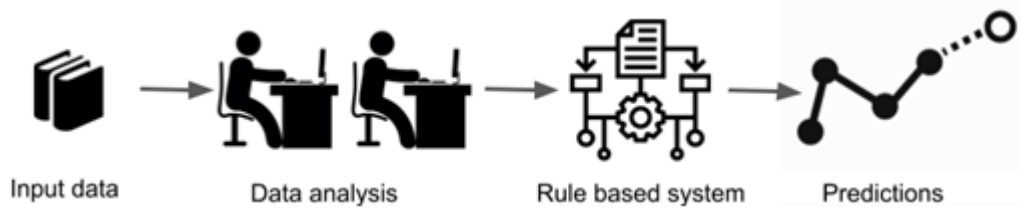
- **1950—70: Early AI, great expectations**
  - 1950: Alan Turing developed the Turing test to test machine intelligence
  - 1950s: Early AI programs encoded in logic, including Samuel's checkers program, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
  - **Problem**: real world is too complex, search space grew exponentially for logical reasoning, outpacing hardware
- **1960s-late—70s: First AI Winter**
- **1970—90: Knowledge-based AI**
  - 1970—80s: Expert systems: elicit specific domain knowledge from experts in the form of if-then rules.
  - Focused on building narrow practical systems in targeted domains. First real application impacted the industry.
  - **Problem**: rules couldn't handle uncertainty of the real world, too complex to maintain
- **1980s-late—90s: Second AI Winter**
- **1990-2010: Machine Learning**
  - Many learning models emerge: neural network, SVM, decision tree, knn,...
  - Use of probability to model uncertainty
  - **AI Spring**!
- **2012-present: Rise of Deep Learning**
  - 2012: AlexNet beats previous benchmark on the ImageNet competition
  - Neural networks gets deeper and larger (trillion parameters)
  - Availability of very large datasets and fast GPU processor
  - Data will drive future discoveries and alleviate the complexity in AI

Evolution of AI Technique

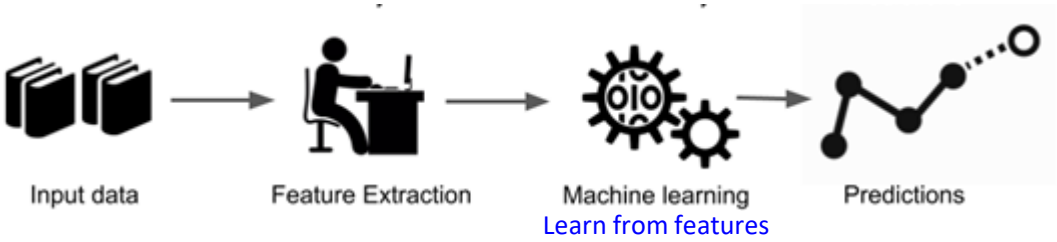


Evolution of AI Technique

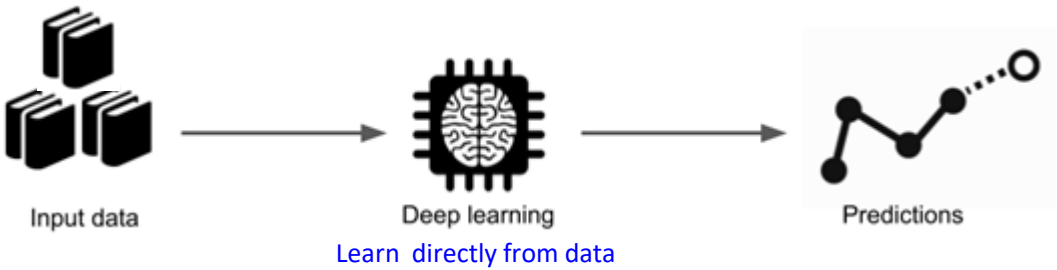
Rule-based Expert System



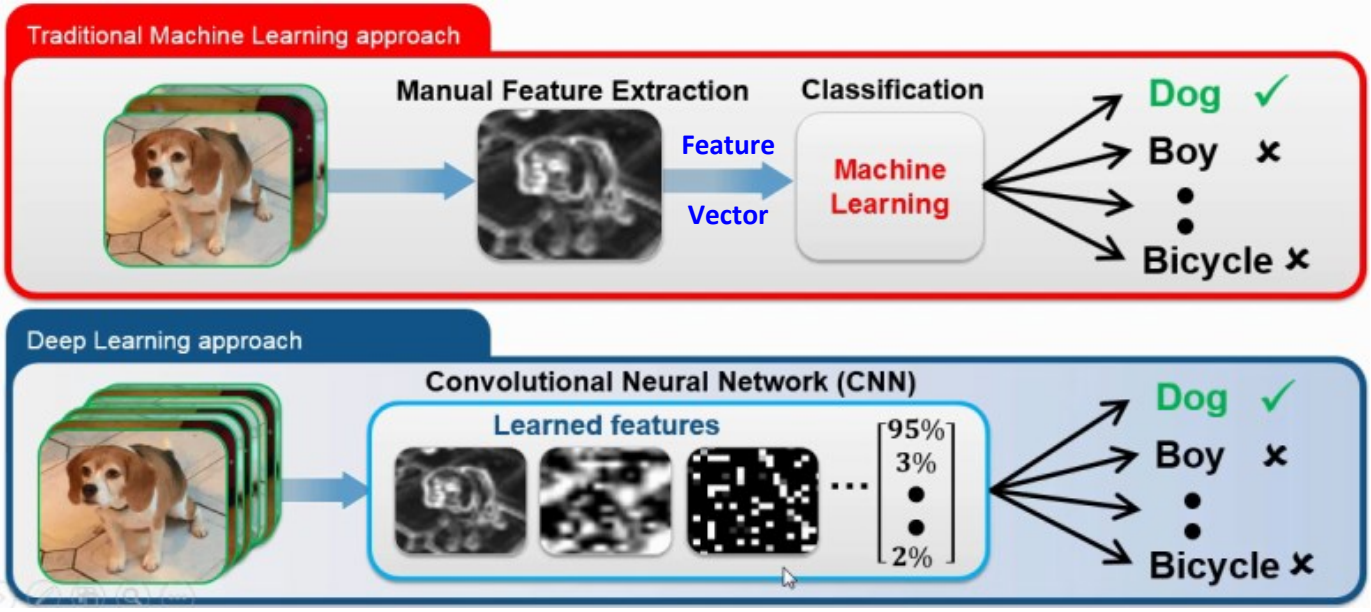
Machine Learning



Deep Learning



Machine Learning vs Deep Learning



Note: This course covers *machine learning* and traditional AI techniques such as *search* and *statistical inference*. Deep learning is covered in **UCCD3074**.

Applications of AI

- Healthcare
- Automobile
- Finance
- Surveillance
- Social Media
- Entertainment
- Education
- Space Exploration
- Gaming
- Robotics
- Agriculture
- E-commerce

Application of AI – Finance

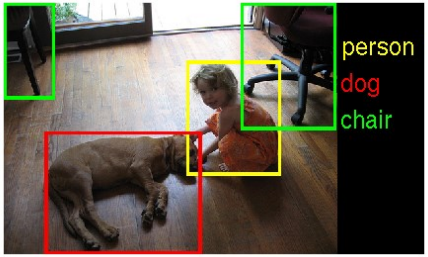
Finance Technologies

- **Input data**: Financial data (e.g. statements, transactions)
- **Output**:
  - Credit approval
  - Fraud detection
  - Sale prediction
  - Inventory forecasting, …

Applications of AI – Computer Vision

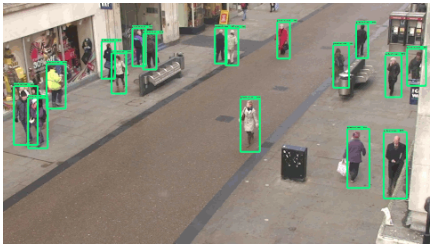
Visual Object Detection

- **Input data**: images
- **Output**: presence/absence of particular objects in the image



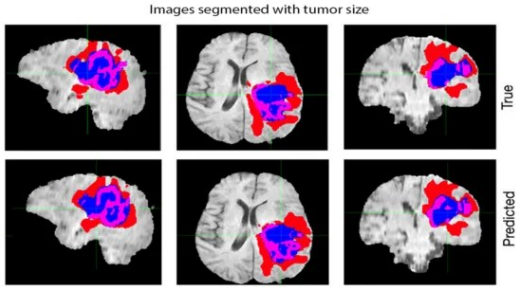
Video Surveillance

- **Input data**: video
- **Output**:
  - Human activity detection
  - Abnormal event detection



Medical Imaging

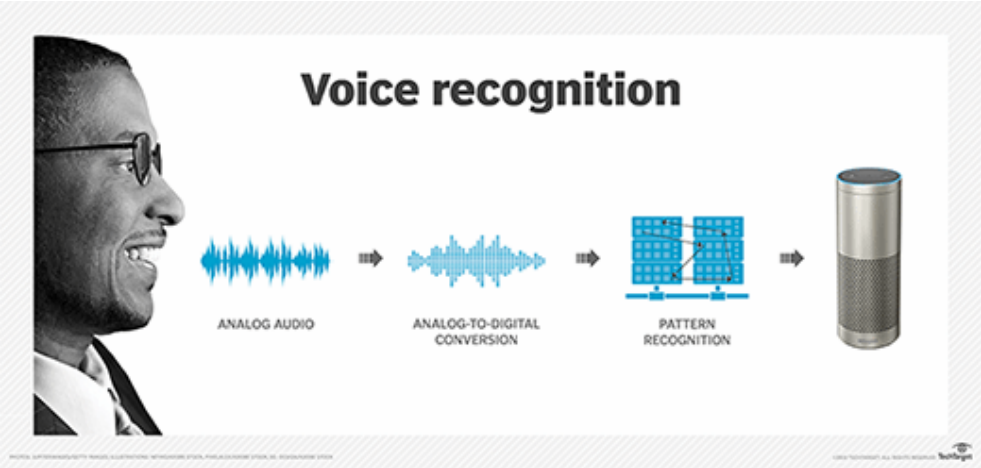
- **Input data**: X-ray images
- **Output**: presence/absence of Tumor in the image



Application of AI – Voice Recognition

Speech Technologies (e.g., Siri, Alexa)

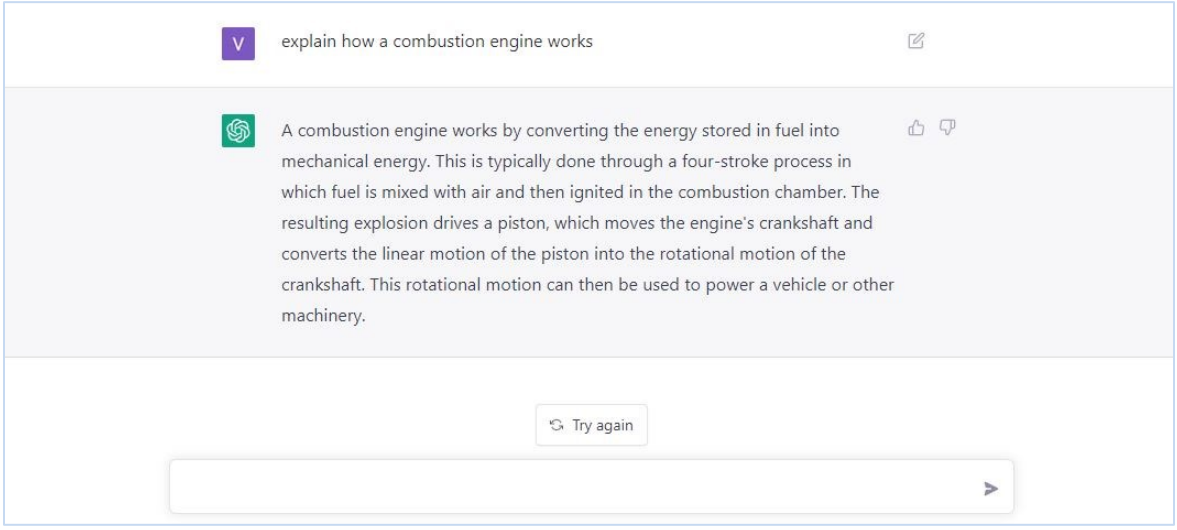
- **Input data**: audio waveform
- **Output**:
  - Text characters
  - Automatic speech recognition (ASR)



Application of AI – Natural Language Processing

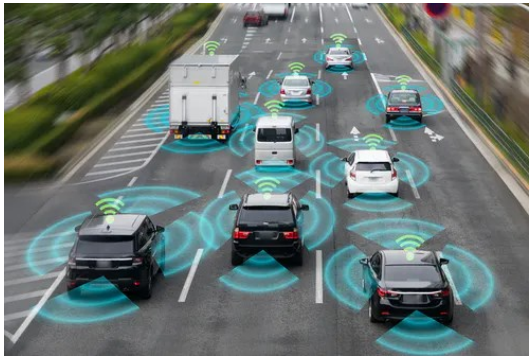
Language Processing Technologies

- **Input data**: text
- **Output**:
  - Machine translation
  - Question answering, personal assistant
  - Text classification, spam filtering, etc.



Application of AI – Autonomous Cars

- Autonomous Cars
  - **Input data**: sensor data, video camera, LIDAR system
  - **Output**: Driving Control (steering rotation, brake level, accelerator level)



Application of AI – more!

Healthcare

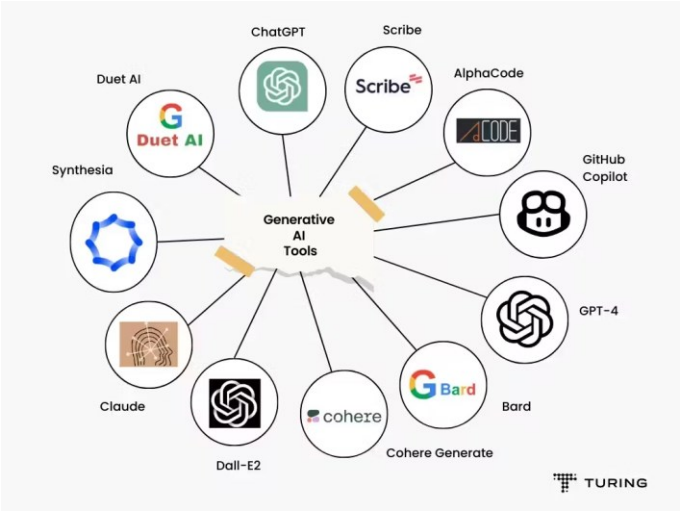
Manufacturing

Games

Route Planning

Generative AI

- Typical machine-learning models learn to make a prediction based on input data.
- **Generative AI** can be thought of as machine-learning models can generate new content, such as text, images, music, or even videos, similar to the data they were trained on, rather than making a prediction about a specific dataset.
- These models are trained on enormous amounts of data to learn the patterns, structures, and styles contained in the training dataset.



Overview of AI Techniques

- AI covers a range of techniques that enable a computer to do somethings that appears to be intelligent, such as:
  - **Search** – search for solutions to some kind of problem
  - **Knowledge reasoning** – drawing conclusion with logical reasoning
  - **Optimization** – finding the optimal solution to a problem
  - **Uncertainty** – probabilistic (statistical) inference
  - **Machine learning and deep learning** – learning from data

Course Outlines

Red = topics covered in this course

Next:

The Fundamentals of Machine Learning