

Lecture 2 - Introduction to Artificial Intelligence

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Introduction to AI — AI and Robotics for Industry

How we think?

Perceive
Understand
Predict
Manipulate
Not just to understand but also to build
intelligent entities.

AI is a new science

Work started after WWII
Still young as a new science

AI is in all fields, now

Philosophy Neuroscience Control theory
Mathematics Psychology Linguistics
Economics Computer engineering

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Introduction to AI — AI and Robotics for Industry

What is AI

- ❖ Two main directions: behaving like humans and rationality
- ❖ Expect AI as thinking as humans, doing as humans and doing right things
- ❖ So, AI is defined as:
 - ❖ Systems that think & act like humans — human centred, an empirical science
 - ❖ Systems that think & act rationally — rational centred, mathematics and engineering

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Introduction to AI — AI and Robotics for Industry

What is AI

- ♦ Acting humanly — The Turing Test approach (proposed by Alan Turing (1950), defined a computer having AI needs following capabilities and composing these six disciplines :
 - ♦ natural language processing — communicating like humans
 - ♦ knowledge representation — storing what it knows
 - ♦ automated reasoning — answering questions
 - ♦ machine learning — adapting to new circumstances and discovering patterns
 - ♦ computer vision & speech — perceiving objects
 - ♦ speech synthesis — a text-to-speech
 - ♦ speech recognition — a speech-to-text
 - ♦ image synthesis — a description to images
 - ♦ image recognition — like face recognition, object identification, OCR, etc.
 - ♦ robotics — manipulating objects and moving about

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What is AI

- ❖ Thinking humanly — the cognitive modelling approach
 - ❖ cognitive science studies what is humans mind and how humans think
 - ❖ cognitive modelling helps AI thinking humanly, especially in vision and natural language
- ❖ Thinking rationally — the “laws of thought” approach (logically & correctly inferences)
- ❖ Acting rationally — the rational agent approach
 - ❖ rational agent is not just a computer program, but also can make right/best decision when uncertainty

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The Disciplines of AI

❖ Philosophy (428 B.C. - present)

- ❖ Conclusions based on rules
- ❖ Relations between brain and mind
- ❖ Knowledge to action
- ❖ Make right decisions

❖ Mathematics (c. 800 - present)

- ❖ Logic
- ❖ Computation
- ❖ Probability theory

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The Disciplines of AI

- ❖ **Economics** (1776 - present), like Bellman’s Markov decision processing (MDP)
 - ❖ How should we make decisions so as to maximum payoff?
 - ❖ How should we do this when others may not go along?
 - ❖ How should we do this when the payoffs may be far in the future?
- ❖ **Neuroscience** (1861 - present)
 - ❖ How do brains process information?

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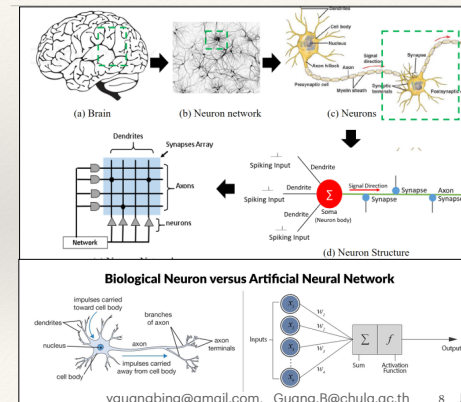
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A Biological Neuron vs. Artificial Neuron



- ❖ Dendrits:(Inputs) Getting other activations
- ❖ Axon: (Output) forward the activation
- ❖ Synapse: transfer of activation:
 - ❖ to other Dendrits of other neurons
 - ❖ a cell has about 1,000 to 10,000 connections to other cells
- ❖ Cell Nucleus: processing, evaluation of activation

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Facts - A Biological Neuron vs. Artificial Neuron

- ❖ GPT3 — the biggest deep learning model for NLP, it has 170 billion parameters. 170billion = 170,000,000,000
- ❖ if each human nucleus cell has 10,000 connections, so roughly the GPT3 is equivalent to 170,000,000,000 / 10,000 = 17,000,000 cells.
- ❖ A normal human brain has $10^{21} = 100,000,000,000,000,000,000$ to $10^{26} = 10,000,000,000,000,000,000,000,000,000$ cells.
- ❖ A normal human brain is 58,823,529,411,746 bigger than GPT3.
- ❖ A cat has 300 million and a dog has 530 million. GPT3 is clever than cats and dogs, but still far away to a normal human being.
- ❖ A dolphin is the smartest, its brain has 257 billion neurons. So, the GPT3 is not smart as a dolphin if just compare the capacity of brain.
- ❖ Built and trained the GPT3 models used hundreds millions dollars. It is extremely expensive than any creatures in the world so far we know.

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The Disciplines of AI

- ❖ Psychology (1879 - present)
 - ❖ How do humans and animals think and act?
- ❖ Computer engineering (1940 - present) Alan Turing
 - ❖ this discipline studies computer hardware and software to answer the question of how to build an efficient computer to be an artifact in AI.
- ❖ Control theory and Cybernetics (1948 - present)
 - ❖ studies how to control by self. Calculus and matrix algebra are tools in control theory
- ❖ Linguistics (1957 - present) - relations of language and thought, computational linguistics or natural language processing
 - ❖ Modern linguistics and AI started at about the same time and grew up together, intersecting in a hybrid field called **computational linguistics or natural language process (NLP)**

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The History of AI

- ❖ The gestation of artificial intelligence (1943 - 1945)
- ❖ The birth of artificial intelligence (1956) -
- ❖ Early enthusiasm, great expectations (1952-1969)
- ❖ A dose of reality (1966-1973)
- ❖ Knowledge-based systems (1969-1979)
- ❖ AI becomes an industry (1980-present)

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The History of AI

- ❖ The return of neural networks (1986-present)
- ❖ AI become a science (1987-present)
- ❖ The emergence of intelligence agents (1995-present)
- ❖ The availability of very large data sets (2001—present)
- ❖ The emergence of machine learning and deep learning (2010-present)
- ❖ The emergence of reinforcement learning and AI (2015-present)
- ❖ Bottle neck again? Ethical problem? Need a very deep pocket to play it?

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What can AI do today?

- ❖ A difficult question
- ❖ Automated planning
 - ❖ eg., NASA's resupply mission
 - ❖ China Chang'e 4
- ❖ Game playing,
 - ❖ like DeepMind
- ❖ Automated control
 - ❖ Tesla's autopilot
- ❖ Diagnosis — medical
- ❖ Logistic Planning,
- ❖ Robotics
- ❖ Language understanding and problem solving, e.g., IBM Watson AI Jeopardy, OpenAI GPT3, Google BERT, etc.,

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Major Problems in AI

- ❖ Solving problems by Searching (basic concepts and common algorithms)
- ❖ Agents (basic concepts and design principles)
- ❖ Games
- ❖ Logic
- ❖ Planning
- ❖ Learning
- ❖ Reinforcement Learning
- ❖ Natural Language Processing
- ❖ Robotics (basic concepts and design principles)

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The Future of AI

- ❖ Bright!



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Recap

- ❖ People think AI differently, but basically something can think and act like humans and rationality, it is AI or at least having AI related capabilities.
- ❖ AI is an interdisciplinary scientific field and a cross-industry development.
- ❖ Philosophers, mathematicians, economists, psychologists, computer engineers and many others together create and develop AI.
- ❖ The history of AI has had cycles of success and misplaced optimism.
- ❖ AI has advanced more rapidly in the past decades and will continue with improvements in the capabilities of real systems.

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- ❖ Reading task: Chapter 1 of the book: Artificial Intelligence—A Modern Approach
- ❖ Notice: Since April 6th is a holiday, that day's class will be recorded with ZOOM meeting. I will send you the record videos for the lecture including lab.
- ❖ Labs are exercises for your practice. You don't need to hand in the labs. Just find your own time to practices.

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Any questions?

Lab practices

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