COMP 4431: Artificial Intelligence

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Department of Computing

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Agenda

- **Session 1: Basic Information of COMP4431**
  - Learning Objectives
  - Co-teaching Mode & Tentative Schedule & Assessment Methods
  - Group Project
  - Lab Session Arrangement
  - Recommended Materials
- **Session 2: History of Artificial Intelligence**
  - Birth & 1st rise -- 1st winter-- 2nd rise -- 2nd winter – 3rd rise -- (4th rise) …

Basic Information of COMP4431

- **Learning Objectives**
  - Understand the fundamental concepts of artificial intelligence;
  - Equip with the knowledge and skills in the programming of artificial intelligence techniques;
  - Master the problem formulation and the typical intelligent algorithms;
  - Understand the technical development of artificial intelligence;
  - Be aware of the ethical issues related to artificial intelligence.

(align with: https://www.polyu.edu.hk/comp/docdrive/ug/subject/COMP4431.pdf)

Basic Information of COMP4431

- **Co-teaching Mode**
- **Lecturer:** Dr. Zhiyuan Wen (Research Assistant Professor) zyuanwen@polyu.edu.hk
- **Teaching Assistant:**
  - 22117795r@connect.polyu.hk Mr. Juwei Shen
  - 24058897r@connect.polyu.hk Mr. Yang Meng
  - weng-yu.zhang@connect.polyu.hk Mr. Wengyu Zhang
- **Co-teaching Lecturer:**
  - **Dr. Xiangmeng Wang (Research Assistant Professor) xiangmengpoly.wang@polyu.edu.hk**
  - **Dr. Wai Man Pang (Lecturer) waiman.pang@polyu.edu.hk**

Basic Information of COMP4431

- **Tentative Schedule**

  - In case of an emergency, such as typhoon signal No. 8, all arrangements will be postponed
  - Please pay close attention to the announcement of COMP4431 on the Blackboard

Week	Date	Lecture in HJ305 (8:30-10:20 am)	Quiz in HJ305 (9:20-9:30 am)	Lab in PQ603 & 604 A-C (10:30-11:20 am)
1	2025.09.04	Introduction to AI and COMP4431 (Dr. Pang, Dr. Wang, Dr. Wen)	-	-
2	2025.09.11	Heuristic Search (Dr. Wang)	-	Lab Session 1 (Mr.Yang Meng, Mr. Juwei Shen)
3	2025.09.18	Technological Trends in Agent Research (Dr. Wang)	Quiz 1	Lab Session 2 (Mr.Yang Meng, Mr. Juwei Shen)
4	2025.09.25	Constraints and Games (Dr. Wen)	-	Lab Session 3 (Mr.Yang Meng, Mr. Juwei Shen)
5	2025.10.02	Decision Tree (Dr. Wen)	Quiz 2	Lab Session 4 (Mr.Yang Meng, Mr. Juwei Shen)
6	2025.10.09	Hill Climbing, Simulated Annealing and GA (Dr. Pang)	-	Lab Session 5 (Mr.Yang Meng, Mr. Juwei Shen)
7	2025.10.16	Machine Learning (Dr. Pang)	Quiz 3	Lab Session 6 (Mr.Yang Meng, Mr. Juwei Shen)
8	2025.10.23	Neural Networks (Dr. Pang)	~~Quiz 4~~	Lab Session 7 (Mr.Yang Meng, Mr. Juwei Shen)
9	2025.10.30	Deep learning (Dr. Pang)	**Quiz 4**	Lab Session 8 (Mr.Yang Meng, Mr. Juwei Shen)
10	2025.11.06	Bayesian (Dr. Wen)	Quiz 5	Lab Session 9 (Mr.Yang Meng, Mr. Juwei Shen)
11	2025.11.13	Advanced Topics in AI-1 (Dr. Wen)	-	-
12	2025.11.20	Advanced Topics in AI-2 (Dr. Wang)	-	-
13	2025.11.27	Final Exam review & Group Project Presentation (Dr. Wen)	-	-

Basic Information of COMP4431

- **Assistant Method**
- **Final exam (70%)**
  - Absence and late situation are handled based on the regulations of the university for the examination
- **Quiz (15%)**
  - Quiz paper will be distributed in the classroom and returned to the TAs face to face immediately after the quiz
  - Zero point for late submission
  - If you miss the quiz due to the medical reason and the visa problem, please send email to TAs for recording
- **Group Project (15%)**

Basic Information of COMP4431

- **Group Project:** Build a Chatbot (Conversational Agent) for: Mental Health Support, Education in AI, or other interested topics/themes
  - 1-4 members/group (the number of members will not influence the grading)
  - The group members are given same score (If not, please send the request to me by email with the justification and the signature of all group members)
  - Each group only needs to submit one copy by one group member
  - **Submission:**
    - One proposal of the group project including the motivation, design method, implementation, etc.
    - Demo presentation (will be shown in the last week) showcase the functions and interface of the Chatbot
    - 50% per day for late submission
    - Date and detailed assessment rubrics will be announced later

Basic Information of COMP4431

- **Lab Session Arrangement**

Week	Topic
2	Generative AI for Text Generation
3	Generative AI for Image Generation
4	Generative AI for Audio Generation
5	Generative AI for Video Generation (1)
6	Generative AI for Video Generation (2)
7	Generative AI for Video Editing
8	Generative AI for Code Generation (1)
9	Generative AI for Code Generation (2)
10	Generative AI for Code Generation (3)

- Lab will start from 10:30 am to 11:20 am at PQ603, PQ604A, PQ604B, PQ604C
- Lab will be given mainly by TAs (Mr. Yang Meng and Mr. Juwei Shen)
- Each lab session includes lectures and hands-on experiments (40 min) and a Q&A (10 min).

Basic Information of COMP4431

- **Recommended Materials**
  - Generative Deep Learning: Teaching Machines To Paint, Write, Compose, and Play (book)
  - Artificial Intelligence & Generative AI for Beginners: The Complete Guide (book)
  - Open Lectures from Dr. Hung-yi Lee (in Chinese)
  - …

Slides and lecture recordings can be found on Blackboard@PolyU

Basic Information of COMP4431



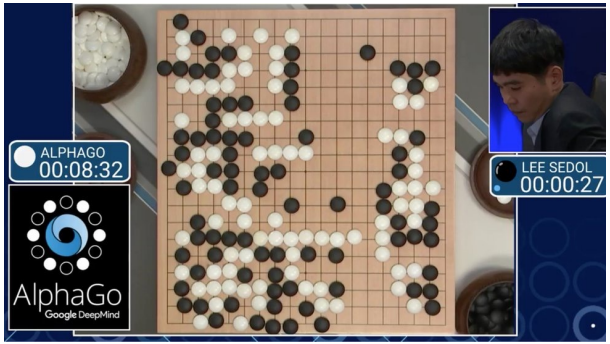
Q&A

History of Artificial Intelligence

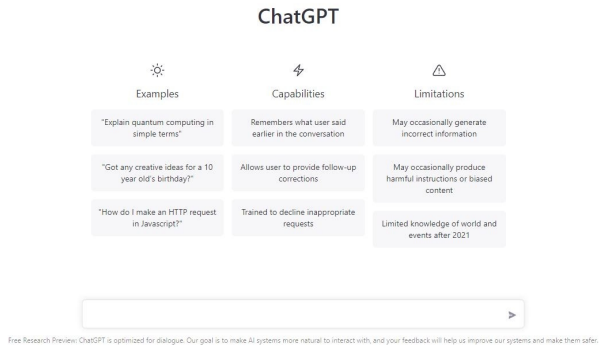
- **What is Artificial Intelligence?**



Garry Kasparov vs. Deep Blue in 1997



AlphaGo v.s. Lee Sedol in 2016



ChatGPT in 2022

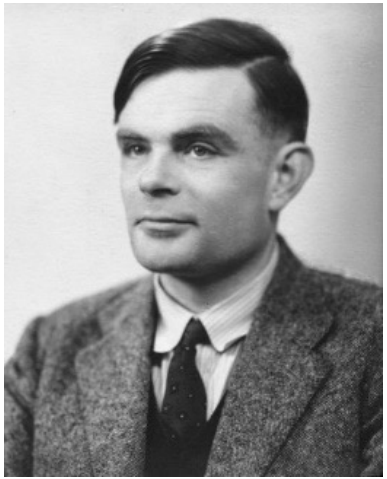
History of Artificial Intelligence

- **What is Artificial Intelligence?**
  - Term coined by John McCarthy in 1956, is concerned with the design of intelligence in an **artificial device**
  - Definition of **intelligence**: quality that enables an entity to function appropriately and with foresight in its environment
  - No widely accepted definition
  - A science and a set of computational technologies that are inspired by—but typically operate quite differently from—the ways people use their neuro systems and bodies to sense, learn, reason, and take action (https://ai100.stanford.edu/2016-report/executive-summary)

History of Artificial Intelligence

- **Alan Turing**

- Born
  - In 1912 at United Kingdom
- Died
  - In 1954 (Aged 41)
- Education
  - Undergraduate at King's College in mathematics
  - PhD from Princeton University
- Contribution to artificial intelligence
  - Propose that modification of behavior could be adapted from learning brain to learning machine in 1948
  - Design Turing test in 1950

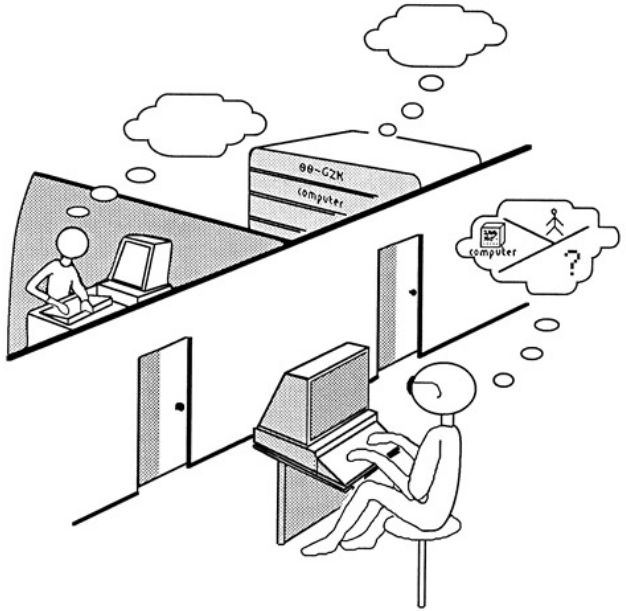




History of Artificial Intelligence

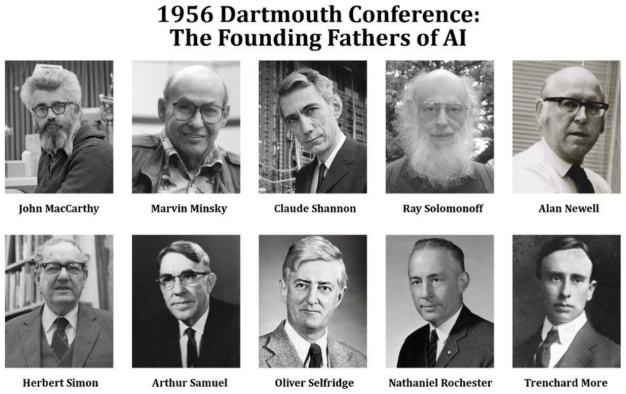
- **Turing Test:** Can machines behave as the human beings?

- Proposed in 1950 by Alan Turing
  - Participate all major argument against AI
- Initial Design
  - Human
    - Types in questions
    - Receives answers on screen
  - Computer/human
    - Processes questions
    - Returns answers
  - Judge
    - Computer or human?
- Limitation
  - Lack of mathematical analysis
  - subjective assessment
  - Not reproducible



History of Artificial Intelligence

- **Dartmouth Summer Research Project on Artificial Intelligence**
- **Seven Research Pillars of Artificial Intelligence Proposed**
  - Automatic Computers
  - How can a computer be programmed to use a language
  - Neuron Nets
  - Theory of the size of a calculation
  - Self-improvements
  - Abstractions
  - Randomness and Creativity



3 main paradigms in AI:

Symbolism: rule-based, expert system

Connectionism: perceptron, neural networks

Actionism: reinforcement learning, Embodied AI

History of Artificial Intelligence

- **Birth Stage and the first rise (1950s-1970s)**
- **Search**
  - Reasoning as search
  - Heuristic search
- **Natural language processing**
  - Eliza is the first Chatbot created in 1966
- **Computer vision**
  - Micro-worlds (blocks for real world simulation)
  - Pixel – shape – object – scene



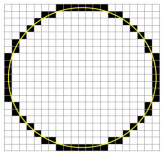
Eliza Chatbot



The Mark I Perceptron



Pixel



Shape



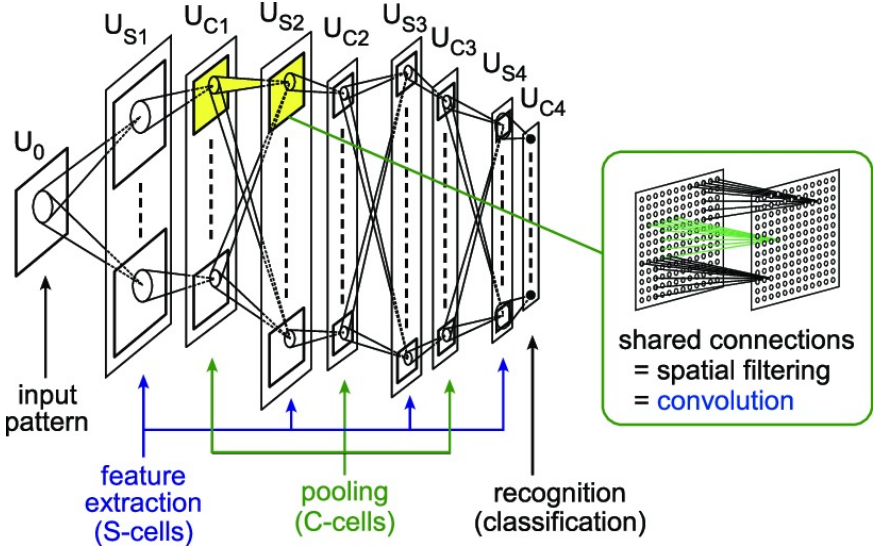
Object



Scene

History of Artificial Intelligence

- **The first winter (1974-1980)**
- **Technical Limitations**
  - Computation power
  - Complexity
  - Lack of data and knowledge
- **High expectation but low output**
  - Fundings were cut in US, UK
- **New terms rather than AI**
  - Machine Learning, Knowledge-based System, Pattern Recognition

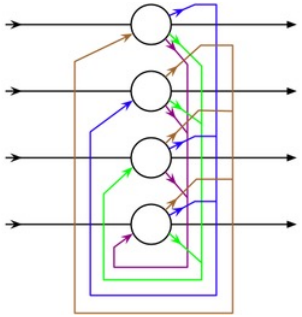


The architecture of the neocognitron (1979)

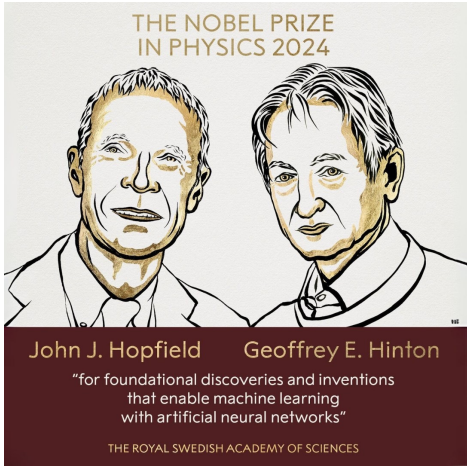
History of Artificial Intelligence

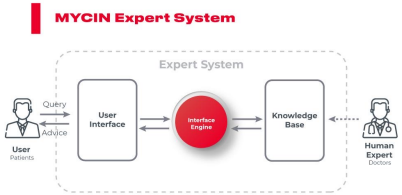
- **The second rise (1980-1987)**

- **The knowledge revolution**
- **Expert system has been widely used till now**
  - Answers questions or solves problems about a specific domain of knowledge
  - Reasoning by logical rules that are derived from the knowledge of experts
- **Hopfield Net**
  - Learn and process information, and can be proven to converge under any fixed conditions



Hopfield Net

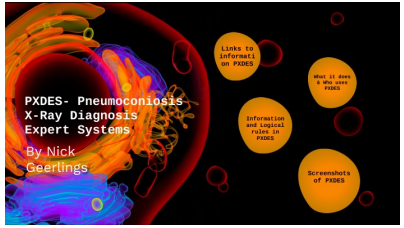




MYCIN: Recognizing Bacteria



DENDRAL: Molecular structure prediction



PXDES: Lung cancer prediction

History of Artificial Intelligence

- **The second winter (1987-1993)**
- **Expert Systems require massive knowledge, yet are not general**
- **Rethinking of the importance of abstract reasoning**
  - Building intelligence from bottom to up
  - Trigger the research of perception and interaction with the environment
  - Body is important
  - Enhance the research of robotics
- **Embodied artificial intelligence**
  - Integrates artificial intelligence into physical entities like robots, making them interact with their physical environment dynamically



Humanoid robot NAO

History of Artificial Intelligence

- **The third rise (1993-2019)**
- **The concept of the intelligent agent is widely spread**
- **The success of deep blue produced by IBM in 1997**
  - First winner of computer chess-playing system
- **The rise of machine learning (with large volume data)**
  - Support vector machines, most powerful binary classifier
- **Autonomous vehicles**
  - DARPA Grand Challenge



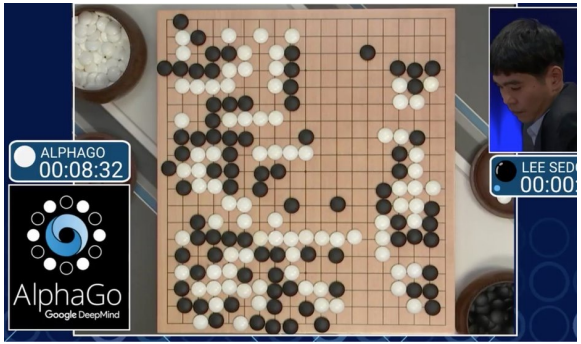
Garry Kasparov vs. Deep Blue



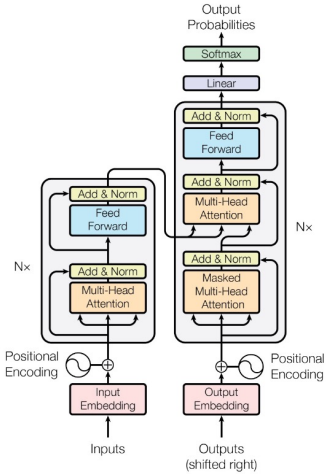
DARPA Grand Challenge

History of Artificial Intelligence

- **The third rise (1993-2019)**
- **Deep Learning (due to GPU development)**
  - Computer Vision
  - Reinforcement Learning
  - Natural language Processing
  - …



AlphaGo v.s. Lee Sedol



The Transformer Model



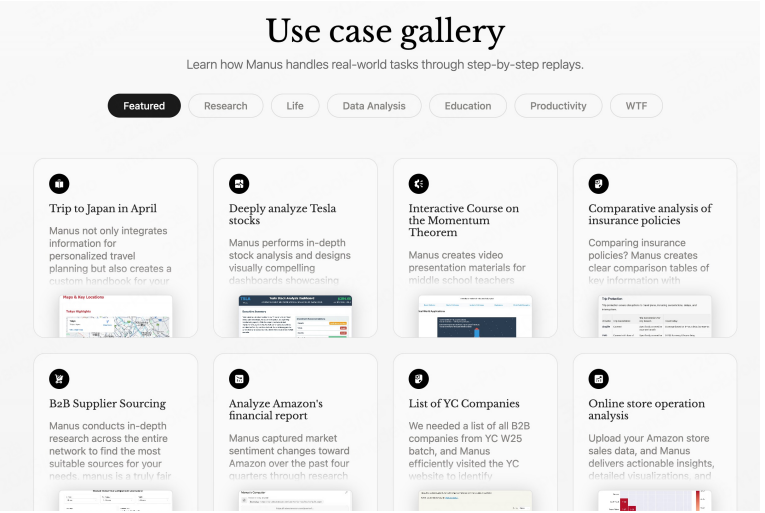
The ImageNet dataset (14,000,000 images)



2018 Turing Award

History of Artificial Intelligence

- **The fourth rise? (2020-now)**
- **Large Language Models**
  - ChatGPT developed in 2022 by OpenAI (from GPT1, GPT2, GPT3, InstructGPT…)
  - Claude, Kimi, Grok, Gemini, DeepSeek,…
- **Generative Artificial Intelligence**
  - Technique that can be used to create new content, including text, code, speech, music, images, and videos.
  - ChatGPT, Suno, Midjourney, Pika
- **Agentic AI**
  - artificial intelligence systems that act with autonomy, initiative, and adaptability to pursue complex goals, rather than simply reacting to commands or following preset rules



Manus


thank
you