



# Introduction of AI to Junior Secondary Education:

## **Seminar on Introducing the Module on Artificial Intelligence**



# Agenda

- 1 Introduction to the Module on Artificial Intelligence**
- 2 Impacts of AI and Application of the Module on Artificial Intelligence**
- 3 AI Teaching Pedagogy**
- 4 School Sharing**
- 5 Survey**



# Introduction To The Module on Artificial Intelligence

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# Outline

- History and background of AI
- Latest AI developments and applications
- Module on Artificial Intelligence
- Demonstrations of Learning Toolkits
- Conclusions

# History and Background of AI



**1943: Perceptron**

**1950: Turing Test**  
(Alan Turing)

**1956: The Dartmouth Conference**

- established AI as a field of study\*
- set out a roadmap for research
- sparked a wave of innovation

**1958: The Perceptron machine** (Frank Rosenblatt)

**The AI boom of the 1960s**

- General Problem Solver (GPS)
- ELIZA program

**1980s: The AI winter**

**1990s: Emergence of NLPs and Computer Vision**

--- → **1985: Digitization → The Rise of Big Data**

----- → **1980: Personal Computing**

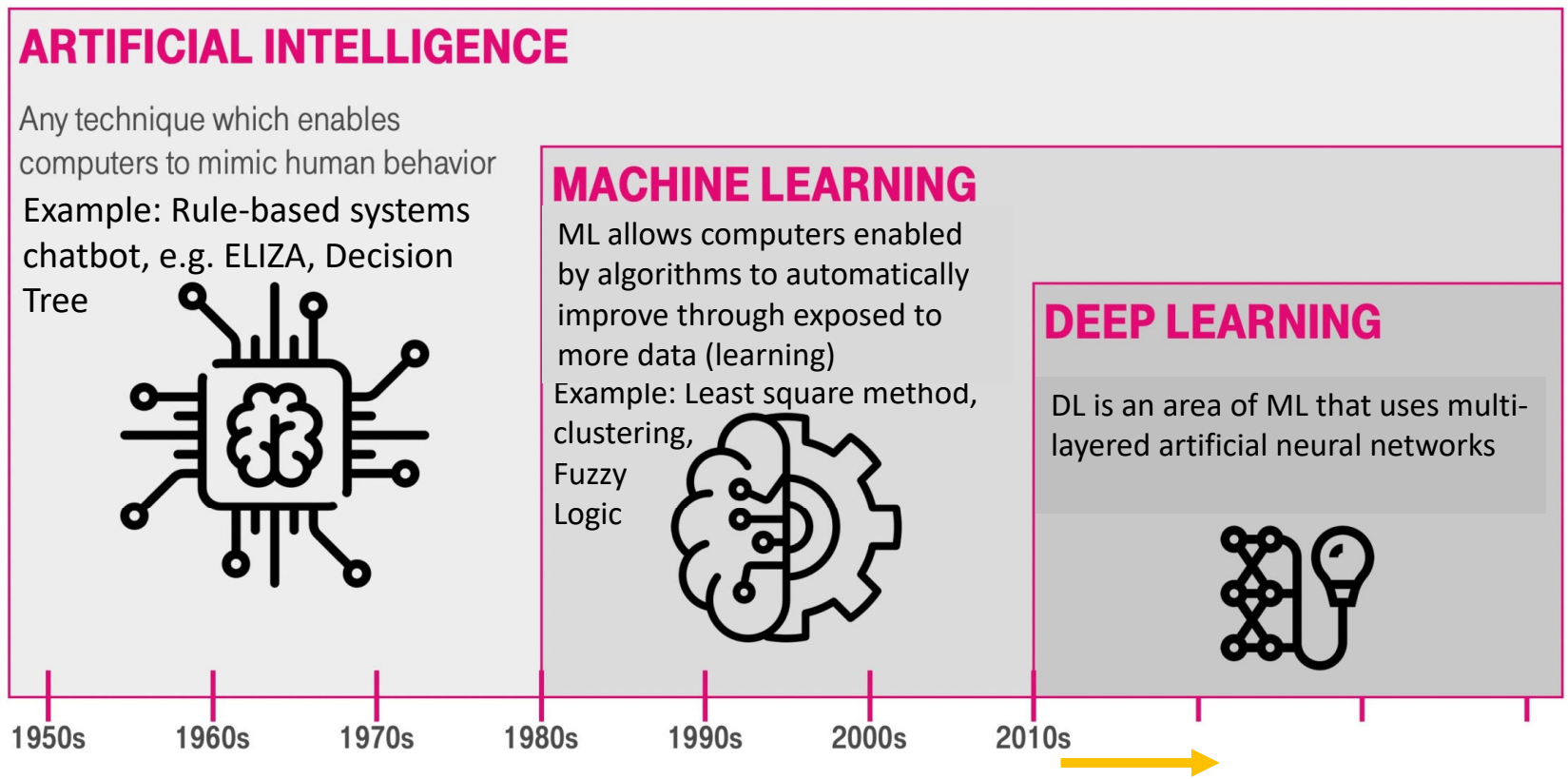
→ **2000 Cloud Computing**

**Mid-2000 Deep Learning**

**2015: Generative AI**

**\* the science and engineering of making computers behave in ways that, until recently, we thought required human intelligence.**

# Artificial Intelligence, Machine Learning and Deep Learning

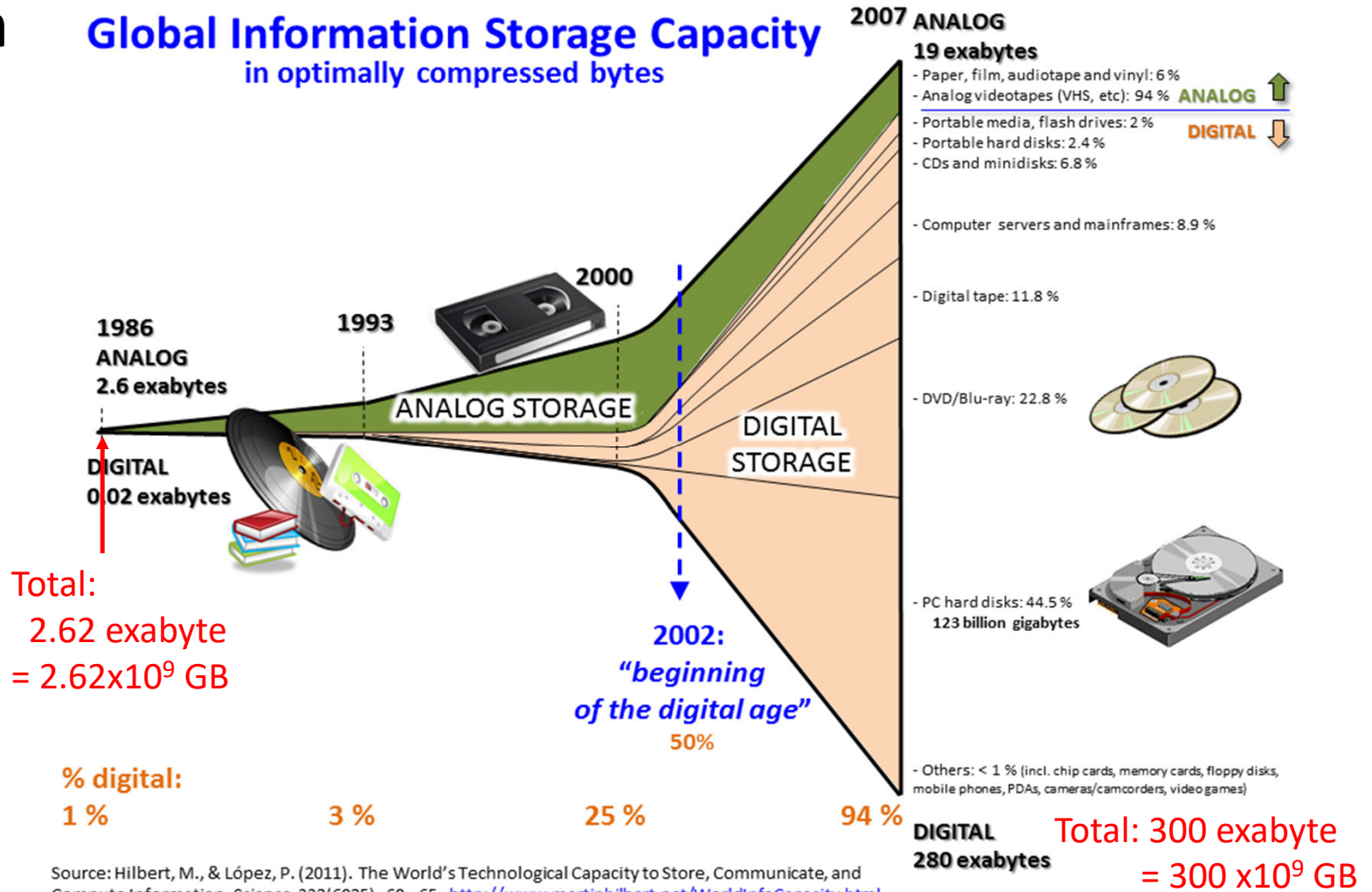


Based on Oracle (<https://blogs.oracle.com/bigdata/difference-ai-machine-learning-deep-learning>)

Golden Age of AI

# Digitization

## Global Information Storage Capacity in optimally compressed bytes

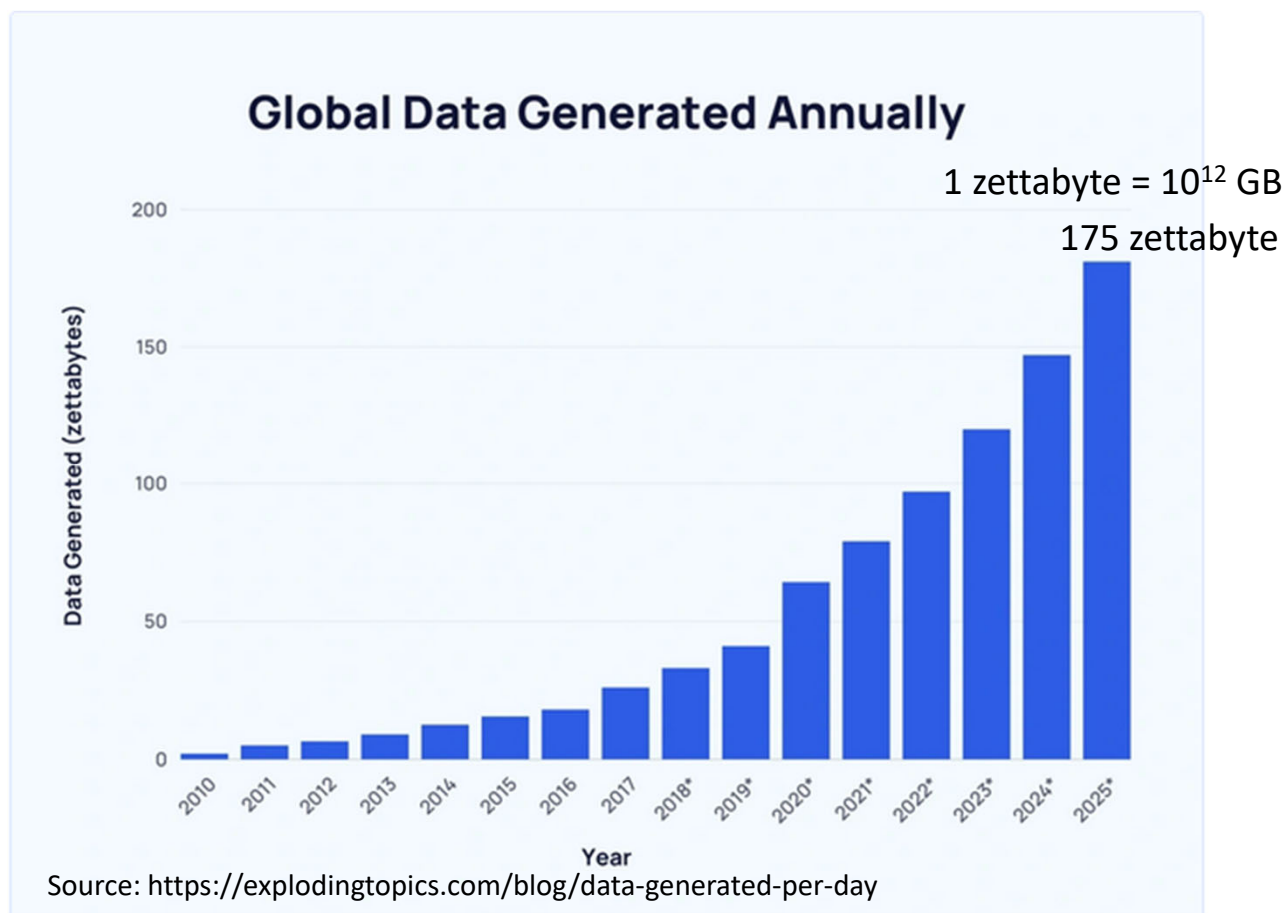


Source: Hilbert, M., & López, P. (2011). The World's Technological Capacity to Store, Communicate, and Compute Information. *Science*, 332(6025), 60–65. <http://www.martinhilbert.net/WorldInfoCapacity.html>

Source: <https://explodingtopics.com/blog/data-generated-per-day>

# BIG Data

- From 2011 to 2022, volume of data generated, harvested, copied, and consumed worldwide grew by ~50 times.
- Between 2020 and 2024, the unique/replicated data ratio is projected to change from 1:9 to 1:10
- Every person on earth created 1.7 megabytes per second in 2020
- GPT-3 model was trained on a dataset of over 40 terabytes (=40x10<sup>3</sup>GB) of data



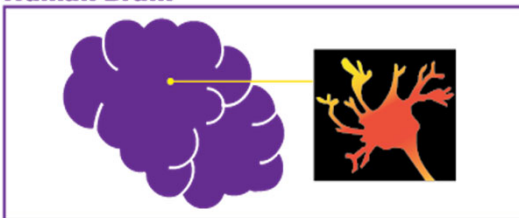


# What is a Neural Network?

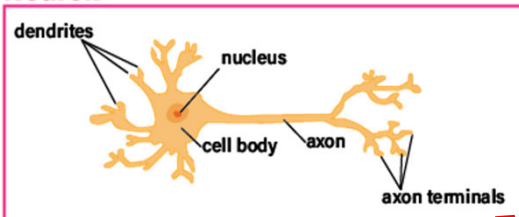
## Perceptron

- Proposed by McCulloch and Pitts in 1943
- model (loosely) the activates of a neuron in human brain

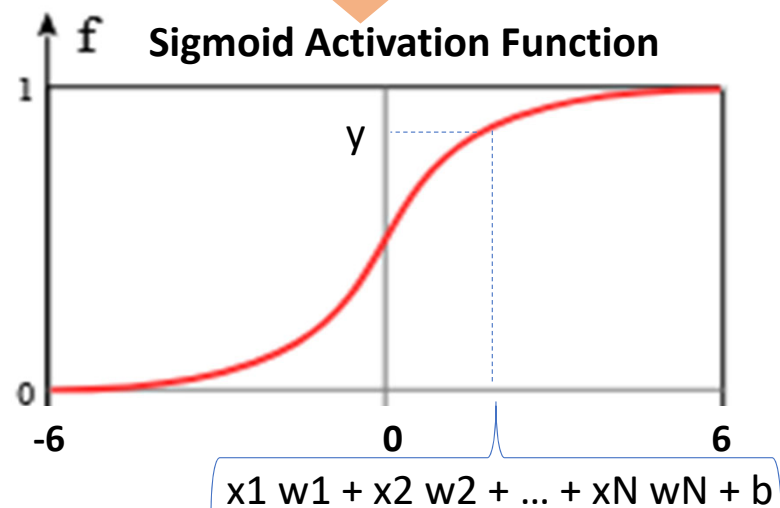
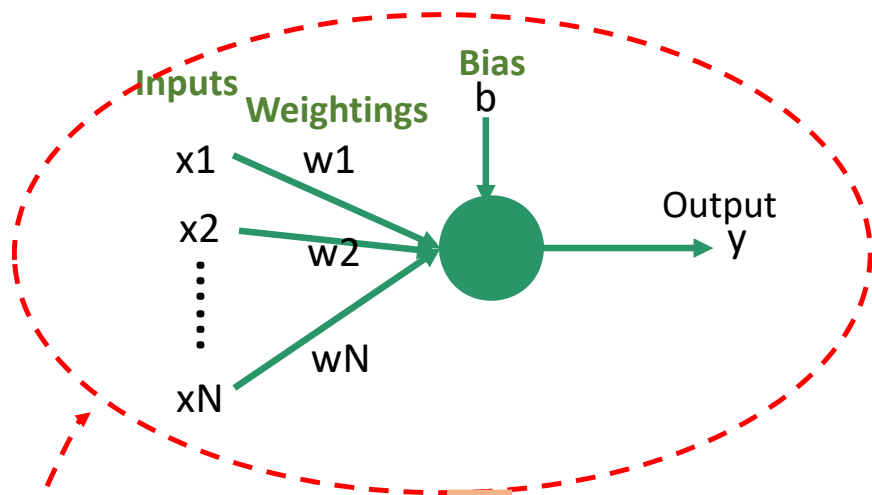
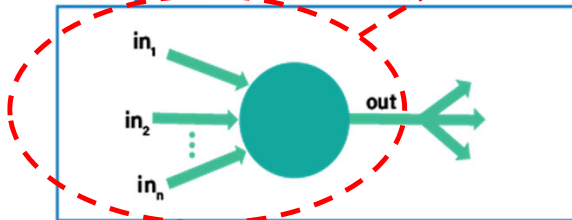
Human Brain



Neuron

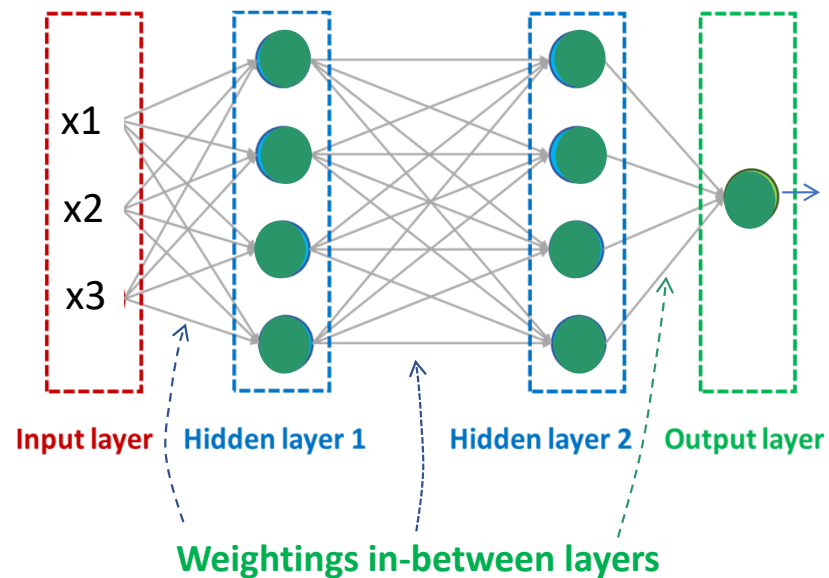


Perceptron

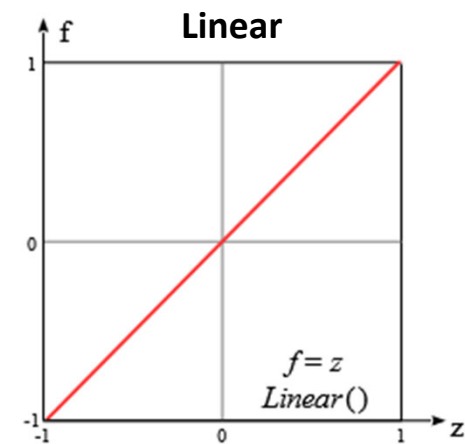
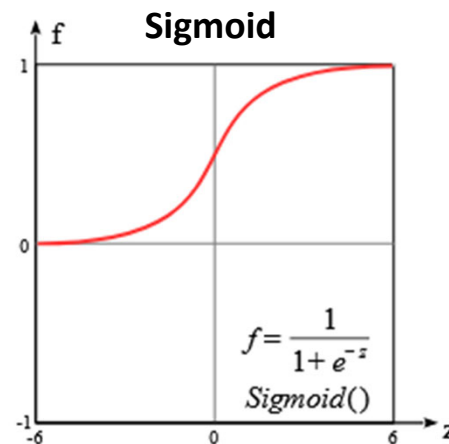
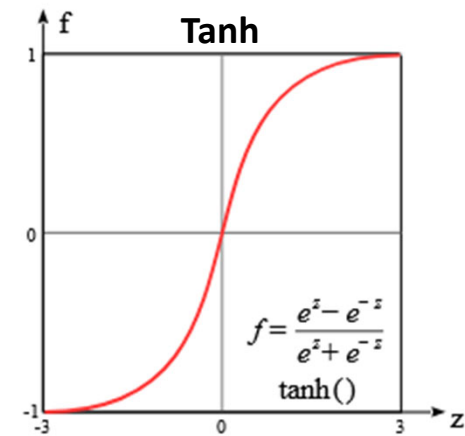
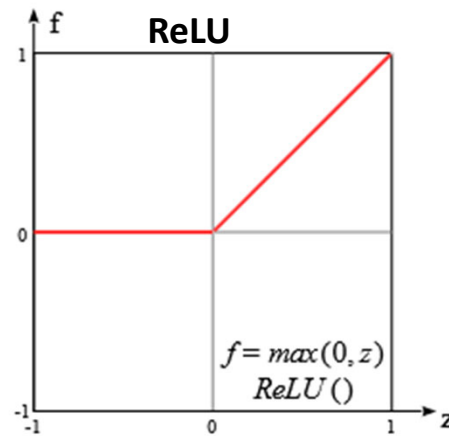


A Neural Network is formed using perceptron as basic units, with the choices of

- # of hidden layers
- # of Nodes (or perceptron) per layers
- Activation Function to use

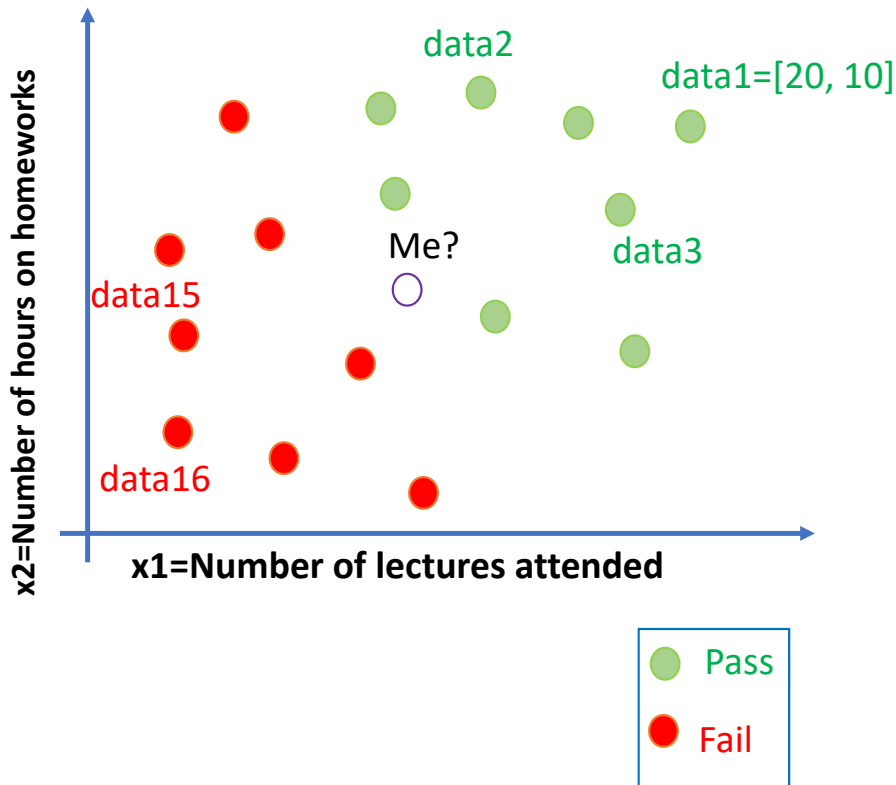


## Types of Activation Functions

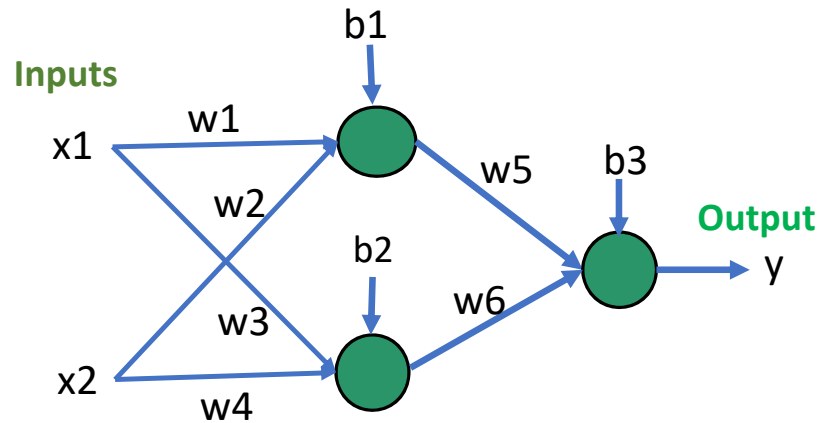


# How Does a Neural Network Learn?

- Consider “我及格嗎?” problem

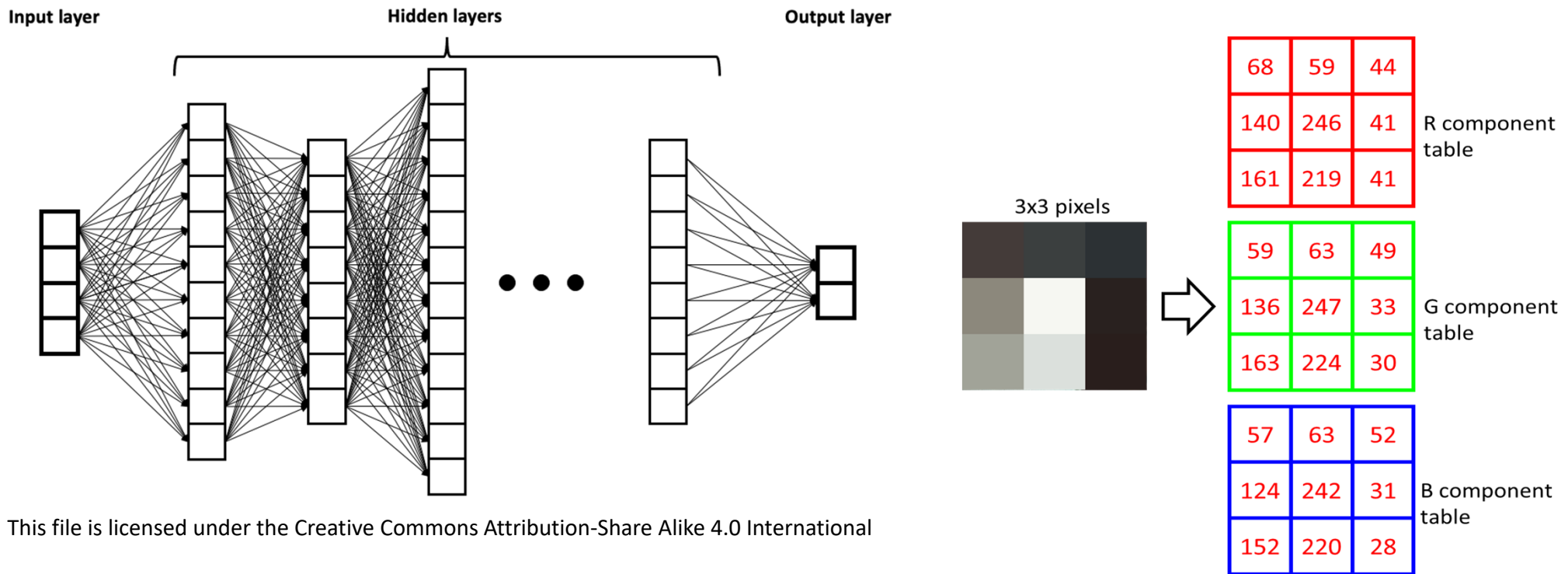


- Form a NN:



- Backpropagation: Technique to find the weightings:  $w_1, w_2, b_1, w_3, w_4, b_2, w_5, w_6, b_3$ , so that the NN outputs matches the actual outcomes of existing data (● and ●).
- The eventual weightings being adopted represent the “trained”/“learned” model
- Apply model to ○

# Deep Learning uses Multi-layers Neural Network

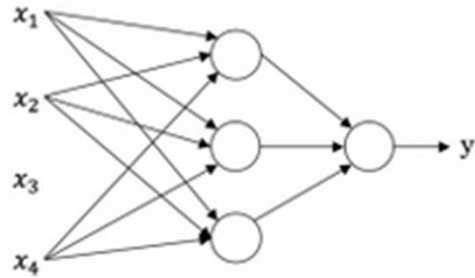


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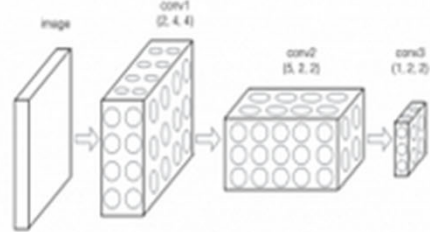
- A color picture with 3 by 3 pixels is characterized  $3 \times 3 \times 3 = 27$  numbers
- A color picture 700x700 pixels is characterized by 1670000 numbers
- GPT-3: 96 layer, 175 billion parameters, 40 Terabytes training data, training cost \$4.6M to train and took 34 days in 1024 CPUs.



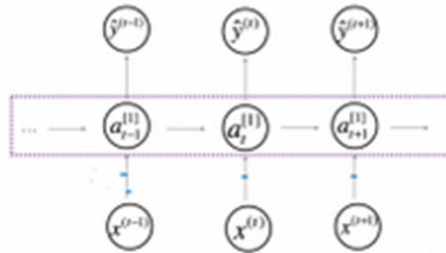
# Types of NN for Different Applications



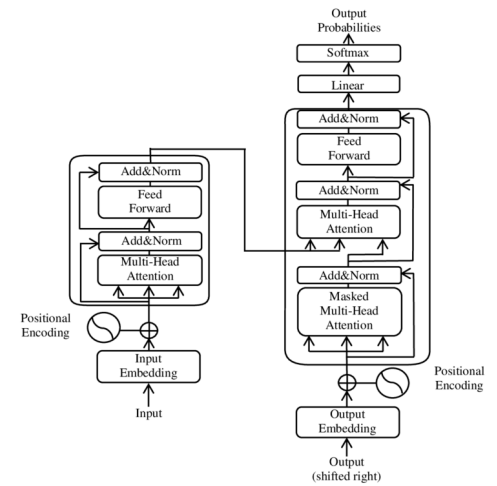
Standard NN



Convolutional NN



Recurrent NN



Transformer

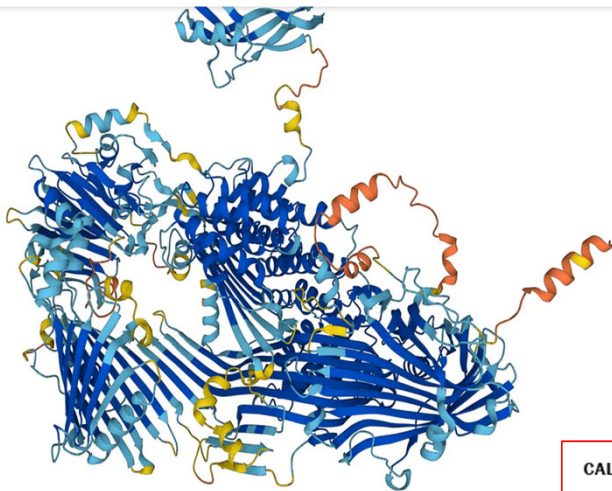
<https://vitalflux.com/wp-content/uploads/2021/11/deep-neural-network-examples-300x113.png>

<https://commons.wikimedia.org/wiki/File:The-Transformer-model-architecture.png#/media/File:The-Transformer-model-architecture.png>

# Latest AI Development and Applications

The “Protein-Folding problem” solved by DeepMind’s AlphaFold predicted the 3-dimensional structures of proteins from 1-dimensional amino acid sequences

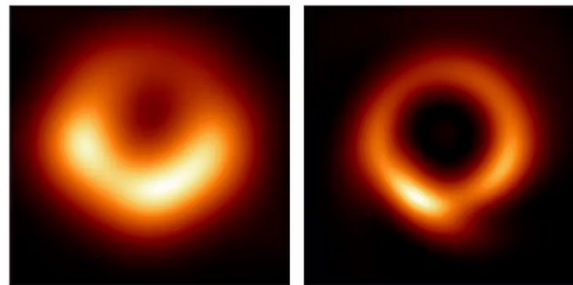
A.I. and Chatbots > Explore Milan With A.I. Testing a Tutorbot Chatbot Prompts to Try A.I.’s Literary Skills What Are the Dangers of A.I



DeepMind announced that its A.I. system AlphaFold had made predictions for nearly all of the 200 million proteins known to exist. DeepMind

<https://www.nytimes.com/2022/08/24/technology/ai-technology-progress.html>

## Analysis: How AI is helping astronomers study the universe



The team that first imaged a black hole, at left, used AI to generate a sharper version of the image, at right, showing the black hole to be larger than originally thought. Photo by Medeiros et al 2023, CC BY-ND

### Making predictions and plugging holes

As in many areas of life recently, generative AI and large language models like ChatGPT are also making waves in the astronomy world.

<https://www.pbs.org/newshour/science/analysis-how-ai-is-helping-astronomers-study-the-universe>

massive amount of data collected by the radio telescopes on the black hole

CALIFORNIA TODAY

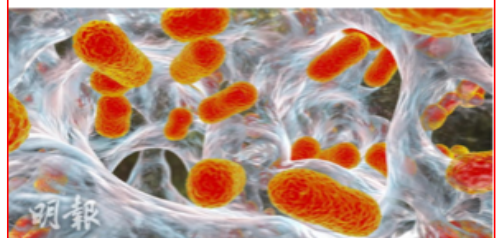
## How Artificial Intelligence Is Fighting Wildfires

Thursday: A lab at the University of California, San Diego, uses data to figure out how fires will burn, and how to help prevent them.

1:39 LTE

美加科學家用AI發現新抗生素 可殺致命超級細菌 (12:47)

2023/5/26



圖為超級細菌「鮑氏不動桿菌」(Acinetobacter baumannii)的電腦構想圖。(法新社)

< 共1幅 >

## Sir Paul McCartney says artificial intelligence has enabled a 'final' Beatles song



Mark Savage  
BBC Music Correspondent

# On the Other Hand ....

1:41 LTE

## 內地AI換臉騙案頻生 安徽男9秒被騙走245萬人民幣

標籤：內地 AI 換臉 騙案 安徽男 9秒 騙走 245萬 人民幣 編輯推介

文章日期：2023年5月26日 12:21

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## Europe takes aim at ChatGPT with what might soon be the West's first A.I. law. Here's what it means

PUBLISHED MON, MAY 15 2023 1:21 AM EDT | UPDATED MON, MAY 15 2023 5:34 AM EDT



Ryan Browne  
@RYAN\_BROWNE

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### KEY POINTS

- A committee of lawmakers in the European Parliament on Thursday approved the EU's AI Act, making it closer to becoming law.
- The regulation takes a risk-based approach to regulating artificial intelligence.
- The AI Act specifies requirements for developers of "foundation models" such as ChatGPT, including provisions to ensure that their training data doesn't violate copyright law.

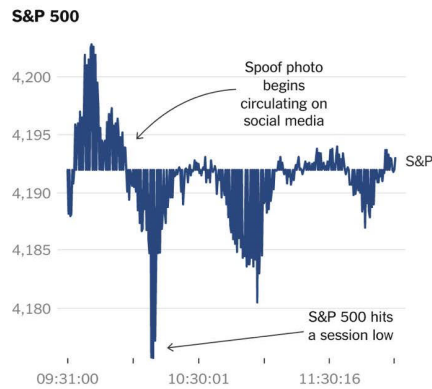
How can strategic into real perform. EY-Parthenon can help unlock

## An A.I.-Generated Spoof Rattles the Markets


A stock sell-off driven by a since-debunked picture underscored fears about how artificial intelligence could be used for nefarious purposes with big consequences.

By Andrew Ross Sorkin, Bernhard Warner, Sarah Kessler, Michael J. de la Merced, Lauren Hirsch and Ephrat Livni

May 23, 2023, 7:56 a.m. ET



Source: Sentieo/AlphaSense • By The New York Times



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IDEAS MADE TO MATTER | ARTIFICIAL INTELLIGENCE

## Why neural net pioneer Geoffrey Hinton is sounding the alarm on AI

by Sara Evans | May 23, 2023

Why It Matters

Geoffrey Hinton, a respected researcher who recently stepped down from Google, said time to confront the existential dangers of artificial intelligence.

## 1,100+ notable signatories just signed an open letter asking 'all AI labs to immediately pause for at least 6 months'

Connie Loizos @cookie / 2:09 PM GMT+8 • March 29, 2023

Comment

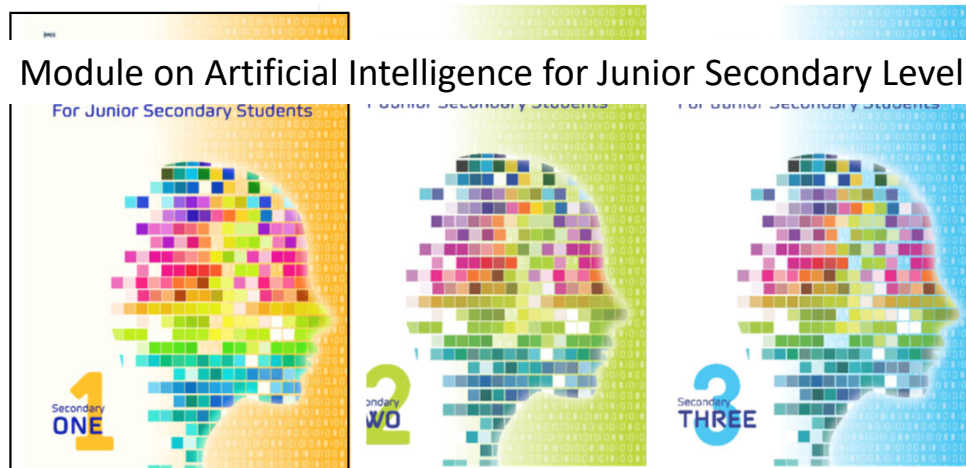


Image Credits: Getty Images

More than 1,100 signatories, including Elon Musk, Steve Wozniak, and Tristan Harris of the Center for Humane Technology, have signed an open letter that was posted online Tuesday evening that calls on "all AI labs to immediately pause for at least 6 months the training of AI systems more powerful than GPT-4."

# AI Education in Junior Secondary Forms

- **Relevancy:** AI making impact on every aspects of society
- **Timely/Urgency:** AI technology is developing fast with wide adoption
- **Potential:** AI harbors tremendous opportunities for the future
- **Responsibility:** Prepare students for proper/ informed use of the technology





# Module on Artificial Intelligence



- Progressive coverage of essential AI technologies with strong emphasis on ethics and future of works

## Booklet 1

Unit 7 – AI in Robotic Reasoning (I)  
 Unit 6 – AI and Computer Simulation (I)  
 Unit 5 – Computer Speech & Language (I)  
 Unit 4 – Computer Vision (I)  
 Unit 3 – AI Ethical Principles  
 Unit 2 – AI Basics (I)  
 Unit 1 – Introduction to AI

## Booklet 2

Unit 8 - Group Project Design, Development and Presentations (I)  
 Unit 7 – Societal Impact of AI (I)  
 Unit 6 – AI and Future of Work (I)  
 Unit 5 – AI in Robotic Reasoning (II)  
 Unit 4 – Computer Speech & Language (II)\*  
 Unit 3 – Computer Vision (II)  
 Unit 2 – AI Ethical Issues  
 Unit 1 – AI Basics (II)\*

## Booklet 3

Unit 6 - Group Project Design, Development and Presentations (II)  
 Unit 5 - Societal Impact of AI (II)\*  
 Unit 4 - AI and Future of Work (II)  
 Unit 3 - AI in Robotic Reasoning (III)  
 Unit 2 - AI and Computer Simulation (II)  
 Unit 1 - Computer Vision (III)

Knowledge + Skill  
 Knowledge + Skill + Attitudes  
 \* Generative AI elements

- Notes for Teachers** to suggest answers for the questions and materials for further reading
- Exercises** to assess students' understanding of the materials
- Summary** to consolidate students' grasp of the basic content of each unit



## Special features in the Teaching Materials

- Hands-on learning through CUHK-JC iCar: “Are You You?” Experiment in Booklet 1-Unit 4 and Food Delivery Experiment in Booklet 3-Unit 3 to arouse the interest of students, and more.
- Online tools and dataset for students to try out AI applications and cultivate their interests and innovation in AI, e.g., Word Association Game in Booklet 2-Unit 4, and Traffic Light Decision Simulator for Booklet 2-Unit 5, etc.
- Examples to enhance the understanding of students
- Reference videos, websites for further reading of the topics

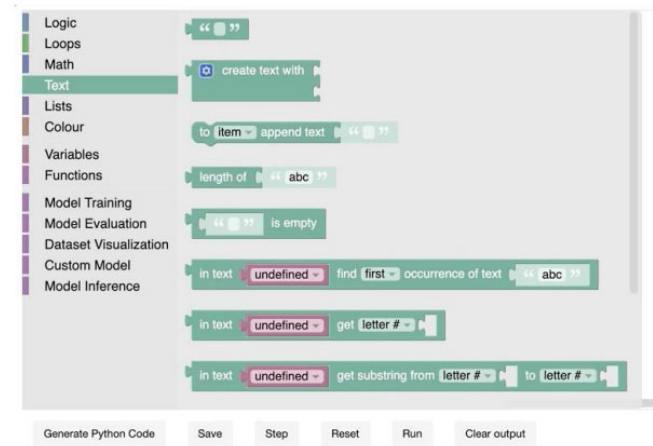
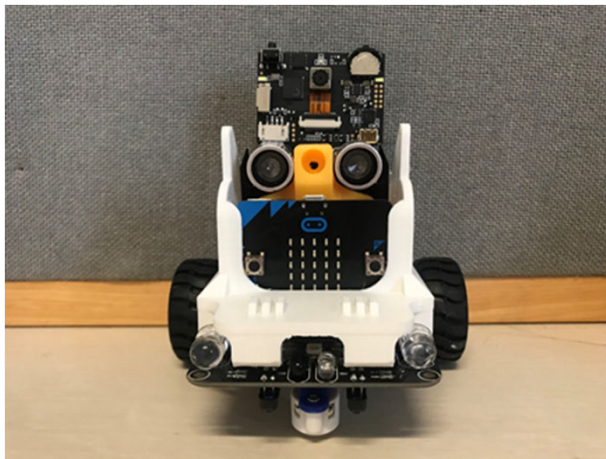


Traffic Light Decision Simulator

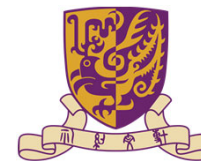
# Demonstrations of Learning Toolkits



- **CUHK-JC iCar** is an AI kits for hands-on learning of AI and development of AI projects
- AI Areas covered: Vision, Voice, Data Training,
- 6 build-in AI functions: Object recognition; Object tracking; Face recognition; Color recognition. Line detection; Tag recognition
- Programming Language: Blockly

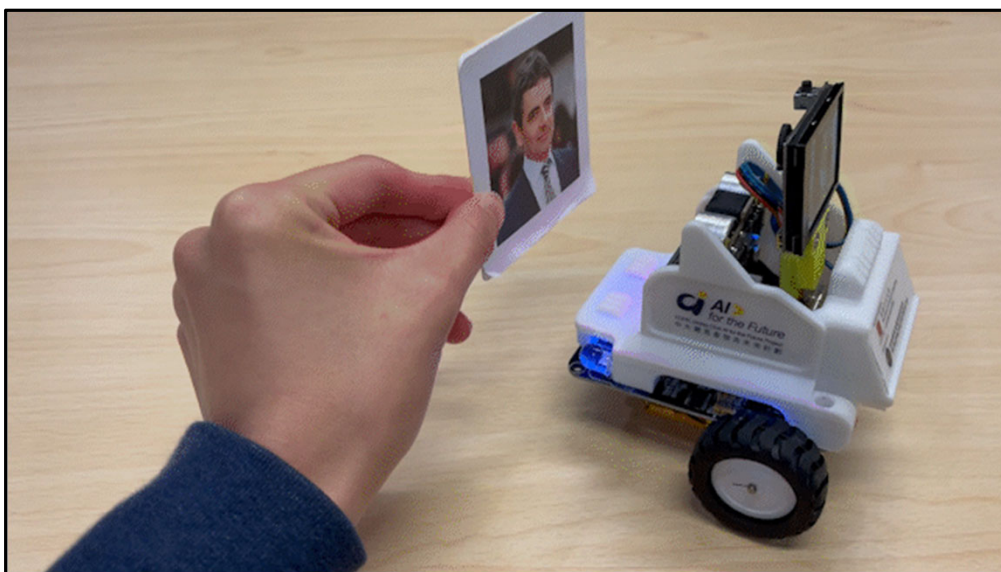


# CUHK-JC iCar



## ▼ CUHK-JC iCar

- 人面識別追蹤實驗 Face-tracking
- 循跡實驗 Line-following

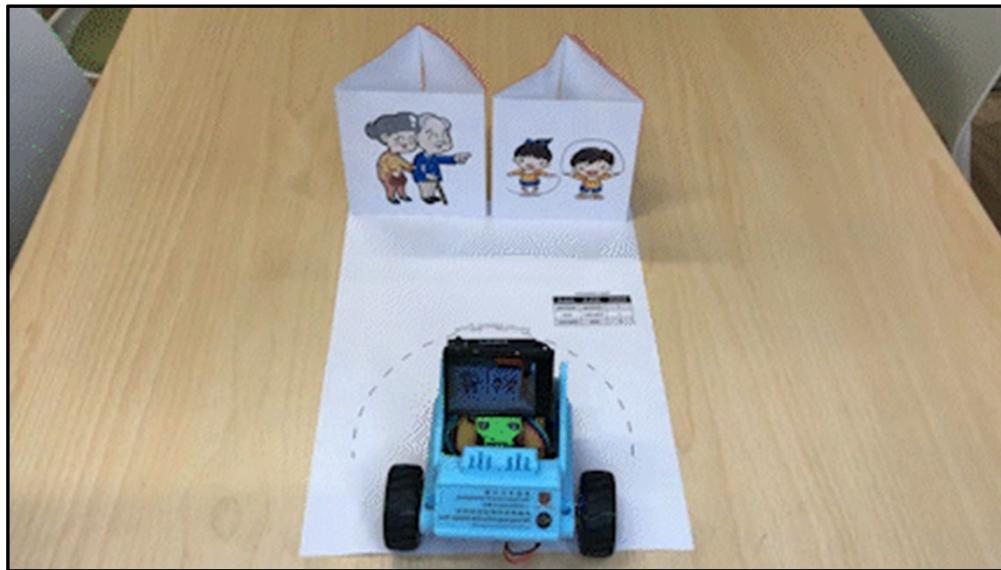


# CUHK-JC iCar



## ▼ CUHK-JC iCar

- 道德困境實驗 Moral Dilemma
- 聲控小車 Voice Recognition



# CUHK-JC iCar

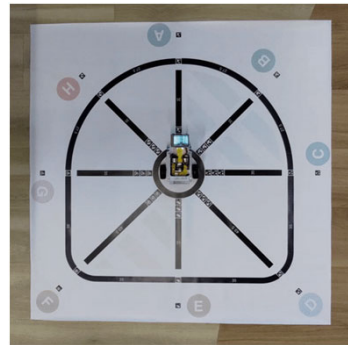


## ▼ CUHK-JC iCar

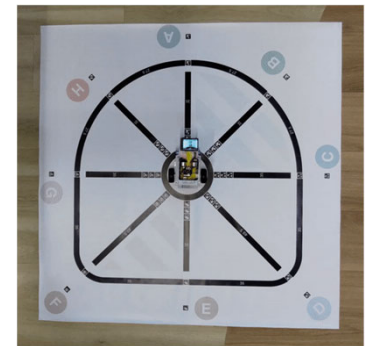
### • Robotic Reasoning Experiment

- **Skill-based Reasoning:** Straight-forward response to complete the task
- **Rule-based Reasoning:** Make decisions base on learned patterns and execute
- **Knowledge-based Reasoning:** Apply machine learning to find the best solution

Skill-based Reasoning

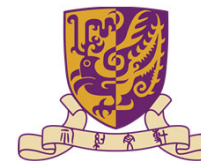


Knowledge-based Reasoning



Rule-based Reasoning

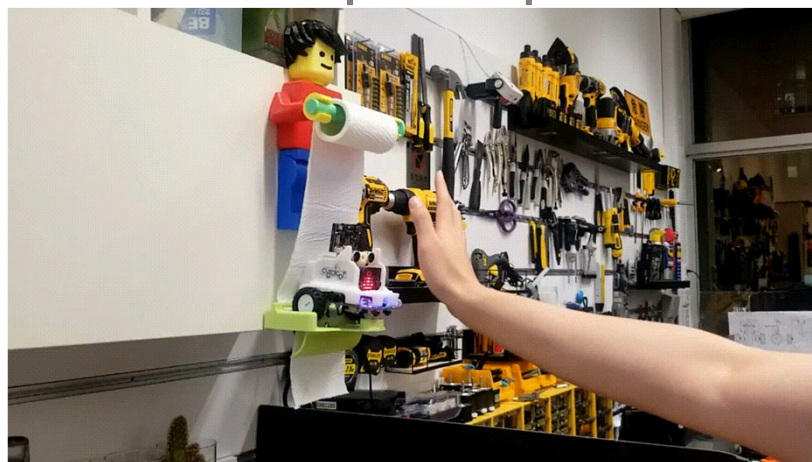
# CUHK-JC iCar for Project Idea/Development



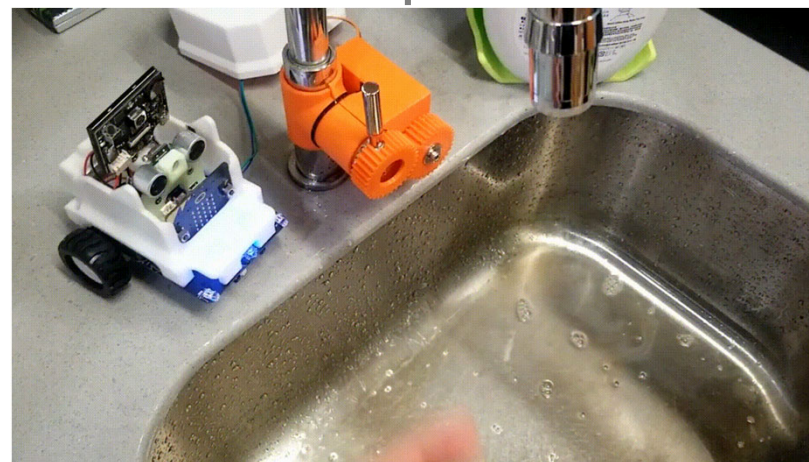
## ▼ CUHK-JC iCar

### • 疫情系列 Pandemic series

- 自動出紙系統
- Toilet Paper Dispenser



- 自動水龍頭開關
- Water Tap Controller



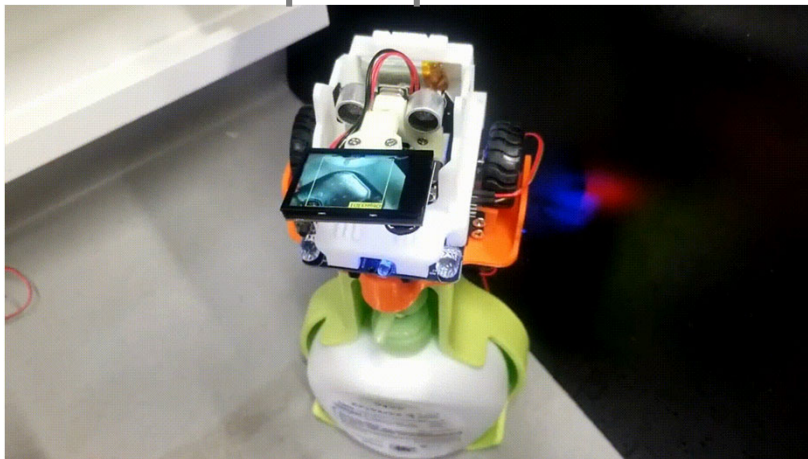
# CUHK-JC iCar for Project Idea/Development



## ▼ CUHK-JC iCar

### • 疫情系列 Pandemic series

- 自動視液機
- Soap Dispenser



- 自動燈制開關
- Automatic Light Switch





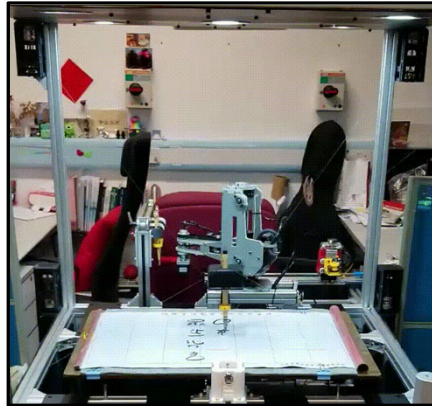
# Further AI Ideas in CUHK AI4Future AI Lab



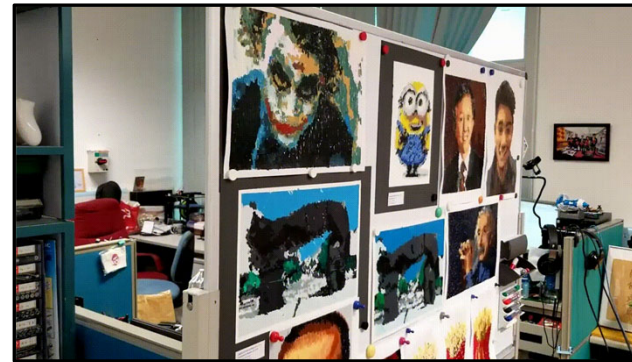
- AI Robots for Art
- AI Robots for Fun
- AI Robots for Daily Life

We welcome school visits to our CUHK AI4Future AI Lab!

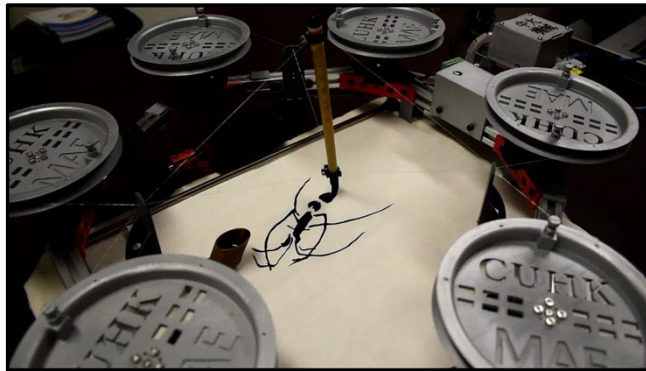
# AI Robots for Art



8軸線控毛筆機 8DOF Cable-Driven Calligraphy Robot ▲



▲ 智能油畫機 Oil Paint Robot

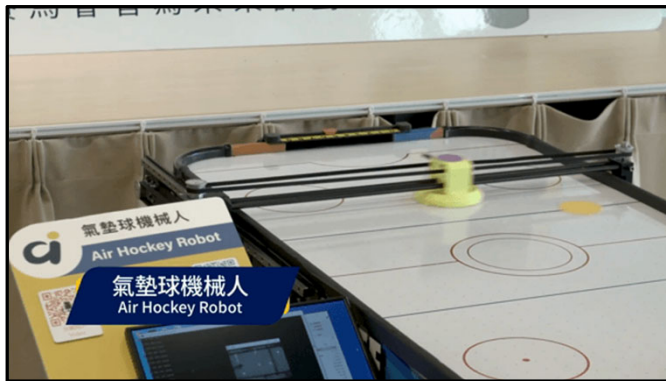
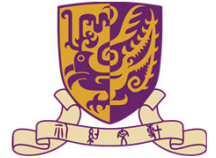


6軸線控毛筆機 6DOF Cable-Driven Calligraphy Robot ▲

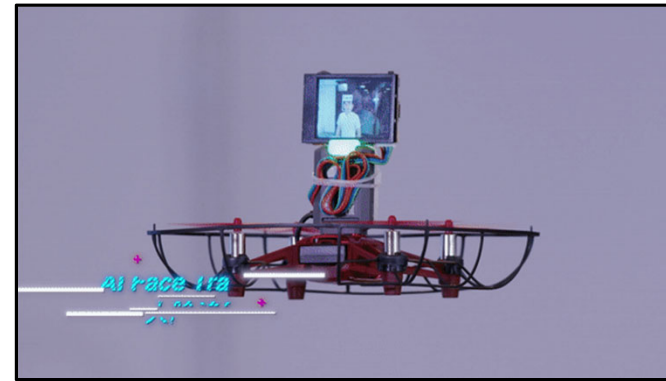


▲ AI書法家 AI Calligrapher

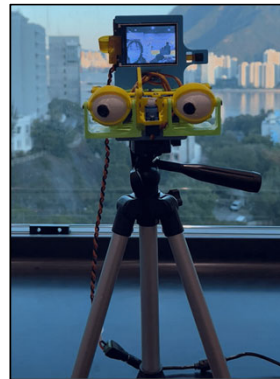
# AI Robots for Fun



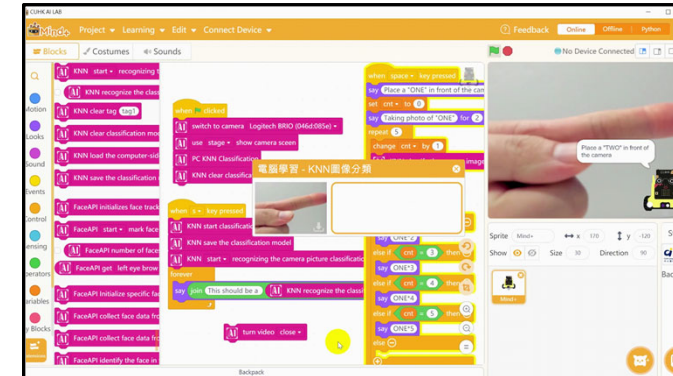
氣墊球機械人 Air Hockey Robot ▲



▲ 人臉追蹤無人機 Face Tracking Drone

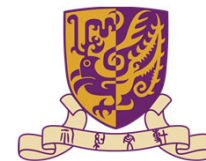


人臉追蹤機械人 Face Tracking Robot ▲

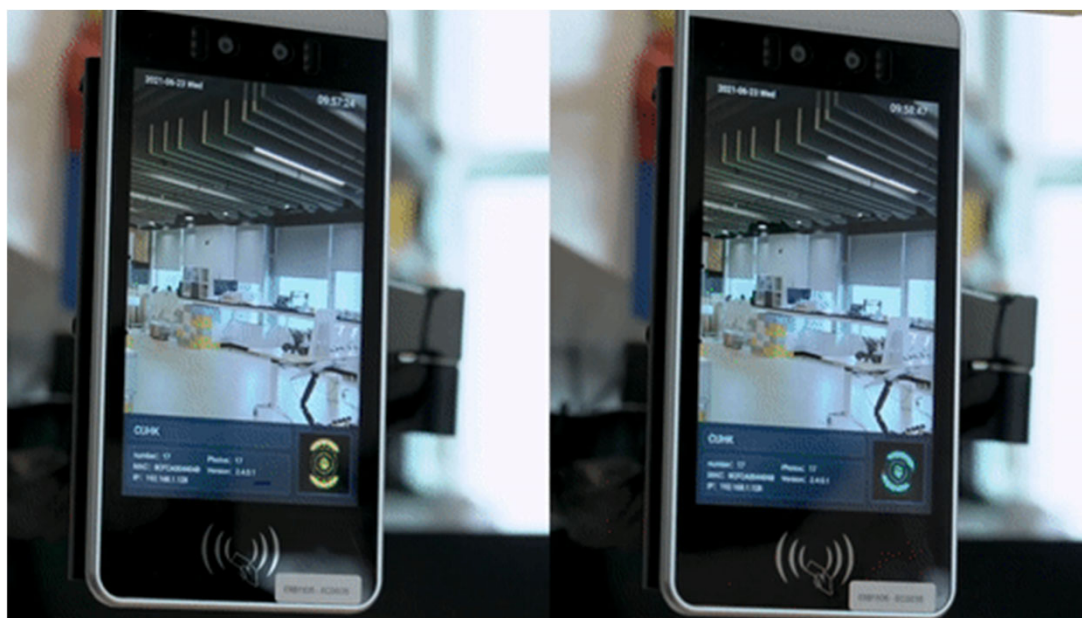


▲ 無人機手勢群飛 Drone Swarming Show (Gesture Control)

# AI for Daily Life



▼ 人臉識別開門系統  
Face Recognition Door Opening System





# Conclusions

- Development of AI has been a long process starting from the 1950s
- While many of the basic ideas have been formed in the 1960s, AI prospers in recent decades due to the rise of BIG data, cloud computing and Deep Learning
- AI encompasses tremendous opportunities for both good and bad
- Today's introduction of "Module on Artificial Intelligence for Junior Secondary Level" is an important step in educating our young generation on this transformative technology
- Imperative to teach students both the basic knowledge of AI and also the proper attitudes to consider and to use the technology
- Privileged to be working with EDB and all the dedicated secondary school teachers in such a meaningful endeavor building up the future generations of Hong Kong