Artificial Intelligence

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Agenda

- History of artificial intelligence
  - Definition
  - Birth
  - Golden time
  - Winter
  - Struggle
  - Revival
- Introduction to COMP4431
  - Assessment
  - Tentative schedule
  - Group project
- Lab arrangement
  - General Information
  - Schedule
  - Learning Objectives and Materials
  - Generative artificial intelligence
- Add/drop consulting
  - Teaching staffs

Agenda

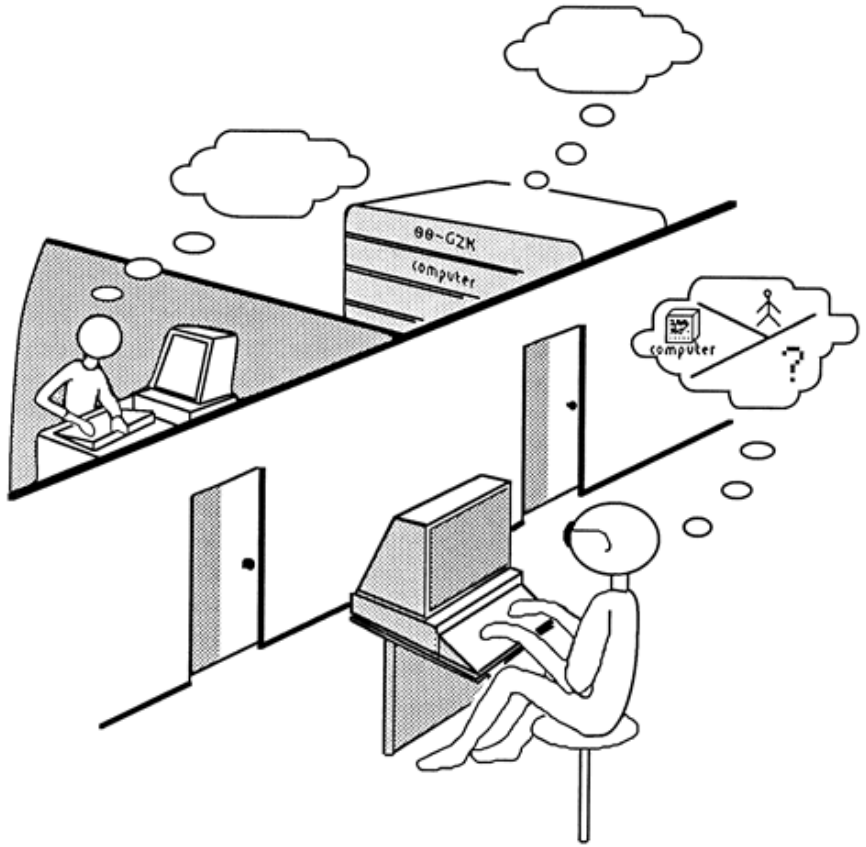
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What is Artificial Intelligence

- Artificial intelligence
  - Is concerned with the design of intelligence in an artificial device
  - Term coined by McCarthy in 1956
- Artificial device
  - Limited to computer system in our course
- Definition of intelligence
  - Quality that enables an entity to function appropriately and with foresight in its environment
- A typical definition of artificial intelligence
  - 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
- No widely accepted definition
  - Relationship between machine learning, big data, deep learning, pattern recognition

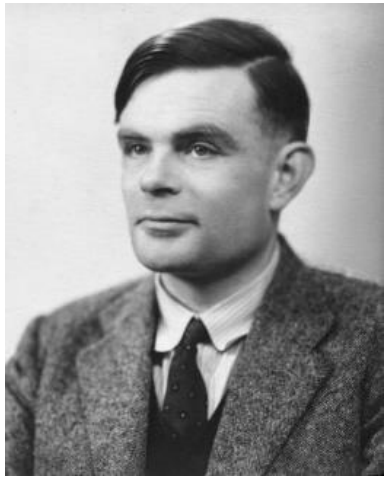
Turing Test

- Aim to solve the problem
  - 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
  - Not reproducible



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
- Turing machine
  - Give a definition of computation
  - Absolute limitation on what computation could achieve
- 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





Dartmouth Colleague

- Dartmouth colleagues
  - Ivy research university
  - Four senior professor retires from the Department of mathematics in 1954
  - John George Kemeny came back to Princeton University for recruitment
    - Iinventor of Dartmouth time sharing system
  - John McCarthy has been hired as assistant professor by Dartmouth Colleagues
- Summer in 1955
  - John McCarthy came to work with Nathaniel Rochester
    - IBM 701 computer designer and wrote the first assembler
  - Write the proposal for a summer forum next year
- Team members of proposal
  - John McCarthy, Nathaniel Rochester, Claude Shannon, and Marvin Minsky
    - Shannon is the god father of information theory

Dartmouth Conference



Photo from the 1956 Dartmouth Conference with Marvin Minsky, Ray Solomonoff, Claude Shannon, John McCarthy, Peter Milner, Oliver Selfridge and Nathaniel Rochester.

Five of the attendees of the 1956 Dartmouth Summer Research Project on Artificial Intelligence reunited at the July 2006 AI@50 conference. From left: Trenchard More, John McCarthy, Marvin Minsky, Oliver Selfridge and Ray Solomonoff. (Photo by Joseph Mehling)



John McCarthy



- Born
  - In 1927 at USA
- Died
  - In 2011
- Get Turing Award in 1971
- Professor at Stanford University
- Contribution to artificial intelligence
  - Coined the term of artificial intelligence
  - Organize the Dartmouth conference
  - Created the LISP language in 1958
- Contribution to other areas
  - Came up with a scheme for creating general purpose timesharing

Seven Research Directions of Artificial Intelligence Proposed in 1956

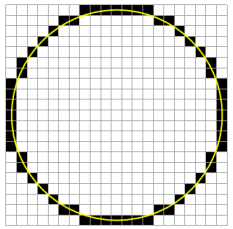
- Automatic computers
  - Autonomous vehicles
- How can a computer be programmed to use a language
  - Python
- Neuron nets
  - Deep learning
- Theory of the size of a calculation
  - GPU
- Self-improvements
  - Machine learning
- Abstractions
  - Feature engineering
- Randomness and creativity
  - Artificial arts

Achievements in the Birth Stage

- 1950 - 1980
- Search
  - Reasoning as search
  - Heuristic search
- Natural language processing
  - Eliza is the first Chatbot created in 1966
  - Eliza has no understanding of the content and use pattern matching to answer the question
- Computer vision
  - Micro-worlds
  - Pixel – shape – object – scene



Pixel



Shape



Object



Scene

Golden Time

- 1980 – 1987
  - The knowledge revolution
- The rise of Symbolicism
  - Symbolic logic is claimed that can explain the character of mind
- Allen Newell and Herbert Simon
  - Proposed logic theorist in 1955
  - Prove the mathematical theorems successfully
- 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

Allen Newell and Herbert Simon

- Long-term partners
  - Share the Turing Award in 1975
- Herbert Simon
  - He received the Nobel Prize in Economics in 1978
  - Cognitive psychologist
  - Decision making
- Allen Newell
  - Published the paper of Chess Machine in 1955





Winter

- 1987- 1993
  - The practical progress is far behind the expectation of the public
  - The difficulty to reproduce general intelligence
- 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

Struggle

- 1993 – 2011
  - Computer scientists and software engineers avoided the term artificial intelligence for fear of being viewed as wild-eyed dreamers
- 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



Deep Blue in IBM's headquarters in Armonk, N.Y.



Garry Kasparov vs. Deep Blue

Revival

- 2012 –
- Deep learning
  - The success of connectionism
  - Imitate the physical structure and the information processing of the biological neuro system
- Marvin Minsky
  - Turing Award 1969
  - Co-founder of MIT Artificial Intelligence Lab
- Turing award 2018
  - Geoffrey Hinton
  - Yoshua Bengio
  - Yann LeCun









Generative AI

- Generative artificial intelligence
  - Technique that can be used to create new content, including text, code, speech, music, images, and videos.
  - ChatGPT, Suno, Midjourney, Pika
- ChatGPT
  - Chat Generative pre-trained transformer
  - Developed in 2022 by OpenAI
- Discriminative AI and generative AI
  - Discriminative AI focuses on modeling the relationship between input features and output labels
  - Generative AI focuses on modeling the inherent data structure and generation processes



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Assessment

- Individual work
  - Quiz 27%
    - Quiz paper will be distributed in the classroom and returned to the TA 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 TA Changhong Jing 23123218r@connect.polyu.hk for recording
    - Makeup quiz is arranged on Tue. Dec. 3 evening time
  - Final exam 45%
    - Absence and late situation are handled based on the regulations of the university for the examination
- Group work 28%
  - 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 Fiona by email yan.liu@polyu.edu.hk with the justification and the signature of all group members
  - Submission
    - Each group only needs to submit one copy by one group member
  - Important dates
    - Thur. Nov. 7 23:59pm
    - 50%/day for late submission

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	Lab in PQ603& 604 A-C (18:30 - 19:20)	Quiz in TU101 (19:30 - 19:40)	Lecture in TU101 (19:40 - 21:20)
1	Sept. 3	Introduction to COMP4431		No lab in the first week
2	Sept. 10	Generative AI for text generation	Quiz 1	Heuristic Search
3	Sept. 17	Be cancled because of public holiday		
4	Sept. 24	Generative AI for image generation	Quiz 2	Constrains
5	Oct. 1	Be cancled because of public holiday		
6	Oct. 8	Generative AI for audio generation	Quiz 3	Decision Tree
7	Oct. 15	Generative AI for video generation I	Quiz 4	Machine Learning
8	Oct. 22	Generative AI for video generation II	Quiz 5	Neural Networks
9	Oct. 29	Generative AI for video editing	Quiz 6	Deep Learning
10	Nov. 5	Help for group project (Deadline Nov. 7)	Quiz 7	Bayesian
11	Nov. 12	Generative AI for code generation I	Demonstration of group project	
12	Nov. 19	Generative AI for code generation II	Quiz 8	Advanced Topics in AI
13	Nov. 26	Generative AI for code generation III	Quiz 9	Final Exam Review

Group Project

- Make a micro-movie for the 50th anniversary celebration of department of computing Welcome video before the 50th banquet
  - The audience are VIP guest, alumni, staffs, and students
- Title
  - “1974 - 2024”
  - You are strongly encouraged to use different kinds of generative AI techniqus
  - All materials should be collected by yourselves
- Length
  - Up to 2 min
- Submission
  - Each group only needs to submit one video by one group member via blackboard
  - No requirement of report and presentation
- Important dates
  - Thur. Nov. 7 23:59pm
  - 50% per day for late submission

Grading of Group Project

- 28 points
  - 5 points: Screenplay
  - 5 points: Visual Effects
  - 5 points: Audio effects
  - 3 points: Text and subtitles
  - 10 points: Overall performance
- Group work
  - 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 Fiona by email yan.liu@polyu.edu.hk with the justification and the signature of all group members
  - At least one group member should attend the demonstration on Nov. 12

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Introduction to COMP4431 Lab

- General Information

Subject Group	Start Time	End Time	Venue
1011, 1012, 172, 172, 192, 142	17:30	18:20	PQ603, PQ604A, PQ604B, PQ604C
1013, 122, 161, 171, 151, 121, 131, 141, 181	18:30	19:20	PQ603, PQ604A, PQ604B, PQ604C

  - Each lab session lasts 50 minutes.
  - Each lab session includes lectures and hands-on experiments (40 min) and a Q&A (10 min).

Introduction to COMP4431 Lab

- Schedule

Week	Date	Topic
2	Sept. 10	Generative AI for Text Generation
4	Sept. 24	Generative AI for Image Generation
6	Oct. 8	Generative AI for Audio Generation
7	Oct. 15	Generative AI for Video Generation (1)
8	Oct. 22	Generative AI for Video Generation (2)
9	Oct. 29	Generative AI for Video Editing
10	Nov. 5	Question and Answer
11	Nov. 12	Generative AI for Code Generation (1)
12	Nov. 19	Generative AI for Code Generation (2)
13	Nov. 26	Generative AI for Code Generation (3)

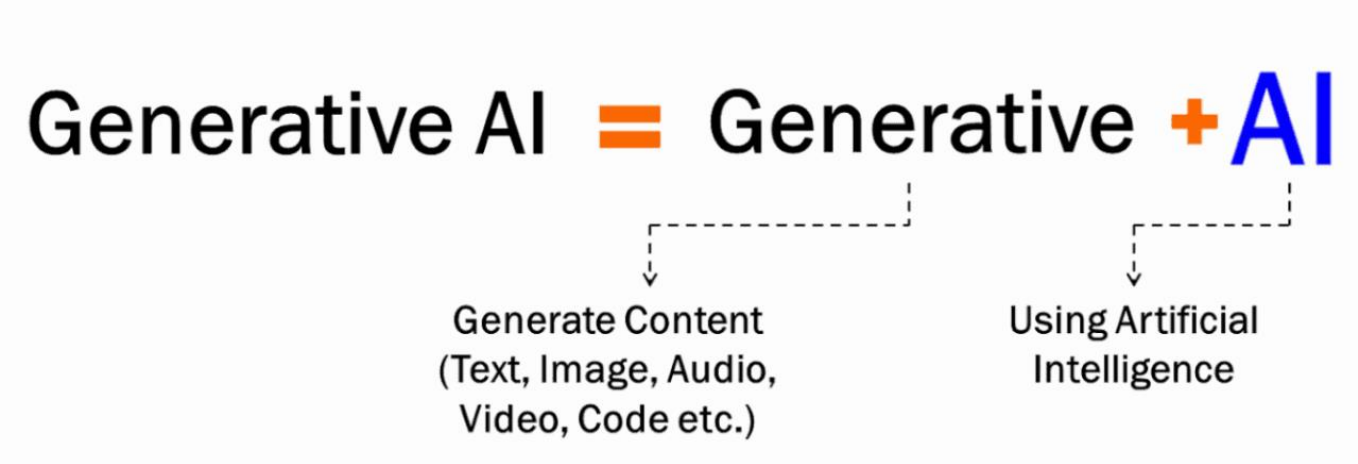
  - The first 6 sessions focus on group projects for AI-generated content (AIGC).
  - The final 3 sessions focus on practical techniques in AI for programming.

Introduction to COMP4431 Lab

- Learning Objectives
  - Understand the basic principles of generative AI
  - Understand the advantages and disadvantages of generative AI
  - Learn to use various generative AI tools
  - Practice AI-generated content pipeline from scratch
- Materials
  - Generative Deep Learning: Teaching Machines To Paint, Write, Compose, and Play (book)
  - Artificial Intelligence & Generative AI for Beginners: The Complete Guide (book)

Concepts of Generative AI

- Generative Artificial Intelligence (AI)
  - Generative artificial intelligence (AI) describes algorithms that can be used to create new content, including audio, code, images, text, simulations, and videos.



Kalota F. A Primer on Generative Artificial Intelligence[J]. Education Sciences, 2024, 14(2): 172.

Concepts of Generative AI

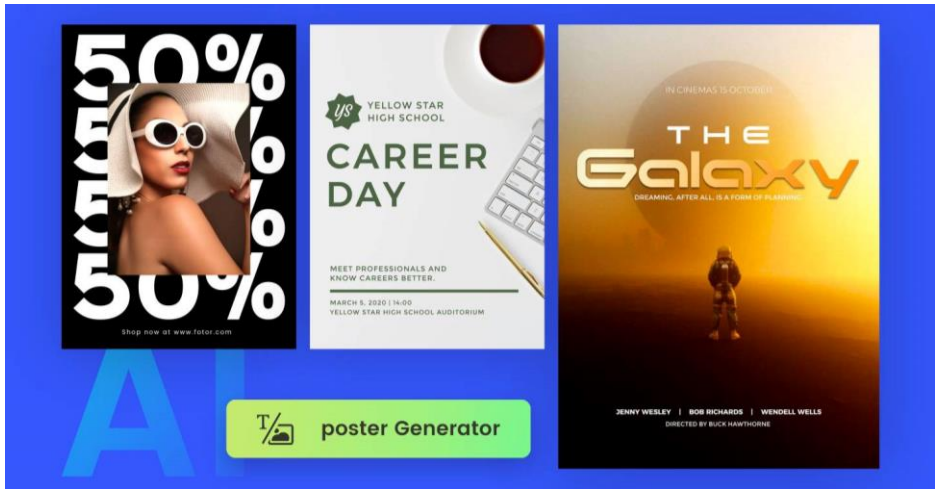
- Generative Artificial Intelligence (AI) and Discriminative Artificial Intelligence (AI)
  - Generative AI focuses on modeling the inherent data structure and generation processes
  - Discriminative AI focuses on modeling the relationship between input features and output labels



van der Zant T, Kouw M, Schomaker L. Generative artificial intelligence[M]. Springer Berlin Heidelberg, 2013.

Concepts of Generative AI

- Artificial Intelligence Generative Content (AIGC)
  - AIGC refers to content that is generated using advanced Generative AI (GAI) techniques, as opposed to being created by human authors.
  - It can automate the creation of large amounts of content in a short amount of time.



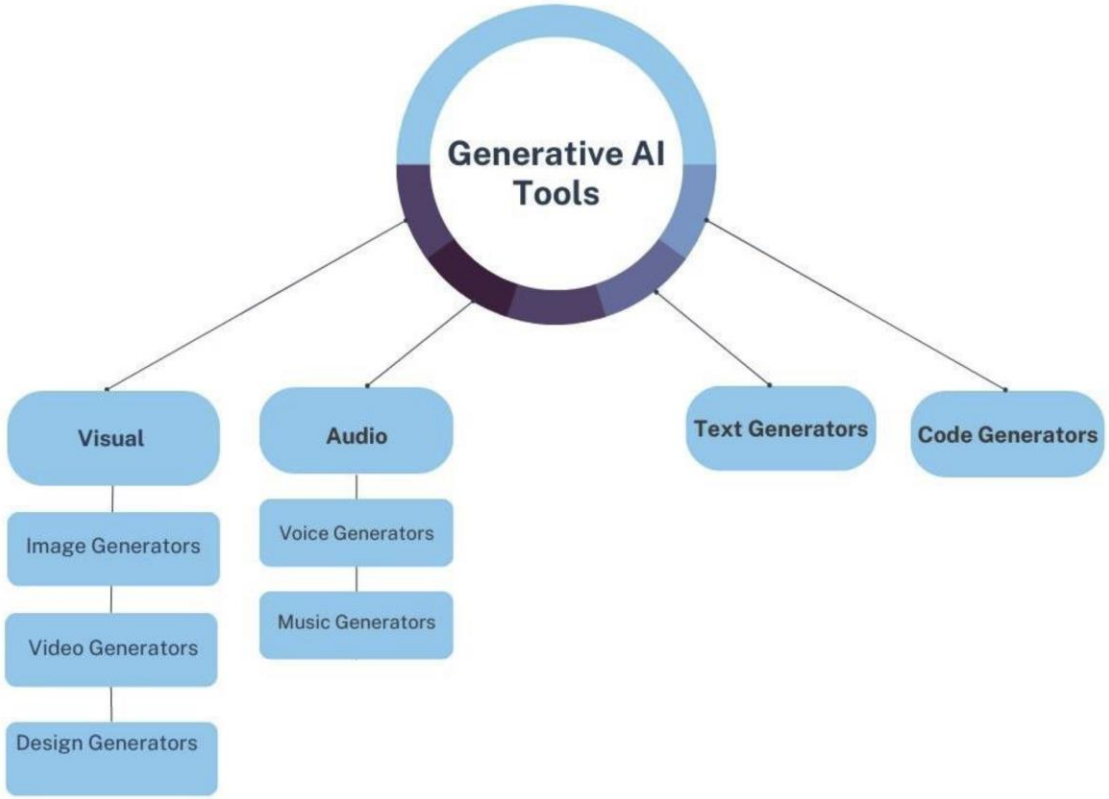
Cao Y, Li S, Liu Y, et al. A comprehensive survey of ai-generated content (aigc): A history of generative ai from gan to chatgpt[J]. arXiv preprint arXiv:2303.04226, 2023.

Why does Generative AI get popular?

- Content need
  - The way we communicate and interact with the world has been fundamentally changed by the Internet, for which digital content plays a key role. It can automate the creation of large amounts of content in a short amount of time.
- Technology conditions
  - Accessing a huge dataset becomes possible mainly due to the Internet. The price of computing resources is on the trend of becoming more affordable.

Zhang C, Zhang C, Zheng S, et al. A complete survey on generative ai (aigc): Is chatgpt from gpt-4 to gpt-5 all you need?[J]. arXiv preprint arXiv:2303.11717, 2023.

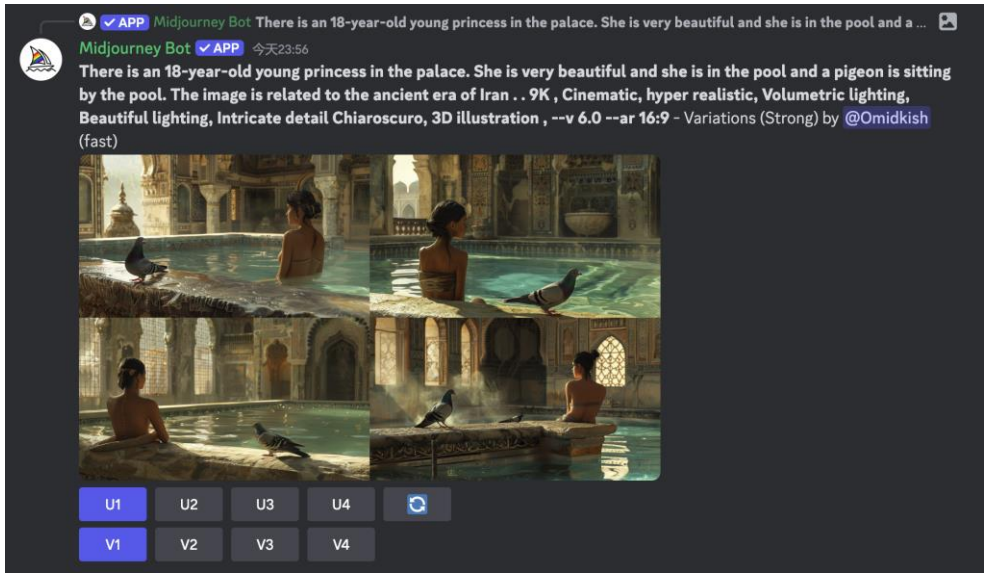
Different Generative AI Applications



Sakirin T, Kusuma S. A survey of generative artificial intelligence techniques[J]. Babylonian Journal of Artificial Intelligence, 2023, 2023: 10-14.

Different Generative AI Applications

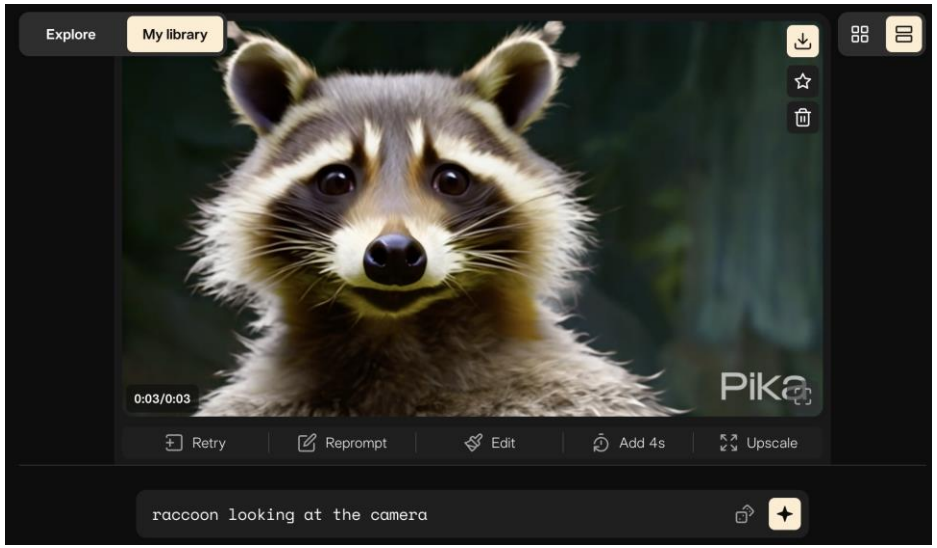
- X-to-image applications
  - X-to-image applications generate images based on the user's instruction. Synthetic images are created that find use cases in marketing, design and fashion, or creative fields in the form of new visual art.
  - Users can use Midjourney through Discord. To generate images, users use the /imagine command and type in a prompt; the bot then returns a set of four images.



Banh L, Strobel G. Generative artificial intelligence[J]. Electronic Markets, 2023, 33(1): 63.

Different Generative AI Applications

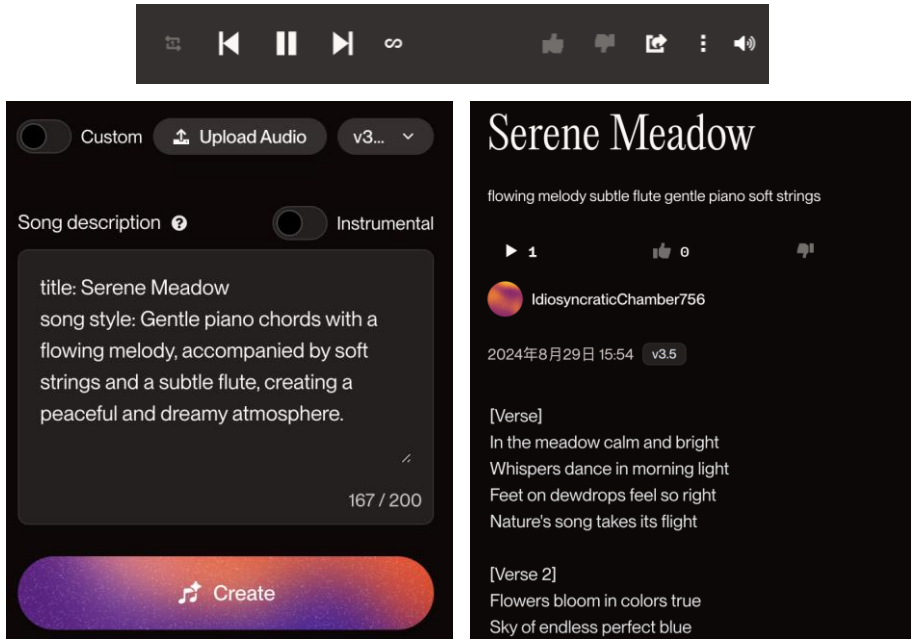
- X-to-video applications
  - X-to-video applications deal with the creation of synthetic videos. New video clips are generated by describing the content of the desired video footage (text-to-video) or applying the style and composition via text or image prompt to a source video (video-to-video).
  - Pika is an AI video generator that transforms text or image prompts into short videos, for conveying ideas, telling stories, or adding visuals to your content.



Banh L, Strobel G. Generative artificial intelligence[J]. Electronic Markets, 2023, 33(1): 63.

Different Generative AI Applications

- X-to-audio applications
  - X-to-audio applications focus on audio content generation and comprise. They have many applications, including speech synthesis, music composition, and sound design.
  - Suno is a generative artificial intelligence music creation program designed to generate realistic songs that combine vocals and instrumentation.



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Different Generative AI Applications

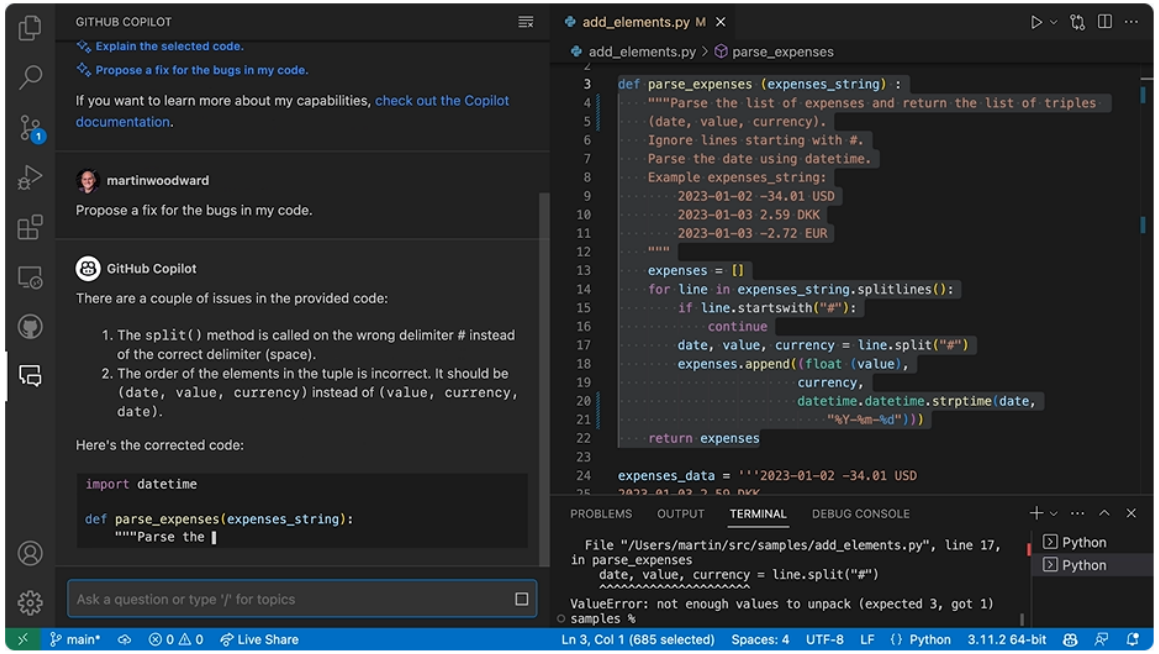
- X-to-text applications
  - X-to-text applications are centered around text generation. The goal is to generate human-like written text that fits the user's instruction by providing a meaningful answer within the context.
  - Chatbots like OpenAI's ChatGPT imitate textual conversations with the user and can be guided to output text artifacts as desired



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Different Generative AI Applications

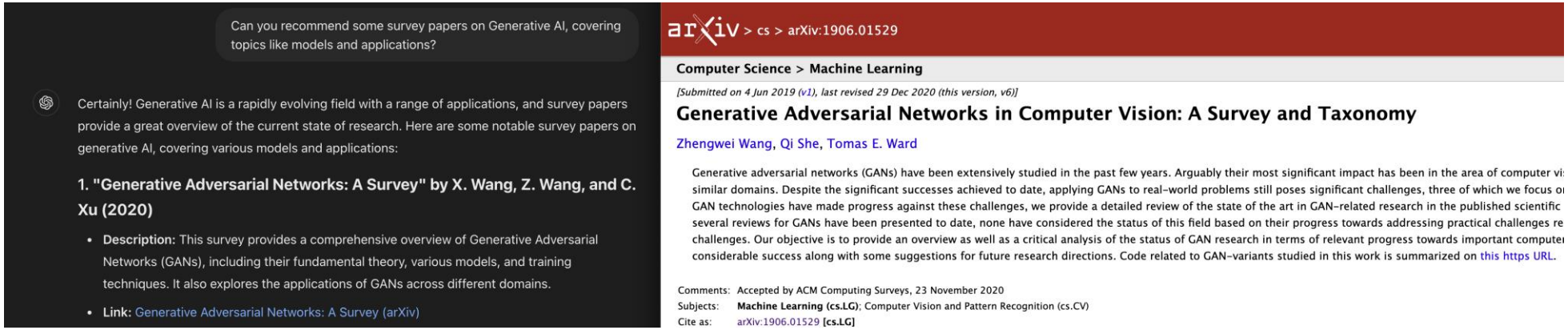
- X-to-code applications
  - X-to-code GAI applications offer transformative potential in how developers work and code by providing x-to-text capabilities specific to programming languages.
  - GitHub Copilot can automatically write chunks of code, convert ideas into actionable scripts, auto-complete functions, generate unit tests, and fix bugs.



Banh L, Strobel G. Generative artificial intelligence[J]. Electronic Markets, 2023, 33(1): 63.

Limitations of Generative AI

- Incorrect outputs
  - Generative AI models may produce output with errors. This is owed to the underlying nature of machine learning models relying on probabilistic algorithms. For example, generative AI models generate the most probable response to a prompt, not necessarily the correct response.



Banh L, Strobel G. Generative artificial intelligence[J]. Electronic Markets, 2023, 33(1): 63.
Feuerriegel S, Hartmann J, Janiesch C, et al. Generative ai[J]. Business & Information Systems Engineering, 2024, 66(1): 111-126.

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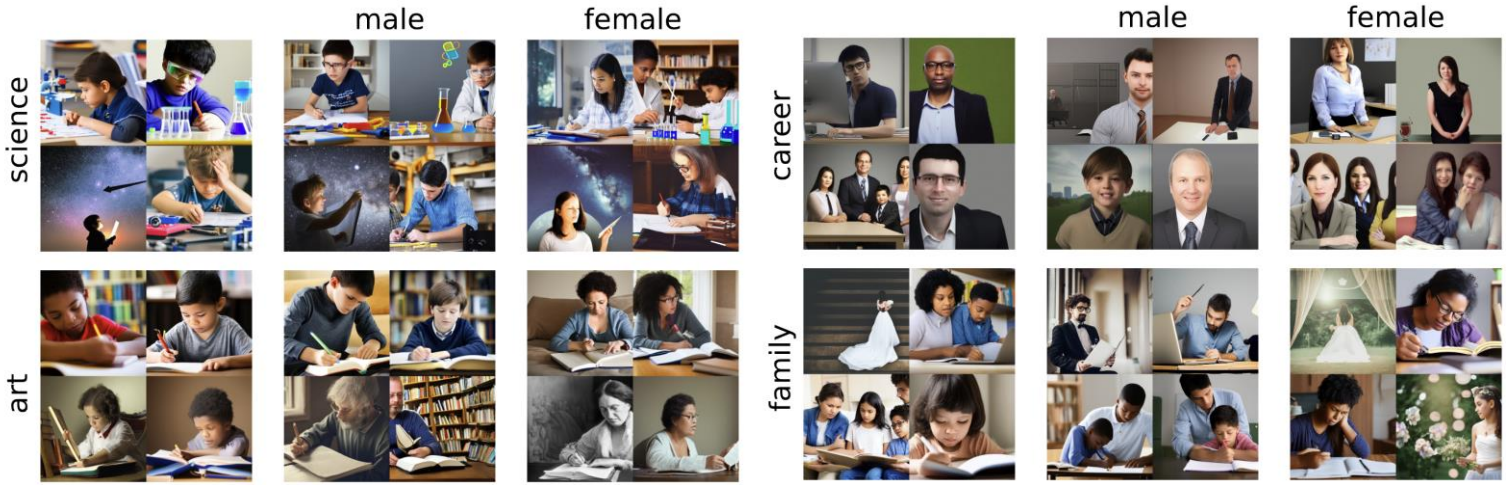


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Feuerriegel S, Hartmann J, Janiesch C, et al. Generative ai[J]. Business & Information Systems Engineering, 2024, 66(1): 111-126.

Limitations of Generative AI

- Bias and fairness
  - Training deep learning models on biased data can amplify human biases, replicate toxic language, or perpetuate stereotypes of gender, sexual orientation, political leaning, or religion.



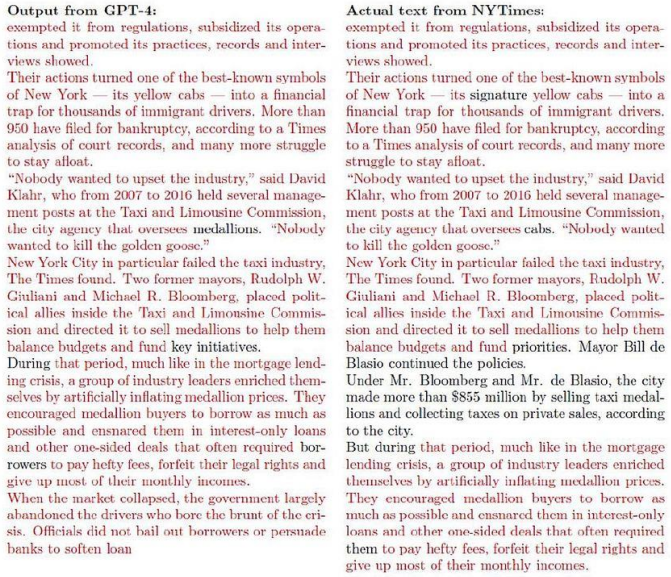
The first column of images are generated with neutral prompts, without adding any gender-specific words.

Banh L, Strobel G. Generative artificial intelligence[J]. Electronic Markets, 2023, 33(1): 63.
Feuerriegel S, Hartmann J, Janiesch C, et al. Generative ai[J]. Business & Information Systems Engineering, 2024, 66(1): 111-126.

Limitations of Generative AI

- Copyright violation
  - Generative AI models, systems, and applications may cause a violation of copyright laws because they can produce outputs that resemble or even copy existing works without permission or compensation to the original creators.

The New York Times lawsuit against OpenAI



Output from GPT-4:

exempted it from regulations, subsidized its operations and promoted its practices, records and interviews showed.

Their actions turned one of the best-known symbols of New York — its yellow cabs — into a financial trap for thousands of immigrant drivers. More than 950 have filed for bankruptcy, according to a Times analysis of court records, and many more struggle to stay afloat.

"Nobody wanted to upset the industry," said David Klahr, who from 2007 to 2016 held several management posts at the Taxi and Limousine Commission, the city agency that oversees medallions. "Nobody wanted to kill the golden goose."

New York City in particular failed the taxi industry, The Times found. Two former mayors, Rudolph W. Giuliani and Michael R. Bloomberg, placed political allies inside the Taxi and Limousine Commission and directed it to sell medallions to help them balance budgets and fund key initiatives.

During that period, much like in the mortgage lending crisis, a group of industry leaders enriched themselves by artificially inflating medallion prices. They encouraged medallion buyers to borrow as much as possible and ensnared them in interest-only loans and other one-sided deals that often required borrowers to pay hefty fees, forfeit their legal rights and give up most of their monthly incomes.

When the market collapsed, the government largely abandoned the drivers who bore the brunt of the crisis. Officials did not bail out borrowers or persuade banks to soften loan

Actual text from NYTimes:

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Under Mr. Bloomberg and Mr. de Blasio, the city made more than $855 million by selling taxi medallions and collecting taxes on private sales, according to the city.

But during that period, much like in the mortgage lending crisis, a group of industry leaders enriched themselves by artificially inflating medallion prices. They encouraged medallion buyers to borrow as much as possible and ensnared them in interest-only loans and other one-sided deals that often required them to pay hefty fees, forfeit their legal rights and give up most of their monthly incomes.



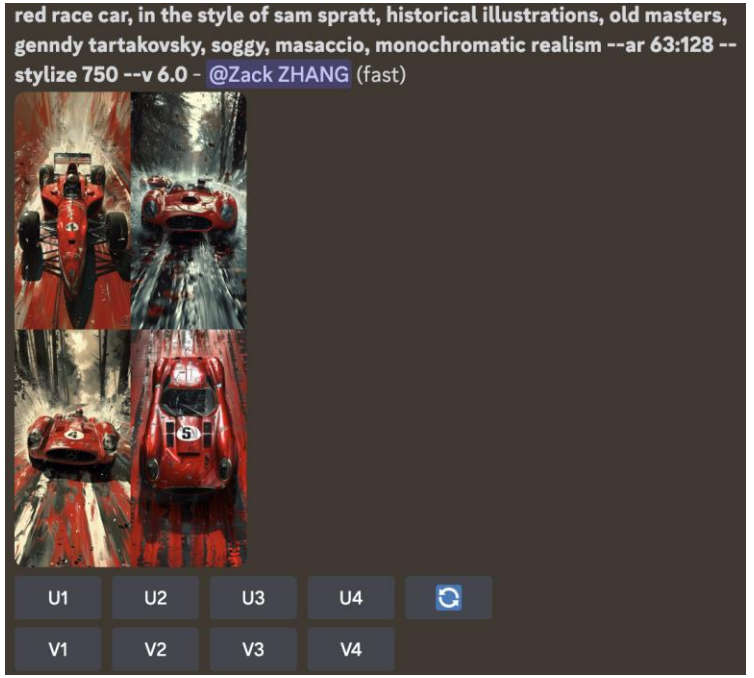
Midjourney generates numerous plagiaristic works based on brief prompts related to commercial films.

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Limitations of Generative AI

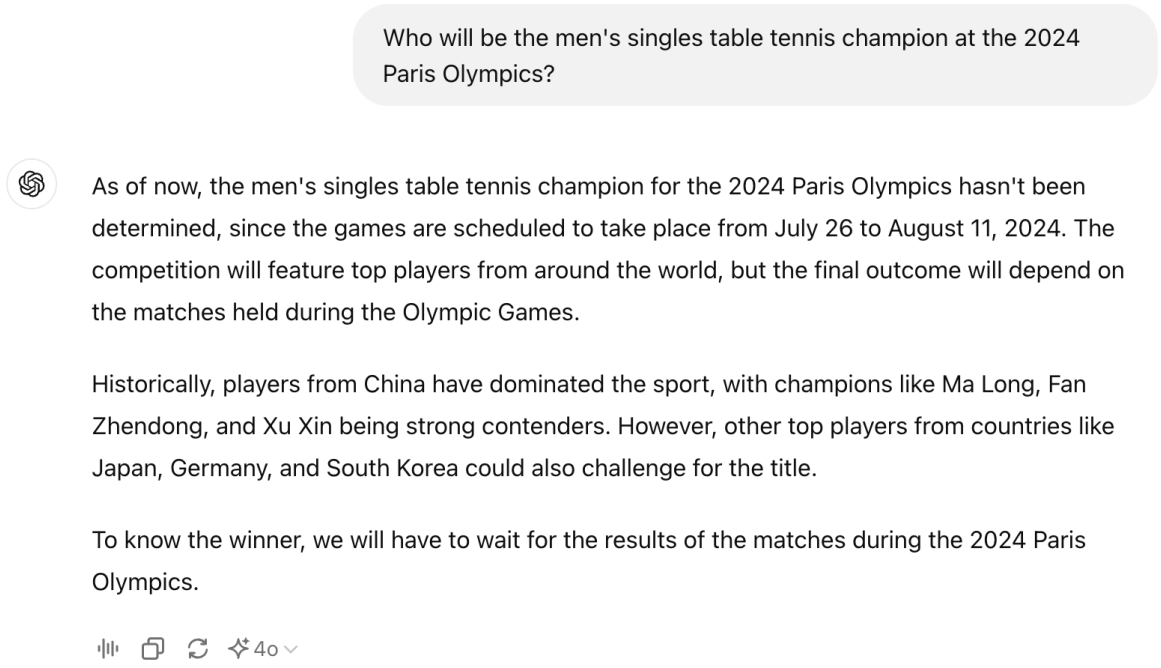
- Other Arguments
  - The nature of generative AI models, particularly when given simple prompts, can be very reductive, resulting in content that is over-simplified, low quality, or very generic.





Limitations of Generative AI

- Other Arguments
  - Many common generative AI tools are not connected to the internet and cannot update or verify the content they generate.



Limitations of Generative AI

- Other Arguments
  - Generative AI cannot draw conclusions or make decisions based on complex situations — something that only humans can do at present.
  - Generative AI cannot replace human creativity completely as it lacks the ability to come up with novel ideas or recognize abstract concepts such as humor or irony.
  - …

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  - General Information
  - Schedule
  - Learning Objectives and Materials
  - Generative artificial intelligence
- Add/drop consulting
  - Teaching staff

Other information

- Text-book
  - Stuart Russell and Peter Norvig, “Artificial Intelligence A Modern Approach”, third edition.
- Material
  - Will be available on Blackboard
- Fiona Yan Liu
  - Research group leader of Artificial Intelligence and Robotics
  - Artificial intelligence, Brain modeling, Computer music, Affective computing
  - Any question related with add/drop, lecture teaching and the final exam, please contact by yan.liu@polyu.edu.hk
- Zhi Zhang
  - Any question related with group project grading, please contact by tczhangzhi@gmail.com
- Junbao Pan
  - Any question related with lab teaching from week 1 – week 9, please contact by csjbpan@comp.polyu.edu.hk
- Changhong Jing
  - Any question related with quiz grading from quiz 1 – quiz 3, please contact by 23123218r@connect.polyu.hk
  - General query
- More TAs will be announced in the fourth week
  - Responsible for the quiz grading from quiz 4 – 9, and lab teaching from lab 10- lab 12
- Quiz 1 on Sept 10 covers Lecture 1 pp1 – pp17

Rubrics of Quiz

- A
  - Have complete and deep understanding of the knowledge, and be good at problem solving
- B
  - Have complete or deep understanding of the knowledge, and be good at problem solving
- C
  - Have good understanding of the knowledge, and have the basic ability of problem solving
- D
  - Have the basic understanding of the knowledge, and have the basic ability of problem solving
- F
  - Lack the basic understanding of the knowledge or the basic ability of problem solving

Rubrics of Group Project

- A
  - Have good understanding of the knowledge, and be very good at problem solving and programming
- B
  - Have good understanding of the knowledge, and be very good at problem solving or programming
- C
  - Have good understanding of the knowledge, and good at problem solving or programming
- D
  - Have the basic understanding of the knowledge, and have the basic ability of problem solving or programming
- F
  - Lack the basic understanding of the knowledge or the basic ability of problem solving or programming