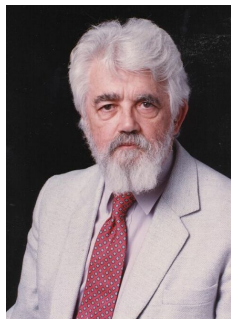# CSIT5900 Lecture 1: Introduction

Department of Computer Science and Engineering
Hong Kong University of Science and Technology

What is AI?

- A calculator?
- ChatGPT?
- An OS like iOS or Windows?
- An editor like Word or Emacs?

What is AI?

According to John McCarthy, one of the founders of AI:

"It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable."

How It Got Started

Ada Lovelace (1815 - 1852), the only child of the poet Lord Byron.

- Her note G describes an algorithm for Babbage's Analytical Engine to compute Bernoulli numbers, and was considered to be the first published computer program.
- She wrote that "The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths."

How It Got Started

Alan Turing (1912 - 1954), the father of computer science.

Alan Turing. Computing machinery and intelligence. *Mind*, 59:433-460, 1950.

"I propose to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think.'"'

How It Got Started

The Dartmouth Conference (1956): proposed by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon:

> We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.

Here was for the first time the term "artificial intelligence" was used (coined by McCarthy).

More, McCarthy, Minsky, Selfridge, Solomonoff (2006)

Shannon, McCarthy, Ed Fredkin and Joseph Weizenbaum (1966)

Some Influential AI Systems

- Marvel (1992) - a real-time expert system that monitors the massive stream of data from the Voyager spacecraft, handling routine tasks, and alerting the analysts to more serious problems at JPL.

- Pegasus (1994) - a speech understanding program that handles airline ticket reservations.

- An AI planning and scheduling system employed by US military during the Gulf War. (DARPA later reported that the savings resulted from using this single AI system had paid back the US Government all its investment on AI during the past 20 years.)

- Deep Blue (1997), AlphaGo (2016) and AlphaGo Zero (2017), IBM Watson (2011), BERT (2018), GPT-3 (2020), AlphaFold (2020), ChatGPT (2022), GPT4 (2023).

How Smart is Today's AI?

Current AI systems are still brittle - many examples (old and new):

- Object recognition: elephant in the room
  https://arxiv.org/pdf/1808.03305.pdf;
- Deep reinforcement learning: change the position of the paddle by a
  few pixels, the DeepMind's system for the breakout game doesn't
  work anymore https://www.vicarious.com/2017/08/07/
  general-game-playing-with-schema-networks/.
- NLP systems: much bigger and better models but still brittle and
  random at times.

Three Aspects of AI

1. What motivate AI researchers? What are their long term goal?
   - AI researchers want to make machines (esp. computer programs) that can do things (for humans) which so far can only be done by humans.
   - In terms of computer science, AI is in the forefront of computer applications.
   - AI's long term goal is to build machines that can sense, think, and act intelligently.
2. What are the techniques and algorithms that have come out of AI?
   - Heuristic search algorithms, knowledge representation languages and reasoners, machine learning algorithms, etc.
3. What are the impacts of AI?
   - On other science and engineering: math, physics, chemistry, biology, etc
   - On our everyday life
   - On humanity in general

Course Objectives

1. Understand AI's challenges and long term goals.
2. Learn fundamental AI techniques and algorithms, not just the current popular ones.
3. Appreciate AI problem solving methodology.

Syllabus

- Designing simple agents (using machine learning, rule-based systems, machine evolution)
- Search (heuristic search, CSP, game tree search, MDP)
- Multiagent systems (game theory and auction)
- Knowledge representation and reasoning
- Uncertainty in AI
- Generative AI

Other course information - see canvas

AI and CS

Is AI part of the CS?

- Computer architecture: design computers using basic elements like gates;
- Networking: design protocols for computers to pass information around;
- Programming languages: design languages to write programs in;
- Database: design database systems for storing data and answering queries about it;
- Software engineering: tools for helping writing and maintaining reliable software;
- Operating systems: design operating systems;

AI? Which part of a computer system is it about?

AI and CS

- AI is the science and engineering of making intelligent computer programs, the frontier of computer applications.
- AI gives you new ways to solve problems on computer: new methodologies, new algorithms, etc.

New Problem Solving Methdology Using Generative AI

Write a python program that accepts a text file of either Chinese or English and outputs the following:

1. The total number of words (Chinese characters) in the file
2. The line numbers of the shortest and longest lines, respectively, in the file
3. The number of lines that contain all of the words in one of the shortest lines.

How do you think you would solve the problem two years ago? How about now? Would GPT4 or CoPilot help?