Applied AI

Lecture 1

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Agenda

- Introduction
- Assessment
- Resources
- Lectures
- Recent Developments
- History, issues
- Next steps

Introduction

Aims: To give the student the background knowledge and practical skills to use and evaluate AI techniques over a range of problem domains.

- Understand the fundamental concepts, issues, and techniques of AI.

- Implement and use AI techniques across a broad range of AI sub-fields.

- Evaluate when and under what conditions it is appropriate to use each AI technique.

- Understand the historical background and evolution of AI techniques.

- Each week an essential technique will be demonstrated via a working implementation followed by a presentation of the theory and conditions needed to enable the student to set up and use the techniques themselves. Guest presentations by experts in a relevant topic will be arranged where possible.

Assessment

Assessment Name	Weight	Qual Mark	Due Date	
Coursework	50	30	Wed, 11th Jan 1pm	Research, implement, and evaluate an AI application.
In-Class Test (On Blackboard)	50	30	Week 12 In your seminar (must attend in person or seek MC)	Multiple choice and short answer questions on the blackboard. Covering all topics up to 11. Duration 90 minutes.

Resources

- Your main resource will be the book Artificial Intelligence: A Modern Approach, Russel and Norvig
  - Access via the **Reading List on Blackboard**
- Sample code in many languages and available on the book website:
- https://github.com/aimacode
- The web (obviously). There are many online courses and tutorials covering every aspect of artificial intelligence.
- arXiv.org approx. 59 000 papers on Artificial Intelligence
- Additional resources will be added during the specific lectures.

Lecture schedule

1. Introduction and History of AI
2. Agents and Environments
3. Search
4. Adversarial Games
5. Knowledge representation and planning
6. -------Engagement week--------
7. Machine Learning
8. Neural Networks
9. Computer Vision/Deep Learning
10. LLMs
11. Reinforcement Learning
12. Revision session

Recent Developments
Companies to watch

- [DeepMind](#)
- [Tesla](#)
- [IBM](#)
- [Microsoft](#)
- [Amazon](#)
- [Meta(Facebook)](#)

Recent Developments: Google Deep Mind

- In April 2023, Google announced that it is merging its two main AI research groups - Google Brain and DeepMind - into a single unit called Google DeepMind

We work on some of the most complex and interesting challenges in AI.

Explore our research across

→ Deep learning

→ Control and robotics

→ Reinforcement learning

→ Sciences

→ Theory and foundations

→ Unsupervised learning and generative models

→ Neuroscience

Recent Developments: LLMs, ChatGPT, Bard, Llama, etc...

- [OpenAI ChatGPT](#)

- [Google Bard](#)

- [Perplexity](#)

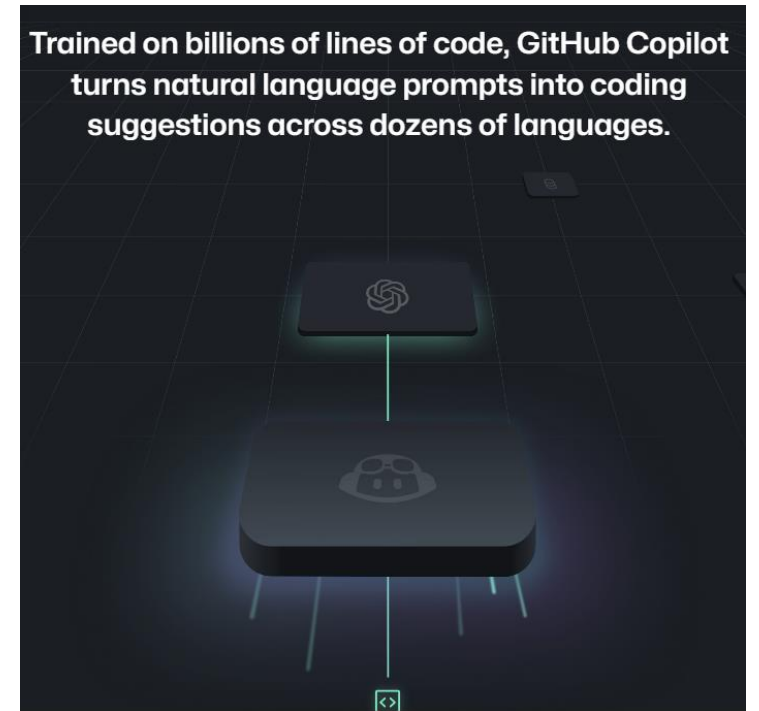- [Open Source](#)

- Controversial –
  - is it sentient?

Recent Developments: Natural Language to code

OpenAI Codex

We've created an improved version of OpenAI Codex, our AI system that translates natural language to code, and we are releasing it through our API in private beta starting today. Codex is the model that powers GitHub Copilot, which we built and launched in partnership with GitHub a month ago. Proficient in more than a dozen programming languages, Codex can now interpret simple commands in natural language and execute them on the user's behalf—making it possible to build a natural language interface to existing applications. We are now inviting businesses and developers to build on top of OpenAI Codex through our API.

Trained on billions of lines of code, GitHub Copilot turns natural language prompts into coding suggestions across dozens of languages.

- https://openai.com/blog/openai-codex/
- https://github.com/features/copilot
- https://aws.amazon.com/codewhisperer

Recent Developments: Natural Language to ART

- DALL-E 2
  - https://openai.com/dall-e-2/

- Midjourney
  - https://www.midjourney.com/home/

- Stable Diffusion (open source)
  - https://stability.ai/blog/stable-diffusion-public-release
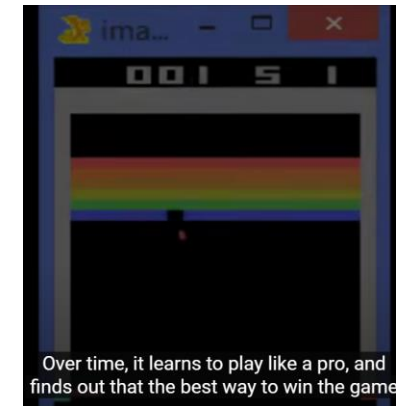 - Try it: https://huggingface.co/spaces/stabilityai/stable-diffusion

Recent Developments: Games:

- AlphaZero: Chess, Go
  - https://www.deepmind.com/blog/alphazero-shedding-new-light-on-chess-shogi-and-go

Over time, it learns to play like a pro, and finds out that the best way to win the game

- 57 Atari games at superhuman level. https://www.youtube.com/watch?v=dJ4rWhpAGFI

- Can beat top human players at the strategy game StarCraftII
  - https://www.nature.com/articles/d41586-019-03298-6

STARCRAFT II

THE ULTIMATE
REAL-TIME STRATEGY GAME

Recent Developments: Boston Dynamics
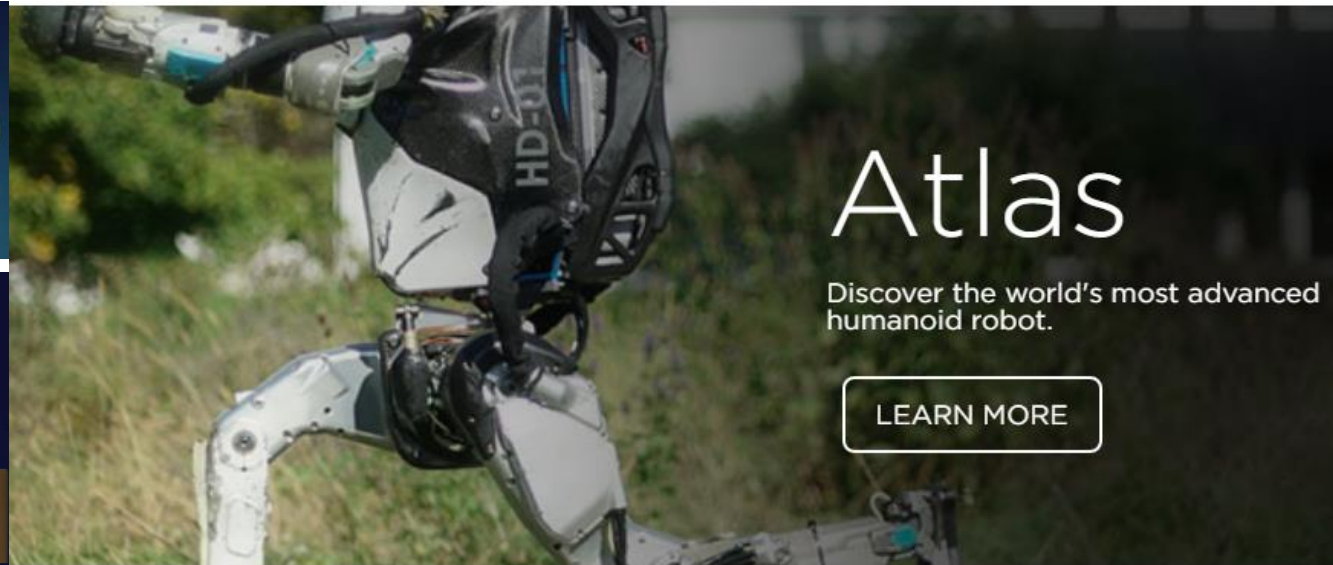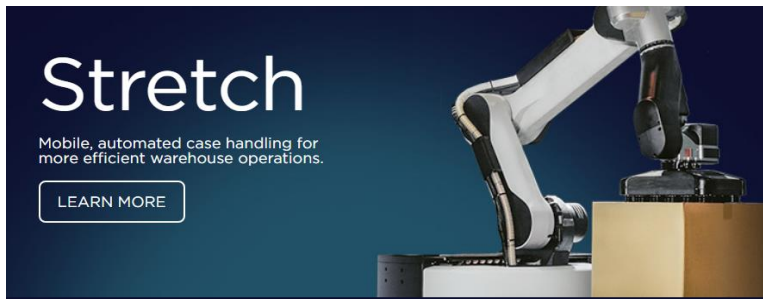
https://www.youtube.com/watch?v=-e1_QhJ1EhQ

AI in Industry

- Healthcare – computer vision for diagnosis.

- Services – Chatbots, virtual bookings

- Financial Services – Fraud detection, Algorithmic trading

- Life Sciences - drug discovery, predicting disease spread.

- Telecommunications – network optimisation, predictive maintenance

- Energy – monitoring, predicting demand

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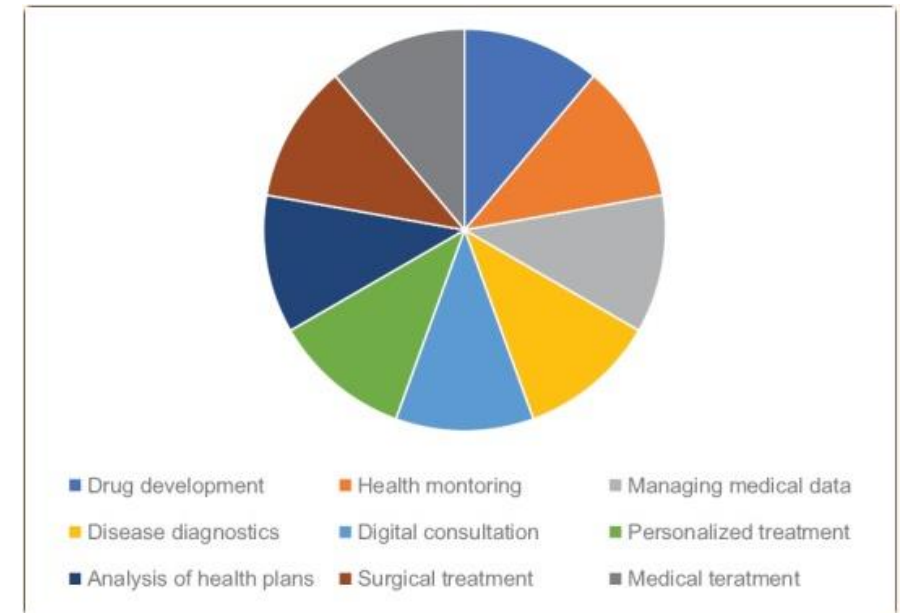
Which AI application is most exciting?

A. Robotics

B. Computer Vision

C. Natural Language Processing

D. Gaming

E. Self Driving

What is Artificial Intelligence?

- Intelligence: the ability to learn and perform suitable techniques to solve problems and achieve goals, appropriate to the context, in an uncertain, ever-varying world. (Prof. Chris Manning, Stanford)

- A term coined by Professor John McCarthy in 1955, was defined by him as "the science and engineering of making intelligent machines"

- Purposely open definition to encourage exploration. This has had positive and negative implications. See: Lighthill report

- Tom Mitchell: "A computer program is said to learn from experience **E** with respect to some class of tasks **T** and performance measure **P**, if its performance at tasks in **T**, as measured by **P**, improves with experience **E**."

- See more definitions here: https://hai.stanford.edu/sites/default/files/2020-09/AI-Definitions-HAI.pdf

Artificial Intelligence
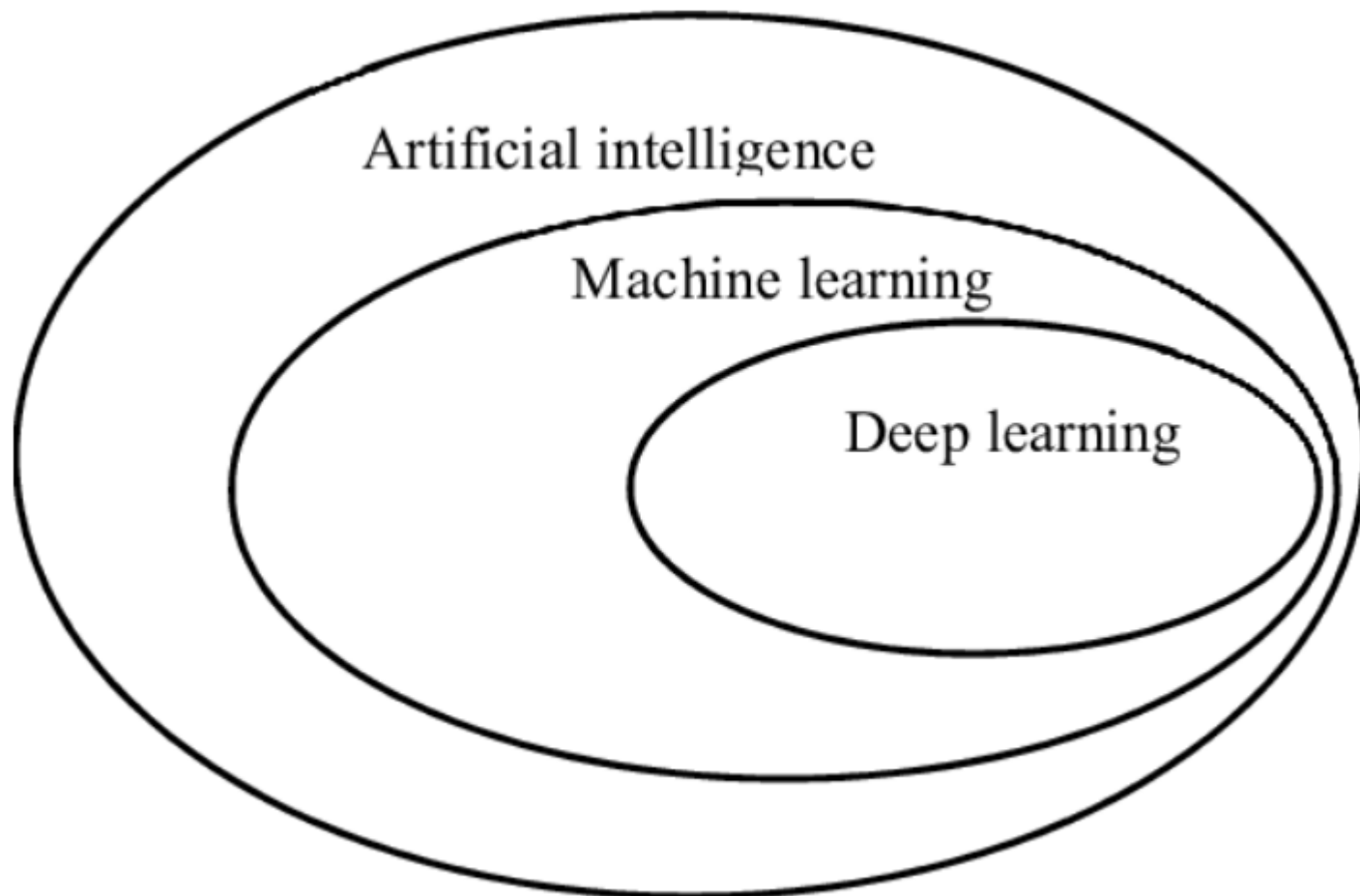
A (Short) History of AI

- 1940—1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"

- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
  - 1965: Robinson's complete algorithm for logical reasoning

- 1970—90: Knowledge-based approaches
  - 1969—79: Early development of knowledge-based systems
  - 1980—88: Expert systems industry booms
  - 1988—93: Expert systems industry busts: "AI Winter"

- 1990—2012: Statistical approaches + subfield expertise
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… "AI Spring"?

- 2012—: Excitement: Look, Ma, no hands!
  - Big data, big compute, neural networks
  - Some re-unification of subfields
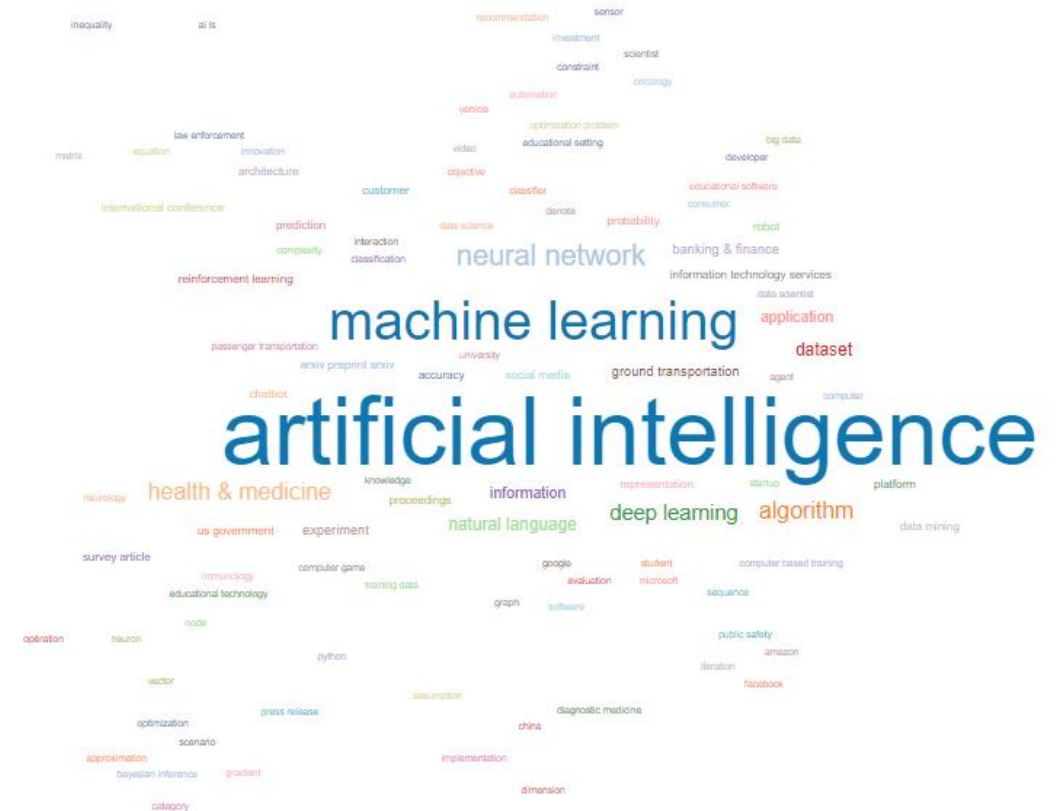 - AI used in many industries
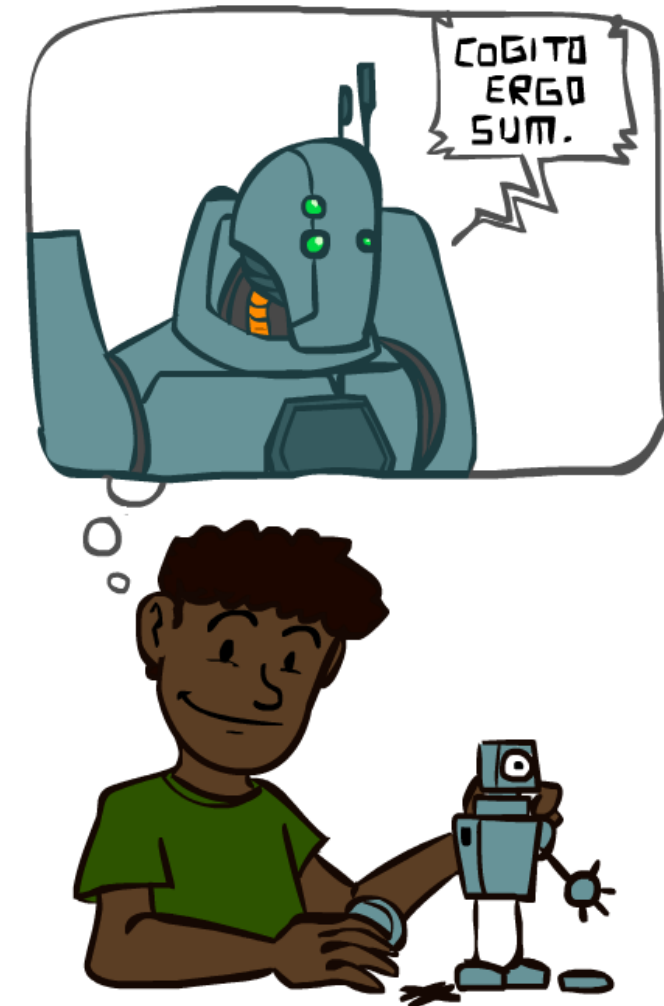
AI – Then and Now

1986-1990 vs 2017-now
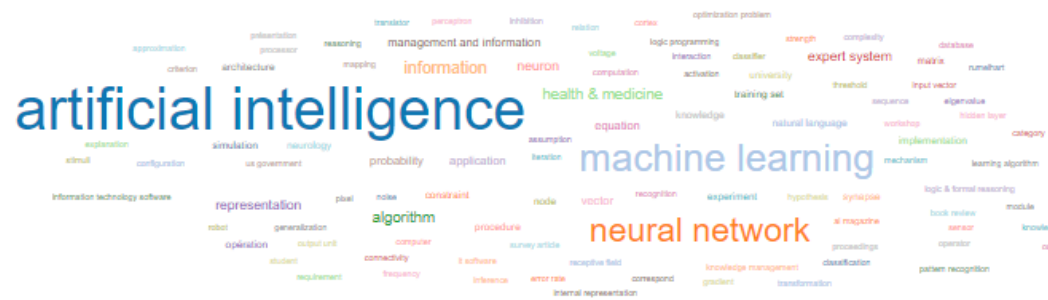
What are the main differences?
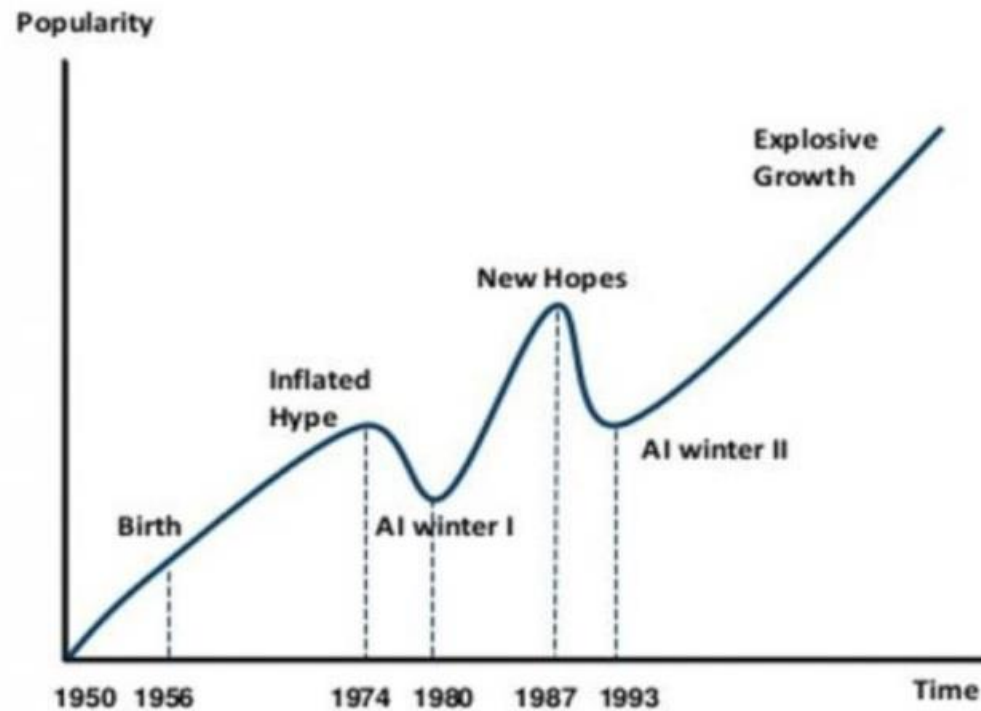Explore other periods on your own.

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Which program was an early AI demonstration of logical reasoning?

A. ELIZA

B. Logic Theorist

C. General Problem Solver

D. Expert systems

AI Promises

AI HAS A LONG HISTORY OF BEING "THE NEXT BIG THING"...

Popularity

Explosive Growth

New Hopes

Inflated Hype

AI winter II

Birth

AI winter I

1950 1956   1974 1980   1987 1993   Time

Timeline of AI Development

- **1950s-1960s**: First AI boom - the age of reasoning, prototype AI developed
- **1970s**: AI winter I
- **1980s-1990s**: Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- **1990s**: AI winter II
- **1997**: Deep Blue beats Gary Kasparov
- **2006**: University of Toronto develops Deep Learning
- **2011**: IBM's Watson won Jeopardy
- **2016**: Go software based on Deep Learning beats world's champions

Golden Age or another AI Winter?

- https://venturebeat.com/2019/11/16/is-ai-in-a-golden-age-or-on-the-verge-of-a-new-winter/

- Lots of hype but also something is different (non toy-domain results)

- Some of the success can be attributed to advancement of computational capability and availability of 'big data'

- AI is always the next big thing, hence never attainable. Should we call it Computational Intelligence to tone down the hype?
  - https://www.youtube.com/watch?v=4sCK-a33Nkk

- Money and marketing vs Scientific reality. Gartner predicts 16Trillion industry by 2030!

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Do you think we are heading towards another AI winter?

Lets discuss briefly.

Issues and concerns with AI

- Ethical/Legal implications – if AI is mainstream who is responsible?
- AI taking over jobs – including creative jobs.
- What happens if/when we reach the **singularity** – many have weighed in on this topic including – Hawkings, Musk, Kurzweil etc
- Can AI achieve Consciousness? Is General AI even possible? Mind transfer?
- Inherent bias in data? AI favours men for jobs due to historic training data
- Can you think of others?

Advantages and benefits of AI

- Higher intelligence brings greater insight and understanding into complex problems. Did AlphaGo destroy the game of Go? Will DALL-E destroy art?

- AI/Robots can do jobs that humans cannot. Greater efficiency 24x7, productivity and hence quality of life.

- Copy/paste knowledge. Transfer of skills – humans need years.

- Aid human engineering and creativity. Bicycles for the mind.

- Autonomous wars – no/less humans involved?

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What concerns you most about AI?

A. Unemployment

B. Bias

C. Privacy

D. Danger

E. Other

Seminar

- No seminar this week but you can do some home study.

- Find your 2 favourite examples of AI, one from fiction and one from real life and explore it. *For example, HAL9000 from the movie 2001 A space Odyssey, and Alpha Zero (Go implementation) , or DALL-E. Compare and contrast and ask yourself, "are we there yet?"* We will discuss your examples in the next lecture.

- Familiarise yourself with the book.
  - Read chapter 1. Introduction.

- Revise your python knowledge from first year.

- In next weeks seminar we will cover Python and work through the environment we will be using: jupyter lab, how to install libraries.

Questions Discussion?