

AI 101





What is AI?

Artificial Intelligence (AI) involves creating computer systems that can perform tasks typically requiring human intelligence. Systems that 'think', or make decisions in some way.

Most AI is 'weak', meaning it's narrow and domain specific.

AGI, or Artificial General Intelligence, is a hypothetical AI system which is general purpose, able to perform a wide variety of tasks. This is termed 'strong' AI.

More general purpose AI models are emerging, and progress is accelerating, but we have not yet seen a true AGI system



AI Applications

Search engines

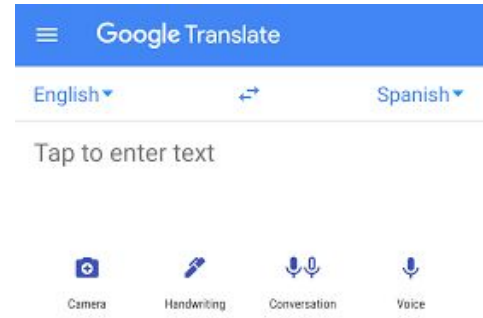
Real-time translation

Voice assistants

Autonomous vehicles

Advanced robotics

... many, many more

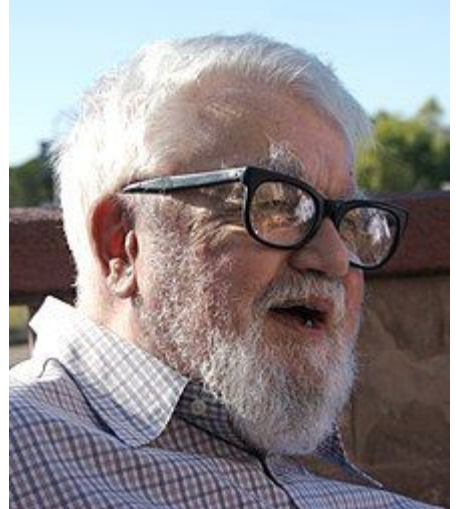
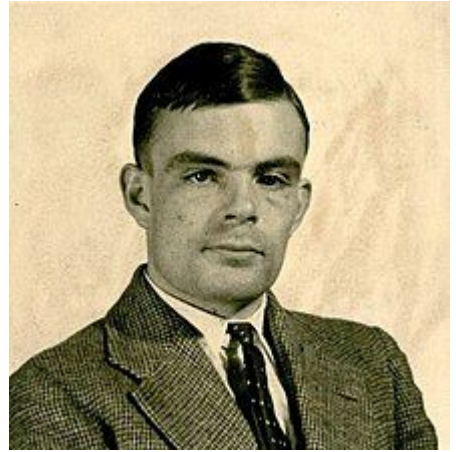




History of AI

1950s - The Conceptual Foundation: Alan Turing proposes the Turing Test to evaluate a machine's ability to exhibit intelligent behavior equivalent to, or indistinguishable from, that of a human.

1956 - The Birth of AI: The term "Artificial Intelligence" is coined by John McCarthy at the Dartmouth Conference, where the goal was to explore ways machines could simulate every aspect of learning or any other feature of intelligence.

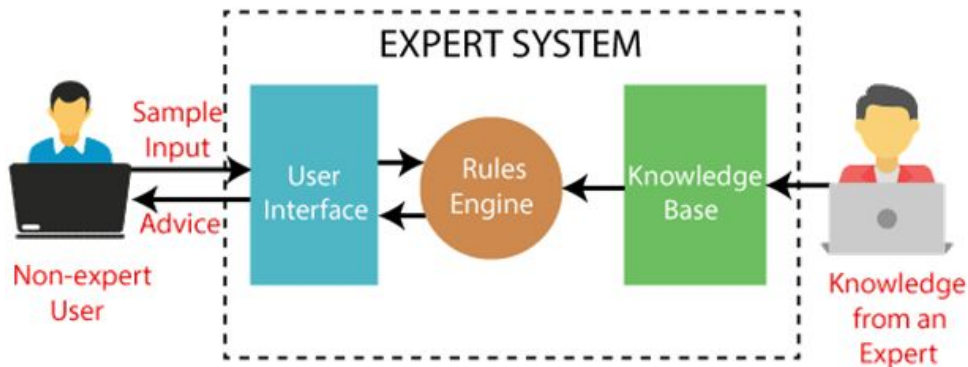




History of AI

1960s to 1970s - Early Enthusiasm and AI Winter: Initial optimism about quick progress in AI led to significant investment. However, the difficulty of task understanding and limited computational power led to the first "AI Winter" by the late 1970s, a period of reduced funding and interest in AI research.

1980s - Revival with Expert Systems: AI experienced a revival with the commercial success of expert systems (diagnosis, financial investment, troubleshooting, customer service etc), which simulated the decision-making ability of a human expert. The expert is modelled with a knowledge base and an inference (rules based) engine. The development of machine learning algorithms also gained momentum.



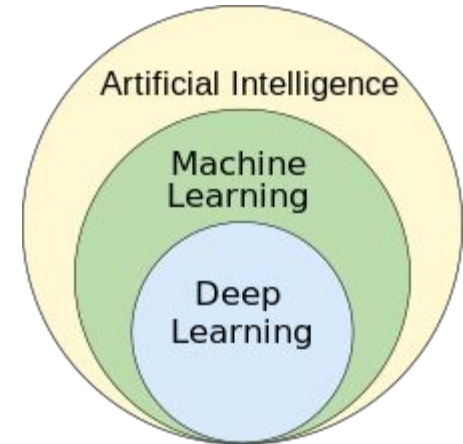
A [Symbolics 3640 Lisp machine](#): an early (1984) platform for expert systems



History of AI

1990s - Machine Learning Takes Off: As computational power increased, so did the effectiveness of machine learning techniques.

The focus shifted from knowledge-driven to data-driven approaches, paving the way for modern AI.



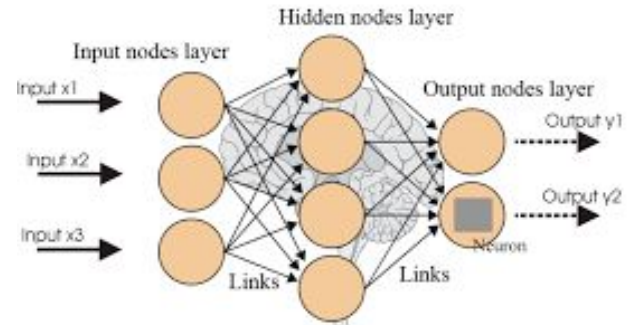


History of AI

2000s - Big Data and Advanced Algorithms: The proliferation of the internet and the digitization of information led to the era of big data.

This provided AI systems with massive amounts of information to learn from.

Deep learning started to become a crucial technology.





History of AI

2010s - AI Goes Mainstream

Breakthroughs in deep learning catalyzed AI performance, particularly in areas like vision and language processing, leading to practical applications such as:

- voice-activated assistants (Alexa, Siri, Echo)
- real-time translation (Google Translate)
- autonomous vehicles (Tesla)





History of AI

2020s - AI is now central in addressing complex problems across various domains, including healthcare, climate science, and finance.

The development and public release of powerful transformer based LLMs (Large Language Models) like GPT and BERT bring the topic into the zeitgeist. Generative AI begins to reshape many creative tools and processes.

Ethical AI and Broad Applications: As AI technology becomes integrated into all sectors of life, issues of ethics, bias, and human impact are at the forefront of the discussion.



How LLMs Work

Based on Probability: LLMs predict the next word (or token) in a sentence by calculating the probability of every possible word that could follow the given text based on training data. They typically choose the word with the highest probability.

Training on Large Datasets: These models are trained on vast amounts of text, allowing them to learn common patterns in language, such as grammar and context. The more diverse and extensive the training data, the more accurate the downstream predictions.

Transformer Architecture: LLMs typically use a specific type of neural network called a transformer. This architecture is designed to handle sequences of data (like sentences) and is particularly good at managing relationships between words, no matter how far apart they are in the text.



How LLMs Work

Self-Attention Mechanism: One key feature of transformers is the self-attention mechanism. This allows the model to weigh the importance of each word in a sentence when predicting the next word. For example, in the sentence "The cat that chased the mouse was hungry," the model recognizes that "was" relates strongly to "cat."

Continuous Learning and Updating: As they are used and exposed to more text, some models continue to refine their predictions.



Uses of Gen-AI in Programming

Code Generation: LLMs can learn patterns in code just like in natural language. This allows them to suggest solutions to problems, generate functions for you based on natural language descriptions etc.

Future generations of these models will be more agentic, engaging in multi-step reasoning, debugging etc (GitHub Copilot Workspaces etc)

Current generation models can be particularly good at explaining code, helping you debug broken code, analysing error messages etc.





Coding LLMs: Risk Factors

Quality and Reliability Issues: GenAI-generated code may not always meet the high standards required for robustness, security, and efficiency. Relying on it without thorough validation could lead to unreliable software products.

Security Vulnerabilities: Automatically generated code could inadvertently introduce security vulnerabilities, especially if the underlying AI models are not trained with security-focused datasets.

Loss of Developer Expertise: Over-reliance on GenAI for coding tasks could lead to a decline in traditional coding skills among programmers, potentially reducing their ability to solve complex problems without AI assistance.

Bias and Fairness: If the training data used by GenAI models is biased, the generated code could perpetuate or amplify these biases, leading to unfair outcomes or discriminatory practices.

