Brief history of AI

- The history of AI begins with the following articles:
  - Turing, A.M. (1950), Computing machinery and intelligence, Mind, Vol. 59, pp. 433-460.

MIND

A QUARTERLY REVIEW

OF

PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND INTELLIGENCE

By A. M. Turing

I propose to consider the question, 'Can machines think?' . . .

Alan Turing - Father of AI

Alan Turing (OBE, FRS)

- Born 23 June 1912, Maida Vale, London, England

- Died 7 June 1954 (aged 41), Wilmslow, Cheshire, England

- Fields: Mathematician, logician, cryptanalyst, computer scientist

- Institutions:
  - University of Manchester
  - National Physical Laboratory
  - Government Code and Cypher School (Britain's codebreaking centre)
  - University of Cambridge

Alan Turing memorial statue in Sackville Park, Manchester

Turing's paper on AI

– A. M. Turing, "Computing Machinery and Intelligence", Mind, (New Series), Vol. 59, No. 236, 1950, pp. 433-460.

Brief history of AI - The Birth of AI

- **The birth of artificial intelligence**
  - 1950: Turing's landmark paper "Computing machinery and intelligence" and Turing Test
  - 1951: AI programs were developed at Manchester:
    - A draughts-playing program by Christopher Strachey
    - A chess-playing program by Dietrich Prinz
    - These ran on the Ferranti Mark I in 1951.
  - 1955: Symbolic reasoning and the Logic Theorist
    - Allen Newell and (future Nobel Laureate) Herbert Simon created the "Logic Theorist". The program would eventually prove 38 of the first 52 theorems in Russell and Whitehead's Principia Mathematica
  - 1956: Dartmouth Conference - "Artificial Intelligence" adopted

Brief history of AI - The Birth of AI

- **The birth of artificial intelligence**
  - 1956: Dartmouth Conference - "Artificial Intelligence" adopted
  - The term 'Artificial Intelligence' was coined in a proposal for the conference at Dartmouth College in 1956

  - The term stuck, though it is perhaps a little unfortunate . . .

Brief history of AI – The Birth of AI

- One of the early research in AI is search problem such as for game-playing. Game-playing can be usefully viewed as a search problem in a space defined by a fixed set of rules
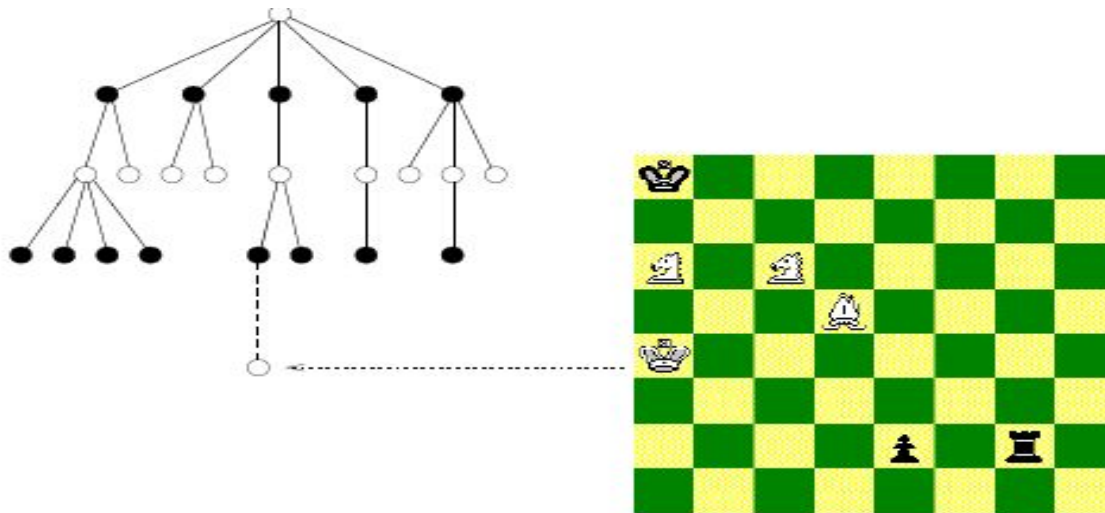
- Nodes are either white or black corresponding to reflect the adversaries' turns.

- The tree of possible moves can be searched for favourable positions.

Brief history of AI – The Birth of AI

- The real success of AI in game-playing was achieved much later after many years' effort.

- It has been shown that this search based approach works extremely well.

- In 1996 IBM Deep Blue beat Gary Kasparov for the first time. and in 1997 an upgraded version won an entire match against the same opponent.

Brief history of AI – The Birth of AI

- Another of the early research in AI was applied the similar idea to **deductive logic**:

All men are mortal	$\forall x\, (\text{man}(x) \rightarrow \text{mortal}(x))$
Socrates is a man	man(Socrates)
Socrates is mortal	mortal(Socrates)

- The discipline of developing programs to perform such logical inferences is known as (automated) **theorem-proving**

- Today, theorem-provers are highly-developed . . .

Brief history of AI – The Birth of AI

- In the early days of AI, it was conjectured that theorem-proving could be used for commonsense reasoning

- The idea was to code common sense knowledge as logical axioms, and employ a theorem-prover.

- Early proponents included John McCarthy and Patrick Hayes.

- The idea is now out of fashion: logic seems to rigid a formalism to accommodate many aspects of commonsense reasoning.

- Basic problem: such systems do not allow for the phenomenon of uncertainty.

Brief history of AI - Golden years 1956-74

- **Research**:
  - **Reasoning as search:** Newell and Simon developed a program called the "General Problem Solver".
  - **Natural language Processing**: Ross Quillian proposed the semantic networks and Margaret Masterman & colleagues at Cambridge design semantic networks for machine translation
  - **Lisp**: John McCarthy (MIT) invented the Lisp language.

- **Funding for AI research**:
 - Significant funding from both USA and UK governments

- **The optimism**:
  - 1965, Simon: "machines will be capable, within twenty years, of doing any work a man can do
  - 1970, Minsky: "In from three to eight years we will have a machine with the general intelligence of an average human being."

Brief history of AI - The golden years

- Semantic Networks

  – A semantic net is a network which represents semantic relations among concepts. It is often used as a form of knowledge representation.

  – Nodes : used to represent objects and descriptions.

  – Links : relate objects and descriptors and represent relationships.
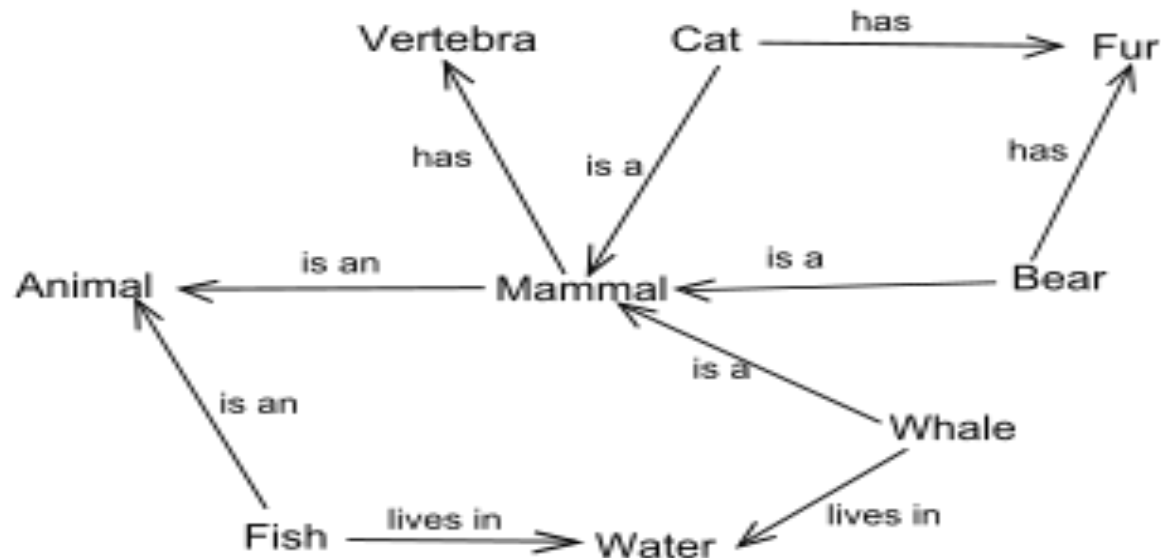
Brief history of AI - The golden years

- Lisp
  - Lisp (or LISP) is a family of computer programming languages with a long history and a distinctive, fully parenthesized syntax.
  - Originally specified in 1958, Lisp is the second-oldest high-level programming language in widespread use today; only Fortran is older.
  - LISP is characterized by the following ideas:
    - computing with symbolic expressions rather than numbers
    - representation of symbolic expressions and other information by list structure in the memory of a computer
    - representation of information in external media mostly by multi-level lists and sometimes by S-expressions
  - An example: lisp S-expression:

    (+ 1 2 (IF (> TIME 10) 3 4))

Brief history of AI - The first AI winter

- **The first AI winter 1974−1980:**
  - **Problems**
    - **Limited computer power**: There was not enough memory or processing speed to accomplish anything truly useful
    - **Intractability and the combinatorial explosion**. In 1972 Richard Karp showed there are many problems that can probably only be solved in exponential time (in the size of the inputs).
    - **Commonsense knowledge and reasoning**. Many important applications like vision or natural language require simply enormous amounts of information about the world and handling uncertainty.
  - **Critiques from across campus**
    - Several philosophers had strong objections to the claims being made by AI researchers and the promised results failed to materialize
  - **The end of funding**
    - The agencies which funded AI research became frustrated with the lack of progress and eventually cut off most funding for AI research.

Brief history of AI - Boom 1980–1987

- **Boom 1980–1987:**

  - In the 1980s a form of AI program called "expert systems" was adopted by corporations around the world and knowledge representation became the focus of mainstream AI research

    - The power of expert systems came from the expert knowledge using **rules** that are derived from the domain experts

    - In 1980, an expert system called XCON was completed for the Digital Equipment Corporation. It was an enormous success: it was saving the company 40 million dollars annually by 1986

    - By 1985 the market for AI had reached over a billion dollars

  - The money returns: the fifth generation project

    - Japan aggressively funded AI within its fifth generation computer project (but based on another AI programming language - Prolog created by Colmerauer in 1972)

    - This inspired the U.S and UK governments to restore funding for AI research

Brief history of AI - Boom 1980–1987

- The expert systems are based a more flexibly interpreted version of the 'rule-based' approach for knowledge representation to replace the logic representation and reasoning

    If <conditions> then <action>

- Collections of (possibly competing) rules of this type are sometimes known as production-systems

    – This architecture was even taken seriously as a model of Human cognition

    – Two of its main champions in this regard were Allen Newell and Herbert Simon.

Brief history of AI - Boom 1980–1987

- One of the major drawbacks of rule-based systems is that they typically lack a clear semantics

    If C then X

    If D then Y

    . . .

  Okay, so now what?

- It is fair to say that this problem was never satisfactorily resolved.

- Basic problem: such systems fail to embody any **coherent underlying theory** of uncertain reasoning, and they were difficult to update and could not learn.

Brief history of AI - the second AI winter

- **the second AI winter 1987−1993**

  - In 1987, the Lisp Machine market was collapsed, as desktop computers from Apple and IBM had been steadily gaining speed and power and in 1987 they became more powerful than the more expensive Lisp machines made by Symbolics and others

  - Eventually the earliest successful expert systems, such as XCON, proved too expensive to maintain, due to difficult to update and unable to learn.

  - In the late 80s and early 90s, funding for AI has been deeply cut due to the limitations of the expert systems and the expectations for Japan's Fifth Generation Project not being met

  - **Nouvelle AI:** But in the late 80s, a completely new approach to AI, based on robotics, has bee proposed by Brooks in his paper "Elephants Don't Play Chess", based on the belief that, to show real intelligence, a machine needs to have a body — it needs to perceive, move, survive and deal with the world.

Brief history of AI - AI 1993−present

- AI achieved its greatest successes, albeit somewhat behind the scenes, due to:

  – the incredible power of computers today

  – a greater emphasis on solving specific subproblems

  – the creation of new ties between AI and other fields working on similar problems

  – a new commitment by researchers to solid mathematical methods and rigorous scientific standards, in particular, based probability and statistical theories

  – Significant progress has been achieved in neural networks, probabilistic methods for uncertain reasoning and statistical machine learning, machine perception (computer vision and Speech), optimisation and evolutionary computation, fuzzy systems, Intelligent agents.