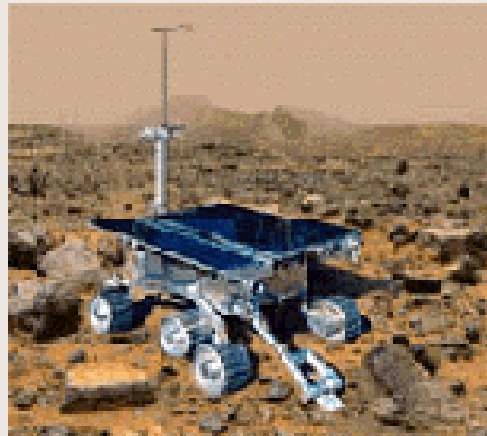


Why study AI?



Labor



Science



Search engines



Medicine/
Diagnosis



Appliances

What else?

What is Artificial Intelligence?

- **AI is a branch of Computer Science concerned with the study and creation of computer systems that exhibit some form of intelligence**
 - **Learn new concepts**
 - **Reason and draw useful conclusions about the world**
 - **Understand a natural language or perceive and comprehend a visual scene**
 - **Perform other types of feats that require human types of intelligence**
- **Goal of AI:** make machines do things that would require intelligence if done by humans.



What is Artificial Intelligence?

AI is Discipline that systematizes and automates intellectual tasks to create machines to

Act like humans	Act rationally
Think like humans	Think rationally

Act Like Humans

- The goal of AI is to create computer systems that perform functions that are assumed to require intelligence when done by humans

→ Methodology:

Take a task at which people are better, e.g.:

- Prove a theorem
- Play chess
- Plan a surgical operation
- Diagnose a disease
- Navigate in a building

and make a computer do it

Think Like Humans

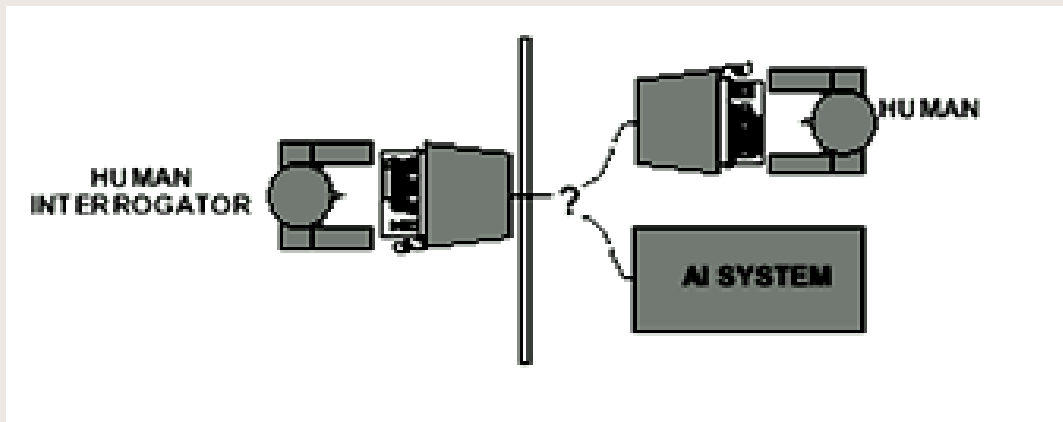
- How the computer performs functions does matter
- Comparison of the traces of the reasoning steps (cognitive science)
- But, do we want to duplicate human imperfections?
- Role of explicit symbolic knowledge (lemmas, concepts, ...)
- Pattern recognition → Neural nets
- Still a research topic: from signals to symbols

Think/Act Rationally

- Always make the “best” decision given what is available (knowledge, time, resources)
- “best” → maximizes the **expected** value of a **utility function** (\neq perfection)
- Strong ties to economics (e.g., game theory), probabilistic modeling, and control theory
- But, to some extent, the role of consciousness, emotions, or fear of dying on intelligence is ignored

Intelligent Machine

- Alan Turing's 1950 article *Computing Machinery and Intelligence* discussed conditions for considering a machine to be intelligent
 - “Can machines think?” \longleftrightarrow “Can machines behave intelligently?”
 - The Turing test (The Imitation Game): Operational definition of intelligence. Can a computer convince a human interrogator that it is a human?
- Computer needs to possess: Natural language processing, Knowledge representation, Automated reasoning, and Machine learning
- Are there any problems/limitations to the Turing Test?



AI Prehistory

- Philosophy Logic, methods of reasoning, mind as physical system foundations of learning, language, rationality
- Mathematics Formal representation and proof algorithms, computation, (un)decidability, (in)tractability, probability
- Economics Utility, decision theory
- Neuroscience Physical substrate for mental activity
- Psychology Phenomena of perception and motor control, experimental techniques
- Computer engineering Building fast computers
- Control theory Design systems that maximize an objective function over time
- Linguistics Knowledge representation, grammar

AI History

The Birth of AI (1943-1956)

- McCulloch and Pitts, A logical Calculus of Ideas Immanent in Nervous Activity, 1943 – Boolean Circuit Model of Brain.
- Turing, Computing Machinery and Intelligence, 1950
- Shannon, Programming a Computer for Playing Chess, 1950

The Rise of AI (1956-1969) and the Discovery of Expert Systems (1970– 1985); Expert Systems Industry booms

- The Dartmouth College Workshop on Machine Intelligence, 1956
- LISP Developed by McCarthy, 1958
- GA (Genetic Algorithm) by John Holland 1962
- Fuzzy Logic by Lotfi Zadeh 1963
- Robinson Developed Complete Algorithm for Logical Reasoning, 1965
- GPS (General Problem Solver) by Newell and Simon 1969
- DENDRAL - First knowledge based expert system supported by NASA to determine the molecular structure of Mars soil. (Buchanan - 1969)
- Minsky, A framework for representing knowledge, 1975
- MYCIN - to diagnose infectious blood disease. (1976)
- PROSPECTOR for mineral exploration developed by Stanford University, (1979).
- PROLOG – a Logic Programming Language (Colmerauer, Roussel and Kowalski –1970)

AI History

AI Winter (1885-1993)

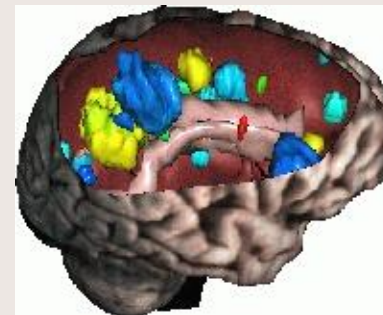
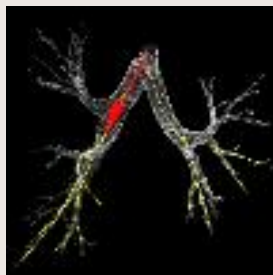
- **Expert Systems Industry busts**

The rebirth of AI (1990 - onwards)

- **Hopfield, Neural Networks**
- **Kohonen, Self-Organized Maps (SOM)**
- **Rumelhart Parallel Distributed Processing**
- **Applications of GA and Fuzzy Logic in AI systems**

Predictions and Reality ... (1/3)

- In the 60's, a famous AI professor from MIT said: "At the end of the summer, we will have developed an electronic eye"
- As of 2004, there is still no general computer vision system capable of understanding complex dynamic scenes
- But computer systems routinely perform road traffic monitoring, facial recognition, medical image analysis, part inspection, motion capture, ...

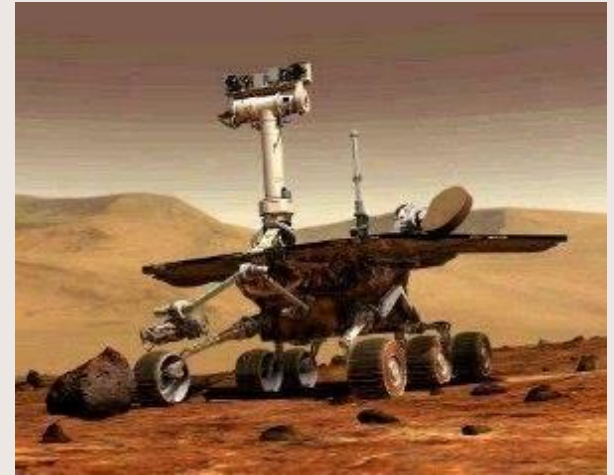


Predictions and Reality ... (2/3)

- In 1958, Herbert Simon (CMU) predicted that within 10 years a computer would be Chess champion
- This prediction became true in 1997.
- Today, computers have won over world champions in several games, including Checkers, Othello, and Chess, but still do not do well in Go
- AI techniques (search, planning, probabilistic reasoning) are used in many video games

Predictions and Reality ... (3/3)

- In the 70's, many believed that computer-controlled robots would soon be everywhere from manufacturing plants to home
- Today, some industries (automobile, electronics) are highly robotized, but home robots are still a thing of the future
- But robots have rolled (are rolling) on Mars, fly autonomously



AI – The Achievements

- Robots make cars in all advanced countries.
- Reasonable machine translation is available for a large range of foreign web pages.
- Computers land 200 ton jumbo jets unaided every few minutes.
- Search systems like Google are not perfect but provide very effective information retrieval
- Robots cut slots for hip joints better than surgeons.
- Medical expert systems can outperform doctors in many areas of diagnosis.

AI – The Achievements

- Deep Blue defeated the reigning world chess champion Garry Kasparov in 1997.
- No hands across America (driving autonomously 98% of the time from Pittsburgh to San Diego).
- During the 1991 Gulf War, US forces deployed an AI logistics planning and scheduling program that involved up to 50,000 vehicles, cargo, and people.
- NASA's on-board autonomous planning program controlled the scheduling of operations for a spacecraft.
- Solves crossword puzzles better than most humans.

AI – A Comment

Despite all these achievements, one of the major philosophers of Cognitive Science wrote recently:

“... the failure of artificial intelligence to produce successful simulation of routine commonsense cognitive competences is notorious, not to say scandalous. We still don't have the fabled machine that can make breakfast without burning down the house; or the one that can translate everyday English into everyday Italian, or the one that can summarize texts..” **(Jerry Fodor, The Mind doesn't Work that Way, 2000, p.37).**

AI Trend

- ❖ **Early AI concentrated on building intelligent machines that mimicked human behavior.**
- ❖ **Present AI devoted to embedding AI algorithms and techniques (neural networks, genetic algorithms, fuzzy logic, and intelligent agents) into software to provide them with the ability to learn, optimize, and reason.**