Artificial Intelligence
Background and Overview

- Philosophers -Two big questions of the universe: How does a human mind work? Can non-humans have minds?

- Some accept that machines can do things that human can do.

- Some don't : highly sophisticated behaviour as love and moral choice.

What is Artificial Intelligence?

- Need to define intelligence: ability to learn n understand, solve problems n make decisions

- A.I. is the study of how to make computers/machine do things (that requires intelligence) at which, at the moment, people are better.

Do we want machine to think and act like human?

Do we want the machine to think and act rationally?

Which one do you prefer?

Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally

Thus, some AI definitions are based on those two different criteria

# There are many definitions

|	
The exciting new effort to make computers thinks ... *machine with minds,* in the full and literal sense" (Haugeland 1985)	"The study of mental faculties through the use of computational models" (Charniak et al. 1985)
"The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990)	A field of study that seeks to explain and emulate intelligent behavior in terms of computational processes" (Schalkol, 1990)

Why study AI?
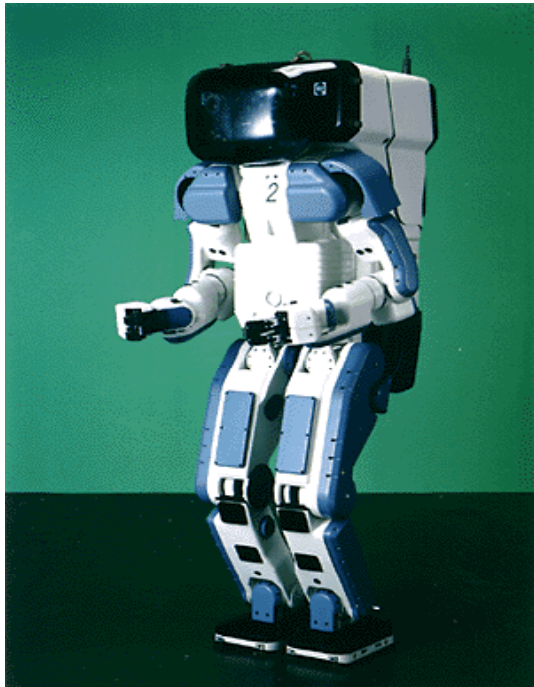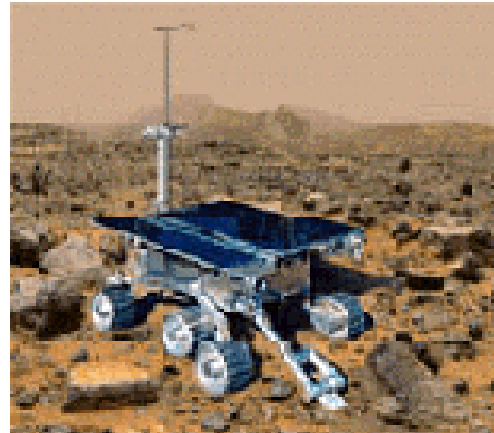
Science

Search engines

Medicine/
Diagnosis

Labor

Appliances

What else?

Honda Humanoid Robot

Walk

Turn

Stairs

http://world.honda.com/robot/

Sony AIBO

Head touch sensor

Tail (equipped with LEDs)

Camera (CMOS image sensor)

Stereo microphone

Speaker

Back touch sensor

Chin touch sensor

Acceleration sensor

PC card slot

Pause button
Chest light

Lithium ion battery pack
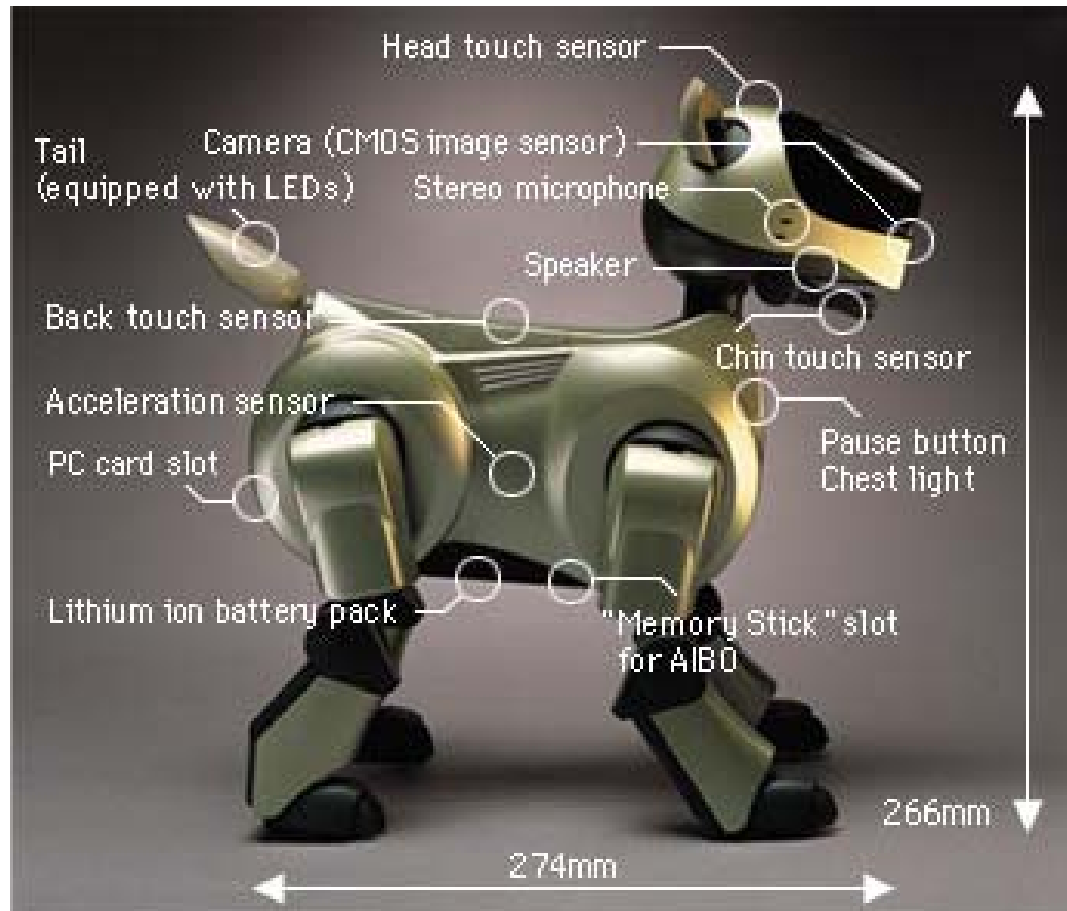
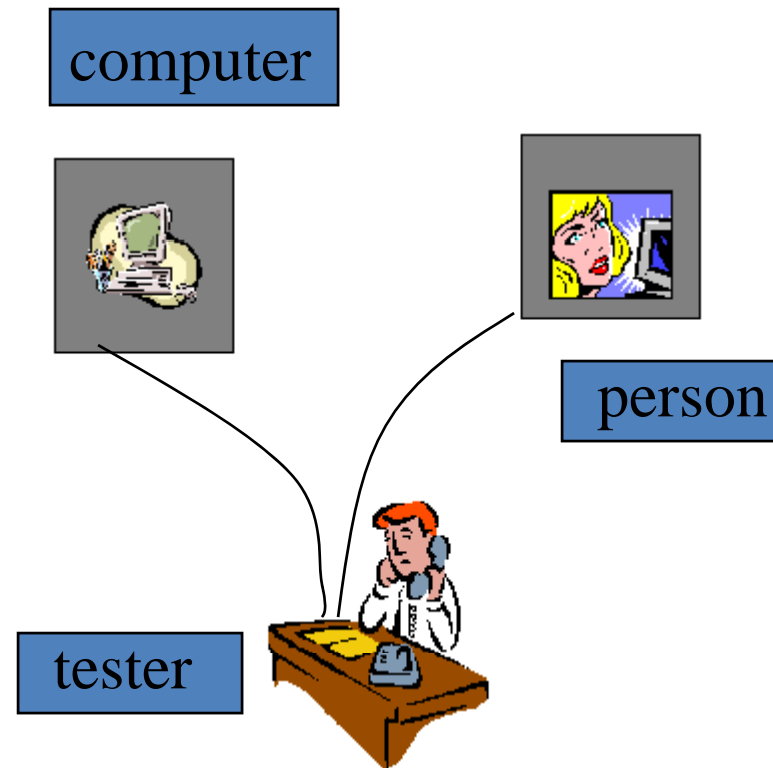"Memory Stick" slot for AIBO

266mm

274mm
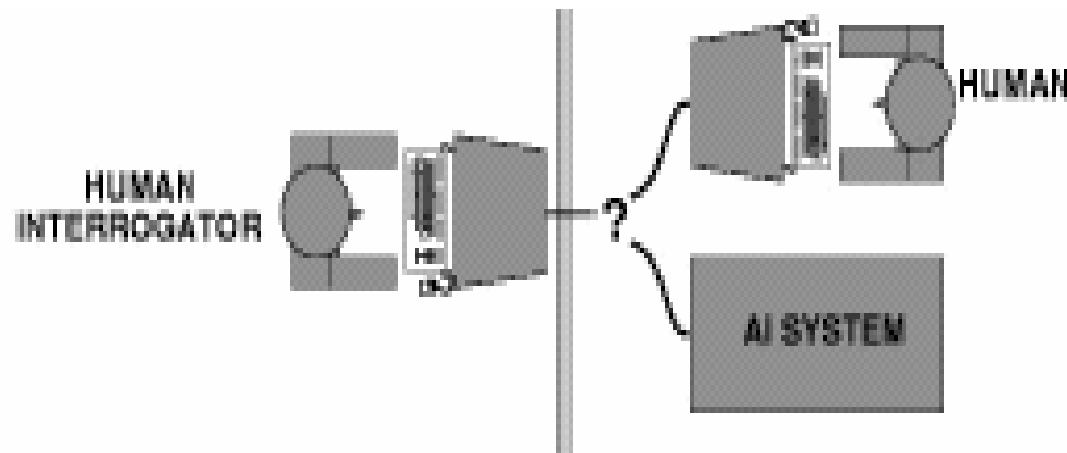
http://www.aibo.com

Turing Test

Turing Test

- Presented by Turing (1950), most significant papers on machine intelligence -"Computing machinery and intelligence"

- Can machines think? --> Can machines behave intelligen

ocw.utm.my

Who is Alan Turing?

- Began scientific career early 1930s

- During second world war, he was key player in german military encoding machine

- After war, designed automatic computing engine, wrote first program for complete chess game

- Turing imitation game: he predicted by 2000, computer would have 30% chance of deceiving interrogator that it was human.

- Better that machines do not behave/think like human. Why?
- From practical point of view, intelligent machine should help human to make decisions, search information, control complex object n understand meaning of words.

History of AI

- Birth of AI (1943-56) – Dark Ages
- First major contribution of AI – neuron model of brain by Warren McCulloch & Walter Pitts (1943)
- McCulloch –second founding father of AI after Alan Turing, third founding – john von neuman
- McCulloch showed that neural network structures could learn
- John von Neumann – key role in Manhattan project (built nuclear bomb)
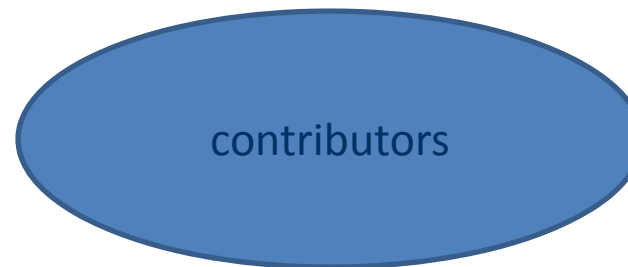
Birth of AI (1943-56) – Dark Ages

- Claude shannon(grad MIT) – joined Bell (1941) – developed chess playing game (1950)

- Summer workshop (1956) @Dartmouth college – responsible to give birth to new science called Artificial intelligence.

(1956-late 1960s) the rise of AI

John McCarthy 1958

Marvin Minsky, 1975

Lotfi Zadeh, 1965

contributors

Rosenblatt 1962

Newell & Simon 1961, 1972

(1956-late 1960s) the rise of AI

- John McCarthy – inventor of AI term –developed oldest programming languages called LISP
- 1958 proposed Advice Taker program (search solution to general problems)
- Marvin Minsky (MIT) his contribution – theory of frame

(1956-late 1960s) the rise of AI

- Rosenblatt 1962 – improved learning/optimization method started by McCulloch & Pitts

- Newell & Simon 1961, 1972 (carnegie mellon) – General Problem Solver (GPS) –most ambitious project. Why abondoned? Failed to solve complicated problems & limited computer capabilities

(1956-late 1960s) the rise of AI

- Lotfi Zadeh (Univ of California Berkeley) – foundation of the fuzzy set theory (1965)

- For outsiders, achievements would be seen as toys, because no AI system at that time could manage real-world problems

Main difficulties of AI in late 1960s

- AI researches - developing general methods for broad problems
- Many of the problems - too broad and difficult to be solved. – machine translation. 1966 all translation project funded by US gov. were cancelled. 1971 British gov. also suspended support for AI
- Limited capabilities of computers

(early 1970s – mid 80s) technology of expert systems

- They just realized!. In order to deliver practical results, need to solve typical cases in narrow areas of expertise

- Shift from general-purpose, knowledge-sparse, weak methods to domain-specific, knowledge intensive techniques

(early 1970s – mid 80s) technology of expert systems

DENDRAL 1971

MYCIN 1972

Software developed

PROSPECTOR 1979
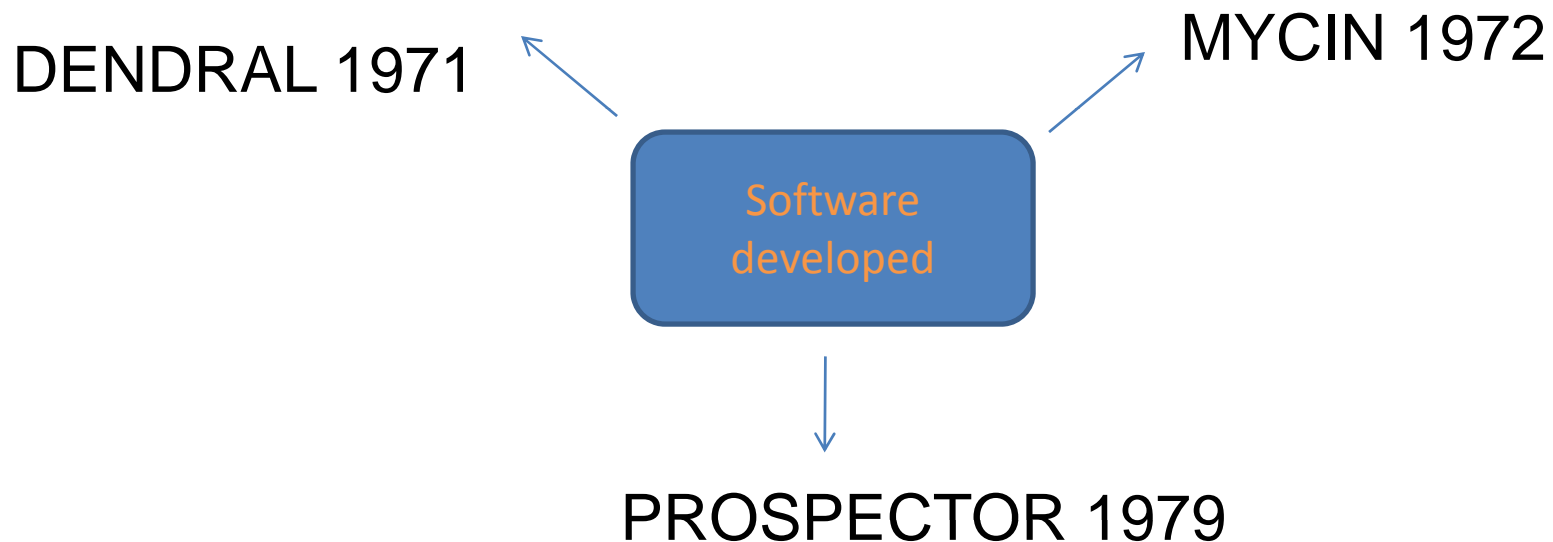
(early 1970s – mid 80s) technology of expert systems (ES)

- DENDRAL program (1971) – determine molecular structure of Martian soil

- Not only use rule of chemistry but also rules-of-thumb ---- called expert system

- Developed by Feigenbaum, buchanan & lederberg

- MYCIN (1972) – feigenbaum & others @stanford U – rule-based ES for diagnosis of infectious blood diseases

(early 1970s – mid 80s) technology of expert systems (ES)

- PROSPECTOR (1979) – for mineral exploration, developed by Stanford Research Inst.

- All used expensive hardware and complicated programming languages (LISP, PROLOG and OPS)

- Only in 1980s, with arrival of personal computers could ordinary researchers & engineers take up the opportunity to develop expert systems.

Limitations of expert systems

- Restricted to a very narrow domain of expertise

- Not as robust & flexible as user might want

- ES have limited explanation capabilities (limit deeper understanding of the problem)

Limitations of expert systems

- Difficult to improve the ES performance

- Cannot be developed fast, 5 to 10 person to build an ES to solve moderate difficult problem

- 30 persons to develop DENDRAL, MYCIN or PROSPECTOR

(mid 80s – onwards) rebirth of NN

- Why most AI researchers deserted AI in the 1970s?
  - Technological: no PC or powerful workstation
  - Psychological – limited capabilities of perceptron? & financial

(mid 80s – onwards) rebirth of NN

- Major contributions by
    - Grossberg 1980
    - Hopfield 1982*
    - Kohonen 1982
    - Barto 1983
    - Rumelhart & McClelland 1986*
    - Broomhead & Lowe 1988

    Most significant & influential works responsible for rebirth of NN

Evolutionary computation (EC)-learning by doing (early 1970s-onwards)

- AI is based on computational models of natural selection and genetics – fittest species have a greater chance to reproduce, and pass their genetic material to next generation.

- EC combines 3 main techniques:
  - GA – John Holland (1975)
  - Evolutionary strategies – Rechenberg (1965), similar to monte carlo search
  - Genetic programming – Koza (92,94)

(late 1980s – onwards) computing with words

- Fuzzy logic (Zadeh 1965) – technology deals with vague, imprecise & uncertain knowledge and data

- Use the concept of linguistic variables in term of words rather than numbers

- Similar to expert sys. That use if-then rules but the rules use words rather than numbers.

- Was taken seriously by the japanese since 1987

Summary

- Definition of AI

- History
  - Dark ages or birth of AI (1943-56)
  - Rise of AI (1956-late 60s)
  - Unfulfilled promises (late 1960s – early 1970s)
  - Technology of expert sys (early 1970s – mid 80s)
  - (Mid 1980s – onwards) rebirth NNs
  - (early 1970s – onwards) evolutionary computation
  - (late 1980s – onwards) computing with words, fuzzy