The Dream of an Intelligent Machine

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Definitions of Artificial Intelligence

- Systems that think like humans
  - "The exiting new effort to make computers think … *machines with minds*, in the full and literal sense."
    (Haugeland, 1985)
  - "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning …"
    (Belman, 1978)

Definitions of Artificial Intelligence

- Systems that think rationally
  - "The study of mental faculties through the use of computational models."
    (Charniak and McDermott, 1985)
  - "The study of the computations that make it possible to perceive, reason, and act."
    (Winston, 1992)

Definitions of Artificial Intelligence

- Systems that act like humans
  - "The art of creating machines that perform functions that require intelligence when performed by people."
    (Kurzweil, 1990)
  - "The study of how to make computers do things at which, at the moment, people are better."
    (Rich and Knight, 1991)

Definitions of Artificial Intelligence

- Systems that act rationally
  - "Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998)
  - "AI … is concerned with intelligent behavior in artefacts." (Nilsson, 1998)

Citations taken from Russell and Norvig's book:
Artificial Intelligence: A Modern Approach

Testing for AI

- Turing test (Alan Turing, 1950)

- Chinese room (John Searle, 1980)

The Beginning of AI

- AI itself is a young field, but …
- It has inherited from other disciplines:
  - Philosophy
  - Mathematics
  - Neuroscience
  - Psychology
  - Computer engineering
  - Linguistics

Gestation of AI

- McCulloch and Pitts (1943):
  - Model of artificial neurons
  - Any computable function can be computed by some network of neurons
  - Suitably defined neural networks can learn
- Newell and Simon (Dartmouth, 1956)
  - Logic Theorist (LT)

Great Expectations

- Early successes:
  - Lisp
  - Microworlds
- Simon (1957):
  - *It is not my aim to surprise or shock you – but the simplest way I can summarize is to say that there are now in the world machines that think, that learn and that create. Moreover, their ability to do these things is going to increase rapidly until – in a visible future – the range of problems they can handle will be coextensive with the range to which human mind has been applied.*

A Dose of Reality

- Many AI problems are intractable:
  - Combinatorial explosion
  - NP-complete
- Solving problems often requires subject knowledge:
  - Translation from one language into another
  - Finding a good route into the city during rush hour

Combinatorial Explosion

- Fable of an ancient Chinese mathematician that did a great deed for the emperor of China
- Certain amount of rice placed on a square of his chessboard as reward
- One grain of rice on the first square and double the prior square for each successive square

Translation English-Russian

- Translation of an English sentence into Russian:

  The spirit is willing but the flesh is weak
- Re-translation of the sentence from Russian into English:

  The vodka is good but the meat is rotten

Knowledge-Based Systems

- Closed-world assumption
- Expertise in a limited field
- Rule-based approach
- Examples:
  - MYCIN
  - DENDRAL
  - PROSPECTOR
  - R1

Games

- Checkers (or draught):
  - Samuel's checker program (1952)
  - Schaeffer's program CHINOOK (won 1992 U.S. Open)
- Chess
  - Kasparov vs. Deep Blue (1997)
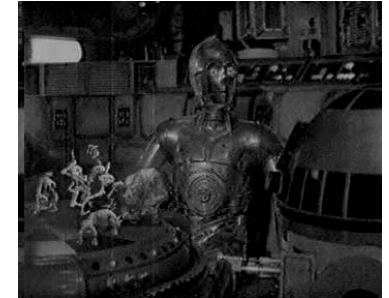
Intelligent Agents

- New paradigm for AI systems:
  - Uses sensors to perceive the environment
  - Uses effectors to act upon that environment
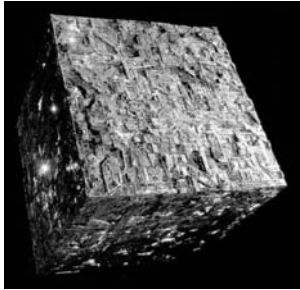 - Uses planning to behave rational

DARPA Grand Challenge

- Autonomous vehicle to complete an under-300 mile, off-road course in the Mojave Desert
- In 2004 no vehicle came even close
- In 2005 Stanford team wins US$ 2 million

Multi-Agent Systems

- Agents collaborating with each other
- Distributed competence/intelligence
- Emergent rather than individual intelligence

Related Issues

- AI and humanoid form
- AI and emotions
- AI and gender
- AI and …