

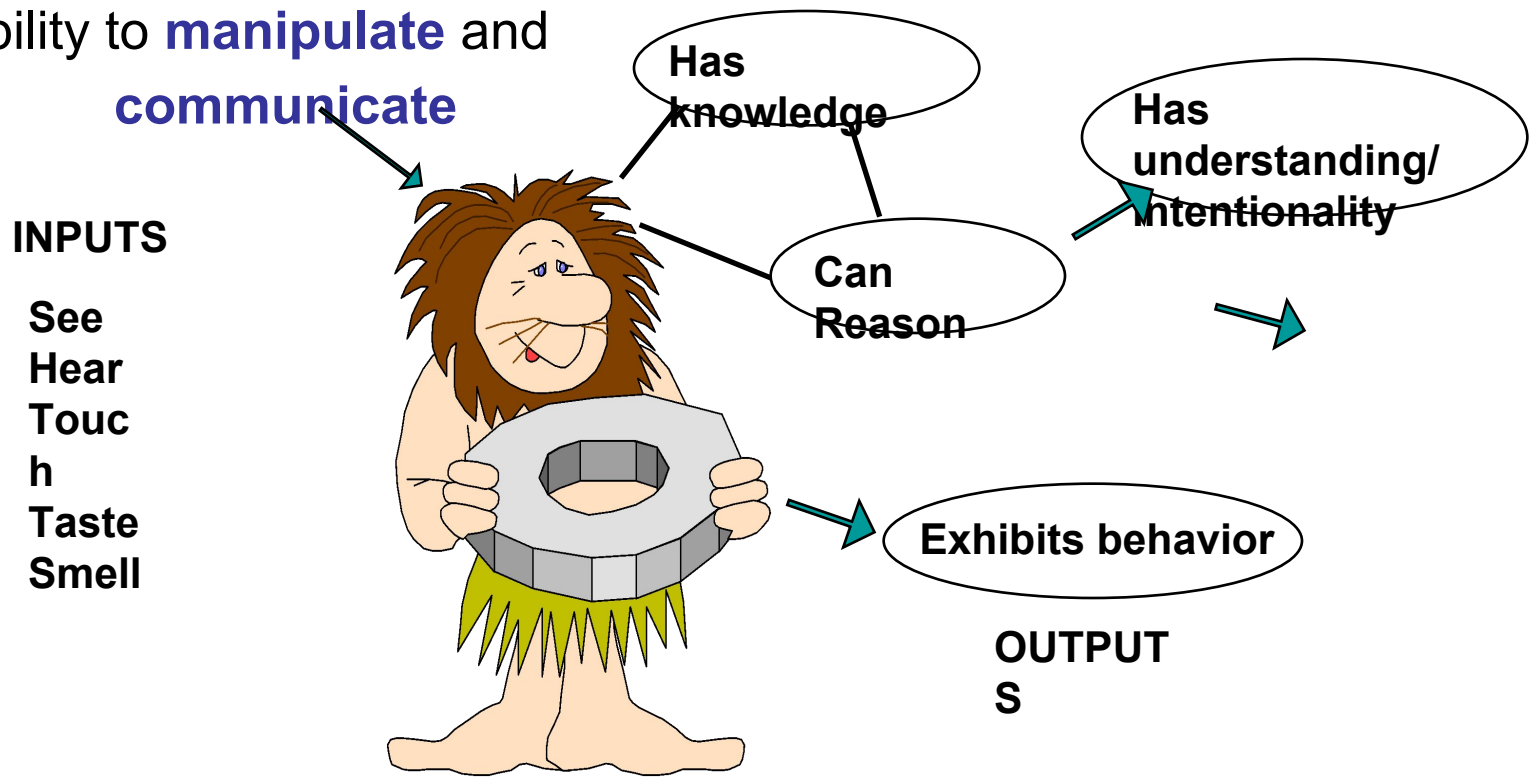
# Course overview

- Introduction and Agents (chapters 1,2)
- Search (chapters 3,4,5,6)
- Logic (chapters 7,8,9)
- Planning (chapters 11,12)
- Uncertainty (chapters 13,14)
- Learning (chapters 18,20)
- Natural Language Processing (chapter 22,23)

# What is Intelligence?

Intelligence, taken as a whole, consists of the following skills:-

1. The ability to **reason**
2. The ability to **acquire and apply** knowledge
3. The ability to **manipulate** and **communicate**



**Artificial Intelligence** is a branch of *Science* which deals with helping machines find solutions to complex problems in a more human-like fashion.

This generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way.

**AI** is generally associated with *Computer Science*, but it has many important links with other fields such as *Maths, Psychology, Cognition, Biology and Philosophy*, among many others.

Our ability to combine knowledge from all these fields will ultimately benefit our progress in the quest of creating an intelligent artificial being.

# What is AI?

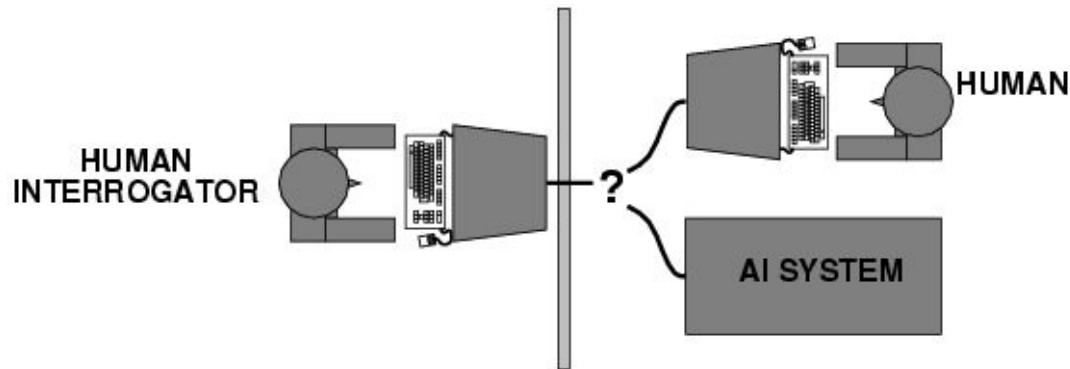
Views of AI fall into four categories:

- Thinking humanly
- Acting humanly
- Thinking rationally
- Acting rationally

The textbook advocates "acting rationally"

# Acting humanly: Turing Test

- Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" ☐ "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game



- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language understanding, learning

# Thinking humanly: cognitive modeling

- 1960s "cognitive revolution": information-processing psychology
- Requires scientific theories of internal activities of the brain
- -- How to validate? Requires
  - 1) Predicting and testing behavior of human subjects (top-down)
  - or 2) Direct identification from neurological data (bottom-up)
- Both approaches (roughly, Cognitive Science and Cognitive Neuroscience)

# Thinking rationally: "laws of thought"

- **Aristotle**: what are correct arguments/thought processes?
- Several Greek schools developed various forms of **logic**: *notation* and *rules of derivation* for thoughts; may or may not have proceeded to the idea of mechanization
- Direct line through **mathematics and philosophy** to **modern AI**

# Acting rationally: rational agent

- **Rational** behavior: doing the right thing
- The right thing: that which is expected to maximize goal achievement, given the available information
- Doesn't necessarily involve thinking – e.g., blinking reflex – but thinking should be in the service of rational action



# Rational agents

- An **agent** is an entity that perceives and acts
- This course is about designing rational agents
- Abstractly, an agent is a function from percept histories to actions:

$$[f: \mathcal{P}^* \rightarrow \mathcal{A}]$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance

# 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

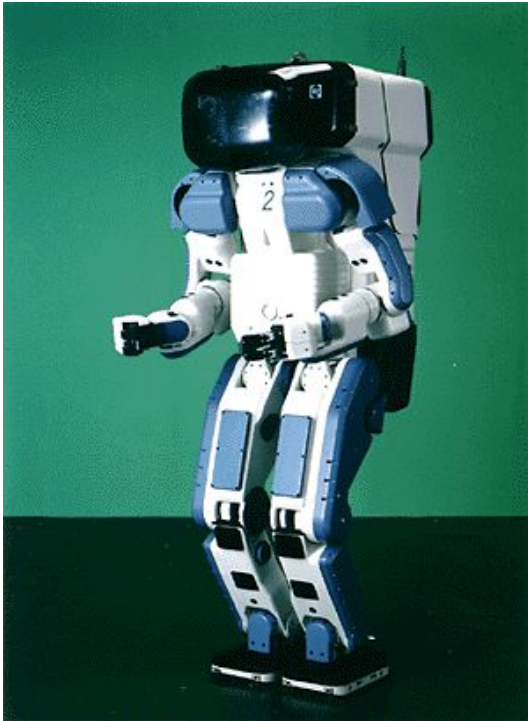
# Abridged history of AI

- 1943 McCulloch & Pitts: Boolean circuit model of brain
- 1950 Turing's "Computing Machinery and Intelligence"
- 1956 Dartmouth meeting: "Artificial Intelligence" adopted
- 1952—69 Look, Ma, no hands!
- 1950s Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
- 1965 Robinson's complete algorithm for logical reasoning
- 1966—73 AI discovers computational complexity  
Neural network research almost disappears
- 1969—79 Early development of knowledge-based systems
- 1980-- AI becomes an industry
- 1986-- Neural networks return to popularity
- 1987-- AI becomes a science
- 1995-- The emergence of intelligent agents

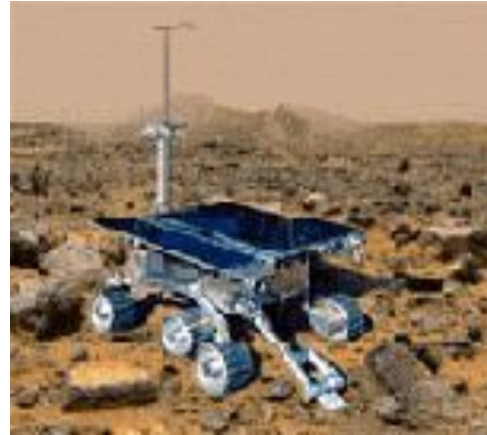
# State of the art

- **Deep Blue** defeated the reigning world chess champion **Garry Kasparov** in 1997
- **Proved a mathematical conjecture** (Robbins conjecture) unsolved for decades
- **ALVINN** No hands across America (driving autonomously 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
- **Proverb** solves crossword puzzles better than most humans

# Why study AI?



Labor



Science



Search engines



Medicine/  
Diagnosis



Appliances

What else?