CS4725/CS6705

Chapter 1: Introduction to AI

What is AI?

- It depends on whom you ask.
- The textbook provides 8 quite different definitions from 8 other books.
- The definitions differ along two dimensions:
  - Reasoning vs. behaviour
  - Emulating humans vs. performing rationally/ideally

Definitions of AI

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

Acting humanly: The Turing test

- Turing test: proposed by Alan Turing in 1950
- Basic idea: Can a computer answer written questions and fool a human interrogator into thinking that the answers are coming from a person?

Acting humanly: The Turing test (cont'd)

- Plenty of debate about whether this really indicates intelligence, but to succeed, a program would require:
  - Natural language processing
  - Knowledge representation
  - Automated reasoning
  - Machine learning
  - Computer vision (in the case of the "total Turing test")
  - Robotics (total Turing test)

Thinking humanly: The cognitive modeling approach

- Cognitive science: combination of AI and psychology to try to develop models of how the human mind works
- Experiments with humans or animals
- AI: using these models to simulate human thinking

Thinking rationally: The “laws of thought” approach

- Aristotle: attempt to codify “right thinking” →logic
- 1965: Programs existed that could, in theory, solve any solvable problem expressed in logical notation, but...
  - Not in a reasonable amount of time
  - Difficult to express informal knowledge in logic, especially when uncertainty is involved

Acting rationally: The rational agent approach

- Agent: something that acts
- Computer agents: expected to act autonomously, perceive their environment, persist over a long time, adapt to change, be able to take on another's goals
- Rational agent: one that acts to achieve the best possible outcome (or best expected outcome)
- Note: Always acting rationally is not feasible in complex environments, but designing such agents will be our ideal goal... and we will talk about limitations.

Fields that have influenced AI

- Philosophy
- Mathematics: logic, algorithms, intractability, probability
- Economics: decision theory, game theory, operations research
- Neuroscience
- Psychology
- Computer Engineering
- Control theory and Cybernetics
- Linguistics

Very brief history of AI

- 1943: McCulloch & Pitts – model of brain, artificial neurons
- 1950: Minsky & Edmonds – first neural network computer
- 1950: Turing test
- 1956: Two-month workshop at Dartmouth College; birth of the term “artificial intelligence”

Very brief history of AI (cont'd)

- 1952-69: Early years – several successes
  - General Problem Solver
  - Geometry Theory Prover
  - Arthur Samuel's checkers player
  - Development of the Lisp language
  - Microworlds
  - More work on neural networks
- 1966-73: Dose of reality
  - Computational complexity – these things are not going to scale up well
  - Neural network research almost died

Very brief history of AI (cont'd)

- 1969-79: Knowledge-based systems
  - Using domain-specific knowledge, focusing on narrower problems
  - Expert systems
  - DENDRAL: inferring molecular structure
  - MYCIN: medical diagnosis
  - SHRDLU: natural language understanding
- 1980-present: AI becomes an industry
  - Development of several companies focusing on expert systems, intelligent computers
  - Late 80s, early 90s: "AI Winter" – many companies had failed to deliver on ambitious promises

Very brief history of AI (cont'd)

- 1986-present: Return of neural networks

- 1987-present: AI adopts the scientific method
  - Rigorous empirical experiments, statistical analysis of results
  - Use of probability and decision theory in AI

Very brief history of AI (cont'd)

- 1995-present: Intelligent agents
  - AI technologies used in many internet tools
  - Renewed interest in human-level AI: need for huge knowledge bases

- 2001-present: Availability of very large data sets

Examples of current state of the art

- Autonomous planning and scheduling: NASA
- Game playing: Deep Blue (chess), Chinook (checkers), Go, backgammon, Othello, Scrabble, etc.
- Driverless robotic vehicles
- Speech recognition
- Machine vision, image recognition
- Spam fighting
- Question answering: IBM Watson, Siri, *etc.*
- Route finding / logistics planning
- Robotics: robot assistants in medicine, robotic vacuum cleaners, military applications, etc.
- Machine translation