CMSC 372  
Artificial Intelligence  
Spring 2015

**Administrivia**

- Lectures: Tues & Thurs 9:55a to 11:15a
- Labs: Tuesdays 1:00p to 3:00p
- Pre-requisites: CMSC B206 or H106 and CMSC B231 or permission of instructor

**What is AI?**

- Machines with minds
- Decision-making and problem solving
- Cognitive modeling/score
- Computational psychology
- Learning
- Thinking Like Humans
- Doing the right thing
- Acting rationally
- Machines with actions
- Robots
- Speech understanding
- Turing Test
- Acting Like Humans
- Intelligent Agents in artifacts
- Learning

**Watson: Jeopardy!**

*February 2011*
What is AI?

Alan Turing (1950)
The Imitation Game

The Turing Test

- Operational test for intelligent behavior
- 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

Problem: Turing Test is not reproducible, constructive, or amenable to mathematical analysis

CAPTCHA?

- Completely Automated Public Turing test to tell Computers and Humans Apart
- A “reverse Turing Test”?

What is AI?

Cognitive Science

- Brain as an information processing system
- Requires theories of internal activities of the brain (level of abstraction? Knowledge or circuits?)
- How to validate?
  - Predicting and testing behavior of human subjects (top-down)
  - Theories from neurological data (bottom-up)
- Two fields: Cognitive Science & Cognitive neuroscience

Problem: Current theories do not explain anything resembling human-level general intelligence
What is AI?

Reasoning with Logic

- Aristotle: What are correct arguments/thought processes?
- Formal logic:
  Socrates is human.
  All humans are mortal.
  Therefore Socrates is mortal.
- Laws of thought govern the operation of the mind.

Problem: Not all intelligent behavior is mediated by logical deliberation. Not easy to formalize informal knowledge. E.g. Most students might be sleepy.

Machines with logic “laws of thought”

Logic

Thinking

Reflecting

Rational

Reasoning

Etc.

What is AI?

Rational Behavior

- Do the right thing.
- That which is expected to maximize goal achievement, given available information.
- Doesn’t necessarily involve “thinking”. E.g. blinking reflex.
- Any thinking there is, should be in service of rational action.

Design Rational Agents.

\[ f: P^* \rightarrow A \]

Problem: Computational limitations make perfect rationality unachievable. So, design best program for given computational resources.

Is intelligence computable?

Physical Symbol System Hypothesis

"a physical symbol system (such as a digital computer, for example) has the necessary and sufficient means for intelligent action."

- Newell & Simon, 1976

Prehistory of AI

- Philosophy
- Mathematics
- Psychology
- Economics
- Linguistics
- Neuroscience
- Computer Science
- Control Theory

Landmarks in AI History

1943
McCulloch & Pitts
Boolean Circuit model of brain

1950
Alan Turing
Computing Machinery & Intelligence

1956
Birth of Artificial Intelligence
Dartmouth Conference

1952
Look Ma, no hands!
GPS, Geometry Prob. Solver, Checkers, LISP

1965
Robinson
Algorithm for logical reasoning

1962
Block et al
Perceptron Convergence Theorem

1966
ALPAC Report
Machine Translation Killed

1969
Minsky & Papert
Perceptrons kills Neural Network Agenda

1976
Newell & Simon
Physical Symbol System Hypothesis

1980
AI becomes an industry
Expert Systems boom

1990
AI Winter
Expert Systems go bust

1985
Rebirth of Neural networks
PDP, Connectionist models, backprop

1988
Resurgence of probability
Nouvelle AI: Alife, Gas, soft computing

1995
Agents everywhere!
Robots, subsumption, human-level AI

2001
AI Spring?
HRI, data-driven AI

2006
AI yields advances
Self-driven cars, MAPGEN, DEEP BLUE
Home robots, Spam filters, etc.

2011
Big Data AI
Watson, Deep Q&A
Language translation
Agenda

• What is AI? History, Foundations, Examples: Overview
• Intelligent Agents
• Problem Solving Using Classical Search Techniques
• Beyond Classical Search
• Adversarial Search & Game Playing
• Constraint Satisfaction Problems
• Knowledge Representation & Reasoning (KRR)
• First Order Logic & Inference
• Classical Planning
• Planning & Acting in the Real World
• Other topics depending upon time...

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