CSE 4308/5360 Artificial Intelligence I

Introduction

What is AI

- What is Artificial Intelligence?

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

What is AI

- Acting like Humans
  - Turing Test (Imitation Game) – Alan Turing (1950)
    - Suggested major components of AI: knowledge, reasoning, language understanding, learning
    - Still relevant today but not really useful

What is AI

- Thinking like Humans
  - To build such a system we need to know how the brain works
    - What level of abstraction?
    - How to validate the system
      - Predicting and testing human behavior (Cognitive Science)
      - Identify from neurological data (Cognitive Neuroscience)
    - These are approaches now considered distinct from AI

What is AI

- Thinking rationally
  - What is rational?
    - Is all human thought rational?
  - Rational thought has been studied since time of Aristotle
    - “Socrates is a man; all men are mortal; Therefore, Socrates is mortal”.
  - We can build systems that can, in principle, solve problems given in such a **logical** notation
    - Not exactly easy to represent all problems in this way
    - This may be computationally intractable

What is AI

- Acting Rationally
  - Rational Behavior: Doing the ‘right’ thing
    - How to define right?
      - Whichever maximizes Goal Payoff
  - Doesn’t necessarily involve thinking (reflex).
    - Any thinking should be in service of rational action
  - Aristotle (Nichomachean Ethics):
    - Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good
  - This is the approach the textbook (and therefore the course) will be studying.

Rational Agent

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:

$$f : P^* \rightarrow A$$

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

Caveat: computational limitations make perfect rationality unachievable so design best program for given machine resources

Foundations of AI

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
Psychology	adaptation
	phenomena of perception and motor control
	experimental techniques (psychophysics, etc.)
Economics	formal theory of rational decisions
Linguistics	knowledge representation
	grammar
Neuroscience	plastic physical substrate for mental activity
Control theory	homeostatic systems, stability
	simple optimal agent designs

History of AI

1943	McCulloch & Pitts: Boolean circuit model of brain
1950	Turing's "Computing Machinery and Intelligence"
1952–69	Look, Ma, no hands!
1950s	Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
1956	Dartmouth meeting: "Artificial Intelligence" adopted
1965	Robinson's complete algorithm for logical reasoning
1966–74	AI discovers computational complexity Neural network research almost disappears
1969–79	Early development of knowledge-based systems
1980–88	Expert systems industry booms
1988–93	Expert systems industry busts: "AI Winter"
1985–95	Neural networks return to popularity
1988–	Resurgence of probability; general increase in technical depth "Nouvelle AI": ALife, GAs, soft computing
1995–	Agents, agents, everywhere . . .
2003–	Human-level AI back on the agenda

State of AI

- Pattern Recognition/Data Mining
- Speech Recognition
- Spam Control
- Autonomous planning and scheduling
- Automated Logistics
- Navigation
- Robotic Vehicles
- Game Playing
- Robotics
- Machine Translation