ARTIFICIAL INTELLIGENCE

Lecture 3

Watch DeepBlue and AlphaGo movies.

Watch at least first episode of Numb3rs Season 1 (CBS Show)

- Solve this

$$P_{i,j} = k \sum_{n=1}^{\text{(total crimes)}} \left[\underbrace{\frac{\phi_{ij}}{(|X_i - x_n| + |Y_j - y_n|)^f}}_{1^{st} \text{ term}} + \underbrace{\frac{(1 - \phi_{ij})(B^{g-f})}{(2B - |X_i - x_n| - |Y_j - y_n|)^g}}_{2^{nd} \text{ term}} \right],$$

$$\text{where: } \phi_{ij} = \begin{cases} 1, & \text{if } (|X_i - x_n| + |Y_j - y_n|) > B \\ 0, & \text{else} \end{cases}$$

THE DEFINATION OF AI

Science of AI

Physics: Where did the *physical universe* come from?
And what laws guide its dynamics?

Biology: How did *biological life* evolve?
And how do living organisms function?

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And how do living organisms function?

AI: What is the nature of *intelligent thought?*

What is intelligence?

- Dictionary.com: *capacity for learning, reasoning, understanding, and similar forms of mental activity*

- Ability to perceive and act in the world
- Reasoning: proving theorems, medical diagnosis
- Planning: take decisions
- Learning and Adaptation: recommend movies, learn traffic patterns
- Understanding: text, speech, visual scene

Intelligence vs. humans

- Are humans intelligent?
  - replicating human behavior early hallmark of intelligence

- Are humans always intelligent?

- Can non-human behavior be intelligent?

What is *artificial* intelligence?

human-like *vs.* rational

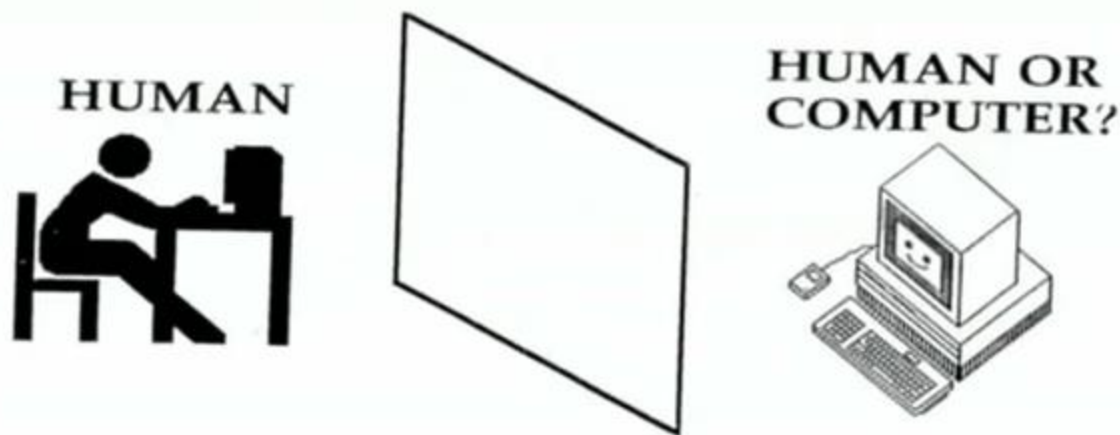|		
thought *vs.* behavior	"[automation of] activities that we associate with human thinking, activities such as decision making, problem solving, learning..." (Bellman 1978)	"The study of mental faculties through the use of computational models" (Charniak & McDertmott 1985)
	"The study of how to make computers do things at which, at the moment, people are better" (Rich & Knight 1991)	"The branch of computer science that is concerned with the automation of intelligent behavior" (Luger & Stubblefield 1993)

What is *artificial* intelligence?

human-like *vs.* rational

thought vs. behavior	Systems that think like humans	Systems that think rationally
	Systems that act like humans	Systems that act rationally

Acting Humanly: Turing's Test

- If the human cannot tell whether the responses from the other side of a wall are coming from a human or computer, then the computer is intelligent.

HUMAN

HUMAN OR COMPUTER?

What is *artificial* intelligence?

human-like *vs.* rational

thought
vs.
behavior

	human-like	rational
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behavior	Systems that act like humans	Systems that act rationally

Thinking Humanly

- Cognitive Science
  - Very hard to understand how humans think
    - Post-facto rationalizations, irrationality of human thinking

- Do we want a machine that beats humans in chess or a machine that *thinks like humans* while beating humans in chess?
  - Deep Blue supposedly DOESN'T think like humans..

- Thinking like humans important in Cognitive Science applications
  - Intelligent tutoring
  - Expressing emotions in interfaces... HCI

- The goal of aeronautical engg is not to fool pigeons in flying

Thinking Rationally: laws of thought

- Aristotle: what are correct arguments/thought processes?
  - Logic

- Problems
  - Not all intelligent behavior is mediated by logical deliberation (reflexes)
  - What is the purpose of thinking?

Acting Humanly

- Loebner Prize
  - Every year in Boston
  - Expertise-dependent tests: limited conversation

- What if people call a human a machine?
  - Shakespeare expert
  - Make human-like errors

- Problems
  - Not reproducible, constructive or mathematically analyzable

Acting rationally

- Rational behavior: doing the right thing
- Need not always be deliberative
  - Reflexive
- Aristotle (Nicomachean ethics)
  - Every art and every inquiry, and similarly every action and every pursuit is thought to aim at some good.

Acting → Thinking?

- **Weak AI Hypothesis vs. Strong AI hypothesis**
  - Weak Hyp: machines could act as if they are intelligent
  - Strong Hyp: machines that act intelligent have to think intelligently too

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Rational Agents

- An agent should strive to do the right thing, based on what it can perceive and the actions it can perform. The right action is the one that will cause the agent to be most successful

- Performance measure: An objective criterion for success of an agent's behavior

- E.g., performance measure of a vacuum-cleaner agent could be amount of dirt cleaned up, amount of time taken, amount of electricity consumed, amount of noise generated, etc.

Ideal Rational Agent

"For each possible percept sequence, does whatever action is expected to maximize its performance measure on the basis of evidence perceived so far and built-in knowledge."

- Rationality vs omniscience?
- Acting in order to obtain valuable information