CSCE 315: Programming Studio

- Introduction to Artificial Intelligence

What is Intelligence

Textbook Definitions

- Thinking like humans

- Acting like humans

- Thinking rationally

- Acting rationally ←

However, it depends on the definition: **whatever the (intelligence) test tests.**

What is AI?

A folk (popular) view of AI

From http://www-2.cs.cmu.edu/afs/cs.cmu.edu/ user/zhuxj/www/travel/fun/ images/terminator.jpg (top); Universal studio's movie "Terminator" (bottom)

But Really, What is AI?

Diverse areas: http://www.aaai.org

- Problem solving

- Reasoning

- Theorem proving

- Learning

- Planning

- Knowledge representation

- Perception and Robotics

- Agents

- **and more**

Approaches

Two basic stances

- Strong AI:
  1. Build something that actually thinks intelligently.
  2. Simulation of thought would give rise to the pheonmenology of thought (i.e., how it feels like to think).

- Weak AI:
  1. Build something that behaves intelligently.
  2. Not worried about its feelings.

Problems

- Strong AI:
  Hard to determine if something is really consciously intelligent or not (the **other minds problem** in philosophy).

- Weak AI:
  Utility of the result is limited by the stated goal. Hard to achieve a **general usefulness** as in true intelligence.

Overview

- Related academic disciplines

- History of AI

- Hard Problems

- Current Trends

Foundations of AI

- Philosophy

- Mathematics

- Psychology

- Cognitive Science

- Linguistics

- Neuroscience

Philosophy of Mind

The mind-body problem:

- Dualism: Mind and body are separate entities.

- Monism: Only mind or body exist, but not both
  1. Idealism: all things are mental
  2. Materialism: all things are material

- Epiphenomenalism: mental phenomena are just side-effects of physical change in the brain (i.e. they do not have causal power over behavior).

Too many variations to mention all.

Mathematics

- Algorithm (al-Khowarazmi)

- Boole

- Hilbert

- Gödel: Incompleteness theorem

- Turing: Halting problem

- Cook and Karp: P, NP, and the like

Representation/Interpretation, Symbol/Computing: the computer/software metahpore.

Psychology

- Behaviorism: stimulus-response and conditioning

- Functionalism: internal representations and processes. Implementation independent.

- Perceptual psychology: vision, audition, etc.

- Cognitive psychology: cognition as information processing.

- Holistic vs. localist debate: emergent vs. simple summation.

Linguistics

- WW II : machine translation.

- Phonetics, syntactic theory, semantics, discourse, etc.

- Innate vs. learned? : Chomsky

- Syntax: finite automata, context free grammar, etc.

- Semantics: semantic nets

- Sub-symbolic: self-organizing maps, episodic memory, recurrent neural nets, etc.

Cognitive Science

Interdisciplinary field studying human perception and cognition, ranging over:

- Neuroscience
- Behavioral science
- Social science
- Psychology
- Computational science
- Information theory
- Cultural studies

Neuroscience

- Staining: Golgi, Nissl
- Hubel and Wiesel: orderly structure of cat visual cortex
- PET scans and CAT scans: localizing functional modules
- fMRI imaging: cognitive and perceptual tasks
- Optical imaging: orderly structure
- TMS: zap and numb your brain

History of AI (I)

Gestation (1943–1956)

- McCulloch and Pitts: early neural nets
- Minsky and Papert: limitations of perceptron
- Newell and Simon: physical symbol system hypothesis
  - Logic Theorist
- Dartmouth Workshop (1956): AI was born
  It is 50(+1) years old (2007)!
  http://en.wikipedia.org/wiki/AI@50

History of AI (II)

Early successes (1952–1969)

- General problem solver
- McCarthy: LISP
- Toy domains: ANALOGY, STUDENT (algebra).
- Widrow and Hoff: adalines
- Rosenblatt: perceptrons

History of AI (III)

The 60's and 70's

- ELIZA

- Genetic algorithms

- Knowledge-based systems: avoid the weak method,

  i.e. search

  - scientific domain

  - engineering domain

  - natural language

The 80's : 5th generation AI – Prolog.

History of AI (IV)

50th anniversary in 2006: http://en.wikipedia.org/wiki/AI@50

- Some quotes from the 50th anniversary event (Rodney

  Brooks):

  – the social sophisitication of 10-year-old

  – the manual dexterity of a 6-year-old

  – the language ability of 4-year-old

  – the visual object recognition of a 2-year-old

Hard Problems (I)

- Physicalism, materialism, and naturalism: brain causes
  mind.

- Functionlism: if it functions in the same way, a silicon brain
  can also be conscious.

- Dualism and homunculus: the Cartesian theatre.

- Wide vs. narrow content: real correspondence, or limited
  to experiential state?

- Intentionality: how can we believe in things that do not
  exist, such as Poseidon.

Hard Problems (II)

- Semantic content and syntactic symbols: how can
  syntacic constructs posess intenionality?

- Symbol grounding: sensory devices produce grounded
  symbols, and composite symbols can be constructed.

- Problem of qualia: why do we feel in such a way?

- Turing test and Searle's Chinese Room
  - system reply
  - robot reply

Hard Problems (III)

- However, the assumption that a collection of unconscious things are unconscious is invalid: think about organic vs. inorganic, life vs inanimate matter.

- Searle's point of view: mind is an emergent phenomena of the neural substrate (biological naturalism).

Current Trends

- Learning: instead of hand-coding or strict reasoning.

- Neural networks and statistical methods

- Genetic algorithms (Evolutionary algorithms)

- Embodied robotics; Dynamical systems approach

- Bioinformatics

- Computational Neuroscience

- Distributed Agents

- Some thoughts on consciousness: Crick and Koch

What We Will Discuss

- Search

- Game tree search