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 phenomenology 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
Mathematics

- Algorithm (al-Khowarazmi)
- Boole
- Hilbert
- Gödel: Incompleteness theorem
- Turing: Halting problem
- Cook and Karp: P, NP, and the like


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(+8) years old (as of 2014)!
  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 sophistication 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

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