COMP 472: Artificial Intelligence
Introduction
Intelligence & The Turing Test

- Russell & Norvig, chap. 1 & 27

Today

1. Recent Breakthroughs
2. Intelligence & the Turing Test
   a) What is intelligence?
   b) What is artificial intelligence?
   c) the TuringTest
3. What do we do in AI?
4. History of AI

What is Intelligence?

- Wikipedia:
  - general definition:
    - Intelligence = the ability to perceive (感知) or infer (推论) information, and to retain it as knowledge to be applied towards adaptive behaviors within an environment or context.
  - specific definition:
    - Intelligence = the capacity for:
      - logic,
      - understanding,
      - reasoning,
      - critical thinking,
      - problem-solving,
      - planning,
      - learning,
      - self-awareness,
      - emotional knowledge,
      - creativity.

左边的AI能做到，右边的做不到

https://en.wikipedia.org/wiki/Intelligence

Natural vs Machine Intelligence

1. Natural Intelligence
    1. Human intelligence
    2. Animal intelligence
2. Machine Intelligence

see https://arxiv.org/pdf/0712.3329.pdf (really nice paper)

Human Intelligence

- intelligence = property of an individual who has the ability to
  - interact with an external environment, problem or situation
  - achieve a goal
  - learn and adapt in an environment is not fully known and may contain new situations that could not have been anticipated in advance.

- often classified as:
  1. verbal-linguistic intelligence - ability to communicate
  2. spatial intelligence - ability to observe the world
  3. logical-mathematical intelligence - ability to solve math problems
  4. emotional intelligence - ability to identify and manage emotions

- "tests of intelligence" try to measure these types of intelligence
  - eg. IQ tests

see https://arxiv.org/pdf/0712.3329.pdf (really nice paper)

Animal Intelligence

- Same notions of
  - perception
  - achieving a goal
  - adapting to a new environment
- But because animals:
  - (perception) animals have different sensory and motor capabilities
  - (goal) not easy to explain to the animal what its goal is, so we usually, reward them with food
- So test for animal intelligence use different methodologies and criteria.
- Examples of animal intelligence
  - Octopuses : can open a jar to get to its contents.
  - Dolphins: can communicate with other dolphins to pass on their knowledge to others.
  - Chimpanzees: can use different tools to carry out complex tasks
  - Elephants: display acts of altruism and self awareness.
  - ...

Is DeepBlue Intelligent?

- In 1996 and 1997 IBM's Deep Blue beat the human chess champion Kasparov in a six-games match.
- But Deep Blue uses:
  - plain brute force technique
  - on a massively parallel supercomputer
  - can explore 200,000,000 positions per second (Kasparov can examine 3/sec)
- Today, emphasis on more *intelligent* chess programs
- in Nov. 2006, Deep Fritz vs. Kramnik, ran on an ordinary Intel Core 2 Duo CPUs

source of image:
http://upload.wikimedia.org/wikipedia/en/c/c6/P11_kasparov_breakout.jpg

Is AlphaGo Intelligent?

- GO was always considered a much harder game to automate than chess because of its very o high a branching factor (35 for chess vs 250 for Go!)
- In 2016, AlphaGo beat Lee Sedol in a five-game match of GO.
- In 2017 AlphaGo beat Ke Jie, the world No.1 ranked player at the time

- AlphaGo uses a Monte Carlo tree search algorithm to find its moves based on knowledge previously "learned" by deep learning

Is game playing intelligent?

- Games are often used in AI has they constitute a "restricted world" with somewhat simple rules

"Chess is far easier than innumerable tasks performed by an infant, such as understanding a simple story, recognizing objects and their relationships, understanding speech, and so forth. For these and nearly all realistic AI problems, the brute force methods in Deep Blue are hopelessly inadequate."

– David Stork

Today

1. Recent Breakthroughs
2. Intelligence & the Turing Test
   a) What is intelligence?
   b) What is artificial intelligence?
   c) the TuringTest
3. What do we do in AI?
4. History of AI

What is artificial intelligence?

- No standard definition of AI among those working in the field
- AI has even been defined as:

"… the collection of problems and methodologies (方法论) studied by artificial intelligence researchers."
- Luger and StubbleField

Other Definitions

- *The exciting new effort to make computers think… machines with minds, in the full and literal sense* (Haugeland, 1985)
- *The art of creating machines that perform functions that require intelligence when performed by people* (Kurzweil, 1990)
- *The study of how to make computers do things at which, at the moment, people are better*. (Rich and Knight, 1991)
- *The study of mental faculties through the use of computational models* (Charniak and McDermott, 1985)
- *A field of study that seeks to explain and emulate intelligent behavior in terms in terms of computational processes (Schalkoff, 1990)*
- *---> The study of the computations that make it possible to perceive, reason, and act* (Winston, 1992)

Approaches to AI: Engineering VS Cognitive Approach

Approach to AI可以分为两种

- Engineering Approach: 我们更在乎engineering这种 //就如同飞机，他并不像鸟一样，但也能飞
  - Tries to find optimal solutions optimal:最理想的
  - No matter how (not necessarily what human do)

只在乎结果，而不在乎怎么做（并不一定要模仿人类）

认知的

- Cognitive Approach:
  - Tries to understand the process 试图理解人类，并不特别在乎result，而在乎result背后的原因
  - Tries to reproduce human behavior (even if wrong result)

Approaches to AI: Weak VS Strong AI

- Weak AI : single application for specific task， 限定于很小的领域

  - aka *narrow AI*
  - A system that can perform **a specific** intellectual task, limited to a narrow area/application

- Strong AI:

  - aka *artificial general intelligence* (AGI)
  - typically used in science fiction sf电影21
  - A system that matches or exceeds human intelligence in **any** intellectual task
  - A system that could have: consciousness, self-awareness, the ability to *feel* sentiments, ...

Today

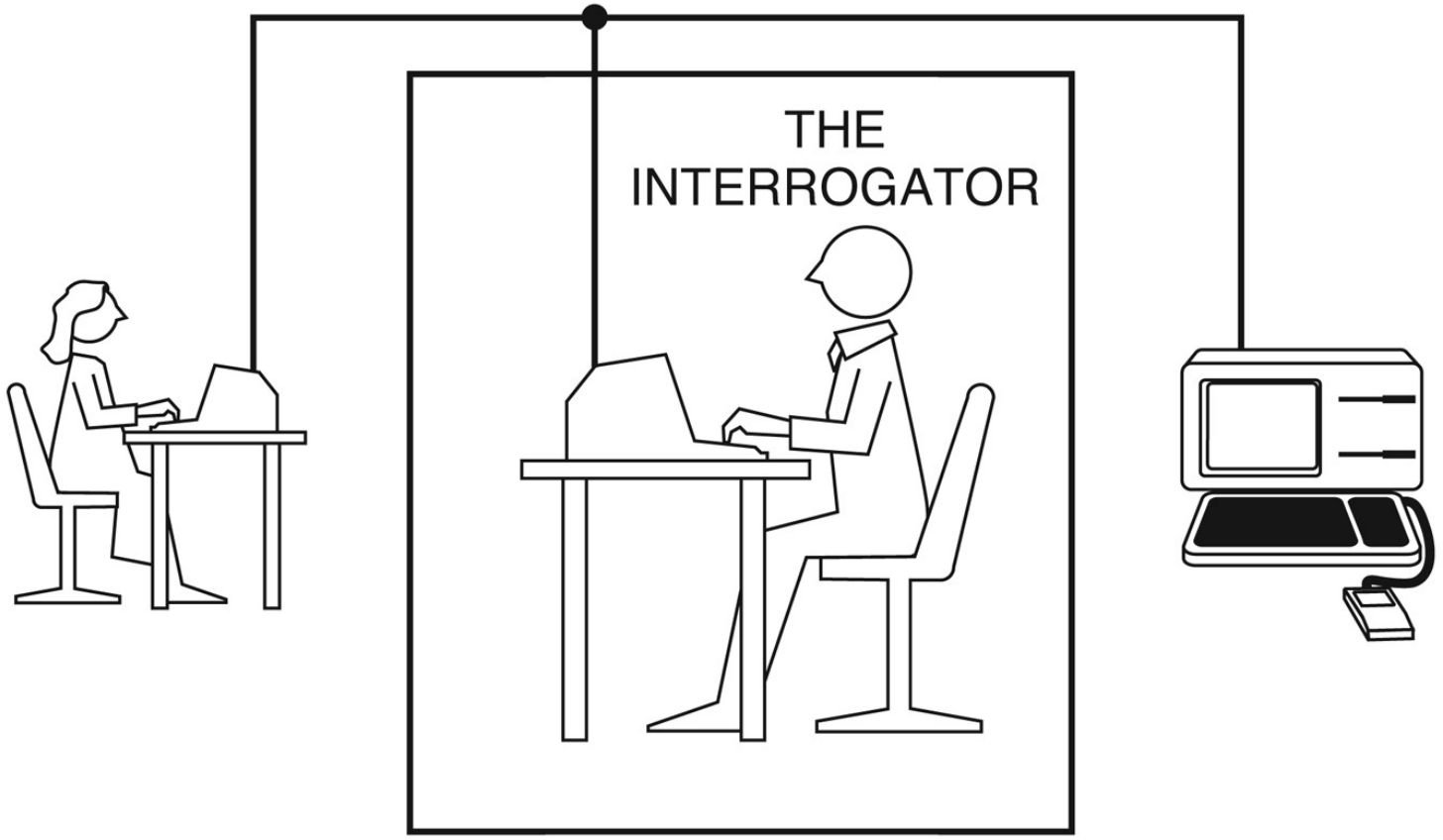
1. Recent Breakthroughs
2. Important Questions
   a) What is intelligence?
   b) What is artificial intelligence?
   c) the TuringTest

3. What do we do in AI?
4. History of AI

A Test for Intelligence…

- The Turing Test
  - The "imitation game"
  - Proposed by Alan Turing in 1950
  - If a human interrogator cannot tell the computer and human apart, then the computer is intelligent
  - Measures the intelligence of a computer vs. a human
  - Turing predicted that by 2000, a machine might have a 30% chance of fooling a person for 5 minutes

The Turing Test



- A human mediates between the interrogator and the machine

The Turing Test

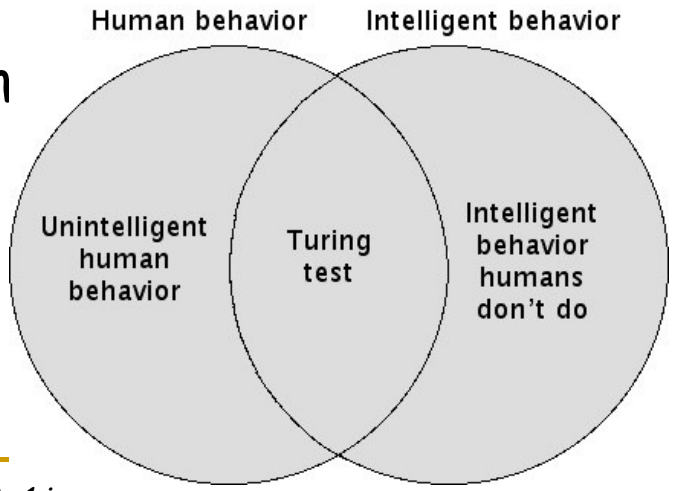
- Some capabilities required to pass the Turing test:
  - Natural Language Processing (NLP) to communicate
  - Knowledge Representation to store knowledge
  - Automated Reasoning to infer new knowledge
  - Machine Learning
  - …

Arguments For the Turing Test

- Objective notion of intelligence
- Prevents us from arguments about the computer's consciousness
- Eliminates bias in favor of humans
- …

Arguments Against Turing Test

- Not reproducible
- Not constructive
- Machine intelligence designed w.r.t. humans
  - test is anthropomorphic. It only tests if the subject *resembles* a human being.
  - unnecessarily restrict machines
  - ex: x-ray vision, fast computation



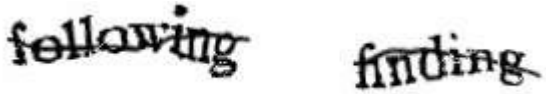
source of image: http://en.wikipedia.org/wiki/Image:Weakness_of_Turing_test_1.jpg

Did anyone pass the Turing Test yet?

- The Long Bets Foundation has $20,000 bet between
  - Mitchell Kapor, founder of Lotus Development, and
  - Ray Kurzweil, inventor
  - Kapor bets that "By 2029 no computer - or "machine intelligence" - will have passed the Turing Test. "
- After more than 60 year ... <drum roll please> ... In 2014, the news reported that a chatbot passed the Turing Test!
- But, Kurzweil himself is not convinced... because the test had restrictions...
  - the chatbot claimed to be a 13-year-old, and
  - one for whom English is not a first language

Current Turing Test

CAPTCHA:



- **C**ompletely **A**utomated **P**ublic **T**uring test to tell **C**omputers and **H**umans **A**part
- the system asks a user to complete a test which the computer is able to generate and grade, but not able to solve.
- Because computers are unable to solve the CAPTCHA, any user entering a correct solution is presumed to be human.
- also known as **reverse Turing test**, because it is:
  - given by a machine and targeted to a human
  - in contrast to the Turing test that is given by a human and targeted to a machine.

source of image:
http://upload.wikimedia.org/wikipedia/commons/b/b6/Modern-captcha.jpg

Today

1. Recent Breakthroughs ✓
2. Intelligence & the Turing Test ✓
   a) What is intelligence? ✓
   b) What is artificial intelligence? ✓
   c) The Turing Test ✓
3. What do we do in AI?
4. History of AI

Up Next

1. Recent Breakthroughs
2. Intelligence & the Turing Test
   a) What is artificial intelligence?
   b) What is intelligence?
   c) Is there a test for intelligence?
3. What do we do in AI?
4. History of AI