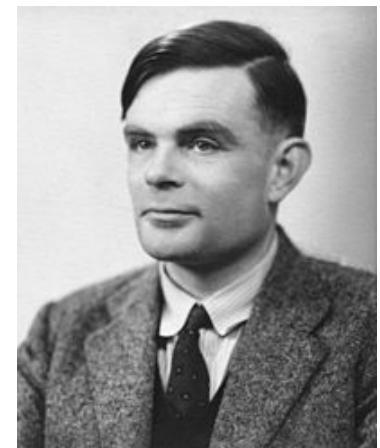


CS440/ECE448: Artificial Intelligence



CS440/ECE448: Artificial Intelligence

Section Q course website:

<http://slazebni.cs.illinois.edu/fall16/>

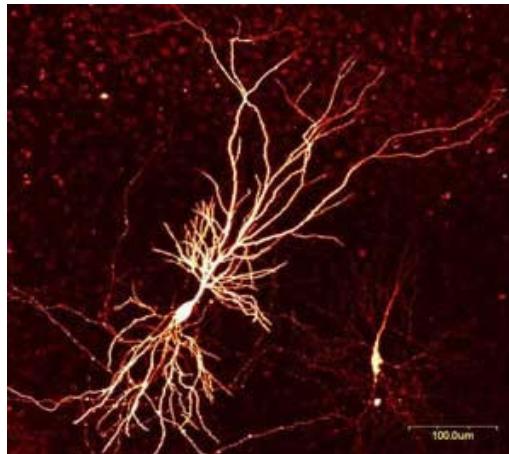
What is AI?

Candidate definitions from the textbook:

1. Thinking humanly	2. Acting humanly
3. Thinking rationally	4. Acting rationally

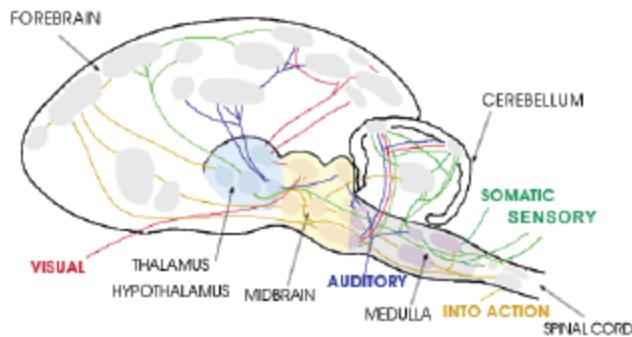
AI definition 1: Thinking humanly

- Need to study the brain as an information processing machine: cognitive science and neuroscience



AI definition 1: Thinking humanly

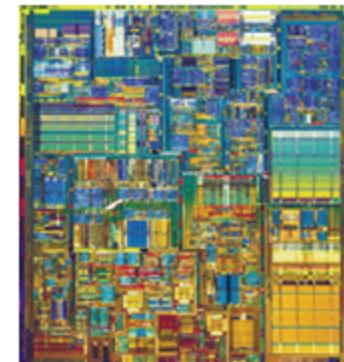
- Can we build a brain?



10^{11} neurons
 10^{14} synapses
cycle time: 10^{-3} sec

VS.

10^9 transistors
 10^{12} bits of RAM
cycle time: 10^{-9} sec



Source: L. Zettlemoyer

AI definition 1: Thinking humanly



Since President Obama announced the **BRAIN Initiative** in April 2013, dozens of leading technology firms, academic institutions, scientists and other key contributors to the field of neuroscience have answered his call and made significant commitments to advancing the Initiative.



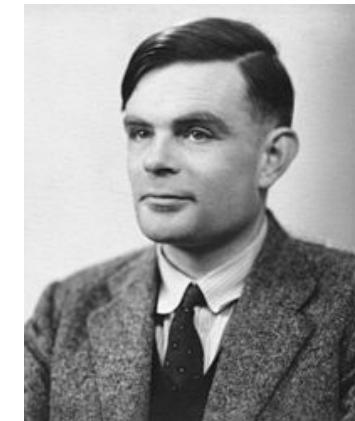
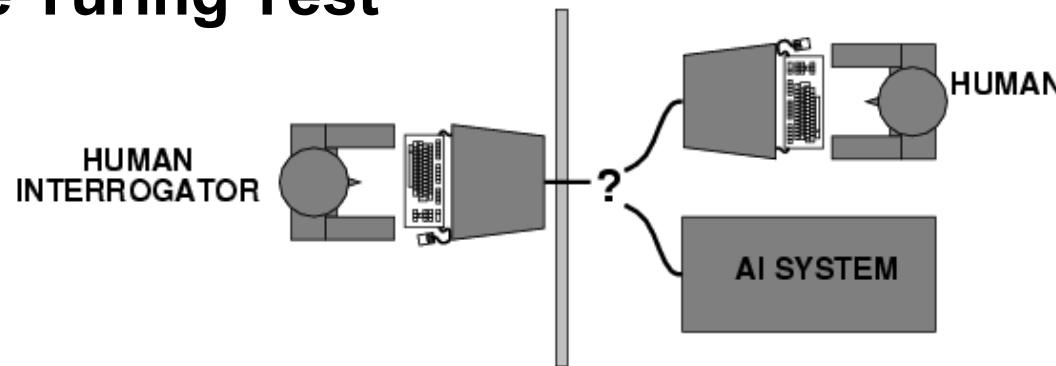
FUTURE COMPUTING

Develop novel neuromorphic and neurorobotic technologies based on the brain's circuitry and computing principles.



AI definition 2: Acting humanly

- **The Turing Test**



- What capabilities would a computer need to have to pass the Turing Test?
 - Natural language processing
 - Knowledge representation
 - Automated reasoning
 - Machine learning
- Turing predicted that by the year 2000, machines would be able to fool 30% of human judges for five minutes

A. Turing, [Computing machinery and intelligence](#), Mind 59, pp. 433-460, 1950

AI is solved?

Computer AI passes Turing test in 'world first'



Eugene Goostman simulates a 13-year-old Ukrainian boy

9 June 2014 Last updated at 08:36 ET

<http://www.bbc.com/news/technology-27762088>

http://en.wikipedia.org/wiki/Eugene_Goostman

<http://www.scottaaronson.com/blog/?p=1858>

A computer program called Eugene Goostman, which simulates a 13-year-old Ukrainian boy, is said to have passed the Turing test at an event organised by the University of Reading.

The test investigates whether people can detect if they are talking to machines or humans.

The experiment is based on Alan Turing's question-and-answer game **Can Machines Think?**

No computer has passed the test before under these conditions, it is reported.

However, some artificial intelligence experts have disputed the victory, suggesting the contest had been weighted in the chatbot's favour.

The 65-year-old **Turing Test** is successfully passed if a computer is mistaken for a human more than 30% of the time during a series of five-minute keyboard conversations.

On 7 June Eugene convinced 33% of the judges at the Royal Society in London that it was human.

Other artificial intelligence (AI) systems also competed, including **Cleverbot**, **Elbot** and **Ultra Hal**.

Judges included actor Robert Llewellyn, who played an intelligent robot in BBC Two's science-fiction sitcom Red Dwarf, and Lord Sharkey, who led the successful campaign for Alan Turing's posthumous pardon, over a conviction for homosexual activity, in 2013.

Eugene was created by Vladimir Veselov, who was born in Russia and now lives in the United States, and Ukrainian-born Eugene Demchenko, who now lives in Russia.

Related Stories

[How the Turing Test inspired AI](#)

[Playing solitaire with Turing](#)

[Is artificial intelligence possible?](#)

[16:22:39] **Local:**
What comes first to mind when you hear the word "toddler"?

[16:22:49] **Remote:**
And second?

[16:23:26] **Local:**
What comes to mind when you hear the word "grown-up"?

[16:23:37] **Remote:**
Please repeat the word to me 5 times.

[16:24:22] **Local:**
What do you think is the purpose of emotion?

Man or machine? A glimpse at one of the conversations.

What's wrong with the Turing test?

- Variability in protocols, judges
- Success depends on deception!
- Chatbots can do well using “cheap tricks”
 - First example: [ELIZA](#) (1966)

A better Turing test?

- **Winograd schema:** Multiple choice questions that can be easily answered by people but cannot be answered by computers using “cheap tricks”

The trophy would not fit in the brown suitcase because it was so small.

What was so small?

- *The trophy*
- *The brown suitcase*

H. Levesque, [On our best behaviour](#), IJCAI 2013

<http://www.newyorker.com/online/blogs/elements/2013/08/why-cant-my-computer-understand-me.html>

A better Turing test?

- **Winograd schema:** Multiple choice questions that can be easily answered by people but cannot be answered by computers using “cheap tricks”

*The trophy would not fit in the brown suitcase because it was so **large**.*

*What was so **large**?*

- *The trophy*
- *The brown suitcase*

H. Levesque, [On our best behaviour](#), IJCAI 2013

<http://www.newyorker.com/online/blogs/elements/2013/08/why-cant-my-computer-understand-me.html>

Winograd schema: More examples

- *The large ball crashed right through the table because it was made of steel. What was made of steel?*
 - *The large ball*
 - *The table*

Winograd schema: More examples

- *The large ball crashed right through the table because it was made of styrofoam. What was made of styrofoam?*
 - *The large ball*
 - *The table*

Winograd schema: More examples

- *The large ball crashed right through the table because it was made of styrofoam. What was made of styrofoam?*
 - *The large ball*
 - *The table*
- *The sack of potatoes had been placed below the bag of flour, so it had to be moved first. What had to be moved first?*
 - *The sack of potatoes*
 - *The bag of flour*

Winograd schema: More examples

- *The large ball crashed right through the table because it was made of styrofoam. What was made of styrofoam?*
 - *The large ball*
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 - *The sack of potatoes*
 - *The bag of flour*
- *Sam tried to paint a picture of shepherds with sheep, but they ended up looking like rabbits. What looked like rabbits?*
 - *The shepherds*
 - *The sheep*

Winograd schema: More examples

- *The large ball crashed right through the table because it was made of styrofoam. What was made of styrofoam?*
 - *The large ball*
 - *The table*
- *The sack of potatoes had been placed above the bag of flour, so it had to be moved first. What had to be moved first?*
 - *The sack of potatoes*
 - *The bag of flour*
- *Sam tried to paint a picture of shepherds with sheep, but they ended up looking like golfers. What looked like golfers?*
 - *The shepherds*
 - *The sheep*

Winograd schema

- Advantages over standard Turing test
 - Test can be administered and graded by machine
 - Does not depend on human subjectivity
 - Does not require ability to generate English sentences
 - Questions cannot be evaded using verbal dodges
 - Questions can be made “Google-proof” (at least for now...)
- Winograd schema challenge
 - Held at IJCAI conference in July 2016
 - Six entries, best system got 58% of 60 questions correct
(humans get 90% correct)

AI definition 3: Thinking rationally

- Idealized or “right” way of thinking
- **Logic:** patterns of argument that always yield correct conclusions when supplied with correct premises
 - *“Socrates is a man; all men are mortal; therefore Socrates is mortal.”*
- **Logicist approach to AI:** describe problem in formal logical notation and apply general deduction procedures to solve it
- Problems with the logicist approach
 - Computational complexity of finding the solution
 - Describing real-world problems and knowledge in logical notation
 - Dealing with uncertainty
 - A lot of “rational” behavior has nothing to do with logic

AI definition 4: Acting rationally

- A **rational agent** acts to optimally achieve its goals
 - Goals are application-dependent and are expressed in terms of the **utility of outcomes**
 - Being rational means **maximizing your (expected) utility**
- This definition of rationality only concerns the decisions/actions that are made, not the cognitive process behind them
- In practice, utility optimization is subject to the agent's computational constraints (**bounded rationality** or **bounded optimality**)

Utility maximization formulation

- Advantages
 - Generality: goes beyond explicit reasoning, and even human cognition altogether
 - Practicality: can be adapted to many real-world problems
 - Naturally accommodates uncertainty
 - Amenable to good scientific and engineering methodology
 - Avoids philosophy and psychology
- Disadvantages?
 - It may be hard to formulate utility functions, especially for complex open-ended tasks
 - The AI may end up “gaming” the utility function, or its operation may have unintended consequences
 - Has limited applicability to humans