

How to Tell a Human apart from a Computer

The Turing Test

February 2011

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Are Computers like Human Brains?

- The impressive contributions of computers during World War II made them earn the eponym of *Giant Brains*.
- There is a superficial similarity between the switching circuits that made up computers and the cells of the human (and animal) nervous system.

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A Superficial Similarity

- The nervous system (including the brain) consists of cells, neurons, that have an elongated part (axon) and connect to other neurons through structures called **synapses**. Under certain conditions a neuron becomes "excited" transmitting an electric wave called *action potential*. When displayed on an oscilloscope the wave has the form of a spike that has a fixed size for a given preparation.
- The fact that a neuron can have only one of two states (quiet or transmitting a spike of fixed size) seemed to make neurons similar to the switching circuits of a computer that can be ON or OFF.

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Two Fallacies

1. While the spike of the action potential has a fixed amplitude a neuron may fire several of them and the time between spikes seems to be an important carrier of information. Therefore neurons are not binary devices.
2. There are billions of neurons in the human brain and their connectivity is the result of millions of years of evolution. In order to build a computer able to simulate the human brain it is not enough to start with basic blocks that may be similar in the two systems. We have to figure out how they are interconnected.

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A Sobering Truth

- Being successful in programming machines to solve mathematical problems tells us nothing about the prospect of replicating human intelligence.
- Mathematics is a human invention that came very late in our evolutionary history so our brains have not well adapted to mathematical tasks.
- It is quite a different story with tasks such as recognizing faces and facial expressions.

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What the Pioneers Said - 1

- John von Neumann wrote a short monograph, *The Computer and the Brain*. He wrote it in the hospital while fighting the cancer that eventually took his life. In the book "he observed that the basic computing hardware of the brain indicated a different methodology than the one used in developing the computer".

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What the Pioneers Said - 2

- Turing proposed a test to determine whether a machine exhibits human level intelligence.
- A person sits on a teletype and types questions that are sent to someone in another room who then replies.
- The questioner tries to determine whether the responder is a human or a computer. If it is a computer and the questioner thinks the responder is a human, then the computer passes the Turing test.
- No machine has ever passed the Turing test.

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A Modern Application of the Turing Test

Completely
Automated
Public
Turing test to tell or CAPTCHA
Computers and
Humans
Apart

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CAPTCHA - 1

- Many web services want to make sure that user accounts are set up only for people and not for computers. (Computer programs that visit web sites are called web-bots, a contraction of web robot.)
- How can they tell apart a web-bot from a human?
- By asking the prospective user to pass a Turing test! If the user passes the test, the web service assumes that the user is human, otherwise the service rejects the user as a web-bot.

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CAPTCHA - 2

To:
E-mail address:

Your Details:
Your name:
E-mail address:

Security image:
Please enter the numbers that appear here in the box below.


Security code:

* INFORMATION REQUIRED

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How Computers Read Optical Character Recognition (OCR)

- Step 1: Separate print (usually dark) from background (usually light).
- Step 2: Pick up individual characters (group of dark pixels)
- Step 3: Identify their shape by looking for strokes, loops, corners, etc
- Step 4: Use rules to classify. For example, an H has two vertical strokes and a short horizontal strokes.

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Frustrating OCR

1	Separate background from print	Use messy background.
2	Pick up individual characters	Have them blend with each other.
3	Find strokes, loops, etc	Make the letters "wiggly"
4	Apply classification rules	It should be hopeless by this point.

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