

Can Machines Think?



Alan Mathison Turing
1912-1954

Father of Computer Science
Mathematician, Logician
Wartime Codebreaker
Victim of Prejudice

*“Mathematics, rightly viewed, possesses not only truth
but supreme beauty, a beauty cold and austere
like that of sculpture.” - Bertrand Russell*

MIND

A QUARTERLY REVIEW

OF

PSYCHOLOGY AND PHILOSOPHY



I.—COMPUTING MACHINERY AND INTELLIGENCE

BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either 'X is A and Y is B' or 'X is B and Y is A'. The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?

Now suppose X is actually A, then A must answer. It is A's

- This paper defined the Turing Test

"BENEDICT CUMBERBATCH IS OUTSTANDING"

RADIO TIMES

"THE BEST BRITISH FILM OF THE YEAR"



THE INDEPENDENT

"AN INSTANT CLASSIC"



GLAMOUR

"A SUPERB THRILLER"



EMPIRE



TIME OUT

THE TIMES

THE BENEDICT CUMBERBATCH KEIRA KNIGHTLEY
**IMITATION
GAME**

12A MODERATE SEX
REFERENCES

BASED ON THE INCREDIBLE TRUE STORY

BLACK BEAR PICTURES PRESENTS AN ANIMATION ENTERTAINMENT / BLACK BEAR PICTURES PRODUCTION A BRISCOL AUTOMATICS PRODUCTION "THE IMITATION GAME" BENEDICT CUMBERBATCH KEIRA KNIGHTLEY MATTHEW GOODIE TERRY KINCAID
WITH CHARLES DANCE AND ANARK STRONG COSTUME DESIGNER ANNA BELLI EXECUTIVE PRODUCERS TANIA PHILLIPS PRODUCED BY SHANNY SHELDON OFFICE PRODUCED BY MARINA LORENTYEVICHA EXECUTIVE PRODUCERS ALEXANDRE DESPLAT AND WILLIAM BOLLEAUD PRODUCED BY OSCAR PARAN AND PETER REISLUP WRITTEN BY ANDRA GROSSMAN DIRECTED BY TOMOSTIKOSKY COSTUME DESIGNER TERRY SCHWARZMAN EXECUTIVE PRODUCERS GRAHAM MOORE PRODUCED BY MORTON TYLUM

f /ImitationGameUK

IN CINEMAS NOVEMBER 14

<http://www.impawards.com>

- This paper defined the Turing Test
- The test is a contentious, oft-debated topic in Artificial Intelligence, Cognitive Science, and Philosophy of Mind

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“...Turing's paper has been considered to represent the ‘beginning’ of artificial intelligence (AI) and the TT has been considered its ultimate goal.”

- This paper defined the Turing Test
- The test is a contentious, oft-debated topic in Artificial Intelligence, Cognitive Science, and Philosophy of Mind

“...it is time for AI to consciously reject the naive anthropomorphism implicit in all such 'imitation games' and adopt a more mature description of its aims”

Ford and Hayes, Turing Test Considered Harmful

It is a landmark paper that you should read

- It might seem an obvious choice
- It might seem a strange choice

I'm only going to describe the paper briefly...

"Occasional hyperbole and flimflam aside, artificial intelligence is a wonderful subject, full of new ideas and possibilities, unfettered by tradition or concern (other than inspirational) for the accidents of human constitution, but disciplined by the limits of mechanical computation." ...
"Any attempt to create and understand minds must be of a philosophical interest. In fact, *AI is philosophy, conducted by novel means.*"

Clark Glymour, Kenneth M. Ford, and Patrick J. Hayes

- It might be a strange choice

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Turing begins by refining the question

'Can Machines Think?'

operationalize

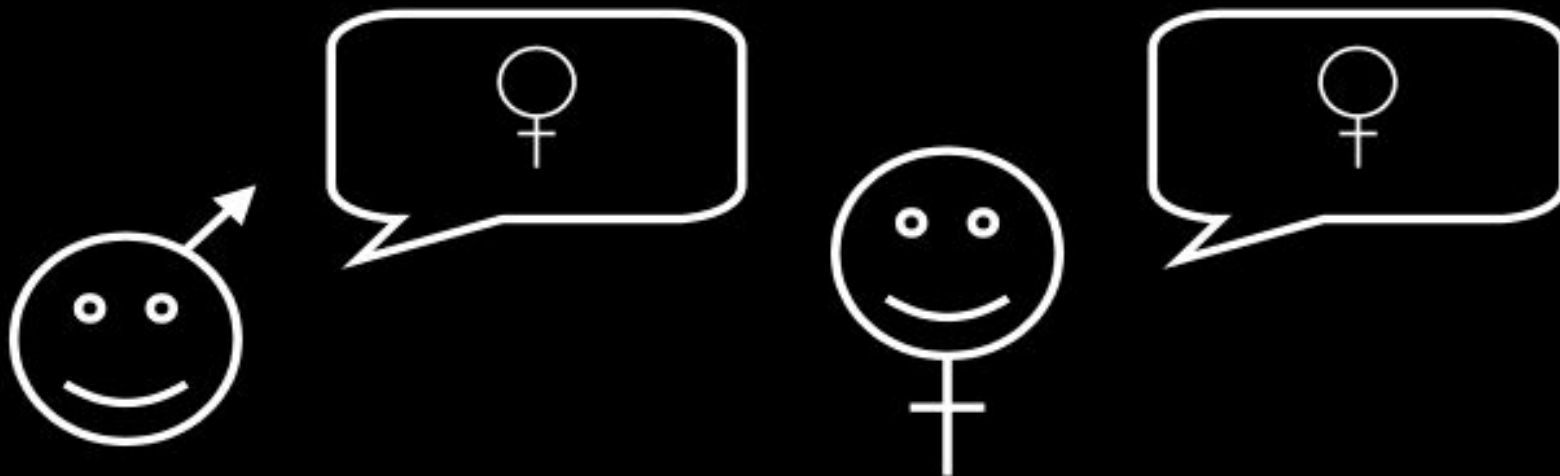


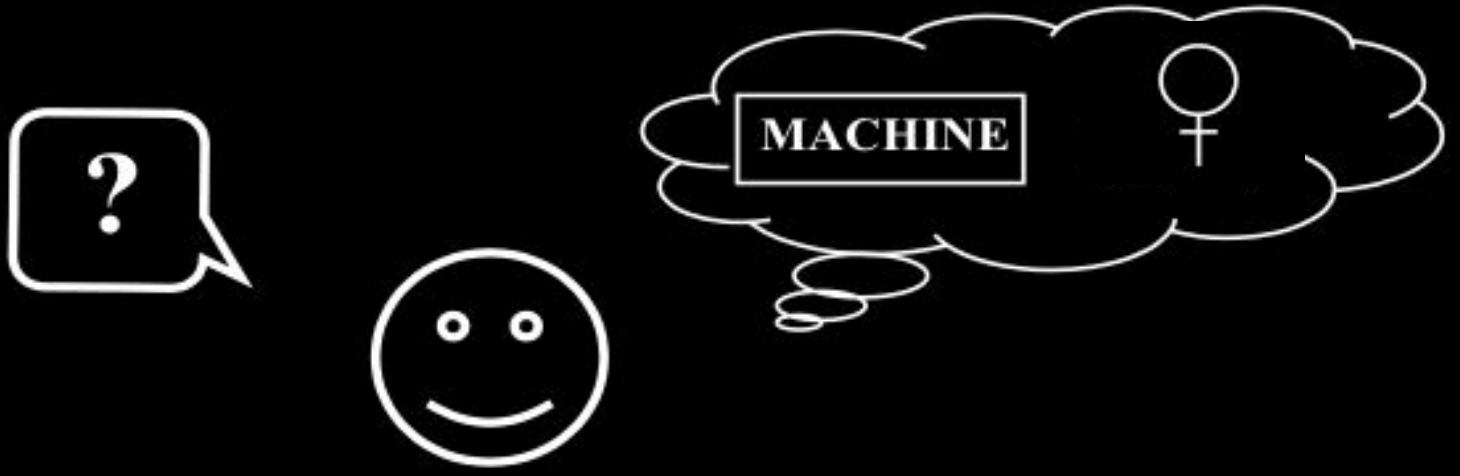
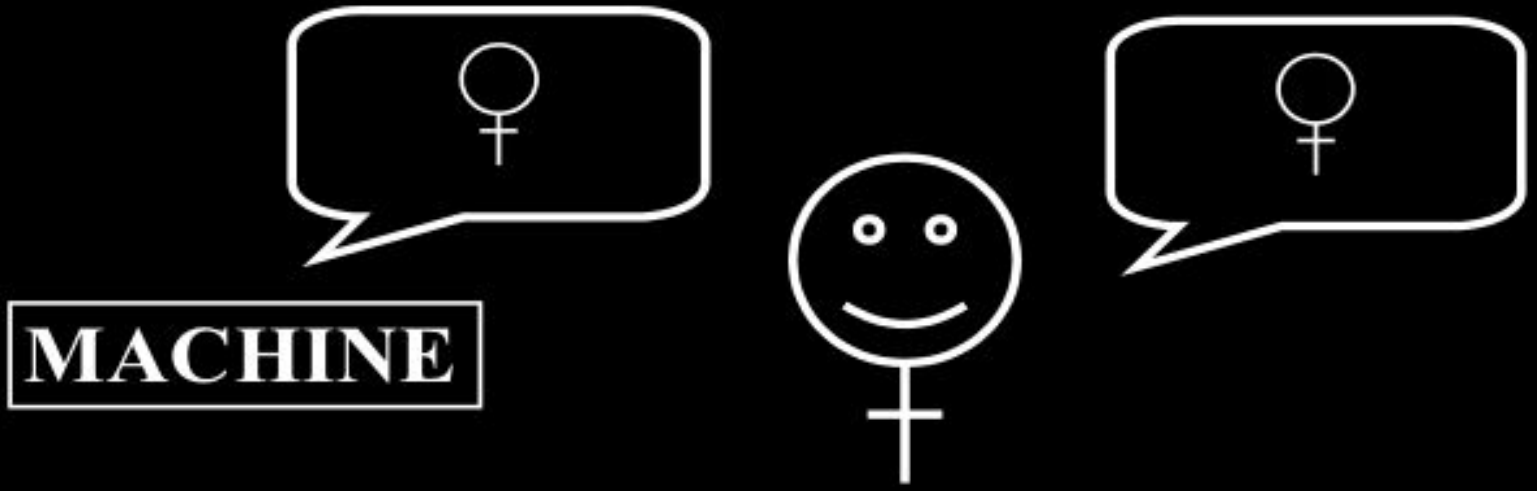
'Are there imaginable digital computers which would do well in the imitation game?'

('Are there discrete state machines which would do well?')

MACHINE







Does the difference matter?

- The machine vs. human is taken as the *standard* interpretation
- Others (Saygin et al., Sterrett 2000) have argued that this closer reading is important
 - This makes it about comparing two forms of deception
 - The computer could outperform a human!
 - Seems to depend less crucially on the interrogator

Antecedents

Géraud de Cordemoy

(1626–1684)

- “How can I, as a thinking being, be certain that the human beings who surround me are also thinking beings, and not simple automatons?”
- He is known for his metaphysics and, since the 1960s for his theory of language



<https://www.wikipedia.org>

Subsequent Variations on the theme

CAPTCHAs

Completely Automated Public Turing test to tell Computers and Humans Apart

As a protection against automated spam, you'll need to type in the words that appear in this image to register an account:
([What is this?](#))

sepalbeam



- As well as asking 'What is the answer to this new form of question?'
 - 'Is this new question a worthy one to investigate?'
- 'May not machines carry out something which ought to be described as thinking but which is very different from what a man does? This objection is a very strong one, but at least we can say that if, nevertheless, a machine can be constructed to play the imitation game satisfactorily, we need not be troubled by this objection.'
- The question which we put in § 1 will not be quite definite until we have specified what we mean by the word 'machine'.

"AI has an engineer's respect for things that work and a pragmatic willingness to try anything that will produce the results needed. In the spirit of medieval astronomy, it wants to save the phenomena, not to hypothesize psychological truth."

Clark Glymour, Kenneth M. Ford, and Patrick J. Hayes

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'I believe that in about fifty years' time it will be possible to programme computers, with a storage capacity of about 10^9 , to make them play the imitation game so well that an average interrogator will not have more than 70% chance of making the right identification after five minutes of questioning.'

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Anyone here bold enough to make quantitative predictions for 2073?

Loebner Prize contests



Loebner Prize contests

How old are you?

See if you can work it out. I was born on 2nd January 2000.

Where should one look for love?

On the internet

Who said “I have a dream”?

You just said that!

What is the third angle in a triangle with internal angles of 90 degrees and 30 degrees?

Earth is the third planet.



The bot's facebook page

Loebner Prize contests

If a chicken roosts with a fox they may be eaten. What may be eaten?

Is this a riddle? Is it part of a car?

I had to go to the toilet during the film because it was too long. What was too long?

Was it worth going to? Is that your opinion? Measuring much from end to end in space or from beginning to end in time; not short or brief.



The bot's facebook page

Loebner Prize contests

“In any case, directing the conversation creates a more sophisticated impression than simply repeating the input back to the interrogator or asking ELIZA-like questions. The situation is similar to watching a team play in the offensive rather than in the defensive.”

(Saygin et al. 2000)

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Loebner astutely declared Minsky a co-sponsor of the contest, since, according to the rules, when the grand prize is won, the contest will not be held again. In that case, with Minsky's contribution, the prize should become \$100,100.”

(Saygin et al. 2000)

Sources, references, and recommended readings

- Alan Turing. “*Computing Machinery and Intelligence*” *Mind*. **49**:433–460, 1950.
- Andrew Hodges. “*Alan Turing: The Enigma*”, New York, N.Y.: Simon & Schuster, 1983.
- B. Jack Copeland has multiple books and papers on Turing and early computers, notably including his edited collection “*The Essential Turing*”
- Douglas R. Hofstadter. “*A Coffeehouse Conversation on the Turing Test*” in “*The Mind's I*”, Penguin, 1981.
- John R. Lucas. “*Minds, Machines, and Gödel: A Retrospect*” *Machines and Thought*. Oxford University Press, U.K. 1996.
- Ayse Pinar Saygin, Ilyas Cicekli, and Varol Akman “*Turing Test: 50 Years Later*” *Minds and Machines*. **10**(4):463–518, Oct/Nov 2000.
- Susan Sterrett. “*Turing’s Two Tests for Intelligence.*” *Minds and Machines*. **10**(4):541–559, Oct/Nov 2000.

Read the original works. Learn from
the masters!

Vannevar Bush, Claude Shannon, Adam Smith, ...

Final words

“We can only see a short distance ahead, but we can see plenty there that needs to be done.”