

# Computational Intelligence



LMU Munich  
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## M I N D

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?

Alan Turing.  
Computing Machinery and Intelligence.  
Mind, 1950.

Who has read any scientific paper in full?

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# How do scientific papers work?

# What was different in 1950?

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# Can Machines Think?



Turing explains...

- chatting
- machines
- computers

“The reader must accept it as a fact that digital computers can be constructed, and indeed have been constructed, according to the principles we have described, and that they can in fact mimic the actions of a human computer very closely.”

“This special property of digital computers, that they can mimic any discrete state machine, is described by saying that they are universal machines. The existence of machines with this property has the important consequence that, considerations of speed apart, it is unnecessary to design various new machines to do various computing processes.”

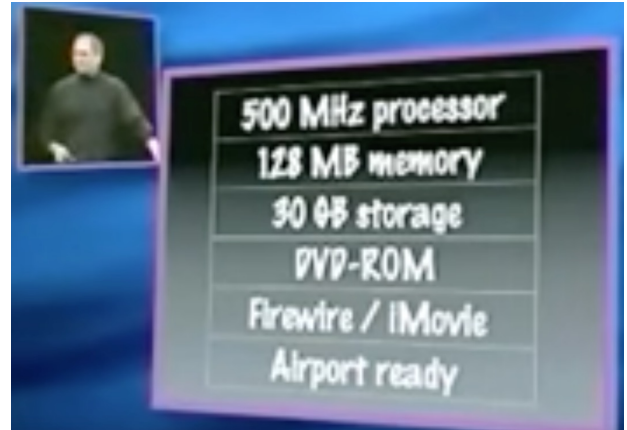
“I believe that in about fifty years’ time it will be possible to programme computers, with a storage capacity of about  $10^9$ , to make them play the imitation game so well that an average interrogator will not have more than 70 per cent, chance of making the right identification after five minutes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

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<https://www.google.com/search?q=10^9+bit>

( $10^9$ ) bits =  
125 megabytes

<https://www.youtube.com/watch?v=QRQd0YtVT0I#t=57m35s>



“Nevertheless I believe that at the end of the century the use of words and general educated opinion will have altered so much that one will be able to speak of machines thinking without expecting to be contradicted.”

# Extensional vs. Intensional Equality

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# The Imitation Game

# Experiment Time!

# Experiment #1

# Experiment #2

# Experiment #3

# The Turing Test or The Imitation Game

# Possible Objections

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1. *theology*



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"Machines take me by surprise  
with great frequency."

Turing, 1950

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9. extra-sensory perception



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*Any other arguments?*