Alan Turing pioniere dell'era digitale

Turing: l'uomo e la scienza

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scienzagiovane
27 ottobre 2012

Chi è Alan M. Turing (1912–1954)?

nato: 23 giugno 1912

OBE, *Order of the British Empire*
FRS, *Fellow of the Royal Society*

Criptoanalista
Matematico
Logico

Pioniere dell'era digitale

- Cosa significa "far di conto"
- Servizio segreto di Sua Maestà: Enigma e Colossus
- Progetto di un calcolatore elettronico
- Riprodurre un cervello e una mente
- Nascita delle forme dall'inanimato

Infanzia

- Padre funzionario della Compagnia delle Indie
- Educazione in collegio...
- Passione per le discipline scientifiche

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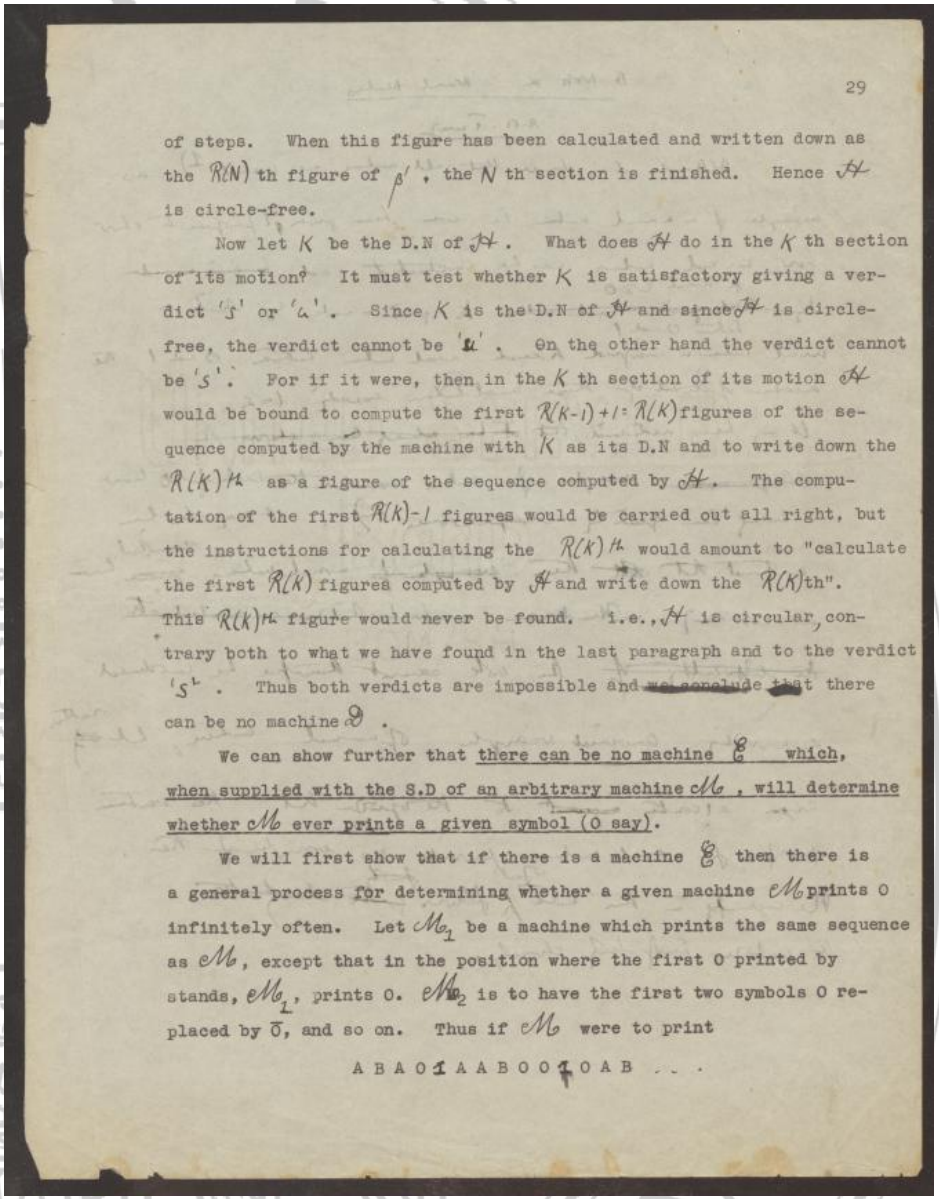
Matematica a Cambridge

King's College

1936: Cosa significa calcolare?



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of steps. When this figure has been calculated and written down as the $R(N)$ th figure of β', the N th section is finished. Hence $\mathcal{H}$ is circle-free.

Now let K be the D.N of $\mathcal{H}$. What does $\mathcal{H}$ do in the K th section of its motion? It must test whether K is satisfactory giving a verdict 's' or 'u'. Since K is the D.N of $\mathcal{H}$ and since $\mathcal{H}$ is circle-free, the verdict cannot be 'u'. On the other hand the verdict cannot be 's'. For if it were, then in the K th section of its motion $\mathcal{H}$ would be bound to compute the first $R(K-1)+1 = R(K)$ figures of the sequence computed by the machine with K as its D.N and to write down the $R(K)$th as a figure of the sequence computed by $\mathcal{H}$. The computation of the first $R(K)-1$ figures would be carried out all right, but the instructions for calculating the $R(K)$th would amount to "calculate the first $R(K)$ figures computed by $\mathcal{H}$ and write down the $R(K)$th". This $R(K)$th figure would never be found. i.e., $\mathcal{H}$ is circular, contrary both to what we have found in the last paragraph and to the verdict 's'. Thus both verdicts are impossible and we conclude that there can be no machine $\mathcal{D}$.

We can show further that there can be no machine $\mathcal{E}$ which, when supplied with the S.D of an arbitrary machine $\mathcal{M}$, will determine whether $\mathcal{M}$ ever prints a given symbol (0 say).

We will first show that if there is a machine $\mathcal{E}$ then there is a general process for determining whether a given machine $\mathcal{M}$ prints 0 infinitely often. Let $\mathcal{M}_1$ be a machine which prints the same sequence as $\mathcal{M}$, except that in the position where the first 0 printed by stands, $\mathcal{M}_1$, prints 0. $\mathcal{M}_2$ is to have the first two symbols 0 replaced by $\overline{0}$, and so on. Thus if $\mathcal{M}$ were to print

A B A 0 1 A A B 0 0 1 0 A B . . .

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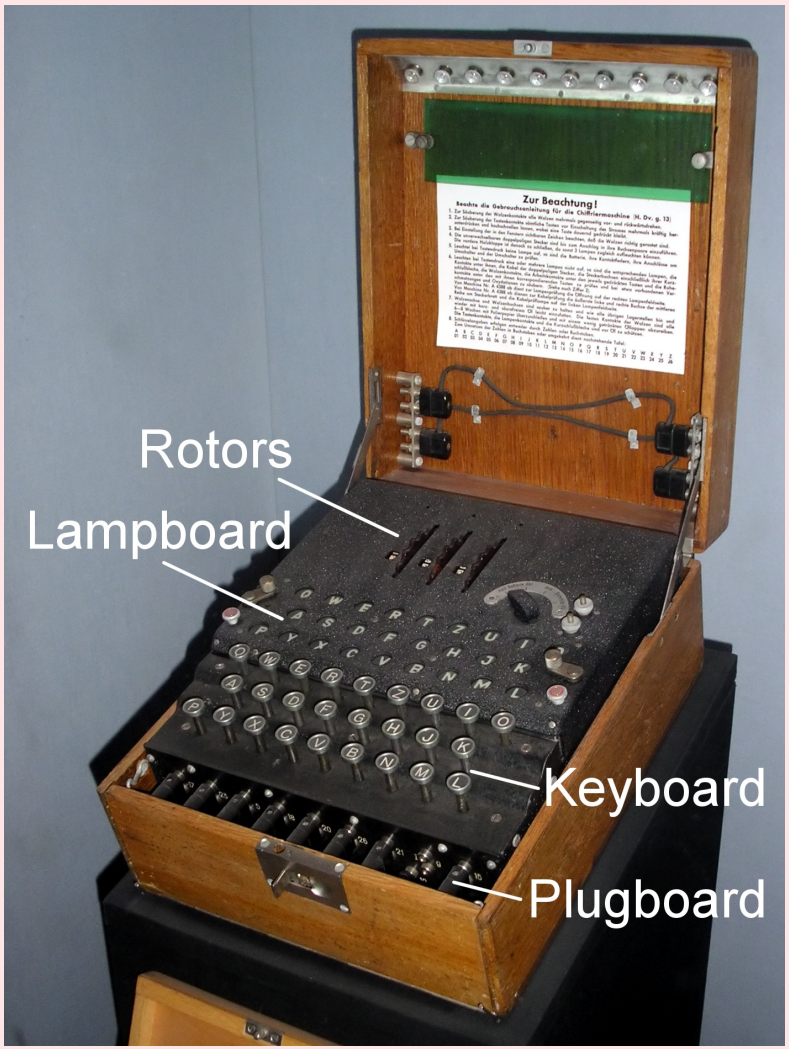
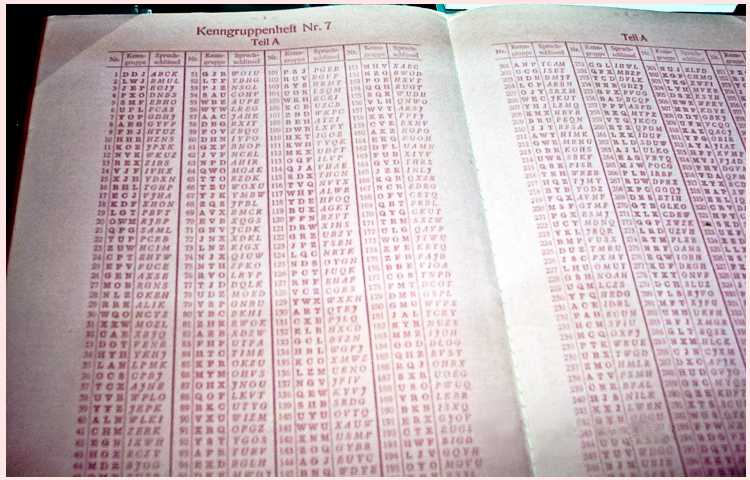
On Computable Numbers, with an Application to the Entscheidungsproblem, Proc. Lond. Math. Soc. (2) 42 pp. 230-265 (1936)

Criptoanalista a Bletchley Park

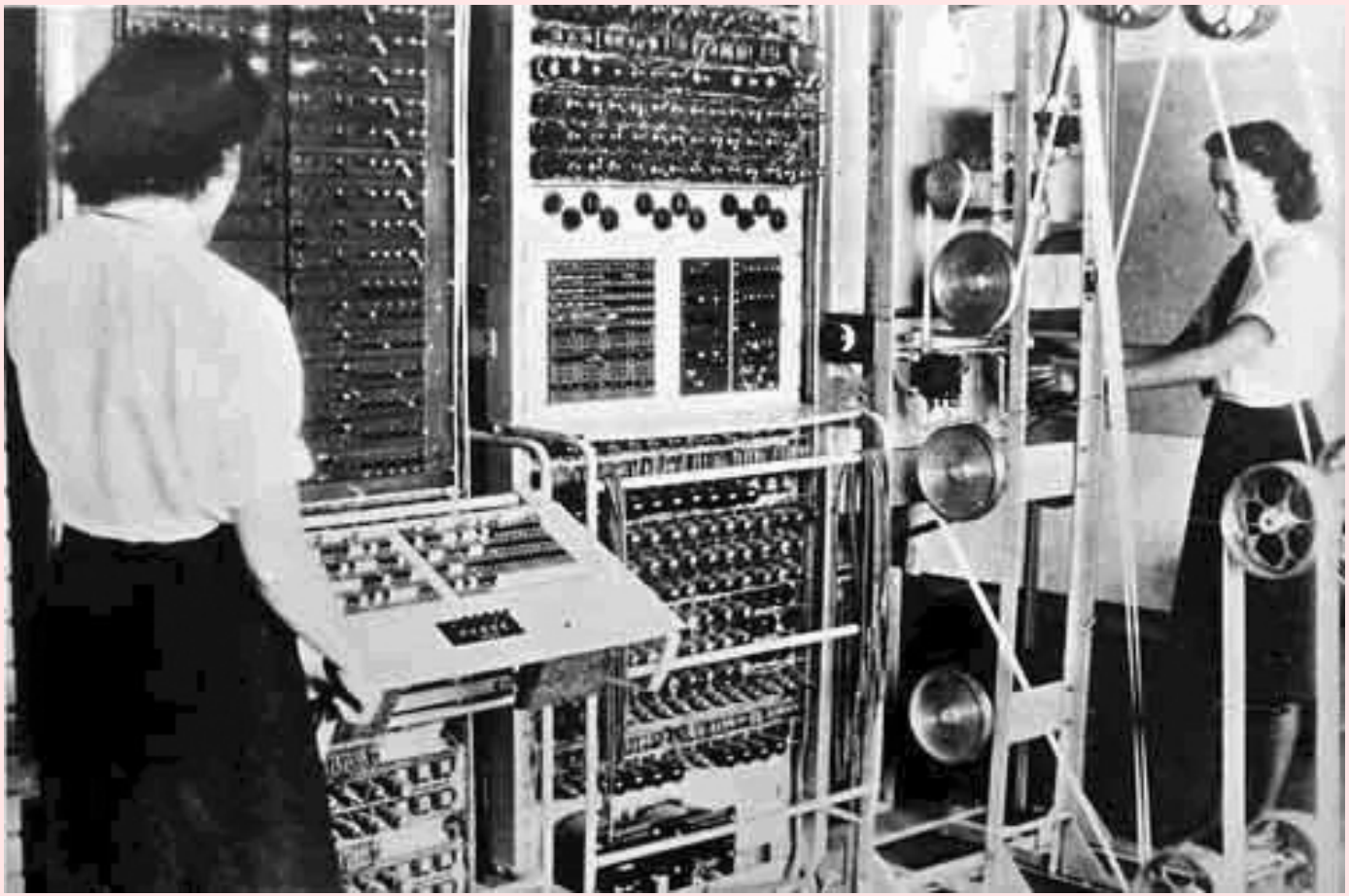
La macchina tedesca Enigma

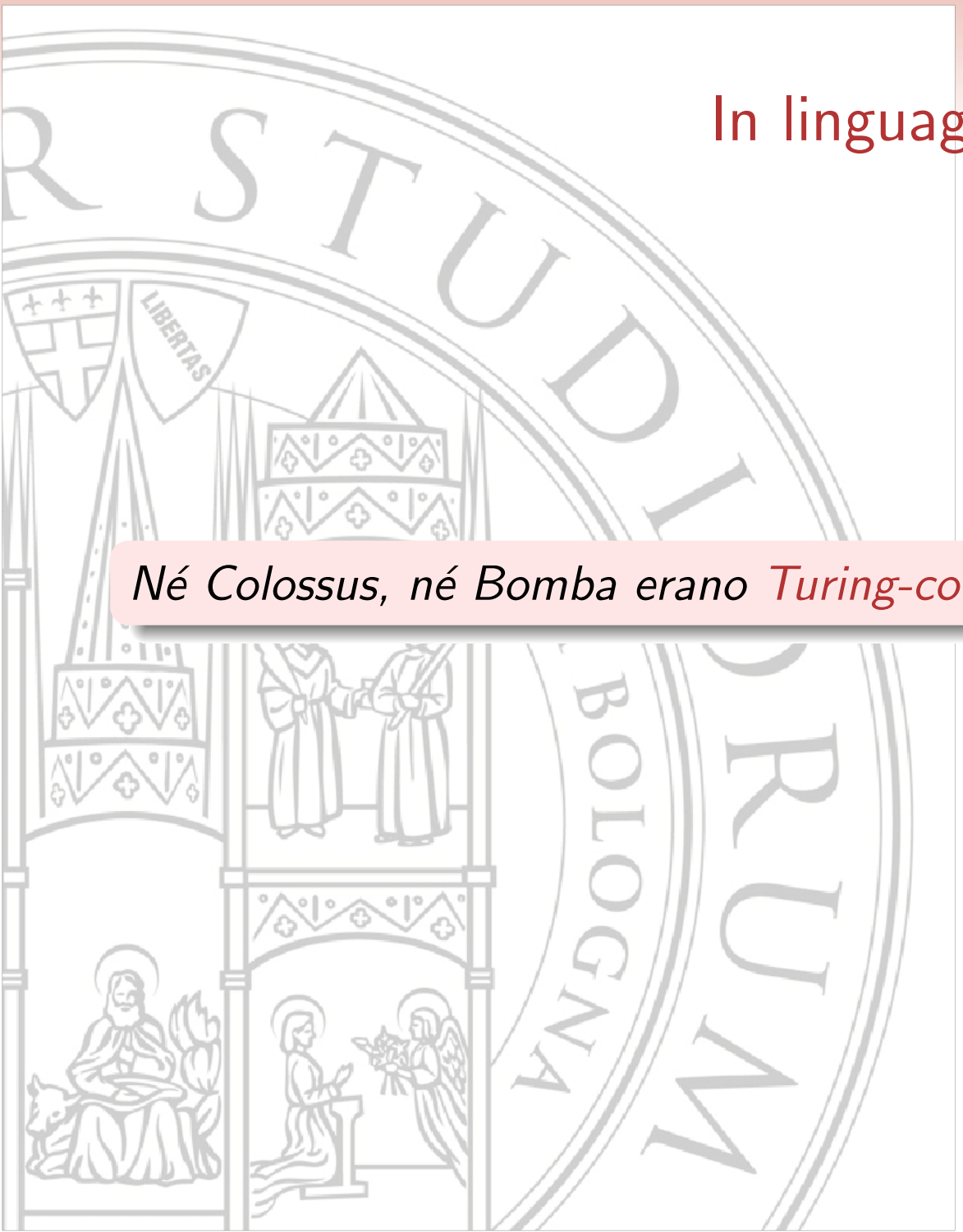




Bomba: calcolatore elettromeccanico

Colossus: calcolatore elettronico





In linguaggio moderno...

Né Colossus, né Bomba erano Turing-completi.

Dopo la guerra...

2 ore, 46 minuti, 3 secondi

solo 11 minuti più lento del vincitore alle Olimpiadi del 1948.

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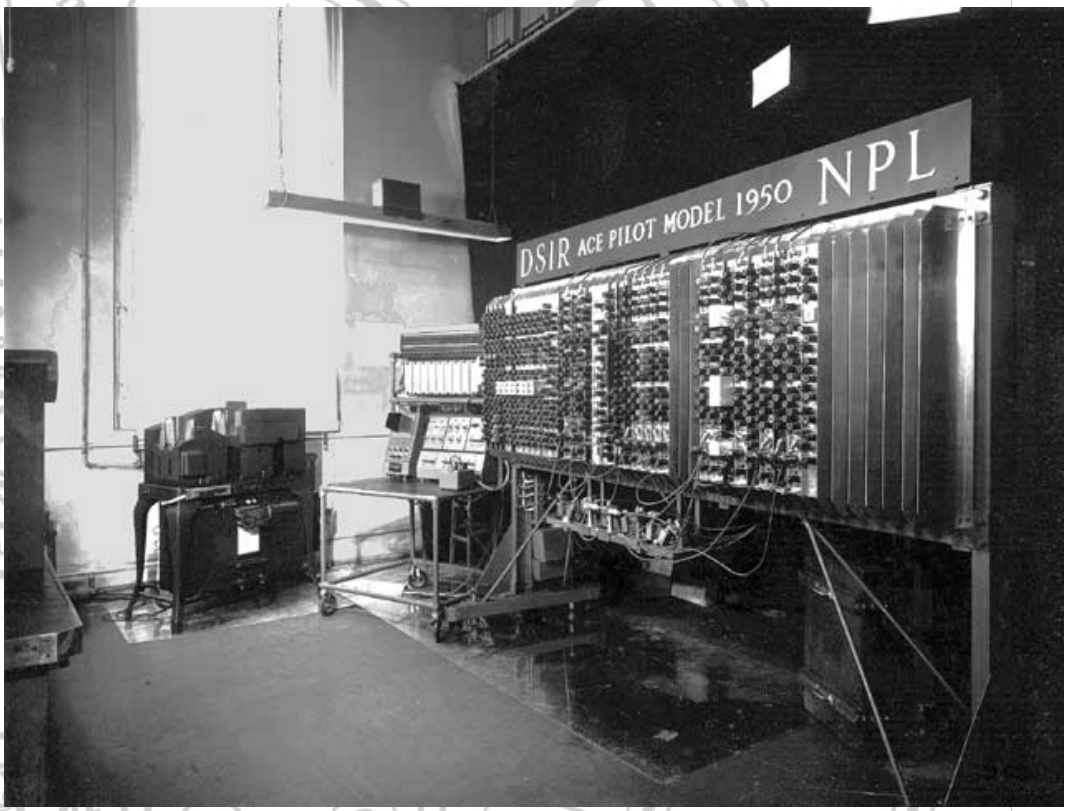
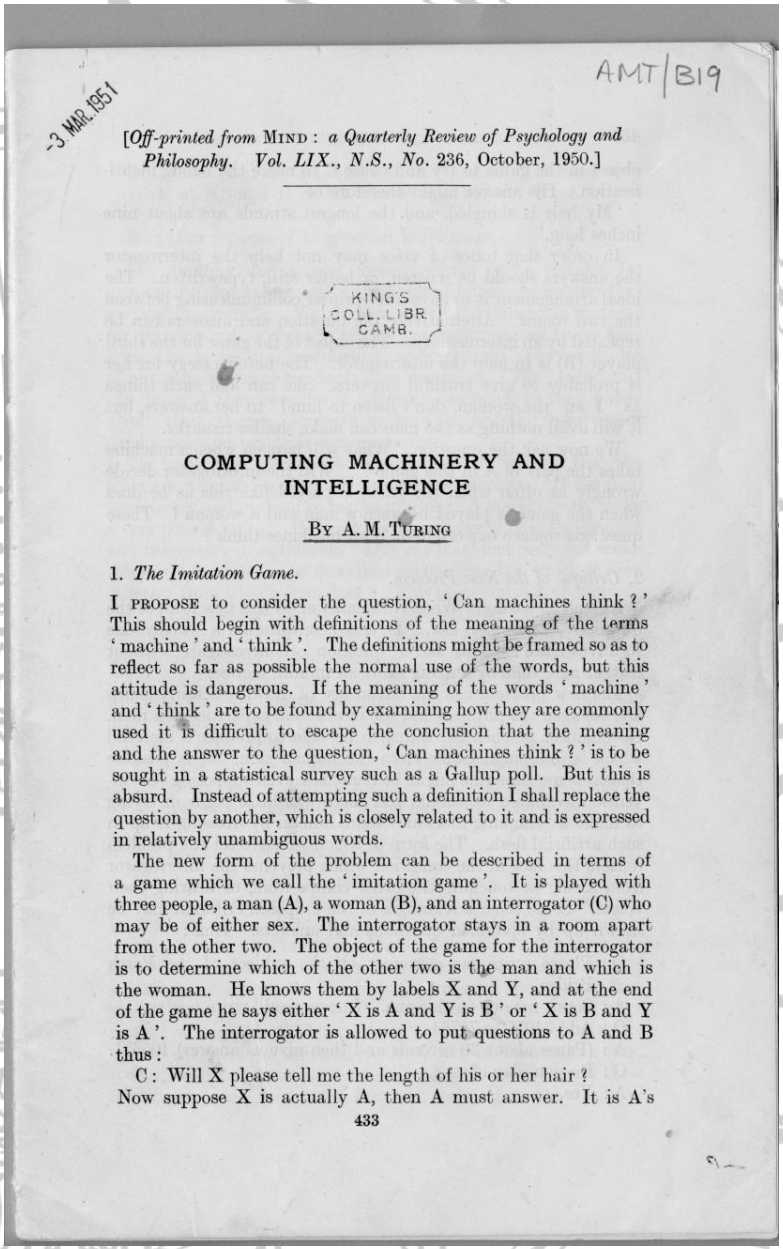
solo 11 minuti più lento del vincitore alle Olimpiadi del 1948.

Un vero calcolatore elettronico: Automatic Computing Engine (1946-1959)



Intelligenza meccanica



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-3 MAR 1951

[*Off-printed from* MIND : *a Quarterly Review of Psychology and Philosophy. Vol. LIX., N.S., No.* 236, October, 1950.]

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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

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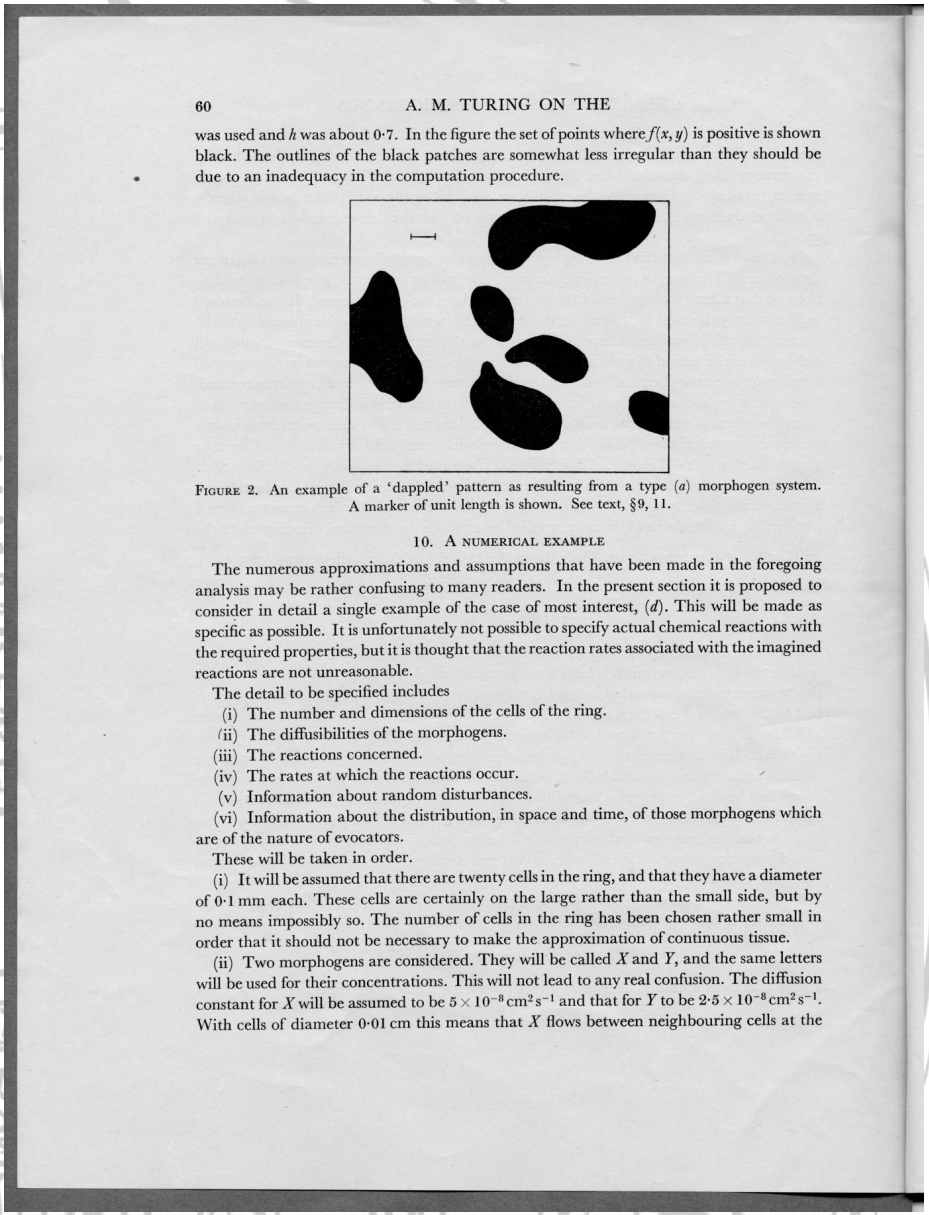
Computing machinery and intelligence,
Mind, Vol. LIX, N.S. No.236,
Oct. 1950

Il gioco dell'imitazione

La morfogenesi



60 A. M. TURING ON THE

was used and h was about 0·7. In the figure the set of points where $f(x, y)$ is positive is shown black. The outlines of the black patches are somewhat less irregular than they should be due to an inadequacy in the computation procedure.

FIGURE 2. An example of a 'dappled' pattern as resulting from a type (*a*) morphogen system. A marker of unit length is shown. See text, §9, 11.

10. A NUMERICAL EXAMPLE

The numerous approximations and assumptions that have been made in the foregoing analysis may be rather confusing to many readers. In the present section it is proposed to consider in detail a single example of the case of most interest, (*d*). This will be made as specific as possible. It is unfortunately not possible to specify actual chemical reactions with the required properties, but it is thought that the reaction rates associated with the imagined reactions are not unreasonable.

The detail to be specified includes

(i) The number and dimensions of the cells of the ring.
(ii) The diffusibilities of the morphogens.
(iii) The reactions concerned.
(iv) The rates at which the reactions occur.
(v) Information about random disturbances.
(vi) Information about the distribution, in space and time, of those morphogens which are of the nature of evocators.

These will be taken in order.

(i) It will be assumed that there are twenty cells in the ring, and that they have a diameter of 0·1 mm each. These cells are certainly on the large rather than the small side, but by no means impossibly so. The number of cells in the ring has been chosen rather small in order that it should not be necessary to make the approximation of continuous tissue.

(ii) Two morphogens are considered. They will be called X and Y, and the same letters will be used for their concentrations. This will not lead to any real confusion. The diffusion constant for X will be assumed to be $5 \times 10^{-8}\,\mathrm{cm^2\,s^{-1}}$ and that for Y to be $2{\cdot}5 \times 10^{-8}\,\mathrm{cm^2\,s^{-1}}$. With cells of diameter 0·01 cm this means that X flows between neighbouring cells at the

The chemical basis of morphogenesis,
Phil. Trans. of the Royal Soc., Series B, No.641, Vol. 237, 14 August 1952

Reazione e diffusione

La vita privata...

Gennaio 1952

- Incontra Arnold, un ragazzo di 19 anni e lo invita a casa
- Un amico di Arnold ruba in casa di Turing
- Alan denuncia il furto
- Spiega di aver avuto una relazione sessuale con Arnold
- È denunciato d'ufficio per atti osceni
- 31 marzo 1952: condannato per atti osceni
- Sceglie la castrazione ormonale invece della prigione

La morte

- 7 giugno 1954: è trovato morto in casa
- Accanto a lui c'è una mela morsicata
- L'autopsia accerta avvelenamento da cianuro