# 天才数学家-图灵

生平

- 图灵（Alan Turing）出生1912年出生于英国，父母常年在印度工作，并且哥哥也是出生在印度。图灵早年在谢伯恩学校念书，擅长长跑。

He was born in London 1912 and his father worked in the Indian Civil Service. He attended the Sherborne School[1] which was a famous public school in Dorset, England. Turing's interests at school were in science, mathematics and chess rather than the classics.

He excelled at long-distance running at the Sherborne, and in later life he completed the marathon in 2 h and 46 min. This time would have made him a candidate for the 1948 Olympic Games that were held in Wembley Stadium in London but he was injured before the games.

引自：O' Regan G. (2013) Alan Turing. In: Giants of Computing. Springer, London.

- 图灵在学校结识了克里斯多夫（Christopher Morcom），并称他为灵魂伴侣。可是克里斯多夫在1930年死于肺结核，留给图灵的是对他深深的思念。

ALAN TURING
The man that broke Enigma

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Christopher Morcom
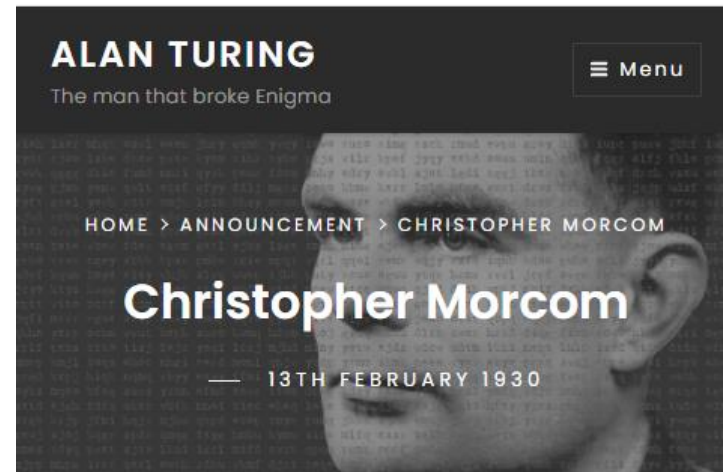
— 13TH FEBRUARY 1930

At Sherborne, Turing formed a significant friendship with fellow pupil Christopher Morcom (13 July 1911 – 13 February 1930), who has been described as Turing's "first love". Their relationship provided inspiration in Turing's future endeavours, but it was cut short by Morcom's death, in

引自：https://alan-turing.co.uk/announcement/christopher-morcom/

- 1931-1934，图灵就读于国王学院。图灵早在1924年证明了中央极限定理（Central Limit Theorem），这个证明使图灵1935年成为国王大学的Fellow。

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引自：https://www.kings.cam.ac.uk/members-and-friends/support/giving/empowering-minds/the-alan-turing-programme

- 希尔伯特1928年关于"数学是否是完备的（complete）"的问题引起了图灵的兴趣，希尔伯特自己的观点是"数学是完备的、一致的（consistent）、可判定的（decidable）"。哥德尔1931年证明了非完备性，但可判定性在1935年尚未解决。图灵证明没有特别强大的机器能解决可判定性问题。但在这一段研究过程中，图灵提出一种比较强大的机器几乎能解决大多数问题，就是图灵机。

The basis in human calculation was emphasised in Turing's arguments. The "squares" of the Turing machine "tape", for instance, originated in Turing's explanation as the squares of a child's exercise book. The atomic operations of scanning, marking, erasing, and moving to left and right were likewise related to human actions. Most importantly, the finitely many "configurations" of a Turing machine were related to the finite number of states of mind, or finite memory, of a human calculator. This very bold appeal to modelling "states of mind" by states of a machine seems already to anticipate the thesis of machine intelligence in 1950.

引自：Hodges A. (2009) Alan Turing and the Turing Test. In: Epstein R., Roberts G., Beber G. (eds) Parsing the Turing Test. Springer, Dordrecht.

- 当时，邱奇也做相关研究。于是，1936-1938年，图灵与邱奇一起在普林斯顿做研究，并获得普林斯顿的博士学位。

clear and unambiguous "Is there a Turing machine for solving the problem in question?" (a proposal now known as the Church-Turing thesis):

> I shall replace the question ['Can machines think?'] by another, which is closely related to it and is expressed in relatively unambiguous words. (1950a: 433)

Some pages later Turing describes this proposal as a *tentative suggestion*:

> It was suggested tentatively that the question 'Can machines think?' should be replaced by 'Are there imaginable digital computers which would do well in the imitation game?' (1950a: 442)

引自：Copeland, B.J. The Turing Test*. Minds and Machines 10, 519-539 (2000).

- 1938年7月图灵返回国王学院参加培训。不久，二战爆发。1942年，图灵参观了美国的贝尔实验室。回到英国，便着手语音加密机（名为Delilah）的研究。

We shall begin in the middle, and with an Alan Turing who may not be familiar to readers of this volume. 'It is thought,' he wrote, 'that ... a very high degree of security indeed can be obtained. There is certainly no comparison in security with any other scrambler of less than ten times the weight. For tank-to-tank and plane-to-plane work, a rather less ambitious form of key will probably be adequate. Such a key unit might be of about the same size as the combining unit.' The day was no ordinary day: it was 6 June 1944, and the system was no ordinary system; it was the 'Delilah' real-time speech and fax scrambler, devised and developed by Turing with the assistance of one engineer, Donald Bayley. According to this report (Turing 1944), the work had begun in early May 1943. It was conducted at the British Secret Service station at Hanslope Park, Buckinghamshire.

引自：Hodges A. (2008) Alan Turing, Logical and Physical. In: Cooper S.B., Löwe B., Sorbi A. (eds) New Computational Paradigms. Springer, New York, NY.

- 战后，图灵的研究兴趣是制造计算机。先后在国家物理实验室（1945）和曼切斯特大学（1948年）从事相关研究。并因此开启了人工智能研究领域。他发表了"Computing Machinery and Intelligence"的论文，并首次提出图灵测试（Turing Test）的概念。论文的第一句话便是一个深邃的问题"Can machines think?"

A. M. Turing (1950) Computing Machinery and Intelligence. *Mind 49*: 433-460.

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

- 大约从1950年开始，图灵的兴趣转向形态生成学（morphogenesis）。1952年，图灵因同性恋被逮捕并接受处罚。1954年6月7日，图灵被认定为自杀，死于氰化物中毒。

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How did Alan Turing die?

Turing pleaded guilty to the gross indecency charge and opted for chemical castration by a series of injections of female hormones.

The pioneering mathematician was rendered impotent and his security clearance was removed - barring him for continuing his work with GCHQ.

He died two years later from cyanide poisoning in an apparent suicide - though there have been suggestions his death was an accident.

引自：https://www.the-sun.com/news/2577821/who-was-alan-turing-death/

- 60年后，英国女王伊丽莎白二世赦免了图灵。英国首相卡梅伦表示：图灵在破解二战德军密码、拯救国家上发挥了关键作用，是一个了不起的人。

LONDON — Nearly 60 years after his death, Queen Elizabeth II has formally pardon famed British mathematician and computer scientist Alan Turing.

Turing, widely considered to be the father of computer science and artificial intelligence and most famous for his work on breaking the German Enigma codes during World War II,

引自：
https://www.lgbtqnation.com/2013/12/queen-pardons-famed-code-breaker-convicted-homosexual-alan-turing/

主要贡献

- 可计算性理论: 通用图灵机（Universal Turing Machine）和图灵可规约性（Turing Reducibility）

2. The behavior of the [human] computer at any moment is determined by the symbols which he is observing, and his state of mind at that moment . . . .

(End of excerpts)

Turing argued that his formalism was sufficiently general to encompass anything that a human being could do when carrying out a definite method. Turing also proposed the notion of <mark>universal Turing machines</mark> capable of simulating the operation of any Turing machine.

引自：(2006) Turing Machines. In: Computation Engineering. Springer, Boston, MA.

- 密码系统分析：恩尼格玛密码机（Enigma）

Nevertheless, Turing would spend the majority of his career focused on what would eventually become modern day computing. He was posted to serve with the US Navy's

引自：https://www.cia.gov/stories/story/the-enigma-of-alan-turing/

- 人工智能: 图灵测试

2. Did Turing Offer a Definition of 'Thinking' (or 'Intelligence')?

In his classic paper on the Turing test, Moor (1976) wrote:

> [T]he proponents and critics of the imitation game have misunderstood its significance. The real value of the imitation game lies not in treating it as the basis for an operational definition but in considering it as a potential source of good inductive evidence for the hypothesis that machines think. (1976: 249; see also Moor, 1987)

引自：Copeland, B.J. The Turing Test*. Minds and Machines 10, 519-539 (2000).

- 数理生物学:形态生成学和图灵假设（Turing hypothesis，关于模式形成的假设）

THE CHEMICAL BASIS OF MORPHOGENESIS

By A. M. TURING, F.R.S. *University of Manchester*

(*Received 9 November 1951—Revised 15 March 1952*)

It is suggested that a system of chemical substances, called morphogens, reacting together and diffusing through a tissue, is adequate to account for the main phenomena of morphogenesis. Such a system, although it may originally be quite homogeneous, may later develop a pattern or structure due to an instability of the homogeneous equilibrium, which is triggered off by random disturbances. Such reaction-diffusion systems are considered in some detail in the case of an isolated ring of cells, a mathematically convenient, though biologically unusual system.

引自：A. M. Turing,The Chemical Basis of Morphogenesis. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, Vol.237, No. 641. (Aug. 14, 1952), pp. 37-72.

ALAN TURING, 1912-1954

S. Barry Cooper, Jan Van Leeuwen, Alan Turing; His Work and Impact.Elsevier, 2013