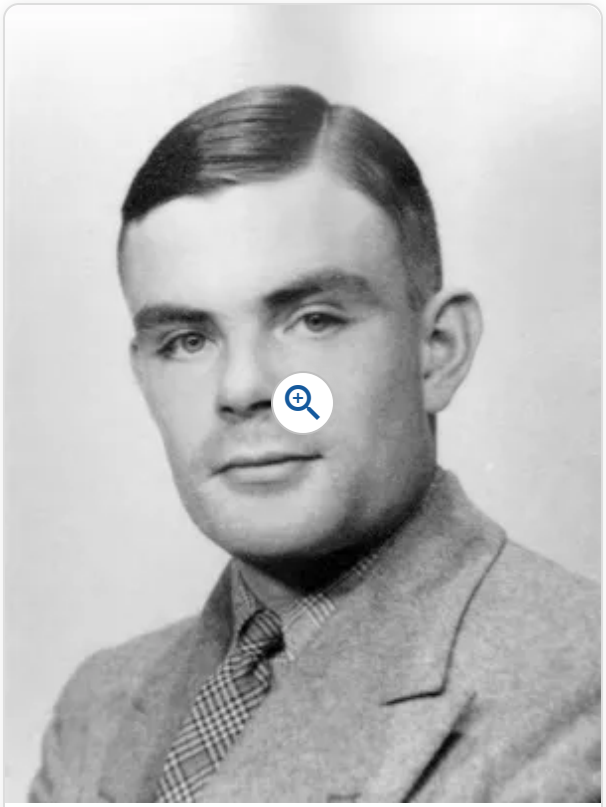
Alan Turing and the beginning of AI

Table of Contents

Theoretical work

The earliest substantial work in the field of artificial intelligence was done in the mid-20th century by the British logician and computer pioneer Alan Mathison Turing. In 1935 Turing described an abstract computing machine consisting of a limitless memory and a scanner that moves back and forth through the memory, symbol by symbol, reading what it finds and writing further symbols. The actions of the scanner are dictated by a program of instructions that also is stored in the memory in the form of symbols. This is Turing's stored-program concept, and implicit in it is the possibility of the machine operating on, and so modifying or improving, its own program. Turing's conception is now known simply as the universal Turing machine. All modern computers are in essence universal Turing machines.



Alan Turing

Alan Turing, c. 1930s.

During World War II, Turing was a leading cryptanalyst at the Government Code and Cypher School in Bletchley Park, Buckinghamshire, England. Turing could not turn to the project of building a stored-program electronic computing

machine until the cessation of hostilities in Europe in 1945. Nevertheless, during the war he gave considerable thought to the issue of machine intelligence. One of Turing's colleagues at Bletchley Park, Donald Michie (who later founded the Department of Machine Intelligence and Perception at the University of Edinburgh), later recalled that Turing often discussed how computers could learn from experience as well as solve new problems through the use of guiding principles—a process now known as heuristic problem solving.

Turing gave quite possibly the earliest public lecture (London, 1947) to mention computer intelligence, saying, "What we want is a machine that can learn from experience," and that the "possibility of letting the machine alter its own instructions provides the mechanism for this." In 1948 he introduced many of the central concepts of AI in a report entitled "Intelligent Machinery." However, Turing did not publish this paper, and many of his ideas were later reinvented by others. For instance, one of Turing's original ideas was to train a network of artificial neurons to perform specific tasks, an approach described in the section Connectionism.

Chess

At Bletchley Park, Turing illustrated his ideas on machine intelligence by reference to chess—a useful source of challenging and clearly defined problems against which proposed methods for problem solving could be tested. In principle, a chess-playing computer could play by searching exhaustively through all the available moves, but in practice this is impossible because it would involve examining an astronomically large number of moves. Heuristics are necessary to guide a narrower, more discriminative search. Although Turing experimented with designing chess programs, he had to content himself with theory in the absence of a computer to run his chess program. The first true AI programs had to await the arrival of stored-program electronic digital computers.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Garry Kasparov playing against Deep Blue

World chess champion Garry Kasparov (left) taking a pawn in the opening...(more)

In 1945 Turing predicted that computers would one day play very good chess, and just over 50 years later, in 1997, Deep Blue, a chess computer built by IBM (International Business Machines Corporation), beat the reigning world champion, Garry Kasparov, in a six-game match. While Turing's prediction came true, his expectation that chess programming would contribute to the understanding of how human beings think did not. The huge improvement in computer chess since Turing's day is attributable to advances in computer engineering rather than advances in AI: Deep Blue's 256 parallel processors enabled it to examine 200 million possible moves per second and to look ahead as many as 14 turns of play. Many agree with Noam Chomsky, a linguist at the Massachusetts Institute of Technology (MIT), who opined that a computer beating a grandmaster at chess is about as interesting as a bulldozer winning an Olympic weightlifting competition.

The Turing test

In 1950 Turing sidestepped the traditional debate concerning the definition of intelligence, introducing a practical test for computer intelligence that is now known simply as the Turing test. The Turing test involves three participants: a computer, a human interrogator, and a human foil. The interrogator attempts to determine, by asking questions of the other two participants, which is the computer. All communication is via keyboard and display screen. The interrogator may ask questions as penetrating and wide-ranging as he or she likes, and the computer is permitted to do everything possible to force a wrong identification. (For instance, the computer might answer "No" in response to "Are you a computer?" and might follow a request to multiply one large number by another with a long pause and an incorrect answer.) The foil must help the interrogator to make a correct identification. A number of different people play

the roles of interrogator and foil, and, if a sufficient proportion of the interrogators are unable to distinguish the computer from the human being, then (according to proponents of Turing's test) the computer is considered an intelligent, thinking entity.

In 1991 the American philanthropist Hugh Loebner started the annual Loebner Prize competition, promising a $100,000 payout to the first computer to pass the Turing test and awarding $2,000 each year to the best effort. However, no AI program has come close to passing an undiluted Turing test. In late 2022 the advent of the large language model ChatGPT reignited conversation about the likelihood that the components of the Turing test had been met. *Buzzfeed* data scientist Max Woolf said that ChatGPT had passed the Turing test in December 2022, but some experts claim that ChatGPT did not pass a true Turing test, because, in ordinary usage, ChatGPT often states that it is a language model.

Early milestones in AI

The first AI programs

The earliest successful AI program was written in 1951 by Christopher Strachey, later director of the Programming Research Group at the University of Oxford. Strachey's checkers (draughts) program ran on the Ferranti Mark I computer at the University of Manchester, England. By the summer of 1952 this program could play a complete game of checkers at a reasonable speed.

Information about the earliest successful demonstration of machine learning was published in 1952. Shopper, written by Anthony Oettinger at the University of Cambridge, ran on the EDSAC computer. Shopper's simulated world was a mall of eight shops. When instructed to purchase an item, Shopper would search for it, visiting shops at random until the item was found. While searching, Shopper would memorize a few of the items stocked in each shop visited (just as a human shopper might). The next time Shopper was sent out for the same item, or for some other item that it had already located, it would go to the right shop straight away. This simple form of learning, as is pointed out in the introductory section What is intelligence?, is called rote learning.

The first AI program to run in the United States also was a checkers program, written in 1952 by Arthur Samuel for the prototype of the IBM 701. Samuel took over the essentials of Strachey's checkers program and over a period of years considerably extended it. In 1955 he added features that enabled the program to learn from experience. Samuel included mechanisms for both rote learning and generalization, enhancements that eventually led to his program's winning one game against a former Connecticut checkers champion in 1962.