John McCarthy

(1927–2011)

The scientist who set computers on the path to common sense.

In 1955, a group of scientists approached the Rockefeller Foundation with a request to fund "a 2 month, 10 man study of artificial intelligence" to be carried out at Dartmouth College in New Hampshire. This was the earliest use of the term 'artificial intelligence', which was coined by one of the proposers — John McCarthy, then an assistant professor of mathematics at Dartmouth.

McCarthy was born in 1927 in Boston, Massachusetts, to an Irish immigrant father and a Lithuanian Jewish immigrant mother. When he was accepted into the California Institute of Technology in Pasadena at the age of 16, McCarthy was able to skip the first two years of mathematics because he had taught himself calculus from textbooks. He received a PhD in mathematics from Princeton University and, after a few other short appointments, became a full professor at Stanford University in California in 1962.

Computer scientists will remember McCarthy as the creator of LISP, one of the oldest programming languages still in wide use today, and as the inventor of time-sharing technology — the sharing of a computing resource among many users.

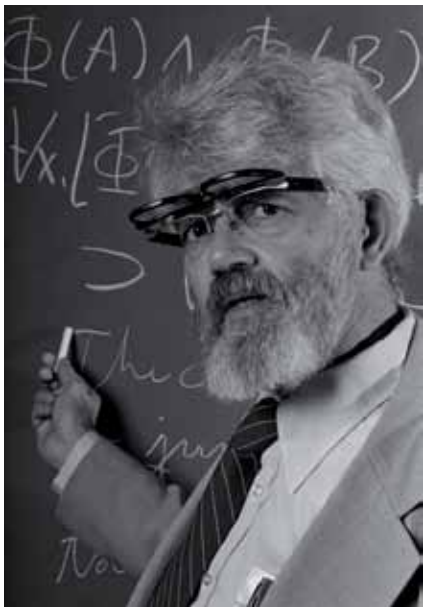
But his most notable contributions were in artificial intelligence. McCarthy's long-term goal was to design a computer program that could derive logical consequences from anything it was told, in combination with its previous knowledge, and act on the basis of its conclusions — a property, he observed, that is similar to "what makes us describe certain humans as having common sense". This research programme was described in his 1959 symposium paper 'Programs with common sense', often referred to as the 'advice-taker' paper, after McCarthy's name for the proposed computer program.

The advice-taker paper quickly became one of the most influential publications in the field. The origins of several branches of artificial intelligence can be traced back to it.

"McCarthy, the consumate independent thinker, never shied away from speaking his mind."

One of these branches is 'automated planning', which aims to generate a strategy that would allow an agent, such as a robot or an unmanned vehicle, to achieve a given goal. In the advice-taker paper, McCarthy gives the example of being seated at a desk at home, where one has a car, and wishing to go to the airport. His common-sense computer program, he posited, should be able to find a simple two-step solution: walk to the car and drive to the airport. This was the first published example of an automated planning problem.

Another sub-area that finds its roots in McCarthy's early work is that of 'knowledge representation': the concept of coding knowledge in formal notation so that computer programs can easily make inferences from



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it. McCarthy's program, for example, would need some knowledge about the distance from home to the airport, to infer that this distance is too far to walk. This differs from most elements of a traditional computer program, which are imperative statements such as: 'increase the value of a variable, *N*, by one'. The advice-taker paper instead stresses the role of declarative sentences.

One of McCarthy's breakthroughs was his theory of circumscription: a mathematical theory of exceptions to general statements. McCarthy realized that the general assertions we make in everyday life are true only in typical cases, and allow for occasional exceptions: as in the statement "I always eat lunch at noon", for example. In mathematics, however, 'always' means literally no exceptions. McCarthy's theory allowed a computer program to presume that things are as expected in the absence of information to the contrary, and to retract its conclusions when it learns about exceptions. This is known as non-monotonic reasoning.

My collaboration with McCarthy began in 1984, when I learned about his work on circumscription and was fascinated by its beauty and intellectual depth. Like dozens of other scientists, I often spent long hours thinking about research problems that he posed. These always touched on fundamental questions of intelligence and often used interesting examples. One familiar logician's example involves a group of missionaries and cannibals aiming to cross a river, given only a small boat and the problem that the cannibals might eat the missionaries if the latter are outnumbered. McCarthy wondered how a computer should deal with variations on the traditional formulation: what if one of the missionaries is Jesus Christ, who can cross the river without a boat? What if three missionaries alone with a cannibal can convert him into a missionary?

Progress towards programs with common sense was at first painfully slow. Efficient implementations of non-monotonic reasoning only became available about ten years ago and are applied in many areas, including the control of spacecraft. But the full realization of McCarthy's dream is still far in the future.

McCarthy's parents, whom he never ceased to love and admire, were members of the Communist Party, and in 1949 he too joined the party. But he broke away from these doctrines a few years later after he subjected them to rational analysis, and became a conservative. The sustainability of human material progress and the desirability of nuclear power were ideas particularly dear to his heart. He opposed affirmative-action policies that led to reverse discrimination, and did not hide his disdain for the sort of political correctness that uses the pronoun 'she' when the gender of a person is irrelevant.

In academia, liberals far outnumber conservatives, and it is understandable that many conservative professors prefer to keep their political views to themselves. McCarthy, the consummate independent thinker, never shied away from speaking his mind, both in science and in politics. ■

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