Ambitious intentions

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AI: The Tumultuous History of the Search for Artificial Intelligence. By Daniel Crevier. *Basic Books: 1993. Pp. 386. $27.50.*

ARTIFICIAL intelligence is unique in the history of science and technology in at least one important way. Its practitioners are entirely absorbed in discovering what can and cannot be done with a complex human invention — the digital computer. This differs from the concerns of, say, an aeronautical engineer or a television set designer in the sense that AI pioneers had set out to produce a *doppelgänger* for biological humans with the simplest of notions of how this could be achieved. Publicly, they made extraordinary claims that to make a machine with the intelligence of a human was merely a matter of making computers bigger and faster. The discovery that their results seemed to fall short of their claims tended to be a much more private affair. As an idle thought, where would an aircraft designer be with a similar record of failure? The answer is that he would be unemployed if not in jail. And yet, even recognizing these errors of judgement, Daniel Crevier in his readable account of AI finds that those who developed the technology over the past 40 years were imaginative and sincere in their beliefs. So how is it that they could be so wrong in their predictions? What purpose did their efforts serve?

These are the questions that Crevier attempts to answer in his speculative history. He draws with good effect on recent interviews with AI gurus such as Marvin Minsky, John McCarthy and Herb Simon. As a former pupil of some of these AI masters, he writes with a good mix of awe for their achievements and scepticism of their pronouncements. This familiarity has both good and bad effects. It gives the accounts a sense of enthusiasm and authority but does not allow Crevier to stand sufficiently far back to remain immune to the seductive idea that the truly intelligent machine is just around the next corner. This leads to contradictions. For example, he writes that in the 1960s "AI blossomed a thousand flowers", only to revise this later as: "At the end of the 1970s the intelligent machine seemed no closer than in the 1960s". If the aims of AI remained elusive, what, then, were the "thousand flowers"?

Crevier suggests that AI led to a deeper understanding of both logical and informal representations of knowledge on computers. The ultimate product was the expert system now commonly used to capture procedures (for example, the configuration of large computers) normally done by humans. But expert systems depend only on a small part of the effort that went into AI. Crevier further suggests that what is now known as "object oriented programming" (letting parts of a program behave like an object with well-defined properties) had its roots in AI. This is undoubtedly true, as is the fact that interesting computer languages such as LISP and PROLOG are products of AI. But it all has the feeling of spin-off rather than pivotal science. For my part, I agree with another of Crevier's suggestions that one of the main effects of AI has been to highlight the informal but speedy way in which intelligent humans behave and the contrast between this behaviour and what can be done by programming a computer. But is this discovery worth the price of unfulfilled AI promises?

Crevier still believes that, despite the failures so far, greater computer power and investment in research will lead to steady progress towards machines that are smart in the human way. He attempts to argue his case by using computer chess as an example. Chess programs have plodded their way steadily up the US professional ranking from being below average in the early 1970s to now being at master level. The progression seems linear and dependent mainly on brute computer power. This leads Crevier to conclude that in the next 10 years not only will the progression lead to a computer program being the world chess champion, but also that AI will evolve successfully in other areas of endeavour that are said to require intelligence.

Both these conclusions suggest that the author has been seduced by the old AI magic. The day that an AI program beats the world chess champion will make the computer about as interesting as the man on a bicycle at a running race. The computer's mechanical nature will by itself disqualify it from the competition. Crevier's second error is that chess is a game that is so constrained that it requires a very special form of intelligence. Away from the chess board the chess master is no more able to cope with the problems of life than the amateur. So while chess computers win their victories, the machinery may not be able to make common-sense decisions.

Crevier suggests that there are already projects that seek to meet the last criticism. He cites Douglas Lenat's "Cyc" (for encyclopaedia) endeavour. This is a $25 million program that encompasses 200 person-years of effort. Lenat is taking the brute-force approach in trying to store a colossal number of basic tenets of common sense — things such as: "People come in two kinds, men and women". Undoubtedly, the bigger and the faster the computer, the more success there will be in accessing and using this knowledge. But Lenat's entire approach may be flawed as it requires storage space roughly in proportion to the number of facts. Recent work in connectionism has shown that distributing knowledge over interacting elements (artificial neurons) could lead to a storage requirement that grows only with the logarithm of the number of facts that need to be stored. It seems likely that the brain would have evolved to use this neat trick. There is no reason why either Lenat or Crevier should be aware of these developments as connectionism has largely been seen as a competing and alien technology by the AI gurus. My own feeling is that the smart machine will have to draw on whatever technology is around and partisan attitudes towards AI will merely lead to systems that are less competent than they might be.

But these are minor quibbles. Crevier's story is a worthwhile tribute to the efforts of those who used their skills and understanding of computing in developing a debate that has not only been technological in nature but has had a considerable influence on philosophy and psychology. In the closing chapters, Crevier asks the interesting question of the pioneers: what do *they* think they were doing? The answer given by Gerald Sussman, the designer in the 1970s of PLANNER, a celebrated robot planning program, shows that there is still much idealism in these retrospective views. He suggests that future historians of science will see AI to have been as great an event as the discovery of calculus: "We are witnessing a breakthrough in the way that people express complex ideas . . . . I believe that this new capacity will have a profound influence on humanity over a long period of time and will be the thing that's remembered many years from now." Unfortunately, the examples he gives for handling complexity are the design of electronic circuits and finding the square root of any given number.

Humanity is surely looking for solutions to deeper complex problems such as wars, economic systems and threats to health. The efforts of the AI geniuses of the last 40 years may well prove to be much less significant than Sussman suggests. Nevertheless, this should not prevent anyone from reading about them in Crevier's book and allow themselves to be beguiled by the excitement of a dream. □

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