The Dartmouth College Artificial Intelligence Conference: The Next Fifty Years.

Article *in* Ai Magazine · January 2006

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The Dartmouth College Artificial Intelligence Conference: The Next Fifty Years

James Moor

■ The Dartmouth College Artificial Intelligence Conference: The Next 50 Years (AI@50) took place July 13–15, 2006. The conference had three objectives: to celebrate the Dartmouth Summer Research Project, which occurred in 1956; to assess how far AI has progressed; and to project where AI is going or should be going. AI@50 was generously funded by the office of the Dean of Faculty and the office of the Provost at Dartmouth College, by DARPA, and by some private donors.

Reflections on 1956

Dating the beginning of any movement is difficult, but the Dartmouth Summer Research Project of 1956 is often taken as the event that initiated AI as a research discipline. John McCarthy, a mathematics professor at Dartmouth at the time, had been disappointed that the papers in *Automata Studies,* which he coedited with Claude Shannon, did not say more about the possibilities of computers possessing intelligence. Thus, in the proposal written by John McCarthy,

Marvin Minsky, Claude Shannon, and Nathaniel Rochester for the 1956 event, McCarthy wanted, as he explained at AI@50, "to nail the flag to the mast." McCarthy is credited for coining the phrase "artificial intelligence" and solidifying the orientation of the field. It is interesting to speculate whether the field would have been any different had it been called "computational intelligence" or any of a number of other possible labels.

Five of the attendees from the original project attended AI@50 (figure 1). Each gave some recollections. McCarthy acknowledged that the 1956 project did not live up to expectations in terms of collaboration. The attendees did not come at the same time and most kept to their own research agenda. McCarthy emphasized that nevertheless there were important research developments at the time, particularly Allen Newell, Cliff Shaw, and Herbert Simon's Information Processing Language (IPL) and the Logic Theory Machine.

Marvin Minsky commented that, although he had been working on neural nets for his dissertation a few years prior to the 1956 project, he dis-

continued this earlier work because he became convinced that advances could be made with other approaches using computers. Minsky expressed the concern that too many in AI today try to do what is popular and publish only successes. He argued that AI can never be a science until it publishes what fails as well as what succeeds.

Oliver Selfridge highlighted the importance of many related areas of research before and after the 1956 summer project that helped to propel AI as a field. The development of improved languages and machines was essential. He offered tribute to many early pioneering activities such as J. C. R. Lickleiter developing time-sharing, Nat Rochester designing IBM computers, and Frank Rosenblatt working with perceptrons.

Trenchard More was sent to the summer project for two separate weeks by the University of Rochester. Some of the best notes describing the AI project were taken by More, although ironically he admitted that he never liked the use of "artificial" or "intelligence" as terms for the field.

Ray Solomonoff said he went to the summer project hoping to convince everyone of the importance of machine learning. He came away knowing a lot about Turing machines that informed future work.

Thus, in some respects the 1956 summer research project fell short of expectations. The participants came at various times and worked on their own projects, and hence it was not really a conference in the usual sense. There was no agreement on a general theory of the field and in particular on a general theory of learning. The field of AI was launched not by agreement on methodology or choice of problems or general theory, but by the shared vision that computers can be made to perform intelligent tasks. This vision was stated boldly in the proposal for the 1956 conference: "The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it."

Figure 1. Trenchard More, John McCarthy, Marvin Minsky, Oliver Selfridge, and Ray Solomonoff.

Evaluations at 2006

There were more than three dozen excellent presentations and events at AI@50, and there is not space to give them the individual treatment each deserves. Leading researchers reported on learning, search, networks, robotics, vision, reasoning, language, cognition, and game playing.[1]

These presentations documented significant accomplishments in AI over the past half century. Consider robotics as one example. As Daniela Rus pointed out, 50 years ago there were no robots as we know them. There were fixed automata for specific jobs. Today robots are everywhere. They vacuum our homes, explore the oceans, travel over the Martian sur-

face, and win the DARPA Grand Challenge in a race of 132 miles in the Mojave Desert. Rus speculated that in the future we might have our own personal robots as we now have our own personal computers, robots that could be tailored to help us with the kind of activities that each of us wants to do. Robot parts might be smart enough to self-assemble to become the kind of structure we need at a given time. Much has been accomplished in robotics, and much to accomplish seems not too far over the horizon.

Although AI has enjoyed much success over the last 50 years, numerous dramatic disagreements remain within the field. Different research areas frequently do not collaborate, re-

searchers utilize different methodologies, and there still is no general theory of intelligence or learning that unites the discipline.

One of the disagreements that was debated at AI@50 is whether AI should be logic based or probability based. McCarthy continues to be fond of a logic-based approach. Ronald Brachman argued that a core idea in the proposal for the 1956 project was that "a large part of human thought consists of manipulating words according to rules of reasoning and rules of conjecture" and that this key idea has served as a common basis for much of AI during the past 50 years. This was the AI revolution or, as McCarthy explained, the counter-revolution, as it was an at-

Figure 2. Dartmouth Hall, Where the Original Activities Took Place.

tack on behaviorism, which had become the dominant position in psychology in the 1950s.

David Mumford argued on the contrary that the last 50 years has experienced the gradual displacement of brittle logic with probabilistic methods. Eugene Charniak supported this position by explaining how natural language processing is now statistical natural language processing. He stated frankly, "Statistics has taken over natural language processing because it works."

Another axis of disagreement, correlated with the logic versus probability issue, is the psychology versus pragmatic paradigm debate. Pat Langley, in the spirit of Allen Newell and Herbert Simon, vigorously maintained that AI should return to its psychological roots if human level AI is to be achieved. Other AI researchers are more inclined to explore what succeeds even if done in nonhuman ways. Peter Norvig suggested that searching, particularly given the huge repository of data on the web, can

show encouraging signs of solving traditional AI problems though not in terms of human psychology. For instance, machine translation with a reasonable degree of accuracy between Arabic and English is now possible through statistical methods though nobody on the relevant research staff speaks Arabic.

Finally, there is the ongoing debate of how useful neural networks might be in achieving AI. Simon Osindero working with Geoffrey Hinton discussed more powerful networks. Both
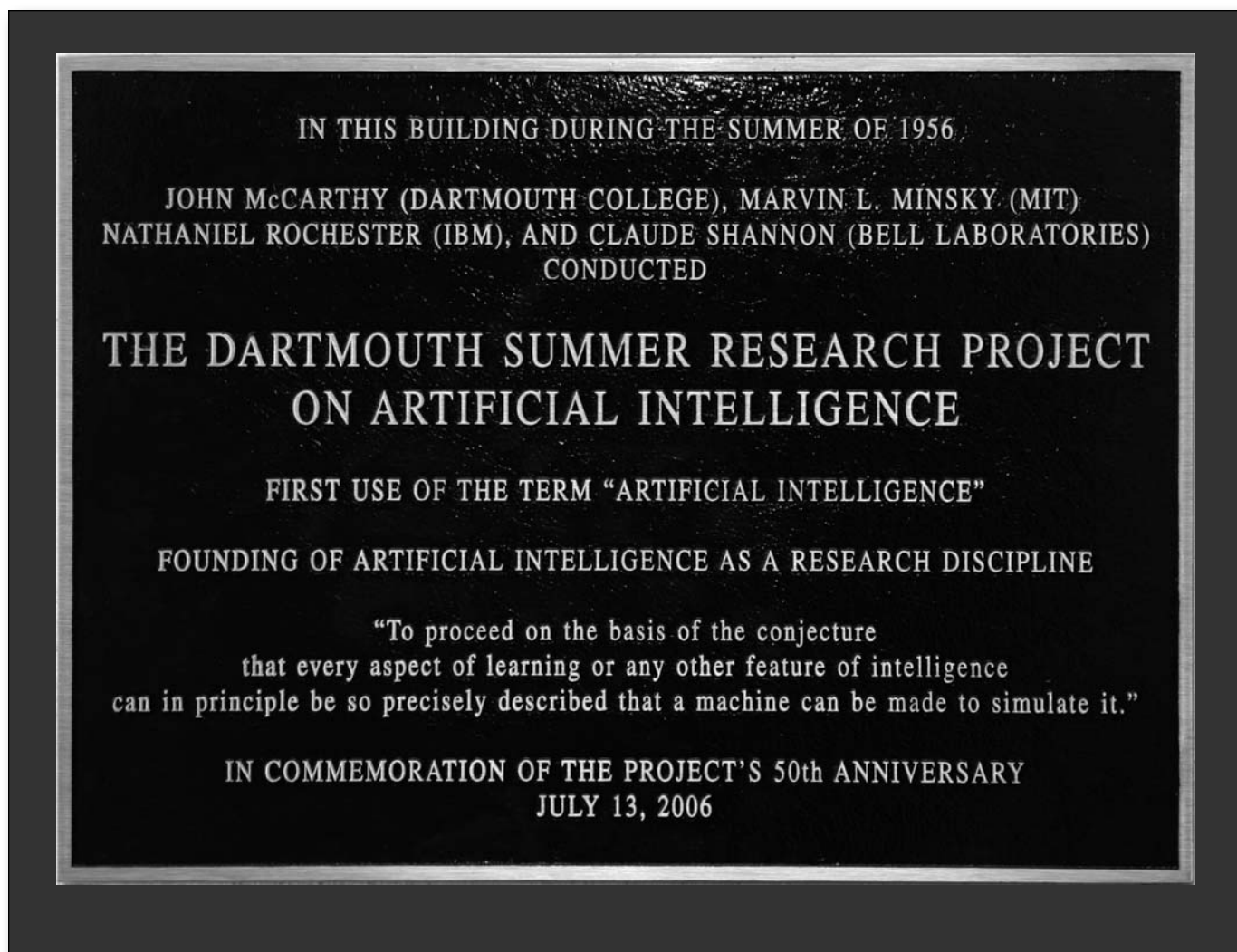
Figure 3. Dartmouth Hall Commerative Plaque.

Terry Sejnowski and Rick Granger explained how much we have learned about the brain in the last decade and how this information is very suggestive for building computer models of intelligent activity.

These various differences can be taken as a sign of health in the field. As Nils Nilsson put it, there are many routes to the summit. Of course, not all of the methods may be fruitful in the long run. Since we don't know which way is best, it is good to have many explored. Despite all the differences, as in 1956, there is a common vision that computers can do intelligent tasks. Perhaps, this vision is all it takes to unite the field.

Projections to 2056

Many predictions about the future of AI were given at AI@50. When asked what AI will be like 50 years from now, the participants from the original conference had diverse positions. McCarthy offered his view that human-level AI is likely but not assured by 2056. Selfridge claimed that computers will do more planning and will incorporate feelings and affect by then but will not be up to human-level AI.

Minsky thought what is needed for significant future progress is a few bright researchers pursuing their own good ideas, not doing what their advisors have done. He lamented that too few students today are pursuing such ideas but rather are attracted into entrepreneurships or law. More hoped that machines would always be under the domination of humans and suggested that machines were very unlikely ever to match the imagination of humans. Solomonoff predicted on the contrary that really smart machines are not that far off. The danger, according to him, is political. Today

disruptive technologies like computing put a great deal of power, a power that can misused, in the hands of individuals and governments.

Ray Kurzweil offered a much more optimistic view about progress and claimed that we can be confident of Turing test–capable AI within a quarter century—a prediction with which many disagreed. Forecasting technological events is always hazardous. Simon once predicted a computer chess champion within 10 years. He was wrong about the 10 years, but it did happen within 40 years. Thus, given an even longer period, another 50 years, it is fascinating to ponder what AI might accomplish.

Sherry Turkle wisely pointed out that the human element is easily overlooked in technological development. Eventually we must relate to such advanced machines if they are developed. The important issue for us may be less about the capabilities of the computers than about our own vulnerabilities when confronted with very sophisticated artificial intelligences.

Several dozen graduate and postdoctoral students were sponsored by DARPA to attend AI@50. Our hope is that many will be inspired by what they observed. Perhaps some of those will present their accomplishments at the 100-year celebration of the Dartmouth Summer Research Project.

Postscript

A plaque honoring the 1956 summer research project has been recently mounted in Dartmouth Hall, the building in which the 1956 summer activities took place (figure 3).

For details of AI@50 and announcements of products resulting from AI@50 please check the conference website.[2]

Notes

1. For more details on the speakers and topics, check www.dartmouth.edu/~ai50/.

2. www.dartmouth.edu/~ai50/.

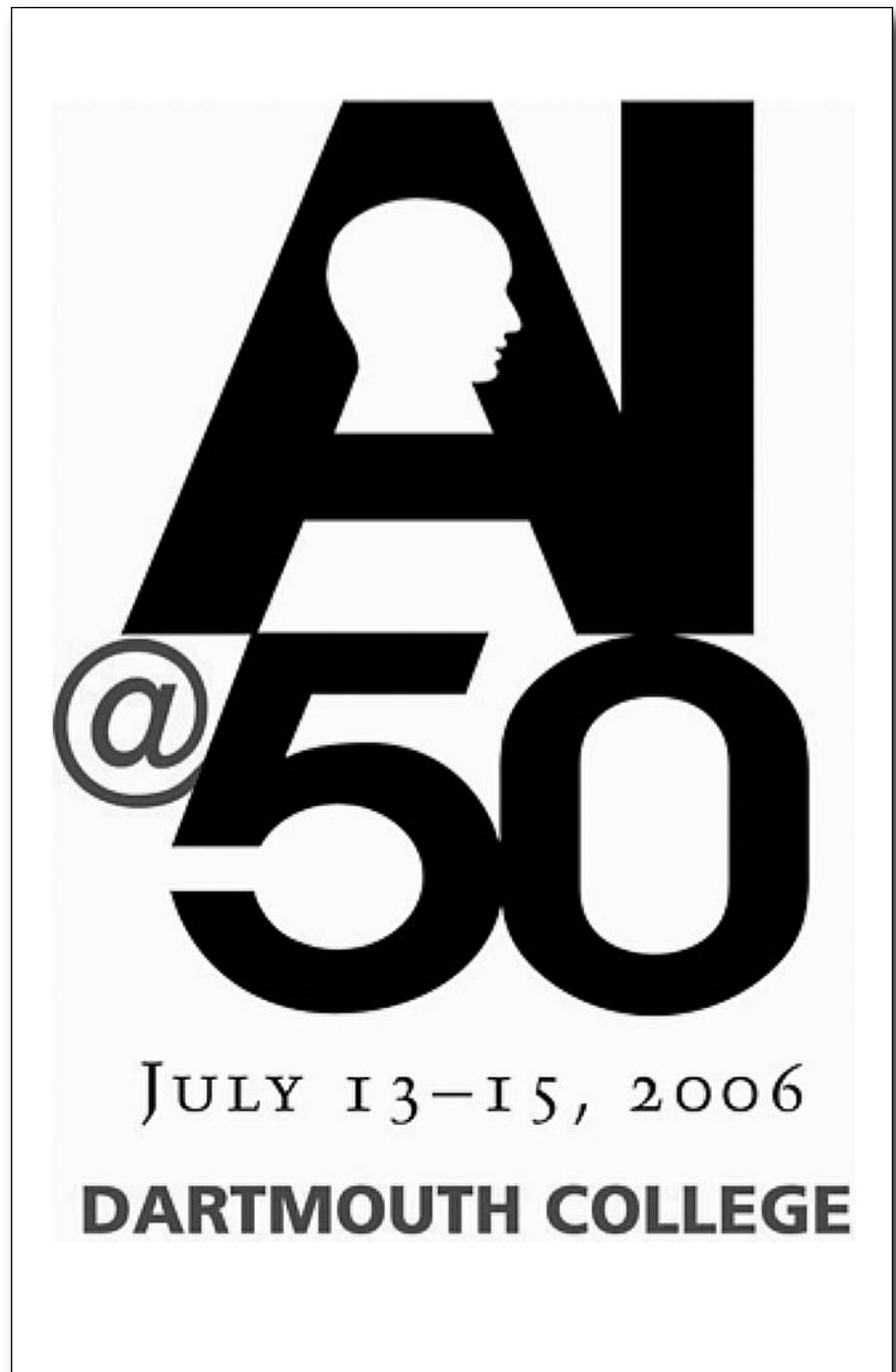**James Moor** is a professor of philosophy at Dartmouth College. He is an adjunct professor with The Centre for Applied Philosophy and Public Ethics (CAPPE) at the Australian National University. He earned his PhD in history and philosophy of science at Indiana University. He publishes on philosophy of artificial intelligence, computer ethics, philosophy of mind, philosophy of science, and logic. He is the editor of the journal *Minds and Machines* and is the president of the International Society for Ethics and Information Technology (INSEIT). He is a recipient of the American Computing Machinery SIGCAS "Making a Difference" award.

Figure 4. The 2006 Conference Logo.