Artificial Intelligence Pioneer

* Posted 01.27.11
* NOVA

Marvin Minsky has long been one of the great human intelligences working in the field of artificial intelligence (AI). A professor at MIT, where he has worked since 1957 and cofounded the AI laboratory in 1959, Minsky is also an inventor, philosopher, and author. In recent years, Minsky has focused his formidable talents on trying to impart the human capacity for commonsense reasoning to machines. In this interview, hear Minsky's take on why it's important to recreate human intelligence, what a five-year-old can do that even the smartest machine cannot, and whether someone will ever invent a computer that laughs at *Seinfeld*.



Marvin Minsky says that when it comes to designing a smart machine, "you mustn't look for a magic bullet"—that is, just a single way to solve all problems. [Enlarge](http://www.pbs.org/wgbh/nova/assets/img/pioneer-artificial-intelligence/image-01-large.jpg)

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**MIND OF THE MACHINE**

**NOVA: You were one of the attendees of the original Dartmouth Summer Research Conference on Artificial Intelligence in 1956. Back then, what was the dream? Was the goal really to build a human intelligence?**

**Marvin Minsky:** Well, the goal was to build something that could do everything we do. [The English mathematician] Alan Turing was perhaps the first person to write intelligible articles about this. He discussed the most complicated processes that we know of and explained in a famous 1936 paper ["On Computable Numbers, With an Application to the *Entscheidungsproblem*"] the idea that you could build one machine that could imitate any other kind of machine, even one more complicated than it. That was the idea of the "universal Turing machine." So here is this great man in 1936 writing about what could happen in the next 100 years, and the rest of us later read this paper and said, "Let's be part of that."

**When you say the goal is to tell a machine to do everything that we can do, what does that mean?**

Well, a typical person goes through childhood, learns a language; some people learn two or three languages. That's a wonderful thing. Then they learn a profession. They get good at architecture or street cleaning or baseball or something like that, but nobody gets good at many things. The smartest person might be an expert in four or five fields. It's been estimated that to be an expert at something you have to know maybe 20,000 fragments of knowledge or skills. And you can only learn a few of those a day, so it takes a few thousand days to become an expert. But why can't a person learn a hundred fields or a thousand specialties? Why is everyone so limited?

So one of the ideas is maybe we could build a machine or some gadgets to add to our brains so that we wouldn't have to spend 10 years getting good at something. Rather we could spend five minutes getting good at 20 things.



Becoming skilled at baseball or any other endeavor takes years. Could smart machines, Minsky wonders, help us get there in minutes? [Enlarge](http://www.pbs.org/wgbh/nova/assets/img/pioneer-artificial-intelligence/image-02-large.jpg)

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**A NARROWING FIELD**

**At that conference in 1956, you all thought we would probably have a true artificial intelligence within about 10 or 15 years, is that right?**

Well, I think maybe 30 or 40 years, within a human lifetime, we thought maybe we would have machines that would be more or less as smart as a person. And I still think that could have happened.

My picture of what happened, at least in the United States and certainly in most other countries, is that this kind of progress of trying new experiments with computers kept happening in the 1960s and '70s and part of the '80s, but then things tightened up. The great laboratories somehow disappeared, economies became tighter, and companies had to make a profit—they couldn't start projects that would take 10 years to pay off.

In the 1950s, '60s, and '70s, almost all of my students became professors teaching other students. But after the 1970s, almost none of my students became professors, because the universities in the United States were filled. Since 1950 the average lifespan in the developed countries has increased one year every four. It's 60 years since 1950, so people are living on average 15 years longer, including the professors. So today, in 2010, very few professors are retiring, and the students have no place to go. Basic research is sort of dying out because there are no new jobs.



With people living longer, professorships that might entice young new talent remain filled far longer. Basic scientific research suffers because of this, Minsky says. [Enlarge](http://www.pbs.org/wgbh/nova/assets/img/pioneer-artificial-intelligence/image-03-large.jpg)

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**That's sobering. But what you and other AI researchers have found is that it's actually pretty difficult to build intelligence, right?**

How hard is it to build an intelligent machine? I don't think it's so hard, but that's my opinion, and I've written two books on how I think one should do it. The basic idea I promote is that you mustn't look for a magic bullet. You mustn't look for one wonderful way to solve all problems. Instead you want to look for 20 or 30 ways to solve different kinds of problems. And to build some kind of higher administrative device that figures out what kind of problem you have and what method to use.

Now, if you take any particular researcher today, it's very unlikely that that researcher is going to work on this architectural level of what the thinking machine should be like. Instead a typical researcher says, "I have a new way to use statistics to solve all problems." Or: "I have a new way to make a system that imitates evolution. It does trials and finds the things that work and remembers the things that don't and gets better that way." And another one says, "It's going to use formal logic and reasoning of a certain kind, and it will figure out everything." So each researcher today is likely to have one particular idea, and that researcher is trying to show that he or she can make a machine that will solve all problems in that way.

I think this is a disease that has spread through my profession. Each practitioner thinks there's one magic way to get a machine to be smart, and so they're all wasting their time in a sense. On the other hand, each of them is improving some particular method, so maybe someday in the near future, or maybe it's two generations away, someone else will come around and say, "Let's put all these together," and then it will be smart.



Commonsense reasoning, which comes naturally to young children, is challenging for a computer, even one as advanced as Watson is. [Enlarge](http://www.pbs.org/wgbh/nova/assets/img/pioneer-artificial-intelligence/image-04-large.jpg)

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**WHAT ABOUT WATSON?**

**"Watson," the computer that plays *Jeopardy!*, is doing very much what you described. Its creators at IBM are using formal logic and machine learning and databases—basically a kitchen-sink approach—to develop a computer that can answer questions about a wide variety of things. They wouldn't say that they are building an artificial intelligence but rather the best question-answering machine ever built.**

There are some projects that have tried to do commonsense reasoning, but none of them can solve difficult problems yet because they're all using one-way—one or another kind of pattern-matching. There aren't any machines that can do the commonsense reasoning that a four- or five-year-old child can do. No machine that I've heard of yet can answer a question that involves, for example, knowing that you can pull something with a string but you can't push something with a string—a simple thing like that.

**But imagine a machine that's playing a game, and the category is "rhyme time." And the clue is: a politician's rant and a frothy dessert. And within two seconds, the machine comes back with "meringue harangue." Now to me that seems like magic. I mean, it's got to be smart, right?**

Well, the average person only knows 20,000 words or so. In one-hundredth of a second, a modern computer can find all possible rhymes in those 20,000 words. Then maybe there are 20 other things it can do, like will a certain phrase connect with a certain year. And if you take about 20 of those, maybe you can answer most *Jeopardy!* questions. I don't know.

But if we're impressed by somebody's program that plays *Jeopardy!*, then we have to ask, is this because it's taking a lot of data and doing something really stupid like the chess programs do, having no knowledge of chess itself but only knowing how to do, say, 20 of a certain kind of search and that's all there is to it? If that's the answer, then yes, ignorant people will be impressed, but people who understand how it works won't be impressed.



If Watson is little more than a glorified chess-playing computer, than AI experts will not be wowed, Minsky says. [Enlarge](http://www.pbs.org/wgbh/nova/assets/img/pioneer-artificial-intelligence/image-05-large.jpg)

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Now, the minute the Watson people publish a scientific paper saying how they did it, then we'll have something to discuss, because maybe some of us will say, "Yes, that is a good new idea, I'm really interested." Or, as in the case of chess programs, we'll say, "Now, I see, this is just another worthless, stupid trick that answers the kinds of questions that most people are interested in for no particular reason"—like what date did a certain baseball player make a certain kind of play. That doesn't require any intelligence to answer if you have the answer in a list.

**But Watson has to understand the question, right? That's hard.**

Well, you don't have to understand the question if just fitting and matching five keywords will give you an 80 percent chance of getting the answer without understanding either the question or the answer.

I have a good human example of this. My friend Joe Weizenbaum, who was one of the pioneers of AI, wrote a program that appeared to have a lot of common sense. It was called ELIZA, after the character in that wonderful [George Bernard] Shaw play *Pygmalion*. Joe said he got the idea because he had an aunt who was considered the wise woman of the neighborhood. People would come and tell her their problems—their daughter did this and that and some terrible thing happened and so forth—and Joe's aunt would listen. And after a while she'd say, "Yes, things like that happen." That's all she did that Joe could remember, but he noticed that it was this kind of reaction of *appearing* to understand that gave her this reputation in the neighborhood.



A five-year-old child knows you can pull but not push something using a string, but does Watson? [Enlarge](http://www.pbs.org/wgbh/nova/assets/img/pioneer-artificial-intelligence/image-06-large.jpg)

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**I hear what you're saying, but I think, Well, there are computer systems that can understand what I'm saying, ones that can answer questions, ones that are almost beginning to see, ones that can basically begin to move through the world. Is it possible that out of all of those we're going to get an artificial intelligence?**

I don't think it will happen without a good architecture. It won't evolve from any particular program. It's a tough one. The problem is that there are some things that impress people, and there are some researchers who, for economic or other reasons, work on things that get an excited reaction from the public.

I'm afraid Watson is that, and I can't tell whether it will ever understand why you can't push something with a string. If you ask the average person why you can't push something with a string, he or she might find it very hard to explain that the string will bend and it won't transmit any force because when it comes to a curve the force will go off the end of the curve [laughs]. No one knows how to think about that.