

Your next boss: A computer algorithm?



An IBM Watson supercomputer. (Los Angeles Times)



By **Russ Mitchell**

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Computers keep getting smaller and faster. That’s been happening for decades. But almost all of them are programmed to do what humans want them to do, the way humans want them to do it, and nothing more.

Now computers are beginning to learn — on their own. Years of research into artificial intelligence are beginning to pay off.

So-called machine learners already are diagnosing diseases, winning on “Jeopardy” and helping make rich hedge fund investors even richer. Machine learning is behind Facebook’s ability to figure out who your friend is by recognizing a picture of her face. Siri and Google Voice Search voice recognition? Machine learning is behind those too. And driverless cars.

Machine learning appears to be poised for rapid proliferation, with enormous implications for the workplace, the economy, politics and human culture.

Pedro Domingos, computer science professor at the University of Washington, offers an overview of the current state of machine learning in his just-published book, “The Master Algorithm: How the Quest for the Ultimate Learning Machine Will Remake Our World.” Domingos recently discussed the subject with The Times. The following is an edited transcript.

What does it mean for a computer to learn?

A machine learns if it gets better with experience, like humans do. Instead of us having to program the machine to do what we want, the machine learns from data and figures it out on its own.

For example, a learning machine looks at a bunch of X-rays and the corresponding diagnoses and teaches itself how to distinguish tumors from the non-tumors.

Or a robot vacuum cleaner gets stuck under a chair. If it's a learning machine, it should be able to figure out how to get unstuck, and then use that knowledge every time it gets stuck in the future.

Should humanity embrace machine learning or fear it?

There's much to embrace and fear in machine learning, and much that we can do to make the most of it. Machine learning lightens the information overload, helps us find jobs and dates, lets cars drive themselves and lets our smartphones understand what we say.

Machine learning will eliminate many jobs, but also create many new ones.

Perhaps the biggest danger is that machines will cause damage while trying to serve us because they take our wishes too literally, or because they lack common sense. Learning algorithms already make a lot of important decisions every day, from who gets credit to who gets interviewed for a job to who gets flagged as a potential terrorist.

And they make mistakes. The cure for that, though, is to make them more intelligent. People worry that computers will get too smart and take over the world, but the real problem is that they're too stupid and they've already taken over the world.

What do you say to the artificial intelligence catastrophists like Stephen Hawking and Elon Musk?

I have the greatest respect for Stephen Hawking and Elon Musk, but I think their fears are based on a misunderstanding of AI. The robots and AIs that we see in Hollywood movies are always humans in disguise,

but real ones aren't.

Being intelligent and being human are two very different things. AI algorithms don't have a will of their own: They just search for solutions to the problems we apply them to, and the more powerful the computers they run on, the harder the problems they can solve.

Computers are just extensions of us. You don't worry that your left arm will slap your face, so why would you worry that a computer will magically turn evil?

Musk says that AI is like summoning the devil, but my fear is that he's the one who's summoning a different devil: If we unnecessarily stoke fears of AI, it could wind up like GMOs [genetically modified foods], which have been banned in many countries despite all their benefits.

If you're in business, how will machine learning affect your life?

Machine learning will make companies much more nimble and adaptable than they are today. The biggest problem with most organizations is that the intelligence of the whole is less than the sum of the parts. People can only collaborate and communicate so much, but learning algorithms can fill that gap by continually communicating among themselves and looping you in as needed.

Machine learning will help you know your customers better. If you have millions of customers but not millions of customer service reps to work with them, algorithms learning about them are the next best thing.

But it goes far beyond that. If you look at the companies that are farthest along this road, like Google and Amazon, they use machine learning in every nook and cranny of what they do.

For example, everyone knows about Amazon's recommender system, but an equally important use of machine learning at Amazon is demand forecasting: predicting how much of each of millions of products people will want to buy, so Amazon can stock them in the appropriate quantities.

Increasingly, the day-to-day decisions in a company will be made by learning algorithms, and our job will be to supervise them and make the longer-range decisions.

What should businesspeople watch out for?

Companies increasingly use learning algorithms to select job applicants and to evaluate employees for promotions and raises, so machine learning could make or break your career. In fact, in the future we'll often see workers whose boss is an algorithm, and they'll be surprisingly happy with it, because algorithms can be fairer, less egotistic and more helpful than at least mediocre bosses.

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If you're in college, or younger, how do you prepare for a world of machine learners?

First, you want to understand what machine learning is and what it does, so you can make the most of it. Machine learning is a bit like having a superpower that makes the world around you adapt itself to you, but like every superpower, you have to know how to use it.

Second, the boundary between what is best done by humans and what is best done by learning algorithms will shift continuously throughout your lifetime, so you also want to be continuously learning new things and evolving what you do so that you're taking advantage of learning algorithms rather than competing with them. If you have a horse, you don't try to outrun it: You ride it. Same with machine learning.

For the non-computer-scientists among us, what is the Master Algorithm?

The Master Algorithm is an algorithm that is capable of learning anything from data. Give it data about the planets' motions, inclined planes and pendulums, and it discovers Newton's laws. Give it DNA crystallography data and it discovers the double helix. From all the data in your smartphone, it learns to predict what you're going to do next and how to help you. Perhaps it can even discover a cure for cancer by learning from a massive database of cancer patient records.

At one level creating such a general-purpose learning algorithm is easier than it seems: Even some of the simplest learning algorithms have mathematical proofs that they can learn anything given enough data. But the catch is that the algorithm has to be able to learn what you want it to using realistic amounts of data and computation. Big data helps, and so does Moore's law, but we also need fundamental insights about learning. One path, intensively pursued these days, is to reverse-engineer the brain -- after all, the best learning algorithm in the universe is the one inside your skull. Another path is to mimic evolution, which created your brain as well as all life on Earth.

Other paths draw on ideas from statistics, logic and psychology. My own view is that it's going to take a combination of ideas from all these different paradigms to invent the Master Algorithm -- a grand unified theory of machine learning, if you will.

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