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Rise of the robots: are you ready?

MIT roboticist Daniela Rus on why we need to collaborate rather than compete with artificial intelligence

Daniela Rus MARCH 6, 2018

When people learn that I'm a robotics and artificial intelligence (AI) researcher, I usually get one of two reactions: they either make jokes about Terminator and the "rise of the machines", or they get excited and ask me how soon their car will be able to drive itself.

While I certainly count myself a member of the second, "excited" group, I know how important it is to understand the very real anxieties that inspire those Terminator jokes. Having done computer science research for many years, I can say with confidence that fears of an AI apocalypse are hugely inflated. Even with all of the major advances being made in this realm today, AI comes nowhere close to people in terms of perception, reasoning, communication and creativity. It lacks social intelligence and can't put together unfamiliar combinations of ideas. These restrictions will hold it back from "out-thinking humanity".

At the same time, I understand the legitimate concern about automation displacing jobs, and think it's valuable to address the ways that emerging technologies will affect the economies of the future. The reality is that the nature of work keeps evolving as new

technologies take over some tasks and create more time for others. Just as machines transformed the world of agriculture a century ago, AI and robotics will profoundly impact many modern industries. Since 1900, US agricultural employment has dropped from 40 per cent to two per cent of the workplace. The transition was undoubtedly difficult for a whole generation of workers but, ultimately, many of them have since found other meaningful vocations suited to their skills.

Of course, it can be hard to imagine the kinds of work that technology will create. A decade ago nobody would have predicted the dozens of new types of jobs, from social media analysts and data scientists to app developers and mobile marketers. Roughly a third of new jobs didn't exist (or barely existed) a quarter of a century ago.

Making robots has traditionally been difficult, tedious and expensive. Each robot is made of a body and a brain, but very few people have the technical skills to both fabricate the body and code its brain. More recently, though, 3D-printing techniques have made it easier to produce a wide range of customised objects that previously could only have come out of factories.

My group at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) is working on engineering tools to automate the design and fabrication of robots. We are close to manufacturing working robots that can be designed by free-form sketching and fabricated to actually walk right out of a 3D printer.

Right now the robots we can make have limited battery life and can only do simple tasks such as moving an object from one side of a room to the other. But with improvements in software and hardware, they'll eventually be robust enough to transport goods long distances or travel to disaster sites to find survivors.

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Another key innovation for manufacturing robots involves soft materials. Most people picture robots as hard hunks of metal, but the robots of the future will come in many different shapes and materials. Taking cues from the animal kingdom, we are now making robots out of squishy, stretchy materials such as rubber,

to actually walk right out of a 3D printer

cloth and even food compounds and liquids. We are inspired by animals like octopuses that can move and manipulate objects without skeletons, and vertebrates like geckos that can run by storing elastic energy in their bones and tissues.

Soft materials enable robots to be smaller, safer and sturdier than their rigid-bodied counterparts, with compliant structures that allow limbs to more easily bend, change direction and squeeze into tight spots. If a soft robot hits something, it is less likely to break or cause damage, and could even be programmed to use those collisions to gain more information about its surroundings.

Our team has developed soft robots that can swim like fish, slither like snakes and even be swallowed to patch wounds inside your stomach. Such approaches could be revolutionary in enabling surgery that is non-invasive, less painful and has lower risks of infection. Further down the road, such robots could even deliver drugs specifically tailored for your genetic makeup, eliminating the trial-and-error nature of many treatment plans.

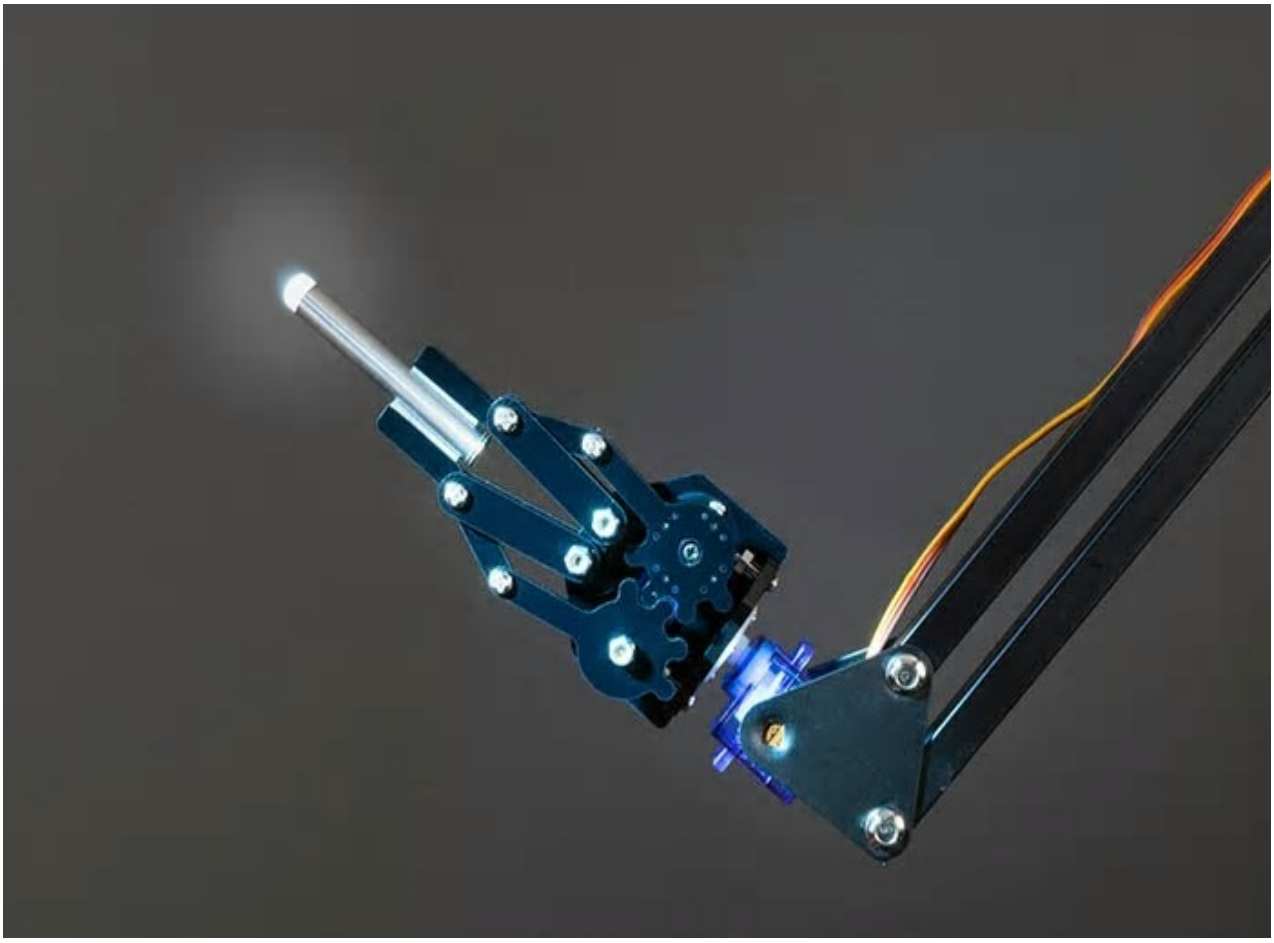
Besides building better bodies for robots, we also have to improve their "brains" — the programs that allow them to perform tasks with agility and versatility. Today's robots are one-trick ponies: Alexa can't vacuum your carpet and Roomba can't order you a takeaway. This is because of limits in how robots reason about the world. To get them to do even the simplest of tasks, you have to meticulously spell out the instructions and program their exact size, shape and function — which isn't particularly practical for non-coders.

In response, researchers at MIT CSAIL and elsewhere are working to develop methods that will allow robots to respond to situations they have not explicitly been programmed for, along with intuitive user-friendly interfaces that let you simply plug in the task you want the robot to do.

Technology and people do not have to be in competition. Machines are better at things like crunching numbers, remembering things, finding patterns, lifting heavy objects, and moving with precision; humans are better at tasks that involve creativity, abstract thinking and uncertainty. Collaborating with AI systems, we can augment and amplify many aspects of work and life. (This is something we take to heart at MIT — this

year we launched MIT Intelligence Quest, a new initiative focused on human/AI intelligence and collaboration.)

A case in point: advances in natural language processing (NLP) have enabled machines to go beyond the simple word recognition that allows Siri and Alexa to give driving directions and buy groceries. Systems will soon be reading and synthesising massive amounts of written information, including entire libraries of books. These new tools will play a valuable role in assisting doctors, lawyers and other specialists in making more informed decisions.



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For example, MIT researchers have collaborated with hospitals to develop AI systems that can help doctors better detect breast cancer. Their method correctly diagnosed 97 per cent of breast cancers as malignant and reduced the number of benign surgeries by more than 30 per cent, compared with human doctors' existing methods. Such systems will not replace doctors: they can't sit down with patients to discuss symptoms or review treatment plans. However, they can help doctors make the right diagnoses and recognise

all the available treatment options — while freeing up doctors to spend more time with their patients.

Such advances raise some important questions. How do we prepare all parts of our society for a future with machines? What kinds of jobs should we be ready for in 25 years? Which actual activities will be automated and what kinds of high-value tasks will we need to be able to do in their place?

Critics often cite job displacement as a reason to discourage further AI research. But history is rife with innovations that have been disruptive: does anyone look back and regret Eli Whitney inventing the cotton gin or James Watt developing the steam engine? Like any technology, AI isn't inherently good or bad. As my MIT colleague Max Tegmark likes to say, "The question is not whether you are 'for' or 'against' AI — that's like asking our ancestors if they were for or against fire."

If fire is inevitable, how we handle it certainly isn't. While I don't believe we can (or should) stop the advance of technology, we do have to think critically about how to integrate AI into our lives and prepare for new kinds of work. Companies are putting major resources into training and retraining, from Google pledging $1bn to train high-tech workers to organisations like Kentucky's Bit Source teaching programming to unemployed coal miners ("from coal to code").

Daniela Rus

Universities like MIT are also working to address such skills gaps by offering free web courses in a wide range of topics. Online education has spurred a paradigm shift. For centuries, we've had a sequential approach to education and work, in which people study for a while and then enter the workforce. In the future, these areas will blend more seamlessly, with employees continuously educating themselves to acquire relevant skills for their jobs.

The jury is still out on how successful these kinds of programmes will be and how well they can scale, but they're part of what technologists and policymakers need to bring to the discussion table to ensure that we stay on top of the changing economic landscape.

I'm personally very excited about the many changes that AI will bring. In an increasingly data-centric world, computers can do more to improve our lives than we ever could have done alone. They can help us move around faster and more safely, improve our ability to diagnose and treat disease and open up new approaches to education, energy and cybersecurity.

Algorithms are helping us to generate key insights about some of the world's biggest challenges: better understanding climate change by analysing sensor data from our oceans, rainforests and atmosphere; allocating excess food to the communities that need it; predicting and responding to natural disasters using cyber-physical sensors; and much more.

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And just as computers continue to help us with thinking work, robots will help us with physical work. Autonomous cars will reduce road fatalities and enable us to go anywhere anytime. Trash cans will take themselves out and self-driving garbage trucks will pick them up. Machines will free us from having to do "dull, dirty and dangerous" — the three D's of robotisation — parts of jobs in construction, mining, nuclear energy and emergency response. As a result, we will be able to focus energy on the more creative and interpersonal skills that we cannot replicate with computers.

In 2015 almost 5.5 million consumer robots were sold; by 2019, that number is expected to rise to more than 42 million. While a world of personal robots may seem to be decades away, with a few key breakthroughs we could get there much faster than you think.

Just two decades ago, computers were reserved for experts because they were large, expensive and hard to access. Now virtually everyone has a smartphone and computation has became the new normal. I believe that the next 20 years will usher in an equally profound change with AI and robotics. Smartphones democratised computing; AI and robotics have the potential to democratise cognitive and physical tasks. They will free us from doing tasks that are dull, dirty and dangerous — and make the world a better place in the process.

Today robots have already become our partners in industrial and domestic settings. They work side by side with people in factories and operating rooms. They mow our lawns, vacuum our floors and even milk our cows. In a few years, I believe they will touch almost every part of our lives.

Computing has already completely upended our world but there's still a lot more that can be done. With ingenuity and insight, technologists are working to transform science fiction into science, and science into reality. I'm looking forward to being part of this exciting ride — especially if an autonomous car is involved.

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