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MIT COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE LABORATORY (CSAIL)

MODULE 4 UNIT 1
Interactive Video Set Video 1 Part 1 Transcript

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THOMAS MALONE: From R2-D2 and C-3PO in *Star Wars* to the evil *Terminator* robot, most of us have already seen many robots in films, television shows, and books. But much of what we know from watching all these science fiction robots is not true of real robots. For instance, most science fiction robots can walk, talk, and do most of the other things people can do, but all real robots today are designed for very specific tasks like transporting people in cars or assembling products in a factory, and they can only do the specific tasks for which they were designed. That means they usually don't look much like humans. Instead, their shapes and sizes are designed to fit the specific tasks they do. The robot in a self-driving car, for instance, doesn't look like a human sitting in the driver's seat. Instead it's a bunch of sensors, motors, and computers embedded invisibly throughout the car. For the purposes of this course, we'll define robots as automated devices that perform physical tasks in the real world. That definition excludes things that people sometimes call robots like robo-advisers for financial investments. But we'll talk about some of these other things in the next module. And now Professor Daniela Rus will give you an introduction to the field of robotics.

DANIELA RUS: Imagine a world, not too far off, where it's as easy to program a robot to do your shopping, or to take a driverless car for a spin, as it is to use a smartphone today. Robots have the potential to improve the quality of our lives at home, at work. They have the potential to advance scientific discovery, they have the potential to power the economy and generally make the world better. And yet, the objective of robotics is not to replace humans by mechanizing and automating tasks; it is to find ways for machines and humans to be more effective together. For example, commuting to work in your driverless car will buy you time and will allow you to read, to work, to catch up on podcasts and, maybe, catch up with your family and friends.

And now, imagine if these cars can learn. Imagine if they learn how you drive, if they learn to never be responsible for an accident. What if they could watch your back on a particularly treacherous part of the highway? What if they could become trusted partners? And what if your car could talk with your refrigerator, figure out that you're out of cat food and suggest where to stop on your way home? These are just a few of the possibilities when we bring together robots, cars, and computing. Now, this is not some kind of imaginary future. This is the future we're building to create a world where everyone can have a robot to help with physical tasks. This is the world of pervasive robotics. This is the future work of pervasive robotics: the connected world of many robots working with many people, doing many tasks.

Now, robots put computation in motion. They are programmable mechanical devices that take input from the world through sensors and impact the world through their actuators. The robots think about the input from the sensors, think about the task they have to do, and then issue commands to their motors to move in the world. Robots come in many different shapes. Robots have humanoid shapes, but this is not necessarily the only way to think about robots. Your car could be a robot. Your garbage can could be a robot. So, robots can come in many different forms. Now, robots could transform everyday life, profoundly. For example, in the future, shopping might look like this. Imagine getting up and sending your personal delivery robot to the store to bring you fresh fruit and bread.

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The store is abuzz with robots and people. Some robots stock shelves, other robots package boxes for delivery. Some people may want to arrive at the store in driverless cars, and some people may want to use autonomous shopping carts to help them navigate, especially if they have limited vision.

Some robots can deliver packages, some robots can help clean up, some robots can help people move things around. This is a very different view of a shopping experience that will be enabled by advances in robotics. These robots have to move in the world. They have to sense, compute, and move in support of their tasks. The robots also have to interact with each other and with people in support of their coordination tasks. So, there's great enthusiasm for autonomous driving. It's happening because of advances in hardware, but also advances in algorithms. Computation has improved dramatically, due to Moore's Law, which states that the power of computing doubles about every two years, because we can pack, more densely, transistors on a small chip, but we have benefited from similar advances in the quality of sensors and the quality of actuators, and this is what makes robots work.

Because robots are bodies and brains, and the bodies are formed of mechanisms that include computation, sensing, actuation, and communication. However, hardware alone is insufficient because the robot needs a brain to control the body, and this is done through algorithms. And recognizing the extraordinary potential of robots in the past couple of years, most car manufacturers have announced autonomous driving projects.

Now, this change towards autonomous driving will be gradual, and in fact this change was defined by five steps towards Level 5 autonomy by the National Highway Traffic Safety Administration. Level 0 is what your car can do today, which is nothing. Level 1 is if you have a high-end car with a rear-pointing camera that helps you decide on what to do. Level 2 enables the car to take small actions on your behalf, like anti-lock brakes. Level 3 allows your car to take longer actions, but the driver has to be ready to take over at any point in time, and this is the current Tesla model. Level 4 is autonomy in some environments, some of the time. And Level 5 is autonomy in all environments, all the time. This is an extraordinarily exciting path to where transportation will become a utility available to anybody, anytime.

THOMAS MALONE: Did you understand all the concepts covered in this video? If you'd like to go over any of the sections again, please click on the relevant button.

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