What is a robot?

Excerpts from John M. Jordan, “Robots.” MIT Press, 2016.

Two relatively recent definitions illustrate the lack of consensus, a real problem when it comes to fostering intelligent debate over a topic with far-reaching implications for personal and public life. Maja J. Mataric of the University of Southern California published The Robotics Primer in 2007 as a K–12 guide to this important field. Almost immediately in the opening chapter, she states that “a robot is an autonomous system which exists in the physical world, can sense its environment, and can act on it to achieve some goals.” She goes on to underline her conviction: “True robots … may be able to take input and advice from humans, but are not completely controlled by them."

Contrast this strict definition, which excludes many familiar machines such as surgical robots, drone aircraft, and industrial robots, with the definition used on a 60 Minutes broadcast in 2013 that focused on technological unemployment. Narrator Steve Kroft began the segment by saying that “everyone has a different idea of what a robot is and what they look like, but the broad universal definition is a machine that can perform the job of a human. They can be mobile or stationary, hardware or software, and they are marching out of the realm of science fiction and into the mainstream.

...for such a familiar concept, it turns out that robots are extremely difficult to define. According to the American Heritage Dictionary of the English Language (3rd edition), a robot is “a mechanical device that sometimes resembles a human being and is capable of performing a variety of often complex human tasks on command or by being programmed in advance” (emphasis mine). This biomimicry raises one set of issues, especially in regard to autonomous robots. The Oxford English Dictionary definition introduces a second, literary area of complexity: “Chiefly Science Fiction. An intelligent artificial being typically made of metal and resembling in some way a human or other animal.”

Roboticists themselves struggle to pin down the definition of their field. George Bekey, an expert in autonomous robots, defined a robot by its characteristics: sensing, artificial cognition, and physical action. “Never ask a roboticist what a robot is,” Illah Reza Nourbakhsh of Carnegie Mellon (and another expert in autonomous robots) tells us. “The answer changes too quickly. By the time researchers finish their most recent debate on what is and isn’t a robot, the frontier moves on as whole new interaction technologies are born.”

The word “robot” originated in the 1920s and was at first a type of slave; robots are often characterized by their capabilities in performing dull, dirty, or dangerous tasks, sparing humans the need to perform them. The science and engineering of the field continue to evolve rapidly—look no further than Google’s self-driving car or the humanoid robots it acquired in the Schaft and Boston Dynamics deals. Given such rapid change, computer scientists cannot come to anything resembling consensus on

what constitutes a robot. Some argue that a given device qualifies if it can (1) sense its surroundings; (2) perform logical reasoning with various inputs; and (3) act upon the physical environment. Others insist a robot must move in physical space (disqualifying the Nest thermostat), while still others say that true robots are autonomous (excluding factory assembly tools). Reason 1 why robots are hard to talk about: the definitions are unsettled, even among those most expert in the field.

Robots are becoming more numerous, more capable, and more diverse. Over the long term, their economic, civic, and destructive impact will likely be on a par with that of the automobile. In such a massive transition, people will care what happens and call for rules, norms, and paths of recourse. Citizens have a vested interest in work, wages, and workplace safety; in aging with dignity; in major changes in global warfare; in privacy; and in other things that robotics has the potential to change.

The laws, stories, economic forces, and blind spots accompanying robots and robotics are neither inevitable nor obvious. They take work to craft, untangle, and assess. The next wave of computing will introduce profound changes, which will eventually rival those brought about by the automobile, household electricity, or running water. (As an example, consider the profound impact of drone warfare in the absence of public or even congressional debate over its ethical, political, and strategic implications.)

Given that the technologies for self-driving cars, embedded or face-mounted computers and sensors, and autonomous robots are all coming to market in a matter of months rather than decades, the circle of people involved in overseeing them needs to be widened. Time and again, engineers and scientists have answered the question, “How can we make this work?” Now it’s time for more of us to ask, “What realistic choices can be made in each of these domains?”—and to help make those choices.