Meeting of the minds for machine intelligence

November 23 2016, by Alison F. Takemura

Tamara Broderick, assistant professor of electrical engineering and computer science at MIT, was a presenter at the 2016 Machine Intelligence Summit. Credit: Marcy Rolerson

Surviving breast cancer changed the course of Regina Barzilay's

research. The experience showed her, in stark relief, that oncologists and their patients lack tools for data-driven decision making. That includes what treatments to recommend, but also whether a patient's sample even warrants a cancer diagnosis, she explained at the Nov. 10 Machine Intelligence Summit, organized by MIT and venture capital firm Pillar.

"We do more machine learning when we decide on Amazon which lipstick you would buy," said Barzilay, the Delta Electronics Professor of Electrical Engineering and Computer Science at MIT. "But not if you were deciding whether you should get treated for cancer."

Barzilay now studies how smarter computing can help patients. She wields the powerful predictive approach called machine learning, a technique that allows computers, given enough data and training, to pick out patterns on their own—sometimes even beyond what humans are capable of pinpointing.

Machine learning has long been vaunted in consumer contexts—Apple's Siri can talk with us because machine learning enables her to understand natural human speech—yet the summit gave a glimpse of the approach's much broader potential. Its reach could offer not only better Siris (e.g., Amazon's "Alexa"), but improved health care and government policies.

Machine intelligence is "absolutely going to revolutionize our lives," said Pillar co-founder Jamie Goldstein '89. Goldstein and Anantha Chandrakasan, head of the MIT Department of Electrical Engineering and Computer Science (EECS) and the Vannevar Bush Professor of Electrical Engineering and Computer Science, organized the conference to bring together industry leaders, venture capitalists, students, and faculty from the Computer Science and Artificial Intelligence (CSAIL), Institute for Data, Systems, and Society (IDSS), and the Laboratory for Information and Decision Systems (LIDS) to discuss real-world problems and machine learning solutions.

Barzilay is already thinking along those lines. Her group's work aims to help doctors and patients make more informed medical decisions with machine learning. She has a vision for the future patient in the oncologist's office: "If you're taking this treatment, [you'll see] how your chances are going to be changed."

Machine senses

Machine learning has already proven powerful. But Antonio Torralba, professor of electrical engineering and computer science, believes that machines can learn faster, and thereby do more. His team's approach mimics the way humans learn in infancy. "We just start playing with things and seeing how they feel," Torralba said. To illustrate, he showed the room a video of a baby turning over squeaky bubble wrap in her hands. Importantly, we notice the noises things make when we move them around, he said.

To give machines a similar sensory experience of the world, a student of Torralba's recorded himself tapping more than a thousand objects with a wooden drumstick. Called "Greatest Hits," the sound collection captured the drumstick clanging ceramic cups, ruffling bushes, and splashing water. After feasting on these videos, a computer could start predicting the sounds of the world—essentially reflecting a grasp of its physics—all without explicit instruction.

Videos of everyday scenes (sans drumstick) also prove deft teachers. Machines are usually guided to pick out objects by training them on annotated images. That means people would meticulously outline a photograph's individual objects, such as people, lamps, and bar stools, so that computers could learn to identify them. But Torralba and his team have found that by giving computers video complete with objects' sounds—such as a street's ambient noise or people talking—a machine's neural network could begin to pick out objects without any guidance at

all.

Torralba recounted how a machine trained this way begins to identify water, the sky, and people's faces. Machines become remarkably adroit at identifying infants, because "they make a very special noise," Torralba said. The recognition of sounds resides in a machine's artificial neurons called units. He continued: "There were a lot of units devoted to babies."

Decision helpers

Once a machine is educated, it can help experts make better decisions.

Stefanie Jegelka, an assistant professor of electrical engineering and computer science, presented how to make machines learn faster and make predictions more reliably, by identifying maximally informative data. Her team has recently developed new techniques that make this process much more practical.

Alternatively, savvy machines can help us evaluate policies. Tamara Broderick, an assistant professor of electrical engineering and computer science, showed how this works. In collaboration with MIT economist Rachael Meager, her team focused on the question of quickly and accurately quantifying uncertainty. For instance, is microlending, or giving people small loans to jumpstart businesses, is actually helping alleviate poverty. We need to understand the variation in returns on these loans to say.

When we ask a computer to tell us how much more value a loan creates—for instance, $4 made for $3 invested—we can also use machine learning to evaluate how robust that outcome is. What would happen if we were to tweak the model? Broderick asked. "Are we going to get the same number out at the end? Or are we going to get fundamentally different numbers and therefore fundamentally different

decisions about what to do—what policy to make?" Machine learning can guide the way.

To our health

But the application of machine intelligence most discussed at the summit was in health care. Mandy Korpusik, a graduate student in CSAIL who shared her work during a pitch session, described an app called Lana that serves as a personal nutritionist. You can tell her what you ate for lunch, and she can recommend what nutrient-rich foods to have in your next meal.

Barzilay, the cancer survivor, wants not only to feed computers clinical reports, but medical scans. These images contain a wealth of information humans alone might be unable to articulate, she said. For example, a machine might be able to discern that given your mammogram, a particular treatment might be 90 percent likely to be effective.

With colleague Tommi Jaakkola, professor of computer science and engineering, Barzilay is also working on extracting the machine's reasoning, a murkier but necessary endeavor. "Doctors, at least the ones at [Massachusetts General Hospital], are not happy just getting a number at the end," Barzilay said. "They need to know why."

Intelligent machines can aid decision making beyond the doctor's office. Data scientists capable of implementing machine learning have become ubiquitous in government agencies, said Aman Bhandari in a fireside chat-style interview with Ash Ashutoush, CEO of information technology firm Actifio. Bhandari is now at pharmaceutical developer Merck, but worked at the White House in President Barack Obama's Office of Science and Technology Policy. During his tenure, the administration heavily pushed digitizing all medical records.

"If you think about health care, we've moved from—and we're still moving from—this stone age of data collection, capture, production, and analysis into this possibly 'industrial era' of all of those things," Bhandari said. "So, the first phase is digitizing the system. The next phase is unleashing data from the U.S. government across every single sector."

Jacqueline Xi, an electrical engineering and computer science senior, came away feeling enthusiastic about machine learning's possibilities. "Just to see everyone in the same room, and people who are founding startups, all here discussing these bigger ideas about how we can connect machine learning across all these groups, is really eye-opening," she said. "It's inspiring."

This story is republished courtesy of MIT News (web.mit.edu/newsoffice/), a popular site that covers news about MIT research, innovation and teaching.

Provided by Massachusetts Institute of Technology