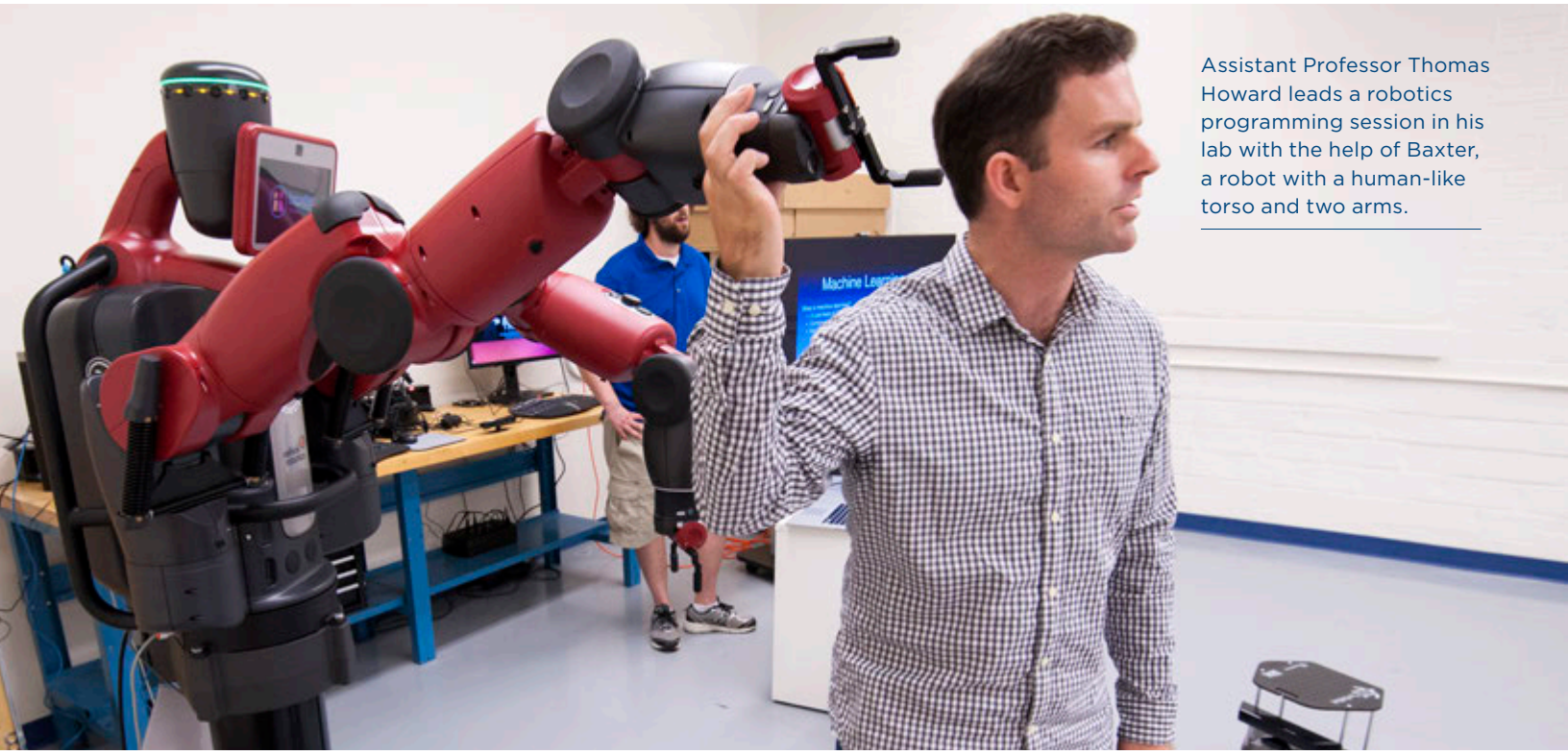
GOERGEN INSTITUTE FOR DATA SCIENCE

FOCUS AREA: **COGNITIVE SCIENCE AND ARTIFICIAL INTELLIGENCE**



Assistant Professor Thomas Howard leads a robotics programming session in his lab with the help of Baxter, a robot with a human-like torso and two arms.

▶ One of the most ambitious and exciting challenges in data science is to model and replicate how people think and learn. The University of Rochester is uniquely positioned to address this problem, as it is home to internationally recognized research in cognitive science and artificial intelligence (AI)—a priority area within the data science initiative. It encompasses research in many areas, including computer science, electrical and computer engineering, linguistics, psychology, neurology, and music.

While cognitive scientists focus on how the brain computes, AI researchers focus on building systems to solve tasks that require intelligence. Both pursue questions about the nature of perception, knowledge, and reasoning.

By increasing our understanding of how the brain makes sense of the world, cognitive scientists can develop new algorithms in machine vision, computational linguistics, and automated reasoning. Likewise, brain scientists can propel their research with advances in engineering.

The University at Work

Computer scientists and cognitive scientists at the University of Rochester are using data science to help make the world a better, more connected, and healthier place.

The New Robotics Lab on Campus

Thomas Howard, assistant professor of electrical and computer engineering, of computer science, and of biomedical engineering, directs the newly formed Robotics and Artificial Intelligence Laboratory. The lab develops robots that learn how to perform complex tasks robustly and efficiently.

A focus of Howard's work is machine learning for human-robot interaction and robot decision making. Machine learning enables robots to quickly learn the correspondences among various forms of data, such as audio or video, and activities that they should perform without explicitly coding such relationships.

Building on experience at NASA and the Massachusetts Institute of Technology, Howard envisions these robots assisting humans with a variety of tasks from planetary

exploration to physical rehabilitation. “Robots are fantastic for tasks that are precise, remote, and repetitive,” he says. “My goal is to make them fast, reliable, and easy to work with.”

Smart Glasses and Public Speaking

Researchers from the Human-Computer Interaction Group have developed a “smart glasses” interface that gives users immediate feedback on volume and speaking rate while being minimally distracting and working in real time. This feedback helps users adjust their delivery, which can improve their public speaking skills. The interface is named Rhema, which means “utterance” in Greek.

Ehsan Hoque, an assistant professor of computer science and senior researcher on the project, has used Rhema while giving lectures. “My wife always tells me that I end up speaking too softly,” he says. “Now, it’s Rhema reminding me to keep my volume up.”

Hoque and others believe that live feedback displayed in a private and nonintrusive manner could also be useful for people with social difficulties (e.g., Asperger’s syndrome), and even for people working in customer service.

Twitter, Food Safety, and Public Health

By “listening” to tweets from patrons of thousands of restaurants, a University-developed system called nEmesis can identify restaurants that are likely sources of food poisoning. Developed by Henry Kautz, the Robin and Tim Wentworth Director of the Goergen Institute for Data Science, the system can be used by public health departments to send out health inspectors before a small food-poisoning outbreak becomes a major one.

nEmesis works by finding tweets where the user is complaining about stomach ailments. It then checks to see if the user has tweeted from a restaurant the day before about any subject. Although any one case of a restaurant visit followed by stomach complaints may be a coincidence, by aggregating millions of tweets nEmesis can deliver actionable information.

Because of successful trial of the system by the Las Vegas Department of Public Health, the Center for Disease Control has given a grant to further develop and deploy the system on a nationwide scale.

The Brain and Efficient Communication

Using an artificial language in a carefully controlled laboratory experiment, a team from the University of Rochester and Georgetown University has shown that many changes to language are simply the brain’s way of ensuring that communication is as sufficiently precise and concise as possible.

“Our research illustrates that humans choose to reshape language when the structure is either overly redundant or confusing,” says T. Florian Jaeger, an associate professor in the Departments of Linguistics, Computer Science, and Brain and Cognitive Sciences.

For instance, when people turn “automobile” into “auto,” use informal contractions, swallow syllables, or take other linguistic shortcuts, their brains are striving for simplicity and meaning. Recent research has shown that these types of shortcuts appear only when their meaning is easily inferable from the context.

In related research, Steven Piantadosi, an assistant professor in the Department of Brain and Cognitive Sciences, has used big language data (the Google Ngram database) to explore this question.

How You Can Help

Funding for professorships, research, graduate fellowships, and undergraduate scholarships will help the Goergen Institute for Data Science leverage existing strengths and build relationships across the University based on common interests that relate to cognitive science and artificial intelligence. Please consider a gift that supports this research.

For more information, contact
Stephen A. Dare
Senior Associate Vice President
University Advancement
(585) 275-7530
stephen.dare@rochester.edu

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