Graham Taylor is animated when he talks about the possibilities of machines learning in new ways. Whether the topic is helping computers determine what is happening in a video without a human’s input, or teaching phones to know their owner based on voice recognition and body movement, his work is clearly a passion.

Yet, for a man whose career is focused on making machines smarter, it’s the human connections that give him the most job satisfaction.

“I feel quite strongly about training the next generation of scientists and engineers,” says Taylor, 37, an assistant professor in the school of engineering at the University of Guelph and leader of the university’s Machine Learning Research Group.

“I’ve had 45 students and staff through the lab since 2012, and they’ve gone out to do excellent stuff. That’s what makes me most excited,” he says in an interview. “They come through here and we have a great time working together, but then they go out and do awesome things. It’s something you get as a professor – or a teacher – that you wouldn’t get just doing research. … I get to enable them as they discover and pursue their own journeys.”

The human side of machine learning

Road to artificial intelligence’s new frontiers is paved with collaboration and sharing

By Andrea Perry
Photography • Dean Palmer

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Taylor’s Machine Learning Research Group currently has 15 members, and he endeavors to create an environment in which members feel motivated to work together, collaborating directly in the lab rather than working elsewhere, something that is always a possibility with computer-based projects.

“These girls and guys could be working on their laptop in a café or at home, or in Tahiti,” he says. “There is something on their laptop in a café or at home, or on artificial intelligence that proved to be a turning point for him.

“The project was to write a program that would play this game called Abalone – a two-player strategy board game – against other groups in the class.” He recalls. “I was on a team with two others, and we put a lot of work into it. . . . We won the tournament on artificial intelligence, which is a lot of fun, and AI is really interesting. So that’s what kind of sparked it.”

He completed a PhD in machine learning at the University of Toronto and a post-doctorate at New York University. In order to be closer to family and in response to an inner call to return to work and research in Canada, he came to Guelph with his wife in 2012, accepting his current position as assistant professor. Their family has grown to include children ages one and three.

Taylor describes his path as a “multi-stage journey” in which he was fortunate to work with many groups and individuals who have gone on to do highly prominent work in the field of artificial intelligence, both in academics and in industry.

One of his post-doc advisers, Yann LeCun, is now the director of AI research at Facebook. And his PhD advisor, Geoffrey Hinton, recipient of the Herzberg Medal, Canada’s top honour in Science and Engineering, is now in an influential position at Google. Taylor was recently named as an Azrieli Global Scholar by the Canadian Institute for Advanced Research, an organization that was instrumental in supporting the pioneering work of LeCun and Hinton.

In 2013, Taylor and his research group partnered with Google to create an Android phone application that uses body movement, voice recognition and other factors to unlock the phone in place of traditional personal identification numbers and passcodes. As Taylor tells this story, whenever he says “Google” his phone on the desk lights up, preparing itself for a voice command from its trusted user.

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“These girls and guys could be working on their laptop in a café or at home, or in Tahiti,” he says. “There is something on their laptop in a café or at home, or at the University of Guelph works through Mnscas Globalink – a not-for-profit research and training organization for young researchers that matches top international undergraduates with Canadian professors for research postings.

And for all the pleasure Taylor enjoys by seeing his team members flourish, it is quite clear that they like him too. Last spring, during the call for nominations for Guelph Life’s 40 Under 40, the one in support of Taylor arrived with a dozen of their names attached.

“I can attribute many of the successes I have had as a graduate student directly to Graham’s efforts,” Griffin Lacey wrote in the nomination letter. “His motivation to help those around him is inspiring, and his actions are always sincere.”

More recently, Nikhil Sapru, a master’s student in Taylor’s group, wrote, “He’s always calm, supportive and takes the time to discuss things I’m working on or would like to pursue.”

“He provides very constructive advice, in a friendly manner, and he always puts up a nice smile no matter how stressed he is,” writes Dhanesh Ramachandaram, a former professor from Malaysia now attached to the research group as a post-doctoral fellow.

Sincerity, friendliness, care and a sense of calm – you can feel that vibration as Taylor explains how he came to be where he is now, sitting in the quiet sunlight at his desk on the third floor of the red-brick Richards Building, along Reynolds Walk at the centre of campus.

What also comes through is a sense of “flow” – the state of being intuitively in synch with your passion and purpose, so that external events seem to conspire to bring you where you need to be. Originally from London, Ont., Taylor’s academic route brought him through the University of Toronto and a post-doctorate at New York University. In order to be closer to family and in response to an inner call to return to work and research in Canada, he came to Guelph with his wife in 2012, accepting his current position as assistant professor. Their family has grown to include children ages one and three.

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Part of it was being in the right place at the right time, and part of it was making good decisions that allowed me to work with some awesome people,” he says.

Taylor was recently appointed as academic director of NextAI, a charitable initiative focused on nurturing and growing Canada’s ecosystem of artificial intelligence startups.

A would-be visitor’s first clue about how much of a role artificial intelligence plays in Taylor’s life occurs when you contact him to set up a meeting. The email reply comes from Amy Ingram, his artificial intelligent personal assistant: “Hi Andrea, Happy to get something on Graham’s calendar. Does Monday, Oct 24 at 11:00 AM EDT work? Alternatively, Graham is available Monday, Oct 24 at 3:00 PM EDT.”

A minute after I choose the 3 p.m. slot, Amy sends a confirmation email and a prompt so that I can add the event to my own calendar.

Arriving at Taylor’s office at the appointed time, I have to know if he created that name Amy Ingram.

“It’s a Google program, and you can choose between Amy and Andrew,” he says, showing me to the seat across from him at his desk. The room is small, with just enough space for the desk, a single computer, a bookshelf and a whiteboard. Taylor’s bicycle, propped next to the bookshelf, covers a third of the open floor space. The single window behind Taylor casts him in clear, natural light.

Machine Learning, the focus of Taylor's research group, is a sub-set of artificial intelligence in which computers have the ability to learn without being explicitly programmed. "When the computer actually learns from the data input and adjusts its own internal programs in order to provide a useful output, that's machine learning."

Taylor rises and draws a diagram on the whiteboard. “And when that learning process is done in stages, with multiple levels of data transformation, that's deep learning, which has become so popular.”

He stresses the basic process: data input, multi-level transformation of data, useful output. In the case of the Google phone app, the phone would study the user to compile identifiable characteristics, such as the user's unique walking pattern, and then program itself to unlock when those specific identifiable characteristics are present.

Within Machine Learning, one of the main focuses for Taylor’s research group is vision. He recently received a $550,000 grant from the Natural Sciences and Engineering Research Council for a three-year international research project aimed at helping computers “see” better.

Basic examples of vision include a computer's ability to see a photograph (data input) and identify the particular face (useful output), or a computer's ability to review video footage and discern what activities, such as walking, running, sitting or kissing, the people are engaging in on screen. Given the proliferation of video media all over the world, from security cameras to YouTube postings, having computers that are able to review and organize footage at high speeds without a human watcher may be increasingly useful.

Glancing out the window as he returns to his desk, Taylor notes that being in Guelph offers unique opportunities to use computer vision by partnering with other areas of strength at the university, such as plant, animal, soil and environmental science.

“You always want to work on stuff that other people are not necessarily working on. Being creative and thinking outside the box are attractive, and that's enabled by having unique problems to solve.”

He gives an example of a project in which his team designed a vision system for a smart trap that was placed in an orchard to look for a certain species of moth that was eating the apples. By identifying the specific areas in which the moths were present, growers could target pesticide spraying, rather than spraying indiscriminately or in areas where it wasn’t needed.

“Wherever there is data, you can apply machine learning, and all of these areas of strength at the university generate a lot of data. These areas are also being increasingly outfitted with sensors, such as drones in agriculture, or sensors in streams that measure water flow and pollution levels. … All of these sensors create opportunities for problems to be solved with machine learning.”

The whiteboard still has Taylor’s sketch on it, describing the deep machine learning process: data input, multi-level transformation of data, useful output.

I see it overlaid, quite beautifully, with the human operation Taylor has created: students and researchers drawn from a variety of backgrounds (data in); learning, guidance, support and opportunity provided by the university through Taylor's expertise, leadership and care (multi-level transformation of data); contributions to the research field and to industry developments (useful output).

The “useful output” has an added twist, given Taylor's focus on human connection and enablement: passionate, skilled and supported human beings released forward onto their own paths.

As Dhanesh Ramachandram writes in a followup email: “There is a strong, ethical work culture in the group and (Taylor) encourages collaborative research. We get the outputs when we can tap into specific skillsets and (Taylor) is excellent in identifying who works best with another.”

Graham Taylor
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