# MACHINES AS COGNITIVE EXTENSION AND LEARNING PARTNERS

COGNITIVE

EDUCATED ROBOTS TRANSFORM HUMAN DEFINITIONS OF LEARNING

"Who needs college if you have the Web?" asked Bill Gates in his closing address at the Techonomy 2010 conference. Indeed, we have come to rely on automated aggregation, search, and analytics to deliver information and assist us in many learning tasks. In the next ten years, automated agents in schools and workplaces will interact with us in new and more intimate ways: they will learn along with us, understand our personal preferences, and become ever more necessary extensions of our memories and cognitive systems. But perhaps more importantly, these systems and devices will help us understand ourselves better, including how we learn and emotionally process the world.

### UNDERSTANDING HUMANS: Discovering the Human Learning Algorithm

How do we learn to walk, talk, think, and do the myriad of other things that make us uniquely human? Robots and automated systems are the latest tools for helping us understand ourselves, the workings of our minds, our reactions to our environments and to others around us. By building machines that "learn," we rely on algorithms—our best representations of human learning. And by observing such machines in action we refine our own understanding of learning as we continuously adjust and tune these systems.

Source: http://www.physorg.com/news158151870.html
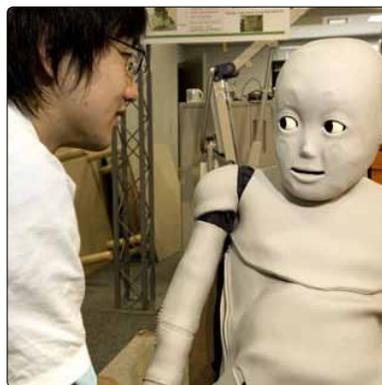
Learning like a child

A Japanese child robot, CB2, uses a learning pattern modeled on how a child learns from a mother.
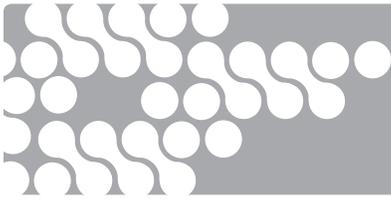

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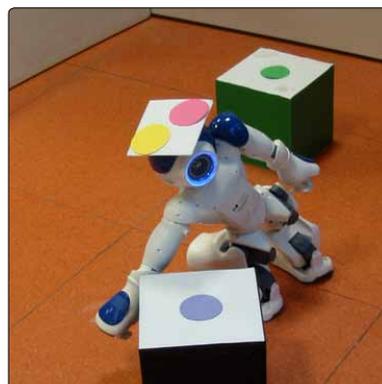
Cognitive system for a robot

Researchers on the Xpero project are building a robot that can explore the world around it and learn through physical experimentation. The robot makes no distinction between preprogrammed and learned knowledge.

THE FUTURE OF
HUMAN-MACHINE
INTERACTION

AUGMENTING HUMANS: Machines as Cognitive Extensions

Our digital tools have become our extended memories and our eyes and ears on the world around us. Machine companions will continue the march to augment our cognitive abilities, increasing the vastness of information we can access, making it ever more portable and present, and extending our cognition and thinking processes.

Source: http://robotic.media.mit.edu/projects/robots/huggable/applications/applications.html
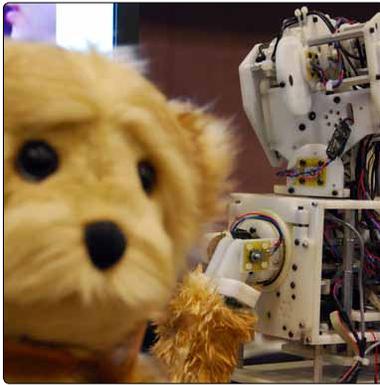
Remote teaching and learning

The Personal Robots Group at MIT has created Huggable, a semi-autonomous robotic communication avatar that a remotely located teacher can control via the Internet to interact with a student in an educational activity.

Source: http://blog.roboteducation.org/node/42

World's smartest robot

iQue, a speaking robot on wheels from Toy Quest, knows the entire Merriam-Webster dictionary (student edition), recollects thousands of historical and other facts, and can learn and remember information about its owner.

Source: http://en.wikipedia.org/wiki/Cosmobot

Telerehabilitation

The child-friendly remote-controlled CosmoBot from AnthroTronix automatically collects data for therapist evaluation as part of a play therapy program that promotes the rehabilitation and development of disabled children.

AUTOMATING TASKS: Doing Boring, Repetitive Teaching Tasks

Researchers are building machines that can engage people and teach them simple skills, including household tasks. Equipped with intelligent software—like motion tracking, speech recognition, and machine vision—these machines are proving to be more effective than humans at some kinds of teaching, such as engaging autistic children. The frontier of this research includes creating machine teachers that learn as they teach, becoming the sort of infinitely patient, highly informed instructors that would be effective in areas like foreign language teaching or in repetitive therapies used to treat developmental problems.

Language teacher

At San Diego's Machine Perception Lab, RUBI helps children to learn a language.

Source: http://www.nytimes.com/2010/07/11/science/11robots.html

Roboticteaching assistants

Robotic teaching assistants are due to go into South Korean preschool classrooms by 2012.

Source: http://www.engadget.com/2010/02/22/robot-teachers-to-invade-korean-classrooms-by-2012/

FORECAST

Robots will increasingly enter educational settings, taking on repetitive activities that require consistent engagement and accuracy, such as repeatedly pronouncing words correctly or spotting arithmetic mistakes. Today these experiences are delivered through impersonal devices (laptops, iPads, phones), but in the next decade machines will take on humanlike features to elicit the emotional responses critical to learning. These robots will learn as they are used, making them increasingly effective and highly personalized learning assistants and cognitive extensions.

(1) New Human-Machine Division of Labor

Classical economics argues that jobs should flow to the part of the globe where they can be performed most cheaply. Robots that learn will upend this model, pushing us to identify what humans are uniquely good at, and which tasks are better done by our machine companions.

(2) Embodied, Emotionally Intelligent Learning Agents

In the next ten years we will see a new generation of robots with different forms. They will combine the intelligence of online agents with physical characteristics that fit into particular learning settings to create optimal learning conditions.

(3) Self-improving Learning Assistants

Our learning assistants will not only deliver information and assistance but also learn about us along the way. They will incorporate new information they acquire and undergo a process of self-improvement, becoming ever more useful and necessary.
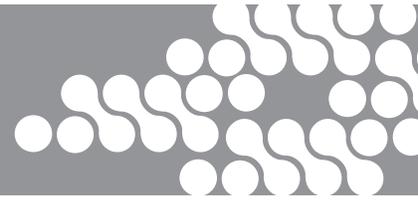
(4) New "How to Use" Guide to Humans

By observing and studying our own interactions with machines, we will learn more about ourselves, our learning processes, and our emotional responses. This new understanding of ourselves will help us build more effective learning assistants

As we develop more symbiotic and intimate relationships with robots, we will need to embark on a large-scale reinvention of our educational institutions and learning processes. The new learning environments will build on the relative strengths of humans and machines to enhance overall learning outcomes. Increasingly, we will come to see machines as teachers or teaching assistants. A generation of children that grows up learning from robots is likely to develop new kinds of emotional attachments and relationships with these devices.

RESOURCES

- The Institute for Personal Robots in Education, a Microsoft-sponsored joint effort between Georgia Tech and Bryn Mawr College, applies and evaluates robots as a context for computer science education. **http://www.roboteducation.org/**

- The Man Who Lied to His Laptop: What Machines Teach Us About Human Relationships by Clifford Nass (Penguin, 2010) examines evidence about the way we interact with our machines to draw insights into strategies for building successful relationships. **http://www.cliffordnass.com/book/index.php**

- The Center for Robotics and Embedded Systems at USC's Viterbi School of Engineering focuses on the science and technology of effective, robust, and scalable robotic systems, some of which have applications in education. **http://cres.usc.edu/Home/**

- The Center for Robotics and Intelligent Machines (RIM@Georgia Tech) brings together robotic expertise at Georgia Tech in a multidisciplinary way, with an emphasis on personal and everyday robotics, as well as the future of automation and the role of robotics in education. **http://robotics.gatech.edu/**

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