Andrea Lockerd Thomaz

CONTACT INFORMATION

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RESEARCH INTERESTS

My work focuses on machines that learn new tasks and goals from ordinary people in everyday human environments. This research works from the assumption that machines meant to learn from people can better take advantage of the ways in which people naturally approach teaching. I want to understand and computationally model specific mechanisms of human social learning in order to build machines that participate in social learning interactions. This work has interconnected goals from Artificial Intelligence and Human-Computer/Robot Interaction: improving the performance of a machine's learning behavior through attention to human interaction and improving the experience of the human teacher by designing interactive learning algorithms based on how people teach. This work tackles many great research questions spanning Machine Learning, Robotics, Human-Computer/Robot Interaction, and Cognitive Science.

EDUCATION

Massachusetts Institute of Technology, Cambridge, MA, USA

Ph.D., Media Arts & Sciences, June 2006

Dissertation Topic: "Socially Guided Machine Learning"

M.S., Media Arts & Sciences, September 2002

Thesis: "Understanding Implicit Social Context in Electronic Communication"

The University of Texas at Austin, Austin, TX, USA

B.S., Electrical and Computer Engineering, May, 1999

HONORS AND AWARDS

HRI 2006, Best Student Poster
Warner Bros. Research Fellowship, 2005
Horowitz Research Fellowship, 2004
Eircom Research Fellowship, 2001

RESEARCH EXPERIENCE

MIT Media Lab, Cambridge, MA, USA

Postdoctoral Associate **June 2006 - present**

The goals of my one-year post-doc with Prof. Cynthia Breazeal have been to publish and present my thesis research at four conferences; to prepare two journal publications of my thesis research; to conduct follow-up research with both the Sophie and Leonardo platforms; and to gain classroom and teaching experience. Additionally, this post-doc involves presenting work to sponsors, assisting in grant proposal preparations, and consulting with lab sponsors including senior management of Fortune 500 companies.

Dissertation Research: Socially Guided Machine Learning **Sept 2003 - June 2006**

Abstract: While the topic of human input to machine learning algorithms has been explored to some extent, prior works have not gone far enough to understand what people will try to communicate when teaching a machine and how algorithms and learning systems can be modified to better accommodate a human partner. Interface techniques have been based on intuition and assumptions rather than grounded in human behavior, and often techniques are not evaluated with everyday people.

Using a computer game, an experiment with human subjects provides several insights about how people approach the task of teaching a machine. In particular, people want to direct and guide an agent's learning process, they quickly use the behavior of the agent to infer a mental model of the learning process, and they utilize positive and negative feedback in asymmetric ways.

Using a robotic platform, Leonardo, and 200 people in follow-up studies of modified versions of the computer game, four *Socially Guided Machine Learning* research themes are developed. 1) The use of human guidance in a machine learning exploration can be successfully incorporated to improve learning performance. 2) Novel learning approaches demonstrate aspects of goal-oriented learning. 3) The transparency of the machine learner can have significant effects on the nature of the instruction received from the human teacher, which in turn positively impacts the learning process. 4) Using asymmetric interpretations of positive and negative feedback from a human partner can result in a more efficient and robust learning experience.

Thesis Committee:

- Advisor: Cynthia Breazeal, Associate Professor of Media Arts & Sciences, MIT
- Andrew Barto, Professor of Computer Science, Univ. of Massachusetts, Amherst
- Rosalind Picard, Professor of Media Arts & Sciences, MIT

Research Assistant to Professor Cynthia Breazeal **Sept. 2003 - June 2006**
In the Robotic Life Group, we develop robotic systems that can naturally work and learn with human partners. Additionally, this RA has involved presenting work, assisting in grant proposal preparations, and consulting with lab sponsors.

Research Assistant to Professor Ted Selker **Sept. 2000 - June 2003**
Assisted in the ongoing development of the Context Aware Computing Group laboratory, incorporating Artificial Intelligence and interactive computer systems.

Microsoft Corporation, Redmond, WA, USA
Internship at Microsoft Research **June 2003 - Sept. 2003**
Interned with the Communities Technologies Group (now Social Computing), led by Marc Smith. Expanded the group's Usenet technologies for mining social statistics to the realm of email. Developed data mining tools, incorporated statistics into the Outlook email client, and ran a usability study to evaluate the accuracy of the mined statistics.

IBM, Austin, TX, USA
Scientist/Engineer RS/6000 Division **June 1999 - July 2000**
Worked with a group of 12 engineers charged with simulating (in C++) the memory subsystems of a RISC symmetric multiprocessor, for the purpose of circuit design verification. I wrote a cache preloader to save millions of cycles needed to achieve specific cache states in processor simulation. I interned with this same group for several semesters during my undergraduate studies.

Teaching Experience

MIT Media Lab, Cambridge, MA, USA

Coordinator of the Robots Reading Group **Fall 2006**
Organized a research reading group around the topic of Human-Robot Interaction. Choose weekly paper topics and lead group discussion.

MAS 622J - Guest Lectures **Fall 2006**
Taught two introductory lectures, one on Reinforcement Learning and another on Neural Networks, to a class of 30-40 MIT graduate students. Prepared an online activity as homework, interactively training an RL agent, to give the students hands-on experience with some of the algorithms presented in class.

Teaching Assistant, Pattern Recognition **Fall 2006**
One of two teaching assistants for the Pattern Recognition and Machine Learning course taught by Prof. Roz Picard, approximately 30 graduate students. In this course the TA responsibilities included: preparing 6-10 problem sets and their solutions; grading problem sets; teaching a one-hour recitation every other week; and holding open office hours 1-2 times a week.

Teaching Assistant, Context-Aware Computing Reading Group **Fall 2002**
Prepared a reading list and led group discussions for a class of graduate and undergraduate students.

Undergraduate Research Opportunities (UROP) mentor **Sept. 2000 - present**
I have supervised undergraduate research projects for six MIT undergraduates for one or more semesters. Supervision has included teaching programming skills (Java, C), guiding architecture design, formulating research plans, and supervising the execution of experiments with human subjects.

Publications

(Note: name appears as either A. Lockerd or A. L. Thomaz)

Journal Articles

A. L. Thomaz and C. Breazeal, "Teachable Robots: Understanding Human Teaching Behavior to Build More Effective Robot Learners," *Artificial Intelligence (AIJ)*, to appear in 2007.

C. Breazeal, M. Berlin, A. Brooks, J. Gray, and A. L. Thomaz, "Using perspective taking to learn from ambiguous demonstrations," *Journal of Robotics and Autonomous Systems (RAS) Special Issue on Robot Programming by Demonstration*, vol. 54, no. 5, pp. 385–393, 2006.

C. Breazeal, A. Brooks, J. Gray, G. Hoffman, J. Lieberman, H. Lee, A. Lockerd, and D. Mulanda, "Tutelage and collaboration for humanoid robots," *International Journal of Humanoid Robotics (IJHR)*, vol. 1, no. 2, 2004.

A. Brooks, J. Gray, G. Hoffman, A. Lockerd, H. Lee, and C. Breazeal, "Robot's play: interactive games with sociable machines," *Computers in Entertainment.*, vol. 2, pp. 1–18, July 2004.

Conference Papers

A. L. Thomaz, G. Hoffman, and C. Breazeal, "Reinforcement learning with human teachers: Understanding how people want to teach robots," in *Proceedings of the 15th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN06)*, 2006.

A. L. Thomaz and C. Breazeal, "Reinforcement learning with human teachers: Evidence of feedback and guidance with implications for learning performance," in *Proceedings of the 21st National Conference on Artificial Intelligence (AAAI)*, 2006.

M. Berlin, J. Gray, A. L. Thomaz, and C. Breazeal, "Perspective taking: An organizing principle for learning in human-robot interaction," in *Proceedings of the 21st National Conference on Artificial Intelligence (AAAI)*, 2006.

A. L. Thomaz and C. Breazeal, "Transparency and socially guided machine learning," in *Proceedings of the 5th International Conference on Developmental Learning (ICDL)*, 2006.

A. L. Thomaz, G. Hoffman, and C. Breazeal, "Experiments in socially guided machine learning: Understanding how humans teach," in *Proceedings of the 1st Annual Conference on Human-Robot Interaction (HRI)*, 2006.

C. Breazeal, C. Kidd, A. L. Thomaz, G. Hoffman, and M. Berlin, "Effects of nonverbal communication on efficiency and robustness in human-robot teamwork," in *Proceedings of the IROS*, 2005.

A. L. Thomaz, M. Berlin, and C. Breazeal, "An embodied computational model of social referencing," in *IEEE International Workshop on Human Robot Interaction (RO-MAN)*, 2005.

A. Lockerd and C. Breazeal, "Tutelage and socially guided robot learning," in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2004.

C. Breazeal, G. Hoffman, and A. Lockerd, "Teaching and working with robots as a collaboration," in *Proceedings of Third International Joint Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, (New York, NY), pp. 1030–1037, 2004.

C. Breazeal, A. Brooks, D. Chilongo, J. Gray, G. Hoffman, C. Kidd, H. Lee, J. Lieberman, and A. Lockerd, "Working collaboratively with humanoid robots," in *Proceedings of IEEE-RAS/RSJ International Conference on Humanoid Robots (Humanoids)*, (Santa Monica, CA), 2004.

W. Bluethmann, R. Ambrose, M. Diftler, E. Huber, A. Fagg, M. Rosenstein, R. Platt, R. Grupen, C. Breazeal, A. Brooks, A. Lockerd, A. Peters, O. C. Jenkins, M. Mataric, and M. Bugajska, "Building an autonomous humanoid tool user," in *Proceedings of IEEE-RAS/RSJ International Conference on Humanoid Robots (Humanoids)*, (Santa Monica, CA), 2004.

A. Brooks, J. Gray, G. Hoffman, A. Lockerd, H. Lee, and C. Breazeal, "Robot's play: interactive games with sociable machines," in *Proceedings of the International Conference on Advances in Computer Entertainment (ACE)*, June 2004.

A. Lockerd and T. Selker, "Driftcatcher: The implicit social context of email," in *Proceedings of Ninth IFIP TC 13 International Conference on Human-Computer Interaction (INTERACT)*, 2003.

A. Lockerd, H. Pham, T. Sharon, and T. Selker, "Mr.web: An automated interactive webmaster," in *Proceedings of ACM SIGCHI Conference on Computer Human Interaction (CHI)*, 2003.

A. Lockerd and F. Mueller, "Lafcam: Leveraging affective feedback camcorder," in *Proceedings of ACM SIGCHI Conference on Computer Human Interaction (CHI)*, 2002.

T. Selker, A. Lockerd, J. Martinez, and W. Burleson, "Eye-are, a glasses-mounted eye motion detection interface," in *Proceedings of ACM SIGCHI Conference on Computer Human Interaction (CHI)*, 2001.

F. Mueller and A. Lockerd, "Cheese: Tracking mouse movement activity on websites, a tool for user modeling," in *Proceedings of ACM SIGCHI Conference on Computer Human Interaction (CHI)*, 2001.

Workshop Papers

A. L. Thomaz and C. Breazeal, "Socially guided machine learning: Designing an algorithm to learn from real-time human interaction," in *NIPS 2005 workshop on Robot Learning in Unstructured Environments*, 2005.

A. L. Thomaz, G. Hoffman, and C. Breazeal, "Real-time interactive reinforcement learning for robots," in *AAAI 2005 Workshop on Human Comprehensible Machine Learning*, 2005.

A. Lockerd and E. Arroyo, "Personal data for personal use: Case studies in user modeling for context-aware computing," in *AAAI Fall Symposium on Etiquette for Human Computer Interaction Working Notes*, 2002.

Conference Presentations

RO-MAN, 2006: "Reinforcement Learning with Human Teachers".

IVA, 2006: "Teachable Characters".

AAAI, 2006: "Reinforcement Learning with Human Teachers".

ICDL, 2006: "Transparency and Socially Guided Machine Learning".

NIPS Workshop, 2005: "Socially Guided Machine Learning: Designing an Algorithm to Learn from Real-Time Human Interaction".

Android Science Workshop, 2005: "Robot Science Meets Social Science: An Embodied Computational Model of Social Referencing".

AAAI Workshop, 2005: "Real-Time Interactive Reinforcement Learning for Robots".

AAAI Workshop, 2004: "Robot Learning Through Collaborative Dialog".

AAMAS, 2004: "Teaching and Working with Robots as Collaboration".

Interact, 2003: "DriftCatcher: The Implicit Social Context of Email".

AAAI Fall Symposium, 2002: "Personal Data for Personal Use".

Sunbelt International Conference on Social Networks, 2002: "DriftCatcher: Enhancing Social Networks Trough Email".

CHI 2001: "Cheese: Tracking Mouse Movements Websites a Tool for User Modeling".

Invited Talks

Robotics Institute Seminar, Carnegie Mellon University, Pittsburgh, PA, Feb. 2007.

Artificial Intelligence Research Group, Harvard University, Cambridge, MA, Feb. 2006.

Computer Science Seminar, Brown University, Providence, R.I., Feb. 2006.

Media Lab Digital Life Sponsor Event, Cambridge, MA, Nov. 2005.

Media Lab Things That Think Sponsor Event, Cambridge, MA, Nov. 2005.

MIT TechLink Mentor Connection Forum, Cambridge, MA, April 2004.

Media Lab Information:Organized Sponsor Event, Cambridge, MA, Oct. 2003.

Media Lab Digital Life Sponsor Event, Cambridge, MA, Oct. 2001.

Media Lab Europe Internal Research Symposium, Dublin, Ireland, Aug. 2001.

Media Lab Europe Context-Aware Computing Workshop, Dublin, Ireland, June 2001.

Professional Activities

Organizing Committee member, HRI 2007 Young Researchers Workshop (at HRI 2007)

Reviewer: T-RO, special issue on "Human-Robot Interaction"

Reviewer: Interaction Studies, issue on "Human-Robot Interactive Communication"

Reviewer: Conference on Human-Computer Interaction (CHI 2007)

Reviewer: Conference on Human-Robot Interaction (HRI 2007)

Reviewer: ACM Conference on Computer Supported Cooperative Work (CSCW 2006)

Reviewer: International Joint Conference on Nerual Networks (IJCNN 2006)

Reviewer: Annual Conference of the Cognitive Science Society (CogSci 2005)

Reviewer: International Conference on Developmental Learning (ICDL 2005)

University Service

MIT Media Lab, Cambridge, MA, USA

MediaWomen founding member, 2003-2006

- Obtained MIT funding for two consecutive years.
- Organized discussions, dinners, and mentoring for Media Lab women students, faculty and staff.

Student Committee Volunteer, 2004-2005
Assisted in building community and fostering communication between students and faculty of the MIT Media Lab, through special event planning, student surveys, and faculty meetings.

Student Representative to the Faculty Search Committee, 2002-2003.

References

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