

# Tom Williams

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*Assistant Professor, Colorado School of Mines*  
*Director, MIRRORLab*

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## Research Interests

**Mission:** Developing genuinely helpful language-enabled intelligent agents

**Interests:** Artificial intelligence (AI); human-robot interaction (HRI); Cognitive science and systems; natural language understanding and pragmatics; intelligent agents; assistive technologies; augmented reality; multi-modal interaction; robot ethics; dempster-shafer theory; uncanny valley

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## Education

2013 – 2017 **Ph.D., Computer Science: Cognitive Science, Tufts University.**

Dissertation: Situated Natural Language Interaction in Uncertain and Open Worlds

Committee: Matthias Scheutz (Chair), Jan P. de Ruiter, Anselm Blumer, Candace Sidner

2011 – 2013 **M.S., Computer Science, Tufts University.**

2007 – 2011 **B.A., Computer Science, Hamilton College.**

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## Employment

Aug. 2017 → **Assistant Professor, Colorado School of Mines.**

Spring 2017 **Teaching Fellow, Tufts University.**

Sum. 2016 **Visiting Researcher, University of Bremen.**

Sum. 2009 **Cyberforensics Consultant, Assured Information Security.**

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## Honors and Awards

### Honors and Awards to Me

**New and Future AI Educator Award, Invited second year participant, EAAI, 2018.**

**New and Future AI Educator Award, EAAI, 2017.**

**Teaching Fellowship, Tufts Graduate Institute for Teaching, 2015.**

**Doctoral Consortia, YRRSDS 2014, HRI 2015, AAAI 2016.**

### Honors and Awards to Students

**Nhan Tran, Accepted Participant, AAAI Student Outreach Workshop, AAAI/EAAI, 2018.**

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## Publications

### Journal Articles

- [J1] Tom Williams and Matthias Scheutz. “Dempster-Shafer Theoretic Resolution of Referential Ambiguity”. In: *Autonomous Robots* (2018 (Submitted)).
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- [J2] Gordon Briggs, Tom Williams, and Matthias Scheutz. “Enabling Robots to Understand Indirect Speech Acts in Task-Based Interactions”. In: *Journal of Human-Robot Interaction (JHRI)* (2017).
- [J3] Tom Williams. “A Consultant Framework for Natural Language Processing in Integrated Robot Architectures”. In: *IEEE Intelligent Informatics Bulletin (IIB)* (2017), pp. 10–14.
- [J4] Tom Williams and Matthias Scheutz. “The State-of-the-Art in Autonomous Wheelchairs Controlled through Natural Language: A Survey”. In: *Robotics and Autonomous Systems (RAS)* (2017).
- [J5] Tom Williams, Priscilla Briggs, and Matthias Scheutz. “Covert Robot-Robot Communication: Human Perceptions and Implications for Human-Robot Interaction”. In: *Journal of Human-Robot Interaction (JHRI)* (2015).

### Book Chapters

- [B1] Tom Williams and Matthias Scheutz. “Reference Resolution in Robotics: A Givenness Hierarchy Theoretic Approach”. In: *The Oxford Handbook of Reference*. Ed. by Jeanette Gundel and Barbara Abbott. Oxford University Press, 2018 (Forthcoming).

### Refereed Conference Papers

- [C1] Tom Williams, Daria Thames, Julia Novakoff, and Matthias Scheutz. ““Thank You for Sharing that Interesting Fact!”: Effects of Capability and Context on Indirect Speech Act Use in Task-Based Human-Robot Dialogue”. In: *Proceedings of the 13th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*. 23% acceptance rate; Best Paper Nominee, 2018.
  - [C2] Maxwell Bennett, Tom Williams, Daria Thames, and Matthias Scheutz. “Differences in Interaction Patterns and Perception for Teleoperated and Autonomous Humanoid Robots”. In: *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2017.
  - [C3] Tom Williams, Collin Johnson, Matthias Scheutz, and Benjamin Kuipers. “A Tale of Two Architectures: A Dual-Citizenship Integration of Natural Language and the Cognitive Map”. In: *Proceedings of the 16th International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS)*. 26% acceptance rate, 2017.
  - [C4] Tom Williams and Matthias Scheutz. “Referring Expression Generation Under Uncertainty: Algorithm and Evaluation Framework”. In: *Proceedings of the 10th International Conference on Natural Language Generation (INLG)*. 2017.
  - [C5] Tom Williams and Matthias Scheutz. “Resolution of Referential Ambiguity in Human-Robot Dialogue Using Dempster-Shafer Theoretic Pragmatics”. In: *Proceedings of Robotics: Science and Systems (RSS)*. 2017.
  - [C6] Tom Williams, Saurav Acharya, Stephanie Schreitter, and Matthias Scheutz. “Situated Open World Reference Resolution for Human-Robot Dialogue”. In: *Proceedings of the 11th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*. 25% acceptance rate, 2016.
  - [C7] Tom Williams and Matthias Scheutz. “A Framework for Resolving Open-World Referential Expressions in Distributed Heterogeneous Knowledge Bases”. In: *Proceedings of the 30th AAAI Conference on Artificial Intelligence (AAAI)*. 26% acceptance rate, 2016.
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- [C8] Tom Williams, Gordon Briggs, Bradley Oosterveld, and Matthias Scheutz. “Going Beyond Command-Based Instructions: Extending Robotic Natural Language Interaction Capabilities”. In: *Proceedings of the Twenty-Ninth AAAI Conference on Artificial Intelligence (AAAI)*. 27% acceptance rate, 2015.
- [C9] Tom Williams and Matthias Scheutz. “A Domain-Independent Model of Open-World Reference Resolution”. In: *Proceedings of the 37th annual meeting of the Cognitive Science Society (COGSCI)*. 2015.
- [C10] Tom Williams and Matthias Scheutz. “POWER: A Domain-Independent Algorithm for Probabilistic, Open-World Entity Resolution”. In: *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2015.
- [C11] Evan Krause, Michael Zillich, Tom Williams, and Matthias Scheutz. “Learning to Recognize Novel Objects in One Shot through Human-Robot Interactions in Natural Language Dialogues”. In: *Proceedings of the Twenty-Eighth AAAI Conference on Artificial Intelligence (AAAI)*. 28% acceptance rate, 2014.
- [C12] Tom Williams, Priscilla Briggs, Nathaniel Pelz, and Matthias Scheutz. “Is Robot Telepathy Acceptable? Investigating Effects of Nonverbal Robot-Robot Communication on Human-Robot Interaction”. In: *Proceedings of the 23rd IEEE Symposium on Robot and Human Interactive Communication (RO-MAN)*. 2014.
- [C13] Tom Williams, Rafael C Núñez, Gordon Briggs, Matthias Scheutz, Kamal Premaratne, and Manohar N Murthi. “A Dempster-Shafer Theoretic Approach to Understanding Indirect Speech Acts”. In: *Advances in Artificial Intelligence— Proceedings of the 14th Ibero-American Conference on AI (IBERAMIA)*. 26% acceptance rate for Natural-Language Processing track, 2014.
- [C14] Tom Williams, Rehj Cantrell, Gordon Briggs, Paul Schermerhorn, and Matthias Scheutz. “Grounding Natural Language References to Unvisited and Hypothetical Locations”. In: *Proceedings of the Twenty-Seventh AAAI Conference on Artificial Intelligence (AAAI)*. 29% acceptance rate, 2013.
- [C15] Leanne Hirshfield, Rebecca Gulotta, Stuart Hirshfield, Sam Hincks, Matthew Russell, Rachel Ward, Tom Williams, and Robert Jacob. “This is your brain on interfaces: enhancing usability testing with functional near-infrared spectroscopy”. In: *Proceedings of the annual conference on Human factors in computing systems (CHI)*. 23% acceptance rate, 2011.
- [C16] Leanne Hirshfield, Stuart Hirshfield, Sam Hincks, Matthew Russell, Rachel Ward, and Tom Williams. “Trust in Human-Computer Interactions as Measured by Frustration, Surprise, and Workload”. In: *Foundations of Augmented Cognition. Directing the Future of Adaptive Systems (FAC)*. 2011.

### *Refereed Workshop and Symposium Papers*

- [W1] Maxwell Bennett, Tom Williams, Daria Thames, and Matthias Scheutz. “Investigating Interactions with Teleoperated and Autonomous Humanoids Using a Suit-Based VR Teleoperation Interface”. In: *Proceedings of the 1st International Workshop on Virtual, Augmented, and Mixed Reality for HRI (VAM-HRI)*. 2018.
- [W2] Nahn Tran, Josh Rands, and Tom Williams. “A Hands-Free Virtual-Reality Teleoperation Interface for Wizard-of-Oz Control”. In: *Proceedings of the 1st International Workshop on Virtual, Augmented, and Mixed Reality for HRI (VAM-HRI)*. 2018.
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- [W3] Tom Williams. “A Framework for Robot-Generated Mixed-Reality Deixis”. In: *Proceedings of the 1st International Workshop on Virtual, Augmented, and Mixed Reality for HRI (VAM-HRI)*. 2018.
- [W4] Tom Williams. “"Who Should I Run Over?": Long-Term Ethical Implications of Natural Language Generation”. In: *Proceedings of the 2018 HRI Workshop on Longitudinal Human-Robot Teaming*. 2018.
- [W5] Lars Kunze, Tom Williams, Nick Hawes, and Matthias Scheutz. “Spatial Referring Expression Generation for HRI: Algorithms and Evaluation Framework”. In: *Proceedings of the AAAI Fall Symposium on AI for HRI (AI-HRI)*. 2017.
- [W6] Tom Williams and Matthias Scheutz. “Referring Expression Generation Under Uncertainty in Integrated Robot Architectures”. In: *Proceedings of the Robotics: Science and Systems Workshop on Human-Centered Robotics: Interaction, Physiological Integration and Autonomy*. 2017.
- [W7] Tom Williams and Matthias Scheutz. “Resolution of Referential Ambiguity Using Dempster-Shafer Theoretic Pragmatics”. In: *Proceedings of the AAAI Fall Symposium on AI for HRI (AI-HRI)*. 2016.
- [W8] Tom Williams, Stephanie Schreitter, Saurav Acharya, and Matthias Scheutz. “Towards Situated Open-World Reference Resolution”. In: *Proceedings of the AAAI Fall Symposium on AI for HRI (AI-HRI)*. 2015.
- [W9] Matthias Scheutz, Gordon Briggs, Rehj Cantrell, Evan Krause, Tom Williams, and Richard Veale. “Novel Mechanisms for Natural Human-Robot Interactions in the DIARC Architecture”. In: *Proceedings of the 2013 AAAI Workshop on Intelligent Robotic Systems*. 2013.

### *Doctoral Consortia*

- [DC1] Tom Williams. “Architectural Mechanisms for Situated Natural Language Understanding in Uncertain and Open Worlds”. In: *Proceedings of the 2016 AAAI Doctoral Consortium*. 38% acceptance rate, 2016.
- [DC2] Tom Williams. “Towards More Natural Human-Robot Dialogue”. In: *Proceedings of the 6th Pioneers Workshop at HRI 2015*. 2015.
- [DC3] Tom Williams. “Position Paper”. In: *Proceedings of the 10th Young Researchers’ Roundtable on Spoken Dialog Systems*. 2014.

### *Theses*

- [T1] Tom Williams. “Situated Natural Language Interaction in Uncertain and Open Worlds”. PhD thesis. Tufts University, 2017.

### *Other Publications*

- [O1] Tom Williams. “Toward Ethical Natural Language Generation for Human-Robot Interaction”. In: *Companion Proceedings of the 13th ACM/IEEE International Conference on Human-Robot Interaction (HRI): Late Breaking Reports*. 2018 (Submitted).
  - [O2] Patricia Alves-Oliveira, Richard G Freedman, Dan Grollman, Laura Herlant, Laura Humphrey, Fei Liu, Ross Mead, Frank Stein, Tom Williams, and Shomir Wilson. “Reports on the 2016 AAAI Fall Symposium Series”. In: *AI Magazine* 38.2 (2017), pp. 86–90.
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- [O3] Eric Eaton, Sven Koenig, Claudia Schulz, Francesco Maurelli, John Lee, Joshua Eckroth, Mark Crowley, Richard Freedman, Rogelio Cardona-Rivera, Tiago Machado, and Tom Williams. “Blue Sky Ideas in Artificial Intelligence Education from the EAAI’17 New and Future AI Educator Program”. In: *Educational Advances in Artificial Intelligence*. 2017.
- [O4] Tom Williams. “Dissertation Briefing: Situated Natural Language Interaction in Uncertain and Open Worlds”. In: *AI Matters*. 2017.
- [O5] Tom Williams, Stephanie Schreitter, Saurav Acharya, and Matthias Scheutz. “Towards Situated Open World Reference Resolution”. In: *Late Breaking Papers at IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*. 2015.
- [O6] Stuart Hirshfield, Colden Prime, and Tom Williams. *A Next-Generation Model for Live Cyber Forensics*. Tech. rep. Rome, NY: AFRL Rome Laboratory, Aug. 2008.
- [O7] Stuart Hirshfield, Colden Prime, and Tom Williams. *A New Model for Live Cyber-Forensics*. Tech. rep. Rome, NY: AFRL Rome Laboratory, Aug. 2007.

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## Research Grants and Gifts

### Institutional Grants

- 2018 **Tech Fee CS-01: Educational Robots for CS-ME Teaching Lab**, Colorado School of Mines, Investigators: Neil Dantam (PI), Kevin Moore, Andrew Petruska, Tom Williams, Hao Zhang, Xiaoli Zhang, Amount: \$56,200.

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## Selected Press Coverage

### Denver Post, 2018.

Opinion sought for “Boulder’s Misty Robotics unveils its first personal robot, but not just anyone can buy it”

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## Talks

### Invited Talks

#### Colloquium Speaker, February 2018.

Mississippi State University, Mississippi State, MS

“Natural Language Pragmatics and Human-Robot Interaction: Empirical, Algorithmic, and Ethical Dimensions”

#### JHRI Session Invited Speaker, March 2017.

ACM/IEEE International Conference on Human-Robot Interaction, Vienna, Austria

“Covert Robot-Robot Communication: Human Perceptions and Implications for Human-Robot Interaction”

#### Colloquium Speaker, April 2017.

MIT Lincoln Laboratory, Lexington, MA

“A Tale of Two Architectures: A Dual-Citizenship Integration of Natural Language and the Cognitive Map”

#### Colloquium Speaker, April 2017.

University of Massachusetts Amherst, Amherst, MA

“Genuine Helpers: Enabling Natural Language Capabilities for Interactive Robots”

#### Colloquium Speaker, July 2016.

MITRE Corporation, Bedford, MA

“Against Robot Telepathy: the Why and How of Verbal Robot-Robot Communication”

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## Other Seminars

### **Lab Seminar Speaker, June 2016.**

Institute for Artificial Intelligence, Universität Bremen, Bremen, Germany  
“Natural Language Understanding for Human-Robot Interaction”

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## Professional Service

### Program Committee Work

#### **Program Committee Co-Chair.**

AAAI Fall Symposium on AI for HRI (AI-HRI) 2016

HRI Pioneers Workshop 2016

#### **Senior Program Committee Member.**

AAAI Conference on Artificial Intelligence (AAAI) 2018

#### **Program Committee Member.**

ICAPS Robotics Track 2018

HRI Pioneers Workshop 2018,2017

ACL/EMNLP Workshop on NLP and Robotics (ROBO-NLP) 2017

### Referee Service

#### **Referee for Journal Articles.**

Journal of Memory and Language, 2018

International Journal of Robotics Research, 2018, 2016, 2015

Sensors, 2017

Cognitive Systems Research, 2016

Autonomous Robots, 2015

#### **External Referee for Conference Proceedings.**

ACM/IEEE International Conference on Human-Robot Interaction (HRI), 2018,2017,2016

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),  
2017,2016,2015

IEEE International Symposium on Robot and Human Interactive Communication (RO-  
MAN), 2016

IEEE International Conference on Development and Learning and on Epigenetic Robotics  
(ICDL-EPIROB), 2016

#### **External Referee for Workshop and Symposia Proceedings.**

AAAI Fall Symposium on Artificial Intelligence for Human-Robot Interaction (AI-HRI)  
2017, 2015

International Workshop on Virtual, Augmented, and Mixed-Reality for Human-Robot  
Interaction (VAM-HRI) 2018

#### **Referee for Workshop Proposals.**

Robotics: Science and Systems (RSS), 2016

### Workshop and Symposium Organization

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**Workshop**, *Virtual, Augmented, and Mixed Reality for Human-Robot Interaction (VAM-HRI)*.

Co-organizers: Dan Szafir (CU Boulder), Tathagata Chakraborti (ASU), Heni Ben-Amor (ASU). *International Conference on Human-Robot Interaction, held in Chicago, IL, in March 2018*

**Symposium**, *Artificial Intelligence for Human-Robot Interaction (AI-HRI)*.

Co-organizers: Elin A. Topp (Lund U), Laura M. Hiatt (NRL), Luca Iocchi (Sapienza), Kalesha Bullard (Georgia Tech), Emmanuel Senft (Plymouth U), Tian Zhou (Purdue), Marc Hanheide (U Lincoln), Frank Broz (Heriot-Watt), Dan Grollman (Sphero), Katrin Lohan (Heriot-Watt), Ross Mead (Semio). *AAAI Fall Symposium, held in Arlington, VA, in November 2017*

**Symposium**, *Artificial Intelligence for Human-Robot Interaction (AI-HRI)*.

Co-organizers: Ross Mead (Semio), Dan Grollman (Sphero), Tiago Ribeiro (U Lisbon), Patricia Alves-Oliveira (U Lisbon), Richard Freedman (UMass Amherst), Nick DePalma (MIT), Gordon Briggs (NRL), Frank Broz (Heriot-Watt), Katrin Lohan (Heriot-Watt), Bradley Hayes (MIT). *AAAI Fall Symposium, held in Arlington, VA, in November 2016*

**Workshop**, *HRI Pioneers*.

Co-organizers: Jill Greczek (USC), Tiago Ribeiro (U Lisbon), Hee-Tae Jung (UMass Amherst), Sam Spaulding (MIT), Chris Crawford (U Florida), Maria Vanessa aus der Wieschen (U Southern Denmark), Hee Rin Lee (Indiana U), Jung Ju Choi (Ewha Womens U), Igor Zubrycki (Politechnika Lodzka). *International Conference on Human-Robot Interaction, held in Christchurch, New Zealand, in March 2016*

## Conference Organization

### Session Chair.

Symposium on Educational Advances in Artificial Intelligence (EAAI), 2018 Special Track Organizer and Chair: Best Practices for Running an AI Research Group

### Other Service

**Invited Representative, School of Engineering**, *Panel on Student Research at President's Council*, Tufts University, 2017.

**Puzzle Contributor**, "My Favorite Marvin", AI Matters, 2017.

**Puzzle Contributor**, *Fun and Games Night*, AAAI Conference on Artificial Intelligence (AAAI), 2015.

## Professional Society Membership

**IEEE RAS, AAAI, ACM, ASEE.**

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## University Service

Board of Student Media, 2017-2018

Computer Science: Graduate Student Committee, 2017-2018

Faculty Advisor: Mines Robotics Club, 2017-2018

Faculty Liason: Board of Computer Science Graduate Students, 2017-2018

CS Department Teaching Faculty Search Committee, 2017

CS@Mines Puzzle Challenge 2017

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## Advising

Doctoral Advisees

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Ryan Blake Jackson, 2018–Present

### Masters Advisees

Stacia Near, 2017–Present

Akshay Swaminathan, 2017–Present

### Non-advisee MIRRORLab Members

Aun Siddiqui (Masters, MechE), 2017–Present

Prasanth Sengadu Suresh (Masters, MechE), 2017–Present

Ryan Fite (Undergraduate, CS), 2018–Present

Marcelo Gonzales (Undergraduate, CS), 2017–Present

Joshua Rands (Undergraduate, CS), 2017–Present

Nhan Tran (Undergraduate, CS), 2017–Present

Lixiao Zhu (Undergraduate, PE), 2017–Present

### Thesis Committee Member

**Jiayi Liu**, *PhD Thesis; Advisors: William Hoff and Hao Zhang*, Department of Computer Science, Colorado School of Mines, 2018 (Anticipated).

Title: TBD

**Kai Liu**, *PhD Thesis; Advisor: Hua Wang*, Department of Computer Science, Colorado School of Mines, 2018 (Anticipated).

Title: TBD

**Saad Elbeleidy**, *Masters Thesis; Advisor: Hua Wang*, Department of Computer Science, Colorado School of Mines, 2018 (Anticipated).

Title: TBD

### Qualification Exam Committee

**Wei Han**, *Advisor: Bo Wu*, Department of Computer Science, Colorado School of Mines, 2017 (Anticipated).

**Warren Watkinson**, *Advisor: Bo Wu*, Department of Computer Science, Colorado School of Mines, 2017 (Anticipated).

## Teaching

### Courses Taught

Term	School	Course #	Course Title	Responses	Evaluation
Spring 2018	Mines	CSCI 598B	Linguistic Human-Robot Interaction	18	N/A
Fall 2017	Mines	CSCI 507	Computer Vision	29	4.59/5.0
Spring 2017	Tufts	COMP 131	Artificial Intelligence	31	3.70/5.0
Fall 2015 <sup>1</sup>	Tufts	COMP 131	Artificial Intelligence	16	4.63/5.0

<sup>1</sup> Co-taught with Anselm Blumer

### Teaching Assistance



Term	School	Course #	Course Title	Course Lead
Fall 2014	Tufts	COMP 150-PR	Probabilistic Robotics	Anselm Blumer
Fall 2013	Tufts	COMP 50	Problem Solving by Computer	Norman Ramsey
Spring 2011	Hamilton	CS 105	Explorations in CS	Stuart Hirshfield
Fall 2010	Hamilton	CS 110	Introduction to CS	Alistair Campbell and Mark Bailey
Spring 2010	Hamilton	CS 110	Introduction to CS	Mark Bailey
Fall 2009	Hamilton	CS 110	Introduction to CS	Alistair Campbell

## Curriculum Development

### **Linguistic Human-Robot Interaction**, *Colorado School of Mines*.

The course explores the capabilities necessary for autonomous robots to participate in natural language dialogue with human partners, including language and gesture understanding, action selection and execution, language and gesture generation, and integrated robot architectures.

### **Artificial Intelligence**, *Tufts University*.

This course is an introductory survey of artificial intelligence (AI). The course covers the history, theory, and computational methods of artificial intelligence, to enable students to (1) identify the major classical and modern AI paradigms, and explain how they relate to each other; (2) analyze the structure of a given problem such that they can choose an appropriate paradigm in which to frame that problem; and (3) implement a wide variety of both classical and modern AI algorithms.

## Outreach

### Public Talks and Presentations

#### **Panelist**, *A Study in Chrome: The Ethics of Silverside*, PAX East, 2015.

Organized and participated in a panel introducing robot ethics to members of the public.

#### **Presenter**, Open House, AAAI Conference on Artificial Intelligence, 2015.

Presented a poster to members of the public.

### Targeted Programs

#### **Volunteer**, AAAI Connections, AAAI Conference on Artificial Intelligence, 2017.

Outreach program targeted at K-12 students from underserved communities and their parents.

#### **Faculty Mentor**, PATHS Program, Colorado School of Mines, 2017.

NSF-Funded scholarship program for academically talented, low-income students in Colorado to study Computer Science at the Colorado School of Mines.