

Education

University of California, Los Angeles (UCLA), Los Angeles, CA

Ph.D. in Computer Science, Artificial Intelligence Concentration; Advisor: Prof. Song-Chun Zhu Expected Jun 2021
Dissertation: "Learning how and why: Causal learning and explanation from physical and interactive environments."

M.S. in Computer Science; Advisor: Prof. Song-Chun Zhu Jun 2017
Thesis: "Learning Complex Functional Manipulations by Human Demonstration and Fluent Discovery."

University of Dayton, Dayton, OH

B.S. in Computer Engineering; Magna Cum Laude; Advisor: Prof. Tarek Taha May 2015
Thesis: "High-Performance Declarative Memory through MapReduce."

Skills

Programming Python, C/C++, Shell, LaTeX, Matlab, PyTorch, Javascript, HTML5, CSS, Node.JS, Java, CUDA

Topics Machine Learning, Graphical Models, Robotics, Cognitive Science, Explainable AI, Reinforcement Learning, Bayesian Networks, Statistical Modeling

Research Experience

Graduate Student Researcher, Computer Science Department, UCLA, Los Angeles, CA

Sep 2016 – Present

Humans build generalizable and explainable representations of their environment through interaction, observation, imitation, intervention, and language. The following research explores how artificial agents can use these five concepts to learn robust and transferable representations of tasks and environments. This work was done in a collaborative, team-based lab environment.

Imitation learning: Training a robot to twist open a medicine bottle

- Captured the complex human hand forces required to open seven different medicine bottles with a tactical glove covered in IMUs (inertial measurement units) and force sensors.
- Constructed robot action planner using a haptic network, And-Or Graph, and the generalized Earley parser.
- Questioned the common structure humans see in the procedure to open any medicine bottle vs. the widely varying forces and action sequences used by the robot for each bottle. This prompted an investigation of abstraction and generalization, outlined in the next project.

Causal learning: Virtual escape room to examine how humans and AI learn transferable causal representations

- Built virtual "escape room" to test causal generalization; surface-level features change room to room while each room is governed by a common abstract causal structure (series of levers) that describes the required actions to "unlock" the escape room.
- Ran human subject experiments to verify human learners are capable of learning the correct abstract causal structure.
- Built hierarchical Bayesian model to achieve similar performance as human learners. This causal model was able to solve the escape room while six state-of-the-art model-free reinforcement learning algorithms failed at the task.
- Result: Both structural abstraction and feature generalization are critical to transfer learning and generalization.

Explainable AI: How can robots explain their behavior to foster human trust?

- Reexamined the imitation learning work by building explainable visual interfaces for the haptic network and And-Or Graph.
- Examined how well these explanations fostered human trust, revealing that the model components that best-fostered human trust did not correspond to the model components that contributed to the best model performance.
- Highlighted the need to consider explainability as a first-class citizen when building AI systems that interact with humans.

Representation learning: The role of language in building generalizable representations

- Built a virtual environment using Unreal Engine 4 (UE4) for embodied AI that couples language (scene graph) and vision.
- Using the environment to create a dataset consisting of images, scene graphs (language labels), and object segmentation.
- The goal of this environment is to provide a playground to learn generalizable, commonsense representations where the latent representation is tightly coupled with language labels.

Professional Experience

- Director and President**, Center for AI and Robot Autonomy (CARA), Los Angeles, CA Mar 2021 - Present
- Seek alternative funding, define vision moving forward, file paperwork to maintain 501(c)(3) status.
- Robotics Research Engineer Intern**, Center for AI and Robot Autonomy (CARA), Los Angeles, CA Jun 2018 - Mar 2020
- Worked on representation learning project to couple vision and language (details under UCLA Graduate Student Researcher).
- Software Engineering Intern**, Aviation Department, Garmin International, Olathe, KS May 2013 - Aug 2013
- Automated the testing process for small craft airplane ACARS systems that send timed status messages to ground stations.
 - Reduced testing time by 40% and saved hundreds of vendor certification testing hours by optimizing simulation timing protocols and adhering to FAA safety standards.

Teaching Experience

- Adjunct Professor**, Computer Science Department, Santa Monica College, Santa Monica, CA Jun 2016 - Present
- Teach one-two 45-student classes/quarter: lead lectures, hold office hours, and create course materials.
 - Instructed 25 courses: Internet Programming (HTML, CSS, JavaScript, MySQL, and PHP), Intro to C, and Intro to C++.
- Teaching Assistant**, Computer Science Department, UCLA, Los Angeles, CA Sep 2015 - Jun 2016
- Teaching assistant for Introduction to C, Introduction to C++: lead discussion hours (~50 students), held office hours.
- Teaching Assistant**, Electric & Computer Engineering Department, University of Dayton, Dayton, OH Jan 2015 - May 2015
- Teaching assistant for Electronic Devices Lab: aided in lab sessions (~40 students).
- Enrichment Workshop Tutor**, School of Engineering, University of Dayton, Dayton, OH Sep 2012 - May 2015
- Tutor for first-year engineering students covering calculus, chemistry, and physics.
 - Lead team of tutors: managed 8 tutors overseeing 40 students.
- Cristo Rey Kansas City High School**, Summer School Teacher, Kansas City, MO May 2011 - Aug 2012
- Taught four junior and senior student classes at a prep school focused on college placement for underrepresented groups.

Podcast

- Co-Host**, Deep End Theory Podcast, UCLA Radio, Los Angeles, CA Jan 2016 - Jan 2020
- Created and hosted an hour-long weekly interview and live performance podcast with 29K+ listens.
 - Interviewed 32 electronic music artists including multiple Grammy-nominated guests.
 - Edited and released over 70 episodes, DJ-ed 40 live mixes, created branding and marketing material to build fanbase.

Journal Publications

- [3] Y. Zhu, T. Gao, L. Feng, S. Huang, **M. Edmonds**, H. Liu, F. Gao, C. Zhang, S. Qi, Y.N. Wu, J. Tenenbaum, S.C. Zhu
“Dark, Beyond Deep: A Paradigm Shift to Cognitive AI with Humanlike Common Sense,” *Engineering* 2020.
- [2] **M. Edmonds***, F. Gao*, H. Liu*, X. Xie*, S. Qi, B. Rothrock, Y. Zhu, Y.N. Wu, H. Lu, S.C. Zhu
“A tale of two explanations: Enhancing human trust by explaining robot behavior,” *Science Robotics* 2019.
- [1] **M. Edmonds**, T. Atahary, S. Douglass, T. Taha.
“Hardware Accelerated Semantic Declarative Memory Systems through CUDA and MapReduce,” *TPDS* 2018.
(* indicates equal contribution)

Conference Publications

- [9] C. Zhang, B. Jia, **M. Edmonds**, S.C. Zhu, Y. Zhu
“ACRE: Abstract Causal REasoning Beyond Covariation,” *CVPR* 2021.
- [8] **M. Edmonds**, X. Ma, S. Qi, Y. Zhu, H. Lu, S.C. Zhu **Oral Pres.**
“Theory-based Causal Transfer: Integrating Instance-level Induction and Abstract-level Structure Learning,” *AAAI* 2020.

- [7] **M. Edmonds**, S. Qi, Y. Zhu, J. Kubricht, S.C. Zhu, H. Lu.
“Decomposing Human Causal Learning: Bottom-up Associative Learning and Top-down Schema Reasoning,” *CogSci 2019*.
- [6] **M. Edmonds***, J. Kubricht*, Colin Summers, Y. Zhu, B. Rothrock, S.C. Zhu, H. Lu. **Oral Pres.**
“Human Causal Transfer: Challenges for Deep Reinforcement Learning,” *CogSci 2018*.
- [5] X. Xie*, H. Liu*, **M. Edmonds**, F. Gao, S. Qi, Y. Zhu, B. Rothrock, S.C. Zhu.
“Unsupervised Learning of Hierarchical Models for Hand-Object Interactions,” *ICRA 2018*.
- [4] **M. Edmonds***, F. Gao*, X. Xie, H. Liu, S. Qi, Y. Zhu, B. Rothrock, & S.C. Zhu. **Oral Pres.**
“Feeling the Force: Integrating Force and Pose for Fluent Discovery through Imitation Learning to Open Medicine Bottles,” *IROS 2017*.
- [3] H. Liu*, X. Xie*, M. Millar*, **M. Edmonds**, F. Gao, Y. Zhu, V. Santos, B. Rothrock, & S.C. Zhu. **Oral Pres.**
“A Glove-based System for Studying Hand-Object Manipulation via Pose and Force Sensing,” *IROS 2017*.
- [2] **M. Edmonds**, T. Atahary, T. Taha, & S. Douglass.
“High Performance Declarative Memory Systems through MapReduce,” *SNPD 2015*.
- [1] D. Prince, **M. Edmonds**, A. Sutter, M. Cusumano, W. Lu, & V. Asari.
“Brain Machine Interface using Emotiv EPOC to control Robai Cyton Robotic Arm,” *NAECON 2015*.
(* indicates equal contribution)

Honors, Awards & Recognition

2020	Press: People prefer robots to explain themselves – and a brief summary doesn’t cut it , The Conversation	Online
2019	Press: A Robot That Explains Its Actions Is a First Step Towards AI We Can (Maybe) Trust , IEEE Spectrum	Online
2017	NSF Doctoral Consortium , IROS 2017	Vancouver, BC
2015	The Anthony Horvath and Elmer Steger Award of Excellence , University of Dayton	Dayton, OH
2014	Eta Kappa Nu IEEE Honor Society , Member	Dayton, OH
2014	Tau Beta Pi Engineering Honor Society , Member	Dayton, OH
2011	Eagle Scout , Boy Scouts of America	Kansas City, KS

Invited Talks

Causal Transfer: Challenges for Causal Learning and Reinforcement Learning	White Mountain, NH
Student speaker at the ONR MURI Meeting	Sep 2018
Causal Imitation: The Necessity of Integrating Observations and Interventions	Pittsburgh, PA
Keynote Speaker at the RSS Causal Imitation Workshop	Jun 2018
Feeling the Force: Integrating Force and Pose for Imitation Learning	Los Angeles, CA
Student speaker at the ONR MURI Meeting	Aug 2017

Conference Presentations

Theory-based Causal Transfer: Integrating Instance-level Induction and Abstract-level Structure Learning	New York, NY
AAAI 2020	Feb 2020
Human Causal Transfer: Challenges for Deep Reinforcement Learning	Madison, WI
CogSci 2018	Jul 2018
Feeling the Force: Integrating Force and Pose for Imitation Learning	Mountain View, CA
CoRL 2017 Lightning Talk	Nov 2017
Feeling the Force: Integrating Force and Pose for Imitation Learning	Vancouver, BC
IROS 2017	Sep 2017