YEN-LING KUO

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RESEARCH VISION & INTERESTS

My research focuses on **enabling generalizations in human-AI/robot interactions** – building machines that can generalize their learned models to robustly interact with humans in novel scenarios. Toward this vision, I develop machine learning models that provide robots with generalizable reasoning skills including **language understanding** and **social interactions**.

EDUCATION

2016 – present **Massachusetts Institute of Technology**, Cambridge, MA
Ph.D. in Computer Science, minor in Cognitive Science, expected summer 2022
Thesis: Robotic Planning with Natural Language
Advisors: Boris Katz, Andrei Barbu

2009 – 2012 **National Taiwan University**, Taipei, Taiwan
M.S. in Computer Science and Information Engineering
Thesis: A Multiagent Reasoning System for Commonsense Knowledge Integration
Award: Best Master Thesis Award by the Taiwanese Association of Artificial Intelligence
Advisor: Jane Yung-jen Hsu

2011 **Massachusetts Institute of Technology**, Cambridge, MA
Visiting Student in Media Arts and Sciences
Advisor: Henry Lieberman

2005 – 2009 **National Taiwan University**, Taipei, Taiwan
B.S. in Computer Science and Information Engineering, minor in Physics

RESEARCH & WORK EXPERIENCE

09/2016 – present **MIT CSAIL & CBMM**
Research Assistant
- **Planning with Compositional Language Models**: Designed and implemented planners that leverage models derived from linguistic parse [3, 9] to extend robots' capabilities to follow commands, plan in dynamic environments [10], and generalize in novel scenarios.
- **Planning with Logics**: Created reinforcement learning agents that plan by incorporating constraints expressed as linear temporal logic in discrete [8] and continuous space [5]. The learned planners are used to learn the meaning of sentences [7].
- **Modeling Interactions**: Developed experiments and computational models for understanding social interactions [2, 4] and human symbolic communication [13].

06/2021 – 08/2021 **Toyota Research Institute** *(host: Guy Rosman)*
Research Intern
- **Trajectory Prediction with Language**: Developed interpretable machine learning models to predict behaviors of multiple road agents by leveraging linguistic representations [1].

09/2011 – 12/2011 **Software Agent Group, MIT Media Lab**
Visiting Student
- **Language Explorer**: Built a mobile language learning app that adapts to a learner's context and capability by leveraging commonsense knowledge and location-based service to automatically arrange materials and generate dialogues.

- **ConceptNet 5**: Designed and implemented the multilingual knowledge base to integrate data from Chinese ConceptNet, ReVerb, and GoalNet.

10/2012 – 08/2016 **Shopping, Google Inc.**

Software Engineer

- Tech Lead for Shop the Look feature, which integrates outfit search and visually similar items to Google search. (*posts on Google AdWords blog and TechCrunch*)
- Developed advanced shopping search features for shopping queries on different platforms.
- Developed machine learning algorithms and crowd-sourcing infrastructure to extract product attributes from image content and product metadata.

06/2008 – 01/2012 **Intelligent Agents Lab**, **NTU CSIE**

Research Assistant

- **Multi-agent Reasoning System**: Built a multi-agent system to provide commonsense reasoning results from multiple knowledge bases for application developers [11].
- **Crowdsourcing of Chinese Commonsense Knowledge**: Created games and analogical reasoning algorithms to build the largest Chinese commonsense knowledge base (over one million sentences) [12, 16] as part of the MIT Open Mind Common Sense project.

06/2011 – 08/2011 **Comparison Ads, Google Inc.**

Software Engineering Intern

- Developed algorithms and pipelines to automatically build entity attribute comparison tables for any entity using large-scale crawled web data.

PUBLICATIONS

Published 10 peer-reviewed conference/journal papers, 2 conference papers in review, and 4 peer-reviewed workshop/short papers in venues such as ICRA, IROS, CoRL, IJCAI, Findings of EMNLP, C&C, HCOMP, TiiS, and Frontiers in Robotics and AI. Have 1 pending patent.

Preprints

[1] **Yen-Ling Kuo**, Xin Huang, Andrei Barbu, Stephen G. McGill, Boris Katz, John J. Leonard, and Guy Rosman. Trajectory Prediction with Linguistic Representations. *Submitted to ICRA 2022, under review*.

[2] Ravi Tejwani*, **Yen-Ling Kuo***, Tianmin Shu, Bennett Stankovits, Dan Gutfreund, Joshua B. Tenenbaum, Boris Katz, and Andrei Barbu. Incorporating Rich Social Interactions Into MDPs. *Submitted to ICRA 2022, under review*. (*equal contribution)

Conference and Journal Publications

[3] **Yen-Ling Kuo**, Boris Katz, and Andrei Barbu. Compositional Networks Enable Systematic Generalization for Grounded Language Understanding. In *Findings of Empirical Methods in Natural Language Processing* (*Findings of EMNLP*)*, 2021*.

[4] Ravi Tejwani*, **Yen-Ling Kuo***, Tianmin Shu, Boris Katz, and Andrei Barbu. Social Interactions as Recursive MDPs. In *Proc. of Conference on Robot Learning* (*CoRL*)*, 2021*. (*equal contribution)

[5] **Yen-Ling Kuo**, Boris Katz, and Andrei Barbu. Compositional RL Agents that Follow Language Commands in Temporal Logic. In *Frontiers in Robotics and AI – Robot and Machine Vision, 2021*.

[6] Yen-Ting Cho, **Yen-Ling Kuo***, Yen-Ting Yeh*, Yen-Yi Huang, Po-Lun Huang. IntuModels: Enabling Interactive Modeling for the Novice through Idea Generation and Selection. In *Proc. of Creativity and Cognition* (*C&C*)*, 2021*. (*equal contribution) [**Best Paper Honorable Mention**]

[7] Christopher Wang, Candace Ross, **Yen-Ling Kuo**, Boris Katz, and Andrei Barbu. Learning a Natural-language to LTL Executable Semantic Parser for Grounded Robotics. In *Proc. of Conference on Robot Learning* (*CoRL*)*, 2020*.

[8] **Yen-Ling Kuo**, Andrei Barbu, and Boris Katz. Encoding Formulas as Deep Networks: Reinforcement Learning from Zero-shot Execution of LTL Formulas. In *Proc. of IEEE/RSJ International Conference on Intelligent Robots and Systems* (*IROS*)*, 2020*.

[9] **Yen-Ling Kuo**, Andrei Barbu, and Boris Katz. Deep Compositional Robotic Planners that Follow Natural Language Commands. In *Proc. of International Conference on Robotics and Automation (ICRA), 2020*.

[10] **Yen-Ling Kuo**, Andrei Barbu, and Boris Katz. Deep Sequential Models for Sampling-based planning. In *Proc. of 2018 IEEE/RSJ International Conference on Intelligent Robots and Systems* (*IROS*), October 2018.

[11] **Yen-Ling Kuo** and Jane Yung-jen Hsu. Planning for Reasoning with Multiple Common Sense Knowledge Bases. *ACM Transactions on Interactive Intelligent Systems (TiiS), Vol. 2, No. 3, Article 17, pp. 1-24*, September 2012.

[12] **Yen-Ling Kuo** and Jane Yung-jen Hsu. Resource-bounded Crowd-sourcing of Commonsense Knowledge. In *Proc. of International Joint Conference on Artificial Intelligence* (*IJCAI*), 2011.

Peer-Reviewed Short and Workshop Publications

[13] Emily Cheng, **Yen-Ling Kuo**, Ignacio Cases, Boris Katz, and Andrei Barbu. Toward Modeling the Emergence of Symbolic Communication. In *Proc. of ICRA Workshop on Social Intelligence in Humans and Robots,* 2021.

[14] Yen-Ting Cho, **Yen-Ling Kuo**, Yen-Ting Yeh, and Yi-Chin Lee. MovIPrint: Move, Explore and Fabricate. In *Proc. of ACM International Conference on Multimedia* (*ACM-MM*)*, 2019*.

[15] **Yen-Ling Kuo**, Jane Yung-jen Hsu, and Fuming Shih. Contextual Commonsense Knowledge Acquisition from Social Content by Crowd-sourcing Explanations. In *Proc. of AAAI Workshop on Human Computation* (*HCOMP*), 2012.

[16] **Yen-Ling Kuo**, Kai-yang Chiang, Cheng-wei Chan, Jong-Chuan Lee, Rex Wang, Edward Shen, and Jane Yung-jen Hsu. Community-based Game Design: Experiments on Social Games for Commonsense Data Collection. In *Proc. of KDD Workshop on Human Computation* (*HCOMP*), 2009.

Patent

[17] **Yen-Ling Kuo**, Boris Katz, and Andrei Barbu. Deep Compositional Robotic Planners that Follow Natural Language Commands. *US Patent App. 17/112,699*. In review.

HONORS & AWARDS

2021 **Best Paper Honorable Mention**, *ACM Conference on Creativity & Cognition*
Top 5% of the submissions.

2019 **Top 10%,** *ICFP Programming Contest 2019 (with Eric Stansifer, MIT)*

2018 – 2022 **CBMM Siemens Graduate Fellowship,** *Siemens Healthineers*
Awarded to one graduate student at MIT CBMM (*announcement on the CBMM website*).

2018 – 2020 **MIT Sandbox Innovation Fund,** *Massachusetts Institute of Technology*
Developed physics simulations and stories in VR for STEM education.

- Created VR learning experiences based on Michael Faraday, Ada Lovelace, and Lewis Carroll's stories and findings.
- Exhibited at National Taiwan Science Education Center (year-long), Pacific Science Center (one day), and Clippers SoCal Science Festival (two days).
- Built an interactive webXR experience with Smithsonian about Apollo 11.

2016 – 2017 **MIT Greater China Computer Science Fellowship,** *Massachusetts Institute of Technology*
Awarded annually to one graduate student from the Greater China area.

2012 **Best Master Thesis Award**, *Taiwanese Association of Artificial Intelligence*
Awarded annually to three master students in AI research among all universities in Taiwan.

2011 **Irving T. Ho Memorial Scholarship**, *Irving T. Ho Memorial Foundation*
Awarded annually to one EE/CSIE graduate student with exceptional research performance.

2011 **Google Anita Borg Memorial Scholarship**, *Google Inc.*
Awarded to female students with outstanding academic performance and leadership demonstration.

2010 **Outstanding Teaching Assistant Award**, *Department of CSIE, NTU*
Awarded to CSIE Teaching Assistants with the highest ratings from students.

TEACHING EXPERIENCE

08/2017, 08/2018, 08/2019 **Teaching Assistant**, *Marine Biology Lab* Woods Hole, MA
- Course: *Brains, Minds, and Machines Summer Course*
- Led and taught Deep Learning and Reinforcement Learning tutorials.
- Supervised projects of graduate students and postdocs from computer science, cognitive science, and neuroscience. Topics include human plan understanding, multi-agent communication and coordination, modeling pursuit and evasion behaviors of birds, social interaction recognition, and composition of policies to form complex behaviors.

09/2018 – 12/2018 **Teaching Assistant**, *Massachusetts Institute of Technology* Cambridge, MA
- Course: *Aspects of a Computational Theory of Intelligence*
- Reviewed, provided feedback, and graded student projects. Held weekly office hours to discuss and answer students' questions.
- Receive an overall score 6.5 in a 7 point-scale course evaluation
  – Stimulated interest: 6.5, Displayed thorough knowledge 6.5, Help me learn: 6.8

02/2010 – 05/2011 **Teaching Assistant**, *National Taiwan University* Taipei, Taiwan
- Courses: *Artificial Intelligence*, *Advanced Artificial Intelligence*
- Held weekly office hours to discuss class, homework, and term projects with students.
- In charge of both written and programming assignments for over 100 students.

MENTORING

Master Research

present Patrice Gobat, Master in Computer Science, ETH Zürich *(with Xi Wang)*
Unsupervised Learning and Segmentation of Atomic Actions from First-Person Perspective

present Razvan-George Pasca, Master in Computer Science, ETH Zürich *(with Xi Wang)*
INTENT - INteraction TENdency towards Targets

2021 Emily Cheng, MEng, MIT *(with Ignacio Cases)*
Modeling the Emergence of Symbolic Communication

2020 Bert Chen, Master in Computer Science, National Taiwan University
Drug-Drug Interaction Discovery using Entity-based Embeddings from BERT

2020 Sabrina Chen, Master in Data Science, HTW Berlin
Aspect-based Sentiment Analysis: An Unsupervised Approach to Expand Sentiment Lexicon

2019 Yu-Siang Wang, Master in Applied Computing, University of Toronto
Look-ahead Decoders for Maximum-likelihood Sequence Models

Undergraduate Research

2019	Daniel Sun, UROP, MIT
2019 Summer	Victor Turbiner, Undergrad Intern, now at Stanford
2018 Summer	Michael Saterson, MIT Summer Research Program, City University of New York
2018	Justin Yu, UROP, MIT

SERVICE & LEADERSHIP

10/2012 – present **Reviewer**

- Robotics: RA-L (2019-2021), ICRA (2020-2022), IROS (2019)
- Artificial Intelligence & Machine Learning: IJCAI (2019), AAAI (2016, 2022), NeurIPS (2021), ICLR (2022)
- Human-Computer Interaction: IUI (2013, 2019), CHI (2021), C&C (2021), Frontiers Social Physics (2021)

09/2021 – present **Student Representative**, *MIT CSAIL Postdoc and Graduate Student Council*

09/2018 – 06/2021 **Organizer**, *MIT Discussion Group on Language and Computation*

06/2018 – 08/2018 **Mentor**, *MIT Summer Research Program for Brain and Cognitive Science*

2018 **Mentor**, *MIT Undergraduate Women in EECS Buddy Program*

10/2015 **Participant & Google Interviewer**, *Grace Hopper Celebration of Women in Computing*

01/2013 – 09/2016 **Tech Intern Mentor & Interviewer**, *Google Inc.*

- Weekly career discussion with mentees; hosted 1 PhD and 6 undergraduate interns.
- Conducted 80+ technical interviews to hire qualified engineers.

07/2007 – 07/2008 **President**, *AIESEC* (*International Association of Students in Economics and Management, http://aiesec.org*) *National Taiwan University Local Committee*

- Initiated an overseas internship program based on social issues for NTU students.
- Organized a leadership development conference for 14 universities in Taiwan in 2008.
- Led more than 100 members to win the 2007-2008 Best Local Committee Award.

SELECTED PRESS

2021 **Giving robots social skills.** *MIT News*
https://news.mit.edu/2021/robots-social-skills-1105

2020 **A robotic planner that responds to natural language commands**. *Tech Xplore*
https://techxplore.com/news/2020-03-robotic-planner-natural-language.html

2019 **Combining artificial intelligence with their passions – Robots that understand language**. *MIT News*
https://cbmm.mit.edu/news-events/news/combining-artificial-intelligence-their-passions-mit-news

2018 **Model helps robots navigate more like humans do.** *MIT News*
https://news.mit.edu/2018/model-helps-robots-navigate-like-humans-1004