Tianmin Shu

CONTACT INFORMATION

Malone Hall 213
3400 N Charles St
Baltimore, MD 21218

Phone: (310) 948-5180
E-mail: tianmin.shu@jhu.edu
Website: https://www.tshu.io

RESEARCH INTERESTS

Machine Social Intelligence, Embodied AI, Human-Robot Interaction, and Computational Social Cognition.

EMPLOYMENT

Johns Hopkins University, Department of Computer Science 01/2024 - Present
Assistant Professor

Johns Hopkins University, Department of Cognitive Science 01/2024 - Present
Assistant Professor (by courtesy)

Massachusetts Institute of Technology 07/2023 - 12/2023
Research Scientist *Advisor: Joshua B. Tenenbaum, Antonio Torralba*

Massachusetts Institute of Technology 07/2019 - 07/2023
Postdoctoral Associate *Advisor: Joshua B. Tenenbaum, Antonio Torralba*

EDUCATION

University of California, Los Angeles, Los Angeles, CA, USA 09/2014 - 06/2019
Ph.D. in Statistics *Advisor: Song-Chun Zhu*

Fudan University, Shanghai, China 09/2010 - 06/2014
B.S. in Electronic Engineering

EXPERIENCE

Facebook AI Research, Menlo Park, CA, USA 06/2018 - 09/2018
Research Intern *Mentor: Yuandong Tian*

Salesforce Research, Palo Alto, CA, USA 06/2017 - 09/2017
Research Intern *Mentor: Caiming Xiong, Richard Socher*

SELECTED HONORS AND AWARDS

Outstanding Paper Award, ACL 2024
Excellent Paper Award, IROS Cognitive and Social Aspects of Human Multi-Robot Interaction Workshop 2022
Best Paper Award, NeurIPS Shared Visual Representations in Human and Machine Intelligence Workshop 2020
Best Paper Award, NeurIPS Cooperative AI Workshop 2020
Computational Modeling Prize in Perception/Action, Cognitive Science Society 2017

PUBLICATIONS

(* indicates equal contribution)

Preprints & Under Review

H. Zhang*, Z. Wang*, Q. Lyu*, Z. Zhang, S. Che, **T. Shu**, Y. Du, and C. Gan. COMBO: Compositional World Models for Embodied Multi-Agent Cooperation. *arXiv:2404.10775.*

Z. Hu*, **T. Shu***. Language Models, Agent Models, and World Models: The LAW for Machine Reasoning and Planning. *arXiv:2312.05230.*

Peer-reviewed Journal Articles

G. Raz, S. Piccolo, J. Medrano, S. Liu, K. Lydic, C. Mei, V. Nguyen, **T. Shu**, R. Saxe. An asynchronous, automated workflow for looking time experiments with infants. *Developmental Psychology, 2024.*

X. Gao, L. Yuan, **T. Shu**, H. Lu, and S.-C. Zhu. Show Me What You Can Do: Capability Calibration on Reachable Workspace for Human-Robot Collaboration. *IEEE Robotics and Automation Letters (RA-L), 2022.*

T. Shu, Y. Peng, S.-C. Zhu, and H. Lu. A Unified Psychological Space for Human Perception of Physical and Social Events. *Cognitive Psychology, 128: 101398, 2021.*

Y. Peng, H. Lee, **T. Shu**, and H. Lu. Exploring Biological Motion Perception in Two-stream Convolutional Neural Networks. *Vision Research, 178: 28-40, 2021.*

Z. Nan, **T. Shu**, R. Gong, S. Wang, P. Wei, S.-C Zhu, and N Zheng. Learning to Infer Human Attention in Daily Activities. *Pattern Recognition, 103: 107314, 2020.*

D. Xie, **T. Shu**, S. Todorovic, and S.-C. Zhu. Learning and Inferring "Dark Matter" and Predicting Human Intents and Trajectories in Videos. *IEEE Trans. on Pattern Analysis and Machine Intelligence (TPAMI), 40(7): 1639-1652, 2018.*

T. Shu*, Y. Peng*, L. Fan, H. Lu, and S.-C. Zhu. Perception of Human Interaction Based on Motion Trajectories: from Aerial Videos to Decontextualized Animations. *Topics in Cognitive Science (TopiCS), 10(1): 225 - 241, 2018.*

Peer-reviewed Conference Papers

L. Ying, K. Jha, S. Aarya, J. B. Tenenbaum, A. Torralba, **T. Shu**. GOMA: Proactive Embodied Cooperative Communication via Goal-Oriented Mental Alignment. *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2024.*

C. Jin, Y. Wu, J. Cao, J. Xiang, Y.-L. Kuo, Z. Hu, T. D. Ullman, A. Torralba, J. B. Tenenbaum, **T. Shu**. MMToM-QA: Multimodal Theory of Mind Question Answering. *The 62nd Annual Meeting of the Association for Computational Linguistics (ACL), 2024.* (**Outstanding Paper Award**)

H. Zhang*, W. Du*, J. Shan, Q. Zhou, Y. Du, J. B. Tenenbaum, **T. Shu**, and C. Gan. Building Cooperative Embodied Agents Modularly with Large Language Models. *12th International Conference on Learning Representations (ICLR), 2024.*

Y. Zhang, P. Robertson, **T. Shu**, S. Hong, and B. Williams. Risk-Bounded Online Team Interventions via Theory of Mind. *IEEE International Conference on Robotics and Automation (ICRA), 2024.*

K. Jha, T. A. Le, C. Jin, Y.-L. Kuo, J. B. Tenenbaum, **T. Shu**. Neural Amortized Inference for Nested Multi-agent Reasoning. *38th AAAI Conference on Artificial Intelligence (AAAI), 2024.*

J. Xiang, T. Tao, Y. Gu, **T. Shu**, Z. Wang, Z. Yang, and Z. Hu. Language Models Meet World Models: Embodied Experiences Enhance Language Models. *37th Annual Conference on Neural Information Processing Systems (NeurIPS), 2023.*

A. Peng, A. Netanyahu, M. K. Ho, **T. Shu**, A. Bobu, J. Shah, P. Agrawal. Diagnosis, Feedback, Adaptation: A Human-in-the-Loop Framework for Test-time Policy Adaptation. *40th International Conference on Machine Learning (ICML), 2023.* (**Acceptance rate: 1827/6538 = 28%**)

X. Puig*, **T. Shu***, J. B. Tenenbaum, A. Torralba. NOPA: Neurally-guided Online Probabilistic Assistance for Building Socially Intelligent Home Assistants. *IEEE International Conference on Robotics and Automation (ICRA), 2023.*

D. Liu, V. Shah, O. Boussif, C. Meo, A. Goyal, **T. Shu**, M. C. Mozer, N. Heess, Y. Bengio. Stateful Active Facilitator: Coordination and Environmental Heterogeneity in Cooperative Multi-Agent Reinforcement Learning. *11th International Conference on Learning Representations (ICLR), 2023.* (**Acceptance rate: 31.8%**)

R. Tejwani*, Y.-L. Kuo*, **T. Shu**, B. Stankovits, D. Gutfreund, J. B. Tenenbaum, B. Katz, and A. Barbu. Zero-shot Linear Combinations of Grounded Social Interactions with Linear Social MDPs. *37th AAAI Conference on Artificial Intelligence (AAAI), 2023.* (**Acceptance rate: 1721/8777=20%**)

A. Netanyahu*, **T. Shu***, J. B. Tenenbaum, and P. Agrawal. Discovering Generalizable Spatial Goal Representations via Graph-based Active Reward Learning. *39th International Conference on Machine Learning (ICML), 2022.* (**Acceptance rate: 1235/5630 = 22%**)

M. Deng, J. Wang, C.-P. Hsieh, Y. Wang, H. Guo, **T. Shu**, M. Song, E. Xing and Z. Hu. RLPrompt: Optimizing Discrete Text Prompts with Reinforcement Learning. *Conference on Empirical Methods in Natural Language Processing (EMNLP), 2022.*

R. Tejwani*, Y.-L. Kuo*, **T. Shu**, B. Stankovits, D. Gutfreund, J. B. Tenenbaum, B. Katz, and A. Barbu. Incorporating Rich Social Interactions Into MDPs. *IEEE International Conference on Robotics and Automation (ICRA), 2022.* (A short version won **Excellent Paper Award** at IROS Cognitive and Social Aspects of Human Multi-Robot Interaction Workshop, 2022)

R. Tejwani*, Y.-L. Kuo*, **T. Shu**, B. Katz, and A. Barbu. Social Interactions as Recursive MDPs. *Conference on Robot Learning (CoRL), 2021.* (**Acceptance rate: 156/400 = 38%**)

T. Shu, A. Bhandwaldar, C. Gan, K. A. Smith, S. Liu, D. Gutfreund, E. Spelke, J. B. Tenenbaum, and T. D. Ullman. AGENT: A Benchmark for Core Psychological Reasoning. *38th International Conference on Machine Learning (ICML), 2021.* (**Acceptance rate: 1184/5513 = 21%**)

X. Puig, **T. Shu**, S. Li, Z. Wang, J. B. Tenenbaum, S. Fidler, and A. Torralba. Watch-And-Help: A Challenge for Social Perception and Human-AI Collaboration. *9th International Conference on Learning Representations (ICLR), 2021.* (**Spotlight presentation, acceptance rate: 5.6%**; a short version won **Best Paper Award** at NeurIPS Cooperative AI Workshop, 2020)

A. Netanyahu*, **T. Shu***, B. Katz, A. Barbu, and J. B. Tenenbaum. PHASE: PHysically-grounded Abstract Social Events for Machine Social Perception. *35th AAAI Conference on Artificial Intelligence (AAAI), 2021.* (**Acceptance rate: 1692/7911=21%**; short version won **Best Paper Award** at NeurIPS Shared Visual Representations in Human and Machine Intelligence Workshop, 2020)

T. Shu, M. Kryven, T. D. Ullman, and J. B. Tenenbaum. Adventures in Flatland: Perceiving Social Interactions Under Physical Dynamics. *42nd Annual Meeting of the Cognitive Science Society (CogSci), 2020.*

X. Gao*, R. Gong*, Y. Zhao, S. Wang, **T. Shu**, and S.-C. Zhu. Joint Mind Modeling for Explanation Generation in Complex Human-Robot Collaborative Tasks. *International Conference on Robot & Human Interactive Communication (RO-MAN), 2020.*

H. Wang, W. Wang, **T. Shu**, W. Liang, and J. Shen. Active Visual Information Gathering for Vision-

Language Navigation. *European Conference on Computer Vision (ECCV), 2020.* (**Acceptance rate: 1360/5150 = 26%**)

T. Shu, Y. Peng, H. Lu, and S.-C. Zhu. Partitioning the Perception of Physical and Social Events Within a Unified Psychological Space. *41st Annual Meeting of the Cognitive Science Society (CogSci), 2019.* (**Oral presentation, acceptance rate: 205/810 = 25.3%**)

T. Shu and Y. Tian. M³RL: Mind-aware Multi-agent Management Reinforcement Learning. *7th International Conference on Learning Representations (ICLR), 2019.* (**Acceptance rate: 525/1591 = 33%**)

P. Wei, Y. Liu, **T. Shu**, N. Zheng, and S.-C. Zhu. Where and Why Are They Looking? Jointly Inferring Human Attention and Intentions in Complex Tasks. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2018.* (**Acceptance rate: 979/3303 = 30%**)

T. Shu, C. Xiong, and R. Socher. Hierarchical and Interpretable Skill Acquisition in Multi-task Reinforcement Learning. *6th International Conference on Learning Representations (ICLR), 2018.* (**Acceptance rate: 337/935 = 36%**)

T. Shu*, Y. Peng*, L. Fan, H. Lu, and S.-C. Zhu. Inferring Human Interaction from Motion Trajectories in Aerial Videos. *39th Annual Meeting of the Cognitive Science Society (CogSci), 2017.* (**Oral presentation, acceptance rate: 255/873 = 29%**) **Computational Modeling Prize**

T. Shu, S. Todorovic, and S.-C. Zhu. CERN: Confidence-Energy Recurrent Network for Group Activity Recognition. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017.* (**Acceptance rate: 783/2680 = 29%**)

T. Shu, X. Gao, M. S. Ryoo, and S.-C. Zhu. Learning Social Affordance Grammar from Videos: Transferring Human Interactions to Human-Robot Interactions. *IEEE International Conference on Robotics and Automation (ICRA), 2017.* (**Acceptance rate: 939/2289=41%**)

T. Shu*, S. Thurman*, D. Chen, S.-C. Zhu, and H. Lu. Critical Features of Joint Actions that Signal Human Interaction. *38th Annual Meeting of the Cognitive Science Society (CogSci), 2016.*

T. Shu, M. S. Ryoo, and S.-C. Zhu. Learning Social Affordance for Human-Robot Interaction. *25th International Joint Conference on Artificial Intelligence (IJCAI), 2016.* (**Acceptance rate: 558/2294= 24%**)

T. Shu, D. Xie, B. Rothrock, S. Todorovic, and S.-C. Zhu. Joint Inference of Groups, Events and Human Roles in Aerial Videos. *IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015.* (**Oral presentation, acceptance rate: 71/2123 = 3.3%**)

Peer-reviewed Workshop Papers

K. Jha, T. A. Le, C. Jin, Y.-L. Kuo, J. B. Tenenbaum, **T. Shu**. Neural Amortized Inference for Nested Multi-agent Reasoning. *AAAI Summer Symposium, 2023.*

X. Gao, R. Gong, **T. Shu**, X. Xie, S. Wang, and S.-C. Zhu. VRKitchen: an Interactive 3D Environment for Learning Real Life Cooking Tasks. *ICML Reinforcement Learning for Real Life Workshop, 2019.*

T. Shu, C. Xiong, Y. N. Wu, and S.-C. Zhu. Interactive Agent Modeling by Learning to Probe. *NeurIPS 2018 Deep Reinforcement Learning Workshop, 2018.*

Peer-reviewed Conference Posters

T. Shu, A. Magaro, M. Kryven, T. D. Ullman, J. B. Tenenbaum. Social Attribution Guides Similarity Judgment of Abstract Scenes *The Annual Meeting of the Vision Sciences Society (VSS), 2022.*

T. Shu, A. Netanyahu, M. Kryven, J. Muchovej, N. Shenoy, B. Katz, A. Barbu, T. D. Ullman, J. B. Tenenbaum. Perceiving social events in a physical world. *The Annual Meeting of the Vision Sciences Society (VSS), 2021.*

MEDIA COVERAGE   "How world models are shaping the future of AI." *The Eye on AI Podcast.* Mar. 10, 2024

"A faster way to teach a robot." *MIT News.* Jul. 18, 2023

"A framework that could improve the social intelligence of home assistants." *Tech Xplore.* Jan. 31, 2023

"A new explainable AI paradigm that could enhance human-robot collaboration." *Tech Xplore.* Aug. 10, 2022

"Scientists Are Trying to Give Robots Social Skills." *Discover Magazine.* Jul. 25, 2022

"Easy for you, tough for a robots." *Science News for Students.* Nov. 18, 2021

"Giving robots social skills." *MIT News.* Nov. 5, 2021

"Can you teach AI common sense?" *VentureBeat.* Jul. 27, 2021

"Researchers design virtual environment to spur development of helpful home robots." *VentureBeat.* Oct. 24, 2020

"AI can learn real-world skills from playing StarCraft and Minecraft." *Science News.* May 14, 2019

"VRKitchen: An interactive virtual environment to train and test AI agents." *Tech Xplore.* Mar. 27, 2019

"Robots taught to work alongside humans by giving high fives." *New Scientist.* Apr. 27, 2017

INVITED TALKS   "Human-level Machine Theory of Mind: Reasoning About the Latent Mental Variables of Humans."
- *Utrecht University*, Jul. 16, 2024
- *Measurement Errors and Latent Variables Workshop, Johns Hopkins University*, May 11, 2024

"Cognitively Inspired Machine Theory of Mind."
- *Guest lecture for EECS 692: Advanced Artificial Intelligence, University of Michigan*, Apr. 8, 2024

"Benchmarking Human-Level Machine Social Intelligence."
- *Cognitive-AI Benchmarking Workshop in Conjunction with CogSci 2023*, Jul. 17, 2023

"Cognitively Inspired Machine Social Intelligence."
- *Social Cognitive Neuroscience Lab, University of Iowa*, Mar. 3, 2023
- *Computational Cognition, Vision, and Learning Group, Johns Hopkins University*, Dec. 2, 2022
- *Robotics Seminar, University of New Hampshire*, Oct. 28, 2022
- *University of Maryland*, Jul. 25, 2022

- *Johns Hopkins University*, Jul. 20, 2022
- *Vision Seminar, Columbia University*, Jun. 29, 2022
- *Visual Intelligence for Transportation (VITA) Lab, EPFL*, Jan. 5, 2022
- *AI Seminar, Information Sciences Institute, USC*, Oct. 22, 2021

"Benchmarking Machine Social Intelligence."
- *Sony Computer Science Laboratories, Paris*, Feb. 17, 2021

"Perceiving Social Interactions Under Physical Dynamics."
- *Virutal Computational Neuroscience (VCN) Journal Club hosted by Stanford, MIT/Harvard, and Princeton*, Nov. 18, 2020

"A Unified Modeling of Physical and Social Events."
- *The Annual Meeting of Multidisciplinary University Initiative (MURI), Edinburgh, UK*, Sep. 4, 2019

"Towards a Better Agent Modeling for Multi-agent Reinforcement Learning."
- *CLVR Speaker Series, University of Southern California*, Nov. 29, 2018

"Social Perception on Heider-Simmel Animations."
- *The Annual Meeting of Multidisciplinary University Initiative (MURI), White Mountain, NH*, Sep. 26, 2018

"Modeling Human Social Interactions."
- *The Annual Meeting of Multidisciplinary University Initiative (MURI), UCLA*, Aug. 23, 2017

"Inferring Human Interactions."
- *3rd Vision Meets Cognition Workshop in Conjunction with CVPR 2017, Honolulu, HI*, Jul. 21, 2017

PROFESSIONAL
SERVICE

Area Chair:
- ICLR (2025)

Conference Reviewer:
- CVPR (2017-2023)
- ICCV (2017, 2019, 2021)
- ECCV (2018, 2020, 2022)
- ICLR (2021-2022, 2024)
- NeurIPS (2020-2024)
- ICML (2021-2024)
- AAAI (2019-2022)
- ICRA (2019)
- CoRL (2023-2024)
- HRI (2024)
- IROS (2017, 2019, 2021, 2022)
- SIGGRAPH Asia (2024)
- RO-MAN (2021)
- CogSci (2022-2024)
- WACV (2021)
- BMVC (2019-2020)
- ACCV (2019)
- PRCV (2019-2020)

Journal Reviewer:

- International Journal of Computer Vision (IJCV)
- IEEE Transactions on Image Processing (TIP)
- IEEE Robotics and Automation Letters
- Autonomous Robotics
- Frontiers in Psychology
- Quarterly Journal of Experimental Psychology
- Computers in Industry

Workshop & Tutorial Organizers:
- RSS 2024 Workshop on Social Intelligence in Humans and Robots
- AAAI 2024 Tutorial on Language Models Meet World Models
- NeurIPS 2023 Tutorial on Language Models Meet World Models
- RSS 2023 Workshop on Social Intelligence in Humans and Robots
- 1st Challenge on Machine Visual Common Sense: Perception, Prediction, Planning at ECCV 2022
- RSS 2022 Workshop on Social Intelligence in Humans and Robots
- ICRA 2021 Workshop on Social Intelligence in Humans and Robots

Workshop Committee:
- ICML 2023 Workshop on Theory of Mind in Communicating Agents
- ICML 2023 Workshop on Interactive Learning with Implicit Human Feedback
- ICLR 2021 Workshop on Embodied Multimodal Learning
- NeurIPS 2019 Workshop on Learning with Rich Experience: Integration of Learning Paradigms
- ICML 2018 Workshop on Theoretical Foundations and Applications of Deep Generative Models
- 3rd Vision Meets Cognition Workshop in Conjunction with CVPR 2017

TEACHING

Johns Hopkins University, Department of Computer Science
EN 601.473/673: Cognitive Artificial Intelligence   Spring 2024
- Instructor

Massachusetts Institute of Technology, Department of Brain & Cognitive Sciences
9.66: Computational Cognitive Science   Fall 2020, Fall 2021, Fall 2022
- Project Teaching Assistant

University of California, Los Angeles, Department of Statistics
STATS 232C: Cognitive Artificial Intelligence   Spring 2018
- Teaching Assistant

STATS 102A: Introduction to Computational Statistics with R   Fall 2017, Winter 2018
- Teaching Assistant

STATS 232A: Statistical Modeling and Learning in Vision and Cognition   Winter 2016
- Teaching Assistant

STATS 130: Getting Up to Speed with SPSS, Stata, SAS, and R   Spring 2015
- Teaching Assistant

MENTORING

At JHU
Undergraduate Students:
- Darren Shih (2024 - present)
- Michael Yi (2024 - present)
- Haojun Shi (2024 - present)
- Shivam Aary (2024 - present)

Master's Students:
- Zixiao Xu (2024 - present)
- Yan Zhuang (2024 - present)
- Mung Yao Jia (2024 - present)
- Yijiang Li (2024 - present)
- Xinyu Fang (2024 - present)
- Shunchang Liu (intern, 2023 - present)

At MIT
Undergraduate Students:
- Jing Cao (2023)
- Hao Liu (visiting student from Tsinghua University, 2023; next: Ph.D. student in Cognitive Psychology at NYU)
- Chuanyang Jin (visiting student from New York University, 2023; next: Ph.D. student in Computer Science at JHU)
- Kunal Jha (visiting student from Dartmouth College, 2022 - 2024; next: Ph.D. student in Computer Science at UW)
- Andy Wang (2022)
- Karen Chung (2021 - 2022)
- Nakul Shenoy (2020 - 2022)
- Annika Magaro (2020 - 2022)
- Arpan Kaphle (2021)

Master's Students:
- Yuying Sun (intern from Boston University, 2023 - present)
- Yutong Wu (2022 - present)
- Yuxin Yan (2022)

At UCLA
Master's Students:
- Yixin Chen (2017 - 2018; next: Ph.D. student in Statistics at UCLA)

Undergraduate Students:
- Qingyi Zhao (2018; next: Master's in Computer Science, UCLA)
- Adam Brownell (2017 - 2018)
- Xiaofeng Gao (2016 Summer; next: Ph.D. student in Statistics at UCLA)
- Xiaopei Zhang (2015 - 2018; next: Master's in Electrical Engineering, UCLA)
- Peimeng Sui (2015 - 2016; next: Master's in Data Science, NYU)
- Zhe Ji (2015; next: Master's in Industrial Engineering & Operations Research, UC Berkeley)

Thesis Committee **At JHU**
- Jieru Mei (2024)
- Yutong Bai (2024)
- Angtian Wang (2024)
- Ju He (2024)