Zizhao **Wang**

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Research focus

- Reinforcement Learning (RL)
- Causal Reasoning
- World Models
- Generative Models (GenAI)
- Robot Learning

Skills

- decision making
  - model-based RL
  - RLHF
  - algorithms (PPO, DPO)
  - offline RL
  - hierarchical RL
  - imitation learning
  - planning
- distributed training, efficient training
- ML frameworks (PyTorch, TensorFlow, CleanRL, etc)
- deployment (Docker, Azure)
- representation learning
- generalization and robustness
- interpretability and explainability
- autonomous driving
- probabilistic graphical models
- simulation (Mujoco, Robosuite, iGibson)
- Python
- data structure, algorithms

Education

2020 - 25	**PhD**, Electrical and Computer Engineering expected graduation: Dec, advisor: **Peter Stone**	**University of Texas at Austin**
2018 - 19	**MS**, Computer Science	**Columbia University**
2016 - 18	**BS**, Computer Engineering (dual degree program)	**University of Michigan**
2014 - 18	**BS**, Electrical and Computer Engineering	**Shanghai Jiao Tong University**

Work Experience

2024/06 **Research Intern** — **Microsoft Research**

- Designed an **generative world model** that can synthesize images of novel scenarios, by using object-centric representations and disentangled representations.
- Implemented the model in PyTorch with transformers and state-space models (two popular building blocks of LLM) as backbones.
- Sped up training with **distributed training** (Distributed Data Parallel).
- Enhanced the generalization of **reinforcement learning** policies by 30%, when learning with generated out-of-distribution data.

2024/01 **Research Intern** — **Honda Research Institute**

- Developed a **motion prediction** algorithm for **autonomous driving** that, reduced prediction error by 48%, by applying **causal reasoning** to vehicle interactions.
- Built a novel **transformer**-based model for vehicle interaction reasoning, improving reasoning performance (vehicle interaction detection accuracy) by 10%.
- Sped up model training with **distributed training** and **efficient CUDA implementations** for sparse attention.

Research Experience

2021-22 **Causal World Model (ICML oral, AAAI oral)** — **University of Texas at Austin**

- Developed a **world model** that can analyzes **causal relationships** between state factors (e.g., whether an object moves because of itself or other objects).
- Increased the model's **out-of-distribution generalization** by 46%, by leveraging the identified relationships and conditioning predictions only on relevant inputs.
- Derived a theoretically-grounded state abstraction for model-based RL, which improved sample efficiency and generalization in **planning** for **robotics** tasks.

2022-23 **Unsupervised Skill Learning (NeurIPS)** — **University of Texas at Austin**

- Proposed a skill discovery method for **structured decision-making** tasks, where reusable skills are learned to induce interactions between state factors.
- Implemented a novel **hierarchical RL** algorithm for skill learning in PyTorch – the high-level policy selects the interaction to induce and the low-level policy learns to induce it using primitive actions.
- Enhanced skill diversity and downstream task performance on long-horizon robotics tasks and structured decision-making tasks by 40%.

2018-19 **Reinforcement Learning from Human Feedback (ICRA, IROS)** — **Columbia University**

- Led the development of an RL model that efficiently **learned from human feedback** and solved various robotics navigation and manipulation tasks.
- Adopted **active learning** to strategically determine when to query humans for feedback, boosting performance by 43% with the same amount of feedback.

Selected Publications

See google scholar (https://tinyurl.com/zizhaowangscholar) for a complete list of publications.

1. Maximizing BCI Human Feedback using Active Learning, *IROS 2020*
   Z Wang*, J Shi*, I Akinola*, and P Allen.
2. Causal Dynamics Learning for Task-Independent State Abstraction, *ICML 2022* (**oral**)
   Z Wang, X Xiao, Z Xu, Y Zhu, and P Stone.
3. Building Minimal and Reusable Causal State Abstractions for RL, *AAAI 2024* (**oral**)
   Z Wang*, C Wang, X Xiao, Y Zhu, and P Stone.
4. SkiLD: Unsupervised Skill Discovery Guided by Local Dependencies, *NeurIPS 2024*
   Z Wang*, J Hu*, C Chuck*, S Chen, R Martín-Martín, A Zhang, S Niekum, P Stone.
5. ELDEN: Exploration via Local Dependencies, *NeurIPS 2023*
   Z Wang*, J Hu*, R Martín-Martín, and P Stone.