Bo-Ruei (Ray) Huang

+1-626-831-3755 | rayray2002.huang@gmail.com | github.com/rayray2002 | linkedin.com/in/huang-bo-ruei | Bo-Ruei Huang

Research Interests

Enthusiastic senior at National Taiwan University pursuing a double major in Electrical Engineering and Computer Science. Eagerly engaged in interdisciplinary exploration at the confluence of computer science and electrical engineering. Possessing three years of immersive research experience in the fields of machine learning, robotics and plantary science. Poised to embark on a promising journey into graduate research.

Education

National Taiwan University *Taipei, Taiwan*

B.S. *Sep 2020 - Dec 2024 (Expected)*

- Majors: **Computer Science and Information Engineering** and **Electrical Engineering** (**Double Major**)
- Overall GPA: **4.23**/4.30
- Rank: 7/264 (**Top 3%**)
- Dean List: 3 Semesters (Top 5%)
- The Phi Tau Phi Scholastic Honor Society Member (**Top 1%** of the college)

Work Experience

Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology *Massachusetts, United States*

Visiting Student *July 2024 - Current*

- Conduct robot learning research mainly related to reinfrocement learning.
- Advisors: **Jiayuan Mao**, **Josh B. Tenenbaum** and **Leslie P. Kaelbling**

Robot Learning Lab, National Taiwan University *Taipei, Taiwan*

Undergraduate Researcher *Mar 2022 - Current*

- Conduct robot learning research mainly related to reinfrocement learning.
- Advisor: **Shao-Hua Sun**

Division of Geological and Planetary Sciences, California Institute of Technology *California, United States*

Summer Undergraduate Research Fellowship *Jun 2023 - Aug 2023*

- BaBar SURF Fellow
- Conduct summer research projects relating to planetary sciences.
- Advisor: **Yuk L. Yung**

Teaching Experience

Cornerstone EECS Design and Implementation, National Taiwan University *Taipei, Taiwan*

Teaching Assistant *Spring 2024*

- Mentor open-ended maker projects for freshmen students integrating hardware and software skills.
- Professors: **Cheng-Wei Chen** and **Jiun-Peng Chen**

Reinfrocement Learning, National Taiwan University *Taipei, Taiwan*

Teaching Assistant *Fall 2023*

- Grade the homeworks for 120 students.
- Mentor RL research projects with bi-weekly meetings.
- Professor: **Shao-Hua Sun**

Signal and System, National Taiwan University *Taipei, Taiwan*

Teaching Assistant *Spring 2023*

- Grade the homeworks and term exams for 200 students.
- Host weekly office hours.
- Professor: **Lin-Shan Lee**

Cornerstone EECS Design and Implementation, National Taiwan University *Taipei, Taiwan*

Teaching Assistant *Spring 2023*

- Mentor open-ended maker projects for freshmen students integrating hardware and software skills.
- Professors: **Kun-You Lin** and **Jiun-Peng Chen**

Research Projects

Diffusion Imitation Learning from Observation (DIFO)

Taipei, Taiwan

National Taiwan University

Apr 2024 - Current

- **Under Review**
- We employ a diffusion model to capture expert and agent transitions by generating the next state, given the current state. Then, we reformulate the learning objective to train the diffusion model as a binary classifier and use it to provide rewards for policy learning.
- Our method demonstrates superior performance in various tasks, including navigation, locomotion, manipulation, and games.
- **Keywords:** Reinforcement Learning, Imitation Learning, Diffusion Model.

Learning Robotics Tasks From Videos

Taipei, Taiwan

National Taiwan University

Dec 2023 - Current

- **Ongoing**
- Value-Implicit Pre-Training (VIP) is unable to solve long horizon tasks with non-monotonic movements. Universal Visual Decomposer (UVD) solve the problem by spliting long horizon tasks into multiple subgoals.
- Language-Image Value learning (LIV) use CLIP to align visual and language embedding from universal reward function.
- With help of planning capabilities of Large Language Models (LLMs), we can adapt LIV to long horizon task with text subgoals.
- **Keywords:** Reinforcement Learning, Robot Learning, Unsupervised Learning, Contrastive Learning.

Object-Centric Value-Implicit Pre-Training

Taipei, Taiwan

National Taiwan University

Sep 2023 - Dec 2024

- **Course Final Project**
- Value-Implicit Pre-Training (VIP) learns a value representation from human videos for downstream RL but lack of information on domain specific tasks like robot manipulation.
- Use Temporal Cycle-Consistency (TCC) to map features of robot arm and object, making VIP more object-centric, to adapt VIP to robot manipulation tasks.
- **Keywords:** Reinforcement Learning, Robot Learning, Unsupervised Learning, Contrastive Learning.

Robotic Peer Learning

Taipei, Taiwan

National Taiwan University

Oct 2023 - Apr 2024

- **Ongoing**
- Given a set of robots, vary from mechanism or dynamics, and a set of skills. Each of the agents learns a protion of skills. We want to make all agents learn all the skills in zero-shot.
- Disentangle agent-relevent and task-relevent features from expert demonstration, and use them for unseen agent-task pair.
- Make robots learn new tasks in peer without centralized foundation models.
- **Keywords:** Reinforcement Learning, Robot Learning, Imitation Learning, Contrastive Learning.

Improving XCO2 Precision in OCO-2/3 Retrievals through Machine Learning-Enabled Extraction of Volcanic Aerosol Information from L1B Spectra

California, United States

California Institute of Technology

Jun 2023 - June 2024

- **Ongoing**
- Volcanic eruptions release CO2, SO2, and aerosols, influencing climate. Satellite measurements like OCO-2 face challenges due to high concentration of volcanic aerosols.
- Applying machine learning, we extract vital aerosol details from OCO data using CALIPSO benchmarks. This boosts accuracy in CO2 retrieval, refining climate impact assessment.
- Our study showcases the power of ML in understanding volcanic aerosols through OCO data. Improved CO2 measurements contribute to better climate modeling and scientific insights.
- **Keywords:** Machine Learning, Aerosols.

LunaX Moon Base Simulator: Exploring Lunar Development and Sustainability

California, United States

California Institute of Technology

Jun 2023 - Sep 2023

- **Unpublishable (Work with NASA JPL)**
- Led the creation of an immersive video game project aligned with NASA's Artemis program objectives, simulating the challenges of lunar development and sustainability.
- Leveraged the Unity platform and harnessed the power of C# programming to construct a comprehensive lunar base simulation. Managed core elements such as resource allocation, life support systems, and strategic infrastructure.
- Successfully merged entertainment and education by crafting a game that not only entertains but also imparts insights into lunar exploration complexities. Bridged the gap between gaming and real-world space endeavors, fostering a greater interest in space exploration among diverse audiences.
- **Keywords:** Unity, Simulation, Lunar.

Offline Multitask Reinforcement Learning with Decision Transformer

Taipei, Taiwan

National Taiwan University

Sep 2022 - June 2023

- **Failed**
- Achieve offline skill merging and interpolation using decision transformer.
- Transform MDP problems into sequence problem to take advantage of transformers.
- **Keywords:** Reinforcement Learning, Offline Learning, Multitask Learning.

Achievements

Fellowships

2023 **BaBar SURF Fellowship**, California Institute of Technology *United States*
2023 **Irving T. Ho Memorial Fellowship**, Irving T. Ho Memorial Foundation *Taiwan*

Scholarships

2023 **NTUEE60 Scholarship (Top 2)**, Nation Taiwan University *Taiwan*
2022 **Jia-Lin Su Memorial Scholarship (Top 1)**, Nation Taiwan University *Taiwan*

Awards

2024 **Best Application**, MakeNTU Hackathon *Taiwan*
2023 **Best Maker**, MakeNTU Hackathon *Taiwan*
2023 **4th-Place**, AIS3 EOF Cybersecurity Competition *Taiwan*
2021 **Second-Place**, General Physics Experiment Creative Competition *Taiwan*
2020 **Third-Place**, Taiwan International Science Fair (TISF) *Taiwan*
2018 **Silver Medalist**, Taiwan Young Physicists' Tournament (TYPT) *Taiwan*

Selected Courses

ML Related Foundation of Artificial Intellegence, Machine Learning, Reinforcement Learning.
CS Related Computer Programming, Data Structures, Algorithms, Operating System, Formal Languages and Automata Theory.
EE Related Logic Design, Electronic Circuits, Electronics, Electromagnetics, Advanced Digital Signal Processing.
Mathematics Calculus, Linear Algebra, Probability, Convex Optimization, Signals and Systems, Discrete Mathematics.

Skills

Programming Python, C/C++, MATLAB, HTML/CSS, JavaScript.
Miscellaneous Unix/Linux, Shell Script, LaTeX, Git.

Languages

English Professional proficiency
Mandarin Native proficiency