Zichen "Charles" Zhang

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Education

Macalester College, St. Pual, MN   *B.A. Expected Dec. 2022*
Major GPA 4.0/4.0   *Mathematics, C.S.*

- Charles J. Turck Presidential Honor Scholarship (Four-year scholarship); School Dean's List (2019 - PRESENT)

Research Interest

My primary research interest lies in designing, developing, optimizing, and deploying elegant learning algorithms as well as their underlying mathematical principles to build autonomous agents that can perform in dynamic environments, solving real-world puzzles for social good. I am interested in both Generalist and Specialist agents.

Research Experience

Research   *CA*
NVIDIA & Stanford Vision and Learning Lab (SVL)   *May. 2022 - Oct. 2022*

- Join the research with people from NVDIA and SVL, supervised by Linxi (Jim) Fan and Yuke Zhu.
- Develop and improve the novel multi-modal prompt driven robotic manipulation tasks suite, VIMABench. Take part in variety of foundation models implementation for sequence modeling upon DistilBert, ResNet, Action-GPT, MaskRCNN, e.t.c. for initial experiments, ablations, and baselines.
- Engineer the high-quality rendering, textures, and UV unwrapped OBJ meshes, and contribute to the *NVISII* code base, especially fixed the issue of loading urdf with primary shape objects.

Research   *Seattle, WA*
PRIOR team, Allen Institute for AI (AI2)   *Sep. 2021 - Present*

- Lead the project to develop, optimize and build solutions of Reset Free Reinforcement Learning with Sink States via Adversarial Gameplay mentored by *Luca Weihs*.
- Apply techniques in dynamism, recurrent models, data augmentation by MDP homomorphism under rotation invariance, experience rollout block storage along with an adversarial reward reply storage training pipeline, etc.
- Contribute codes and tutorials for baseline experiments and pretrained models of MuJoCo environments to the project of the modular and flexible learning framework *AllenAct*.

Summer Research   *St. Paul, MN*
Advised by Professor Lisa Naples, MACALESTER COLLEGE   *Jun. 2021 - Aug. 2021*

- After answering the Traveling Salesman Problem (TSP) in mathematics, develop and prove theorems and lemmas to extend the characterization of geometric measures that are carried by rectifiable curves in the dyadic cube system.
- Present algorithms for the construction of a rectifiable curve using appropriately chosen δ-neighborhood.

Research   *Beijing, China*
R & D Department, Thorough Images   *Jan. 2021 - May 2021*

- Lead the project of automated scoring systems for human epidermal growth factor receptor 2 (HER-2) after immunohistochemical (IHC) staining mentored by co-CEO & CTO *Shuhao Wang.*
- Apply for the National Invention Patent (Chinese) and proceed to deploy in top Chinese hospitals.
- Use techniques realized by OpenCV and Skiamge with various types of neural networks implemented by PyTorch and TensorFlow libraries to preprocess, recognize, segment, and classify in the pathological images for various pathological examinations.

Summer Research   *St. Paul, MN*
Advised by Prof. Esra Kadioglu Urtis, MACALESTER COLLEGE   *Jun. 2020 - Aug. 2020*

- Develop Q learning based algorithms with simulations for UAVs coverage building in Gym or by graph.
- Create a Gym environment for the coverage path planning for multiple drones using ACKTR deep provided by Stable Baselines (OpenAI), with comparison with the stability and convergence with DQN, DDPG, PPO, A2C, and A3C.

Publications / Preprints

* indicates equal contribution, † indicates equal advising

VIMA: General Robot Manipulation with Multimodal Prompts
Y. Jiang, A. Gupta*, *Z. Zhang**, G. Wang*, Y. Dou, Y. Chen, L. Fei-Fei, A. Anandkumar, Y. Zhu†, and L. Fan†,
under submission, 2022
A transformer that ingests multimodal prompt and controls a robot arm for a wide range of manipulation tasks.

Reset Free Reinforcement Learning with Sink States via Adversarial Gameplay
Z. Zhang, L. Weihs, in progress, 2022
Current Research about Reset Free Reinforcement Learning with Sink States via Adversarial Gameplay.

Automated Scoring System of HER2 in Pathological Images under the Microscope
Z. Zhang, L. Wang, and S. Wang, 18th European Congress on Digital Pathology (ECDP), 2022
Research paper for automatically recognizing and scoring HER-2 status under pathological images with interpretable procedures.

Characterization of Rectifiable Measures Carried by Lipschitz Curves
Z. Zhang, Y. Wu, and L. Naples, JMM Contributed Paper Session, AMS-PME Poster Session, 2022
Accepted for Joint Mathematics Meeting (JMM) 2022, AMS Contributed Paper Session on Functions of Complex Variables, Measure and Integration Theory (**1** of **6** presenters), and America Mathematical Society-Pi Mu Epsilon (AMS-PME) Poster Session.

Area Coverage with Unmanned Aerial Vehicles Using Reinforcement Learning
Z. Zhang, E. Landgren, F. Zhang, A. Gould, and E. Kadioglu-Urtis, Preprint, 2020
Research paper for summer research at Macalester mentored by Esra Kadioglu Urtis (now at Wake Forest University).

Design and Optimization of Comb Drive Accelerator for High Frequency Oscillation
Z. Zhang, C. Chen, Modern Mechanical Engineering 8.01 (2018): 1.
Mentored by Dr. Chen (UCLA), a finite element code is used for design, optimization, and visualization of a comb drive accelerator.

Generalized Trajectory Problems of Fixed-Point and Fixed-Line with Motion Scaling
Z. Zhang Mathematical Study and Research (China) (19), 2017
Chinese geometrical paper for mathematical Olympics competitions, generalized trajectory problems by an elegant method.

Teaching

Teaching Assistant at Macalester College

Fall 2022	**COMP 484: Intro to Artificial Intelligence**
Spring 2022	**MATH 378: Complex Analysis**
Fall 2021	**STAT/COMP 112: Intro to Data Science**
Spring 2021	**COMP 394 Topics Course: Reinforcement Learning** design and write code implementations for homework and class materials
Fall 2020	**COMP 128: Data Structure**
Spring 2020	**STAT/COMP 112: Intro to Data Science**

Programming Skills

Python	PyTorch, TensorFlow, OpenCV, AllenAct, NVISII, Pybullet, MuJuCo, Gym, Baselines, nltk
R	xgboost, ggplot, ggmap, plotly, leaflet, gganimate, rvest, shinny
Others	Java, C++, C, Blender, MATLAB, SQL, Vue, HTML, CSS, TEX

References

Luca Weihs, *Senior Research Scientist, Allen Institute for AI, lucaw@allenai.org*
Linxi (Jim) Fan, *AI Research Scientist, NVIDIA, linxif@nvidia.com*
Shuhao Wang, *CTO, co-CEO, Thorough Images, eric.wang@thorough.ai*
Lisa Naples, *Assistant Professor, Macalester College, lnaples@macalester.edu*
Esra Kadioglu-Urtis, *Visiting Professor, Macalester College, kadioglu@gmail.com*