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, Computer Science*

- 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 (embodied, multi) agents that can perform in dynamic environments, solving real-world puzzles for social good. I am especially interested in the safety, generalizability, and sample efficiency for vision-based reinforcement learning in the real world.

Research Experience

Research *CA*

Stanford Vision and Learning Lab (SVL) & NVIDIA *May. 2022 - Present*

- Join the research with people from SVL and NVDIA, supervised by Linxi (Jim) Fan and Yuke Zhu.
- Develop and improve the novel multi-modal prompt driven robotic manipulation tasks.
- Develop models including multi-modal encoder upon DistilBert, ResNet, Action-GPT, e.t.c. for ablations and baselines.

Research *Seattle, WA*

PRIOR team, Allen Institute for AI (AI2) *Aug. 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

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

Spring 2022 **Complex Analysis**
Fall 2021 **STAT/COMP 112 Intro to Data Science**
Spring 2021 **Reinforcement Learning** design and write code implementations for homework and class materials
Fall 2020 **Data Structure**
Spring 2020 **Intro to Data Science**

Relevant Coursework

Coursework at Macalester College (4.0/4.0)

Math Stats CS Optimization (plan), Advanced in Data Science (plan), Bodies/Minds: AI Robotics, Mathematical Statistics, Signal Processing, Topology, Reinforcement Learning, Database Management Systems, Probability, Combinatorics, Numerical Analysis, Algorithm Design and Analysis, Computer Systems Organization, Data Structure, Software Design and Development, Differential Equations, Complex Analysis, Real Analysis, Digital Ethics.

Online Courses

ML, RL CS542 Statistical Reinforcement Learning *(Prof. Nan Jiang, UIUC)*, Machine Learning *(Prof. Andrew Ng, Stanford)*

Programming Skills

Python numpy, matplotlib, PyTorch, TensorFlow, Keras, Paddle, OpenCV, AllenAct, XGBoost, Gym, Baselines, nltk
R ggplot, ggmap, plotly, leaflet, gganimate, rvest, shinny
Others ROS, Java, C++, C, 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*