Lingzhi Kong

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EDUCATION

Northeastern University   Sep. 2019 – Sep. 2022
Master of Science in Robotics - Computer Science   *Boston, MA*

Northeastern University   Sep. 2015 – Jan. 2018
Master of Engineering in Control Engineering   *Shenyang, China*

Inner Mongolia University of Technology   Sep. 2010 – July 2014
Bachelor of Engineering in Electrical Engineering   *Huhhot, China*

TECHNICAL AND PERSONAL SKILLS

Programming: *Proficient in* Python, MATLAB, Pytorch, Numpy; *some experience in* C/C++, Javascript, Node JS, ROS, Mongodb.
Tools and operating system: *Proficient in* Latex, Git, Linux.
Language: English (*Professional working proficiency*); Chinese (*native*); Mongolian (*daily conversation*).

EXPERIENCE

Research Assistant   Jan. 2021 – present
Khoury College of Computer Sciences, Northeastern Univeristy   *Boston, MA*

- Conducted research on Deep Neural Networks and Group Theory, with Prof. Lawson Wong and Prof. Robin Walters.

Teaching Assistant   Sep. 2020 – Dec. 2020
CS 5180 Reinforcement Learning and Decision Making, Khoury College of Computer Sciences   *Boston, MA*

- Designed coding assignments regarding topics in the course.
- Provided guidance for students' course projects in terms of implementation and project choice.

Software Developer   May 2016 – May 2017
Shenyang Institute of Automation, Chinese Academy of Sciences   *Shenyang, China*

- Developed the software for a surgical robot for bone surgery.

PROJECTS

Differentiable Equivariant Planning Neural Networks   Oct. 2021 – present

This work proposed differentiable equivariant planning networks, which enables an artificial agent to learn to plan and at the same time, exploits group symmetries such as rotations, reflections, and permutations. This is important for data that has symmetries, such as navigation, graph, molecules, etc. Our networks outperformed previous methods in a 2D navigation environment in terms of both data efficiency and accuracy.

- Formulated our framework by introducing group symmetries based on existing value iteration frameworks.
- Implemented the models guided by the formulation using **convolutional LSTM** and applied them to 2D navigation environments.
- Conducted several baseline experiments to compare with our models and demonstrated our models outperformed baseline algorithms.

Social Media Web Application   Sept. 2021 – Dec. 2021

This project built a web application that implements a social network similar to Twitter. It designed for people who could share their moods and feelings during Covid-19. The user can create and edit new posts and other users can reply or like the posts.

- Implemented Backend using **Node.js** and designed **RESTful APIs** based on **Express.js** to handle HTTP requests and responses in JSON format.
- Applied **MongoDB** and Mongoose as repository to handle high frequency of information and interactions
- Built the interactive web frontend workflow using **React.js**.

Compositional Generalization in Object-Oriented Environments
Jan. 2021 – Dec. 2021

This work formalized the compositional generalization problem using group theory and homomorphism. Motivated by the formulation, we proposed a framework, which aimed to learn objects representations and their relations, and then algebraically compose those components to understand infinite scenes with novel combinations of objects.

- Participated in formulating the problem using group theory and homomorphism.
- Implemented the models guided by our formulation using **Graph Neural Networks**
- Implemented the environments for our experiments.
- Conducted several baseline experiments to compare with our models.

Mobile Robot Mapping and Navigation | *Robotic Navigation, ROS*
Oct. 2020 – Dec. 2020

The first goal of this project is to solve a Maze, i.e. find the exit path from where the robot is located, and the second goal is to realize real-time obstacle avoidance.

- Implemented an algorithm that enables the robot to explore the whole Maze environment and at the same time build a map of the environment using SLAM mapping package in Robot Operating System (ROS).
- Implemented the A* algorithm for path planning.
- Utilized Dynamic window approach in ROS packages to realize real-time obstacle avoidance.

Teaching an Artificial Agent to Play CarRacing Game | *deep RL, Data Aggregation*
Oct. 2019 – Dec. 2019

This project addressed decision making problems in autonomous driving by applying deep reinforcement learning and imitation learning algorithm in a simulated car racing environment.

- Implemented Dataset Aggregation (DAGGER) algorithm and applied it to OpenAI gym car racing environment.
- Demonstrated DAGGER is able to solve the CarRacing game using expert demonstrations.
- Demonstrated the efficacy of Proximal Policy Optimization in sequential decision-making problem.

Image-Guided Surgical Robot for Bone Surgery | *Surgical Robot*
May 2016 – May 2017

This work aimed to develop an image-guided surgical robotic system for bone resection. The system consists of a computer with imaging software, and a UR5 robot arm mounted with a surgical tool. The surgeon could plan a surgery path in imaging software, and then the robot would follow the path to perform the surgery.

- Developed the prototype of a surgical robot for bone surgery using Python and C++.
- Implemented the algorithms for 3D surgical path generation.
- Implemented the visualization module of the robot position and orientation using Visualization Toolkit.
- Implemented the registration algorithm to build the relationship between physical world space and image space.
- Integrated imaging software, robot control software, and hardware.
- Conducted the isolated trial experiment of bone resection and repair at a hospital.

RELEVANT COURSEWORK

- Algorithms
- Operating Systems
- Matrix Analysis
- Machine Learning
- Reinforcement Learning
- Mobile Robotics
- Micro-computer Architecture

PUBLICATION

- Linfeng Zhao, Lingzhi Kong, Robin Walters, Lawson L.S. Wong. Toward Compositional Generalization in Object-Oriented World Modeling. *International Conference on Machine Learning (ICML)*, 2022 (**Oral**)
- Lingzhi Kong, Linfeng Zhao, Robin Walters, Lawson L.S. Wong. Differentiable Equivariant Planning Neural Networks. *In submission*
- Linfeng Zhao, Lingzhi Kong, Robin Walters, Lawson L.S. Wong. Implicit Symmetric Planner: Integrating Symmetry into Model-based Planning. *Conference on Reinforcement Learning and Decision Making (RLDM)*, 2022

AWARDS & ACTIVITIES

2017 Graduate Project Scholarship, Shenyang Institute of Automation, Chinese Academy of Sciences
2017 Title of Outstanding Student, Shenyang Institute of Automation, Chinese Academy of Sciences
2016 Championship of Student Basketball Match, Shenyang Institute of Automation, Chinese Academy of Sciences
2016 The 1st Prize Scholarship, Graduate School of Northeastern University, China
2013 Title of Outstanding Leader of the Student Union, Inner Mongolia University of Technology
2013 Cycling in Qinghai-Tibet Line, Yumazhe Cycling Association, Huhhot
2012 The 2nd Place of College Student Basketball Match, Inner Mongolia University of Technology
2012 Title of Excellent Team, Educational Assistance Activities in Countryside
2011 National Encouragement Scholarship, Inner Mongolia University of Technology