YOONWOO KIM

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RESEARCH INTEREST

Keywords: Task and Motion Planning, Multi-robot planning, Reinforcement Learning, Dexterous Manipulation

My research objective is to create robots that can make intelligent decisions based on the environment and possible actions. My current research focuses on creating a unified probabilistic framework using a factor graph representation to plan in discrete and continuous state spaces. I am interested in leveraging learning-based methods such as reinforcement learning and latent state representations to push the boundaries of task and motion planning.

EDUCATION

Georgia Institute of Technology Aug 2020 - May 2023
Master of Computer Science
Thesis: Task Planning in Factor Graph Representation (Advisor: Prof. Frank Dellaert)

Georgia Institute of Technology Aug 2016 - May 2020
Bachelor of Computer Science, Graduated with Highest Honors

RESEARCH EXPERIENCE

Research Assistant Aug 2019 - Present
BORG Lab, Georgia Institute of Technology (Advised by **Prof. Frank Dellaert**) *Atlanta, GA*

- Proposed classical planner using max product elimination algorithm on a factor graph representation and implemented in C++. [Git]
- Contributed to C++ open source library (**GTSAM**) by implementing discrete probabilistic factor optimized for sparsity. The algorithm sped up sparse factor multiplication by 19.6 times on average. [Git]
- Implemented feature pyramid network with Swift for TensorFlow and tested on image segmentation task achieving 36AP on COCO dataset to contribute to Google's S4TF team.
- Estimated reachability map of the 7-DoF mobile manipulator using synthetic pose data from Rviz ROS and visualized in augmented reality using ARkit.

Research Assistant May 2022 - Aug 2022
Korea Advanced Institute of Science and Technology (Advised by **Prof. Beomjoon Kim**) *Seoul, South Korea*

- Proposed task and motion planning algorithm with 3D geometric and physics-based reasoning.
- Investigated uncertainty-aware 3D shape completion model using voxel-based variational autoencoder.
- Designed conditional energy-based grasp generation model while comparing various training methods such as MCMC sampling and NCE in Pytorch.
- Implemented robotic grasping simulation in Nvidia Issac Gym.

Visiting Undergraduate Researcher May 2019 - Aug 2019
Tokyo Institute of Technology *Tokyo, Japan*

- Investigated automating hyperparameter optimization process for reinforcement learning algorithms using the covariance matrix adaptation evolutionary strategy (CMA-ES). [Git]
- Demonstrated DQN algorithm optimized by CMA-ES performed 3.5 times better than the baseline hyperparameters provided by OpenAI when tested on a simple environment.

Machine Learning Intern May 2019 - Aug 2019
Emory University Hospital *Atlanta, GA*

- Applied natural language processing technique to automate and filter appropriate radiology studies.
- Improved model accuracy from 54% to 88% by applying BERT pre-trained model on a biomedical dataset.

WORK EXPERIENCE

Autonomous Driving Software Engineer Intern May 2021 - Aug 2021
Lucid Motors *Newark, CA*

- Implemented auto-calibration for the Lucid Air model by developing a vision-based ground normal estimation model in Pytorch with an average error of 1.2 degrees.
- Enabled sharing feature encoder backbone through developing multitask learning framework in Pytorch which combines segmentation and depth estimation branch.

Software Engineer Intern May 2020 - Aug 2020
Samsung Strategy and Innovation Center *San Jose, CA*

- Selected as the top three teams nationwide in Samsung's Uventure competition.
- Demonstrated use case of human-robot interaction tool by delivering a working demo of the pipeline in ROS package.
- Developed depth-based target estimation model and custom gesture detection model in Pytorch utilizing RGB-D camera and lidar sensors on Turtlebot2.

TEACHING

CS6476 Computer Vision, Teaching Assistant Fall 2021, Spring 2022
Georgia Institute of Technology *Atlanta, GA*

- Assisted class size of 250 students on campus by holding weekly office hours and replying to questions online.
- Designed and implemented an image segmentation project using the Kitti road segmentation dataset with Pytorch.

CS6601 Artificial Intelligence, Teaching Assistant Spring 2021
Georgia Institute of Technology *Atlanta, GA*

- Assisted class size of 600 students online through holding weekly office hours, replying to questions online, and writing exam questions.

PROJECTS

Teaching a Robotic Guide Dog to Walk with Human User (Advisor: Prof. Sehoon Ha)
Proposed and tested model and training scheme to train a locomotion policy for a quadrupedal robotic guide dog to walk while resisting external forces applied from the human.

Incremental Object Grounding using Scene Graphs (Advisor: Prof. Sonia Chernova)
Improved previous state-of-the-art object grounding task by 30% through using image and language scene graphs and proposing a novel incremental algorithm. Paper submitted.

Learning Generalized Representations via Combining Pretext Tasks (Advisor: Prof. Judy Hoffman)
Improved data-efficiency by 4% by using autoencoder to combine representations of various downstream tasks.

PUBLICATIONS

Thesis

- **Yoonwoo Kim**. "Task Planning in Factor Graph Representation", 2023. [pdf]
  - *Committee: Prof. Frank Dellaert (Advisor), Prof. Matthew Gombolay, Prof. Danfei Xu*

Preprints

- **Yoonwoo Kim**, John Seon Keun Yi, Sonia Chernova. "Incremental Object Grounding Using Scene Graphs", *Submitted to HRI Late Breaking Reports 2023.* [arXiv]

SKILLS

Technical Skills	C++, Python, Java, PyTorch, GTSAM, Docker, ROS
Language	English, Korean

HONORS AND AWARDS

- **Highest Honors, Institutional Award**, Georgia Institute of Technology (2020)
- **Nominated as finalist of Samsung Uventure Competition (top 3)**, Samsung Strategy and Innovation Center (2020)
- **Faculty Honors**, Georgia Institute of Technology (Summer 2017)
- **Dean's List**, Georgia Institute of Technology (Fall 2016, Spring 2017, Fall 2017, Spring 2018, Fall 2018)