Robotics and Embedded Systems

Human Brain Project

Master/Bachelor Thesis - Semester Project

Complex Robotic Manipulation via Actionable Representation Learning Guided Exploration

Background

Representation learning refers to a transformation of an observation, such as camera image or state observations, into a form that is easier to manipulate to perform a downstream task. In combination with reinforcement learning (RL), salient representations can enable generalizable RL controllers to be learned for dynamic changing tasks with static pattern in which a planner can focus on which states to reach, rather than how those states are reached. For goal reaching tasks, one intuitive example can be imagined as a football scoring task in which the goal keeper is blocking the ball from going to the goal. Therefore, it is essential to explore better methods to extract representations and integrate it to more complicated downstream tasks. Recent research on this topic are developing fast and prosperously, such as the actionable representation control (ARC) [1] and universal planning network (UPN) [3]. However, there are still a set of research problems to be explored and possible tasks that can be better solved with representation learning [2].

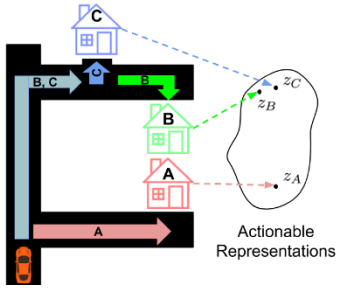
Your Tasks

In this thesis, your task will be learning state-of-the-art knowledge of reinforcement learning and representation learning and then develop more advanced algorithms or application scenarios. To be specific:

1. You will first learn basic knowledge of reinforcement learning. Online materials are recommended, such as David Silver course and Standford CS 234.
2. You will reproduce the results of state-of-the-art representation algorithms and other related research results. By doing this, you will have a deep understanding of related knowledge.
3. You will explore your own ideas or choose from one of the possible ideas that we offer, investigate a novel algorithm that makes improvement on the state-of-the-art.

Requirement

- High self-motivation;
- Six month working time;
- Experiences or knowledge from related courses
- Python programming experiences.



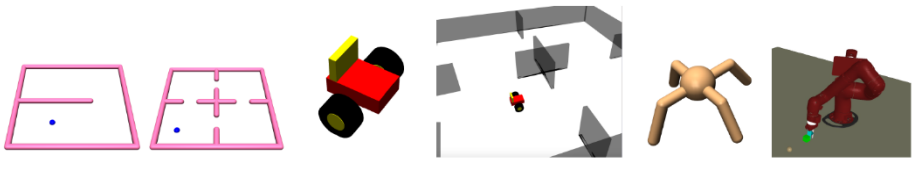


Figure 1 A concept of representation learning and possible robotic applications

Supervisor: Prof. Alois Knoll

Advisor: Zhenshan Bing

bing@in.tum.de

Lehrstuhl für Echtzeitsysteme und Robotik,

Fakultät für Informatik, Technische Universität München

[1] *Ghosh, Dibya, Abhishek Gupta, and Sergey Levine. "Learning actionable representations with goal-conditioned policies." arXiv preprint arXiv:1811.07819 (2018).*

[2] *Nasiriany, Soroush, et al. "Planning with Goal-Conditioned Policies." Advances in Neural Information Processing Systems. 2019.*

[3] *Srinivas, Aravind, et al. "Universal planning networks." arXiv preprint arXiv:1804.00645 (2018).*