TECHNISCHE UNIVERSITÄT MÜNCHEN
Human-centered Assistive Robotics
UNIV.-PROF. DR.-ING. DONGHEUI LEE

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MASTER'S THESIS

Intuitive Knowledge Representations for Interactive Robot Programming

Problem description:

We are aiming towards an era, where robot programming is not only subject to experts but requires shop floor workers and people in daily life situations to program robots. Learning from Demonstration (LfD) has been proven as an appropriate method to do so but if task structures are getting more complex, the user might loose control of what the system has already been learned and what are its limitations. We can overcome this by employing active learning techniques where the system decides what information is missing. Additionally, we want to present the system's knowledge in an intuitive way to increase explainability [1], correctability and parameterization options for constraints that cannot be extracted from demonstration.
The goal of this project is to extend an existing LfD framework [2] with active learning techniques to speed up task learning and at the same time, provide an interactive communication channel that gives the user all necessary options to understand and control the task definition process.

Tasks:

- Literature survey on robot LfD, active learning and interactive robot programming
- Development of an active learning method for graph-based task structures with semantic annotation of task segments (skills) [3]
- Combination of different sensor modalities: motion, force, and optionally vision
- Design and implementation of an interactive feedback channel (GUI and possibly speech) that represents the task and allows correctability
- Experimental evaluation of system capabilities and human-robot interaction performance

Bibliography:

[1] Mark Edmonds, Feng Gao, Hangxin Liu, Xu Xie, Siyuan Qi, Brandon Rothrock, Yixin Zhu, Ying Nian Wu, Hongjing Lu, and Song-Chun Zhu. A tale of two explanations: Enhancing human trust by explaining robot behavior. *Science Robotics*, 4(37), 2019.
[2] T. Eiband, M. Saveriano, and D. Lee. Intuitive programming of conditional tasks by demonstration of multiple solutions. *IEEE Robotics and Automation Letters*, 4(4):4483–4490, Oct 2019.
[3] Scott Niekum, Sachin Chitta, Andrew G Barto, Bhaskara Marthi, and Sarah Osentoski. Incremental semantically grounded learning from demonstration. In *Robotics: Science and Systems*, volume 9. Berlin, Germany, 2013.

Supervisor:	M. Sc. Thomas Eiband
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(D. Lee)
Univ.-Professor