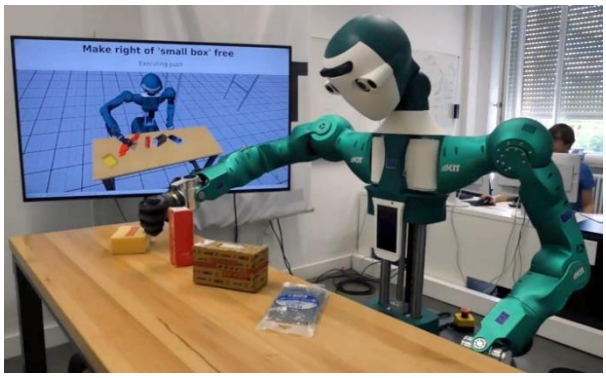
Incremental Learning of Object-Action-Effects using Multiple Learning Modes

Modern Machine Learning methods utilize massive amounts of data to learn complex models. Usually, all training data must be acquired before learning can start. Then, learning is done offline by processing batches of training data. The learned model can only be deployed after training converges. However, in robotics, acquiring large amounts of training data is usually infeasible. Therefore, applied learning methods must be sample-efficient and allow the robot to incrementally learn from new experience.



The humanoid robot ARMAR-6 predicts effects of pushing actions on objects in a table-top scene. Its prediction model has been learned offline and on simulation data. By incrementally learning from new experience, the robot could improve its prediction model.

In this work, you will investigate how effects of manipulation actions can be learned using multiple learning methods with varying complexity. For example, with only few samples, a simple linear model could be learned. After acquiring more samples, the performance of the simple model may degrade, therefore, switching to a more complex model may be appropriate (e.g. polynomial model, Gaussian Mixture Models, Neural Network).

Relevant research questions include:

- When and how to switch between models? This requires an understanding of how well the current models perform.
- How can simple models be used to bootstrap more complex models in a semi-supervised manner?

In this project, you will work with the humanoid robot ARMAR-6 as well as several robotics and machine learning tools:

- ArmarX (C++, Python): armarx.humanoids.kit.edu
- Tensorflow (Python): tensorflow.org
- Scikit-learn (Python): scikit-learn.org

Kontakt: Fabian Paus (fabian.paus@kit.edu), Rainer Kartmann (rainer.kartmann@kit.edu)

Institut für Anthropomatik und Robotik | Lehrstuhl Prof. Asfour (H^2T) | www.humanoids.kit.edu