



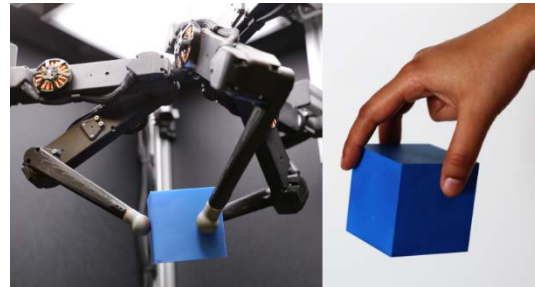
## Master Thesis Projects

# Learning and Dynamical Systems

Machine learning algorithms, which aim at extracting and recognizing patterns from observed data, will play a central role for enabling robotic systems that efficiently and seamlessly adapt to changing environments. While current supervised learning techniques have been very successful at tasks such as image recognition, speech recognition, or personalized recommendations, their extension to cyber-physical and robotic systems leads to many challenges. A promising approach to deal with these challenges is to incorporate the wealth of a-priori known structure that many robotic and cyber-physical systems have, such as approximate models based on first principles, symmetries, and invariants. This could improve the sample complexity, ensure that the predictions generalize to unseen situations, and could also facilitate down-stream tasks.

At the Empirical Inference Department and the Learning and Dynamical Systems Group we seek to extend and combine techniques from machine learning, dynamical systems, and control theory in order to enable future cyber-physical and robotic systems. While rigorous theory and mathematical analysis forms the basis of our research, we also evaluate our methods in experiments on real-world systems (see pictures below).

We are continuously looking for outstanding students who are eager to do their master's thesis on a challenging research project in a highly stimulating environment. We have a variety of possible projects available, covering theoretical and/or practical aspects of machine learning in connection to cyber-physical systems.



Photos: Real-world experiments at the Empirical Inference Department (left: table tennis robot, right: dexterous manipulation challenge).

### **Empirical Inference Department (<https://ei.is.mpg.de/>)**

The Empirical Inference Department is headed by Prof. B. Schölkopf and part of the Max Planck Institute for Intelligent Systems located in Tübingen, Germany. The Max Planck Institute for Intelligent Systems and ETH Zurich are in close collaboration, for example via the Max Planck ETH Center for Learning Systems. Accommodation at the institute's guest house may be available for the duration of the project, and travel to international conferences can be supported if the project leads to a publication.

### **Prerequisites**

Strong analytical skills and programming experience (Python, MATLAB, C/C++ or similar). Background in machine learning, control theory, statistics, or mathematical optimization is a plus.

### **Contact**

If you have any questions do not hesitate to contact us. When applying for a project, please include your CV, bachelor's and master's transcripts, and a one-page letter of motivation describing your research interests and educational background.

Dr. Michael Muehlebach, [michael.muehlebach@tuebingen.mpg.de](mailto:michael.muehlebach@tuebingen.mpg.de)