



Master Thesis (6M) or Research Thesis (3M)

Thesis title	Causal model identification with multivariate and discrete input
Thesis description	<p>Deep learning is flexible and very powerful due to its excellent feature learning and pattern recognition capability. However, deep learning suffers from some serious limitations: lack of explainability and poor cross-domain generalization. Causal learning is a new emerging research area. It combines deep learning with causality in order to address the above bottlenecks. The core of causal learning is a structural causal model (SCM) explaining the cause-effect relationships of all involved variables. In practice, given observed data and the underlying causal graph, the remaining causal mechanisms of the SCM have to be estimated from data.</p> <p>The aim of this thesis is investigation of model identification algorithms, in particular for the multivariate input case where some of the input variables may be discrete-valued (categorical). The steps of the thesis are:</p> <ul style="list-style-type: none"> • Literature study • Leverage and improvement of existing model identification algorithms from literature • Design of synthetical data like $Y=f(X_1,\dots,X_d,N)$ and estimate the model (function $f()$ and distribution of N) from observations of X_1,\dots,X_d,Y • If successful, apply the same technique to real data (RGB images of street scenes) in autonomous driving. <p>During the thesis, you will learn a lot of modern mathematical concepts and methods for causal modeling and model identification (structural causal model, normalizing flows, Gaussian process regression, ...)</p>
Qualifications	<ul style="list-style-type: none"> • Interest on causal learning • Strong knowledge in mathematics and deep learning • Programming skills in Python and Pytorch
Begin	According to agreement
Duration	6M for Master thesis or 3M for Research thesis in case of excellent students
Language	English or German
Supervisor	Prof. Yang (bin.yang@iss.uni-stuttgart.de)