**Associate Professor Shunsuke Horii**

**Bayes Optimal Estimation of Intervention Effects and its Approximation**

Abstract: To estimate the causal effect under Structural Causal Models (SCMs), it has to know or estimate the model that generates the data. However, it is often difficult to verify which model is correct based only on the data, so some models remain candidates for the data generating model. In this study, we first show from a Bayesian perspective that it is Bayes optimal to average the causal effects estimated under each model rather than estimating the causal effect under a single fixed model. This idea is also known as Bayesian model averaging, and our study is an attempt to apply it to the causal estimation under SCM. Although the Bayesian model averaging is optimal, as the number of candidate models increases, the weighting calculations become computationally hard. We develop an approximation to the Bayes optimal estimator by using the variational Bayes method. We show the effectiveness of the proposed methods through numerical experiments based on synthetic and semi-synthetic data.

**Assistant Professor Yuta Nakahara**

**Statistical Models for Image Processing: Hierarchical Representation of Global and Local Structures of Images**

Abstract: There are two types of image processing. One is with statistical models, and another is without statistical models. Practically, the latter works well, for example, deep neural networks. However, there is a difficulty to give statistical optimality or guarantee. Therefore, the development of statistical models is required theoretically. In this study, I introduce an idea to represent both global and local structure of images as hierarchical statistical models. I will talk about a probabilistic block segmentation model based on quadtrees as the model for the global one and a two-dimensional auto-regressive model for the local one, especially in this presentation.