Deep Generative Model: A Statistical Perspective (STT 997)

Instructor: Younggeun Kim (kimyo145@msu.edu)

Room and Time: TT 12:40PM-2:00PM at WH C506

Objective: This course aims to provide a comprehensive understanding of generative models, machine learning methods for learning and synthesizing complex and large-scale data, and to enhance the ability to implement these models. Topics include latent variable models, statistical distances used to learn distributions, and advanced applications such as temporal, multi-modal, and medical data scenarios in generative model literature.

Description: Generative models are statistical models that learn high-dimensional data distributions and can generate realistic synthetic data. Key components include model classes that approximate data distributions, statistical distances that quantify discrepancies between real and model distributions, and inferences based on them. This course aims to deepen insight into and knowledge of the statistical principles behind these components, explore transitions in generative model literature, with a particular focus on deep generative models, and provide hands-on experience with popular algorithms.

Given the broader impact and growing importance of generative models in interdisciplinary fields, this course welcomes students interested in generative models from diverse backgrounds, including Computer Science and Engineering (CSE), Computational Mathematics, Science and Engineering (CMSE), and the Department of Mathematics. To make the course more inclusive, several lectures on preliminary statistical knowledge, such as likelihood maximization principles and information theory, as well as basics of Python and PyTorch programming, will be provided.

Prerequisites: There are no specific prerequisite courses; however, students interested in this course may review the slides from my STT 990 seminar talk, available at https://kyg0910.github.io/teaching/. This was a 3-hour talk that briefly introduced popular statistical distances and their roles in generative models for graduate students in the Department of Statistics and Probability. For example, the lecture on preliminary statistical knowledge in this STT 997 course will cover the basics of statistical distances to aid understanding of these slides.

Textbook (not required): Goodfellow, Ian. "Deep learning" (2016); online access (free): https://www.deeplearningbook.org/