

## SS22 MTH994: Machine Learning

**Instructor:** Guowei Wei – wei@math.msu.edu

**Office:** D301 Well Hall

**Course Description:** Machine Learning (ML), including deep learning (DL), is a powerful technique widely used in many data science areas such as finance, insurance, economics, biology, bioinformatics, drug discovery, engineering, language processing, face recognition, image segmentation, etc. In this course, we will not only discuss the theoretical framework of ML algorithms and architectures but also put an emphasis on programming skills so that each student is able to implement advanced ML algorithms for real-world problems. This course will cover some basic material, such linear regression (LR), logistic regression (LR), support vector machine (SVM), kernel learning (KL), and decision trees (DT), manifold learning, and statistic learning. We will also discuss DL, back-propagation, transfer learning, convolutional neural networks (CNNs), recurrent neural network (RNNs), variational autoencoder (VAE), encoder, decoder, transformer, generative adversarial network (GAN). The course will try to help graduate students with their research needs in ML and DL. The mathematical foundation of ML and DL, such as geometry, topology, combinatorics, and partial differential equation, will be an emphasis throughout the entire course.

**Prerequisites:** None but assuming a student knows advanced calculus, linear algebra, and has good coding skill.

**Text:** There is no required textbook for this course (A full set of lecture notes and tutorial materials will be provided at no cost.).