FS18 MTH994-Sec-001: Machine Learning

Instructor: Guowei Wei – wei@math.msu.edu
Office: D301 Well Hall

Course Description: Machine Learning (ML) is a powerful technique widely used in many big data areas such as insurance, economics, biology, bioinformatics, medicine, engineering, face recognition etc. In this course, we will not only discuss theoretical framework of ML algorithms and architectures but also put an emphasis on programming skills so that each student is able to implement ML algorithms for real-world problems. The course starts with linear regression, logistic regressions, *k*-means, *k*-nearest neighbors, support vector machine, and decision trees, including random forest and gradient boosting trees. After discussing these elementary materials, more advanced methodologies such as deep neural networks, back-propagation, convolutional neural network (CNN), recurrent neural network (RNN), and generative adversarial network (GAN), will be studied. The course will try to help graduate students with their research needs in ML.

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

Text: There is no required text for this course.

SS19 MTH994-Sec-001: Machine Learning

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Course Description: The second semester course on machine learning (ML) will be focused on advanced techniques and algorithms, including the design and optimization of artificial neural networks (ANN), transfer learning (TL), convolutional neural network (CNN), recurrent neural network (RNN), capsule network (CapsNet), autoencoder (AE), generative adversarial network (GAN), Boltzmann machine (BM), deep belief network (DBN) etc. We will also discuss research-level topics, such as analyzing the intrinsic dimensionality of dataset encoding, making deep learning more transparent (less a black-box), more efficient, and more robust in the selection of hyperparameters, designing new machine algorithms and reformulating ML algorithms from the mathematical point of view. This course draws on a variety of mathematical subjects, including algebra, topology, geometry, analysis, differential equation, optimization, statistics and probability. This course will involve active research in ML.

Prerequisites: A student needs to have passed the first semester course on ML.

Text: There is no required text for this course