In this class project, we will systematically implement and examine the three major categories of machine learning techniques of this course, including supervised learning, un-supervised learning and deep learning. For each section of the project, you will need to submit the code you used to complete the project and a report explaining your methods and math.

**Part 1: Density estimation and classification**

In this part, you need to first perform parameter estimation for a given dataset (which is a subset from the MNIST dataset). The MNIST dataset contains 70,000 images of handwritten digits, divided into 60,000 training images and 10,000 testing images. You will submit the code and a report explaining your approach and the math you used. These deliverables are due at the end of week 3.

**Part 2: Unsupervised Learning (K-means)**

In this part, you are required to implement the k-means algorithm and apply your implementation on the given dataset, which contains a set of 2-D points. You are required to implement two different strategies for choosing the initial cluster centers. You will submit the code and a report explaining your approach and the math you used. These deliverables are due at the end of week 5.

**Part 3: Classification Using Neural Networks and Deep Learning**

In this part, we will revisit the Handwritten Digits Recognition task in Part 1, using a convolutional neural network. The basic dataset is the same MNIST dataset from Part I, but you may choose to use only a subset for training and testing, if speed performance with the entire dataset becomes a bottleneck. For example, you may use only 6000 samples for training (each digit with 600 samples) and 1000 samples for testing (each digit with 100 samples). You will submit the code and a report explaining your approach and the math you used. These deliverables are due at the end of week 8.