

## Course Project for ECE 503

Students who have registered for ECE 503 are required to complete a course project. A perfect project is worth 10 points (out of 100) of the course credit.

Concerning project topics, you have two options:

Option I: Implement a method of your choice to classify MNIST handwritten digits. The data sets for this problem are the same as those used in Lab Experiment 4, and they are available from the Dataset in Brightspace.

Option II: Identify and solve an ML application problem of your choice that has technical complexity comparable with the problem in Option I, where optimization plays a critical role in its solution.

If you decide to choose Option I, be aware that

- (1) the same problem has been addressed in Lab Experiment 4. Therefore, to earn credit the techniques and methods to be used in your project must be different from that of Experiment 4.
- (2) there are many techniques available from the literature that are applicable to the classification of MNIST handwritten digits. These include, for example, PCA based and hinge-loss based methods for multi-class classifications. Listed below are a very small number of samples:
  - J. Weston and C. Watkins, "Support vector machines for multi-class pattern recognition," ESANN'1999 Proceedings – European Symposium on Artificial Neural Networks, Bruges, Belgium, April 1999, pp. 219-224.
  - K. Crammer and Y. Singer, "On the algorithmic implementation of multiclass kernel-based vector machines," Journal of Machine Learning Research, 2 (2001), pp. 265-292.
  - W.-S. Lu, "Handwritten digits recognition using PCA of histogram of oriented gradient," Proc. PacRim Conf., Victoria, BC, Canada, August 2017.

Components of your project report include:

- an introduction describing technical background of the problem;
- a section that formulates the problem at hand as an optimization problem;
- a section describing solution method(s);
- a section presenting computer simulations and numerical results;
- a reference listing the papers and sources that the report cites; and
- an appendix to include the MATLAB code used.

The norm of report's length is 15 to 20 pages.

A pdf file of your project report is due on the same day as the final exam (date to be announced). Please submit your report through Brightspace.