# ITC 6230 “Deep Learning”

## Winter 2023

# Final Project Description

**Due Date:** Midnight of the last day of classes

ALL options are for **single** person teams. Choose *one option only* from the above 2 options.

**Option 1:** Write a program that implements the Adam optimizer for training feed-forward neural networks using the Back-Propagation (BP) method for automatically computing the gradient of the loss function of the neural network, and test your implementation on a number of datasets. You are NOT allowed to use any code from Open-Source libraries such as PyTorch, Tensorflow, Keras, Caffe, sklearn, WEKA, MOA, deeplearning4J etc. The implementation must be your own code instead of copy-paste of code from any publicly available implementation.

Features to implement:

* Adam optimizer for training feed-forward neural networks (20 pts)
* The code must allow for neural networks consisting of nodes with different activation functions, supporting at least the following ones: ReLU, sigmoid, tangent, and linear. (20 pts)
* The code **must support reading a neural network topology from a file**, together with training and test dataset and ground-truth labels pairs. The same file must provide the parameters of the Adam optimizer (10 pts)
* The code must allow reading from the topology file **multiple** hidden layers. (10 pts)
* The code must allow specifying the loss function to optimize. Loss functions include the mean sum of square errors (MSE) (regression) and the categorical cross entropy function (classification). (10 pts)

Allowed implementation languages: Java/Scala, Python, C/C++, Julia.

(10 pts) Document using doc-strings (python) or Javadoc (Java/Scala) every class and method/function of your code.

(10 pts) Document the format of the topology file that your code can read.

(10 pts) Test your code on a series of experiments on test data (whose real labels will NOT be given) to be provided by the class instructor.

**Option 2: REQUIRES INSTRUCTOR APPROVAL.** Propose your own project to the class instructor. Provide a 1-2 page document with your proposal, containing the following information:

1. Brief Project Description: what the project is all about. The purpose of the project, and the techniques you will develop/use to carry out the project.

2. Datasets to be used: where and how you will obtain the data to experiment with.

3. Data Pre-processing to be required: describe what kind of data pre-processing and/or ETL techniques will be required before running the ML techniques you decide upon for the project.

4. ML techniques to be used: briefly mention what ML techniques you will use. If you will be developing your own algorithms, be sure to mention this. Otherwise, mention what ML libraries you will be using (e.g. Tensorflow with Tensorboard and Keras etc.)

**DUE DATE FOR SUBMITTING OPTION 2 PROPOSALS: March 14, 2023**

Once your project is approved, the criteria for grading Option 2 are the following:

(10 pts): Correct methodology for the project implementation: have a feasible path towards implementing your project (e.g. describe data acquisition process, possible outlier detection and removal, model training on sufficient computing hardware, validation data, etc.)

(40 pts): Originality of the proposed work: the project must show that something not done before was undertaken.

(30 pts): Correct use of the techniques utilized or developed.

(20 pts): Completeness of results including documentation and final report.