HW 4: ECE 601 Machine Learning for Engineers

Important Notes:

(a) When a HW question asks for writing a code, you would need to include the entire code as well as the output of the program as well as any other analysis requested in the question.

(b) Don't panic about the length of the HW assignment. HW assignments are treated as opportunities for improving learning and understanding, so I might include some extra text to help you better understand the concepts or learn about a point that was not covered during the class. The actual work needed from you is indeed manageable.

(c) Combine your solutions in **one** zip file called `homework4_UMassUSERNAME.zip`.

1. Consider the following neural network. Write a Python code to compute the output of the network given any input $x = [x_1, x_2]$. (Although, this is not required, try to write the code in a way that could be extended to a general implementation, i.e., a larger neural network.)

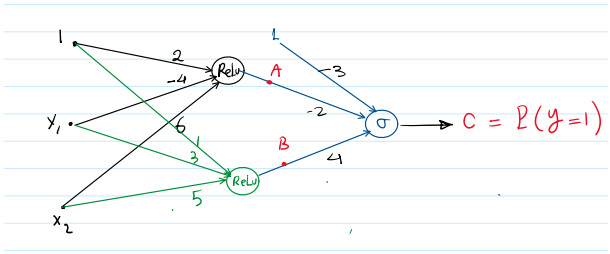

Figure 1: A simple neural network

2. In this question, we will apply a fully connected neural network to a real dataset containing health data of a population. This is the same dataset you used in Question 2 of HW3, which includes a column at the end indicating whether a person has heart disease. Our goal is to predict the presence of heart disease using the other columns in the dataset.

   Write your code including the following steps:

   (a) Load the dataset `heart.csv` as you did in Question 2 of HW3.

(b) Apply One-Hot Encoding to convert categorical data into numerical values.

(c) Implement a fully connected neural network without regularization on the dataset obtained from part (b). Use the neural network model code provided in `Lecture-7-Notes-Notebook.ipynb`, which is included in the class materials for Lecture 7 (available in Module 4 on Canvas). First, adapt the code to fit the dataset, noting that the input size should match the size of each sample from the dataset and that there are two classes to be predicted. Next, experiment with the network architecture by varying the number of hidden layers and neurons, as well as adjusting the epochs and minibatch sizes, to achieve an accuracy rate of over 80%.

(d) Repeat the process from part (c), but this time incorporate L2 regularization into the neural network. Experiment with the network architecture to achieve an accuracy rate of over 85%.