San José State University
Computer Science Department
CS156, Introduction to Artificial Intelligence, Spring 2021

Homework #6

Objective:

This homework's objective is to implement a single layer perceptron to classify handwritten digits (MNIST dataset).

Details:

For this assignment you will be using the handwritten digits dataset MNIST. You will implement digit classification from image data using a single layer perceptron.

Use any of the previously demonstrated methods to load the MNIST dataset. The most convenient is to use *load_digits()* function in scikitlearn. Once the data is loaded, each image will have to be reshaped/flattened into a single array. Also, note that MNIST data will need to be normalized. Here's an example of an easy way to do so (here X contains the flattened image data):

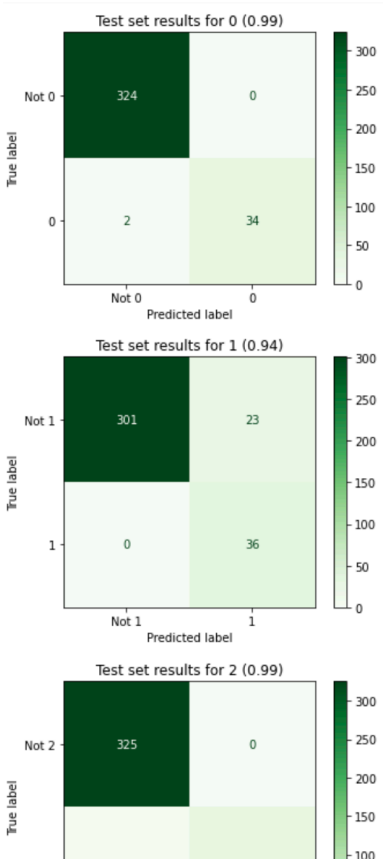
X = X.astype("float32") / 255

Remember that perceptron is a binary classifier. MNIST dataset is a multi-class dataset. This means that you will have to reformulate this multi-class classification problem as a set of multiple binary classification problems. A binary classifier for any given class would solve a class-vs-not (or one-vs-all) problem. In your code you will have to iterate over each possible class label and construct a new output variable vector where the value is 1 for observations of that digit class and 0 otherwise. Alternatively, you can use the same method to convert categorical variables to a set of binary variables I described in homework 5.

For each class label, split the data into training and test sets with 80/20 proportion. Make sure to stratify your split:

train_test_split(X, Y, test_size=0.2, random_state=0, stratify=Y)

Train a single layer perceptron model on the training data and compute accuracy of the model on the test data. Output a non-normalized confusion matrix for the test set prediction results. Include the class label and the accuracy in the title of the plot. Your code should output 10 total confusion matrices, one for each digit. Your output should look something like this (colors and the exact word choice are not important):



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Submission:

Email your assignment submission to me at Yulia.Newton@sjsu.edu and the grader (Akshay Kajale) at akshay.kajale@sjsu.edu. Make sure to email this submission by 11:59pm on the due date listed in Canvas. Your sent email is the proof of submission. The subject of the email should say "CS156 Assignment 6". In the body of the email list your name as it appears on the class roster and your student ID. Attach to this email both the pdf of your Jupyter notebook, which contains the solution for this homework assignment, as well as the notebook itself (the notebook file with .ipynb extension). Make sure to submit both files, otherwise the submission will not be considered complete.

Grading:

I will return the grades as fast as we can grade this homework. Normally it should not take more than a few weeks.

A total of 10 points are possible for this homework assignment.