

111B Data Science and Python Programming

Homework Assignment #7

Due: 6/13 12:00:00

The Faceless Men are a religious society of assassins who worship and serve the Many-Faced God, a god of death. It was told that the first Faceless Man was born in the volcanic slave mines of Valyria. No one really knows who he is and where he comes from. The only certain information is that he was active among the slaves and listened to their prayers. In the slave mines, there are people from hundreds of countries, and everyone prays to their gods in their own language, praying for the same thing - relief from pain, this extremely simple little thing. However, no one gets the response.

Until a blackout night caused by a mischievous, little, and cute animal, he realized the truth of the world that, all gods have their own tools, and people living in this world are only carrying out their will. People of different ethnic groups crying and praying the same thing to hundreds of different gods are actually crying out to the same God with hundreds of different faces, and he is the tool of this God, giving them the gift of God on their behalf. Once people have received the gift of God from him, he will say

VAAAX MORA6HULLIS

After talking about this nonsense, let's go back to our homework. This time, the God of Homework only has 10 faces. Your task is to use the Neural network algorithm to distinguish these 10 faces in the dataset.

Problem #1: Neural Network for Image Classification

There are two folders named "Training" and "Testing" in the file "hw7_data.zip," which consists of the images of 10 different people. Each image in the dataset is a grayscale image with size of 32x32 pixels as shown below.



The images are categorized based on the prefix of their filenames under this rule,

$\{\text{category}\}_{\{\text{index}\}}.\text{png}$.

For example, "America_001.png" indicates the second image of America category and "Taiwan_033.png". represents the 34th image of Taiwan category, respectively.

Please implement the neural network (NN) algorithm by yourself to classify these 10 kinds of images in the dataset. Please notice that **deep learning packages such as PyTorch and TensorFlow ARE STRICTLY PROHIBITED in this homework**. You can only accomplish this task with NumPy. The following requirements should be followed:

1. Please design a NN model architecture with **at least 2 hidden layers** and perform the random initialization for model weights.
2. Run backpropagation algorithm to optimize the parameters. Use cross-entropy loss as your loss function.
3. Train your model using the data provided in the ‘Training’ folder.
4. Plot the learning curves and the accuracy of classification versus the number of iterations (or epochs) until convergence for training data.
5. Show your result (classification accuracy) on the **testing data (the baseline of classification accuracy is 70%)**.
6. Please summarize your result in a report named **“report_hw7.pdf.”**

KINDLY REMINDER

The baseline model contains 300 and 100 neurons in the first and second hidden layers.

Grading	
Baseline	60%
Analysis	40%
Improvement	10% Bonus

Please accomplish this homework with an organized code (e.g., with main script and function script). For example, you can package your scripts that related to the class object in a module “**objs.py**”, some useful functions in other module, and remain the main content in the main script “**main_hw7.py**” clear. In addition, you should use “**argparse**” to set all related parameters of this homework. Here is a template for your code structure:

```
111B_hw7_0123456789
├─ objs.py          # Objects
├─ utils.py         # Utility functions for hw7
├─ main_hw7.py      # Main script of hw7
└─ report_hw7.pdf   # Report of hw7
```

You don’t need to follow this structure, just keep your main script clean.

Hand in procedure:

As we had mentioned in the lecture, you should list all your collaborators in your programs. Here is the template:

```
"""
Created on Sun Aug 7 01:23:45 2022

@author: Xi Winnie, student ID

@collaborators: Jane Doe, her student ID
                John Doe, his student ID
"""
```

Please save your code as a “**.zip**”, “**.7z**”, or “**.rar**” file, where the file name should follow this format:

111B_hw7_**ID**.zip

For example,

111B_**hw7_0123456789**.zip

Please be aware. **We are not going to accept any homework file with wrong file name or without signature.** Please double check the content of your files.

Once you have accomplished your works, you can upload your homework to the “E3@NYCU” system. There will be a section for uploading your homework.