

Assignment 3
CSL7620: Machine Learning
AY 2023-24, Semester – I
Due on: 10-11-2023

M.M: 105

General Instructions:

1. Clearly mention the assumptions you have made, if any.
2. Clearly report any resources you have used while attempting the assignment.
3. Any submission received in another format or after the deadline will not be evaluated.
4. Make sure to add references to the resources that you have used while attempting the assignment.
5. Plagiarism of any kind will not be tolerated and will result in zero marks.
6. Select your dataset correctly. If found otherwise, your assignment will not be evaluated.

Submission Guidelines:

1. Prepare a Python code file for the task and name it as **YourRollNo.py**. There should be one and only one .py file. No need to prepare a separate .py file per subtask. **The .py files must not be named like <roll no> task1(1).py**
2. Submit a single report depicting methods, results, and observations. There is no need to add theory behind the concepts. Preparing a report is mandatory; failing it will lead to non-evaluation of the assignment.
3. Name your report as **YourRollNo.pdf**. Also, **provide your colab file link in the report**. Make sure that the file is sharable.
4. There is **no need to make a zip file**. Just upload both the codes and a report directly on the google-classroom, that is, submission will contain {YourRollNo.py and YourRollNo.pdf}. **Do not upload files in any other format**.
5. Do not download the .ipynb file, rename it as .py, and upload it. .ipynb files are not exactly in a readable form, so uploading it will only result in you receiving 0 marks for the same. You have an option to download a .py file in google colab. Use it to get the .py format.
6. Do not copy-paste code or screenshots, etc. in the report. The report should look like a technical document, containing plots, tables, etc. whenever necessary.
7. **Adhere to the instructions given, failing them may result in a penalty.**

Task:

Building a Neural Network from Scratch

Objective:

In this assignment, you are required to implement a neural network from scratch in Python. Build a feedforward neural network and implement backpropagation for training. By the end of this assignment, you should have a working neural network that can be trained on a simple dataset for multi-class classification.

Dataset:

Get the dataset from [here](#). The dataset consists of 70k images representing 10 different object categories.

Network Architecture:

1. The network should contain 3 hidden layers. Excluding input and output layers. Set the network architecture as:
 - a. Input layer = set to the size of the dimensions
 - b. Output layer = set to the size of the #classes
 - c. Hidden layer1 = 128
 - d. Hidden layer2 = 64
 - e. Hidden layer3 = 32
2. Initialize the weights randomly using seed value as the last three digits of your roll number. For example, your roll number is P23CS001, then your seed value should be 1. Set bias = 1.
3. Use Train-test splits as randomized 70:30, 80:20 and 90:10.
4. Set batch size as your year of admission. For example, your roll number is P23CS001, then your batch size should be 23.
5. Set 'sigmoid' as activation function for hidden layers and 'softmax' for output layer.
6. Use Gradient Descent for optimization. Loss function as crossentropy.
7. Train for 25 epochs. Plot accuracy and loss per epoch.
8. Prepare a Confusion matrix for all the combinations of the network. You may use an in-built function for this purpose.
9. Report total trainable and non-trainable parameters.

Bonus: Use regularization/early stopping to avoid overfitting, if it occurs.

Note: Do not use in-built functions, unless mentioned.

Grading Rubrics:

Correctness and completeness of the neural network implementation (40 points)

Implementation of feedforward and backpropagation (30 points)

Proper handling of training and evaluation (20 points)

Documentation and clarity of code (10 points)

Bonus (5 points)