CE6146 Introduction to Deep Learning

Assignment 1

Objective

To implement and understand the behavior of neural networks on different types of problems. You will determine whether each problem is a regression, binary classification, or multiclass classification task.

Datasets

```
from sklearn.datasets import load_boston
from sklearn.datasets import load_breast_cancer
from tensorflow.keras.datasets import fashion_mnist

data_task1 = load_boston()
data_task2 = load_breast_cancer()
(train_images, train_labels), (test_images, test_labels) = fashion_mnist.load_data()
```

1. Boston Housing Dataset

   The Boston Housing dataset contains information about the housing values in the suburbs of Boston. The dataset has 506 instances and 13 numerical/categorical attributes. The target variable is the median value of the homes. Your task is to predict this median value.

2. Breast Cancer Dataset

   The Breast Cancer dataset contains features computed from a digitized image of a fine needle aspirate (FNA) of a breast mass. There are 569 instances and 30 attributes. The labels are 'malignant' and 'benign'. Your task is to predict these labels based on the features.

3. Fashion-MNIST Dataset (Multiclass Classification)

   The Fashion-MNIST dataset comprises of 60,000 training images and 10,000 testing images. Each example is a 28x28 grayscale image, associated with a label from 10 classes like T-shirt, Trouser, Pullover, etc. Your task is to categorize these images into their respective classes.

Development Environment

You are free to use any development environment of your choice, including Google Colab or any other free online tools. Please clearly indicate in your submission which environment you used. If you used ChatGPT or any other tool for assistance, include the specific prompt you used for obtaining help.

Tasks

Task 1: Implement a Feedforward Neural Network for Regression

What You Should Provide:

1. Python code for loading and preprocessing the dataset.
2. Python code implementing your chosen neural network architecture.
3. Training and validation curves plotted over epochs.
4. Evaluation metrics on the test set.
5. A brief report explaining your architecture, choice of hyperparameters, and observations from the learning curves.

Task 2: Breast Cancer Dataset

What You Should Provide:

1. Python code for loading and preprocessing the dataset.
2. Python code implementing your chosen neural network architecture.
3. Training and validation curves plotted over epochs.
4. Evaluation metrics on the test set.
5. A brief report explaining your architecture, choice of hyperparameters, and observations from the learning curves.

Task 3: Fashion-MNIST Dataset

What You Should Provide:

1. Python code for loading and preprocessing the dataset.
2. Python code implementing your chosen neural network architecture.
3. Training and validation curves plotted over epochs.
4. Evaluation metrics on the test set.
5. A brief report explaining your architecture, choice of hyperparameters, and observations from the learning curves.

Evaluation Criteria

1. Data Preprocessing: 20%
2. Code Quality, Model Implementation, and Reproducibility: 30%
3. Results and Analysis: 25%
4. Documentation: 25%

Submission Requirements

1. Submit your assignment as a zip file to **ee-class** before **2023-11-03 23:00**.
2. The zip file should contain:
   - A Python file (.py) containing all the code.
   - A PDF file containing all the brief reports for each task.
3. The name of the zip file must follow the format “1121_CE6145_ID_HW1.zip”.
4. If your submission does not meet these requirements, **5 points** will be deducted from your total score.

Example of File Structure Inside Zip

1121_CE6145_100201006_HW1.zip

|-- 100201006_HW1.py

|-- 100201006_HW1.pdf

CE6146 Introduction to Deep Learning

Assignment 1 Report

100201006

Development Environment

- Describe the development environment used, including software and hardware specifications.
- If you received assistance from tools like ChatGPT, document the specific prompt you used for obtaining help.

Task 1

Data Preprocessing

- Explanation of how and why the data was prepared for training.

Model Architecture

- Detailed description of the neural network architecture implemented.

Choice of Hyperparameters

- Explanation of the chosen hyperparameters and their significance.

Learning Curves

- Plots and interpretation of the training and validation learning curves.

Summary

- A brief summary encapsulating key findings, challenges faced, and lessons learned from Task 1.

Task 2

(Same subsections as Task 1)

Task 3

(Same subsections as Task 1)

References

- List any academic papers, websites, or other resources referenced in your report.