CE6146 Introduction to Deep Learning

Assignment 2

Due Date: 2023-12-08 23:00

Objective

In this assignment, you will implement deep learning models to analyze sequence data. Specifically, you will use LSTM and GRU for sequence prediction and employ an autoencoder to conduct unsupervised analysis. You will be given three datasets: classification, regression, and unlabeled.

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: Human Activity Classification with LSTM

Dataset: Human Activity Recognition Using Smartphones Data Set from UCI Machine Learning Repository[1].

Objective: Build an LSTM model to classify activities based on sensor data.

Implementation:

1. Preprocess the data by normalizing and encoding the activities.
2. Split the data into training and testing sets.
3. Design and train an LSTM network.
4. Evaluate the model using appropriate metrics.

What You Should Provide:

1. Python code for loading and preprocessing the dataset.
2. Python code implementing your chosen neural network architecture.

[1]https://archive.ics.uci.edu/dataset/240/human+activity+recognition+using+smartphones

3. Training and validation curves plotted over epochs.
4. A brief report explaining your architecture, choice of hyperparameters, and observations from the learning curves.

Task 2: Temperature Series Forecasting with GRU

Dataset: Daily Minimum Temperatures in Melbourne from Kaggle[2].

Objective: Forecast future temperature values using a GRU network.

Implementation:

1. Preprocess the dataset for time-series forecasting.
2. Build a GRU model tailored for regression.
3. Train and validate the model.
4. Evaluate the predictions using appropriate metrics.

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. A brief report explaining your architecture, choice of hyperparameters, and observations from the learning curves.

```
from sklearn.datasets import fetch_olivetti_faces
data = fetch_olivetti_faces()
faces = data.images
```

Task 3: Unsupervised Feature Learning with Autoencoders

Dataset: Olivetti Faces Dataset

Objective: Implement an autoencoder to perform dimensionality reduction and feature learning on the Olivetti Faces Dataset, exploring the representations of facial features.

Implementation:

1. Data Preprocessing: Normalize pixel values and reshape images for the autoencoder input.
2. Model Architecture: Construct an autoencoder with convolutional layers to handle the spatial data structure.
3. Training: Train the model using the faces data, optimizing the encoder to capture the essential characteristics of the data.
4. Model Evaluation: Use reconstruction error to evaluate model performance.
5. Feature Visualization: Visualize the weights of the first encoder layer to interpret learned features.

[2]https://www.kaggle.com/datasets/paulbrabban/daily-minimum-temperatures-in-melbourne

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. 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 **2023-12-08 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_CE614**6**_ID_HW2.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_CE614**6**_100201006_HW2.zip

|-- 100201006_HW1.py

|-- 100201006_HW1.pdf

CE6146 Introduction to Deep Learning

Assignment 2 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.