MCA572– Neural Networks and Deep Learning

V MCA

04-12-2024

ETE III - LAB TEST

Marks: 50 Time: 3 hrs (10.45 -1.45 PM)

General Instructions

1. The file you have to save with your name, last 3 digits of register number and program number "Aaron_201_Lab1".
2. The implemented code you have to upload in Github and in the Google Classroom in the given scheduled time.
3. **Question 1** (for **Odd** Register Numbers) and **Question 2** (for **Even** Register Numbers)

Question 1 - LSTM Autoencoder
Objective:
You are required to build an **LSTM Autoencoder** to detect anomalies in a time series dataset. The dataset contains daily temperature readings from a weather station over the course of a few years. Parameters in the dataset [Date and Temperature]

Question 2 - CNN Autoencoder for Image Reconstruction
Objective:
Develop and evaluate a Convolutional Neural Network (CNN) Autoencoder to reconstruct images from a given dataset.

Question 1 - LSTM Autoencoder
You are required to build an **LSTM Autoencoder** to detect anomalies in a time series dataset. The dataset contains daily temperature readings from a weather station over the course of a few years. Parameters in the dataset [Date and Temperature]
https://drive.google.com/drive/folders/1rD4HcUNmh7fLz-bt68VxQMfGzPzV-oeF
[You can also prepare Synthetic dataset with 2500 instances with the features Date and Temperature]

Your task is to:

1. **Load the dataset**: The dataset will contain a single column temperature and a date column.
2. **Preprocess the data**: Normalize the temperature data and split it into training and testing sets.
3. **Build an LSTM Autoencoder**:
    - The encoder should reduce the input dimensions to a latent representation.
    - The decoder should reconstruct the input from the latent representation.
4. **Train the model**: Train the autoencoder on the training data and evaluate the reconstruction error on the test set.
5. **Anomaly Detection**: Use the reconstruction error to detect anomalies. Define a threshold for the reconstruction error, and identify days where the temperature is considered anomalous.
6. **Visualize the results**: Plot the original temperature data and highlight the detected anomalies.

Question 2 - CNN Autoencoder for Image Reconstruction
Objective:
Develop and evaluate a Convolutional Neural Network (CNN) Autoencoder to reconstruct images from a given dataset.
https://www.kaggle.com/datasets/codebreaker619/columbia-university-image-library
https://drive.google.com/drive/folders/1spXbIsdW3hdPD7lPnRmavi_LH0BWM6qC

Instructions:

1. **Dataset:**
    - Use the Columbia University Object Image Library (COIL) dataset.
    - Split the dataset into training (80%) and testing (20%) sets.
2. **Model Development:**
    - Construct a CNN Autoencoder with:
        - **Encoder:** Use convolutional layers with ReLU activation to reduce the input image to a lower-dimensional latent representation.
        - **Decoder:** Use transpose convolutional layers to reconstruct the image from the latent space.
3. **Training:**
    - Use the Mean Squared Error (MSE) loss function.
    - Use Adam optimizer with a learning rate of 0.001.
    - Train the model for 20 epochs with a suitable batch size.
4. **Evaluation:**
    - Evaluate the model's performance using the testing set.
    - Visualize the reconstructed images and compare them to the original images.
    - Calculate and report the MSE on the test set.
5. **Deliverables:**
    - Submit the Python code with comments explaining each step.
    - Include the following outputs in the report:

1. Architecture of the CNN Autoencoder.
2. Loss curve during training.
3. Original vs. reconstructed images (at least 5 examples).
4. Final test MSE value.

Program Evaluation Rubrics

Writing of Pseudocode and structure of the Model	(20 Marks)
Exploratory Data Analysis using visualization	(5 Marks)
Code Complexity, Implementation with proper Documentation	(10 Marks)
Result analysis and visualization with suitable diagram, writing the insights	(5 Marks)
Viva (Model Understanding, Clarity of concepts)	(10 Marks)