ASSIGNMENT-3

Individual Assignment (100 points)

Instructions:

- Submit the paper review as a word or pdf file.
- Submit elegant code with substantial comments as a Python notebook along with the HTML version.
- You are expected to work independently. Plagiarism in any form will not be tolerated.
- You may take selective help from AI models to solve this assignment.

1. Paper Review – Select and review a technical paper from the list of papers in Group 3 (20)

2. Build two RNNs (an LSTM and GRU) models that can learn the Sine wave from assignment 2 (20)
    - Summarize the model architecture.
    - Explain the hyperparameters used and the reason why they were used.
    - Provide an explanation (calculation) of the number of parameters in each layer.
    - Compare your RNN model with the MLP used earlier.

3. Perform transfer learning using CNNs to classify the IP 102 dataset from assignment 2 (40).

    a) Transfer Learning (20)
    - Use the existing test/train splits of the data.
    - Select any two pre-trained models such as VGG, Resnet or EfficientNet of any size.
    - Freeze most of the layers, unfreeze and train the last few layers on the dataset.
    - Compare the transfer learned models to your best custom model (from previous assignment) in their accuracy and other metrics.

    b) Web application (20)
    - Build a web application for users to upload test images and plot the predicted class.
    - Deploy your trained models into the webapp.
    - Provide a dropdown selector so users can select multiple models/versions for inference.
    - Submit your code and provide screenshots of the web interface and sample predictions.

    c) Unsupervised segmentation (20)
    - Remove the top layers from your best performing CNN and extract feature from your images.
    - Flatten the feature vectors obtained in the previous step for further processing.
    - Apply clustering algorithms (K-means or DBSCAN) on the flattened feature vectors to group similar image patches together. This results in distinct segments or regions within the image.
    - Visualize the segmented image by coloring each region according to its corresponding cluster label.
    - Evaluate the performance of your unsupervised image segmentation approach using as visual inspection and metrics like Silhouette Score, etc.

4. Identify and analyze bias and fairness in deep learning models (20)

- Download and prepare the FairFace dataset.
- Provide a summary of what you would like to analyze.
- Train a deep learning model to perform specific attribute classification. For example, such attributes can be race, gender, or age for facial dataset. The model can use any architecture, but you must justify your choice of architecture and explain why it is suitable for this problem.
- Evaluate the model's performance on the validation set using at least two metrics such as accuracy, F1 score, confusion matrix etc.
- Analyze the model's fairness and bias by analyzing its performance on the testing set. You can use one of the following metrics, or one of your choices.
    - Equal opportunity
    - Disparate impact