Deep Learning CT3 Mini Project

Context:

Assume you are a Data Scientist tasked with solving challenges in the agricultural industry, particularly focusing on the detection of diseases in crops. You have been given the responsibility to build a model that can classify images of beans into various categories to assist farmers in identifying disease-infected crops. You will apply transfer learning using TensorFlow and MobileNet to achieve this goal.

Objective:

The goal of this exam is to assess your ability to apply transfer learning to a real-world agricultural problem. You will load a dataset of bean images, preprocess them, apply a pre-trained MobileNet model, and deploy your solution in a user-friendly application to assist farmers.

Dataset Loading (1 Marks)

Assume you are working with a dataset of bean images for classifying diseases.
Load the TensorFlow Beans dataset and verify it has loaded correctly by displaying basic information about the dataset structure and class labels. Describe any preprocessing steps that might be required to prepare the dataset for the machine learning model.

Use the following code to load the dataset

```
import tensorflow_datasets as tfds
(ds_train, ds_test), ds_info = tfds.load(
    'beans',
    split=['train', 'test'],
    as_supervised=True,
    with_info=True
)
```

Data Visualization (2 Marks)

As part of your analysis, visualize at least 5 images from the training dataset along with their corresponding class labels. Briefly describe any observations about the classes or dataset structure based on the visualization.

Data Preprocessing (1 Marks)

In order to feed the images into the MobileNet model, the images need to be resized. Resize the images to ensure they are compatible with the input requirements of MobileNet. Explain the resizing technique used and why it is necessary in the context of the model's architecture.

Model Setup for Transfer Learning (2 Marks)

You are applying transfer learning to leverage pre-trained ImageNet weights with MobileNet for this task. Set up the MobileNet model with pre-trained weights, and apply transfer learning by freezing certain layers and adapting others for the classification task on the Beans dataset. Specify which layers you chose to freeze or fine-tune and explain your reasoning.

Training the Model (3 Marks)

As a Data Scientist, you need to train the model on the preprocessed dataset. Train the model using the resized images, incorporating early stopping to prevent overfitting. Describe the role of early stopping and explain any parameters you used, such as batch size, learning rate, or epochs, in order to achieve the best performance.

Model Evaluation (2 Marks)

Evaluate the trained model on the test dataset to assess its performance in classifying new bean images. Report key metrics such as accuracy, precision, and recall. Analyze the results briefly, indicating if the model performed satisfactorily and any potential areas for improvement in the classification of crop diseases.

Model Saving and Reusability (1 Marks)

After successfully training the model, you need to save the model for future use in production. Save the trained model in the ".keras" format. Outline the steps involved in saving the model and explain how it can be loaded and reused in a different environment or by other team members.

Deploying a Streamlit Application (3 Marks)

To help farmers identify diseased beans easily, create a Streamlit application where users can upload an image of a bean and receive a prediction of its class based on your trained

model.

Requirements:
- The application should have a simple interface where users can upload an image.
- Upon uploading, the app should preprocess the image (resize it as required) and make a prediction using the saved model.
- Display the predicted class label and, optionally, the confidence score for each class.
- Ensure that the application handles errors gracefully, such as notifying the user if an unsupported file type is uploaded.