PROJECT PROPOSAL: FOOD-101 IMAGE CLASSIFICATION USING DEEP LEARNING

TITLE:

Image Classification of Food Dishes Using Deep Learning with Fine-Tuned ResNet on Food-101 Dataset

PROJECT DESCRIPTION:

The goal of this capstone project is to develop a deep learning model capable of accurately classifying images of food dishes. By leveraging the Food-101 dataset, which includes 101,000 images across 101 distinct categories, a pre-trained ResNet model will be fine-tuned in PyTorch.

This project aims to demonstrate practical applications of deep learning in the culinary and food industry, where automated food recognition can aid in dietary tracking, restaurant menu analysis, and more.

WHY IS IT GOOD?

This project is valuable for several reasons:

1. Real-World Application: Automated food recognition has practical applications in health and nutrition, enhancing user experience in food delivery services, and aiding visually impaired individuals.
2. Complexity and Challenge: The Food-101 dataset provides a diverse set of food images, challenging the model to differentiate between visually similar dishes, thereby allowing plenty of opportunity to learn and experiment.
3. Skill Demonstration: This project will showcase the application of transfer learning, fine-tuning pre-trained models, and evaluating performance using a complex and large-scale dataset, highlighting proficiency in using PyTorch for deep learning tasks.

HOW WILL YOU DO IT?

The project will be conducted in the following steps:

1. Data Preprocessing: Load and preprocess the Food-101 dataset, including resizing images, normalization, and splitting into training, validation, and test sets.
2. Model Selection: Choose the ResNet architecture (e.g., ResNet-50) pre-trained on ImageNet. Modify the final layers to accommodate the 101 classes in the Food-101 dataset.
3. Fine-Tuning: Fine-tune the pre-trained ResNet model on the Food-101 dataset. This involves freezing the initial layers to retain learned features and training the final layers to adapt to the new dataset.

4. Training: Train the fine-tuned ResNet model using the training dataset. Utilize techniques such as data augmentation to enhance model robustness and prevent overfitting.
5. Evaluation: Evaluate the model's performance using the validation and test datasets. Metrics such as accuracy, precision, recall, and F1-score will be used to assess the model's effectiveness.
6. Hyperparameter Tuning: Experiment with different hyperparameters (e.g., learning rate, batch size, number of epochs) to optimize the model's performance.

DATA:

The Food-101 dataset, available publicly, contains 101,000 images categorized into 101 food classes, with 1,000 images per class.

The dataset is available for download as a PyTorch Dataset: https://pytorch.org/vision/main/generated/torchvision.datasets.Food101.html#torchvision.datasets.Food101

EVALUATION OF SYSTEM PERFORMANCE:

The system's performance will be evaluated using the following methods:

1. Confusion Matrix: To visualize the model's classification accuracy across different food categories.
2. Accuracy: The percentage of correctly classified images out of the total images.
3. Precision, Recall, and F1-score: To provide a detailed understanding of the model's performance, especially in cases of class imbalance.
4. Loss Curves: To monitor the training and validation loss over epochs, ensuring the model is learning effectively and not overfitting.

By following this structured approach, the project aims to build a robust image classification model that can accurately identify various food dishes, demonstrating the practical application of deep learning in real-world scenarios through fine-tuning a state-of-the-art pre-trained model.