**Introduction**

This project implements two different neural network architectures for image classification using the Imagenette dataset. The dataset consists of a subset of ImageNet images across 10 classes, serving as a benchmark for classification tasks.

**Dataset Preparation**

* Dataset: Imagenette, a subset of ImageNet designed for benchmarking classification models.
* Data Split: 80% training, 20% validation.
* Preprocessing:
* Images resized to 224×224 for model compatibility.
* Pixel values normalized (0-1) for stability.
* Data augmentation applied to the training set (random flipping and brightness adjustments).

**Neural Network Architectures**

**Simple Convolutional Neural Network (CNN)**

* Input Layer: 224×224×3 images.

**Hidden Layers:**

* Three Conv2D layers with ReLU activation for feature extraction.
* MaxPooling2D layers to reduce dimensionality.
* Flatten layer to transition to fully connected layers.
* Dense layer with 128 neurons.
* Output Layer: Softmax activation for 10-class classification.

**Transfer Learning with MobileNetV2**

**Base Model:** Pretrained MobileNetV2 with frozen weights.

**Additional Layers:**

* GlobalAveragePooling2D to reduce spatial dimensions.
* Fully connected Dense layer with 128 neurons.
* Softmax output layer for 10-class classification.

**Training Process**

**Data Augmentation**: Applied only to the training set to improve generalization.

**Callbacks:**

* Early Stopping: Stops training if validation performance does not improve.
* ReduceLROnPlateau: Reduces learning rate when performance stalls.

**Training Parameters:**

* Optimizer: Adam (learning rate = 0.001).
* Loss Function: Sparse Categorical Crossentropy.
* Batch Size: 32.
* Epochs: 10.

**Evaluation & Results**

* CNN Accuracy: 56% after 10 epochs.
* MobileNetV2 Accuracy: 98% after 10 epochs.
* Loss Trend: Validation loss decreased consistently for MobileNetV2, indicating superior learning.
* Visualization: Accuracy/loss plots confirm MobileNetV2's stability and effectiveness.

**Conclusion**

This project demonstrates the effectiveness of transfer learning in image classification. While a basic CNN achieved moderate accuracy (56%), leveraging MobileNetV2 significantly improved accuracy to 98%. Transfer learning proves to be a powerful approach for small datasets, benefiting from pretrained feature extraction.

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