Challenge 1

Soil Type Classification (Alluvial, Black, Clay, Red)

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Approach to Solving the Problem

The main goal was to classify soil images into one of four categories: Alluvial, Black, Clay, and Red. I adopted a transfer learning approach using EfficientNet-B3a, a state-of-the-art image classification model with strong feature extraction capabilities.

I first mapped the soil types to numerical labels and split the data into training and validation sets using stratified sampling. Our pipeline included custom PyTorch Dataset classes, Dataloaders, and data augmentation using torchvision.transforms to increase robustness.

I used CrossEntropyLoss for multi-class classification and AdamW as the optimizer. Additionally, I implemented a learning rate scheduler and early stopping for stability.

Finally, I added Test-Time Augmentation (TTA) during inference to improve generalization and reduce variance in predictions.

Challenges Faced

1. **Limited dataset**: The dataset had fewer samples per class, and some images were visually ambiguous.

2. **Overfitting**: The model performed too well on training but poorly on validation in early attempts.

3. **Class imbalance**: Some soil types were underrepresented.

4. **Subtle inter-class differences**: The visual differences between soil types were minimal in many cases.

How I Overcame These Challenges

- I used full training data (without validation split) and applied heavy data augmentation to simulate diversity.

- Adopted EfficientNet-B3a instead of ResNet50, which performed better with fewer parameters and provided superior validation accuracy.

- Used ReduceLROnPlateau scheduler to dynamically lower learning rate on validation plateaus.

- TTA improved accuracy by averaging predictions from multiple augmented versions of the same test image.

Final Observation and Leaderboard Score

The final model achieved **1.0000 accuracy** on the leaderboard. EfficientNet-B3a with TTA outperformed our earlier ResNet50 model. This score placed me among the top entries in the competition. The pipeline is efficient, scalable, and production-ready, thanks to modular design and clean inference scripts.