**README**

This project implements face verification using the ArcFace model on a ResNet101 backbone, focusing on robust data augmentation and hyperparameter settings for improved accuracy.

**Model Architecture**

* **Backbone**: ResNet101 pretrained on ImageNet (IMAGENET1K\_V1) is used as the feature extractor. The fully connected (FC) layer of ResNet101 is removed, and ArcFace is applied to enforce a cosine-based margin.
* **ArcFace**: The ArcMarginProduct module adds a cosine margin for better discrimination, using settings of:
  + s = 64.0: Scaling factor to adjust the output.
  + m = 0.9: Margin parameter that enhances feature separation.

**Data Augmentation**

* **Train Transformations**:
  + Resize(112): Resizes images to 112x112.
  + RandAugment(): Applies random transformations, increasing data diversity.
  + ToTensor() and Normalize(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5]): Standardize images to have a mean and standard deviation of 0.5 across each channel.
* **Verification Dataset Transformations**:
  + CenterCrop(112): Crops the center portion of each image for consistent verification input size.
  + ToTensor() and Normalize(mean=[0.5, 0.5, 0.5], std=[0.5, 0.5, 0.5]): Ensures normalized inputs for testing as well.
* **Additional Techniques**:
  + **Mixup**: Combines two images and labels in a batch to prevent overfitting and enhance robustness.
  + **CutMix**: Mixes random regions of one image with another for improved model generalization.

**Hyperparameters**

* **Batch Size**: 64, selected for a balance between computational efficiency and performance.
* **Learning Rate**: 0.001, using Adam optimizer.
* **Loss Function**: Cross-entropy with label smoothing of 0.1.
* **Scheduler**: CosineAnnealingLR with T\_max = 20, decays the learning rate smoothly over epochs.

**Ensemble**

After training, the top-3 performing models based on validation accuracy are selected for ensemble. These models’ predictions are averaged for the final test results, ensuring robustness in face verification.

**WandB logs**

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**Training and Validation Logs**

The training and validation logs, visualized via Weights & Biases (wandb), illustrate performance trends over epochs:

* **Training Accuracy (train\_cls\_acc)** and **Validation Accuracy (valid\_cls\_acc)** initially increase, peaking around the middle epochs, and then start to decline. This trend suggests that overfitting occurs in the later epochs, as the model’s generalization ability decreases.
* **Training Loss (train\_loss)** and **Validation Loss (valid\_loss)** decrease steadily at first, reaching a minimum in the mid-epochs, but then begin to rise again, which also indicates signs of overfitting.
* **Verification Accuracy (valid\_ret\_acc)** shows initial growth and then stabilizes, highlighting the model’s verification capability.

To mitigate overfitting and maximize verification performance, we performed an **ensemble** using the top 3 models based on validation accuracy. By averaging the predictions of each selected model, the ensemble improves robustness and stability in the final test results.