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Problem Set 3 Report

1. **Train your Resnet model and report the results.**

   On making use of the Resnet18 model and on along with the CIFAR10 dataset, the model achieved an accuracy of around 63% after 50 epochs with Adam optimizer and learning rate 0.001. The loss function used was Cross Entropy loss and the aim was to minimize this loss as the model is trained. The batch size was chosen to be 32 and the training data was reduced from 50000 samples to around 10000 samples.

2. **Mixup augmentation-**

   On training the model with the same optimization function and parameters,

   For alpha=0.2, the accuracy of the model increased slightly by approximately 2% to achieve a test accuracy of around 65% after 50 epochs.

   For alpha=0.4, the accuracy of the model increased even more by approximately 3% as compared to the initial model and a testing accuracy of around 66% was obtained after 100 epochs.

3. **Cutout augmentation-**

   On making use of cutout augmentation with the window size, K=16 an accuracy of around 64% was obtained when training the model with the same parameters after 50 epochs.

4. **Standard augmentation-**

   On making use of standard augmentation by choosing a random shift k1, k2 in the range [-4,4] and performing a horizontal flip on the images with a 50% probability, an accuracy of around 75% was obtained when training the model for 50 epochs with the same parameters.

5. **Combination of all the augmentations (Mixup, Cutout and Standard)**

   When we make use of all the 3 augmentation (standard, cutout and finally mixup) we observe that the images tend to be very disturbed as compared to the original images and a testing accuracy of only about 25% was obtained after 50 epochs with a learning rate of 0.001.

   As we can see from the results that combining all the 3 augmentations together cause the model to lose its accuracy and perform badly as compared to making use of the augmentations by themselves. One reason for this could be that as a result of applying all the 3 augmentations on the data, the original image tends to get distorted a lot more and so the testing accuracy for the model falls significantly.

6. **The role of data augmentation-**

   From making use of the different types of augmentation we can conclude that data augmentation can be utilized to increase the accuracy of a model considerably when used to the right extent. It can be used to introduce certain variations in the training data and make the model more versatile to handle missing pixels (cutout augmentation), differently positioned and rotated images (standard augmentation) and also cases when the input images are not entirely clear and have certain unforeseen variations (mixup augmentation).

The training loss for the model was lower in almost every augmentation as compared to when the model was trained with just the training data. However the training loss was significantly higher when all the 3 augmentations were used simultaneously to train the model.

The testing accuracy increased for each of the augmentations when they were used by themselves. However, on making use of all the 3 augmentations together on each of the images, we observe that the testing accuracy of the model decreases significantly.

Therefore it can be concluded that the augmentations should be chosen carefully in such a way that the original images are not completely distorted.