Report
RBE595 Deep Learning: Homework 8-9

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Dataset:

We divided the whole dataset into 3 parts: Training (60%), Validation (20%) and Testing (20%).

Development of models:

We developed 3 variants of a model and also tested with the VGG16 model.

1. **Model A1:**
    a. A total of 7 layers.
    b. Four convolution layers with ‘relu’ activations and three fully connected layers with two layers having ‘relu’ activation and the last one having ‘softmax’ activation.
    c. The first convolution layer uses a 7*7 kernel, the second and third convolution layers use a 5*5 kernel and the fourth convolution layer uses a 3*3 kernel.
    d. We used a dropout of 0.5 for the first two fully connected layers.
    e. We augmented the data by tuning the following parameters: rotation, width shift, height shift, shear, zoom, horizontal flip, vertical flip and rescale.

2. **Model A2:**
    a. A total of 7 layers.
    b. Four convolution layers with ‘relu’ activations and three fully connected layers with two layers having ‘relu’ activation and the last one having ‘softmax’ activation.
    c. The first and second convolution layers use a 5*5 kernel, the third and fourth convolution layer use a 3*3 kernel.
    d. We used a dropout of 0.5 for the first two fully connected layers.
    e. We augmented the data by tuning the following parameters: rotation, zoom, horizontal flip, vertical flip and rescale.

3. **Model A3:**
    a. A total of 7 layers.
    b. Four convolution layers with ‘relu’ activations and three fully connected layers with two layers having ‘relu’ activation and the last one having ‘softmax’ activation.
    c. All the convolution layers use a 3*3 kernel.
    d. We used a dropout of 0.8 for the first two fully connected layers.
    e. We augmented the data by tuning the following parameters: rotation, zoom, horizontal flip and rescale.

4. **VGG16 Model:** Thirteen Convolution layers with ‘relu’ activations and three fully connected layers with two layers having ‘relu’ activations and the last one having ‘softmax’ activation. We augmented the data by tuning the following parameters: rotation, width shift, height shift, shear, zoom, horizontal flip, vertical flip and rescale.

Performance of models:

The detailed performance of all models can be seen in the logs folder.

1. **Model A1:**
    We ran it for 50 epochs. It started with an training accuracy of 21% and reached 26% at the end of the 50 epochs. Looking at this, we tuned our parameters a bit and made the A2 model.

    The validation accuracy varies from 18% to 30%.

2. **Model A2:**
    We ran this model for a total of 200 epochs. We trained this model in intervals of 50 epochs, saving weights after each interval and loading the previous weights (if available) before starting the new training interval. For the first 50 epochs, it started with 20% training accuracy and went to 33%. Looking at this we decided to train it for 50 more epochs which seemed to be a good decision as it gave us a training accuracy of 58% at the end of 100 epochs. It seemed like we had a good model and so we continued the training for two more intervals giving a training accuracy of 74% and finally about 80% accuracy at the end of 200 epochs. But the model had reached saturation as now the training accuracy would fluctuate between 77-82% for the last 30 epochs.

The validation accuracy varies from 18% to 90%.

3. **Model A3:**
   We ran this model for 50 epochs. It started with a training accuracy of 20% and ended with a training accuracy of 23%. Thus we dropped this model.

   The validation accuracy varies from 17% to 29%.

4. **VGG16 Model:**
   Unlike the no augmentation dataset, the VGG16 model gives very poor performance with the augmented dataset. We ran it for 30 epochs. It started with a training accuracy of 20%, kept fluctuating around 19-22% and ended with 21%.

   The validation accuracy varies from 18% to 23%.

Due to time constraints, we couldn't improve on our A2 model. But we'll surely attempt to improve on the performance in future.