Assignment 5 -Report

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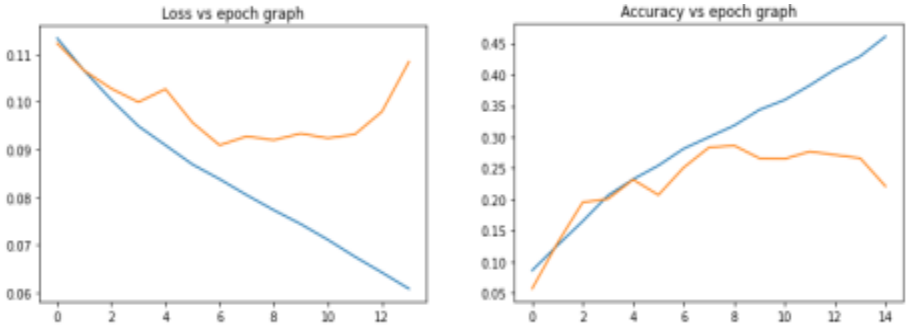
Analysis of the number of layers :

- All the models were trained for 8 epochs.
- Batch size is 32
- The loss function used was cross entropy loss.

In each of the below models, every model is an extension of the previous model i.e. all changes made till the previous model are retained in the next model with an additional change.

1. Initial Basic Model :

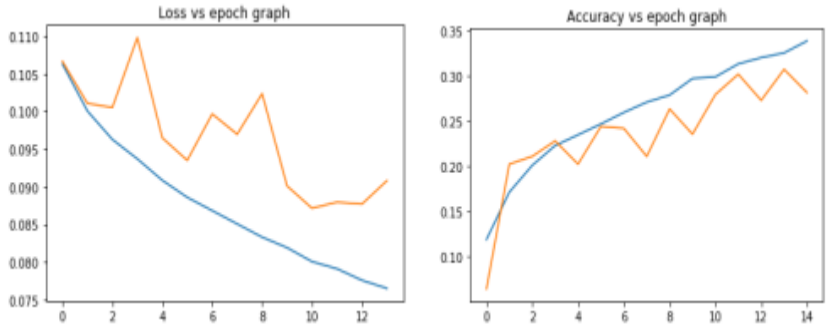
- The basic model consisted of 4 convolutional layers and 3 fully connected layers.
- ReLU activation was used at each layer and max pooling was used at each of the convolutional layers.
- The optimizer used was the Adagrad optimizer and the activation function used in the end is LogSoftmax.
    - **Graphs Obtained :**



- If we observe the model suffers with overfitting and the performance on the validation set starts to decrease after 7-8 epochs.

2. Adding Dropout :

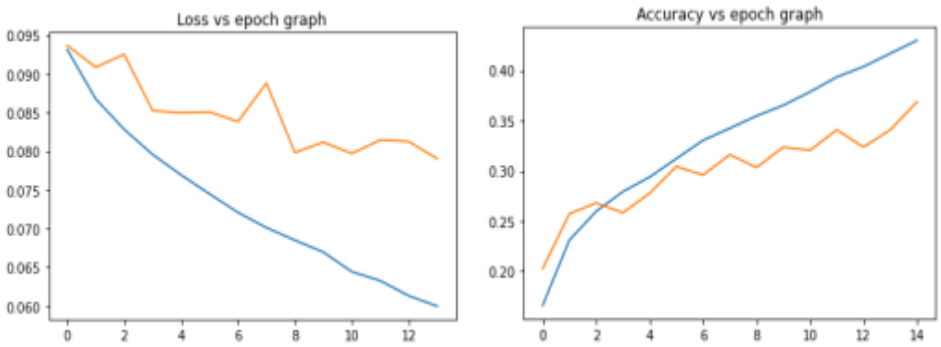
- The overfitting problem encountered with the above model can be countered by adding dropout layers in the mode.
- Dropout layers randomly change some of the values to zero and hence control the extent of overfitting.
    - **Graphs Obtained :**



    - If we observe the model wasn't overfitting and the accuracy was increasing and is better compared to the basic model.

3. Adding Batch Norm :

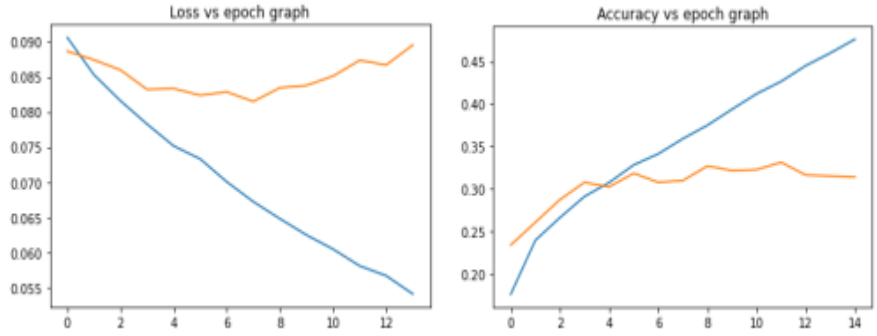
- Adding batch normalization layers in the model accelerates the training process and also regularizes the model.
- Batch normalization automatically standardizes the layer output and uses this for sending to the next layer.
    - **Graphs Obtained :**



- If we observe the model was able to reach higher accuracy quickly and also the overfitting problem was further reduced.

4. Usage of Different Optimizer :

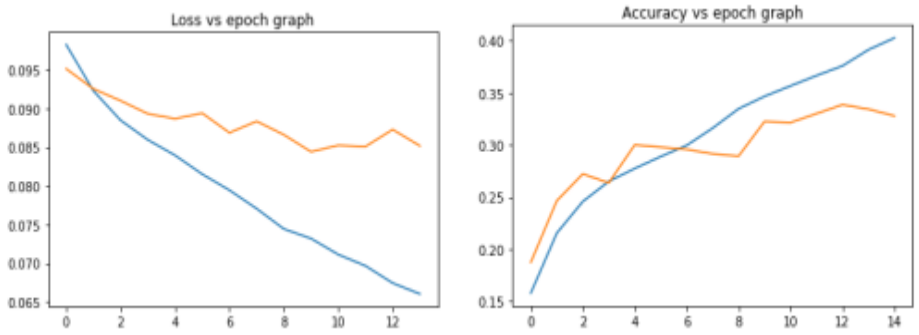
- Here, the Adagrad optimizer was replaced with Adam optimizer.
- Adam optimizer is a good optimizer which is widely used in training neural networks.
- Adam optimizer intelligently controls the learning rate where the learning rate increases if the gradients are high and decreases if the gradients are low.
- This makes the model converge faster than that with the other optimizers.
    - **Graphs Obtained :**



- If we observe the model converged quickly as the training process accelerated and the model started to overfit early.

5. Adding New Layers :

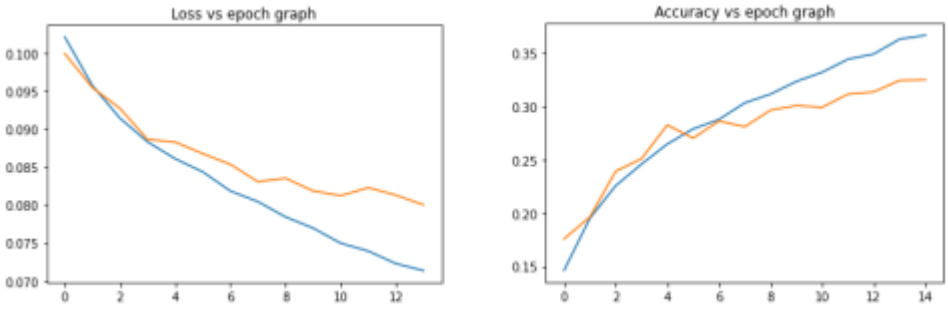
- Here, a new convolutional layer is added to the model.
- Generally deep networks with more layers increases the scope of learning, but also has the danger of overfitting.
- So, deeper networks have to be built carefully such that overfitting doesn't happen.
- In this model, a new convolutional layer is added.
    - **Graphs Obtained :**



- If we observe the scope of training is improved and the model was able to achieve higher validation accuracies than the previous model.

6. Data Augmentation :

- Here, the augmented data was used for training the data.
- In the augmented data, the first half is the original dataset itself and the second half of the data contained transformed images.
- The transformations include Center cropping , Resizing back the image to the original size, Horizontal flipping, Random erasing, Normalizing.
- All these augmented images increase the size of the dataset and also largely helps the model from overfitting as the same sample is given by basic transformations and the model thinks of reasonable methods to fit the tough images.
    - **Graphs Obtained :**

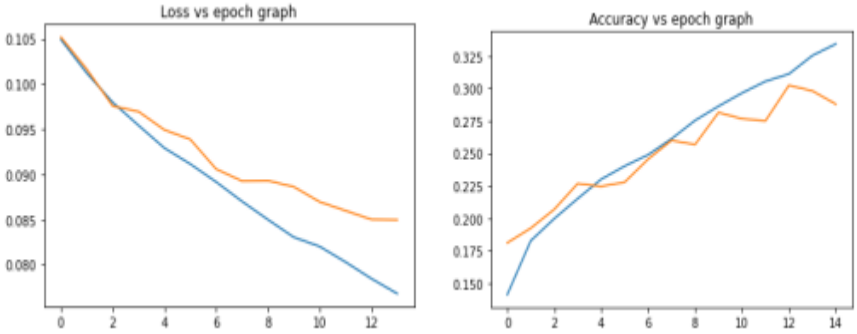


- If we observe the performance of train and val sets are almost identical because the model learns to correctly classify tough images

and learns better (there is further scope for learning but the training was stopped at 15 epochs).

7. Different Pooling Strategy :

- Here, the pooling strategy was changed from max pooling to average pooling.
- Max pool selects the brighter parts of the image and sharpens the image.
- Average pooling selects the pixels with average brightness and smoothens the image.
- In general there is not certain expected performance of these and the performance depends in the dataset.
- In this case, the performance is better for max pooling because sharper images are better suited for classifying in our case.
    - **Graphs Obtained :**



8. Different activation function at the end :

- Here, the activation function at the end is replaced by softmax instead of LogSoftmax.