**CSYE7374 - Cognitive Computing & Deep Neural Networks**

**Assignment 1 – Convolutional Neural Network Analysis**

**By**

**Gaurang Davda**

The base CIFAR-10 CNN model from keras-examples have a configuration consisting of combination of Conv2D, ReLU Activation, MaxPooling2D, Dropout and Dense layers. This model tends to underfit and so improvements have been made to this model by using few layers different than those mentioned above.

**SpatialDropout2D layer:- The addition of Spatial dropout layers with 20% dropout rate is avoid the model to overfit during higher epochs. Spatial dropout 2d performs the same function as Dropout, however it drops entire 2D feature maps instead of individual elements. If adjacent pixels within feature maps are strongly correlated then regular dropout will not regularize the activations and will otherwise just result in an effective learning rate decrease. In this case, SpatialDropout2D will help promote independence between feature maps and should be used instead.**

**ParametricReLU layer:- The PReLU layer is** generalizes the traditional rectified unit. PReLU improves model fitting with nearly zero extra computational cost and little overfitting risk. Second, we derive a robust initialization method that particularly considers the rectifier nonlinearities.

**Conv2D layer:-** The number of neurons in each of the convolutional layers should keep on increasing to capture maximum number of features in the images.

**Flatten layer:-** The importance of this layer is that it converts a n-dimensional array to a 1 dimensional array which is very important as to reduce the complexity of the network, we need to add Dense layers following the convolutional layers and Dense layers do expect 1 dimensional inputs.

**Dense layer:-** Dense layers a traditional MLP layers. A linear operation in which every input is connected to every output by a weight. These are generally followed by non-linear layers like Activation layers.

**Conv2D layer:-** The layer consists of a set of “filters”. The filters take a subset of the input data at a time, but are applied across the full input (by sweeping over the input). The operations performed by this layer are still linear/matrix multiplications, but they go through an activation function at the output, which is usually a non-linear operation.

**Pooling layer:-** Consecutive layers of the network are activated by “higher” or more complex features that are exhibited by a larger area of the networks input data. A pooling layer effectively down samples the output of the prior layer, reducing the number of operations required for all the following layers, but still passing on the valid information from the previous layer.

**Conclusion –** To attain stability, low bias, low variance and to get high accuracy and low model loss is not possible in CIFAR-10 dataset until and unless training and testing datasets are combined and reshuffled and split and then re-processed by keras pre-processing.

On my Best model, I performed experiments by varying the following parameters.

1. **Optimizer –** I used adam optimizer instead of RMSPROP optimizer. The retraining lead nothing to but overfitting of my model with difference between training and testing accuracy of around 8-9 %
2. **Loss function –** I used mean\_squared\_error loss function instead of categorical\_crossentropy but found that the model was extremely overfitting with the difference between the training and testing accuracy of around 9-10%
3. **Learning rate –** I tried to increase the learning rate from 0.0001 to 0.0002. The model was overfitting with the difference of 7-8% between the training and testing accuracies.

**Hence I would like to recommend my Best Model from Part 2A as my recommended model**

**With Training accuracy – 91.6% and Validation accuracy – 84.9% and**

**With Training loss – 25.04% and Validation loss – 49.7%**