Split Kernels

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Problem Statement

- Implement a CNN from scratch for Classification of objects for CIFAR 100 Dataset
- Implement a Split Kernel CNN for above built architecture
- Compare the accuracy and Time taken.

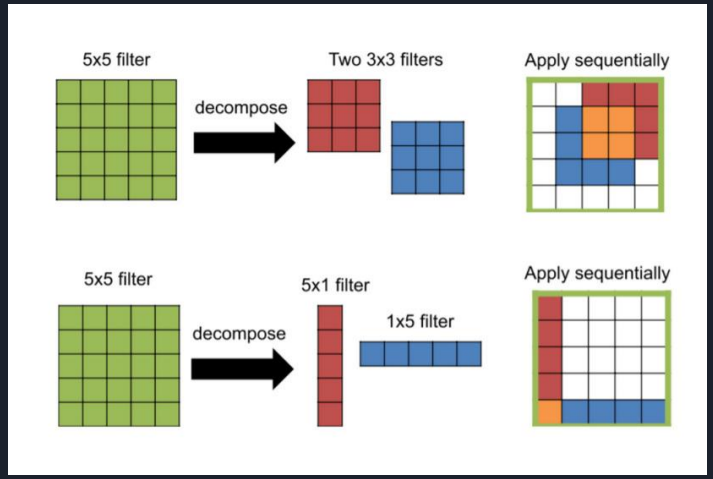
Dataset

- No of Classes: 100
- Size of Image 32 x 32 x 3
- No of Images per class: 600
- There are 500 training images and 100 testing images per class.
- Each image comes with a "fine" label (the class to which it belongs) and a "coarse" label (the superclass to which it belongs).
- Sample classes: aquarium fish, orchids,bottle etc..

What are Split Kernels ?

- A spatial separable convolution simply divides a kernel into two, smaller kernels.
- Example :

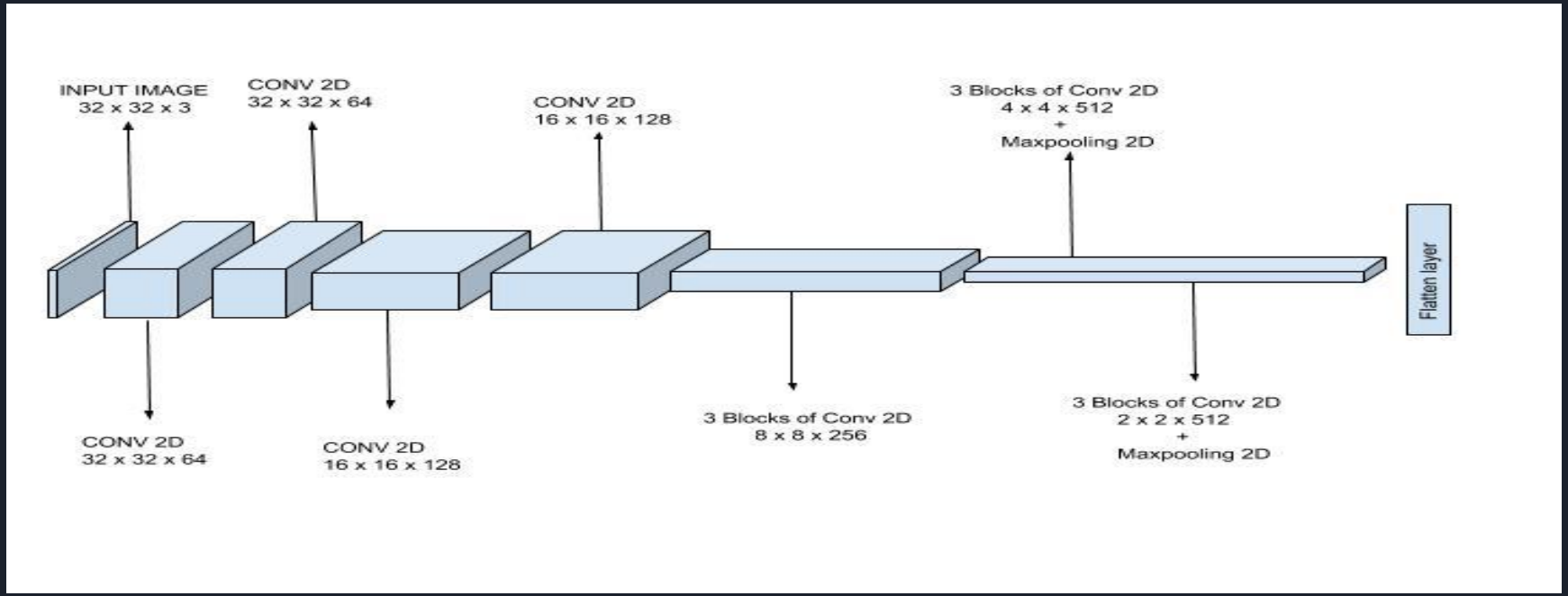
$$\begin{bmatrix} 3 & 6 & 9 \\ 4 & 8 & 12 \\ 5 & 10 & 15 \end{bmatrix} = \begin{bmatrix} 3 \\ 4 \\ 5 \end{bmatrix} \times \begin{bmatrix} 1 & 2 & 3 \end{bmatrix}$$



Advantages Of Split Kernels

- Number of Calculation done are reduced
  - In the above example instead of doing one convolution with 9 multiplications, we do two convolutions with 3 multiplications each (6 in total) to achieve the same effect.
- With less calculations, computational complexity goes down, and the network is able to run faster
- Splits kernels helps in decreasing no of parameters to calculate. But the issue with split kernels is that all the kernels cannot be separated into two parts.

CNN Architecture without Split Kernels



Training Procedure

- Test and training images are converted into 32 bit float values. Both the train and test images are normalized.
- We used a Data generator to generate more images by rotating, shifting the training data images.
- We used categorical_crossentropy as our loss function.
- We tried tuning Hyperparameters to get optimal results .
- An Image of size 32 x 32 x3 is given as input to model. As the depth of the model is increased the no of filters are increased by a factor of 2 and size of the feature map is decreased by a factor of 2 . After the Flatten layer there is a dense layer which classifies the images into one of the 100 classes.

CNN Architecture with Split Kernel

- The Architecture is same as the part A but instead of one normal (3 x 3) kernels we used two (3 x 1) and (1 x 3) kernels and retrained the model again.

Time and Accuracy Comparisons

- Time Comparison:
  - Average time taken by our architecture for each epoch without using split kernels is 90 seconds and with split kernels is 78 seconds.
- Accuracy Comparison :
  - State of art model has an accuracy of 91.3%. The maximum accuracy we could attain without split kernel is 69.16% and by using split kernels we observed a drop in accuracy and the maximum accuracy we got is 47.15% .We trained both of them using same architecture.

Time and Accuracy Comparisons

	Without Split Kernel	With Spilt Kernel
Accuracy Comparison	69.19 %	47.15 %
Time Comparison For Each Epoch	90 Sec	78 Sec
Average Time Comparison For Testing an 10000 Images	161 sec	138 sec

- State Of Art Accuracy without split kernels is 91.3% .