Project Part 3 [10 points] Deep Learning with CNN [Due 9 Dec 2022, 11:59pm]

In this task, we will perform the classification task, using a convolutional neural network. The dataset is the CIFAR-10 dataset. We will experiment with a convolutional neural network with the following parameter settings:

- The input size is the size of the image (32x32x3).
- *First layer* – Convolution layer with 32 kernels of size 3x3. It is followed by ReLU activation layer and batch normalization layer.
- *Second layer* – Convolution layer with 32 kernels of size 3x3. It is followed by ReLU activation layer and batch normalization layer.
- *Third layer* – Max pooling layer with 2x2 kernel.
- *Fourth layer* – Dropout layer with 0.2 probability of setting a node to 0 during training.
- *Fifth layer* – Convolution layer with 64 kernels of size 3x3. It is followed by ReLU activation layer and batch normalization layer.
- *Sixth layer* – Convolution layer with 64 kernels of size 3x3. It is followed by ReLU activation layer and batch normalization layer.
- *Seventh layer* – Max pooling layer with 2x2 kernel.
- *Eighth layer* – Dropout layer with 0.3 probability of setting a node to 0 during training.
- *Ninth layer* – Convolution layer with 128 kernels of size 3x3. It is followed by ReLU activation layer and batch normalization layer.
- *Tenth layer* – Convolution layer with 128 kernels of size 3x3. It is followed by ReLU activation layer and batch normalization layer.
- *Eleventh layer* – Max pooling layer with 2x2 kernel.
- *Twelfth layer* – Dropout layer with 0.4 probability of setting a node to 0 during training.
- *Last layer* – Fully connected layer with 10 nodes (corresponding to the 10 classes) and SoftMax activation function.

The padding for the layers is set as 'same' which means zero padding is added to keep the output dimensions same as input for the layer.

We will train such a network with the training set and then test it on the testing set.

You will be given the baseline code. You are required to experiment with the code by changing some of the hyper-parameters according to the following code and then report the test accuracy for each of them.

Algorithm: Convolutional Neural Network

Resources: CIFAR-10 dataset, Google CoLab

Workspace: Google CoLab (see file intro_to_colab.pdf for more details)

Language: Python

Your specific tasks:

1. Read intro_to_colab.pdf to get familiar with the platform.
2. Run the baseline code (provided in baseline.ipynb file) and report the test accuracy.
3. Change the following settings and report the test accuracy:
    a. Change learning rate to – i) 0.05 ii) 0.0001
    b. Change kernel size for first convolutional layer to 7x7
    c. Change optimizer to RMSProp
    d. Remove all the batch normalization layers in the network
    e. Change all dropout values (units to drop) - i) 0.7
    f. Change batch size – i) 16 ii) 256

Note: Change in the parameters is meaningful to assist your understanding of the behavior/performance of the network. For each of the combinations mentioned above, you must explain what you think is the effect of change in the setting on the test accuracy (e.g., one or two sentences description).

What to submit:

1. Your code for the above steps.
2. A report summarizing the results with the following format-
    a. Introduction – start with problem statement, data description etc.
    b. Method – your understanding of using this svm package, steps followed
    c. Results and observation – the results asked in each of the steps like test accuracy (any intermediate results you want to show) along with your observations
    d. Conclusion

    Note: There is no minimum or maximum length requirement for the report. Writing the report is the opportunity for you to reflect on your understanding of the problems/tasks through organizing your results.
3. The report should be typed (*handwritten reports are not allowed*) and in a .pdf format (to be submitted as separate document, not included within the code file).
4. Do not submit a .zip file. Submit multiple individual files on Canvas instead.