Deep Learning
(696-04) Assignment 2

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The program consists of classes : Conv(), Maxpool(), Flatten(), FullyConnected() and CNN().

All these classes consists of forward and backward propogation taking place in that layer except CNN() class.

The Convolution layer computes the output of neurons that are connected to local regions or receptive fields in the input, each computing a dot product between their weights and a small receptive field to which they are connected to in the input volume. You use this layer to filtering: as the window moves over the image, you check for patterns in that section of the image. This works because of filters, which are multiplied by the values outputted by the convolution.

The Maxpool selects the highest pixel value from a region depending on its size.

In the end, fully connected layer is used to flatten the high-level features that are learned by convolutional layers and combining all the features. It passes the flattened output to the output layer where you use a softmax classifier to predict the input class label.

In the program, L2 regularization is used in order to avoid overfitting.

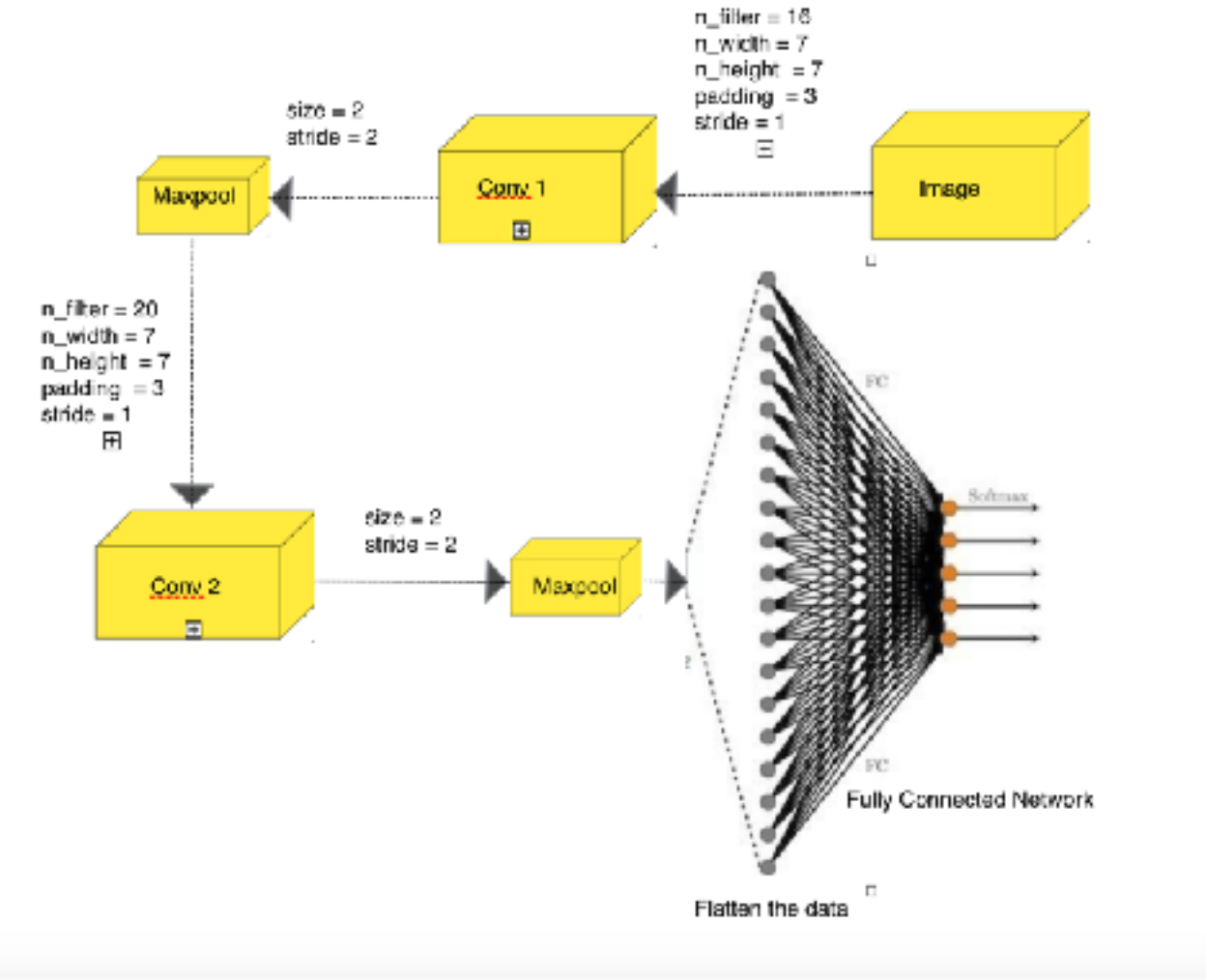
The create_batches function is used to divide the data into smaller batch sizes (approximately between 10-30) and the batch stochastic gradient descent is used to update the parameters.

The oneHotIt function Encodes Target Label IDs to one hot vector of size m where m is the number of unique labels.

The accuracy function is to compute the training and test data with the predicated value.

The loss_plot function is to plot the loss versus the epochs and the accuracy_plot is to plot the Training and testing accuracy versus the epochs.

The diagram given below depicts the architecture of the Convolution Neural Network of the program.

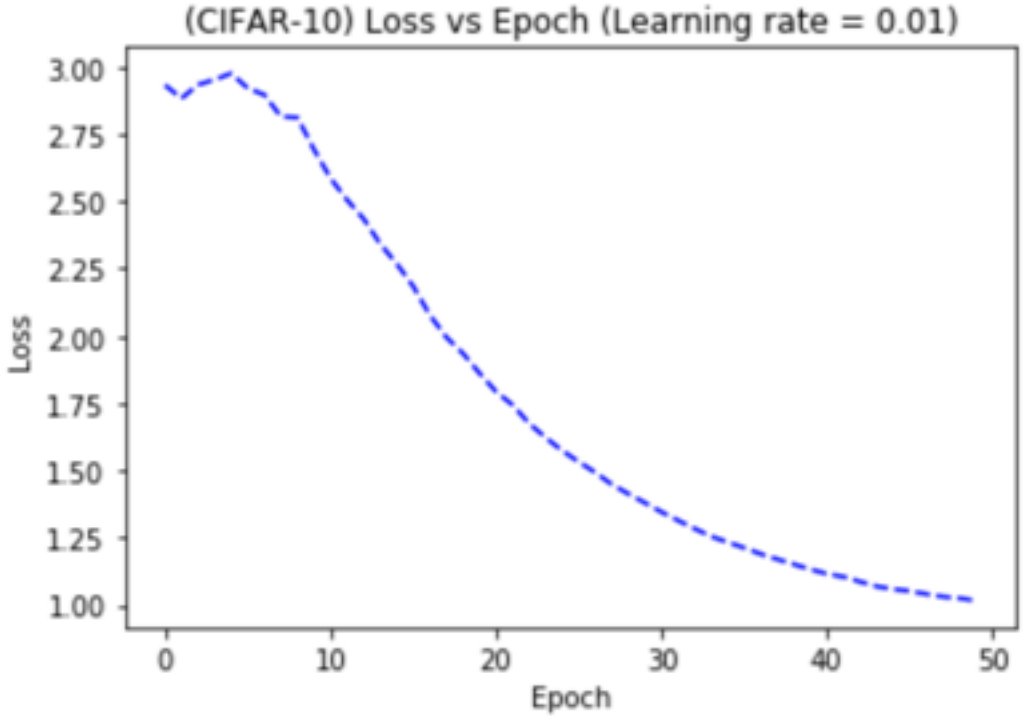


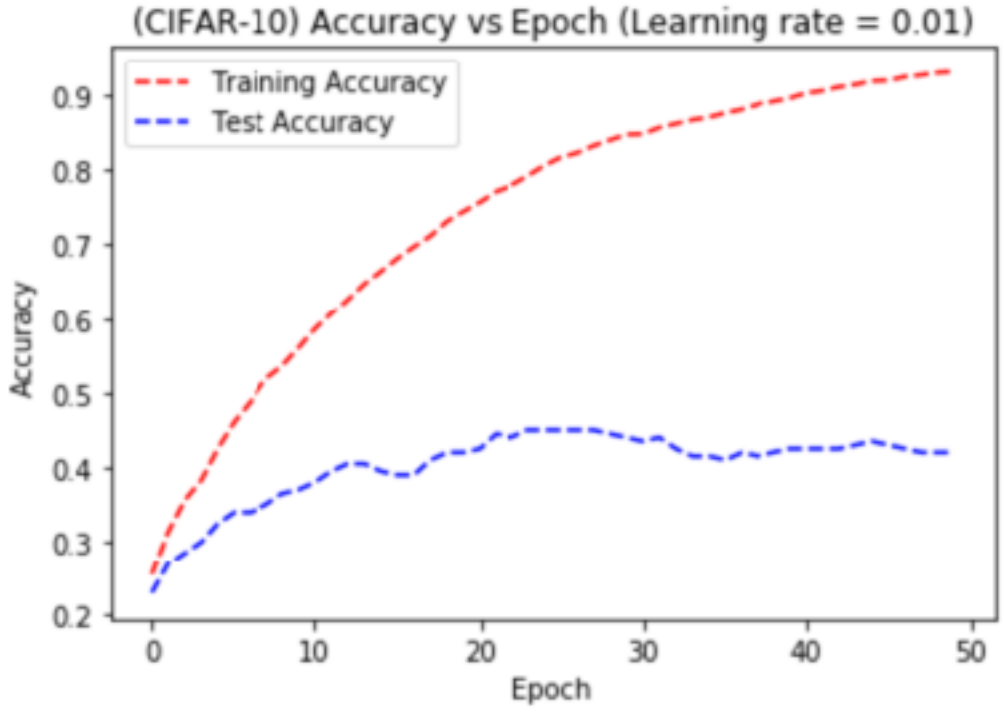
RESULT

The plots and the result given below are based on the reduced size of the data, in order to show the working and correctness of the code. I have generated these results on 5% of the total CIFAR-10 data. The code works successfully on the full CIFAR-10 data, but it takes a lot of time to train the model, so used smaller size to present the results.

```
Epoch 1
Loss = 2.931502448518231
Training Accuracy = 0.2548
Test Accuracy = 0.23
-----------------------------------------
Epoch 2
Loss = 2.88244443044099
Training Accuracy = 0.314
Test Accuracy = 0.27
-----------------------------------------
Epoch 3
Loss = 2.9330007622067793
Training Accuracy = 0.3564
Test Accuracy = 0.285
-----------------------------------------
Epoch 4
Loss = 2.951902842816294
Training Accuracy = 0.3832
Test Accuracy = 0.3
-----------------------------------------
Epoch 5
Loss = 2.9750692727286942
Training Accuracy = 0.4256
Test Accuracy = 0.325
-----------------------------------------
Epoch 6
Loss = 2.919995230190565
Training Accuracy = 0.4608
Test Accuracy = 0.34
-----------------------------------------
Epoch 7
Loss = 2.8955617457904205
Training Accuracy = 0.488
Test Accuracy = 0.34
-----------------------------------------
Epoch 8
Loss = 2.8148285009719887
Training Accuracy = 0.518
```

```
-----------------------------------------
Epoch 9
Loss = 2.8115037737575053
Training Accuracy = 0.5352
Test Accuracy = 0.365
-----------------------------------------
Epoch 10
Loss = 2.69208460928746
Training Accuracy = 0.5592
Test Accuracy = 0.37
-----------------------------------------
Epoch 11
Loss = 2.5854944226452234
Training Accuracy = 0.5852
Test Accuracy = 0.38
-----------------------------------------
Epoch 12
Loss = 2.5052208094761332
Training Accuracy = 0.6064
Test Accuracy = 0.395
-----------------------------------------
Epoch 13
Loss = 2.4350201509946148
Training Accuracy = 0.6264
Test Accuracy = 0.405
-----------------------------------------
Epoch 14
Loss = 2.342054131938083
Training Accuracy = 0.6476
Test Accuracy = 0.405
-----------------------------------------
Epoch 15
Loss = 2.268109620720872
Training Accuracy = 0.6644
Test Accuracy = 0.395
-----------------------------------------
Epoch 16
Loss = 2.1837875300654748
Training Accuracy = 0.682
```


(CIFAR-10) Loss vs Epoch (Learning rate = 0.01)
Loss
Epoch
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0
10
20
30
40
50


(CIFAR-10) Accuracy vs Epoch (Learning rate = 0.01)
Training Accuracy
Test Accuracy
Accuracy
Epoch
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
10
20
30
40
50