

NEURAL NETWORK

Part 1)

Output of model,

A full connected neural network that inputs a Cifar-10 image and predicts output of shape (10000, 10) 10 outputs, 1 probability for each class.

```
...:
...: model.predict(X_test)
=====
Learning complete
=====
Prediction for X_test
313/313 [=====] - 1s 2ms/step
Out[73]:
array([[0.20924349, 0.6658492, 0.5572132, ..., 0.46565697, 0.2041076,
        0.5707872 ],
       [0.21464315, 0.66903037, 0.55967635, ..., 0.4679007, 0.20842427,
        0.5803212 ],
       [0.21464315, 0.66903037, 0.55967635, ..., 0.4679007, 0.20842427,
        0.5803212 ],
       ...,
       [0.21464315, 0.66903037, 0.55967635, ..., 0.4679007, 0.20842427,
        0.5803212 ],
       [0.21464315, 0.66903037, 0.55967635, ..., 0.4679007, 0.20842427,
        0.5803212 ],
       [0.21464315, 0.66903037, 0.55967635, ..., 0.4679007, 0.20842427,
        0.5803212 ]], dtype=float32)

In [74]: np.shape(model.predict(X_test))
313/313 [=====] - 1s 2ms/step
Out[74]: (10000, 10)
```

Activate Windows

Accuracy of model with 5 neurons, Epoches=5, No Conv2D and MaxPooling layers

```
Y_test One Hot encoded Complete
=====
shape of X_test dataset is (10000, 32, 32, 3)
shape of Y_test dataset is (10000,)
=====
Makig 5 neurons layer
Epoch 1/5
1563/1563 [=====] - 8s 4ms/step - loss: 2.0886 - accuracy: 0.2179
Epoch 2/5
1563/1563 [=====] - 5s 3ms/step - loss: 2.0003 - accuracy: 0.2554
Epoch 3/5
1563/1563 [=====] - 6s 4ms/step - loss: 1.9711 - accuracy: 0.2675
Epoch 4/5
1563/1563 [=====] - 7s 4ms/step - loss: 1.9477 - accuracy: 0.2809
Epoch 5/5
1563/1563 [=====] - 5s 3ms/step - loss: 1.9372 - accuracy: 0.2842

In [71]:
...: opt=keras.optimizers.SGD(lr=0.05)
...: model.compile(opt,
...:               loss='categorical_crossentropy', #categorical_crossentropy cause Y_train and
Y_test is One_Hot_encoded or its a discrete value
...:               metrics=['accuracy'])
```

Accuracy of model with 5 neurons, Epoches=10, with Conv2D and MaxPooling layers .

```
...: np.shape(model.predict(X_test))
Epoch 1/10
1563/1563 [=====] - 30s 18ms/step - loss: 2.2481 - accuracy: 0.1674
Epoch 2/10
1563/1563 [=====] - 29s 18ms/step - loss: 2.0394 - accuracy: 0.2756
Epoch 3/10
1563/1563 [=====] - 28s 18ms/step - loss: 1.9198 - accuracy: 0.3130
Epoch 4/10
1563/1563 [=====] - 28s 18ms/step - loss: 1.8079 - accuracy: 0.3429
Epoch 5/10
1563/1563 [=====] - 29s 18ms/step - loss: 1.7153 - accuracy: 0.3660
Epoch 6/10
1563/1563 [=====] - 29s 18ms/step - loss: 1.6473 - accuracy: 0.3881
Epoch 7/10
1563/1563 [=====] - 29s 18ms/step - loss: 1.5955 - accuracy: 0.4075
Epoch 8/10
1563/1563 [=====] - 31s 20ms/step - loss: 1.5533 - accuracy: 0.4280
Epoch 9/10
1563/1563 [=====] - 28s 18ms/step - loss: 1.5170 - accuracy: 0.4432
Epoch 10/10
1563/1563 [=====] - 28s 18ms/step - loss: 1.4831 - accuracy: 0.4595
=====
Learning complete
=====
```

Accuracy improved to 45.9% with first layer of 5 neurons.

Part2)

Now we will increase first layer of 64 neurons, 2 Conv2d and 2 Maxpooling layers

```
Epoch 3/5
1563/1563 [=====] - 98s 63ms/step - loss: 1.8360 - accuracy: 0.3431
Epoch 4/5
1563/1563 [=====] - 100s 64ms/step - loss: 1.7907 - accuracy: 0.3615
Epoch 5/5
1563/1563 [=====] - 113s 72ms/step - loss: 1.7503 - accuracy: 0.3763
Epoch 1/10
1563/1563 [=====] - 56s 35ms/step - loss: 1.7333 - accuracy: 0.3717
Epoch 2/10
1563/1563 [=====] - 58s 37ms/step - loss: 1.3110 - accuracy: 0.5373
Epoch 3/10
1563/1563 [=====] - 54s 35ms/step - loss: 1.1376 - accuracy: 0.6026
Epoch 4/10
1563/1563 [=====] - 63s 40ms/step - loss: 1.0245 - accuracy: 0.6419
Epoch 5/10
1563/1563 [=====] - 70s 45ms/step - loss: 0.9386 - accuracy: 0.6753
Epoch 6/10
1563/1563 [=====] - 58s 37ms/step - loss: 0.8618 - accuracy: 0.6992
Epoch 7/10
1563/1563 [=====] - 59s 38ms/step - loss: 0.8118 - accuracy: 0.7175
Epoch 8/10
1563/1563 [=====] - 67s 43ms/step - loss: 0.7628 - accuracy: 0.7321
Epoch 9/10
1563/1563 [=====] - 53s 34ms/step - loss: 0.7255 - accuracy: 0.7496
Epoch 10/10
1563/1563 [=====] - 53s 34ms/step - loss: 0.6919 - accuracy: 0.7612
```

Accuracy improved to 76.12%.

Part 3)

1 NN accuracy was found to be 14%

Naïve Bayes accuracy was found to be: 17%

CNN accuracy at 10th epoch is 76.12%