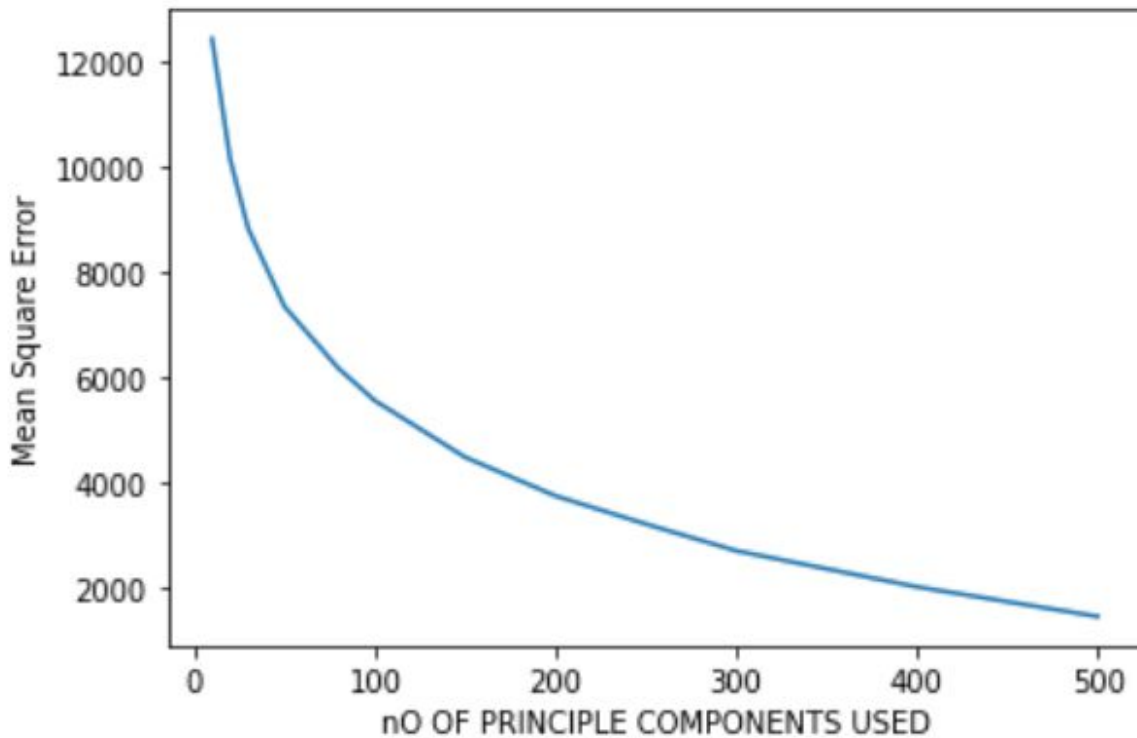


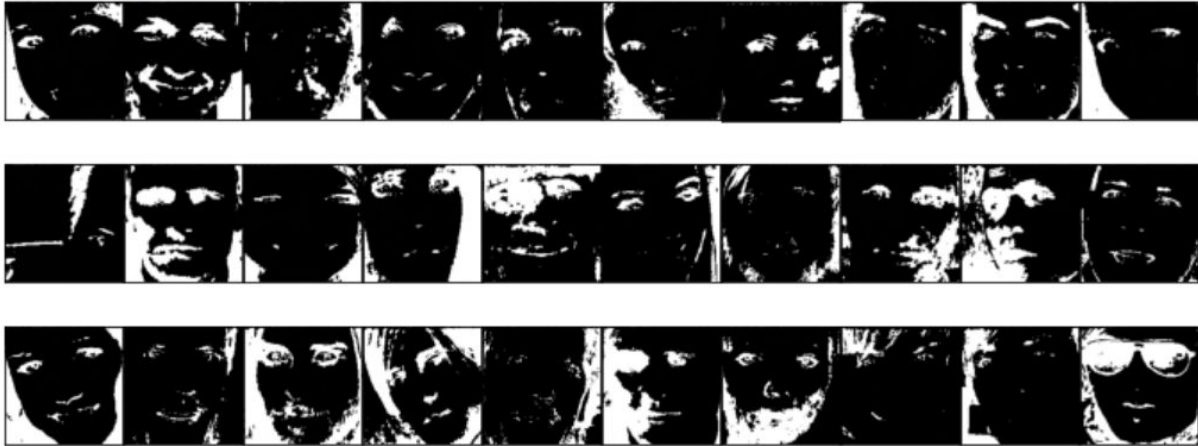
REPORT FOR ASSIGNMENT 3

Q1. PCA

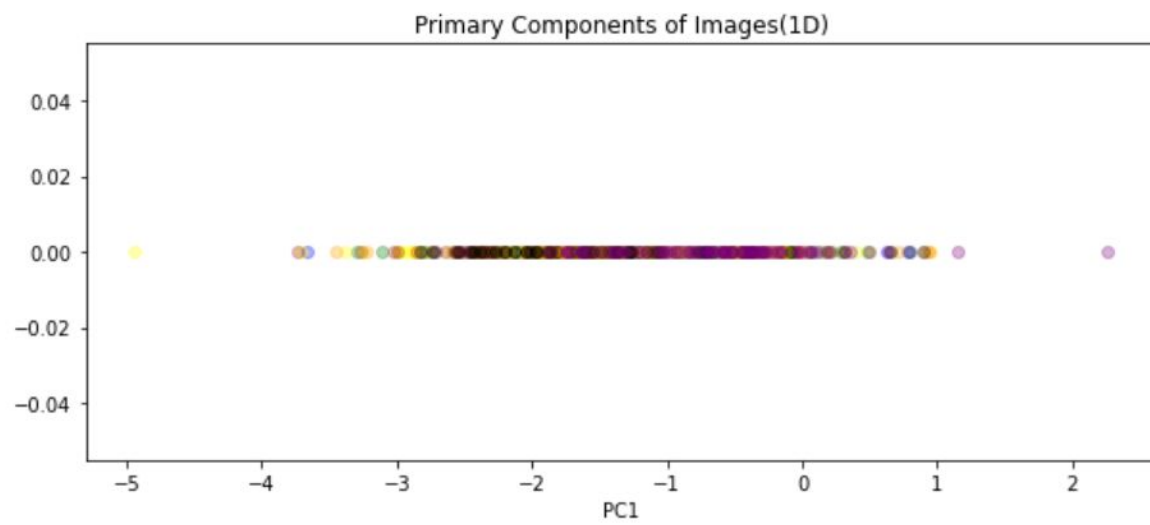
1. Observation No. of Components vs Mean Square Error

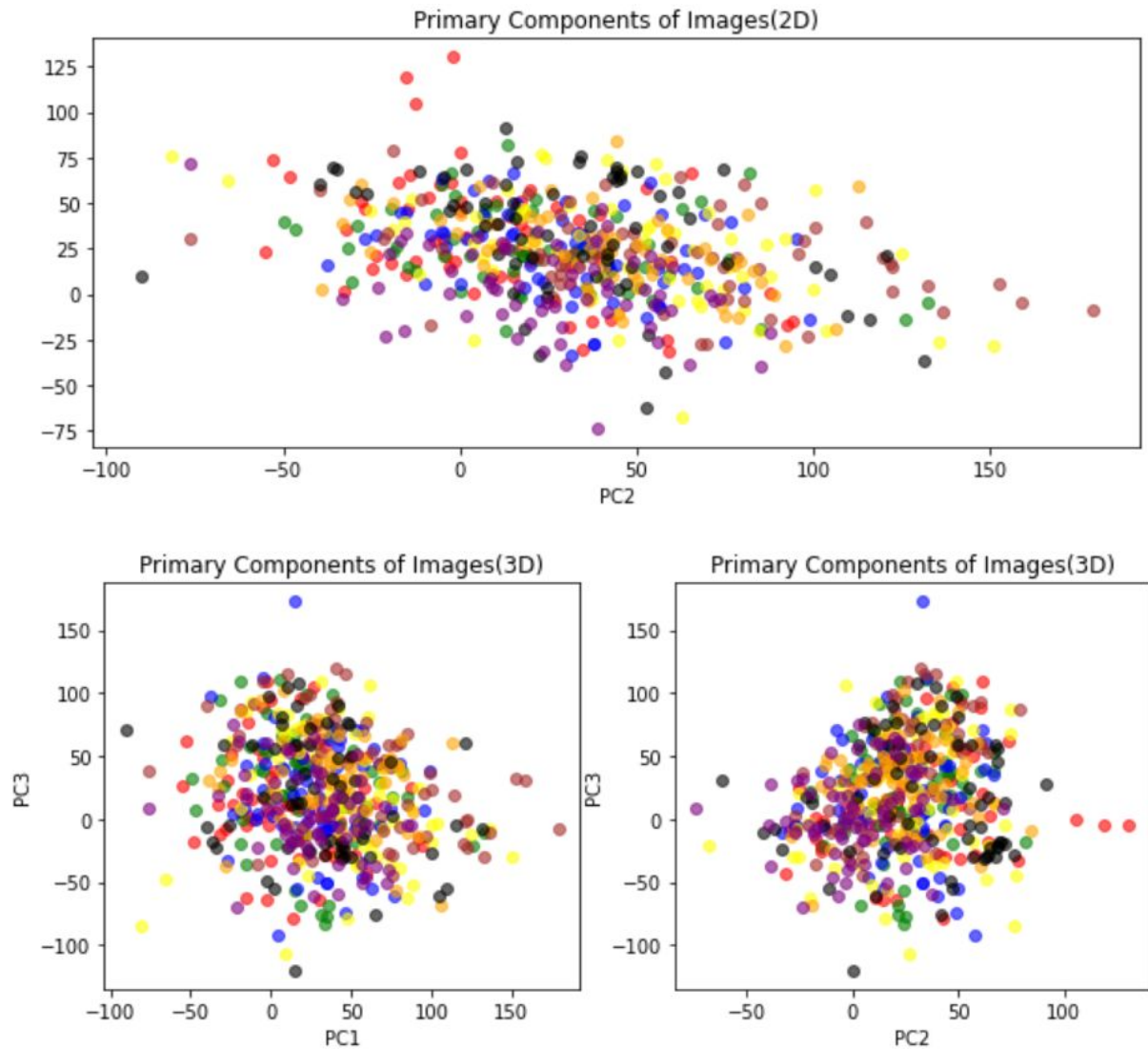


2. Reconstructing Images after PCA Reduction



3. Scatter Plots





Q2.Logistic Regression

1. Accuracy - 0.644230
2. Confusion Matrix

Confusion matrix

```
[ ] 1 confusion_matrix(Y_Test, y_pred)

↳ array([[13,  2,  0,  0,  1,  1,  0,  0],
         [ 1,  7,  0,  2,  0,  2,  0,  0],
         [ 3,  2, 10,  1,  0,  0,  1,  0],
         [ 0,  1,  1,  5,  3,  0,  0,  2],
         [ 0,  0,  0,  0,  6,  1,  1,  0],
         [ 0,  0,  0,  1,  1,  9,  0,  0],
         [ 0,  4,  1,  0,  1,  1,  3,  0],
         [ 1,  0,  0,  1,  1,  0,  0, 14]])
```

3. Classification Report

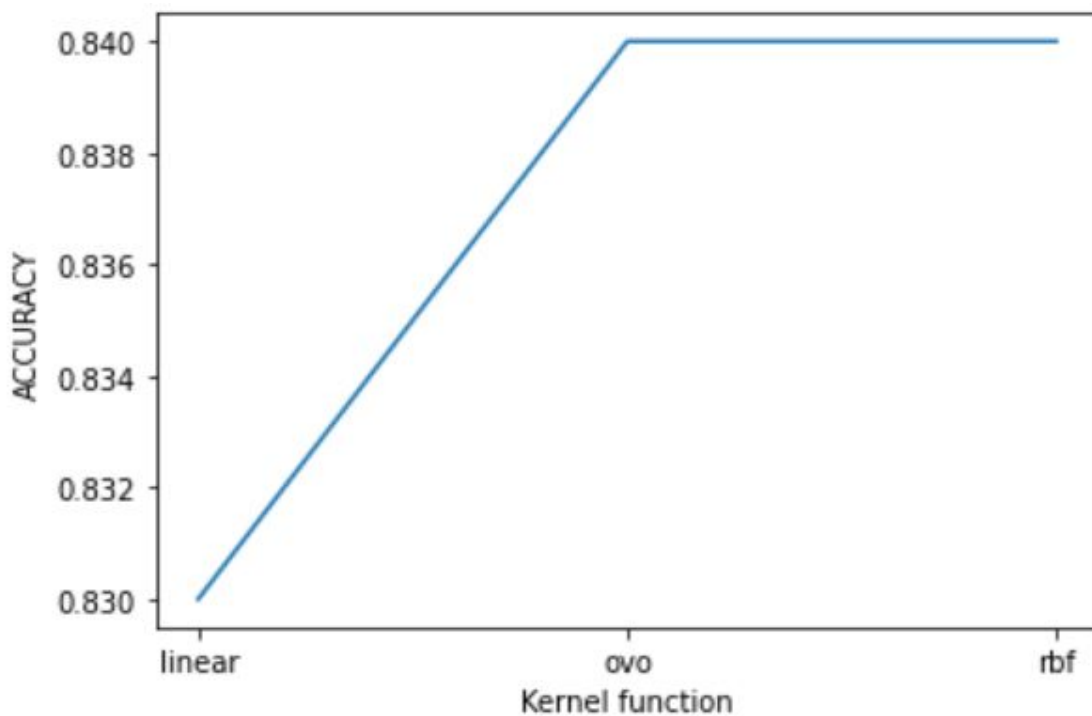
	precision	recall	f1-score	support
0	0.72	0.76	0.74	17
1	0.44	0.58	0.50	12
2	0.83	0.59	0.69	17
3	0.50	0.42	0.45	12
4	0.46	0.75	0.57	8
5	0.64	0.82	0.72	11
6	0.60	0.30	0.40	10
7	0.88	0.82	0.85	17
accuracy			0.64	104
macro avg	0.63	0.63	0.62	104
weighted avg	0.67	0.64	0.64	104

4. F1 Score : 0.6158713

Q3. MNIST Classification

A. Using SVM:

1. Kernel VS Accuracy Graph :



Linear SVM Observation

Accuracy - 0.84

F1 score - 0.8371

Confusion Matrix -

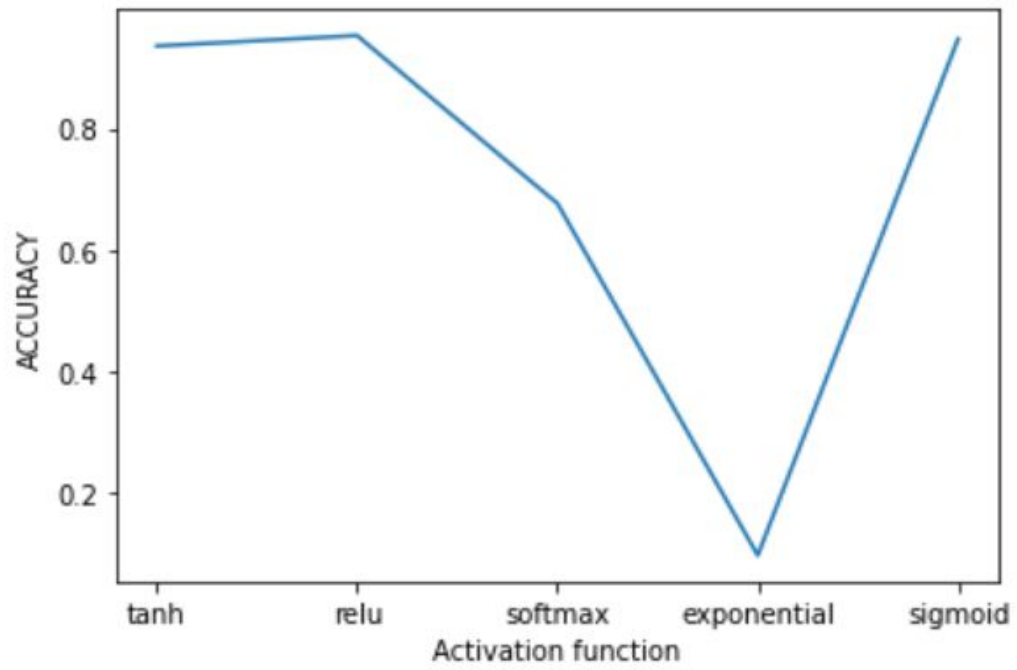
```
array([[ 829,    0,   18,    7,    4,   45,   27,   22,   25,    3],
       [    0, 1100,    9,    3,    0,    3,    6,    3,   11,    0],
       [   21,   28,  805,   22,   23,    7,   28,   43,   50,    5],
       [    4,    5,   24,  845,    8,   42,   10,   25,   41,    6],
       [    2,   10,    2,    7,  840,    3,   28,   15,   12,   63],
       [   10,   24,   18,   36,   16,  661,   28,   19,   67,   13],
       [   17,    7,    9,    0,   12,   14,  883,    7,    9,    0],
       [    4,   19,    8,    5,   11,    5,    4,  936,    3,   33],
       [   26,   53,   20,   40,   18,   30,   14,   10,  736,   27],
       [    7,    8,    0,   37,   54,   20,    5,   73,   40,  765]])
```

Classification Report-

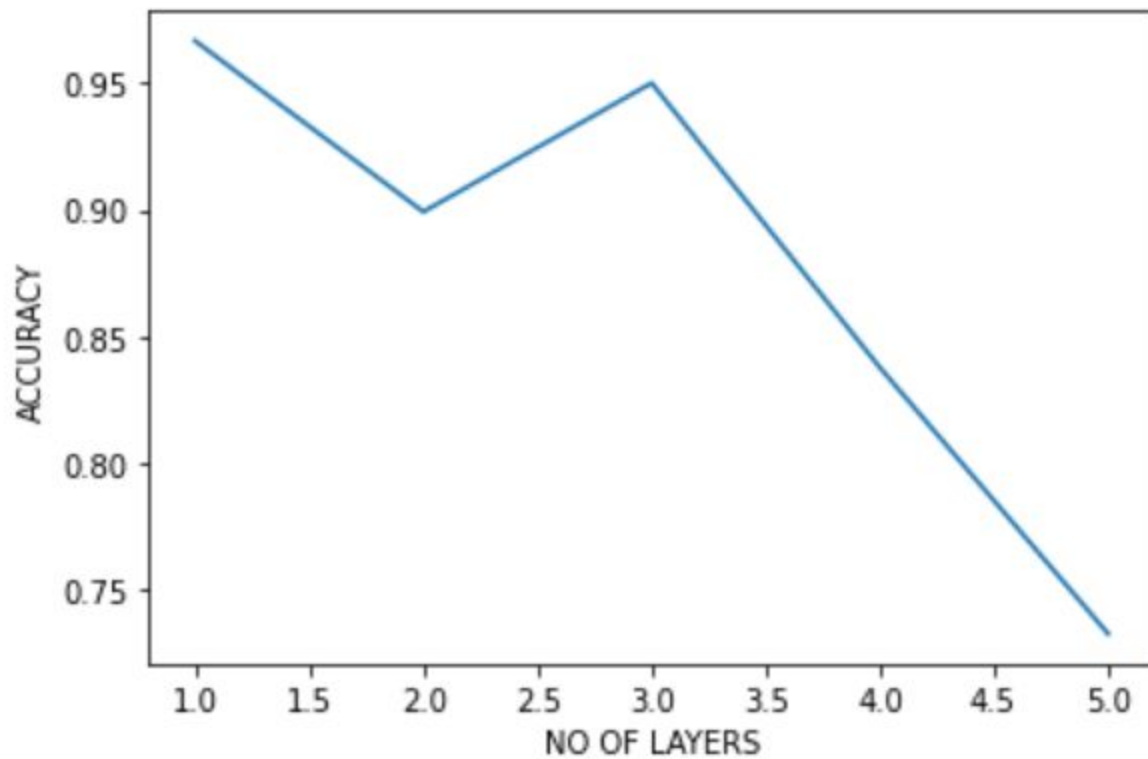
	precision	recall	f1-score	support
0	0.90	0.85	0.87	980
1	0.88	0.97	0.92	1135
2	0.88	0.78	0.83	1032
3	0.84	0.84	0.84	1010
4	0.85	0.86	0.85	982
5	0.80	0.74	0.77	892
6	0.85	0.92	0.89	958
7	0.81	0.91	0.86	1028
8	0.74	0.76	0.75	974
9	0.84	0.76	0.80	1009
accuracy			0.84	10000
macro avg	0.84	0.84	0.84	10000
weighted avg	0.84	0.84	0.84	10000

B. Using MLP :

1. Plot for Activation Function Vs Accuracy



2. Plot for No. of Layers Vs Accuracy



3. Accuracy - 97.47

4. F1 Score - 0.97450

5. Confusion Matrix

```
array([[ 971,    1,    0,    0,    0,    0,    3,    2,    3,    0],
       [   0, 1127,    1,    1,    0,    1,    2,    0,    3,    0],
       [   5,    2, 1002,    4,    5,    0,    2,    9,    3,    0],
       [   0,    0,    4,  989,    2,    2,    0,    9,    4,    0],
       [   0,    2,    4,    0,  966,    0,    2,    3,    0,    5],
       [   4,    0,    0,   19,    2,  852,    7,    2,    3,    3],
       [   6,    3,    1,    1,    3,    2,  940,    0,    2,    0],
       [   1,    6,    7,    1,    0,    0,    0, 1005,    2,    6],
       [   2,    1,    4,    6,    5,    6,    2,    2,  945,    1],
       [   4,    5,    0,   14,   19,    2,    0,   10,    5,  950]])
```

6. Classification Report

	precision	recall	f1-score	support
0	0.98	0.99	0.98	980
1	0.98	0.99	0.99	1135
2	0.98	0.97	0.98	1032
3	0.96	0.98	0.97	1010
4	0.96	0.98	0.97	982
5	0.98	0.96	0.97	892
6	0.98	0.98	0.98	958
7	0.96	0.98	0.97	1028
8	0.97	0.97	0.97	974
9	0.98	0.94	0.96	1009
accuracy			0.97	10000
macro avg	0.97	0.97	0.97	10000
weighted avg	0.97	0.97	0.97	10000

C. Using CNN:

1.Accuracy - 98.58

2.F1 Score - 0.985

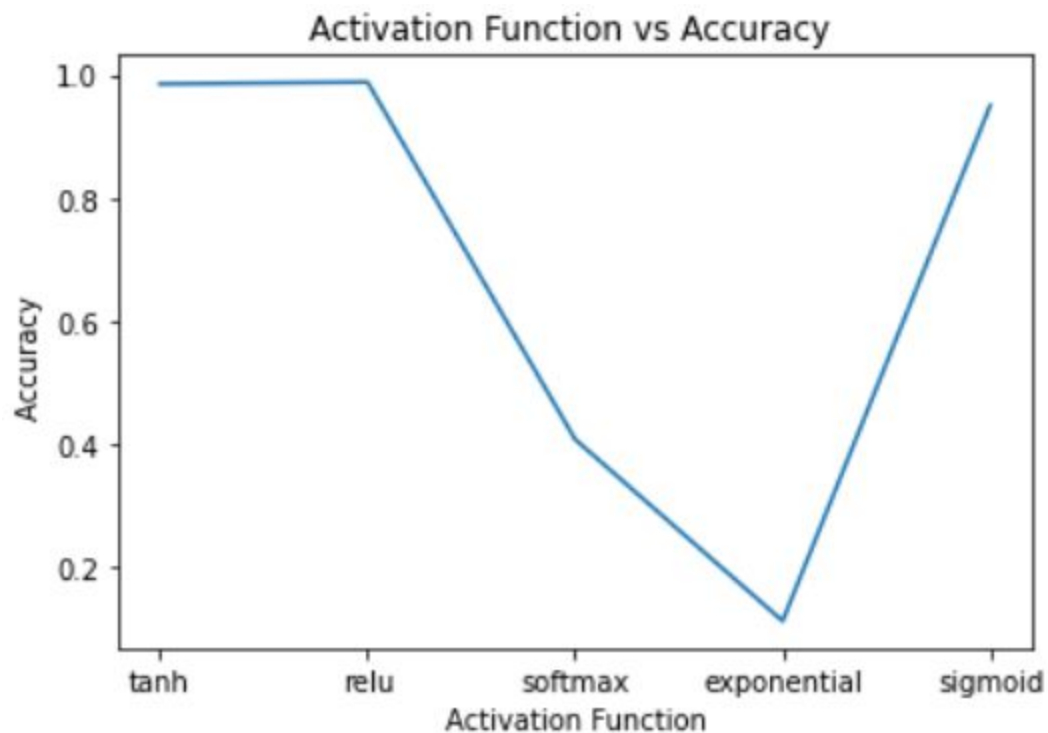
3.Confusion Matrix -

```
array([[ 975,    1,    0,    0,    0,    0,    3,    0,    1,    0],
       [    0, 1124,    2,    2,    1,    1,    2,    0,    3,    0],
       [    1,    0, 1021,    0,    0,    0,    1,    7,    2,    0],
       [    0,    0,    7,  987,    0,   11,    0,    3,    2,    0],
       [    2,    0,    1,    0,  969,    0,    1,    2,    3,    4],
       [    1,    0,    0,    4,    0,  884,    2,    0,    0,    1],
       [    2,    3,    0,    0,    2,    5,  945,    0,    1,    0],
       [    0,    1,    5,    1,    0,    0,    0, 1019,    1,    1],
       [    2,    0,    0,    1,    1,    6,    1,    2,  960,    1],
       [    0,    1,    3,    0,   11,    7,    0,    9,    4,  974]])
```

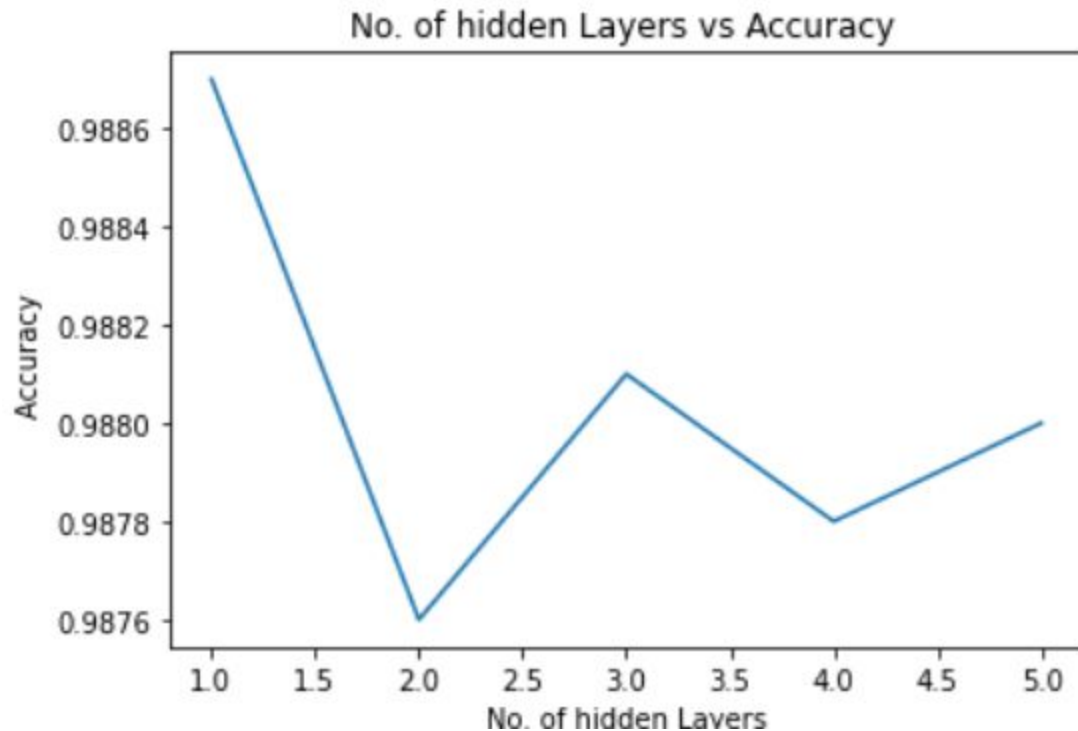
4. Classification report-

	precision	recall	f1-score	support
0	0.99	0.99	0.99	980
1	0.99	0.99	0.99	1135
2	0.98	0.99	0.99	1032
3	0.99	0.98	0.98	1010
4	0.98	0.99	0.99	982
5	0.97	0.99	0.98	892
6	0.99	0.99	0.99	958
7	0.98	0.99	0.98	1028
8	0.98	0.99	0.98	974
9	0.99	0.97	0.98	1009
accuracy			0.99	10000
macro avg	0.99	0.99	0.99	10000
weighted avg	0.99	0.99	0.99	10000

5. Graph for Activation Function vs Accuracy



6. Graph for No. of Layers vs Accuracy



Q4. Regression

Observation Using Linear Regression :

Root Mean Square Error - 0.212

Mean Absolute Percentage Error - 10.34 %

R2 Score - 0.93

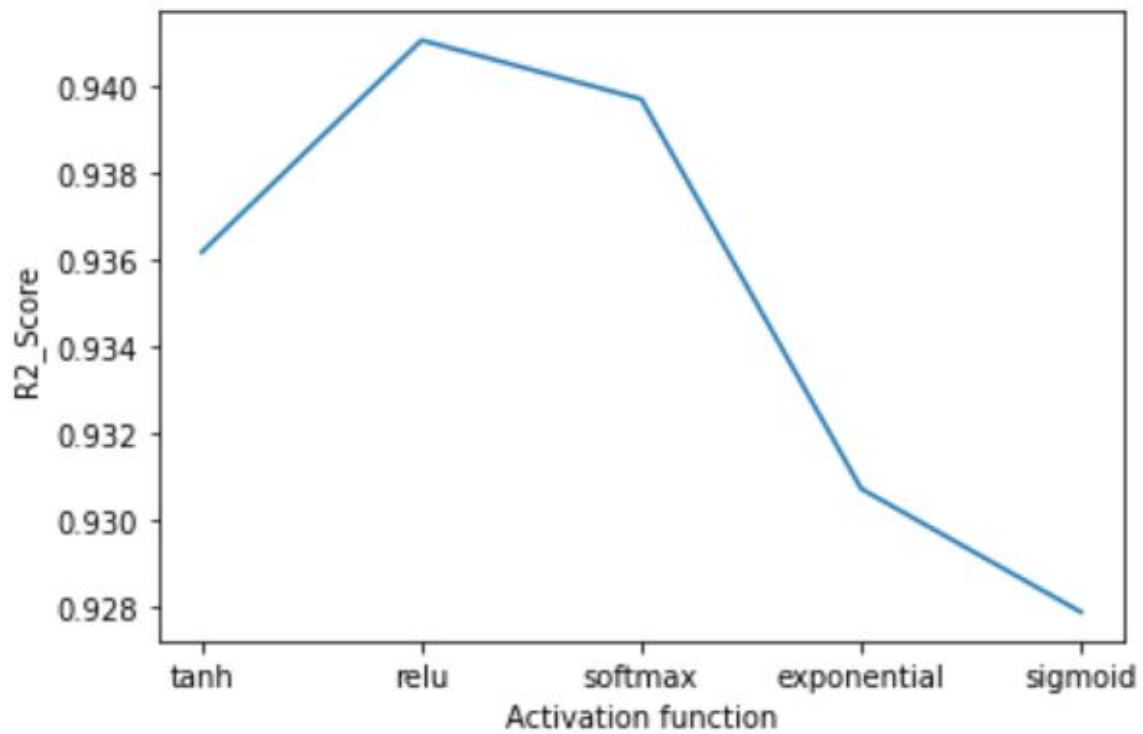
Observation Using MLP:

1.Root Mean Square Error - 0.227

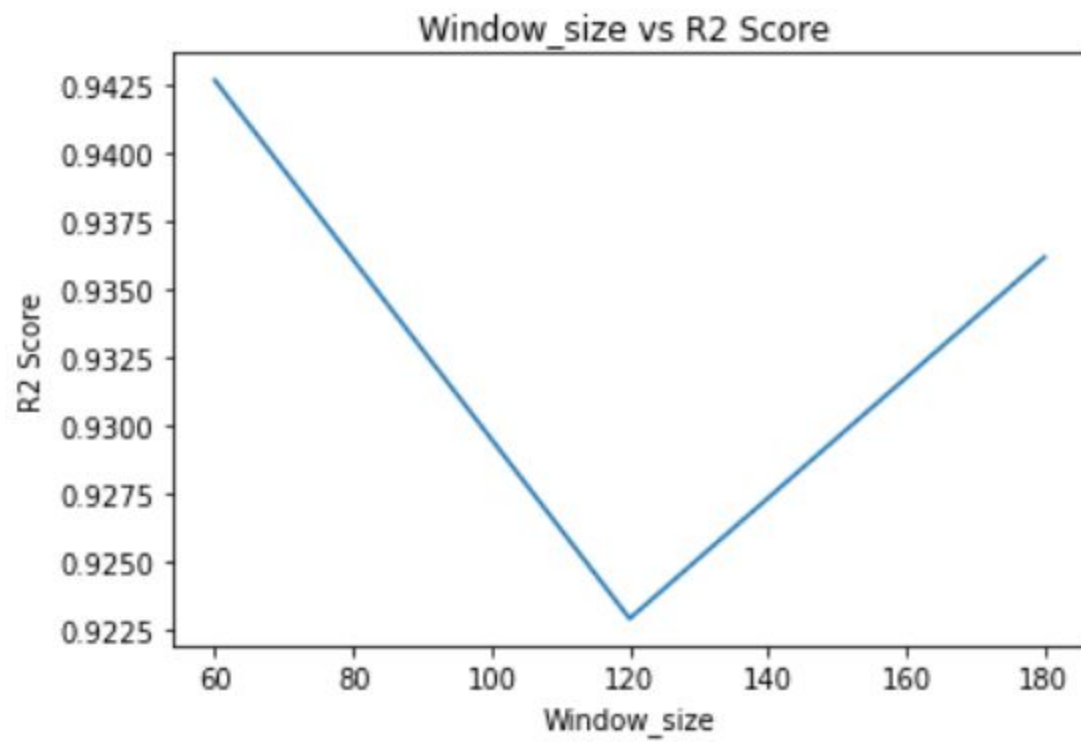
2. Mean Absolute Percentage Error - 10.47 %

2.R2 Score - 0.96

3. Graph for Activation vs R2 Score



4. Graph for Window Size vs R2 Score



5. Graph for No. of Layers Vs R2 Score

