Q4

a)

```
On training the model on entire training data
The test accuracy of linear SVM is: 0.9787735849056604
Number of support vectors: 28
```

b)

```
On training the model on first 50 training data points
The test accuracy of linear SVM is: 0.9811320754716981
Number of support vectors: 2

On training the model on first 100 training data points
The test accuracy of linear SVM is: 0.9811320754716981
Number of support vectors: 4

On training the model on first 200 training data points
The test accuracy of linear SVM is: 0.9811320754716981
Number of support vectors: 8

On training the model on first 800 training data points
The test accuracy of linear SVM is: 0.9811320754716981
Number of support vectors: 14
```

c)

```
For c = 0.0001
The training error of polynomial SVM with degree 2: 0.25368353619474693
The training error of polynomial SVM with degree 5: 0.01857783472133245
4
The number of support vectors of polynomial SVM with degree 2: 1112
The number of support vectors of polynomial SVM with degree 5: 188
The testing error of polynomial SVM with degree 2: 0.2570754716981132
The testing error of polynomial SVM with degree 5: 0.028301886792452824

For c = 0.001
The training error of polynomial SVM with degree 2: 0.014093529788597015
The training error of polynomial SVM with degree 5: 0.006406149903907754
The number of support vectors of polynomial SVM with degree 2: 456
The number of support vectors of polynomial SVM with degree 5: 72
The testing error of polynomial SVM with degree 2: 0.025943396226415094
The testing error of polynomial SVM with degree 5: 0.018867924528301883

For c = 0.01
The training error of polynomial SVM with degree 2: 0.005124919923126248
The training error of polynomial SVM with degree 5: 0.004484304932735439
The number of support vectors of polynomial SVM with degree 2: 132
The number of support vectors of polynomial SVM with degree 5: 34
The testing error of polynomial SVM with degree 2: 0.018867924528301883
The testing error of polynomial SVM with degree 5: 0.01650943396226412

For c = 1
```

```
The training error of polynomial SVM with degree 2: 0.00448430493273543
9
The training error of polynomial SVM with degree 5: 0.00384368994234463
02
The number of support vectors of polynomial SVM with degree 2: 28
The number of support vectors of polynomial SVM with degree 5: 25
The testing error of polynomial SVM with degree 2: 0.021226415094339646
The testing error of polynomial SVM with degree 5: 0.02358490566037741

So, the statement 1 is FALSE
So, the statement 2 is TRUE
So, the statement 3 is FALSE
So, the statement 4 is FALSE
```

d)

```
For c = 0.01
The training error of rbf SVM: 0.0038436899423446302
The number of support vectors of rbf SVM: 406
The number of support vectors of rbf SVM: 406
The testing error of rbf SVM: 0.02358490566037741

For c = 1
The training error of rbf SVM: 0.004484304932735439
The number of support vectors of rbf SVM: 31
The number of support vectors of rbf SVM: 31
The testing error of rbf SVM: 0.021226415094339646

For c = 100
The training error of rbf SVM: 0.0032030749519538215
The number of support vectors of rbf SVM: 22
The number of support vectors of rbf SVM: 22
The testing error of rbf SVM: 0.018867924528301883

For c = 10000.0
The training error of rbf SVM: 0.002562459961563124
The number of support vectors of rbf SVM: 19
The number of support vectors of rbf SVM: 19
The testing error of rbf SVM: 0.02358490566037741

For c = 1000000.0
The training error of rbf SVM: 0.0006406149903908087
The number of support vectors of rbf SVM: 17
The number of support vectors of rbf SVM: 17
The testing error of rbf SVM: 0.02358490566037741

So, the lowest training error (0.0006406149903908087) occurs at C=10000
00(1e6)
So, the lowest testing error (0.018867924528301883) occurs at C=100(1e2
)
```

Q5

a)

```
For Linear SVM
Number of support vectors: 1084
Training error: 0.0
Validation error: 0.02400000000000002
```

b)

```
For rbf kernel SVM
Number of support vectors: 6000
Training error: 0.0
Validation error: 0.5

For polynomial kernel SVM
Number of support vectors: 1332
Training error: 0.0004999999999999449
Validation error: 0.020000000000000018

Clearly, both linear kernel and rbf kernel SVMs give lowest training er
rors. Both have training error of 0.
```