Home Work – 5

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Q1:

a.

```
Best Value of C: 10
ECV for the best C: 0.016656426640452304
```

b,c:

```
In-sample error (E_in): 0.017296604740550947
E_test: 0.037735849056603765
```

results from HW2 using linear model:

```
E_in (Training Error): 0.019218449711723255
Bound based on Ein: 0.053592505888220135

E_test (Test Error): 0.04009433962264151
Bound based on Etest: 0.10604957971688328
```

Etest using SVM is 0.0377 and Etest using linear model from HW2 is 0.04009

They are very close.

Q2:

a,b,c:

```
Best C: 0.1
ECV for the best C: 0.033333333333333215
In-sample error (Ein): 0.020000000000000018
Etest using Dtest(Dataset picked except the 300 in sample data): 0.03934207601689266
E_test on ZipDigits.test: 0.0433482810164425
```

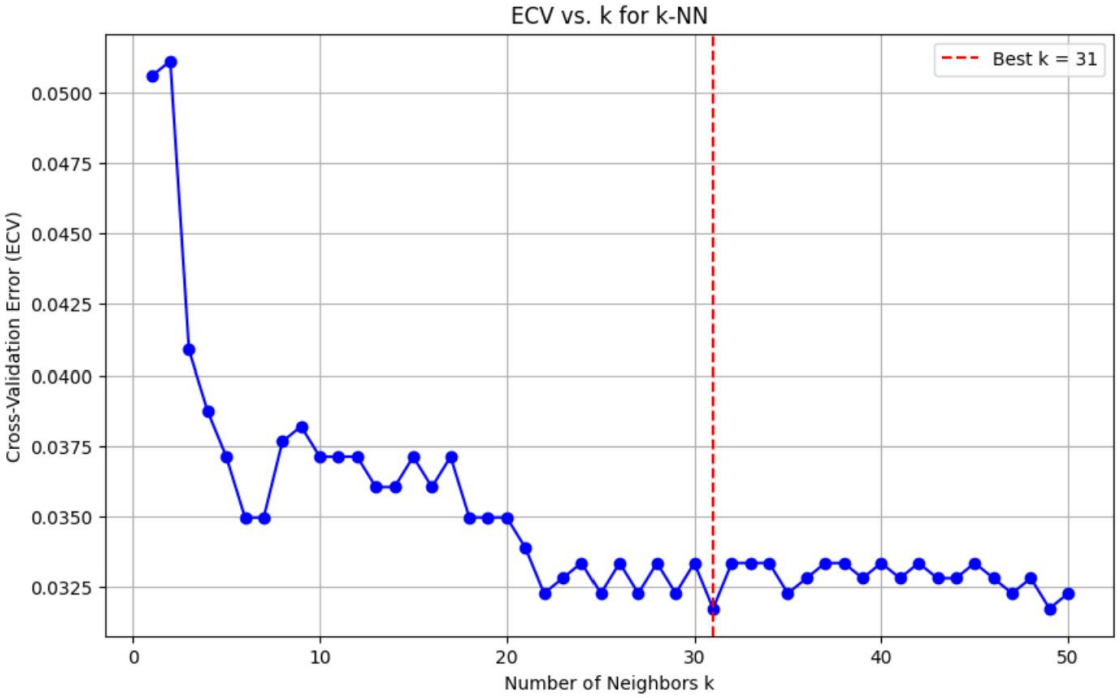
Compare with E_test on 10^{th} degree polynomial in HW4:

```
E_out (classification error): 0.04000889086463658
```

Since the Test data we used are Dtest in HW4,

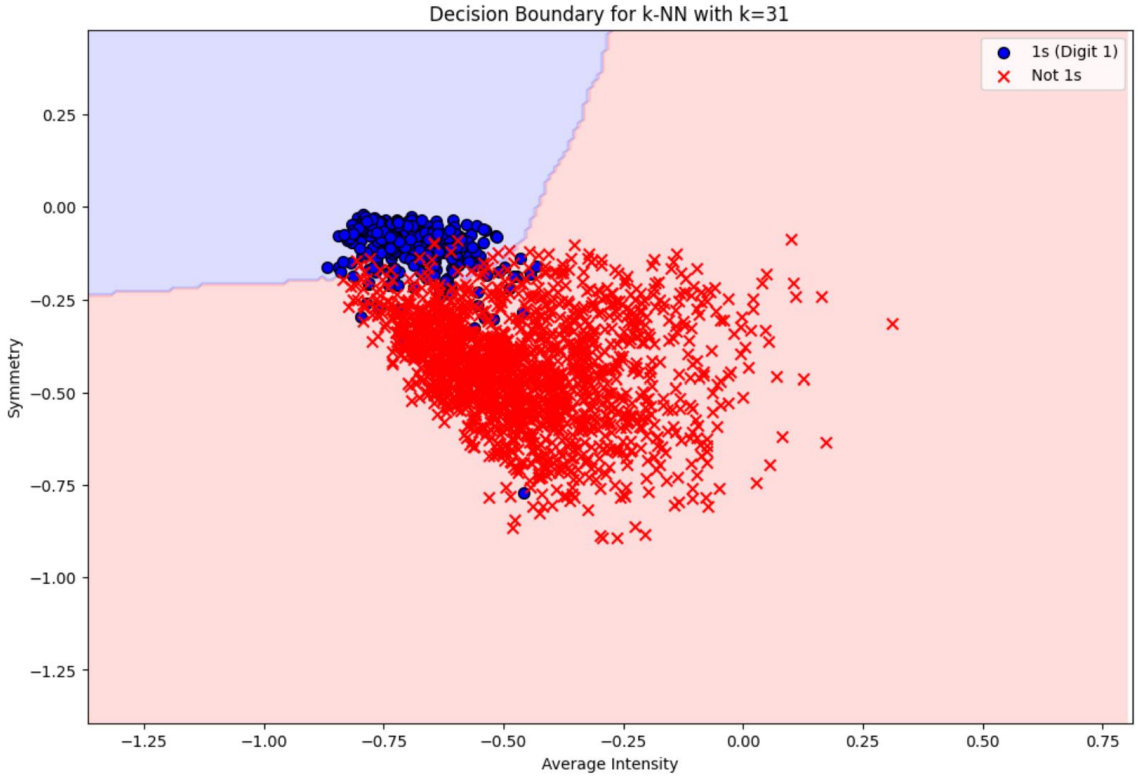
Etest using SVM with the polynomial kernel is 0.03934 and E_out in HW4 which is calculated using Ztest(after transformations) is 0.040008. They are close.

Q3: a.




```
Optimal value of k: 31
Lowest ECV: 0.031740718198417506
```

b,c.



```
In-sample error (E_in): 0.03227541689080149
Cross-validation error (ECV) for the best k: 0.031740718198417506
Test error (E_test) for k-NN with k=31: 0.03132141416857104
```

Google colab link:
https://colab.research.google.com/drive/1pg8pnEvZzJWQUOI8GgVik9ys7a3Y0tpK#scrollTo=kJ6OM_EFLrvJ