

## Homework-5

### 1. SVM

#### a. Output

Properties, Methods

Iteration	Set	Set Size	Feasibility Gap	Delta Gradient	KKT Violation	Number of Supp. Vec.	Objective	Constraint Violation
0	active	400	9.975062e-01	2.000000e+00	1.000000e+00	0	0.000000e+00	0.000000e+00
1000	active	400	8.086108e-01	4.906733e+00	3.003870e+00	98	-7.860229e+01	3.538836e-16
2000	active	400	6.262981e-01	4.887927e+00	2.837723e+00	168	-1.552860e+02	1.627171e-15
3000	active	400	4.660856e-01	4.646935e+00	3.068184e+00	241	-2.293820e+02	2.650657e-15
4000	active	400	2.776394e-01	4.480914e+00	2.901675e+00	312	-3.017355e+02	3.278627e-15
5000	active	400	1.134816e-01	4.307787e+00	3.416449e+00	377	-3.693480e+02	2.279427e-15
5888	active	400	5.242751e-07	4.336607e-04	2.891071e-04	397	-3.957550e+02	2.785966e-15

Exiting Active Set upon convergence due to DeltaGradient.

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Exiting Active Set upon convergence due to DeltaGradient.

b. Performance was slower on the training sets but faster on the test data sets for each case

c. The number of support vectors increases with each iteration when using both the decision trees and the SVM classifier with the different parameters, although the factor by which it increases lowers for each iteration on both the datasets.

### 2. Decision tree and pruned decision tree

#### a. Output

```

Md1 =
  ClassificationTree
    ResponseName: 'Y'
    CategoricalPredictors: []
    ClassNames: [-1 1]
    ScoreTransform: 'none'
    NumObservations: 400

  Properties, Methods
Md2 =
  RegressionTree
    ResponseName: 'Y'
    CategoricalPredictors: []
    ResponseTransform: 'none'
    NumObservations: 400

  Properties, Methods
Md3 =
  ClassificationTree
    ResponseName: 'Y'
    CategoricalPredictors: []
    ClassNames: [-1 1]
    ScoreTransform: 'none'
    NumObservations: 400

  Properties, Methods
Md4 =
  RegressionTree
    ResponseName: 'Y'
    CategoricalPredictors: []
    ResponseTransform: 'none'
    NumObservations: 400

```

b. Performance was slower on the training sets but faster on the test data sets for each decision tree, The pruned decision tree was overall faster compared to the normal decision tree

c. The number of support vectors increases with each iteration when using both the decision trees and the SVM classifier with the different parameters, although the factor by which it increases lowers for each iteration on both the datasets.

**Pruning helps because it removes parts of the decision tree that do not provide power to classify classes**

3. SVM has faster performance and provides better results because data is sparse and easy to classify

