

## Implementing classifiers on the dataset and Parameter Tuning

### 1) Decision Trees

Experiment	Classifier	Train/Test Ratio	Minsplit	CP	Outcome (Accuracy)
1		80,20	45	0.04	54%
2		80,20	45	0.06	63%
3		80,20	45	0.09	64%
4		80,20	45	0.005	64%
5		80,20	55	0.005	68%
6		80,20	60	0.005	69%
7		80,20	60	0.009	69.5%
8		80,20	60	0.05	62%
9		80,20	40	0.05	59%
10		90,10	60	0.009	77%

#### Decision Trees Parameter Tuning: (Parameters -> Minsplit, CP)

1. Firstly, an increase in CP by keeping Minsplit constant, leads to an increase in accuracy.
2. Similarly, decrease in CP by keeping Minsplit constant, leads to an decrease in accuracy which can be observed -> experiments [7:8].
3. Furthermore, an increase / decrease on Minsplit keeping CP constant, leads to corresponding increase and decrease in accuracy.
4. Finally, keeping Minisplit higher and CP lower we can get to better accuracy. The best accuracy is observed in the 10th experiment for a Train/Test ratio of 90,10.

### 2) Perceptron

Experiment	Classifier	Train/Test Ratio	stepmax	r	Outcome (Accuracy)
1		80,20	1e+05	1	99.1%
2		80,20	1e+05	5	99.2%
3		80,20	1e+05	25	98.9%
4		80,20	1e+05	55	99.15%
5		80,20	1e+05	550	99.3%
6		80,20	1e+04	550	99.5%
7		80,20	1e+03	550	99.3%
8		80,20	1e+02	550	99.42%
9		80,20	1e+08	550	99.35%

### Perceptron Parameter Tuning: (Parameters -> Stepmax, r)

1. We started experiments with very less repetitions gradually increasing it keeping stepmax constant.
  2. As the number of reps (r) increased, accuracy increased -> Experiments [1:5].
  3. Effect of stepmax on accuracy is minimal. -> Experiments [5:9]
- Hence, the best parameter Values would be r= 550 or more.

### 3) Neural Net

Experiment	Classifier	Train/Test Ratio	hidden	rep	Outcome (Accuracy)
1		80:20	3	1	98.22%
2		80:20	3	2	99.31%
3		80:20	3	3	98.69%
4		80:20	2	2	98.92%
5		80:20	2	1	98.77%
6		80:20	4	2	98.73%
7		80:20	c(2,1)	2	98.97%
8		80:20	c(3,2)	2	99.07%
9		80:20	c(2,2)	2	99.14%
10		95:05	3	2	99.51%

### Neural net Parameter Tuning: (Parameters -> hidden, rep)

1. Tried with some random values for hidden and rep first.
2. We got maximum on hidden = 3 and rep = 2 for 80:20 split as 99.31 -> Experiment [2]
3. then tried increasing, decreasing rep and hidden we got less accuracy -> Experiments [3:6]
4. Also tried with 2 hidden layers with different node combinations which also gave less accuracy -> Experiments [7:9]
5. Then we Increased split on Train/Test data, Accuracy went up from 99.31 to 99.51 which is obvious considering more training data. -> Experiments [2 & 10]

Hence, the best parameter Values would be hidden = 3 and rep = 2.

#### 4) SVM

Experiment	Classifier	Train/Test Ratio	Cost	gamma	Outcome (Accuracy)
1		80,20	100	0.001	63%
2		80,20	100	0.0005	65%
3		80,20	100	0.00005	68%
4		80,20	10000	0.001	61%
5		80,20	100000	0.001	57%
6		80,20	700000	0.001	50%
7		80,20	700000	0.005	49%
8		80,20	700000	0.0001	62%
9		80,20	700000	0.0005	59%
10		80,20	700000	0.00001	44%
11		80,20	100000	0.00001	63%
12		85,15	100	0.00005	70%

##### SVM Parameter Tuning: (Parameters -> Cost, gamma)

1. First we tried decreasing gamma keeping cost constant, which leads to increase in accuracy. -> Experiments [1:3]
2. Similarly, increase in gamma keeping cost constant leads to decrease in accuracy which can be observed in -> experiments [6, 7 and 8, 9]
3. Finally, increase in cost keeping gamma constant leads to decrease in accuracy which can be observed in -> experiments [4, 5 and 6].
4. Ideally, keeping the values of cost (100) and gamma (0.00005) low and Train/Test ratio of 85,15 leads to best accuracy in the above set of experiments. -> Experiment [12]

#### 5) Naïve Bayes

Experiment	Classifier	Train/Test Ratio	Threshold	Laplace	Outcome (Accuracy)
1		80:20	0.00001	0	59.01%
2		80:20	0.00005	0	55.73%
3		80:20	0.0001	0	63.93%
4		80:20	0.001	0	65.57%
5		80:20	0.01	0	63.93%
6		80:20	0.01	1	63.93%
7		80:20	0.01	2	63.93%
8		80:20	0.01	3	65.57%
9		95:05	0.001	0	68.75%

### Naive Bayes Parameter Tuning: (Parameters -> Threshold, Laplace)

1. First we tried without laplace parameter with very less threshold values.
2. We observed best Accuracy on Threshold = 0.001 -> Experiments [1:5]
3. We varied Laplace from 0 to 3 keeping Threshold constant, Which did not affect accuracy much. -> Experiments [5:8]
4. Then we Increased split on Train/Test data, Accuracy went up from 65.57 to 68.75 which is obvious considering more training data. -> Experiments [4 & 9]

Hence, the best parameter Values would be Threshold = 0.001 and Laplace = 0.