Assignment 10 (Soft-Computing)

Objective: To learn how to train and predict a soft margin-SVM with RBF kernel using SMO algorithm.

1. Use the dataset of heart disease provided on my assignment folder of the course with the following pre-processing and instructions:

   - Use only two features for simplicity- age (data in column #1) and trestbps (on admission to the hospital, data in column #4, i.e resting blood pressure in mm/Hg)
   - Modify the last column (# 14) from 1 –heart disease & 0 –no heart disease to $Y^{(i)} = \{1 \text{ and } -1\}$.
   - Apply feature scaling methods to the data of Col# 1 and Col# 4.
   - Use 70% data for training and 30% for testing.

2. Study the J Platt's paper on SMO algorithm provided in this folder for your convenience and implement.
3. For further inspiration you may see this Github implementation:
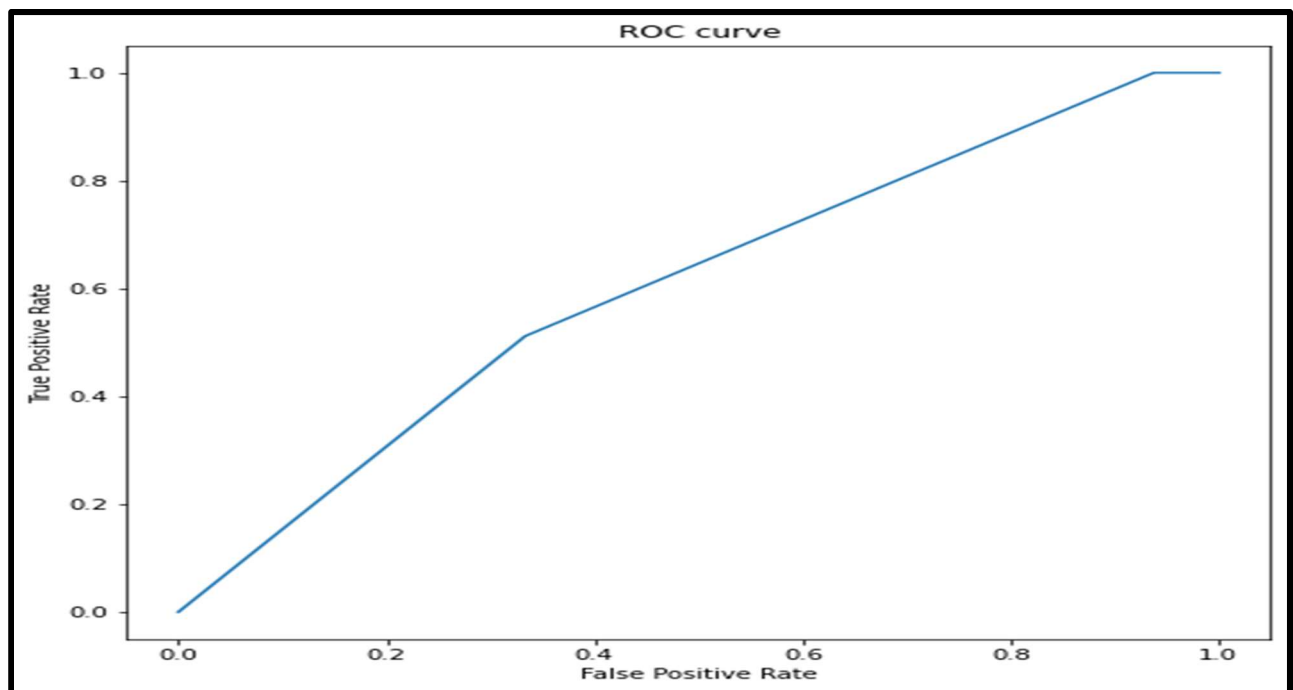4. Always put proper references for the materials you are using.

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Observed Training Iterations in Different Kernels-

SMO Training Observation Table-

	Linear Kernel	RBF Kernel	Poly. Kernel
Iterations	17	26	42
Accuracy	57.14	57	59.34
Epochs/Passes	50	50	50

Polynomial Kernel ROC Curve-

Linear Kernel Accuracy and Training Iteration-

```
Iteration :   1 , Difference :   8.306623862918075 , Changes :   41
Iteration :   2 , Difference :   6.244997998398398 , Changes :   22
Iteration :   3 , Difference :   5.5677643628300215 , Changes :   16
Iteration :   4 , Difference :   3.3166247903554 , Changes :   6
Iteration :   5 , Difference :   3.872983346207417 , Changes :   8
Iteration :   6 , Difference :   3.1622776601683795 , Changes :   5
Iteration :   7 , Difference :   2.0 , Changes :   2
Iteration :   8 , Difference :   2.449489742783178 , Changes :   3
Iteration :   9 , Difference :   0.0 , Changes :   0
Iteration :   10 , Difference :   2.8284271247461903 , Changes :   4
Iteration :   11 , Difference :   0.0 , Changes :   0
Iteration :   12 , Difference :   0.0 , Changes :   0
Iteration :   13 , Difference :   2.0 , Changes :   2
Iteration :   14 , Difference :   0.0 , Changes :   0
Iteration :   15 , Difference :   0.0 , Changes :   0
Iteration :   16 , Difference :   0.0 , Changes :   0
Iteration :   17 , Difference :   0.0 , Changes :   0
60.43956043956044
```

RBF Kernel Accuracy and Training Iteration-

```
Iteration :   1 , Difference :   8.717797887081348 , Changes :   42
Iteration :   2 , Difference :   5.291502622129181 , Changes :   14
Iteration :   3 , Difference :   4.58257569495584 , Changes :   11
Iteration :   4 , Difference :   3.872983346207417 , Changes :   8
Iteration :   5 , Difference :   3.1622776601683795 , Changes :   5
Iteration :   6 , Difference :   3.605551275463989 , Changes :   7
Iteration :   7 , Difference :   3.3166247903554 , Changes :   6
Iteration :   8 , Difference :   2.0 , Changes :   2
Iteration :   9 , Difference :   3.1622776601683795 , Changes :   5
Iteration :   10 , Difference :   1.4142135623730951 , Changes :   1
Iteration :   11 , Difference :   2.0 , Changes :   2
Iteration :   12 , Difference :   2.449489742783178 , Changes :   3
Iteration :   13 , Difference :   0.0 , Changes :   0
Iteration :   14 , Difference :   2.0 , Changes :   2
Iteration :   15 , Difference :   2.8284271247461903 , Changes :   4
Iteration :   16 , Difference :   2.449489742783178 , Changes :   3
Iteration :   17 , Difference :   1.4142135623730951 , Changes :   1
Iteration :   18 , Difference :   1.4142135623730951 , Changes :   1
Iteration :   19 , Difference :   0.0 , Changes :   0
Iteration :   20 , Difference :   1.7320508075688772 , Changes :   2
Iteration :   21 , Difference :   0.0 , Changes :   0
Iteration :   22 , Difference :   1.4142135623730951 , Changes :   1
Iteration :   23 , Difference :   0.0 , Changes :   0
Iteration :   24 , Difference :   0.0 , Changes :   0
Iteration :   25 , Difference :   0.0 , Changes :   0
Iteration :   26 , Difference :   0.0 , Changes :   0
57.14285714285714
```

Polynomial Kernel Accuracy and Training Iteration-

```
Iteration :  1 , Difference :  7.732477524771597 , Changes :  35
Iteration :  2 , Difference :  5.5677643628300215 , Changes :  18
Iteration :  3 , Difference :  4.69041575982343 , Changes :  11
Iteration :  4 , Difference :  4.69041575982343 , Changes :  13
Iteration :  5 , Difference :  4.123105625617661 , Changes :  9
Iteration :  6 , Difference :  3.1622776601683795 , Changes :  5
Iteration :  7 , Difference :  2.34845690312685 96 , Changes :  3
Iteration :  8 , Difference :  2.8343577329221854 , Changes :  5
Iteration :  9 , Difference :  2.449489742783178 , Changes :  3
Iteration :  10 , Difference :  3.1622776601683795 , Changes :  6
Iteration :  11 , Difference :  0.0 , Changes :  0
Iteration :  12 , Difference :  0.18325871923537812 , Changes :  1
Iteration :  13 , Difference :  2.449489742783178 , Changes :  3
Iteration :  14 , Difference :  1.4142135623730951 , Changes :  1
Iteration :  15 , Difference :  0.0 , Changes :  0
Iteration :  16 , Difference :  2.0 , Changes :  2
Iteration :  17 , Difference :  2.0 , Changes :  2
Iteration :  18 , Difference :  1.7320508075688772 , Changes :  2
Iteration :  19 , Difference :  2.0 , Changes :  2
Iteration :  20 , Difference :  0.0 , Changes :  0
Iteration :  21 , Difference :  2.0 , Changes :  2
Iteration :  22 , Difference :  0.0 , Changes :  0
Iteration :  23 , Difference :  0.0 , Changes :  0
Iteration :  24 , Difference :  0.0 , Changes :  0
Iteration :  25 , Difference :  1.4142135623730951 , Changes :  1
Iteration :  26 , Difference :  0.0 , Changes :  0
Iteration :  27 , Difference :  0.0 , Changes :  0
Iteration :  28 , Difference :  1.4142135623730951 , Changes :  1
Iteration :  29 , Difference :  0.18325871923537812 , Changes :  1
Iteration :  30 , Difference :  1.2309548431377169 , Changes :  1
Iteration :  31 , Difference :  0.0 , Changes :  0
Iteration :  32 , Difference :  0.0 , Changes :  0
Iteration :  33 , Difference :  1.4142135623730951 , Changes :  1
Iteration :  34 , Difference :  0.8046692950134227 , Changes :  1
Iteration :  35 , Difference :  0.0 , Changes :  0
Iteration :  36 , Difference :  0.0 , Changes :  0
Iteration :  37 , Difference :  0.0 , Changes :  0
Iteration :  38 , Difference :  1.2309548431377169 , Changes :  1
Iteration :  39 , Difference :  0.0 , Changes :  0
Iteration :  40 , Difference :  0.0 , Changes :  0
Iteration :  41 , Difference :  0.0 , Changes :  0
Iteration :  42 , Difference :  0.0 , Changes :  0
59.34065934065934
```