Assignment2 Question1

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September 2017

1 Kernel Trick

We were give lineraly non seperable data and the task was to project these dat poins to a higher dimensional space where they become linearly sepearable. We are asked to come up with different kernels which can do the above mentioned task. Following were the kernels used by me.
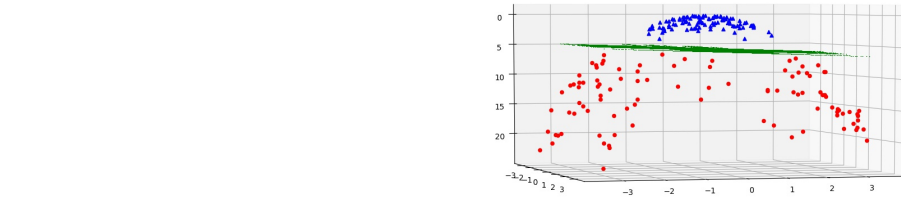
1. **kernel 1**

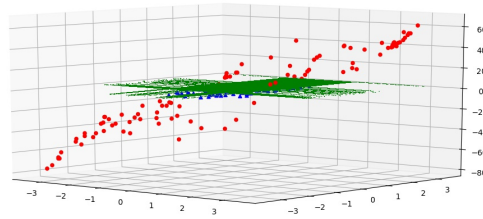Figure 1: kernel used:$(x, y, x^2 + y^2)$

2. **kernel 2**

Figure 2: kernel used:$(x,\ y\ ,x^3+y^3)$
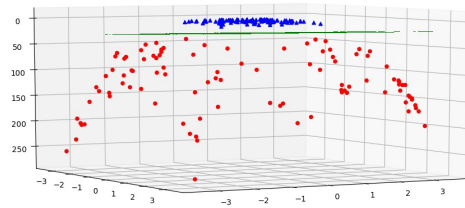
3. **kernel 3**

Figure 3: kernel used:$(x,\ y\ ,x^4+y^4$

4. **kernel 4**
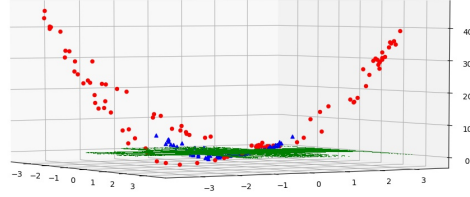
Figure 4: kernel used:$(x, y, (x+y)^2$

Table 1: Accuracy of different kernels

Kernels	Accuracy (%)
kernel 1	100.0
kernel 2	67.0
kernel 3	70.0
kernel 4	100

2 English letter classification

The task here is to classify english alphabets using SVM classifier with differnet kernels and report the accuracies and other metrics. The kernels used and the metrics obtained are mentioned below.

Table 2: SVM with linear kernel

C	Accuracy	Precision	Recall	F1
0.1	0.868	0.868	0.868	0.868
0.2	0.866	0.866	0.866	0.866
0.3	0.865	0.865	0.865	0.865
0.4	0.866	0.866	0.866	0.866
0.5	0.867	0.867	0.867	0.867
0.6	0.867	0.867	0.867	0.867
0.7	0.867	0.867	0.867	0.867
0.8	0.8675	0.8675	0.8675	0.8675
0.9	0.868	0.868	0.868	0.868
1	0.868	0.868	0.868	0.868

Table 3: SVM with RBF kernel

C	Accuracy	Precision	Recall	F1
0.1	0.8955	0.8955	0.8955	0.8955
0.2	0.939	0.939	0.939	0.939
0.3	0.9525	0.9525	0.9525	0.9525
0.4	0.958	0.958	0.958	0.958
0.5	0.9615	0.9615	0.9615	0.9615
0.6	0.9645	0.9645	0.9645	0.9645
0.7	0.9645	0.9645	0.9645	0.9645
0.8	0.9645	0.9645	0.9645	0.9645
0.9	0.9655	0.9655	0.9655	0.9655
1	0.966	0.966	0.966	0.966

Table 4: SVM with polynomial kernel

alpha	Accuracy	Precision	Recall	F1
0.1	0.945	0.945	0.945	0.945
0.2	0.9455	0.9455	0.9455	0.9455
0.3	0.9455	0.9455	0.9455	0.9455
0.4	0.9455	0.9455	0.9455	0.9455
0.5	0.9455	0.9455	0.9455	0.9455
0.6	0.9455	0.9455	0.9455	0.9455
0.7	0.9455	0.9455	0.9455	0.9455
0.8	0.9455	0.9455	0.9455	0.9455
0.9	0.9455	0.9455	0.9455	0.9455
1	0.9455	0.9455	0.9455	0.9455

2.1 Observtions

From the above table it is clear that SVM with RBF kernal and regularization parameter set between 0.5 and 0.7 gives us the best accuracy and F1-score.

2.2 Discriminative features

Table 5: below table show the first 5 columns and first 10 columns of our training dataset

	1	2	3	4	5	6	7	8	9	10	11
1	2	6	2	4	1	0	2	5	6	0	0
2	4	5	5	3	3	5	7	4	7	6	6
3	6	8	9	7	7	10	4	2	3	10	3
4	4	5	5	4	3	6	6	6	6	6	6
5	5	5	6	8	3	7	7	4	15	9	6

Table 6: The Below table shows the correlation between various pair wise features.

Feature column	Feature column	Correlation
2	6	0.0164270523
5	8	0.0158006049
4	6	0.0155163664
7	13	-0.0122513032
4	10	0.0118695798
1	8	0.0114925492
2	14	0.0093562807
5	7	-0.0058001778
4	11	-0.0040734195
4	12	-0.002251683
4	7	-0.0007162956

According to the above table selecting the the feature 4 and 12 should give us the highest accuracy and F1 score since they are the least correlated.

The accuracy that we get on just using feature 4 and 12 is **30.85**