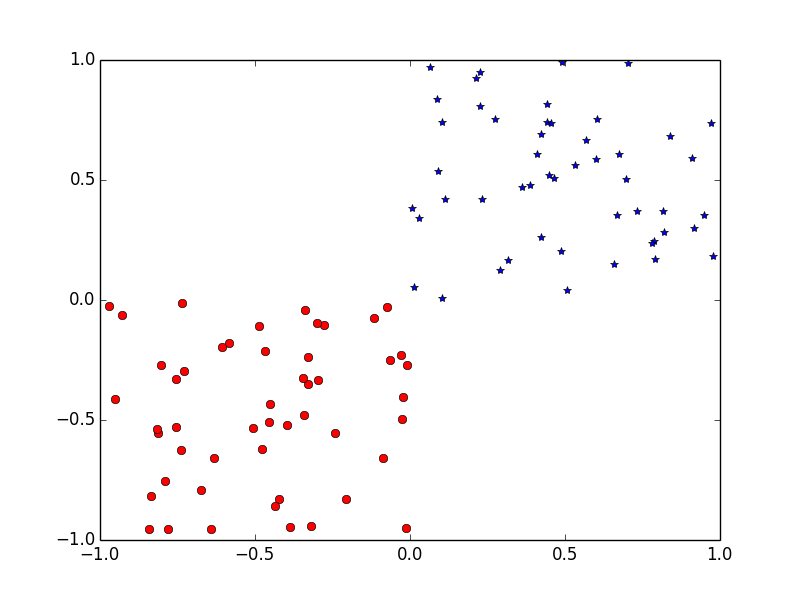
CS584 Assignment 4

Weilun Zhao; A20329942

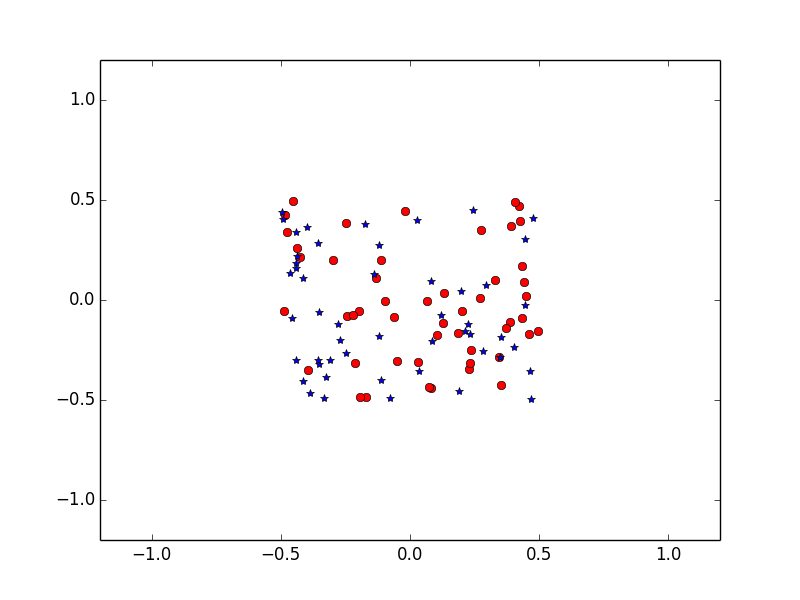
# 1. Data generate:

2D feature vector of two classes; totally having 100 number of data;

## Linearly separable:

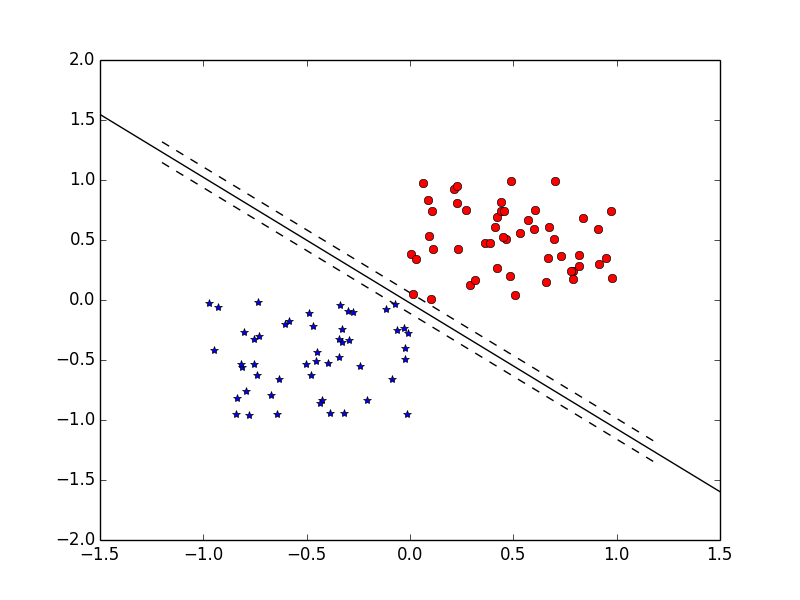


## non-Linearly separable



# 2. hard margin SVM

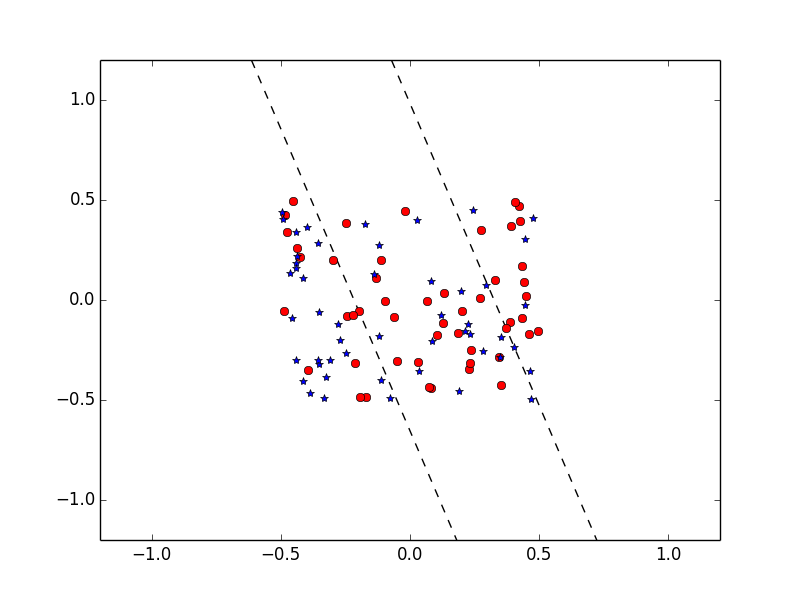
## Linearly Separable



## Two hand Cross Validation in Linearly Separable

|  |  |  |
| --- | --- | --- |
|  | Cross 1 | Cross 2 |
| Plot data graph | ../figure_CrossVal1.png | ../figure_CrossVal2.png |
| Performance | | |
| Confusion matrix | [[25 0]  [ 0 25]] | [[25 0]  [ 1 24]] |
| Accuracy | 1.0 | 0.98 |
| Precision | 1.0 | 0.961538461538 |
| Recall | 1.0 | 1.0 |
| Fmeasure | 1.0 | 0.980392156863 |
| Total Performance | | |
| Accuracy | 0.99 | |
| Precision | 0.98 | |
| Recall | 1.0 | |
| Fmeasure | 0.989898989899 | |

## Non Linearly Separable



## Two hand Cross Validation in Non Linearly Separable

|  |  |  |
| --- | --- | --- |
|  | Cross 1 | Cross 2 |
| Plot data graph | ../NolinearSep/CrossValNoSep1.png | ../NolinearSep/CrossValNoSep2.png |
| Performance | | |
| Confusion matrix | [[13 12]  [10 15]] | [[17 8]  [13 12]] |
| Accuracy | 0.56 | 0.58 |
| Precision | 0.565217391304 | 0.566666666667 |
| Recall | 0.52 | 0.68 |
| Fmeasure | 0.541666666667 | 0.618181818182 |
| Total Performance | | |
| Accuracy | 0.618181818182 | |
| Precision | 0.6 | |
| Recall | 0.566037735849 | |
| Fmeasure | 0.582524271845 | |

# 3. Soft margins SVM:

soft margins definition:

is slack variables;

Based on the formula in the question 3:

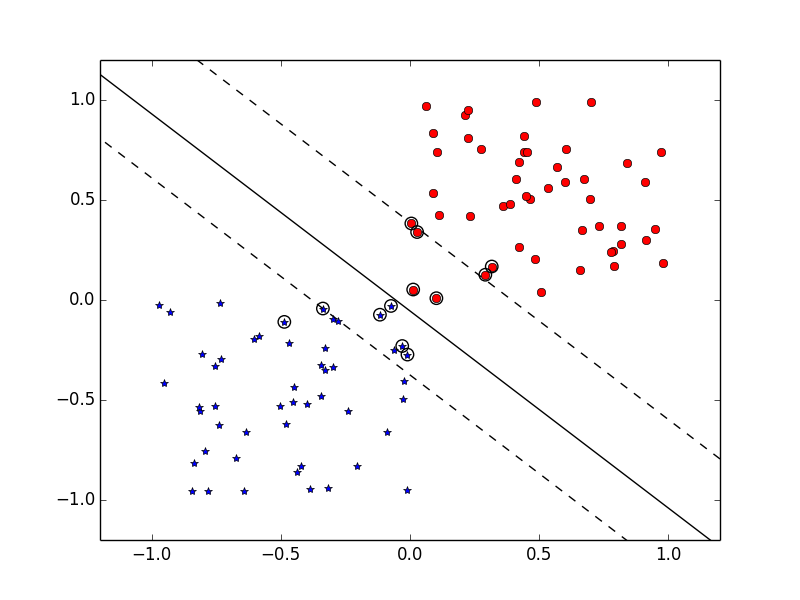
We want to using partial derivative to get ;

I can get:

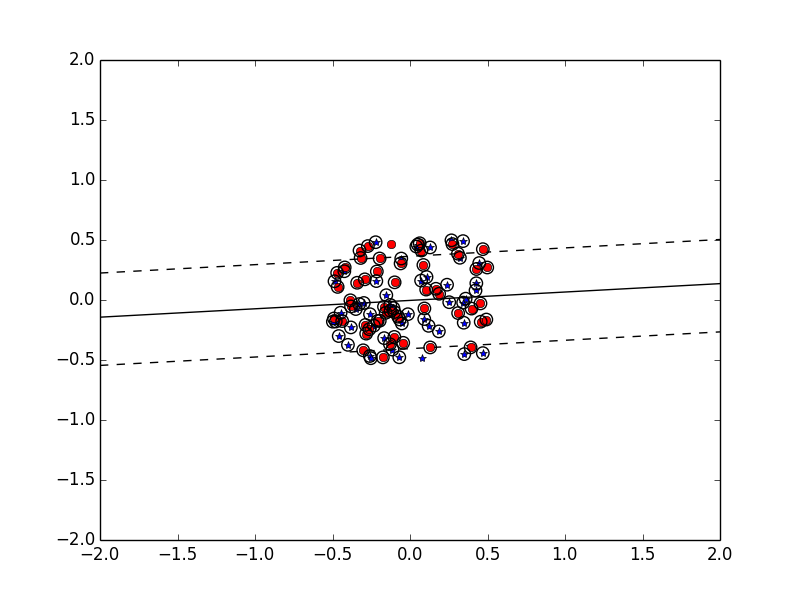
and put W into then get the result of

# 4. Implement Soft margins SVM

## Soft margins with Linearly separable dataset

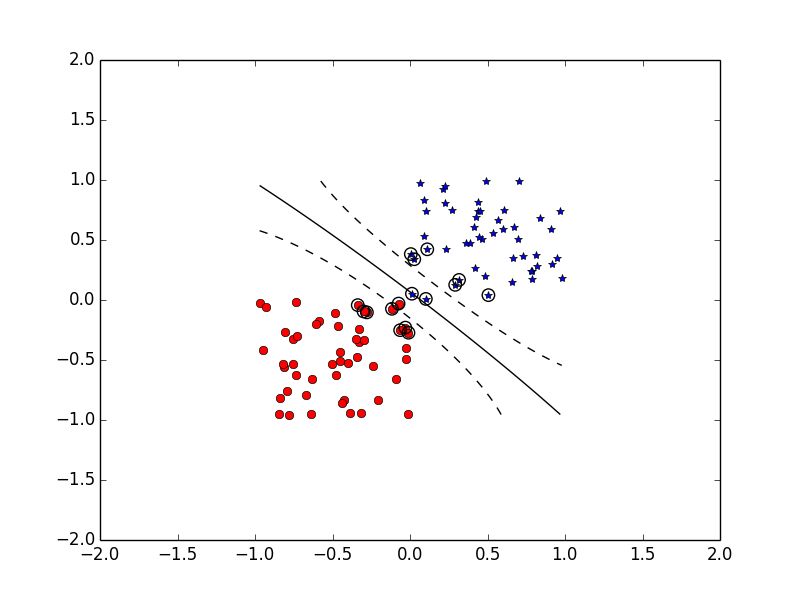


## Soft margins with Non Linearly separable dataset



# 5. Implement Kernel-based SVM

## Kernel based SVM

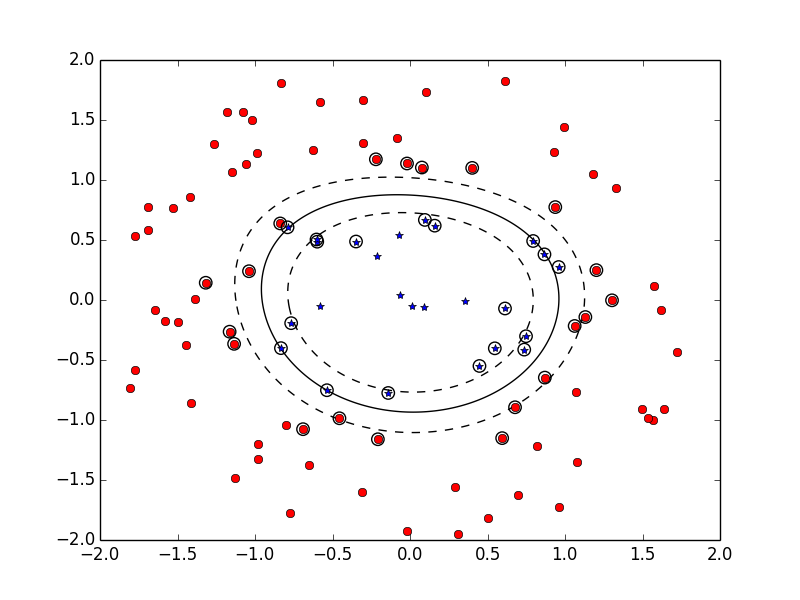


## Two hand Cross Validation

|  |  |  |
| --- | --- | --- |
|  | Cross 1 | Cross 2 |
| Plot data graph | ../KernelCross/KernalCrossVal2_1.png | ../KernelCross/KernalCrossVal2_2.png |
| Performance | | |
| Confusion matrix | [[25 0]  [ 0 24]] | [[24 1]  [ 0 25]] |
| Accuracy | 1.0 | 0.98 |
| Precision | 1.0 | 1.0 |
| Recall | 1.0 | 0.96 |
| Fmeasure | 1.0 | 0.979591836735 |
| Total Performance | | |
| Accuracy | 0.99 | |
| Precision | 1.0 | |
| Recall | 0.98 | |
| Fmeasure | 0.989898989899 | |

## External Dataset

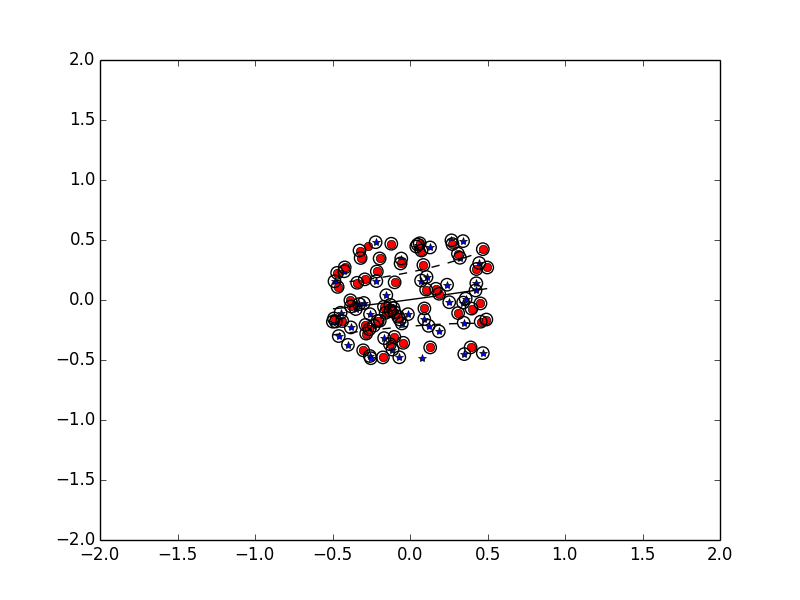
### Circle dataset:



### Two hand cross validation

|  |  |  |
| --- | --- | --- |
|  | Cross 1 | Cross 2 |
| Plot data graph | ../KernelCross/KernalCrossVal1.png | ../KernelCross/KernalCrossVal2.png |
| Performance | | |
| Confusion matrix | [[12 0]  [ 4 34]] | [[ 6 7]  [ 0 37]] |
| Accuracy | 0.92 | 0.86 |
| Precision | 0.75 | 1.0 |
| Recall | 1.0 | 0.461538461538 |
| Fmeasure | 0.857142857143 | 0.631578947368 |
| Total Performance | | |
| Accuracy | 0.89 | |
| Precision | 0.818181818182 | |
| Recall | 0.72 | |
| Fmeasure | 0.765957446809 | |

### Non Linear Separable Dataset



### Two hand cross validation

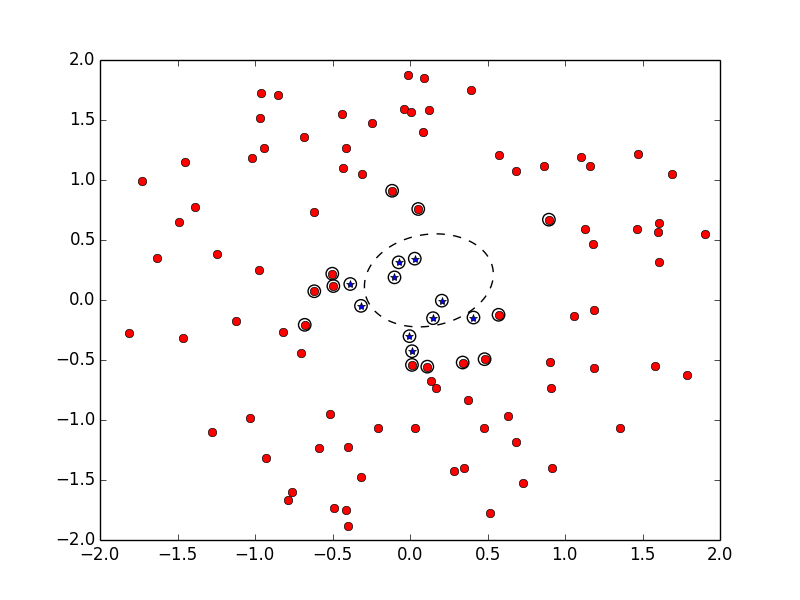
|  |  |  |
| --- | --- | --- |
|  | Cross 1 | Cross 2 |
| Plot data graph | ../KernelCross/KernelNonlinearCrossVal1.png | ../KernelCross/KernelNonlinearCrossVal2.png |
| Performance | | |
| Confusion matrix | [[13 12]  [10 15]] | [[19 6]  [15 10]] |
| Accuracy | 0.56 | 0.58 |
| Precision | 0.565217391304 | 0.558823529412 |
| Recall | 0.52 | 0.76 |
| Fmeasure | 0.541666666667 | 0.64406779661 |
| Total Performance | | |
| Accuracy | 0.565656565657 | |
| Precision | 0.553571428571 | |
| Recall | 0.632653061224 | |
| Fmeasure | 0.5904761904766 | |

Explanation: Kernel-based SVM is way to classified dataset which is non linearly separable.

In addition, using kernel trick to solve high dimension feature is more efficient.

# 6. Testing one class which has substantially more example

## Using Kernel dataset



## two hand cross validation

|  |  |  |
| --- | --- | --- |
|  | Cross 1 | Cross 2 |
| Plot data graph | ../KernelCross/SubKer_6/Sub_cross1.png | ../KernelCross/SubKer_6/Sub_cross2.png |
| Performance | | |
| Confusion matrix | [[ 4 0]  [ 3 43]] | [[ 0 6]  [ 0 44]] |
| Accuracy | 0.94 | 0.88 |
| Precision | 0.571428571429 | 0 |
| Recall | 1.0 | 0 |
| Fmeasure | 0.727272727273 | 0 |
| Total Performance | | |
| Accuracy | 0.91 | |
| Precision | 0.571428571429 | |
| Recall | 0.4 | |
| Fmeasure | 0.470588235294 | |

Explanation: If one class has substantially more examples, the SVM has a tendency to evaluate the test data with this class feature. The class with substantially more examples influents the weight of feature and decrease other class data evaluation.