**CM0669 Machine Learning and Computer Vision**

**Lab 2** Linear and Non-linear SVM classification

**1. Linear SVM classification**

Download the matlab codes ‘LSVM\_SL\_SW\_out\_SE\_VERS.m’, ‘LSVM\_PL\_PW\_out\_SE\_VERS.m’, ‘LSVM\_SL\_SW\_PL\_PW\_out\_SE\_VERS.m’, ‘LSVM\_SL\_SW\_out\_VERS\_VIRG.m’, ‘LSVM\_PL\_PW\_out\_VERS\_VIRG.m’, ‘LSVM\_SL\_SW\_PL\_PW\_out\_VERS\_VIRG.m’ in folder ‘Week2’.

Each Matlab code implements a linear SVM classifier for the training. However, as you have seen in Lab1, they differ in terms of the input and output used. For instance, ‘LSVM\_SL\_SW\_out\_SE\_VERS.m’ is a linear SVM classifier using as input **S**epal **L**ength and **S**epal **W**idth and as output the ‘**SE**tosa’ and ‘**VERS**icolor’ class labels (See figure below)



Similar to what you have seen in Lab1, for the evaluation of each linear SVM classifier, 80 samples (specimens) have been used for the training while the testing is performed on 20 samples.

1. Open up Matlab and browse ‘help using the desktop’. A new window will open. Type in the ‘search results’ tab ‘svmtrain’ (without quotation marks). A helpful description of the built-in function ‘svmtrain’ will be given with good examples. Similarly, you can type ‘svmclassify’ to understand how to use its syntax for the classification.
2. Open up each Matlab code using the Matlab workspace and understand its content (note that each Matlab code is well commented.).
3. Run the codes and complete the results in the table given below.
4. Compare and analyse the results.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Linear SVM | | | | | | | | |
| Input | | | | Output | | | Evaluation | |
| Sepal  Length | Sepal  Width | Petal  Length | Petal  Width | Setosa | Versicolor | Virginica | Training Error (%) | Testing  Error (%) |
| Yes | Yes | No | No | Yes | Yes | No | 0.0750 | 0.2500 |
| No | No | Yes | Yes | Yes | Yes | No | 0 | 0.0500 |
| Yes | Yes | Yes | Yes | Yes | Yes | No | 0.0300 | 0.1500 |
| Yes | Yes | No | No | No | Yes | Yes | 0 | 0 |
| No | No | Yes | Yes | No | Yes | Yes | 0.0500 | 0.0500 |
| Yes | Yes | Yes | Yes | No | Yes | Yes | 0 | 0 |

**2. Linear SVM classification**

Create new Matlab codes from the existing ones so that you can fill in the following tables:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SVM with polynomial of power 3 as kernel function | | | | | | | | |
| Input | | | | Output | | | Evaluation | |
| Sepal  Length | Sepal  Width | Petal  Length | Petal  Width | Setosa | Versicolor | Virginica | Training Error (%) | Testing  Error (%) |
| Yes | Yes | No | No | Yes | Yes | No |  |  |
| No | No | Yes | Yes | Yes | Yes | No |  |  |
| Yes | Yes | Yes | Yes | Yes | Yes | No |  |  |
| Yes | Yes | No | No | No | Yes | Yes |  |  |
| No | No | Yes | Yes | No | Yes | Yes |  |  |
| Yes | Yes | Yes | Yes | No | Yes | Yes |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SVM with radial-basis as kernel function (σ=1.5) | | | | | | | | |
| Input | | | | Output | | | Evaluation | |
| Sepal  Length | Sepal  Width | Petal  Length | Petal  Width | Setosa | Versicolor | Virginica | Training Error (%) | Testing  Error (%) |
| Yes | Yes | No | No | Yes | Yes | No |  |  |
| No | No | Yes | Yes | Yes | Yes | No |  |  |
| Yes | Yes | Yes | Yes | Yes | Yes | No |  |  |
| Yes | Yes | No | No | No | Yes | Yes |  |  |
| No | No | Yes | Yes | No | Yes | Yes |  |  |
| Yes | Yes | Yes | Yes | No | Yes | Yes |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SVM with hyperbolic tangent as kernel function (*p*1=0.1, *p*2=−0.5) | | | | | | | | |
| Input | | | | Output | | | Evaluation | |
| Sepal  Length | Sepal  Width | Petal  Length | Petal  Width | Setosa | Versicolor | Virginica | Training Error (%) | Testing  Error (%) |
| Yes | Yes | No | No | Yes | Yes | No |  |  |
| No | No | Yes | Yes | Yes | Yes | No |  |  |
| Yes | Yes | Yes | Yes | Yes | Yes | No |  |  |
| Yes | Yes | No | No | No | Yes | Yes |  |  |
| No | No | Yes | Yes | No | Yes | Yes |  |  |
| Yes | Yes | Yes | Yes | No | Yes | Yes |  |  |

Analyse the results and compare with the previous ones which you have obtained with the linear SVM classifier.