**Part 1, Theory (15%)**

1. What is the difference between a rule-based system and a machine learning

system? **(5%)**

a rule-based system is the system which rules inputted by humans (like the form of if-then-else statements) and data inputted to be processed. Comparing to a machine learning system, rule-based system just contains fixed knowledge which couldn’t be changed over time. In this way a machine learning system has ability to learn therefore existing knowledge can be changed or discarded, and new knowledge can be acquired to create their own model and these models can then be applied to

new data to produce original answers. Machine learning system can be regard as a real AI.

2. What is the difference between unsupervised and supervised learning? **(5%)**

In Supervised learning, we train the machine using labeled data(the data type we already know) whereas in unsupervised learning we makes use of unlabeled data(unforeseen data type). Supervised learning usually fit a function from a given training data set, and when new data arrives, we can predict the result based on this fitted function, such as Regression and Classification. But unsupervised learning has no labeled input data and there is no definite result, therefore the dataset needs to be classified based on the similarity between the different data, such as Clustering.

3. What do we mean when we say that a machine learning system is overfitting?

**(5%)**

A machine learning system overfitting means this system fit a model but this model be fitted by the training data too well and the model is too complicated. Therefore, new data is hardly applied by this system.

**Part 2, Practice (85%)**

1

TP:6

TN:8

FP:3

FN:3

precision = TP/(TP+FP) = 0.67

recall = TP/(TP+FN) = 0.67

accuracy =(TP+TN)/(TP+TN+FP+FN) = 0.7

f-measure = 2\*precision\*recall/(precision+recall) = 0.67

2.

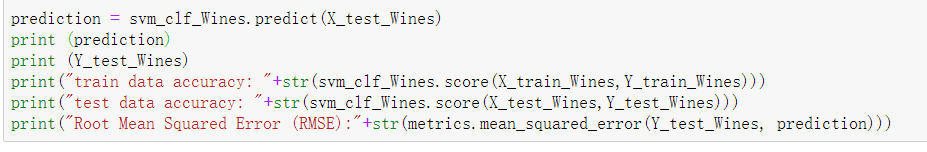
For this unseen wine quality prediction problem we firstly think about the SVM regression model with Gaussian kernal, because we can see the wine quality could be totally classified as 1, 2, 3, 4, 5, 6 and 7. Therefore this case is a classification problem.

The train:

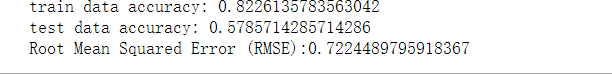


Here the penalty parameter is 1

Do the predict:

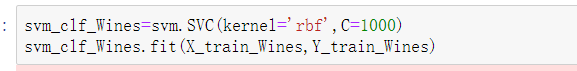


Output:



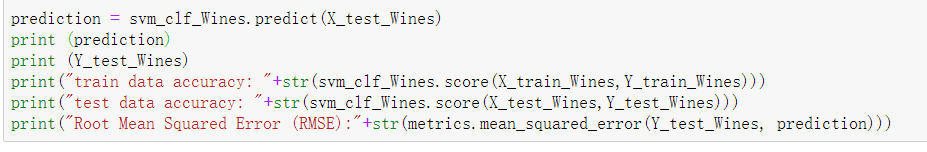
And another method to solve this problem is

The code:

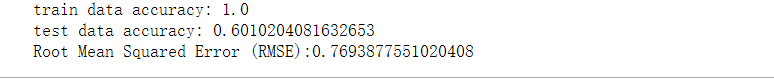


Here we adjust the penalty parameter to 1000

Do the predict:



Output



For both tasks and all error metrics, the SVM is the best choice. The differences are higher for small tolerances and in particular for the white wine (e.g. for T = 0.25, the SVM accuracy is almost two times better when compared to other methods).

3.

3.1 table data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Fold | Accuracy | Precision | Recall | F-measure |
| 1 | 0.77 | 0.77 | 0.77 | 0.77 |
| 2 | 0.78 | 0.78 | 0.78 | 0.77 |
| 3 | 0.76 | 0.76 | 0.76 | 0.75 |
| 4 | 0.75 | 0.76 | 0.75 | 0.75 |
| 5 | 0.76 | 0.76 | 0.76 | 0.76 |
| 6 | 0.74 | 0.74 | 0.74 | 0.73 |
| 7 | 0.78 | 0.78 | 0.78 | 0.78 |
| 8 | 0.77 | 0.77 | 0.77 | 0.76 |
| 9 | 0.79 | 0.79 | 0.79 | 0.79 |
| 10 | 0.80 | 0.80 | 0.80 | 0.80 |
| Average | 0.77 | 0.77 | 0.77 | 0.77 |

3.2 the data preprocessed

3.3 feature chosen

3.4 model trained and evaluated