**Task 1:**

|  |  |  |
| --- | --- | --- |
| Kernel values | Accuracy with SVM (Binary) % | Accuracy with SVM (Multi-class) % |
| Linear | 95.9 | 94.4 |
| rbf | 96.15 | 86 |

Table 1: Accuracy with SVM for the binary and multi-class task.

**Task 2:**

|  |  |  |
| --- | --- | --- |
| n\_neighbors | Accuracy with K-NN (Binary) (%) | Accuracy with K-NN (Multi-class) (%) |
| 2 | 95.780 |  |
| 3 | 95.536 |  |
| 4 | 95.808 |  |
| 6 | 95.892 |  |
| 8 | 95.880 |  |
| 10 | 95.936 |  |

Table 2: Accuracy with K-NN for the binary and multi-class task.

**Task 3:**

The accuracy of decision tree algorithm is 95.024 percent.

The confusion matrix for all of the algorithm used are listed below:

**Confusion matrix of binary classification**

SVM (linear): [[22702, 97],   
 [ 928, 1273]]

SVM (rbf): [[22775, 24],  
 [ 939, 1262]]

KNN (k=2): [[22680, 119],  
 [ 936, 1265]]

KNN (k=3): [[22525, 274],  
 [ 842, 1359]]

KNN (k=4): [[22704, 95],  
 [ 953, 1248]]

KNN (k=6): [[22735, 64],  
 [ 963, 1238]]

KNN (k=8): [[22740, 59],  
 [ 971, 1230]]

KNN (k=10): [[22758, 41],  
 [ 975, 1226]]

Decision Tree: [[22146, 653],  
 [ 591, 1610]]

**Confusion matrix of multi-class classification**

Confusion Matrix of SVM with linear kernel:

[[115 1 0 0]

[ 4 111 11 0]

[ 0 3 127 5]

[ 0 0 4 119]]

Confusion Matrix of SVM with rbf kernel:

[[105 11 0 0]

[ 12 99 15 0]

[ 0 19 112 4]

[ 0 0 9 114]]

Confusion Matrix of SVM with poly kernel:

[[92 24 0 0]

[12 86 28 0]

[ 0 27 94 14]

[ 0 0 27 96]]

Confusion Matrix of KNN with n\_neighbors = 2:

[[91 23 2 0]

[55 48 22 1]

[22 55 48 10]

[ 3 35 58 27]]

Confusion Matrix of KNN with n\_neighbors = 3:

[[76 33 6 1]

[48 47 27 4]

[24 47 41 23]

[ 1 30 31 61]]

Confusion matrix of KNN with n\_neighbors = 4:

[[84 26 6 0]

[45 46 32 3]

[17 41 56 21]

[ 0 16 50 57]]

Confusion Matrix of KNN with n\_neighbors = 6:

[[89 25 2 0]

[50 45 29 2]

[17 41 57 20]

[ 0 18 48 57]]

Confusion matrix of KNN with n\_neighbors = 8:

[[80 34 2 0]

[38 51 30 7]

[13 44 56 22]

[ 2 12 46 63]]

Confusion matrix of KNN with n\_neighbors = 10:

[[82 31 3 0]

[41 52 30 3]

[13 42 62 18]

[ 1 12 44 66]]

Confusion matrix of Decision Tree:

[[103 13 0 0]

[ 7 99 20 0]

[ 0 23 97 15]

[ 0 0 9 114]]