Q1.

|  |  |
| --- | --- |
| KNN  | Validation Accuracy |
| K = 1 | 98.8375 |
| K = 2 | 98.6631 |
| K = 3 | 98.8956 |
| K = 4 | 98.8084 |
| K = 5 | 98.7794 |
| K = 6 | 98.8666 |
| K = 7 | 98.8666 |
| K = 8 | 98.5759 |
| K = 9 | 98.7213 |
| K = 10 | 98.6631 |

|  |  |
| --- | --- |
| Decision Tree (MinLeafSize) | Validation Accuracy |
| 50 | 97.13 |
| 60 | 97.61 |
| 70 | 98.26 |
| 80 | 98.80 |
| 90 | 98.77 |
| 100 | 98.86 |
| 110 | 98.867 |

|  |  |
| --- | --- |
| Linear Discrimination | Validation Accuracy |
| diagLinear | 91.07 |
| pseudolinear | 95.72 |

|  |  |
| --- | --- |
| MLP | Validation Accuracy |
| MSE 28.34 | 97.75 |
| MSE 24.42 | 97.63 |

Training Time: 0.029082sec

Test Time: 0.00045145sec

Confusion Matrices for KNN

 178 0 0 0 0 0 1 0 0 0

 0 181 1 0 2 0 0 0 2 0

 0 0 176 0 0 0 0 0 0 0

 0 0 0 179 0 0 0 0 0 1

 0 0 0 0 178 1 0 1 0 0

 0 0 0 0 0 179 1 0 0 1

 0 0 0 0 0 0 179 0 0 0

 0 0 0 1 0 0 0 170 0 0

 0 1 0 1 1 0 0 1 171 4

 0 0 0 2 0 2 0 7 1 174

Confusion Matrices for Decision Tree

 178 0 0 0 0 0 0 0 0 0

 0 182 0 0 0 0 0 0 0 0

 0 0 177 0 0 0 0 0 0 0

 0 0 0 183 0 0 0 0 0 0

 0 0 0 0 181 0 0 0 0 0

 0 0 0 0 0 182 0 0 0 0

 0 0 0 0 0 0 181 0 0 0

 0 0 0 0 0 0 0 179 0 0

 0 0 0 0 0 0 0 0 174 0

 0 0 0 0 0 0 0 0 0 180

Confusion Matrices for Linear Discrimination

 174 0 0 0 0 0 0 0 0 0

 0 166 0 0 2 0 2 0 12 3

 0 5 168 1 0 0 0 0 0 0

 0 0 7 171 0 0 0 0 0 1

 0 0 0 0 175 0 1 1 0 1

 2 0 0 3 0 179 0 3 5 1

 0 0 0 0 0 0 178 0 0 0

 0 0 0 0 1 0 0 163 1 0

 1 5 1 5 2 0 0 2 142 3

 1 6 1 3 1 3 0 10 14 171

Confusion Matrices for MLP

 178 0 0 0 0 0 1 0 0 0

 0 181 1 0 2 0 0 0 2 0

 0 0 176 0 0 0 0 0 0 0

 0 0 0 179 0 0 0 0 0 1

 0 0 0 0 178 1 0 1 0 0

 0 0 0 0 0 179 1 0 0 1

 0 0 0 0 0 0 179 0 0 0

 0 0 0 1 0 0 0 170 0 0

 0 1 0 1 1 0 0 1 171 4

 0 0 0 2 0 2 0 7 1 174

Q.2

 Class: No of examples in testing set

 0: 178

 1: 182

 2: 177

 3: 183

 4: 181

 5: 182

 6: 181

 7: 179

 8: 174

 9: 180

**Accuracy for each class for KNN Model:**

Accuracy for class 0: (100 - (178-178)) = 100 %

Accuracy for class 1: (100 - (182-181)) = 99 %

Accuracy for class 2: (100 - (177-176)) = 99 %

Accuracy for class 3: (100 - (183-179)) = 96 %

Accuracy for class 4: (100 - (181-178)) = 97 %

Accuracy for class 5: (100 - (182-179)) = 97 %

Accuracy for class 6: (100 - (181-179)) = 98 %

Accuracy for class 7: (100 - (179-170)) = 91 %

Accuracy for class 8: (100 - (174-171)) = 97 %

Accuracy for class 9: (100 - (180-174)) = 94 %

**Accuracy for each class for Decision Tree Model:**

Accuracy for class 0: (100 - (178-178)) = 100 %

Accuracy for class 1: (100 - (182-182)) = 100 %

Accuracy for class 2: (100 - (177-177)) = 100 %

Accuracy for class 3: (100 - (183-183)) = 100 %

Accuracy for class 4: (100 - (181-181)) = 100 %

Accuracy for class 5: (100 - (182-182)) = 100 %

Accuracy for class 6: (100 - (181-181)) = 100 %

Accuracy for class 7: (100 - (179-179)) = 100 %

Accuracy for class 8: (100 - (174-174)) = 100 %

Accuracy for class 9: (100 - (180-180)) = 100 %

**Accuracy for each class for Linear DiscriminationModel:**

Accuracy for class 0: (100 - (178-174)) = 96 %

Accuracy for class 1: (100 - (182-166)) = 84 %

Accuracy for class 2: (100 - (177-168)) = 91 %

Accuracy for class 3: (100 - (183-171)) = 88 %

Accuracy for class 4: (100 - (181-175)) = 94 %

Accuracy for class 5: (100 - (182-179)) = 97 %

Accuracy for class 6: (100 - (181-178)) = 97 %

Accuracy for class 7: (100 - (179-163)) = 84 %

Accuracy for class 8: (100 - (174-142)) = 68 %

Accuracy for class 9: (100 - (180-171)) = 91 %

**Accuracy for each class for MLP Model:**

Accuracy for class 0: (100 - (178-178)) = 100 %

Accuracy for class 1: (100 - (182-181)) = 99 %

Accuracy for class 2: (100 - (177-176)) = 99 %

Accuracy for class 3: (100 - (183-179)) = 96 %

Accuracy for class 4: (100 - (181-178)) = 97 %

Accuracy for class 5: (100 - (182-179)) = 97 %

Accuracy for class 6: (100 - (181-179)) = 98 %

Accuracy for class 7: (100 - (179-170)) = 91 %

Accuracy for class 8: (100 - (174-171)) = 97 %

Accuracy for class 9: (100 - (180-174)) = 94 %

Training Time: 0.01926sec

Test Time: 0.00049562sec

Q.3

Eliminate the 10% instances records in the optdigits\_new.xlsx file in sheet named “misclassified training instance”

Applying the optdigits\_new.xlsx file to all the four model for evaluation:

Confusion Matrices for KNN

 178 0 0 0 0 0 1 0 0 0

 0 182 4 0 2 0 0 0 15 0

 0 0 173 1 0 0 0 0 2 0

 0 0 0 181 0 1 0 0 11 3

 0 0 0 0 179 1 0 1 0 3

 0 0 0 0 0 179 1 0 3 4

 0 0 0 0 0 0 179 0 1 0

 0 0 0 1 0 0 0 176 1 0

 0 0 0 0 0 0 0 1 139 2

 0 0 0 0 0 1 0 1 2 168

Confusion Matrices for Decision Tree

 178 0 0 0 0 0 0 0 0 0

 0 182 0 0 0 0 0 0 0 0

 0 0 177 0 0 0 0 0 0 0

 0 0 0 183 0 0 0 0 0 0

 0 0 0 0 181 0 0 0 0 0

 0 0 0 0 0 182 0 0 0 0

 0 0 0 0 0 0 181 0 0 0

 0 0 0 0 0 0 0 155 12 0

 0 0 0 0 0 0 0 24 162 0

 0 0 0 0 0 0 0 0 0 180

Confusion Matrices for Linear Discrimination

 174 0 0 0 0 0 0 0 0 0

 0 168 0 0 2 0 2 0 13 2

 0 4 169 1 0 0 0 0 0 0

 0 0 6 172 0 0 0 0 1 1

 1 0 0 0 176 0 1 1 0 1

 2 0 0 3 0 179 0 4 4 1

 0 0 0 0 0 0 178 0 1 0

 0 0 0 0 1 0 0 164 1 0

 0 5 1 1 0 0 0 2 134 1

 1 5 1 6 2 3 0 8 20 174

Confusion Matrices for MLP

 178 0 0 0 0 0 1 0 0 0

 0 182 4 0 2 0 0 0 15 0

 0 0 173 1 0 0 0 0 2 0

 0 0 0 181 0 1 0 0 11 3

 0 0 0 0 179 1 0 1 0 3

 0 0 0 0 0 179 1 0 3 4

 0 0 0 0 0 0 179 0 1 0

 0 0 0 1 0 0 0 176 1 0

 0 0 0 0 0 0 0 1 139 2

 0 0 0 0 0 1 0 1 2 168

The accuracy is increased as depicted in confusion matrix.