Machine Learning Programming Assignment 1

Name : Shubham Shankar
UTA ID: 1001761068
Section: 2208-CSE-6363-004

Code Results:

Once the code starts running it will call the evaluate function, which will further call k-fold where cross validation will be done. Once that is done it runs the K nearest algorithm, Distances are calculated, and predictions are made.

We use 4 distance measures to calculate:

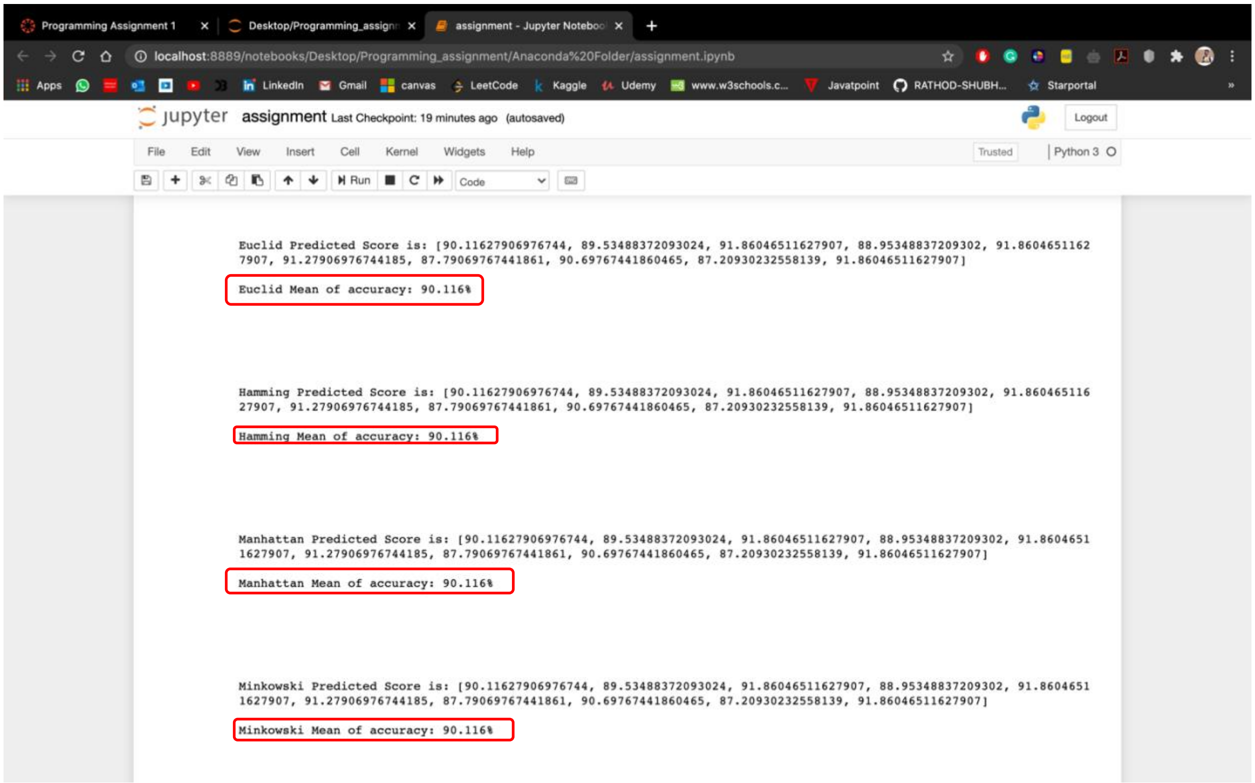
- Euclidian Distance
- Hamming Distance
- Minkowski Distance
- Manhattan Distance.

1. **Car dataset**:

Dataset is used from : https://archive.ics.uci.edu/ml/datasets/Car+Evaluation

In the code when the user enters '1' , user selects car data set.

The Output of code:


Programming Assignment 1
Desktop/Programming_assignm
assignment - Jupyter Noteboo
localhost:8889/notebooks/Desktop/Programming_assignment/Anaconda%20Folder/assignment.ipynb
Apps
LinkedIn
Gmail
canvas
LeetCode
Kaggle
Udemy
www.w3schools.c...
Javatpoint
RATHOD-SHUBH...
Starportal
jupyter
assignment Last Checkpoint: 19 minutes ago (autosaved)
Logout
File
Edit
View
Insert
Cell
Kernel
Widgets
Help
Trusted
Python 3
Run
Code

```
Euclid Predicted Score is: [90.11627906976744, 89.53488372093024, 91.86046511627907, 88.95348837209302, 91.8604651162
7907, 91.27906976744185, 87.79069767441861, 90.69767441860465, 87.20930232558139, 91.86046511627907]

Euclid Mean of accuracy: 90.116%


Hamming Predicted Score is: [90.11627906976744, 89.53488372093024, 91.86046511627907, 88.95348837209302, 91.860465116
27907, 91.27906976744185, 87.79069767441861, 90.69767441860465, 87.20930232558139, 91.86046511627907]

Hamming Mean of accuracy: 90.116%


Manhattan Predicted Score is: [90.11627906976744, 89.53488372093024, 91.86046511627907, 88.95348837209302, 91.8604651
1627907, 91.27906976744185, 87.79069767441861, 90.69767441860465, 87.20930232558139, 91.86046511627907]

Manhattan Mean of accuracy: 90.116%


Minkowski Predicted Score is: [90.11627906976744, 89.53488372093024, 91.86046511627907, 88.95348837209302, 91.8604651
1627907, 91.27906976744185, 87.79069767441861, 90.69767441860465, 87.20930232558139, 91.86046511627907]

Minkowski Mean of accuracy: 90.116%
```

Machine Learning Programming Assignment 1

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Section: 2208-CSE-6363-004

Output of Weka:

```
                              === Run information ===

Scheme:       weka.classifiers.lazy.IBk -K 5 -W 0 -A "weka.core.neighboursearch.LinearNNSearch -
A \"weka.core.EuclideanDistance -R first-last\""
Relation:     car-weka.filters.unsupervised.attribute.StringToNominal-R3-4-
weka.filters.unsupervised.attribute.StringToNominal-R3-4
Instances:    1728
Attributes:   7
              1
              2
              3
              4
              5
              6
              7
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

IB1 instance-based classifier
using 5 nearest neighbour(s) for classification


Time taken to build model: 0.01 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1616               93.5185 %
Incorrectly Classified Instances       112                6.4815 %
Kappa statistic                          0.853
Mean absolute error                      0.1122
Root mean squared error                  0.1953
Relative absolute error                 48.9977 %
Root relative squared error             57.7645 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===
```

Machine Learning Programming Assignment 1

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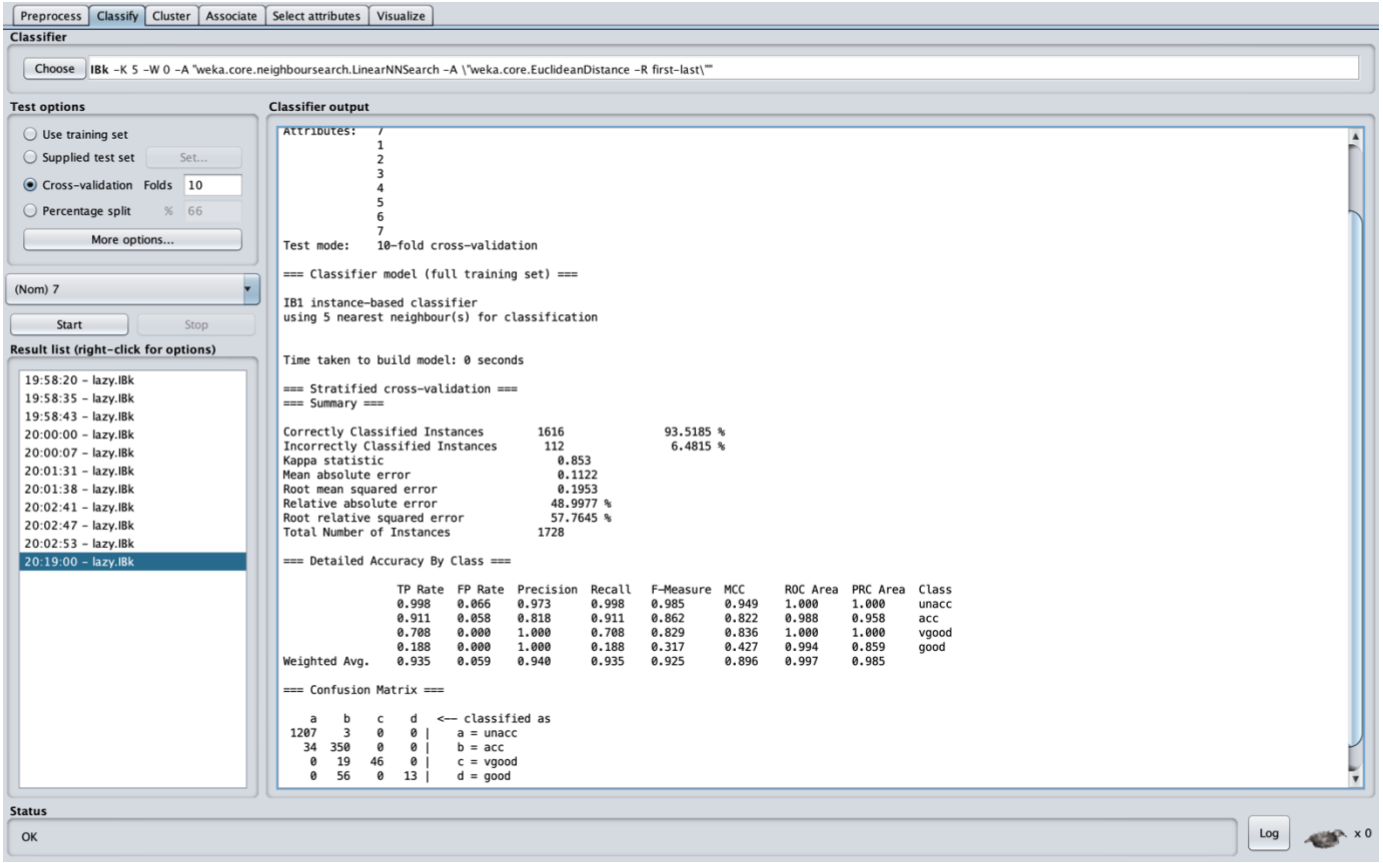
```
                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.998    0.066    0.973      0.998    0.985      0.949    1.000     1.000     unacc
                 0.911    0.058    0.818      0.911    0.862      0.822    0.988     0.958     acc
                 0.708    0.000    1.000      0.708    0.829      0.836    1.000     1.000     vgood
                 0.188    0.000    1.000      0.188    0.317      0.427    0.994     0.859     good
Weighted Avg.    0.935    0.059    0.940      0.935    0.925      0.896    0.997     0.985

=== Confusion Matrix ===

    a    b    c    d   <-- classified as
 1207    3    0    0 |    a = unacc
   34  350    0    0 |    b = acc
    0   19   46    0 |    c = vgood
    0   56    0   13 |    d = good
```



IBk -K 5 -W 0 -A "weka.core.neighboursearch.LinearNNSearch -A \"weka.core.EuclideanDistance -R first-last\""

○ Use training set
○ Supplied test set
● Cross-validation Folds 10
○ Percentage split % 66

(Nom) 7

Status: OK

```
Attributes:   7
              1
              2
              3
              4
              5
              6
              7
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

IB1 instance-based classifier
using 5 nearest neighbour(s) for classification


Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances        1616               93.5185 %
Incorrectly Classified Instances       112                6.4815 %
Kappa statistic                          0.853
Mean absolute error                      0.1122
Root mean squared error                  0.1953
Relative absolute error                 48.9977 %
Root relative squared error             57.7645 %
Total Number of Instances             1728

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.998    0.066    0.973      0.998    0.985      0.949    1.000     1.000     unacc
                 0.911    0.058    0.818      0.911    0.862      0.822    0.988     0.958     acc
                 0.708    0.000    1.000      0.708    0.829      0.836    1.000     1.000     vgood
                 0.188    0.000    1.000      0.188    0.317      0.427    0.994     0.859     good
Weighted Avg.    0.935    0.059    0.940      0.935    0.925      0.896    0.997     0.985

=== Confusion Matrix ===

    a    b    c    d   <-- classified as
 1207    3    0    0 |    a = unacc
   34  350    0    0 |    b = acc
    0   19   46    0 |    c = vgood
    0   56    0   13 |    d = good
```

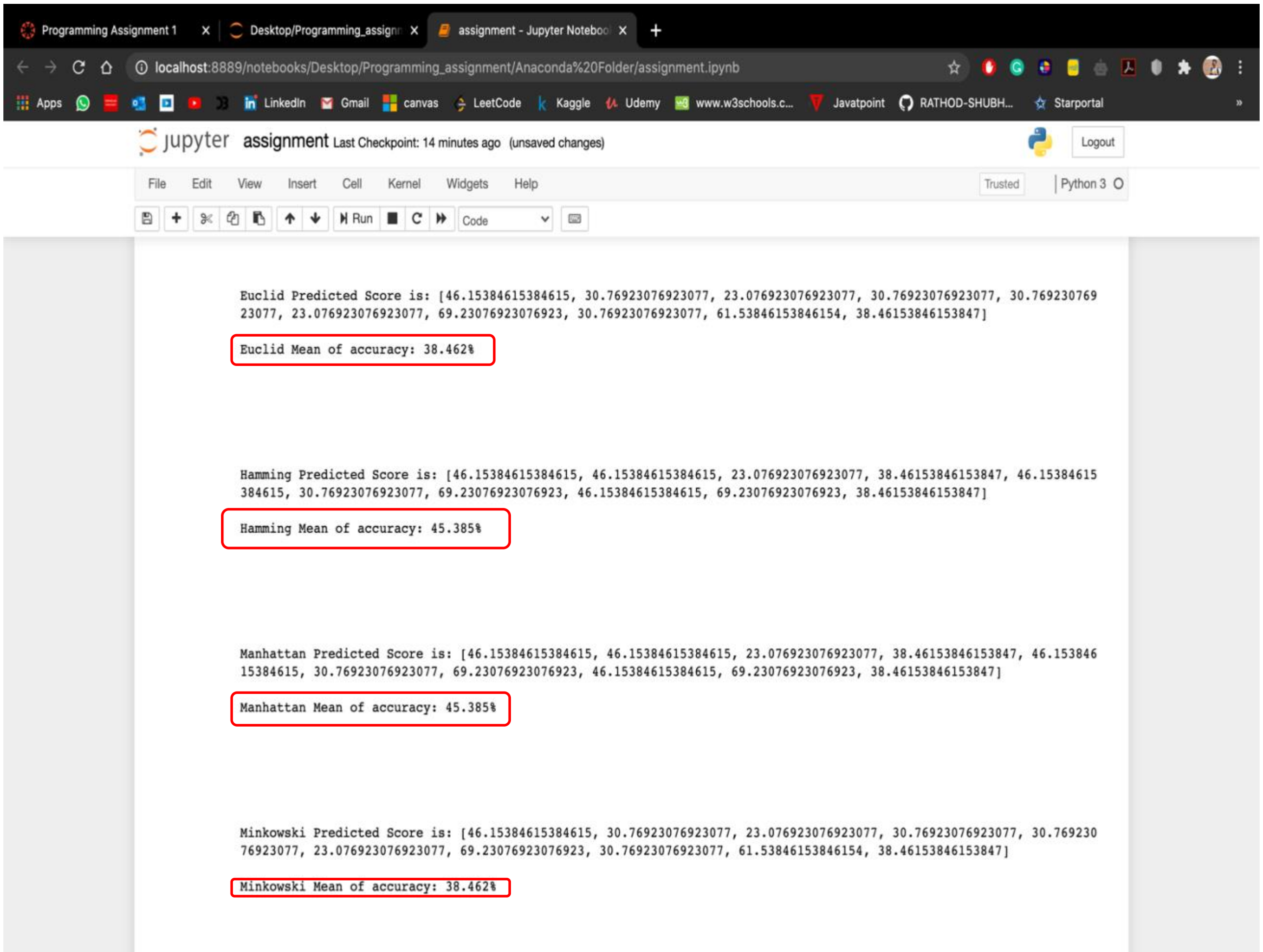
Accuracy from code: 90.116 %
Accuracy from weka: 93.5185 %

2. Hayes-Roth dataset:

Dataset is used from : https://archive.ics.uci.edu/ml/datasets/Hayes-Roth

In the code when the user enters '2', user selects hayes roth data set.

Output of code:


Programming Assignment 1
Desktop/Programming_assignr
assignment - Jupyter Noteboo
localhost:8889/notebooks/Desktop/Programming_assignment/Anaconda%20Folder/assignment.ipynb
jupyter assignment Last Checkpoint: 14 minutes ago (unsaved changes)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code

```
Euclid Predicted Score is: [46.15384615384615, 30.76923076923077, 23.076923076923077, 30.76923076923077, 30.769230769
23077, 23.076923076923077, 69.23076923076923, 30.76923076923077, 61.53846153846154, 38.46153846153847]

Euclid Mean of accuracy: 38.462%



Hamming Predicted Score is: [46.15384615384615, 46.15384615384615, 23.076923076923077, 38.46153846153847, 46.15384615
384615, 30.76923076923077, 69.23076923076923, 46.15384615384615, 69.23076923076923, 38.46153846153847]

Hamming Mean of accuracy: 45.385%



Manhattan Predicted Score is: [46.15384615384615, 46.15384615384615, 23.076923076923077, 38.46153846153847, 46.153846
15384615, 30.76923076923077, 69.23076923076923, 46.15384615384615, 69.23076923076923, 38.46153846153847]

Manhattan Mean of accuracy: 45.385%



Minkowski Predicted Score is: [46.15384615384615, 30.76923076923077, 23.076923076923077, 30.76923076923077, 30.769230
76923077, 23.076923076923077, 69.23076923076923, 30.76923076923077, 61.53846153846154, 38.46153846153847]

Minkowski Mean of accuracy: 38.462%
```

Machine Learning Programming Assignment 1

Name : Shubham Shankar
UTA ID: 1001761068
Section: 2208-CSE-6363-004

Output from weka:

```
                                    === Run information ===

Scheme:       weka.classifiers.lazy.IBk -K 5 -W 0 -A "weka.core.neighboursearch.LinearNNSearch -
A \"weka.core.EuclideanDistance -R first-last\""
Relation:     hayes-roth-weka.filters.unsupervised.attribute.NumericToNominal-Rfirst-last
Instances:    132
Attributes:   6
              1
              2
              3
              4
              5
              6
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

IB1 instance-based classifier
using 5 nearest neighbour(s) for classification


Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances          84               63.6364 %
Incorrectly Classified Instances        48               36.3636 %
Kappa statistic                          0.4143
Mean absolute error                      0.3501
Root mean squared error                  0.4079
Relative absolute error                 80.7647 %
Root relative squared error             87.6388 %
Total Number of Instances              132
```

Machine Learning Programming Assignment 1

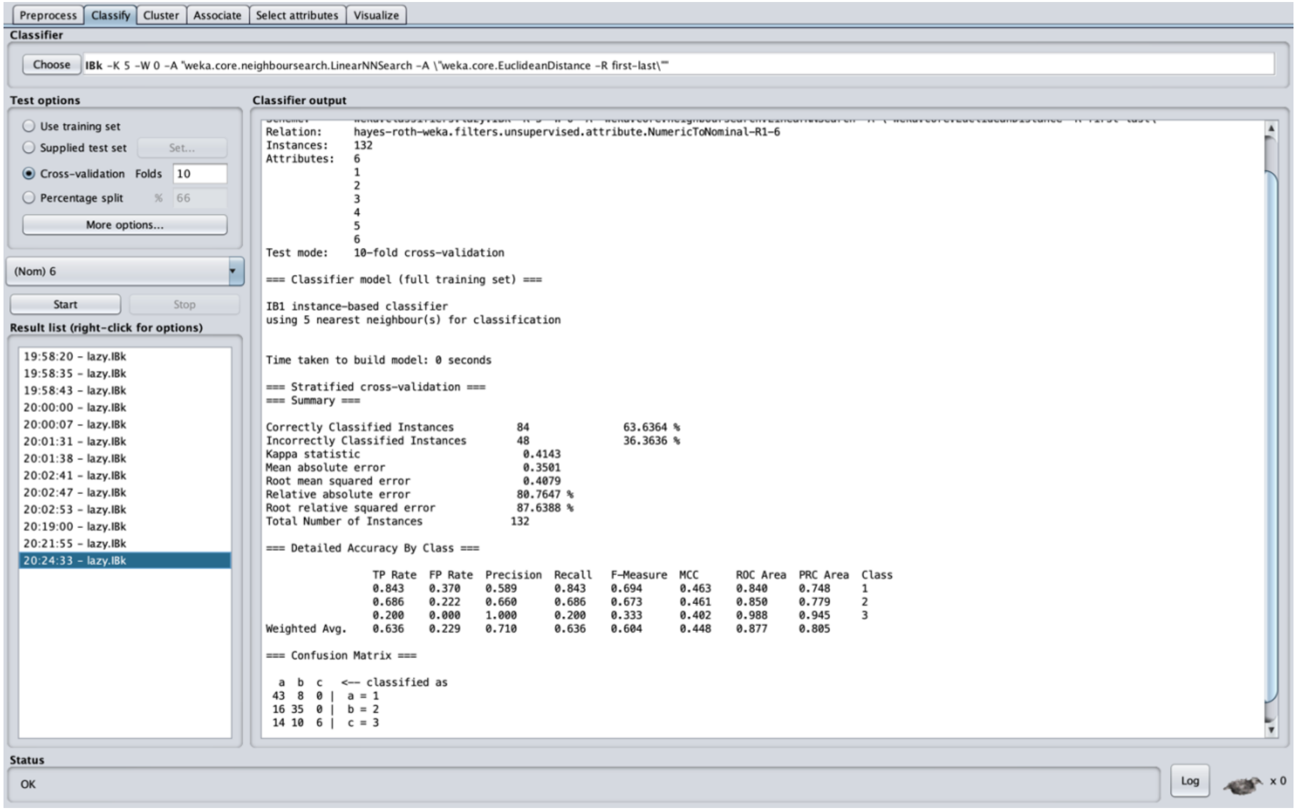
Name : Shubham Shankar
UTA ID: 1001761068
Section: 2208-CSE-6363-004

```
=== Detailed Accuracy By Class ===

              TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
              0.843    0.370    0.589      0.843    0.694      0.463    0.840     0.748     1
              0.686    0.222    0.660      0.686    0.673      0.461    0.850     0.779     2
              0.200    0.000    1.000      0.200    0.333      0.402    0.988     0.945     3
Weighted Avg.   0.636    0.229    0.710      0.636    0.604      0.448    0.877     0.805

=== Confusion Matrix ===

  a  b  c   <-- classified as
 43  8  0 |  a = 1
 16 35  0 |  b = 2
 14 10  6 |  c = 3
```



IBk -K 5 -W 0 -A "weka.core.neighboursearch.LinearNNSearch -A \"weka.core.EuclideanDistance -R first-last\""

○ Use training set
○ Supplied test set Set...
● Cross-validation Folds 10
○ Percentage split % 66

(Nom) 6

Result list (right-click for options)

```
19:58:20 - lazy.IBk
19:58:35 - lazy.IBk
19:58:43 - lazy.IBk
20:00:00 - lazy.IBk
20:00:07 - lazy.IBk
20:01:31 - lazy.IBk
20:01:38 - lazy.IBk
20:02:41 - lazy.IBk
20:02:47 - lazy.IBk
20:02:53 - lazy.IBk
20:19:00 - lazy.IBk
20:21:55 - lazy.IBk
20:24:33 - lazy.IBk
```

Classifier output

```
Relation:     hayes-roth-weka.filters.unsupervised.attribute.NumericToNominal-R1-6
Instances:    132
Attributes:   6
              1
              2
              3
              4
              5
              6
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

IB1 instance-based classifier
using 5 nearest neighbour(s) for classification


Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances          84               63.6364 %
Incorrectly Classified Instances        48               36.3636 %
Kappa statistic                          0.4143
Mean absolute error                      0.3501
Root mean squared error                  0.4079
Relative absolute error                 80.7647 %
Root relative squared error             87.6388 %
Total Number of Instances              132

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.843    0.370    0.589      0.843    0.694      0.463    0.840     0.748     1
                 0.686    0.222    0.660      0.686    0.673      0.461    0.850     0.779     2
                 0.200    0.000    1.000      0.200    0.333      0.402    0.988     0.945     3
Weighted Avg.    0.636    0.229    0.710      0.636    0.604      0.448    0.877     0.805

=== Confusion Matrix ===

  a  b  c   <-- classified as
 43  8  0 |  a = 1
 16 35  0 |  b = 2
 14 10  6 |  c = 3
```

Status
OK

Machine Learning Programming Assignment 1

Name : Shubham Shankar
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Section: 2208-CSE-6363-004

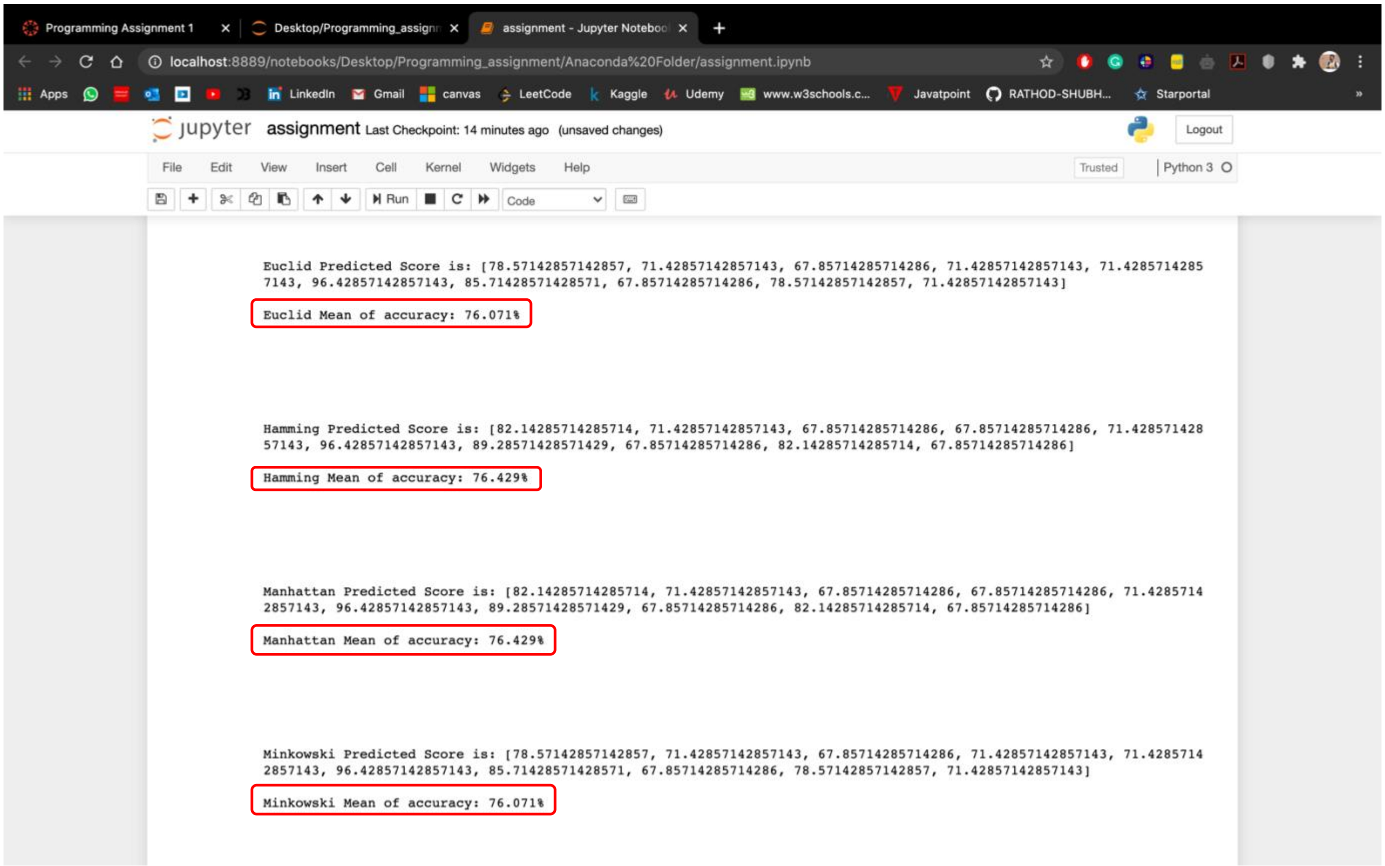
Accuracy from code: 45.385 %
Accuracy from weka: 63.6364 %

3. Breast-Cancer Dataset

Dataset is used from : https://archive.ics.uci.edu/ml/datasets/Breast+Cancer

In the code when the user enters ‘3’, user selects Breast Cancer data set.

Output of code:


Programming Assignment 1
Desktop/Programming_assignm
assignment - Jupyter Notebook
localhost:8889/notebooks/Desktop/Programming_assignment/Anaconda%20Folder/assignment.ipynb
Apps
LinkedIn
Gmail
canvas
LeetCode
Kaggle
Udemy
www.w3schools.c...
Javatpoint
RATHOD-SHUBH...
Starportal
jupyter
assignment Last Checkpoint: 14 minutes ago (unsaved changes)
Logout
File
Edit
View
Insert
Cell
Kernel
Widgets
Help
Trusted
Python 3
Run
Code

```
Euclid Predicted Score is: [78.57142857142857, 71.42857142857143, 67.85714285714286, 71.42857142857143, 71.4285714285
7143, 96.42857142857143, 85.71428571428571, 67.85714285714286, 78.57142857142857, 71.42857142857143]

Euclid Mean of accuracy: 76.071%



Hamming Predicted Score is: [82.14285714285714, 71.42857142857143, 67.85714285714286, 67.85714285714286, 71.428571428
57143, 96.42857142857143, 89.28571428571429, 67.85714285714286, 82.14285714285714, 67.85714285714286]

Hamming Mean of accuracy: 76.429%



Manhattan Predicted Score is: [82.14285714285714, 71.42857142857143, 67.85714285714286, 67.85714285714286, 71.4285714
2857143, 96.42857142857143, 89.28571428571429, 67.85714285714286, 82.14285714285714, 67.85714285714286]

Manhattan Mean of accuracy: 76.429%



Minkowski Predicted Score is: [78.57142857142857, 71.42857142857143, 67.85714285714286, 71.42857142857143, 71.4285714
2857143, 96.42857142857143, 85.71428571428571, 67.85714285714286, 78.57142857142857, 71.42857142857143]

Minkowski Mean of accuracy: 76.071%
```

Machine Learning Programming Assignment 1

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Section: 2208-CSE-6363-004

Output from Weka:

```
                              === Run information ===

Scheme:       weka.classifiers.lazy.IBk -K 5 -W 0 -A "weka.core.neighboursearch.LinearNNSearch -
A \"weka.core.EuclideanDistance -R first-last\""
Relation:     breast-cancer
Instances:    286
Attributes:   10
              1
              2
              3
              4
              5
              6
              7
              8
              9
              10
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

IB1 instance-based classifier
using 5 nearest neighbour(s) for classification


Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         220               76.9231 %
Incorrectly Classified Instances        66               23.0769 %
Kappa statistic                          0.181
Mean absolute error                      0.2975
Root mean squared error                  0.4158
Relative absolute error                 81.8349 %
Root relative squared error             97.6636 %
Total Number of Instances              286
```

Machine Learning Programming Assignment 1

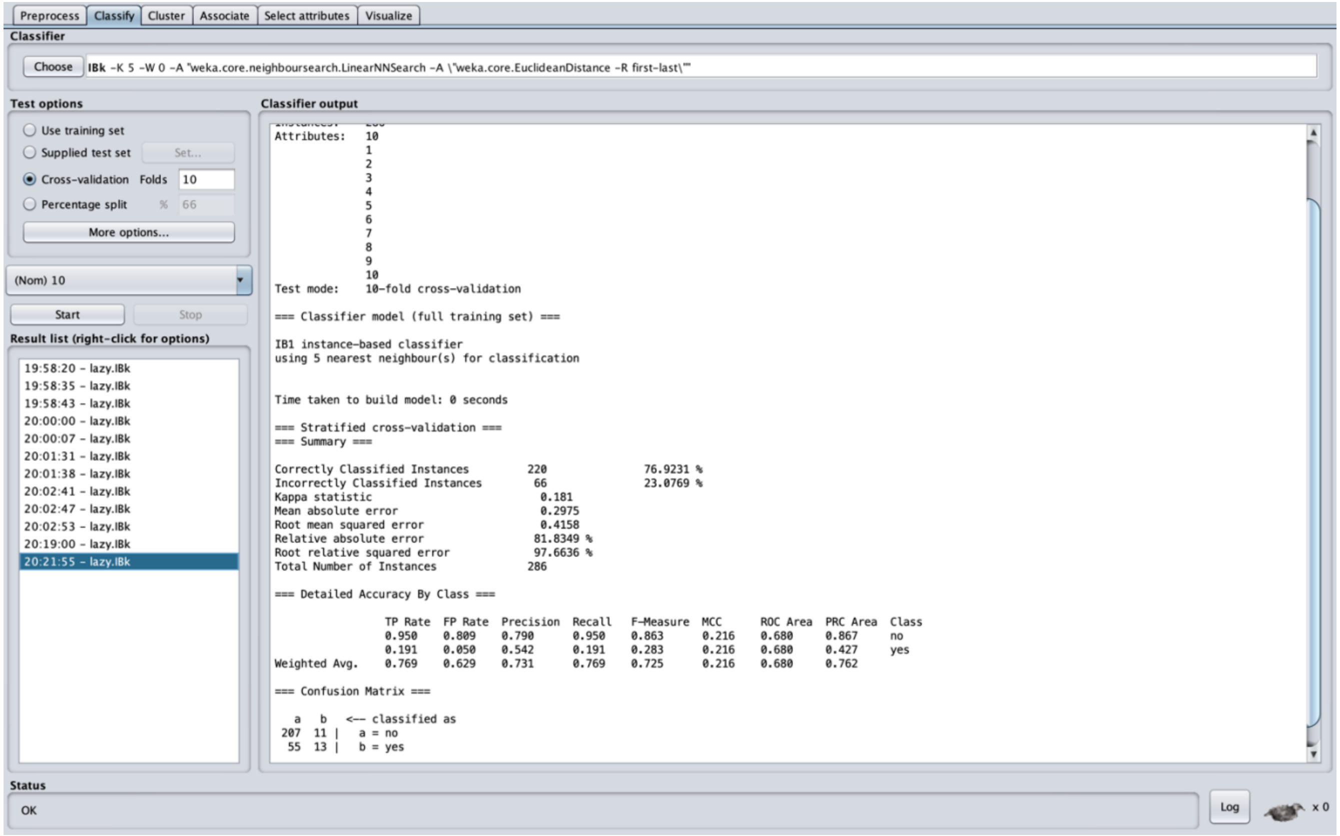
Name : Shubham Shankar
UTA ID: 1001761068
Section: 2208-CSE-6363-004

```
=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.950    0.809    0.790      0.950    0.863      0.216    0.680     0.867     no
                 0.191    0.050    0.542      0.191    0.283      0.216    0.680     0.427     yes
Weighted Avg.    0.769    0.629    0.731      0.769    0.725      0.216    0.680     0.762

=== Confusion Matrix ===

   a   b   <-- classified as
 207  11 |   a = no
  55  13 |   b = yes
```



IBk -K 5 -W 0 -A "weka.core.neighboursearch.LinearNNSearch -A \"weka.core.EuclideanDistance -R first-last\""

○ Use training set
○ Supplied test set
● Cross-validation Folds 10
○ Percentage split % 66

(Nom) 10

19:58:20 - lazy.IBk
19:58:35 - lazy.IBk
19:58:43 - lazy.IBk
20:00:00 - lazy.IBk
20:00:07 - lazy.IBk
20:01:31 - lazy.IBk
20:01:38 - lazy.IBk
20:02:41 - lazy.IBk
20:02:47 - lazy.IBk
20:02:53 - lazy.IBk
20:19:00 - lazy.IBk
20:21:55 - lazy.IBk

```
Attributes:   10
              1
              2
              3
              4
              5
              6
              7
              8
              9
              10
Test mode:    10-fold cross-validation

=== Classifier model (full training set) ===

IB1 instance-based classifier
using 5 nearest neighbour(s) for classification


Time taken to build model: 0 seconds

=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances         220               76.9231 %
Incorrectly Classified Instances        66               23.0769 %
Kappa statistic                          0.181
Mean absolute error                      0.2975
Root mean squared error                  0.4158
Relative absolute error                 81.8349 %
Root relative squared error             97.6636 %
Total Number of Instances              286

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0.950    0.809    0.790      0.950    0.863      0.216    0.680     0.867     no
                 0.191    0.050    0.542      0.191    0.283      0.216    0.680     0.427     yes
Weighted Avg.    0.769    0.629    0.731      0.769    0.725      0.216    0.680     0.762

=== Confusion Matrix ===

   a   b   <-- classified as
 207  11 |   a = no
  55  13 |   b = yes
```

OK

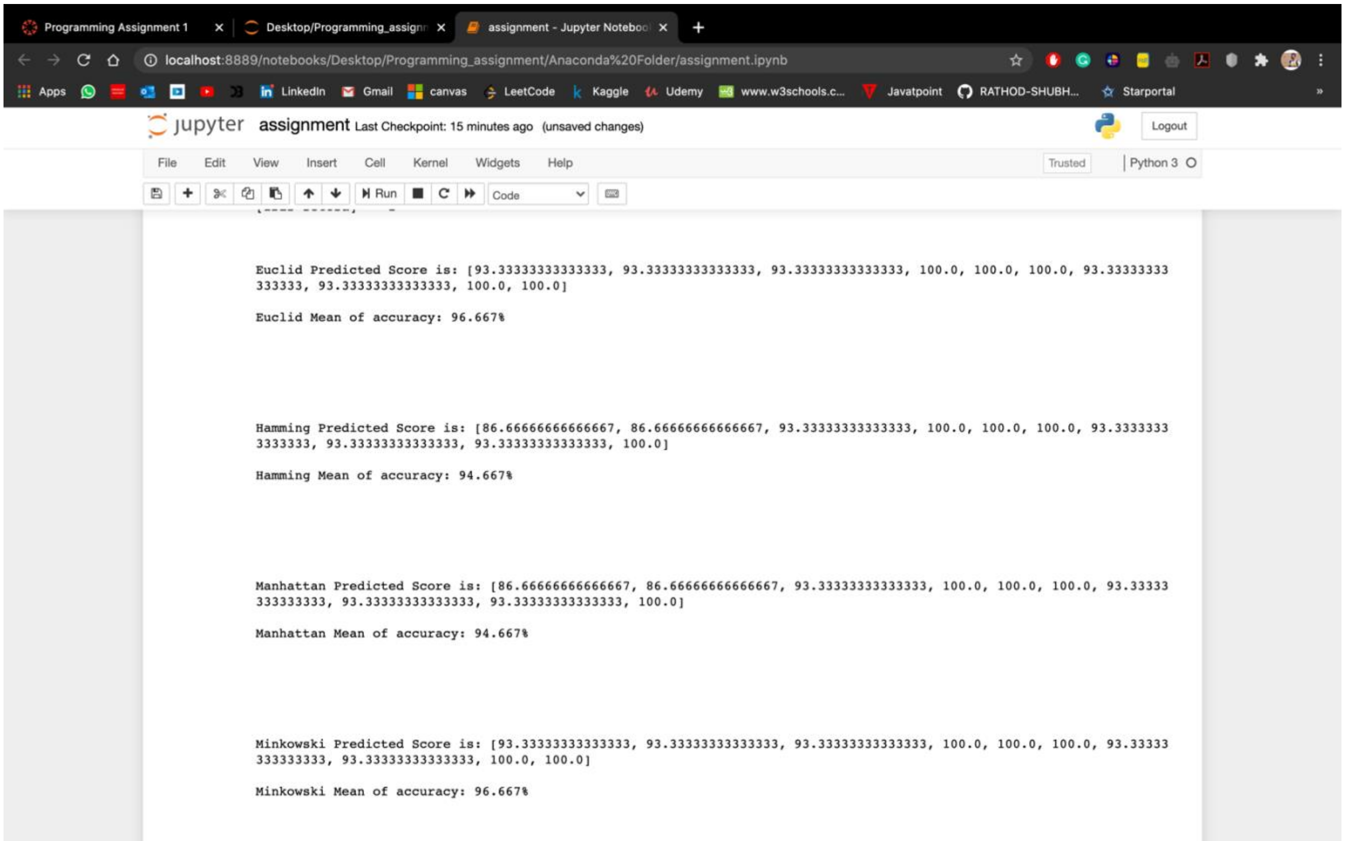
Accuracy from code: 76.429 %
Accuracy from weka: 76.923 %

4. Irish Dataset

Dataset is used from: https://raw.githubusercontent.com/jbrownlee/Datasets/master/iris.csv

In the code when the user enters ‘4’, user selects Irish data set.

Output of Code:


Programming Assignment 1
Desktop/Programming_assign
assignment - Jupyter Notebook
localhost:8889/notebooks/Desktop/Programming_assignment/Anaconda%20Folder/assignment.ipynb
Apps
LinkedIn
Gmail
canvas
LeetCode
Kaggle
Udemy
www.w3schools.c...
Javatpoint
RATHOD-SHUBH...
Starportal
jupyter
assignment Last Checkpoint: 15 minutes ago (unsaved changes)
Logout
File
Edit
View
Insert
Cell
Kernel
Widgets
Help
Trusted
Python 3
Run
Code

```
Euclid Predicted Score is: [93.33333333333333, 93.33333333333333, 93.33333333333333, 100.0, 100.0, 100.0, 93.33333333
333333, 93.33333333333333, 100.0, 100.0]

Euclid Mean of accuracy: 96.667%



Hamming Predicted Score is: [86.66666666666667, 86.66666666666667, 93.33333333333333, 100.0, 100.0, 100.0, 93.3333333
3333333, 93.33333333333333, 93.33333333333333, 100.0]

Hamming Mean of accuracy: 94.667%



Manhattan Predicted Score is: [86.66666666666667, 86.66666666666667, 93.33333333333333, 100.0, 100.0, 100.0, 93.33333
333333333, 93.33333333333333, 93.33333333333333, 100.0]

Manhattan Mean of accuracy: 94.667%



Minkowski Predicted Score is: [93.33333333333333, 93.33333333333333, 93.33333333333333, 100.0, 100.0, 100.0, 93.33333
333333333, 93.33333333333333, 100.0, 100.0]

Minkowski Mean of accuracy: 96.667%
```

Accuracy from code: 96.667 %

Machine Learning Programming Assignment 1

Name : Shubham Shankar
UTA ID: 1001761068
Section: 2208-CSE-6363-004

References

1. https://machinelearningmastery.com/tutorial-to-implement-k-nearest-neighbors-in-python-from-scratch/
2. https://machinelearningmastery.com/k-fold-cross-validation/
3. https://ljvmiranda921.github.io/notebook/2017/02/09/k-nearest-neighbors/
4. https://machinelearningmastery.com/distance-measures-for-machine-learning/#:~:text=of%20Distance%20Measures-,Distance%20measures%20play%20an%20important%20role%20in%20machine%20learning.,objects%20in%20a%20problem%20domain.&text=Another%20unsupervised%20l
5. https://www.programiz.com/python-programming/methods/list/remove

Extensions In Code

1. True KNN: Tried Larger and larger value of k (number of neighbors).
2. Implement different distance measure.