|  |  |
| --- | --- |
| **Dataset1:** | EEG\_EyeState.csv |
| Algorithm1: | KNN |
| Algorithm2: | Logit-Boost |
| Algorithm3: | BD-LSTM |
| Algorithm4: | SVAE |
|  | |
| **Datase2:** | Patient\_Treatement\_Classification.csv |
| Algorithm1: | LR |
| Algorithm2: | Random-Forest |
| Algorithm3: | ANN |
| Algorithm4: | SVAE |

**Dataset and Algorithm description:**

**Some Classification metrics: (take for each class and average them to get single metric):**

1. PPV = (TP)/(TP+FP) # Precision or Positive\_Precdictive\_Value (PPV)
2. Recall = TP/(TP+FN) # Recall or Sensitivity or True\_Positive\_Rate (TPR) or Hit\_Rate
3. F1\_S = (2\*PPV\*Recall)/(PPV+Recall) # F1 Score or Harmonic Mean
4. F1\_M = (PPV+Recall)/2 # F1 Measure
5. Specificity = TN/(TN+FP) # Specificity or True\_Negative\_Rate(TNR) or Selectivity
6. NPV = TN/(TN+FN) # Negative\_Predictive\_Value
7. FPR = FP/(FP+TN) # False\_Positive\_Rate
8. FNR = FN/(TP+FN) # False\_Negative\_Rate or Miss\_Rate
9. FDR = FP/(TP+FP) # False\_Discovery\_Rate
10. CSI = TP/(TP+FN+FP) # Critical\_Success\_Index or Threat\_Score(TS)
11. FM = sqrt(PPV\*Recall) # Fowlkes\_Mallows\_Index
12. BA = (Recall+Specificity)/2 # Balanced\_Accuracy
13. MCC = (TP\*TN-FP\*FN)/(sqrt((TP+FP)\

\*(TP+FN)\*(TN+FP)\*(TN+FN))) # Mathews\_Correlation\_Coefficient

1. BI = Recall+Specificity-1 or TPR-FPR # Bookmaker\_Informedness or Informedness
2. MK = PPV+NPV-1 # Markedness or delta

Optional

1. FOR = FN/(FN+TN) # False\_Omission\_Rate
2. PLR = Recall/FPR # Positive\_Likelihood\_Ratio
3. NLR = FNR/Specificity # Negative\_Likelihood\_Ratio
4. PT = sqrt(FPR)/\

(sqrt(Recall)+sqrt(FPR)) # Prevalence\_Threshold

1. DOR = PLR/NLR # Diagnostic\_Odds\_Ratio

* 21. Accuracy # Overall accuracy, not for each class
* 22. Cohen Kappa score # Overall Kappa score, not for each class

**Result analysis Procedure:**

1. **First try all algorithm for each dataset.**
2. **Now for each dataset choose best 3 or 4 algorithms**

* One best from Normal ML Classification methods,
* One best from Deep learning Classification methods,
* One best from Ensemble learning Classification methods,
* And one best from unsupervised or semi supervised methods (optional)

1. **Now Do the following tables for each dataset:**

**For Dataset1:**

**Table 1 (For Normal Split)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Split Ratio** | **Classification metric 1** | | **Classification metric 2** | **Classification metric 3** |
| Algorithm1 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |
|  |  | |  |  |  |
| Algorithm2 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |
|  |  | |  |  |  |
| Algorithm3 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |
|  |  | |  |  |  |
| Algorithm4 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |

**Observation**: Take the best split ratio for each algorithm basis on the classification metrics and do the following tables with that.

Updated Algorithm1:

Best Split=

Reason:

Updated Algorithm2:

Best Split=

Reason:

Updated Algorithm3:

Best Split=

Reason:

Updated Algorithm4:

Best Split=

Reason:

**Table 2 (For feature selection)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Feature selection** | **Classification metric 1** | **Classification metric 2** | **Classification metric 3** |
| Algorithm1 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classifier |  |  |  |
| Chi-Square |  |  |  |
|  |  |  |  |  |
| Algorithm2 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classifier |  |  |  |
| Chi-Square |  |  |  |
|  |  |  |  |  |
| Algorithm3 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classifier |  |  |  |
| Chi-Square |  |  |  |
|  |  |  |  |  |
| Algorithm4 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classifier |  |  |  |
| Chi-Square |  |  |  |

**Observation**: Take the best feature selection technique for each algorithm basis on the classification metrics and do the following tables with that.

**Updated Algorithm1:**

Best Split=

Best Feature selection=

Reason:

**Updated Algorithm2:**

Best Split=

Best Feature selection=

Reason:

**Updated Algorithm3:**

Best Split=

Best Feature selection=

Reason:

**Updated Algorithm4:**

Best Split=

Best Feature selection=

Reason:

**Table 3 (For Cross Validation)**

**[Kfold or stratified Kfold (K=10 or 5 or 4 based on best split 90-10 or 80-20 or 75-25 respectively for each algorithm)]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Cross Validation** | **Classification metric 1** | **Classification metric 2** | **Classification metric 3** |
| Algorithm1 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |
|  |  |  |  |  |
| Algorithm2 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |
|  |  |  |  |  |
| Algorithm3 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |
|  |  |  |  |  |
| Algorithm4 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |

**Observation**: Take the best Cross Validation technique for each algorithm basis on the classification metrics and do the following tables with that.

Updated Algorithm1:

Best Split=

Best CV=

Reason:

Updated Algorithm2:

Best Split=

Best CV=

Reason:

Updated Algorithm3:

Best Split=

Best CV=

Reason:

Updated Algorithm4:

Best Split=

Best CV=

Reason:

**Table 4 (For Model Optimization using Hyperparameter Tuning)**

**[CV = best CV techniques for each algorithm]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Model Optimization** | **Classification metric 13** | **Classification metric 14** | **Classification metric 15** |
| Algorithm1 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |
|  |  |  |  |  |
| Algorithm2 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |
|  |  |  |  |  |
| Algorithm3 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |
|  |  |  |  |  |
| Algorithm4 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |

**Observation**: Take the best Model Optimization using Hyperparameter tuningtechnique for each algorithm basis on the classification metrics and do the following table with that.

**Updated Algorithm1:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Updated Algorithm2:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Updated Algorithm3:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Updated Algorithm4:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Table 5 (For Choosing best model)**

**Reason:**

|  |  |
| --- | --- |
| **Best algorithm Name** |  |
| **Model description** |  |
|  | |
| **Classification metric 1** |  |
| **Classification metric 2** |  |
| **Classification metric 3** |  |
| **Classification metric 4** |  |
| **Classification metric 5** |  |
| **Classification metric 6** |  |
| **Classification metric 7** |  |
| **Classification metric 8** |  |
| **Classification metric 9** |  |
| **Classification metric 10** |  |
| **Classification metric 11** |  |
| **Classification metric 12** |  |
| **Classification metric 13** |  |
| **Classification metric 14** |  |
| **Classification metric 15** |  |
| **Classification metric 16** |  |
| **Classification metric 17** |  |
| **Classification metric 18** |  |
| **Classification metric 19** |  |
| **Classification metric 20** |  |
| **Classification metric 21** |  |
| **Classification metric 22** |  |

**Table: Speck-NOA Encryption and Decryption Time**

|  |  |  |
| --- | --- | --- |
| Data Size | Encryption Time (Sec.) | Decryption Time (Sec.) |
| 20 | 2.72 | 2.28 |
| 40 | 3.40 | 2.90 |
| 60 | 4.54 | 3.95 |
| 80 | 6.69 | 6.17 |
| 100 | 12.64 | 12.51 |

**Table: Simon-GTOA Encryption and Decryption Time**

|  |  |  |
| --- | --- | --- |
| Data Size | Encryption Time (Sec.) | Decryption Time (Sec.) |
| 20 | 3.03 | 3.05 |
| 40 | 3.83 | 3.82 |
| 60 | 5.10 | 5.06 |
| 80 | 7.71 | 7.62 |
| 100 | 15.61 | 15.21 |

**For Dataset2:**

**Table 1 (For Normal Split)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Split Ratio** | **Classification metric 1** | | **Classification metric 2** | **Classification metric 3** |
| Algorithm1 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |
|  |  | |  |  |  |
| Algorithm2 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |
|  |  | |  |  |  |
| Algorithm3 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |
|  |  | |  |  |  |
| Algorithm4 | Train 90%, Test 10% | |  |  |  |
| Train 80%, Test 20% | |  |  |  |
| Train75%, Test 25% | |  |  |  |

**Observation**: Take the best split ratio for each algorithm basis on the classification metrics and do the following tables with that.

Updated Algorithm1:

Best Split=

Reason:

Updated Algorithm2:

Best Split=

Reason:

Updated Algorithm3:

Best Split=

Reason:

Updated Algorithm4:

Best Split=

Reason:

**Table 2 (For feature selection)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Feature selection** | **Classification metric 1** | **Classification metric 2** | **Classification metric 3** |
| Algorithm1 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classif |  |  |  |
| Chi-Square |  |  |  |
|  |  |  |  |  |
| Algorithm2 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classif |  |  |  |
| Chi-Square |  |  |  |
|  |  |  |  |  |
| Algorithm3 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classif |  |  |  |
| Chi-Square |  |  |  |
|  |  |  |  |  |
| Algorithm4 | Without |  |  |  |
| Correlation Coefficient |  |  |  |
| Mutual Info Classif |  |  |  |
| Chi-Square |  |  |  |

**Observation**: Take the best feature selection technique for each algorithm basis on the classification metrics and do the following tables with that.

**Updated Algorithm1:**

Best Split=

Best Feature selection=

Reason:

**Updated Algorithm2:**

Best Split=

Best Feature selection=

Reason:

**Updated Algorithm3:**

Best Split=

Best Feature selection=

Reason:

**Updated Algorithm4:**

Best Split=

Best Feature selection=

Reason:

**Table 3 (For Cross Validation)**

**[Kfold or stratified Kfold (K=10 or 5 or 4 based on best split 90-10 or 80-20 or 75-25 respectively for each algorithm)]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Cross Validation** | **Classification metric 1** | **Classification metric 2** | **Classification metric 3** |
| Algorithm1 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |
|  |  |  |  |  |
| Algorithm2 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |
|  |  |  |  |  |
| Algorithm3 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |
|  |  |  |  |  |
| Algorithm4 | Kfold |  |  |  |
| Stratified Kfold |  |  |  |
| Shuffle Split |  |  |  |

**Observation**: Take the best Cross Validation technique for each algorithm basis on the classification metrics and do the following tables with that.

Updated Algorithm1:

Best Split=

Best CV=

Reason:

Updated Algorithm2:

Best Split=

Best CV=

Reason:

Updated Algorithm3:

Best Split=

Best CV=

Reason:

Updated Algorithm4:

Best Split=

Best CV=

Reason:

**Table 4 (For Model Optimization using Hyperparameter Tuning)**

**[CV = best CV techniques for each algorithm]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | **Model Optimization** | **Classification metric 13** | **Classification metric 14** | **Classification metric 15** |
| Algorithm1 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |
|  |  |  |  |  |
| Algorithm2 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |
|  |  |  |  |  |
| Algorithm3 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |
|  |  |  |  |  |
| Algorithm4 | RandomizedSearchCV |  |  |  |
| Hyperopt |  |  |  |
| Optuna |  |  |  |
| Nature-Inspired |  |  |  |

**Observation**: Take the best Model Optimization using Hyperparameter tuningtechnique for each algorithm basis on the classification metrics and do the following table with that.

**Updated Algorithm1:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Updated Algorithm2:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Updated Algorithm3:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Updated Algorithm4:**

Best Split=

Best CV=

Best Feature selection=

Best Model optimization=

Reason:

**Table 5 (For Choosing best model)**

**Reason:**

|  |  |
| --- | --- |
| **Best algorithm Name** |  |
| **Model description** |  |
|  | |
| **Classification metric 1** |  |
| **Classification metric 2** |  |
| **Classification metric 3** |  |
| **Classification metric 4** |  |
| **Classification metric 5** |  |
| **Classification metric 6** |  |
| **Classification metric 7** |  |
| **Classification metric 8** |  |
| **Classification metric 9** |  |
| **Classification metric 10** |  |
| **Classification metric 11** |  |
| **Classification metric 12** |  |
| **Classification metric 13** |  |
| **Classification metric 14** |  |
| **Classification metric 15** |  |
| **Classification metric 16** |  |
| **Classification metric 17** |  |
| **Classification metric 18** |  |
| **Classification metric 19** |  |
| **Classification metric 20** |  |
| **Classification metric 21** |  |
| **Classification metric 22** |  |