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| **Model** | **Model Hyper-parameters** |
| 1-Logistic Regression-LASSO | Regularization type :lasso (L1) ,strength C=1 |
| 2-Logistic Regression-Ridge | Regularization type :Ridge (L2) ,strength C=1 |
| 3-Neural Network | Number of hidden neurons =100,activation=ReLu, solver=SGD, regularization,α=0.0001,number of iterations=1000,replicable training |
| 4-SVM-RBF | SVM TYPE=SVM ,Cost(C)=1,Regression loss epsilon (Ꜫ)=0.1,Kernel=RBF, g:auto,numerical tolerance=0.001,iteration limit=100 |
| 5-SVM -LINEAR | SVM TYPE=SVM ,Cost(C)=1,Regression loss epsilon (Ꜫ)=0.1,Kernel=linear, g:auto,numerical tolerance=0.001,iteration limit=100 |
| 6-kNN | Number of neighbors =5, metric=Euclidean, weight=uniform |
| 7-Random Forest | Number of trees=10, do not split subsets smaller than= 5 |
| 8-Naive Bayes | Default |
| 9-SGD | Classification loss function =Hinge, regularization method=Ridge(L2), learning rate=constant, initial learning rate=0.01, number of iterations=1000, Tolerance (stopping criterion)=0.001 |
| 10-Tree | Induce binary tree, min number of instances in leaves =2, do not split subsets smaller than= 5,limit the maximal tree depth=100,stop when majority reaches=95% |
| 11-AdaBoost | Base estimator=tree, number of estimators=50, learning rate=1, classification algorithm=SAMME, regression loss function=exponential |
| 12-CN2 rule inducer | Rule ordering=ordered, covering algorithm=exclusive , rule search: evaluation measure=Entropy , Beam width=5,Rule Filtering  Minimum rule coverage=1, maximum rule length=5 |
| 13-XGB classifier | Default |
| 14-Extra Trees | max\_depth=4, criterion='entropy', random\_state=123 |
| 15-Decision Tree | max\_depth=4, random\_state=123 |
| 16- Gaussian Process Classifier | Default |
| 17-Gradient Boosting Classifier | n\_estimators =100, learning\_rate=1.0, max\_depth=1, random\_state=0 |
| 18-Hist Gradient Boosting Classifier | Default |
| 19-Bagging Classifier | MLPClassifier(), max\_samples=0.5, max\_features=0.5 |
| 20-MultinomialNB | Default |

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| Summary of the experiment results on the ML algorithms for **DB6 results**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **LogLoss** | **Specificity** |
| 1-Neural Network | 0.9838 | 0.9833 | 0.9833 | 0.9838 | 0.0835 | 0.9992 |
| 2-Extra gradient boosting | 0.9689 | 0.9594 | 0.8971 | 0.8437 | -- | -- |
| 3-SVM-RBF | 0.8414 | 0.8291 | 0.8356 | 0.8414 | 0.7315 | 0.9956 |
| 4-Random Forest | 0.3877 | 0.3617 | 0.3581 | 0.3877 | 3.1401 | 0.9770 |
| 5-AdaBoost | 0.3802 | 0.3808 | 0.3819 | 0.3802 | 5.3965 | 0.9861 |
| 6-kNN | 0.3089 | 0.3014 | 0.3427 | 0.3089 | 12.0165 | 0.9846 |
| 7-Tree | 0.2480 | 0.2423 | 0.2395 | 0.2480 | 8.5230 | 0.9825 |
| 8-CN2 rule inducer | 0.2108 | 0.1564 | 0.1764 | 0.2108 | 3.9933 | 0.9357 |
| 9-Logistic Regression-ridge | 0.1399 | 0.0353 | 0.0247 | 0.1399 | 4.4053 | 0.8610 |
| 10-lasso | 0.1396 | 0.0347 | 0.0248 | 0.1396 | 4.4018 | 0.8609 |
| 11-SGD | 0.0453 | 0.0420 | 0.0413 | 0.0453 | 32.9738 | 0.9711 |
| 12-SVM-linear | 0.0247 | 0.0185 | 0.0867 | 0.0247 | 4.4579 | 0.9958 |
| 13-Naive Bayes | 0.1403 | 0.0359 | 0.0250 | 0.1403 | 4.4116 | 0.8615 |
| 14-Extra Trees |  |  |  |  |  |  |
| 15-DecisionTree |  |  |  |  |  |  |

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| Summary of the experiment results on the ML algorithms for **DB5 results**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **LogLoss** | **Specificity** |
| 1-Neural Network | 0.9584 | 0.9555 | 0.9562 | 0.9584 | 0.1830 | 0.9978 |
| 2-Extra gradient boosting | 0.8929 | 0.9169 | 87.14 | 80.96 | -- | -- |
| 3-AdaBoost | 0.5231 | 0.5238 | 0.5248 | 0.5231 | 5.3958 | 0.9902 |
| 4-Random Forest | 0.4649 | 0.4417 | 0.4375 | 0.4649 | 2.7362 | 0.9825 |
| 5-Tree | 0.4014 | 0.3963 | 0.3952 | 0.4014 | 7.1606 | 0.9873 |
| 6-SVM-RBF | 0.3670 | 0.3366 | 0.3604 | 0.3670 | 2.5793 | 0.9866 |
| 7-kNN | 0.2745 | 0.2757 | 0.3002 | 0.2745 | 12.0402 | 0.9869 |
| 8-CN2 rule inducer | 0.2362 | 0.1920 | 0.1917 | 0.2362 | 4.0813 | 0.9650 |
| 9-Naive Bayes | 0.1460 | 0.0535 | 0.0447 | 0.1460 | 3.7479 | 0.8847 |
| 10-lasso | 0.1392 | 0.0340 | 0.0194 | 0.1392 | 4.6350 | 0.8608 |
| 11-Logistic Regression-ridge | 0.1392 | 0.0340 | 0.0194 | 0.1392 | 4.6389 | 0.8608 |
| 12-SGD | 0.0279 | 0.0281 | 0.0321 | 0.0279 | 33.5741 | 0.9783 |
| 13-SVM-linear | 0.0130 | 0.0112 | 0.0467 | 0.0130 | 4.5291 | 0.9923 |
| 14-Extra Trees |  |  |  |  |  |  |
| 15-DecisionTree |  |  |  |  |  |  |

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| Summary of the experiment results on the ML algorithms for **DB4 results**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **LogLoss** | **Specificity** |
| 1-Neural Network | 0.9818 | 0.9811 | 0.9810 | 0.9818 | 0.0913 | 0.9991 |
| 2-Extra gradient boosting | 0.9694 | 0.9611 | 0.8724 | 0.8227 | -- | -- |
| 3-SVM-RBF | 0.8415 | 0.8287 | 0.8347 | 0.8415 | 0.7448 | 0.9957 |
| 4-Random Forest | 0.3927 | 0.3668 | 0.3644 | 0.3927 | 3.0590 | 0.9768 |
| 5-AdaBoost | 0.3788 | 0.3793 | 0.3802 | 0.3788 | 5.4751 | 0.9860 |
| 6-kNN | 0.3070 | 0.2992 | 0.3398 | 0.3070 | 12.0449 | 0.9845 |
| 7-Tree | 0.2493 | 0.2435 | 0.2407 | 0.2493 | 8.5705 | 0.9826 |
| 8-CN2 rule inducer | 0.2110 | 0.1567 | 0.1771 | 0.2110 | 4.0559 | 0.9349 |
| 9-Logistic Regression-ridge | 0.1398 | 0.0351 | 0.0239 | 0.1398 | 4.4135 | 0.8611 |
| 10-LR-lasso | 0.1395 | 0.0346 | 0.0248 | 0.1395 | 4.4099 | 0.8610 |
| 11-Naive Bayes | 0.1066 | 0.0314 | 0.0251 | 0.1066 | 4.5858 | 0.8853 |
| 12-SGD | 0.0484 | 0.0426 | 0.0404 | 0.0484 | 32.8660 | 0.9677 |
| 13-SVM-linear | 0.0241 | 0.0177 | 0.0900 | 0.0241 | 4.4547 | 0.9962 |
| 14-Extra Trees |  |  |  |  |  |  |
| 15-DecisionTree |  |  |  |  |  |  |

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| Summary of the experiment results on the ML algorithms for **DB3 results**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **LogLoss** | **Specificity** |
| 1-Neural Network | 0.9847 | 0.9842 | 0.9841 | 0.9847 | 0.0881 | 0.9999 |
| 2-Extra gradient boosting | 0.9698 | 0.9624 | 0.8785 | 0.8333 | -- | -- |
| 3-SVM-RBF | 0.8272 | 0.8148 | 0.8237 | 0.8272 | 0.7130 | 0.9987 |
| 4-Random Forest | 0.3449 | 0.3342 | 0.3309 | 0.3449 | 3.3462 | 0.9945 |
| 5-AdaBoost | 0.2912 | 0.2917 | 0.2925 | 0.2912 | 5.5366 | 0.9947 |
| 6-kNN | 0.2565 | 0.2564 | 0.3139 | 0.2565 | 12.6816 | 0.9937 |
| 7-Tree | 0.2188 | 0.2143 | 0.2132 | 0.2188 | 8.9658 | 0.9939 |
| 8-CN2 rule inducer | 0.1699 | 0.1399 | 0.1570 | 0.1699 | 4.0092 | 0.9912 |
| 9-SVM-linear | 0.0232 | 0.0115 | 0.0325 | 0.0232 | 4.7693 | 0.9957 |
| 10-LASSO | 0.0226 | 0.0143 | 0.0175 | 0.0226 | 4.7122 | 0.9886 |
| 11-SGD | 0.0225 | 0.0217 | 0.0242 | 0.0225 | 33.7604 | 0.9925 |
| 12-RIDGE | 0.0224 | 0.0149 | 0.0196 | 0.0224 | 4.7145 | 0.9885 |
| 13-Naive Bayes | 0.0090 | 0.0082 | 0.0171 | 0.0090 | 4.8896 | 0.9960 |
| 14-Extra Trees |  |  |  |  |  |  |
| 15-DecisionTree |  |  |  |  |  |  |

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| Summary of the experiment results on the ML algorithms for **DB2 results**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **LogLoss** | **Specificity** |
| 1-Neural Network | 0.9570 | 0.9537 | 0.9531 | 0.9570 | 0.1977 | 0.9977 |
| 2-Extra gradient boosting | 91.68 | 0.9542 | 0.8783 | 0.8152 | -- | -- |
| 3-AdaBoost | 0.5214 | 0.5224 | 0.5237 | 0.5214 | 5.4745 | 0.9903 |
| 4-Random Forest | 0.4681 | 0.4454 | 0.4412 | 0.4681 | 2.7116 | 0.9825 |
| 5-Tree | 0.4000 | 0.3949 | 0.3937 | 0.4000 | 7.2306 | 0.9873 |
| 6-SVM-RBF | 0.3667 | 0.3367 | 0.3637 | 0.3667 | 2.5763 | 0.9870 |
| 7-kNN | 0.2770 | 0.2778 | 0.3031 | 0.2770 | 11.9563 | 0.9870 |
| 8-CN2 rule inducer | 0.2405 | 0.1968 | 0.1980 | 0.2405 | 4.1407 | 0.9651 |
| 9-LASSO | 0.1391 | 0.0340 | 0.0194 | 0.1391 | 4.6429 | 0.8609 |
| 10-RIDGE | 0.1391 | 0.0340 | 0.0194 | 0.1391 | 4.6475 | 0.8609 |
| 11-Naive Bayes | 0.0878 | 0.0474 | 0.0491 | 0.0878 | 4.1091 | 0.9333 |
| 12-SGD | 0.0393 | 0.0329 | 0.0315 | 0.0393 | 33.1828 | 0.9651 |
| 13-SVM-linear | 0.0131 | 0.0116 | 0.0672 | 0.0131 | 4.5032 | 0.9924 |
| 14-Extra Trees |  |  |  |  |  |  |
| 15-DecisionTree |  |  |  |  |  |  |

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| Summary of the experiment results on the ML algorithms for **DB1**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **LogLoss** | **Specificity** |
| 1-Neural Network | 0.9650 | 0.9624 | 0.9626 | 0.9650 | 0.1841 | 0.9998 |
| 2-Extra gradient boosting | 0.9758 | 0.9668 | 0.8876 | 0.8483 | -- | -- |
| 3-AdaBoost | 0.5217 | 0.5231 | 0.5250 | 0.5217 | 5.5357 | 0.9963 |
| 4-Random Forest | 0.4362 | 0.4195 | 0.4152 | 0.4362 | 2.8346 | 0.9951 |
| 5-Tree | 0.4025 | 0.3944 | 0.3917 | 0.4025 | 7.3003 | 0.9952 |
| 6-SVM-RBF | 0.3486 | 0.3212 | 0.3481 | 0.3486 | 2.4756 | 0.9938 |
| 7-kNN | 0.2247 | 0.2276 | 0.2601 | 0.2247 | 12.7415 | 0.9932 |
| 8-CN2 rule inducer | 0.1946 | 0.1691 | 0.1821 | 0.1946 | 4.2143 | 0.9918 |
| 9-Naive Bayes | 0.0218 | 0.0212 | 0.0296 | 0.0218 | 4.2921 | 0.9984 |
| 10-SGD | 0.0147 | 0.0131 | 0.0158 | 0.0147 | 34.0302 | 0.9924 |
| 11-SVM-linear | 0.0095 | 0.0071 | 0.0346 | 0.0095 | 4.8583 | 0.9943 |
| 12-RIDGE | 0.0069 | 0.0016 | 0.0010 | 0.0069 | 5.0078 | 0.9855 |
| 13-LASSO | 0.0068 | 0.0016 | 0.0009 | 0.0068 | 5.0051 | 0.9854 |
| 14-Extra Trees |  |  |  |  |  |  |
| 15-DecisionTree |  |  |  |  |  |  |

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| **Summary results**  **Sampling type:** 10-fold Cross validation **Target class:** Average over classes | | | | | | |
| **Model** | **DB1 accuracy** | **DB2 accuracy** | **DB3 accuracy** | **DB4 accuracy** | **DB5 accuracy** | **DB6 accuracy** |
| 1-Neural Network (MLP) | **0.9650** | **0.9570** | **0.9847** | **0.9818** | **0.9584** | **0.9838** |
| 2-Extra Gradient boosting | **0.9758** | **0.9168** | **0.9641** | **0.9694** | **0.8929** | **0.9689** |
| 3-AdaBoost | **0.5217** | **0.5214** | 0.2912 | 0.3788 | **0.5231** | 0.3802 |
| 4-Random Forest | 0.4362 | 0.4681 | 0.3449 | 0.3927 | 0.4649 | 0.3877 |
| 5-Tree | 0.4025 | 0.4000 | 0.2188 | 0.2493 | 0.4014 | 0.2480 |
| 6-SVM-RBF | 0.3486 | 0.3667 | **0.8272** | **0.8415** | 0.3670 | **0.8414** |
| 7-kNN | 0.2247 | 0.2770 | 0.2565 | 0.3070 | 0.2745 | 0.3089 |
| 8-CN2 rule inducer | 0.1946 | 0.2405 | 0.1699 | 0.2110 | 0.2362 | 0.2108 |
| 9-Extra Trees |  |  |  |  | 0.1392 | 0.1392 |
| 10-DecisionTree |  |  |  |  | 0.1507 | 0.1392 |
| 11-Naive Bayes | 0.0218 | 0.0878 | 0.0090 | 0.1066 | 0.1460 | 0.1403 |
| 12-SGD | 0.0147 | 0.0393 | 0.0225 | 0.0484 | 0.0279 | 0.0453 |
| 13-SVM-linear | 0.0095 | 0.0131 | 0.0232 | 0.0241 | 0.0130 | 0.0247 |
| 14-LR-RIDGE | 0.0069 | 0.1391 | 0.0224 | 0.1398 | 0.1392 | 0.1399 |
| 15-LR-LASSO | 0.0068 | 0.1391 | 0.0226 | 0.1395 | 0.1392 | 0.1396 |
| 16-Gaussian Process Classifier |  |  |  |  |  |  |
| 17-Gradient Boosting Classifier |  |  |  |  |  |  |
| 18-Hist Gradient Boosting Classifier |  |  |  |  |  |  |
| 19-Bagging Classifier |  |  |  |  |  |  |
| 20-MultinomialNB |  |  |  |  |  |  |

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| Table XXVIII  datasets description | | | | | | |
|  | Dataset1 | Dataset2 | Dataset3 | Dataset4 | Dataset5 | Dataset 6 |
| Number of instances | 65536 | 65536 | 65536 | 65536 | 65483 | 65483 |
| Input attributes | 8 (Decimal) | 8 (Decimal) | 16 (Binary) | 16 (Binary) | 8(Decimal) | 16  (Binary) |
| Output classes | 254 | 239 | 254 | 239 | 221 | 221 |

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| **DB3 result with different MLP optimizers**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | | |
| **Model** | **Optimizer** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **Log-loss** | **Specificity** |
| Neural Network (MLP) | ADAM | 0.9925 | 0.9924 | 0.9924 | 0.9925 | 0.0313 | 1.0000 |
| Neural Network (MLP) | SGD | 0.9847 | 0.9842 | 0.9841 | 0.9847 | 0.0881 | 0.9999 |
| Neural Network (MLP) | L-BFGS-B | 0.9842 | 0.9840 | 0.9840 | 0.9842 | 0.0738 | 0.9999 |

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| **DB6 result with different MLP optimizers**  **Sampling type:** Stratified 10-fold Cross validation **Target class:** Average over classes | | | | | | | |
| **Model** | **Optimizer** | **Classification accuracy** | **F-measure** | **Precision** | **Recall** | **Log-Loss** | **Specificity** |
| Neural Network (MLP) | ADAM | 0.9927 | 0.9927 | 0.9927 | 0.9927 | 0.0251 | 0.9997 |
| Neural Network (MLP) | SGD | 0.9838 | 0.9833 | 0.9833 | 0.9838 | 0.0835 | 0.9992 |
| Neural Network (MLP) | L-BFGS-B | 0.9853 | 0.9853 | 0.9854 | 0.9853 | 0.0640 | 0.9997 |