Script 1:

* Online learning with the allowable maximum hyperbox size ranging from 0.01 to 0.99

|  |  |
| --- | --- |
| Circle: | Yeast: |
| Ringnorm: | Twonorm: |
| Waveform: | Complex9: |
| Synthetic: | Thyroid: |
| DiagnosticBreastCancer: | Iris: |
| Zelnik6: | Ionosphere: |
| Segmentation: | Spiral: |
| Wine: | Glass: |
| Heart: |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Dataset | Teta | Fixed value | | | Adaptive value (Tetaend = 0.02) | | |
| No. hyperboxes | Training time (s) | Testing Error | No. hyperboxes | Training time (s) | Testing Error |
| 1 | Circle | 0.9 | 5 | 0.035696 | 0.525 | 102 | 5.119177 | **0.02** |
| 0.8 | 9 | 0.048805 | 0.335 | 91 | 4.638855 | **0.02** |
| 0.7 | 8 | 0.044865 | 0.295 | 95 | 4.604942 | **0.02** |
| 0.6 | 10 | 0.058617 | 0.36 | 87 | 4.229779 | **0.01** |
| 0.5 | 14 | 0.057802 | 0.2 | 78 | 3.801875 | **0.015** |
| 0.4 | 16 | 0.074613 | 0.17 | 95 | 4.072175 | **0.03** |
| 2 | Yeast | 0.9 | 18 | 0.080361 | **0.07047** | 18 | 0.212556 | **0.07047** |
| 0.8 | 18 | 0.07835 | **0.073826** | 18 | 0.213637 | **0.073826** |
| 0.7 | 24 | 0.109559 | **0.080537** | 24 | 0.245972 | **0.080537** |
| 0.6 | 32 | 0.189432 | **0.090604** | 32 | 0.331934 | **0.090604** |
| 0.5 | 41 | 0.310771 | **0.107383** | 41 | 0.423137 | **0.107383** |
| 0.4 | 57 | 0.416428 | **0.184564** | 57 | 0.54463 | **0.184564** |
| 3 | Ringnorm | 0.9 | 4 | 0.288532 | 0.270946 | 2916 | 691.7493 | **0.095946** |
| 0.8 | 8 | 0.37788 | 0.243919 | 2119 | 396.2975 | **0.045946** |
| 0.7 | 15 | 0.61842 | 0.150676 | 2284 | 417.455 | **0.041216** |
| 0.6 | 40 | 1.928227 | 0.140541 | 2333 | 449.8673 | **0.048649** |
| 0.5 | 113 | 7.57929 | 0.098649 | 2737 | 573.2839 | **0.044595** |
| 0.4 | 346 | 26.50375 | 0.108784 | 3075 | 654.2868 | **0.052703** |
| 4 | Twonorm | 0.9 | 4 | 0.265908 | 0.491892 | 3853 | 946.4887 | **0.077703** |
| 0.8 | 7 | 0.371788 | 0.473649 | 3730 | 909.0026 | **0.056081** |
| 0.7 | 14 | 0.507712 | 0.459459 | 3800 | 883.1652 | **0.062838** |
| 0.6 | 33 | 1.239249 | 0.417568 | 3795 | 802.6004 | **0.041892** |
| 0.5 | 102 | 5.838362 | 0.315541 | 3793 | 812.0698 | **0.040541** |
| 0.4 | 353 | 30.00317 | 0.094595 | 3626 | 665.4966 | **0.04527** |
| 5 | Waveform | 0.9 | 8 | 0.23192 | 0.590591 | 3615 | 593.686 | **0.17017** |
| 0.8 | 11 | 0.309691 | 0.471471 | 3633 | 580.4931 | **0.184184** |
| 0.7 | 17 | 0.46499 | 0.458458 | 3576 | 574.7092 | **0.163163** |
| 0.6 | 33 | 0.974045 | 0.401401 | 3558 | 584.0646 | **0.166166** |
| 0.5 | 78 | 2.845259 | 0.332332 | 3534 | 519.53 | **0.172172** |
| 0.4 | 235 | 11.53645 | 0.252252 | 3320 | 392.1689 | **0.157157** |
| 6 | Complex9 | 0.9 | 10 | 0.2296 | 0.289951 | 46 | 11.9306 | **0.003295** |
| 0.8 | 10 | 0.171144 | 0.285008 | 46 | 13.64179 | **0.003295** |
| 0.7 | 10 | 0.168102 | 0.275124 | 46 | 9.5216 | **0.003295** |
| 0.6 | 10 | 0.164192 | 0.273476 | 44 | 10.5655 | **0.003295** |
| 0.5 | 12 | 0.137661 | 0.120264 | 45 | 11.90522 | **0.003295** |
| 0.4 | 18 | 0.181044 | 0.115321 | 36 | 6.105699 | **0.004942** |
| 7 | Synthetic | 0.9 | 2 | 0.010453 | 0.159 | 86 | 1.71143 | **0.122** |
| 0.8 | 2 | 0.010523 | 0.159 | 83 | 1.702995 | **0.134** |
| 0.7 | 3 | 0.019454 | **0.136** | 103 | 1.879304 | 0.141 |
| 0.6 | 6 | 0.023526 | 0.148 | 86 | 1.548005 | **0.119** |
| 0.5 | 6 | 0.027415 | **0.121** | 112 | 1.831751 | 0.131 |
| 0.4 | 9 | 0.018304 | 0.226 | 100 | 1.619761 | **0.149** |
| 8 | Thyroid | 0.9 | 5 | 0.010243 | **0.046512** | 31 | 0.535429 | 0.069767 |
| 0.8 | 6 | 0.010206 | **0.046512** | 35 | 0.568381 | **0.046512** |
| 0.7 | 6 | 0.010169 | **0.046512** | 40 | 0.546852 | 0.069767 |
| 0.6 | 7 | 0.010938 | **0.046512** | 25 | 0.29225 | 0.069767 |
| 0.5 | 9 | 0.013968 | **0.046512** | 15 | 0.106719 | **0.046512** |
| 0.4 | 12 | 0.014122 | **0.069767** | 24 | 0.277064 | 0.093023 |
| 9 | Diagnostic Breast Cancer | 0.9 | 8 | 0.030984 | 0.106195 | 113 | 3.373541 | **0.053097** |
| 0.8 | 9 | 0.036227 | 0.265487 | 82 | 2.107013 | **0.053097** |
| 0.7 | 14 | 0.059283 | **0.035398** | 95 | 2.219643 | 0.053097 |
| 0.6 | 19 | 0.102904 | 0.061947 | 68 | 1.611819 | **0.053097** |
| 0.5 | 27 | 0.128935 | **0.044248** | 76 | 1.410068 | 0.061947 |
| 0.4 | 46 | 0.208163 | **0.070796** | 72 | 0.958312 | 0.079646 |
| 10 | Iris | 0.9 | 3 | 0.006334 | **0.066667** | 8 | 0.225399 | 0.1 |
| 0.8 | 5 | 0.007568 | **0.066667** | 7 | 0.132004 | 0.1 |
| 0.7 | 5 | 0.007265 | **0.066667** | 8 | 0.188403 | 0.1 |
| 0.6 | 6 | 0.007611 | **0.066667** | 8 | 0.134298 | 0.1 |
| 0.5 | 8 | 0.009072 | **0.066667** | 12 | 0.140028 | 0.1 |
| 0.4 | 10 | 0.011461 | **0.066667** | 15 | 0.138015 | 0.1 |
| 11 | Zelnik6 | 0.9 | 4 | 0.026351 | 0.489362 | 14 | 0.496538 | **0** |
| 0.8 | 5 | 0.010678 | 0.638298 | 19 | 0.614739 | **0** |
| 0.7 | 6 | 0.010077 | 0.361702 | 16 | 0.52025 | **0** |
| 0.6 | 7 | 0.018104 | 0.340426 | 13 | 0.493226 | **0** |
| 0.5 | 7 | 0.017123 | 0.085106 | 10 | 0.334558 | **0** |
| 0.4 | 9 | 0.011017 | **0** | 11 | 0.292359 | **0** |
| 12 | Ionosphere | 0.9 | 54 | 0.143232 | **0.085714** | 54 | 0.174539 | **0.085714** |
| 0.8 | 66 | 0.147211 | 0.128571 | 66 | 0.185092 | 0.128571 |
| 0.7 | 70 | 0.166665 | 0.114286 | 70 | 0.230092 | 0.114286 |
| 0.6 | 76 | 0.180658 | 0.114286 | 76 | 0.225637 | 0.114286 |
| 0.5 | 92 | 0.225784 | 0.142857 | 92 | 0.28769 | 0.142857 |
| 0.4 | 117 | 0.290045 | 0.128571 | 117 | 0.32992 | 0.128571 |
| 13 | Segmentation | 0.9 | 27 | 0.213779 | 0.041126 | 27 | 0.469234 | 0.041126 |
| 0.8 | 27 | 0.240322 | 0.032468 | 27 | 0.678639 | 0.032468 |
| 0.7 | 34 | 0.304066 | 0.045455 | 34 | 0.528612 | 0.045455 |
| 0.6 | 41 | 0.356107 | 0.036797 | 41 | 0.614649 | 0.036797 |
| 0.5 | 56 | 0.483269 | 0.032468 | 56 | 0.831272 | 0.032468 |
| 0.4 | 96 | 0.858513 | 0.04329 | 96 | 1.388232 | 0.04329 |
| 14 | Spiral | 0.9 | 2 | 0.0316 | 0.435 | 77 | 5.056616 | 0.015 |
| 0.8 | 6 | 0.055839 | 0.425 | 66 | 4.648747 | 0.025 |
| 0.7 | 7 | 0.039931 | 0.39 | 57 | 4.15806 | 0.02 |
| 0.6 | 8 | 0.045073 | 0.405 | 65 | 4.304623 | 0.02 |
| 0.5 | 10 | 0.050318 | 0.41 | 74 | 4.114633 | 0.02 |
| 0.4 | 13 | 0.058436 | 0.385 | 72 | 3.751594 | 0.005 |
| 15 | Wine | 0.9 | 5 | 0.012877 | **0.055556** | 12 | 0.168136 | **0.055556** |
| 0.8 | 6 | 0.013693 | 0.111111 | 11 | 0.069374 | **0.055556** |
| 0.7 | 11 | 0.018934 | 0.055556 | 14 | 0.10626 | **0.027778** |
| 0.6 | 17 | 0.026016 | **0.055556** | 17 | 0.03712 | 0.055556 |
| 0.5 | 22 | 0.032684 | **0.027778** | 22 | 0.045008 | **0.027778** |
| 0.4 | 37 | 0.044512 | **0.027778** | 37 | 0.064293 | **0.027778** |
| 16 | Glass | 0.9 | 10 | 0.01435 | 0.534884 | 71 | 1.262104 | **0.232558** |
| 0.8 | 12 | 0.024641 | **0.348837** | 51 | 0.789521 | 0.418605 |
| 0.7 | 15 | 0.019393 | 0.534884 | 88 | 1.136702 | **0.395349** |
| 0.6 | 17 | 0.036995 | 0.55814 | 55 | 0.794521 | **0.348837** |
| 0.5 | 20 | 0.024965 | 0.511628 | 81 | 1.006614 | **0.325581** |
| 0.4 | 29 | 0.038237 | 0.44186 | 53 | 0.438364 | **0.232558** |
| 17 | Heart | 0.9 | 61 | 0.096625 | **0.148148** | 61 | 0.114839 | **0.148148** |
| 0.8 | 62 | 0.088285 | **0.12963** | 62 | 0.122985 | **0.12963** |
| 0.7 | 64 | 0.091611 | **0.148148** | 64 | 0.111992 | **0.148148** |
| 0.6 | 86 | 0.122687 | **0.185185** | 86 | 0.148092 | **0.185185** |
| 0.5 | 94 | 0.132774 | **0.203704** | 94 | 0.150029 | **0.203704** |
| 0.4 | 130 | 0.152286 | **0.166667** | 130 | 0.161006 | **0.166667** |
| 18 | spherical\_5\_2 | 0.9 | 5 | 0.012726 | **0** | 5 | 0.028311 | **0** |
| 0.8 | 5 | 0.012423 | **0** | 5 | 0.034418 | **0** |
| 0.7 | 5 | 0.012194 | **0** | 5 | 0.028015 | **0** |
| 0.6 | 5 | 0.012833 | **0** | 5 | 0.031275 | **0** |
| 0.5 | 5 | 0.011926 | **0** | 5 | 0.032549 | **0** |
| 0.4 | 5 | 0.011869 | **0** | 5 | 0.027651 | **0** |

Test :

Impact of data presentation order on the performance of GFMM

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ID | Dataset | Measure | Online GFMM | | | AGGLO-2 | | | Full batch learning | | |
| No. boxes | Training time (s) | Testing Error | No. boxes | Training time (s) | Testing Error | No. boxes | Training time (s) | Testing Error |
| 1 | Circle | Mean | 16.3 | 0.100689 | 0.073 | 38.8 | 0.393818 | 0.0105 | 40 | 32.01423 | 0.015 |
| Std | 1.1 | 0.012123 | 0.017205 | 0.979796 | 0.029309 | 0.002693 | 0 | 1.51986 | 3.47E-18 |
| Min | 14 | 0.090582 | 0.035 | 38 | 0.359107 | 0.005 | 40 | 30.57348 | 0.015 |
| Max | 18 | 0.130829 | 0.1 | 41 | 0.451615 | 0.015 | 40 | 34.89486 | 0.015 |
| 2 | Yeast | Mean | 57.5 | 0.5887 | 0.158389 | 62.1 | 0.782415 | 0.167785 | 57.1 | 86.9299 | 0.17349 |
|  |  | Std | 1.360147 | 0.01434 | 0.01131 | 1.640122 | 0.022361 | 0.01123 | 0.538516 | 1.930786 | 0.002621 |
|  |  | Min | 54 | 0.566204 | 0.137584 | 60 | 0.740078 | 0.147651 | 56 | 85.16704 | 0.167785 |
|  |  | Max | 59 | 0.615102 | 0.174497 | 65 | 0.824444 | 0.187919 | 58 | 91.55358 | 0.177852 |
| 3 | Complex9 | Mean | 18.9 | 0.308417 | 0.057167 | 24.7 | 1.593086 | 0 | 27 | 444.4228 | 0 |
|  |  | Std | 1.577973 | 0.068703 | 0.030821 | 1.615549 | 0.13996 | 0 | 0 | 11.05499 | 0 |
|  |  | Min | 17 | 0.241902 | 0.011532 | 23 | 1.463901 | 0 | 27 | 428.8465 | 0 |
|  |  | Max | 21 | 0.478462 | 0.125206 | 28 | 1.942556 | 0 | 27 | 457.0755 | 0 |
| 4 | Synthetic | Mean | 9.6 | 0.02721 | 0.175 | 36.4 | 0.241393 | 0.1289 | 35 | 1.916963 | 0.123 |
|  |  | Std | 0.663325 | 0.004428 | 0.024743 | 1.113553 | 0.01143 | 0.008336 | 0 | 0.02668 | 0 |
|  |  | Min | 9 | 0.022103 | 0.135 | 35 | 0.217312 | 0.11 | 35 | 1.887276 | 0.123 |
|  |  | Max | 11 | 0.038381 | 0.216 | 38 | 0.25576 | 0.139 | 35 | 1.97697 | 0.123 |
| 5 | Thyroid | Mean | 12.9 | 0.032233 | 0.062791 | 14.5 | 0.062962 | 0.05814 | 16 | 0.873118 | 0.023256 |
|  |  | Std | 0.830662 | 0.008458 | 0.010657 | 1.118034 | 0.014527 | 0.011628 | 0 | 0.065727 | 0 |
|  |  | Min | 12 | 0.020467 | 0.046512 | 13 | 0.047061 | 0.046512 | 16 | 0.766557 | 0.023256 |
|  |  | Max | 14 | 0.051404 | 0.069767 | 17 | 0.091337 | 0.069767 | 16 | 0.972639 | 0.023256 |
| 6 | Diagnostic Breast Cancer | Mean | 45.8 | 0.256114 | 0.055752 | 56 | 0.630512 | 0.064602 | 50 | 21.95683 | 0.070796 |
|  |  | Std | 1.249 | 0.023272 | 0.013738 | 1.788854 | 0.10114 | 0.015354 | 0 | 0.176121 | 1.39E-17 |
|  |  | Min | 44 | 0.218316 | 0.035398 | 52 | 0.528186 | 0.035398 | 50 | 21.7368 | 0.070796 |
|  |  | Max | 48 | 0.300595 | 0.079646 | 59 | 0.862741 | 0.088496 | 50 | 22.37043 | 0.070796 |
| 7 | Iris | Mean | 10 | 0.015074 | 0.093333 | 10.3 | 0.03205 | 0.093333 | 10 | 0.212101 | 0.1 |
|  |  | Std | 0.447214 | 0.004801 | 0.013333 | 0.458258 | 0.005936 | 0.013333 | 0 | 0.011905 | 0 |
|  |  | Min | 9 | 0.009814 | 0.066667 | 10 | 0.028051 | 0.066667 | 10 | 0.197378 | 0.1 |
|  |  | Max | 11 | 0.024192 | 0.1 | 11 | 0.048016 | 0.1 | 10 | 0.234825 | 0.1 |
| 8 | Zelnik6 | Mean | 8.8 | 0.016207 | 0.03617 | 9.1 | 0.05199 | 0 | 9 | 0.898516 | 0 |
|  |  | Std | 0.748331 | 0.003082 | 0.048565 | 0.3 | 0.002307 | 0 | 0 | 0.033422 | 0 |
|  |  | Min | 8 | 0.013148 | 0 | 9 | 0.04741 | 0 | 9 | 0.848812 | 0 |
|  |  | Max | 10 | 0.023776 | 0.170213 | 10 | 0.056728 | 0 | 9 | 0.970355 | 0 |
| 9 | Ionosphere | Mean | 118.4 | 0.207497 | 0.132857 | 119.1 | 0.561487 | 0.122857 | 120 | 4.734358 | 0.142857 |
|  |  | Std | 1.2 | 0.025882 | 0.009147 | 1.577973 | 0.07937 | 0.013093 | 0 | 0.062069 | 0 |
|  |  | Min | 116 | 0.171859 | 0.114286 | 115 | 0.480978 | 0.1 | 120 | 4.654508 | 0.142857 |
|  |  | Max | 120 | 0.253867 | 0.142857 | 121 | 0.714058 | 0.142857 | 120 | 4.848478 | 0.142857 |
| 10 | Segmentation | Mean | 100.6 | 1.123317 | 0.044156 | 106.7 | 3.316679 | 0.046537 | 101.8 | 208.4138 | 0.04394 |
|  |  | Std | 2.2 | 0.051643 | 0.006362 | 1.791647 | 0.123292 | 0.005908 | 0.4 | 2.695821 | 0.001948 |
|  |  | Min | 97 | 1.040967 | 0.030303 | 103 | 3.116383 | 0.036797 | 101 | 204.3208 | 0.041126 |
|  |  | Max | 104 | 1.212294 | 0.054113 | 109 | 3.55849 | 0.058442 | 102 | 212.7037 | 0.045455 |
| 11 | Spiral | Mean | 14.4 | 0.137119 | 0.3185 | 24.4 | 0.321363 | 0.0085 | 24 | 24.17375 | 0.015 |
|  |  | Std | 1.356466 | 0.019657 | 0.115045 | 1.019804 | 0.012749 | 0.0045 | 0 | 0.148678 | 3.47E-18 |
|  |  | Min | 13 | 0.115732 | 0.13 | 22 | 0.306155 | 0.005 | 24 | 23.97529 | 0.015 |
|  |  | Max | 17 | 0.181235 | 0.535 | 26 | 0.349374 | 0.015 | 24 | 24.37896 | 0.015 |
| 12 | Wine | Mean | 35.4 | 0.065251 | 0.027778 | 36.4 | 0.133735 | 0.011111 | 34 | 0.966239 | 0.083333 |
|  |  | Std | 1.113553 | 0.008831 | 0.012423 | 1.019804 | 0.028073 | 0.018426 | 0 | 0.029105 | 0 |
|  |  | Min | 33 | 0.051612 | 0 | 35 | 0.103731 | 0 | 34 | 0.919606 | 0.083333 |
|  |  | Max | 37 | 0.080142 | 0.055556 | 38 | 0.19264 | 0.055556 | 34 | 1.02014 | 0.083333 |
| 13 | Glass | Mean | 28.5 | 0.053819 | 0.393023 | 32.3 | 0.078724 | 0.318605 | 33 | 0.795289 | 0.232558 |
|  |  | Std | 0.806226 | 0.011982 | 0.051427 | 0.9 | 0.00461 | 0.040347 | 0 | 0.026708 | 0 |
|  |  | Min | 27 | 0.04463 | 0.325581 | 31 | 0.073898 | 0.232558 | 33 | 0.759466 | 0.232558 |
|  |  | Max | 30 | 0.080433 | 0.511628 | 34 | 0.090485 | 0.372093 | 33 | 0.838429 | 0.232558 |
| 14 | Heart | Mean | 130.2 | 0.16429 | 0.170371 | 130.3 | 0.166587 | 0.17963 | 131 | 0.787343 | 0.175926 |
|  |  | Std | 0.748331 | 0.011472 | 0.011111 | 0.9 | 0.00713 | 0.008486 | 0 | 0.027015 | 0.009259 |
|  |  | Min | 129 | 0.141454 | 0.148148 | 129 | 0.154666 | 0.166667 | 131 | 0.753562 | 0.166667 |
|  |  | Max | 131 | 0.179301 | 0.185185 | 132 | 0.181222 | 0.185185 | 131 | 0.855024 | 0.185185 |

Test:

Online and Aggomerative learning combinations:

Test 2:

Comparison of GFMM with popular machine learning algorithms

Each dataset was shuffled randomly, and 80% data were used for testing, and the others were testing data. Each experiment was run 10 times.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ID** | **Dataset** | **Algorithm** | **Mean** | | **Std** | | **Min** | | **Max** | |
| **Training time (s)** | **Testing Error** | **Training time (s)** | **Testing error** | **Training time (s)** | **Testing error** | **Training time (s)** | **Testing error** |
| 1 | Circle | Online GFMM | 0.203682 | 0.0465 | 0.007671 | 0.006403 | 0.191734 | 0.035 | 0.218173 | 0.065 |
| Agglo-2 GFMM | 0.510217 | 0.0005 | 0.01962 | 0.0015 | 0.487872 | 0 | 0.558809 | 0.005 |
| KNN | 0.000543 | 0.016 | 1.10E-04 | 7.68E-03 | 0.000475 | 0.005 | 0.0008 | 0.03 |
| MLP | 0.982825 | 0.0675 | 0.318839 | 0.151001 | 0.027983 | 0.01 | 1.1263 | 0.52 |
| Naïve Bayes | 0.000607 | 0.0505 | 0.000144 | 0.010112 | 0.000504 | 0.035 | 0.000893 | 0.065 |
| Decision Tree | 0.001529 | 0.0085 | 2.79E-04 | 5.94E-03 | 0.001152 | 0 | 0.001815 | 0.02 |
| SVM | 0.013213 | 0.0215 | 0.001638 | 0.013048 | 0.00916 | 0.005 | 0.015244 | 0.05 |
| 2 | Yeast | Online GFMM | 1.176668 | 0.050842 | 0.03504 | 0.01141 | 1.131595 | 0.02357 | 1.237576 | 0.063973 |
| Agglo-2 GFMM | 2.292641 | 0.057912 | 0.0376 | 0.01052 | 2.246873 | 0.03704 | 2.352635 | 0.06734 |
| KNN | 0.00134 | 0.327609 | 1.94E-04 | 3.02E-02 | 0.001222 | 0.276094 | 0.001903 | 0.37037 |
| MLP | 1.380306 | 0.410101 | 0.266275 | 0.026759 | 1.035078 | 0.367003 | 1.945908 | 0.464646 |
| Naïve Bayes | 0.00115 | 0.900674 | 0.000179 | 0.012975 | 0.001048 | 0.882155 | 0.001641 | 0.922559 |
| Decision Tree | 0.005862 | 0.094949 | 7.09E-04 | 1.05E-02 | 0.004215 | 0.080808 | 0.006967 | 0.117845 |
| SVM | 0.060631 | 0.579125 | 0.004951 | 0.014125 | 0.05169 | 0.558923 | 0.066675 | 0.602694 |
| 3 | Ringnorm | Online GFMM |  |  |  |  |  |  |  |  |
| Agglo-2 GFMM |  |  |  |  |  |  |  |  |
| KNN |  |  |  |  |  |  |  |  |
| MLP |  |  |  |  |  |  |  |  |
| Naïve Bayes |  |  |  |  |  |  |  |  |
| Decision Tree |  |  |  |  |  |  |  |  |
| SVM |  |  |  |  |  |  |  |  |
| 4 | Twonorm | Online GFMM |  |  |  |  |  |  |  |  |
| Agglo-2 GFMM |  |  |  |  |  |  |  |  |
| KNN |  |  |  |  |  |  |  |  |
| MLP |  |  |  |  |  |  |  |  |
| Naïve Bayes |  |  |  |  |  |  |  |  |
| Decision Tree |  |  |  |  |  |  |  |  |
| SVM |  |  |  |  |  |  |  |  |
| 5 | Waveform | Online GFMM |  |  |  |  |  |  |  |  |
| Agglo-2 GFMM |  |  |  |  |  |  |  |  |
| KNN |  |  |  |  |  |  |  |  |
| MLP |  |  |  |  |  |  |  |  |
| Naïve Bayes |  |  |  |  |  |  |  |  |
| Decision Tree |  |  |  |  |  |  |  |  |
| SVM |  |  |  |  |  |  |  |  |
| 6 | Complex9 | Online GFMM | 0.273755 | 0.06145 | 0.01193 | 0.006403 | 0.257895 | 0.041186 | 0.292904 | 0.080725 |
| Agglo-2 GFMM | 1.592544 | 0 | 0.017541 | 0 | 1.567453 | 0 | 1.631355 | 0 |
| KNN | 0.001451 | 0 | 2.53E-04 | 0 | 0.001263 | 0 | 0.001947 | 0 |
| MLP | 2.751623 | 0.070181 | 0.512569 | 0.031845 | 1.901844 | 0.011532 | 4.01556 | 0.116969 |
| Naïve Bayes | 0.001286 | 0.058649 | 0.00026 | 0.012088 | 0.001081 | 0.036244 | 0.001726 | 0.079077 |
| Decision Tree | 0.003565 | 0.000988 | 4.31E-04 | 8.07E-04 | 0.002698 | 0 | 0.003943 | 0.001647 |
| SVM | 0.059421 | 0.133773 | 0.005257 | 0.013298 | 0.051073 | 0.121911 | 0.067348 | 0.163097 |
| 7 | Synthetic | Online GFMM | 0.047288 | 0.1528 | 0.007415 | 0.014511 | 0.036707 | 0.136 | 0.059835 | 0.18 |
| Agglo-2 GFMM | 0.416335 | 0.0984 | 0.016668 | 0.014773 | 0.389953 | 0.068 | 0.446445 | 0.112 |
| KNN | 0.000344 | 0.1056 | 7.88E-05 | 1.68E-02 | 0.000292 | 0.076 | 0.000544 | 0.136 |
| MLP | 0.260999 | 0.1132 | 0.047837 | 0.016975 | 0.193552 | 0.088 | 0.343084 | 0.148 |
| Naïve Bayes | 0.000477 | 0.1128 | 0.000104 | 0.012238 | 0.00042 | 0.096 | 0.00074 | 0.136 |
| Decision Tree | 0.000585 | 0.1236 | 7.87E-05 | 2.16E-02 | 0.000428 | 0.088 | 0.000656 | 0.164 |
| SVM | 0.001718 | 0.1064 | 8.11E-05 | 0.013879 | 0.001633 | 0.084 | 0.001891 | 0.128 |
| 8 | Thyroid | Online GFMM | 0.04207 | 0.027907 | 0.003287 | 0.017403 | 0.037648 | 0 | 0.04809 | 0.046512 |
| Agglo-2 GFMM | 0.153683 | 0.009302 | 0.011224 | 0.011393 | 0.136697 | 0 | 0.167455 | 0.023256 |
| KNN | 0.000333 | 0.046512 | 5.50E-05 | 2.75E-02 | 0.000281 | 0 | 0.000436 | 0.093023 |
| MLP | 0.318709 | 0.083721 | 0.012033 | 0.078658 | 0.296383 | 0 | 0.33635 | 0.27907 |
| Naïve Bayes | 0.000573 | 0.030233 | 0.000102 | 0.02093 | 0.000483 | 0 | 0.000784 | 0.069767 |
| Decision Tree | 0.000524 | 0.027907 | 8.90E-05 | 1.74E-02 | 0.000411 | 0 | 0.000662 | 0.046512 |
| SVM | 0.000935 | 0.176744 | 0.000183 | 0.04186 | 0.000703 | 0.116279 | 0.001164 | 0.27907 |
| 9 | Diagnostic Breast Cancer | Online GFMM | 0.611455 | 0.014912 | 0.033539 | 0.006403 | 0.58517 | 0.008772 | 0.699269 | 0.026316 |
| Agglo-2 GFMM | 2.817561 | 0.013158 | 0.043729 | 0.005884 | 2.754356 | 0.008772 | 2.89534 | 0.026316 |
| KNN | 0.000606 | 0.024562 | 7.65E-05 | 1.02E-02 | 0.000565 | 0.008772 | 0.000833 | 0.035088 |
| MLP | 0.38536 | 0.022807 | 0.14468 | 0.011899 | 0.265842 | 0.008772 | 0.798158 | 0.052632 |
| Naïve Bayes | 0.000644 | 0.066667 | 7.62E-05 | 0.014252 | 0.000597 | 0.052632 | 0.000866 | 0.096491 |
| Decision Tree | 0.006008 | 0.017544 | 7.74E-04 | 8.77E-03 | 0.00434 | 0.008772 | 0.006779 | 0.035088 |
| SVM | 0.005971 | 0.044737 | 0.000542 | 0.015419 | 0.004513 | 0.026316 | 0.00654 | 0.070175 |
| 10 | Iris | Online GFMM | 0.020117 | 0.03 | 0.003461 | 0.017951 | 0.017415 | 0 | 0.029236 | 0.066667 |
| Agglo-2 GFMM | 0.048701 | 0.03 | 0.006737 | 0.017951 | 0.042765 | 0 | 0.060464 | 0.066667 |
| KNN | 0.000286 | 0.04 | 6.37E-05 | 2.00E-02 | 0.000236 | 0 | 0.0004 | 0.066667 |
| MLP | 0.223368 | 0.036667 | 0.014286 | 0.045826 | 0.204793 | 0 | 0.256018 | 0.133333 |
| Naïve Bayes | 0.000544 | 0.05 | 0.000116 | 0.030732 | 0.000437 | 0 | 0.000763 | 0.1 |
| Decision Tree | 0.000287 | 0.026667 | 4.73E-05 | 2.00E-02 | 0.000239 | 0 | 0.000356 | 0.066667 |
| SVM | 0.000544 | 0.043333 | 0.000101 | 0.03 | 0.000451 | 0 | 0.000712 | 0.1 |
| 11 | Zelnik6 | Online GFMM | 0.021607 | 0 | 0.00452 | 0 | 0.015327 | 0 | 0.027603 | 0 |
| Agglo-2 GFMM | 0.094207 | 0 | 0.00719 | 0 | 0.081717 | 0 | 0.110017 | 0 |
| KNN | 0.000365 | 0.016667 | 5.57E-05 | 0.0125 | 0.000268 | 0 | 0.000416 | 0.041667 |
| MLP | 0.333165 | 0.152083 | 0.012431 | 0.044731 | 0.314648 | 0.0625 | 0.354247 | 0.208333 |
| Naïve Bayes | 0.000701 | 0 | 0.000123 | 0 | 0.00046 | 0 | 0.000846 | 0 |
| Decision Tree | 0.000473 | 0 | 6.01E-05 | 0 | 0.000315 | 0 | 0.000558 | 0 |
| SVM | 0.001175 | 0.185417 | 0.000167 | 0.03892 | 0.000745 | 0.125 | 0.001431 | 0.229167 |
| 12 | Ionosphere | Online GFMM | 0.465027 | 0.022536 | 0.016624 | 0.009342 | 0.442107 | 0.014085 | 0.493518 | 0.042254 |
| Agglo-2 GFMM | 1.375475 | 0.022536 | 0.028876 | 0.009342 | 1.331572 | 0.014085 | 1.42611 | 0.042254 |
| KNN | 0.000505 | 0.102817 | 1.88E-05 | 4.13E-02 | 0.000487 | 0.042254 | 0.000542 | 0.183099 |
| MLP | 0.312438 | 0.025352 | 0.041105 | 0.017592 | 0.253166 | 0 | 0.37525 | 0.056338 |
| Naïve Bayes | 0.000584 | 0.095775 | 5.50E-05 | 0.049114 | 0.000541 | 0.028169 | 0.000707 | 0.197183 |
| Decision Tree | 0.003607 | 0.035212 | 6.94E-04 | 1.92E-02 | 0.002746 | 0.014085 | 0.004611 | 0.070423 |
| SVM | 0.003845 | 0.107043 | 0.000602 | 0.062418 | 0.003035 | 0.014085 | 0.004539 | 0.239437 |
| 13 | Segmentation | Online GFMM | 3.405594 | 0.008225 | 0.08509 | 0.003596 | 3.305823 | 0.002165 | 3.611503 | 0.015152 |
| Agglo-2 GFMM | 8.728578 | 0.010823 | 0.112653 | 0.003991 | 8.582847 | 0.002165 | 8.944272 | 0.015152 |
| KNN | 0.003305 | 0.03355 | 8.07E-04 | 6.44E-03 | 0.002637 | 0.021645 | 0.004678 | 0.04329 |
| MLP | 1.739889 | 0.060173 | 0.344478 | 0.014801 | 1.007457 | 0.038961 | 2.160905 | 0.080087 |
| Naïve Bayes | 0.001458 | 0.197186 | 0.000208 | 0.015562 | 0.001276 | 0.17316 | 0.002018 | 0.227273 |
| Decision Tree | 0.016873 | 0.008442 | 1.41E-03 | 4.04E-03 | 0.01357 | 0.002165 | 0.018563 | 0.017316 |
| SVM | 0.085871 | 0.124459 | 0.005233 | 0.013281 | 0.079158 | 0.106061 | 0.093472 | 0.147186 |
| 14 | Spiral | Online GFMM | 0.160468 | 0.0785 | 0.010658 | 0.016286 | 0.138069 | 0.05 | 0.181376 | 0.1 |
| Agglo-2 GFMM | 0.423796 | 0.002 | 0.0132 | 0.003317 | 0.402749 | 0 | 0.456372 | 0.01 |
| KNN | 0.000563 | 0 | 1.24E-04 | 0 | 0.000472 | 0 | 0.000825 | 0 |
| MLP | 0.535629 | 0.3545 | 0.414642 | 0.039399 | 0.132766 | 0.255 | 1.092448 | 0.405 |
| Naïve Bayes | 0.000573 | 0.344 | 9.97E-05 | 0.026814 | 0.000492 | 0.285 | 0.000745 | 0.385 |
| Decision Tree | 0.001178 | 0.0005 | 1.53E-04 | 1.50E-03 | 0.000856 | 0 | 0.001306 | 0.005 |
| SVM | 0.018544 | 0.342 | 0.001961 | 0.02358 | 0.015783 | 0.295 | 0.021102 | 0.385 |
| 15 | Wine | Online GFMM | 0.113806 | 0 | 0.009864 | 0 | 0.100289 | 0 | 0.130781 | 0 |
| Agglo-2 GFMM | 0.370526 | 0 | 0.009057 | 0 | 0.355556 | 0 | 0.38626 | 0 |
| KNN | 0.000324 | 0.019445 | 5.84E-05 | 1.78E-02 | 0.000279 | 0 | 0.000446 | 0.055556 |
| MLP | 0.313666 | 0.008333 | 0.013484 | 0.012729 | 0.291769 | 0 | 0.330553 | 0.027778 |
| Naïve Bayes | 0.000517 | 0.027778 | 7.20E-05 | 0.021517 | 0.000464 | 0 | 0.00072 | 0.055556 |
| Decision Tree | 0.000711 | 0.016667 | 1.19E-04 | 1.84E-02 | 0.000547 | 0 | 0.000835 | 0.055556 |
| SVM | 0.001071 | 0.013889 | 0.000177 | 0.018634 | 0.000794 | 0 | 0.001232 | 0.055556 |
| 16 | Glass | Online GFMM | 0.074479 | 0.074419 | 0.008711 | 0.029046 | 0.059171 | 0.023256 | 0.087266 | 0.116279 |
| Agglo-2 GFMM | 0.189874 | 0.07907 | 0.010464 | 0.031546 | 0.164289 | 0.023256 | 0.201022 | 0.139535 |
| KNN | 0.000357 | 0.251163 | 7.54E-05 | 4.00E-02 | 0.000293 | 0.209302 | 0.000489 | 0.325581 |
| MLP | 0.328374 | 0.318605 | 0.009161 | 0.060688 | 0.316414 | 0.209302 | 0.341538 | 0.418605 |
| Naïve Bayes | 0.000747 | 0.430233 | 0.000166 | 0.043196 | 0.000621 | 0.372093 | 0.001031 | 0.511628 |
| Decision Tree | 0.001081 | 0.081395 | 1.66E-04 | 4.91E-02 | 0.000835 | 0 | 0.001259 | 0.139535 |
| SVM | 0.002009 | 0.506977 | 0.000345 | 0.05772 | 0.001467 | 0.418605 | 0.002336 | 0.604651 |
| 17 | Heart | Online GFMM | 0.212295 | 0.035185 | 0.00802 | 0.024074 | 0.197636 | 0 | 0.222508 | 0.074074 |
| Agglo-2 GFMM | 0.314258 | 0.035185 | 0.007318 | 0.024074 | 0.303302 | 0 | 0.32633 | 0.074074 |
| KNN | 0.000345 | 0.161111 | 5.68E-05 | 4.69E-02 | 0.0003 | 0.092593 | 0.000462 | 0.222222 |
| MLP | 0.152074 | 0.153704 | 0.038952 | 0.049725 | 0.107359 | 0.055556 | 0.253896 | 0.222222 |
| Naïve Bayes | 0.000498 | 0.138889 | 6.78E-05 | 0.025188 | 0.000448 | 0.092593 | 0.00067 | 0.185185 |
| Decision Tree | 0.000871 | 0.05 | 8.86E-05 | 2.20E-02 | 0.000633 | 0.018519 | 0.00096 | 0.092593 |
| SVM | 0.001661 | 0.138889 | 0.000362 | 0.030146 | 0.001152 | 0.092593 | 0.00258 | 0.185185 |
| 18 | spherical\_5\_2 | Online GFMM | 0.035586 | 0 | 0.003332 | 0 | 0.030068 | 0 | 0.039482 | 0 |
| Agglo-2 GFMM | 0.082787 | 0 | 0.006034 | 0 | 0.07366 | 0 | 0.093909 | 0 |
| KNN | 0.000374 | 0.012 | 5.69E-05 | 1.83E-02 | 0.000279 | 0 | 0.000424 | 0.06 |
| MLP | 0.341181 | 0.08 | 0.010616 | 0.073212 | 0.327993 | 0 | 0.360165 | 0.26 |
| Naïve Bayes | 0.000769 | 0.006 | 0.000122 | 0.012806 | 0.000559 | 0 | 0.000922 | 0.04 |
| Decision Tree | 0.000403 | 0 | 7.25E-05 | 0 | 0.000296 | 0 | 0.000492 | 0 |
| SVM | 0.001489 | 0.024 | 0.000309 | 0.019596 | 0.00103 | 0 | 0.001954 | 0.06 |