

HiGEC: Enhanced Hierarchical Classification with Optimized Exploitation for Improved Multi-Class Performance

This supplementary document contains additional figures that complement the main text of the paper titled: “HiGEC: Improving Multi-Class Classification with Automated Hierarchy Generation and Extended Exploitation Schemes”.

Each figure is labeled and referenced in the main text where appropriate.

1. EXTRA FIGURES AND TABLES

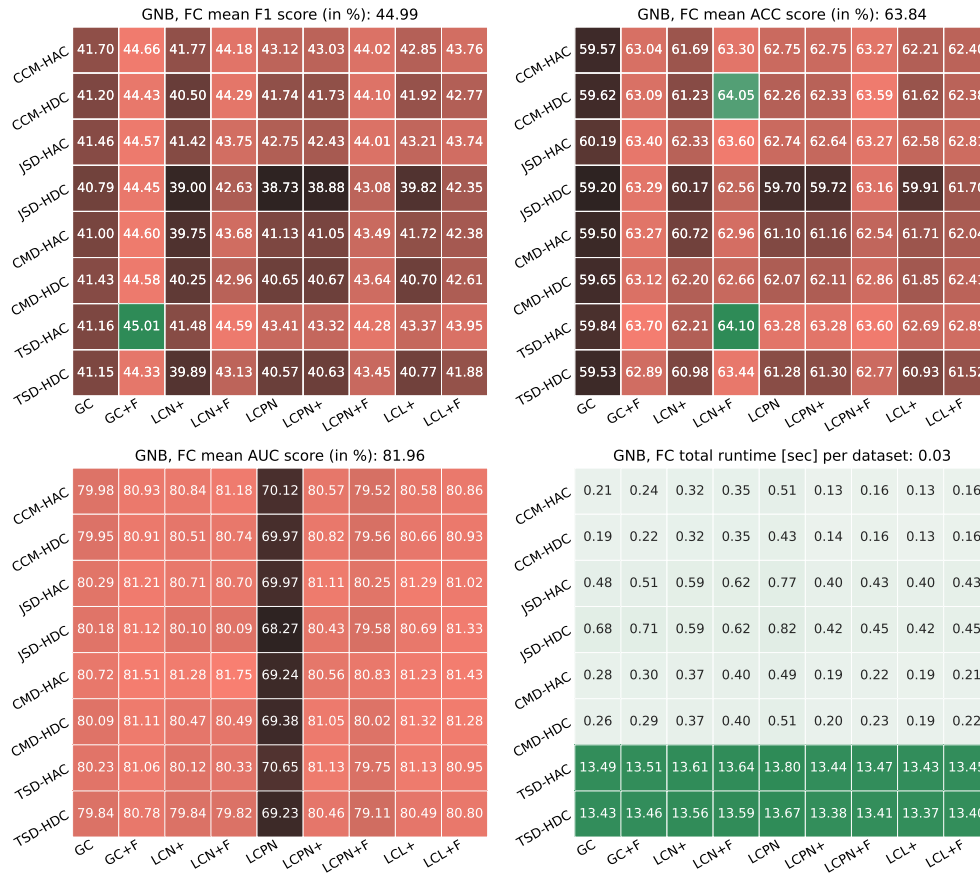


Fig. S1. Mean F1, ACC, AUC, and runtime durations (HG, training, and inference) across the development set comparison of all HG and HE methods for GNB.

Table S1. Key abbreviations used

<i>Abbreviations</i>	
ML	Machine Learning
FC	Flat Classification
OVA	One vs All
AVA	All vs All
HC	Hierarchical Classification
HG	Hierarchy Generation
HE	Hierarchy Exploitation
HiGEC	Hierarchy Generation and Extended Classification
CCM	Class Conditional Means
JSD	Jensen-Shannon Divergence
TSD	Task Similarity Distance
CMD	Confusion Matrix-based Distance
HAC	Hierarchical Agglomerative Clustering
HDC	Hierarchical Divisive Clustering
GC	Global Classification
LCN	Local Classifier per Node
LCPN	Local Classifier per Parent Node
LCL	Local Classifier per Level
LCN+	LCN with extended prediction phase
LCN+F	LCN extended with FC
LCPN+	LCPN with extended prediction phase
LCPN+F	LCPN extended with FC
LCL+	LCL with extended prediction phase
LCL+F	LCL extended with FC
MCCV	Monte Carlo Cross Validation
F1	F1 score
ACC	Accuracy
AUC	Area Under the receiver operating characteristic Curve
CDD	Critical Difference Diagram
MCM	Multiple Comparison Matrix
XGB	eXtreme Gradient Boosting
LGB	Light Gradient Boosting machine
CATB	CATBoost
RF	Random Forests
ETC	Extremely randomized Tree Classifier
CART	Classification and Regression Trees
LDA	Linear Discriminant Analysis
wpKNN	weighted probabilistic K-Nearest Neighbor
GNB	Gaussian Naive Bayes
FTT	Feature Tokenizer Transformer

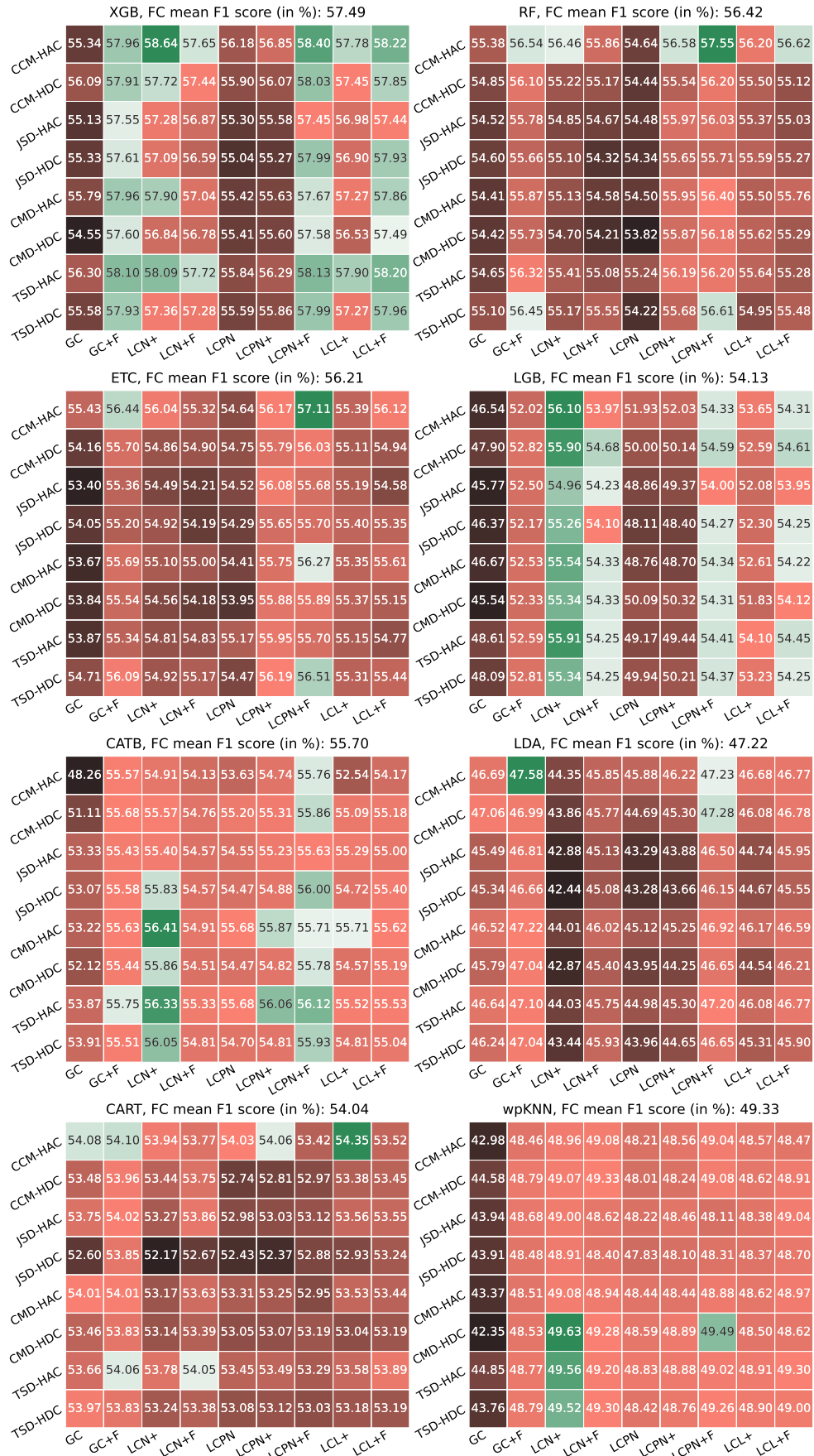


Fig. S2. Mean F1 comparison of all HG and HE methods for base classifiers.

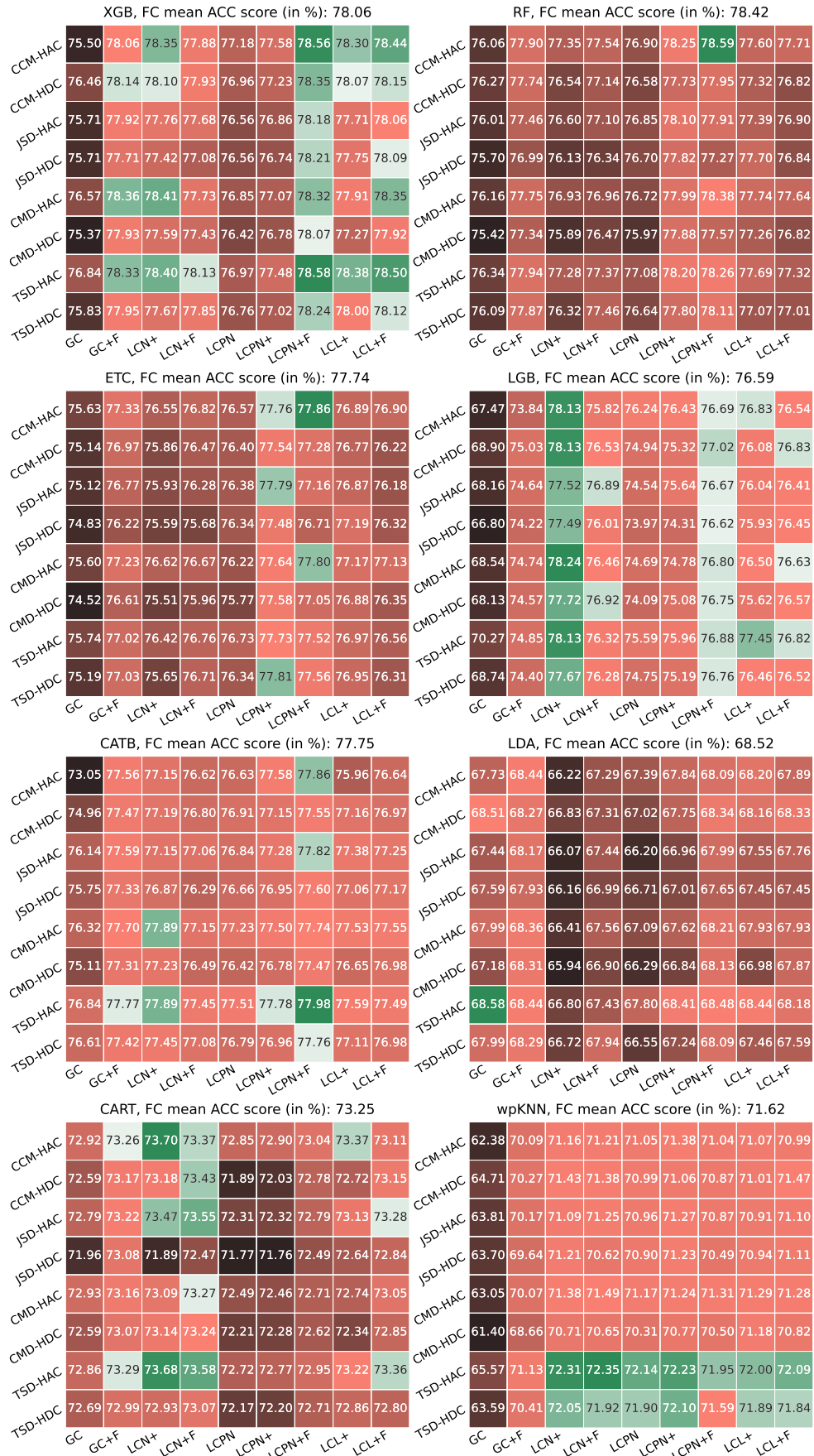


Fig. S3. Mean ACC comparison of all HG and HE methods for base classifiers.

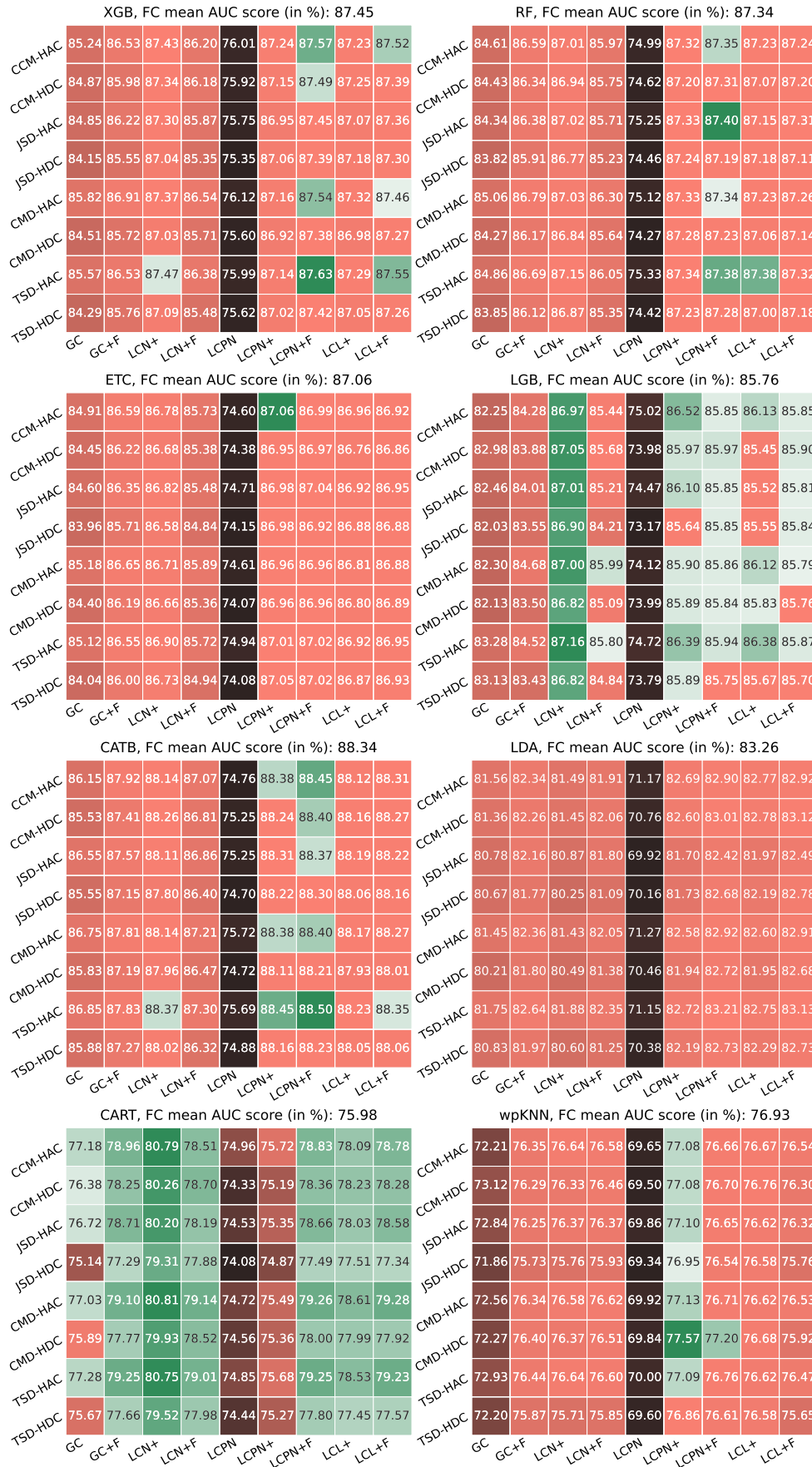


Fig. S4. Mean AUC comparison of all HG and HE methods for base classifiers.

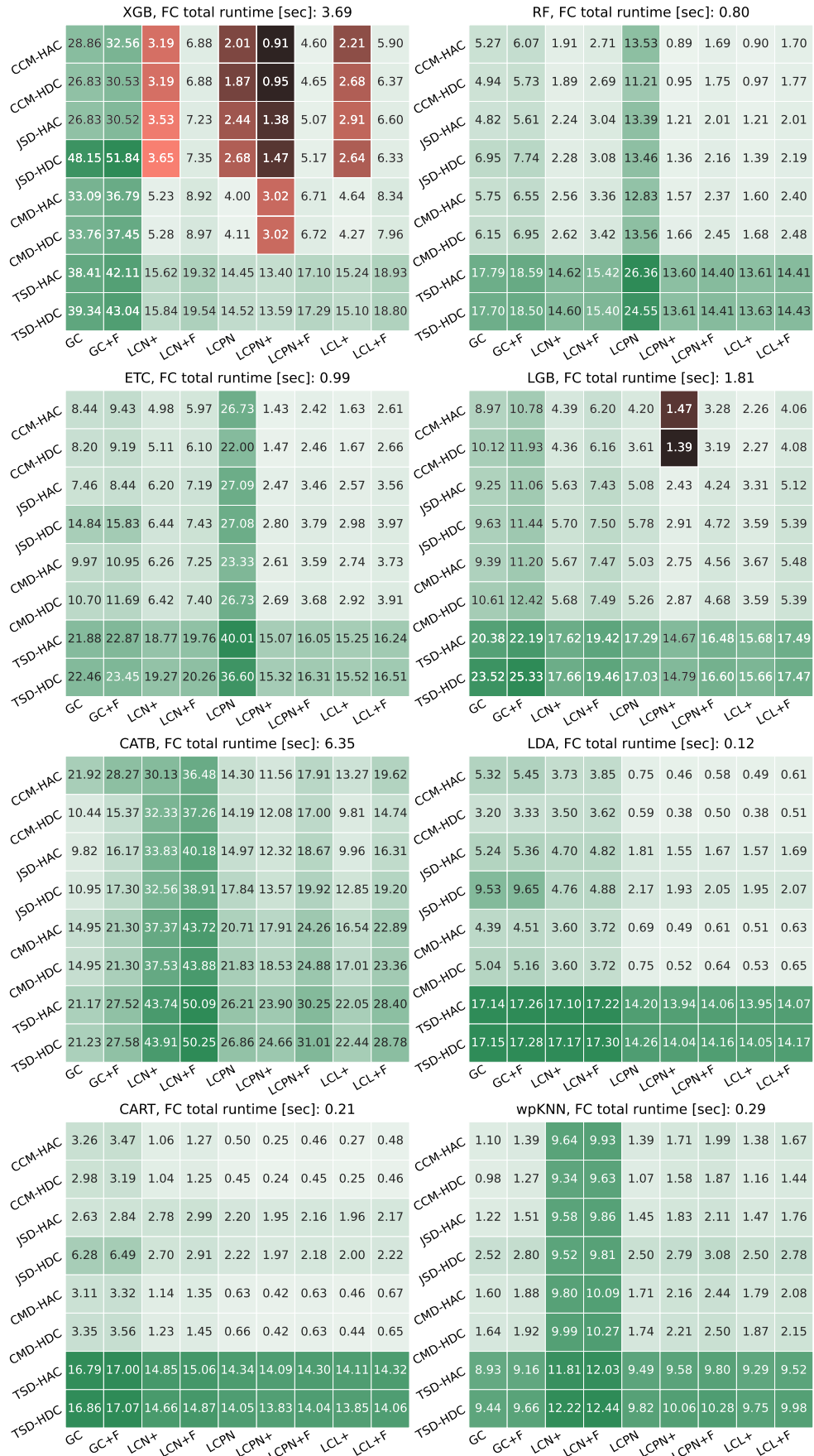


Fig. S5. Mean runtime (HG, training, and inference) comparison of all HG and HE methods for base classifiers.

Table S2. Key notations used

Notations

k	Number of flat classes
η	Number of hierarchical classes
m	Number of examples
n	Number of features
$\ell_{u,a}^{v,d}$	Node label
u	Node index
a	Index of parent (ancestor) node
v	Level index
d	Indicator of being left (0) or right (1) child (descendant)
f	FC model
h^G	GC model
h_u^N	LCN model working at node with index u
h_u^P	LCPN model working at parent node with index u
h_v^L	LCL model working at level v

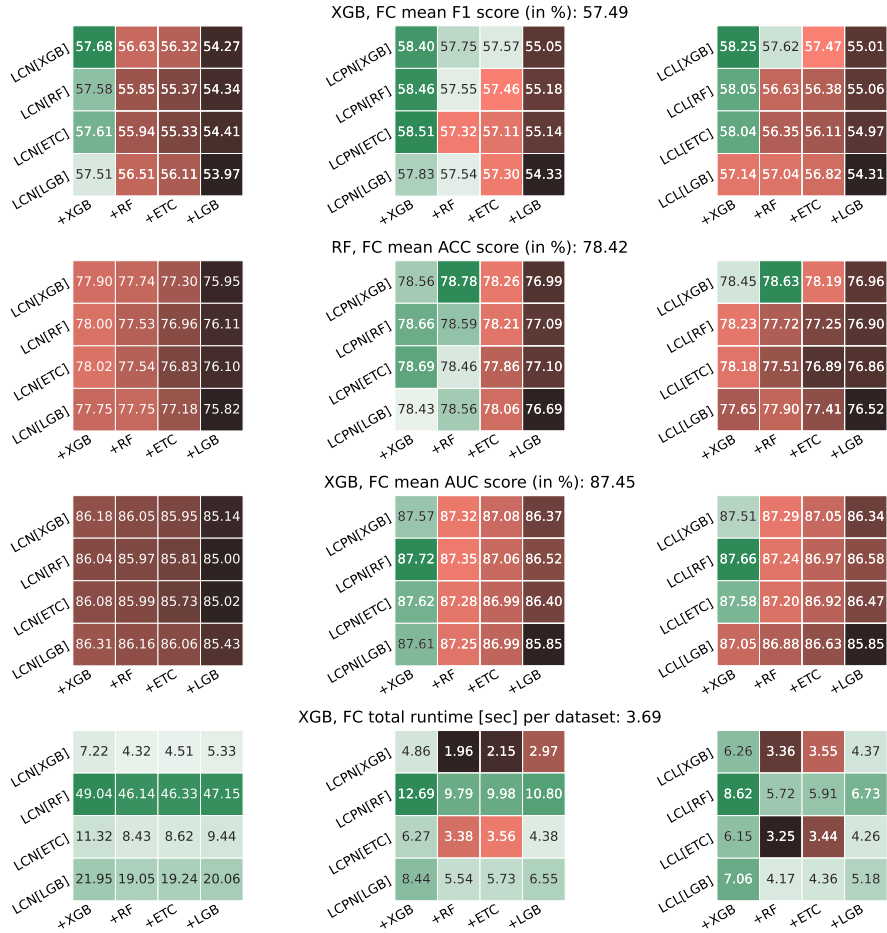


Fig. S6. Hybrid HE+F mean F1, ACC, AUC, and runtime (HG, training, and inference) scores using XGB, RF, ETC, and LGB base classifiers.

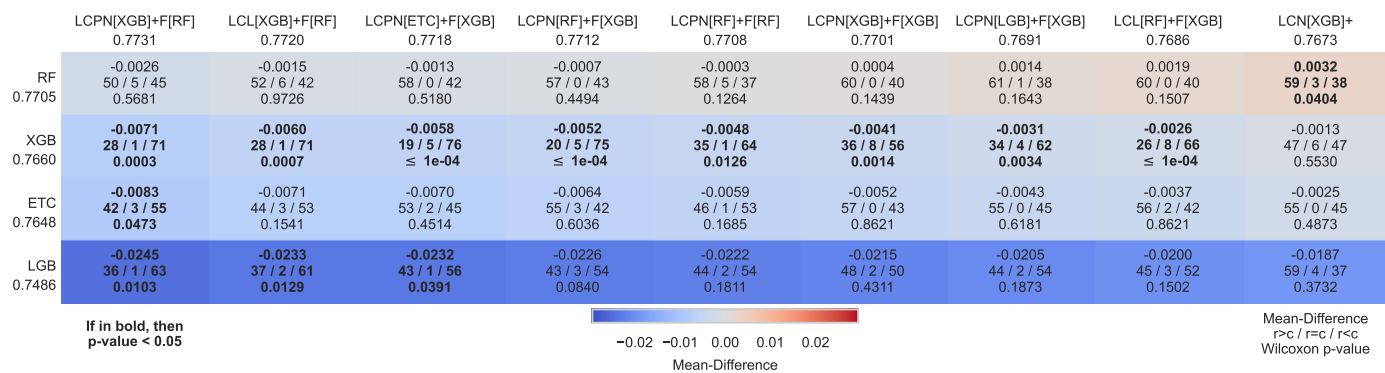


Fig. S7. MCM comparing the mean ACC of selected HiGEC schemes and top FC including XGB, RF, ETC, and LGB base classifiers.

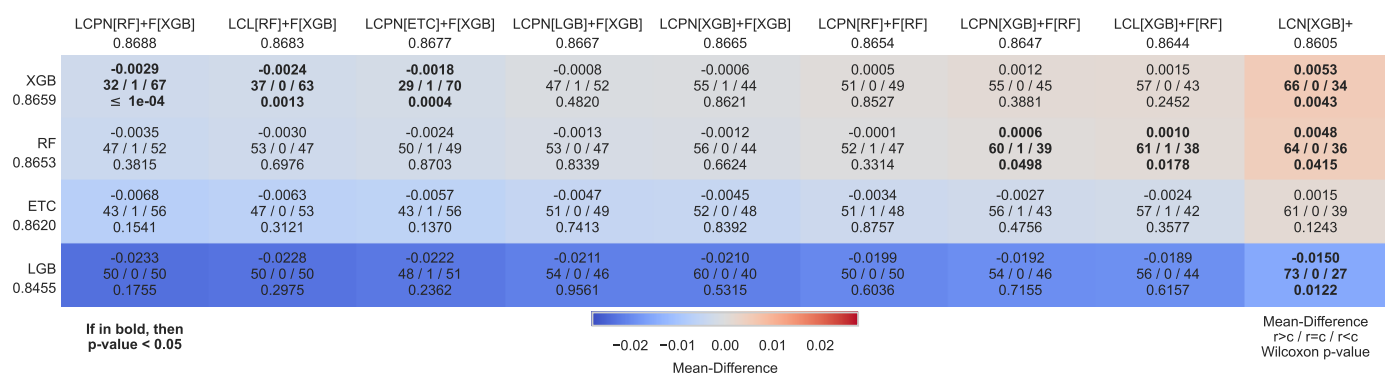


Fig. S8. MCM comparing the mean AUC of selected HiGEC schemes and top FC including XGB, RF, ETC, and LGB base classifiers.

Table S3. MCCV mean F1 scores and std values for selected FC and HiGEC schemes. Best mean score for each dataset is highlighted.

name	RF	XGB	ETC	LGB	LCN[XGB]+	LCPN[ETC]+F[XGB]	LCPN[RF]+F[XGB]	LCPN[XGB]+F[XGB]
air-quality-and-pollution	0.9291±0.0089	0.9284±0.0116	0.9247±0.0110	0.9290±0.0105	0.9271±0.0119	0.9291±0.0114	0.9289±0.0112	0.9290±0.0101
alizadeh-2000-v2	0.9485±0.0630	0.8594±0.1081	0.9743±0.0515	0.9440±0.0668	0.8841±0.1039	0.8809±0.1219	0.8681±0.1153	0.9357±0.0643
amazon-commerce-reviews	0.6670±0.0281	0.7090±0.0253	0.7273±0.0098	0.7077±0.0294	0.5945±0.0203	0.7402±0.0221	0.7257±0.0262	0.5890±0.0157
analcatdata-halloffame	0.6588±0.0652	0.6516±0.0563	0.6663±0.0507	0.6490±0.0648	0.6565±0.0733	0.6530±0.0621	0.6532±0.0624	0.6474±0.0738
analcatdata-happiness	0.3204±0.1043	0.3990±0.0990	0.2605±0.1078	0.5259±0.1395	0.5285±0.0643	0.4019±0.1092	0.4019±0.1092	0.3601±0.0962
anneal	0.7733±0.0739	0.7976±0.0746	0.7814±0.0627	0.7722±0.0749	0.7690±0.0866	0.7995±0.0811	0.8021±0.0887	0.7871±0.0717
arrythmia	0.5761±0.0438	0.5924±0.0744	0.5257±0.0488	0.5946±0.0609	0.6397±0.0380	0.6305±0.0654	0.6281±0.0664	0.6267±0.0755
artificial-characters	0.9102±0.0058	0.8998±0.0078	0.9095±0.0065	0.9119±0.0081	0.8917±0.0055	0.9199±0.0060	0.9139±0.0067	0.9102±0.0069
auto-ml-selector	0.3392±0.0961	0.3710±0.1210	0.2765±0.0984	0.3560±0.1240	0.3635±0.1234	0.3682±0.1178	0.3782±0.1265	0.3922±0.1208
auto-univ-au4-2500	0.4071±0.0133	0.4562±0.0118	0.3850±0.0127	0.4627±0.0145	0.4670±0.0118	0.4560±0.0119	0.4560±0.0119	0.4071±0.0133
auto-univ-au7-1100	0.3775±0.0307	0.3680±0.0245	0.3614±0.0357	0.3701±0.0338	0.3813±0.0320	0.3785±0.0342	0.3772±0.0261	0.3598±0.0346
bach	0.5470±0.0379	0.5756±0.0389	0.5575±0.0381	0.0231±0.0127	0.5916±0.0295	0.5876±0.0374	0.5823±0.0395	0.5447±0.0353
baseball	0.6634±0.0590	0.6516±0.0563	0.6663±0.0507	0.6490±0.0648	0.6565±0.0733	0.6530±0.0621	0.6532±0.0624	0.6439±0.0713
bridges	0.5828±0.1390	0.5335±0.0787	0.5567±0.0822	0.4521±0.1287	0.5701±0.0998	0.5448±0.0780	0.5582±0.1020	0.5771±0.1267
calendar-dow	0.5704±0.0303	0.5569±0.0385	0.5794±0.0415	0.5620±0.0320	0.5655±0.0320	0.5669±0.0278	0.5651±0.0304	0.5730±0.0283
cars	0.7804±0.0451	0.7802±0.0356	0.7710±0.0384	0.7790±0.0671	0.7782±0.0398	0.7797±0.0415	0.7824±0.0436	0.7863±0.0533
cervical-cancer-risk	0.2480±0.0224	0.2315±0.0283	0.2510±0.0198	0.2082±0.0202	0.2234±0.0243	0.2328±0.0281	0.2304±0.0287	0.2454±0.0207
cleveland-nominal	0.2638±0.0286	0.2663±0.0453	0.2825±0.0412	0.2605±0.0307	0.2519±0.0434	0.2669±0.0565	0.2604±0.0490	0.2601±0.0439
cnac-9	0.9304±0.0055	0.9194±0.0154	0.9405±0.0139	0.8423±0.0145	0.8958±0.0143	0.9255±0.0152	0.9242±0.0165	0.9291±0.0104
collins	0.2055±0.0232	0.2030±0.0180	0.2057±0.0199	0.1932±0.0213	0.1868±0.0181	0.2164±0.0183	0.2088±0.0141	0.2033±0.0224
deng-reads	0.9339±0.0218	0.9430±0.0197	0.9368±0.0126	0.9540±0.0563	0.9750±0.0244	0.9623±0.0154	0.9623±0.0154	0.9382±0.0211
dgf	0.6104±0.0533	0.6355±0.0690	0.6394±0.0533	0.6333±0.0725	0.6352±0.0960	0.6506±0.0920	0.6347±0.0676	0.6151±0.0719
diabetes-130-us	0.3920±0.0024	0.4066±0.0031	0.3906±0.0023	0.3999±0.0033	0.3563±0.0028	0.3481±0.0023	0.3505±0.0022	0.3426±0.0027
diggle-table-a2	0.9585±0.0304	0.9628±0.0144	0.9747±0.0186	0.9791±0.0113	0.9690±0.0175	0.9644±0.0143	0.9643±0.0143	0.9731±0.0168
eda-mortgage-ny	0.5001±0.0036	0.4850±0.0031	0.4927±0.0031	0.4824±0.0038	0.4681±0.0051	0.4861±0.0036	0.4823±0.0022	0.4845±0.0042
energy-efficiency	0.6951±0.0253	0.6972±0.0373	0.6870±0.0363	0.6857±0.0261	0.6951±0.0388	0.7036±0.0372	0.6946±0.0417	0.6948±0.0309
financial-risk-assessment	0.2796±0.0039	0.3045±0.0065	0.2999±0.0117	0.2686±0.0032	0.3098±0.0115	0.3081±0.0184	0.3076±0.0192	0.2942±0.0216
flangs	0.5562±0.0746	0.5597±0.0591	0.5161±0.0586	0.5663±0.1027	0.5712±0.0675	0.5833±0.0612	0.5741±0.0580	0.5922±0.0808
flare	0.6143±0.0239	0.6207±0.0187	0.6050±0.0166	0.6126±0.0280	0.6127±0.0248	0.6235±0.0212	0.6212±0.0202	0.6152±0.0255
football-player-position	0.8476±0.0134	0.8456±0.0152	0.8466±0.0184	0.8483±0.0124	0.8491±0.0128	0.8495±0.0133	0.8479±0.0132	0.8507±0.0113
golub-1999-v2	0.8575±0.1599	0.9233±0.0789	0.8984±0.1400	0.9164±0.1282	0.9065±0.0629	0.9250±0.0675	0.9301±0.0671	0.8371±0.1300
hayes-roth	0.8212±0.0303	0.7848±0.0417	0.8247±0.0573	0.8224±0.0793	0.8020±0.0528	0.8160±0.0474	0.8177±0.0452	0.8212±0.0303
heart-h	0.3579±0.0385	0.3402±0.0646	0.3581±0.0673	0.3054±0.0637	0.2958±0.0667	0.3602±0.0564	0.3579±0.0562	0.3459±0.0475
heart-switzerland	0.2571±0.0463	0.2760±0.0837	0.2455±0.0646	0.2354±0.0555	0.2420±0.0773	0.2883±0.0886	0.2878±0.0842	0.2742±0.0510
helen	0.2037±0.0044	0.2124±0.0047	0.2053±0.0051	0.0197±0.0083	0.1903±0.0052	0.2169±0.0033	0.2152±0.0039	0.2102±0.0032
hepatitis-c	0.5256±0.0714	0.5570±0.0762	0.5596±0.0546	0.5880±0.0833	0.6150±0.0925	0.5922±0.0498	0.5922±0.0498	0.5773±0.0623
hypothyroid	0.3608±0.0188	0.3575±0.0236	0.3622±0.0201	0.3544±0.0225	0.3513±0.0207	0.3599±0.0197	0.3626±0.0230	0.3595±0.0179
internet-firewall	0.8427±0.0375	0.8234±0.0531	0.8291±0.0413	0.8115±0.0950	0.8310±0.0492	0.8234±0.0531	0.8234±0.0531	0.8431±0.0376
ipums-la-98-small	0.4097±0.0138	0.4079±0.0171	0.4157±0.0185	0.4071±0.0194	0.4057±0.0207	0.4108±0.0160	0.4105±0.0196	0.4105±0.0142
ipums-la-99-small	0.4437±0.0088	0.4454±0.0145	0.4264±0.0146	0.4435±0.0145	0.4358±0.0126	0.4405±0.0164	0.4439±0.0148	0.4401±0.0135
khan-2001	0.9881±0.0357	0.9699±0.0331	0.9945±0.0165	0.9782±0.0348	0.9740±0.0263	0.9845±0.0239	0.9845±0.0239	0.9875±0.0376
kropt	0.8306±0.0083	0.8622±0.0115	0.8003±0.0122	0.5748±0.0984	0.8466±0.0101	0.8632±0.0062	0.8636±0.0091	0.8458±0.0118
led24	0.7198±0.0114	0.6880±0.0185	0.7182±0.0130	0.6972±0.0196	0.6946±0.0184	0.6968±0.0155	0.6969±0.0149	0.7105±0.0122
led-7digit	0.6838±0.0302	0.6875±0.0398	0.6842±0.0377	0.6917±0.0420	0.6995±0.0331	0.6866±0.0457	0.6858±0.0352	0.7006±0.0449
leukemia	0.7361±0.1254	0.8904±0.1465	0.8661±0.0404	0.9422±0.0632	0.8894±0.1482	0.9156±0.1121	0.9395±0.0634	0.8799±0.1330
lung	0.7055±0.0890	0.7351±0.1063	0.7230±0.0884	0.8637±0.1030	0.8545±0.0653	0.7760±0.1018	0.7532±0.1029	0.7181±0.0490
lymphoma-burkitt	0.7961±0.0830	0.8254±0.0677	0.7631±0.0627	0.7967±0.0499	0.7636±0.0822	0.8255±0.0705	0.8255±0.0705	0.7995±0.0957
mabbob-ela-as-2d	0.3216±0.0474	0.3783±0.0332	0.3099±0.0553	0.3652±0.0377	0.3770±0.0306	0.3717±0.0275	0.3841±0.0305	0.3291±0.0511
mental-health-detection	0.4143±0.0427	0.4162±0.0467	0.4135±0.0449	0.4136±0.0520	0.4261±0.0453	0.4255±0.0456	0.4269±0.0434	0.4281±0.0458
meta-all	0.4832±0.1442	0.4996±0.1652	0.4828±0.1230	0.3979±0.1432	0.4590±0.1504	0.5044±0.1712	0.5044±0.1712	0.4859±0.1372

Table S4. Continuation of Table S3

name	RF	XGB	ETC	LGB	LCN[XGB]+	LCPN[ETC]+F[XGB]	LCPN[RF]+F[XGB]	LCPN[XGB]+F[XGB]
meta-batchincremental	0.4146±0.1038	0.4267±0.0925	0.3972±0.0885	0.4364±0.0920	0.4099±0.1321	0.4203±0.1083	0.4057±0.1145	0.3694±0.1160
meta-instanceincremental	0.7530±0.2114	0.7503±0.2203	0.7989±0.2383	0.7919±0.1432	0.7227±0.2235	0.7556±0.2188	0.7430±0.2078	0.6866±0.2031
mfeat-fourier	0.8175±0.0191	0.8244±0.0229	0.8281±0.0158	0.8320±0.0238	0.8301±0.0164	0.8274±0.0196	0.8258±0.0214	0.8107±0.0194
mfeat-zernike	0.7705±0.0132	0.7815±0.0098	0.7854±0.0123	0.7851±0.0071	0.7804±0.0102	0.7859±0.0123	0.7827±0.0106	0.7624±0.0190
mobile-price	0.8783±0.0176	0.9135±0.0176	0.8675±0.0235	0.9153±0.0184	0.9188±0.0153	0.9127±0.0162	0.9129±0.0156	0.8976±0.0278
okcupid-stem	0.5083±0.0094	0.5353±0.0048	0.4972±0.0040	0.5236±0.0043	0.5398±0.0049	0.5457±0.0046	0.5473±0.0043	0.5282±0.0080
olindda-outliers	0.8176±0.1141	0.7654±0.1223	0.7711±0.0943	0.7653±0.1178	0.6950±0.1318	0.7762±0.1073	0.7705±0.1095	0.7674±0.0873
ovarian-tumour	0.4959±0.0563	0.5570±0.0762	0.5596±0.0546	0.5880±0.0833	0.6150±0.0925	0.5922±0.0498	0.5922±0.0498	0.5909±0.0429
page-blocks	0.8501±0.0292	0.8478±0.0177	0.8407±0.0313	0.8355±0.0386	0.8505±0.0220	0.8517±0.0170	0.8488±0.0170	0.8470±0.0243
pasture	0.7743±0.1629	0.7680±0.1571	0.7597±0.1476	0.1333±0.0000	0.7437±0.1556	0.7747±0.1409	0.7894±0.1441	0.7810±0.1471
prmn-cushings	0.6637±0.2039	0.6102±0.2736	0.5935±0.2601	0.2500±0.0000	0.7055±0.2219	0.6519±0.2689	0.6519±0.2689	0.6943±0.1571
rel-wc	0.6428±0.0276	0.7936±0.0322	0.6763±0.0271	0.7206±0.0353	0.7692±0.0346	0.8012±0.0334	0.7962±0.0350	0.7240±0.0352
rmfts-sleepdata	0.4082±0.0355	0.4038±0.0232	0.4082±0.0299	0.4033±0.0219	0.3966±0.0277	0.3968±0.0259	0.4008±0.0267	0.3951±0.0346
robot-failures-lp1	0.8252±0.0686	0.7260±0.0831	0.8581±0.0817	0.7593±0.0927	0.7404±0.1184	0.7488±0.0855	0.7439±0.0854	0.8478±0.0580
robot-failures-lp2	0.4347±0.1626	0.5732±0.2123	0.4764±0.1562	0.1143±0.0000	0.6282±0.1726	0.6049±0.1697	0.5934±0.1739	0.5849±0.1405
rsct2010-1	0.3545±0.0558	0.6528±0.0728	0.3277±0.0797	0.6175±0.1618	0.6697±0.0859	0.6528±0.0728	0.6528±0.0728	0.5937±0.1710
rsct2010-2	0.4025±0.0869	0.6528±0.0728	0.3277±0.0797	0.6175±0.1618	0.6697±0.0859	0.6528±0.0728	0.6528±0.0728	0.6420±0.1395
rsct2010-3	0.7376±0.0429	0.7973±0.1133	0.7345±0.0352	0.7722±0.1038	0.8447±0.1081	0.8193±0.1145	0.8193±0.1145	0.7196±0.0471
rsct2010-4	0.2790±0.0568	0.3354±0.0975	0.2868±0.0815	0.3124±0.0769	0.3420±0.0461	0.3399±0.0642	0.3336±0.0547	0.3002±0.0818
rsct2010-6	0.4207±0.1091	0.4339±0.1159	0.4063±0.0929	0.5013±0.1151	0.5292±0.1012	0.4630±0.1194	0.4631±0.1174	0.4574±0.1516
sds17	0.9738±0.0011	0.9713±0.0012	0.9678±0.0012	0.9740±0.0013	0.9714±0.0014	0.9712±0.0013	0.9721±0.0011	0.9725±0.0012
segment	0.9792±0.0038	0.9846±0.0055	0.9810±0.0056	0.9848±0.0053	0.9840±0.0065	0.9853±0.0057	0.9848±0.0056	0.9796±0.0070
shuttle	0.9410±0.0550	0.9676±0.0464	0.9665±0.0285	0.3536±0.0830	0.9826±0.0247	0.9783±0.0254	0.9783±0.0255	0.9824±0.0241
soybean	0.2282±0.0251	0.2167±0.0168	0.2263±0.0188	0.2302±0.0227	0.2380±0.0254	0.2345±0.0148	0.2330±0.0190	0.2288±0.0233
spectrometer	0.5191±0.0334	0.4581±0.0483	0.5154±0.0538	0.4771±0.0481	0.4618±0.0427	0.4779±0.0436	0.4709±0.0451	0.5045±0.0303
students-academic-success	0.6828±0.0168	0.6887±0.0172	0.6860±0.0167	0.6927±0.0140	0.6799±0.0179	0.6865±0.0145	0.6824±0.0155	0.6634±0.0139
thyroid-allp	0.4749±0.0253	0.4580±0.0203	0.4703±0.0352	0.4498±0.0283	0.4650±0.0259	0.4730±0.0280	0.4706±0.0250	0.4820±0.0210
thyroid-allhyper	0.4776±0.0214	0.4580±0.0203	0.4703±0.0352	0.4498±0.0283	0.4650±0.0259	0.4730±0.0280	0.4706±0.0250	0.4749±0.0173
thyroid-allhypo	0.4763±0.0254	0.4580±0.0203	0.4703±0.0352	0.4498±0.0283	0.4650±0.0259	0.4730±0.0280	0.4706±0.0250	0.4730±0.0219
thyroid-allrep	0.4750±0.0261	0.4580±0.0203	0.4703±0.0352	0.4498±0.0283	0.4650±0.0259	0.4730±0.0280	0.4706±0.0250	0.4768±0.0194
thyroid-dis	0.4768±0.0221	0.4580±0.0203	0.4703±0.0352	0.4498±0.0283	0.4650±0.0259	0.4730±0.0280	0.4706±0.0250	0.4837±0.0254
tumors-11	0.7975±0.0862	0.8118±0.0698	0.8248±0.0667	0.8652±0.0674	0.8215±0.0881	0.8163±0.0779	0.8188±0.0836	0.8404±0.0453
visualizing-livestock	0.3427±0.0622	0.3527±0.0537	0.2073±0.0560	0.3501±0.0448	0.3598±0.0659	0.3459±0.0621	0.3479±0.0500	0.3414±0.0705
volcanoes-a2	0.3673±0.0496	0.3520±0.0837	0.3401±0.0532	0.3557±0.0629	0.3439±0.0766	0.3516±0.0755	0.3543±0.0718	0.3636±0.0541
volcanoes-a3	0.3084±0.0339	0.3032±0.0366	0.3219±0.0577	0.3051±0.0599	0.2956±0.0353	0.3011±0.0449	0.3178±0.0392	0.2860±0.0358
volcanoes-b1	0.2883±0.0156	0.3033±0.0283	0.2804±0.0188	0.3071±0.0190	0.3034±0.0260	0.3005±0.0258	0.3048±0.0292	0.2949±0.0221
volcanoes-b3	0.2853±0.0223	0.3174±0.0364	0.2607±0.0213	0.2877±0.0252	0.3069±0.0302	0.2985±0.0457	0.3068±0.0419	0.2841±0.0248
volcanoes-b4	0.2801±0.0185	0.2990±0.0217	0.2689±0.0191	0.2885±0.0209	0.2913±0.0252	0.2911±0.0306	0.2970±0.0271	0.2991±0.0310
volcanoes-b6	0.2897±0.0206	0.2955±0.0237	0.2754±0.0212	0.2874±0.0194	0.2991±0.0261	0.2874±0.0263	0.2904±0.0249	0.2957±0.0233
volcanoes-d1	0.2371±0.0250	0.2404±0.0224	0.2259±0.0198	0.2323±0.0146	0.2500±0.0285	0.2414±0.0320	0.2491±0.0313	0.2490±0.0350
volcanoes-d2	0.2367±0.0259	0.2290±0.0213	0.2325±0.0262	0.2264±0.0170	0.2591±0.0196	0.2464±0.0330	0.2443±0.0270	0.2538±0.0172
volcanoes-d3	0.2428±0.0191	0.2404±0.0276	0.2283±0.0211	0.2482±0.0290	0.2638±0.0394	0.2559±0.0354	0.2549±0.0317	0.2578±0.0296
volcanoes-d4	0.2490±0.0206	0.2549±0.0249	0.2312±0.0230	0.2512±0.0271	0.2654±0.0245	0.2573±0.0205	0.2589±0.0232	0.2666±0.0235
volcanoes-e1	0.2759±0.0735	0.2875±0.0548	0.2675±0.0613	0.2807±0.0503	0.2599±0.0554	0.2823±0.0501	0.2902±0.0517	0.2700±0.0748
volcanoes-e3	0.2902±0.0742	0.2882±0.0607	0.2750±0.0557	0.3025±0.0754	0.2833±0.0579	0.2891±0.0676	0.2894±0.0676	0.2809±0.0685
volcanoes-e5	0.2576±0.0310	0.2814±0.0487	0.2462±0.0335	0.2635±0.0455	0.2771±0.0474	0.2835±0.0422	0.2715±0.0353	0.2770±0.0625
walking-activity	0.6142±0.0035	0.6038±0.0026	0.6170±0.0028	0.5418±0.0544	0.5909±0.0031	0.6195±0.0027	0.6174±0.0027	0.6166±0.0043
wine-quality-red	0.3878±0.0369	0.3853±0.0381	0.3823±0.0358	0.3887±0.0382	0.3749±0.0411	0.3809±0.0347	0.3808±0.0349	0.3777±0.0403
wine-quality-white	0.4211±0.0116	0.4246±0.0224	0.4237±0.0166	0.4157±0.0204	0.4062±0.0148	0.4266±0.0214	0.4229±0.0197	0.4137±0.0124
zoo	0.9032±0.1331	0.8927±0.1416	0.9402±0.0918	0.9141±0.1082	0.8383±0.1755	0.9210±0.0968	0.9233±0.0941	0.9032±0.1331
No of winner	10	3	14	11	24	18	8	12