录

附 录

A 论文完整实验结果

A.1 表 4.8 的完整结果

表 A.1 为第四章中 4.2.7 节处表 4.8 的完整结果。主要记录了第四章提出的 MNESG-EL 算 法与现有经典集成学习算法在 ACC、AUC、F-M 和 G-M 四个评价指标的对比结果。

表 4.8 与经典集成学习算法比较

Table 4.8 Comparison with classical ensemble learning algorithms

		Cla						
数据集		Gla				Wisc		
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SBAG	0.7526	0.7400	0.6727	0.7364	0.9648	0.9611	0.9501	0.9609
SERIO	± 0.0872	± 0.0747	± 0.0763	± 0.0728	± 0.0095	± 0.0138	± 0.0138	± 0.0139
UBAG	0.7430	0.7549	0.6903	0.7508	0.9582	0.9609	0.9445	0.9607
UDAU	± 0.0882	± 0.0817	± 0.0807	± 0.0826	± 0.0119	± 0.0112	± 0.0137	± 0.0114
SBO	0.8354	0.7839	0.7232	0.7767	0.9648	0.9652	0.9506	0.9651
SDO	± 0.0596	± 0.0652	± 0.0830	± 0.0659	± 0.0141	± 0.0145	± 0.0196	± 0.0145
RBO	0.7663	0.7724	0.7043	0.7702	0.9736	0.9739	0.9627	0.9738
KDO	± 0.0717	± 0.0864	± 0.0911	± 0.0838	± 0.0083	± 0.0111	± 0.0120	± 0.0113
EBO	0.7860	0.8013	0.7440	0.7979	0.9546	0.9526	0.9358	0.9522
EBO	± 0.0812	± 0.0695	± 0.0683	± 0.0745	± 0.0141	± 0.0154	± 0.0194	± 0.0157
DAC	0.7055	0.7274	0.6599	0.7218	0.9657	0.9473	0.9658	0.9619
BAC	± 0.0693	± 0.0738	± 0.0703	± 0.0741	± 0.0095	± 0.0132	± 0.0095	± 0.0095
Easy	0.6903	0.7127	0.6468	0.7079	0.9619	0.9610	0.9463	0.9610
Easy	± 0.0926	± 0.0962	± 0.0963	± 0.0957	± 0.0119	± 0.0117	± 0.0166	± 0.0117
MNESG-	0.7614	0.7757	0.7130	0.7543	0.9780	0.9812	0.9694	0.9811
EL(default)	± 0.0835	± 0.0403	± 0.0393	± 0.0615	± 0.0052	± 0.0048	± 0.0070	± 0.0048
MNESG-	0.9721	0.9662	0.9599	0.9656	0.9898	0.9921	0.9857	0.9921
EL	±0.0104	±0.0011	±0.0125	±0.0011	± 0.0083	±0.0064	±0.0115	± 0.0065
数据集		Pir	na			Iri	s0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.7590	0.7274	0.6434	0.7196	0.9866	0.9800	0.9789	0.9794
SBAG	±0.0158	±0.0155	±0.0212	±0.0165	±0.0182	±0.0273	±0.0288	±0.0281

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Piı	ma			Iri	s0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.7214	0.7383	0.6666	0.7355	0.9866	0.9800	0.9789	0.9794
UBAG	± 0.0408	±0.0352	±0.0356	±0.0363	±0.0182	±0.0273	±0.0288	± 0.0281
apo	0.7408	0.7291	0.6469	0.7257	0.9933	0.9900	0.9894	0.9897
SBO	±0.0356	±0.0529	± 0.0697	± 0.0575	±0.0149	±0.0223	±0.0235	± 0.0229
D DO	0.7356	0.7293	0.6511	0.7278	0.9933	0.9900	0.9894	0.9897
RBO	± 0.0309	± 0.0337	± 0.0414	± 0.0342	± 0.0149	±0.0223	± 0.0235	± 0.0229
EDO	0.7792	0.7566	0.6852	0.7541	0.9933	0.9900	0.9894	0.9897
EBO	± 0.0480	±0.0392	± 0.0437	± 0.0379	± 0.0149	±0.0223	±0.0235	± 0.0229
DAG	0.6901	0.7020	0.6252	0.6982	1.0	1.0	1.0	1.0
BAC	± 0.0307	±0.0256	±0.0277	± 0.0258	1±0	1±0	1±0	1±0
T.	0.7143	0.7124	0.6344	0.7114	0.9933	0.9900	0.9894	0.9897
Easy	± 0.0306	± 0.0423	±0.0512	± 0.0423	± 0.0149	±0.0223	± 0.0235	± 0.0229
MNESG-	0.7435	0.7220	0.6223	0.6945	1.0	1.0	1.0	1.0
EL(default)	±0.0349	± 0.0475	±0.1029	±0.0933	1±0	1±0	1±0	1±0
,			_0.10_0	-0.0755				
MNESG-	0.8243	0.7954	0.7327	0.7823	1.10	1.10	1.10	1.10
,			0.7327	0.7823	1±0	1±0	1±0	1±0
MNESG-	0.8243	0.7954	0.7327 ±0.0494	0.7823	1±0	1±0 Habe		1±0
MNESG- EL	0.8243	0.7954 ±0.0343	0.7327 ±0.0494	0.7823	1±0		rman	1±0
MNESG- EL 数据集 评价指标	0.8243 ±0.0302	0.7954 ±0.0343 Yea	0.7327 ±0.0494	0.7823 ±0.0460		Habe	rman F-M	
MNESG- EL 数据集	0.8243 ±0.0302	0.7954 ±0.0343 Yea AUC	0.7327 ±0.0494 ast1 F-M	0.7823 ±0.0460 G-M	ACC	Habe	rman F-M	G-M 0.6208
MNESG- EL 数据集 评价指标 SBAG	0.8243 ± 0.0302 ACC 0.7030	0.7954 ±0.0343 Yea AUC 0.6924	0.7327 ±0.0494 ast1 F-M 0.5621	0.7823 ±0.0460 G-M 0.6855	ACC 0.6532	Habe AUC 0.6304	rman F-M 0.4698	G-M 0.6208
MNESG- EL 数据集 评价指标	0.8243 ±0.0302 ACC 0.7030 ±0.0246	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347	0.7823 ±0.0460 G-M 0.6855 ±0.0331	ACC 0.6532 ±0.0654	Habe AUC 0.6304 ±0.0521	F-M 0.4698 ±0.0637	G-M 0.6208 ±0.0463
MNESG- EL 数据集 评价指标 SBAG UBAG	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204	ACC 0.6532 ±0.0654 0.6598	Habe AUC 0.6304 ±0.0521 0.6422	F-M 0.4698 ±0.0637 0.4861	G-M 0.6208 ±0.0463 0.6188
MNESG- EL 数据集 评价指标 SBAG	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263 ±0.0239	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210 ±0.0347	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989 ±0.0418	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204 ±0.0351	ACC 0.6532 ±0.0654 0.6598 ±0.0565	Habe AUC 0.6304 ±0.0521 0.6422 ±0.0476	F-M 0.4698 ±0.0637 0.4861 ±0.0640	G-M 0.6208 ±0.0463 0.6188 ±0.0802
MNESG- EL 数据集 评价指标 SBAG UBAG	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263 ±0.0239 0.7183	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210 ±0.0347 0.6946	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989 ±0.0418 0.5648	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204 ±0.0351 0.6865	ACC 0.6532 ±0.0654 0.6598 ±0.0565 0.6370	Habe AUC 0.6304 ±0.0521 0.6422 ±0.0476 0.6145	F-M 0.4698 ±0.0637 0.4861 ±0.0640 0.4517	G-M 0.6208 ±0.0463 0.6188 ±0.0802 0.6096
MNESG- EL 数据集 评价指标 SBAG UBAG	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263 ±0.0239 0.7183 ±0.0336	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210 ±0.0347 0.6946 ±0.0280	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989 ±0.0418 0.5648 ±0.0401	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204 ±0.0351 0.6865 ±0.0366	ACC 0.6532 ±0.0654 0.6598 ±0.0565 0.6370 ±0.0473	Habe AUC 0.6304 ±0.0521 0.6422 ±0.0476 0.6145 ±0.0540	F-M 0.4698 ±0.0637 0.4861 ±0.0640 0.4517 ±0.0698	$\begin{array}{c} \text{G-M} \\ 0.6208 \\ \pm 0.0463 \\ 0.6188 \\ \pm 0.0802 \\ 0.6096 \\ \pm 0.0572 \end{array}$
MNESG- EL 数据集 评价指标 SBAG UBAG SBO	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263 ±0.0239 0.7183 ±0.0336 0.7398	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210 ±0.0347 0.6946 ±0.0280 0.7104	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989 ±0.0418 0.5648 ±0.0401 0.5864	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204 ±0.0351 0.6865 ±0.0366 0.7066	ACC 0.6532 ±0.0654 0.6598 ±0.0565 0.6370 ±0.0473 0.6575	Habe AUC 0.6304 ±0.0521 0.6422 ±0.0476 0.6145 ±0.0540 0.6639	F-M 0.4698 ±0.0637 0.4861 ±0.0640 0.4517 ±0.0698 0.5076	$\begin{array}{c} \text{G-M} \\ 0.6208 \\ \pm 0.0463 \\ 0.6188 \\ \pm 0.0802 \\ 0.6096 \\ \pm 0.0572 \\ 0.6575 \end{array}$
MNESG- EL 数据集 评价指标 SBAG UBAG	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263 ±0.0239 0.7183 ±0.0336 0.7398 ±0.0253	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210 ±0.0347 0.6946 ±0.0280 0.7104 ±0.0400	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989 ±0.0418 0.5648 ±0.0401 0.5864 ±0.0522	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204 ±0.0351 0.6865 ±0.0366 0.7066 ±0.0434	$\begin{array}{c} ACC \\ 0.6532 \\ \pm 0.0654 \\ 0.6598 \\ \pm 0.0565 \\ 0.6370 \\ \pm 0.0473 \\ 0.6575 \\ \pm 0.0641 \end{array}$	Habe AUC 0.6304 ±0.0521 0.6422 ±0.0476 0.6145 ±0.0540 0.6639 ±0.0376	F-M 0.4698 ±0.0637 0.4861 ±0.0640 0.4517 ±0.0698 0.5076 ±0.0488	$\begin{array}{c} \text{G-M} \\ 0.6208 \\ \pm 0.0463 \\ 0.6188 \\ \pm 0.0802 \\ 0.6096 \\ \pm 0.0572 \\ 0.6575 \\ \pm 0.0382 \end{array}$
MNESG- EL 数据集 评价指标 SBAG UBAG SBO	0.8243 ±0.0302 ACC 0.7030 ±0.0246 0.7263 ±0.0239 0.7183 ±0.0336 0.7398 ±0.0253 0.6913	0.7954 ±0.0343 Yea AUC 0.6924 ±0.0239 0.7210 ±0.0347 0.6946 ±0.0280 0.7104 ±0.0400 0.7081	0.7327 ±0.0494 ast1 F-M 0.5621 ±0.0347 0.5989 ±0.0418 0.5648 ±0.0401 0.5864 ±0.0522 0.5857	0.7823 ±0.0460 G-M 0.6855 ±0.0331 0.7204 ±0.0351 0.6865 ±0.0366 0.7066 ±0.0434 0.7032	$\begin{array}{c} ACC \\ 0.6532 \\ \pm 0.0654 \\ 0.6598 \\ \pm 0.0565 \\ 0.6370 \\ \pm 0.0473 \\ 0.6575 \\ \pm 0.0641 \\ 0.7018 \end{array}$	Habe AUC 0.6304 ±0.0521 0.6422 ±0.0476 0.6145 ±0.0540 0.6639 ±0.0376 0.6548	F-M 0.4698 ±0.0637 0.4861 ±0.0640 0.4517 ±0.0698 0.5076 ±0.0488 0.4901	$\begin{array}{c} \text{G-M} \\ 0.6208 \\ \pm 0.0463 \\ 0.6188 \\ \pm 0.0802 \\ 0.6096 \\ \pm 0.0572 \\ 0.6575 \\ \pm 0.0382 \\ 0.6375 \end{array}$

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Yea	ıst1			Habe	rman	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
_	0.6543	0.6752	0.5481	0.6728	0.6843	0.6008	0.3728	0.5165
Easy	±0.0207	±0.0144	±0.0146	±0.0156	± 0.0758	±0.1185	±0.2543	±0.2490
MNESG-	0.6914	0.7028	0.5788	0.6957	0.7284	0.6819	0.5259	0.6333
EL(default)	± 0.0558	±0.0194	±0.0222	±0.0227	±0.1128	±0.0402	± 0.0744	± 0.0653
MNESG-	0.7399	0.7397	0.6246	0.7366	0.9905	0.9947	0.9556	0.9947
EL	±0.0516	±0.0239	±0.0357	±0.0211	±0.0130	±0.0072	±0.0609	±0.0073
数据集		Vehi	icle2			Vehi	icle3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9621	0.9525	0.9270	0.9532	0.7677	0.7618	0.6190	0.7613
SBAG	±0.0130	±0.0245	±0.0261	±0.0244	± 0.0092	± 0.0170	± 0.0195	± 0.0177
LIDAG	0.9566	0.9536	0.9235	0.9599	0.7411	0.7768	0.6213	0.7720
UBAG	±0.0179	± 0.0082	±0.0320	±0.0175	± 0.0234	±0.0235	± 0.0265	± 0.0219
CDO	0.9657	0.9661	0.9328	0.9660	0.7718	0.7441	0.6015	0.7402
SBO	± 0.0188	± 0.0140	± 0.0375	± 0.0140	± 0.0287	± 0.0348	± 0.0423	± 0.0386
DDO	0.9621	0.9671	0.9304	0.9669	0.7564	0.7493	0.5993	0.7464
RBO	± 0.0184	±0.0206	± 0.0340	±0.0206	± 0.0295	± 0.0545	± 0.0643	± 0.0584
EDO	0.9704	0.9681	0.9442	0.9680	0.7494	0.7902	0.6364	0.7854
EBO	±0.0200	±0.0210	±0.0373	±0.0212	± 0.0343	±0.0315	± 0.0377	± 0.0312
DAC	0.9515	0.9539	0.9114	0.9536	0.7055	0.7360	0.5765	0.7314
BAC	± 0.0153	± 0.0050	± 0.0241	± 0.0051	± 0.0446	± 0.0400	± 0.0459	± 0.0391
Easy	0.9455	0.9559	0.9031	0.9555	0.7257	0.7386	0.5830	0.7377
Easy	± 0.0211	± 0.0176	± 0.0352	± 0.0178	± 0.0351	± 0.0360	± 0.0420	± 0.0362
MNESG-	0.9468	0.9447	0.9011	0.9446	0.7448	0.7555	0.6034	0.7503
EL(default)	± 0.0120	± 0.0146	± 0.0218	± 0.0146	± 0.0397	± 0.0376	± 0.0442	± 0.0401
MNESG-	0.9503	0.9606	0.9148	0.9599	0.8120	0.7870	0.6601	0.7785
EL	± 0.0456	±0.0313	± 0.0694	± 0.0325	±0.0383	± 0.0509	±0.0586	±0.0612
数据集	G	ilass-0-1-2	-3_vs_4-5-	6		Vehi	icle0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9203	0.9198	0.8509	0.9183	0.9337	0.9359	0.8703	0.9355
SBAG	± 0.0487	±0.0466	± 0.0872	±0.0465	±0.0215	±0.0308	±0.0416	±0.0311

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集	G	ilass-0-1-2	-3_vs_4-5-	-6		Vehi	ic le0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8831	0.8885	0.7903	0.8862	0.9349	0.9523	0.8769	0.9516
UBAG	±0.0520	± 0.0503	± 0.0863	± 0.0491	±0.0131	±0.0189	± 0.0251	± 0.0187
ano.	0.9392	0.9185	0.8730	0.9171	0.9396	0.9311	0.8768	0.9305
SBO	±0.0390	± 0.0514	± 0.0807	± 0.0524	±0.0252	±0.0385	± 0.0519	± 0.0389
P.D.O	0.9203	0.9269	0.8529	0.9258	0.9550	0.9618	0.9108	0.9617
RBO	± 0.0428	± 0.0324	± 0.0740	± 0.0322	±0.0106	± 0.0138	± 0.0206	± 0.0137
EDO	0.9161	0.9101	0.8414	0.9078	0.9397	0.9466	0.8827	0.9465
EBO	± 0.0533	± 0.0514	± 0.0880	± 0.0522	±0.0234	± 0.0279	± 0.0440	± 0.0278
DAC	0.9157	0.8892	0.8255	0.9054	0.9255	0.9356	0.8588	0.9353
BAC	± 0.0359	± 0.0517	± 0.0715	± 0.0435	± 0.0239	± 0.0223	± 0.0393	± 0.0225
F	0.9219	0.9171	0.8536	0.9159	0.9302	0.9370	0.8652	0.9365
Easy	± 0.0268	± 0.0313	± 0.0521	± 0.0319	± 0.0224	±0.0312	± 0.0418	± 0.0315
MNESG-	0.9628	0.9548	0.9254	0.9539	0.8208	0.9007	0.8336	0.8966
EL(default)	±0.0202	±0.0185	±0.0332	± 0.0188	±0.0199	± 0.0545	± 0.0542	±0.0618
EE(Geraan)		****						
MNESG-	0.9953	0.9970	0.9905	0.9969	0.9657	0.9655	0.9311	0.9652
. ,			0.9905	0.9969				
MNESG-	0.9953	0.9970	0.9905 ±0.0213	0.9969	0.9657	0.9655	0.9311 ±0.0349	0.9652
MNESG- EL	0.9953	0.9970 ±0.0068	0.9905 ±0.0213	0.9969	0.9657	0.9655 ±0.0118	0.9311 ±0.0349	0.9652
MNESG- EL 数据集 评价指标	0.9953 ±0.0104	0.9970 ±0.0068	0.9905 ±0.0213	0.9969 ±0.0068	0.9657 ±0.0190	0.9655 ±0.0118	0.9311 ±0.0349	0.9652 ±0.0119
MNESG- EL 数据集	0.9953 ±0.0104	0.9970 ±0.0068 Ecc AUC 0.8998	0.9905 ±0.0213 blil F-M	0.9969 ±0.0068 G-M	0.9657 ±0.0190 ACC	0.9655 ±0.0118 Eco	0.9311 ±0.0349 oli2 F-M 0.7606	0.9652 ±0.0119 G-M 0.8870
MNESG- EL 数据集 评价指标 SBAG	0.9953 ±0.0104 ACC 0.8814	0.9970 ±0.0068 Ecc AUC 0.8998	0.9905 ±0.0213 bli1 F-M 0.7865	0.9969 ±0.0068 G-M 0.8975	0.9657 ± 0.0190 ACC 0.9168	0.9655 ±0.0118 Ecc AUC 0.8926	0.9311 ±0.0349 oli2 F-M 0.7606	0.9652 ±0.0119 G-M 0.8870
MNESG- EL 数据集 评价指标	0.9953 ±0.0104 ACC 0.8814 ±0.0376	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196	0.9905 ±0.0213 bli1 F-M 0.7865 ±0.0489	0.9969 ±0.0068 G-M 0.8975 ±0.0187	0.9657 ±0.0190 ACC 0.9168 ±0.0379	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042	0.9652 ±0.0119 G-M 0.8870 ±0.0744
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990	0.9905 ±0.0213 bli1 F-M 0.7865 ±0.0489 0.7777	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897
MNESG- EL 数据集 评价指标 SBAG	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721 ±0.0540	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990 ±0.0501	0.9905 ±0.0213 oli1 F-M 0.7865 ±0.0489 0.7777 ±0.0761	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961 ±0.0510	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929 ±0.0408	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899 ±0.0353	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247 ±0.0834	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897 ±0.0353
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721 ±0.0540 0.8840	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990 ±0.0501 0.8474	0.9905 ±0.0213 oli1 F-M 0.7865 ±0.0489 0.7777 ±0.0761 0.7562	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961 ±0.0510 0.8436	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929 ±0.0408 0.9346	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899 ±0.0353 0.9090	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247 ±0.0834 0.8023	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897 ±0.0353 0.9054
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721 ±0.0540 0.8840 ±0.0436	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990 ±0.0501 0.8474 ±0.0587	0.9905 ±0.0213 oli1 F-M 0.7865 ±0.0489 0.7777 ±0.0761 0.7562 ±0.0916	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961 ±0.0510 0.8436 ±0.0621	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929 ±0.0408 0.9346 ±0.0301	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899 ±0.0353 0.9090 ±0.0786	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247 ±0.0834 0.8023 ±0.0962	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897 ±0.0353 0.9054 ±0.0842
MNESG- EL 数据集 评价指标 SBAG UBAG SBO	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721 ±0.0540 0.8840 ±0.0436 0.8839	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990 ±0.0501 0.8474 ±0.0587 0.9068	0.9905 ±0.0213 oli1 F-M 0.7865 ±0.0489 0.7777 ±0.0761 0.7562 ±0.0916 0.7908	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961 ±0.0510 0.8436 ±0.0621 0.9042	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929 ±0.0408 0.9346 ±0.0301 0.9046	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899 ±0.0353 0.9090 ±0.0786 0.8905	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247 ±0.0834 0.8023 ±0.0962 0.7408	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897 ±0.0353 0.9054 ±0.0842 0.8878
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721 ±0.0540 0.8840 ±0.0436 0.8839 ±0.0266	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990 ±0.0501 0.8474 ±0.0587 0.9068 ±0.0290	0.9905 ±0.0213 oli1 F-M 0.7865 ±0.0489 0.7777 ±0.0761 0.7562 ±0.0916 0.7908 ±0.0348	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961 ±0.0510 0.8436 ±0.0621 0.9042 ±0.0289	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929 ±0.0408 0.9346 ±0.0301 0.9046 ±0.0252	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899 ±0.0353 0.9090 ±0.0786 0.8905 ±0.0332	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247 ±0.0834 0.8023 ±0.0962 0.7408 ±0.0364	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897 ±0.0353 0.9054 ±0.0842 0.8878 ±0.0356
MNESG- EL 数据集 评价指标 SBAG UBAG SBO	0.9953 ±0.0104 ACC 0.8814 ±0.0376 0.8721 ±0.0540 0.8840 ±0.0436 0.8839 ±0.0266 0.8750	0.9970 ±0.0068 Ecc AUC 0.8998 ±0.0196 0.8990 ±0.0501 0.8474 ±0.0587 0.9068 ±0.0290 0.8918	0.9905 ±0.0213 oli1 F-M 0.7865 ±0.0489 0.7777 ±0.0761 0.7562 ±0.0916 0.7908 ±0.0348 0.7820	0.9969 ±0.0068 G-M 0.8975 ±0.0187 0.8961 ±0.0510 0.8436 ±0.0621 0.9042 ±0.0289 0.8878	0.9657 ±0.0190 ACC 0.9168 ±0.0379 0.8929 ±0.0408 0.9346 ±0.0301 0.9046 ±0.0252 0.8990	0.9655 ±0.0118 Ecc AUC 0.8926 ±0.0721 0.8899 ±0.0353 0.9090 ±0.0786 0.8905 ±0.0332 0.8862	0.9311 ±0.0349 oli2 F-M 0.7606 ±0.1042 0.7247 ±0.0834 0.8023 ±0.0962 0.7408 ±0.0364 0.7357	0.9652 ±0.0119 G-M 0.8870 ±0.0744 0.8897 ±0.0353 0.9054 ±0.0842 0.8878 ±0.0356 0.8857

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Eco	olil			Eco	oli2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8481	0.8698	0.7383	0.8666	0.8212	0.8485	0.6095	0.8459
Easy	±0.0611	±0.0564	±0.0855	±0.0570	± 0.0427	±0.0298	±0.0525	±0.0284
MNESG-	0.9139	0.9070	0.8331	0.9046	0.9316	0.9202	0.8035	0.9191
EL(default)	± 0.0504	±0.0425	± 0.0843	±0.0453	±0.0266	±0.0526	± 0.0748	±0.0534
MNESG-	0.9910	0.9800	0.9793	0.9797	0.9761	0.9538	0.9242	0.9532
EL	±0.0082	±0.0183	±0.0189	±0.0186	±0.0257	±0.0291	±0.0787	±0.0293
数据集		Gla	ıss6			Yea	ıst3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9346	0.8923	0.7657	0.8836	0.9413	0.9401	0.7822	0.9401
SBAG	±0.0191	±0.0965	± 0.1005	±0.1123	± 0.0218	± 0.0197	± 0.0661	± 0.0197
LIDAG	0.8972	0.9159	0.7159	0.9115	0.9279	0.9353	0.7472	0.9350
UBAG	± 0.0421	±0.0576	± 0.0953	± 0.0553	± 0.0258	±0.0155	± 0.0673	± 0.0156
CDO	0.9345	0.8504	0.7447	0.8353	0.9386	0.8795	0.7427	0.8761
SBO	± 0.0106	± 0.0815	± 0.0615	± 0.0970	± 0.0086	± 0.0148	± 0.0290	± 0.0157
RBO	0.9108	0.9227	0.7507	0.9182	0.9225	0.9188	0.7260	0.9188
KBO	± 0.0518	± 0.0342	± 0.1082	± 0.0340	± 0.0263	± 0.0240	± 0.0698	± 0.0240
EDO	0.8877	0.8932	0.7121	0.8912	0.9198	0.9281	0.7244	0.9277
EBO	± 0.0894	± 0.0700	± 0.1598	± 0.0701	± 0.0252	± 0.0166	± 0.0597	± 0.0168
BAC	0.8875	0.8932	0.6893	0.8913	0.9076	0.9079	0.6871	0.9079
DAC	± 0.0395	± 0.0359	± 0.0791	± 0.0352	± 0.0257	± 0.0316	± 0.0697	± 0.0316
Fooy	0.8550	0.8463	0.6050	0.8390	0.9130	0.9109	0.6989	0.9108
Easy	± 0.0387	± 0.0935	± 0.1065	± 0.1036	± 0.0222	± 0.0274	± 0.0580	± 0.0274
MNESG-	0.9673	0.9359	0.8823	0.9333	0.9373	0.8819	0.7349	0.8753
EL(default)	±0.0126	± 0.0408	± 0.0369	± 0.0429	± 0.0182	± 0.0776	± 0.0974	± 0.0897
MNESG-	0.9766	0.9586	0.9132	0.9551	0.9905	0.9947	0.9556	0.9947
EL	±0.0233	±0.0709	±0.0881	±0.0783	±0.0130	±0.0072	±0.0609	±0.0073
数据集		Eco	oli3			Yeast-	2-vs-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SDAC	0.8898	0.8754	0.6197	0.8736	0.9163	0.8910	0.6664	0.8861
SBAG	± 0.0227	± 0.0467	± 0.0525	± 0.0481	± 0.0108	± 0.0753	± 0.0600	± 0.0830

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Eco	oli3			Yeast-	2-vs-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8424	0.8994	0.5710	0.8955	0.9124	0.9335	0.6914	0.9324
UBAG	±0.0520	±0.0386	±0.0843	±0.0396	± 0.0305	±0.0229	± 0.0662	± 0.0229
g D O	0.9107	0.8744	0.6563	0.8693	0.9435	0.8893	0.7428	0.9058
SBO	±0.0179	±0.0735	±0.0814	± 0.0823	± 0.0187	±0.0455	± 0.0829	± 0.0581
220	0.8720	0.8402	0.5778	0.8346	0.9299	0.9263	0.7342	0.9247
RBO	±0.0522	±0.0332	± 0.0686	± 0.0337	± 0.0371	±0.0296	±0.0819	± 0.0309
EDO	0.8621	0.8605	0.5621	0.8552	0.9144	0.9267	0.7024	0.9253
EBO	± 0.0174	± 0.0746	± 0.0549	± 0.0810	± 0.0510	±0.0196	±0.1029	± 0.0209
DAG	0.8090	0.8112	0.4820	0.7996	0.9066	0.8866	0.6632	0.8827
BAC	±0.1216	± 0.0749	±0.1089	± 0.0831	±0.0520	± 0.0358	± 0.0875	± 0.0396
T.	0.8451	0.8504	0.5544	0.8439	0.9046	0.9212	0.6642	0.9199
Easy	± 0.0822	± 0.0463	± 0.0845	± 0.0493	± 0.0221	± 0.0433	± 0.0618	± 0.0435
MNESG-	0.8958	0.9166	0.6539	0.9154	0.9590	0.9068	0.8080	0.9006
EL(default)	±0.0153	± 0.0357	± 0.0376	± 0.0350	± 0.0273	± 0.0702	±0.1153	± 0.0796
MNESG-	0.9628	0.9442	0.8806	0.9413	0.9845	0.9833	0.9286	0.9832
MNESG- EL	0.9628 ±0.0584	0.9442 ±0.0516	0.8806 ±0.1533	0.9413 ±0.0544	0.9845 ±0.0128	0.9833 ±0.0251	0.9286 ±0.0532	0.9832 ±0.0253
		±0.0516		±0.0544			±0.0532	
EL		±0.0516	±0.1533	±0.0544		±0.0251	±0.0532	
EL 数据集 评价指标	±0.0584	±0.0516 Yeast-0-5-	±0.1533	±0.0544	±0.0128	±0.0251	±0.0532	±0.0253
EL数据集	±0.0584	±0.0516 Yeast-0-5- AUC	± 0.1533 6-7-9-vs-4 F-M	±0.0544	±0.0128	±0.0251 Glass-0- AUC	±0.0532 1-6_vs_2 F-M	±0.0253
EL 数据集 评价指标 SBAG	±0.0584 ACC 0.8541	±0.0516 Yeast-0-5- AUC 0.8217	±0.1533 6-7-9-vs-4 F-M 0.5089	±0.0544 G-M 0.8165	±0.0128 ACC 0.8331	±0.0251 Glass-0- AUC 0.6676	±0.0532 1-6_vs_2 F-M 0.4020	±0.0253 G-M 0.5605
EL 数据集 评价指标	±0.0584 ACC 0.8541 ±0.0340	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822	±0.1533 6-7-9-vs-4 F-M 0.5089 ±0.1030	±0.0544 G-M 0.8165 ±0.0885	±0.0128 ACC 0.8331 ±0.0475	±0.0251 Glass-0- AUC 0.6676 ±0.1698	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666	±0.0253 G-M 0.5605 ±0.3434
EL 数据集 评价指标 SBAG UBAG	±0.0584 ACC 0.8541 ±0.0340 0.7916	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969	±0.1533 6-7-9-vs-4 F-M 0.5089 ±0.1030 0.4271	#0.0544 G-M 0.8165 #0.0885 0.7963	±0.0128 ACC 0.8331 ±0.0475 0.6667	±0.0251 Glass-0- AUC 0.6676 ±0.1698 0.7035	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771	G-M 0.5605 ±0.3434 0.6863
EL 数据集 评价指标 SBAG	#0.0584 ACC 0.8541 ±0.0340 0.7916 ±0.0179	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969 ±0.0385	± 0.1533 6-7-9-vs-4 F-M 0.5089 ± 0.1030 0.4271 ± 0.0403	G-M 0.8165 ±0.0885 0.7963 ±0.0386	±0.0128 ACC 0.8331 ±0.0475 0.6667 ±0.0261	±0.0251 Glass-0- AUC 0.6676 ±0.1698 0.7035 ±0.1160	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771 ±0.0862	G-M 0.5605 ±0.3434 0.6863 ±0.1213
EL 数据集 评价指标 SBAG UBAG	±0.0584 ACC 0.8541 ±0.0340 0.7916 ±0.0179 0.8900	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969 ±0.0385 0.7727	±0.1533 6-7-9-vs-4 F-M 0.5089 ±0.1030 0.4271 ±0.0403 0.5235	G-M 0.8165 ±0.0885 0.7963 ±0.0386 0.7523	±0.0128 ACC 0.8331 ±0.0475 0.6667 ±0.0261 0.8491	±0.0251 Glass-0- AUC 0.6676 ±0.1698 0.7035 ±0.1160 0.6014	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771 ±0.0862 0.3234	G-M 0.5605 ±0.3434 0.6863 ±0.1213 0.4569
EL 数据集 评价指标 SBAG UBAG	±0.0584 ACC 0.8541 ±0.0340 0.7916 ±0.0179 0.8900 ±0.0321	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969 ±0.0385 0.7727 ±0.0907	±0.1533 6-7-9-vs-4 F-M 0.5089 ±0.1030 0.4271 ±0.0403 0.5235 ±0.1359	#0.0544 G-M 0.8165 #0.0885 0.7963 #0.0386 0.7523 #0.1114	±0.0128 ACC 0.8331 ±0.0475 0.6667 ±0.0261 0.8491 ±0.0423	±0.0251 Glass-0- AUC 0.6676 ±0.1698 0.7035 ±0.1160 0.6014 ±0.1304	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771 ±0.0862 0.3234 ±0.1658	G-M 0.5605 ±0.3434 0.6863 ±0.1213 0.4569 ±0.2871
EL 数据集 评价指标 SBAG UBAG SBO	±0.0584 ACC 0.8541 ±0.0340 0.7916 ±0.0179 0.8900 ±0.0321 0.8351	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969 ±0.0385 0.7727 ±0.0907 0.7862	±0.1533 6-7-9-vs-4 F-M 0.5089 ±0.1030 0.4271 ±0.0403 0.5235 ±0.1359 0.4581	#0.0544 G-M 0.8165 #0.0885 0.7963 #0.0386 0.7523 #0.1114 0.7788	±0.0128 ACC 0.8331 ±0.0475 0.6667 ±0.0261 0.8491 ±0.0423 0.7809	±0.0251 Glass-0- AUC 0.6676 ±0.1698 0.7035 ±0.1160 0.6014 ±0.1304 0.6999	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771 ±0.0862 0.3234 ±0.1658 0.3196	#0.0253 G-M 0.5605 ±0.3434 0.6863 ±0.1213 0.4569 ±0.2871 0.6692
EL 数据集 评价指标 SBAG UBAG	±0.0584 ACC 0.8541 ±0.0340 0.7916 ±0.0179 0.8900 ±0.0321 0.8351 ±0.0295	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969 ±0.0385 0.7727 ±0.0907 0.7862 ±0.0899	± 0.1533 6-7-9-vs-4 F-M 0.5089 ± 0.1030 0.4271 ± 0.0403 0.5235 ± 0.1359 0.4581 ± 0.0987	±0.0544 G-M 0.8165 ±0.0885 0.7963 ±0.0386 0.7523 ±0.1114 0.7788 ±0.0982	±0.0128 ACC 0.8331 ±0.0475 0.6667 ±0.0261 0.8491 ±0.0423 0.7809 ±0.0607	±0.0251 Glass-0- AUC 0.6676 ±0.1698 0.7035 ±0.1160 0.6014 ±0.1304 0.6999 ±0.1416	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771 ±0.0862 0.3234 ±0.1658 0.3196 ±0.1500	#0.0253 G-M 0.5605 ±0.3434 0.6863 ±0.1213 0.4569 ±0.2871 0.6692 ±0.1733
EL 数据集 评价指标 SBAG UBAG SBO	±0.0584 ACC 0.8541 ±0.0340 0.7916 ±0.0179 0.8900 ±0.0321 0.8351 ±0.0295 0.8180	±0.0516 Yeast-0-5- AUC 0.8217 ±0.0822 0.7969 ±0.0385 0.7727 ±0.0907 0.7862 ±0.0899 0.8206	±0.1533 6-7-9-vs-4 F-M 0.5089 ±0.1030 0.4271 ±0.0403 0.5235 ±0.1359 0.4581 ±0.0987 0.4692	±0.0544 G-M 0.8165 ±0.0885 0.7963 ±0.0386 0.7523 ±0.1114 0.7788 ±0.0982 0.8197	±0.0128 ACC 0.8331 ±0.0475 0.6667 ±0.0261 0.8491 ±0.0423 0.7809 ±0.0607 0.7182	±0.0251 Glass-0-1 AUC 0.6676 ±0.1698 0.7035 ±0.1160 0.6014 ±0.1304 0.6999 ±0.1416 0.7930	±0.0532 1-6_vs_2 F-M 0.4020 ±0.1666 0.2771 ±0.0862 0.3234 ±0.1658 0.3196 ±0.1500 0.3669	#0.0253 G-M 0.5605 #0.3434 0.6863 #0.1213 0.4569 #0.2871 0.6692 #0.1733 0.7851

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Yeast-0-5-	6-7-9-vs-4			Glass-0-	1-6_vs_2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8047	0.7801	0.4298	0.7757	0.6345	0.7390	0.3066	0.7259
Easy	±0.0516	±0.0640	±0.0675	±0.0693	±0.1013	±0.1278	±0.1166	±0.1226
MNESG-	0.8146	0.8176	0.4618	0.8112	0.8961	0.6244	0.3333	0.5267
EL(default)	± 0.0478	±0.0934	± 0.0965	±0.1015	± 0.0019	±0.0194	± 0.0006	± 0.0479
MNESG-	0.9263	0.9235	0.6977	0.9184	0.9795	0.9000	0.8857	0.8928
EL	±0.0039	±0.0779	±0.0370	±0.0873	±0.0115	±0.0559	±0.0639	±0.0599
数据集		Gla	ss2			Yeast-	1-vs-7	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.8174	0.7019	0.3847	0.6077	0.8237	0.7208	0.3174	0.7074
SBAG	±0.0518	±0.1399	±0.1180	±0.3421	± 0.0556	±0.0367	± 0.0480	±0.0455
IID I G	0.5888	0.7766	0.2796	0.7428	0.7363	0.6883	0.2361	0.6778
UBAG	±0.0579	± 0.0316	± 0.0375	± 0.0422	± 0.0262	± 0.0798	± 0.0525	± 0.0981
CDO	0.8594	0.7330	0.4141	0.7114	0.8065	0.7259	0.3142	0.7170
SBO	± 0.0585	± 0.0945	± 0.1420	± 0.1150	± 0.0742	± 0.0319	± 0.0662	± 0.0356
RBO	0.7662	0.6375	0.3190	0.6110	0.8257	0.7827	0.3601	0.7749
KBO	± 0.1562	±0.1506	± 0.2350	±0.1610	± 0.0558	± 0.0943	± 0.0813	± 0.1005
EDO	0.7053	0.7646	0.3129	0.7569	0.7996	0.7222	0.2946	0.7105
EBO	± 0.0626	± 0.0711	± 0.0714	± 0.0638	± 0.0336	± 0.1005	± 0.0899	± 0.1192
DAC	0.5750	0.6174	0.2064	0.6134	0.6404	0.6526	0.1974	0.6425
BAC	± 0.1166	± 0.1515	± 0.0854	± 0.1478	± 0.0785	± 0.1016	± 0.0634	± 0.1109
Fagy	0.5933	0.7795	0.2903	0.7445	0.6817	0.7212	0.2425	0.7113
Easy	± 0.1077	± 0.0565	± 0.0845	± 0.0766	± 0.0821	± 0.0346	± 0.0201	± 0.0416
MNESG-	0.6957	0.7595	0.3018	0.7378	0.6455	0.8023	0.2690	0.7753
EL(default)	± 0.1946	± 0.0043	± 0.0874	± 0.0187	± 0.1230	± 0.0658	± 0.0662	± 0.0848
MNESG-	0.9814	0.8607	0.8400	0.8532	0.8110	0.8214	0.3732	0.8210
EL	±0.0104	±0.0745	±0.0894	±0.0821	± 0.0531	±0.0294	±0.0614	±0.0291
数据集		Gla	ss4			Eco	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9060	0.9025	0.5733	0.8921	0.9524	0.8810	0.7463	0.8753
SBAG	±0.0610	± 0.0885	±0.1382	±0.1066	±0.0193	± 0.0497	±0.1452	± 0.0523

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Gla	ss4			Eco	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
I TD A C	0.8773	0.8593	0.4666	0.8487	0.8363	0.8427	0.4118	0.8394
UBAG	± 0.0577	± 0.1031	±0.1027	±0.1153	± 0.0802	± 0.0773	±0.1298	± 0.0756
CDO	0.9343	0.8866	0.6189	0.8749	0.9582	0.8373	0.6666	0.8177
SBO	± 0.0355	± 0.1011	±0.1166	± 0.1178	± 0.0164	± 0.0964	±0.1020	±0.1151
P.D.O.	0.9018	0.9004	0.5563	0.8962	0.8927	0.8961	0.5680	0.8920
RBO	± 0.0665	± 0.1392	± 0.2347	± 0.1469	± 0.0867	± 0.0714	± 0.2540	± 0.0737
EDO	0.8975	0.8666	0.6187	0.8578	0.8600	0.9021	0.5121	0.9005
EBO	± 0.1390	± 0.1520	± 0.2352	± 0.1610	± 0.1016	± 0.1029	± 0.2370	± 0.1026
BAC	0.8036	0.8480	0.3915	0.8393	0.8539	0.8989	0.4491	0.8956
BAC	± 0.0881	± 0.1249	±0.2176	± 0.1301	± 0.0492	± 0.0593	± 0.1020	± 0.0596
F	0.8693	0.8208	0.4389	0.8108	0.8869	0.8930	0.4888	0.8897
Easy	± 0.0706	± 0.1130	± 0.1094	± 0.1214	± 0.0248	± 0.0531	± 0.0248	± 0.0541
MNESG-	0.9765	0.9104	0.8000	0.9020	0.9045	0.9258	0.6436	0.9214
EL(default)	± 0.0001	±0.1090	± 0.0001	±0.1209	± 0.0977	±0.0542	±0.2550	± 0.0582
,								
MNESG-	0.9902	0.9949	0.9200	0.9948	0.9911	0.9953	0.9333	0.9952
MNESG-	0.9902	0.9949	0.9200 ±0.1095	0.9948	0.9911	0.9953	0.9333 ±0.0609	0.9952
MNESG- EL	0.9902	0.9949 ±0.0070	0.9200 ±0.1095	0.9948	0.9911	0.9953 ±0.0043	0.9333 ±0.0609	0.9952
MNESG- EL 数据集 评价指标	0.9902 ±0.0134	0.9949 ±0.0070 Abalon	0.9200 ± 0.1095 ne9-18	0.9948 ±0.0071	0.9911 ±0.0081	0.9953 ±0.0043 Shuttle-o	0.9333 ±0.0609 c2-vs-c4	0.9952 ±0.0043
MNESG- EL 数据集	0.9902 ±0.0134	0.9949 ±0.0070 Abalon AUC	0.9200 ± 0.1095 ne9-18 F-M	0.9948 ±0.0071	0.9911 ±0.0081	0.9953 ±0.0043 Shuttle-o	0.9333 ±0.0609 c2-vs-c4 F-M	0.9952 ±0.0043
MNESG- EL 数据集 评价指标 SBAG	0.9902 ±0.0134 ACC 0.8617	0.9949 ±0.0070 Abalon AUC 0.7257	0.9200 ±0.1095 ne9-18 F-M 0.3392	0.9948 ±0.0071 G-M 0.6932	0.9911 ±0.0081 ACC 0.9221	0.9953 ±0.0043 Shuttle-o AUC 0.9558	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334	0.9952 ±0.0043 G-M 0.9551
MNESG- EL 数据集 评价指标	0.9902 ±0.0134 ACC 0.8617 ±0.0601	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904	0.9948 ±0.0071 G-M 0.6932 ±0.1850	0.9911 ±0.0081 ACC 0.9221 ±0.0109	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383	0.9952 ±0.0043 G-M 0.9551 ±0.0076
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658
MNESG- EL 数据集 评价指标 SBAG	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369 ±0.0566	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819 ±0.0526	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755 ±0.0453	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770 ±0.0536	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384 ±0.0842	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473 ±0.0447	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666 ±0.3248	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658 ±0.0467
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369 ±0.0566 0.9137	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819 ±0.0526 0.7533	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755 ±0.0453 0.4560	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770 ±0.0536 0.7149	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384 ±0.0842 0.9340	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473 ±0.0447 0.9114	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666 ±0.3248 0.6269	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658 ±0.0467 0.9027
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369 ±0.0566 0.9137 ±0.0458	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819 ±0.0526 0.7533 ±0.1430	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755 ±0.0453 0.4560 ±0.2876	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770 ±0.0536 0.7149 ±0.1897	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384 ±0.0842 0.9340 ±0.0241	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473 ±0.0447 0.9114 ±0.0904	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666 ±0.3248 0.6269 ±0.0362	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658 ±0.0467 0.9027 ±0.1095
MNESG- EL 数据集 评价指标 SBAG UBAG SBO	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369 ±0.0566 0.9137 ±0.0458 0.8002	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819 ±0.0526 0.7533 ±0.1430 0.7906	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755 ±0.0453 0.4560 ±0.2876 0.3146	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770 ±0.0536 0.7149 ±0.1897 0.7834	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384 ±0.0842 0.9340 ±0.0241 0.9692 ±0.0688	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473 ±0.0447 0.9114 ±0.0904 0.9840 ±0.0357	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666 ±0.3248 0.6269 ±0.0362 0.8666 ±0.2981	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658 ±0.0467 0.9027 ±0.1095 0.9833 ±0.0373
MNESG- EL 数据集 评价指标 SBAG UBAG	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369 ±0.0566 0.9137 ±0.0458 0.8002 ±0.0353	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819 ±0.0526 0.7533 ±0.1430 0.7906 ±0.0992	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755 ±0.0453 0.4560 ±0.2876 0.3146 ±0.0807	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770 ±0.0536 0.7149 ±0.1897 0.7834 ±0.1052	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384 ±0.0842 0.9340 ±0.0241 0.9692	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473 ±0.0447 0.9114 ±0.0904 0.9840	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666 ±0.3248 0.6269 ±0.0362 0.8666	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658 ±0.0467 0.9027 ±0.1095 0.9833
MNESG- EL 数据集 评价指标 SBAG UBAG SBO	0.9902 ±0.0134 ACC 0.8617 ±0.0601 0.7369 ±0.0566 0.9137 ±0.0458 0.8002 ±0.0353 0.7523	0.9949 ±0.0070 Abalon AUC 0.7257 ±0.1537 0.7819 ±0.0526 0.7533 ±0.1430 0.7906 ±0.0992 0.7326	0.9200 ±0.1095 ne9-18 F-M 0.3392 ±0.1904 0.2755 ±0.0453 0.4560 ±0.2876 0.3146 ±0.0807 0.2504	0.9948 ±0.0071 G-M 0.6932 ±0.1850 0.7770 ±0.0536 0.7149 ±0.1897 0.7834 ±0.1052 0.7196	0.9911 ±0.0081 ACC 0.9221 ±0.0109 0.9384 ±0.0842 0.9340 ±0.0241 0.9692 ±0.0688	0.9953 ±0.0043 Shuttle-0 AUC 0.9558 ±0.0077 0.9473 ±0.0447 0.9114 ±0.0904 0.9840 ±0.0357	0.9333 ±0.0609 c2-vs-c4 F-M 0.6334 ±0.0383 0.7666 ±0.3248 0.6269 ±0.0362 0.8666 ±0.2981	0.9952 ±0.0043 G-M 0.9551 ±0.0076 0.9658 ±0.0467 0.9027 ±0.1095 0.9833 ±0.0373

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Abalor	ne9-18			Shuttle-o	2-vs-c4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
T.	0.6880	0.7220	0.2257	0.7165	4.0	4.0	4.0	4.0
Easy	± 0.0665	± 0.0595	± 0.0444	± 0.0586	1±0	1±0	1±0	1±0
MNESG-	0.9110	0.8057	0.4882	0.7968	1.0	1.0	1.0	1.0
EL(default)	±0.0581	± 0.0724	±0.2028	± 0.0756	1±0	1±0	1±0	1±0
MNESG-	0.9623	0.9212	0.7166	0.9173	1.0	1.0	1.0	1.0
EL	±0.0048	±0.0807	±0.0151	±0.0859	1±0	1±0	1±0	1±0
数据集		Gla	ss5			Yeast-	2-vs-8	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9488	0.9256	0.6619	0.9164	0.9584	0.8109	0.5473	0.7697
SBAG	± 0.0382	± 0.0998	± 0.1980	±0.1185	± 0.0181	±0.1566	± 0.1410	± 0.2034
IDAC	0.9495	0.5266	0.9512	0.9065	0.7590	0.7307	0.2327	0.7215
UBAG	± 0.0310	± 0.2712	±0.0298	± 0.0569	± 0.1437	± 0.1349	± 0.1257	± 0.1378
SBO	0.9673	0.9353	0.6933	0.9266	0.9646	0.7902	0.5833	0.7528
SBO	± 0.0126	± 0.1037	± 0.0596	± 0.1228	± 0.0174	± 0.1070	± 0.1666	± 0.1564
RBO	0.8976	0.9463	0.5815	0.9438	0.9335	0.8457	0.4846	0.8403
KBO	± 0.0879	± 0.0461	± 0.3015	± 0.0487	± 0.0059	± 0.0030	± 0.0210	± 0.0027
EBO	0.9297	0.9634	0.6066	0.9623	0.7820	0.7666	0.2238	0.7613
EBO	± 0.0572	± 0.0298	± 0.2832	± 0.0310	± 0.0375	± 0.0844	± 0.0514	± 0.0878
BAC	0.9018	0.9487	0.4866	0.9471	0.6823	0.7625	0.1910	0.7485
DAC	± 0.0476	± 0.0249	± 0.1849	± 0.0261	± 0.0972	± 0.1149	± 0.0758	± 0.1142
Easy	0.9390	0.9682	0.6266	0.9674	0.7637	0.7571	0.2214	0.7471
Lasy	± 0.0538	± 0.0280	± 0.2385	± 0.0292	± 0.0961	± 0.1331	± 0.0736	± 0.1340
MNESG-	0.9884	0.9939	0.9000	0.9939	0.8961	0.7066	0.3026	0.6246
EL(default)	±0.0164	± 0.0086	± 0.1414	± 0.0087	± 0.0927	± 0.1603	± 0.0901	± 0.2253
MNESG-	0.9884	0.9939	0.9000	0.9939	0.9792	0.8696	0.7532	0.8547
EL	±0.0164	±0.0086	±0.1414	±0.0087	±0.0121	±0.0978	±0.1358	±0.1152
数据集		Yea	ıst4			Winequa	lity-red-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SBAG	0.7978	0.8339	0.2345	0.8307	0.8930	0.6523	0.1970	0.5921
SDAU	± 0.0482	± 0.0374	± 0.0278	± 0.0327	± 0.0156	± 0.0732	± 0.0716	± 0.1039

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集		Yea	ıst4			Winequal	lity-red-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.7742	0.8452	0.2097	0.8179	0.6897	0.6666	0.1206	0.6600
UBAG	±0.0275	± 0.0970	±0.0219	±0.0717	± 0.0454	±0.0750	± 0.0285	± 0.0797
g D O	0.8215	0.7979	0.2466	0.7835	0.9392	0.5867	0.2180	0.3999
SBO	± 0.0885	± 0.0779	± 0.0488	±0.0916	± 0.0047	±0.0582	± 0.0403	±0.2266
220	0.8200	0.8199	0.2398	0.8165	0.8116	0.6228	0.1330	0.5879
RBO	± 0.0347	± 0.0472	±0.0170	± 0.0462	± 0.0324	± 0.0453	± 0.0335	± 0.0552
EDO	0.8126	0.8372	0.2437	0.8340	0.7535	0.6110	0.1051	0.5630
EBO	± 0.0403	± 0.0611	± 0.0397	±0.0594	± 0.0876	± 0.0788	±0.0124	± 0.1616
DAG	0.7850	0.7747	0.2031	0.7710	0.6113	0.6500	0.1021	0.6335
BAC	±0.0532	± 0.0966	±0.0592	±0.1002	± 0.0831	± 0.0791	±0.0186	± 0.0727
Г	0.7998	0.8191	0.2337	0.8159	0.6611	0.6403	0.1083	0.6206
Easy	± 0.0588	± 0.0865	± 0.0750	± 0.0880	±0.1143	± 0.0669	± 0.0217	± 0.0824
MNESG-	0.8653	0.8579	0.2990	0.8573	0.6953	0.7326	0.1584	0.7074
EL(default)	± 0.0190	±0.0243	±0.0123	±0.0247	±0.1522	±0.0554	± 0.0331	± 0.0423
MNESG-	0.9097	0.8209	0.3553	0.8122	0.9677	0.6034	0.2699	0.4239
EL	±0.0142	±0.0693	±0.0457	± 0.0781	±0.0018	±0.1003	±0.1787	±0.2120
数据集		Yeast-1-2	-8-9-vs-7			Yea	ıst5	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SDAC	0.8253	0.6711	0.1498	0.6200	0.9703	0.9618	0.6669	0.9612
SBAG	± 0.0177	± 0.1485	± 0.0788	± 0.2011	± 0.0122	± 0.0320	± 0.0925	± 0.0325
UBAG	0.7285	0.7147	0.1423	0.7089	0.9393	0.9458	0.4917	0.9451
UDAU	± 0.0661	± 0.0517	± 0.0212	± 0.0561	± 0.0189	± 0.0293	± 0.0811	± 0.0294
SBO	0.8171	0.7299	0.1851	0.7065	0.9757	0.9444	0.7018	0.9418
SBO	± 0.0096	± 0.1313	± 0.0714	± 0.1625	± 0.0087	± 0.0555	± 0.0541	± 0.0589
RBO	0.8456	0.7389	0.1992	0.7191	0.9440	0.9604	0.5158	0.9600
KDO	± 0.0239	± 0.0896	± 0.0365	± 0.1208	± 0.1475	± 0.0282	± 0.0678	± 0.0282
EBO	0.7696	0.6714	0.1440	0.6537	0.9602	0.9458	0.5849	0.9452
EDU	± 0.0990	± 0.0611	± 0.0471	± 0.0801	± 0.0096	± 0.0308	± 0.0624	± 0.0312
DAC	0.6472	0.6727	0.1122	0.6702	0.9333	0.9534	0.4736	0.9526
BAC	± 0.0484	± 0.0260	± 0.0093	±0.0229	± 0.0197	±0.0220	± 0.0642	±0.0221

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

	7.8 COII			i chscinoic	icarning an	-		
数据集		Yeast-1-2	2-8-9-vs-7			Yea	ıst5	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
Easy	0.5957	0.6783	0.1130	0.6591	0.9198	0.9479	0.4253	0.9470
Lasy	± 0.1497	± 0.0562	± 0.0231	± 0.0712	± 0.0191	± 0.0223	± 0.0464	± 0.0222
MNESG-	0.6943	0.7919	0.1916	0.7826	0.9158	0.9566	0.4342	0.9554
EL(default)	± 0.1227	± 0.0580	± 0.1012	± 0.0852	± 0.0381	± 0.0196	± 0.1065	± 0.0207
MNESG-	0.8468	0.8000	0.2628	0.7954	0.9636	0.9597	0.6231	0.9592
EL	±0.0976	±0.0066	±0.0997	±0.0137	± 0.0140	± 0.0291	± 0.0788	± 0.0295
数据集		Yea	ast6		W	inequality-v	white-3_vs	_7
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9521	0.8360	0.4103	0.8179	0.9333	0.6605	0.1980	0.5865
SBAG	± 0.0114	±0.1076	± 0.0799	± 0.1288	± 0.0143	± 0.0675	± 0.0557	±0.1133
LIDAG	0.8679	0.8766	0.2466	0.8746	0.7411	0.7698	0.1237	0.7674
UBAG	± 0.0335	± 0.0594	± 0.0502	± 0.0593	± 0.0529	± 0.0618	± 0.0255	± 0.0581
CDO	0.9676	0.7743	0.4407	0.7252	0.9518	0.7310	0.3025	0.6772
SBO	±0.0084	±0.1489	±0.1667	± 0.1973	± 0.0032	±0.1207	± 0.1000	± 0.1771
DDO	0.8746	0.8382	0.2353	0.8307	0.7866	0.7198	0.1347	0.7101
RBO	± 0.0377	± 0.0795	±0.0390	± 0.0848	± 0.0873	±0.1365	± 0.0713	±0.1409
EDO	0.8712	0.8225	0.2206	0.8135	0.7688	0.7107	0.1176	0.6940
EBO	±0.0517	±0.1086	±0.0575	±0.1236	± 0.0550	±0.1565	± 0.0589	±0.1782
DAG	0.7776	0.8162	0.1548	0.8135	$0.7069\pm$	0.7279	0.1043	0.7223
BAC	± 0.0334	± 0.0426	± 0.0158	± 0.0405	0.0517	± 0.1075	± 0.0323	± 0.1054
Г	0.7755	0.8293	0.1603	0.8246	0.5966	0.6715	0.0779	0.6521
Easy	±0.0493	± 0.0513	±0.0266	± 0.0488	±0.1318	±0.0420	±0.0115	± 0.0527
MNESG-	0.8814	0.8974	0.2685	0.8921	0.8694	0.8111	0.2398	0.8082
EL(default)	±0.0237	±0.0921	±0.0570	±0.0994	± 0.0904	±0.0462	±0.1322	±0.0429
MNESG-	0.9137	0.8868	0.3234	0.8861	0.9889	0.8111	0.7113	0.7855
EL	±0.0173	±0.0170	±0.0472	±0.0175	±0.0045	±0.0722	±0.1216	±0.0916
数据集	W	inequality-	red-8_vs_6	5-7		Kr-vs-k-zei	ro_vs_eigh	t
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.9005	0.7349	0.1937	0.7054	0.9294	0.9564	0.6436	0.9562
SBAG	±0.0354	± 0.0847	±0.0712	±0.1165	±0.0140	±0.0120	±0.0659	±0.0118
<u> </u>								

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集	W 4.8 COII	inequality-				-	o_vs_eigh	t
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.6596	0.7446	0.0956	0.7323	0.8376	0.8779	0.1802	0.8704
UBAG	± 0.0886	± 0.0555	±0.230	±0.0490	±0.0610	±0.0683	±0.0277	± 0.0744
gp.o	0.9502	0.7298	0.2955	0.6764	0.9374	0.9177	0.6434	0.9151
SBO	±0.0139	±0.1264	±0.1582	± 0.1776	±0.0122	±0.0611	±0.0661	± 0.0642
DDO.	0.8070	0.7139	0.1151	0.6886	0.8945	0.9462	0.2836	0.9444
RBO	± 0.0423	±0.1216	± 0.0452	± 0.1536	± 0.0467	±0.0238	± 0.0897	± 0.0252
EDO	0.6830	0.6750	0.0813	0.6610	0.9095	0.9539	0.3081	0.9526
EBO	± 0.1012	± 0.0523	± 0.0108	± 0.0447	± 0.0337	± 0.0172	± 0.0860	± 0.0180
DAC	0.6783	0.7625	0.1043	0.7467	0.8362	0.9165	0.1970	0.9128
BAC	± 0.1094	± 0.1077	± 0.0379	± 0.1106	± 0.0679	± 0.0347	± 0.0545	± 0.0391
Г	0.6549	0.6933	0.0819	0.6748	0.8602	0.8732	0.1979	0.8693
Easy	± 0.0726	± 0.1589	± 0.0382	± 0.1727	± 0.0333	± 0.0909	± 0.0683	± 0.0940
MNESG-	0.6932	0.6599	0.1222	0.5730	0.9534	0.9436	0.4269	0.9408
EL(default)	± 0.1517	± 0.0788	± 0.0629	± 0.1182	± 0.0093	± 0.0745	± 0.0647	± 0.0801
MNESG-	0.8302	0.9136	0.2679	0.9069	0.9932	0.9965	0.8684	0.9965
EL	±0.1735	±0.0082	±0.2273	±0.0974	±0.0080	±0.0041	±0.0239	±0.0041
数据集		Shuttle-	2_vs_5		Kddcu	p-buffer_o	verflow_vs	s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SDAC	1 + 0							
SBAG		1 . 0	1.0	1 . 0	0.9996	0.9833	0.9818	0.9826
	1±0	1±0	1±0	1±0	0.9996 ±0.0010	0.9833 ± 0.0373	0.9818 ± 0.0407	0.9826 ± 0.0390
LIDAC								
UBAG	1±0 1±0	1±0 1±0	1±0 1±0	1±0 1±0	±0.0010	± 0.0373	± 0.0407	±0.0390
	1±0	1±0	1±0	1±0	±0.0010 0.9861	±0.0373 0.9929	±0.0407 0.7471	±0.0390 0.9929
UBAG SBO					± 0.0010 0.9861 ± 0.0168	±0.0373 0.9929 ±0.0085	± 0.0407 0.7471 ± 0.2704	±0.0390 0.9929 ±0.0086
SBO	1±0	1±0	1±0	1±0	± 0.0010 0.9861 ± 0.0168 0.9986	± 0.0373 0.9929 ± 0.0085 0.9828	± 0.0407 0.7471 ± 0.2704 0.9532	±0.0390 0.9929 ±0.0086 0.9821
	1±0 1±0	1±0 1±0	1±0 1±0	1±0 1±0	± 0.0010 0.9861 ± 0.0168 0.9986 ± 0.0020	± 0.0373 0.9929 ± 0.0085 0.9828 ± 0.0370	± 0.0407 0.7471 ± 0.2704 0.9532 ± 0.0666	± 0.0390 0.9929 ± 0.0086 0.9821 ± 0.0387
SBO RBO	1±0 1±0 0.9834 ±0.0371	1±0 1±0 0.9915 ±0.0188	1±0 1±0 0.8533 ±0.3279	1±0 1±0 0.9913 ±0.0192	± 0.0010 0.9861 ± 0.0168 0.9986 ± 0.0020 0.9605	± 0.0373 0.9929 ± 0.0085 0.9828 ± 0.0370 0.9800	± 0.0407 0.7471 ± 0.2704 0.9532 ± 0.0666 0.4848	± 0.0390 0.9929 ± 0.0086 0.9821 ± 0.0387 0.9797
SBO	1±0 1±0 0.9834	1±0 1±0 0.9915	1±0 1±0 0.8533	1±0 1±0 0.9913	± 0.0010 0.9861 ± 0.0168 0.9986 ± 0.0020 0.9605 ± 0.0232	± 0.0373 0.9929 ± 0.0085 0.9828 ± 0.0370 0.9800 ± 0.0117	± 0.0407 0.7471 ± 0.2704 0.9532 ± 0.0666 0.4848 ± 0.2898	±0.0390 0.9929 ±0.0086 0.9821 ±0.0387 0.9797 ±0.0119
SBO RBO	1±0 1±0 0.9834 ±0.0371	1±0 1±0 0.9915 ±0.0188	1±0 1±0 0.8533 ±0.3279	1±0 1±0 0.9913 ±0.0192	± 0.0010 0.9861 ± 0.0168 0.9986 ± 0.0020 0.9605 ± 0.0232 0.9852	± 0.0373 0.9929 ± 0.0085 0.9828 ± 0.0370 0.9800 ± 0.0117 0.9760	± 0.0407 0.7471 ± 0.2704 0.9532 ± 0.0666 0.4848 ± 0.2898 0.7387	± 0.0390 0.9929 ± 0.0086 0.9821 ± 0.0387 0.9797 ± 0.0119 0.9752

表 4.8 与经典集成学习算法比较(续)

Table 4.8 Comparison with classical ensemble learning algorithms (continued)

数据集	1.8 COII	-	2_vs_5			<u> </u>	verflow_v	s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
Easy	1±0	1±0	1±0	1±0	0.9520	0.9757	0.3622	0.9754
Lasy	1±0	140	1±0	140	± 0.0078	± 0.0039	± 0.0357	± 0.0041
MNESG-	0.9970	0.9262	0.8895	0.9212	1±0	1±0	1±0	1±0
EL(default)	± 0.0024	± 0.0631	± 0.0890	± 0.0697	120	120	120	120
MNESG-	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
EL	120	140	120	120	120	120	120	120
数据集	K	r-vs-k-zer	o_vs_fiftee	en		Rootkit_in	napvsback	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SBAG	0.9694	0.9570	0.7258	0.9553	0.9854	0.9543	0.8769	0.9525
SDAO	± 0.0142	± 0.0492	± 0.0399	± 0.0523	± 0.0644	± 0.0621	± 0.1315	± 0.0644
UBAG	0.9334	0.9662	0.2830	0.9656	0.9825	0.9115	0.8420	0.9073
UDAU	±0.0196	± 0.0099	± 0.0757	± 0.0102	± 0.0279	± 0.0506	± 0.1243	± 0.0528
SBO	0.9660	0.9462	0.7178	0.9439	0.9858	0.9545	0.8987	0.9528
300	± 0.0153	± 0.0542	± 0.0448	± 0.0577	± 0.0290	± 0.0623	± 0.1244	± 0.0646
RBO	0.9402	0.9697	0.3391	0.9691	0.9818	0.9327	0.8057	0.9300
KDO	± 0.0347	± 0.0176	± 0.1441	± 0.0181	± 0.0283	± 0.0620	± 0.2371	± 0.0643
EBO	0.9544	0.9769	0.4431	0.9765	0.9829	0.9315	0.8642	0.9285
EBO	± 0.0340	± 0.0172	± 0.2470	± 0.0176	± 0.0282	± 0.0631	± 0.1432	± 0.0658
BAC	0.9366	0.9679	0.3257	0.9672	0.9863	0.9547	0.9169	0.9530
DAC	± 0.0292	± 0.0148	± 0.1712	± 0.0151	± 0.0292	± 0.0625	± 0.1327	± 0.0648
Easy	0.9357	0.9674	0.2950	0.9668	0.9784	0.9094	0.7531	0.9055
Lasy	± 0.0235	± 0.0119	± 0.0914	± 0.0122	± 0.0266	± 0.0514	±0.2110	± 0.0535
MNESG-	0.9973	0.9788	0.9005	0.9777	0.9991	0.9550	0.9492	0.9521
EL(default)	± 0.0019	± 0.0441	± 0.0651	± 0.0466	± 0.0012	± 0.0622	± 0.0705	± 0.0664
MNESG-	0.9995	0.9833	0.9818	0.9826	0.9996	0.9998	0.9778	0.9998
EL	±0.0010	±0.0622	±0.0407	±0.0390	±0.0010	±0.0001	±0.0497	±0.0001

A.2 表 4.11 的完整结果

表 A.2 为第四章中 4.2.7 节处表 4.11 的完整结果。主要记录了第四章提出的 MNESG-EL 算法与最先进的集成算法在 ACC、AUC、F-M 和 G-M 四个评价指标的对比结果。

表 4.11 SOTA 算法和本节提出算法之间的比较结果

Table 4.11 Comparison results between SOTA and proposed algorithm

数据集		Gla	ss1			Wisc	onsin	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.7756	0.7687	0.7008	0.7668	0.9326	0.9337	0.9072	0.9335
EASE	± 0.0801	± 0.0901	±0.1109	± 0.0911	± 0.0224	±0.0234	± 0.0303	± 0.0234
CDE	0.7754	0.7546	0.6845	0.7509	0.9238	0.9154	0.8915	0.9140
SPE	± 0.0646	± 0.0679	± 0.0901	± 0.0694	± 0.0149	± 0.0055	± 0.0150	± 0.0057
HUE	0.7942	0.7872	0.7238	0.7848	0.9253	0.9262	0.8975	0.9259
HUE	± 0.0351	± 0.0430	± 0.0462	± 0.0426	± 0.0202	± 0.0182	± 0.0255	± 0.0183
ECLID4	0.7620	0.7543	0.6849	0.7511	0.9385	0.9401	0.9154	0.9399
ECUBoost	± 0.0776	± 0.0821	± 0.0934	± 0.0816	± 0.0228	± 0.0218	± 0.0308	± 0.0218
MNESG-	0.7614	0.7757	0.7130	0.7543	0.9780	0.9812	0.9694	0.9811
EL(default)	± 0.0835	± 0.0403	± 0.0393	± 0.0615	± 0.0052	± 0.0048	± 0.0070	± 0.0048
MNESG-	0.9721	0.9662	0.9599	0.9656	0.9898 0.9921		0.9857	0.9921
EL	±0.0104	±0.0011	±0.0125	±0.0011	±0.0083 ±0.0064		±0.0115	±0.0065
数据集		Pit	na			Ir	is0	
评价指标					ACC AUC			
ינערםנועוא	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	ACC 0.6523	AUC 0.6474	F-M 0.5590	G-M 0.6466				
EASE					ACC 1±0	AUC 1±0	F-M 1±0	G-M 1±0
EASE	0.6523	0.6474	0.5590	0.6466	1±0	1±0	1±0	1±0
	0.6523 ±0.0306	0.6474 ±0.0297	0.5590 ±0.0319	0.6466 ±0.0297				
EASE SPE	0.6523 ±0.0306 0.6470	0.6474 ±0.0297 0.6335	0.5590 ±0.0319 0.5372	0.6466 ±0.0297 0.6311	1±0 1±0	1±0 1±0	1±0 1±0	1±0 1±0
EASE	0.6523 ± 0.0306 0.6470 ± 0.0277	0.6474 ± 0.0297 0.6335 ± 0.0344	0.5590 ± 0.0319 0.5372 ± 0.0446	0.6466 ± 0.0297 0.6311 ± 0.0359	1±0	1±0	1±0	1±0
EASE SPE HUE	0.6523 ± 0.0306 0.6470 ± 0.0277 0.6588	0.6474 ± 0.0297 0.6335 ± 0.0344 0.6419	0.5590 ± 0.0319 0.5372 ± 0.0446 0.5455	0.6466 ± 0.0297 0.6311 ± 0.0359 0.6392	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0
EASE SPE	0.6523 ± 0.0306 0.6470 ± 0.0277 0.6588 ± 0.0338	0.6474 ± 0.0297 0.6335 ± 0.0344 0.6419 ± 0.0339	0.5590 ± 0.0319 0.5372 ± 0.0446 0.5455 ± 0.0387	0.6466 ± 0.0297 0.6311 ± 0.0359 0.6392 ± 0.0339	1±0 1±0	1±0 1±0	1±0 1±0	1±0 1±0
EASE SPE HUE	0.6523 ± 0.0306 0.6470 ± 0.0277 0.6588 ± 0.0338 0.6745	0.6474 ± 0.0297 0.6335 ± 0.0344 0.6419 ± 0.0339 0.6437	0.5590 ± 0.0319 0.5372 ± 0.0446 0.5455 ± 0.0387 0.5357	0.6466 ± 0.0297 0.6311 ± 0.0359 0.6392 ± 0.0339 0.6326	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0
EASE SPE HUE ECUBoost	0.6523 ± 0.0306 0.6470 ± 0.0277 0.6588 ± 0.0338 0.6745 ± 0.0314	0.6474 ± 0.0297 0.6335 ± 0.0344 0.6419 ± 0.0339 0.6437 ± 0.0312	0.5590 ± 0.0319 0.5372 ± 0.0446 0.5455 ± 0.0387 0.5357 ± 0.0431	0.6466 ± 0.0297 0.6311 ± 0.0359 0.6392 ± 0.0339 0.6326 ± 0.0367	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0
EASE SPE HUE ECUBoost MNESG-	0.6523 ± 0.0306 0.6470 ± 0.0277 0.6588 ± 0.0338 0.6745 ± 0.0314 0.7435	0.6474 ± 0.0297 0.6335 ± 0.0344 0.6419 ± 0.0339 0.6437 ± 0.0312 0.7220	0.5590 ± 0.0319 0.5372 ± 0.0446 0.5455 ± 0.0387 0.5357 ± 0.0431 0.6223	0.6466 ± 0.0297 0.6311 ± 0.0359 0.6392 ± 0.0339 0.6326 ± 0.0367 0.6945	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集		Yea	ıst1			Habe	rman	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.7358	0.7256	0.6054	0.7241	0.6312	0.5877	0.4199	0.5792
EASE	± 0.0238	±0.0244	± 0.0311	± 0.0248	± 0.0802	±0.0779	± 0.0827	± 0.0792
CDE	0.7237	0.7040	0.5804	0.7015	0.5846	0.5823	0.4259	0.5807
SPE	± 0.0408	± 0.0357	± 0.0441	± 0.0355	± 0.0690	±0.0730	± 0.0793	± 0.0720
тип	0.7243	0.7058	0.5818	0.7042	0.5819	0.5339	0.3559	0.5188
HUE	± 0.0278	± 0.0278	± 0.0353	± 0.0280	± 0.0796	± 0.0715	± 0.0764	± 0.0707
ECUBoost	0.7385	0.7193	0.5986	0.7175	0.4932	0.5519	0.4132	0.5327
ECUBOOSI	± 0.0191	± 0.0161	± 0.0205	± 0.0162	± 0.0634	± 0.0743	± 0.0719	± 0.0719
MNESG-	0.6914	0.7028	0.5788	0.6957	0.7284	0.6819	0.5259	0.6333
EL(default)	± 0.0558	± 0.0194	± 0.0222	± 0.0227	± 0.1128	± 0.0402	± 0.0744	± 0.0653
MNESG-	0.7399	0.7397	0.6246	0.7366	0.9905	0.9947	0.9556	0.9947
EL	±0.0516	±0.0239	± 0.0357	±0.0211	±0.0130	±0.0072	±0.0609	±0.0073
数据集		Vehi	icle2			Vehi	icle3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.9645	0.9559	0.9257	0.9556	0.7623	0.7281	0.5815	0.7242
EASE	± 0.0134	± 0.0189	± 0.0280	± 0.0191	± 0.0278	± 0.0367	± 0.0494	± 0.0387
SPE	0.9645	0.9595	0.9328	0.9593	0.7553	0.7206	0.5713	0.7168
SEE	± 0.0158	± 0.0166	± 0.0294	± 0.0167	± 0.0079	± 0.0073	± 0.0100	± 0.0088
HUE	0.9538	0.9525	0.9149	0.9523	0.7270	0.7333	0.5783	0.7311
HOL	± 0.0219	± 0.0178	± 0.0375	± 0.0178	± 0.0374	± 0.0376	± 0.0438	± 0.0363
ECUBoost	0.9704	0.9636	0.9434	0.9632	0.7647	0.6860	0.5308	0.6672
ECCBOOST	±0.0106	±0.0126	± 0.0183	± 0.0128	± 0.0285	± 0.0193	± 0.0293	± 0.0172
MNESG-	0.9468	0.9447	0.9011	0.9446	0.7623	0.7281	0.5815	0.7242
EL(default)	± 0.0120	± 0.0146	± 0.0218	± 0.0146	± 0.0278	± 0.0367	± 0.0494	± 0.0387
MNESG-	0.9503	0.9606	0.9148	0.9599	0.8120	0.7870	0.6601	0.7785
EL	± 0.0456	± 0.0313	± 0.0694	± 0.0325	± 0.0383	±0.0509	±0.0586	±0.0612
数据集		ilass-0-1-2	-3_vs_4-5-	6		Vehi	icle0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.9346	0.9173	0.8668	0.9157	0.9597	0.9545	0.9181	0.9544
EASE	±0.0307	± 0.0380	±0.0569	±0.0391	±0.0196	±0.0184	±0.0376	±0.0184

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集	C	ilass-0-1-2	-3_vs_4-5-	6		Vehi	cle0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8967	0.8558	0.7840	0.8472	0.9598	0.9459	0.9154	0.9451
SPE	± 0.0448	±0.0552	±0.0720	± 0.0607	±0.0137	±0.0160	±0.0267	±0.0168
	0.7270	0.7333	0.5783	0.7311	0.9491	0.9581	0.9004	0.9579
HUE	± 0.0374	±0.0376	±0.0438	±0.0363	± 0.0087	±0.0087	±0.0162	± 0.0086
	0.9345	0.9172	0.8640	0.9133	0.9539	0.9542	0.9084	0.9535
ECUBoost	±0.0175	±0.0419	±0.0376	± 0.0461	± 0.0195	±0.0203	±0.0357	±0.0206
MNESG-	0.9346	0.9173	0.8668	0.9157	0.8208	0.9007	0.8336	0.8966
EL(default)	±0.0307	±0.0380	±0.0569	±0.0391	±0.0199	± 0.0545	±0.0542	± 0.0618
MNESG-	0.9953	0.9970	0.9905	0.9969	0.9657	0.9655	0.9311	0.9652
EL	±0.0104	±0.0068	±0.0213	±0.0068	±0.0190	±0.0118	±0.0349	±0.0119
数据集		Eco	olil			Eco	oli2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.8989	0.8607	0.7802	0.8560	0.9256	0.8871	0.7886	0.8840
EASE	± 0.0314	± 0.0500	± 0.0693	± 0.0536	± 0.0523	± 0.0689	±0.1235	± 0.0704
CDE	0.8841	0.8484	0.7524	0.8406	0.9435	0.8942	0.8214	0.8895
SPE	±0.0349	± 0.0653	± 0.0802	± 0.0732	± 0.0303	± 0.0525	±0.0922	± 0.0569
шт	0.8571	0.8704	0.7476	0.8693	0.8838	0.8846	0.7035	0.8831
HUE	± 0.0545	±0.0412	± 0.0791	± 0.0418	± 0.0176	± 0.0208	± 0.0223	± 0.0203
ECLID (0.9136	0.8569	0.7981	0.8488	0.8746	0.8575	0.7371	0.8454
ECUBoost	± 0.0404	± 0.0625	± 0.0987	± 0.0684	± 0.1476	± 0.0961	± 0.1897	±0.1095
MNESG-	0.9139	0.9070	0.8331	0.9046	0.9316	0.9202	0.8035	0.9191
EL(default)	± 0.0504	± 0.0425	± 0.0843	± 0.0453	± 0.0266	± 0.0526	± 0.0748	± 0.0534
MNESG-	0.9910	0.9800	0.9793	0.9797	0.9761	0.9538	0.9242	0.9532
EL	± 0.0082	±0.0183	±0.0189	±0.0186	±0.0257	±0.0291	±0.0787	±0.0293
数据集		Gla	ıss6			Yea	st3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EACE	0.9486	0.9250	0.8197	0.9210	0.9353	0.8826	0.7335	0.8791
EASE	± 0.0092	± 0.0623	±0.0512	± 0.0676	± 0.0062	±0.0331	± 0.0327	±0.0354
CDE	0.9439	0.8944	0.7921	0.8861	0.9366	0.8810	0.7392	0.8779
SPE	± 0.0347	±0.0963	±0.1383	±0.1090	±0.0157	± 0.0263	±0.0576	± 0.0281

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集		*	ss6		ia proposeo	Yea		-)
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.9302	0.9175	0.7967	0.9157	0.9110	0.8964	0.6876	0.8955
HUE	±0.0465	±0.0435	±0.1158	± 0.0441	± 0.0208	±0.0203	± 0.0478	±0.0213
	0.9485	0.9250	0.8387	0.9203	0.9366	0.8969	0.7477	0.8942
ECUBoost	±0.0519	± 0.0669	±0.1382	±0.0721	±0.0152	±0.0334	±0.0422	±0.0365
MNESG-	0.9673	0.9359	0.8823	0.9333	0.9373	0.8819	0.7349	0.8753
EL(default)	±0.0126	± 0.0408	±0.0369	±0.0429	±0.0182	±0.0776	±0.0974	± 0.0897
MNESG-	0.9766	0.9586	0.9132	0.9551	0.9905	0.9947	0.9556	0.9947
EL	±0.0233	±0.0709	±0.0881	±0.0783	±0.0130	±0.0072	±0.0609	±0.0073
数据集		Eco	oli3			Yeast-	2-vs-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.9078	0.8097	0.6100	0.7882	0.9416	0.8623	0.7188	0.8517
EASE	±0.0472	±0.1166	±0.1820	±0.1378	± 0.0261	± 0.0856	±0.1360	± 0.0979
CDE	0.8986	0.7919	0.5695	0.7721	0.9572	0.9316	0.8096	0.9302
SPE	± 0.0259	± 0.0953	± 0.1207	± 0.1094	± 0.0131	± 0.0273	± 0.0486	± 0.0285
тип	0.8572	0.8698	0.5736	0.8693	0.8910	0.9047	0.6277	0.9037
HUE	± 0.0444	± 0.0447	± 0.0911	± 0.0443	± 0.0187	± 0.0378	± 0.0546	± 0.0374
ECI D4	0.9195	0.8414	0.6571	0.8274	0.9163	0.8661	0.6630	0.8594
ECUBoost	± 0.0336	± 0.0921	± 0.1281	± 0.1096	± 0.0265	± 0.0434	± 0.0430	± 0.0508
MNESG-	0.8958	0.9166	0.6539	0.9154	0.9590	0.9068	0.8080	0.9006
EL(default)	± 0.0153	± 0.0357	± 0.0376	± 0.0350	± 0.0273	± 0.0702	± 0.1153	± 0.0796
MNESG-	0.9628	0.9442	0.8806	0.9413	0.9845	0.9833	0.9286	0.9832
EL	±0.0584	±0.0516	±0.1533	±0.0544	±0.0128	±0.0251	±0.0532	±0.0253
数据集		Yeast-0-5-	6-7-9-vs-4			Glass-0-	1-6_vs_2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.8806	0.8095	0.5387	0.8021	0.7916	0.5700	0.2004	0.4436
EASE	± 0.0233	± 0.0620	± 0.0817	± 0.0676	± 0.0600	± 0.0783	± 0.1249	± 0.2274
SPE	0.8599	0.8016	0.5109	0.7956	0.7759	0.7054	0.2966	0.6121
SFE	± 0.0494	± 0.0910	± 0.1306	± 0.0947	± 0.0543	± 0.1384	± 0.1573	± 0.3086
HUE	0.8086	0.7813	0.4440	0.7794	0.6399	0.7059	0.2799	0.6843
	± 0.0549	± 0.0486	± 0.1000	± 0.0493	±0.1113	± 0.0675	± 0.0489	± 0.0737

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集		Yeast-0-5-	6-7-9-vs-4		•		1-6_vs_2	<u> </u>
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8977	0.7840	0.5538	0.7672	0.6197	0.5061	0.1207	0.3878
ECUBoost	±0.0299	±0.0367	±0.0394	±0.0488	±0.1118	±0.1231	±0.0815	±0.2236
MNESG-	0.8146	0.8176	0.4618	0.8112	0.8961	0.6244	0.3333	0.5267
EL(default)	± 0.0478	±0.0934	± 0.0965	±0.1015	±0.0019	±0.0194	± 0.0006	± 0.0479
MNESG-	0.9263	0.9235	0.6977	0.9184	0.9795	0.9000	0.8857	0.8928
EL	±0.0039	±0.0779	±0.0370	±0.0873	±0.0115	±0.0559	±0.0639	±0.0599
数据集		Gla	ss2			Yeast-	1-vs-7	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.7944	0.7202	0.3147	0.6918	0.8323	0.7088	0.2996	0.6767
EASE	±0.0165	±0.1439	±0.1203	±0.1640	±0.0389	±0.0945	±0.0735	±0.1230
CDE	0.7849	0.6842	0.2911	0.6617	0.7581	0.7001	0.2519	0.6888
SPE	± 0.0237	± 0.0887	± 0.0997	±0.1144	± 0.0205	± 0.0920	± 0.0564	± 0.0945
TH III	0.6966	0.7596	0.3145	0.7518	0.6950	0.6663	0.2188	0.6430
HUE	± 0.0859	± 0.0851	± 0.0845	± 0.0819	± 0.0887	± 0.1180	± 0.0905	± 0.1286
ECLID4	0.7988	0.7003	0.3233	0.6831	0.8583	0.7537	0.3722	0.7390
ECUBoost	± 0.0549	± 0.0758	± 0.0975	± 0.0928	±0.0308	± 0.0489	± 0.0445	± 0.0603
MNESG-	0.6957	0.7595	0.3018	0.7378	0.6455	0.8023	0.2690	0.7753
EL(default)	± 0.1946	± 0.0043	± 0.0874	± 0.0187	± 0.1230	± 0.0658	± 0.0662	± 0.0848
MNESG-	0.9814	0.8607	0.8400	0.8532	0.8110	0.8214	0.3732	0.8210
EL	±0.0104	±0.0745	±0.0894	±0.0821	±0.0531	±0.0294	±0.0614	±0.0291
数据集		Gla	ss4			Ec	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.9486	0.8160	0.5895	0.7847	0.9582	0.8373	0.6716	0.8096
LASE	± 0.0270	± 0.1426	± 0.2248	± 0.1711	± 0.0274	± 0.1251	± 0.2234	± 0.1669
SPE	0.9486	0.8943	0.6599	0.8842	0.9642	0.8873	0.7365	0.8756
SEE	± 0.0227	± 0.1058	± 0.1688	± 0.1187	± 0.0223	± 0.0871	± 0.1263	± 0.1012
HUE	0.8321	0.8626	0.4204	0.8502	0.8747	0.8865	0.4833	0.8808
HOL	± 0.0919	± 0.0873	± 0.1110	± 0.0989	± 0.0515	± 0.1137	± 0.1598	±0.1211
ECUBoost	0.9627	0.9492	0.7690	0.9466	0.9612	0.8623	0.6978	0.8436
ECODOOS!	±0.0237	± 0.0710	±0.1489	± 0.0759	± 0.0152	± 0.1014	± 0.0939	±0.1202

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集		Gla	ss4			Ec	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESG-	0.9765	0.9104	0.8000	0.9020	0.9045	0.9258	0.6436	0.9214
EL(default)	± 0.0001	±0.1090	± 0.0001	±0.1209	± 0.0977	±0.0542	±0.2550	± 0.0582
MNESG-	0.9902	0.9949	0.9200	0.9948	0.9911	0.9953	0.9333	0.9952
EL	±0.0134	±0.0070	±0.1095	±0.0071	±0.0081	±0.0043	±0.0609	±0.0043
数据集		Abaloı	ne9-18			Shuttle-	c2-vs-c4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.9083	0.7935	0.4554	0.7758	1.0	1.0	1.0	1.0
EASE	± 0.0205	± 0.0862	±0.1128	± 0.1065	1±0	1±0	1±0	1±0
CDE	0.8768	0.7574	0.3636	0.7407	0.9923	0.9000	0.8000	0.8000
SPE	± 0.0096	±0.0591	± 0.0334	± 0.0688	±0.0153	±0.2000	± 0.4000	± 0.4000
тип	0.8371	0.7571	0.3202	0.7501	1.0	1.0	1.0	1.0
HUE	± 0.0160	± 0.0417	± 0.0416	± 0.0469	1±0	1±0	1±0	1±0
ECLID (0.8617	0.7951	0.3780	0.7766	0.9923	0.9500	0.9333	0.9414
ECUBoost	± 0.0470	± 0.0890	± 0.0694	± 0.1180	± 0.0153	± 0.0999	±0.1333	± 0.1171
MNESG-	0.9110	0.8057	0.4882	0.7968	1.0	1.0	1.0	1.0
EL(default)	± 0.0581	± 0.0724	± 0.2028	± 0.0756	1±0	1±0	1±0	1±0
MNESG-	0.9623	0.9212	0.7166	0.9173	1.0	1.0	1.0	1.0
EL	±0.0048	±0.0807	±0.0151	±0.0859	1±0	1±0	1±0	1±0
数据集		Gla	ss5			Yeast-	2-vs-8	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.9812	0.8926	0.7142	0.7925	0.9169	0.7653	0.3915	0.7433
EASE	± 0.0271	±0.1968	±0.3938	±0.3965	± 0.0287	±0.0626	±0.1006	± 0.0756
CDE	0.9812	0.9902	0.8476	0.9900	0.8609	0.7600	0.2637	0.7180
SPE	± 0.0271	± 0.0142	± 0.1890	± 0.0144	± 0.0267	± 0.1574	±0.1019	± 0.2037
тип	0.8788	0.9365	0.4504	0.9336	0.7923	0.7959	0.2517	0.7895
HUE	± 0.0677	± 0.0356	± 0.1291	± 0.0382	± 0.0579	± 0.0973	± 0.0684	± 0.0990
ECLID 4	0.9112	0.9536	0.5454	0.9518	0.8318	0.7448	0.2510	0.7334
ECUBoost	± 0.0629	± 0.0330	± 0.2082	± 0.0348	± 0.0444	±0.0453	± 0.0470	± 0.0569
MNESG-	0.9884	0.9939	0.9000	0.9939	0.8961	0.7066	0.3026	0.6246
EL(default)	±0.0164	±0.0086	±0.1414	±0.0087	± 0.0927	±0.1603	± 0.0901	±0.2253

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集		Gla	ss5		•	Yeast-	2-vs-8	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESG-	0.9884	0.9939	0.9000	0.9939	0.9792	0.8696	0.7532	0.8547
EL	±0.0164	±0.0086	±0.1414	±0.0087	±0.0121	±0.0978	±0.1358	±0.1152
数据集		Yea	ıst4			Winequa	lity-red-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.9083	0.7893	0.3316	0.7725	0.7785	0.6124	0.1142	0.5779
EASE	± 0.0164	± 0.0782	± 0.0671	± 0.0917	± 0.0302	± 0.0568	± 0.0266	± 0.0831
CDE	0.8712	0.8000	0.2791	0.7951	0.7173	0.6168	0.1091	0.6010
SPE	± 0.0095	± 0.0392	± 0.0350	± 0.0437	± 0.0542	± 0.0693	± 0.0345	± 0.0795
HUE	0.8167	0.8112	0.2351	0.8094	0.6960	0.6892	0.1294	0.6877
HUE	± 0.0300	± 0.0534	± 0.0373	± 0.0520	± 0.0204	± 0.0451	±0.0156	± 0.0459
ECLID (0.9204	0.8176	0.3891	0.8087	0.6292	0.5906	0.0932	0.5529
ECUBoost	±0.0229	± 0.0429	± 0.0734	± 0.0485	± 0.1777	± 0.0374	± 0.0192	± 0.0582
MNESG-	0.8653	0.8579	0.2990	0.8573	0.6953	0.7326	0.1584	0.7074
EL(default)	± 0.0190	± 0.0243	± 0.0123	± 0.0247	± 0.1522	±0.0554	± 0.0331	± 0.0423
MNESG-	0.9097	0.8209	0.3553	0.8122	0.9677	0.6034	0.2699	0.4239
EL	±0.0142	± 0.0693	± 0.0457	± 0.0781	±0.0018	± 0.1003	±0.1787	±0.2120
数据集		Yeast-1-2	-8-9-vs-7			Yea	ast5	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.7877	0.6646	0.1424	0.6491	0.9770	0.9006	0.6854	0.8956
EASE	± 0.0520	± 0.0267	± 0.0266	± 0.0288	±0.0068	± 0.0427	± 0.0728	± 0.0481
SPE	0.6980	0.6989	0.1274	0.6940	0.9757	0.8892	0.6666	0.8815
SEL	± 0.0373	± 0.0447	± 0.0117	± 0.0469	± 0.0107	± 0.0673	± 0.1285	± 0.0777
HUE	0.6737	0.6703	0.1129	0.6592	0.9501	0.9513	0.5349	0.9509
HOL	± 0.0439	± 0.0719	± 0.0223	± 0.0845	± 0.0100	± 0.0299	± 0.0514	± 0.0300
ECUBoost	0.6737	0.7025	0.1559	0.6843	0.9770	0.8885	0.6720	0.8794
ECODOOSI	± 0.1902	± 0.1043	± 0.0735	± 0.1096	± 0.0077	± 0.0738	± 0.0938	± 0.0842
MNESG-	0.6943	0.7919	0.1916	0.7826	0.9158	0.9566	0.4342	0.9554
EL(default)	± 0.1227	± 0.0580	± 0.1012	± 0.0852	± 0.0381	± 0.0196	± 0.1065	± 0.0207
MNESG-	0.8468	0.8000	0.2628	0.7954	0.9636	0.9597	0.6231	0.9592
EL	±0.0976	±0.0066	±0.0997	±0.0137	±0.0140	±0.0291	± 0.0788	±0.0295

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

数据集		Yea	ıst6		W	inequality-	white-3_vs	_7
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.9420	0.8030	0.3509	0.7842	0.9433	0.7511	0.2923	0.6427
EASE	±0.0124	± 0.0698	±0.0635	± 0.0874	±0.0214	±0.1385	±0.1600	±0.3257
~~~	0.9103	0.8425	0.3038	0.8302	0.8888	0.7232	0.1834	0.6890
SPE	$\pm 0.0311$	±0.1048	$\pm 0.0909$	±0.1192	±0.0312	$\pm 0.0841$	±0.0531	±0.1201
	0.8786	0.8542	0.2482	0.8529	0.8022	0.7034	0.1153	0.6816
HUE	±0.0248	±0.0245	±0.0312	±0.0265	±0.0191	$\pm 0.0887$	±0.0293	±0.1219
ECLE	0.9615	0.8130	0.4507	0.7946	0.6188	0.6829	0.1007	0.6595
ECUBoost	±0.0083	±0.0597	±0.0919	$\pm 0.0768$	±0.1883	$\pm 0.0831$	$\pm 0.0560$	$\pm 0.0964$
MNESG-	0.8814	0.8974	0.2685	0.8921	0.8694	0.8111	0.2398	0.8082
EL(default)	$\pm 0.0237$	±0.0921	$\pm 0.0570$	±0.0994	±0.0904	±0.0462	±0.1322	±0.0429
MNESG-	0.9137	0.8868	0.3234	0.8861	0.9889	0.8111	0.7113	0.7855
EL	±0.0173	±0.0170	$\pm 0.0472$	±0.0175	±0.0045	±0.0722	±0.1216	±0.0916
数据集	W	inequality-1	ed-8_vs_6	-7	]	Kr-vs-k-ze	ro_vs_eigh	t
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.7964	0.5859	0.0732	0.4735	0.9863	0.9244	0.7045	0.9151
EASE	$\pm 0.0550$	±0.1207	$\pm 0.0488$	±0.2590	$\pm 0.0075$	$\pm 0.0983$	±0.1528	$\pm 0.1137$
CDE	0.6257	0.6213	0.0623	0.5999	0.9678	0.8627	0.4549	0.8407
SPE	$\pm 0.0731$	$\pm 0.0944$	$\pm 0.0188$	±0.1044	$\pm 0.0073$	$\pm 0.1268$	±0.1158	$\pm 0.1573$
тип	0.5918	0.6367	0.0638	0.6250	0.9171	0.9577	0.3116	0.9568
HUE	$\pm 0.0551$	$\pm 0.0701$	$\pm 0.0046$	$\pm 0.0588$	$\pm 0.0135$	$\pm 0.0069$	$\pm 0.0331$	$\pm 0.0072$
ECLID4	0.2350	0.5604	0.0480	0.4130	0.8712	0.8951	0.2418	0.8914
ECUBoost	$\pm 0.1469$	$\pm 0.0913$	$\pm 0.0092$	±0.1613	$\pm 0.0521$	$\pm 0.0940$	$\pm 0.1103$	$\pm 0.0970$
MNESG-	0.6932	0.6599	0.1222	0.5730	0.9534	0.9436	0.4269	0.9408
EL(default)	$\pm 0.1517$	$\pm 0.0788$	$\pm 0.0629$	$\pm 0.1182$	$\pm 0.0093$	$\pm 0.0745$	$\pm 0.0647$	$\pm 0.0801$
MNESG-	0.8302	0.9136	0.2679	0.9069	0.9932	0.9965	0.8684	0.9965
EL	±0.1735	$\pm 0.0082$	±0.2273	±0.0974	±0.0080	±0.0041	±0.0239	±0.0041
数据集		Shuttle-	2_vs_5		Kddcu	p-buffer_o	verflow_vs	s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
SPE	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0

表 4.11 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.11 Comparison results between SOTA and proposed algorithm (continued)

Table	able 4.11 Comparison results between SO1A and proposed algorithm (continued)							1)
数据集		Shuttle-	-2_vs_5		Kddeu	p-buffer_o	verflow_vs	s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
HUE	1±0	1±0	1±0	1±0	0.9995	0.9833	0.9818	0.9825
					$\pm 0.0008$	$\pm 0.0333$	$\pm 0.0363$	$\pm 0.0348$
ECUBoost	1±0	1±0	1±0	1±0	0.9991	0.9666	0.9636	0.9651
Leeboost	1=0	1_0	1=0	1=0	$\pm 0.0010$	$\pm 0.0408$	$\pm 0.0445$	$\pm 0.0426$
MNESG-	0.9970	0.9262	0.8895	0.9212	1±0	1±0	1±0	1±0
EL(default)	$\pm 0.0024$	$\pm 0.0631$	$\pm 0.0890$	$\pm 0.0697$	120	120	120	140
MNESG-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
EL	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
数据集	K	Kr-vs-k-zer	o_vs_fiftee	en		Rootkit_in	napvsback	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.9990	0.9797	0.9595	0.9786	0.9995	0.9800	0.9777	0.9788
EASE	$\pm 0.0011$	$\pm 0.0398$	$\pm 0.0498$	$\pm 0.0421$	$\pm 0.0008$	$\pm 0.0399$	$\pm 0.0444$	$\pm 0.0422$
SPE	0.9995	0.9997	0.9846	0.9997	0.9991	0.9550	0.9492	0.9520
SEE	$\pm 0.0009$	$\pm 0.0004$	$\pm 0.0307$	$\pm 0.0004$	$\pm 0.0011$	$\pm 0.0556$	$\pm 0.0630$	$\pm 0.0593$
HUE	0.9872	0.9771	0.6964	0.9763	0.9950	0.9479	0.8300	0.9446
HOL	$\pm 0.0099$	$\pm 0.0317$	$\pm 0.1634$	$\pm 0.0331$	$\pm 0.0078$	$\pm 0.0637$	$\pm 0.2357$	$\pm 0.0678$
ECI ID4	1±0	1.0	1.0	1.0	0.9991	0.9600	0.9500	0.9549
ECUBoost	1±0	1±0	1±0	1±0	$\pm 0.0017$	$\pm 0.0799$	$\pm 0.1000$	$\pm 0.0901$
MNESG-	0.9973	0.9788	0.9005	0.9777	0.9991	0.9550	0.9492	0.9521
EL(default)	$\pm 0.0019$	$\pm 0.0441$	$\pm 0.0651$	$\pm 0.0466$	$\pm 0.0012$	$\pm 0.0622$	$\pm 0.0705$	$\pm 0.0664$
MNESG-	0.9995	0.9833	0.9818	0.9826	0.9996	0.9998	0.9778	0.9998
EL	$\pm 0.0010$	±0.0622	$\pm 0.0407$	±0.0390	±0.0010	±0.0001	±0.0497	±0.0001

### A.3 表 4.15 的完整结果

表 A.3 为第四章中 4.2.7 节处表 4.15 的完整结果。主要记录了第四章提出的 MNESG-EL 算法与基于样本生成的深度学习方法的对比结果。

表 4.15 与基于样本生成的深度学习方法的比较

Table 4.15 Comparison with sample generation based deep learning methods

数据集	算法	AUC	F-M	G-M
	CNN+SMOTE	0.6522±0.0381	0.4668±0.0509	0.6405±0.0399
	CNN+AE+GAN	0.8376±0.0541	0.4303±0.0690	0.8295±0.0556
	BED	0.8495±0.0251	$0.7584 \pm 0.0268$	0.8467±0.0269
F 1'1	RVGAN-TL	0.8123±0.0510	0.7252±0.0654	0.7991±0.0583
Ecoli1	EAL-GAN	0.9226±0.0441	$0.6968 \pm 0.0960$	0.8624±0.0518
	DLE-ISMOTE	0.7663±0.0599	$0.5826 \pm 0.0710$	0.7463±0.0910
	MNESG-EL(default)	0.9070±0.0425	$0.8331 \pm 0.0843$	0.9046±0.0453
	MNESG-EL	0.9800±0.0183	0.9793±0.0189	0.9797±0.0186
	CNN+SMOTE	$0.8288 \pm 0.0831$	$0.4810 \pm 0.0636$	$0.8209 \pm 0.0851$
	CNN+AE+GAN	0.8325±0.0129	$0.4944 {\pm} 0.0305$	$0.8321 \pm 0.0134$
	BED	0.9197±0.0212	$0.5941 \pm 0.0679$	0.9159±0.0231
E12	RVGAN-TL	$0.7443 \pm 0.0883$	$0.5621 \pm 0.1560$	$0.7031\pm0.1180$
Ecoli3	EAL-GAN	0.9200±0.0574	$0.6086 \pm 0.1530$	$0.8650 \pm 0.0664$
	DLE-ISMOTE	0.8452±0.0183	$0.5227 \pm 0.0227$	0.8451±0.0185
	MNESG-EL(default)	0.9166±0.0357	$0.6539 \pm 0.0376$	$0.9154 \pm 0.0350$
	MNESG-EL	0.9442±0.0516	0.8806±0.1533	0.9413±0.0544
	CNN+SMOTE	$0.6025 \pm 0.0765$	$0.2151\pm0.0601$	0.5629±0.0842
	CNN+AE+GAN	$0.6065 \pm 0.0932$	$0.2314 \pm 0.0872$	0.5952±0.1070
	BED	0.7133±0.0775	$0.2488 \pm 0.0416$	$0.6887 \pm 0.0682$
Class 0 1 ( ass 2	RVGAN-TL	0.5935±0.1600	0.1967±0.2410	0.3269±0.1560
Glass-0-1-6_vs_2	EAL-GAN	0.6389±0.1290	$0.3704 \pm 0.1250$	0.5992±0.0997
	DLE-ISMOTE	$0.6698 \pm 0.1210$	$0.2269 \pm 0.0769$	0.6143±0.1400
	MNESG-EL(default)	0.6244±0.0194	0.3333±0.0006	0.5267±0.0479
	MNESG-EL	0.9000±0.0559	0.8857±0.0639	0.8928±0.0599
Chuttle 22 vs 24	CNN+SMOTE	0.9957±0.0088	$0.9918 \pm 0.0112$	0.9957±0.0089
Shuttle-c2-vs-c4	CNN+AE+GAN	0.9997±0.0007	0.9959±0.0091	0.9997±0.0007

表 4.15 与基于样本生成的深度学习方法的比较(续)

Table 4.15 Comparison with sample generation based deep learning methods (continued)

数据集	算法	AUC	F-M	G-M
	BED	1±0	1±0	1±0
	RVGAN-TL	1±0	1±0	1±0
GL vil 2 A	EAL-GAN	0.9960±0.0120	0.9940±0.0143	0.9905±0.0234
Shuttle-c2-vs-c4	DLE-ISMOTE	0.9791±0.0022	0.9787±0.0054	0.9789±0.0028
	MNESG-EL(default)	1±0	1±0	1±0
	MNESG-EL	1±0	1±0	1±0
	CNN+SMOTE	$0.8279 \pm 0.0325$	$0.2963 \pm 0.0204$	$0.8250\pm0.0349$
	CNN+AE+GAN	0.7970±0.0335	0.2983±0.0538	0.7907±0.0380
	BED	$0.8573 \pm 0.0080$	0.2508±0.0155	0.8562±0.0084
<b>3</b> 7	RVGAN-TL	0.6352±0.0755	$0.3328 \pm 0.0716$	$0.4948 \pm 0.0937$
Yeast4	EAL-GAN	0.8764±0.0604	0.3045±0.1130	0.4533±0.1130
	DLE-ISMOTE	0.8552±0.0179	0.2910±0.0252	0.8545±0.0181
	MNESG-EL(default)	$0.8579 \pm 0.0243$	0.2990±0.0123	0.8573±0.0247
	MNESG-EL	$0.8209 \pm 0.0693$	0.3553±0.0457	$0.8122 \pm 0.0781$
	CNN+SMOTE	0.9242±0.0513	0.4922±0.1120	$0.9228 \pm 0.0560$
	CNN+AE+GAN	0.9183±0.0398	$0.4335 \pm 0.0560$	$0.9168 \pm 0.0408$
	BED	0.9785±0.0016	$0.5925 \pm 0.0168$	0.9782±0.0016
V45	RVGAN-TL	0.7991±0.0721	0.6638±0.0878	0.7685±0.0977
Yeast5	EAL-GAN	0.9715±0.0391	$0.5556 \pm 0.0242$	$0.8094 \pm 0.0264$
	DLE-ISMOTE	0.9687±0.0086	$0.4810 \pm 0.0707$	$0.9682 \pm 0.0089$
	MNESG-EL(default)	0.9566±0.0196	$0.4342\pm0.1065$	0.9554±0.0207
	MNESG-EL	0.9597±0.0291	$0.6231 \pm 0.0788$	$0.9592 \pm 0.0295$
	CNN+SMOTE	$0.8739 \pm 0.0517$	$0.2753 \pm 0.0567$	$0.8724 \pm 0.0532$
	CNN+AE+GAN	$0.8663 \pm 0.0744$	$0.2485 \pm 0.0550$	$0.8639 \pm 0.0754$
	BED	$0.8829 \pm 0.0291$	$0.2586 \pm 0.0147$	$0.8823 \pm 0.0282$
Yeast6	RVGAN-TL	$0.7098 \pm 0.0678$	$0.4821\pm0.1540$	0.6415±0.1160
i casto	EAL-GAN	$0.9336 \pm 0.0355$	0.5476±0.0982	$0.7020\pm0.0496$
	DLE-ISMOTE	0.9345±0.0186	$0.2717 \pm 0.0261$	0.9321±0.0192
	MNESG-EL(default)	$0.8974 \pm 0.0921$	$0.2685 \pm 0.0570$	$0.8921 \pm 0.0994$
	MNESG-EL	0.8868±0.0170	0.3234±0.0472	0.8861±0.0175

表 4.15 与基于样本生成的深度学习方法的比较(续)

Table 4.15 Comparison with sample generation based deep learning methods (continued)

数据集	算法	AUC	F-M	G-M
	CNN+SMOTE	0.6434±0.0762	0.0896±0.0288	0.6250±0.0934
	CNN+AE+GAN	0.6026±0.0315	$0.0550\pm0.0041$	0.6002±0.0327
	BED	0.6613±0.0621	0.0801±0.0142	0.6587±0.0619
Winequality-red-	RVGAN-TL	0.6470±0.0193	0.3800±0.0653	0.5447±0.0372
8_vs_6-7	EAL-GAN	0.5294±0.1690	$0.0400 \pm 0.1000$	$0.0000\pm0.0000$
	DLE-ISMOTE	0.5722±0.0810	0.0957±0.0791	0.5714±0.0865
	MNESG-EL(default)	$0.6599 \pm 0.0788$	$0.1222 \pm 0.0629$	0.5730±0.1182
	MNESG-EL	0.9136±0.0082	$0.2679 \pm 0.2273$	0.9069±0.0974
	CNN+SMOTE	$0.9994 \pm 0.0008$	$0.9636 \pm 0.0498$	$0.9994 \pm 0.008$
	CNN+AE+GAN	$0.9989 \pm 0.0004$	$0.9351 \pm 0.0237$	$0.9989 \pm 0.004$
	BED	0.9991±0.0008	0.9453±0.0471	$0.9991 \pm 0.008$
Shuttle 2 ve 5	RVGAN-TL	1±0	1±0	1±0
Shuttle-2_vs_5	EAL-GAN	1±0	1±0	1±0
	DLE-ISMOTE	$0.9992 \pm 0.0008$	$0.9545 \pm 0.0455$	$0.9992 \pm 0.008$
	MNESG-EL(default)	$0.9970 \pm 0.0024$	$0.9262 \pm 0.0631$	$0.8895 \pm 0.0890$
	MNESG-EL	1±0	1±0	1±0
	CNN+SMOTE	$0.9993 \pm 0.0006$	$0.9414 \pm 0.0541$	$0.9993 \pm 0.0006$
	CNN+AE+GAN	$0.9050\pm0.0102$	$0.8532 \pm 0.1380$	$0.8935 \pm 0.1210$
	BED	1±0	1±0	1±0
Rootkit imapvsback	RVGAN-TL	1±0	1±0	1±0
Rootkii_iiiapvsoack	EAL-GAN	$0.9538 \pm 0.0092$	$0.9190 \pm 0.0174$	$0.9298 \pm 0.0161$
	DLE-ISMOTE	$0.9375 \pm 0.0625$	$0.9286 \pm 0.0714$	$0.9330 \pm 0.0670$
	ADJECC EL (1.C. 1)	0.9550±0.0622	$0.9492 \pm 0.0705$	0.9521±0.0664
	MNESG-EL(default)	$0.9330\pm0.0022$	0.7772±0.0703	0.7321±0.000 <del>1</del>

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### A.4 表 4.20 的完整结果

表 A.4 为第四章中 4.3.4 节处表 4.20 的完整结果。主要记录了第四章提出的 MNESM-EL 算 法与现有经典集成学习算法在 ACC、AUC、F-M 和 G-M 四个评价指标的对比结果。

表 4.20 与经典集成学习算法比较

Table 4.20 Comparison with classical ensemble learning algorithms

数据集		Gla					onsin	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.7526	0.7400	0.6727	0.7364	0.9648	0.9611	0.9501	0.9609
SBAG	$\pm 0.0872$	$\pm 0.0747$	±0.0763	±0.0728	±0.0095	±0.0138	±0.0138	±0.0139
LTD 4 C	0.7430	0.7549	0.6903	0.7508	0.9582	0.9609	0.9445	0.9607
UBAG	$\pm 0.0882$	$\pm 0.0817$	$\pm 0.0807$	±0.0826	$\pm 0.0119$	$\pm 0.0112$	$\pm 0.0137$	$\pm 0.0114$
gDO.	0.8354	0.7839	0.7232	0.7767	0.9648	0.9652	0.9506	0.9651
SBO	$\pm 0.0596$	$\pm 0.0652$	$\pm 0.0830$	$\pm 0.0659$	±0.0141	±0.0145	±0.0196	$\pm 0.0145$
DDO	0.7663	0.7724	0.7043	0.7702	0.9736	0.9739	0.9627	0.9738
RBO	$\pm 0.0717$	$\pm 0.0864$	$\pm 0.0911$	$\pm 0.0838$	$\pm 0.0083$	$\pm 0.0111$	±0.0120	$\pm 0.0113$
EDO	0.7860	0.8013	0.7440	0.7979	0.9546	0.9526	0.9358	0.9522
EBO	$\pm 0.0812$	$\pm 0.0695$	$\pm 0.0683$	$\pm 0.0745$	$\pm 0.0141$	$\pm 0.0154$	$\pm 0.0194$	$\pm 0.0157$
DAC	0.7055	0.7274	0.6599	0.7218	0.9657	0.9473	0.9658	0.9619
BAC	$\pm 0.0693$	$\pm 0.0738$	$\pm 0.0703$	$\pm 0.0741$	$\pm 0.0095$	±0.0132	$\pm 0.0095$	$\pm 0.0095$
E	0.6903	0.7127	0.6468	0.7079	0.9619	0.9610	0.9463	0.9610
Easy	$\pm 0.0926$	$\pm 0.0962$	$\pm 0.0963$	$\pm 0.0957$	±0.0119	$\pm 0.0117$	$\pm 0.0166$	$\pm 0.0117$
MNESM-	0.8178	0.8114	0.7467	0.7852	0.9795	0.9823	0.9714	0.9822
EL(default)	$\pm 0.0723$	$\pm 0.0720$	±0.1329	$\pm 0.1040$	$\pm 0.0120$	$\pm 0.0112$	$\pm 0.0168$	$\pm 0.0112$
MNESM-	0.9859	0.9862	0.9802	0.9860	0.9927	0.9924	0.9895	0.9924
EL	±0.0128	±0.0141	±0.0181	±0.0143	±0.0090	±0.0091	±0.0129	±0.0091
数据集		Pir	na			Iri	s0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.7590	0.7274	0.6434	0.7196	0.9866	0.9800	0.9789	0.9794
SBAG	$\pm 0.0158$	$\pm 0.0155$	$\pm 0.0212$	$\pm 0.0165$	$\pm 0.0182$	$\pm 0.0273$	$\pm 0.0288$	$\pm 0.0281$
UBAG	0.7214	0.7383	0.6666	0.7355	0.9866	0.9800	0.9789	0.9794
UBAG	$\pm 0.0408$	$\pm 0.0352$	$\pm 0.0356$	$\pm 0.0363$	$\pm 0.0182$	$\pm 0.0273$	$\pm 0.0288$	$\pm 0.0281$
CDO	0.7408	0.7291	0.6469	0.7257	0.9933	0.9900	0.9894	0.9897
SBO	±0.0356	±0.0529	$\pm 0.0697$	±0.0575	±0.0149	±0.0223	±0.0235	±0.0229

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Pi	ma			Iri	is0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
DDC.	0.7356	0.7293	0.6511	0.7278	0.9933	0.9900	0.9894	0.9897
RBO	±0.0309	$\pm 0.0337$	$\pm 0.0414$	$\pm 0.0342$	±0.0149	$\pm 0.0223$	±0.0235	$\pm 0.0229$
EDO	0.7792	0.7566	0.6852	0.7541	0.9933	0.9900	0.9894	0.9897
EBO	$\pm 0.0480$	$\pm 0.0392$	$\pm 0.0437$	$\pm 0.0379$	±0.0149	±0.0223	±0.0235	$\pm 0.0229$
D. C	0.6901	0.7020	0.6252	0.6982	4.0	4.0	4 . 0	4 . 0
BAC	$\pm 0.0307$	$\pm 0.0256$	$\pm 0.0277$	$\pm 0.0258$	1±0	1±0	1±0	1±0
F	0.7143	0.7124	0.6344	0.7114	0.9933	0.9900	0.9894	0.9897
Easy	$\pm 0.0306$	$\pm 0.0423$	$\pm 0.0512$	$\pm 0.0423$	$\pm 0.0149$	$\pm 0.0223$	$\pm 0.0235$	$\pm 0.0229$
MNESM-	0.7616	0.7683	0.6969	0.7574	1.0	1 . 0	1.0	1.0
EL(default)	$\pm 0.0472$	$\pm 0.0326$	$\pm 0.0391$	$\pm 0.0331$	1±0	1±0	1±0	1±0
MNESM-	0.8255	0.8171	0.7580	0.8119	1.0	1.0	1.0	1.0
EL	±0.0299	±0.0331	±0.0414	±0.0350	1±0	1±0	1±0	1±0
数据集		Yea	ıst1			Habe	rman	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.7030	0.6924	0.5621	0.6855	0.6532	0.6304	0.4698	0.6208
SBAG	$\pm 0.0246$	$\pm 0.0239$	$\pm 0.0347$	$\pm 0.0331$	$\pm 0.0654$	±0.0521	$\pm 0.0637$	$\pm 0.0463$
IDAC	0.7263	0.7210	0.5989	0.7204	0.6598	0.6422	0.4861	0.6188
UBAG	$\pm 0.0239$	$\pm 0.0347$	$\pm 0.0418$	$\pm 0.0351$	$\pm 0.0565$	$\pm 0.0476$	$\pm 0.0640$	$\pm 0.0802$
CDO	0.7183	0.6946	0.5648	0.6865	0.6370	0.6145	0.4517	0.6096
SBO	$\pm 0.0336$	$\pm 0.0280$	$\pm 0.0401$	$\pm 0.0366$	$\pm 0.0473$	$\pm 0.0540$	$\pm 0.0698$	$\pm 0.0572$
DDO	0.7398	0.7104	0.5864	0.7066	0.6575	0.6639	0.5076	0.6575
RBO	$\pm 0.0253$	$\pm 0.0400$	$\pm 0.0522$	$\pm 0.0434$	$\pm 0.0641$	$\pm 0.0376$	$\pm 0.0488$	$\pm 0.0382$
EDO	0.6913	0.7081	0.5857	0.7032	0.7018	0.6548	0.4901	0.6375
EBO	$\pm 0.0551$	$\pm 0.0307$	$\pm 0.0394$	$\pm 0.0304$	$\pm 0.0427$	$\pm 0.0647$	$\pm 0.0849$	$\pm 0.0719$
BAC	0.6440	0.6794	0.5885	0.6696	0.6172	0.6210	0.6581	0.6189
DAC	$\pm 0.0433$	$\pm 0.0080$	$\pm 0.0456$	$\pm 0.0192$	$\pm 0.0830$	$\pm 0.0920$	$\pm 0.1180$	$\pm 0.0919$
Foor	0.6543	0.6752	0.5481	0.6728	0.6843	0.6008	0.3728	0.5165
Easy	$\pm 0.0207$	$\pm 0.0144$	$\pm 0.0146$	$\pm 0.0156$	$\pm 0.0758$	±0.1185	$\pm 0.2543$	$\pm 0.2490$
MNESM-	0.7251	0.7313	0.6110	0.7288	0.7661	0.7193	0.5744	0.6934
EL(default)	$\pm 0.0411$	$\pm 0.0364$	$\pm 0.0421$	$\pm 0.0377$	$\pm 0.0427$	$\pm 0.0457$	$\pm 0.0431$	$\pm 0.0683$

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Yea	ıst1			Habe	rman	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-	0.7985	0.7501	0.6388	0.7379	0.9560	0.9570	0.9564	0.9238
EL	±0.0225	±0.0458	±0.0622	±0.0674	±0.0254	±0.0112	±0.0110	±0.0387
数据集		Vehi	icle2			Vehi	cle3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CD A C	0.9621	0.9525	0.9270	0.9532	0.7677	0.7618	0.6190	0.7613
SBAG	$\pm 0.0130$	$\pm 0.0245$	±0.0261	$\pm 0.0244$	$\pm 0.0092$	±0.0170	±0.0195	$\pm 0.0177$
LIDAC	0.9566	0.9536	0.9235	0.9599	0.7411	0.7768	0.6213	0.7720
UBAG	$\pm 0.0179$	$\pm 0.0082$	$\pm 0.0320$	$\pm 0.0175$	$\pm 0.0234$	±0.0235	±0.0265	$\pm 0.0219$
CDO	0.9657	0.9661	0.9328	0.9660	0.7718	0.7441	0.6015	0.7402
SBO	$\pm 0.0188$	$\pm 0.0140$	$\pm 0.0375$	$\pm 0.0140$	$\pm 0.0287$	$\pm 0.0348$	$\pm 0.0423$	$\pm 0.0386$
DDO.	0.9621	0.9671	0.9304	0.9669	0.7564	0.7493	0.5993	0.7464
RBO	$\pm 0.0184$	$\pm 0.0206$	$\pm 0.0340$	$\pm 0.0206$	$\pm 0.0295$	$\pm 0.0545$	$\pm 0.0643$	$\pm 0.0584$
EDO	0.9704	0.9681	0.9442	0.9680	0.7494	0.7902	0.6364	0.7854
EBO	$\pm 0.0200$	$\pm 0.0210$	$\pm 0.0373$	$\pm 0.0212$	$\pm 0.0343$	$\pm 0.0315$	$\pm 0.0377$	$\pm 0.0312$
DAC	0.9515	0.9539	0.9114	0.9536	0.7055	0.7360	0.5765	0.7314
BAC	$\pm 0.0153$	$\pm 0.0050$	$\pm 0.0241$	$\pm 0.0051$	$\pm 0.0446$	$\pm 0.0400$	±0.0459	$\pm 0.0391$
Г	0.9455	0.9559	0.9031	0.9555	0.7257	0.7386	0.5830	0.7377
Easy	$\pm 0.0211$	$\pm 0.0176$	$\pm 0.0352$	$\pm 0.0178$	$\pm 0.0351$	$\pm 0.0360$	$\pm 0.0420$	$\pm 0.0362$
MNESM-	0.9752	0.9682	0.9520	0.9681	0.8144	0.7996	0.6777	0.7967
EL(default)	$\pm 0.0153$	$\pm 0.0174$	$\pm 0.0295$	$\pm 0.0175$	$\pm 0.0424$	$\pm 0.0273$	$\pm 0.0457$	$\pm 0.0264$
MNESM-	0.9834	0.9784	0.9679	0.9783	0.8475	0.8356	0.7279	0.8350
EL	±0.0088	±0.0137	±0.0171	±0.0138	±0.0218	±0.0207	±0.0305	±0.0210
数据集	G	Glass-0-1-2	-3_vs_4-5-	-6		Vehi	cle0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9203	0.9198	0.8509	0.9183	0.9337	0.9359	0.8703	0.9355
SBAG	$\pm 0.0487$	$\pm 0.0466$	$\pm 0.0872$	$\pm 0.0465$	$\pm 0.0215$	$\pm 0.0308$	$\pm 0.0416$	$\pm 0.0311$
IIDAC	0.8831	0.8885	0.7903	0.8862	0.9349	0.9523	0.8769	0.9516
UBAG	$\pm 0.0520$	$\pm 0.0503$	$\pm 0.0863$	$\pm 0.0491$	±0.0131	±0.0189	±0.0251	$\pm 0.0187$
CDO	0.9392	0.9185	0.8730	0.9171	0.9396	0.9311	0.8768	0.9305
SBO	$\pm 0.0390$	±0.0514	$\pm 0.0807$	±0.0524	±0.0252	$\pm 0.0385$	±0.0519	±0.0389

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集	C	ilass-0-1-2	-3_vs_4-5-	-6		Vehi	ic le0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
DDC.	0.9203	0.9269	0.8529	0.9258	0.9550	0.9618	0.9108	0.9617
RBO	±0.0428	$\pm 0.0324$	$\pm 0.0740$	±0.0322	±0.0106	±0.0138	$\pm 0.0206$	$\pm 0.0137$
EDO	0.9161	0.9101	0.8414	0.9078	0.9397	0.9466	0.8827	0.9465
EBO	±0.0533	$\pm 0.0514$	$\pm 0.0880$	±0.0522	$\pm 0.0234$	±0.0279	$\pm 0.0440$	$\pm 0.0278$
D. C	0.9157	0.8892	0.8255	0.9054	0.9255	0.9356	0.8588	0.9353
BAC	±0.0359	$\pm 0.0517$	±0.0715	±0.0435	$\pm 0.0239$	±0.0223	$\pm 0.0393$	$\pm 0.0225$
T.	0.9219	0.9171	0.8536	0.9159	0.9302	0.9370	0.8652	0.9365
Easy	$\pm 0.0268$	$\pm 0.0313$	$\pm 0.0521$	$\pm 0.0319$	$\pm 0.0224$	±0.0312	$\pm 0.0418$	$\pm 0.0315$
MNESM-	0.9764	0.9708	0.9504	0.9704	0.9645	0.9663	0.9282	0.9663
EL(default)	±0.0168	$\pm 0.0274$	$\pm 0.0354$	$\pm 0.0278$	±0.0168	±0.0176	$\pm 0.0333$	$\pm 0.0176$
MNESM-	1.0	1.0	4.0	1.0	0.9716	0.9779	0.9459	0.9777
EL	1±0	1±0	1±0	1±0	±0.0341	±0.0247	±0.0622	±0.0250
数据集		Eco	olil			Eco	oli2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.8814	0.8998	0.7865	0.8975	0.9168	0.8926	0.7606	0.8870
SBAG	$\pm 0.0376$	$\pm 0.0196$	$\pm 0.0489$	$\pm 0.0187$	$\pm 0.0379$	$\pm 0.0721$	$\pm 0.1042$	$\pm 0.0744$
IDAC	0.8721	0.8990	0.7777	0.8961	0.8929	0.8899	0.7247	0.8897
UBAG	$\pm 0.0540$	$\pm 0.0501$	$\pm 0.0761$	$\pm 0.0510$	$\pm 0.0408$	±0.0353	$\pm 0.0834$	$\pm 0.0353$
CDO	0.8840	0.8474	0.7562	0.8436	0.9346	0.9090	0.8023	0.9054
SBO	$\pm 0.0436$	$\pm 0.0587$	$\pm 0.0916$	$\pm 0.0621$	$\pm 0.0301$	$\pm 0.0786$	$\pm 0.0962$	$\pm 0.0842$
DDO	0.8839	0.9068	0.7908	0.9042	0.9046	0.8905	0.7408	0.8878
RBO	$\pm 0.0266$	$\pm 0.0290$	$\pm 0.0348$	$\pm 0.0289$	$\pm 0.0252$	±0.0332	$\pm 0.0364$	$\pm 0.0356$
EDO	0.8750	0.8918	0.7820	0.8878	0.8990	0.8862	0.7357	0.8857
EBO	$\pm 0.0734$	$\pm 0.0578$	$\pm 0.0953$	$\pm 0.0616$	$\pm 0.0570$	$\pm 0.0639$	$\pm 0.1204$	$\pm 0.0645$
BAC	0.8600	0.8637	0.7475	0.8616	0.8539	0.8670	0.6552	0.8653
DAC	$\pm 0.0584$	$\pm 0.0439$	$\pm 0.0773$	$\pm 0.0434$	$\pm 0.0376$	$\pm 0.0341$	$\pm 0.0653$	$\pm 0.0332$
Foor	0.8481	0.8698	0.7383	0.8666	0.8212	0.8485	0.6095	0.8459
Easy	$\pm 0.0611$	$\pm 0.0564$	$\pm 0.0855$	$\pm 0.0570$	$\pm 0.0427$	$\pm 0.0298$	$\pm 0.0525$	$\pm 0.0284$
MNESM-	0.9345	0.9438	0.8721	0.9432	0.9613	0.9533	0.8828	0.9530
EL(default)	±0.0249	±0.0164	±0.0410	±0.0166	±0.0171	$\pm 0.0311$	±0.0524	±0.0313

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Eco	oli1			Eco	oli2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-	0.9910	0.9847	0.9793	0.9844	0.9910	0.9865	0.9713	0.9862
EL	±0.0200	±0.0341	±0.0463	±0.0349	±0.0134	±0.0218	±0.0416	±0.0223
数据集		Gla	ss6			Yea	st3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CD 4 C	0.9346	0.8923	0.7657	0.8836	0.9413	0.9401	0.7822	0.9401
SBAG	±0.0191	$\pm 0.0965$	$\pm 0.1005$	±0.1123	$\pm 0.0218$	$\pm 0.0197$	$\pm 0.0661$	$\pm 0.0197$
LIDAC	0.8972	0.9159	0.7159	0.9115	0.9279	0.9353	0.7472	0.9350
UBAG	$\pm 0.0421$	$\pm 0.0576$	±0.0953	$\pm 0.0553$	±0.0258	±0.0155	±0.0673	$\pm 0.0156$
GDO.	0.9345	0.8504	0.7447	0.8353	0.9386	0.8795	0.7427	0.8761
SBO	±0.0106	$\pm 0.0815$	$\pm 0.0615$	$\pm 0.0970$	$\pm 0.0086$	$\pm 0.0148$	$\pm 0.0290$	$\pm 0.0157$
DDO.	0.9108	0.9227	0.7507	0.9182	0.9225	0.9188	0.7260	0.9188
RBO	$\pm 0.0518$	$\pm 0.0342$	$\pm 0.1082$	$\pm 0.0340$	$\pm 0.0263$	$\pm 0.0240$	$\pm 0.0698$	$\pm 0.0240$
EDO	0.8877	0.8932	0.7121	0.8912	0.9198	0.9281	0.7244	0.9277
EBO	$\pm 0.0894$	$\pm 0.0700$	$\pm 0.1598$	$\pm 0.0701$	$\pm 0.0252$	$\pm 0.0166$	$\pm 0.0597$	$\pm 0.0168$
DAC	0.8875	0.8932	0.6893	0.8913	0.9076	0.9079	0.6871	0.9079
BAC	$\pm 0.0395$	$\pm 0.0359$	$\pm 0.0791$	±0.0352	$\pm 0.0257$	±0.0316	$\pm 0.0697$	$\pm 0.0316$
Г	0.8550	0.8463	0.6050	0.8390	0.9130	0.9109	0.6989	0.9108
Easy	$\pm 0.0387$	$\pm 0.0935$	$\pm 0.1065$	$\pm 0.1036$	$\pm 0.0222$	$\pm 0.0274$	$\pm 0.0580$	$\pm 0.0274$
MNESM-	0.9812	0.9892	0.9359	0.9891	0.9535	0.9175	0.8040	0.9159
EL(default)	$\pm 0.0199$	$\pm 0.0113$	$\pm 0.0690$	$\pm 0.0115$	$\pm 0.0080$	$\pm 0.0314$	$\pm 0.0366$	$\pm 0.0328$
MNESM-	0.9953	0.9973	0.9846	0.9973	0.9656	0.9404	0.8563	0.9394
EL	±0.0104	±0.0060	±0.0344	±0.0061	±0.0168	±0.0258	±0.0595	±0.0267
数据集		Eco	oli3			Yeast-	2-vs-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.8898	0.8754	0.6197	0.8736	0.9163	0.8910	0.6664	0.8861
SBAG	$\pm 0.0227$	$\pm 0.0467$	$\pm 0.0525$	$\pm 0.0481$	$\pm 0.0108$	$\pm 0.0753$	$\pm 0.0600$	$\pm 0.0830$
IDAC	0.8424	0.8994	0.5710	0.8955	0.9124	0.9335	0.6914	0.9324
UBAG	$\pm 0.0520$	±0.0386	$\pm 0.0843$	±0.0396	$\pm 0.0305$	±0.0229	$\pm 0.0662$	$\pm 0.0229$
CDO	0.9107	0.8744	0.6563	0.8693	0.9435	0.8893	0.7428	0.9058
SBO	±0.0179	$\pm 0.0735$	$\pm 0.0814$	$\pm 0.0823$	$\pm 0.0187$	$\pm 0.0455$	±0.0829	$\pm 0.0581$

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Eco	oli3			Yeast-	2-vs-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
<b>DDO</b>	0.8720	0.8402	0.5778	0.8346	0.9299	0.9263	0.7342	0.9247
RBO	$\pm 0.0522$	±0.0332	$\pm 0.0686$	$\pm 0.0337$	$\pm 0.0371$	±0.0296	$\pm 0.0819$	$\pm 0.0309$
EDO	0.8621	0.8605	0.5621	0.8552	0.9144	0.9267	0.7024	0.9253
EBO	±0.0174	$\pm 0.0746$	±0.0549	$\pm 0.0810$	±0.0510	±0.0196	±0.1029	$\pm 0.0209$
Dic	0.8090	0.8112	0.4820	0.7996	0.9066	0.8866	0.6632	0.8827
BAC	±0.1216	$\pm 0.0749$	±0.1089	$\pm 0.0831$	$\pm 0.0520$	$\pm 0.0358$	$\pm 0.0875$	$\pm 0.0396$
F	0.8451	0.8504	0.5544	0.8439	0.9046	0.9212	0.6642	0.9199
Easy	$\pm 0.0822$	$\pm 0.0463$	$\pm 0.0845$	$\pm 0.0493$	$\pm 0.0221$	$\pm 0.0433$	$\pm 0.0618$	$\pm 0.0435$
MNESM-	0.9166	0.8776	0.6499	0.8553	0.9669	0.9371	0.8404	0.9344
EL(default)	±0.0135	±0.1354	±0.1227	±0.1824	$\pm 0.0148$	$\pm 0.0604$	$\pm 0.0791$	$\pm 0.0651$
MNESM-	0.9852	0.9917	0.9367	0.9917	0.9942	0.9789	0.9694	0.9784
EL	±0.0148	±0.0083	±0.0625	±0.0083	±0.0053	±0.0265	±0.0280	±0.0272
数据集		Yeast-0-5-	6-7-9-vs-4			Glass-0-	1-6_vs_2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.8541	0.8217	0.5089	0.8165	0.8331	0.6676	0.4020	0.5605
SBAG	$\pm 0.0340$	$\pm 0.0822$	$\pm 0.1030$	$\pm 0.0885$	$\pm 0.0475$	±0.1698	$\pm 0.1666$	$\pm 0.3434$
LIDAC	0.7916	0.7969	0.4271	0.7963	0.6667	0.7035	0.2771	0.6863
UBAG	$\pm 0.0179$	$\pm 0.0385$	$\pm 0.0403$	$\pm 0.0386$	$\pm 0.0261$	$\pm 0.1160$	$\pm 0.0862$	$\pm 0.1213$
SDO	0.8900	0.7727	0.5235	0.7523	0.8491	0.6014	0.3234	0.4569
SBO	$\pm 0.0321$	$\pm 0.0907$	$\pm 0.1359$	$\pm 0.1114$	$\pm 0.0423$	$\pm 0.1304$	$\pm 0.1658$	$\pm 0.2871$
RBO	0.8351	0.7862	0.4581	0.7788	0.7809	0.6999	0.3196	0.6692
KDO	$\pm 0.0295$	$\pm 0.0899$	$\pm 0.0987$	$\pm 0.0982$	$\pm 0.0607$	±0.1416	$\pm 0.1500$	$\pm 0.1733$
EBO	0.8180	0.8206	0.4692	0.8197	0.7182	0.7930	0.3669	0.7851
EDO	$\pm 0.0324$	$\pm 0.0471$	$\pm 0.0679$	$\pm 0.0473$	$\pm 0.0896$	$\pm 0.1055$	$\pm 0.1032$	$\pm 0.1015$
BAC	0.7557	0.7511	0.3686	0.7456	0.6300	0.6254	0.2199	0.5965
DAC	$\pm 0.0313$	$\pm 0.0658$	$\pm 0.0432$	$\pm 0.0636$	$\pm 0.1074$	$\pm 0.1762$	$\pm 0.0984$	$\pm 0.1821$
Easy	0.8047	0.7801	0.4298	0.7757	0.6345	0.7390	0.3066	0.7259
Lasy	$\pm 0.0516$	$\pm 0.0640$	$\pm 0.0675$	$\pm 0.0693$	$\pm 0.1013$	$\pm 0.1278$	$\pm 0.1166$	±0.1226
MNESM-	0.8486	0.8813	0.5432	0.8801	0.8086	0.8583	0.4715	0.8525
EL(default)	$\pm 0.0285$	±0.0309	$\pm 0.0482$	$\pm 0.0305$	$\pm 0.0927$	$\pm 0.0779$	$\pm 0.1238$	$\pm 0.0793$

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Yeast-0-5-	6-7-9-vs-4			Glass-0-1	1-6_vs_2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-	0.9593	0.8705	0.7214	0.8224	0.9842	0.9964	0.9643	0.9964
EL	±0.0258	±0.1821	±0.3026	±0.2851	±0.0444	±0.0071	±0.0714	±0.0072
数据集		Gla	ass2			Yeast	1vs7	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CD A C	0.8174	0.7019	0.3847	0.6077	0.8237	0.7208	0.3174	0.7074
SBAG	$\pm 0.0518$	±0.1399	$\pm 0.1180$	$\pm 0.3421$	$\pm 0.0556$	±0.0367	$\pm 0.0480$	$\pm 0.0455$
LIDAC	0.5888	0.7766	0.2796	0.7428	0.7363	0.6883	0.2361	0.6778
UBAG	$\pm 0.0579$	±0.0316	$\pm 0.0375$	$\pm 0.0422$	$\pm 0.0262$	$\pm 0.0798$	$\pm 0.0525$	$\pm 0.0981$
CDO	0.8594	0.7330	0.4141	0.7114	0.8065	0.7259	0.3142	0.7170
SBO	$\pm 0.0585$	$\pm 0.0945$	±0.1420	$\pm 0.1150$	$\pm 0.0742$	±0.0319	$\pm 0.0662$	$\pm 0.0356$
DDO	0.7662	0.6375	0.3190	0.6110	0.8257	0.7827	0.3601	0.7749
RBO	$\pm 0.1562$	±0.1506	$\pm 0.2350$	$\pm 0.1610$	$\pm 0.0558$	$\pm 0.0943$	$\pm 0.0813$	$\pm 0.1005$
EDO	0.7053	0.7646	0.3129	0.7569	0.7996	0.7222	0.2946	0.7105
EBO	$\pm 0.0626$	$\pm 0.0711$	$\pm 0.0714$	$\pm 0.0638$	$\pm 0.0336$	$\pm 0.1005$	$\pm 0.0899$	$\pm 0.1192$
BAC	0.5750	0.6174	0.2064	0.6134	0.6404	0.6526	0.1974	0.6425
DAC	$\pm 0.1166$	$\pm 0.1515$	$\pm 0.0854$	$\pm 0.1478$	$\pm 0.0785$	$\pm 0.1016$	$\pm 0.0634$	$\pm 0.1109$
Faces	0.5933	0.7795	0.2903	0.7445	0.6817	0.7212	0.2425	0.7113
Easy	$\pm 0.1077$	$\pm 0.0565$	$\pm 0.0845$	$\pm 0.0766$	$\pm 0.0821$	$\pm 0.0346$	$\pm 0.0201$	$\pm 0.0416$
MNESM-	0.8543	0.9199	0.6005	0.9149	0.7525	0.8159	0.3228	0.8072
EL(default)	$\pm 0.1076$	$\pm 0.0594$	$\pm 0.2240$	$\pm 0.0638$	$\pm 0.0637$	$\pm 0.0870$	$\pm 0.0673$	$\pm 0.0844$
MNESM-	0.9937	0.9724	0.9286	0.9936	0.9236	0.8817	0.5934	0.8741
EL	$\pm 0.0073$	±0.0373	±0.0825	$\pm 0.0073$	$\pm 0.0303$	±0.0933	±0.0311	±0.1020
数据集		Gla	ss4			Есс	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SDAC	0.9060	0.9025	0.5733	0.8921	0.9524	0.8810	0.7463	0.8753
SBAG	$\pm 0.0610$	$\pm 0.0885$	$\pm 0.1382$	$\pm 0.1066$	$\pm 0.0193$	$\pm 0.0497$	$\pm 0.1452$	$\pm 0.0523$
IIDAG	0.8773	0.8593	0.4666	0.8487	0.8363	0.8427	0.4118	0.8394
UBAG	$\pm 0.0577$	$\pm 0.1031$	$\pm 0.1027$	$\pm 0.1153$	$\pm 0.0802$	$\pm 0.0773$	$\pm 0.1298$	$\pm 0.0756$
CDO	0.9343	0.8866	0.6189	0.8749	0.9582	0.8373	0.6666	0.8177
SBO	$\pm 0.0355$	±0.1011	±0.1166	$\pm 0.1178$	±0.0164	$\pm 0.0964$	±0.1020	±0.1151

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Gla	ss4			Eco	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
<b>DDO</b>	0.9018	0.9004	0.5563	0.8962	0.8927	0.8961	0.5680	0.8920
RBO	$\pm 0.0665$	±0.1392	$\pm 0.2347$	$\pm 0.1469$	$\pm 0.0867$	$\pm 0.0714$	±0.2540	$\pm 0.0737$
EDO	0.8975	0.8666	0.6187	0.8578	0.8600	0.9021	0.5121	0.9005
EBO	±0.1390	±0.1520	$\pm 0.2352$	$\pm 0.1610$	$\pm 0.1016$	±0.1029	$\pm 0.2370$	$\pm 0.1026$
DAG	0.8036	0.8480	0.3915	0.8393	0.8539	0.8989	0.4491	0.8956
BAC	$\pm 0.0881$	±0.1249	$\pm 0.2176$	$\pm 0.1301$	$\pm 0.0492$	$\pm 0.0593$	$\pm 0.1020$	$\pm 0.0596$
E	0.8693	0.8208	0.4389	0.8108	0.8869	0.8930	0.4888	0.8897
Easy	$\pm 0.0706$	$\pm 0.1130$	$\pm 0.1094$	$\pm 0.1214$	$\pm 0.0248$	$\pm 0.0531$	$\pm 0.0248$	$\pm 0.0541$
MNESM-	0.9847	0.9403	0.8857	0.9346	0.9653	0.9035	0.7389	0.8985
EL(default)	±0.0133	$\pm 0.0928$	$\pm 0.1030$	$\pm 0.1025$	$\pm 0.0087$	$\pm 0.0700$	$\pm 0.0674$	$\pm 0.0742$
MNESM-	1.0	1.0	1 . 0	1±0	1.0	1.0	1.0	1.0
EL	1±0	1±0	1±0	1±V	1±0	1±0	1±0	1±0
数据集		Abaloı	ne9-18			Shuttle-o	2-vs-c4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SBAG	0.8617	0.7257	0.3392	0.6932	0.9221	0.9558	0.6334	0.9551
SDAU	$\pm 0.0601$	$\pm 0.1537$	$\pm 0.1904$	$\pm 0.1850$	$\pm 0.0109$	$\pm 0.0077$	$\pm 0.0383$	$\pm 0.0076$
LIDAC	0.7369	0.7819	0.2755	0.7770	0.9384	0.9473	0.7666	0.9658
UBAG	$\pm 0.0566$	$\pm 0.0526$	$\pm 0.0453$	$\pm 0.0536$	$\pm 0.0842$	$\pm 0.0447$	$\pm 0.3248$	$\pm 0.0467$
SBO	0.9137	0.7533	0.4560	0.7149	0.9340	0.9114	0.6269	0.9027
<b>SBO</b>	$\pm 0.0458$	$\pm 0.1430$	$\pm 0.2876$	$\pm 0.1897$	$\pm 0.0241$	$\pm 0.0904$	$\pm 0.0362$	$\pm 0.1095$
RBO	0.8002	0.7906	0.3146	0.7834	0.9692	0.9840	0.8666	0.9833
KbO	$\pm 0.0353$	$\pm 0.0992$	$\pm 0.0807$	$\pm 0.1052$	$\pm 0.0688$	$\pm 0.0357$	$\pm 0.2981$	$\pm 0.0373$
EBO	0.7523	0.7326	0.2504	0.7196	1 . 0	1.0	1.0	1 . 0
EBO	$\pm 0.0597$	$\pm 0.0941$	$\pm 0.0572$	$\pm 0.1073$	1±0	1±0	1±0	1±0
BAC	0.7358	0.7502	0.2628	0.7463	1.10	1.10	1.10	10
DAC	$\pm 0.0713$	$\pm 0.1094$	$\pm 0.0932$	$\pm 0.1094$	1±0	1±0	1±0	1±0
Fooy	0.6880	0.7220	0.2257	0.7165	1±0	140	1±0	1±0
Easy	$\pm 0.0665$	$\pm 0.0595$	$\pm 0.0444$	$\pm 0.0586$	1±0	1±0	1±0	1±0
MNESM-	0.9429	0.7631	0.5238	0.7276	1.10	1±0	1±0	1 + 0
EL(default)	±0.0141	$\pm 0.0830$	±0.0412	$\pm 0.1167$	1±0	1±0	1±0	1±0

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集	ic 4.20 Con		ne9-18		<u> </u>	Shuttle-o		
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-	0.9829	0.9026	0.8375	0.8975	4.0	4.0	4.0	4 : 0
EL	±0.0048	±0.0442	±0.0530	±0.0489	1±0	1±0	1±0	1±0
数据集		Gla	ss5			Yeast	t2vs8	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9488	0.9256	0.6619	0.9164	0.9584	0.8109	0.5473	0.7697
SBAG	$\pm 0.0382$	$\pm 0.0998$	$\pm 0.1980$	±0.1185	$\pm 0.0181$	±0.1566	±0.1410	$\pm 0.2034$
IDAC	0.9495	0.5266	0.9512	0.9065	0.7590	0.7307	0.2327	0.7215
UBAG	$\pm 0.0310$	$\pm 0.2712$	$\pm 0.0298$	$\pm 0.0569$	$\pm 0.1437$	$\pm 0.1349$	$\pm 0.1257$	$\pm 0.1378$
SDO	0.9673	0.9353	0.6933	0.9266	0.9646	0.7902	0.5833	0.7528
SBO	±0.0126	$\pm 0.1037$	$\pm 0.0596$	±0.1228	$\pm 0.0174$	$\pm 0.1070$	$\pm 0.1666$	$\pm 0.1564$
DDO	0.8976	0.9463	0.5815	0.9438	0.9335	0.8457	0.4846	0.8403
RBO	$\pm 0.0879$	$\pm 0.0461$	$\pm 0.3015$	$\pm 0.0487$	$\pm 0.0059$	$\pm 0.0030$	$\pm 0.0210$	$\pm 0.0027$
EDO	0.9297	0.9634	0.6066	0.9623	0.7820	0.7666	0.2238	0.7613
EBO	$\pm 0.0572$	$\pm 0.0298$	$\pm 0.2832$	$\pm 0.0310$	$\pm 0.0375$	$\pm 0.0844$	$\pm 0.0514$	$\pm 0.0878$
DAC	0.9018	0.9487	0.4866	0.9471	0.6823	0.7625	0.1910	0.7485
BAC	$\pm 0.0476$	$\pm 0.0249$	$\pm 0.1849$	$\pm 0.0261$	$\pm 0.0972$	$\pm 0.1149$	$\pm 0.0758$	$\pm 0.1142$
Eagre	0.9390	0.9682	0.6266	0.9674	0.7637	0.7571	0.2214	0.7471
Easy	$\pm 0.0538$	$\pm 0.0280$	$\pm 0.2385$	$\pm 0.0292$	$\pm 0.0961$	$\pm 0.1331$	$\pm 0.0736$	$\pm 0.1340$
MNESM-	0.9845	0.9126	0.8222	0.8983	0.8824	0.8988	0.4218	0.8878
EL(default)	$\pm 0.0134$	$\pm 0.1409$	$\pm 0.1678$	$\pm 0.1657$	$\pm 0.0627$	$\pm 0.0418$	$\pm 0.1143$	$\pm 0.0438$
MNESM-	1±0	1±0	1±0	1±0	0.9917	0.9000	0.8762	0.8944
EL	1±0	1±0	1±0	1±0	±0.0087	±0.1046	±0.1372	±0.1212
数据集		Yea	ıst4			Winequa	lity-red-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.7978	0.8339	0.2345	0.8307	0.8930	0.6523	0.1970	0.5921
SBAG	$\pm 0.0482$	$\pm 0.0374$	$\pm 0.0278$	$\pm 0.0327$	$\pm 0.0156$	$\pm 0.0732$	$\pm 0.0716$	$\pm 0.1039$
UBAG	0.7742	0.8452	0.2097	0.8179	0.6897	0.6666	0.1206	0.6600
UDAU	$\pm 0.0275$	$\pm 0.0970$	$\pm 0.0219$	$\pm 0.0717$	$\pm 0.0454$	$\pm 0.0750$	$\pm 0.0285$	$\pm 0.0797$
CDO	0.8215	0.7979	0.2466	0.7835	0.9392	0.5867	0.2180	0.3999
SBO	$\pm 0.0885$	$\pm 0.0779$	$\pm 0.0488$	±0.0916	$\pm 0.0047$	$\pm 0.0582$	$\pm 0.0403$	±0.2266

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Yea	ıst4			Winequa	lity-red-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
DDC.	0.8200	0.8199	0.2398	0.8165	0.8116	0.6228	0.1330	0.5879
RBO	$\pm 0.0347$	$\pm 0.0472$	$\pm 0.0170$	±0.0462	$\pm 0.0324$	$\pm 0.0453$	$\pm 0.0335$	$\pm 0.0552$
EDO	0.8126	0.8372	0.2437	0.8340	0.7535	0.6110	0.1051	0.5630
EBO	±0.0403	$\pm 0.0611$	±0.0397	$\pm 0.0594$	$\pm 0.0876$	$\pm 0.0788$	±0.0124	±0.1616
D.C.	0.7850	0.7747	0.2031	0.7710	0.6113	0.6500	0.1021	0.6335
BAC	$\pm 0.0532$	±0.0966	$\pm 0.0592$	±0.1002	$\pm 0.0831$	$\pm 0.0791$	$\pm 0.0186$	$\pm 0.0727$
Б	0.7998	0.8191	0.2337	0.8159	0.6611	0.6403	0.1083	0.6206
Easy	$\pm 0.0588$	$\pm 0.0865$	$\pm 0.0750$	$\pm 0.0880$	$\pm 0.1143$	$\pm 0.0669$	$\pm 0.0217$	$\pm 0.0824$
MNESM-	0.8719	0.9337	0.3693	0.9308	0.6232	0.6880	0.1228	0.6828
EL(default)	$\pm 0.0671$	$\pm 0.0347$	±0.1069	$\pm 0.0377$	$\pm 0.0569$	$\pm 0.0603$	$\pm 0.0244$	$\pm 0.0589$
MNESM-	0.9535	0.7951	0.4398	0.7744	0.9694	0.7268	0.2998	0.6911
EL	±0.0121	$\pm 0.0709$	±0.0426	$\pm 0.0883$	±0.0034	±0.0767	±0.0590	±0.1078
数据集		Yeast-1-2	2-8-9-vs-7			Yea	ıst5	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.8253	0.6711	0.1498	0.6200	0.9703	0.9618	0.6669	0.9612
SBAG	$\pm 0.0177$	±0.1485	$\pm 0.0788$	±0.2011	$\pm 0.0122$	$\pm 0.0320$	$\pm 0.0925$	$\pm 0.0325$
LIDAC	0.7285	0.7147	0.1423	0.7089	0.9393	0.9458	0.4917	0.9451
UBAG	$\pm 0.0661$	$\pm 0.0517$	$\pm 0.0212$	$\pm 0.0561$	$\pm 0.0189$	$\pm 0.0293$	$\pm 0.0811$	$\pm 0.0294$
CDO	0.8171	0.7299	0.1851	0.7065	0.9757	0.9444	0.7018	0.9418
SBO	$\pm 0.0096$	$\pm 0.1313$	$\pm 0.0714$	$\pm 0.1625$	$\pm 0.0087$	$\pm 0.0555$	$\pm 0.0541$	$\pm 0.0589$
RBO	0.8456	0.7389	0.1992	0.7191	0.9440	0.9604	0.5158	0.9600
KDO	$\pm 0.0239$	$\pm 0.0896$	$\pm 0.0365$	$\pm 0.1208$	$\pm 0.1475$	$\pm 0.0282$	$\pm 0.0678$	$\pm 0.0282$
EDO	0.7696	0.6714	0.1440	0.6537	0.9602	0.9458	0.5849	0.9452
EBO	$\pm 0.0990$	$\pm 0.0611$	$\pm 0.0471$	$\pm 0.0801$	$\pm 0.0096$	$\pm 0.0308$	$\pm 0.0624$	$\pm 0.0312$
BAC	0.6472	0.6727	0.1122	0.6702	0.9333	0.9534	0.4736	0.9526
DAC	$\pm 0.0484$	$\pm 0.0260$	$\pm 0.0093$	$\pm 0.0229$	$\pm 0.0197$	$\pm 0.0220$	$\pm 0.0642$	$\pm 0.0221$
Fooy	0.5957	0.6783	0.1130	0.6591	0.9198	0.9479	0.4253	0.9470
Easy	$\pm 0.1497$	$\pm 0.0562$	$\pm 0.0231$	$\pm 0.0712$	$\pm 0.0191$	$\pm 0.0223$	$\pm 0.0464$	$\pm 0.0222$
MNESM-	0.8504	0.8152	0.2988	0.8035	0.9650	0.9483	0.6228	0.9475
EL(default)	±0.1242	±0.0318	±0.1210	±0.0299	$\pm 0.0140$	±0.0256	$\pm 0.0757$	$\pm 0.0260$

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Yeast-1-2	-8-9-vs-7			Yea	ıst5	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-	0.9762	0.7056	0.5227	0.6403	0.9811	0.9688	0.7589	0.9682
EL	±0.0037	±0.0551	±0.0321	±0.0890	±0.0111	±0.0291	±0.1097	±0.0297
数据集		Yea	ıst6		W	inequality-v	white-3_vs	_7
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CD A C	0.9521	0.8360	0.4103	0.8179	0.9333	0.6605	0.1980	0.5865
SBAG	$\pm 0.0114$	$\pm 0.1076$	$\pm 0.0799$	$\pm 0.1288$	$\pm 0.0143$	$\pm 0.0675$	$\pm 0.0557$	$\pm 0.1133$
LIDAG	0.8679	0.8766	0.2466	0.8746	0.7411	0.7698	0.1237	0.7674
UBAG	$\pm 0.0335$	±0.0594	$\pm 0.0502$	$\pm 0.0593$	$\pm 0.0529$	$\pm 0.0618$	±0.0255	$\pm 0.0581$
gpo.	0.9676	0.7743	0.4407	0.7252	0.9518	0.7310	0.3025	0.6772
SBO	$\pm 0.0084$	±0.1489	±0.1667	$\pm 0.1973$	$\pm 0.0032$	±0.1207	±0.1000	$\pm 0.1771$
DDO	0.8746	0.8382	0.2353	0.8307	0.7866	0.7198	0.1347	0.7101
RBO	$\pm 0.0377$	$\pm 0.0795$	$\pm 0.0390$	$\pm 0.0848$	$\pm 0.0873$	$\pm 0.1365$	$\pm 0.0713$	$\pm 0.1409$
EDO	0.8712	0.8225	0.2206	0.8135	0.7688	0.7107	0.1176	0.6940
EBO	$\pm 0.0517$	$\pm 0.1086$	$\pm 0.0575$	$\pm 0.1236$	$\pm 0.0550$	$\pm 0.1565$	$\pm 0.0589$	$\pm 0.1782$
DAG	0.7776	0.8162	0.1548	0.8135	$0.7069 \pm$	0.7279	0.1043	0.7223
BAC	$\pm 0.0334$	$\pm 0.0426$	$\pm 0.0158$	$\pm 0.0405$	0.0517	$\pm 0.1075$	$\pm 0.0323$	$\pm 0.1054$
Г	0.7755	0.8293	0.1603	0.8246	0.5966	0.6715	0.0779	0.6521
Easy	$\pm 0.0493$	$\pm 0.0513$	$\pm 0.0266$	$\pm 0.0488$	±0.1318	$\pm 0.0420$	±0.0115	$\pm 0.0527$
MNESM-	0.8882	0.9148	0.2941	0.9136	0.8889	0.8617	0.2522	0.8521
EL(default)	$\pm 0.0337$	±0.0416	$\pm 0.0620$	$\pm 0.0411$	$\pm 0.0147$	$\pm 0.0779$	$\pm 0.0589$	$\pm 0.0788$
MNESM-	0.9747	0.8999	0.6365	0.8937	0.9917	0.8736	0.7778	0.8595
EL	±0.0177	±0.0595	±0.1070	$\pm 0.0651$	±0.0039	±0.1748	±0.1571	±0.2051
数据集	W	inequality-	red-8_vs_6	5-7	]	Kr-vs-k-zei	o_vs_eigh	t
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9005	0.7349	0.1937	0.7054	0.9294	0.9564	0.6436	0.9562
SBAG	$\pm 0.0354$	$\pm 0.0847$	±0.0712	±0.1165	$\pm 0.0140$	±0.0120	±0.0659	$\pm 0.0118$
IDAC	0.6596	0.7446	0.0956	0.7323	0.8376	0.8779	0.1802	0.8704
UBAG	$\pm 0.0886$	±0.0555	$\pm 0.230$	$\pm 0.0490$	$\pm 0.0610$	$\pm 0.0683$	±0.0277	$\pm 0.0744$
ano	0.9502	0.7298	0.2955	0.6764	0.9374	0.9177	0.6434	0.9151
SBO	±0.0139	±0.1264	±0.1582	±0.1776	±0.0122	±0.0611	±0.0661	±0.0642

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集	W	inequality-1	red-8_vs_6	5-7	]	Kr-vs-k-zei	ro_vs_eigh	t
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
<b>D</b> DO	0.8070	0.7139	0.1151	0.6886	0.8945	0.9462	0.2836	0.9444
RBO	±0.0423	±0.1216	±0.0452	±0.1536	$\pm 0.0467$	±0.0238	$\pm 0.0897$	$\pm 0.0252$
EDO	0.6830	0.6750	0.0813	0.6610	0.9095	0.9539	0.3081	0.9526
EBO	±0.1012	±0.0523	±0.0108	$\pm 0.0447$	$\pm 0.0337$	±0.0172	$\pm 0.0860$	$\pm 0.0180$
D. C	0.6783	0.7625	0.1043	0.7467	0.8362	0.9165	0.1970	0.9128
BAC	±0.1094	$\pm 0.1077$	$\pm 0.0379$	±0.1106	$\pm 0.0679$	$\pm 0.0347$	$\pm 0.0545$	$\pm 0.0391$
Б	0.6549	0.6933	0.0819	0.6748	0.8602	0.8732	0.1979	0.8693
Easy	$\pm 0.0726$	±0.1589	$\pm 0.0382$	$\pm 0.1727$	$\pm 0.0333$	$\pm 0.0909$	$\pm 0.0683$	$\pm 0.0940$
MNESM-	0.7903	0.8110	0.1429	0.8019	0.9959	0.9979	0.9045	0.9979
EL(default)	$\pm 0.0981$	$\pm 0.0652$	$\pm 0.0000$	$\pm 0.0612$	$\pm 0.0029$	$\pm 0.0015$	$\pm 0.0648$	$\pm 0.0015$
MNESM-	0.8962	0.9183	0.2764	0.9097	0.9979	0.9990	0.9510	0.9990
EL	$\pm 0.0071$	±0.0437	$\pm 0.0347$	±0.0225	±0.0019	±0.0000	±0.0450	±0.0000
数据集		Shuttle-	-2_vs_5		Kddcup-buffer_overflow_vs_bac			s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
SBAG	1±0	1±0	1±0	1±0	0.9996	0.9833	0.9818	0.9826
SDAU	1=0	1±0	1=0	1±0	$\pm 0.0010$	$\pm 0.0373$	$\pm 0.0407$	$\pm 0.0390$
UBAG	1±0	1±0	1±0	1.10	0.9861	0.9929	0.7471	0.9929
UBAG	1±0	1±0	1±0	1±0	$\pm 0.0168$	$\pm 0.0085$	$\pm 0.2704$	$\pm 0.0086$
SBO	1±0	1±0	1±0	1±0	0.9986	0.9828	0.9532	0.9821
SBO	1±0	1±0	1±0	1±0	$\pm 0.0020$	$\pm 0.0370$	$\pm 0.0666$	$\pm 0.0387$
RBO	0.9834	0.9915	0.8533	0.9913	0.9605	0.9800	0.4848	0.9797
KDO	$\pm 0.0371$	$\pm 0.0188$	$\pm 0.3279$	$\pm 0.0192$	$\pm 0.0232$	$\pm 0.0117$	$\pm 0.2898$	$\pm 0.0119$
EBO	1±0	1±0	1±0	1±0	0.9852	0.9760	0.7387	0.9752
EBO	1±0	140	1±0	140	$\pm 0.0201$	$\pm 0.0345$	$\pm 0.2556$	$\pm 0.0361$
BAC	1±0	1±0	1±0	1±0	0.9771	0.9884	0.6533	0.9882
DAC	1±0	1±0	140	140	$\pm 0.0223$	$\pm 0.0113$	$\pm 0.3207$	$\pm 0.0114$
Easy	1±0	1±0	1±0	1±0	0.9520	0.9757	0.3622	0.9754
Lasy	1±0	140	1±0	1±0	$\pm 0.0078$	$\pm 0.0039$	$\pm 0.0357$	$\pm 0.0041$
MNESM-	0.9994	0.9997	0.9810	0.9997	0.9996	0.9833	0.9818	0.9826
EL(default)	$\pm 0.0008$	$\pm 0.0004$	±0.0261	$\pm 0.0004$	$\pm 0.0010$	$\pm 0.0373$	$\pm 0.0407$	$\pm 0.0390$

表 4.20 与经典集成学习算法比较(续)

Table 4.20 Comparison with classical ensemble learning algorithms (continued)

数据集		Shuttle-	-2_vs_5		Kddcu	p-buffer_o	verflow_vs	s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM- EL	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
数据集	K	r-vs-k-zer	o_vs_fiftee	en		Rootkit_in	napvsback	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
CDAC	0.9694	0.9570	0.7258	0.9553	0.9854	0.9543	0.8769	0.9525
SBAG	$\pm 0.0142$	$\pm 0.0492$	$\pm 0.0399$	$\pm 0.0523$	$\pm 0.0644$	$\pm 0.0621$	$\pm 0.1315$	$\pm 0.0644$
LIDAC	0.9334	0.9662	0.2830	0.9656	0.9825	0.9115	0.8420	0.9073
UBAG	$\pm 0.0196$	$\pm 0.0099$	$\pm 0.0757$	$\pm 0.0102$	$\pm 0.0279$	$\pm 0.0506$	$\pm 0.1243$	$\pm 0.0528$
SBO	0.9660	0.9462	0.7178	0.9439	0.9858	0.9545	0.8987	0.9528
SDO	$\pm 0.0153$	$\pm 0.0542$	$\pm 0.0448$	$\pm 0.0577$	$\pm 0.0290$	$\pm 0.0623$	$\pm 0.1244$	$\pm 0.0646$
DDO	0.9402	0.9697	0.3391	0.9691	0.9818	0.9327	0.8057	0.9300
RBO	$\pm 0.0347$	$\pm 0.0176$	$\pm 0.1441$	$\pm 0.0181$	$\pm 0.0283$	$\pm 0.0620$	$\pm 0.2371$	$\pm 0.0643$
EBO	0.9544	0.9769	0.4431	0.9765	0.9829	0.9315	0.8642	0.9285
EDU	$\pm 0.0340$	$\pm 0.0172$	$\pm 0.2470$	$\pm 0.0176$	$\pm 0.0282$	$\pm 0.0631$	$\pm 0.1432$	$\pm 0.0658$
BAC	0.9366	0.9679	0.3257	0.9672	0.9863	0.9547	0.9169	0.9530
DAC	$\pm 0.0292$	$\pm 0.0148$	$\pm 0.1712$	$\pm 0.0151$	$\pm 0.0292$	$\pm 0.0625$	$\pm 0.1327$	$\pm 0.0648$
E	0.9357	0.9674	0.2950	0.9668	0.9784	0.9094	0.7531	0.9055
Easy	$\pm 0.0235$	$\pm 0.0119$	$\pm 0.0914$	$\pm 0.0122$	$\pm 0.0266$	$\pm 0.0514$	±0.2110	$\pm 0.0535$
MNESM-	0.9995	0.9998	0.9846	0.9998	1±0	1±0	1.0	1±0
EL(default)	$\pm 0.0010$	$\pm 0.0005$	$\pm 0.0344$	$\pm 0.0005$	1±0	1±0	1±0	1±0
MNESM- EL	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0

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## A.5 表 4.23 的完整结果

表 A.5 为第四章中 4.3.4 节处表 4.23 的完整结果。主要记录了第四章提出的 MNESM-EL 算 法与最先进的集成算法在 ACC、AUC、F-M 和 G-M 四个评价指标的对比结果。

表 4.23 SOTA 算法和本节提出算法之间的比较结果

Table 4.23 Comparison results between SOTA and proposed algorithm

数据集		Gla	ss1			Wisconsin					
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M			
E. CE	0.7756	0.7687	0.7008	0.7668	0.9326	0.9337	0.9072	0.9335			
EASE	$\pm 0.0801$	$\pm 0.0901$	±0.1109	$\pm 0.0911$	±0.0224	±0.0234	$\pm 0.0303$	±0.0234			
CDE	0.7754	0.7546	0.6845	0.7509	0.9238	0.9154	0.8915	0.9140			
SPE	$\pm 0.0646$	$\pm 0.0679$	$\pm 0.0901$	$\pm 0.0694$	$\pm 0.0149$	$\pm 0.0055$	$\pm 0.0150$	$\pm 0.0057$			
тип	0.7942	0.7872	0.7238	0.7848	0.9253	0.9262	0.8975	0.9259			
HUE	$\pm 0.0351$	$\pm 0.0430$	$\pm 0.0462$	$\pm 0.0426$	$\pm 0.0202$	±0.0182	$\pm 0.0255$	$\pm 0.0183$			
ECLID4	0.7620	0.7543	0.6849	0.7511	0.9385	0.9401	0.9154	0.9399			
ECUBoost	$\pm 0.0776$	$\pm 0.0821$	$\pm 0.0934$	$\pm 0.0816$	$\pm 0.0228$	$\pm 0.0218$	$\pm 0.0308$	$\pm 0.0218$			
MNESM-	0.8178	0.8114	0.7467	0.7852	0.9795	0.9823	0.9714	0.9822			
EL(default)	$\pm 0.0723$	$\pm 0.0720$	$\pm 0.1329$	$\pm 0.1040$	$\pm 0.0120$	$\pm 0.0112$	$\pm 0.0168$	$\pm 0.0112$			
MNESM-	0.9859	0.9862	0.9802	0.9860	0.9927	0.9924	0.9895	0.9924			
EL	±0.0128	±0.0141	±0.0181	±0.0143	±0.0090	±0.0091	±0.0129	±0.0091			
数据集		Pir	na	Pima			Iris0				
ノエ ハ ヤド エー											
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M			
	ACC 0.6523	AUC 0.6474	F-M 0.5590	G-M 0.6466							
评价指标 EASE					ACC 1±0	AUC 1±0	F-M 1±0	G-M 1±0			
EASE	0.6523	0.6474	0.5590	0.6466	1±0	1±0	1±0	1±0			
	0.6523 ±0.0306	0.6474 ±0.0297	0.5590 ±0.0319	0.6466 ±0.0297							
EASE SPE	0.6523 ±0.0306 0.6470	0.6474 ±0.0297 0.6335	0.5590 ±0.0319 0.5372	0.6466 ±0.0297 0.6311	1±0 1±0	1±0 1±0	1±0 1±0	1±0 1±0			
EASE	$0.6523$ $\pm 0.0306$ $0.6470$ $\pm 0.0277$	$0.6474$ $\pm 0.0297$ $0.6335$ $\pm 0.0344$	$0.5590$ $\pm 0.0319$ $0.5372$ $\pm 0.0446$	$0.6466$ $\pm 0.0297$ $0.6311$ $\pm 0.0359$	1±0	1±0	1±0	1±0			
EASE SPE HUE	$0.6523$ $\pm 0.0306$ $0.6470$ $\pm 0.0277$ $0.6588$	$0.6474$ $\pm 0.0297$ $0.6335$ $\pm 0.0344$ $0.6419$	$0.5590$ $\pm 0.0319$ $0.5372$ $\pm 0.0446$ $0.5455$	$0.6466$ $\pm 0.0297$ $0.6311$ $\pm 0.0359$ $0.6392$	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0			
EASE SPE	$0.6523$ $\pm 0.0306$ $0.6470$ $\pm 0.0277$ $0.6588$ $\pm 0.0338$	$0.6474$ $\pm 0.0297$ $0.6335$ $\pm 0.0344$ $0.6419$ $\pm 0.0339$	$0.5590$ $\pm 0.0319$ $0.5372$ $\pm 0.0446$ $0.5455$ $\pm 0.0387$	$0.6466$ $\pm 0.0297$ $0.6311$ $\pm 0.0359$ $0.6392$ $\pm 0.0339$	1±0 1±0	1±0 1±0	1±0 1±0	1±0 1±0			
EASE SPE HUE	$0.6523$ $\pm 0.0306$ $0.6470$ $\pm 0.0277$ $0.6588$ $\pm 0.0338$ $0.6745$	$0.6474$ $\pm 0.0297$ $0.6335$ $\pm 0.0344$ $0.6419$ $\pm 0.0339$ $0.6437$	$0.5590$ $\pm 0.0319$ $0.5372$ $\pm 0.0446$ $0.5455$ $\pm 0.0387$ $0.5357$	$0.6466$ $\pm 0.0297$ $0.6311$ $\pm 0.0359$ $0.6392$ $\pm 0.0339$ $0.6326$	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0			
EASE  SPE  HUE  ECUBoost	$0.6523$ $\pm 0.0306$ $0.6470$ $\pm 0.0277$ $0.6588$ $\pm 0.0338$ $0.6745$ $\pm 0.0314$	$0.6474$ $\pm 0.0297$ $0.6335$ $\pm 0.0344$ $0.6419$ $\pm 0.0339$ $0.6437$ $\pm 0.0312$	$0.5590$ $\pm 0.0319$ $0.5372$ $\pm 0.0446$ $0.5455$ $\pm 0.0387$ $0.5357$ $\pm 0.0431$	$0.6466$ $\pm 0.0297$ $0.6311$ $\pm 0.0359$ $0.6392$ $\pm 0.0339$ $0.6326$ $\pm 0.0367$	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0	1±0 1±0 1±0			
EASE  SPE  HUE  ECUBoost  MNESM-	$0.6523$ $\pm 0.0306$ $0.6470$ $\pm 0.0277$ $0.6588$ $\pm 0.0338$ $0.6745$ $\pm 0.0314$ $0.7616$	$0.6474$ $\pm 0.0297$ $0.6335$ $\pm 0.0344$ $0.6419$ $\pm 0.0339$ $0.6437$ $\pm 0.0312$ $0.7683$	$0.5590$ $\pm 0.0319$ $0.5372$ $\pm 0.0446$ $0.5455$ $\pm 0.0387$ $0.5357$ $\pm 0.0431$ $0.6969$	$0.6466$ $\pm 0.0297$ $0.6311$ $\pm 0.0359$ $0.6392$ $\pm 0.0339$ $0.6326$ $\pm 0.0367$ $0.7574$	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0	1±0 1±0 1±0 1±0			

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集		Yea	ıst1			Habe	rman	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
FACE	0.7358	0.7256	0.6054	0.7241	0.6312	0.5877	0.4199	0.5792
EASE	$\pm 0.0238$	$\pm 0.0244$	$\pm 0.0311$	$\pm 0.0248$	$\pm 0.0802$	±0.0779	$\pm 0.0827$	$\pm 0.0792$
CDE	0.7237	0.7040	0.5804	0.7015	0.5846	0.5823	0.4259	0.5807
SPE	$\pm 0.0408$	$\pm 0.0357$	$\pm 0.0441$	$\pm 0.0355$	$\pm 0.0690$	$\pm 0.0730$	$\pm 0.0793$	$\pm 0.0720$
	0.7243	0.7058	0.5818	0.7042	0.5819	0.5339	0.3559	0.5188
HUE	$\pm 0.0278$	$\pm 0.0278$	$\pm 0.0353$	$\pm 0.0280$	$\pm 0.0796$	$\pm 0.0715$	$\pm 0.0764$	$\pm 0.0707$
ECLID (	0.7385	0.7193	0.5986	0.7175	0.4932	0.5519	0.4132	0.5327
ECUBoost	$\pm 0.0191$	$\pm 0.0161$	$\pm 0.0205$	$\pm 0.0162$	$\pm 0.0634$	$\pm 0.0743$	$\pm 0.0719$	$\pm 0.0719$
MNESM-	0.7251	0.7313	0.6110	0.7288	0.7661	0.7193	0.5744	0.6934
EL(default)	$\pm 0.0411$	$\pm 0.0364$	$\pm 0.0421$	$\pm 0.0377$	$\pm 0.0427$	$\pm 0.0457$	$\pm 0.0431$	$\pm 0.0683$
MNESM-	0.7985	0.7501	0.6388	0.7379	0.9560	0.9570	0.9564	0.9238
EL	±0.0225	±0.0458	±0.0622	±0.0674	±0.0254	±0.0112	±0.0110	±0.0387
数据集		Vehi	icle2			Veh	icle3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.9645	0.9559	0.9257	0.9556	0.7623	0.7281	0.5815	0.7242
EASE	$\pm 0.0134$	$\pm 0.0189$	$\pm 0.0280$	$\pm 0.0191$	$\pm 0.0278$	$\pm 0.0367$	$\pm 0.0494$	$\pm 0.0387$
SPE	0.9645	0.9595	0.9328	0.9593	0.7553	0.7206	0.5713	0.7168
SPE	$\pm 0.0158$	$\pm 0.0166$	$\pm 0.0294$	$\pm 0.0167$	$\pm 0.0079$	$\pm 0.0073$	$\pm 0.0100$	$\pm 0.0088$
HUE	0.9538	0.9525	0.9149	0.9523	0.7270	0.7333	0.5783	0.7311
HOL	$\pm 0.0219$	$\pm 0.0178$	$\pm 0.0375$	$\pm 0.0178$	$\pm 0.0374$	$\pm 0.0376$	$\pm 0.0438$	$\pm 0.0363$
ECUBoost	0.9704	0.9636	0.9434	0.9632	0.7647	0.6860	0.5308	0.6672
ECODOOSI	$\pm 0.0106$	$\pm 0.0126$	$\pm 0.0183$	$\pm 0.0128$	$\pm 0.0285$	$\pm 0.0193$	$\pm 0.0293$	$\pm 0.0172$
MNESM-	0.9752	0.9682	0.9520	0.9681	0.8144	0.7996	0.6777	0.7967
EL(default)	$\pm 0.0153$	$\pm 0.0174$	$\pm 0.0295$	$\pm 0.0175$	$\pm 0.0424$	$\pm 0.0273$	$\pm 0.0457$	$\pm 0.0264$
MNESM-	0.9834	0.9784	0.9679	0.9783	0.8475	0.8356	0.7279	0.8350
EL	±0.0088	±0.0137	±0.0171	±0.0138	±0.0218	±0.0207	±0.0305	±0.0210
数据集		Glass-0-1-2	-3_vs_4-5-	6		Veh	icle0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EACE	0.9346	0.9173	0.8668	0.9157	0.9597	0.9545	0.9181	0.9544
EASE	$\pm 0.0307$	$\pm 0.0380$	$\pm 0.0569$	±0.0391	±0.0196	±0.0184	$\pm 0.0376$	±0.0184

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集	C	3lass-0-1-2	-3_vs_4-5-	6		Vehi	cle0	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8967	0.8558	0.7840	0.8472	0.9598	0.9459	0.9154	0.9451
SPE	$\pm 0.0448$	±0.0552	±0.0720	$\pm 0.0607$	±0.0137	±0.0160	±0.0267	$\pm 0.0168$
I III III	0.7270	0.7333	0.5783	0.7311	0.9491	0.9581	0.9004	0.9579
HUE	$\pm 0.0374$	±0.0376	±0.0438	±0.0363	$\pm 0.0087$	$\pm 0.0087$	±0.0162	$\pm 0.0086$
ECLE	0.9345	0.9172	0.8640	0.9133	0.9539	0.9542	0.9084	0.9535
ECUBoost	$\pm 0.0175$	±0.0419	±0.0376	$\pm 0.0461$	±0.0195	$\pm 0.0203$	$\pm 0.0357$	$\pm 0.0206$
MNESM-	0.9764	0.9708	0.9504	0.9704	0.9645	0.9663	0.9282	0.9663
EL(default)	$\pm 0.0168$	$\pm 0.0274$	$\pm 0.0354$	$\pm 0.0278$	$\pm 0.0168$	±0.0176	$\pm 0.0333$	$\pm 0.0176$
MNESM-	1.0	1.0	1.0	1.0	0.9716	0.9779	0.9459	0.9777
EL	1±0	1±0	1±0	1±0	±0.0341	±0.0247	±0.0622	±0.0250
数据集		Eco	olil			Eco	oli2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.8989	0.8607	0.7802	0.8560	0.9256	0.8871	0.7886	0.8840
EASE	$\pm 0.0314$	$\pm 0.0500$	$\pm 0.0693$	$\pm 0.0536$	$\pm 0.0523$	$\pm 0.0689$	±0.1235	$\pm 0.0704$
CDE	0.8841	0.8484	0.7524	0.8406	0.9435	0.8942	0.8214	0.8895
SPE	$\pm 0.0349$	$\pm 0.0653$	$\pm 0.0802$	$\pm 0.0732$	$\pm 0.0303$	$\pm 0.0525$	$\pm 0.0922$	$\pm 0.0569$
шт	0.8571	0.8704	0.7476	0.8693	0.8838	0.8846	0.7035	0.8831
HUE	$\pm 0.0545$	$\pm 0.0412$	$\pm 0.0791$	$\pm 0.0418$	$\pm 0.0176$	$\pm 0.0208$	$\pm 0.0223$	$\pm 0.0203$
ECLIDaget	0.9136	0.8569	0.7981	0.8488	0.8746	0.8575	0.7371	0.8454
ECUBoost	$\pm 0.0404$	$\pm 0.0625$	$\pm 0.0987$	$\pm 0.0684$	$\pm 0.1476$	$\pm 0.0961$	$\pm 0.1897$	$\pm 0.1095$
MNESM-	0.9345	0.9438	0.8721	0.9432	0.9613	0.9533	0.8828	0.9530
EL(default)	$\pm 0.0249$	$\pm 0.0164$	$\pm 0.0410$	$\pm 0.0166$	$\pm 0.0171$	$\pm 0.0311$	$\pm 0.0524$	$\pm 0.0313$
MNESM-	0.9910	0.9847	0.9793	0.9844	0.9910	0.9865	0.9713	0.9862
EL	±0.0200	±0.0341	±0.0463	±0.0349	±0.0134	±0.0218	±0.0416	±0.0223
数据集		Gla	iss6			Yea	ıst3	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.9486	0.9250	0.8197	0.9210	0.9353	0.8826	0.7335	0.8791
EASE	$\pm 0.0092$	$\pm 0.0623$	$\pm 0.0512$	$\pm 0.0676$	$\pm 0.0062$	$\pm 0.0331$	$\pm 0.0327$	$\pm 0.0354$
CDE	0.9439	0.8944	0.7921	0.8861	0.9366	0.8810	0.7392	0.8779
SPE	$\pm 0.0347$	$\pm 0.0963$	±0.1383	±0.1090	±0.0157	±0.0263	$\pm 0.0576$	$\pm 0.0281$

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集			ss6		na propose	Yea		
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.9302	0.9175	0.7967	0.9157	0.9110	0.8964	0.6876	0.8955
HUE	±0.0465	±0.0435	±0.1158	±0.0441	±0.0208	±0.0203	±0.0478	±0.0213
7.67.7	0.9485	0.9250	0.8387	0.9203	0.9366	0.8969	0.7477	0.8942
ECUBoost	±0.0519	±0.0669	±0.1382	±0.0721	±0.0152	±0.0334	±0.0422	±0.0365
MNESM-	0.9812	0.9892	0.9359	0.9891	0.9535	0.9175	0.8040	0.9159
EL(default)	±0.0199	±0.0113	±0.0690	±0.0115	$\pm 0.0080$	±0.0314	±0.0366	$\pm 0.0328$
MNESM-	0.9953	0.9973	0.9846	0.9973	0.9656	0.9404	0.8563	0.9394
EL	±0.0104	±0.0060	±0.0344	±0.0061	±0.0168	±0.0258	±0.0595	±0.0267
数据集		Eco	oli3			Yeast-	2-vs-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
FACE	0.9078	0.8097	0.6100	0.7882	0.9416	0.8623	0.7188	0.8517
EASE	$\pm 0.0472$	$\pm 0.1166$	$\pm 0.1820$	$\pm 0.1378$	$\pm 0.0261$	$\pm 0.0856$	±0.1360	$\pm 0.0979$
CDE	0.8986	0.7919	0.5695	0.7721	0.9572	0.9316	0.8096	0.9302
SPE	$\pm 0.0259$	$\pm 0.0953$	$\pm 0.1207$	$\pm 0.1094$	$\pm 0.0131$	$\pm 0.0273$	$\pm 0.0486$	$\pm 0.0285$
HUE	0.8572	0.8698	0.5736	0.8693	0.8910	0.9047	0.6277	0.9037
HUE	$\pm 0.0444$	$\pm 0.0447$	$\pm 0.0911$	$\pm 0.0443$	$\pm 0.0187$	$\pm 0.0378$	$\pm 0.0546$	$\pm 0.0374$
ECI Doost	0.9195	0.8414	0.6571	0.8274	0.9163	0.8661	0.6630	0.8594
ECUBoost	$\pm 0.0336$	$\pm 0.0921$	$\pm 0.1281$	$\pm 0.1096$	$\pm 0.0265$	$\pm 0.0434$	$\pm 0.0430$	$\pm 0.0508$
MNESM-	0.9166	0.8776	0.6499	0.8553	0.9669	0.9371	0.8404	0.9344
EL(default)	$\pm 0.0135$	$\pm 0.1354$	$\pm 0.1227$	$\pm 0.1824$	$\pm 0.0148$	$\pm 0.0604$	$\pm 0.0791$	$\pm 0.0651$
MNESM-	0.9852	0.9917	0.9367	0.9917	0.9942	0.9789	0.9694	0.9784
EL	±0.0148	±0.0083	±0.0625	±0.0083	±0.0053	±0.0265	±0.0280	±0.0272
数据集		Yeast-0-5-	6-7-9-vs-4			Glass-0-	1-6_vs_2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.8806	0.8095	0.5387	0.8021	0.7916	0.5700	0.2004	0.4436
EASE	$\pm 0.0233$	$\pm 0.0620$	$\pm 0.0817$	$\pm 0.0676$	$\pm 0.0600$	$\pm 0.0783$	$\pm 0.1249$	$\pm 0.2274$
SPE	0.8599	0.8016	0.5109	0.7956	0.7759	0.7054	0.2966	0.6121
SEL	$\pm 0.0494$	$\pm 0.0910$	$\pm 0.1306$	$\pm 0.0947$	$\pm 0.0543$	$\pm 0.1384$	$\pm 0.1573$	$\pm 0.3086$
HUE	0.8086	0.7813	0.4440	0.7794	0.6399	0.7059	0.2799	0.6843
	$\pm 0.0549$	$\pm 0.0486$	±0.1000	±0.0493	±0.1113	$\pm 0.0675$	$\pm 0.0489$	$\pm 0.0737$

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集		Yeast-0-5-	6-7-9-vs-4		• •		1-6_vs_2	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.8977	0.7840	0.5538	0.7672	0.6197	0.5061	0.1207	0.3878
ECUBoost	±0.0299	±0.0367	±0.0394	±0.0488	±0.1118	±0.1231	±0.0815	±0.2236
MNESM-	0.8486	0.8813	0.5432	0.8801	0.8086	0.8583	0.4715	0.8525
EL(default)	±0.0285	±0.0309	±0.0482	±0.0305	±0.0927	±0.0779	±0.1238	±0.0793
MNESM-	0.9593	0.8705	0.7214	0.8224	0.9842	0.9964	0.9643	0.9964
EL	±0.0258	±0.1821	±0.3026	±0.2851	±0.0444	±0.0071	±0.0714	±0.0072
数据集		Gla	ss2			Yeas	t1vs7	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EAGE	0.7944	0.7202	0.3147	0.6918	0.8323	0.7088	0.2996	0.6767
EASE	±0.0165	±0.1439	±0.1203	±0.1640	±0.0389	±0.0945	±0.0735	±0.1230
CDE	0.7849	0.6842	0.2911	0.6617	0.7581	0.7001	0.2519	0.6888
SPE	$\pm 0.0237$	$\pm 0.0887$	$\pm 0.0997$	±0.1144	$\pm 0.0205$	$\pm 0.0920$	$\pm 0.0564$	$\pm 0.0945$
I III IIC	0.6966	0.7596	0.3145	0.7518	0.6950	0.6663	0.2188	0.6430
HUE	$\pm 0.0859$	$\pm 0.0851$	$\pm 0.0845$	$\pm 0.0819$	$\pm 0.0887$	$\pm 0.1180$	$\pm 0.0905$	$\pm 0.1286$
ECLID 4	0.7988	0.7003	0.3233	0.6831	0.8583	0.7537	0.3722	0.7390
ECUBoost	±0.0549	$\pm 0.0758$	$\pm 0.0975$	$\pm 0.0928$	$\pm 0.0308$	$\pm 0.0489$	$\pm 0.0445$	$\pm 0.0603$
MNESM-	0.8543	0.9199	0.6005	0.9149	0.7525	0.8159	0.3228	0.8072
EL(default)	$\pm 0.1076$	$\pm 0.0594$	$\pm 0.2240$	$\pm 0.0638$	$\pm 0.0637$	$\pm 0.0870$	$\pm 0.0673$	$\pm 0.0844$
MNESM-	0.9937	0.9724	0.9286	0.9936	0.9236	0.8817	0.5934	0.8741
EL	±0.0073	±0.0373	±0.0825	±0.0073	±0.0303	±0.0933	±0.0311	±0.1020
数据集		Gla	ss4			Ec	oli4	_
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EACE	0.9486	0.8160	0.5895	0.7847	0.9582	0.8373	0.6716	0.8096
EASE	$\pm 0.0270$	$\pm 0.1426$	$\pm 0.2248$	$\pm 0.1711$	$\pm 0.0274$	$\pm 0.1251$	$\pm 0.2234$	$\pm 0.1669$
CDE	0.9486	0.8943	0.6599	0.8842	0.9642	0.8873	0.7365	0.8756
SPE	$\pm 0.0227$	$\pm 0.1058$	$\pm 0.1688$	$\pm 0.1187$	$\pm 0.0223$	$\pm 0.0871$	$\pm 0.1263$	$\pm 0.1012$
ти по	0.8321	0.8626	0.4204	0.8502	0.8747	0.8865	0.4833	0.8808
HUE	$\pm 0.0919$	$\pm 0.0873$	±0.1110	$\pm 0.0989$	±0.0515	±0.1137	±0.1598	±0.1211
ECLTD 4	0.9627	0.9492	0.7690	0.9466	0.9612	0.8623	0.6978	0.8436
ECUBoost	±0.0237	$\pm 0.0710$	±0.1489	$\pm 0.0759$	±0.0152	±0.1014	$\pm 0.0939$	±0.1202

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集		Gla	ss4		• •	Ec	oli4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-	0.9847	0.9403	0.8857	0.9346	0.9653	0.9035	0.7389	0.8985
EL(default)	±0.0133	±0.0928	±0.1030	±0.1025	$\pm 0.0087$	$\pm 0.0700$	±0.0674	$\pm 0.0742$
MNESM-	4.0	4.0	4 . 0	4.0	4.0	4.0	4.0	4 . 0
EL	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
数据集		Abaloı	ne9-18			Shuttle-	c2-vs-c4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EACE	0.9083	0.7935	0.4554	0.7758	1 . 0	1.0	1 1 0	1.0
EASE	$\pm 0.0205$	$\pm 0.0862$	±0.1128	$\pm 0.1065$	1±0	1±0	1±0	1±0
CDE	0.8768	0.7574	0.3636	0.7407	0.9923	0.9000	0.8000	0.8000
SPE	$\pm 0.0096$	±0.0591	$\pm 0.0334$	$\pm 0.0688$	±0.0153	±0.2000	$\pm 0.4000$	$\pm 0.4000$
тип	0.8371	0.7571	0.3202	0.7501	1.0	1.0	1.0	1.0
HUE	$\pm 0.0160$	$\pm 0.0417$	$\pm 0.0416$	$\pm 0.0469$	1±0	1±0	1±0	1±0
ECLID4	0.8617	0.7951	0.3780	0.7766	0.9923	0.9500	0.9333	0.9414
ECUBoost	$\pm 0.0470$	$\pm 0.0890$	$\pm 0.0694$	$\pm 0.1180$	$\pm 0.0153$	$\pm 0.0999$	$\pm 0.1333$	$\pm 0.1171$
MNESM-	0.9429	0.7631	0.5238	0.7276	1±0	1±0	1±0	1±0
EL(default)	$\pm 0.0141$	$\pm 0.0830$	$\pm 0.0412$	$\pm 0.1167$	1±0	1±0	1±0	1±0
MNESM-	0.9829	0.9026	0.8375	0.8975	1.0	1.0	1.0	1.0
EL	±0.0048	±0.0442	±0.0530	±0.0489	1±0	1±0	1±0	1±0
数据集		Gla	ss5			Yeas	t2vs8	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	0.9812	0.8926	0.7142	0.7925	0.9169	0.7653	0.3915	0.7433
EASE	$\pm 0.0271$	$\pm 0.1968$	$\pm 0.3938$	$\pm 0.3965$	$\pm 0.0287$	$\pm 0.0626$	$\pm 0.1006$	$\pm 0.0756$
CDE	0.9812	0.9902	0.8476	0.9900	0.8609	0.7600	0.2637	0.7180
SPE	$\pm 0.0271$	$\pm 0.0142$	$\pm 0.1890$	$\pm 0.0144$	$\pm 0.0267$	$\pm 0.1574$	$\pm 0.1019$	$\pm 0.2037$
шт	0.8788	0.9365	0.4504	0.9336	0.7923	0.7959	0.2517	0.7895
HUE	$\pm 0.0677$	$\pm 0.0356$	$\pm 0.1291$	$\pm 0.0382$	$\pm 0.0579$	$\pm 0.0973$	$\pm 0.0684$	$\pm 0.0990$
ECI Do cot	0.9112	0.9536	0.5454	0.9518	0.8318	0.7448	0.2510	0.7334
ECUBoost	$\pm 0.0629$	±0.0330	$\pm 0.2082$	$\pm 0.0348$	$\pm 0.0444$	$\pm 0.0453$	$\pm 0.0470$	$\pm 0.0569$
MNESM-	0.9845	0.9126	0.8222	0.8983	0.8824	0.8988	0.4218	0.8878
EL(default)	$\pm 0.0134$	±0.1409	±0.1678	±0.1657	$\pm 0.0627$	$\pm 0.0418$	±0.1143	$\pm 0.0438$

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集		Gla	ss5			Yeas	t2vs8	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
MNESM-					0.9917	0.9000	0.8762	0.8944
EL	1±0	1±0	1±0	1±0	±0.0087	±0.1046	±0.1372	±0.1212
数据集		Yea	ıst4			Winequa	lity-red-4	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
FACE	0.9083	0.7893	0.3316	0.7725	0.7785	0.6124	0.1142	0.5779
EASE	$\pm 0.0164$	$\pm 0.0782$	$\pm 0.0671$	$\pm 0.0917$	$\pm 0.0302$	±0.0568	$\pm 0.0266$	$\pm 0.0831$
CDE	0.8712	0.8000	0.2791	0.7951	0.7173	0.6168	0.1091	0.6010
SPE	$\pm 0.0095$	$\pm 0.0392$	$\pm 0.0350$	$\pm 0.0437$	$\pm 0.0542$	±0.0693	$\pm 0.0345$	$\pm 0.0795$
тип	0.8167	0.8112	0.2351	0.8094	0.6960	0.6892	0.1294	0.6877
HUE	$\pm 0.0300$	$\pm 0.0534$	$\pm 0.0373$	±0.0520	$\pm 0.0204$	±0.0451	±0.0156	$\pm 0.0459$
ECLE	0.9204	0.8176	0.3891	0.8087	0.6292	0.5906	0.0932	0.5529
ECUBoost	$\pm 0.0229$	$\pm 0.0429$	$\pm 0.0734$	$\pm 0.0485$	$\pm 0.1777$	±0.0374	±0.0192	$\pm 0.0582$
MNESM-	0.8719	0.9337	0.3693	0.9308	0.6232	0.6880	0.1228	0.6828
EL(default)	$\pm 0.0671$	$\pm 0.0347$	$\pm 0.1069$	$\pm 0.0377$	$\pm 0.0569$	$\pm 0.0603$	$\pm 0.0244$	$\pm 0.0589$
MNESM-	0.9535	0.7951	0.4398	0.7744	0.9694	0.7268	0.2998	0.6911
EL	±0.0121	$\pm 0.0709$	±0.0426	$\pm 0.0883$	±0.0034	±0.0767	±0.0590	±0.1078
数据集		Yeast-1-2	-8-9-vs-7			Yea	ast5	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
FACE	0.7877	0.6646	0.1424	0.6491	0.9770	0.9006	0.6854	0.8956
EASE	$\pm 0.0520$	$\pm 0.0267$	$\pm 0.0266$	$\pm 0.0288$	$\pm 0.0068$	$\pm 0.0427$	$\pm 0.0728$	$\pm 0.0481$
CDE	0.6980	0.6989	0.1274	0.6940	0.9757	0.8892	0.6666	0.8815
SPE	$\pm 0.0373$	$\pm 0.0447$	$\pm 0.0117$	$\pm 0.0469$	$\pm 0.0107$	$\pm 0.0673$	$\pm 0.1285$	$\pm 0.0777$
шт	0.6737	0.6703	0.1129	0.6592	0.9501	0.9513	0.5349	0.9509
HUE	$\pm 0.0439$	$\pm 0.0719$	$\pm 0.0223$	$\pm 0.0845$	$\pm 0.0100$	$\pm 0.0299$	$\pm 0.0514$	$\pm 0.0300$
ECLID t	0.6737	0.7025	0.1559	0.6843	0.9770	0.8885	0.6720	0.8794
ECUBoost	$\pm 0.1902$	$\pm 0.1043$	$\pm 0.0735$	$\pm 0.1096$	$\pm 0.0077$	$\pm 0.0738$	$\pm 0.0938$	$\pm 0.0842$
MNESM-	0.8504	0.8152	0.2988	0.8035	0.9650	0.9483	0.6228	0.9475
EL(default)	±0.1242	±0.0318	±0.1210	±0.0299	$\pm 0.0140$	±0.0256	$\pm 0.0757$	$\pm 0.0260$
MNESM-	0.9762	0.7056	0.5227	0.6403	0.9811	0.9688	0.7589	0.9682
EL	±0.0037	$\pm 0.0551$	±0.0321	$\pm 0.0890$	±0.0111	±0.0291	±0.1097	±0.0297

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集		Yea	ıst6		W		white-3_vs	
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
	0.9420	0.8030	0.3509	0.7842	0.9433	0.7511	0.2923	0.6427
EASE	±0.0124	$\pm 0.0698$	±0.0635	$\pm 0.0874$	±0.0214	±0.1385	±0.1600	±0.3257
an E	0.9103	0.8425	0.3038	0.8302	0.8888	0.7232	0.1834	0.6890
SPE	$\pm 0.0311$	±0.1048	±0.0909	±0.1192	±0.0312	±0.0841	$\pm 0.0531$	±0.1201
	0.8786	0.8542	0.2482	0.8529	0.8022	0.7034	0.1153	0.6816
HUE	$\pm 0.0248$	$\pm 0.0245$	$\pm 0.0312$	$\pm 0.0265$	±0.0191	$\pm 0.0887$	$\pm 0.0293$	±0.1219
ECLID (	0.9615	0.8130	0.4507	0.7946	0.6188	0.6829	0.1007	0.6595
ECUBoost	$\pm 0.0083$	$\pm 0.0597$	$\pm 0.0919$	$\pm 0.0768$	±0.1883	$\pm 0.0831$	$\pm 0.0560$	$\pm 0.0964$
MNESM-	0.8882	0.9148	0.2941	0.9136	0.8889	0.8617	0.2522	0.8521
EL(default)	$\pm 0.0337$	±0.0416	$\pm 0.0620$	±0.0411	$\pm 0.0147$	±0.0779	$\pm 0.0589$	$\pm 0.0788$
MNESM-	0.9747	0.8999	0.6365	0.8937	0.9917	0.8736	0.7778	0.8595
EL	±0.0177	$\pm 0.0595$	±0.1070	$\pm 0.0651$	±0.0039	±0.1748	±0.1571	±0.2051
数据集	W	inequality-1	red-8_vs_6	-7	Kr-vs-k-zero_vs_eight			
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EACE	0.7964	0.5859	0.0732	0.4735	0.9863	0.9244	0.7045	0.9151
EASE	$\pm 0.0550$	$\pm 0.1207$	$\pm 0.0488$	$\pm 0.2590$	$\pm 0.0075$	$\pm 0.0983$	$\pm 0.1528$	$\pm 0.1137$
CDE	0.6257	0.6213	0.0623	0.5999	0.9678	0.8627	0.4549	0.8407
SPE	$\pm 0.0731$	$\pm 0.0944$	$\pm 0.0188$	$\pm 0.1044$	$\pm 0.0073$	$\pm 0.1268$	$\pm 0.1158$	$\pm 0.1573$
HUE	0.5918	0.6367	0.0638	0.6250	0.9171	0.9577	0.3116	0.9568
HUE	$\pm 0.0551$	$\pm 0.0701$	$\pm 0.0046$	$\pm 0.0588$	$\pm 0.0135$	$\pm 0.0069$	$\pm 0.0331$	$\pm 0.0072$
ECUBoost	0.2350	0.5604	0.0480	0.4130	0.8712	0.8951	0.2418	0.8914
ECCBOOST	$\pm 0.1469$	$\pm 0.0913$	$\pm 0.0092$	$\pm 0.1613$	$\pm 0.0521$	$\pm 0.0940$	$\pm 0.1103$	$\pm 0.0970$
MNESM-	0.7903	0.8110	0.1429	0.8019	0.9959	0.9979	0.9045	0.9979
EL(default)	$\pm 0.0981$	$\pm 0.0652$	$\pm 0.0000$	$\pm 0.0612$	$\pm 0.0029$	$\pm 0.0015$	$\pm 0.0648$	$\pm 0.0015$
MNESM-	0.8962	0.9183	0.2764	0.9097	0.9979	0.9990	0.9510	0.9990
EL	±0.0071	±0.0437	±0.0347	±0.0225	±0.0019	±0.0000	±0.0450	±0.0000
数据集		Shuttle-	-2_vs_5		Kddcu	p-buffer_o	verflow_vs	s_back
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EASE	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
SPE	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0

表 4.23 SOTA 算法和本节提出算法之间的比较结果(续)

Table 4.23 Comparison results between SOTA and proposed algorithm (continued)

数据集	4.23 Com		-2_vs_5			p-buffer_o		,
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
I W III	1.0	1.0	1.0	1.0	0.9995	0.9833	0.9818	0.9825
HUE	1±0	1±0	1±0	1±0	$\pm 0.0008$	$\pm 0.0333$	$\pm 0.0363$	±0.0348
ECI De est	1±0	1±0	1±0	1.0	0.9991	0.9666	0.9636	0.9651
ECUBoost	1±0	1±0	1±0	1±0	$\pm 0.0010$	$\pm 0.0408$	$\pm 0.0445$	±0.0426
MNESM-	0.9994	0.9997	0.9810	0.9997	0.9996	0.9833	0.9818	0.9826
EL(default)	$\pm 0.0008$	$\pm 0.0004$	$\pm 0.0261$	$\pm 0.0004$	$\pm 0.0010$	$\pm 0.0373$	$\pm 0.0407$	$\pm 0.0390$
MNESM-	1.0	1.0	1±0	1±0	1±0	1.0	1 + 0	1±0
EL	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0
数据集	K	Kr-vs-k-zer	o_vs_fiftee	en	Rootkit_imapvsback			
评价指标	ACC	AUC	F-M	G-M	ACC	AUC	F-M	G-M
EACE	0.9990	0.9797	0.9595	0.9786	0.9995	0.9800	0.9777	0.9788
EASE	$\pm 0.0011$	$\pm 0.0398$	$\pm 0.0498$	$\pm 0.0421$	$\pm 0.0008$	$\pm 0.0399$	$\pm 0.0444$	$\pm 0.0422$
CDE	0.9995	0.9997	0.9846	0.9997	0.9991	0.9550	0.9492	0.9520
SPE	$\pm 0.0009$	$\pm 0.0004$	$\pm 0.0307$	$\pm 0.0004$	$\pm 0.0011$	$\pm 0.0556$	$\pm 0.0630$	$\pm 0.0593$
HUE	0.9872	0.9771	0.6964	0.9763	0.9950	0.9479	0.8300	0.9446
HUE	$\pm 0.0099$	$\pm 0.0317$	$\pm 0.1634$	$\pm 0.0331$	$\pm 0.0078$	$\pm 0.0637$	$\pm 0.2357$	$\pm 0.0678$
ECLIDeest	1.0	1.0	1.0	1.0	0.9991	0.9600	0.9500	0.9549
ECUBoost	1±0	1±0	1±0	1±0	$\pm 0.0017$	$\pm 0.0799$	$\pm 0.1000$	$\pm 0.0901$
MNESM-	0.9995	0.9998	0.9846	0.9998	1±0	1±0	1±0	1±0
EL(default)	$\pm 0.0010$	$\pm 0.0005$	$\pm 0.0344$	$\pm 0.0005$	1±0	1±0	1±0	1±0
MNESM- EL	1±0	1±0	1±0	1±0	1±0	1±0	1±0	1±0

## A.6 表 4.27 的完整结果

表 A.6 为第四章中 4.3.4 节处表 4.27 的完整结果。主要记录了第四章提出的 MNESM-EL 算 法与基于样本生成的深度学习方法的对比结果。

表 4.27 与基于样本生成的深度学习方法的比较

Table 4.27 Comparison with sample generation based deep learning methods

数据集	算法	AUC	F-M	G-M
	CNN+SMOTE	0.6522±0.0381	$0.4668 \pm 0.0509$	0.6405±0.0399
	CNN+AE+GAN	$0.8376 \pm 0.0541$	$0.4303 \pm 0.0690$	0.8295±0.0556
	BED	$0.8495 \pm 0.0251$	$0.7584 \pm 0.0268$	$0.8467 \pm 0.0269$
Ecolil	RVGAN-TL	$0.8123 \pm 0.0510$	$0.7252 \pm 0.0654$	$0.7991 \pm 0.0583$
ECOIII	EAL-GAN	$0.9226 \pm 0.0441$	$0.6968 \pm 0.0960$	$0.8624 \pm 0.0518$
	DLE-ISMOTE	$0.7663 \pm 0.0599$	$0.5826 \pm 0.0710$	$0.7463 \pm 0.0910$
	MNESM-EL(default)	$0.9438 \pm 0.0164$	$0.8721 \pm 0.0410$	$0.9432 \pm 0.0166$
	MNESM-EL	0.9847±0.0341	0.9793±0.0463	0.9844±0.0349
	CNN+SMOTE	$0.8288 \pm 0.0831$	$0.4810 \pm 0.0636$	$0.8209 \pm 0.0851$
	CNN+AE+GAN	0.8325±0.0129	$0.4944 \pm 0.0305$	$0.8321 \pm 0.0134$
	BED	0.9197±0.0212	0.5941±0.0679	0.9159±0.0231
F 1'2	RVGAN-TL	$0.7443 \pm 0.0883$	$0.5621 \pm 0.1560$	$0.7031 \pm 0.1180$
Ecoli3	EAL-GAN	$0.9200 \pm 0.0574$	$0.6086 \pm 0.1530$	$0.8650 \pm 0.0664$
	DLE-ISMOTE	0.8452±0.0183	$0.5227 \pm 0.0227$	$0.8451 \pm 0.0185$
	MNESM-EL(default)	$0.8776 \pm 0.1354$	$0.6499 \pm 0.1227$	$0.8553 \pm 0.1824$
	MNESM-EL	0.9917±0.0083	0.9367±0.0625	0.9917±0.0083
	CNN+SMOTE	$0.6025 \pm 0.0765$	$0.2151\pm0.0601$	$0.5629 \pm 0.0842$
	CNN+AE+GAN	$0.6065 \pm 0.0932$	$0.2314 \pm 0.0872$	$0.5952 \pm 0.1070$
	BED	$0.7133 \pm 0.0775$	$0.2488 \pm 0.0416$	$0.6887 \pm 0.0682$
Class 0.1 ( ass 2	RVGAN-TL	0.5935±0.1600	0.1967±0.2410	0.3269±0.1560
Glass-0-1-6_vs_2	EAL-GAN	$0.6389 \pm 0.1290$	$0.3704 \pm 0.1250$	$0.5992 \pm 0.0997$
	DLE-ISMOTE	$0.6698 \pm 0.1210$	$0.2269\pm0.0769$	$0.6143 \pm 0.1400$
	MNESM-EL(default)	$0.8583 \pm 0.0779$	0.4715±0.1238	0.8525±0.0793
	MNESM-EL	0.9964±0.0071	0.9643±0.0714	0.9964±0.0072
Shuttle-c2-vs-c4	CNN+SMOTE	0.9957±0.0088	$0.9918 \pm 0.0112$	0.9957±0.0089
SHULLE-CZ-VS-C4	CNN+AE+GAN	0.9997±0.0007	$0.9959 \pm 0.0091$	$0.9997 \pm 0.0007$

表 4.27 与基于样本生成的深度学习方法的比较(续)

Table 4.27 Comparison with sample generation based deep learning methods (continued)

数据集	算法	AUC	F-M	G-M
Shuttle-c2-vs-c4	BED	1±0	1±0	1±0
	RVGAN-TL	1±0	1±0	1±0
	EAL-GAN	0.9960±0.0120	0.9940±0.0143	0.9905±0.0234
	DLE-ISMOTE	0.9791±0.0022	$0.9787 \pm 0.0054$	$0.9789 \pm 0.0028$
	MNESM-EL(default)	1±0	1±0	1±0
	MNESM-EL	1±0	1±0	1±0
	CNN+SMOTE	$0.8279 \pm 0.0325$	0.2963±0.0204	$0.8250\pm0.0349$
	CNN+AE+GAN	$0.7970 \pm 0.0335$	0.2983±0.0538	$0.7907 \pm 0.0380$
	BED	$0.8573 \pm 0.0080$	0.2508±0.0155	$0.8562 \pm 0.0084$
Yeast4	RVGAN-TL	0.6352±0.0755	0.3328±0.0716	$0.4948 \pm 0.0937$
	EAL-GAN	0.8764±0.0604	0.3045±0.1130	0.4533±0.1130
	DLE-ISMOTE	0.8552±0.0179	0.2910±0.0252	$0.8545 \pm 0.0181$
	MNESM-EL(default)	$0.9337 \pm 0.0347$	$0.3693 \pm 0.1069$	$0.9308 \pm 0.0377$
	MNESM-EL	$0.7951 \pm 0.0709$	0.4398±0.0426	0.7744±0.0883
	CNN+SMOTE	0.9242±0.0513	$0.4922 \pm 0.1120$	$0.9228 \pm 0.0560$
	CNN+AE+GAN	$0.9183 \pm 0.0398$	$0.4335 \pm 0.0560$	$0.9168 \pm 0.0408$
	BED	0.9785±0.0016	$0.5925 \pm 0.0168$	$0.9782 \pm 0.0016$
Vecat5	RVGAN-TL	$0.7991 \pm 0.0721$	$0.6638 \pm 0.0878$	$0.7685 \pm 0.0977$
Yeast5	EAL-GAN	$0.9715 \pm 0.0391$	$0.5556 \pm 0.0242$	$0.8094 \pm 0.0264$
	DLE-ISMOTE	$0.9687 \pm 0.0086$	$0.4810 \pm 0.0707$	$0.9682 \pm 0.0089$
	MNESM-EL(default)	$0.9483 \pm 0.0256$	$0.6228 \pm 0.0757$	$0.9475 \pm 0.0260$
	MNESM-EL	$0.9688 \pm 0.0291$	0.7589±0.1097	$0.9682 \pm 0.0297$
Yeast6	CNN+SMOTE	$0.8739 \pm 0.0517$	$0.2753 \pm 0.0567$	$0.8724 \pm 0.0532$
	CNN+AE+GAN	$0.8663 \pm 0.0744$	$0.2485 \pm 0.0550$	$0.8639 \pm 0.0754$
	BED	$0.8829 \pm 0.0291$	$0.2586 \pm 0.0147$	$0.8823 \pm 0.0282$
	RVGAN-TL	$0.7098 \pm 0.0678$	$0.4821 \pm 0.1540$	$0.6415 \pm 0.1160$
	EAL-GAN	$0.9336 \pm 0.0355$	$0.5476 \pm 0.0982$	$0.7020 \pm 0.0496$
	DLE-ISMOTE	0.9345±0.0186	$0.2717 \pm 0.0261$	$0.9321 \pm 0.0192$
	MNESM-EL(default)	0.9148±0.0416	$0.2941 \pm 0.0620$	$0.9136 \pm 0.0411$
	MNESM-EL	0.8999±0.0595	0.6365±0.1070	0.8937±0.0651

表 4.27 与基于样本生成的深度学习方法的比较(续)

Table 4.27 Comparison with sample generation based deep learning methods (continued)

数据集	算法	AUC	F-M	G-M
	CNN+SMOTE	0.6434±0.0762	0.0896±0.0288	0.6250±0.0934
	CNN+AE+GAN	0.6026±0.0315	$0.0550\pm0.0041$	0.6002±0.0327
	BED	0.6613±0.0621	0.0801±0.0142	0.6587±0.0619
Winequality-red-	RVGAN-TL	0.6470±0.0193	0.3800±0.0653	0.5447±0.0372
8_vs_6-7	EAL-GAN	0.5294±0.1690	$0.0400 \pm 0.1000$	$0.0000\pm0.0000$
	DLE-ISMOTE	0.5722±0.0810	0.0957±0.0791	0.5714±0.0865
	MNESM-EL(default)	$0.8110 \pm 0.0652$	$0.1429 \pm 0.0000$	$0.8019 \pm 0.0612$
	MNESM-EL	0.9183±0.0437	$0.2764 \pm 0.0347$	0.9097±0.0225
Shuttle-2_vs_5	CNN+SMOTE	0.9994±0.0008	$0.9636 \pm 0.0498$	$0.9994 \pm 0.008$
	CNN+AE+GAN	$0.9989 \pm 0.0004$	$0.9351 \pm 0.0237$	$0.9989 \pm 0.004$
	BED	0.9991±0.0008	$0.9453 \pm 0.0471$	$0.9991 \pm 0.008$
	RVGAN-TL	1±0	1±0	1±0
	EAL-GAN	1±0	1±0	1±0
	DLE-ISMOTE	$0.9992 \pm 0.0008$	$0.9545 \pm 0.0455$	$0.9992 \pm 0.008$
	MNESM-EL(default)	0.9997±0.0004	$0.9810 \pm 0.0261$	$0.9997 \pm 0.0004$
	MNESM-EL	1±0	1±0	1±0
Rootkit_imapvsback	CNN+SMOTE	0.9993±0.0006	$0.9414 \pm 0.0541$	$0.9993 \pm 0.0006$
	CNN+AE+GAN	0.9050±0.0102	$0.8532 \pm 0.1380$	$0.8935 \pm 0.1210$
	BED	1±0	1±0	1±0
	RVGAN-TL	1±0	1±0	1±0
	EAL-GAN	$0.9538 \pm 0.0092$	$0.9190 \pm 0.0174$	$0.9298 \pm 0.0161$
	DLE-ISMOTE	$0.9375 \pm 0.0625$	$0.9286 \pm 0.0714$	$0.9330 \pm 0.0670$
	MNESM-EL(default)	1±0	1±0	1±0
	MNESM-EL	1±0	1±0	1±0