

A Appendix

Table 1 presents the performance of the model under single-task learning and multi-task learning frameworks across four multi-class classification tasks. For each task, we evaluate four metrics: accuracy, AUC, F1 score, and maximum accuracy. The results are compared across different encoder backbones, and the table highlights the differences in performance between the single-task and multi-task setups.

Table 1. Performance comparison between single-task and multi-task learning across four gastric classification tasks using different encoders.

Encoder	Task	Index	Accuracy	AUC	F1-Score	Max Accuracy
Virchow	Single	GC	0.7246±0.0324	0.9027±0.0132	0.7220±0.0296	0.7665
		GA	0.7846±0.0189	0.8578±0.0251	0.7842±0.0183	0.8020
		AC	0.6016±0.0607	0.8611±0.0349	0.5891±0.0729	0.6751
		IM	0.7856±0.0679	0.9446±0.0397	0.7653±0.0663	0.8426
	Multi-task	GC	0.7398±0.0111	0.9100±0.0047	0.7367±0.0170	0.7994
		GA	0.8018±0.0073	0.8807±0.0069	0.7636±0.0369	0.8223
		AC	0.6625±0.0429	0.8935±0.0081	0.6883±0.0414	0.6751
		IM	0.8385±0.0100	0.9671±0.0028	0.8173±0.0164	0.8776
Conch	Single	GC	0.7250±0.0342	0.9035±0.0155	0.7494±0.0327	0.7704
		GA	0.7703±0.0287	0.8659±0.0202	0.7677±0.0293	0.8024
		AC	0.6473±0.0576	0.8867±0.0205	0.6353±0.0695	0.6904
		IM	0.8192±0.0556	0.9581±0.0144	0.8097±0.0513	0.8776
	Multi-task	GC	0.7581±0.0174	0.9174±0.0062	0.7545±0.0185	0.8173
		GA	0.7917±0.0059	0.8770±0.0058	0.7521±0.0399	0.8122
		AC	0.6544±0.0236	0.8956±0.0076	0.6725±0.0394	0.7310
		IM	0.8272±0.0103	0.9635±0.0033	0.8139±0.0097	0.8528
Prov	Single	GC	0.7460±0.0333	0.9018±0.0138	0.7437±0.0326	0.7817
		GA	0.7713±0.0277	0.8445±0.0348	0.7705±0.0264	0.8214
		AC	0.6290±0.0464	0.8737±0.0201	0.6107±0.0619	0.6802
		IM	0.8293±0.0138	0.9590±0.0062	0.8257±0.0174	0.8376
	Multi-task	GC	0.7530±0.0035	0.9025±0.0055	0.7508±0.0046	0.7614
		GA	0.7754±0.0120	0.8607±0.0152	0.7304±0.0385	0.8204
		AC	0.6321±0.0094	0.8869±0.0042	0.6672±0.0405	0.6548
		IM	0.8282±0.0110	0.9640±0.0035	0.8172±0.0068	0.8477
Uni	Single	GC	0.7429±0.0240	0.9046±0.0169	0.7402±0.0203	0.7817
		GA	0.7703±0.0287	0.8659±0.0202	0.7677±0.0293	0.8024
		AC	0.6473±0.0576	0.8867±0.0205	0.6353±0.0695	0.6802
		IM	0.8192±0.0556	0.9581±0.0144	0.8097±0.0513	0.8528
	Multi-task	GC	0.7368±0.0126	0.9034±0.0024	0.7323±0.0093	0.7614
		GA	0.7815±0.0060	0.8696±0.0047	0.7606±0.0232	0.8173
		AC	0.6280±0.0255	0.8702±0.0121	0.6567±0.0421	0.7107
		IM	0.8191±0.0064	0.9604±0.0024	0.8093±0.0282	0.8316

Table 2 presents the performance comparison between single-task learning and multi-task learning frameworks across four binary classification tasks using different encoders. The evaluation includes four metrics: Accuracy, AUC, F1-score, and Maximum Accuracy. The results highlight the differences between single-task and multi-task setups, allowing an assessment of the impact of multi-task learning on each classification task.

Table 2. Comparison between single-task and multi-task learning on four binary classification tasks using different encoders.

Encoder	Task	Index	Accuracy	AUC	F1-Score	Max Accuracy
Virchow	Single	GC	1(0)	1(0)	1(0)	1
		GA	0.8592±0.0303	0.9348±0.0049	0.8610±0.0289	0.8679
		AC	0.8273±0.0187	0.9347±0.0130	0.8266±0.0187	0.8532
		IM	0.9671±0.0131	0.9857±0.0072	0.9671±0.0131	0.9771
	Multi-task	GC	1(0)	1(0)	1(0)	1
		GA	0.8620±0.0071	0.9422±0.0031	0.8609±0.0096	0.8767
		AC	0.8437±0.0081	0.9467±0.0061	0.8257±0.0550	0.8984
		IM	0.9698±0.0085	0.9875±0.0027	0.9698±0.0085	0.9823
Conch	Single	GC	1(0)	1(0)	1(0)	1
		GA	0.8702±0.0169	0.9414±0.0148	0.8703±0.0173	0.8915
		AC	0.8208±0.0129	0.9333±0.0127	0.8208±0.0145	0.8852
		IM	0.9625±0.0142	0.9932±0.0039	0.9625±0.0142	0.9771
	Multi-task	GC	1(0)	1(0)	1(0)	1
		GA	0.8757±0.0059	0.9419±0.0050	0.8688±0.0075	0.8904
		AC	0.8528±0.0333	0.9461±0.0007	0.8778±0.0215	0.8927
		IM	0.9671±0.0060	0.9943±0.0019	0.9671±0.0060	0.9772
Prov	Single	GC	0.9982±0.0041	0.9973±0.0060	0.9982±0.0041	1
		GA	0.8601±0.0165	0.9218±0.0235	0.8608±0.0168	0.8808
		AC	0.8280±0.0454	0.9137±0.0604	0.8193±0.0510	0.8448
		IM	0.9488±0.0131	0.9786±0.0073	0.9488±0.0131	0.9664
	Multi-task	GC	0.9991±0.0009	1(0)	0.9991±0.0009	1
		GA	0.8720±0.0076	0.9408±0.0054	0.8702±0.0079	0.8904
		AC	0.8281±0.0125	0.9270±0.0092	0.8540±0.0349	0.8540
		IM	0.9543±0.0079	0.9765±0.0084	0.9543±0.0079	0.9726
Uni	Single	GC	1(0)	1(0)	1(0)	1
		GA	0.8711±0.0144	0.9430±0.0145	0.8713±0.0146	0.8887
		AC	0.8419±0.0308	0.9380±0.0066	0.8412±0.0316	0.8585
		IM	0.9708±0.0160	0.9866±0.0069	0.9708±0.0160	0.9772
	Multi-task	GC	1(0)	1(0)	1(0)	1
		GA	0.8739±0.0096	0.9440±0.0032	0.8740±0.0082	0.8995
		AC	0.8455±0.0044	0.9420±0.0033	0.8740±0.0243	0.8923
		IM	0.9644±0.0081	0.9892±0.0032	0.9643±0.0081	0.9771