

Table 1: Experimental results of our method UNREAL and other baselines on *four class-imbalanced node classification benchmark datasets* with $\rho = 10$. We report averaged balanced accuracy (bAcc,%) and F1-score (%) with the standard errors over 5 repetitions on the GNN architectures.

	Dataset	Cora		CiteSeer		PubMed		Amazon-Computers	
	Imbalance Ratio ($\rho = 10$)	bAcc.	F1	bAcc.	F1	bAcc.	F1	bAcc.	F1
GCN	Vanilla	62.82 \pm 1.43	61.67 \pm 1.59	38.72 \pm 1.88	28.74 \pm 3.21	65.64 \pm 1.72	56.97 \pm 3.17	80.01 \pm 0.71	71.56 \pm 0.81
	Re-Weight	65.36 \pm 1.15	64.97 \pm 1.39	44.69 \pm 1.78	38.61 \pm 2.37	69.06 \pm 1.84	64.08 \pm 2.97	80.93 \pm 1.30	73.99 \pm 2.20
	PC Softmax	68.04 \pm 0.82	67.84 \pm 0.81	50.18 \pm 0.55	46.14 \pm 0.14	72.46 \pm 0.80	70.27 \pm 0.94	81.54 \pm 0.76	73.30 \pm 0.51
	GraphSMOTE	66.39 \pm 0.56	65.49 \pm 0.93	44.87 \pm 1.12	39.20 \pm 1.62	67.91 \pm 0.64	62.68 \pm 1.92	79.48 \pm 0.47	72.63 \pm 0.76
	BalancedSoftmax	69.98 \pm 0.58	68.68 \pm 0.55	55.52 \pm 0.97	53.74 \pm 1.42	73.73 \pm 0.89	71.53 \pm 1.06	81.46 \pm 0.74	<u>74.31 \pm 0.51</u>
	BalancedSoftmax (w TAM)	69.94 \pm 0.45	69.54 \pm 0.47	56.73 \pm 0.71	56.15 \pm 0.78	74.62 \pm 0.97	72.25 \pm 1.30	82.36 \pm 0.67	72.94 \pm 1.43
	Renode	67.03 \pm 1.41	67.16 \pm 1.67	43.47 \pm 2.22	37.52 \pm 3.10	71.40 \pm 1.42	67.27 \pm 2.96	81.89 \pm 0.77	73.13 \pm 1.60
	Renode (w TAM)	68.26 \pm 1.84	68.11 \pm 1.97	46.20 \pm 1.17	39.96 \pm 2.76	72.63 \pm 2.03	68.28 \pm 3.30	80.36 \pm 1.19	72.51 \pm 0.68
	GraphENS	70.89 \pm 0.71	70.90 \pm 0.81	56.57 \pm 0.98	55.29 \pm 1.33	72.13 \pm 1.04	70.72 \pm 1.07	<u>82.40 \pm 0.39</u>	74.26 \pm 1.05
	GraphENS (w TAM)	<u>71.69 \pm 0.36</u>	<u>72.14 \pm 0.51</u>	<u>58.01 \pm 0.68</u>	<u>56.32 \pm 1.03</u>	<u>74.14 \pm 1.42</u>	<u>72.42 \pm 1.39</u>	81.02 \pm 0.99	70.78 \pm 1.72
	UNREAL	78.33 \pm 1.04	76.44 \pm 1.06	65.63 \pm 1.38	64.94 \pm 1.38	75.35 \pm 1.41	73.65 \pm 1.43	85.08 \pm 0.38	75.27 \pm 0.23
	Δ	+6.64	+4.30	+7.62	+8.62	+1.21	+1.23	+2.68	+0.96
	Vanilla	62.33 \pm 1.56	61.82 \pm 1.84	38.84 \pm 1.13	31.25 \pm 1.64	64.60 \pm 1.64	55.24 \pm 2.80	79.04 \pm 1.60	70.00 \pm 2.50
	Re-Weight	66.87 \pm 0.97	66.62 \pm 1.13	45.47 \pm 2.35	40.60 \pm 2.98	68.10 \pm 2.85	63.76 \pm 3.54	80.38 \pm 0.66	69.99 \pm 0.76
GAT	PC Softmax	66.69 \pm 0.79	66.04 \pm 1.10	50.78 \pm 1.66	48.56 \pm 2.08	72.88 \pm 0.83	71.09 \pm 0.89	79.43 \pm 0.94	71.33 \pm 0.86
	GraphSMOTE	66.71 \pm 0.32	65.01 \pm 1.21	45.68 \pm 0.93	38.96 \pm 0.97	67.43 \pm 1.23	61.97 \pm 2.54	79.38 \pm 1.97	69.76 \pm 2.31
	BalancedSoftmax	67.89 \pm 0.36	67.96 \pm 0.41	54.78 \pm 1.25	51.83 \pm 2.11	72.30 \pm 1.20	69.30 \pm 1.79	<u>82.02 \pm 1.19</u>	<u>72.94 \pm 1.54</u>
	BalancedSoftmax (w TAM)	69.16 \pm 0.27	69.39 \pm 0.37	56.30 \pm 1.25	53.87 \pm 1.14	73.50 \pm 1.24	71.36 \pm 1.99	75.54 \pm 2.09	66.69 \pm 1.44
	Renode	67.33 \pm 0.79	68.08 \pm 1.16	44.48 \pm 2.06	37.93 \pm 2.87	69.93 \pm 2.10	65.27 \pm 2.90	76.01 \pm 1.08	66.72 \pm 1.42
	Renode (w TAM)	67.50 \pm 0.67	68.06 \pm 0.96	45.12 \pm 1.41	39.29 \pm 1.79	70.66 \pm 2.13	66.94 \pm 3.54	74.30 \pm 1.13	66.13 \pm 1.75
	GraphENS	<u>70.45 \pm 1.25</u>	69.87 \pm 1.32	51.45 \pm 1.28	47.98 \pm 2.08	73.15 \pm 1.24	71.90 \pm 1.03	81.23 \pm 0.74	71.23 \pm 0.42
	GraphENS (w TAM)	70.15 \pm 0.18	<u>70.00 \pm 0.40</u>	<u>56.15 \pm 1.13</u>	<u>54.31 \pm 1.68</u>	<u>73.45 \pm 1.07</u>	<u>72.10 \pm 0.36</u>	81.07 \pm 1.03	71.27 \pm 1.98
	UNREAL	78.91 \pm 0.59	75.99 \pm 0.47	64.10 \pm 1.49	63.44 \pm 1.47	74.68 \pm 1.43	72.78 \pm 0.89	85.62 \pm 0.44	75.34 \pm 0.99
	Δ	+8.46	+5.99	+7.80	+9.13	+1.23	+0.68	+3.60	+2.40
	Vanilla	61.82 \pm 0.97	60.97 \pm 1.07	43.18 \pm 0.52	36.66 \pm 1.25	68.68 \pm 1.51	64.16 \pm 2.38	72.36 \pm 2.39	64.32 \pm 2.21
	Re-Weight	63.94 \pm 1.07	63.82 \pm 1.30	46.17 \pm 1.32	40.13 \pm 1.68	69.89 \pm 1.60	65.71 \pm 2.31	76.08 \pm 1.14	65.76 \pm 1.40
	PC Softmax	65.79 \pm 0.70	66.04 \pm 0.92	50.66 \pm 0.99	47.48 \pm 1.66	71.49 \pm 0.94	70.23 \pm 0.67	74.63 \pm 3.01	66.44 \pm 4.04
	GraphSMOTE	61.65 \pm 0.34	60.97 \pm 0.98	42.73 \pm 2.87	35.18 \pm 1.75	66.63 \pm 0.65	61.97 \pm 2.54	71.85 \pm 0.98	68.92 \pm 0.73
SAGE	BalancedSoftmax	67.43 \pm 0.61	67.66 \pm 0.69	51.74 \pm 2.32	49.01 \pm 3.16	71.36 \pm 1.37	69.66 \pm 1.81	73.67 \pm 1.11	65.23 \pm 2.44
	BalancedSoftmax (w TAM)	69.03 \pm 0.92	69.03 \pm 0.97	51.93 \pm 2.19	48.67 \pm 3.25	72.28 \pm 1.47	71.02 \pm 1.31	77.00 \pm 2.93	70.85 \pm 2.28
	Renode	66.84 \pm 1.78	67.08 \pm 1.75	48.65 \pm 1.37	44.25 \pm 2.20	71.37 \pm 1.33	67.78 \pm 1.38	77.37 \pm 0.74	68.42 \pm 1.81
	Renode (w TAM)	67.28 \pm 1.11	67.15 \pm 1.11	48.39 \pm 1.76	43.56 \pm 2.31	71.25 \pm 1.07	68.69 \pm 0.98	74.87 \pm 2.25	66.87 \pm 2.52
	GraphENS	68.74 \pm 0.46	68.34 \pm 0.33	53.51 \pm 0.78	51.42 \pm 1.19	70.97 \pm 0.78	70.00 \pm 1.22	<u>82.57 \pm 0.50</u>	71.95 \pm 0.51
	GraphENS (w TAM)	<u>70.45 \pm 0.74</u>	<u>70.40 \pm 0.75</u>	<u>54.69 \pm 1.12</u>	<u>53.56 \pm 1.86</u>	<u>73.61 \pm 1.35</u>	<u>72.50 \pm 1.58</u>	82.17 \pm 0.93	72.46 \pm 1.00
	UNREAL	75.99 \pm 0.98	73.63 \pm 1.23	66.45 \pm 0.39	65.83 \pm 0.30	74.78 \pm 1.30	72.80 \pm 0.54	83.21 \pm 1.50	<u>70.81 \pm 1.70</u>
	Δ	+5.44	+3.23	+11.76	+12.77	+1.07	+0.30	+0.64	-1.65

Table 2: Experimental results of our method UNREAL and other baselines on *four class-imbalanced node classification benchmark datasets* with $\rho = 20$. We report averaged balanced accuracy (bAcc, %) and F1-score (%) with the standard errors over 5 repetitions on three representative GNN architectures.

	Dataset	Cora		CiteSeer		PubMed		Amazon-Computers	
	Imbalance Ratio ($\rho = 20$)	bAcc.	F1	bAcc.	F1	bAcc.	F1	bAcc.	F1
GCN	Vanilla	53.20 \pm 0.88	47.81 \pm 1.23	35.32 \pm 0.15	21.81 \pm 0.12	61.13 \pm 0.35	46.85 \pm 0.76	72.34 \pm 2.92	65.42 \pm 3.00
	Re-Weight	57.51 \pm 1.05	54.63 \pm 1.08	36.99 \pm 1.79	27.33 \pm 2.32	66.52 \pm 2.42	58.22 \pm 3.65	72.45 \pm 2.06	65.85 \pm 1.46
	PC Softmax	61.74 \pm 1.50	60.55 \pm 1.97	42.53 \pm 1.53	36.54 \pm 1.13	68.26 \pm 1.99	66.54 \pm 1.87	73.84 \pm 2.64	66.32 \pm 2.97
	BalancedSoftmax	64.06 \pm 0.74	62.88 \pm 0.86	47.29 \pm 1.29	44.08 \pm 1.71	69.71 \pm 1.74	68.31 \pm 1.71	76.92 \pm 2.01	69.86 \pm 1.99
	BalancedSoftmax (w TAM)	64.75 \pm 0.54	63.46 \pm 0.72	48.52 \pm 1.62	46.38 \pm 1.79	69.95 \pm 2.09	68.90 \pm 1.86	77.09 \pm 2.02	69.86 \pm 1.76
	Renode	59.40 \pm 1.00	56.88 \pm 1.52	38.25 \pm 1.60	27.61 \pm 2.25	67.45 \pm 3.34	60.40 \pm 5.74	74.15 \pm 1.72	67.27 \pm 0.92
	Renode (w TAM)	59.88 \pm 1.16	58.05 \pm 1.66	41.11 \pm 2.45	31.58 \pm 2.62	68.53 \pm 3.53	64.82 \pm 4.32	73.46 \pm 1.77	67.50 \pm 1.18
	GraphENS	67.30 \pm 1.45	66.82 \pm 1.40	46.39 \pm 3.48	42.38 \pm 4.14	71.37 \pm 1.77	69.37 \pm 1.69	75.41 \pm 1.75	69.32 \pm 1.58
	GraphENS (w TAM)	66.94 \pm 1.38	66.67 \pm 1.42	48.80 \pm 2.98	45.06 \pm 4.16	71.92 \pm 1.58	69.35 \pm 1.88	75.78 \pm 1.57	68.58 \pm 1.78
	UNREAL	77.02 \pm 0.75	74.15 \pm 0.87	55.81 \pm 6.11	55.19 \pm 6.23	73.06 \pm 1.87	70.77 \pm 1.96	85.69 \pm 0.11	74.81 \pm 0.68
	Δ	+9.72	+7.33	+7.01	+8.81	+1.14	+1.40	+8.60	+4.95
	Vanilla	51.51 \pm 0.53	46.59 \pm 0.61	34.74 \pm 0.16	22.00 \pm 0.15	60.22 \pm 0.47	46.03 \pm 0.70	68.09 \pm 2.96	60.08 \pm 2.76
	Re-Weight	58.68 \pm 3.44	55.98 \pm 3.97	36.78 \pm 0.94	26.63 \pm 1.61	63.47 \pm 1.73	54.63 \pm 3.25	71.44 \pm 2.42	62.86 \pm 1.94
	PC Softmax	59.62 \pm 1.41	58.77 \pm 1.95	43.38 \pm 2.01	37.76 \pm 2.12	70.81 \pm 1.41	70.25 \pm 1.30	71.16 \pm 1.15	62.26 \pm 0.87
GAT	BalancedSoftmax	62.05 \pm 1.62	61.14 \pm 1.71	47.89 \pm 1.25	44.84 \pm 1.35	69.91 \pm 1.68	67.43 \pm 1.73	72.91 \pm 1.93	62.79 \pm 0.98
	BalancedSoftmax (w TAM)	63.30 \pm 0.99	62.81 \pm 1.18	49.34 \pm 1.29	46.92 \pm 1.39	71.17 \pm 2.09	68.85 \pm 2.90	65.59 \pm 2.86	58.12 \pm 1.22
	Renode	59.52 \pm 2.28	57.16 \pm 2.47	37.21 \pm 2.01	27.09 \pm 3.17	64.56 \pm 1.65	55.87 \pm 2.83	69.34 \pm 2.35	59.02 \pm 1.67
	Renode (w TAM)	61.32 \pm 2.18	59.19 \pm 2.64	39.85 \pm 2.20	30.63 \pm 2.63	66.28 \pm 3.24	58.99 \pm 3.04	65.81 \pm 2.57	56.73 \pm 1.62
	GraphENS	64.52 \pm 2.05	62.52 \pm 1.84	43.74 \pm 3.81	37.47 \pm 4.21	69.00 \pm 2.67	65.54 \pm 3.54	71.78 \pm 2.30	61.83 \pm 1.75
	GraphENS (w TAM)	65.78 \pm 1.62	63.80 \pm 1.79	44.81 \pm 2.66	39.47 \pm 3.54	70.33 \pm 2.33	67.00 \pm 3.25	73.55 \pm 2.04	64.03 \pm 1.32
	UNREAL	79.10 \pm 0.71	76.21 \pm 0.58	55.11 \pm 5.00	53.67 \pm 5.51	72.54 \pm 1.52	70.54 \pm 1.91	83.19 \pm 0.66	74.39 \pm 0.89
	Δ	+13.22	+12.41	+6.75	+8.81	+1.37	+1.69	+9.64	+10.36
	Vanilla	54.61 \pm 1.21	50.95 \pm 1.90	37.36 \pm 1.03	27.49 \pm 1.41	62.04 \pm 1.34	54.18 \pm 1.73	62.70 \pm 2.87	55.39 \pm 2.69
	Re-Weight	57.37 \pm 0.61	55.30 \pm 0.72	37.69 \pm 1.20	27.92 \pm 2.01	65.01 \pm 2.69	58.34 \pm 2.19	68.31 \pm 2.06	60.45 \pm 2.40
	PC Softmax	59.25 \pm 0.74	58.55 \pm 0.81	42.77 \pm 1.82	40.08 \pm 1.82	70.55 \pm 1.19	67.60 \pm 1.59	70.57 \pm 2.86	62.73 \pm 2.69
	BalancedSoftmax	61.93 \pm 1.26	60.89 \pm 1.36	43.64 \pm 1.33	38.31 \pm 1.13	69.89 \pm 1.40	68.12 \pm 0.78	68.45 \pm 2.92	62.12 \pm 3.10
	BalancedSoftmax (w TAM)	64.16 \pm 0.94	63.63 \pm 1.10	44.32 \pm 2.36	40.17 \pm 2.06	70.06 \pm 1.46	69.54 \pm 1.35	66.10 \pm 2.37	59.22 \pm 2.48
	Renode	58.48 \pm 0.97	55.39 \pm 0.94	40.65 \pm 2.36	31.78 \pm 3.24	66.50 \pm 2.63	58.72 \pm 4.16	68.36 \pm 1.54	61.60 \pm 2.00
SAGE	Renode (w TAM)	59.77 \pm 2.20	57.98 \pm 2.79	42.50 \pm 0.93	35.11 \pm 1.84	67.31 \pm 2.73	60.63 \pm 3.49	66.42 \pm 2.32	58.62 \pm 1.95
	GraphENS	63.54 \pm 0.91	62.20 \pm 0.87	44.89 \pm 2.51	40.48 \pm 2.94	71.37 \pm 1.77	69.37 \pm 1.69	75.47 \pm 2.20	67.49 \pm 1.65
	GraphENS (w TAM)	63.39 \pm 1.36	61.66 \pm 1.53	45.92 \pm 1.96	41.97 \pm 2.50	69.62 \pm 2.57	66.85 \pm 3.00	75.75 \pm 2.30	68.86 \pm 1.29
	UNREAL	73.10 \pm 1.60	69.92 \pm 1.43	58.35 \pm 4.58	57.51 \pm 4.92	73.67 \pm 0.58	71.15 \pm 0.67	78.88 \pm 2.16	69.00 \pm 1.42
	Δ	+8.94	+5.69	+12.43	+15.54	+2.30	+1.61	+3.13	+0.14

Table 3: Experimental results of our method UNREAL and other baselines on *four class-imbalanced node classification benchmark datasets* with $\rho = 50$. We report averaged balanced accuracy (bAcc, %) and F1-score (%) with the standard errors over 5 repetitions on three representative GNN architectures.

	Cora		CiteSeer		PubMed		Amazon-Computers		
	Imbalance Ratio ($\rho = 50$)	bAcc.	F1	bAcc.	F1	bAcc.	F1	bAcc.	F1
GCN	Vanilla	51.81 \pm 0.62	43.98 \pm 1.00	37.59 \pm 0.17	23.54 \pm 0.13	61.65 \pm 0.34	47.95 \pm 0.58	77.36 \pm 3.41	69.68 \pm 3.12
	Re-Weight	58.54 \pm 2.39	54.13 \pm 3.20	38.19 \pm 1.28	27.43 \pm 2.34	65.70 \pm 1.59	56.35 \pm 4.26	79.10 \pm 2.44	71.40 \pm 2.86
	PC Softmax	64.87 \pm 2.23	62.01 \pm 3.14	42.42 \pm 2.19	38.83 \pm 2.70	69.21 \pm 0.59	69.40 \pm 0.87	81.90 \pm 1.63	74.34 \pm 2.13
	BalancedSoftmax	65.94 \pm 1.55	64.00 \pm 2.05	47.62 \pm 1.11	46.55 \pm 1.46	70.40 \pm 1.00	69.04 \pm 0.66	<u>82.97 \pm 0.83</u>	73.74 \pm 1.27
	BalancedSoftmax (w TAM)	68.57 \pm 1.58	67.25 \pm 1.27	53.43 \pm 2.42	51.74 \pm 2.80	77.20 \pm 1.45	74.86 \pm 0.99	81.74 \pm 2.30	73.85 \pm 2.68
	Renode	62.22 \pm 1.76	61.18 \pm 2.24	41.23 \pm 1.66	33.66 \pm 2.69	68.67 \pm 1.21	63.05 \pm 1.47	81.71 \pm 0.99	72.55 \pm 1.61
	Renode (w TAM)	63.93 \pm 1.96	61.64 \pm 2.71	48.17 \pm 1.58	41.07 \pm 2.34	69.63 \pm 2.55	64.30 \pm 3.51	80.55 \pm 1.75	72.33 \pm 1.63
	GraphENS	63.47 \pm 0.98	62.21 \pm 1.65	48.17 \pm 1.58	41.07 \pm 2.34	69.63 \pm 2.55	64.30 \pm 3.51	81.63 \pm 2.35	72.57 \pm 2.33
	GraphENS (w TAM)	65.05 \pm 1.11	62.11 \pm 1.98	45.03 \pm 1.34	42.65 \pm 1.94	69.74 \pm 0.78	70.82 \pm 0.63	81.69 \pm 2.22	72.09 \pm 1.75
	UNREAL	75.62 \pm 2.02	72.59 \pm 2.13	59.97 \pm 4.59	58.66 \pm 5.20	78.55 \pm 0.84	75.91 \pm 0.81	85.54 \pm 0.26	75.76 \pm 0.13
	Δ	+7.05	+5.34	+6.54	+6.92	+1.35	+1.06	+2.57	+1.91
	Vanilla	53.90 \pm 0.63	45.53 \pm 0.89	36.48 \pm 0.08	23.68 \pm 0.16	60.16 \pm 0.47	46.99 \pm 0.58	72.42 \pm 2.17	64.41 \pm 2.68
	Re-Weight	59.78 \pm 1.92	56.69 \pm 2.21	38.70 \pm 2.23	29.38 \pm 3.06	66.27 \pm 0.68	57.34 \pm 1.41	73.46 \pm 3.07	67.00 \pm 2.60
	PC Softmax	59.44 \pm 2.62	58.06 \pm 2.69	43.13 \pm 1.56	37.04 \pm 2.07	70.86 \pm 0.44	70.96 \pm 0.54	77.21 \pm 2.90	69.17 \pm 2.89
GAT	BalancedSoftmax	64.71 \pm 2.28	62.55 \pm 2.61	51.89 \pm 1.15	49.36 \pm 1.52	70.94 \pm 1.09	70.33 \pm 0.99	77.49 \pm 1.58	70.44 \pm 2.33
	BalancedSoftmax (w TAM)	<u>68.05 \pm 1.03</u>	<u>66.07 \pm 1.14</u>	<u>54.28 \pm 0.79</u>	<u>52.77 \pm 0.97</u>	<u>75.65 \pm 1.11</u>	<u>74.02 \pm 1.44</u>	78.86 \pm 1.53	70.71 \pm 2.04
	Renode	63.81 \pm 1.72	60.63 \pm 2.26	41.60 \pm 2.30	33.94 \pm 4.60	70.35 \pm 1.26	67.43 \pm 0.01	72.39 \pm 2.75	65.23 \pm 3.35
	Renode (w TAM)	64.40 \pm 1.83	63.48 \pm 2.83	43.54 \pm 1.54	35.80 \pm 2.43	71.23 \pm 2.04	66.61 \pm 4.31	76.07 \pm 2.70	68.43 \pm 2.68
	GraphENS	64.52 \pm 2.51	61.41 \pm 3.15	45.23 \pm 2.97	41.12 \pm 4.23	69.66 \pm 1.01	66.83 \pm 0.94	78.36 \pm 2.74	70.44 \pm 2.51
	GraphENS (w TAM)	65.33 \pm 2.67	65.34 \pm 2.53	48.00 \pm 1.46	48.14 \pm 1.43	71.50 \pm 1.26	72.58 \pm 1.07	<u>80.02 \pm 2.32</u>	<u>72.38 \pm 2.47</u>
	UNREAL	77.07 \pm 0.83	73.44 \pm 1.05	57.70 \pm 4.35	56.81 \pm 4.67	79.41 \pm 0.29	77.38 \pm 0.39	86.06 \pm 0.45	77.55 \pm 0.71
	Δ	+9.02	+7.37	+3.42	+4.04	+3.76	+3.36	+6.04	+5.17
	Vanilla	53.02 \pm 0.83	45.58 \pm 1.30	38.81 \pm 0.89	25.28 \pm 0.51	61.41 \pm 1.01	50.46 \pm 2.47	56.53 \pm 2.12	48.52 \pm 2.75
	Re-Weight	58.03 \pm 0.81	54.32 \pm 0.99	38.49 \pm 1.34	30.41 \pm 1.82	62.41 \pm 0.90	51.37 \pm 2.62	70.36 \pm 2.21	61.52 \pm 2.73
SAGE	PC Softmax	62.33 \pm 1.62	59.97 \pm 1.98	41.79 \pm 1.19	36.90 \pm 0.84	69.58 \pm 1.09	67.13 \pm 0.95	73.53 \pm 2.02	66.12 \pm 3.19
	BalancedSoftmax	64.57 \pm 0.77	62.22 \pm 0.82	41.84 \pm 1.72	40.09 \pm 1.04	70.43 \pm 0.38	68.99 \pm 0.99	73.27 \pm 2.30	68.30 \pm 1.97
	BalancedSoftmax (w TAM)	65.97 \pm 0.71	65.53 \pm 0.88	52.89 \pm 1.65	49.92 \pm 1.83	71.11 \pm 0.75	71.73 \pm 0.79	73.12 \pm 1.41	66.45 \pm 1.04
	Renode	61.35 \pm 1.86	58.88 \pm 2.53	40.37 \pm 2.33	32.57 \pm 3.62	67.54 \pm 3.05	59.77 \pm 5.30	70.46 \pm 3.45	62.30 \pm 4.40
	Renode (w TAM)	62.79 \pm 0.47	61.05 \pm 0.82	43.04 \pm 1.30	36.97 \pm 1.92	71.79 \pm 1.33	67.80 \pm 2.45	74.55 \pm 2.95	66.06 \pm 2.16
	GraphENS	63.95 \pm 0.96	62.63 \pm 2.12	41.99 \pm 1.54	37.44 \pm 2.43	66.07 \pm 1.12	61.63 \pm 1.82	76.21 \pm 2.84	68.10 \pm 2.56
	GraphENS (w TAM)	<u>65.98 \pm 1.37</u>	64.84 \pm 1.13	49.54 \pm 1.79	49.48 \pm 1.70	<u>73.24 \pm 1.32</u>	<u>73.73 \pm 1.14</u>	<u>80.75 \pm 1.22</u>	<u>72.31 \pm 0.95</u>
	UNREAL	76.04 \pm 1.30	72.99 \pm 1.25	58.70 \pm 4.10	57.53 \pm 4.59	75.27 \pm 1.26	72.16 \pm 1.50	82.03 \pm 0.77	72.98 \pm 0.52
	Δ	+10.06	+7.46	+5.81	+7.61	+2.03	-1.57	+1.28	+0.67

Table 4: Experimental results of our method UNREAL and other baselines on *four class-imbalanced node classification benchmark datasets* with $\rho = 100$. We report averaged balanced accuracy (bAcc,%) and F1-score (%) with the standard errors over 5 repetitions on three representative GNN architectures.

	Cora		CiteSeer		PubMed		Amazon-Computers		
	Imbalance Ratio ($\rho = 100$)	bAcc.	F1	bAcc.	F1	bAcc.	F1	bAcc.	F1
GCN	Vanilla	51.62 \pm 0.20	43.91 \pm 0.25	38.83 \pm 0.26	24.71 \pm 0.25	61.28 \pm 0.12	47.55 \pm 0.16	76.09 \pm 3.79	69.32 \pm 3.49
	Re-Weight	59.11 \pm 1.06	54.04 \pm 1.36	42.67 \pm 2.06	33.17 \pm 3.40	67.14 \pm 2.71	55.24 \pm 5.36	81.53 \pm 2.20	71.45 \pm 2.05
	PC Softmax	63.75 \pm 1.02	61.19 \pm 1.43	38.34 \pm 0.71	33.65 \pm 1.42	70.85 \pm 0.44	70.26 \pm 0.63	82.22 \pm 1.99	72.38 \pm 2.52
	BalancedSoftmax	63.03 \pm 1.57	61.28 \pm 1.77	48.49 \pm 1.20	46.59 \pm 1.34	70.77 \pm 1.88	68.88 \pm 1.74	83.33 \pm 3.35	74.34 \pm 2.74
	BalancedSoftmax (w TAM)	69.44 \pm 0.59	67.10 \pm 0.88	52.60 \pm 0.69	51.21 \pm 0.84	73.73 \pm 1.10	73.72 \pm 0.83	83.70 \pm 2.17	75.39 \pm 1.43
	Renode	60.76 \pm 2.53	58.09 \pm 3.00	43.41 \pm 2.07	33.69 \pm 2.76	67.63 \pm 2.77	61.70 \pm 4.84	82.13 \pm 1.73	71.79 \pm 1.85
	Renode (w TAM)	64.19 \pm 1.46	60.90 \pm 1.56	44.78 \pm 1.51	35.90 \pm 2.61	70.53 \pm 0.75	64.35 \pm 1.79	82.32 \pm 2.19	73.09 \pm 1.75
	GraphENS	63.00 \pm 1.30	62.33 \pm 1.67	45.99 \pm 2.06	37.23 \pm 3.40	68.65 \pm 1.00	62.17 \pm 1.60	83.37 \pm 2.17	73.96 \pm 1.98
	GraphENS (w TAM)	60.40 \pm 4.42	57.77 \pm 4.02	42.72 \pm 2.54	39.40 \pm 2.57	70.73 \pm 1.96	72.50 \pm 1.87	81.29 \pm 1.52	71.66 \pm 1.75
	UNREAL	72.82 \pm 3.55	69.12 \pm 3.45	57.66 \pm 1.96	56.50 \pm 1.12	78.73 \pm 0.88	76.03 \pm 1.08	84.30 \pm 0.30	76.06 \pm 0.32
	Δ	+3.38	+2.02	+5.06	+5.29	+5.00	+2.31	+0.60	+0.67
	Vanilla	51.58 \pm 0.32	43.37 \pm 0.21	37.91 \pm 0.28	23.49 \pm 0.21	62.07 \pm 0.17	47.39 \pm 0.20	72.66 \pm 2.97	64.87 \pm 3.46
	Re-Weight	58.28 \pm 1.88	54.47 \pm 2.35	38.13 \pm 1.55	29.60 \pm 3.02	67.41 \pm 2.69	58.06 \pm 5.07	77.10 \pm 3.26	68.35 \pm 2.71
	PC Softmax	63.74 \pm 2.01	59.76 \pm 2.19	45.07 \pm 1.13	39.21 \pm 2.29	69.68 \pm 1.29	69.44 \pm 1.29	79.72 \pm 1.52	70.78 \pm 1.45
GAT	BalancedSoftmax	63.19 \pm 1.35	61.03 \pm 1.46	46.03 \pm 2.11	43.38 \pm 2.24	71.45 \pm 1.23	69.10 \pm 1.20	79.15 \pm 2.08	69.68 \pm 2.13
	BalancedSoftmax (w TAM)	64.96 \pm 3.23	62.91 \pm 3.96	52.75 \pm 1.29	50.69 \pm 1.83	73.38 \pm 0.77	72.45 \pm 0.88	80.86 \pm 2.52	72.93 \pm 2.95
	Renode	60.04 \pm 2.21	58.04 \pm 2.66	42.40 \pm 2.97	34.09 \pm 0.04	68.54 \pm 2.11	65.63 \pm 3.15	75.34 \pm 1.65	69.99 \pm 1.60
	Renode (w TAM)	63.45 \pm 1.41	61.51 \pm 1.95	41.55 \pm 1.39	36.13 \pm 2.87	71.53 \pm 2.35	68.11 \pm 4.28	78.60 \pm 1.90	70.35 \pm 2.80
	GraphENS	63.93 \pm 2.70	61.77 \pm 3.38	44.43 \pm 1.90	39.26 \pm 2.55	68.50 \pm 1.81	64.14 \pm 3.28	81.63 \pm 2.08	71.20 \pm 2.75
	GraphENS (w TAM)	62.52 \pm 0.95	61.65 \pm 1.19	45.79 \pm 1.31	44.80 \pm 1.14	69.09 \pm 1.11	70.64 \pm 1.10	83.33 \pm 0.83	72.81 \pm 1.22
	UNREAL	75.42 \pm 0.91	71.50 \pm 0.89	60.35 \pm 1.87	59.63 \pm 1.86	77.88 \pm 1.31	74.98 \pm 1.35	85.33 \pm 0.19	75.83 \pm 0.74
	Δ	+10.46	+8.59	+7.60	+8.94	+4.50	+2.53	+2.00	+3.02
	Vanilla	52.65 \pm 0.24	43.79 \pm 0.47	36.63 \pm 0.09	24.12 \pm 0.09	62.29 \pm 0.25	47.02 \pm 0.38	55.94 \pm 2.37	47.21 \pm 2.73
	Re-Weight	59.42 \pm 2.88	55.26 \pm 4.40	36.24 \pm 1.30	27.07 \pm 2.88	63.33 \pm 0.75	55.11 \pm 1.62	70.76 \pm 3.35	62.09 \pm 3.30
SAGE	PC Softmax	64.01 \pm 1.15	60.74 \pm 1.68	44.74 \pm 1.41	37.61 \pm 1.69	72.62 \pm 1.42	70.95 \pm 1.70	75.96 \pm 2.44	69.12 \pm 2.90
	BalancedSoftmax	63.43 \pm 2.12	62.30 \pm 2.27	49.33 \pm 1.12	44.58 \pm 1.64	70.68 \pm 0.92	69.15 \pm 0.84	74.66 \pm 0.86	66.28 \pm 1.92
	BalancedSoftmax (w TAM)	66.58 \pm 1.53	64.56 \pm 2.49	53.33 \pm 1.06	50.15 \pm 1.45	72.59 \pm 2.06	72.22 \pm 2.08	78.01 \pm 1.06	71.02 \pm 1.08
	Renode	62.42 \pm 0.90	60.08 \pm 1.19	39.61 \pm 2.66	30.13 \pm 3.86	67.11 \pm 1.12	61.09 \pm 3.50	73.73 \pm 2.26	64.47 \pm 2.39
	Renode (w TAM)	62.06 \pm 2.08	60.72 \pm 3.32	42.08 \pm 1.88	33.19 \pm 3.45	69.95 \pm 1.01	65.99 \pm 2.28	74.81 \pm 3.29	67.48 \pm 3.32
	GraphENS	63.09 \pm 0.97	61.20 \pm 1.74	42.03 \pm 1.88	36.71 \pm 2.99	69.71 \pm 1.87	63.47 \pm 3.87	81.33 \pm 1.66	72.83 \pm 1.76
	GraphENS (w TAM)	65.95 \pm 2.25	63.88 \pm 1.78	51.03 \pm 1.51	50.49 \pm 1.88	73.58 \pm 2.01	72.44 \pm 1.77	81.72 \pm 1.08	72.31 \pm 1.98
	UNREAL	73.47 \pm 2.31	68.30 \pm 2.11	59.77 \pm 2.98	58.92 \pm 3.07	77.11 \pm 0.59	74.03 \pm 0.81	82.92 \pm 2.94	73.11 \pm 2.57
	Δ	+6.89	+3.74	+6.44	+8.43	+3.53	+1.59	+1.20	+0.28

Table 5: Experimental results of our method UNREAL and other baselines on *CS-Random*. We report averaged balanced accuracy (bAcc,%) and F1-score (%) with the standard errors over 5 repetitions on three representative GNN architectures.

Dataset(<i>CS-Random</i>)	GCN		GAT		SAGE	
Imbalance Ratio($\rho = 41.00$)	bAcc.	F1	bAcc.	F1	bAcc.	F1
Vanilla	84.85 \pm 0.16	87.12 \pm 0.14	82.47 \pm 0.36	84.21 \pm 0.31	83.76 \pm 0.27	86.22 \pm 0.19
Re-Weight	87.42 \pm 0.17	88.70 \pm 0.10	83.55 \pm 0.39	84.73 \pm 0.32	85.76 \pm 0.24	87.32 \pm 0.16
PC Softmax	88.36 \pm 0.12	88.94 \pm 0.04	85.22 \pm 0.31	85.54 \pm 0.33	87.18 \pm 0.14	88.00 \pm 0.19
GraphSMOTE	85.76 \pm 1.73	87.31 \pm 1.32	84.65 \pm 1.32	85.63 \pm 1.01	85.76 \pm 1.98	87.34 \pm 0.98
BalancedSoftmax	87.72 \pm 0.07	88.67 \pm 0.07	84.38 \pm 0.20	84.53 \pm 0.41	86.78 \pm 0.10	88.05 \pm 0.09
BalancedSoftmax (w TAM)	88.22 \pm 0.11	89.22 \pm 0.08	85.48 \pm 0.24	85.77 \pm 0.50	87.83 \pm 0.13	88.77 \pm 0.07
Renode	87.53 \pm 0.11	88.91 \pm 0.06	85.98 \pm 0.19	86.97 \pm 0.09	86.13 \pm 0.10	87.89 \pm 0.09
Renode (w TAM)	87.55 \pm 0.06	89.03 \pm 0.05	86.61 \pm 0.30	87.42 \pm 0.24	85.21 \pm 0.33	87.01 \pm 0.31
GraphENS	85.97 \pm 0.29	86.68 \pm 0.20	85.86 \pm 0.19	86.51 \pm 0.32	85.39 \pm 0.26	86.41 \pm 0.24
GraphENS (w TAM)	86.34 \pm 0.12	87.36 \pm 0.08	86.29 \pm 0.20	87.28 \pm 0.13	85.99 \pm 0.13	87.25 \pm 0.07
UNREAL	88.94 \pm 0.09	89.87 \pm 0.06	87.65 \pm 0.12	87.65 \pm 0.11	88.03 \pm 0.21	88.65 \pm 0.07
Δ	+ 0.58	+ 0.65	+ 1.04	+ 0.23	+ 0.20	- 0.12

Table 6: Experimental results of our method UNREAL and other baselines on *naturally imbalanced setting Computers-Random*. We report averaged balanced accuracy (bAcc,%) and F1-score (%) with the standard errors over 5 repetitions on three representative GNN architectures.

Dataset (<i>Computers-Random</i>)	GCN		GAT		SAGE	
Imbalance Ratio($\rho = 25.50$)	bAcc.	F1	bAcc.	F1	bAcc.	F1
Vanilla	78.43 \pm 0.41	77.14 \pm 0.39	71.35 \pm 1.18	69.60 \pm 1.11	65.30 \pm 1.07	64.77 \pm 1.19
Re-Weight	80.49 \pm 0.44	75.07 \pm 0.58	71.95 \pm 0.80	70.67 \pm 0.51	66.50 \pm 1.47	66.10 \pm 1.46
PC Softmax	81.34 \pm 0.55	75.17 \pm 0.57	70.56 \pm 1.46	67.26 \pm 1.48	69.73 \pm 0.53	67.03 \pm 0.6
GraphSMOTE	80.50 \pm 1.11	73.79 \pm 0.14	71.98 \pm 0.21	67.98 \pm 0.31	72.69 \pm 0.82	68.73 \pm 1.01
BalancedSoftmax	81.39 \pm 0.25	74.54 \pm 0.64	72.09 \pm 0.31	68.38 \pm 0.69	73.80 \pm 1.06	69.74 \pm 0.60
BalancedSoftmax (w TAM)	81.64 \pm 0.48	75.59 \pm 0.83	74.00 \pm 0.77	70.72 \pm 0.50	73.77 \pm 1.26	71.03 \pm 0.69
Renode	81.64 \pm 0.34	76.87 \pm 0.32	72.80 \pm 0.94	71.40 \pm 0.97	70.94 \pm 1.50	70.04 \pm 1.16
Renode (w TAM)	80.50 \pm 1.11	75.79 \pm 0.14	71.98 \pm 0.21	70.98 \pm 0.31	72.69 \pm 0.82	70.73 \pm 1.01
GraphENS	82.66 \pm 0.61	76.55 \pm 0.17	75.25 \pm 0.85	71.49 \pm 0.54	77.64 \pm 0.52	72.65 \pm 0.53
GraphENS (w TAM)	82.83 \pm 0.68	76.76 \pm 0.39	75.81 \pm 0.72	72.62 \pm 0.57	78.98 \pm 0.60	73.59 \pm 0.55
UNREAL	85.32 \pm 0.22	80.43 \pm 0.56	82.52 \pm 0.35	78.90 \pm 0.38	75.81 \pm 1.86	71.86 \pm 1.86
Δ	+2.49	+3.97	+6.71	+6.28	-3.17	-1.73

Table 7: Analyzed experimental results of Node-Reordering and DHS on *Cora* with $\rho = 1, 5, 10, 20, 50, 100$. We select 100 unlabeled nodes newly added to the minority class of training set through different method combinations, and evaluate the validity of Node-Reordering & DHS by testing the accuracy (%) with the standard errors of the pseudo labels for these nodes. We report averaged results over 5 repetitions on three representative GNN architectures.

Dataset		Cora					
	Imbalance Ratio (ρ)	$\rho = 1$	$\rho = 5$	$\rho = 10$	$\rho = 20$	$\rho = 50$	$\rho = 100$
GCN	DPAM+Confidence Ranking	61.40 \pm 2.73	62.40 \pm 2.59	60.20 \pm 1.02	58.40 \pm 1.05	57.60 \pm 1.86	58.40 \pm 2.15
	DPAM+Geometric Ranking	64.00 \pm 3.67	61.20 \pm 2.89	61.20 \pm 2.54	63.60 \pm 1.31	55.60 \pm 2.31	47.80 \pm 2.87
	DPAM+Node-Reordering	89.65 \pm 3.23	86.98 \pm 0.21	88.32 \pm 0.83	85.32 \pm 2.98	90.87 \pm 2.31	71.60 \pm 2.91
	DPAM+Confidence Ranking+DHS	71.00 \pm 5.47	75.40 \pm 2.15	68.20 \pm 1.25	69.40 \pm 1.28	67.80 \pm 2.75	66.60 \pm 0.16
	DPAM+Geometric Ranking+DHS	69.60 \pm 3.78	73.80 \pm 0.45	64.80 \pm 1.26	64.20 \pm 1.91	57.00 \pm 1.57	69.00 \pm 1.71
	DPAM+Node-Reordering+DHS(UNREAL)	92.80 \pm 1.30	96.40 \pm 4.27	92.20 \pm 0.85	89.40 \pm 1.37	93.00 \pm 0.82	77.80 \pm 2.50
GAT	DPAM+Confidence Ranking	61.60 \pm 4.26	64.00 \pm 2.07	62.60 \pm 3.47	57.80 \pm 1.65	58.20 \pm 1.07	60.60 \pm 0.79
	DPAM+Geometric Ranking	64.00 \pm 2.78	67.80 \pm 3.76	65.00 \pm 4.30	52.00 \pm 1.02	65.20 \pm 2.58	40.80 \pm 2.63
	DPAM+Node-Reordering	91.79 \pm 0.23	90.45 \pm 5.78	84.32 \pm 3.45	88.34 \pm 0.23	90.32 \pm 0.43	75.34 \pm 1.54
	DPAM+Confidence Ranking+DHS	69.80 \pm 2.77	72.80 \pm 3.94	72.40 \pm 1.13	67.60 \pm 1.59	71.60 \pm 9.12	64.00 \pm 1.74
	DPAM+Geometric Ranking+DHS	73.60 \pm 4.82	74.00 \pm 5.47	68.40 \pm 1.62	57.20 \pm 2.17	68.00 \pm 1.17	62.00 \pm 1.53
	DPAM+Node-Reordering+DHS(UNREAL)	93.80 \pm 1.92	91.20 \pm 4.60	90.40 \pm 1.69	90.00 \pm 9.92	94.60 \pm 4.92	78.20 \pm 2.47
SAGE	DPAM+Confidence Ranking	54.80 \pm 4.96	53.00 \pm 2.46	51.80 \pm 1.97	43.60 \pm 2.57	46.20 \pm 0.53	41.60 \pm 1.14
	DPAM+Geometric Ranking	53.60 \pm 2.78	45.40 \pm 1.75	40.60 \pm 0.26	52.60 \pm 2.47	47.40 \pm 4.27	44.80 \pm 2.84
	DPAM+Node-Reordering	90.69 \pm 0.21	86.90 \pm 0.56	86.45 \pm 3.21	88.34 \pm 2.43	75.34 \pm 4.20	76.43 \pm 1.43
	DPAM+Confidence Ranking+DHS	66.20 \pm 5.78	59.00 \pm 3.04	63.80 \pm 1.52	54.60 \pm 1.64	60.60 \pm 1.37	57.40 \pm 2.26
	DPAM+Geometric Ranking+DHS	61.60 \pm 3.71	61.80 \pm 5.21	54.00 \pm 7.31	53.60 \pm 1.38	63.00 \pm 1.23	45.20 \pm 1.96
	DPAM+Node-Reordering+DHS(UNREAL)	97.80 \pm 1.78	92.20 \pm 1.32	90.80 \pm 1.82	89.20 \pm 1.39	94.20 \pm 8.04	85.40 \pm 1.02

Table 8: Analyzed experimental results of Node-Reordering and DHS on *Amazon-Computers* with $\rho = 1, 5, 10, 20, 50, 100$. We select 100 unlabeled nodes newly added to the minority class of training set through different method combinations, and evaluate the validity of Node-Reordering & DHS by testing the accuracy (%) with the standard errors of the pseudo labels for these nodes. We report averaged results over 5 repetitions on three representative GNN architectures.

Dataset		Amazon-Computers					
Imbalance Ratio (ρ)		$\rho = 1$	$\rho = 5$	$\rho = 10$	$\rho = 20$	$\rho = 50$	$\rho = 100$
GCN	DPAM+Confidence Ranking	75.40 \pm 2.50	70.20 \pm 3.03	74.88 \pm 3.11	68.20 \pm 4.20	63.60 \pm 2.30	61.40 \pm 1.51
	DPAM+Geometric Ranking	76.00 \pm 1.41	74.80 \pm 4.71	76.80 \pm 2.28	65.80 \pm 3.27	64.80 \pm 3.70	65.60 \pm 3.98
	DPAM+Node-Reordering	82.80 \pm 2.38	79.60 \pm 3.64	78.20 \pm 0.26	74.00 \pm 3.28	65.20 \pm 1.87	66.00 \pm 2.82
	DPAM+Confidence Ranking+DHS	76.40 \pm 2.07	67.20 \pm 4.32	75.80 \pm 2.38	66.20 \pm 3.70	62.80 \pm 0.12	59.20 \pm 1.30
	DPAM+Geometric Ranking+DHS	78.20 \pm 0.83	80.00 \pm 1.22	76.40 \pm 1.67	66.00 \pm 2.44	64.20 \pm 3.83	66.20 \pm 2.38
	DPAM+Node-Reordering+DHS(UNREAL)	84.40 \pm 3.60	82.20 \pm 2.16	80.40 \pm 3.46	80.60 \pm 1.51	69.60 \pm 3.04	66.40 \pm 3.20
GAT	DPAM+Confidence Ranking	84.60 \pm 2.40	79.20 \pm 1.78	73.00 \pm 2.12	74.80 \pm 2.16	65.00 \pm 1.73	68.60 \pm 1.40
	DPAM+Geometric Ranking	86.00 \pm 3.80	79.80 \pm 2.94	74.80 \pm 3.42	75.00 \pm 2.91	70.80 \pm 2.16	69.40 \pm 1.10
	DPAM+Node-Reordering	87.40 \pm 2.30	80.60 \pm 3.04	80.40 \pm 2.19	79.00 \pm 3.67	75.00 \pm 1.22	73.40 \pm 2.52
	DPAM+Confidence Ranking+DHS	84.20 \pm 1.64	79.40 \pm 2.07	76.40 \pm 6.50	76.00 \pm 2.34	66.00 \pm 0.12	72.00 \pm 1.84
	DPAM+Geometric Ranking+DHS	83.80 \pm 1.09	80.20 \pm 1.09	76.20 \pm 2.28	77.80 \pm 2.58	71.60 \pm 0.89	69.00 \pm 1.16
	DPAM+Node-Reordering+DHS(UNREAL)	89.00 \pm 2.54	86.60 \pm 2.50	85.60 \pm 4.44	83.40 \pm 3.31	78.00 \pm 3.39	79.80 \pm 3.03
SAGE	DPAM+Confidence Ranking	85.20 \pm 3.38	80.20 \pm 6.26	84.8 \pm 0.83	77.60 \pm 0.89	61.00 \pm 0.70	65.40 \pm 2.65
	DPAM+Geometric Ranking	86.00 \pm 0.70	81.20 \pm 2.16	83.40 \pm 1.14	78.00 \pm 1.22	61.40 \pm 0.54	65.00 \pm 1.72
	DPAM+Node-Reordering	86.00 \pm 1.58	83.20 \pm 3.27	84.60 \pm 0.54	79.20 \pm 1.92	61.80 \pm 0.44	67.80 \pm 1.03
	DPAM+Confidence Ranking+DHS	86.40 \pm 2.07	81.60 \pm 3.20	83.40 \pm 1.14	79.20 \pm 0.44	61.20 \pm 0.44	70.40 \pm 3.59
	DPAM+Geometric Ranking+DHS	87.00 \pm 2.12	80.80 \pm 2.48	84.20 \pm 1.30	78.20 \pm 1.48	61.20 \pm 0.47	68.20 \pm 1.72
	DPAM+Node-Reordering+DHS(UNREAL)	88.20 \pm 2.16	87.60 \pm 1.14	85.40 \pm 4.72	78.00 \pm 1.55	66.20 \pm 2.86	72.20 \pm 0.83

Table 9: Experimental results of DPAM effectiveness on Cora with $\rho = 1, 5, 10, 20, 50, 100$. We observe the accuracy (%) of the pseudo-label (prediction of the classifier) of the aligned node set \mathcal{U}_{in} and the discarded node set \mathcal{U}_{out} respectively. We report averaged results with the standard errors over 5 repetitions on three representative GNN architectures. *All*, *Labeled*, *Unlabeled* represent the size of whole nodes, labeled nodes, and unlabeled nodes on the graph. *Align*, *Out*, *Align-True*, *Out-True* represent the size of \mathcal{U}_{in} , \mathcal{U}_{out} , nodes with accurate pseudo-labels of \mathcal{U}_{in} , \mathcal{U}_{out} respectively.

	Dataset	All	Labled	Unlabled	Align	Align-True	Accuracy(%)	Out	Out-True	Accuracy(%)
GCN	$\rho = 1$	2708	140	2568	2072.00 \pm 10.29	1391.00 \pm 22.56	67.11 \pm 1.17	496.00 \pm 10.29	233.80 \pm 16.66	47.17 \pm 3.74
	$\rho = 5$	2708	92	2616	2122.80 \pm 18.93	1392.00 \pm 34.21	65.58 \pm 1.57	493.20 \pm 18.73	186.80 \pm 13.08	37.86 \pm 1.75
	$\rho = 10$	2708	86	2622	2134.60 \pm 23.42	1326.40 \pm 24.23	62.14 \pm 1.67	487.40 \pm 23.43	181.60 \pm 18.24	37.32 \pm 3.13
	$\rho = 20$	2708	83	2625	2149.60 \pm 17.67	1310.20 \pm 86.72	60.97 \pm 3.50	475.40 \pm 17.67	169.80 \pm 21.47	35.64 \pm 3.44
	$\rho = 50$	2708	203	2505	1860.80 \pm 31.15	1059.40 \pm 58.77	56.90 \pm 2.62	644.20 \pm 31.14	225.80 \pm 10.70	35.05 \pm 3.79
	$\rho = 100$	2708	403	2305	1820.40 \pm 12.42	1001.60 \pm 21.60	55.02 \pm 3.99	484.60 \pm 23.99	151.40 \pm 20.74	31.78 \pm 2.37
GAT	$\rho = 1$	2708	140	2568	2072.00 \pm 37.18	1412.40 \pm 37.31	68.16 \pm 1.41	496.00 \pm 20.89	239.40 \pm 11.37	48.29 \pm 2.15
	$\rho = 5$	2708	92	2616	2141.40 \pm 26.36	1433.00 \pm 59.82	66.90 \pm 2.09	474.60 \pm 26.36	195.20 \pm 24.68	41.02 \pm 3.27
	$\rho = 10$	2708	86	2622	2132.60 \pm 29.94	1377.40 \pm 49.61	64.58 \pm 1.60	489.40 \pm 29.95	185.80 \pm 12.28	37.97 \pm 1.13
	$\rho = 20$	2708	83	2625	2150.60 \pm 37.35	1344.60 \pm 54.17	62.16 \pm 1.64	462.40 \pm 33.28	178.00 \pm 5.05	38.60 \pm 2.12
	$\rho = 50$	2708	140	2568	1892.40 \pm 37.18	1080.80 \pm 31.86	57.52 \pm 1.52	612.60 \pm 37.17	271.20 \pm 6.30	44.35 \pm 1.86
	$\rho = 100$	2708	403	2305	1934.60 \pm 19.65	1038.20 \pm 21.08	53.66 \pm 0.83	370.40 \pm 37.17	147.53 \pm 3.20	39.83 \pm 1.36
SAGE	$\rho = 1$	2708	140	2568	1944.00 \pm 25.77	973.40 \pm 32.26	51.27 \pm 3.36	624.00 \pm 25.77	237.00 \pm 13.28	36.11 \pm 4.07
	$\rho = 5$	2708	92	2616	2004.40 \pm 35.50	1038.20 \pm 22.53	51.80 \pm 3.73	611.60 \pm 35.50	203.80 \pm 7.15	33.40 \pm 1.85
	$\rho = 10$	2708	86	2622	2041.60 \pm 32.48	1039.00 \pm 41.32	50.89 \pm 1.88	580.40 \pm 32.48	189.20 \pm 2.35	32.56 \pm 4.25
	$\rho = 20$	2708	83	2625	2040.20 \pm 30.94	1002.20 \pm 66.97	48.95 \pm 2.66	578.80 \pm 30.95	186.60 \pm 18.00	32.18 \pm 1.57
	$\rho = 50$	2708	203	2505	1789.40 \pm 30.56	870.20 \pm 24.33	48.63 \pm 1.03	715.60 \pm 30.56	242.40 \pm 16.77	33.87 \pm 1.18
	$\rho = 100$	2708	403	2305	1859.00 \pm 192.42	914.41 \pm 23.65	49.26 \pm 2.59	446.00 \pm 21.24	138.87 \pm 6.32	31.15 \pm 2.43

Table 10: Experimental results of DPAM effectiveness on *Amazon-Computers* with $\rho = 1, 5, 10, 20, 50, 100$. We observe the accuracy (%) of the pseudo-label (prediction of the classifier) of the aligned node set \mathcal{U}_{in} and the discarded node set \mathcal{U}_{out} respectively. We report averaged results with the standard errors over 5 repetitions on three representative GNN architectures. All, Labeled, Unlabeled represent the size of whole nodes, labeled nodes, and unlabeled nodes on the graph. Align, Out, Align-True, Out-True represent the size of \mathcal{U}_{in} , \mathcal{U}_{out} , nodes with accurate pseudo-labels of \mathcal{U}_{in} , \mathcal{U}_{out} respectively.

	Dataset	All	Labled	Unlabeled	Align	Align-True	Accuracy(%)	Out	Out-True	Accuracy(%)
GCN	$\rho = 1$	13752	200	13552	11977.60 \pm 108.09	9603.80 \pm 93.34	80.08 \pm 3.07	1554.40 \pm 08.23	676.60 \pm 141.11	43.58 \pm 2.83
	$\rho = 5$	13752	120	13632	11593.60 \pm 73.16	9172.80 \pm 87.32	79.06 \pm 1.17	2308.40 \pm 173.54	544.40 \pm 66.26	30.74 \pm 9.09
	$\rho = 10$	13752	110	13642	11822.40 \pm 13.43	8786.60 \pm 55.48	74.24 \pm 0.83	1807.60 \pm 109.34	495.00 \pm 100.37	27.24 \pm 4.30
	$\rho = 20$	13752	105	13647	11866.60 \pm 17.34	8698.20 \pm 188.13	73.40 \pm 1.39	1780.40 \pm 67.36	521.00 \pm 60.76	29.20 \pm 2.41
	$\rho = 50$	13752	255	13497	11843.20 \pm 168.20	8994.40 \pm 175.24	75.94 \pm 0.75	1653.80 \pm 138.11	474.20 \pm 50.72	28.68 \pm 2.16
	$\rho = 100$	13752	505	13247	9159.00 \pm 192.42	7352.90 \pm 61.23	81.41 \pm 4.59	4088.00 \pm 93.99	1129.60 \pm 75.74	28.67 \pm 4.77
GAT	$\rho = 1$	13752	200	13552	12008.00 \pm 101.93	9984.20 \pm 308.03	83.44 \pm 4.13	1544.80 \pm 101.94	580.40 \pm 190.49	43.33 \pm 1.32
	$\rho = 5$	13752	120	13632	11570.80 \pm 136.11	8715.00 \pm 86.33	75.33 \pm 0.54	2061.20 \pm 136.13	477.00 \pm 97.07	25.39 \pm 1.33
	$\rho = 10$	13752	110	13642	8947.60 \pm 13.40	6680.40 \pm 177.54	75.85 \pm 6.07	4694.40 \pm 134.74	591.80 \pm 13.74	15.94 \pm 2.97
	$\rho = 20$	13752	105	13647	10245.80 \pm 68.00	7300.80 \pm 64.89	71.42 \pm 1.80	3401.20 \pm 69.76	370.60 \pm 43.87	18.52 \pm 0.09
	$\rho = 50$	13752	255	13497	10133.60 \pm 31.56	7772.00 \pm 155.87	77.17 \pm 2.85	3363.40 \pm 10.42	457.20 \pm 108.19	19.28 \pm 1.43
	$\rho = 100$	13752	505	13247	11377.00 \pm 63.32	9122.20 \pm 96.70	80.46 \pm 1.01	1910.00 \pm 63.32	458.20 \pm 41.04	24.78 \pm 2.04
SAGE	$\rho = 1$	13752	200	13552	10815.20 \pm 86.50	7131.40 \pm 72.83	65.94 \pm 0.28	2736.80 \pm 86.50	965.40 \pm 56.42	35.26 \pm 1.31
	$\rho = 5$	13752	120	13632	10627.80 \pm 78.33	6728.00 \pm 53.24	63.25 \pm 0.36	3004.20 \pm 78.03	978.20 \pm 59.93	32.55 \pm 1.49
	$\rho = 10$	13752	110	13642	10475.00 \pm 118.41	6015.00 \pm 41.14	57.43 \pm 4.01	3167.00 \pm 18.41	1064.40 \pm 52.71	33.59 \pm 6.23
	$\rho = 20$	13752	105	13647	10653.20 \pm 87.35	5998.40 \pm 69.35	56.30 \pm 4.01	2993.80 \pm 87.35	886.20 \pm 73.25	29.57 \pm 1.77
	$\rho = 50$	13752	255	13497	11044.80 \pm 129.14	6760.80 \pm 50.26	61.22 \pm 3.42	2442.20 \pm 28.48	879.00 \pm 91.45	35.71 \pm 1.78
	$\rho = 100$	13752	505	13247	9175.20 \pm 32.53	6475.60 \pm 80.88	72.07 \pm 1.96	4071.80 \pm 32.63	1218.60 \pm 14.70	34.43 \pm 1.08