

Table 1. @Reviewer reTY, @Reviewer ExMB:

Performance over diverse graph transformer backbones.

Method	Graphormer	GraphGPS	GraphTrans	SAN
ERM	66.42 $\pm$ 1.26	67.19 $\pm$ 1.29	68.85 $\pm$ 2.29	68.36 $\pm$ 1.46
DropEdge	65.89 $\pm$ 2.34	66.24 $\pm$ 2.29	66.93 $\pm$ 2.87	67.43 $\pm$ 1.67
FLAG	66.53 $\pm$ 1.96	67.78 $\pm$ 1.48	68.67 $\pm$ 2.02	68.99 $\pm$ 2.08
G-Mixup	66.02 $\pm$ 3.28	67.34 $\pm$ 2.10	67.80 $\pm$ 2.14	67.60 $\pm$ 2.21
AIA (ours)	66.97$\pm$2.23	68.02$\pm$2.34	69.88$\pm$2.55	69.35$\pm$2.44

Table 2. @Reviewer ExMB: Performance over diverse backbones.

Backbone	Method	Motif		Molbbbp	
		base	size	scaffold	size
GIN	EEM	68.66 $\pm$ 4.25	51.74 $\pm$ 2.88	68.10 $\pm$ 1.68	78.29 $\pm$ 3.76
	M-Mixup	70.08 $\pm$ 3.82	51.48 $\pm$ 4.91	68.75 $\pm$ 0.34	78.92 $\pm$ 2.43
	FLAG	61.12 $\pm$ 5.39	51.66 $\pm$ 4.14	67.69 $\pm$ 2.36	79.26 $\pm$ 2.26
	AIA (ours)	73.64$\pm$5.15	55.85$\pm$7.98	70.79$\pm$1.53	81.03$\pm$5.15
GCN	EEM	67.41 $\pm$ 4.47	50.76 $\pm$ 2.92	66.44 $\pm$ 1.91	77.79 $\pm$ 4.04
	M-Mixup	68.83 $\pm$ 4.04	51.50 $\pm$ 4.95	67.09 $\pm$ 0.57	78.42 $\pm$ 2.71
	FLAG	59.87 $\pm$ 5.61	50.99 $\pm$ 4.18	66.03 $\pm$ 2.59	78.76 $\pm$ 2.54
	AIA (ours)	72.39$\pm$5.37	54.87$\pm$5.02	69.13$\pm$1.76	80.53$\pm$4.43
GCNII	EEM	67.84 $\pm$ 4.74	51.74 $\pm$ 3.15	67.64 $\pm$ 1.84	77.96 $\pm$ 4.02
	M-Mixup	67.53 $\pm$ 4.31	52.31 $\pm$ 5.18	66.64 $\pm$ 0.50	76.67 $\pm$ 2.69
	FLAG	58.67 $\pm$ 5.88	50.18 $\pm$ 4.41	66.72 $\pm$ 2.52	78.55 $\pm$ 2.52
	AIA (ours)	72.70$\pm$4.14	53.23$\pm$6.25	67.93$\pm$1.69	79.72$\pm$3.37
GAT	EEM	66.53 $\pm$ 4.42	51.16 $\pm$ 3.22	66.51 $\pm$ 1.77	77.41 $\pm$ 3.81
	M-Mixup	69.25 $\pm$ 3.99	51.37 $\pm$ 5.25	66.95 $\pm$ 0.43	77.21 $\pm$ 2.48
	FLAG	59.53 $\pm$ 5.56	51.32 $\pm$ 4.48	67.36 $\pm$ 2.45	77.87 $\pm$ 2.31
	AIA (ours)	71.95$\pm$3.39	54.38$\pm$6.32	69.21$\pm$1.62	78.49$\pm$3.20

Table 3. @Reviewer J9ZS: Comparisons with similar augmentation methods.

Comparisons	ADGCL	RGCL	EERM	FLAG	GREa	Our AIA
Task	Graph classification (SSL)	Graph classification (SSL)	Node classification	Node & Graph classification	Graph classification	Graph classification
Is it specifically designed for graph covariate shift?	$\times$	$\times$	$\times$	$\times$	$\times$	$\checkmark$
How to generate augmented graphs?	Mask generator	Mask generator	K mask matrices	Perturbations	Mask generator	Mask generators $T_{\theta_1}(\cdot)$ and $T_{\theta_1}(\cdot)$
Are node features taken into account?	$\times$	$\checkmark$	$\times$	$\checkmark$	$\checkmark$	$\checkmark$
Are graph structures taken into account?	$\checkmark$	$\times$	$\checkmark$	$\times$	$\times$	$\checkmark$
How to capture stable features?	-	-	-	-	Mask generator	Mask generator $T_{\theta_1}(\cdot)$
Metric for environmental discrepancy	-	-	-	-	-	$GCS(\tilde{P}, P)$
How to augment environmental features?	-	-	“Blindly” maximize $\mathbb{V}_e[R(e)]$	PGD-based perturbations	Removal & Replacement	Maximize $GCS(\tilde{P}, P)$
Learning principles for stable features	-	-	$\min_{\theta} \mathbb{V}_e[R(e)]$	-	Sufficiency & Independence	Sufficiency & Independence
Theoretical basis	Information Bottleneck	-	IRM	-	-	DRO & IRM & Certified robustness
Generalization scope	-	-	K environments	-	-	Robust radius ρ : $GCS(\tilde{P}, P) \leq \rho$

Table 4. @Reviewer J9ZS: Augmentation diversity.

Method	Full Graph	Env. Feature	Sta. Feature
DropEdge	0.999 $\pm$ 0.065	0.933 $\pm$ 0.029	0.971 $\pm$ 0.067
FLAG	0.323 $\pm$ 0.026	0.328 $\pm$ 0.088	0.321 $\pm$ 0.082
G-Mixup	0.816 $\pm$ 0.328	0.801 $\pm$ 0.210	0.789 $\pm$ 0.121
ADGCL	0.459 $\pm$ 0.152	0.414 $\pm$ 0.102	0.331 $\pm$ 0.112
RGCL	0.482 $\pm$ 0.284	0.447 $\pm$ 0.319	0.357 $\pm$ 0.201
AIA (ours)	0.561 $\pm$ 0.223	0.508 $\pm$ 0.136	0.259 $\pm$ 0.106

Table 5. @Reviewer J9ZS, @Reviewer ExMB: Running time, model size and performance improvement.

Dataset	ERM		CAL			DIR			AIA (ours)		
	Running Time	Model Size	Running Time	Model Size	Performance Improvement	Running Time	Model Size	Performance Improvement	Running Time	Model Size	Performance Improvement
Motif	00h 51m 19s	1.515M	01h 37m 15s	2.213M	$\downarrow$ 2.98%	01h 50m 27s	2.158M	$\downarrow$ 5.03%	01h 49m 08s	2.366M	$\uparrow$ 7.55%
CMNIST	01h 56m 32s	1.517M	02h 28m 49s	2.244M	$\downarrow$ 2.13%	02h 34m 35s	2.161M	$\uparrow$ 16.08%	02h 45m 30s	2.373M	$\uparrow$ 27.17%
Molbbbp	00h 11m 58s	1.515M	00h 18m 22s	2.213M	$\uparrow$ 0.81%	00h 20m 11s	2.158M	$\downarrow$ 2.12%	00h 19m 37s	2.366M	$\uparrow$ 3.72%
Molhiv	00h 27m 19s	1.515M	00h 46m 14s	2.213M	$\downarrow$ 3.23%	00h 58m 40s	2.158M	$\downarrow$ 2.59%	00h 55m 46s	2.366M	$\uparrow$ 2.54%