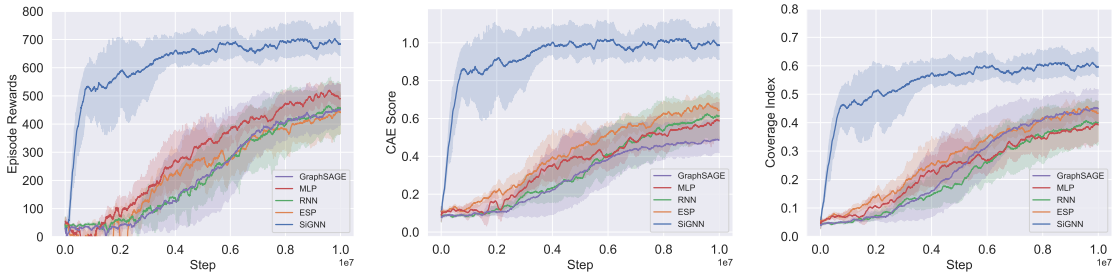
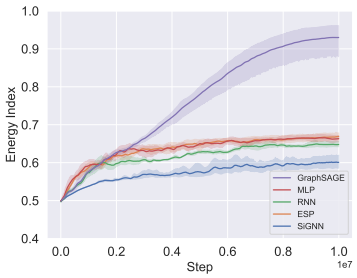
I. Supplementary for Convergence and Performance



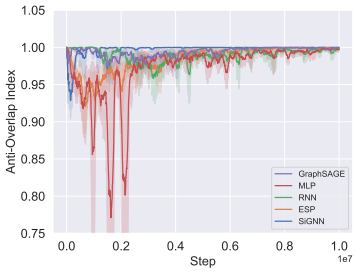
(a) Reward curves

(b) CAE score curves

(c) Coverage index curves

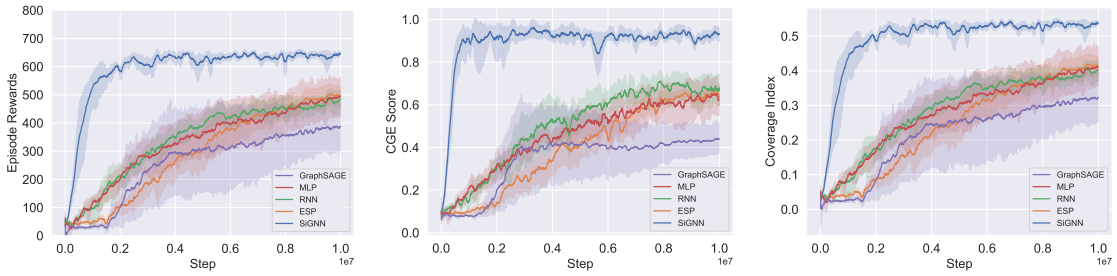


(d) Energy index curves



(e) Anti-overlap index curves

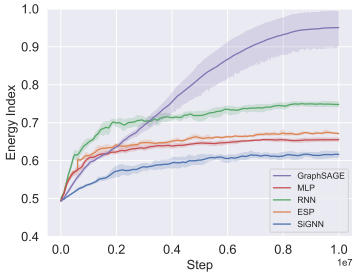
Fig. 1. The curves of rewards, CAE scores and corresponding indexes for scenario with global observation.



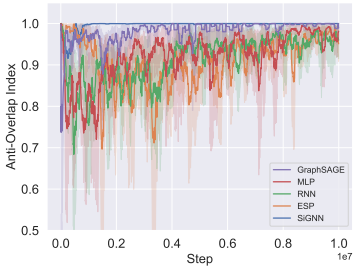
(a) Reward curves

(b) CAE score curves

(c) Coverage index curves



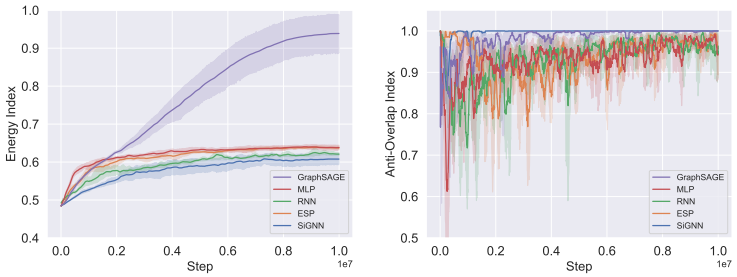
(d) Energy index curves



(e) Anti-overlap index curves

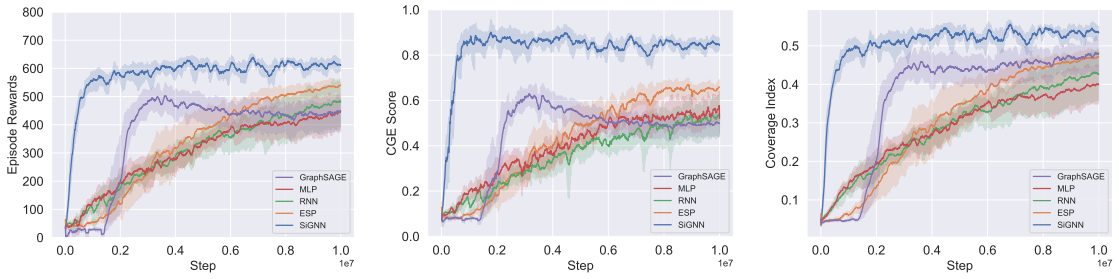
Fig. 2. The curves of rewards, CAE scores and corresponding indexes for scenario with $R_{\text{obs}} = 70$.

(a) Reward curves (b) CAE score curves (c) Coverage index curves

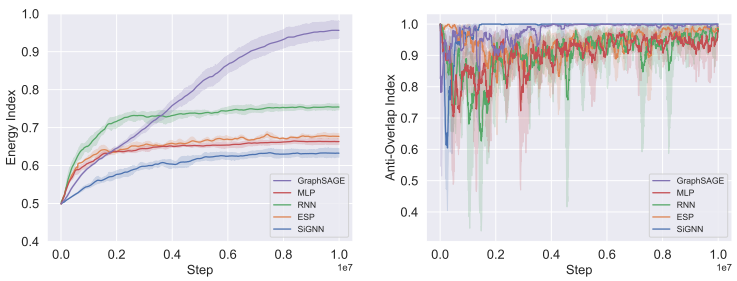


(d) Energy index curves (e) Anti-overlap index curves

Fig. 3. The curves of rewards, CAE scores and corresponding indexes for scenario with $R_{\text{obs}} = 50$.



(a) Reward curves (b) CAE score curves (c) Coverage index curves



(d) Energy index curves (e) Anti-overlap index curves

Fig. 4. The curves of rewards, CAE scores and corresponding indexes for scenario with $R_{\text{obs}} = 30$.

II. Supplementary for Comparison among Learning-based Approaches

TABLE I

Metric Performance under Global Observation

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4861 ± 0.1105	0.4495 ± 0.0716	0.9299 ± 0.0543	0.3998 ± 0.0979
MLP	0.5866 ± 0.1165	0.3921 ± 0.0759	0.6632 ± 0.0111	0.9975 ± 0.0027
RNN	0.6129 ± 0.1552	0.3998 ± 0.0979	0.6478 ± 0.0084	0.9972 ± 0.0027
ESP	0.6428 ± 0.0739	0.4332 ± 0.0488	0.6689 ± 0.0119	0.9883 ± 0.0028
SiGNN	$\mathbf{0.9852 \pm 0.1104}$	$\mathbf{0.5947 \pm 0.0563}$	$\mathbf{0.6008 \pm 0.0209}$	$\mathbf{0.9999 \pm 0.0001}$

TABLE II

Metric Performance under $R_{\text{obs}} = 70$

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4379 ± 0.0893	0.3220 ± 0.0893	0.9505 ± 0.0579	0.9895 ± 0.0235
MLP	0.6213 ± 0.0936	0.4121 ± 0.0741	0.6551 ± 0.0054	0.9816 ± 0.0257
RNN	0.6817 ± 0.0810	0.4032 ± 0.0355	0.7479 ± 0.0079	0.9602 ± 0.0498
ESP	0.6363 ± 0.0471	0.4024 ± 0.0355	0.6713 ± 0.0017	0.9511 ± 0.0490
SiGNN	$\mathbf{0.8728 \pm 0.0376}$	$\mathbf{0.5380 \pm 0.0078}$	$\mathbf{0.6164 \pm 0.0097}$	$\mathbf{1.0000 \pm 0.0000}$

TABLE III

Metric Performance under $R_{\text{obs}} = 50$

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4379 ± 0.0893	0.4065 ± 0.0537	0.9387 ± 0.0645	0.9985 ± 0.0015
MLP	0.6313 ± 0.0936	0.4304 ± 0.0752	0.6382 ± 0.0084	0.9420 ± 0.0673
RNN	0.7017 ± 0.0810	0.4529 ± 0.0528	0.6208 ± 0.0047	0.9635 ± 0.0528
ESP	0.6663 ± 0.0471	0.4439 ± 0.0142	0.6373 ± 0.0053	0.9572 ± 0.0691
SiGNN	$\mathbf{0.9313 \pm 0.0376}$	$\mathbf{0.5655 \pm 0.0109}$	$\mathbf{0.6078 \pm 0.0181}$	$\mathbf{1.0000 \pm 0.0000}$

TABLE IV

Metric Performance under $R_{\text{obs}} = 30$

Algorithm	CAE Score	Coverage Index	Energy Index	Anti-Overlap Index
GraphSAGE	0.4997 ± 0.0619	0.4802 ± 0.0523	0.9562 ± 0.0274	0.9932 ± 0.0150
MLP	0.5201 ± 0.0887	0.4001 ± 0.0613	0.6631 ± 0.0090	0.9794 ± 0.0245
RNN	0.5340 ± 0.1114	0.4269 ± 0.0794	0.7542 ± 0.0097	0.9760 ± 0.0218
ESP	0.6587 ± 0.0442	0.4713 ± 0.0287	0.6769 ± 0.0085	0.9891 ± 0.0157
SiGNN	$\mathbf{0.8444 \pm 0.0286}$	$\mathbf{0.5340 \pm 0.0197}$	$\mathbf{0.6324 \pm 0.0143}$	$\mathbf{1.0000 \pm 0.0000}$

III. Supplementary for Scalability

TABLE V

Scalability Performance under Partial Observation $R_{\text{obs}} = 70$

Number	Steps	EGNN	MLP	RNN	ESP	Graphsage
5	300k	$\mathbf{607.38 \pm 14.71}$	293.33 ± 25.42	311.68 ± 44.21	208.59 ± 39.30	268.24 ± 38.50
	1000k	$\mathbf{667.62 \pm 23.57}$	474.58 ± 42.24	498.68 ± 39.93	507.34 ± 34.14	394.69 ± 54.24
10	300k	$\mathbf{424.53 \pm 19.85}$	7.83 ± 38.26	37.69 ± 38.89	7.57 ± 31.23	-36.17 ± 43.52
	1000k	$\mathbf{488.82 \pm 24.14}$	95.46 ± 55.96	101.78 ± 42.95	86.08 ± 67.34	-335.17 ± 88.26
15	300k	$\mathbf{246.75 \pm 27.47}$	-245.42 ± 32.58	-310.77 ± 52.13	-92.52 ± 35.62	-256.23 ± 67.32
	1000k	$\mathbf{268.82 \pm 35.52}$	-81.04 ± 52.62	26.52 ± 58.76	24.56 ± 67.73	-491.34 ± 74.36
20	300k	$\mathbf{35.77 \pm 63.15}$	-452.94 ± 44.52	-295.15 ± 38.46	-378.42 ± 82.74	-378.18 ± 62.52
	1000k	$\mathbf{141.87 \pm 67.32}$	-623.17 ± 50.70	-56.64 ± 62.10	-174.42 ± 104.42	-876.13 ± 124.33

TABLE VI

Scalability Performance under Partial Observation $R_{\text{obs}} = 50$

Number	Steps	EGNN	MLP	RNN	ESP	Graphsage
5	300k	$\mathbf{619.76 \pm 26.43}$	286.22 ± 32.60	331.68 ± 44.21	198.59 ± 29.30	288.24 ± 38.50
	1000k	$\mathbf{649.61 \pm 26.11}$	489.38 ± 52.24	517.68 ± 29.90	501.34 ± 34.14	364.69 ± 54.24
10	300k	$\mathbf{378.06 \pm 23.45}$	39.84 ± 38.26	53.41 ± 38.89	-6.62 ± 51.92	-6.57 ± 54.14
	1000k	$\mathbf{462.59 \pm 33.42}$	75.71 ± 55.96	90.77 ± 49.17	83.47 ± 48.53	-235.17 ± 78.42
15	300k	$\mathbf{235.31 \pm 31.50}$	-202.66 ± 41.68	-214.55 ± 44.50	-104.39 ± 67.43	-144.95 ± 87.31
	1000k	$\mathbf{226.83 \pm 41.22}$	-58.44 ± 60.13	43.01 ± 69.55	55.68 ± 41.77	-526.73 ± 93.47
20	300k	$\mathbf{50.68 \pm 37.32}$	-322.46 ± 84.61	-336.59 ± 52.36	-426.25 ± 76.15	-558.18 ± 95.12
	1000k	$\mathbf{122.14 \pm 57.21}$	-378.82 ± 76.32	-78.14 ± 82.23	-118.54 ± 45.50	-943.23 ± 154.33

TABLE VII

Scalability Performance under Partial Observation $R_{\text{obs}} = 30$

Number	Steps	EGNN	MLP	RNN	ESP	Graphsage
5	300k	$\mathbf{593.12 \pm 35.78}$	254.56 ± 53.27	243.58 ± 43.12	231.88 ± 78.74	488.32 ± 57.96
	1000k	$\mathbf{615.26 \pm 25.73}$	453.71 ± 51.92	472.88 ± 40.56	543.24 ± 43.25	439.74 ± 75.27
10	300k	$\mathbf{394.88 \pm 32.12}$	43.83 ± 47.59	49.99 ± 39.24	34.98 ± 62.81	-62.13 ± 53.34
	1000k	$\mathbf{411.17 \pm 28.45}$	101.43 ± 66.78	117.37 ± 82.61	66.57 ± 37.48	-171.87 ± 69.14
15	300k	$\mathbf{160.62 \pm 30.67}$	-215.73 ± 50.45	-112.4 ± 45.12	-154.59 ± 68.34	-96.49 ± 58.23
	1000k	$\mathbf{259.82 \pm 27.54}$	-141.24 ± 59.87	20.05 ± 70.29	23.09 ± 40.12	-486.23 ± 74.36
20	300k	$\mathbf{70.93 \pm 46.78}$	-357.58 ± 45.21	-278.35 ± 53.87	-336.45 ± 55.34	-376.38 ± 62.78
	1000k	$\mathbf{125.62 \pm 29.45}$	-288.76 ± 51.34	-16.24 ± 61.25	-78.34 ± 86.12	-683.23 ± 73.29