Inference of Gene Regulatory Networks from Single-Cell RNA-Sequencing Data using Cartesian Genetic Programming

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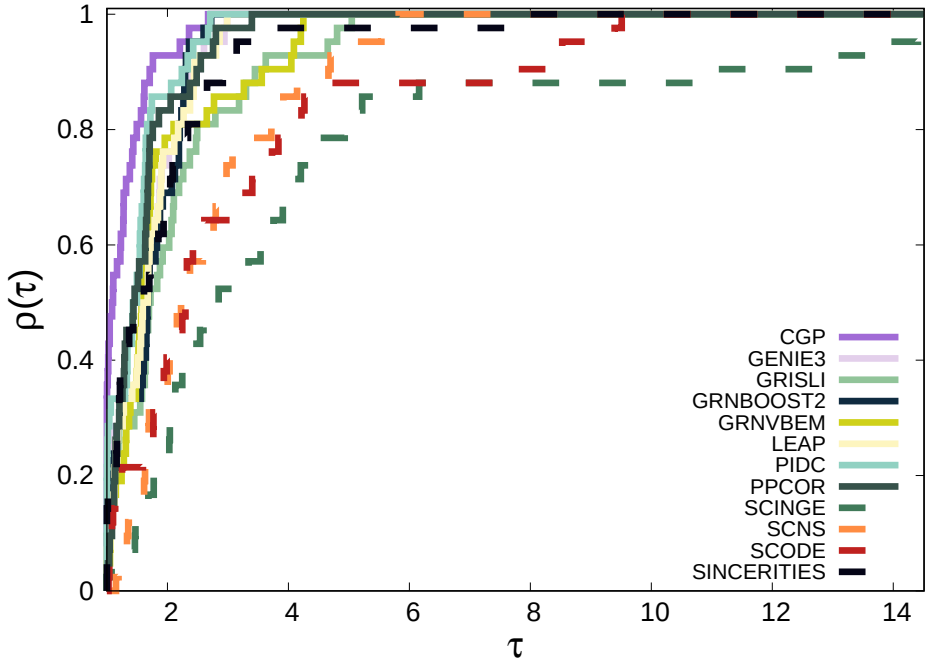
Supplementary Material

This supplementary material presents additional details, the performance profiles, and extra tabular results, reconstructed networks, and boxplots that were obtained by Cartesian Genetic Programming (CGP) and other algorithms presented in [17], when solving the proposed benchmark problems.

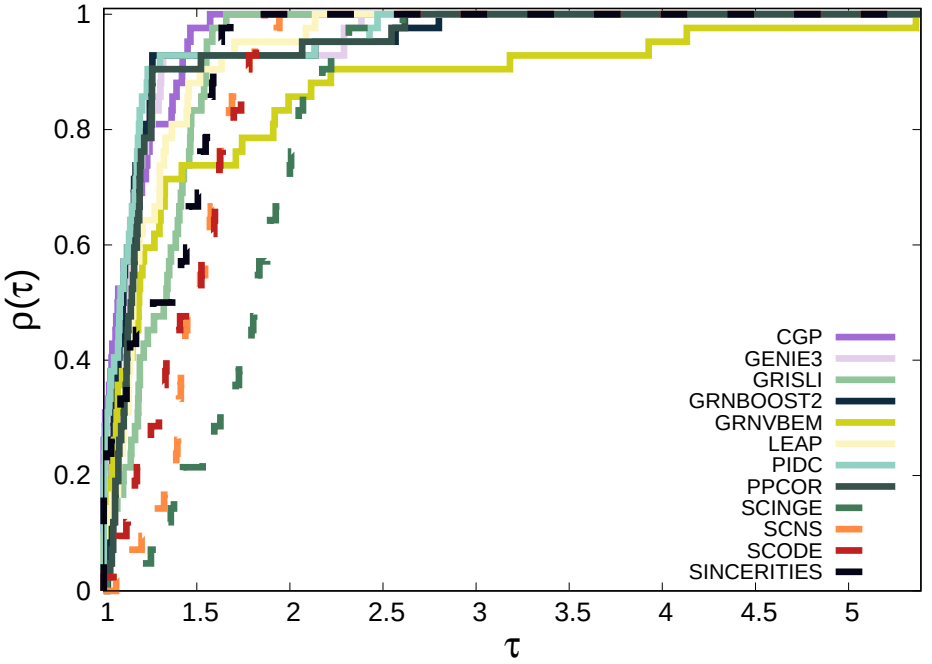
The performance profiles for median values are presented in Figures 1a and 1b and the respective area bar plots in Figures 2a and 2b. For best values, the results of the performance profiles are shown in Figures 3a and 3b and the respective area bar plots in Figures 4a and 4b for AUPRC and AUROC, respectively.

The results are presented for Synthetic (Linear, Linear Long, Bifurcating, Bifurcating Converging and Trifurcating), considering 100, 200, 500, 2000 and 5000 cells, shown in figs. 5a to 20b and tables 1 to 60 for AUPRC and AUROC values, and Curated (mCAD, VSC, HSC and GSD), considering 0%, 50% and 70% dropout rates, shown in figs. 23a to 32b and tables 61 to 84 for AUPRC and AUROC values. For all problems we present the ground-truth network and the best network obtained by the proposal, considering the AUPRC value. The metrics used are maximum (highest value of AUPRC or AUROC), third quantile, median, first quantile, minimum (lowest value of AUPRC or AUROC), mean, standard deviation, Kruskal-Wallis' p-value, and Dunn's p-value.

In all tables, the best results are highlighted in boldface. For Dunn's p-values, the reference is CGP.

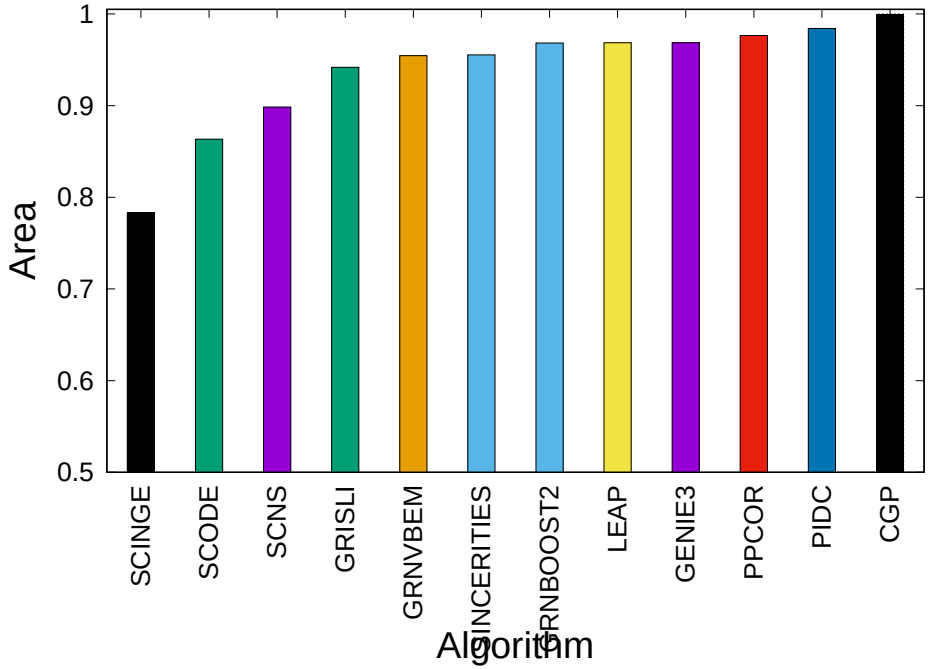


(a) Performance Profiles of the median values for AUPRC considering the 12 algorithms.

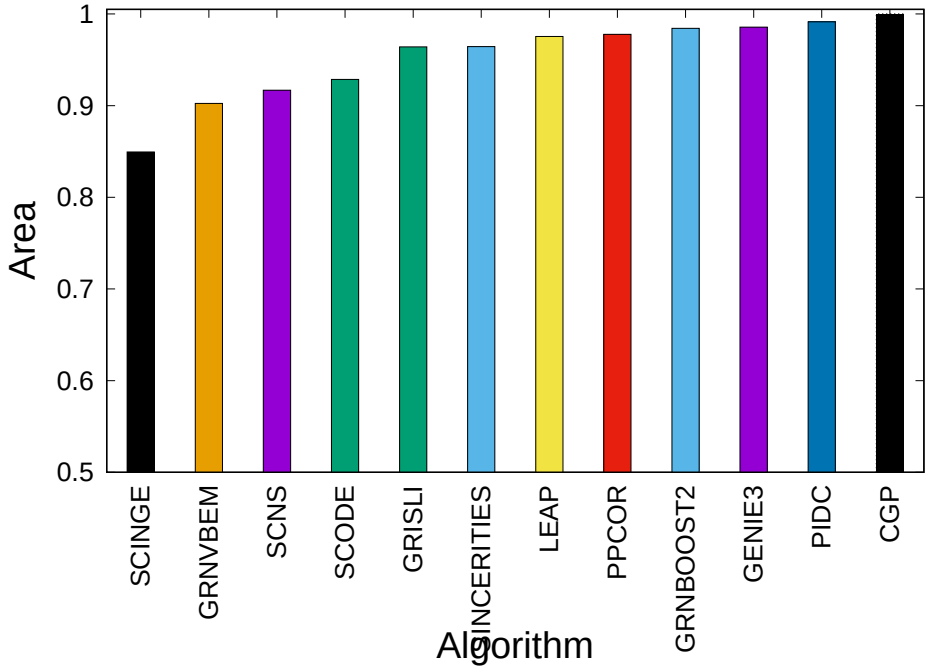


(b) Performance Profiles of the median values for AUROC considering the 12 algorithms.

Figure 1: Performance profiles considering the median values for AUPRC and AUROC.

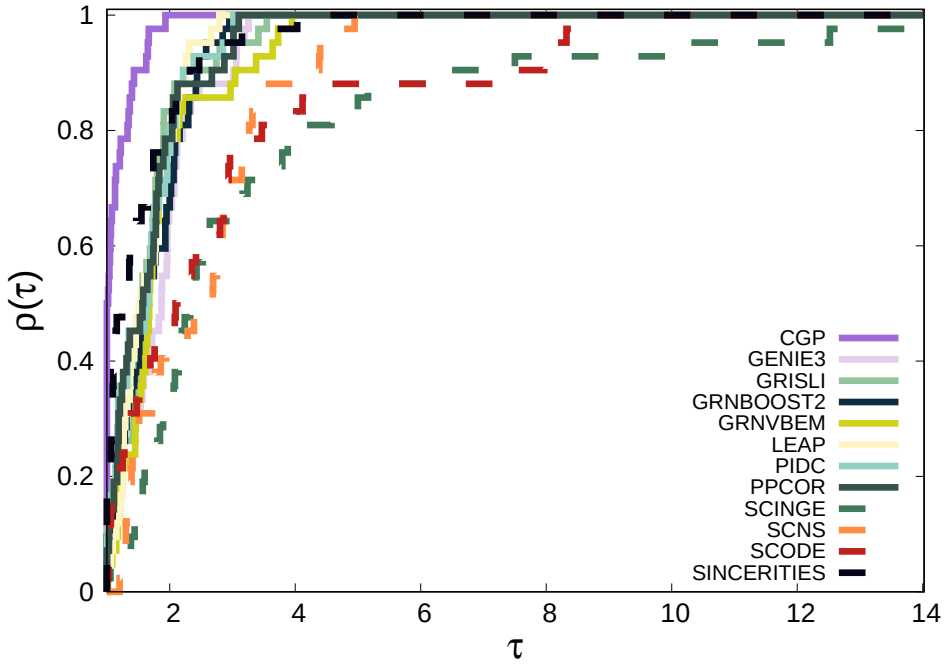


(a) Area Bar Plot of the median values for AUPRC considering the 12 algorithms.

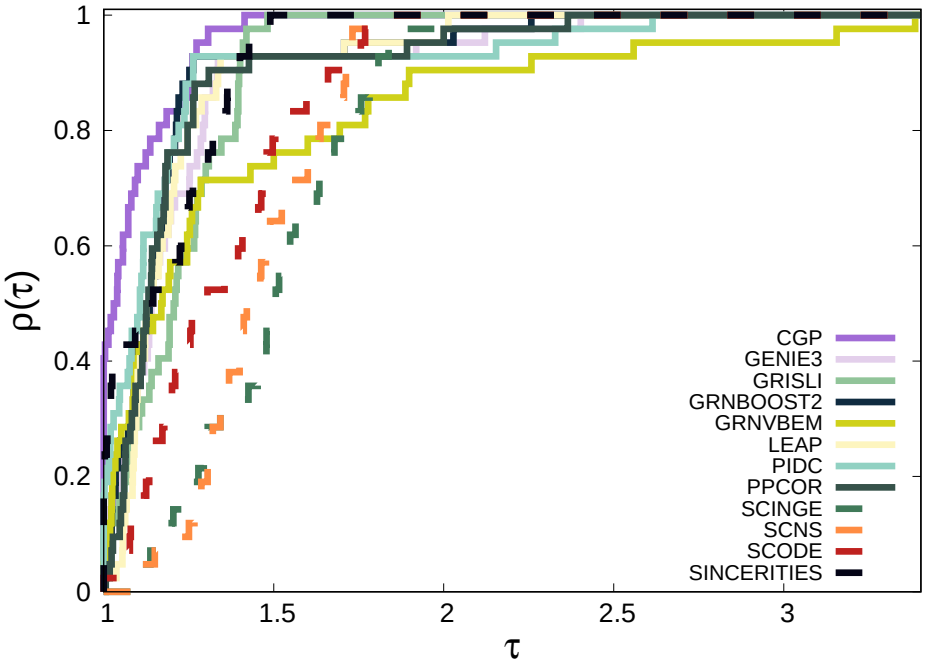


(b) Area Bar Plot of the median values for AUUROC considering the 12 algorithms.

Figure 2: Area Bar Plots considering the median values for AUPRC and AUROC.

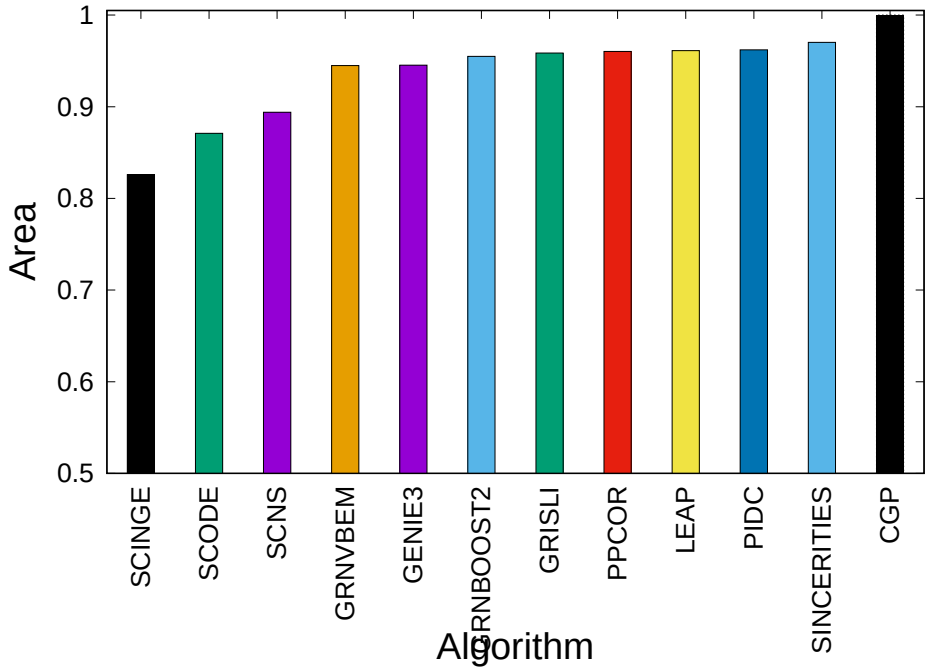


(a) Performance Profiles of the best values for AUPRC considering the 12 algorithms.

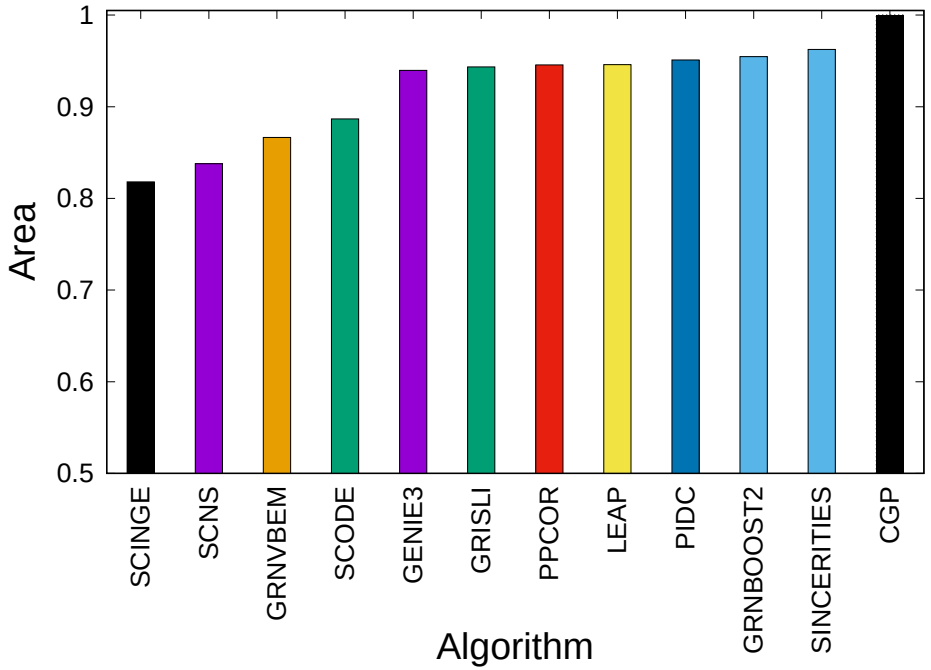


(b) Performance Profiles of the best values for AUROC considering the 12 algorithms.

Figure 3: Performance profiles considering the best values for AUPRC and AUROC.



(a) Area Bar Plot of the best values for AUPRC considering the 12 algorithms.

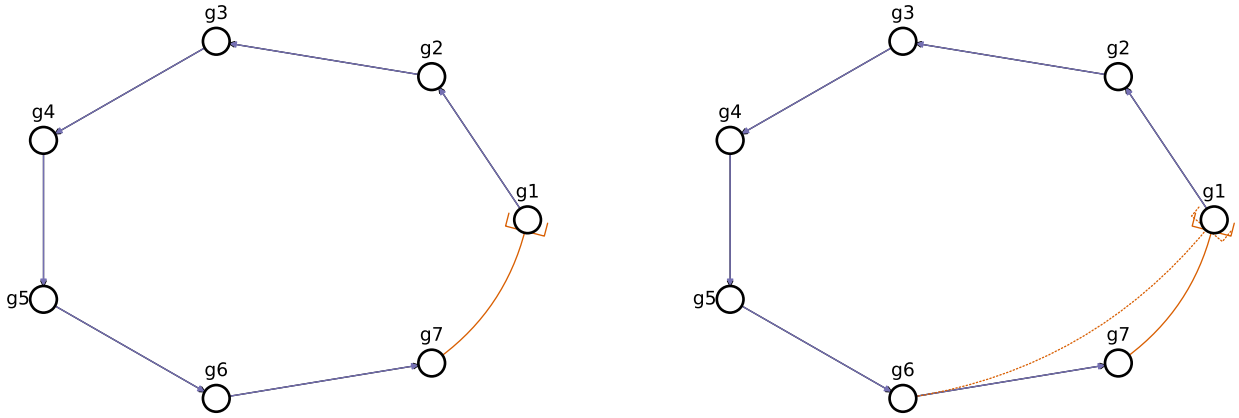


(b) Area Bar Plot of the best values for AUUROC considering the 12 algorithms.

Figure 4: Area Bar Plots considering the best values for AUPRC and AUROC.

1 Linear

The Linear problem consists of 7 genes and one pseudotime. CGP was not able to find and reconstruct the network completely. The following tables present the results for AUPRC (tables 1 to 5) and AUROC (tables 6 to 10), respectively. The ground-truth and reconstructed networks are presented in Figure 5.



(a) Ground-truth network.

(b) Reconstructed network.

Figure 5: Ground-truth and reconstructed Linear networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

1.1 AUPRC

Table 1: AUPRC LI-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9809**	0.6561	0.4592	0.4458	0.2699	0.5611	0.2087		-
SCNS	0.328	0.3129	0.3017	0.2373	0.1827	0.2778	0.0495		7.38E-04
PIDC	0.5	0.4727	0.418	0.4045	0.3939	0.4371	0.0383		4.76E-01
GRNVBEM	0.7821	0.6811	0.6191	0.5696	0.4316	0.6187	0.0922		3.29E-01
GENIE3	0.5367	0.4507	0.4044	0.3507	0.3152	0.4099	0.0731		1.90E-01
GRNBOOST2	0.4244	0.3971	0.3467	0.3196	0.2858	0.3541	0.0443		3.08E-02
PPCOR	0.4762	0.4617	0.3982	0.3982	0.3088	0.4111	0.051	2.01E-14	2.29E-01
SCODE	0.3313	0.2328	0.2054	0.1902	0.1505	0.2155	0.0486		4.46E-05
SINCERITIES	0.3971	0.3513	0.2152	0.1776	0.1368	0.2509	0.0969		2.30E-04
LEAP	0.7814	**0.7218**	**0.6512**	**0.5888**	**0.5219**	**0.654**	0.0817		2.12E-01
GRISLI	0.8403	0.693	0.5415	0.3632	0.1963	0.5336	0.204		7.92E-01
SCINGE	0.2142	0.1748	0.1666	0.1536	0.1216	0.165	**0.0241**		1.10E-06

Table 2: AUPRC LI-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9809**	0.6994	0.4458	0.4458	0.436	0.5883	0.1918		-
SCNS	0.3115	0.3038	0.2417	0.181	0.1745	0.2418	0.0601		8.57E-05
PIDC	0.4689	0.4599	0.4552	0.4515	0.3939	0.447	**0.0244**		3.93E-01
GRNVBEM	0.6588	0.6318	0.6255	0.6137	**0.5078**	0.6133	0.0415		4.11E-01
GENIE3	0.4819	0.4599	0.3894	0.3453	0.3219	0.3985	0.0592		9.34E-02
GRNBOOST2	0.4057	0.3288	0.315	0.3062	0.2857	0.327	0.04	3.82E-16	3.52E-03
PPCOR	0.5092	0.4666	0.4326	0.3906	0.3557	0.4276	0.0474		1.77E-01
SCODE	0.3426	0.2255	0.1873	0.1719	0.1401	0.2113	0.0648		2.93E-05
SINCERITIES	0.5639	0.3862	0.3169	0.2017	0.1644	0.3182	0.124		4.31E-03
LEAP	0.7743	0.7131	0.66	0.5348	0.4686	0.6306	0.1055		3.78E-01
GRISLI	0.8137	**0.7982**	**0.7184**	**0.6168**	0.4332	**0.6831**	0.1278		2.66E-01
SCINGE	0.2428	0.1532	0.144	0.1401	0.1259	0.1577	0.0354		7.18E-07

Table 3: AUPRC LI-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9809**	**0.8091**	0.4458	0.4458	0.4101	0.6148	0.2266		-
SCNS	0.309	0.3004	0.2892	0.2068	0.1626	0.2578	0.0581		8.13E-05
PIDC	0.5	0.4774	0.4708	0.4618	0.4123	0.4657	**0.0273**		4.52E-01
GRNVBEM	0.806	0.7563	0.6341	0.5755	0.5083	0.6546	0.1035		3.65E-01
GENIE3	0.5	0.4115	0.3865	0.3752	0.3478	0.3993	0.0407		3.50E-02
GRNBOOST2	0.4543	0.3552	0.3463	0.3417	0.3108	0.3555	0.0359	1.29E-15	5.48E-03
PPCOR	0.4762	0.4606	0.4341	0.4176	0.3881	0.4353	0.0285		1.59E-01
SCODE	0.2337	0.2097	0.1785	0.1621	0.1444	0.1849	0.0296		5.01E-06
SINCERITIES	0.9157	0.6638	0.4474	0.3408	0.19	0.5192	0.2328		3.22E-01
LEAP	0.7768	0.7077	**0.666**	**0.5911**	**0.5725**	**0.6596**	0.0685		3.35E-01
GRISLI	0.8912	0.7292	0.643	0.5584	0.4353	0.6543	0.1366		4.29E-01
SCINGE	0.2526	0.2085	0.1652	0.1412	0.1138	0.1744	0.0421		2.45E-06

Table 4: AUPRC LI-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9809**	**0.9112**	0.4458	0.4458	0.436	0.631	0.2412		-
SCNS	0.3001	0.2847	0.2719	0.1735	0.1627	0.2383	0.0566		9.79E-05
PIDC	0.4904	0.4762	0.4708	0.4644	0.4456	0.4695	**0.0115**		5.69E-01
GRNVBEM	0.5385	0.5104	0.4955	0.4707	0.4313	0.4911	0.0302		8.88E-01
GENIE3	0.4719	0.3818	0.3762	0.3638	0.352	0.3818	0.0329		2.53E-02
GRNBOOST2	0.5079	0.3918	0.3473	0.3369	0.2987	0.3722	0.0626	5.45E-15	1.80E-02
PPCOR	0.5488	0.4856	0.466	0.4437	0.4252	0.4707	0.0348		4.70E-01
SCODE	0.3097	0.1964	0.1783	0.1677	0.1423	0.1982	0.0554		3.78E-05
SINCERITIES	0.9211	0.8931	0.6548	0.4761	0.3767	0.6684	0.2123		5.04E-01
LEAP	0.7746	0.7201	0.6622	**0.5613**	**0.5436**	0.6501	0.0846		1.73E-01
GRISLI	0.8886	0.8793	**0.7608**	0.5413	0.4656	**0.7143**	0.1655		1.75E-01
SCINGE	0.4705	0.1831	0.1735	0.1421	0.1237	0.194	0.0954		4.72E-05

Table 5: AUPRC LI-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9809	**0.9809**	0.5741	0.4458	0.4458	0.6855	0.2523		-
SCNS	0.3142	0.294	0.2771	0.197	0.1528	0.2522	0.058		3.77E-05
PIDC	0.5	0.4958	0.4803	0.4629	0.4551	0.4785	**0.0167**		4.11E-01
GRNVBEM	0.5482	0.4643	0.4568	0.4368	0.4313	0.4609	0.0324		1.67E-01
GENIE3	0.4719	0.3825	0.3696	0.3649	0.3535	0.3833	0.0332		7.78E-03
GRNBOOST2	0.4354	0.3684	0.36	0.3534	0.3168	0.3633	0.0295	1.66E-17	2.17E-03
PPCOR	0.5488	0.5	0.4693	0.4373	0.4121	0.4716	0.0423		2.45E-01
SCODE	0.2429	0.2188	0.1975	0.1846	0.1561	0.1993	0.0273		7.66E-06
SINCERITIES	**1.0**	0.8977	**0.8253**	**0.6975**	0.4882	**0.7906**	0.1567		2.12E-01
LEAP	0.7733	0.7258	0.6555	0.5465	0.5298	0.6452	0.0941		5.50E-01
GRISLI	0.8179	0.7635	0.719	0.5868	**0.5593**	0.6863	0.0918		3.75E-01
SCINGE	0.2728	0.1429	0.134	0.1277	0.1206	0.1497	0.0433		3.43E-07

1.2 AUROC

Table 6: AUROC LI-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9959**	0.8306	0.7429	0.7306	0.6367	0.7865	0.0994		-
SCNS	0.6204	0.5852	0.5837	0.5485	0.5286	0.5749	**0.0301**		1.08E-03
PIDC	0.9	0.8633	0.7816	0.7551	0.6878	0.8004	0.0672		6.83E-01
GRNVBEM	0.9469	**0.9357**	**0.9163**	**0.8898**	**0.802**	**0.9065**	0.0414		2.42E-02
GENIE3	0.8816	0.8735	0.8531	0.8102	0.7388	0.8367	0.0448		3.07E-01
GRNBOOST2	0.8735	0.7633	0.7327	0.6878	0.6449	0.7441	0.0732	3.02E-14	4.85E-01
PPCOR	0.8429	0.7306	0.7286	0.7286	0.6143	0.729	0.0571		3.28E-01
SCODE	0.7265	0.648	0.5592	0.5388	0.4449	0.5763	0.0894		1.45E-03
SINCERITIES	0.6816	0.6291	0.6041	0.5265	0.4286	0.5735	0.0794		1.48E-03
LEAP	0.9061	0.852	0.8265	0.7918	0.7612	0.8259	0.0432		4.14E-01
GRISLI	0.9306	0.8531	0.7673	0.7051	0.5102	0.7608	0.1241		7.53E-01
SCINGE	0.6367	0.5429	0.501	0.4612	0.3449	0.5061	0.0795		1.09E-04

Table 7: AUROC LI-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9959**	0.8367	0.7429	0.7429	0.7327	0.8008	0.085		-
SCNS	0.5837	0.5704	0.548	0.525	0.4653	0.5433	0.0342		6.26E-04
PIDC	0.8592	0.8469	0.8102	0.7878	0.7122	0.8086	0.0439		6.53E-01
GRNVBEM	0.9571	**0.9383**	**0.9255**	**0.848**	**0.8286**	**0.9002**	0.0493		2.46E-02
GENIE3	0.8735	0.8429	0.8265	0.8214	0.7755	0.8306	**0.0262**		2.90E-01
GRNBOOST2	0.849	0.7684	0.7367	0.7133	0.6612	0.7412	0.0567	3.36E-14	2.82E-01
PPCOR	0.8429	0.7872	0.7837	0.7286	0.6714	0.7671	0.0524		5.96E-01
SCODE	0.6653	0.6286	0.5776	0.5153	0.4367	0.5702	0.0734		1.35E-03
SINCERITIES	0.8224	0.6724	0.6092	0.5296	0.4592	0.6198	0.1124		1.28E-02
LEAP	0.8367	0.8077	0.8031	0.777	0.749	0.7963	0.0271		9.72E-01
GRISLI	0.902	0.8622	0.8367	0.8122	0.6571	0.8245	0.0641		3.14E-01
SCINGE	0.6653	0.5071	0.4612	0.4056	0.3857	0.4849	0.0981		9.15E-05

Table 8: AUROC LI-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9959**	0.8888	0.7429	0.7429	0.7367	0.819	0.103		-
SCNS	0.5755	0.5612	0.5276	0.5051	0.4612	0.5271	0.037		1.09E-03
PIDC	0.9	0.8755	0.8633	0.8388	0.7449	0.8469	0.0508		2.38E-01
GRNVBEM	0.9714	**0.9454**	**0.9327**	**0.9097**	**0.8367**	**0.9218**	0.0403		9.14E-03
GENIE3	0.8776	0.8724	0.8673	0.8418	0.8122	0.8555	0.0222		1.32E-01
GRNBOOST2	0.8449	0.8265	0.8143	0.7949	0.7061	0.8041	0.0371		9.72E-01
PPCOR	0.8429	0.8378	0.7816	0.7699	0.7163	0.791	0.0445	8.52E-13	7.24E-01
SCODE	0.6735	0.6061	0.5367	0.4857	0.4571	0.5478	0.0685		1.71E-03
SINCERITIES	0.9755	0.8883	0.7949	0.7622	0.5653	0.8122	0.1138		8.40E-01
LEAP	0.8327	0.8204	0.8051	0.7929	0.7673	0.8039	**0.0208**		8.37E-01
GRISLI	0.9551	0.8898	0.8143	0.7755	0.7388	0.8327	0.0702		6.00E-01
SCINGE	0.6612	0.6133	0.5173	0.4551	0.3061	0.5186	0.1067		1.09E-03

Table 9: AUROC LI-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9959**	0.9577	0.7429	0.7429	0.7327	0.8278	0.1141		-
SCNS	0.5531	0.5143	0.5112	0.4944	0.449	0.5053	0.0301		1.07E-03
PIDC	0.8918	0.8735	0.8633	0.8469	0.8102	0.8576	0.0233		2.38E-01
GRNVBEM	0.9143	0.8985	0.8908	**0.8816**	0.8041	0.8829	0.0288		3.76E-02
GENIE3	0.8694	0.8571	0.8469	0.8367	**0.8163**	0.8461	**0.0161**		4.54E-01
GRNBOOST2	0.8776	0.8429	0.8286	0.7939	0.7714	0.8212	0.0326		9.95E-01
PPCOR	0.8918	0.8745	0.8449	0.7908	0.7694	0.8347	0.0436	7.76E-13	6.41E-01
SCODE	0.6	0.5867	0.5551	0.5276	0.4653	0.5469	0.0466		4.96E-03
SINCERITIES	0.9714	**0.9602**	**0.9112**	0.826	0.7714	**0.8949**	0.0722		5.79E-02
LEAP	0.8327	0.8153	0.8041	0.7694	0.7367	0.7945	0.0309		4.23E-01
GRISLI	0.9388	0.9051	0.8673	0.8112	0.7755	0.8624	0.0564		2.11E-01
SCINGE	0.6735	0.5827	0.5041	0.4423	0.3673	0.5092	0.091		1.31E-03

Table 10: AUROC LI-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9959	**0.9959**	0.7929	0.7429	0.7429	0.8541	0.1194		-
SCNS	0.5776	0.5449	0.4949	0.4842	0.4224	0.5063	0.0459		2.84E-04
PIDC	0.9	0.8959	0.8796	0.8429	0.8102	0.8673	0.0305		4.22E-01
GRNVBEM	0.9184	0.8816	0.8694	0.8286	0.7857	0.8561	0.0396		6.57E-01
GENIE3	0.8735	0.8602	0.8531	0.8418	**0.8367**	0.8522	**0.0109**		8.02E-01
GRNBOOST2	0.849	0.8439	0.8265	0.798	0.7755	0.82	0.0257		4.23E-01
PPCOR	0.902	0.898	0.848	0.802	0.7612	0.8433	0.054	9.89E-14	9.00E-01
SCODE	0.6531	0.6235	0.598	0.5449	0.4776	0.5833	0.054		1.76E-03
SINCERITIES	**1.0**	0.9786	**0.9551**	**0.9082**	0.8224	**0.938**	0.0529		3.31E-02
LEAP	0.8286	0.8112	0.7898	0.7418	0.7224	0.7798	0.0373		9.03E-02
GRISLI	0.9347	0.8918	0.8653	0.8459	0.7918	0.8657	0.0436		5.16E-01
SCINGE	0.5612	0.4658	0.4122	0.3939	0.3592	0.4312	0.0562		2.93E-05

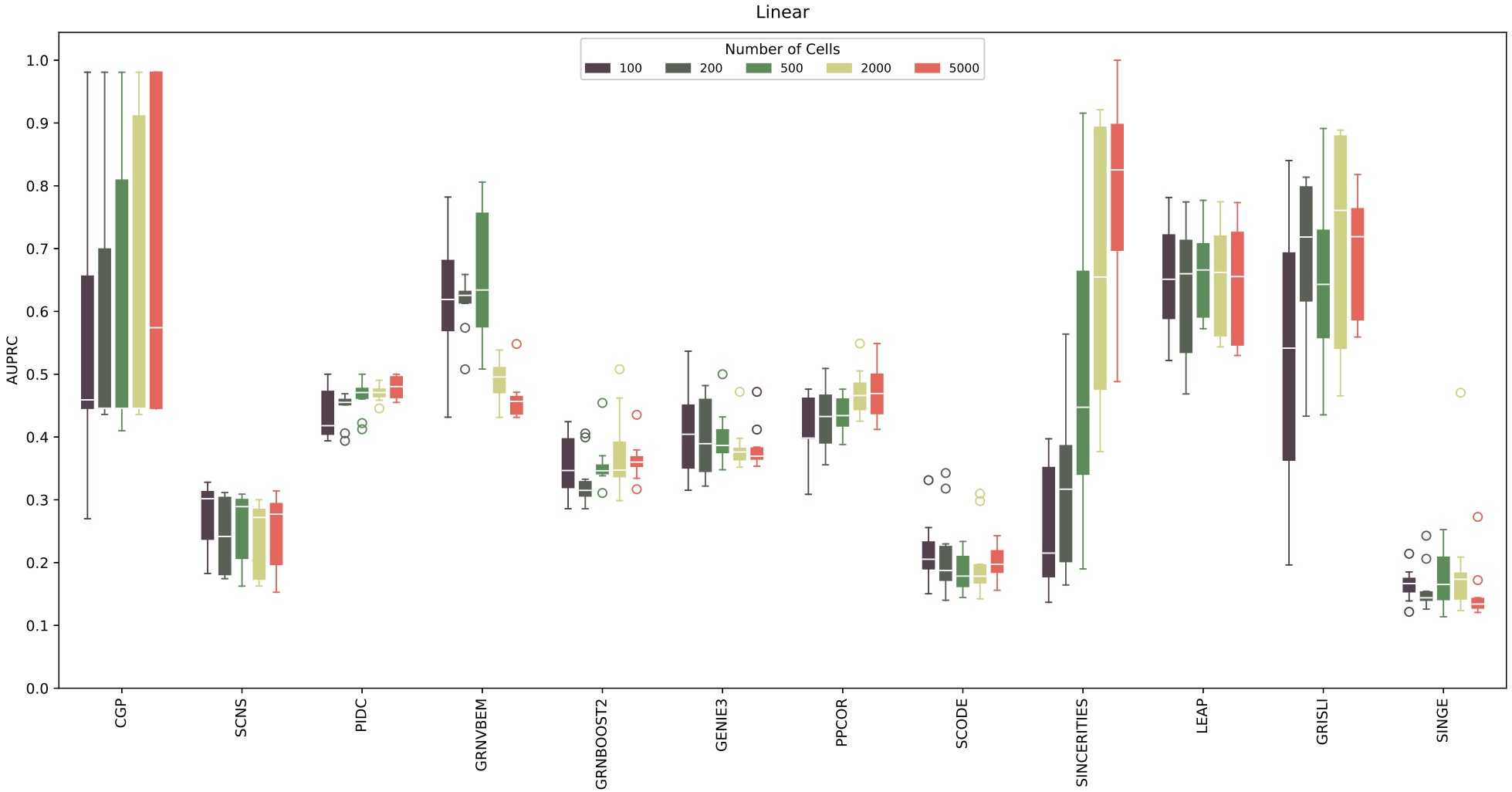


Figure 6: AUPRC boxplots considering the 12 algorithms for Linear problem.

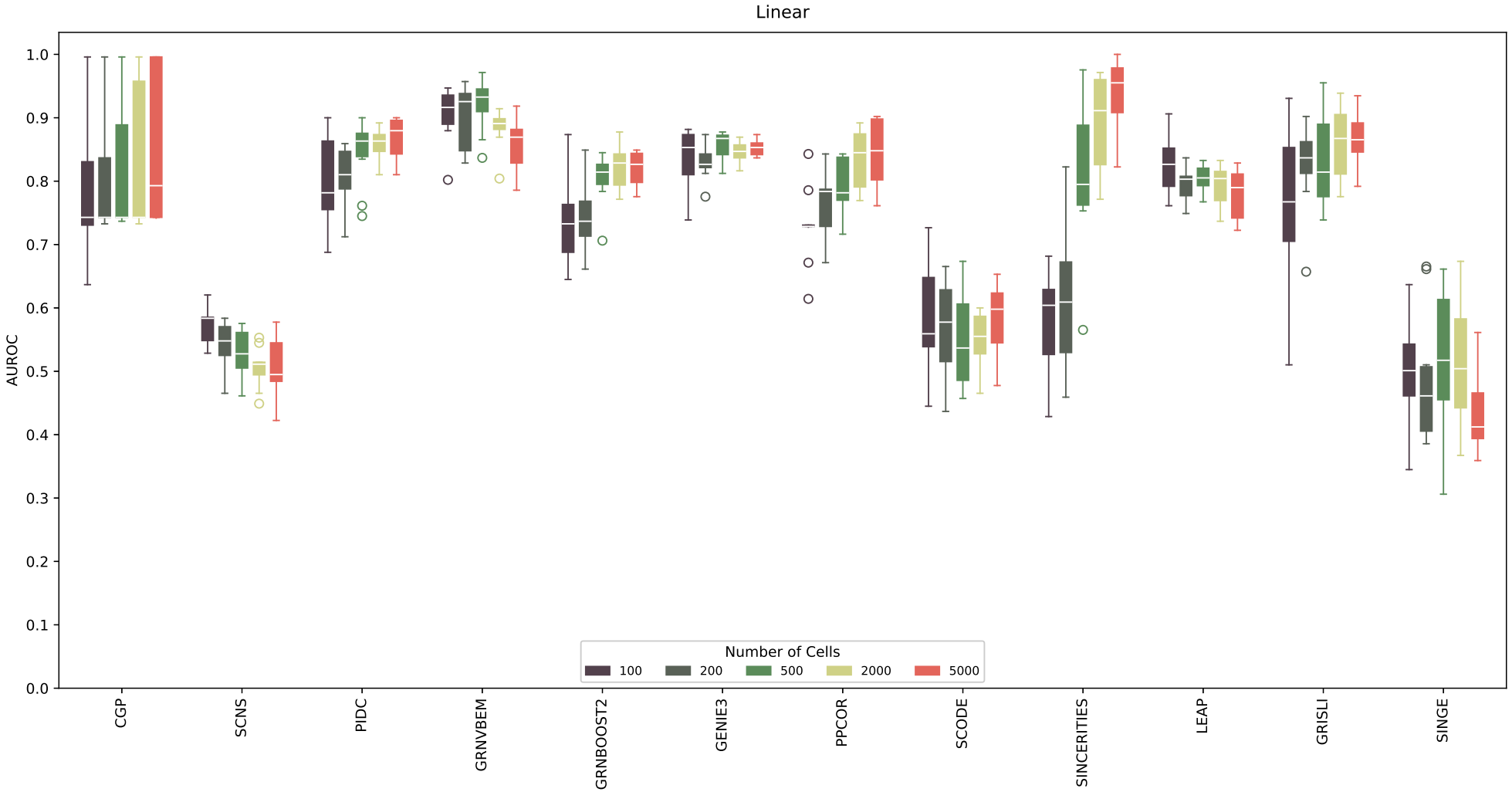
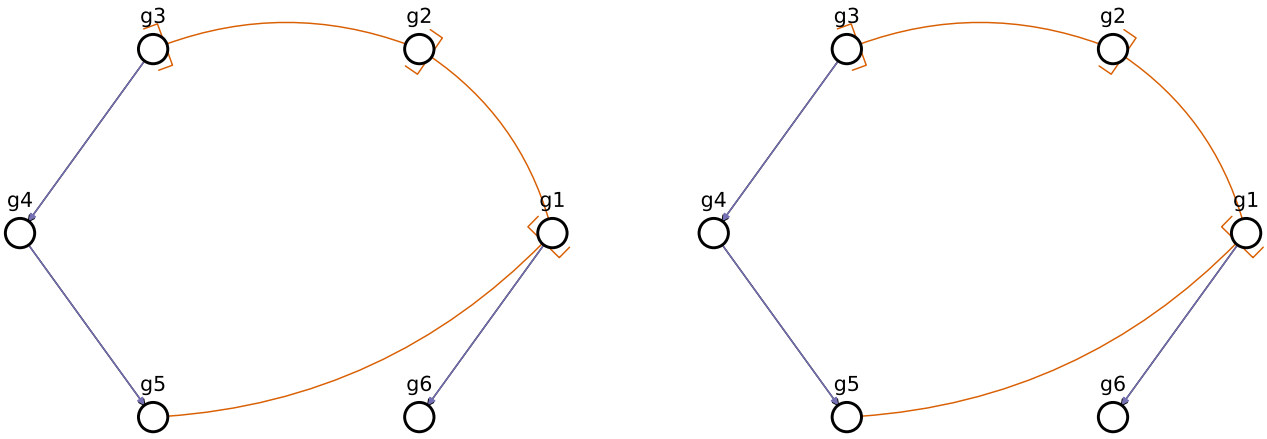


Figure 7: AUROC boxplots considering the 12 algorithms for Linear problem.

2 Cycle

The Cycle problem consists of 6 genes and one pseudotime. CGP was able to find and reconstruct the network completely. The following tables present the results for AUPRC (tables 11 to 15) and AUROC (tables 16 to 20), respectively.



(a) Ground-truth network.

(b) Reconstructed network.

Figure 8: Ground-truth and reconstructed Cycle networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

2.1 AUPRC

Table 11: AUPRC CY-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.8773**	**0.7357**	**0.6897**	**0.421**	**0.7536**	0.1717		-
SCNS	0.29	0.2618	0.2391	0.1961	0.1693	0.2313	0.0374		1.66E-08
PIDC	0.4519	0.3712	0.3287	0.3028	0.2866	0.3452	0.0509		1.48E-02
GRNVBEM	0.4643	0.3812	0.2656	0.2232	0.1769	0.295	0.0972		8.58E-05
GENIE3	0.3266	0.3172	0.3117	0.3036	0.2803	0.3081	**0.0132**		8.11E-04
GRNBOOST2	0.3389	0.3239	0.3121	0.2861	0.2706	0.3071	0.0223		7.39E-04
PPCOR	0.4706	0.3989	0.2961	0.2721	0.2514	0.3317	0.0736		1.90E-03
SCODE	0.4804	0.3655	0.3201	0.2397	0.1935	0.3107	0.0843	2.46E-10	6.27E-04
SINCERITIES	0.4301	0.2682	0.2339	0.1895	0.1656	0.2457	0.0737		1.85E-07
LEAP	0.4742	0.3481	0.3243	0.3107	0.2794	0.3416	0.0549		1.13E-02
GRISLI	0.5924	0.4036	0.351	0.3345	0.2247	0.3763	0.0988		3.79E-02
SCINGE	0.2635	0.1924	0.1687	0.1487	0.1372	0.1773	0.0375		2.87E-11

Table 12: AUPRC CY-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.9173**	**0.7814**	**0.5901**	**0.563**	**0.7689**	0.1632		-
SCNS	0.3572	0.2264	0.209	0.1809	0.1561	0.2155	0.0534		8.41E-09
PIDC	0.4193	0.3292	0.3221	0.3028	0.2998	0.326	0.0333		6.54E-03
GRNVBEM	0.4525	0.3122	0.2947	0.2202	0.1503	0.2802	0.0815		2.08E-05
GENIE3	0.3259	0.3131	0.2999	0.293	0.2705	0.301	**0.0152**		2.13E-04
GRNBOOST2	0.4068	0.3828	0.35	0.2959	0.2742	0.3418	0.0465	6.89E-08	1.71E-02
PPCOR	0.3741	0.3382	0.3062	0.2806	0.2772	0.3142	0.0362		1.10E-03
SCODE	0.3441	0.2956	0.2216	0.1982	0.1748	0.2438	0.0611		6.72E-07
SINCERITIES	0.476	0.4201	0.3417	0.212	0.1957	0.3254	0.1025		2.12E-03
LEAP	0.3581	0.3495	0.3202	0.3046	0.2727	0.3211	0.0284		4.36E-03
GRISLI	0.525	0.3262	0.2799	0.2294	0.2173	0.3127	0.1048		1.98E-04
SCINGE	0.4181	0.2677	0.1924	0.144	0.1334	0.2176	0.0871		1.02E-08

Table 13: AUPRC CY-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.8053**	**0.7524**	**0.5901**	**0.563**	**0.7385**	0.1448		-
SCNS	0.3898	0.2427	0.1921	0.174	0.1614	0.2233	0.0683		2.40E-08
PIDC	0.3315	0.3315	0.3221	0.3054	0.2998	0.3192	0.0133		4.44E-03
GRNVBEM	0.2682	0.2288	0.1839	0.1711	0.1529	0.1983	0.038		4.13E-10
GENIE3	0.3134	0.3019	0.2979	0.2927	0.2721	0.2956	0.0117		4.33E-05
GRNBOOST2	0.3515	0.3318	0.3261	0.3169	0.2603	0.3173	0.0279	1.95E-09	4.67E-03
PPCOR	0.3315	0.3261	0.3174	0.31	0.2998	0.3174	**0.0104**		2.62E-03
SCODE	0.3403	0.2976	0.2211	0.1878	0.1725	0.2398	0.0633		8.45E-07
SINCERITIES	0.6452	0.5204	0.3886	0.3116	0.2712	0.4236	0.1217		6.23E-02
LEAP	0.4422	0.3742	0.3169	0.2925	0.2734	0.3379	0.0554		5.76E-03
GRISLI	0.576	0.4777	0.3018	0.2298	0.1569	0.3404	0.1419		8.09E-04
SCINGE	0.3789	0.3306	0.2314	0.1907	0.1533	0.256	0.0802		7.89E-06

Table 14: AUPRC CY-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9444**	**0.9235**	**0.8727**	**0.7922**	**0.563**	**0.8194**	0.137		-
SCNS	0.3954	0.2509	0.2347	0.1878	0.1614	0.2362	0.063		1.02E-07
PIDC	0.3315	0.3221	0.3221	0.3116	0.2998	0.3174	0.0108		1.13E-02
GRNVBEM	0.2795	0.2267	0.2075	0.191	0.1568	0.2103	0.0317		3.74E-09
GENIE3	0.3132	0.3032	0.2922	0.2868	0.2817	0.295	**0.0099**		1.88E-04
GRNBOOST2	0.3874	0.342	0.3204	0.3003	0.2771	0.3219	0.0311	3.49E-12	9.57E-03
PPCOR	0.3289	0.3237	0.3116	0.3004	0.2978	0.3124	0.0116		5.06E-03
SCODE	0.3371	0.2414	0.1984	0.1898	0.1625	0.2184	0.0473		2.49E-08
SINCERITIES	0.9296	0.7986	0.7258	0.5942	0.3688	0.6835	0.1596		7.00E-01
LEAP	0.4458	0.3206	0.3049	0.283	0.2689	0.3184	0.0507		1.60E-03
GRISLI	0.5329	0.378	0.2644	0.2074	0.183	0.3029	0.114		1.27E-04
SCINGE	0.389	0.3073	0.2325	0.1919	0.1435	0.2493	0.0754		2.96E-06

Table 15: AUPRC CY-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	0.8913	**0.8611**	**0.7806**	0.563	0.8083	0.136		-
SCNS	0.3511	0.2086	0.1833	0.1623	0.1569	0.1999	0.055		2.89E-08
PIDC	0.3315	0.3292	0.3221	0.3221	0.2998	0.3205	0.0111		4.35E-02
GRNVBEM	0.2532	0.2334	0.2027	0.1913	0.1679	0.2092	0.0271		1.26E-07
GENIE3	0.307	0.2996	0.2926	0.2781	0.2705	0.2897	0.0132		5.97E-04
GRNBOOST2	0.3873	0.3433	0.3315	0.3103	0.2852	0.3305	0.0285		6.41E-02
PPCOR	0.3315	0.3228	0.3125	0.3086	0.2975	0.3148	**0.0109**	1.61E-15	2.40E-02
SCODE	0.2488	0.2199	0.2042	0.1856	0.1736	0.2048	0.0218		8.85E-08
SINCERITIES	0.941	**0.9093**	0.8479	0.7532	**0.5954**	**0.817**	0.1091		9.85E-01
LEAP	0.376	0.308	0.2881	0.2788	0.2572	0.2996	0.0336		2.31E-03
GRISLI	0.6627	0.4019	0.2703	0.2083	0.1612	0.3271	0.1575		4.59E-04
SCINGE	0.2	0.1997	0.1746	0.169	0.1614	0.1818	0.0151		1.29E-09

2.2 AUROC

Table 16: AUROC CY-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.9149**	**0.8906**	**0.8828**	0.7292	**0.8892**	0.0776		-
SCNS	0.625	0.5938	0.5521	0.5295	0.4514	0.5549	0.0484		9.32E-07
PIDC	0.8194	0.7778	0.7639	0.75	**0.7361**	0.7667	0.0247		2.03E-01
GRNVBEM	0.625	0.592	0.5208	0.4878	0.4167	0.5306	0.0662		1.50E-07
GENIE3	0.7708	0.7569	0.75	0.7448	0.7083	0.7479	**0.017**		6.45E-02
GRNBOOST2	0.7917	0.7639	0.7604	0.7326	0.7083	0.7514	0.0256		9.27E-02
PPCOR	0.7639	0.75	0.7066	0.6623	0.6076	0.7	0.0548	3.79E-15	7.13E-03
SCODE	0.6181	0.559	0.5243	0.5087	0.4236	0.5285	0.0517		1.13E-07
SINCERITIES	0.7361	0.5938	0.5451	0.4253	0.3819	0.5344	0.1152		4.06E-07
LEAP	0.8889	0.7925	0.7691	0.7535	0.7222	0.783	0.0476		3.07E-01
GRISLI	0.8056	0.7257	0.6736	0.5868	0.5417	0.6681	0.0869		1.90E-03
SCINGE	0.6458	0.5156	0.4097	0.3576	0.309	0.4385	0.1022		9.52E-10

Table 17: AUROC CY-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.9766**	**0.8837**	**0.8125**	**0.7917**	**0.8948**	0.08		-
SCNS	0.5903	0.5686	0.5521	0.4896	0.4167	0.5288	0.0557		8.68E-08
PIDC	0.8056	0.7882	0.7778	0.7535	0.75	0.7736	0.0187		2.10E-01
GRNVBEM	0.6667	0.5703	0.5069	0.4618	0.3681	0.5122	0.082		1.85E-08
GENIE3	0.7778	0.7552	0.7431	0.7361	0.7083	0.7451	**0.0179**		3.00E-02
GRNBOOST2	0.8472	0.8177	0.7847	0.7396	0.7083	0.7812	0.0461		2.10E-01
PPCOR	0.8021	0.7708	0.7361	0.6762	0.6667	0.7285	0.0478	1.08E-15	1.83E-02
SCODE	0.5556	0.5122	0.5	0.4792	0.4167	0.4944	0.0358		1.84E-09
SINCERITIES	0.7986	0.6311	0.5868	0.5234	0.5069	0.5955	0.0841		1.31E-05
LEAP	0.8021	0.7665	0.7622	0.737	0.7222	0.7566	0.0228		6.27E-02
GRISLI	0.7153	0.6927	0.6319	0.559	0.5	0.6222	0.0761		2.73E-05
SCINGE	0.6597	0.5781	0.5104	0.3351	0.2778	0.4764	0.136		1.37E-08

Table 18: AUROC CY-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.9444**	**0.8958**	**0.8125**	**0.7917**	**0.8903**	0.0739		-
SCNS	0.6562	0.6146	0.4948	0.4661	0.4375	0.533	0.0773		3.91E-08
PIDC	0.7917	0.7917	0.7778	0.7569	0.75	0.775	0.0173		1.91E-01
GRNVBEM	0.5903	0.5486	0.467	0.4514	0.3958	0.4882	0.0623		1.47E-09
GENIE3	0.7569	0.7431	0.7431	0.7378	0.7153	0.7396	**0.0117**		3.10E-03
GRNBOOST2	0.7986	0.783	0.7778	0.7587	0.6875	0.7625	0.0346	4.43E-16	8.54E-02
PPCOR	0.7917	0.7856	0.7691	0.7613	0.75	0.7715	0.0147		1.21E-01
SCODE	0.5694	0.5	0.4931	0.467	0.4375	0.4965	0.0409		7.02E-09
SINCERITIES	0.7882	0.7543	0.7222	0.6997	0.6389	0.7229	0.043		2.35E-03
LEAP	0.875	0.8168	0.7708	0.7396	0.6944	0.7809	0.0549		8.48E-02
GRISLI	0.7431	0.6944	0.6458	0.5417	0.4028	0.6083	0.1088		2.22E-06
SCINGE	0.7014	0.5955	0.5243	0.4488	0.3819	0.5247	0.1007		2.09E-08

Table 19: AUROC CY-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9826**	**0.9757**	**0.9618**	**0.8854**	**0.7917**	**0.9198**	0.0722		-
SCNS	0.6354	0.6024	0.5677	0.5069	0.4375	0.5538	0.0592		1.78E-07
PIDC	0.7917	0.7778	0.7778	0.7639	0.75	0.7722	0.0142		8.14E-02
GRNVBEM	0.5556	0.5104	0.4826	0.474	0.3958	0.4861	0.0409		1.16E-09
GENIE3	0.7569	0.7431	0.7431	0.7292	0.7222	0.7382	**0.0112**		9.73E-04
GRNBOOST2	0.8125	0.783	0.7708	0.7431	0.7222	0.7653	0.0269	8.04E-16	2.84E-02
PPCOR	0.7882	0.7769	0.7639	0.7509	0.7465	0.7649	0.0141		3.87E-02
SCODE	0.5556	0.5469	0.5174	0.4948	0.4236	0.5104	0.0409		1.07E-08
SINCERITIES	0.9722	0.9219	0.8524	0.8099	0.75	0.8611	0.0717		5.54E-01
LEAP	0.875	0.7743	0.7552	0.7318	0.7153	0.7656	0.0477		1.48E-02
GRISLI	0.7708	0.6632	0.6076	0.5312	0.4653	0.5993	0.0912		2.52E-06
SCINGE	0.7778	0.6094	0.4757	0.4418	0.3542	0.5233	0.1289		3.40E-08

Table 20: AUROC CY-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**1.0**	**0.9688**	**0.9583**	0.8958	0.7917	0.9198	0.0711		-
SCNS	0.6528	0.5486	0.4931	0.4392	0.4132	0.5031	0.0731		3.03E-08
PIDC	0.7917	0.7882	0.7778	0.7778	0.75	0.7764	0.0145		1.32E-01
GRNVBEM	0.5625	0.5373	0.5017	0.4332	0.4167	0.4892	0.0529		1.44E-08
GENIE3	0.75	0.7361	0.7326	0.724	0.7083	0.7292	**0.0124**		1.43E-03
GRNBOOST2	0.8194	0.7847	0.7812	0.7535	0.7292	0.7757	0.0267	1.61E-17	1.04E-01
PPCOR	0.7917	0.7778	0.7639	0.7613	0.7465	0.7681	0.0148		6.69E-02
SCODE	0.5694	0.5469	0.5139	0.4878	0.4514	0.5132	0.0402		1.32E-07
SINCERITIES	0.9792	0.967	0.9444	**0.9062**	**0.8576**	**0.9309**	0.0429		8.98E-01
LEAP	0.8264	0.7595	0.7361	0.724	0.691	0.7469	0.0379		9.74E-03
GRISLI	0.7639	0.6927	0.6181	0.5747	0.4306	0.6215	0.0924		3.18E-05
SCINGE	0.5069	0.5	0.4792	0.4583	0.4375	0.4778	0.0226		4.69E-09

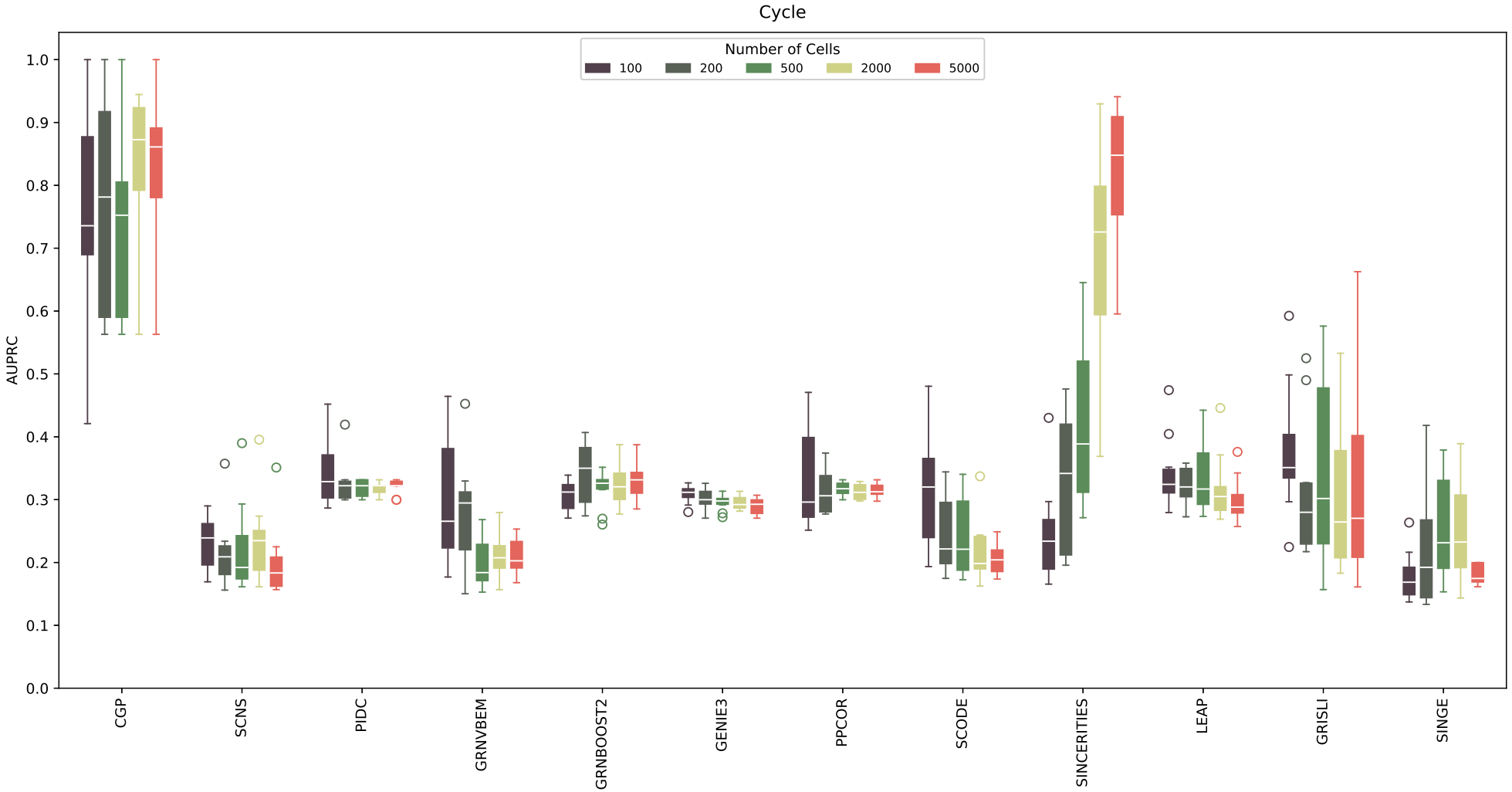


Figure 9: AUPRC boxplots considering the 12 algorithms for Cycle problem.

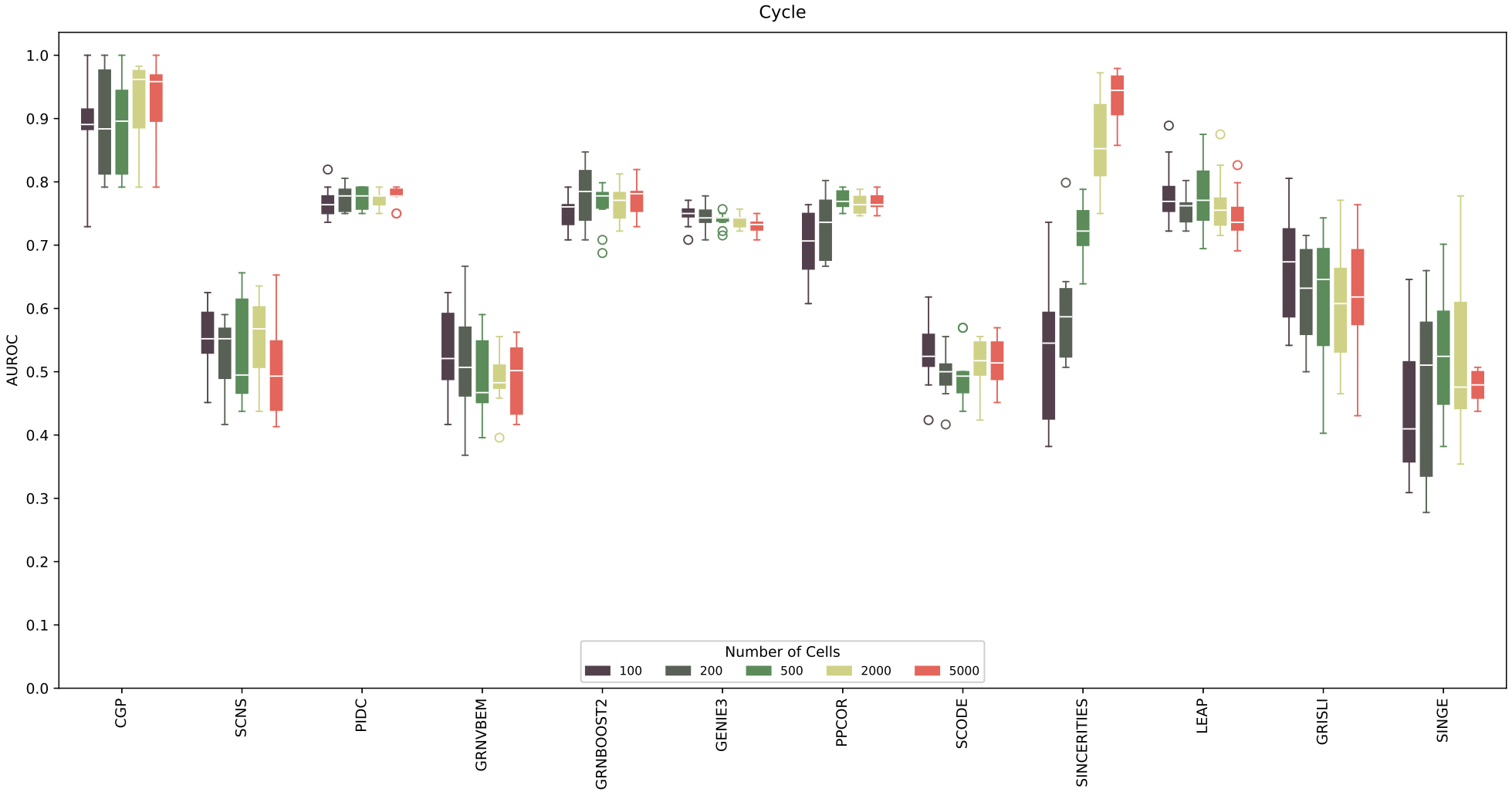
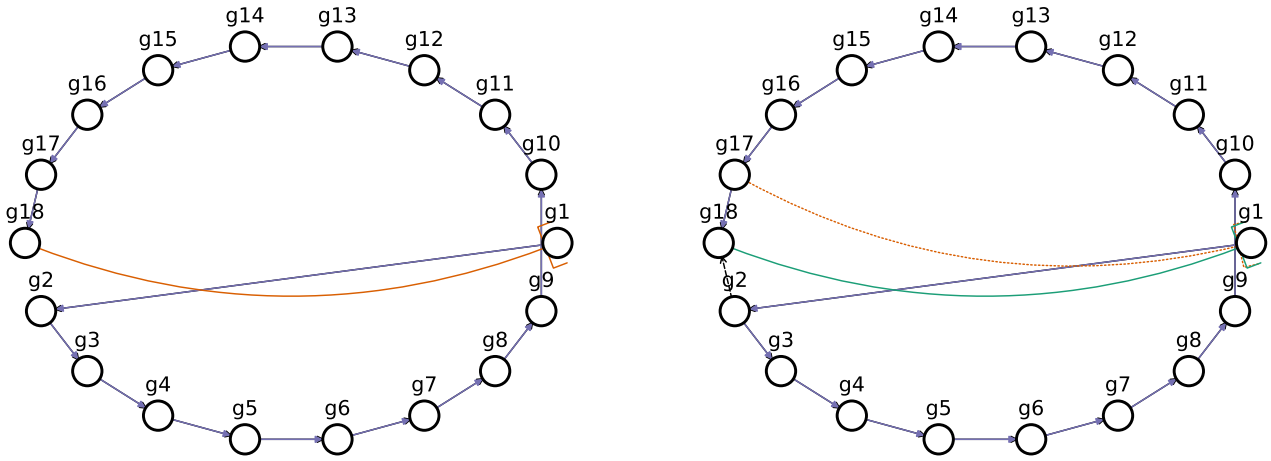


Figure 10: AUROC boxplots considering the 12 algorithms for Cycle problem.

3 Linear Long

The Linear Long problem consists of 18 genes and one pseudotime. CGP was not able to find and reconstruct the network completely, as shown in Figure 11b. The following tables present the results for AUPRC (tables 21 to 25) and AUROC (tables 26 to 30), respectively.



(a) Ground-truth network.

(b) Reconstructed network.

Figure 11: Ground-truth and reconstructed Linear Long networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

3.1 AUPRC

Table 21: AUPRC LL-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.7863**	**0.6655**	**0.6207**	**0.5902**	**0.4522**	**0.6213**	0.0892		-
SCNS	0.17	0.1286	0.1066	0.0853	0.0727	0.1098	0.0289		2.53E-07
PIDC	0.4715	0.4621	0.437	0.3645	0.3146	0.4142	0.0536		1.59E-01
GRNVBEM	0.6843	0.5373	0.4849	0.4336	0.2214	0.4716	0.1188		3.22E-01
GENIE3	0.4611	0.4114	0.3549	0.3452	0.2808	0.368	0.0534		3.67E-02
GRNBOOST2	0.381	0.3108	0.2833	0.2718	0.2275	0.2942	0.0461		4.06E-03
PPCOR	0.2535	0.1995	0.1828	0.1515	0.1138	0.18	0.0451		4.85E-05
SCODE	0.0987	0.0922	0.0795	0.075	0.0714	0.0831	**0.0099**	1.04E-17	5.53E-09
SINCERITIES	0.195	0.1278	0.0816	0.068	0.0578	0.1019	0.0429		3.00E-08
LEAP	0.5707	0.4197	0.4121	0.38	0.3541	0.4179	0.0596		1.41E-01
GRISLI	0.2865	0.2082	0.1292	0.1045	0.0888	0.1604	0.0708		8.92E-06
SCINGE	0.1242	0.0627	0.0568	0.05	0.0427	0.0614	0.0221		1.93E-11

Table 22: AUPRC LL-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8536**	**0.7598**	**0.7023**	**0.6286**	**0.4666**	**0.6896**	0.1028		-
SCNS	0.1946	0.1448	0.14	0.106	0.0623	0.1281	0.0355		2.50E-08
PIDC	0.4906	0.4827	0.4694	0.4207	0.3135	0.4466	0.0529		1.94E-01
GRNVBEM	0.5856	0.4809	0.4486	0.3626	0.308	0.4359	0.0819		9.72E-02
GENIE3	0.4556	0.4171	0.3745	0.3352	0.3079	0.3794	0.0484		1.43E-02
GRNBOOST2	0.4266	0.3695	0.3186	0.2959	0.2303	0.3281	0.0535		1.17E-03
PPCOR	0.4183	0.3545	0.3418	0.3088	0.2922	0.3418	0.0387	3.65E-17	2.46E-03
SCODE	0.0983	0.0886	0.0824	0.0791	0.0635	0.0836	**0.0096**		2.98E-10
SINCERITIES	0.2707	0.2114	0.1984	0.1193	0.0813	0.1749	0.0606		4.66E-07
LEAP	0.5828	0.4679	0.4174	0.3643	0.3306	0.4309	0.0815		8.97E-02
GRISLI	0.3791	0.245	0.2037	0.158	0.0983	0.2195	0.0892		9.19E-06
SCINGE	0.1138	0.0685	0.0554	0.0465	0.0437	0.0617	0.0202		7.26E-12

Table 23: AUPRC LL-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8536**	**0.853**	**0.7648**	**0.6879**	**0.4744**	**0.7479**	0.1153		-
SCNS	0.1986	0.1804	0.1381	0.1127	0.0657	0.1419	0.0401		5.00E-08
PIDC	0.5	0.4963	0.4756	0.4543	0.4219	0.4721	0.0252		1.69E-01
GRNVBEM	0.5201	0.5124	0.4648	0.3969	0.3915	0.4571	0.0533		9.09E-02
GENIE3	0.4294	0.3602	0.3481	0.3383	0.2937	0.3545	0.0362		2.36E-04
GRNBOOST2	0.5269	0.4112	0.3602	0.3446	0.2277	0.3695	0.081		1.43E-03
PPCOR	0.4768	0.4459	0.4114	0.3837	0.2756	0.4043	0.0544	1.04E-16	8.56E-03
SCODE	0.1055	0.0944	0.0897	0.0758	0.0744	0.087	**0.0102**		4.15E-10
SINCERITIES	0.4906	0.4276	0.3868	0.2526	0.0914	0.3473	0.1246		1.20E-03
LEAP	0.5664	0.5277	0.4798	0.4437	0.3467	0.476	0.0645		1.46E-01
GRISLI	0.3051	0.2267	0.1644	0.1155	0.1058	0.1792	0.0679		3.21E-07
SCINGE	0.084	0.0671	0.0531	0.0501	0.0439	0.0589	0.0124		5.29E-12

Table 24: AUPRC LL-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8536**	**0.7878**	**0.7598**	**0.7183**	**0.7031**	**0.7635**	0.0531		-
SCNS	0.1941	0.1848	0.163	0.1072	0.0556	0.1463	0.0471		2.89E-08
PIDC	0.5	0.5	0.4936	0.441	0.4095	0.4709	0.036		1.39E-01
GRNVBEM	0.51	0.4724	0.4512	0.4308	0.3837	0.451	0.0338		6.32E-02
GENIE3	0.3849	0.3741	0.3359	0.3233	0.3109	0.3451	0.0277		1.74E-04
GRNBOOST2	0.4122	0.3665	0.3354	0.3238	0.2641	0.3435	0.0423		1.78E-04
PPCOR	0.4794	0.4664	0.4461	0.4156	0.3556	0.4327	0.0423	5.01E-17	2.75E-02
SCODE	0.1163	0.0861	0.0799	0.0736	0.0654	0.0832	0.0143		3.51E-10
SINCERITIES	0.7901	0.6941	0.5553	0.2733	0.1851	0.5014	0.2218		4.63E-02
LEAP	0.4832	0.4516	0.4415	0.4078	0.3173	0.4213	0.051		1.43E-02
GRISLI	0.25	0.1929	0.1505	0.1301	0.1194	0.1663	0.0459		1.18E-07
SCINGE	0.0682	0.0568	0.0526	0.0459	0.0403	0.0523	**0.0083**		3.06E-12

Table 25: AUPRC LL-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.9141**	**0.7932**	**0.7616**	**0.7315**	**0.5498**	**0.7564**	0.0859		-
SCNS	0.1848	0.1848	0.1838	0.1137	0.0587	0.1477	0.0476		1.45E-08
PIDC	0.5	0.5	0.493	0.4486	0.4363	0.4768	0.0267		1.18E-01
GRNVBEM	0.4754	0.4595	0.4496	0.4491	0.1508	0.4247	0.0917		1.34E-02
GENIE3	0.3693	0.3297	0.3255	0.3186	0.3113	0.3282	0.0153		2.51E-05
GRNBOOST2	0.4518	0.4025	0.3673	0.3238	0.2556	0.3644	0.0583	7.46E-15	2.77E-04
PPCOR	0.4979	0.4715	0.4539	0.4144	0.3576	0.4413	0.0448		2.18E-02
SCODE	0.1098	0.0857	0.0811	0.075	0.066	0.0824	0.0113		6.00E-10
SINCERITIES	0.6735	0.6506	0.5301	0.2708	0.1886	0.4689	0.1874		3.06E-02
LEAP	0.4777	0.4699	0.4021	0.3781	0.3154	0.4105	0.0564		6.00E-03
GRISLI	0.2576	0.2338	0.21	0.1862	0.1625	0.21	0.0475		2.69E-03
SCINGE	0.0655	0.0596	0.0546	0.0466	0.0424	0.0541	**0.0079**		3.36E-12

3.2 AUROC

Table 26: AUROC LL-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9117	0.8977	0.8513	0.8492	0.786	0.8607	0.0392		-
SCNS	0.6883	0.6614	0.6415	0.6104	0.557	0.6321	0.0417		2.17E-03
PIDC	0.961	**0.9552**	0.9406	0.865	0.7948	0.908	0.0635		2.89E-01
GRNVBEM	**0.9633**	0.9435	0.9008	0.8855	0.7338	0.8981	0.0625		3.82E-01
GENIE3	0.9562	0.9477	**0.9417**	**0.916**	**0.8463**	**0.927**	0.0319		1.73E-01
GRNBOOST2	0.8848	0.8589	0.85	0.7462	0.6873	0.8084	0.0692		5.25E-01
PPCOR	0.6751	0.6437	0.6188	0.5962	0.5815	0.6236	0.032	7.50E-17	1.09E-03
SCODE	0.6512	0.6276	0.6148	0.5959	0.5675	0.6108	**0.0238**		3.97E-04
SINCERITIES	0.7067	0.671	0.6087	0.5607	0.5031	0.6121	0.0663		6.27E-04
LEAP	0.9061	0.8919	0.8705	0.8278	0.7797	0.8584	0.0401		9.85E-01
GRISLI	0.8493	0.7447	0.7042	0.6687	0.6343	0.712	0.0599		6.99E-02
SCINGE	0.5598	0.538	0.4757	0.457	0.3738	0.4811	0.0603		8.20E-07

Table 27: AUROC LL-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9132	0.9106	0.8799	0.8526	0.7818	0.8721	0.0434		-
SCNS	0.7183	0.7115	0.6825	0.6159	0.5245	0.6592	0.0607		9.31E-04
PIDC	**0.9653**	**0.963**	**0.9485**	0.8865	0.8322	0.9248	0.0461		1.41E-01
GRNVBEM	0.9579	0.9269	0.9183	0.9009	0.8025	0.9076	0.0395		3.22E-01
GENIE3	0.9522	0.9493	0.9456	**0.9257**	**0.9109**	**0.9377**	**0.0153**		7.50E-02
GRNBOOST2	0.9331	0.923	0.88	0.8075	0.7292	0.8609	0.0669	3.78E-16	9.74E-01
PPCOR	0.9074	0.8481	0.7933	0.737	0.7248	0.7974	0.06		1.50E-01
SCODE	0.6582	0.6445	0.6236	0.5879	0.5602	0.6155	0.0365		1.74E-04
SINCERITIES	0.8426	0.7787	0.7495	0.6968	0.5469	0.7255	0.0908		1.31E-02
LEAP	0.8891	0.8747	0.8611	0.8387	0.7935	0.8558	0.0278		6.95E-01
GRISLI	0.8463	0.8178	0.7942	0.739	0.5965	0.766	0.0726		5.22E-02
SCINGE	0.5858	0.5153	0.4768	0.418	0.3919	0.478	0.0659		3.80E-06

Table 28: AUROC LL-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9406	0.9132	0.9105	0.8836	0.808	0.8965	0.0341		-
SCNS	0.7213	0.6913	0.6786	0.6483	0.5344	0.659	0.0533		8.89E-04
PIDC	**0.9688**	**0.9668**	**0.9531**	0.9153	0.8723	**0.9391**	0.0324		1.18E-01
GRNVBEM	0.9615	0.9216	0.9176	0.8831	0.8425	0.907	0.0351		6.30E-01
GENIE3	0.9512	0.9457	0.9434	**0.9339**	**0.9032**	0.9366	**0.0148**		1.45E-01
GRNBOOST2	0.9456	0.9389	0.9087	0.8131	0.7286	0.8735	0.0746	3.04E-14	8.35E-01
PPCOR	0.963	0.91	0.8796	0.8513	0.6948	0.8674	0.0725		6.30E-01
SCODE	0.6659	0.6431	0.6254	0.6004	0.5795	0.6226	0.027		2.19E-04
SINCERITIES	0.9549	0.9407	0.9153	0.8432	0.6356	0.8723	0.0944		9.95E-01
LEAP	0.8877	0.874	0.8586	0.8458	0.7976	0.8541	0.0287		2.50E-01
GRISLI	0.8708	0.8179	0.7503	0.7296	0.5681	0.759	0.0805		1.86E-02
SCINGE	0.6092	0.5397	0.473	0.4437	0.3763	0.4887	0.07		7.44E-06

Table 29: AUROC LL-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9132	0.9114	0.9112	0.8872	0.8542	0.8967	0.0231		-
SCNS	0.7214	0.7113	0.695	0.6474	0.4808	0.6677	0.0695		4.40E-03
PIDC	0.9688	0.9688	0.9659	0.8869	0.8333	0.93	0.0517		1.39E-01
GRNVBEM	0.9689	0.9552	0.9234	0.9099	0.8954	0.9312	0.026		2.39E-01
GENIE3	0.9485	0.9457	0.9436	**0.9339**	**0.9205**	**0.9387**	**0.01**		1.83E-01
GRNBOOST2	0.9539	0.9468	0.9423	0.8683	0.8289	0.9114	0.0503	5.06E-15	4.77E-01
PPCOR	0.9611	0.9569	0.9391	0.856	0.795	0.9058	0.0617		4.39E-01
SCODE	0.6892	0.6727	0.615	0.5923	0.5268	0.6217	0.0509		9.74E-04
SINCERITIES	**0.9873**	**0.9802**	**0.9722**	0.8897	0.7627	0.925	0.076		1.18E-01
LEAP	0.8802	0.8631	0.8461	0.8176	0.8053	0.8424	0.025		3.22E-01
GRISLI	0.8156	0.7867	0.786	0.7642	0.6759	0.7708	0.0368		3.44E-02
SCINGE	0.5372	0.4805	0.4377	0.41	0.3384	0.4422	0.0581		5.56E-05

Table 30: AUROC LL-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.9702	0.9391	0.9117	0.9115	0.8247	0.917	0.036		-
SCNS	0.6968	0.695	0.695	0.6767	0.4942	0.6617	0.0646		3.00E-03
PIDC	0.9688	0.9688	0.9653	0.9284	0.8634	**0.9406**	0.0378		1.91E-01
GRNVBEM	0.961	0.9362	0.9198	0.9155	0.6253	0.899	0.0925		9.67E-01
GENIE3	0.9462	0.944	0.9423	**0.9372**	**0.9203**	0.9391	**0.0075**		4.65E-01
GRNBOOST2	0.9614	0.9544	0.9475	0.8761	0.8017	0.9127	0.0553	1.06E-12	6.85E-01
PPCOR	0.9667	0.9565	0.9487	0.8674	0.7948	0.9121	0.0585		6.54E-01
SCODE	0.6537	0.6321	0.5983	0.5552	0.5154	0.5888	0.0477		5.47E-04
SINCERITIES	**0.9836**	**0.9801**	**0.9699**	0.9113	0.7993	0.9386	0.0584		1.68E-01
LEAP	0.8771	0.8582	0.8415	0.8151	0.7898	0.8371	0.0262		9.56E-02
GRISLI	0.826	0.8212	0.8165	0.8117	0.8069	0.8165	0.0095		2.42E-01
SCINGE	0.5457	0.5067	0.4738	0.4207	0.3708	0.4647	0.0533		2.43E-05

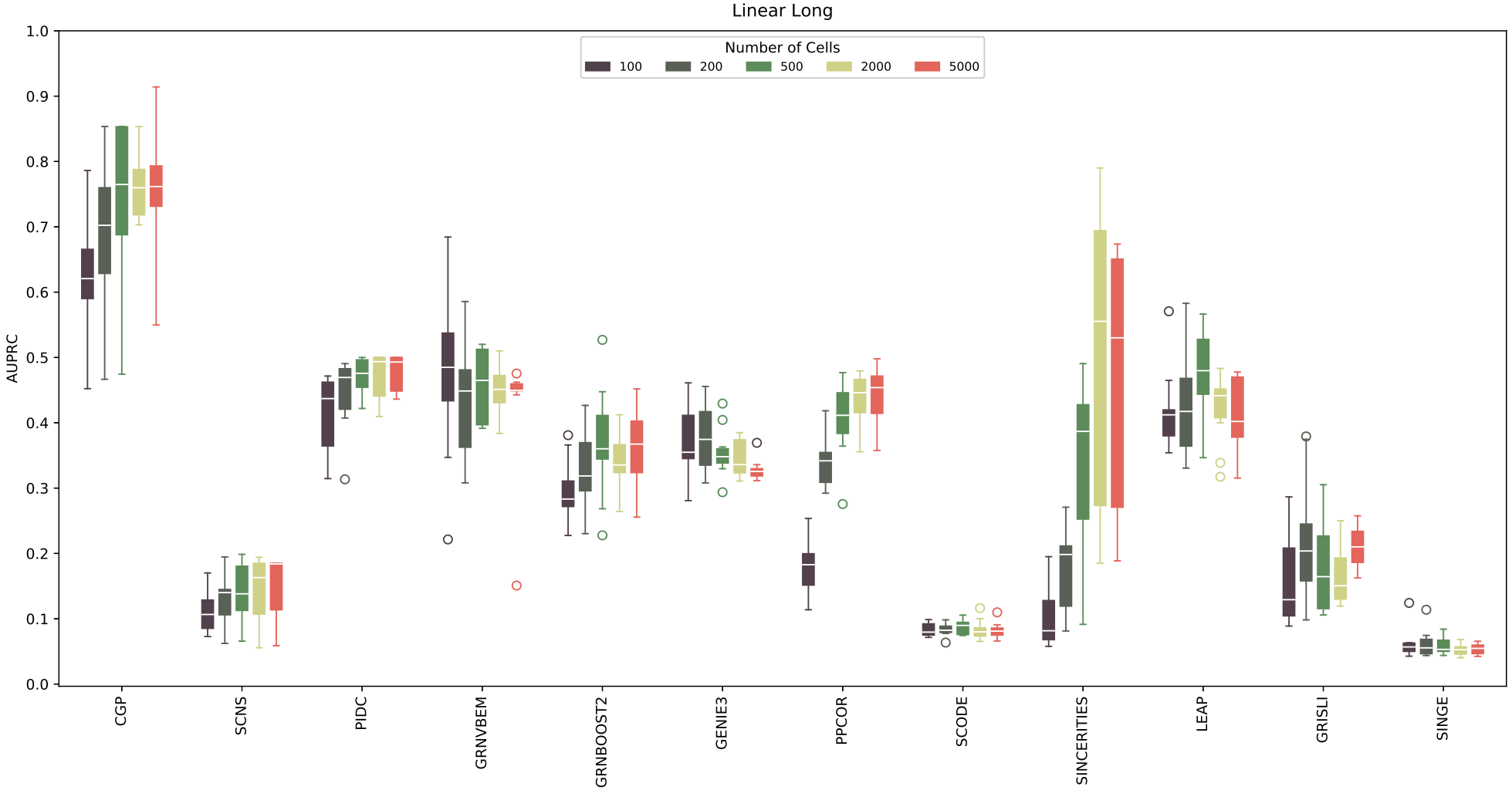


Figure 12: AUPRC boxplots considering the 12 algorithms for Linear Long problem.

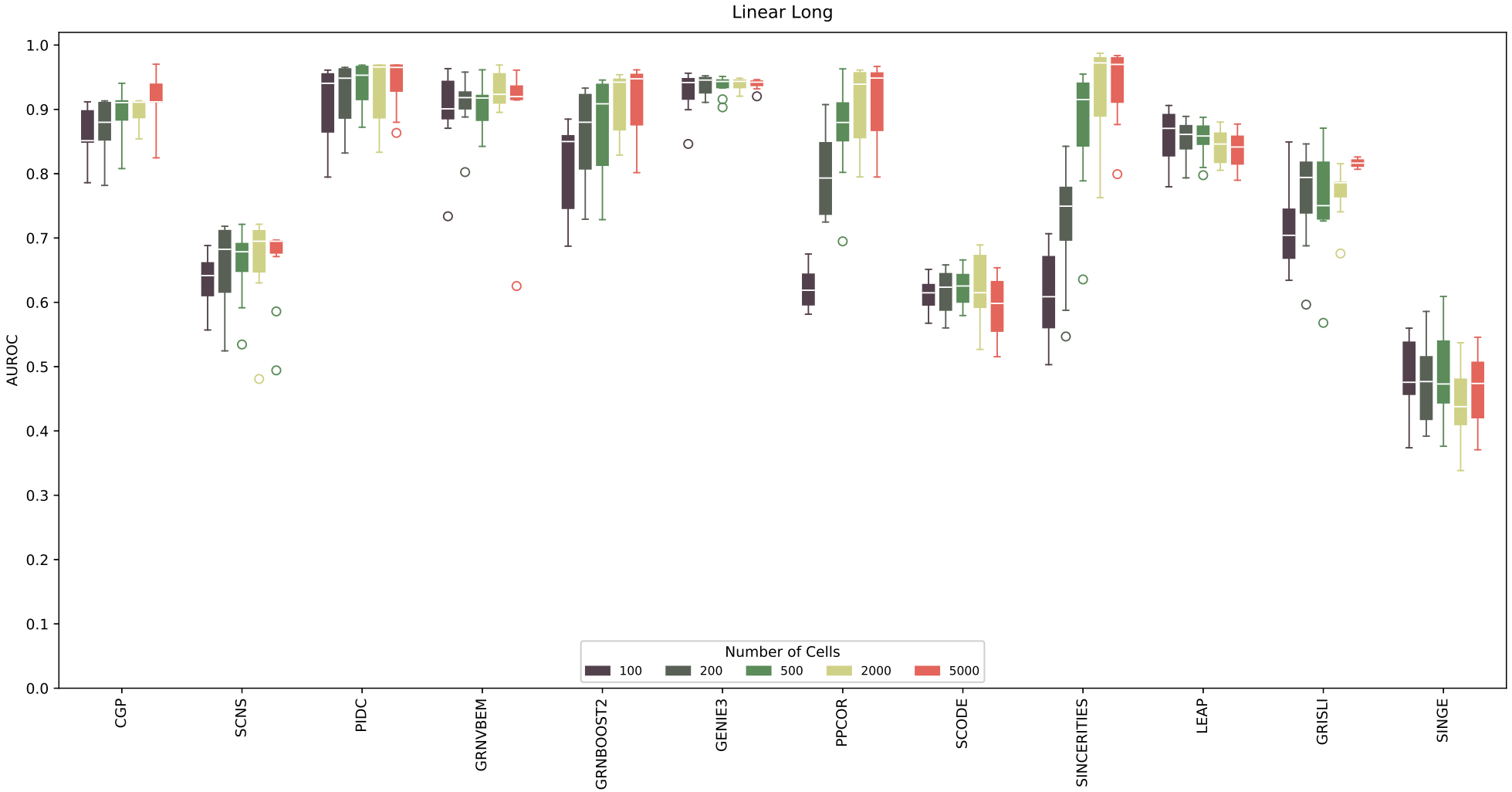
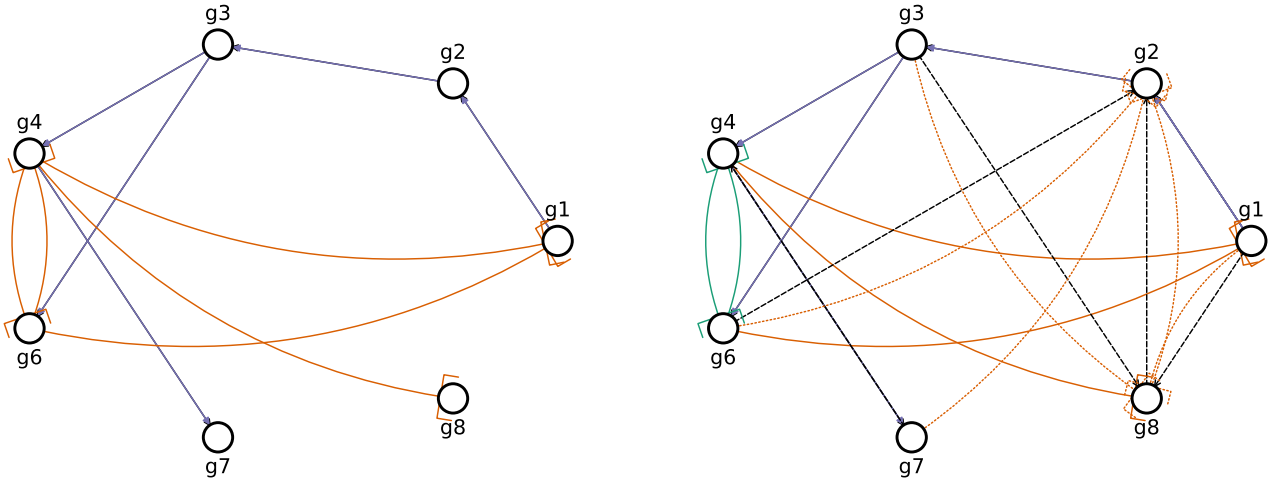


Figure 13: AUROC boxplots considering the 12 algorithms for Linear Long problem.

4 Bifurcating

The Bifurcating problem consists of 7 genes and two pseudotimes. CGP was not able to find and reconstruct the network completely, as shown in Figure 14b. The following tables present the results for AUPRC (tables 31 to 35) and AUROC (tables 36 to 40), respectively.



(a) Ground-truth network.

(b) Reconstructed network.

Figure 14: Ground-truth and reconstructed Bifurcating networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

4.1 AUPRC

Table 31: AUPRC BF-100

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	**0.8352**	**0.5764**	**0.4968**	**0.4584**	**0.4266**	**0.5406**	0.1161		-
SCNS	0.3017	0.2791	0.2684	0.2564	0.2149	0.2648	**0.0236**		1.14E-06
PIDC	0.3953	0.3798	0.3471	0.3147	0.2941	0.3459	0.0365		1.29E-02
GRNVBEM	0.456	0.4096	0.3579	0.325	0.2548	0.3615	0.0592		2.98E-02
GENIE3	0.378	0.3608	0.3088	0.2767	0.2705	0.3184	0.0425		9.10E-04
GRNBOOST2	0.4003	0.3358	0.3023	0.2659	0.2562	0.3067	0.0449		2.88E-04
PPCOR	0.6238	0.4097	0.3949	0.3483	0.3117	0.4132	0.0954		1.46E-01
SCODE	0.5516	0.3496	0.248	0.2173	0.167	0.2923	0.1137	1.61E-08	1.03E-05
SINCERITIES	0.4319	0.3836	0.3082	0.284	0.1965	0.3168	0.0746		8.89E-04
LEAP	0.3605	0.325	0.2958	0.255	0.2091	0.2916	0.0472		3.89E-05
GRISLI	0.5921	0.3763	0.2448	0.227	0.1952	0.3107	0.1192		5.42E-05
SCINGE	0.3588	0.2097	0.1914	0.1765	0.1454	0.2091	0.0577		7.66E-10

Table 32: AUPRC BF-200

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	0.6151	**0.5334**	**0.5108**	**0.4577**	0.3307	**0.4927**	0.073		-
SCNS	0.3343	0.2727	0.2433	0.2278	0.1942	0.2532	0.0399		9.67E-07
PIDC	0.4887	0.4187	0.3932	0.3618	0.3172	0.3937	0.049		2.66E-01
GRNVBEM	0.3732	0.3338	0.3171	0.2871	0.2727	0.3148	**0.0304**		3.59E-03
GENIE3	0.3846	0.3475	0.3055	0.2743	0.2528	0.3124	0.0433		2.31E-03
GRNBOOST2	0.4151	0.344	0.2833	0.2735	0.2719	0.3118	0.0488	1.25E-08	1.56E-03
PPCOR	**0.6495**	0.4287	0.3859	0.3723	**0.3378**	0.4167	0.0834		3.89E-01
SCODE	0.4409	0.3679	0.2758	0.2181	0.1806	0.2952	0.0928		1.57E-04
SINCERITIES	0.5898	0.412	0.2561	0.2186	0.1808	0.3214	0.1389		2.48E-04
LEAP	0.5198	0.2965	0.2771	0.253	0.2335	0.2986	0.0795		1.28E-04
GRISLI	0.3771	0.3102	0.2967	0.2312	0.1915	0.2835	0.0593		8.13E-05
SCINGE	0.2897	0.2586	0.2397	0.1851	0.1529	0.2249	0.0483		3.61E-08

Table 33: AUPRC BF-500

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	0.6399	**0.5706**	**0.5182**	**0.4924**	**0.4008**	**0.5202**	0.075		-
SCNS	0.3584	0.2694	0.2435	0.2225	0.18	0.2504	0.0451		2.36E-07
PIDC	0.572	0.402	0.3869	0.3755	0.3056	0.4046	0.0737		1.99E-01
GRNVBEM	0.3943	0.3315	0.3042	0.2605	0.2394	0.3015	0.0464		2.96E-04
GENIE3	0.3391	0.3199	0.3119	0.2945	0.2726	0.3075	**0.0185**		9.53E-04
GRNBOOST2	0.4923	0.4197	0.304	0.2967	0.2737	0.3513	0.0768	2.26E-11	1.15E-02
PPCOR	**0.6662**	0.4601	0.4042	0.3725	0.3222	0.442	0.1063		3.58E-01
SCODE	0.3934	0.3504	0.2929	0.2524	0.1818	0.2953	0.0658		1.74E-04
SINCERITIES	0.5757	0.4773	0.4369	0.2992	0.2396	0.4058	0.1105		7.93E-02
LEAP	0.3665	0.3204	0.2756	0.2663	0.2535	0.2917	0.0374		9.54E-05
GRISLI	0.3509	0.3017	0.246	0.2235	0.1947	0.263	0.0525		2.38E-06
SCINGE	0.3108	0.2195	0.204	0.182	0.1619	0.2084	0.0411		1.24E-09

Table 34: AUPRC BF-2000

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	0.6049	0.5572	0.5225	0.4844	**0.4491**	0.5222	0.0543		-
SCNS	0.3978	0.3078	0.2637	0.2498	0.2131	0.2842	0.0616		6.60E-06
PIDC	0.5061	0.4193	0.404	0.3806	0.3245	0.4035	0.0446		1.45E-01
GRNVBEM	0.3745	0.3167	0.3118	0.2943	0.2704	0.313	**0.0309**		2.88E-04
GENIE3	0.43	0.3329	0.3187	0.3066	0.2868	0.3276	0.0376		1.71E-03
GRNBOOST2	0.488	0.431	0.3227	0.3029	0.2821	0.3626	0.0762	3.92E-13	9.40E-03
PPCOR	0.6601	0.4917	0.4138	0.3826	0.3236	0.4549	0.1098		3.13E-01
SCODE	0.5451	0.3629	0.3292	0.2681	0.203	0.3387	0.0984		1.53E-03
SINCERITIES	**0.6838**	**0.6604**	**0.5368**	**0.5056**	0.4111	**0.5658**	0.0891		8.07E-01
LEAP	0.3685	0.3201	0.2784	0.2694	0.2605	0.2967	0.0371		3.02E-05
GRISLI	0.3586	0.2995	0.2792	0.2488	0.1848	0.2709	0.0503		2.61E-06
SCINGE	0.331	0.2027	0.1885	0.1689	0.1571	0.1992	0.0476		2.44E-09

Table 35: AUPRC BF-5000

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	0.6372	0.6049	0.5499	0.5161	0.4491	0.5495	0.0626		-
SCNS	0.4076	0.3276	0.2552	0.244	0.2311	0.2854	0.0559		1.00E-05
PIDC	0.544	0.4076	0.4049	0.3817	0.3671	0.4103	0.0477		1.41E-01
GRNVBEM	0.3391	0.3126	0.3097	0.2831	0.2631	0.3027	0.0234		9.05E-05
GENIE3	0.347	0.3333	0.324	0.3088	0.2997	0.3223	**0.016**		9.53E-04
GRNBOOST2	0.5001	0.4612	0.3251	0.3099	0.287	0.372	0.0814	1.61E-13	1.09E-02
PPCOR	0.69	0.4813	0.4212	0.3822	0.3153	0.4591	0.1162		2.95E-01
SCODE	0.5203	0.4231	0.3797	0.2425	0.1907	0.3461	0.1106		2.36E-03
SINCERITIES	**0.7202**	**0.6281**	**0.606**	**0.5428**	**0.48**	**0.5899**	0.0682		7.63E-01
LEAP	0.3494	0.3175	0.2784	0.269	0.2585	0.2922	0.0322		2.55E-05
GRISLI	0.3518	0.3309	0.268	0.2303	0.2159	0.2792	0.0517		9.18E-06
SCINGE	0.2727	0.1983	0.1712	0.1599	0.156	0.1894	0.0401		7.06E-10

4.2 AUROC

Table 36: AUROC BF-100

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	**0.8672**	**0.7977**	**0.7805**	**0.7352**	**0.7172**	**0.7764**	0.044		-
SCNS	0.5938	0.582	0.557	0.5289	0.4719	0.548	**0.0413**		9.96E-07
PIDC	0.7312	0.6984	0.6469	0.6312	0.5	0.6512	0.0625		2.68E-02
GRNVBEM	0.7969	0.7148	0.6531	0.6227	0.5531	0.6645	0.0712		4.12E-02
GENIE3	0.775	0.6797	0.6344	0.5898	0.5469	0.6369	0.0651		6.86E-03
GRNBOOST2	0.7531	0.6578	0.6187	0.6062	0.5875	0.6384	0.0496	9.42E-09	1.11E-02
PPCOR	0.7609	0.7129	0.6711	0.6102	0.5687	0.6669	0.0615		5.38E-02
SCODE	0.7938	0.6547	0.5625	0.4977	0.275	0.5584	0.1383		3.28E-05
SINCERITIES	0.7859	0.6121	0.5656	0.5082	0.3984	0.5647	0.1036		2.65E-05
LEAP	0.7562	0.698	0.6	0.568	0.4594	0.6205	0.0874		1.94E-03
GRISLI	0.7469	0.5766	0.5328	0.4824	0.4328	0.5425	0.0836		1.40E-06
SCINGE	0.6641	0.4574	0.4156	0.3523	0.1891	0.4198	0.124		2.29E-09

Table 37: AUROC BF-200

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	**0.8406**	**0.8121**	**0.7414**	**0.7086**	**0.6458**	**0.7536**	0.0643		-
SCNS	0.6531	0.5805	0.5203	0.4969	0.4297	0.5364	0.0666		2.82E-06
PIDC	0.7812	0.7297	0.7156	0.6953	0.6062	0.7025	0.0505		4.48E-01
GRNVBEM	0.7344	0.6332	0.6094	0.5945	0.55	0.6158	0.0495		2.49E-03
GENIE3	0.7125	0.6695	0.6422	0.607	0.5687	0.6419	0.0428		2.32E-02
GRNBOOST2	0.7062	0.693	0.6375	0.6203	0.6094	0.6538	**0.0369**	4.30E-09	4.92E-02
PPCOR	0.7953	0.709	0.6547	0.6414	0.6141	0.6823	0.0625		2.08E-01
SCODE	0.7	0.6617	0.5719	0.4883	0.35	0.5619	0.1107		1.74E-04
SINCERITIES	0.7641	0.607	0.5422	0.4875	0.3688	0.5586	0.122		6.37E-05
LEAP	0.775	0.6484	0.6219	0.5578	0.525	0.6202	0.0773		4.58E-03
GRISLI	0.6922	0.5867	0.5484	0.516	0.4219	0.5483	0.0725		7.43E-06
SCINGE	0.6469	0.5246	0.4766	0.3973	0.225	0.4512	0.1253		6.19E-08

Table 38: AUROC BF-500

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	**0.8656**	**0.8375**	**0.7992**	**0.7781**	**0.6641**	**0.7903**	0.0595		-
SCNS	0.6344	0.5684	0.5266	0.4723	0.3875	0.5208	0.0676		1.58E-07
PIDC	0.75	0.7375	0.7219	0.7062	0.6	0.7094	0.0442		2.36E-01
GRNVBEM	0.6906	0.6836	0.6281	0.5984	0.5453	0.6311	0.0525		1.48E-03
GENIE3	0.7156	0.6727	0.6516	0.6383	0.5844	0.6534	0.0323		6.29E-03
GRNBOOST2	0.725	0.6867	0.675	0.6695	0.6375	0.6772	**0.0213**	7.77E-13	3.64E-02
PPCOR	0.8266	0.775	0.7195	0.6984	0.625	0.7277	0.0629		3.04E-01
SCODE	0.7281	0.6484	0.6125	0.5562	0.3312	0.5834	0.11		9.28E-05
SINCERITIES	0.7922	0.7453	0.7	0.6102	0.5453	0.6811	0.0811		4.81E-02
LEAP	0.7438	0.7062	0.6	0.5672	0.5406	0.6275	0.0751		1.34E-03
GRISLI	0.6141	0.5418	0.5141	0.4688	0.4156	0.5142	0.0589		6.79E-08
SCINGE	0.5297	0.4648	0.4258	0.3691	0.2906	0.4102	0.0747		2.86E-10

Table 39: AUROC BF-2000

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	0.8656	0.8445	0.8047	0.7906	**0.7375**	0.8088	0.0412		-
SCNS	0.6094	0.5762	0.5258	0.5023	0.4797	0.5375	0.0432		1.43E-07
PIDC	0.7625	0.7469	0.7344	0.7016	0.6375	0.7219	0.0365		1.59E-01
GRNVBEM	0.7	0.6383	0.6242	0.5961	0.5531	0.6222	0.0406		1.72E-04
GENIE3	0.7188	0.6867	0.6562	0.6422	0.6313	0.6644	**0.027**		5.93E-03
GRNBOOST2	0.7406	0.7016	0.6922	0.6648	0.65	0.6884	0.0272	5.99E-15	3.28E-02
PPCOR	0.8313	0.8059	0.7406	0.673	0.6187	0.735	0.0739		2.09E-01
SCODE	0.7438	0.6953	0.6344	0.5656	0.4625	0.6275	0.0876		7.47E-04
SINCERITIES	**0.9**	**0.8684**	**0.8281**	**0.816**	0.7063	**0.8308**	0.0507		7.85E-01
LEAP	0.7672	0.6969	0.6062	0.5758	0.5594	0.637	0.0707		6.72E-04
GRISLI	0.6422	0.5973	0.5789	0.5039	0.3812	0.5422	0.0823		8.20E-07
SCINGE	0.5531	0.432	0.4	0.3258	0.2531	0.3919	0.0829		4.06E-10

Table 40: AUROC BF-5000

Method	Min.	1st Quant.	Median	3rd Quant.	Max.	Mean	Std.	p_{kw}	p_d
CGP	0.875	0.8656	0.8344	0.8	0.7375	0.8247	0.0463		-
SCNS	0.6422	0.5836	0.5359	0.4969	0.475	0.542	0.0523		4.50E-07
PIDC	0.7563	0.7469	0.7344	0.7172	0.7	0.7312	**0.0183**		1.86E-01
GRNVBEM	0.6375	0.6297	0.6125	0.5652	0.5281	0.597	0.0403		2.00E-05
GENIE3	0.7063	0.6773	0.6594	0.6484	0.6438	0.6662	0.0203		4.49E-03
GRNBOOST2	0.7406	0.7156	0.6969	0.6727	0.6562	0.6959	0.0265	5.18E-15	2.79E-02
PPCOR	0.8609	0.8039	0.7383	0.6969	0.5938	0.7384	0.0804		1.34E-01
SCODE	0.7781	0.7453	0.7141	0.5008	0.3719	0.6297	0.1463		3.27E-03
SINCERITIES	**0.9125**	**0.8805**	**0.8695**	**0.8461**	**0.8266**	**0.8691**	0.0269		5.80E-01
LEAP	0.7437	0.6883	0.6016	0.5773	0.5531	0.6309	0.0662		3.60E-04
GRISLI	0.6578	0.634	0.5648	0.5188	0.4984	0.5739	0.0607		6.11E-06
SCINGE	0.5047	0.3781	0.3336	0.282	0.2609	0.3484	0.0767		3.10E-10

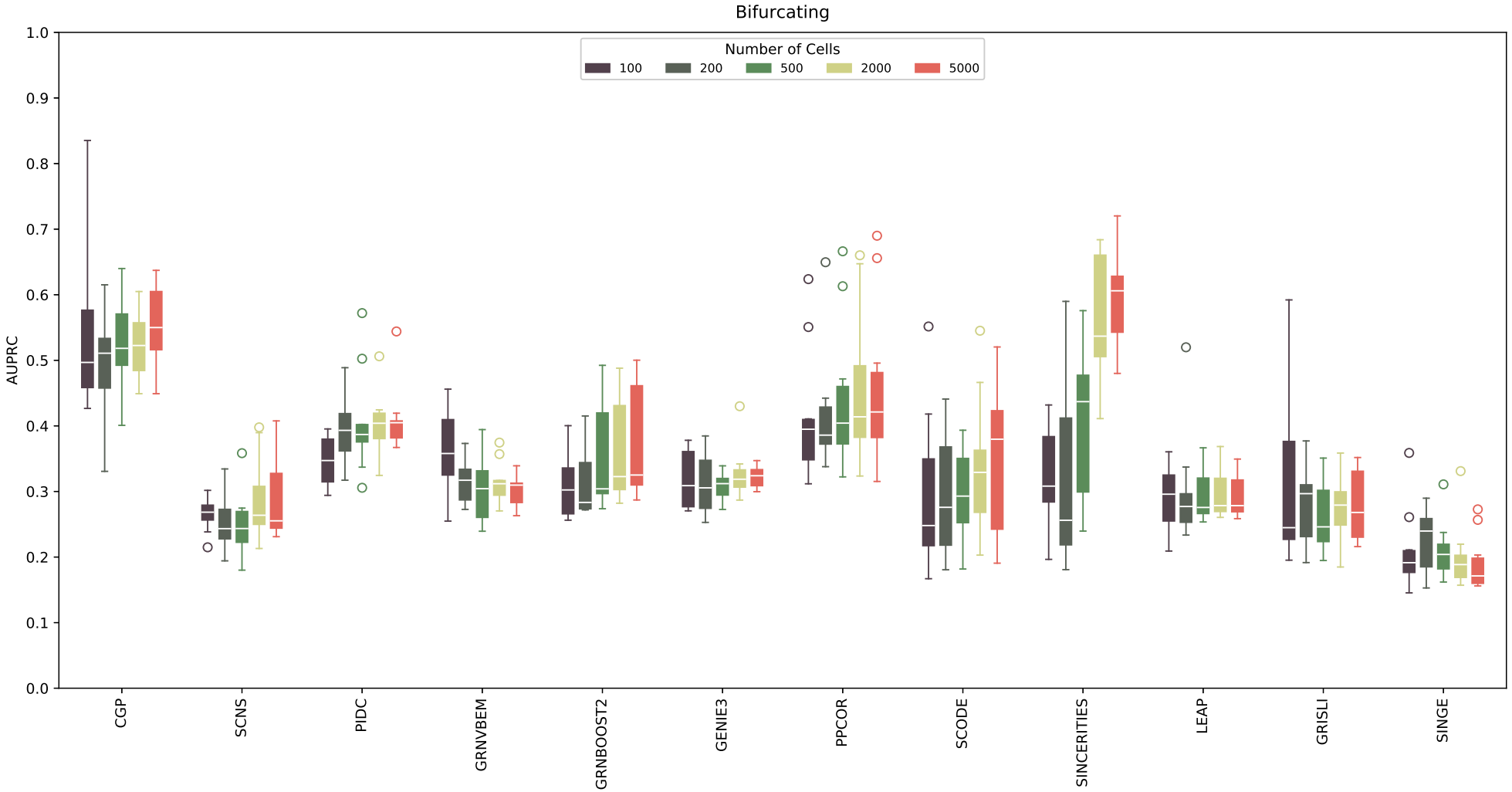


Figure 15: AUPRC boxplots considering the 12 algorithms for Bifurcating problem.

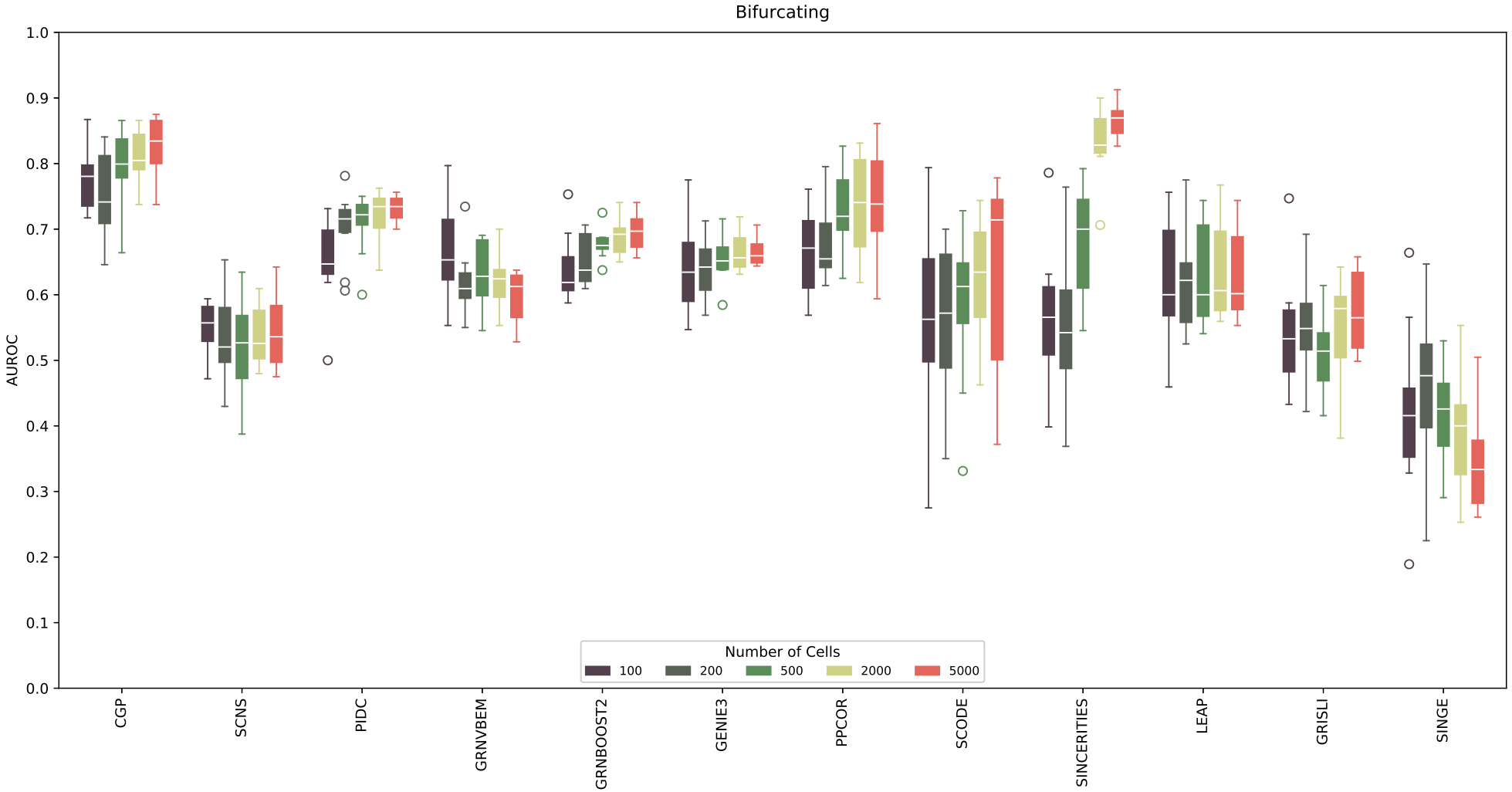
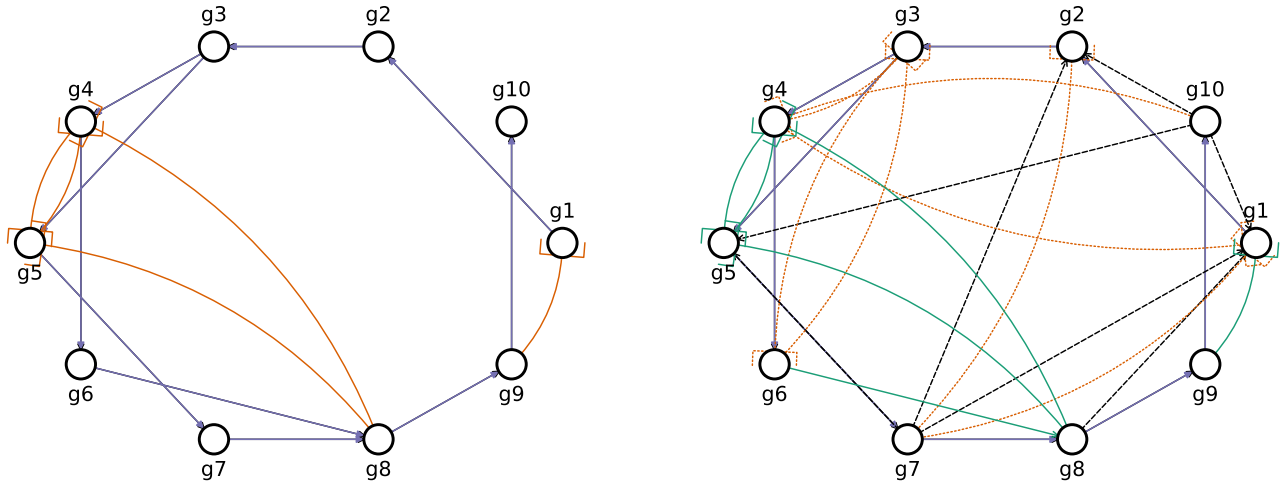


Figure 16: AUROC boxplots considering the 12 algorithms for Bifurcating problem.

5 Bifurcating Converging

The Bifurcating Converging problem consists of 10 genes and two pseudotimes. CGP was not able to find and reconstruct the network completely, as shown in Figure 17b. The following tables present the results for AUPRC (tables 41 to 45) and AUROC (tables 46 to 50), respectively.



(a) Ground-truth network.

(b) Reconstructed network.

Figure 17: Ground-truth and reconstructed Bifurcating Converging networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

5.1 AUPRC

Table 41: AUPRC BFC-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.6848**	**0.5721**	0.5022	0.4476	0.2667	0.5031	0.117		-
SCNS	0.2995	0.2771	0.2359	0.228	0.2234	0.2505	0.0291		2.41E-05
PIDC	0.5111	0.3369	0.3155	0.2914	0.2168	0.3228	0.0741		2.17E-02
GRNVBEM	0.6721	0.5503	**0.5253**	**0.4486**	**0.3211**	**0.5053**	0.0897		8.12E-01
GENIE3	0.3642	0.3406	0.3171	0.2965	0.2778	0.3186	**0.0279**		3.61E-02
GRNBOOST2	0.3545	0.3305	0.3127	0.2784	0.2349	0.3032	0.038		1.05E-02
PPCOR	0.4486	0.3629	0.3075	0.2904	0.2472	0.3249	0.0604		3.23E-02
SCODE	0.2939	0.2581	0.2283	0.2034	0.1975	0.234	0.0326	2.61E-14	3.57E-06
SINCERITIES	0.2528	0.1869	0.1801	0.1591	0.1525	0.1868	0.0342		2.16E-08
LEAP	0.4767	0.4111	0.3519	0.3114	0.2905	0.365	0.0606		2.05E-01
GRISLI	0.4393	0.3425	0.3196	0.2727	0.2388	0.3166	0.0579		1.96E-02
SCINGE	0.2165	0.1892	0.1572	0.132	0.1112	0.1614	0.034		1.64E-09

Table 42: AUPRC BFC-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.6589**	**0.5653**	**0.5352**	**0.4909**	**0.464**	**0.5361**	0.0582		-
SCNS	0.2391	0.2379	0.2279	0.2219	0.2081	0.2278	**0.0104**		7.43E-08
PIDC	0.4056	0.3331	0.3069	0.2809	0.2709	0.3192	0.0447		1.31E-03
GRNVBEM	0.5467	0.4412	0.4058	0.395	0.357	0.4295	0.0603		4.76E-01
GENIE3	0.3526	0.3348	0.3291	0.3212	0.3028	0.3277	0.0154		3.45E-03
GRNBOOST2	0.377	0.3257	0.3156	0.3111	0.2975	0.3247	0.0238	1.07E-15	1.95E-03
PPCOR	0.3898	0.3738	0.367	0.3473	0.2968	0.359	0.0251		5.38E-02
SCODE	0.2675	0.2329	0.221	0.1982	0.1897	0.2205	0.0243		1.72E-08
SINCERITIES	0.3231	0.2547	0.2033	0.1788	0.1368	0.2136	0.0548		1.33E-08
LEAP	0.4967	0.3515	0.3419	0.3174	0.3007	0.3492	0.0533		1.09E-02
GRISLI	0.44	0.3733	0.316	0.2451	0.1904	0.3124	0.0779		9.75E-04
SCINGE	0.2033	0.1708	0.1487	0.1187	0.1124	0.1482	0.0302		7.59E-12

Table 43: AUPRC BFC-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6828	0.4594	0.4347	**0.409**	**0.3821**	**0.4648**	0.0905		-
SCNS	0.2702	0.2316	0.2214	0.214	0.2076	0.226	0.0178		1.36E-07
PIDC	0.4169	0.3725	0.3316	0.3046	0.2795	0.3378	0.0442		4.06E-03
GRNVBEM	0.5326	0.4735	0.4213	0.3766	0.3679	0.4293	0.0549		6.62E-01
GENIE3	0.3716	0.3473	0.3392	0.3228	0.298	0.338	0.0215		2.17E-03
GRNBOOST2	0.4086	0.3707	0.3534	0.3363	0.3132	0.3559	0.0297	1.45E-12	1.46E-02
PPCOR	0.4157	0.407	0.3969	0.3934	0.3722	0.3975	**0.0122**		4.00E-01
SCODE	0.3	0.2727	0.2374	0.2214	0.1917	0.2436	0.0328		6.09E-07
SINCERITIES	**0.7263**	**0.4906**	**0.444**	0.3666	0.1541	0.4161	0.1568		2.22E-01
LEAP	0.4709	0.3695	0.3472	0.3277	0.313	0.3581	0.0447		1.54E-02
GRISLI	0.496	0.4288	0.3731	0.3306	0.2886	0.3826	0.065		8.26E-02
SCINGE	0.3309	0.2044	0.1691	0.1338	0.1153	0.1823	0.0621		1.14E-08

Table 44: AUPRC BFC-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.5557	0.4445	0.4415	0.3723	0.3387	0.4233	0.0622		-
SCNS	0.2398	0.2322	0.2263	0.2234	0.2143	0.2278	**0.0074**		1.13E-05
PIDC	0.414	0.3796	0.3707	0.3453	0.261	0.3533	0.0472		1.05E-01
GRNVBEM	0.4618	0.4254	0.379	0.3523	0.3055	0.3831	0.051		3.41E-01
GENIE3	0.3777	0.3432	0.337	0.3327	0.3063	0.3389	0.018		9.76E-03
GRNBOOST2	0.4884	0.401	0.3782	0.3634	0.3437	0.3939	0.0458		5.08E-01
PPCOR	0.4573	0.4411	0.4261	0.4066	**0.379**	0.4233	0.0259	1.81E-14	7.24E-01
SCODE	0.2773	0.2603	0.2331	0.221	0.1855	0.2354	0.0291		2.21E-05
SINCERITIES	**0.796**	**0.6954**	**0.6087**	**0.4934**	0.3394	**0.5862**	0.1495		2.39E-01
LEAP	0.4481	0.3622	0.3403	0.3327	0.3254	0.3587	0.0387		4.99E-02
GRISLI	0.5211	0.4233	0.3925	0.3736	0.3454	0.4032	0.0473		7.04E-01
SCINGE	0.2658	0.1763	0.1447	0.1247	0.1118	0.1575	0.044		3.32E-07

Table 45: AUPRC BFC-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.521	0.4851	0.4442	0.3731	0.3151	0.4337	0.0706		-
SCNS	0.2454	0.2271	0.2241	0.2136	0.1997	0.2222	**0.0133**		7.23E-06
PIDC	0.4082	0.378	0.3484	0.3232	0.2482	0.3476	0.0452		5.14E-02
GRNVBEM	0.4311	0.3754	0.3422	0.3098	0.2759	0.3443	0.0457		3.97E-02
GENIE3	0.3676	0.3481	0.3388	0.3335	0.3095	0.3401	0.0149		2.37E-02
GRNBOOST2	0.4416	0.4163	0.3934	0.3694	0.3474	0.3931	0.0313		5.16E-01
PPCOR	0.4531	0.4397	0.4296	0.4087	0.3896	0.4235	0.0209		9.33E-01
SCODE	0.2481	0.2406	0.2325	0.2069	0.1909	0.2253	0.0198	1.09E-15	1.24E-05
SINCERITIES	**0.8608**	**0.8041**	**0.719**	**0.5519**	**0.4438**	**0.6823**	0.1436		1.08E-01
LEAP	0.4008	0.3671	0.3401	0.3266	0.3095	0.3467	0.0267		3.50E-02
GRISLI	0.4781	0.4512	0.3928	0.3504	0.25	0.3905	0.0682		4.79E-01
SCINGE	0.1668	0.1593	0.1377	0.1281	0.1224	0.142	0.0165		6.92E-08

5.2 AUROC

Table 46: AUROC BFC-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.8373	0.8023	**0.7869**	**0.7711**	0.68	0.7822	0.04		-
SCNS	0.7067	0.6558	0.646	0.6368	0.6236	0.654	**0.027**		3.83E-04
PIDC	0.7773	0.6956	0.668	0.6556	0.5658	0.6797	0.0576		7.28E-03
GRNVBEM	**0.8978**	**0.8202**	0.7804	0.7543	**0.7067**	**0.788**	0.054		9.08E-01
GENIE3	0.792	0.7718	0.7489	0.7247	0.6676	0.7448	0.0343		3.40E-01
GRNBOOST2	0.7698	0.7447	0.7062	0.6536	0.5564	0.692	0.0632		1.62E-02
PPCOR	0.756	0.6791	0.646	0.6129	0.5929	0.6553	0.0512	1.56E-13	5.00E-04
SCODE	0.736	0.6578	0.632	0.6042	0.5973	0.6401	0.0423		8.81E-05
SINCERITIES	0.6289	0.5692	0.5431	0.4948	0.4609	0.5352	0.0492		9.44E-09
LEAP	0.8236	0.7602	0.7307	0.6879	0.6409	0.7265	0.0518		1.28E-01
GRISLI	0.7444	0.7054	0.6638	0.6221	0.5911	0.6628	0.0485		1.04E-03
SCINGE	0.5964	0.5384	0.4556	0.3968	0.2796	0.4592	0.0957		8.64E-10

Table 47: AUROC BFC-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8596**	**0.8312**	**0.8216**	**0.8023**	0.7098	**0.8109**	0.0388		-
SCNS	0.6787	0.664	0.6462	0.633	0.5991	0.6454	**0.0236**		3.36E-06
PIDC	0.7702	0.7302	0.6964	0.6693	0.6298	0.6988	0.045		2.21E-03
GRNVBEM	0.8311	0.7857	0.7636	0.7347	0.6707	0.76	0.043		1.99E-01
GENIE3	0.8124	0.7907	0.7493	0.7296	**0.7218**	0.7594	0.0338		2.02E-01
GRNBOOST2	0.7867	0.7531	0.7458	0.7076	0.6569	0.7324	0.036		4.32E-02
PPCOR	0.7644	0.7293	0.7276	0.6997	0.6698	0.7177	0.0275		1.14E-02
SCODE	0.6827	0.6431	0.6147	0.5962	0.5813	0.6215	0.0316	6.41E-14	3.21E-07
SINCERITIES	0.6889	0.6084	0.564	0.4886	0.4316	0.5552	0.0808		1.40E-08
LEAP	0.8129	0.7847	0.7193	0.6778	0.6569	0.73	0.0565		3.67E-02
GRISLI	0.7933	0.7672	0.6764	0.6564	0.5462	0.6934	0.074		2.05E-03
SCINGE	0.5587	0.5177	0.4338	0.3426	0.3049	0.4303	0.094		6.96E-11

Table 48: AUROC BFC-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8933**	0.8151	0.7747	0.7414	0.7258	0.784	0.0497		-
SCNS	0.7142	0.6583	0.6291	0.6237	0.5956	0.6413	0.0347		2.36E-04
PIDC	0.8129	0.7604	0.6982	0.6644	0.6227	0.7101	0.0594		4.16E-02
GRNVBEM	0.8702	**0.8463**	**0.8331**	**0.8117**	**0.7929**	**0.8309**	0.0243		1.03E-01
GENIE3	0.8124	0.7869	0.7698	0.7613	0.7324	0.7727	0.0226		8.05E-01
GRNBOOST2	0.8213	0.8016	0.7689	0.7576	0.7324	0.7761	0.0273	7.46E-12	8.75E-01
PPCOR	0.8004	0.7963	0.7838	0.7727	0.7516	0.7809	**0.0172**		9.97E-01
SCODE	0.7218	0.6953	0.6644	0.6431	0.5858	0.6609	0.0435		8.39E-04
SINCERITIES	0.8693	0.807	0.7422	0.7273	0.4738	0.7307	0.1175		3.40E-01
LEAP	0.8613	0.8132	0.7344	0.6981	0.6773	0.7547	0.0635		4.25E-01
GRISLI	0.8258	0.732	0.7131	0.6878	0.6422	0.7195	0.0506		5.58E-02
SCINGE	0.5369	0.4911	0.4538	0.3842	0.3258	0.44	0.0667		1.14E-06

Table 49: AUROC BFC-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.8756	0.7884	0.7842	0.7734	0.728	0.7868	0.0373		-
SCNS	0.6524	0.6377	0.6349	0.6267	0.6222	0.6344	**0.0091**		2.71E-04
PIDC	0.788	0.7356	0.7293	0.7093	0.6333	0.722	0.0434		5.58E-02
GRNVBEM	0.8511	0.8231	0.8062	0.7808	0.7556	0.8031	0.0298		4.50E-01
GENIE3	0.8053	0.7842	0.7778	0.7729	0.7547	0.7785	0.0138		7.90E-01
GRNBOOST2	0.8204	0.8	0.7849	0.7676	0.7556	0.7868	0.0216	1.51E-14	9.59E-01
PPCOR	0.8431	0.8338	0.8258	**0.8197**	**0.8004**	0.8248	0.0129		8.32E-02
SCODE	0.7191	0.6873	0.6516	0.6404	0.5973	0.6569	0.0369		1.51E-03
SINCERITIES	**0.9387**	**0.9109**	**0.8676**	0.817	0.7129	**0.8538**	0.0691		1.14E-01
LEAP	0.848	0.8144	0.7644	0.7211	0.6658	0.765	0.0561		6.07E-01
GRISLI	0.7862	0.7711	0.7553	0.7026	0.6484	0.735	0.047		1.15E-01
SCINGE	0.5342	0.4879	0.406	0.3704	0.2996	0.4208	0.0753		7.11E-06

Table 50: AUROC BFC-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.8498	0.8224	0.786	0.7749	0.7062	0.7892	0.0405		-
SCNS	0.6516	0.6371	0.6324	0.6108	0.5738	0.6236	0.0215		1.34E-04
PIDC	0.7809	0.7276	0.7036	0.6769	0.6511	0.7092	0.0411		2.35E-02
GRNVBEM	0.8653	0.7979	0.7716	0.7377	0.6844	0.7741	0.0511		5.76E-01
GENIE3	0.8116	0.7818	0.7751	0.764	0.7458	0.7748	0.0171		4.12E-01
GRNBOOST2	0.7964	0.7953	0.788	0.7789	0.7769	0.7869	**0.008**	2.48E-15	9.67E-01
PPCOR	0.8347	0.8284	0.8271	0.8247	0.792	0.824	0.0111		1.90E-01
SCODE	0.6924	0.668	0.6493	0.6242	0.5884	0.6449	0.031		5.43E-04
SINCERITIES	**0.9662**	**0.9502**	**0.916**	**0.9002**	**0.8089**	**0.9148**	0.0437		2.40E-02
LEAP	0.832	0.8237	0.7693	0.7022	0.6676	0.7609	0.0606		4.74E-01
GRISLI	0.7924	0.7886	0.7742	0.7563	0.6267	0.7559	0.0498		2.80E-01
SCINGE	0.5258	0.4522	0.4082	0.3879	0.3316	0.4221	0.058		2.70E-06

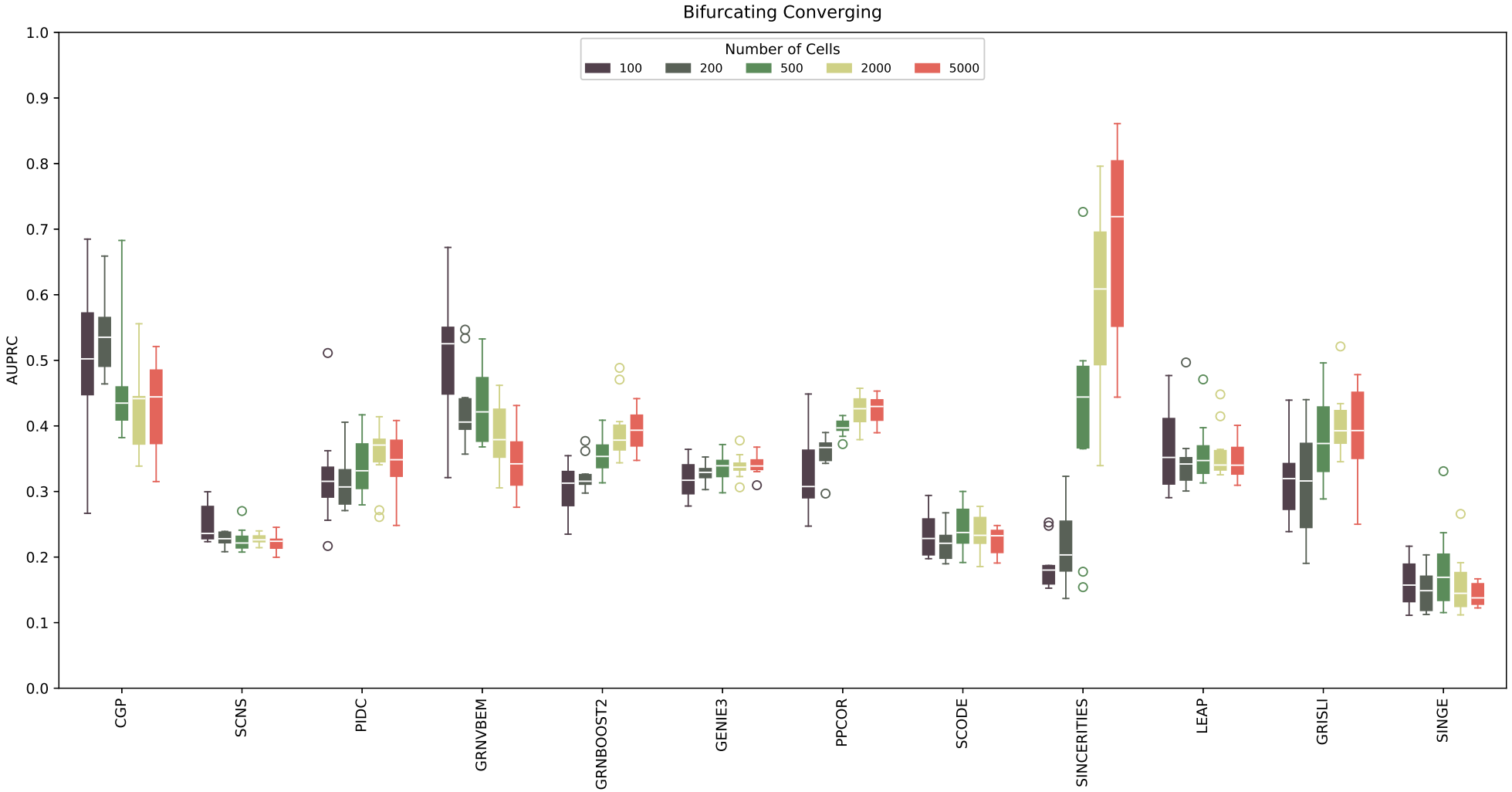


Figure 18: AUPRC boxplots considering the 12 algorithms for Bifurcating Converging problem.

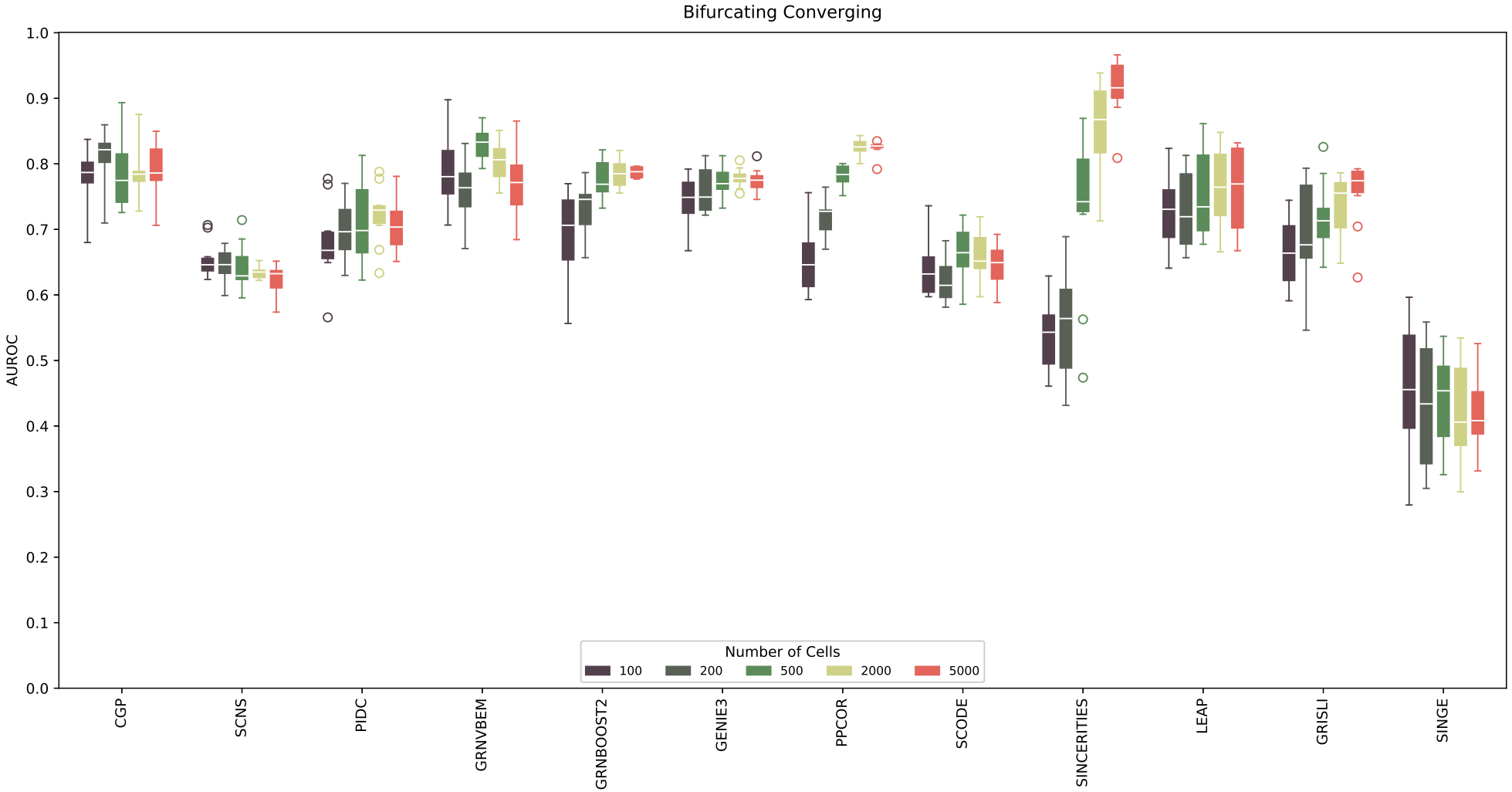
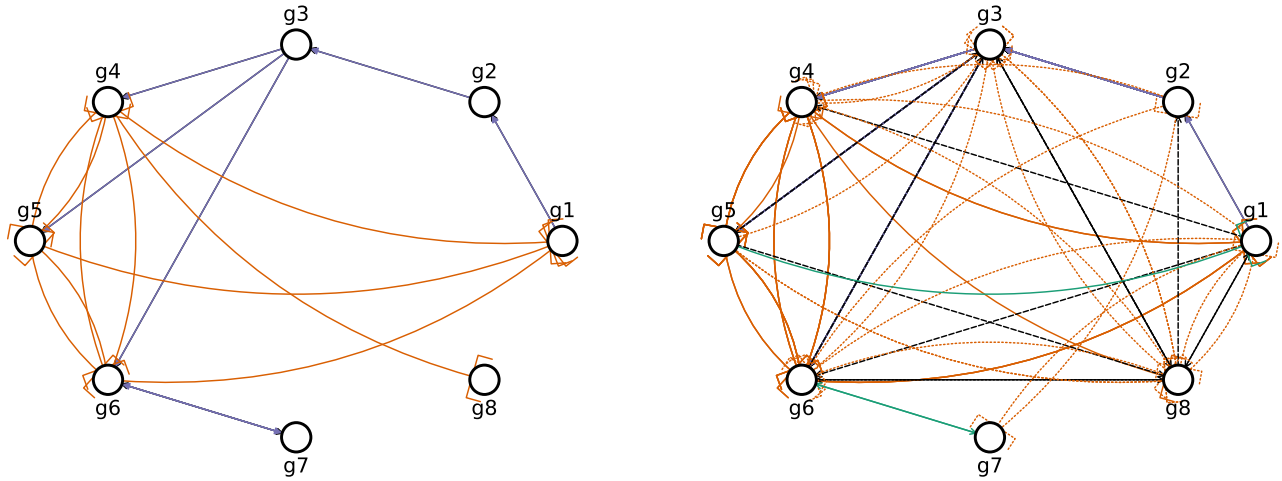


Figure 19: AUROC boxplots considering the 12 algorithms for Bifurcating Converging problem.

6 Trifurcating

The Trifurcating problem consists of 8 genes and three pseudotimes. CGP was not able to find and reconstruct the network completely, as shown in Figure 20b. The following tables present the results for AUPRC (tables 51 to 55) and AUROC (tables 56 to 60), respectively.



(a) Ground-truth network.

(b) Reconstructed network.

Figure 20: Ground-truth and reconstructed Trifurcating networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

6.1 AUPRC

Table 51: AUPRC TF-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6848	0.5688	0.5288	0.4747	0.4481	0.5403	0.0783		-
SCNS	0.5671	0.4382	0.3933	0.3607	0.3186	0.4156	0.0802		2.84E-02
PIDC	0.6934	0.5867	**0.5357**	**0.5026**	**0.4852**	**0.5545**	0.0631		6.57E-01
GRNVBEM	0.5074	0.4676	0.4308	0.3805	0.2966	0.419	0.0622		1.96E-02
GENIE3	0.5972	0.5581	0.5244	0.4938	0.4534	0.5277	0.0444		9.69E-01
GRNBOOST2	0.659	0.5674	0.5174	0.489	0.4483	0.5319	0.0585		9.90E-01
PPCOR	0.563	0.5351	0.5123	0.4957	0.4398	0.5097	**0.0342**		7.33E-01
SCODE	0.3982	0.2798	0.2694	0.2635	0.2566	0.2878	0.0436	3.26E-12	2.96E-06
SINCERITIES	0.5405	0.3375	0.3154	0.2989	0.2579	0.3326	0.0753		1.78E-04
LEAP	**0.7386**	**0.6113**	0.5275	0.4771	0.3383	0.5466	0.117		9.59E-01
GRISLI	0.4269	0.3616	0.3389	0.3098	0.2407	0.3325	0.0496		1.49E-04
SCINGE	0.5123	0.4071	0.318	0.3003	0.2605	0.3514	0.0778		5.18E-04

Table 52: AUPRC TF-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.6894**	**0.6259**	0.523	0.5105	0.4401	0.5511	0.0801		-
SCNS	0.5323	0.4037	0.3446	0.2862	0.2383	0.3529	0.0836		5.18E-04
PIDC	0.6003	0.5644	0.5435	0.4705	0.4327	0.521	0.057		7.38E-01
GRNVBEM	0.5725	0.4845	0.4407	0.388	0.2864	0.4435	0.0831		5.79E-02
GENIE3	0.6175	0.556	0.5397	0.5033	0.4584	0.5392	0.0476		9.64E-01
GRNBOOST2	0.6188	0.5498	0.5215	0.49	**0.4606**	0.5242	0.0445	7.72E-13	7.58E-01
PPCOR	0.6213	0.5229	0.4958	0.4486	0.4174	0.4954	0.0563		3.25E-01
SCODE	0.5191	0.3315	0.279	0.2431	0.211	0.3043	0.0905		1.81E-05
SINCERITIES	0.4777	0.3342	0.3125	0.2797	0.2513	0.3202	0.0617		6.21E-05
LEAP	0.6476	0.5962	**0.5782**	**0.5194**	0.414	**0.554**	0.0689		7.53E-01
GRISLI	0.4391	0.3961	0.3533	0.308	0.2566	0.3519	0.0542		4.27E-04
SCINGE	0.3733	0.3019	0.2789	0.2505	0.2262	0.2828	**0.0439**		2.87E-06

Table 53: AUPRC TF-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.7351**	**0.6663**	0.5494	0.4837	0.4584	**0.5713**	0.0984		-
SCNS	0.4857	0.3817	0.339	0.2765	0.2336	0.3413	0.0758		9.29E-05
PIDC	0.6236	0.5973	**0.5754**	**0.5308**	0.4652	0.5615	0.0477		7.09E-01
GRNVBEM	0.4681	0.4445	0.4211	0.3949	0.3196	0.4092	0.0476		4.58E-03
GENIE3	0.5893	0.5713	0.5352	0.4914	0.4485	0.5285	0.0494		7.38E-01
GRNBOOST2	0.5602	0.5385	0.5217	0.4904	0.4509	0.5135	0.0366		5.16E-01
PPCOR	0.5385	0.5325	0.5144	0.4966	**0.4671**	0.5107	**0.0237**	4.75E-14	4.60E-01
SCODE	0.3465	0.3208	0.2964	0.2605	0.2289	0.293	0.037		1.57E-06
SINCERITIES	0.5419	0.3074	0.2758	0.2624	0.2456	0.3138	0.0882		1.16E-05
LEAP	0.6124	0.5881	0.5465	0.5053	0.4216	0.534	0.0642		8.37E-01
GRISLI	0.4937	0.3615	0.351	0.3415	0.3135	0.361	0.0469		6.12E-04
SCINGE	0.4075	0.3735	0.3244	0.2742	0.2157	0.3222	0.0622		2.27E-05

Table 54: AUPRC TF-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.7374**	0.6001	0.5725	0.485	0.3801	0.5489	0.0982		-
SCNS	0.4244	0.3506	0.3047	0.2798	0.2625	0.319	0.0509		7.71E-05
PIDC	0.6456	**0.6069**	**0.5743**	**0.5579**	0.4872	**0.5715**	0.0497		5.37E-01
GRNVBEM	0.4277	0.4123	0.3849	0.3662	0.308	0.3833	0.0354		2.52E-03
GENIE3	0.5795	0.5565	0.5386	0.5257	0.4597	0.5344	0.0325		8.22E-01
GRNBOOST2	0.5733	0.5496	0.5041	0.4712	0.4221	0.5055	0.0474		3.68E-01
PPCOR	0.6102	0.5468	0.5298	0.5053	**0.4934**	0.5355	0.0367	4.01E-14	8.07E-01
SCODE	0.313	0.2845	0.2557	0.2416	0.2356	0.2646	**0.0276**		1.43E-06
SINCERITIES	0.6586	0.5958	0.4775	0.3981	0.292	0.4852	0.1188		2.72E-01
LEAP	0.6411	0.582	0.5426	0.4944	0.4809	0.5443	0.0515		9.59E-01
GRISLI	0.5113	0.4152	0.3956	0.362	0.3272	0.3977	0.0552		5.17E-03
SCINGE	0.3398	0.287	0.2453	0.2361	0.2077	0.2631	0.0431		1.10E-06

Table 55: AUPRC TF-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.7299	0.5687	0.5411	0.497	0.4722	0.5582	0.0797		-
SCNS	0.4966	0.3816	0.3603	0.3434	0.2559	0.3646	0.0576		7.92E-04
PIDC	0.6194	**0.6057**	**0.5873**	0.5026	0.4712	**0.5616**	0.0581		6.25E-01
GRNVBEM	0.4388	0.4034	0.3856	0.365	0.3011	0.3795	0.0389		1.95E-03
GENIE3	0.5724	0.56	0.5298	**0.526**	0.4508	0.5341	0.0331		9.23E-01
GRNBOOST2	0.5851	0.5192	0.5051	0.4845	0.4618	0.5072	0.0336	6.07E-15	3.58E-01
PPCOR	0.5803	0.5613	0.5415	0.5093	**0.5066**	0.5379	0.0263		9.79E-01
SCODE	0.3487	0.3033	0.2552	0.2443	0.2285	0.2727	0.0396		1.47E-06
SINCERITIES	**0.7302**	0.5721	0.554	0.4907	0.4318	0.55	0.0892		9.13E-01
LEAP	0.6682	0.5804	0.5219	0.4974	0.4632	0.5415	0.0595		9.03E-01
GRISLI	0.465	0.3688	0.3612	0.3402	0.3155	0.3614	0.0392		5.43E-04
SCINGE	0.2888	0.2761	0.2616	0.249	0.2218	0.261	**0.0186**		1.21E-06

6.2 AUROC

Table 56: AUROC TF-100

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.8205	**0.7958**	**0.7598**	**0.7306**	0.5641	**0.7488**	0.0708		-
SCNS	0.7104	0.6702	0.6312	0.5848	0.5483	0.6288	0.0526		1.61E-02
PIDC	0.7971	0.727	0.687	0.638	0.592	0.6834	0.0635		2.29E-01
GRNVBEM	0.7866	0.7195	0.629	0.556	0.4962	0.6394	0.1006		2.96E-02
GENIE3	0.7873	0.713	0.675	0.6154	0.5928	0.6736	0.0645		1.55E-01
GRNBOOST2	0.8386	0.7436	0.6923	0.6312	**0.6124**	0.6968	0.0703	7.78E-12	3.22E-01
PPCOR	0.6735	0.651	0.6384	0.6161	0.5814	0.6351	**0.0266**		2.51E-02
SCODE	0.6063	0.4977	0.4676	0.454	0.368	0.4858	0.0661		5.24E-07
SINCERITIES	0.6953	0.5377	0.48	0.4568	0.4027	0.5037	0.0796		2.27E-06
LEAP	**0.8537**	0.7954	0.7549	0.6908	0.5799	0.744	0.081		8.40E-01
GRISLI	0.5762	0.5434	0.5207	0.4661	0.4103	0.5052	0.049		1.76E-06
SCINGE	0.6357	0.5202	0.4962	0.4402	0.4329	0.5051	0.0713		2.74E-06

Table 57: AUROC TF-200

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8831**	0.7756	0.7632	0.7189	**0.7074**	**0.7637**	0.051		-
SCNS	0.6742	0.6608	0.5581	0.484	0.3989	0.56	0.0951		1.98E-04
PIDC	0.7911	0.736	0.7142	0.6576	0.6041	0.7033	0.0585		2.42E-01
GRNVBEM	0.7413	0.6978	0.6621	0.6465	0.5324	0.66	0.0565		4.06E-02
GENIE3	0.7617	0.7334	0.6735	0.629	0.5973	0.6801	0.0594		1.03E-01
GRNBOOST2	0.8175	0.7602	0.7466	0.7281	0.6833	0.7454	**0.0353**	1.67E-13	7.80E-01
PPCOR	0.773	0.6422	0.612	0.5884	0.5475	0.6257	0.0597		5.43E-03
SCODE	0.7722	0.583	0.4827	0.4005	0.2881	0.4922	0.1396		8.52E-06
SINCERITIES	0.5928	0.5468	0.5068	0.4425	0.3952	0.4977	0.0615		1.62E-06
LEAP	0.8273	**0.8018**	**0.7692**	**0.7345**	0.6629	0.763	0.0479		9.28E-01
GRISLI	0.6327	0.5956	0.5234	0.4891	0.4367	0.5355	0.0684		2.06E-05
SCINGE	0.5973	0.5074	0.4223	0.3712	0.3333	0.4425	0.0818		9.03E-08

Table 58: AUROC TF-500

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8544**	**0.8292**	0.7598	0.713	0.7006	**0.7698**	0.0578		-
SCNS	0.6523	0.6154	0.5566	0.4749	0.3846	0.5429	0.0844		2.06E-05
PIDC	0.8303	0.7655	0.7217	0.6757	0.6312	0.7253	0.0623		4.14E-01
GRNVBEM	0.7285	0.6963	0.6821	0.6167	0.5581	0.6601	0.0531		1.85E-02
GENIE3	0.7134	0.7044	0.678	0.6225	0.6109	0.6664	0.0412		3.00E-02
GRNBOOST2	0.7768	0.7534	0.7466	0.7251	**0.7074**	0.7422	**0.0209**	3.67E-14	7.72E-01
PPCOR	0.7549	0.7236	0.6603	0.612	0.5498	0.6644	0.0665		3.28E-02
SCODE	0.6305	0.5618	0.4925	0.4276	0.3635	0.4985	0.0893		1.29E-06
SINCERITIES	0.7179	0.5403	0.4687	0.4191	0.4042	0.5007	0.0985		1.76E-06
LEAP	0.81	0.7994	**0.7873**	**0.7313**	0.6802	0.7634	0.0452		9.82E-01
GRISLI	0.6131	0.5758	0.5366	0.5196	0.4729	0.5413	0.0443		8.27E-06
SCINGE	0.6199	0.5471	0.494	0.4408	0.3077	0.4876	0.0857		5.70E-07

Table 59: AUROC TF-2000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.8703	**0.8162**	0.7651	0.7097	0.5965	0.7572	0.0764		-
SCNS	0.6071	0.5577	0.5045	0.4851	0.4548	0.5216	0.0512		1.35E-05
PIDC	0.8213	0.8017	0.7187	0.6908	0.6674	0.7398	0.0582		7.67E-01
GRNVBEM	0.7134	0.6718	0.6546	0.602	0.5158	0.6371	0.0573		1.15E-02
GENIE3	0.7089	0.6927	0.6652	0.644	0.635	0.6682	0.0259		4.77E-02
GRNBOOST2	0.7934	0.7579	0.7436	0.7089	0.6863	0.737	0.0331	1.65E-14	7.36E-01
PPCOR	0.8137	0.7304	0.6938	0.6499	0.6003	0.6971	0.0613		2.01E-01
SCODE	0.5566	0.4985	0.4404	0.3918	0.359	0.4459	0.0612		3.21E-07
SINCERITIES	**0.8884**	0.7643	0.6912	0.6282	0.4925	0.6919	0.11		1.82E-01
LEAP	0.8077	0.7945	**0.779**	**0.7581**	**0.7308**	**0.7747**	**0.0253**		5.94E-01
GRISLI	0.6365	0.6016	0.5803	0.5354	0.4713	0.5667	0.0497		1.74E-04
SCINGE	0.6116	0.4768	0.405	0.3897	0.2813	0.4327	0.0924		3.44E-07

Table 60: AUROC TF-5000

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	**0.8959**	**0.8013**	0.7768	0.731	0.6599	**0.7735**	0.0636		-
SCNS	0.6388	0.5747	0.5528	0.5403	0.4419	0.5532	0.0513		1.58E-05
PIDC	0.8273	0.7994	0.7519	0.6863	0.6704	0.7462	0.0571		6.12E-01
GRNVBEM	0.7112	0.6744	0.6599	0.6207	0.5068	0.6392	0.0601		2.95E-03
GENIE3	0.7029	0.6946	0.6614	0.6459	0.6259	0.6662	0.0267		8.56E-03
GRNBOOST2	0.7738	0.75	0.7406	0.7266	0.7059	0.741	**0.0208**	1.81E-15	5.02E-01
PPCOR	0.7851	0.7568	0.7244	0.6427	0.6229	0.7064	0.0598		1.59E-01
SCODE	0.6124	0.543	0.4389	0.4042	0.3575	0.4673	0.0863		2.17E-07
SINCERITIES	0.8884	0.747	0.741	0.7245	0.6817	0.7495	0.0536		6.05E-01
LEAP	0.8235	0.7994	**0.7817**	**0.7455**	**0.7127**	0.7732	0.033		7.82E-01
GRISLI	0.7051	0.5924	0.5558	0.5194	0.4736	0.5627	0.0668		3.78E-05
SCINGE	0.5121	0.4915	0.4529	0.4284	0.3379	0.4527	0.0497		7.83E-08

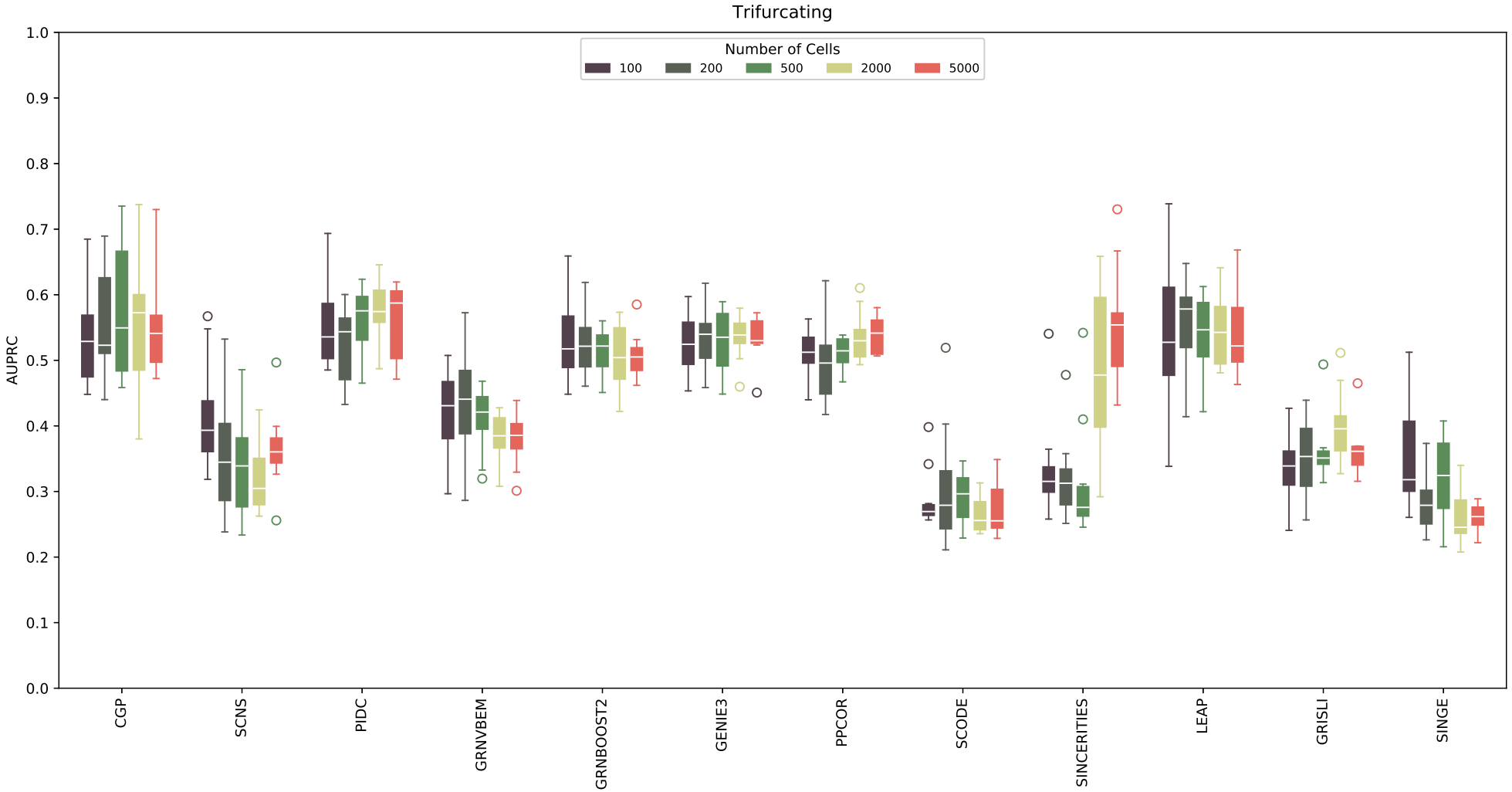


Figure 21: AUPRC boxplots considering the 12 algorithms for Trifurcating problem.

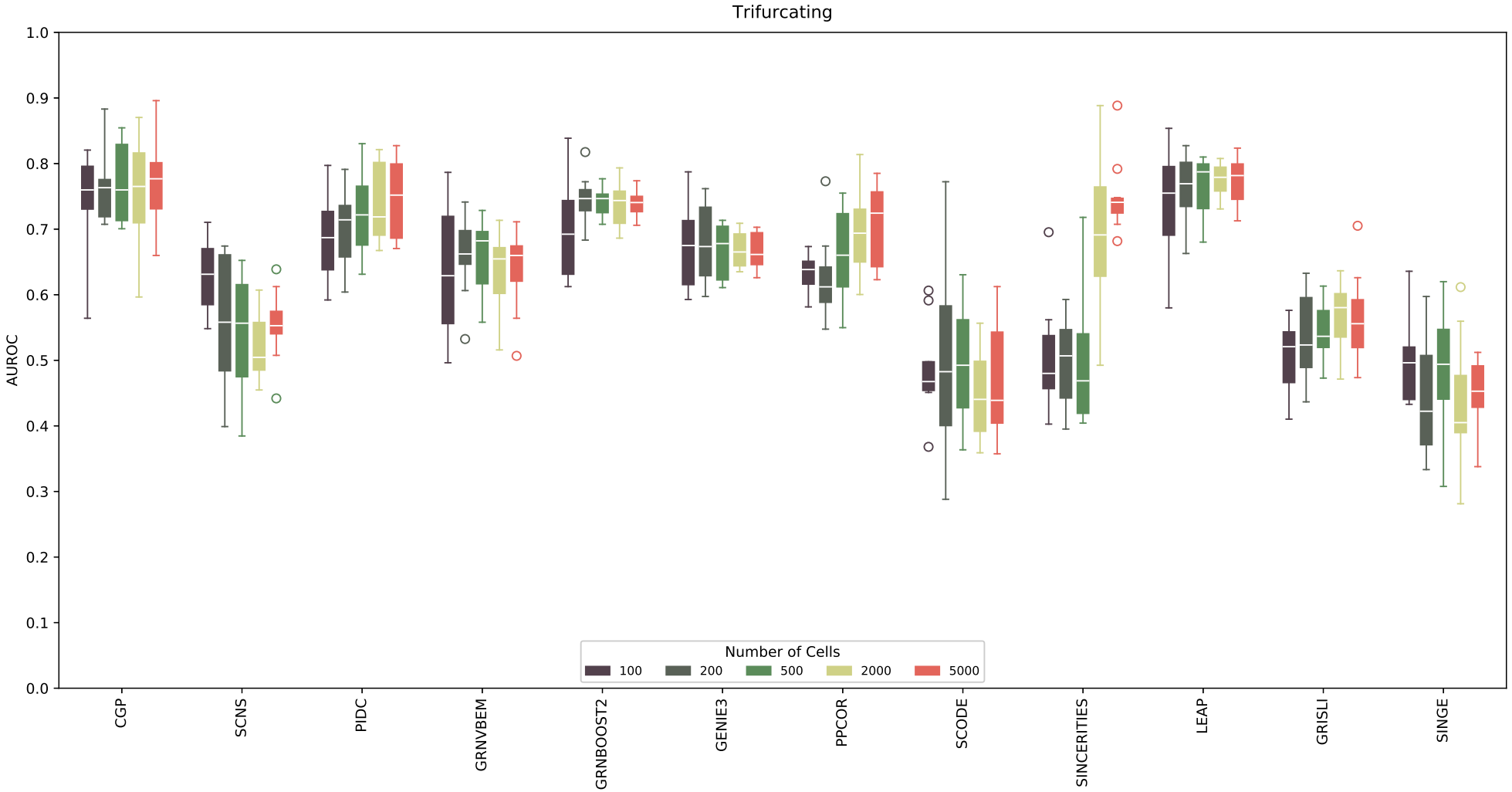
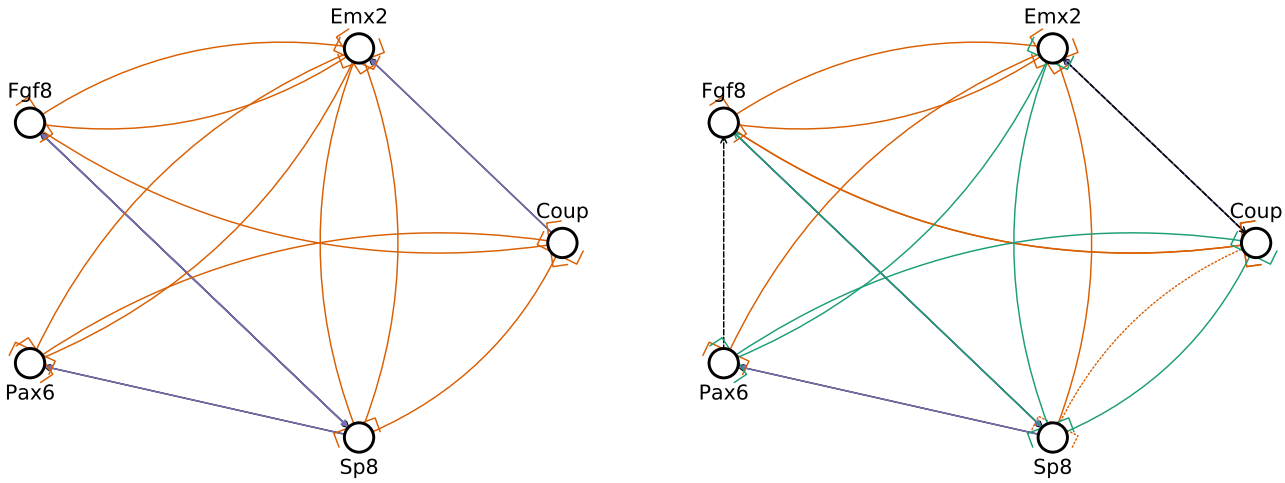


Figure 22: AUROC boxplots considering the 12 algorithms for Trifurcating problem.

7 mCAD

The mammalian Cortical Area Development (mCAD) [29] model contains five transcription factors connected by 14 interactions and captures the expected gene expression patterns in the anterior and posterior compartments respectively and results in two steady states [17].



(a) Ground-truth network.

(b) Reconstructed network.

Figure 23: Ground-truth and reconstructed mCAD networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

7.1 AUPRC

Table 61: AUPRC mCAD-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.7508	0.7508	0.6452	0.5719	0.5291	0.654	0.0865		-
SCNS	0.6894	0.6355	0.617	0.6123	0.5692	0.6222	0.036		7.97E-01
PIDC	0.5426	0.5347	0.5166	0.5137	0.511	0.5224	0.0123		1.36E-02
GRNVBEM	0.5191	0.5057	0.4915	0.4781	0.4726	0.4931	0.0163		5.71E-05
GENIE3	0.5264	0.5189	0.5147	0.5147	0.5136	0.5174	**0.004**		9.76E-03
GRNBOOST2	0.5413	0.5102	0.5089	0.5044	0.4855	0.5074	0.0142		3.97E-04
PPCOR	0.5506	0.5288	0.5017	0.4947	0.4928	0.512	0.0221		1.07E-03
SCODE	0.8504	0.8099	0.7976	0.7929	**0.7314**	0.7976	0.0333	5.51E-17	8.15E-02
SINCERITIES	0.7936	0.6972	0.6833	0.6317	0.4943	0.6613	0.0776		9.23E-01
LEAP	0.5668	0.5513	0.5472	0.5409	0.5338	0.5471	0.0095		1.73E-01
GRISLI	**0.9054**	**0.8725**	**0.8494**	**0.7978**	0.7168	**0.8302**	0.0616		3.78E-02
SCINGE	0.8558	0.8278	0.7714	0.7521	0.6771	0.7802	0.0561		1.28E-01

Table 62: AUPRC mCAD-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.7624	0.6926	0.6452	0.5766	0.5596	0.6466	0.0713		-
SCNS	0.6697	0.6275	0.6088	0.5774	0.5681	0.6104	0.0358		7.43E-01
PIDC	0.5261	0.5168	0.5046	0.5004	0.4934	0.5076	**0.0103**		2.52E-03
GRNVBEM	0.5203	0.4927	0.4816	0.476	0.4713	0.4873	0.0148		3.68E-05
GENIE3	0.5571	0.5371	0.5131	0.5083	0.5042	0.5232	0.0188		1.83E-02
GRNBOOST2	0.5523	0.5316	0.4982	0.4861	0.4755	0.5078	0.0261	1.15E-16	1.71E-03
PPCOR	0.5524	0.5382	0.4996	0.4818	0.4781	0.5082	0.0293		1.43E-03
SCODE	0.8485	0.8402	0.8031	0.7904	**0.7523**	0.8102	0.0307		5.46E-02
SINCERITIES	0.7977	0.731	0.6775	0.6089	0.5188	0.6635	0.0913		9.54E-01
LEAP	0.5973	0.5305	0.5196	0.5154	0.508	0.5287	0.0244		3.79E-02
GRISLI	**0.872**	0.7527	0.7254	0.7191	0.6565	0.7462	0.0582		2.86E-01
SCINGE	0.8684	**0.8455**	**0.8237**	**0.7935**	0.7391	**0.8174**	0.0376		4.56E-02

Table 63: AUPRC mCAD-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6561	0.6561	0.6403	0.6081	0.5515	0.6281	0.0331		-
SCNS	0.691	0.6226	0.611	0.5849	0.5692	0.6149	0.0374		8.47E-01
PIDC	0.5534	0.535	0.5263	0.5062	0.4989	0.5234	**0.0174**		2.46E-03
GRNVBEM	0.5474	0.5147	0.4663	0.4556	0.4445	0.4851	0.0362		1.09E-04
GENIE3	0.5739	0.5539	0.5405	0.5179	0.5062	0.5379	0.0218		1.51E-02
GRNBOOST2	0.5791	0.534	0.5226	0.5025	0.4781	0.5226	0.0281	3.33E-16	2.62E-03
PPCOR	0.5633	0.5605	0.5377	0.5124	0.5021	0.5359	0.0234		1.26E-02
SCODE	0.8468	0.8169	0.7826	**0.7534**	**0.7263**	**0.7841**	0.0401		3.34E-02
SINCERITIES	0.7778	0.7197	0.6387	0.5854	0.5485	0.6522	0.0784		8.47E-01
LEAP	0.6461	0.6267	0.5736	0.5414	0.5331	0.583	0.0433		2.83E-01
GRISLI	**0.8834**	**0.8277**	**0.814**	0.6818	0.6294	0.7689	0.0844		5.54E-02
SCINGE	0.8254	0.78	0.7551	0.7347	0.6576	0.7526	0.0481		7.93E-02

7.2 AUROC

Table 64: AUROC mCAD-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6264	0.6264	0.5165	0.375	0.3242	0.4978	0.122		-
SCNS	0.5	0.467	0.4505	0.4396	0.3956	0.4495	0.0329		7.53E-01
PIDC	0.3132	0.3132	0.3022	0.2912	0.2912	0.3022	**0.011**		4.22E-03
GRNVBEM	0.2418	0.206	0.1868	0.1538	0.1319	0.1835	0.0358		2.73E-06
GENIE3	0.3407	0.3187	0.3077	0.3077	0.3077	0.3154	**0.011**		1.49E-02
GRNBOOST2	0.3626	0.294	0.2857	0.2692	0.2088	0.2802	0.0391	1.66E-17	4.69E-04
PPCOR	0.3462	0.3091	0.2802	0.2582	0.2527	0.2879	0.0336		1.25E-03
SCODE	0.7582	0.6786	0.6538	0.6401	0.5604	0.6538	0.0504		1.11E-01
SINCERITIES	0.6264	0.5055	0.4505	0.4162	0.2418	0.4451	0.1017		5.54E-01
LEAP	0.4066	0.3709	0.3516	0.3407	0.3132	0.3538	0.0256		1.65E-01
GRISLI	**0.8187**	**0.7541**	**0.7335**	**0.6964**	**0.6484**	**0.7275**	0.0513		2.74E-02
SCINGE	0.7198	0.6195	0.5852	0.5453	0.5055	0.5929	0.0656		3.32E-01

Table 65: AUROC mCAD-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6319	0.5412	0.5055	0.4135	0.3626	0.4934	0.0899		-
SCNS	0.478	0.4643	0.4478	0.4052	0.3791	0.4357	0.0331		6.81E-01
PIDC	0.3352	0.3077	0.2802	0.2692	0.2473	0.2868	**0.0256**		2.68E-03
GRNVBEM	0.2473	0.1799	0.1676	0.1497	0.1429	0.1736	0.0312		4.43E-06
GENIE3	0.4066	0.3489	0.3022	0.2885	0.2747	0.3198	0.0424		1.62E-02
GRNBOOST2	0.3846	0.3516	0.2473	0.2253	0.1868	0.2791	0.0701		2.36E-03
PPCOR	0.3901	0.342	0.272	0.2184	0.2033	0.283	0.0701	3.31E-17	2.62E-03
SCODE	**0.7802**	0.7225	**0.6923**	0.6511	**0.6264**	0.6923	0.0464		7.50E-02
SINCERITIES	0.6374	0.5137	0.489	0.3805	0.3132	0.4621	0.0985		6.97E-01
LEAP	0.3901	0.3379	0.3242	0.3146	0.2967	0.333	0.0296		4.81E-02
GRISLI	**0.7802**	**0.728**	**0.6923**	**0.6772**	0.5879	**0.6973**	0.049		5.79E-02
SCINGE	0.7088	0.6992	0.6813	0.6387	0.5495	0.6599	0.0536		1.36E-01

Table 66: AUROC mCAD-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.544	0.544	0.4863	0.4286	0.3352	0.4736	0.0749		-
SCNS	0.5165	0.4698	0.4451	0.4272	0.3956	0.4495	**0.0339**		9.10E-01
PIDC	0.3571	0.3352	0.3242	0.2747	0.2692	0.3132	0.034		4.72E-03
GRNVBEM	0.3407	0.2871	0.1291	0.0907	0.0549	0.1791	0.1041		8.01E-05
GENIE3	0.3626	0.3269	0.3022	0.2857	0.2418	0.3033	0.0345		2.26E-03
GRNBOOST2	0.4505	0.3489	0.3242	0.2665	0.1868	0.3154	0.0727	2.16E-16	8.47E-03
PPCOR	0.4066	0.3709	0.3352	0.2788	0.2363	0.3253	0.0553		1.25E-02
SCODE	0.7143	0.6731	0.6429	0.5852	**0.5604**	0.6341	0.0499		4.19E-02
SINCERITIES	0.5824	0.5316	0.4313	0.3736	0.3407	0.4495	0.085		7.41E-01
LEAP	0.4505	0.4396	0.4066	0.3777	0.3242	0.4044	0.0393		3.82E-01
GRISLI	**0.7692**	**0.7349**	**0.6923**	**0.6195**	0.5165	**0.6714**	0.0758		2.23E-02
SCINGE	0.6978	0.6319	0.5797	0.5453	0.522	0.5918	0.0558		1.15E-01

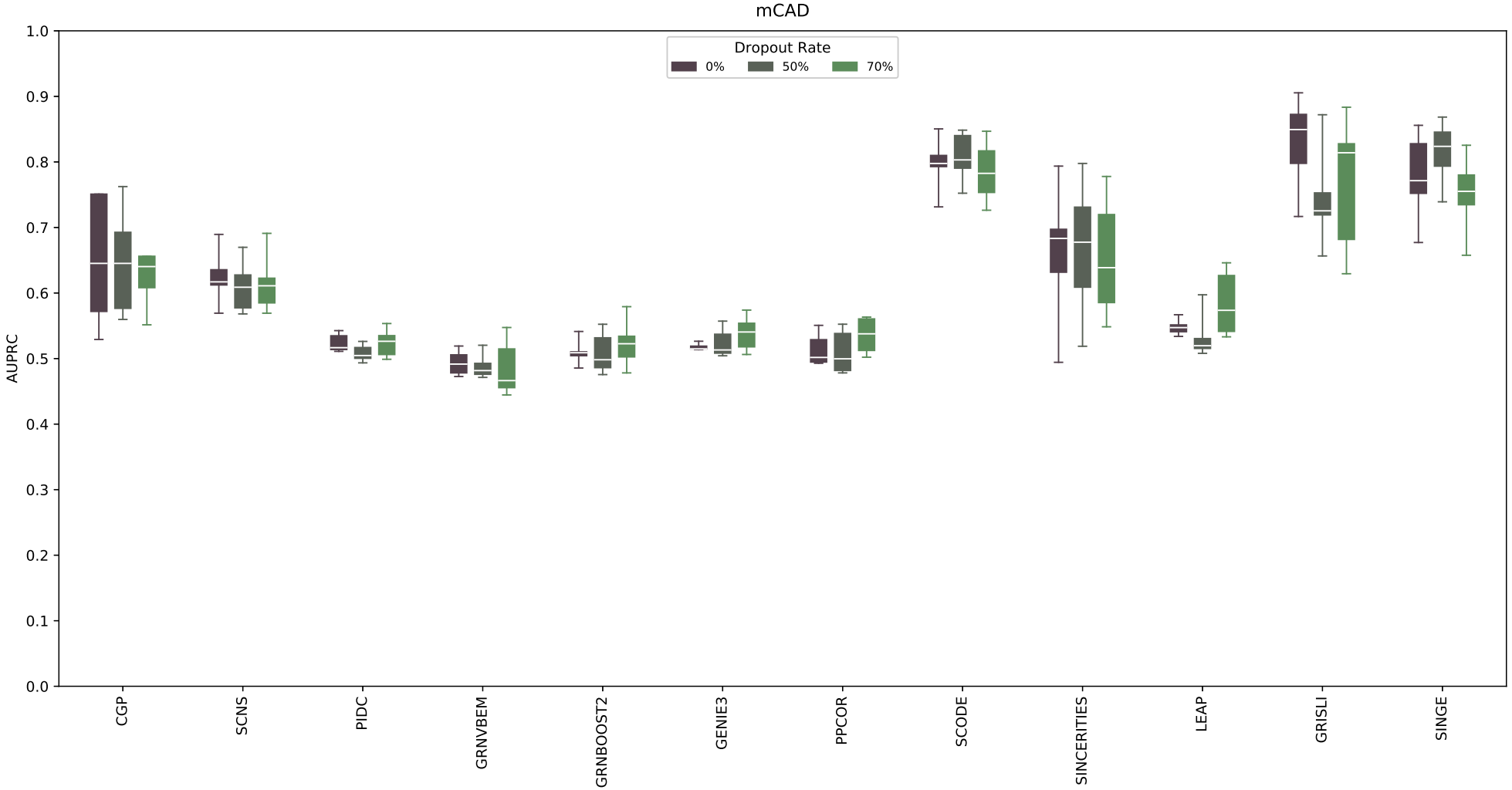


Figure 24: AUPRC boxplots considering the 12 algorithms for mCAD problem.

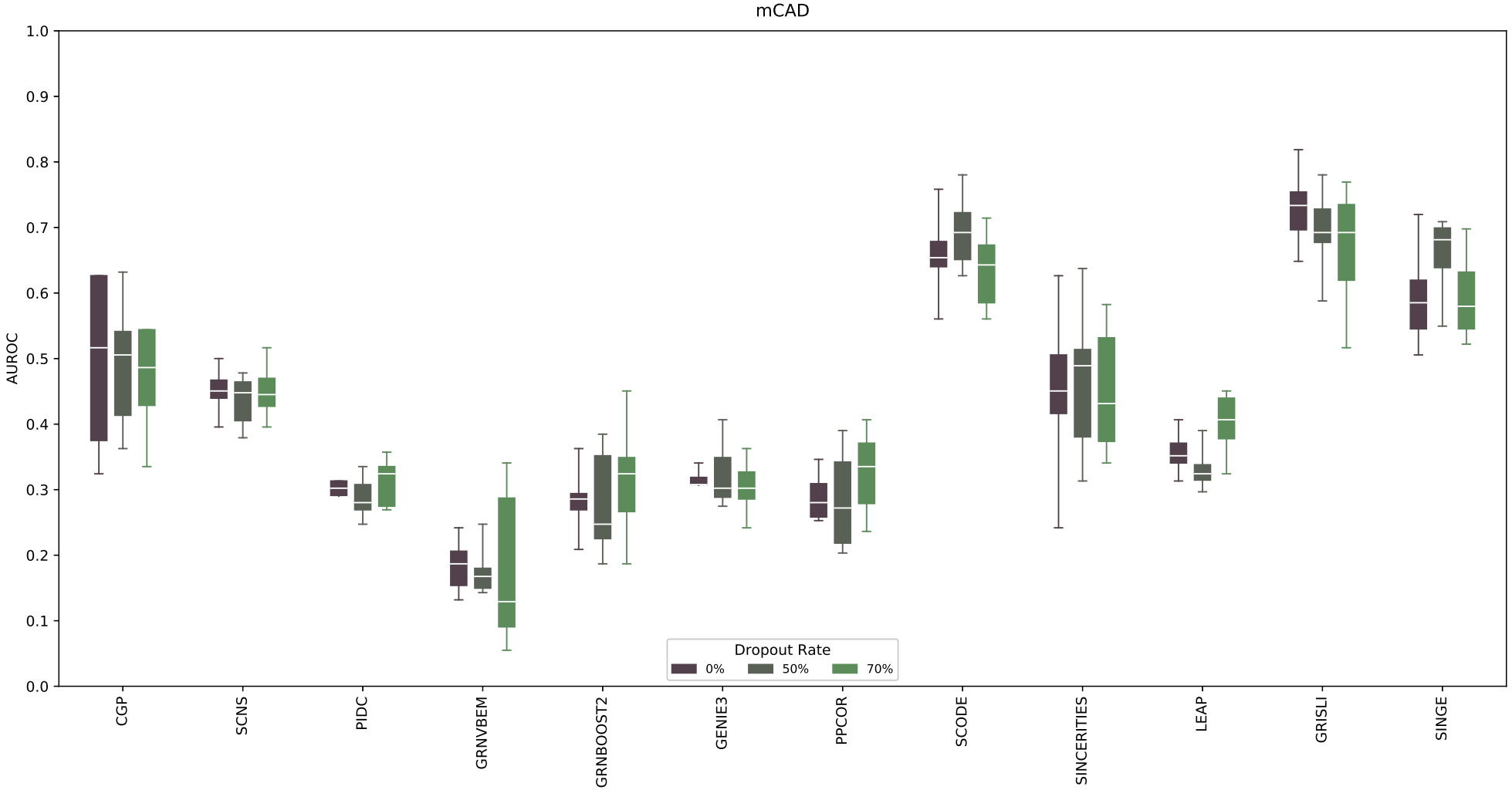
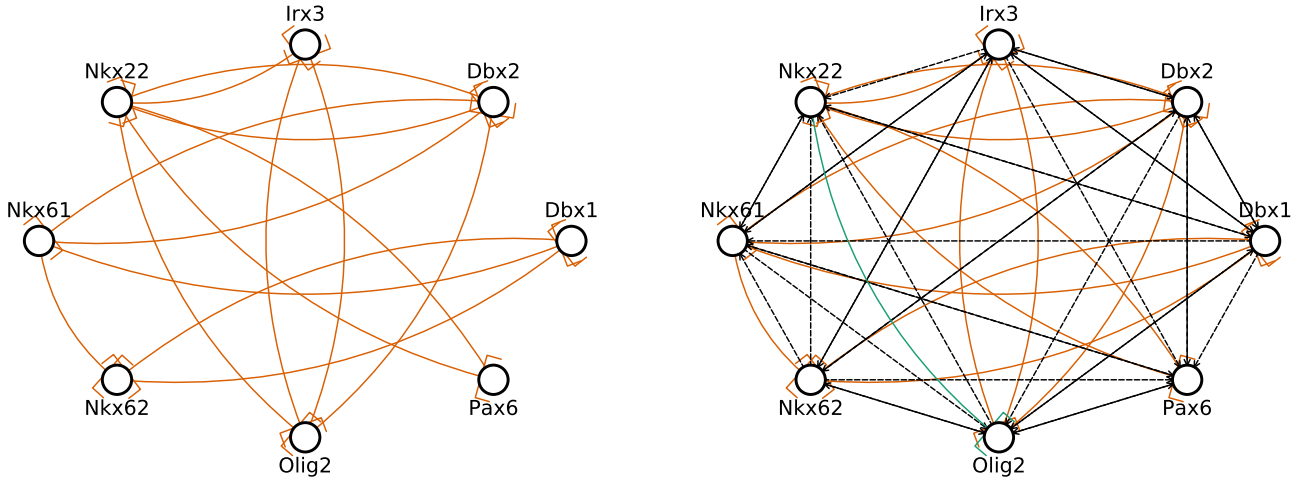


Figure 25: AUROC boxplots considering the 12 algorithms for mCAD problem.

8 VSC

The ventral spinal cord development (VSC) [30] model consists of 8 transcription factors involved in ventralization contains 15 interactions, all of which are inhibitory. It succeeds in accounting for five distinct neural progenitor cell types [17].



(a) Ground-truth network.

(b) Reconstructed network.

Figure 26: Ground-truth and reconstructed VSC networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

8.1 AUPRC

Table 67: AUPRC VSC-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.4683	0.3287	0.3138	0.2789	0.2338	0.3217	0.0667		-
SCNS	0.2679	0.2679	0.2679	0.2679	0.2679	0.2679	**0.0**		2.12E-01
PIDC	0.7603	0.7363	0.7295	0.6921	0.6604	0.7167	0.0298		6.55E-04
GRNVBEM	0.2091	0.185	0.1827	0.176	0.1684	0.1842	0.0118		4.30E-03
GENIE3	0.753	**0.7421**	**0.7401**	**0.7357**	**0.7256**	**0.7386**	0.0074		7.67E-05
GRNBOOST2	**0.7614**	0.7229	0.7197	0.7111	0.6975	0.7227	0.0196	4.07E-17	7.71E-04
PPCOR	0.6139	0.5892	0.5739	0.5519	0.5456	0.5741	0.0232		2.21E-02
SCODE	0.4325	0.3616	0.3037	0.272	0.2481	0.3217	0.0627		9.85E-01
SINCERITIES	0.3563	0.2981	0.2786	0.253	0.2185	0.2796	0.0375		4.18E-01
LEAP	0.3374	0.2734	0.264	0.237	0.2102	0.2621	0.0335		1.81E-01
GRISLI	0.4173	0.3567	0.3375	0.2926	0.26	0.33	0.0458		6.95E-01
SCINGE	0.4755	0.4697	0.3846	0.3223	0.2834	0.3893	0.0742		2.98E-01

Table 68: AUPRC VSC-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.4671	0.4395	0.3431	0.3069	0.2457	0.3607	0.075		-
SCNS	0.2679	0.2679	0.2679	0.2679	0.2679	0.2679	**0.0**		4.84E-02
PIDC	**0.779**	**0.7628**	**0.7568**	**0.751**	**0.6851**	**0.7489**	0.0269		1.37E-04
GRNVBEM	0.2558	0.2219	0.2126	0.201	0.1945	0.2169	0.0204		1.46E-03
GENIE3	0.6311	0.5972	0.5823	0.5285	0.4565	0.5599	0.0584		3.28E-02
GRNBOOST2	0.6288	0.5972	0.584	0.5723	0.5587	0.5869	0.0208		2.48E-02
PPCOR	0.6568	0.6535	0.6264	0.6177	0.6111	0.6331	0.018		2.16E-03
SCODE	0.6096	0.3636	0.3257	0.289	0.2738	0.3607	0.1017	3.42E-16	9.49E-01
SINCERITIES	0.3923	0.3134	0.2928	0.2708	0.254	0.3035	0.045		2.89E-01
LEAP	0.388	0.3596	0.311	0.2715	0.2119	0.3129	0.0544		4.14E-01
GRISLI	0.4384	0.337	0.3058	0.2721	0.2425	0.3117	0.0546		3.61E-01
SCINGE	0.411	0.3932	0.3821	0.2938	0.2755	0.3518	0.0523		9.44E-01

Table 69: AUPRC VSC-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.373	0.3071	0.259	0.2275	0.1938	0.2709	0.0532		-
SCNS	0.2679	0.2679	0.2679	0.2679	0.2679	0.2679	**0.0**		8.72E-01
PIDC	**0.7208**	**0.7139**	**0.6925**	**0.6553**	**0.6384**	**0.6852**	0.03		7.91E-08
GRNVBEM	0.2426	0.2235	0.2122	0.2058	0.1977	0.2149	0.0136		1.31E-01
GENIE3	0.3677	0.3656	0.3634	0.36	0.3531	0.3621	0.0043		1.48E-02
GRNBOOST2	0.4675	0.4396	0.4352	0.4297	0.4179	0.4358	0.0128		1.45E-04
PPCOR	0.6187	0.5903	0.576	0.5636	0.5428	0.5776	0.0208		2.29E-06
SCODE	0.4439	0.4261	0.3916	0.3605	0.2944	0.3842	0.0491	1.18E-15	5.05E-03
SINCERITIES	0.4912	0.3373	0.2958	0.2839	0.2728	0.3227	0.0614		1.94E-01
LEAP	0.3892	0.3317	0.2825	0.2551	0.2233	0.2945	0.052		5.50E-01
GRISLI	0.4605	0.3069	0.2919	0.258	0.2072	0.2958	0.0639		5.46E-01
SCINGE	0.4936	0.392	0.3394	0.3239	0.2262	0.3526	0.0684		4.28E-02

8.2 AUROC

Table 70: AUROC VSC-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6805	0.628	0.5541	0.5014	0.4211	0.5608	0.0778		-
SCNS	0.5	0.5	0.5	0.5	0.5	0.5	**0.0**		2.10E-01
PIDC	**0.8528**	0.8171	0.8008	0.7894	0.7715	0.8037	0.0223		4.69E-04
GRNVBEM	0.3333	0.2663	0.2553	0.2382	0.2033	0.2607	0.038		4.22E-03
GENIE3	0.8163	0.8057	0.7967	0.7878	0.7854	0.7974	0.0101		1.02E-03
GRNBOOST2	0.8439	**0.826**	**0.8122**	**0.8028**	**0.7967**	**0.8154**	0.0148	4.35E-16	8.77E-05
PPCOR	0.7252	0.7209	0.7057	0.6841	0.6707	0.702	0.0192		2.72E-02
SCODE	0.6797	0.6203	0.5325	0.5207	0.4537	0.5595	0.0706		9.54E-01
SINCERITIES	0.6179	0.537	0.5114	0.4807	0.413	0.5144	0.0573		3.85E-01
LEAP	0.6846	0.5717	0.5354	0.4697	0.4033	0.5289	0.0775		5.80E-01
GRISLI	0.6561	0.5963	0.574	0.549	0.4789	0.5696	0.0532		8.37E-01
SCINGE	0.7106	0.6065	0.5817	0.5319	0.5098	0.5865	0.0618		5.65E-01

Table 71: AUROC VSC-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.7707	0.6929	0.613	0.5583	0.4593	0.6199	0.0913		-
SCNS	0.5	0.5	0.5	0.5	0.5	0.5	**0.0**		1.40E-02
PIDC	**0.8659**	**0.8488**	**0.8366**	**0.8195**	**0.8138**	**0.8369**	0.0174		5.41E-04
GRNVBEM	0.4561	0.4059	0.3768	0.3207	0.3081	0.3728	0.0515		4.58E-04
GENIE3	0.7854	0.761	0.7504	0.7411	0.7252	0.752	0.0165		3.38E-02
GRNBOOST2	0.8309	0.8159	0.8138	0.8057	0.7967	0.8125	0.0094	2.51E-16	3.23E-03
PPCOR	0.7415	0.7346	0.7228	0.6945	0.6886	0.7167	0.0203		1.37E-01
SCODE	0.735	0.585	0.5691	0.5195	0.4049	0.5608	0.0795		3.82E-01
SINCERITIES	0.635	0.5697	0.5309	0.5197	0.4634	0.5446	0.046		2.25E-01
LEAP	0.6724	0.6124	0.5744	0.5429	0.3967	0.5706	0.0718		5.33E-01
GRISLI	0.6724	0.5965	0.5488	0.5118	0.448	0.5521	0.0682		2.83E-01
SCINGE	0.6691	0.6492	0.5866	0.5543	0.4911	0.5917	0.0598		6.71E-01

Table 72: AUROC VSC-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6854	0.5742	0.5272	0.428	0.3415	0.5113	0.1013		-
SCNS	0.5	0.5	0.5	0.5	0.5	0.5	**0.0**		5.78E-01
PIDC	**0.8561**	**0.8447**	**0.8285**	**0.8211**	**0.8138**	**0.8317**	0.0141		8.98E-07
GRNVBEM	0.4537	0.4067	0.3919	0.3665	0.3333	0.3902	0.0389		5.10E-02
GENIE3	0.6407	0.639	0.635	0.6313	0.6228	0.634	0.0057		1.59E-02
GRNBOOST2	0.7984	0.7801	0.7764	0.7711	0.7642	0.7784	0.0102	5.37E-16	8.42E-05
PPCOR	0.8366	0.7998	0.7809	0.7746	0.7447	0.7872	0.0262		3.36E-05
SCODE	0.6748	0.6366	0.6016	0.5837	0.5756	0.6122	0.0317		6.00E-02
SINCERITIES	0.6374	0.6041	0.5683	0.5486	0.5236	0.5741	0.036		3.10E-01
LEAP	0.6407	0.5522	0.5073	0.4724	0.439	0.5141	0.0588		9.23E-01
GRISLI	0.7171	0.5665	0.4996	0.4913	0.3902	0.5311	0.0858		9.64E-01
SCINGE	0.6911	0.6382	0.6089	0.5423	0.4577	0.5937	0.0678		1.32E-01

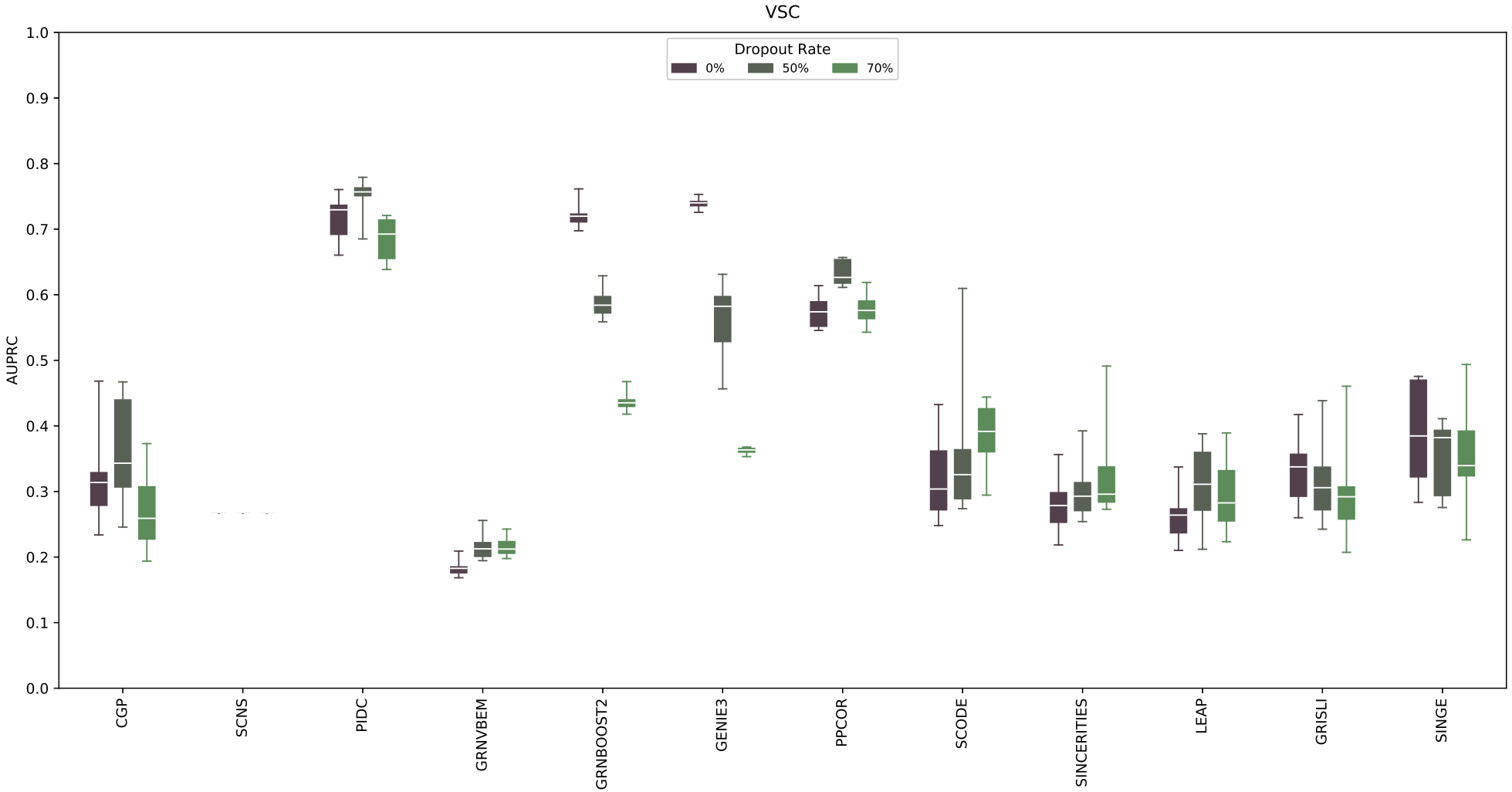


Figure 27: AUPRC boxplots considering the 12 algorithms for VSC problem.

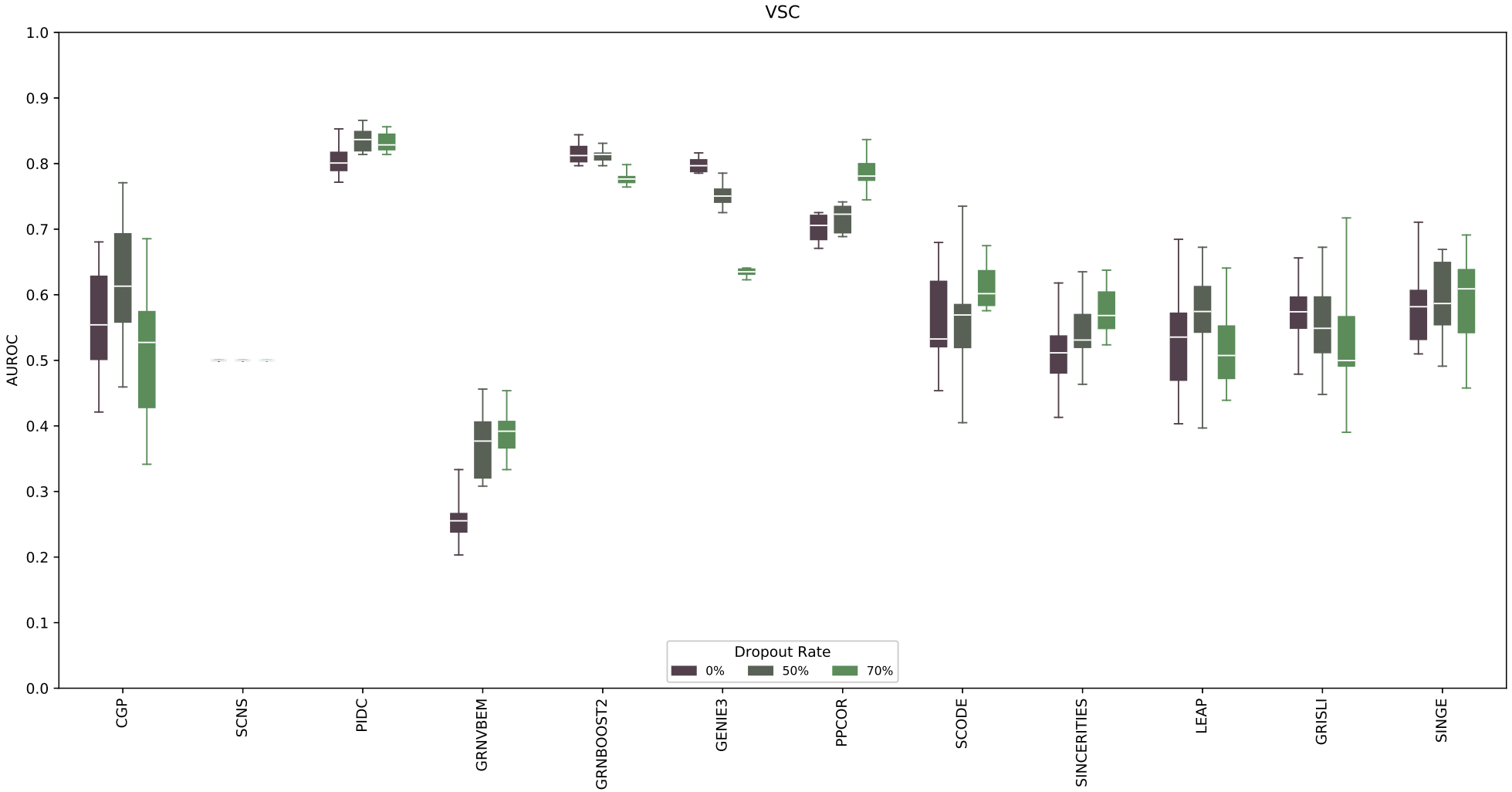
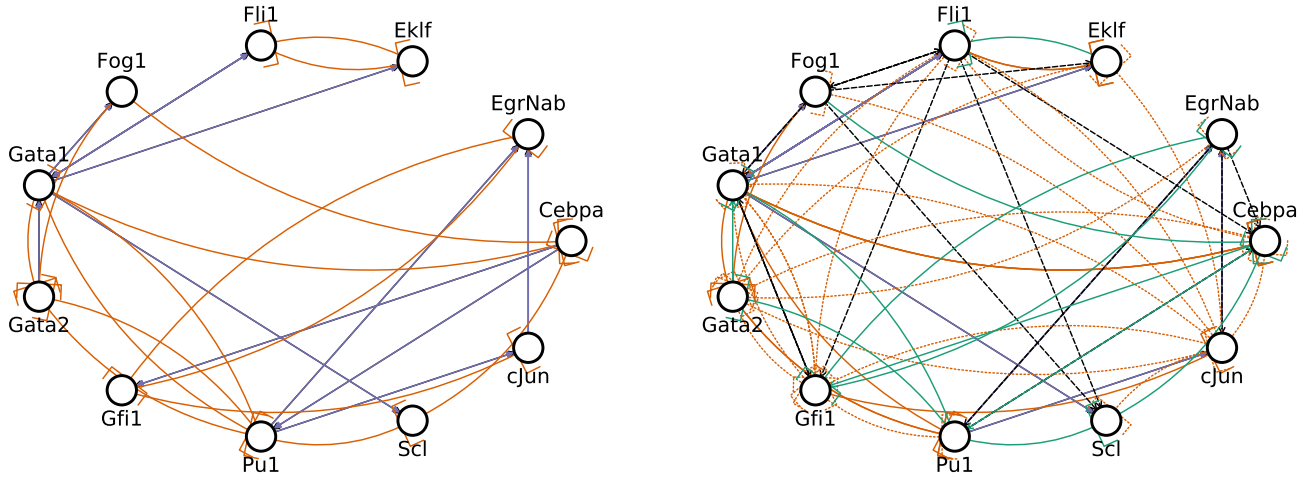


Figure 28: AUROC boxplots considering the 12 algorithms for VSC problem.

9 HSC

The hematopoietic stem cell (HSC) differentiation [31] model consists of 11 transcription factors and contains 30 interactions, 15 activations and 15 inhibitory. It succeeds in accounting for four distinct steady states [17].



(a) Ground-truth network.

(b) Reconstructed network.

Figure 29: Ground-truth and reconstructed HSC networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

9.1 AUPRC

Table 73: AUPRC HSC-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.4032	0.3198	0.2658	0.2535	0.2241	0.2901	0.0563		-
SCNS	0.3803	0.3378	0.2806	0.265	0.2547	0.3008	0.0453		7.28E-01
PIDC	0.4897	0.4806	0.4667	**0.4646**	**0.4556**	**0.4707**	**0.0109**		1.01E-04
GRNVBEM	0.3302	0.3217	0.3116	0.2977	0.2792	0.3088	0.016		4.25E-01
GENIE3	0.4968	0.4808	0.4665	0.4524	0.4353	0.4661	0.0188		1.74E-04
GRNBOOST2	**0.5357**	**0.4973**	**0.4682**	0.4556	0.3736	0.4663	0.0468	1.77E-17	1.83E-04
PPCOR	0.4512	0.4238	0.4091	0.3877	0.3676	0.4067	0.0256		2.21E-02
SCODE	0.4698	0.434	0.4254	0.3972	0.3368	0.4147	0.0394		1.07E-02
SINCERITIES	0.3241	0.2648	0.255	0.228	0.2015	0.2535	0.0371		3.93E-01
LEAP	0.2986	0.2884	0.2749	0.2646	0.2233	0.2713	0.0217		8.37E-01
GRISLI	0.258	0.2383	0.2262	0.2176	0.2043	0.228	0.0157		1.15E-01
SCINGE	0.2215	0.2005	0.1981	0.189	0.1808	0.1969	0.0113		1.36E-02

Table 74: AUPRC HSC-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.3502	0.2979	0.2857	0.2714	0.2462	0.2915	0.0325		-
SCNS	0.3313	0.2927	0.2647	0.2576	0.2484	0.2791	0.0292		6.90E-01
PIDC	0.4803	0.4584	**0.4472**	**0.4318**	**0.417**	**0.4458**	0.0195		7.05E-04
GRNVBEM	0.3179	0.2891	0.2843	0.2749	0.2554	0.284	0.0175		9.44E-01
GENIE3	0.4609	0.4443	0.4361	0.4217	0.3949	0.4314	0.0198		2.86E-03
GRNBOOST2	**0.4902**	**0.4643**	0.4426	0.4205	0.3925	0.4426	0.0313	2.51E-17	1.25E-03
PPCOR	0.421	0.4017	0.3844	0.3731	0.327	0.3844	0.0255		8.61E-02
SCODE	0.4371	0.4027	0.3937	0.3816	0.3498	0.3937	0.0255		5.38E-02
SINCERITIES	0.2969	0.2538	0.2185	0.2167	0.177	0.2306	0.0344		4.16E-02
LEAP	0.2727	0.2503	0.235	0.2278	0.2007	0.2385	0.0206		7.29E-02
GRISLI	0.3004	0.2636	0.2383	0.2324	0.2209	0.2485	0.0246		1.59E-01
SCINGE	0.2376	0.2236	0.2121	0.2043	0.1915	0.214	**0.0155**		7.49E-03

Table 75: AUPRC HSC-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.4167	0.3876	0.3527	0.2998	0.2509	0.344	0.0528		-
SCNS	0.3203	0.2843	0.2549	0.2508	0.239	0.2676	0.0252		3.85E-02
PIDC	0.436	0.4185	**0.4119**	**0.4071**	0.3863	**0.4121**	0.0145		3.50E-02
GRNVBEM	0.301	0.2847	0.2785	0.265	0.2544	0.277	0.0146		9.85E-02
GENIE3	0.4127	0.4085	0.4023	0.3977	**0.3903**	0.4021	**0.0073**		9.72E-02
GRNBOOST2	**0.4369**	**0.42**	0.4039	0.3869	0.3491	0.4023	0.0254	3.02E-16	7.60E-02
PPCOR	0.371	0.3678	0.3627	0.342	0.3238	0.3538	0.0174		9.03E-01
SCODE	0.4209	0.3917	0.3573	0.329	0.312	0.3625	0.0372		5.76E-01
SINCERITIES	0.3369	0.2907	0.2393	0.2111	0.2038	0.2527	0.0442		8.09E-03
LEAP	0.2601	0.25	0.246	0.2179	0.2085	0.2359	0.0185		1.53E-03
GRISLI	0.3066	0.2768	0.2451	0.2325	0.2038	0.2528	0.029		8.40E-03
SCINGE	0.2627	0.2159	0.2028	0.19	0.1864	0.2078	0.0222		6.38E-05

9.2 AUROC

Table 76: AUROC HSC-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6376	0.5951	0.5413	0.516	0.4531	0.5517	0.0554		-
SCNS	0.6158	0.5574	0.5308	0.5204	0.4794	0.5385	0.0371		8.07E-01
PIDC	0.7958	0.7768	0.7637	0.7473	0.7326	0.7621	0.019		9.29E-05
GRNVBEM	0.6724	0.6478	0.6043	0.5975	0.5907	0.6213	0.0291		1.83E-01
GENIE3	0.8008	**0.7879**	**0.7853**	**0.7771**	**0.7688**	**0.7841**	**0.0097**		6.03E-06
GRNBOOST2	**0.804**	0.7831	0.7541	0.7399	0.7248	0.7607	0.0259	4.40E-18	7.30E-05
PPCOR	0.7351	0.6972	0.6856	0.6656	0.6348	0.6847	0.0291		9.06E-03
SCODE	0.7092	0.6812	0.6664	0.6525	0.6355	0.6672	0.0223		2.00E-02
SINCERITIES	0.5742	0.5249	0.5037	0.492	0.4299	0.5031	0.0415		3.10E-01
LEAP	0.6326	0.6216	0.6033	0.5616	0.4975	0.5878	0.0428		5.00E-01
GRISLI	0.5664	0.5317	0.5072	0.4835	0.4663	0.5095	0.0299		3.58E-01
SCINGE	0.4789	0.4485	0.4378	0.4041	0.3883	0.431	0.0288		2.79E-02

Table 77: AUROC HSC-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6172	0.5912	0.5488	0.5171	0.4966	0.5552	0.0414		-
SCNS	0.5591	0.5497	0.5312	0.5124	0.4567	0.5258	0.0304		5.04E-01
PIDC	0.7701	0.7601	0.7546	0.7276	0.7024	0.7442	0.0219		1.49E-04
GRNVBEM	0.6307	0.6118	0.5847	0.564	0.5053	0.5825	0.0364		5.25E-01
GENIE3	**0.7857**	**0.7742**	**0.7633**	**0.7505**	**0.7326**	**0.7602**	0.0172		2.77E-05
GRNBOOST2	0.7674	0.7412	0.7303	0.716	0.6941	0.7304	0.0228	4.51E-17	4.07E-04
PPCOR	0.7285	0.6828	0.6787	0.6523	0.6376	0.6739	0.0257		1.59E-02
SCODE	0.6868	0.6693	0.6538	0.6488	0.6401	0.6589	**0.0143**		3.23E-02
SINCERITIES	0.6225	0.5328	0.4912	0.4528	0.3622	0.4953	0.0739		2.24E-01
LEAP	0.5847	0.5573	0.5259	0.4944	0.4421	0.5229	0.0446		4.88E-01
GRISLI	0.6207	0.5569	0.5366	0.5143	0.4785	0.5402	0.0379		7.28E-01
SCINGE	0.5087	0.4697	0.4594	0.448	0.4201	0.4592	0.024		2.70E-02

Table 78: AUROC HSC-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.6827	0.6465	0.6197	0.5684	0.5039	0.6097	0.0547		-
SCNS	0.5685	0.5327	0.5019	0.4865	0.4505	0.5079	0.0341		2.33E-02
PIDC	**0.7509**	**0.7365**	**0.7221**	0.7012	0.6914	0.7208	0.0202		6.94E-03
GRNVBEM	0.5881	0.5788	0.5438	0.5299	0.514	0.5515	0.026		2.09E-01
GENIE3	0.744	0.7284	0.7207	**0.7155**	**0.7138**	**0.723**	**0.0091**		5.49E-03
GRNBOOST2	0.7445	0.7175	0.707	0.7007	0.6827	0.7091	0.0178	8.04E-17	2.25E-02
PPCOR	0.7056	0.6835	0.66	0.6526	0.6337	0.6671	0.0228		2.46E-01
SCODE	0.7202	0.6686	0.6394	0.6339	0.6076	0.6528	0.0313		3.84E-01
SINCERITIES	0.609	0.5506	0.5002	0.4526	0.3707	0.5015	0.0703		2.64E-02
LEAP	0.5643	0.5525	0.5459	0.4904	0.4645	0.525	0.0366		7.24E-02
GRISLI	0.5918	0.5797	0.5306	0.5262	0.4501	0.5418	0.0413		1.44E-01
SCINGE	0.5103	0.4524	0.4439	0.4199	0.4105	0.4459	0.0299		4.94E-04

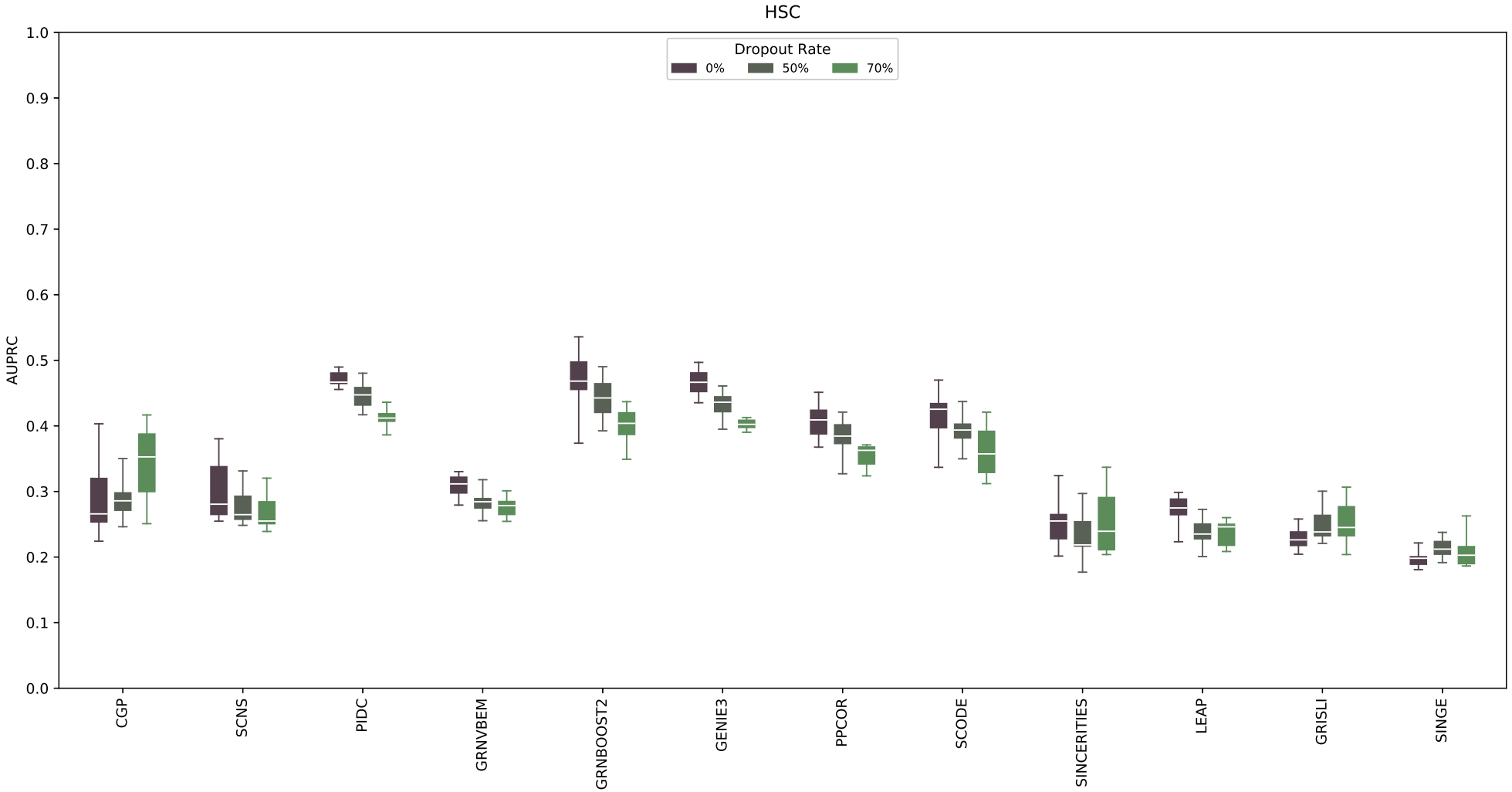


Figure 30: AUPRC boxplots considering the 12 algorithms for HSC problem.

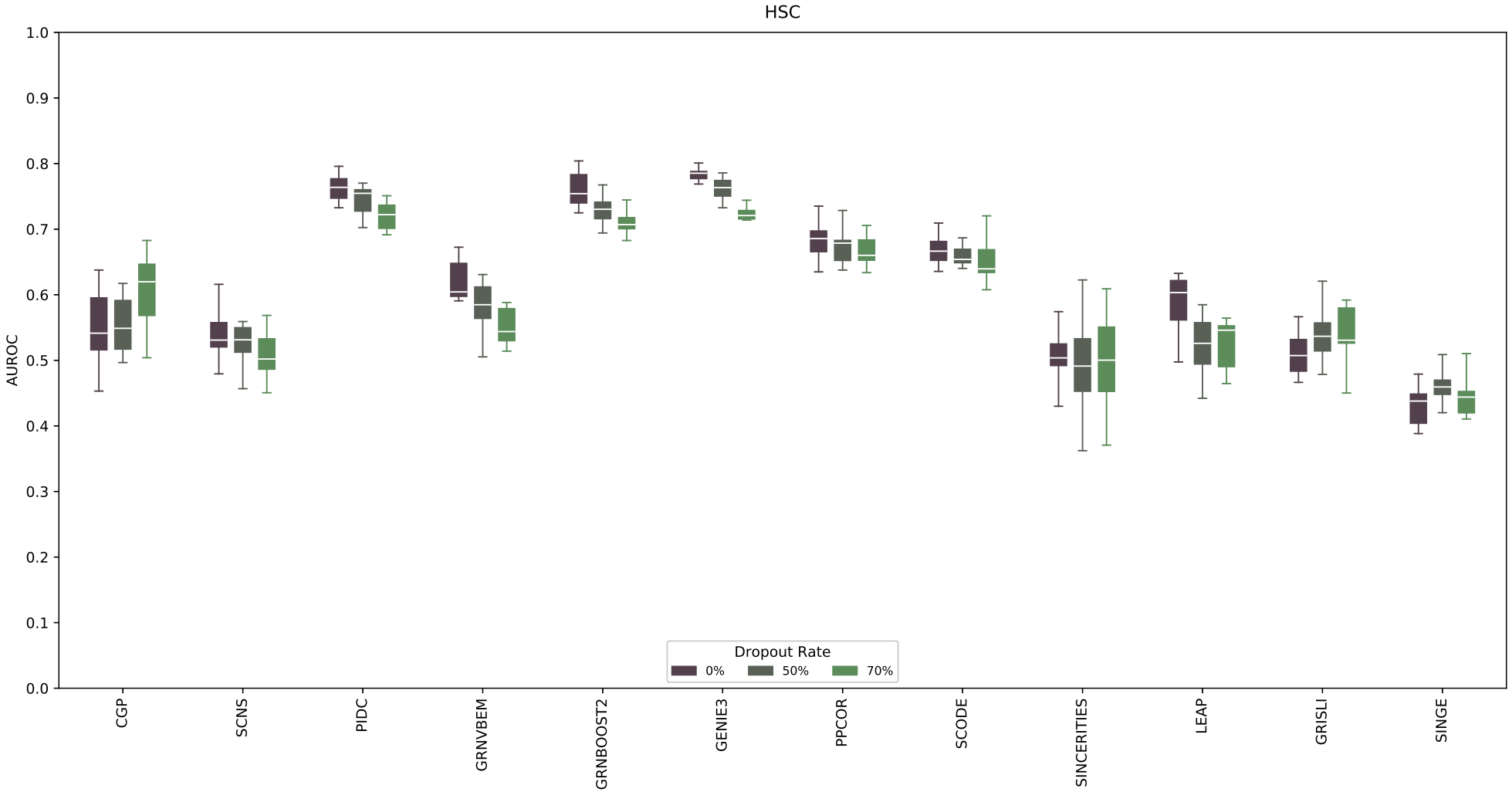
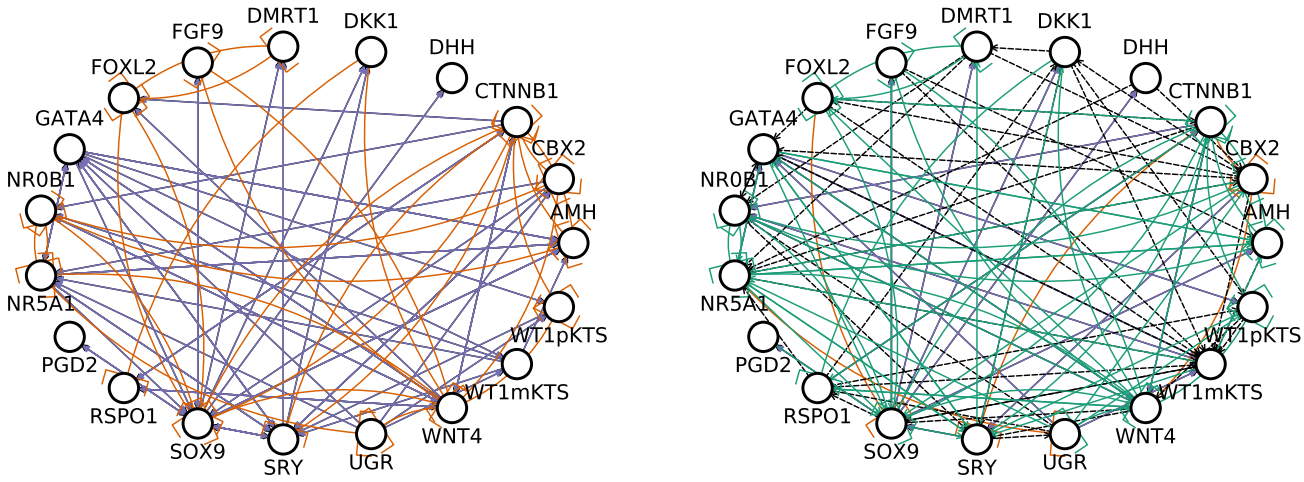


Figure 31: AUROC boxplots considering the 12 algorithms for HSC problem.

10 GSD

The gonadal sex determination (GSD) [32] model consists of 19 transcription factors and contains 86 interactions, 27 activations and 59 inhibitory. It succeeds in accounting for two distinct steady states [17].



(a) Ground-truth network.

(b) Reconstructed network.

Figure 32: Ground-truth and reconstructed GSD networks. Blue lines represent activation and orange lines, inhibition. Solid lines are correct relationships and dashed lines are relationships obtained only by the proposal. Green lines are relationships in the ground-truth network that the proposal did not find.

10.1 AUPRC

Table 79: AUPRC GSD-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.263	0.2552	0.248	0.2399	0.2073	0.2453	0.0156		-
SCNS	0.2575	0.2526	0.2482	0.247	0.2418	0.2491	0.0048		9.90E-01
PIDC	0.3018	0.2949	0.2934	0.2896	0.2856	0.2929	0.0044		4.85E-05
GRNVBEM	0.3056	0.2971	0.2854	0.2712	0.2603	0.2848	0.0155		8.89E-04
GENIE3	0.2814	0.2804	0.2785	0.2769	0.2716	0.278	0.0029		9.23E-03
GRNBOOST2	0.293	0.2872	0.2836	0.2713	0.266	0.2804	0.0095		3.45E-03
PPCOR	0.3232	0.3125	**0.3053**	**0.2973**	**0.2864**	0.3046	0.0109	2.11E-14	1.97E-06
SCODE	0.3402	**0.331**	0.2925	0.2644	0.212	0.2909	0.0418		1.04E-03
SINCERITIES	0.2888	0.2571	0.2508	0.2435	0.2294	0.251	0.016		7.28E-01
LEAP	0.2615	0.2599	0.2583	0.2569	0.2547	0.2583	**0.002**		3.38E-01
GRISLI	**0.3589**	0.3286	0.3041	0.2809	0.2623	**0.305**	0.0299		2.94E-05
SCINGE	0.2284	0.2055	0.1895	0.1869	0.1827	0.1977	0.0144		1.54E-01

Table 80: AUPRC GSD-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.2772	0.2665	0.2288	0.2125	0.1854	0.2355	0.0304		-
SCNS	0.2509	0.2494	0.2448	0.2432	0.2421	0.2459	**0.0034**		9.79E-01
PIDC	0.2972	0.2939	0.2891	**0.2835**	**0.2786**	**0.2886**	0.006		1.38E-04
GRNVBEM	0.3323	**0.2993**	**0.2916**	0.2715	0.2237	0.2855	0.027		5.43E-04
GENIE3	0.2963	0.2835	0.282	0.2709	0.2579	0.2791	0.0111		3.90E-03
GRNBOOST2	0.2933	0.29	0.279	0.2595	0.2514	0.2754	0.0161	1.42E-09	9.58E-03
PPCOR	0.328	0.2922	0.2866	0.278	0.2484	0.2864	0.0192		7.38E-04
SCODE	**0.3386**	0.2942	0.2689	0.2413	0.2054	0.2692	0.0426		3.85E-02
SINCERITIES	0.311	0.274	0.2504	0.2353	0.2211	0.2553	0.0279		3.13E-01
LEAP	0.276	0.2618	0.2585	0.2503	0.2421	0.2569	0.0099		4.00E-01
GRISLI	0.3143	0.2884	0.2812	0.2742	0.2573	0.2836	0.0169		2.17E-03
SCINGE	0.2291	0.2107	0.1982	0.1906	0.1804	0.2004	0.015		1.18E-01

Table 81: AUPRC GSD-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.296	0.2541	0.2319	0.2176	0.1986	0.2398	0.0311		-
SCNS	0.2533	0.2516	0.2466	0.2391	0.2384	0.2456	**0.006**		9.95E-01
PIDC	0.2924	0.2891	0.2826	0.2653	0.2561	0.2774	0.0135		1.78E-03
GRNVBEM	0.2806	0.2711	0.254	0.2497	0.2221	0.2558	0.0182		2.29E-01
GENIE3	**0.3045**	**0.2897**	**0.2835**	**0.2686**	**0.2625**	**0.2814**	0.0134		5.18E-04
GRNBOOST2	0.282	0.2657	0.2619	0.255	0.2449	0.2612	0.0095		7.93E-02
PPCOR	0.3039	0.2869	0.2729	0.2666	0.2452	0.2744	0.0169	6.54E-10	3.98E-03
SCODE	0.2848	0.2445	0.2267	0.2196	0.1898	0.2339	0.0273		6.48E-01
SINCERITIES	0.2973	0.2622	0.2517	0.2444	0.2192	0.2525	0.0207		3.89E-01
LEAP	0.3039	0.2474	0.2465	0.234	0.2315	0.2476	0.02		8.32E-01
GRISLI	0.3026	0.2833	0.2671	0.2581	0.2544	0.2721	0.0163		6.42E-03
SCINGE	0.2202	0.2012	0.1937	0.19	0.1775	0.1975	0.0128		2.25E-02

10.2 AUROC

Table 82: AUROC GSD-0

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.5479	0.5362	0.5291	0.5216	0.4803	0.5262	0.0185		-
SCNS	0.5784	0.5717	0.5652	0.5638	0.5621	0.5678	0.0053		8.26E-02
PIDC	**0.637**	**0.6283**	**0.6181**	**0.6132**	**0.6043**	**0.6201**	0.01		5.53E-10
GRNVBEM	0.6228	0.5966	0.5797	0.5663	0.555	0.5831	0.0221		1.86E-03
GENIE3	0.6046	0.602	0.601	0.5996	0.5944	0.6004	**0.0027**		1.52E-06
GRNBOOST2	0.6075	0.6035	0.5931	0.5859	0.5825	0.5943	0.0093	1.04E-12	3.20E-05
PPCOR	0.6064	0.5928	0.5828	0.5723	0.5644	0.5838	0.014		1.34E-03
SCODE	0.5994	0.5864	0.573	0.5583	0.4802	0.5658	0.032		3.03E-02
SINCERITIES	0.6047	0.5928	0.567	0.5553	0.5465	0.5722	0.021		1.90E-02
LEAP	0.6031	0.5948	0.5919	0.5901	0.5876	0.5934	0.0047		6.55E-05
GRISLI	0.6279	0.6129	0.5759	0.5512	0.5393	0.5805	0.0315		2.26E-03
SCINGE	0.5451	0.4702	0.4488	0.438	0.434	0.4621	0.0341		5.41E-01

Table 83: AUROC GSD-50

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.5508	0.5435	0.507	0.4875	0.4408	0.5099	0.0349		-
SCNS	0.5674	0.5651	0.5547	0.5507	0.5494	0.5573	**0.0072**		1.46E-01
PIDC	0.6244	**0.6117**	**0.6049**	**0.6015**	**0.5974**	**0.607**	0.0076		5.32E-09
GRNVBEM	0.6077	0.5847	0.5656	0.5585	0.5212	0.5684	0.0228		8.09E-03
GENIE3	0.6043	0.6016	0.5994	0.5881	0.5796	0.5954	0.0086		7.68E-07
GRNBOOST2	0.5951	0.5764	0.5682	0.5617	0.5538	0.5701	0.0115	2.01E-12	1.07E-02
PPCOR	0.5799	0.5765	0.575	0.5675	0.5237	0.5682	0.0157		9.40E-03
SCODE	0.5803	0.5764	0.5654	0.5436	0.4725	0.5487	0.0396		6.99E-02
SINCERITIES	**0.6527**	0.6009	0.5817	0.5476	0.515	0.5782	0.0378		1.20E-03
LEAP	0.595	0.5869	0.5852	0.5755	0.5547	0.5807	0.0124		3.26E-04
GRISLI	0.6238	0.602	0.5893	0.5866	0.5435	0.5891	0.0208		1.97E-05
SCINGE	0.5106	0.4811	0.4563	0.4423	0.4153	0.4613	0.0297		4.83E-01

Table 84: AUROC GSD-70

Method	Max.	3rd Quant.	Median	1st Quant.	Min.	Mean	Std.	p_{kw}	p_d
CGP	0.5827	0.5336	0.5113	0.4941	0.468	0.5178	0.034		-
SCNS	0.5774	0.5717	0.5501	0.5476	0.5467	0.5577	0.0131		3.55E-02
PIDC	0.6076	0.5919	**0.5867**	**0.579**	**0.5675**	**0.5867**	0.0113		2.48E-05
GRNVBEM	0.5442	0.5267	0.5185	0.5044	0.4817	0.517	0.0186		6.76E-01
GENIE3	0.5916	0.5833	0.5789	0.5683	0.5631	0.5772	**0.0096**		3.60E-04
GRNBOOST2	0.5648	0.5552	0.5484	0.5414	0.5258	0.5477	0.0105	2.08E-12	1.67E-01
PPCOR	0.6004	0.5836	0.5621	0.5359	0.5304	0.5624	0.026		1.54E-02
SCODE	0.5688	0.5416	0.5196	0.4971	0.432	0.5115	0.0411		8.93E-01
SINCERITIES	0.6344	0.5955	0.5797	0.5701	0.5201	0.5788	0.0325		9.53E-04
LEAP	0.5809	0.55	0.5436	0.5326	0.5279	0.5443	0.0151		2.58E-01
GRISLI	**0.6365**	**0.5992**	0.582	0.5655	0.5543	0.5849	0.0246		1.49E-04
SCINGE	0.5283	0.4714	0.4524	0.4469	0.3902	0.4578	0.0342		1.05E-01

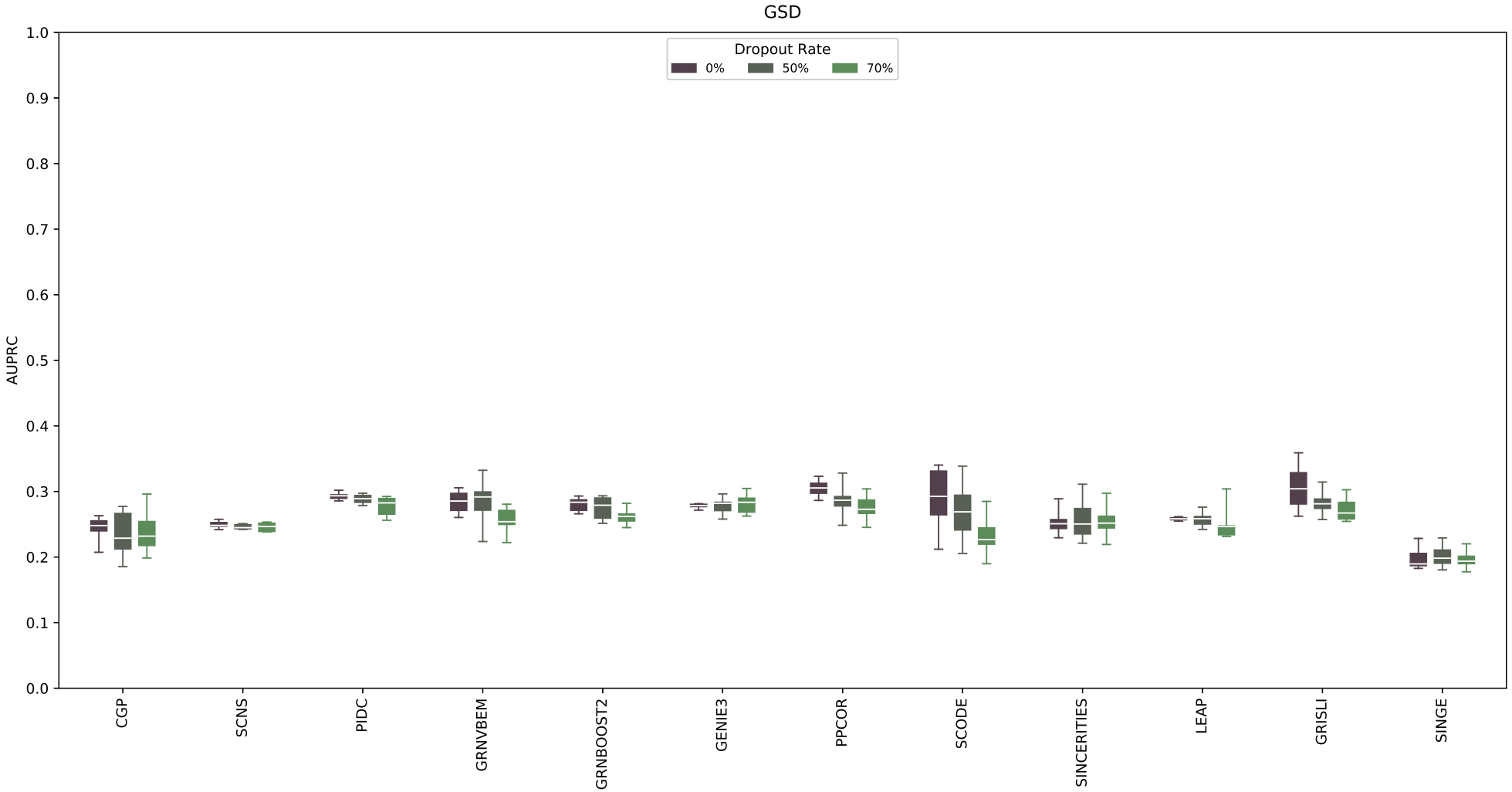


Figure 33: AUPRC boxplots considering the 12 algorithms for GSD problem.

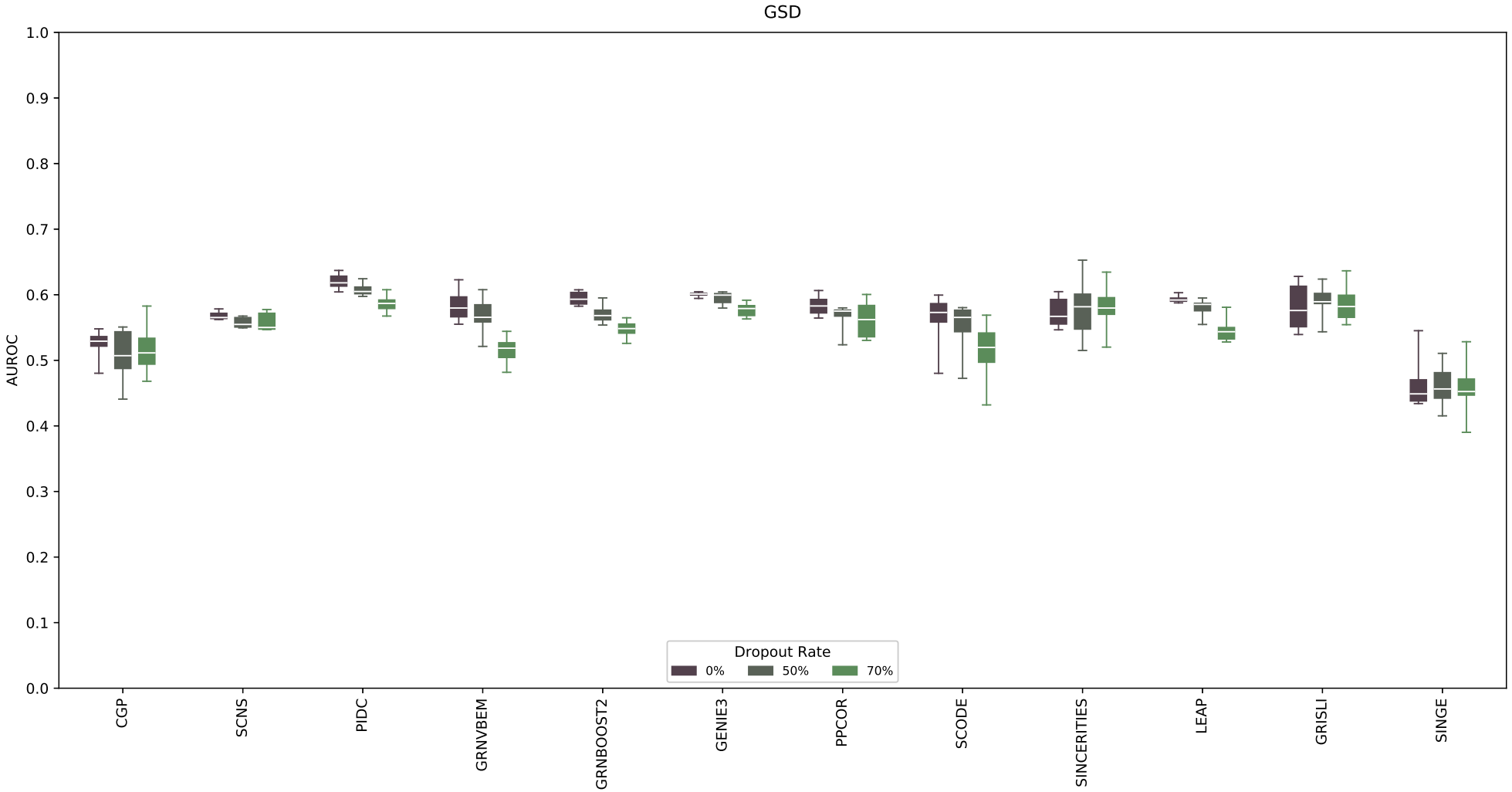


Figure 34: AUROC boxplots considering the 12 algorithms for GSD problem.

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