

The Fifth International Verification of Neural Networks Competition (VNN-COMP 2024): Summary and Results

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Abstract

This report summarizes the fifth International Verification of Neural Networks Competition (VNN-COMP 2024), held as a part of the 6th Workshop on Formal Methods for ML-Enabled Autonomous Systems (FoMLAS) that was colocated with the 35th International Conference on Computer-Aided Verification (CAV). The goal of the competition is to provide an objective comparison of the state-of-the-art methods in neural network verification, in terms of scalability and speed. Along this line, we used standard formats (ONNX for neural networks and VNNLIB for specifications), standard hardware (all tools are run by the organizers on AWS), and tool parameters provided by the tool authors. This report summarizes the rules, benchmarks, participating tools, results, and lessons learned from this competition.

1 Total Score

Table 1: Overall Score

#	Tool	Score
1	α - β -CROWN	900.0
2	PyRAT	398.5
3	nnenum	72.2
4	NeuralSAT	46.4

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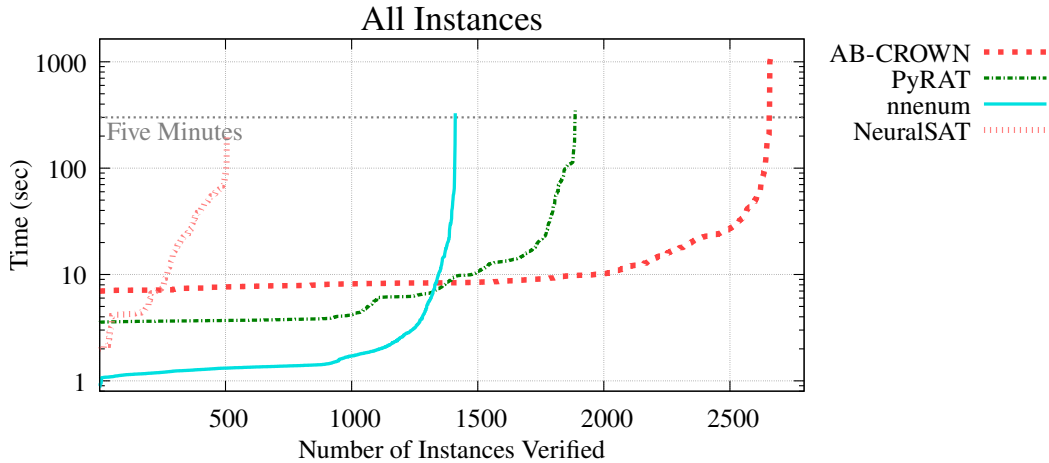


Figure 1: Cactus Plot for All Instances.

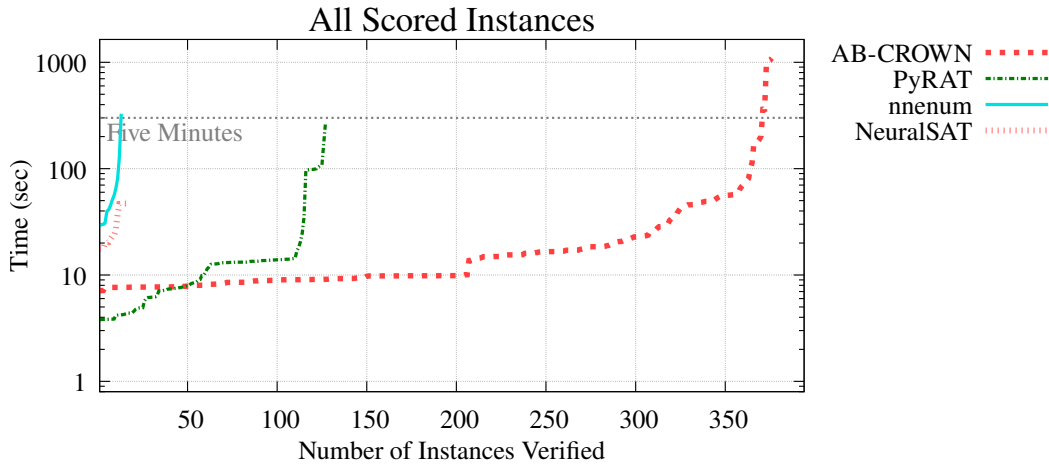


Figure 2: Cactus Plot for All Scored Instances.

2 Scored Benchmarks

Table 2: Benchmark 2024-cctsdbs-yolo-2023

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	11	28	0	0	390	100.0 100.0%
2	PyRAT	0	2	0	0	20	5.1 5.1%

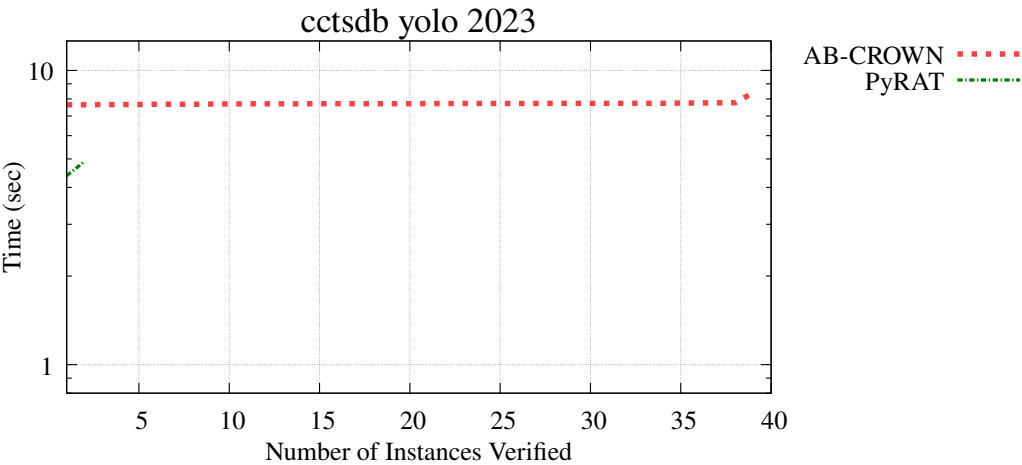


Figure 3: Cactus Plot for cctsdbs yolo 2023.

Table 3: Benchmark 2024-collins-aerospace-benchmark

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	PyRAT	0	6	0	0	60	100.0	100.0%
2	α - β -CROWN	0	6	0	0	60	100.0	100.0%

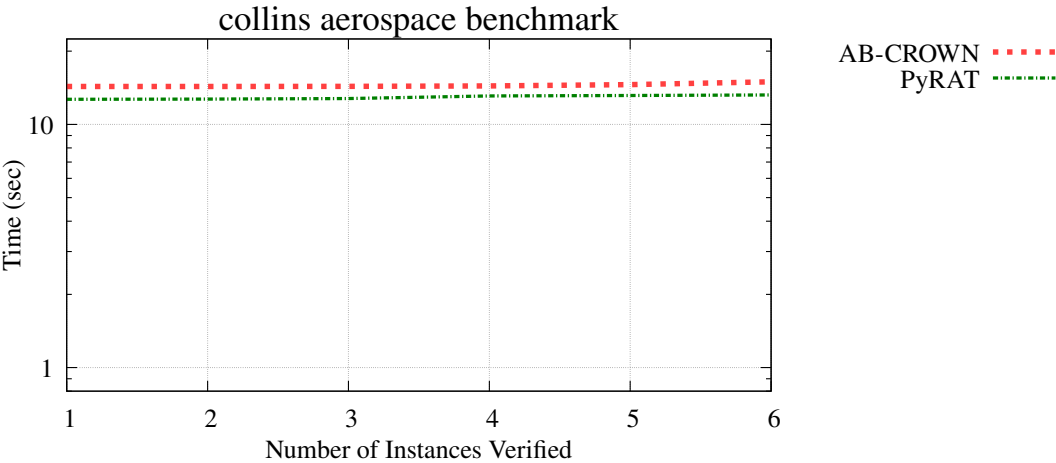


Figure 4: Cactus Plot for collins aerospace benchmark.

Table 4: Benchmark 2024-lsnc

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	40	0	0	0	400	100.0	100.0%
2	PyRAT	15	0	0	0	150	37.5	37.5%

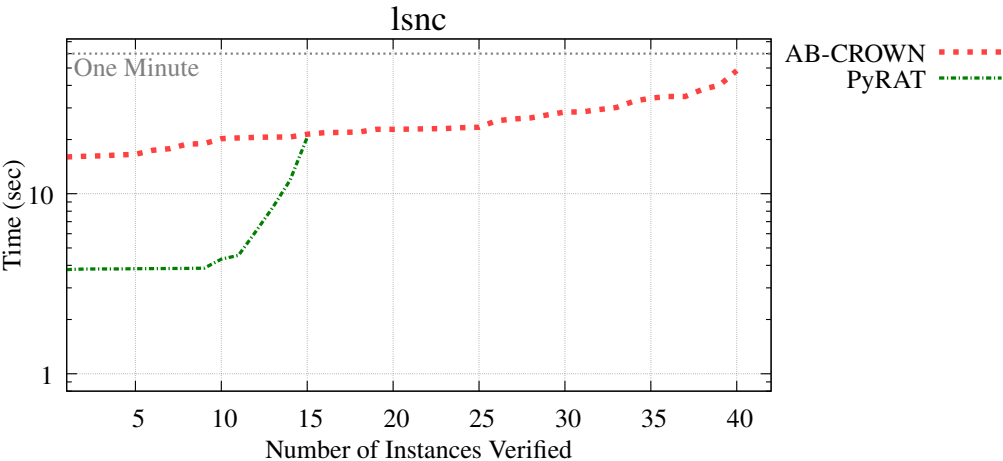


Figure 5: Cactus Plot for lsnc.

Table 5: Benchmark 2024-ml4acopf-2023

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	22	0	0	0	220	100.0 95.7%
2	PyRAT	15	0	0	0	150	68.2 65.2%

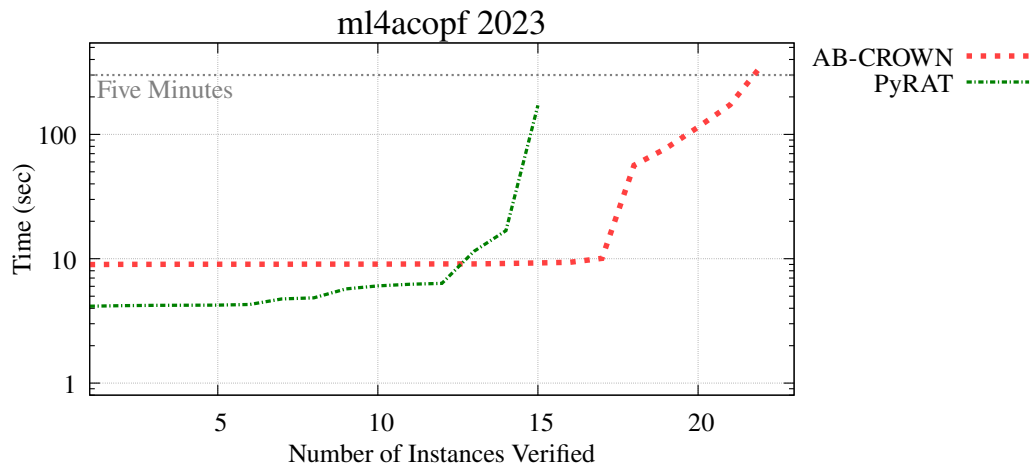


Figure 6: Cactus Plot for ml4acopf 2023.

Table 6: Benchmark 2024-ml4acopf-2024

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	59	3	0	0	620	100.0 89.9%
2	PyRAT	29	3	0	0	320	51.6 46.4%

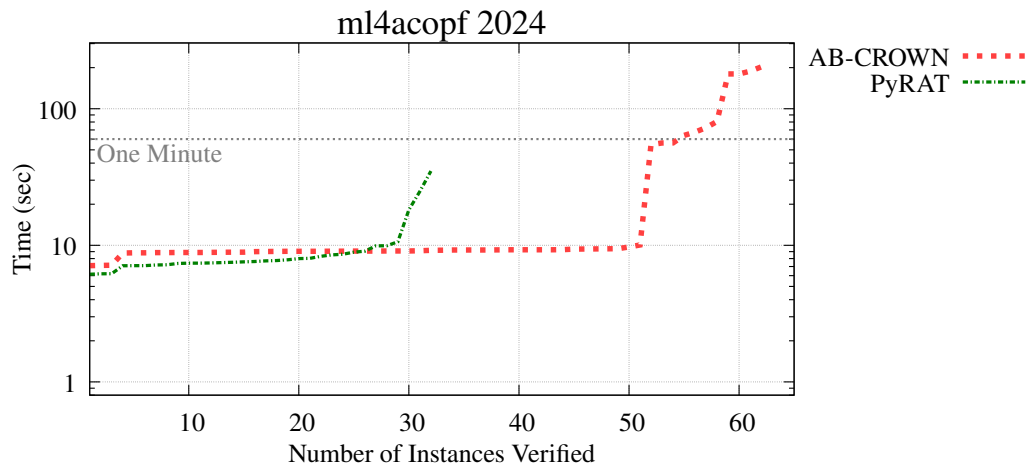


Figure 7: Cactus Plot for ml4acopf 2024.

Table 7: Benchmark 2024-traffic-signs-recognition-2023

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	0	45	0	0	450	100.0
2	PyRAT	0	4	0	0	40	8.9
3	NeuralSAT	0	0	0	11	-1650	0

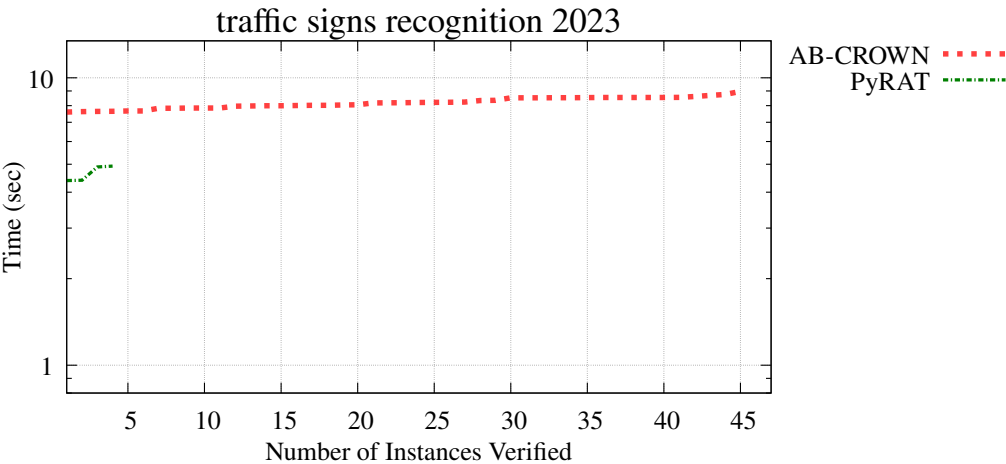


Figure 8: Cactus Plot for traffic signs recognition 2023.

Table 8: Benchmark 2024-vggnet16-2023

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	18	0	0	0	180	100.0%
2	nnenum	13	0	0	0	130	72.2%
3	PyRAT	10	0	0	0	100	55.6%
4	NeuralSAT	6	0	0	0	60	33.3%

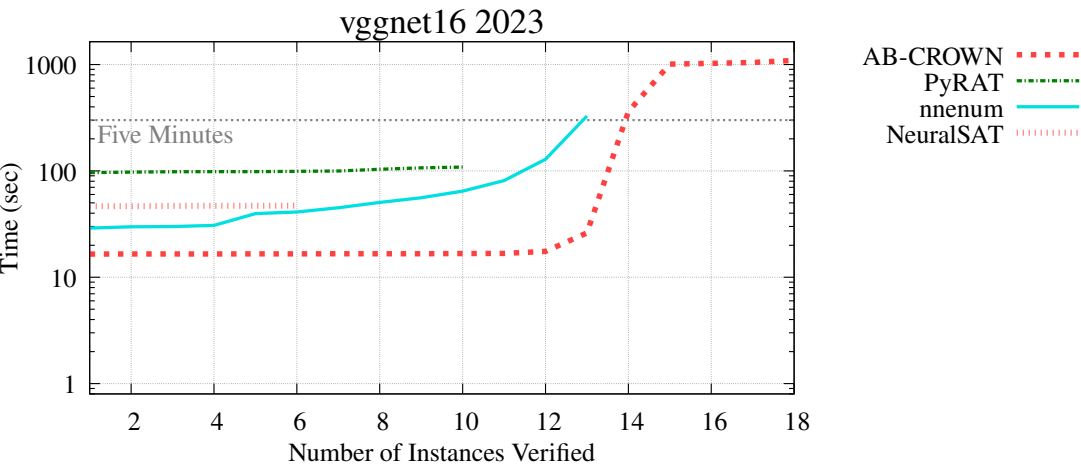


Figure 9: Cactus Plot for vggnet16 2023.

Table 9: Benchmark 2024-vit-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	84	0	0	0	840	100.0	42.0%
2	NeuralSAT	11	0	0	0	110	13.1	5.5%

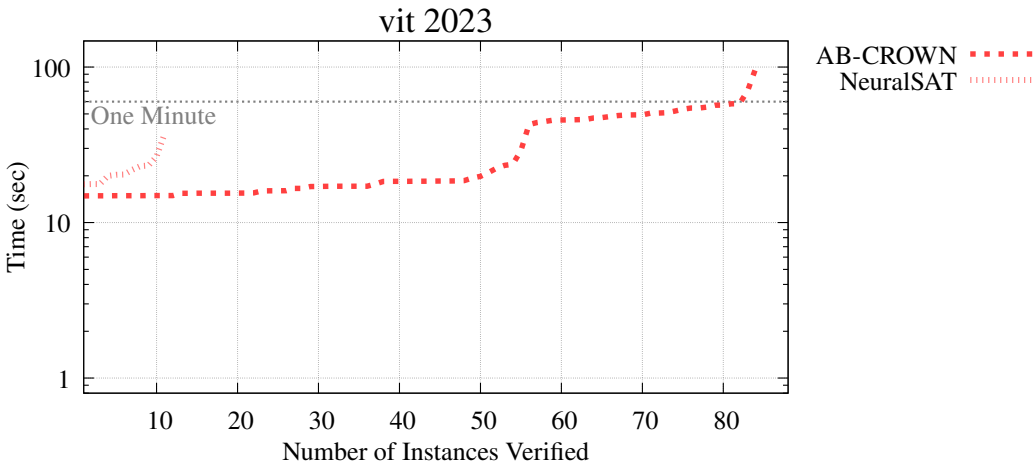


Figure 10: Cactus Plot for vit 2023.

Table 10: Benchmark 2024-yolo-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	60	0	0	0	600	100.0	83.3%
2	PyRAT	43	0	0	0	430	71.7	59.7%

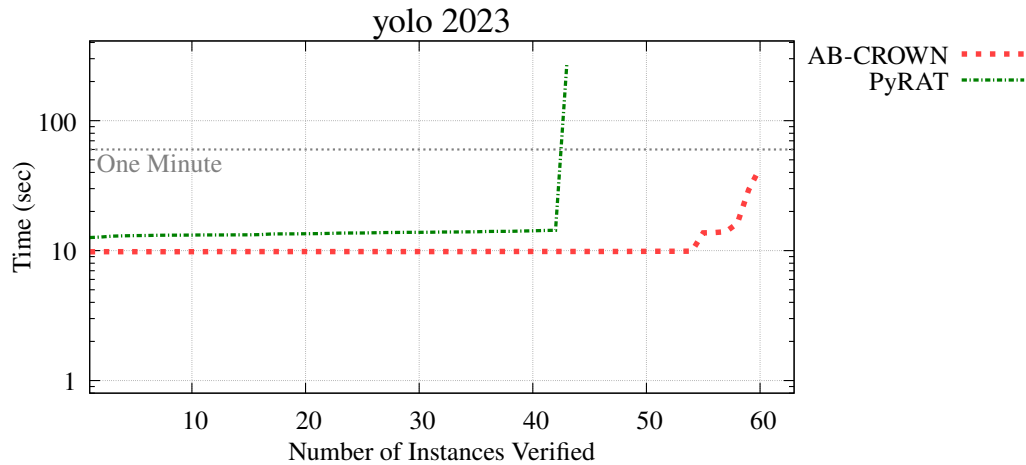


Figure 11: Cactus Plot for yolo 2023.

3 Unscoed Benchmarks

Table 11: Benchmark 2024-acasxu-2023

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	139	47	0	0	1860	100.0%
2	nnenum	139	46	0	0	1850	99.5%
3	PyRAT	137	47	0	0	1840	98.9%
4	Marabou	134	45	0	1	1640	96.2%
5	NeVer2	121	40	0	0	1610	86.6%
6	NNV	70	27	0	0	970	52.2%
7	CORA	134	7	0	36	-3990	75.8%
8	NeuralSAT	138	0	0	46	-5520	74.2%

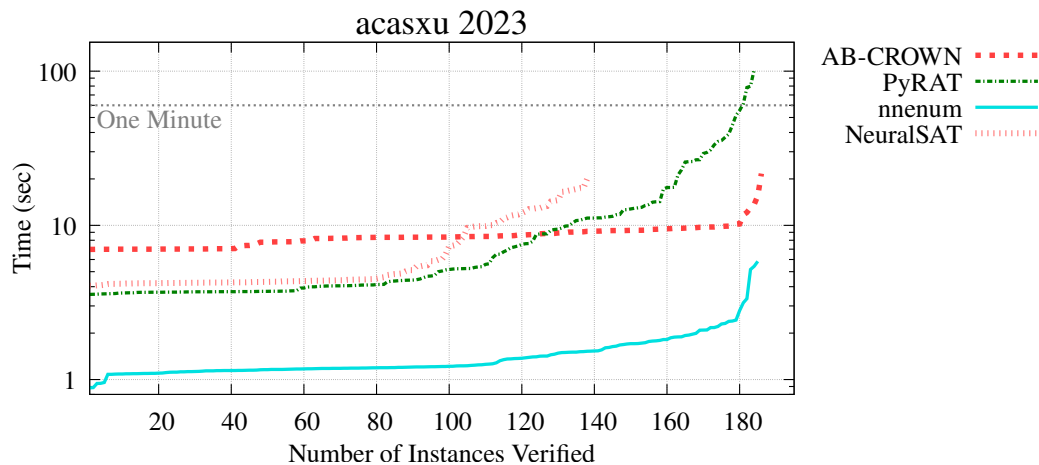


Figure 12: Cactus Plot for acasxu 2023.

Table 12: Benchmark 2024-cgan-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	PyRAT	8	13	0	0	210	100.0	100.0%
2	α - β -CROWN	8	13	0	0	210	100.0	100.0%
3	nnenum	6	11	0	0	170	81.0	81.0%
4	NNV	6	11	0	0	170	81.0	81.0%
5	Marabou	0	13	0	0	130	61.9	61.9%
6	NeuralSAT	8	0	0	11	-1570	0	38.1%

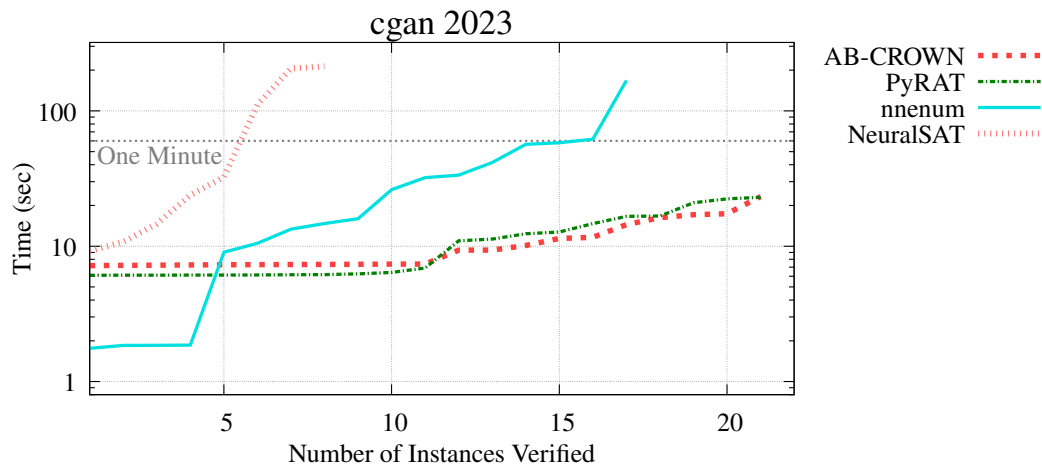


Figure 13: Cactus Plot for cgan 2023.

Table 13: Benchmark 2024-cifar100

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	117	32	0	0	1490	100.0	74.5%
2	PyRAT	67	25	0	0	920	61.7	46.0%
3	Marabou	0	30	0	0	300	20.1	15.0%
4	NeuralSAT	89	0	0	23	-2560	0	44.5%

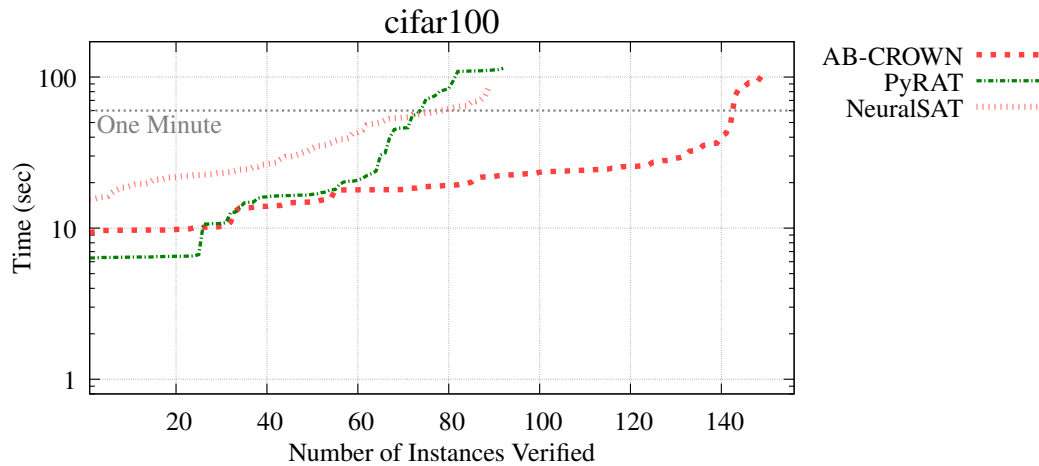


Figure 14: Cactus Plot for cifar100.

Table 14: Benchmark 2024-collins-rul-cnn-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	nnenum	30	32	0	0	620	100.0	100.0%
2	NNV	30	32	0	0	620	100.0	100.0%
3	Marabou	30	32	0	0	620	100.0	100.0%
4	α - β -CROWN	30	32	0	0	620	100.0	100.0%
5	PyRAT	30	28	0	0	580	93.5	93.5%
6	CORA	0	19	0	11	-1460	0	30.6%
7	NeuralSAT	30	0	0	32	-4500	0	48.4%

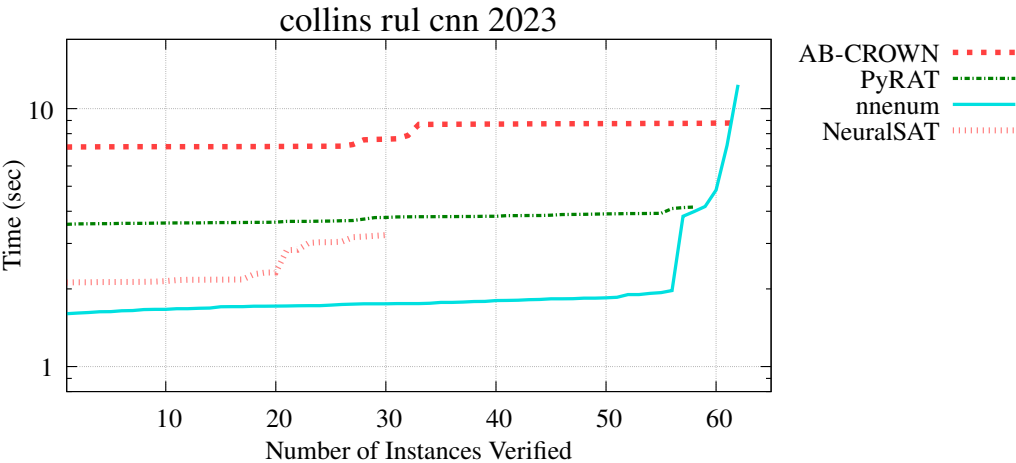


Figure 15: Cactus Plot for collins rul cnn 2023.

Table 15: Benchmark 2024-cora

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	24	134	0	0	1580	100.0	87.8%
2	Marabou	22	134	0	0	1560	98.7	86.7%
3	PyRAT	22	128	0	0	1500	94.9	83.3%
4	NNV	15	47	0	0	620	39.2	34.4%
5	NeVer2	17	11	0	0	280	17.7	15.6%
6	nenum	20	6	0	0	260	16.5	14.4%
7	CORA	21	5	0	54	-7840	0	14.4%
8	NeuralSAT	23	0	0	134	-19870	0	12.8%

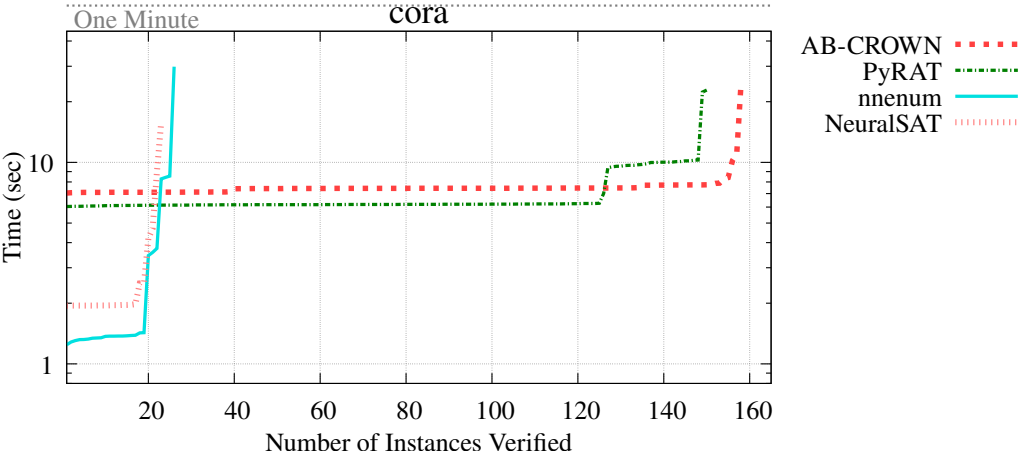


Figure 16: Cactus Plot for cora.

Table 16: Benchmark 2024-dist-shift-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	PyRAT	63	8	0	0	710	100.0	98.6%
2	CORA	63	8	0	0	710	100.0	98.6%
3	α - β -CROWN	63	8	0	0	710	100.0	98.6%
4	Marabou	62	7	0	0	690	97.2	95.8%
5	NNV	51	5	0	0	560	78.9	77.8%

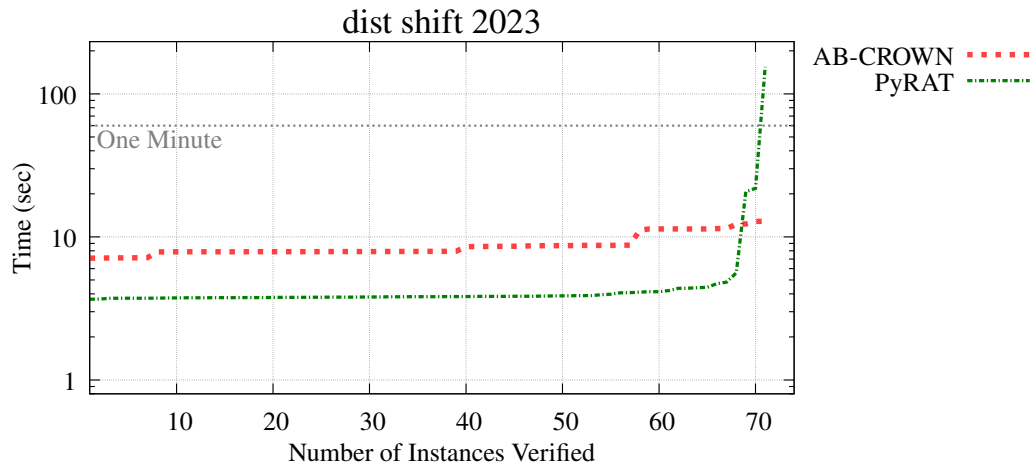


Figure 17: Cactus Plot for dist shift 2023.

Table 17: Benchmark 2024-linearizenn

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	PyRAT	59	1	0	0	600	100.0	100.0%
2	Marabou	59	1	0	0	600	100.0	100.0%
3	α - β -CROWN	59	1	0	0	600	100.0	100.0%
4	nnenum	59	0	0	1	440	73.3	98.3%

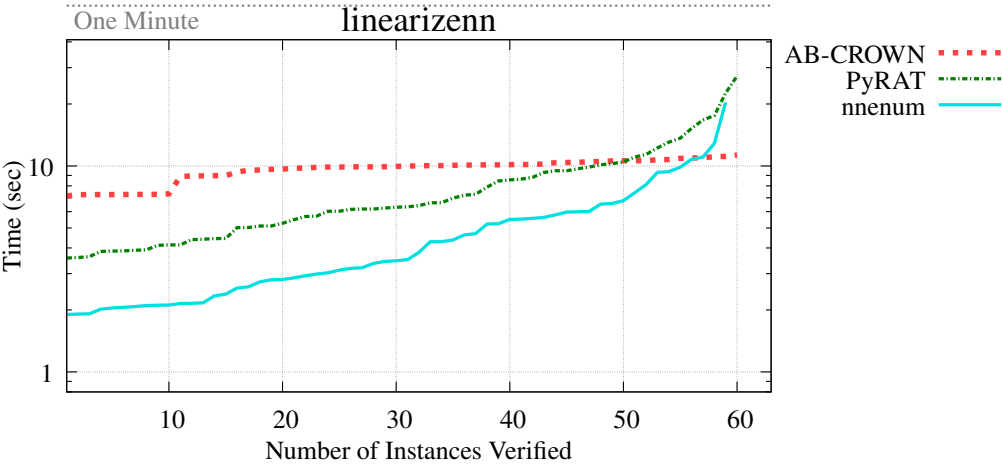


Figure 18: Cactus Plot for linearizenn.

Table 18: Benchmark 2024-metaroom-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	91	7	0	0	980	100.0	98.0%
2	PyRAT	91	6	0	0	970	99.0	97.0%
3	NNV	90	2	0	0	920	93.9	92.0%
4	Marabou	46	7	0	0	530	54.1	53.0%
5	nenum	44	2	0	0	460	46.9	46.0%
6	NeuralSAT	91	0	0	7	-140	0	91.0%

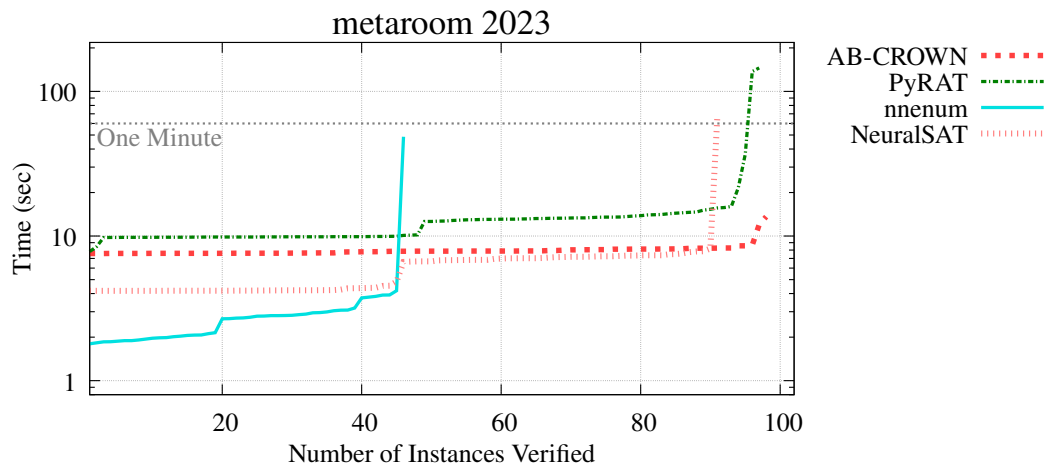


Figure 19: Cactus Plot for metaroom 2023.

Table 19: Benchmark 2024-nn4sys-2023

#	Tool	Verified	Falsified	Fastest	Penalty Points	Score	Solved
1	α - β -CROWN	194	0	0	0	1940	100.0%
2	PyRAT	53	0	0	0	530	27.3%
3	Marabou	24	0	0	0	240	12.4%
4	nnenum	22	0	0	0	220	11.3%
5	CORA	2	0	0	0	20	1.0%

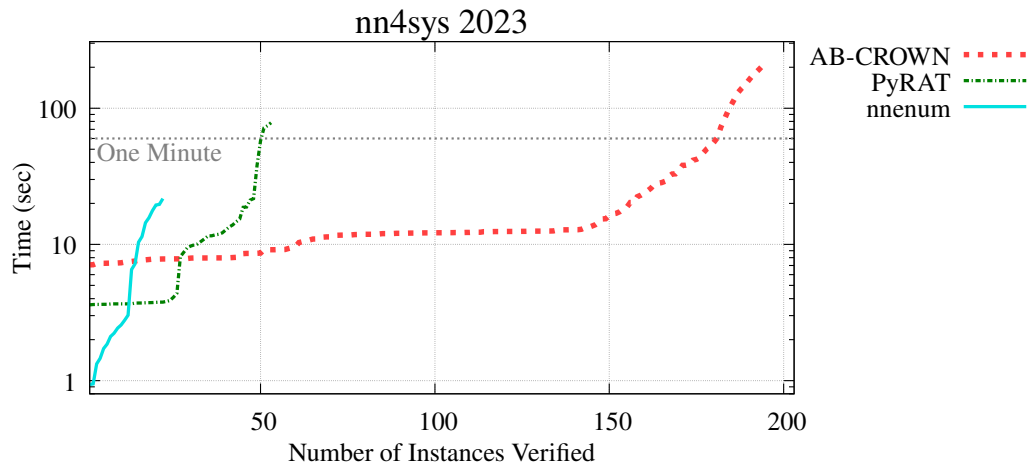


Figure 20: Cactus Plot for nn4sys 2023.

Table 20: Benchmark 2024-safenlp

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	421	659	0	0	10800	100.0	100.0%
2	nnenum	321	642	0	1	9480	87.8	89.2%
3	PyRAT	277	586	0	0	8630	79.9	79.9%
4	NeVer2	161	466	0	0	6270	58.1	58.1%
5	CORA	266	269	0	0	5350	49.5	49.5%
6	NNV	166	165	0	0	3310	30.6	30.6%
7	Marabou	300	375	0	402	-53550	0	62.5%

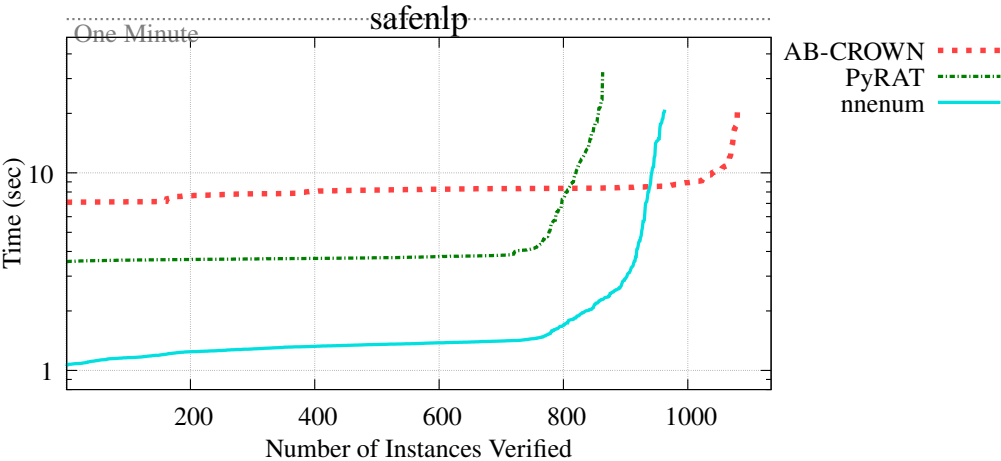


Figure 21: Cactus Plot for safenlp.

Table 21: Benchmark 2024-tinyimagenet

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	α - β -CROWN	131	43	0	0	1740	100.0	87.0%
2	PyRAT	48	31	0	0	790	45.4	39.5%
3	Marabou	0	43	0	0	430	24.7	21.5%
4	NNV	0	2	0	0	20	1.1	1.0%
5	CORA	0	2	0	0	20	1.1	1.0%
6	NeuralSAT	95	0	0	11	-700	0	47.5%

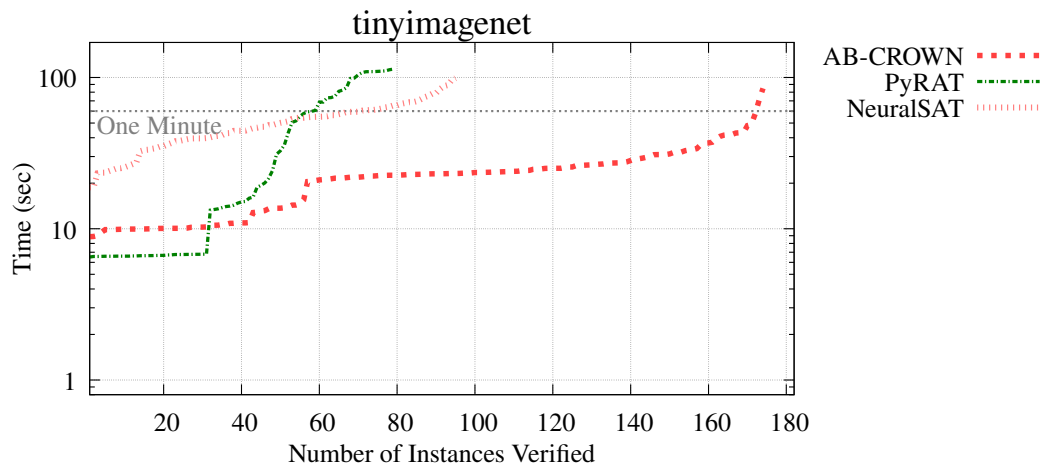


Figure 22: Cactus Plot for tinyimagenet.

Table 22: Benchmark 2024-tlverifybench-2023

#	Tool	Verified	Falsified	Fastest	Penalty	Points	Score	Solved
1	PyRAT	15	17	0	0	320	100.0	100.0%
2	NeVer2	23	9	0	0	320	100.0	100.0%
3	CORA	15	17	0	0	320	100.0	100.0%
4	α - β -CROWN	15	17	0	0	320	100.0	100.0%
5	Marabou	13	17	0	0	300	93.8	93.8%
6	nnenum	2	16	0	0	180	56.2	56.2%
7	NNV	0	17	0	0	170	53.1	53.1%
8	NeuralSAT	15	0	0	17	-2400	0	46.9%

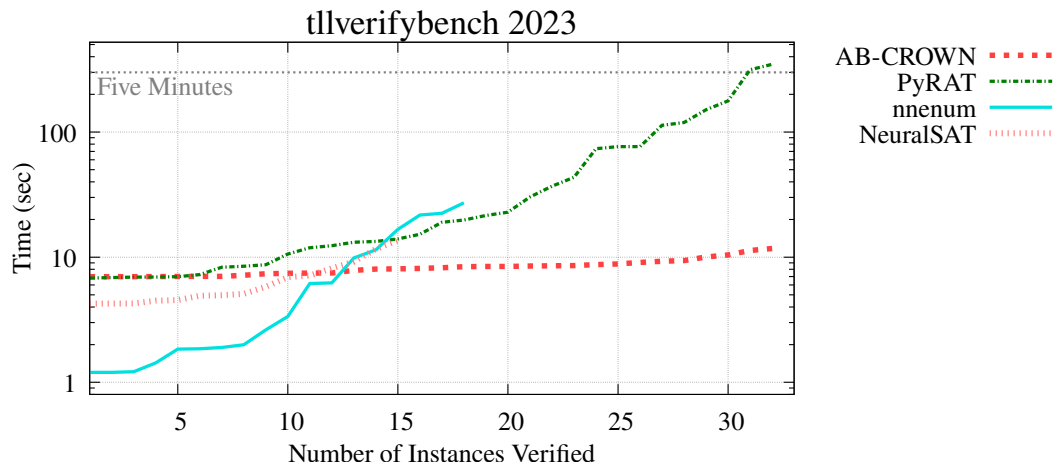


Figure 23: Cactus Plot for tlverifybench 2023.

4 Stats

Table 23: Overhead

#	Tool	Seconds
1	NeuralSAT	1.0
2	nnenum	1.3
3	PyRAT	3.6
4	α - β -CROWN	7.0
5	CORA	inf
6	Marabou	inf
7	NeVer2	inf
8	NNV	inf

Table 24: Num Benchmarks Participated

#	Tool	Count
1	α - β -CROWN	9
2	PyRAT	8
3	NeuralSAT	3
4	nnenum	1
5	NeVer2	0
6	NNV	0
7	Marabou	0
8	CORA	0

Table 25: Num Instances Verified

#	Tool	Count
1	α - β -CROWN	376
2	PyRAT	127
3	NeuralSAT	17
4	nnenum	13

Table 26: Num SAT

#	Tool	Count
1	α - β -CROWN	82
2	PyRAT	15

Table 27: Num UNSAT

#	Tool	Count
1	α - β -CROWN	294
2	PyRAT	112
3	NeuralSAT	17
4	nenum	13

Table 28: Incorrect Results (or Missing CE)

#	Tool	Count
1	NeuralSAT	11

5 Detailed Results

Table 29: Instance Runtimes. Fastest times are **blue**. Second fastest are **green**. Penalties are red crosses (✗).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Ctsdb Yolo 2023	0	UNSAT	8.39	-	-	-
2024 Ctsdb Yolo 2023	1	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	2	UNSAT	7.76	-	-	-
2024 Ctsdb Yolo 2023	3	UNSAT	7.75	-	-	-
2024 Ctsdb Yolo 2023	4	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	5	UNSAT	7.65	-	-	-
2024 Ctsdb Yolo 2023	6	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	7	UNSAT	7.64	-	-	-
2024 Ctsdb Yolo 2023	8	UNSAT	7.69	-	-	-
2024 Ctsdb Yolo 2023	9	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	10	UNSAT	7.71	-	-	-
2024 Ctsdb Yolo 2023	11	UNSAT	7.72	4.91	-	-
2024 Ctsdb Yolo 2023	12	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	13	UNSAT	7.73	-	-	-
2024 Ctsdb Yolo 2023	14	UNSAT	7.65	-	-	-
2024 Ctsdb Yolo 2023	15	UNSAT	7.73	-	-	-
2024 Ctsdb Yolo 2023	16	UNSAT	7.75	-	-	-
2024 Ctsdb Yolo 2023	17	UNSAT	7.71	-	-	-
2024 Ctsdb Yolo 2023	18	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	19	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	20	UNSAT	7.71	4.38	-	-
2024 Ctsdb Yolo 2023	21	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	22	UNSAT	7.76	-	-	-
2024 Ctsdb Yolo 2023	23	UNSAT	7.69	-	-	-
2024 Ctsdb Yolo 2023	24	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	25	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	26	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	27	UNSAT	7.67	-	-	-
2024 Ctsdb Yolo 2023	28	UNSAT	7.65	-	-	-
2024 Ctsdb Yolo 2023	29	UNSAT	7.67	-	-	-
2024 Ctsdb Yolo 2023	30	UNSAT	7.73	-	-	-
2024 Ctsdb Yolo 2023	31	UNSAT	7.70	-	-	-
2024 Ctsdb Yolo 2023	32	UNSAT	7.64	-	-	-
2024 Ctsdb Yolo 2023	33	UNSAT	7.71	-	-	-
2024 Ctsdb Yolo 2023	34	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	35	UNSAT	7.67	-	-	-
2024 Ctsdb Yolo 2023	36	UNSAT	7.72	-	-	-
2024 Ctsdb Yolo 2023	37	UNSAT	7.73	-	-	-
2024 Ctsdb Yolo 2023	38	UNSAT	7.71	-	-	-
2024 Collins Aerospace Benchmark	0	UNSAT	15.0	12.7	-	-
2024 Collins Aerospace Benchmark	1	UNSAT	14.6	12.7	-	-
2024 Collins Aerospace Benchmark	2	UNSAT	14.3	13.2	-	-
2024 Collins Aerospace Benchmark	3	UNSAT	14.3	12.8	-	-
2024 Collins Aerospace Benchmark	4	UNSAT	14.3	13.1	-	-
2024 Collins Aerospace Benchmark	5	UNSAT	14.4	13.2	-	-
2024 Lsnc	0	UNSAT	34.0	-	-	-
2024 Lsnc	1	UNSAT	20.6	-	-	-
2024 Lsnc	2	UNSAT	16.4	-	-	-
2024 Lsnc	3	UNSAT	21.9	-	-	-
2024 Lsnc	4	UNSAT	17.8	-	-	-
2024 Lsnc	5	UNSAT	16.2	-	-	-
2024 Lsnc	6	UNSAT	20.6	-	-	-
2024 Lsnc	7	UNSAT	21.4	-	-	-
2024 Lsnc	8	UNSAT	18.9	-	-	-
2024 Lsnc	9	UNSAT	16.1	-	-	-
2024 Lsnc	10	UNSAT	26.0	-	-	-
2024 Lsnc	11	UNSAT	20.2	-	-	-
2024 Lsnc	12	UNSAT	16.6	-	-	-
2024 Lsnc	13	UNSAT	17.4	-	-	-
2024 Lsnc	14	UNSAT	20.7	-	-	-
2024 Lsnc	15	UNSAT	19.0	-	-	-
2024 Lsnc	16	UNSAT	16.0	-	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (✗).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Lsnc	17	UNSAT	32.7	-	-	-
2024 Lsnc	18	UNSAT	20.4	-	-	-
2024 Lsnc	19	UNSAT	26.4	-	-	-
2024 Lsnc	20	UNSAT	30.1	20.6	-	-
2024 Lsnc	21	UNSAT	22.9	3.85	-	-
2024 Lsnc	22	UNSAT	28.5	4.55	-	-
2024 Lsnc	23	UNSAT	22.8	3.83	-	-
2024 Lsnc	24	UNSAT	23.3	3.82	-	-
2024 Lsnc	25	UNSAT	29.4	6.16	-	-
2024 Lsnc	26	UNSAT	48.3	-	-	-
2024 Lsnc	27	UNSAT	23.0	3.82	-	-
2024 Lsnc	28	UNSAT	34.7	-	-	-
2024 Lsnc	29	UNSAT	40.1	-	-	-
2024 Lsnc	30	UNSAT	21.8	3.84	-	-
2024 Lsnc	31	UNSAT	38.0	-	-	-
2024 Lsnc	32	UNSAT	22.0	3.84	-	-
2024 Lsnc	33	UNSAT	23.0	3.79	-	-
2024 Lsnc	34	UNSAT	25.4	11.9	-	-
2024 Lsnc	35	UNSAT	22.8	3.86	-	-
2024 Lsnc	36	UNSAT	23.4	3.82	-	-
2024 Lsnc	37	UNSAT	27.4	8.41	-	-
2024 Lsnc	38	UNSAT	28.4	4.33	-	-
2024 Lsnc	39	UNSAT	34.7	-	-	-
2024 Ml4acopf 2023	0	UNSAT	77.2	-	-	-
2024 Ml4acopf 2023	1	UNSAT	56.4	6.23	-	-
2024 Ml4acopf 2023	2	UNSAT	114	6.06	-	-
2024 Ml4acopf 2023	3	UNSAT	9.08	-	-	-
2024 Ml4acopf 2023	4	UNSAT	9.08	4.76	-	-
2024 Ml4acopf 2023	5	UNSAT	9.02	-	-	-
2024 Ml4acopf 2023	6	UNSAT	9.01	-	-	-
2024 Ml4acopf 2023	7	UNSAT	9.26	4.15	-	-
2024 Ml4acopf 2023	8	UNSAT	9.03	171	-	-
2024 Ml4acopf 2023	9	UNSAT	8.98	4.28	-	-
2024 Ml4acopf 2023	10	UNSAT	9.03	5.72	-	-
2024 Ml4acopf 2023	11	UNSAT	9.05	4.20	-	-
2024 Ml4acopf 2023	12	UNSAT	9.06	4.85	-	-
2024 Ml4acopf 2023	13	UNSAT	9.03	4.22	-	-
2024 Ml4acopf 2023	14	UNSAT	9.16	-	-	-
2024 Ml4acopf 2023	15	UNSAT	10.1	4.24	-	-
2024 Ml4acopf 2023	16	UNSAT	9.07	-	-	-
2024 Ml4acopf 2023	17	UNSAT	9.04	4.22	-	-
2024 Ml4acopf 2023	18	UNSAT	9.05	-	-	-
2024 Ml4acopf 2023	19	UNSAT	362	11.4	-	-
2024 Ml4acopf 2023	20	UNSAT	9.37	6.34	-	-
2024 Ml4acopf 2023	21	?	-	-	-	-
2024 Ml4acopf 2023	22	UNSAT	173	16.8	-	-
2024 Ml4acopf 2024	0	UNSAT	9.27	-	-	-
2024 Ml4acopf 2024	1	UNSAT	9.28	-	-	-
2024 Ml4acopf 2024	2	UNSAT	9.42	9.91	-	-
2024 Ml4acopf 2024	3	UNSAT	9.24	-	-	-
2024 Ml4acopf 2024	4	UNSAT	9.13	9.94	-	-
2024 Ml4acopf 2024	5	UNSAT	9.28	18.2	-	-
2024 Ml4acopf 2024	6	UNSAT	9.25	7.48	-	-
2024 Ml4acopf 2024	7	UNSAT	9.24	8.90	-	-
2024 Ml4acopf 2024	8	UNSAT	9.27	7.41	-	-
2024 Ml4acopf 2024	9	UNSAT	7.13	6.18	-	-
2024 Ml4acopf 2024	10	UNSAT	9.38	-	-	-
2024 Ml4acopf 2024	11	UNSAT	9.25	-	-	-
2024 Ml4acopf 2024	12	UNSAT	9.28	7.43	-	-
2024 Ml4acopf 2024	13	UNSAT	9.29	-	-	-
2024 Ml4acopf 2024	14	UNSAT	80.7	-	-	-
2024 Ml4acopf 2024	15	UNSAT	56.1	8.31	-	-
2024 Ml4acopf 2024	16	?	-	-	-	-
2024 Ml4acopf 2024	17	UNSAT	9.19	-	-	-
2024 Ml4acopf 2024	18	UNSAT	9.09	7.36	-	-
2024 Ml4acopf 2024	19	UNSAT	180	-	-	-
2024 Ml4acopf 2024	20	UNSAT	9.21	7.84	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (X).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Ml4acopf 2024	21	?	-	-	-	-
2024 Ml4acopf 2024	22	UNSAT	180	-	-	-
2024 Ml4acopf 2024	23	UNSAT	8.90	-	-	-
2024 Ml4acopf 2024	24	UNSAT	8.86	-	-	-
2024 Ml4acopf 2024	25	UNSAT	8.99	8.51	-	-
2024 Ml4acopf 2024	26	UNSAT	8.81	-	-	-
2024 Ml4acopf 2024	27	UNSAT	8.79	8.60	-	-
2024 Ml4acopf 2024	28	UNSAT	8.90	35.0	-	-
2024 Ml4acopf 2024	29	UNSAT	8.84	7.17	-	-
2024 Ml4acopf 2024	30	UNSAT	8.86	24.9	-	-
2024 Ml4acopf 2024	31	UNSAT	8.87	10.6	-	-
2024 Ml4acopf 2024	32	UNSAT	7.09	6.14	-	-
2024 Ml4acopf 2024	33	UNSAT	9.04	-	-	-
2024 Ml4acopf 2024	34	UNSAT	8.86	-	-	-
2024 Ml4acopf 2024	35	UNSAT	8.84	7.21	-	-
2024 Ml4acopf 2024	36	UNSAT	8.81	-	-	-
2024 Ml4acopf 2024	37	UNSAT	63.8	-	-	-
2024 Ml4acopf 2024	38	UNSAT	54.6	-	-	-
2024 Ml4acopf 2024	39	UNSAT	67.5	-	-	-
2024 Ml4acopf 2024	40	UNSAT	7.15	6.20	-	-
2024 Ml4acopf 2024	41	UNSAT	8.91	7.40	-	-
2024 Ml4acopf 2024	42	UNSAT	9.03	-	-	-
2024 Ml4acopf 2024	43	UNSAT	9.08	-	-	-
2024 Ml4acopf 2024	44	UNSAT	9.24	7.62	-	-
2024 Ml4acopf 2024	45	UNSAT	9.09	-	-	-
2024 Ml4acopf 2024	46	UNSAT	9.05	7.69	-	-
2024 Ml4acopf 2024	47	UNSAT	9.04	8.03	-	-
2024 Ml4acopf 2024	48	UNSAT	9.04	7.10	-	-
2024 Ml4acopf 2024	49	UNSAT	9.09	8.00	-	-
2024 Ml4acopf 2024	50	UNSAT	9.06	7.09	-	-
2024 Ml4acopf 2024	51	UNSAT	9.05	-	-	-
2024 Ml4acopf 2024	52	UNSAT	10.1	7.74	-	-
2024 Ml4acopf 2024	53	UNSAT	9.08	-	-	-
2024 Ml4acopf 2024	54	UNSAT	9.02	7.09	-	-
2024 Ml4acopf 2024	55	UNSAT	9.07	-	-	-
2024 Ml4acopf 2024	56	UNSAT	202	-	-	-
2024 Ml4acopf 2024	57	UNSAT	9.73	7.58	-	-
2024 Ml4acopf 2024	58	?	-	-	-	-
2024 Ml4acopf 2024	59	UNSAT	188	-	-	-
2024 Ml4acopf 2024	60	?	-	-	-	-
2024 Ml4acopf 2024	61	UNSAT	56.2	-	-	-
2024 Ml4acopf 2024	62	UNSAT	72.7	-	-	-
2024 Ml4acopf 2024	63	UNSAT	9.44	-	-	-
2024 Ml4acopf 2024	64	UNSAT	9.43	9.06	-	-
2024 Ml4acopf 2024	65	?	-	-	-	-
2024 Ml4acopf 2024	66	UNSAT	9.39	7.51	-	-
2024 Ml4acopf 2024	67	?	-	-	-	-
2024 Ml4acopf 2024	68	?	-	-	-	-
2024 Traffic Signs Recognition 2023 0	UNSAT	8.02	-	-	-	-
2024 Traffic Signs Recognition 2023 1	UNSAT	8.06	-	-	-	-
2024 Traffic Signs Recognition 2023 2	UNSAT	7.96	-	-	-	-
2024 Traffic Signs Recognition 2023 3	UNSAT	7.98	-	-	-	-
2024 Traffic Signs Recognition 2023 4	UNSAT	7.66	4.39	-	-	X
2024 Traffic Signs Recognition 2023 5	UNSAT	7.99	-	-	-	X
2024 Traffic Signs Recognition 2023 6	UNSAT	7.64	-	-	-	-
2024 Traffic Signs Recognition 2023 7	UNSAT	7.62	-	-	-	X
2024 Traffic Signs Recognition 2023 8	UNSAT	7.60	-	-	-	X
2024 Traffic Signs Recognition 2023 9	UNSAT	7.64	4.40	-	-	X
2024 Traffic Signs Recognition 2023 10	UNSAT	8.02	-	-	-	-
2024 Traffic Signs Recognition 2023 11	UNSAT	8.00	-	-	-	-
2024 Traffic Signs Recognition 2023 12	UNSAT	7.99	-	-	-	-
2024 Traffic Signs Recognition 2023 13	UNSAT	8.04	-	-	-	-
2024 Traffic Signs Recognition 2023 14	UNSAT	7.66	-	-	-	X
2024 Traffic Signs Recognition 2023 15	UNSAT	8.75	-	-	-	-
2024 Traffic Signs Recognition 2023 16	UNSAT	8.35	-	-	-	-
2024 Traffic Signs Recognition 2023 17	UNSAT	8.24	-	-	-	-
2024 Traffic Signs Recognition 2023 18	UNSAT	8.19	-	-	-	-
2024 Traffic Signs Recognition 2023 19	UNSAT	8.18	-	-	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (X).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Traffic Signs Recognition 2023 20	UNSAT	8.33	-	-	-	-
2024 Traffic Signs Recognition 2023 21	UNSAT	8.21	-	-	-	-
2024 Traffic Signs Recognition 2023 22	UNSAT	8.21	-	-	-	-
2024 Traffic Signs Recognition 2023 23	UNSAT	8.22	-	-	-	-
2024 Traffic Signs Recognition 2023 24	UNSAT	7.83	-	-	-	X
2024 Traffic Signs Recognition 2023 25	UNSAT	8.19	-	-	-	-
2024 Traffic Signs Recognition 2023 26	UNSAT	7.85	4.93	-	-	X
2024 Traffic Signs Recognition 2023 27	UNSAT	7.85	-	-	-	X
2024 Traffic Signs Recognition 2023 28	UNSAT	7.85	-	-	-	X
2024 Traffic Signs Recognition 2023 29	UNSAT	7.84	4.90	-	-	X
2024 Traffic Signs Recognition 2023 30	UNSAT	8.96	-	-	-	-
2024 Traffic Signs Recognition 2023 31	UNSAT	8.61	-	-	-	-
2024 Traffic Signs Recognition 2023 32	UNSAT	8.53	-	-	-	-
2024 Traffic Signs Recognition 2023 33	UNSAT	8.52	-	-	-	-
2024 Traffic Signs Recognition 2023 34	UNSAT	8.54	-	-	-	-
2024 Traffic Signs Recognition 2023 35	UNSAT	8.68	-	-	-	-
2024 Traffic Signs Recognition 2023 36	UNSAT	8.53	-	-	-	-
2024 Traffic Signs Recognition 2023 37	UNSAT	8.54	-	-	-	-
2024 Traffic Signs Recognition 2023 38	UNSAT	8.52	-	-	-	-
2024 Traffic Signs Recognition 2023 39	UNSAT	8.52	-	-	-	-
2024 Traffic Signs Recognition 2023 40	UNSAT	8.51	-	-	-	-
2024 Traffic Signs Recognition 2023 41	UNSAT	8.55	-	-	-	-
2024 Traffic Signs Recognition 2023 42	UNSAT	8.54	-	-	-	-
2024 Traffic Signs Recognition 2023 43	UNSAT	8.54	-	-	-	-
2024 Traffic Signs Recognition 2023 44	UNSAT	8.54	-	-	-	-
2024 Vggnet16 2023	0	UNSAT	16.5	99.1	29.0	47.0
2024 Vggnet16 2023	1	UNSAT	16.5	96.2	29.8	46.5
2024 Vggnet16 2023	2	UNSAT	16.6	98.4	30.8	-
2024 Vggnet16 2023	3	UNSAT	16.6	97.4	29.9	47.0
2024 Vggnet16 2023	4	UNSAT	16.6	99.8	45.0	46.5
2024 Vggnet16 2023	5	UNSAT	16.6	107	55.9	-
2024 Vggnet16 2023	6	UNSAT	16.6	98.4	39.6	47.1
2024 Vggnet16 2023	7	UNSAT	16.7	104	50.5	-
2024 Vggnet16 2023	8	UNSAT	16.7	-	81.1	-
2024 Vggnet16 2023	9	UNSAT	16.6	98.2	41.1	46.8
2024 Vggnet16 2023	10	UNSAT	16.6	109	64.5	-
2024 Vggnet16 2023	11	UNSAT	17.5	-	129	-
2024 Vggnet16 2023	12	UNSAT	361	-	-	-
2024 Vggnet16 2023	13	UNSAT	26.1	-	328	-
2024 Vggnet16 2023	14	UNSAT	1024	-	-	-
2024 Vggnet16 2023	15	UNSAT	1009	-	-	-
2024 Vggnet16 2023	16	UNSAT	1046	-	-	-
2024 Vggnet16 2023	17	UNSAT	1092	-	-	-
2024 Vit 2023	0	UNSAT	16.0	-	-	-
2024 Vit 2023	1	UNSAT	17.1	-	-	-
2024 Vit 2023	2	UNSAT	16.0	-	-	-
2024 Vit 2023	3	?	-	-	-	-
2024 Vit 2023	4	?	-	-	-	-
2024 Vit 2023	5	?	-	-	-	-
2024 Vit 2023	6	UNSAT	15.5	-	-	23.1
2024 Vit 2023	7	?	-	-	-	-
2024 Vit 2023	8	?	-	-	-	-
2024 Vit 2023	9	?	-	-	-	-
2024 Vit 2023	10	?	-	-	-	-
2024 Vit 2023	11	UNSAT	14.9	-	-	17.7
2024 Vit 2023	12	UNSAT	16.6	-	-	-
2024 Vit 2023	13	UNSAT	14.9	-	-	17.7
2024 Vit 2023	14	?	-	-	-	-
2024 Vit 2023	15	?	-	-	-	-
2024 Vit 2023	16	?	-	-	-	-
2024 Vit 2023	17	UNSAT	29.1	-	-	-
2024 Vit 2023	18	?	-	-	-	-
2024 Vit 2023	19	UNSAT	14.9	-	-	-
2024 Vit 2023	20	UNSAT	48.1	-	-	-
2024 Vit 2023	21	UNSAT	54.6	-	-	26.6
2024 Vit 2023	22	?	-	-	-	-
2024 Vit 2023	23	?	-	-	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (X).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Vit 2023	24	UNSAT	14.9	-	-	17.6
2024 Vit 2023	25	?	-	-	-	-
2024 Vit 2023	26	?	-	-	-	-
2024 Vit 2023	27	?	-	-	-	-
2024 Vit 2023	28	?	-	-	-	-
2024 Vit 2023	29	?	-	-	-	-
2024 Vit 2023	30	UNSAT	44.0	-	-	-
2024 Vit 2023	31	UNSAT	14.9	-	-	-
2024 Vit 2023	32	UNSAT	15.5	-	-	-
2024 Vit 2023	33	UNSAT	15.5	-	-	21.8
2024 Vit 2023	34	UNSAT	57.0	-	-	-
2024 Vit 2023	35	?	-	-	-	-
2024 Vit 2023	36	?	-	-	-	-
2024 Vit 2023	37	?	-	-	-	-
2024 Vit 2023	38	UNSAT	47.1	-	-	-
2024 Vit 2023	39	?	-	-	-	-
2024 Vit 2023	40	UNSAT	15.5	-	-	-
2024 Vit 2023	41	UNSAT	21.0	-	-	-
2024 Vit 2023	42	?	-	-	-	-
2024 Vit 2023	43	?	-	-	-	-
2024 Vit 2023	44	?	-	-	-	-
2024 Vit 2023	45	?	-	-	-	-
2024 Vit 2023	46	UNSAT	14.9	-	-	-
2024 Vit 2023	47	?	-	-	-	-
2024 Vit 2023	48	?	-	-	-	-
2024 Vit 2023	49	?	-	-	-	-
2024 Vit 2023	50	UNSAT	14.9	-	-	-
2024 Vit 2023	51	?	-	-	-	-
2024 Vit 2023	52	UNSAT	48.8	-	-	-
2024 Vit 2023	53	?	-	-	-	-
2024 Vit 2023	54	UNSAT	15.5	-	-	-
2024 Vit 2023	55	?	-	-	-	-
2024 Vit 2023	56	UNSAT	14.9	-	-	-
2024 Vit 2023	57	?	-	-	-	-
2024 Vit 2023	58	UNSAT	15.5	-	-	20.3
2024 Vit 2023	59	?	-	-	-	-
2024 Vit 2023	60	?	-	-	-	-
2024 Vit 2023	61	?	-	-	-	-
2024 Vit 2023	62	?	-	-	-	-
2024 Vit 2023	63	UNSAT	15.4	-	-	-
2024 Vit 2023	64	UNSAT	16.0	-	-	20.0
2024 Vit 2023	65	UNSAT	15.4	-	-	-
2024 Vit 2023	66	?	-	-	-	-
2024 Vit 2023	67	?	-	-	-	-
2024 Vit 2023	68	?	-	-	-	-
2024 Vit 2023	69	?	-	-	-	-
2024 Vit 2023	70	?	-	-	-	-
2024 Vit 2023	71	UNSAT	15.5	-	-	-
2024 Vit 2023	72	?	-	-	-	-
2024 Vit 2023	73	UNSAT	16.6	-	-	-
2024 Vit 2023	74	UNSAT	42.7	-	-	37.4
2024 Vit 2023	75	UNSAT	15.5	-	-	-
2024 Vit 2023	76	?	-	-	-	-
2024 Vit 2023	77	UNSAT	16.0	-	-	23.3
2024 Vit 2023	78	UNSAT	14.9	-	-	-
2024 Vit 2023	79	?	-	-	-	-
2024 Vit 2023	80	UNSAT	17.7	-	-	-
2024 Vit 2023	81	UNSAT	14.9	-	-	20.4
2024 Vit 2023	82	?	-	-	-	-
2024 Vit 2023	83	?	-	-	-	-
2024 Vit 2023	84	?	-	-	-	-
2024 Vit 2023	85	UNSAT	19.3	-	-	-
2024 Vit 2023	86	?	-	-	-	-
2024 Vit 2023	87	UNSAT	23.4	-	-	-
2024 Vit 2023	88	?	-	-	-	-
2024 Vit 2023	89	UNSAT	14.9	-	-	-
2024 Vit 2023	90	?	-	-	-	-
2024 Vit 2023	91	UNSAT	14.9	-	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (X).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Vit 2023	92	?	-	-	-	-
2024 Vit 2023	93	UNSAT	44.7	-	-	-
2024 Vit 2023	94	?	-	-	-	-
2024 Vit 2023	95	?	-	-	-	-
2024 Vit 2023	96	?	-	-	-	-
2024 Vit 2023	97	?	-	-	-	-
2024 Vit 2023	98	?	-	-	-	-
2024 Vit 2023	99	?	-	-	-	-
2024 Vit 2023	100	?	-	-	-	-
2024 Vit 2023	101	?	-	-	-	-
2024 Vit 2023	102	?	-	-	-	-
2024 Vit 2023	103	UNSAT	50.5	-	-	-
2024 Vit 2023	104	?	-	-	-	-
2024 Vit 2023	105	?	-	-	-	-
2024 Vit 2023	106	UNSAT	17.1	-	-	-
2024 Vit 2023	107	?	-	-	-	-
2024 Vit 2023	108	?	-	-	-	-
2024 Vit 2023	109	?	-	-	-	-
2024 Vit 2023	110	?	-	-	-	-
2024 Vit 2023	111	?	-	-	-	-
2024 Vit 2023	112	?	-	-	-	-
2024 Vit 2023	113	UNSAT	54.6	-	-	-
2024 Vit 2023	114	?	-	-	-	-
2024 Vit 2023	115	?	-	-	-	-
2024 Vit 2023	116	UNSAT	19.8	-	-	-
2024 Vit 2023	117	UNSAT	18.5	-	-	-
2024 Vit 2023	118	?	-	-	-	-
2024 Vit 2023	119	?	-	-	-	-
2024 Vit 2023	120	UNSAT	18.5	-	-	-
2024 Vit 2023	121	UNSAT	45.8	-	-	-
2024 Vit 2023	122	UNSAT	50.9	-	-	-
2024 Vit 2023	123	?	-	-	-	-
2024 Vit 2023	124	UNSAT	18.6	-	-	-
2024 Vit 2023	125	?	-	-	-	-
2024 Vit 2023	126	?	-	-	-	-
2024 Vit 2023	127	?	-	-	-	-
2024 Vit 2023	128	?	-	-	-	-
2024 Vit 2023	129	?	-	-	-	-
2024 Vit 2023	130	?	-	-	-	-
2024 Vit 2023	131	?	-	-	-	-
2024 Vit 2023	132	UNSAT	50.7	-	-	-
2024 Vit 2023	133	UNSAT	18.4	-	-	-
2024 Vit 2023	134	UNSAT	18.5	-	-	-
2024 Vit 2023	135	UNSAT	98.2	-	-	-
2024 Vit 2023	136	?	-	-	-	-
2024 Vit 2023	137	?	-	-	-	-
2024 Vit 2023	138	UNSAT	47.3	-	-	-
2024 Vit 2023	139	?	-	-	-	-
2024 Vit 2023	140	?	-	-	-	-
2024 Vit 2023	141	UNSAT	17.1	-	-	-
2024 Vit 2023	142	?	-	-	-	-
2024 Vit 2023	143	?	-	-	-	-
2024 Vit 2023	144	?	-	-	-	-
2024 Vit 2023	145	?	-	-	-	-
2024 Vit 2023	146	UNSAT	49.3	-	-	-
2024 Vit 2023	147	UNSAT	58.0	-	-	-
2024 Vit 2023	148	UNSAT	17.1	-	-	-
2024 Vit 2023	149	UNSAT	53.6	-	-	-
2024 Vit 2023	150	UNSAT	49.2	-	-	-
2024 Vit 2023	151	UNSAT	45.7	-	-	-
2024 Vit 2023	152	?	-	-	-	-
2024 Vit 2023	153	?	-	-	-	-
2024 Vit 2023	154	UNSAT	70.5	-	-	-
2024 Vit 2023	155	?	-	-	-	-
2024 Vit 2023	156	?	-	-	-	-
2024 Vit 2023	157	UNSAT	49.2	-	-	-
2024 Vit 2023	158	?	-	-	-	-
2024 Vit 2023	159	?	-	-	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (✗).

Category	Id	Result	α - β -C	PyRAT	NNen	NSAT
2024 Vit 2023	160	?	-	-	-	-
2024 Vit 2023	161	?	-	-	-	-
2024 Vit 2023	162	?	-	-	-	-
2024 Vit 2023	163	UNSAT	46.1	-	-	-
2024 Vit 2023	164	UNSAT	17.1	-	-	-
2024 Vit 2023	165	?	-	-	-	-
2024 Vit 2023	166	UNSAT	17.1	-	-	-
2024 Vit 2023	167	?	-	-	-	-
2024 Vit 2023	168	?	-	-	-	-
2024 Vit 2023	169	?	-	-	-	-
2024 Vit 2023	170	?	-	-	-	-
2024 Vit 2023	171	?	-	-	-	-
2024 Vit 2023	172	?	-	-	-	-
2024 Vit 2023	173	UNSAT	22.4	-	-	-
2024 Vit 2023	174	?	-	-	-	-
2024 Vit 2023	175	UNSAT	18.4	-	-	-
2024 Vit 2023	176	UNSAT	18.5	-	-	-
2024 Vit 2023	177	?	-	-	-	-
2024 Vit 2023	178	UNSAT	18.5	-	-	-
2024 Vit 2023	179	?	-	-	-	-
2024 Vit 2023	180	UNSAT	18.4	-	-	-
2024 Vit 2023	181	?	-	-	-	-
2024 Vit 2023	182	UNSAT	45.6	-	-	-
2024 Vit 2023	183	UNSAT	18.4	-	-	-
2024 Vit 2023	184	UNSAT	56.8	-	-	-
2024 Vit 2023	185	UNSAT	17.1	-	-	-
2024 Vit 2023	186	?	-	-	-	-
2024 Vit 2023	187	?	-	-	-	-
2024 Vit 2023	188	?	-	-	-	-
2024 Vit 2023	189	UNSAT	23.7	-	-	-
2024 Vit 2023	190	UNSAT	58.0	-	-	-
2024 Vit 2023	191	UNSAT	52.2	-	-	-
2024 Vit 2023	192	UNSAT	18.4	-	-	-
2024 Vit 2023	193	?	-	-	-	-
2024 Vit 2023	194	UNSAT	55.3	-	-	-
2024 Vit 2023	195	?	-	-	-	-
2024 Vit 2023	196	?	-	-	-	-
2024 Vit 2023	197	UNSAT	17.1	-	-	-
2024 Vit 2023	198	?	-	-	-	-
2024 Vit 2023	199	UNSAT	45.9	-	-	-
2024 Yolo 2023	0	UNSAT	9.83	14.3	-	-
2024 Yolo 2023	1	UNSAT	9.81	13.3	-	-
2024 Yolo 2023	2	?	-	-	-	-
2024 Yolo 2023	3	UNSAT	9.82	13.8	-	-
2024 Yolo 2023	4	UNSAT	9.81	13.8	-	-
2024 Yolo 2023	5	UNSAT	13.7	-	-	-
2024 Yolo 2023	6	UNSAT	9.83	14.0	-	-
2024 Yolo 2023	7	UNSAT	9.84	-	-	-
2024 Yolo 2023	8	UNSAT	9.84	13.9	-	-
2024 Yolo 2023	9	UNSAT	9.82	-	-	-
2024 Yolo 2023	10	UNSAT	9.86	-	-	-
2024 Yolo 2023	11	UNSAT	9.84	274	-	-
2024 Yolo 2023	12	UNSAT	9.86	-	-	-
2024 Yolo 2023	13	UNSAT	9.83	13.2	-	-
2024 Yolo 2023	14	UNSAT	16.2	-	-	-
2024 Yolo 2023	15	UNSAT	9.83	-	-	-
2024 Yolo 2023	16	UNSAT	14.0	-	-	-
2024 Yolo 2023	17	?	-	-	-	-
2024 Yolo 2023	18	?	-	-	-	-
2024 Yolo 2023	19	UNSAT	9.84	-	-	-
2024 Yolo 2023	20	UNSAT	9.84	13.6	-	-
2024 Yolo 2023	21	?	-	-	-	-
2024 Yolo 2023	22	UNSAT	9.83	13.5	-	-
2024 Yolo 2023	23	UNSAT	9.80	-	-	-
2024 Yolo 2023	24	UNSAT	9.80	14.3	-	-
2024 Yolo 2023	25	?	-	-	-	-
2024 Yolo 2023	26	?	-	-	-	-
2024 Yolo 2023	27	?	-	-	-	-

Table 29: Instance Runtimes. Fastest times are blue. Second fastest are green. Penalties are red crosses (✗).

Category	Id	Result	α	β	C	PyRAT	NNen	NSAT
2024 Yolo 2023	28	UNSAT	9.82	14.1	-	-	-	-
2024 Yolo 2023	29	UNSAT	9.82	13.7	-	-	-	-
2024 Yolo 2023	30	UNSAT	9.89	13.6	-	-	-	-
2024 Yolo 2023	31	UNSAT	9.85	13.2	-	-	-	-
2024 Yolo 2023	32	UNSAT	13.8	-	-	-	-	-
2024 Yolo 2023	33	?	-	-	-	-	-	-
2024 Yolo 2023	34	UNSAT	29.4	-	-	-	-	-
2024 Yolo 2023	35	UNSAT	9.82	13.0	-	-	-	-
2024 Yolo 2023	36	UNSAT	9.86	14.1	-	-	-	-
2024 Yolo 2023	37	UNSAT	9.85	13.2	-	-	-	-
2024 Yolo 2023	38	UNSAT	9.84	13.4	-	-	-	-
2024 Yolo 2023	39	UNSAT	9.84	-	-	-	-	-
2024 Yolo 2023	40	UNSAT	9.83	13.2	-	-	-	-
2024 Yolo 2023	41	UNSAT	43.5	-	-	-	-	-
2024 Yolo 2023	42	UNSAT	9.83	13.9	-	-	-	-
2024 Yolo 2023	43	UNSAT	9.80	13.2	-	-	-	-
2024 Yolo 2023	44	UNSAT	9.88	12.7	-	-	-	-
2024 Yolo 2023	45	UNSAT	9.84	12.6	-	-	-	-
2024 Yolo 2023	46	UNSAT	9.82	13.2	-	-	-	-
2024 Yolo 2023	47	UNSAT	9.82	13.0	-	-	-	-
2024 Yolo 2023	48	UNSAT	9.85	13.2	-	-	-	-
2024 Yolo 2023	49	UNSAT	9.82	13.5	-	-	-	-
2024 Yolo 2023	50	UNSAT	9.83	14.0	-	-	-	-
2024 Yolo 2023	51	?	-	-	-	-	-	-
2024 Yolo 2023	52	UNSAT	9.81	14.1	-	-	-	-
2024 Yolo 2023	53	UNSAT	9.88	13.7	-	-	-	-
2024 Yolo 2023	54	UNSAT	9.85	13.2	-	-	-	-
2024 Yolo 2023	55	UNSAT	9.85	13.7	-	-	-	-
2024 Yolo 2023	56	UNSAT	9.82	13.5	-	-	-	-
2024 Yolo 2023	57	UNSAT	9.82	13.8	-	-	-	-
2024 Yolo 2023	58	UNSAT	9.84	13.1	-	-	-	-
2024 Yolo 2023	59	UNSAT	9.90	13.1	-	-	-	-
2024 Yolo 2023	60	UNSAT	9.86	14.2	-	-	-	-
2024 Yolo 2023	61	UNSAT	9.82	-	-	-	-	-
2024 Yolo 2023	62	UNSAT	9.87	-	-	-	-	-
2024 Yolo 2023	63	UNSAT	9.82	-	-	-	-	-
2024 Yolo 2023	64	?	-	-	-	-	-	-
2024 Yolo 2023	65	UNSAT	9.83	13.9	-	-	-	-
2024 Yolo 2023	66	UNSAT	9.82	13.9	-	-	-	-
2024 Yolo 2023	67	?	-	-	-	-	-	-
2024 Yolo 2023	68	UNSAT	9.83	13.8	-	-	-	-
2024 Yolo 2023	69	?	-	-	-	-	-	-
2024 Yolo 2023	70	UNSAT	9.85	12.9	-	-	-	-
2024 Yolo 2023	71	UNSAT	9.83	13.5	-	-	-	-