

Max-SAT Evaluation 2012

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Outline

- 1 Introduction
- 2 Evaluation overview
- 3 Results for Complete Solvers
- 4 Results for Incomplete Solvers
- 5 Conclusion

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Objectives

- Evaluate the performance of existing **solvers**
- Maintain a set of challenging **benchmarks**
- Identify successful solving **techniques**
- Stimulate researchers to **improve** their solvers and to submit new challenging benchmarks
- Gain new **insights** for future evaluations

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- 1 Introduction
- 2 Evaluation overview**
 - Categories
 - Solvers
 - Evaluation Environment
- 3 Results for Complete Solvers
- 4 Results for Incomplete Solvers
- 5 Conclusion

Global figures

- 7th MaxSAT Evaluation
- 12 solvers (18 all versions)
- 2680 instances
- > 23,846 hours

Categories

- Max-SAT
 - All soft clauses
 - Unary weights
- Weighted Max-SAT
 - All soft clauses
 - Integer positive weights
- Partial Max-SAT
 - Hard and soft clauses
 - Unary weights
- Weighted Partial Max-SAT
 - Hard and soft clauses
 - Integer positive weights

Categories

- Max-SAT (600 instances)
 - Random (378 instances)
 - Crafted (167 instances)
 - Industrial (55 instances)
- Weighted Max-SAT (276 instances)
 - Random (160 instances)
 - Crafted (116 instances)

Categories

- Partial Max-SAT (1086 instances)
 - Random (210 instances)
 - Crafted (372 instances)
 - Industrial (504 instances)
- Weighted Partial Max-SAT (718 instances)
 - Random (120 instances)
 - Crafted (372 instances)
 - Industrial (226 instances)

Complete Solvers

- **akmaxsat and akmaxsat_ls** (A. Kuegel)
- **IncMaxSatz** (H. Lin, K. Su, C.M. Li)
- **iut_rr_rv and iut_rr_ls** (R. Ramezani)
- **QMaxSat and QMaxSat-g2** (M. Koshimura, X. An, H. Fujita, R. Hasegawa)
- **SAT4J MaxSAT** (D. Le Berre)
- **PM2 and WPM1** (C. Ansótegui, M. L. Bonet, J. Levy)
- **pwbo1.0 and pwbo1.1** (R. Martins, V. Manquinho, I. Lynce)
- **ShinMaxSat** (K. Honjyo, T. Tanjo)
- **WMaxSatz-2009 and WMaxSatz+** (C. M. Li, F. Manyà, J. Argelich)
- **wbo1.6** (V. Manquinho, J. Marques-Silva, J. Planes, R. Martins)

Incomplete Solvers

- **ubcsat-irots** (D. Tompkins)
- **sat4j maxsat** (D. Le Berre)

Evaluation Environment

Cluster specification:

Operating System	Rocks Cluster 5.2.0 Linux 2.6.18
Processor	AMD Opteron 248 Processor, 2 GHz
Memory	450 MB
Cache	1024 KB
Compilers	GCC 4.1.2, javac JDK 1.6.0

Evaluation Environment

Resources:

- 450 MB of [memory](#)
- [Timeout](#) of 1800 seconds

Ranking:

- 1 Number of [solved instances](#)
- 2 [Time](#) needed to solve those instances

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 - Max-SAT
 - Weighted Max-SAT
 - Partial Max-SAT
 - Weighted Partial Max-SAT
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Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- iut_rr_ls and iut_rr_rv
- QMaxSat-g2
- SAT4J MaxSAT
- ShinMaxSat
- PM2 and WPM1
- wbo 1.6
- WMaxSatz-2009 and WMaxSatz+

Max-SAT category (Benchmarks)

Random

- Random Max-2-SAT
- Random Max-3-SAT
- Random Highgirth
- Random Min-2-SAT

Crafted

- Max-Cut
- Bipartite Max-Cut

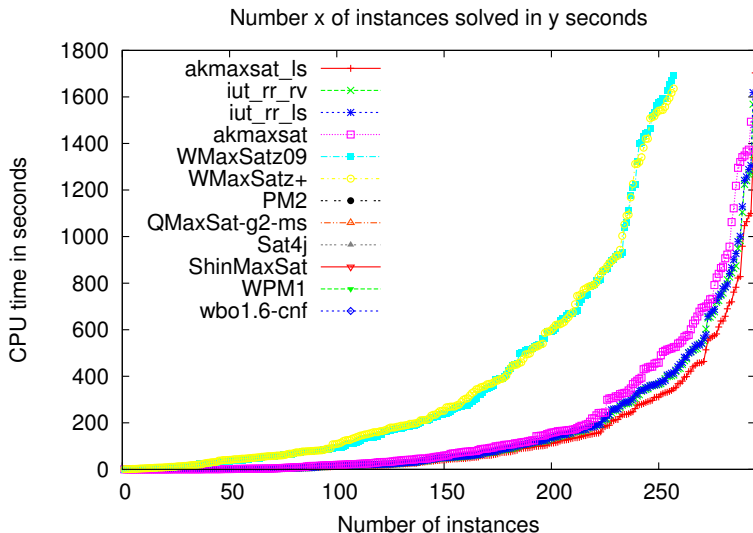
Industrial

- Circuit Debugging Problems

Max-SAT category (Random)

Rank	Solver	# Solved (295)	Total time
1	akmaxsat_ls	295	42536.84
2	iut_rr_rv	294	48027.28
3	iut_rr_ls	294	48921.76
4	akmaxsat	293	56241.61
5	WMaxSatz09	257	91670.57
6	WMaxSatz+	257	92622.28
7	PM2	0	0.00
8	QMaxSat-g2-ms	0	0.00
9	Sat4j	0	0.00
10	ShinMaxSat	0	0.00
11	WPM1	0	0.00
12	wbo1.6-cnf	0	0.00

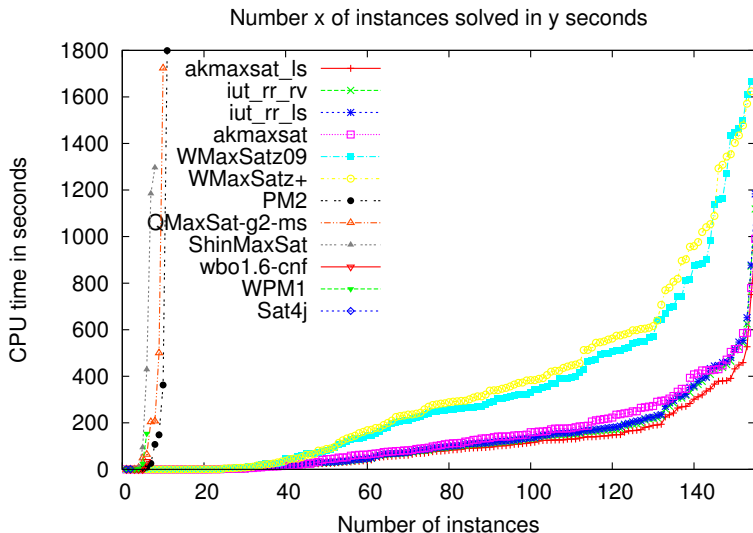
Max-SAT category (Random)



Max-SAT category (Crafted)

Rank	Solver	# Solved (156)	Total time
1	akmaxsat_ls	155	17442.13
2	iut_rr_rv	155	20424.88
3	iut_rr_ls	155	21103.98
4	akmaxsat	155	22876.72
5	WMaxSatz09	154	50746.74
6	WMaxSatz+	154	55133.30
7	PM2	11	2451.69
8	QMaxSat-g2-ms	10	2754.34
9	ShinMaxSat	8	3013.51
10	wbo1.6-cnf	6	34.56
11	WPM1	6	181.76
12	Sat4j	2	1.42

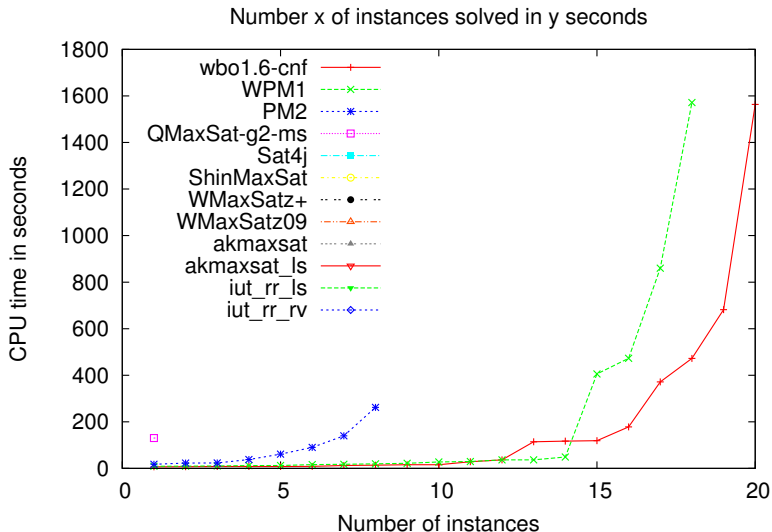
Max-SAT category (Crafted)



Max-SAT category (Industrial)

Rank	Solver	# Solved (23)	Total time
1	wbo1.6-cnf	20	3786.01
2	WPM1	18	3616.24
3	PM2	8	653.61
4	QMaxSat-g2-ms	1	130.52
5	Sat4j	0	0.00
6	ShinMaxSat	0	0.00
7	WMaxSatz+	0	0.00
8	WMaxSatz09	0	0.00
9	akmaxsat	0	0.00
10	akmaxsat_ls	0	0.00
11	iut_rr_ls	0	0.00
12	iut_rr_rv	0	0.00

Max-SAT category (Industrial)



Weighted Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- iut_rr_ls and iut_rr_rv
- SAT4J MaxSAT
- ShinMaxSat
- WPM1
- wbo 1.6
- WMaxSatz-2009 and WMaxSatz+

Weighted Max-SAT category (Benchmarks)

Random

- Random Weighted Max-2-SAT
- Random Weighted Max-3-SAT

Crafted

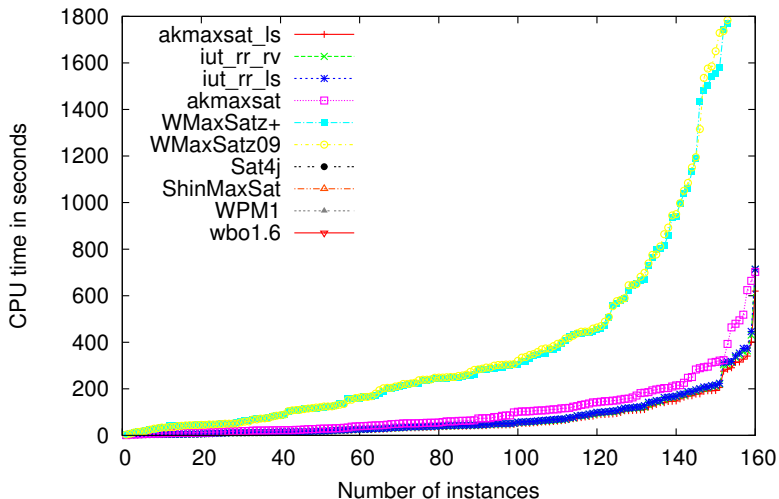
- FRB (Forced Model RB)
- Weighted Max-Cut
- Ramsey

Weighted Max-SAT category (Random)

Rank	Solver	# Solved (160)	Total time
1	akmaxsat_ls	160	10841.65
2	iut_rr_rv	160	11853.32
3	iut_rr_ls	160	12133.02
4	akmaxsat	160	17116.55
5	WMaxSatz+	153	53423.69
6	WMaxSatz09	153	54397.66
7	Sat4j	0	0.00
8	ShinMaxSat	0	0.00
9	WPM1	0	0.00
10	wbo1.6	0	0.00

Weighted Max-SAT category (Random)

Number x of instances solved in y seconds

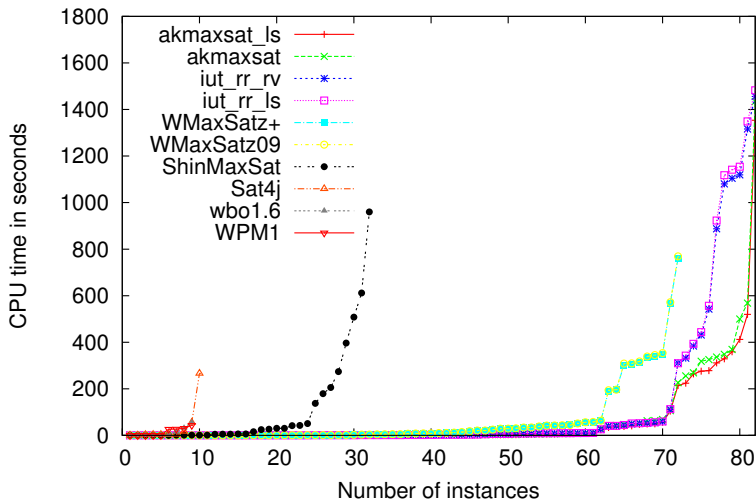


Weighted Max-SAT category (Crafted)

Rank	Solver	# Solved (96)	Total time
1	akmaxsat_ls	82	5128.29
2	akmaxsat	82	5636.36
3	iut_rr_rv	82	9641.71
4	iut_rr_ls	82	9905.82
5	WMaxSatz+	72	4445.59
6	WMaxSatz09	72	4499.99
7	ShinMaxSat	32	3567.98
8	Sat4j	10	356.85
9	wbo1.6	9	105.56
10	WPM1	9	128.32

Weighted Max-SAT category (Crafted)

Number x of instances solved in y seconds



Partial Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- iut_rr_ls and iut_rr_rv
- QMaxSat and QMaxSat-g2
- pwbo2.0
- SAT4J MaxSAT
- ShinMaxSat
- WPM1 and PM2
- wbo 1.6
- WMaxSatz-2009 and WMaxSatz+

Partial Max-SAT category (Benchmarks)

Random

- Random Partial Max-2-SAT and Max-3-SAT
- Random Min-2-SAT and Min-3-SAT

Crafted

- FRB, Job Shop
- Max-Clique, Max-One
- Minimal Encodings
- PB miplib

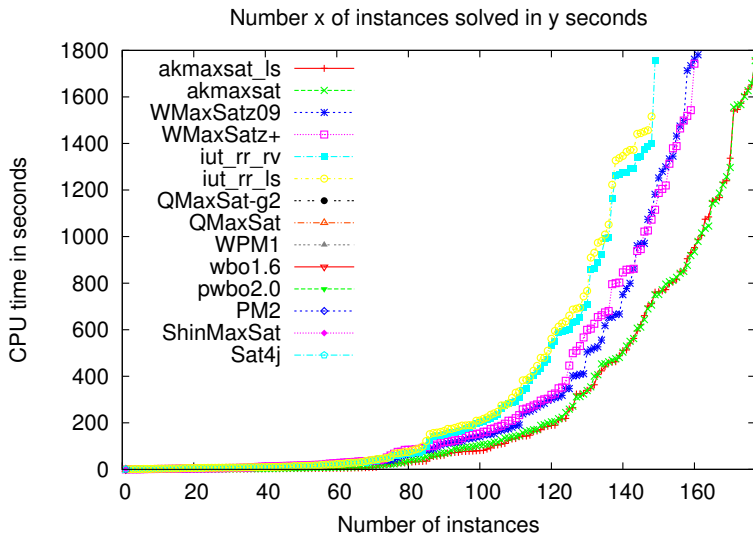
Industrial

- Circuit Trace Compaction
- Haplotype Assembly
- BCP, PBO
- Protein
- Components of the Advanced Encryption Standard

Partial Max-SAT category (Random)

Rank	Solver	# Solved (181)	Total time
1	akmaxsat_ls	177	48984.13
2	akmaxsat	177	49714.82
3	WMaxSatz09	161	44136.56
4	WMaxSatz+	160	44377.27
5	iut_rr_rv	149	40018.01
6	iut_rr_ls	148	40832.31
7	QMaxSat-g2	1	0.01
8	QMaxSat	1	0.01
9	WPM1	1	0.01
10	wbo1.6	1	0.01
11	pwbo2.0	1	0.02
12	PM2	1	0.03
13	ShinMaxSat	1	0.14
14	Sat4j	1	0.98

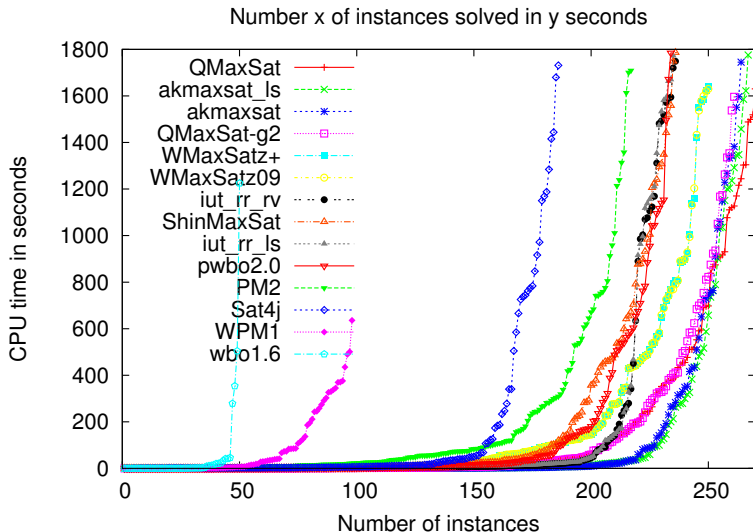
Partial Max-SAT category (Random)



Partial Max-SAT category (Crafted)

Rank	Solver	# Solved (316)	Total time
1	QMaxSat	270	39796.28
2	akmaxsat_ls	267	29029.41
3	akmaxsat	264	27173.60
4	QMaxSat-g2	261	31024.24
5	WMaxSatz+	250	37694.30
6	WMaxSatz09	250	37699.30
7	iut_rr_rv	236	27538.53
8	ShinMaxSat	236	36580.45
9	iut_rr_ls	235	26450.33
10	pwbo2.0	234	28298.73
11	PM2	217	34859.18
12	Sat4j	186	24032.64
13	WPM1	98	8211.30
14	wbo1.6	50	2645.58

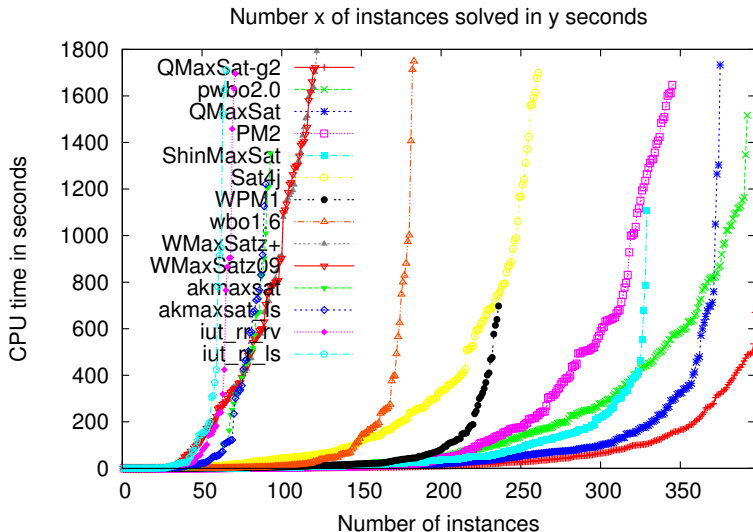
Partial Max-SAT category (Crafted)



Partial Max-SAT category (Industrial)

Rank	Solver	# Solved (425)	Total time
1	QMaxSat-g2	397	24170.55
2	pwbo2.0	392	75010.99
3	QMaxSat	375	31625.25
4	PM2	345	73241.05
5	ShinMaxSat	329	22630.93
6	Sat4j	261	63151.83
7	WPM1	236	12163.39
8	wbo1.6	183	18922.45
9	WMaxSatz+	122	54437.37
10	WMaxSatz09	121	52958.78
11	akmaxsat	93	16967.91
12	akmaxsat_ls	90	14098.89
13	iut_rr_rv	71	11450.74
14	iut_rr_ls	65	10929.61

Partial Max-SAT category (Industrial)



Weighted Partial Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- iut_rr_ls and iut_rr_rv
- pwbo 2.1
- SAT4J MaxSAT
- ShinMaxSat
- WPM1 and PM2
- wbo 1.6
- WMaxSatz-2009 and WMaxSatz+

Weighted Partial Max-SAT category (Benchmarks)

Random

- Random Weighted Partial Max-2-SAT and Max-3-SAT

Crafted

- Auctions
- Minimal Encodings (Planning, Warehouses)
- PB MIPLib
- Random Bayesian Networks – MPE
- Spot5

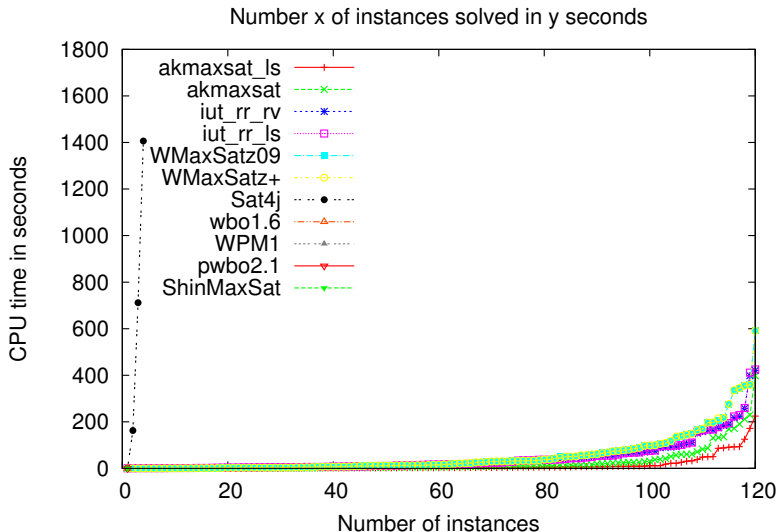
Industrial

- Haplotyping with Pedigrees
- Timetabling
- Upgradeability Problem

Weighted Partial Max-SAT category (Random)

Rank	Solver	# Solved (120)	Total time
1	akmaxsat_ls	120	1633.77
2	akmaxsat	120	3126.60
3	iut_rr_rv	120	5368.85
4	iut_rr_ls	120	5497.27
5	WMaxSatz09	120	6616.71
6	WMaxSatz+	120	6621.28
7	Sat4j	4	2281.24
8	wbo1.6	1	0.01
9	WPM1	1	0.01
10	pwbo2.1	1	0.02
11	ShinMaxSat	1	0.16

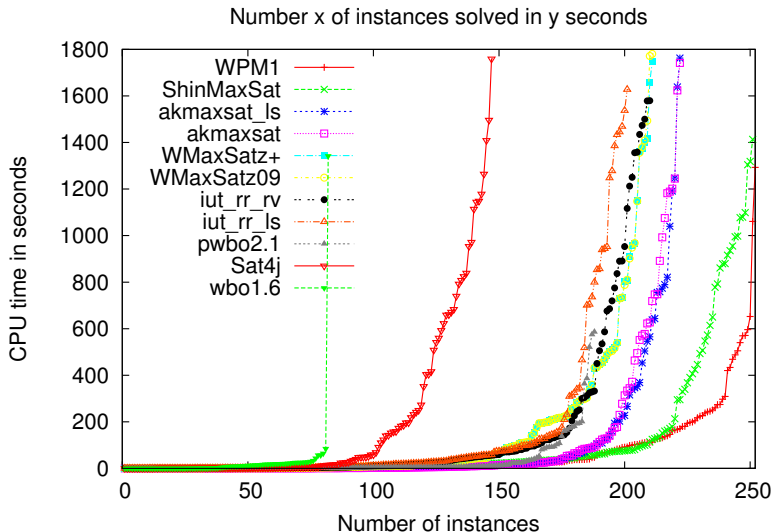
Weighted Partial Max-SAT category (Random)



Weighted Partial Max-SAT category (Crafted)

Rank	Solver	# Solved (337)	Total time
1	WPM1	252	16986.78
2	ShinMaxSat	251	28490.86
3	akmaxsat_ls	222	19887.00
4	akmaxsat	222	22240.48
5	WMaxSatz+	211	29356.98
6	WMaxSatz09	211	29522.60
7	iut_rr_rv	210	29920.61
8	iut_rr_ls	201	26697.13
9	pwbo2.1	188	5576.73
10	Sat4j	147	27688.67
11	wbo1.6	82	2308.56

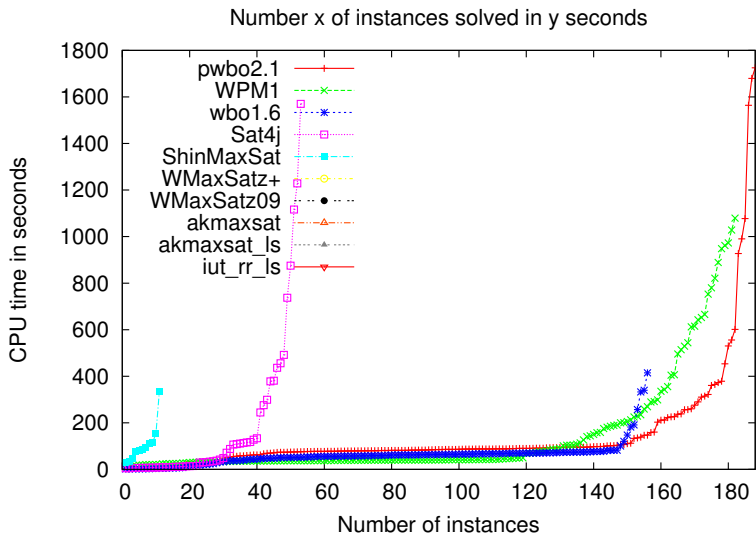
Weighted Partial Max-SAT category (Crafted)



Weighted Partial Max-SAT category (Industrial)

Rank	Solver	# Solved (196)	Total time
1	pwbo2.1	188	27266.50
2	WPM1	182	25793.87
3	wbo1.6	156	9623.29
4	Sat4j	53	10067.43
5	ShinMaxSat	11	1163.17
6	WMaxSatz+	0	0.00
7	WMaxSatz09	0	0.00
8	akmaxsat	0	0.00
9	akmaxsat_ls	0	0.00
10	iut_rr_ls	0	0.00

Weighted Partial Max-SAT category (Industrial)



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Solvers

This is the **first year** we evaluate incomplete solvers.

Ranking:

- 1 Number of **solved instances**. (*solved instance* = best solution given by any incomplete solver)

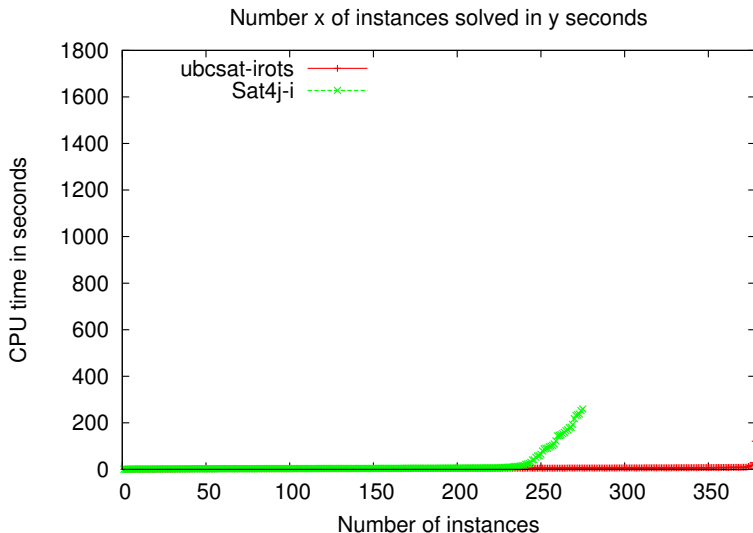
Solvers:

- Sat4J MaxSAT (D. Le Berre)
- ubcsat-irots (D. Tompkins)

Max-SAT category (Random)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	378	1826.49
2	Sat4j-i	0	0.00

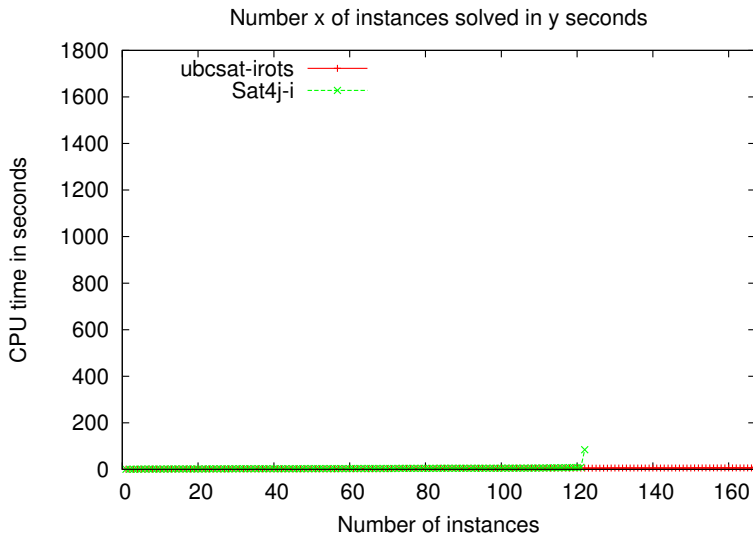
Max-SAT category (Random)



Max-SAT category (Crafted)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	167	629.90
2	Sat4j-i	2	0.96

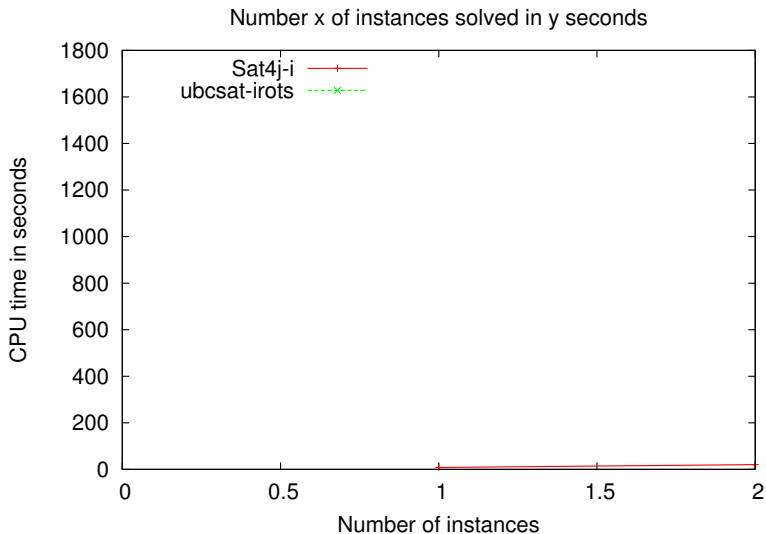
Max-SAT category (Crafted)



Max-SAT category (Industrial)

Rank	Solver	# Solved	Total time
1	Sat4j-i	2	28.22
2	ubcsat-irots	0	0.00

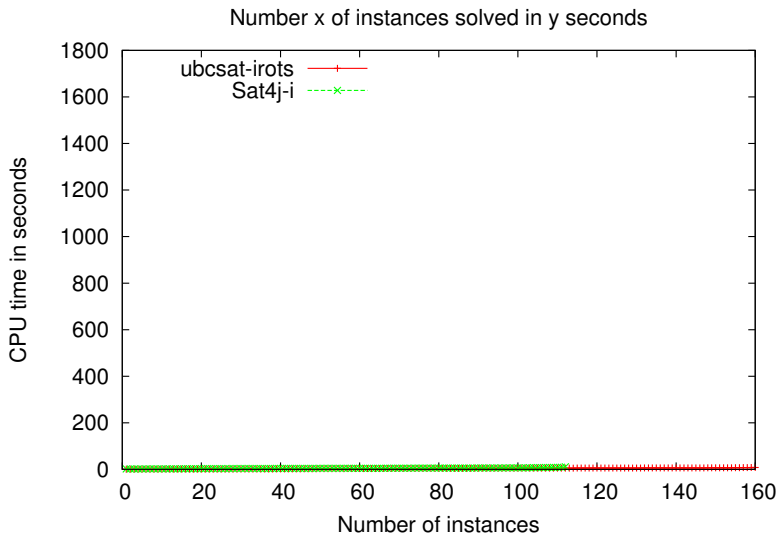
Max-SAT category (Industrial)



Weighted Max-SAT category (Random)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	160	620.33
2	Sat4j-i	0	0.00

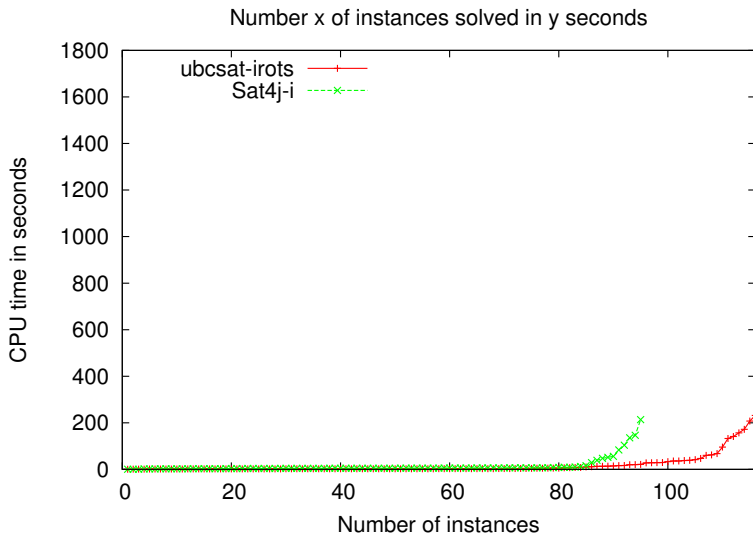
Weighted Max-SAT category (Random)



Weighted Max-SAT category (Crafted)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	116	2106.83
2	Sat4j-i	10	222.51

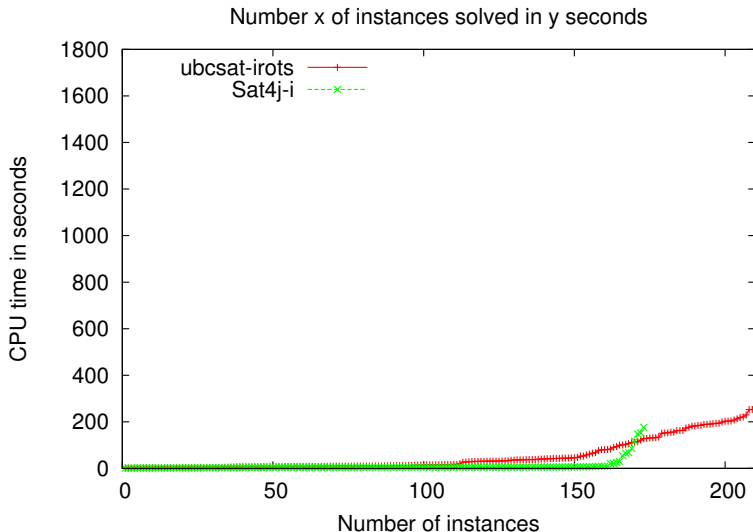
Weighted Max-SAT category (Crafted)



Partial Max-SAT category (Random)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	202	10324.15
2	Sat4j-i	10	204.06

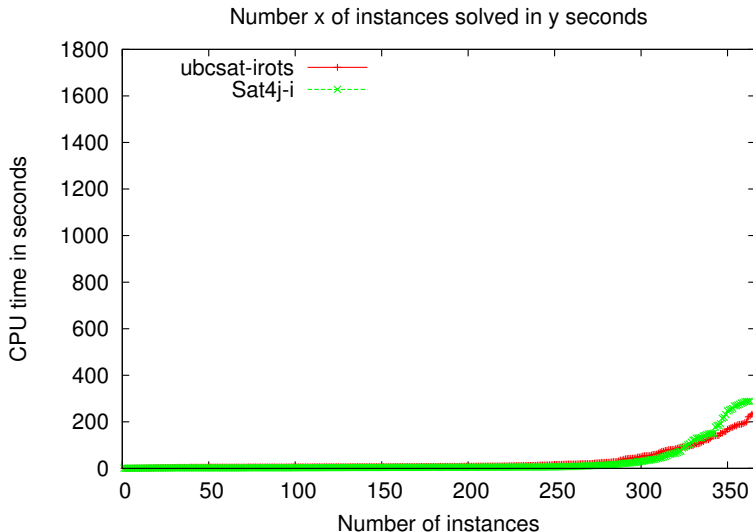
Partial Max-SAT category (Random)



Partial Max-SAT category (Crafted)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	329	8313.64
2	Sat4j-i	182	3071.23

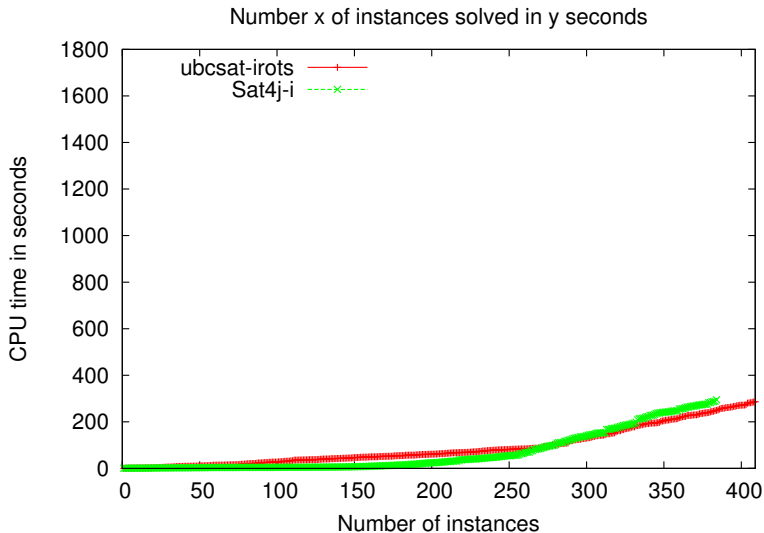
Partial Max-SAT category (Crafted)



Partial Max-SAT category (Industrial)

Rank	Solver	# Solved	Total time
1	Sat4j-i	367	24298.28
2	ubcsat-irots	120	7574.79

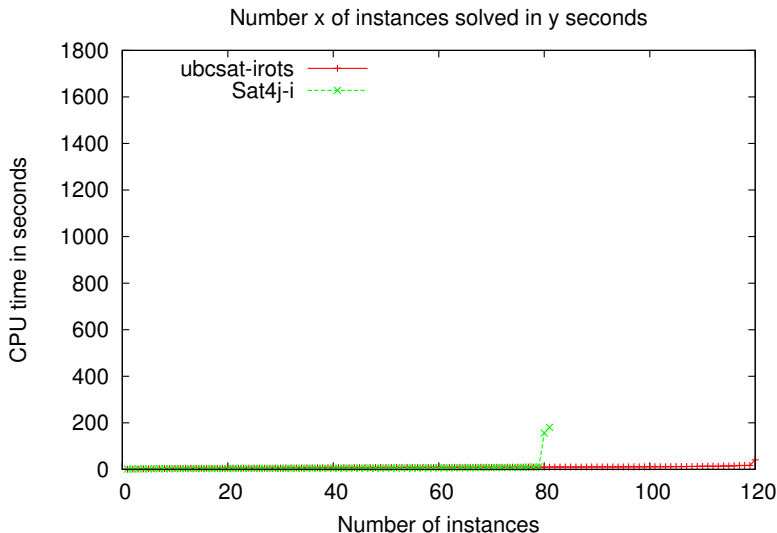
Partial Max-SAT category (Industrial)



Weighted Partial Max-SAT category (Random)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	120	1037.32
2	Sat4j-i	2	336.81

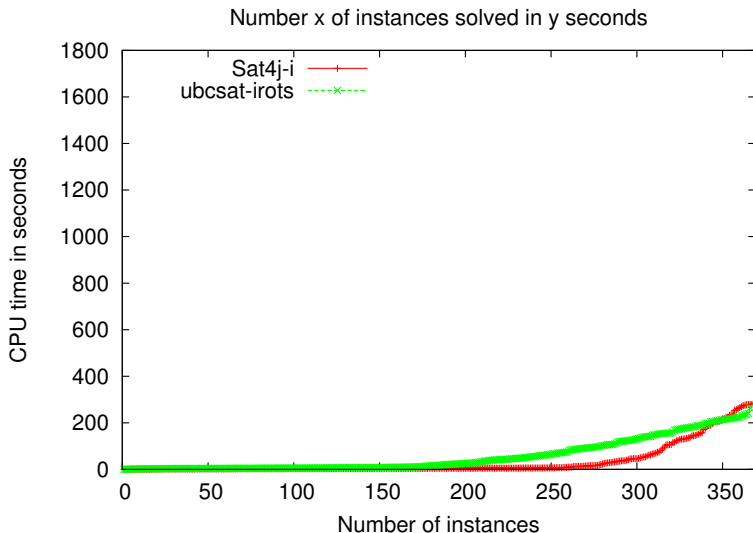
Weighted Partial Max-SAT category (Random)



Weighted Partial Max-SAT category (Crafted)

Rank	Solver	# Solved	Total time
1	ubcsat-irots	260	9105.59
2	Sat4j-i	221	3620.01

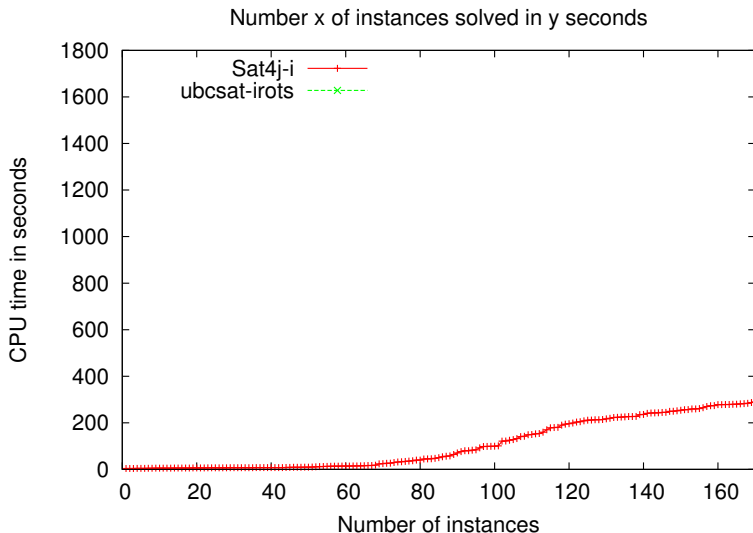
Weighted Partial Max-SAT category (Crafted)



Weighted Partial Max-SAT category (Industrial)

Rank	Solver	# Solved	Total time
1	Sat4j-i	170	17747.74
2	ubcsat-irots	0	0.00

Weighted Partial Max-SAT category (Industrial)



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Web page

- Max-SAT Evaluation 2012 web page
 - `http://maxsat.ia.udl.cat/`
- Tables with mean times and number of solved instances
- Tables with percentages of solved instances for each set
- All the plots in this presentation
- Detailed results for each instance (with a Best solver column)

Thanks

Thanks to the [people that contributed](#) solvers and benchmarks, and to the [Universitat de Lleida](#) for allowing us to use its cluster.

We encourage you to participate in the

[Max-SAT Evaluation 2013!](#)