

Max-SAT Evaluation 2011

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Outline

- 1 Introduction
- 2 Evaluation structure
- 3 Results

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Objectives

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

Outline

- 1 Introduction
- 2 Evaluation structure
 - Categories
 - Solvers
 - Evaluation Environment
- 3 Results

Categories

- Complete solvers
 - Unweighted Max-SAT
 - Weighted Max-SAT
 - Partial Max-SAT
 - Weighted Partial Max-SAT
- Incomplete solvers
 - **New this year!**

Categories (Complete solvers 1/2)

- Max-SAT
 - Random (282 instances)
 - Crafted (167 instances)
 - Industrial (55 instances)
- Weighted Max-SAT
 - Random (160 instances)
 - Crafted (116 instances)
 - Industrial (7 instances, contributed by Matthew Gwynne and Oliver Kullmann)

Categories (Complete solvers 2/2)

- Partial Max-SAT
 - Random (210 instances)
 - Crafted (372 instances)
 - Industrial (497 instances)
- Weighted Partial Max-SAT
 - Random (120 instances)
 - Crafted (372 instances)
 - Industrial (226 instances, contributed by Ana Graça, Inês Lynce and João Marques-Silva)

Solvers

- **akmaxsat and akmaxsat_Is** (Adrian Kuegel)
- **clasp** (Benjamin Kaufmann)
- **IncMaxSatz** (Han Lin, Kaile Su, Chu Min Li)
- **IncWMaxSatz** (H. Lin, K. Su, C. M. Li, J. Argelich)
- **QMaxSat** (M. Koshimura, X. An, H. Fujita, R. Hasegawa)
- **SAT4J MaxSAT** (Daniel Le Berre)
- **PM2, WPM1 and WPM2** (C. Ansótegui, M. L. Bonet, J. Levy)
- **pwbo1.0 and pwbo1.1** (R. Martins, V. Manquinho, I. Lynce)
- **WMaxSatz-2009 and WMaxSatz+** (C. M. Li, F. Manyà, J. Argelich)
- **wbo1.6** (V. Manquinho , J. Marques-Silva, J. Planes, R. Martins)

Evaluation Environment

Cluster specification:

- Operating System: Rocks Cluster 5.2.0 Linux 2.6.18
- Processor: AMD Opteron 248 Processor, 2 GHz
- Memory: 512 MB
- Cache: 1024 KB
- Compilers: GCC 3.4.3, javac JDK 1.6.0

Evaluation Environment

Resources:

- 512MB of memory
- Timeout of 1800 seconds

Ranking:

- 1 Number of solved instances
- 2 Time needed to solve those instances

Outline

- 1 Introduction
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- 3 Results**
 - Max-SAT
 - Weighted Max-SAT
 - Partial Max-SAT
 - Weighted Partial Max-SAT

Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- clasp
- IncMaxSatz
- QMaxSat
- SAT4J MaxSAT
- 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

Crafted

- Max-Cut
- Bipartite Max-Cut

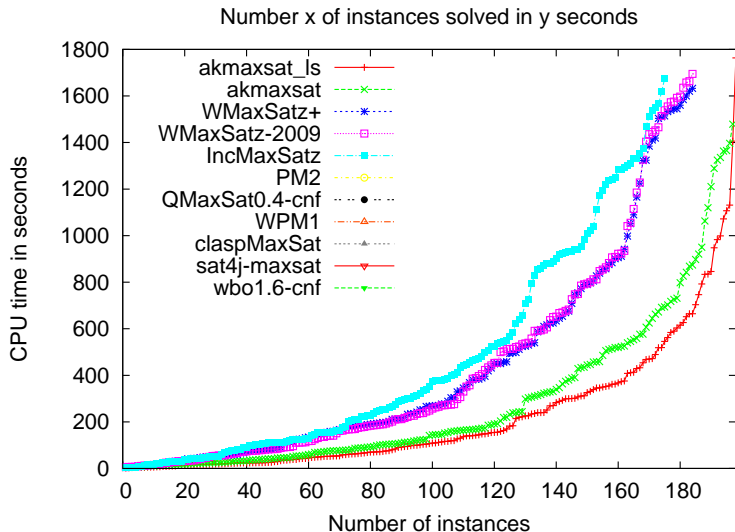
Industrial

- Circuit Debugging Problems

Max-SAT category (Random)

Rank	Solver	# Solved (282)	Total time
1	akmaxsat_ls	198	44217.85
2	akmaxsat	197	54996.33
3	WMaxSatz+	184	77669.84
4	WMaxSatz-2009	184	78175.88
5	IncMaxSatz	175	79341.96
6	PM2	0	0.00
7	QMaxSat0.4-cnf	0	0.00
8	WPM1	0	0.00
9	claspMaxSat	0	0.00
10	sat4j-maxsat	0	0.00
11	wbo1.6-cnf	0	0.00

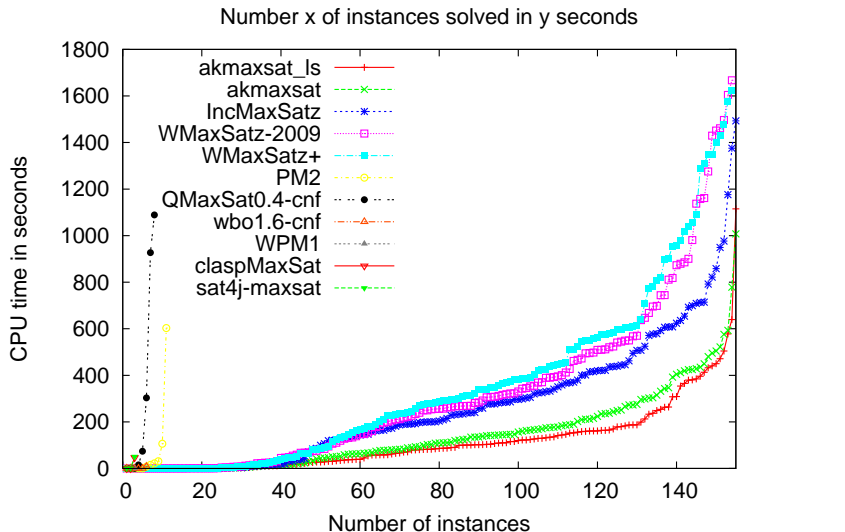
Max-SAT category (Random)



Max-SAT category (Crafted)

Rank	Solver	# Solved (167)	Total time
1	akmaxsat_ls	155	18530.03
2	akmaxsat	155	22881.00
3	IncMaxSatz	155	41424.13
4	WMaxSatz-2009	154	50739.41
5	WMaxSatz+	154	55130.22
6	PM2	11	784.32
7	QMaxSat0.4-cnf	8	2409.10
8	wbo1.6-cnf	6	8.10
9	WPM1	3	0.03
10	claspMaxSat	3	46.76
11	sat4j-maxsat	3	52.88

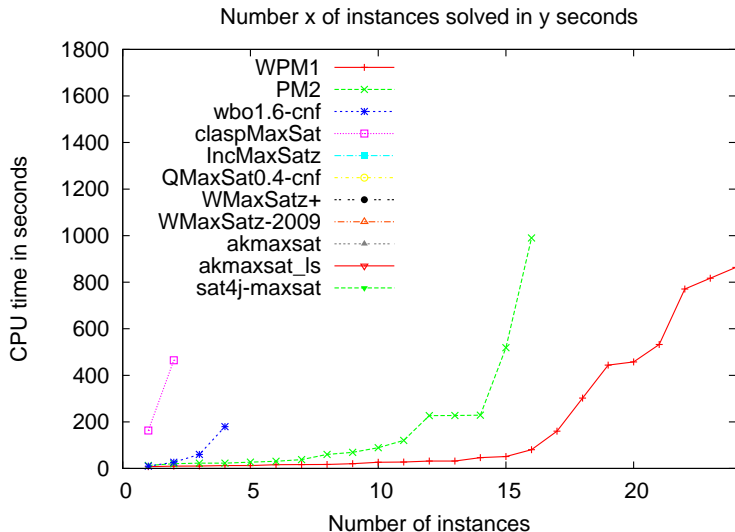
Max-SAT category (Crafted)



Max-SAT category (Industrial)

Rank	Solver	# Solved (55)	Total time
1	WPM1	24	4766.23
2	PM2	16	2705.79
3	wbo1.6-cnf	4	276.44
4	claspMaxSat	2	627.53
5	IncMaxSatz	0	0.00
6	QMaxSat0.4-cnf	0	0.00
7	WMaxSatz+	0	0.00
8	WMaxSatz-2009	0	0.00
9	akmaxsat	0	0.00
10	akmaxsat_ls	0	0.00
11	sat4j-maxsat	0	0.00

Max-SAT category (Industrial)



Weighted Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- clasp
- IncWMaxSatz
- SAT4J MaxSAT
- WPM1 and WPM2
- 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
- Weighted Max-Cut
- Ramsey

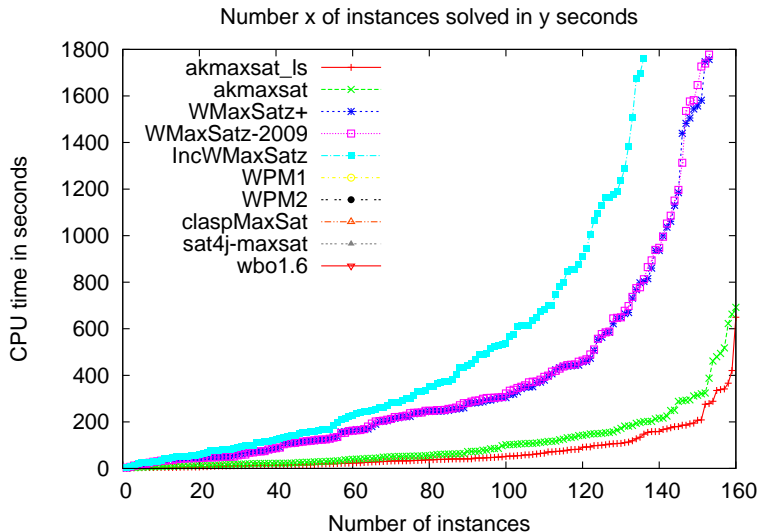
Industrial

- Components of the Advanced Encryption Standard

Weighted Max-SAT category (Random)

Rank	Solver	# Solved (160)	Total time
1	akmaxsat_ls	160	11242.88
2	akmaxsat	160	17107.23
3	WMaxSatz+	153	53444.43
4	WMaxSatz-2009	153	54382.88
5	IncWMaxSatz	136	55382.49
6	WPM1	0	0.00
7	WPM2	0	0.00
8	claspMaxSat	0	0.00
9	sat4j-maxsat	0	0.00
10	wbo1.6	0	0.00

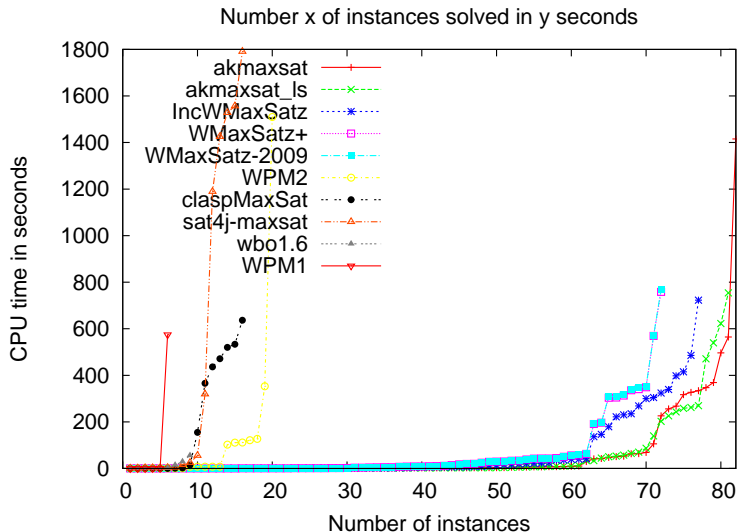
Weighted Max-SAT category (Random)



Weighted Max-SAT category (Crafted)

Rank	Solver	# Solved (116)	Total time
1	akmaxsat	82	5607.83
2	akmaxsat_ls	81	4608.85
3	IncWMaxSatz	77	5153.77
4	WMaxSatz+	72	4449.06
5	WMaxSatz-2009	72	4502.24
6	WPM2	20	2477.46
7	claspMaxSat	16	3136.14
8	sat4j-maxsat	16	7922.28
9	wbo1.6	9	103.52
10	WPM1	6	575.63

Weighted Max-SAT category (Crafted)



Weighted Max-SAT category (Industrial)

Rank	Solver	# Solved (7)	Total time
1	IncWMaxSatz	1	967.49
2	akmaxsat_ls	1	1140.02
3	akmaxsat	1	1347.20
4	WMaxSatz+	0	0.00
5	WMaxSatz-2009	0	0.00
6	WPM1	0	0.00
7	WPM2	0	0.00
8	claspMaxSat	0	0.00
9	sat4j-maxsat	0	0.00
10	wbo1.6	0	0.00

Partial Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- clasp
- IncWMaxSatz
- QMaxSat0.4 and 0.11
- pwbo1.0 and 1.1
- SAT4J MaxSAT
- 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

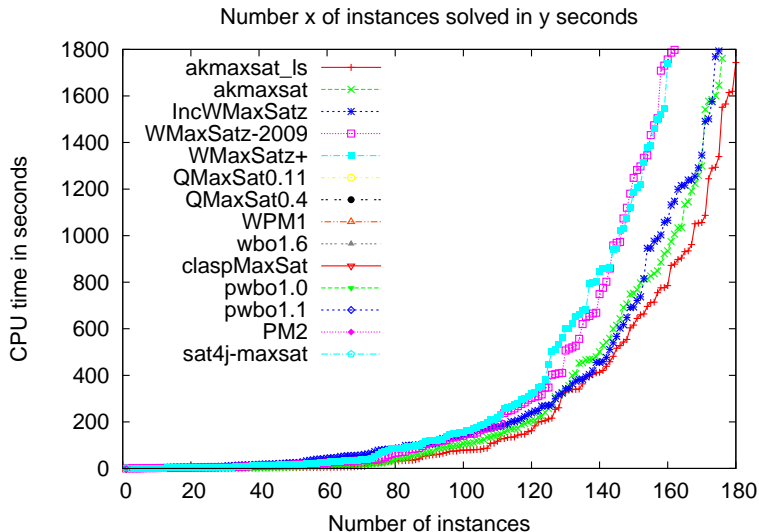
Industrial

- Circuit Trace Compaction
- Haplotype Assembly
- BCP, PBO
- Protein

Partial Max-SAT category (Random)

Rank	Solver	# Solved (210)	Total time
1	akmaxsat_ls	180	46197.41
2	akmaxsat	176	48060.92
3	IncWMaxSatz	175	50415.37
4	WMaxSatz-2009	162	45952.52
5	WMaxSatz+	160	44396.93
6	QMaxSat0.11	1	0.00
7	QMaxSat0.4	1	0.00
8	WPM1	1	0.01
9	wbo1.6	1	0.01
10	claspMaxSat	1	0.02
11	pwbo1.0	1	0.02
12	pwbo1.1	1	0.02
13	PM2	1	0.03
14	sat4j-maxsat	1	1.28

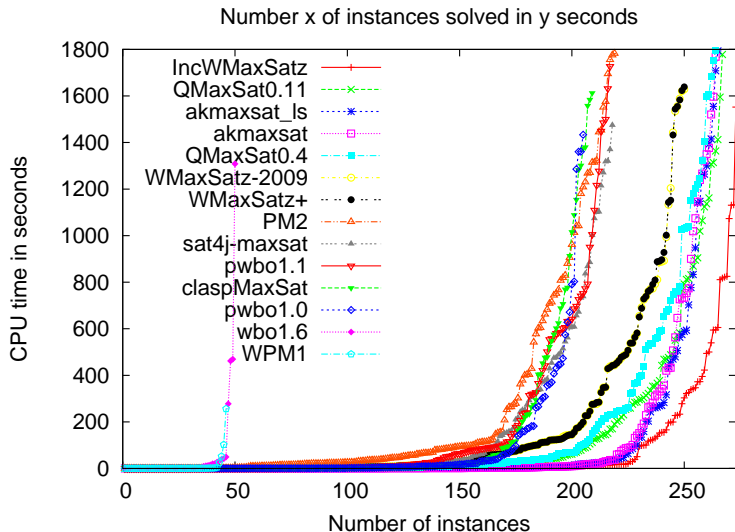
Partial Max-SAT category (Random)



Partial Max-SAT category (Crafted)

Rank	Solver	# Solved (372)	Total time
1	IncWMaxSatz	273	18981.23
2	QMaxSat0.11	267	35074.21
3	akmaxsat_ls	265	26379.56
4	akmaxsat	264	27137.79
5	QMaxSat0.4	264	40678.58
6	WMaxSatz-2009	250	37524.64
7	WMaxSatz+	250	37624.28
8	PM2	219	49403.71
9	sat4j-maxsat	218	31593.35
10	pwbo1.1	217	33250.35
11	claspMaxSat	209	26012.79
12	pwbo1.0	205	16350.35
13	wbo1.6	50	2806.83
14	WPM1	46	449.06

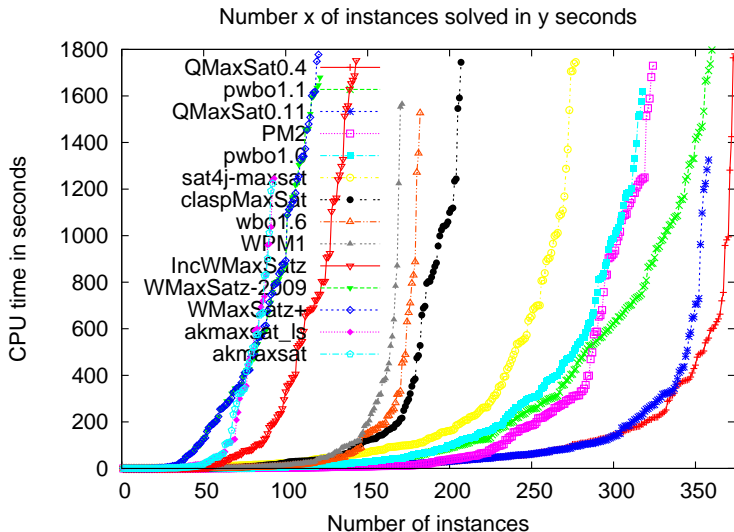
Partial Max-SAT category (Crafted)



Partial Max-SAT category (Industrial)

Rank	Solver	# Solved (497)	Total time
1	QMaxSat0.4	374	40160.31
2	pwbo1.1	360	94743.71
3	QMaxSat0.11	358	32545.85
4	PM2	324	56051.91
5	pwbo1.0	318	63237.14
6	sat4j-maxsat	277	54798.07
7	claspMaxSat	207	36329.86
8	wbo1.6	182	16859.19
9	WPM1	171	15460.45
10	IncWMaxSatz	143	44706.77
11	WMaxSatz-2009	121	53102.20
12	WMaxSatz+	120	51775.70
13	akmaxsat_ls	93	16435.50
14	akmaxsat	92	15688.42

Partial Max-SAT category (Industrial)



Weighted Partial Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- clasp
- IncWMaxSatz
- SAT4J MaxSAT
- WPM1 and WPM2
- 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
- PB miplib
- Random Networks
- Weighted CSP

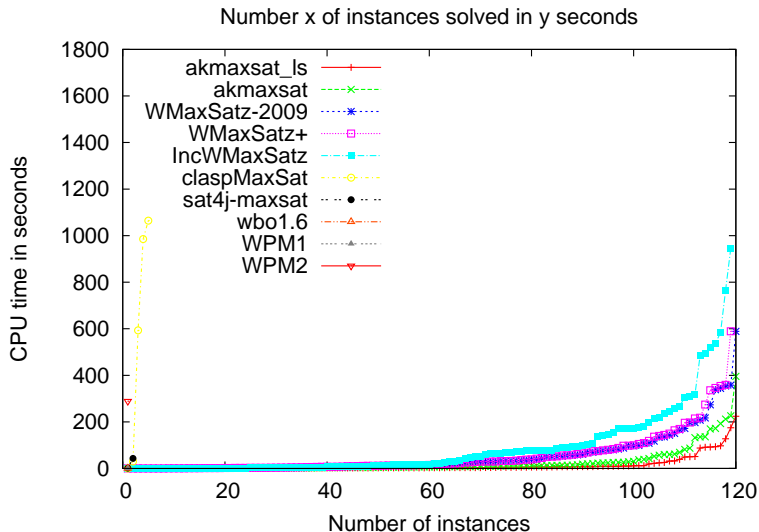
Industrial

- Haplotyping with Pedigrees
- Timetabling
- Upgradeability Problem

Weighted Partial Max-SAT category (Random)

Rank	Solver	# Solved (120)	Total time
1	akmaxsat_ls	120	1669.31
2	akmaxsat	120	3127.77
3	WMaxSatz-2009	120	6619.32
4	WMaxSatz+	119	6584.61
5	IncWMaxSatz	119	10969.69
6	claspMaxSat	5	2672.22
7	sat4j-maxsat	2	44.50
8	wbo1.6	1	0.01
9	WPM1	1	0.01
10	WPM2	1	288.75

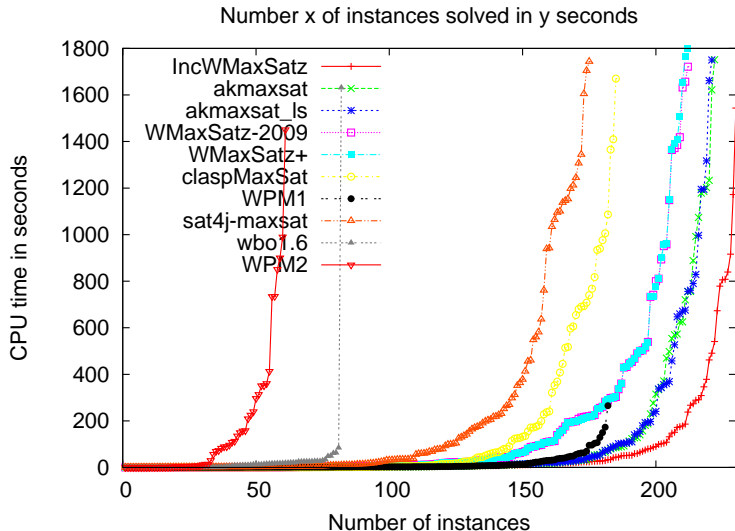
Weighted Partial Max-SAT category (Random)



Weighted Partial Max-SAT category (Crafted)

Rank	Solver	# Solved (372)	Total time
1	IncWMaxSatz	230	14975.39
2	akmaxsat	222	22270.66
3	akmaxsat_ls	221	20726.47
4	WMaxSatz-2009	212	30877.18
5	WMaxSatz+	212	31219.97
6	claspMaxSat	185	23059.08
7	WPM1	182	2407.95
8	sat4j-maxsat	175	33049.87
9	wbo1.6	82	2600.55
10	WPM2	61	9928.31

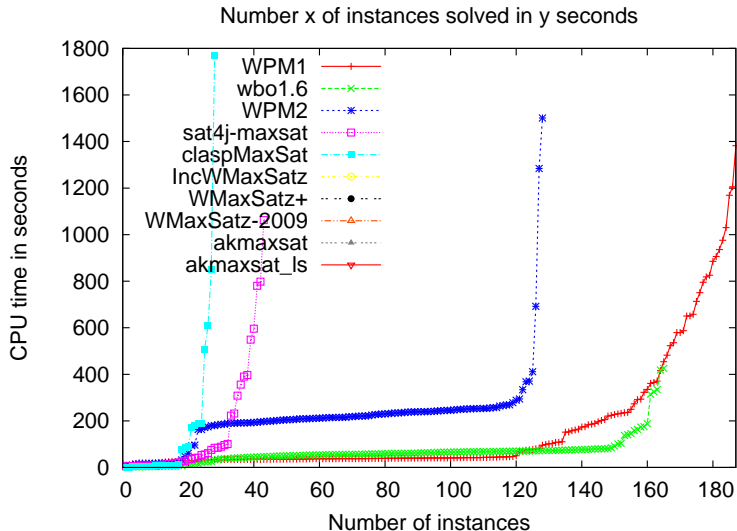
Weighted Partial Max-SAT category (Crafted)



Weighted Partial Max-SAT category (Industrial)

Rank	Solver	# Solved (226)	Total time
1	WPM1	187	30766.57
2	wbo1.6	165	11082.13
3	WPM2	128	27583.14
4	sat4j-maxsat	43	6778.05
5	claspMaxSat	28	4814.65
6	IncWMaxSatz	0	0.00
7	WMaxSatz+	0	0.00
8	WMaxSatz-2009	0	0.00
9	akmaxsat	0	0.00
10	akmaxsat_ls	0	0.00

Weighted Partial Max-SAT category (Industrial)



Web page

- Max-SAT Evaluation 2011 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 of 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 to use its cluster

We encourage you to participate in the [Max-SAT Evaluation 2012!](#)