

Max-SAT Evaluation 2010

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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 1/2

- Max-SAT
 - Random (300 instances)
 - Crafted (167 instances)
 - Industrial (77 instances)
- Weighted Max-SAT
 - Random (200 instances, contributed by Adrian Kuegel)
 - Crafted (149 instances)
 - Industrial (0 instances)

The integer limit has been incremented from 2^{31} to 2^{63}

Categories 2/2

- Partial Max-SAT
 - Random (240 instances)
 - Crafted (385 instances)
 - Industrial (497 instances)
- Weighted Partial Max-SAT
 - Random (150 instances)
 - Crafted (378 instances)
 - Industrial (132 instances, contributed by R. J. Asín)

The integer limit has been incremented from 2^{31} to 2^{63}

Solvers

- **akmaxsat and akmaxsat_Is** (Adrian Kuegel)
- **SAT4J MAXSAT 2.2.0** (Daniel Le Berre)
- **QMaxSAT** (Miyuki Koshimura, Tong Zhang)
- **IncMaxSatz** (Han Lin, Kaile Su, Chu Min Li)
- **IncWMaxSatz** (H. Lin, K. Su, C. M. Li, J. Argelich)
- **Maxsat_Power and WMaxsat_Power** (A. Bahrami, S. R. Mousavi, M. Farshchian)
- **LS_Power and LSW_Power** (A. Bahrami, S. R. Mousavi, M. Farshchian)
- **wbo 1.4a and wbo 1.4b** (V. Manquinho, J. Marques-Silva, J. Planes)
- **PM2, WPM1 and WPM2** (C. Ansótegui, M. L. Bonet, J. Levy)
- **WMaxSatz-2009 and WMaxSatz+** (C. M. Li, F. Manyà, J. Argelich)

Evaluation Environment

Web page:

- Re-designed and developed by F. Guitart

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

2 Evaluation structure

3 Results

- Max-SAT
- Weighted Max-SAT
- Partial Max-SAT
- Weighted Partial Max-SAT

Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- SAT4J MAXSAT 2.2.0
- IncMaxSatz
- Maxsat_Power
- LS_Power
- wbo 1.4a
- PM2 and WPM1
- 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

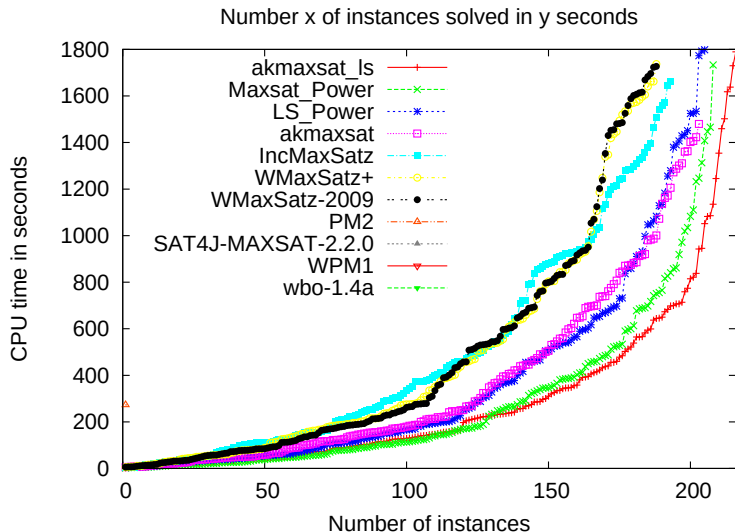
Industrial

- Circuit Debugging Problems

Max-SAT category (Random)

Rank	Solver	# Solved (300)	Total time
1	akmaxsat_ls	216	61620.59
2	Maxsat_Power	208	56371.84
3	LS_Power	205	73651.22
4	akmaxsat	203	71956.42
5	IncMaxSatz	193	90861.21
6	WMaxSatz+	188	83723.59
7	WMaxSatz-2009	188	83932.80
8	PM2	1	272.94
9	SAT4J-MAXSAT-2.2.0	0	0.00
10	WPM1	0	0.00
11	wbo-1.4a	0	0.00

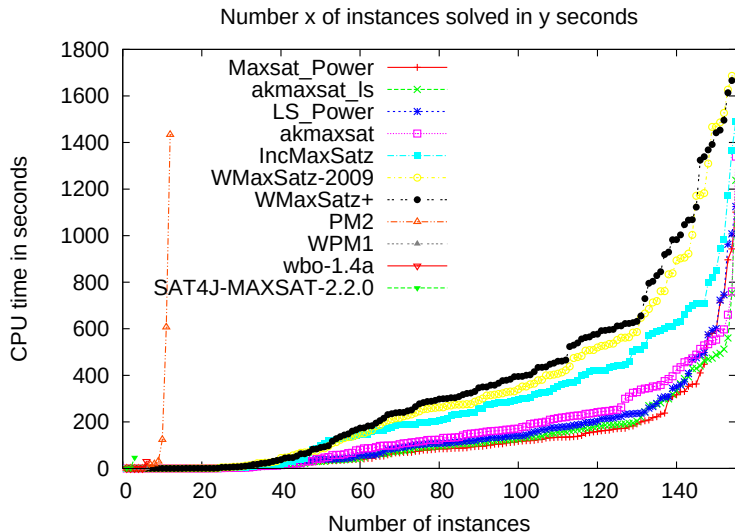
Max-SAT category (Random)



Max-SAT category (Crafted)

Rank	Solver	# Solved (167)	Total time
1	Maxsat_Power	155	19614.63
2	akmaxsat_ls	155	20172.95
3	LS_Power	155	23242.63
4	akmaxsat	155	25783.10
5	IncMaxSatz	155	41408.08
6	WMaxSatz-2009	154	51917.66
7	WMaxSatz+	154	56582.94
8	PM2	12	2237.35
9	WPM1	6	0.75
10	wbo-1.4a	6	30.60
11	SAT4J-MAXSAT-2.2.0	3	48.62

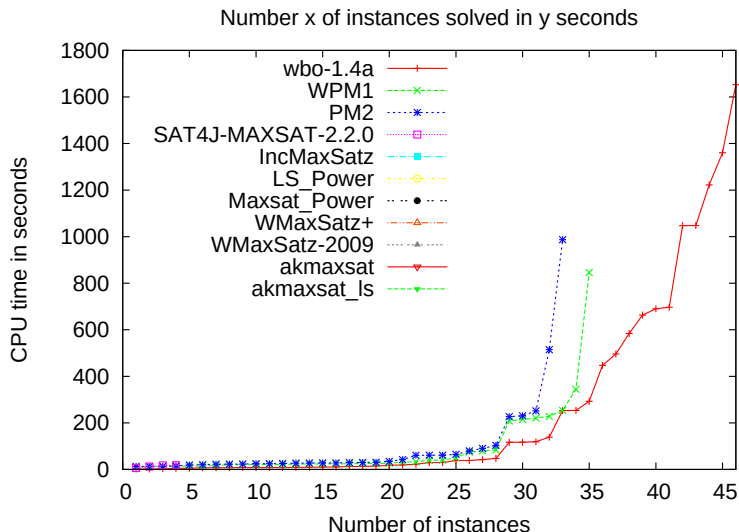
Max-SAT category (Crafted)



Max-SAT category (Industrial)

Rank	Solver	# Solved (77)	Total time
1	wbo-1.4a	46	11632.72
2	WPM1	35	3141.85
3	PM2	33	3245.24
4	SAT4J-MAXSAT-2.2.0	4	53.58
5	IncMaxSatz	0	0.00
6	LS_Power	0	0.00
7	Maxsat_Power	0	0.00
8	WMaxSatz+	0	0.00
9	WMaxSatz-2009	0	0.00
10	akmaxsat	0	0.00
11	akmaxsat_ls	0	0.00

Max-SAT category (Industrial)



Weighted Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- SAT4J MAXSAT 2.2.0
- IncWMaxSatz
- WMaxsat_Power
- LSW_Power
- wbo 1.4a
- WPM1 and WPM2
- WMaxSatz-2009 and WMaxSatz+

Weighted Max-SAT category (Benchmarks)

Random

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

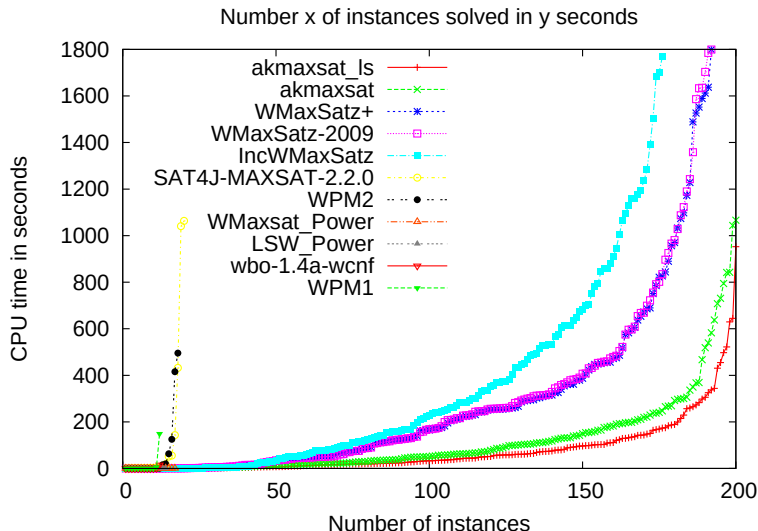
Crafted

- FRB
- Weighted Max-Cut
- Ramsey

Weighted Max-SAT category (Random)

Rank	Solver	# Solved (200)	Total time
1	akmaxsat_ls	200	15828.80
2	akmaxsat	200	23883.88
3	WMaxSatz+	192	53405.00
4	WMaxSatz-2009	192	54374.22
5	IncWMaxSatz	176	55503.68
6	SAT4J-MAXSAT-2.2.0	20	2836.41
7	WPM2	18	1135.59
8	WMaxsat_Power	17	2.10
9	LSW_Power	14	1.95
10	wbo-1.4a	12	16.55
11	WPM1	12	155.03

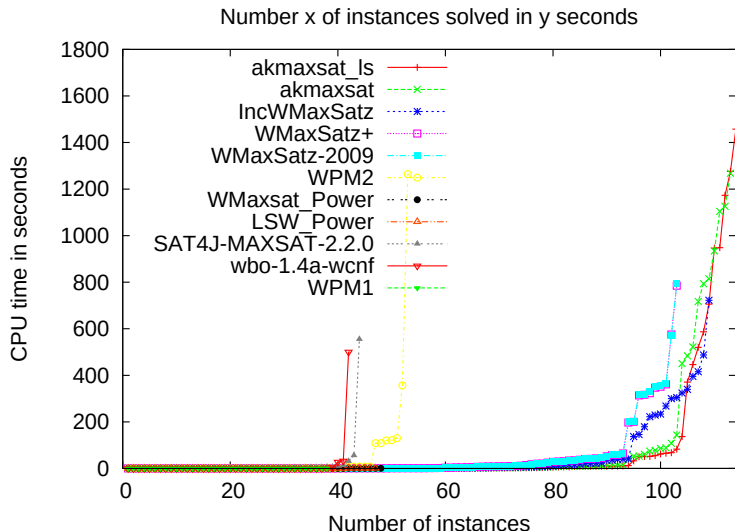
Weighted Max-SAT category (Random)



Weighted Max-SAT category (Crafted)

Rank	Solver	# Solved (149)	Total time
1	akmaxsat_ls	114	9253.35
2	akmaxsat	113	9208.90
3	IncWMaxSatz	109	5174.97
4	WMaxSatz+	103	4590.12
5	WMaxSatz-2009	103	4637.44
6	WPM2	53	2253.93
7	WMaxsat_Power	48	4.05
8	LSW_Power	47	3.56
9	SAT4J-MAXSAT-2.2.0	44	734.81
10	wbo-1.4a	42	565.64
11	WPM1	38	1.94

Weighted Max-SAT category (Crafted)



Partial Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- SAT4J MAXSAT 2.2.0
- QMaxSAT
- IncWMaxSatz
- WMaxsat_Power
- LSW_Power
- wbo 1.4a and wbo 1.4b
- PM2 and WPM1
- 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

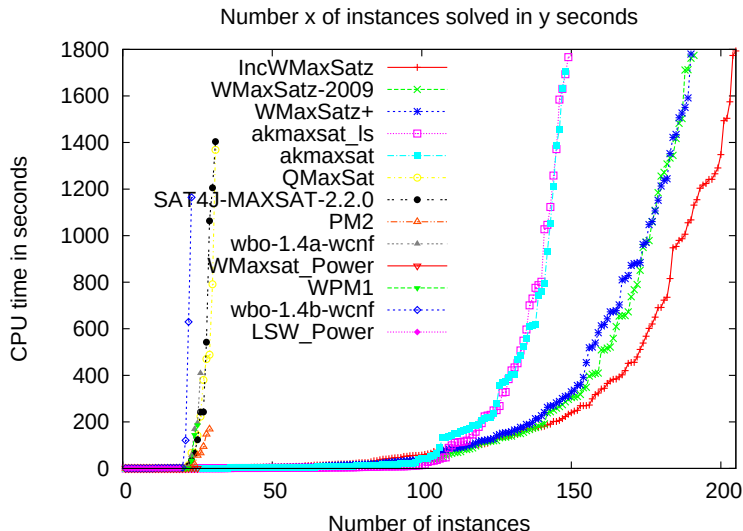
Industrial

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

Partial Max-SAT category (Random)

Rank	Solver	# Solved (240)	Total time
1	IncWMaxSatz	205	50494.05
2	WMaxSatz-2009	191	44061.89
3	WMaxSatz+	190	45490.82
4	akmaxsat_ls	149	23937.20
5	akmaxsat	148	22315.56
6	QMaxSat	31	4011.76
7	SAT4J-MAXSAT-2.2.0	31	4954.78
8	PM2	29	557.82
9	wbo-1.4a	26	835.82
10	WMaxsat_Power	25	2.56
11	WPM1	25	366.22
12	wbo-1.4b	23	1937.41
13	LSW_Power	19	1.08

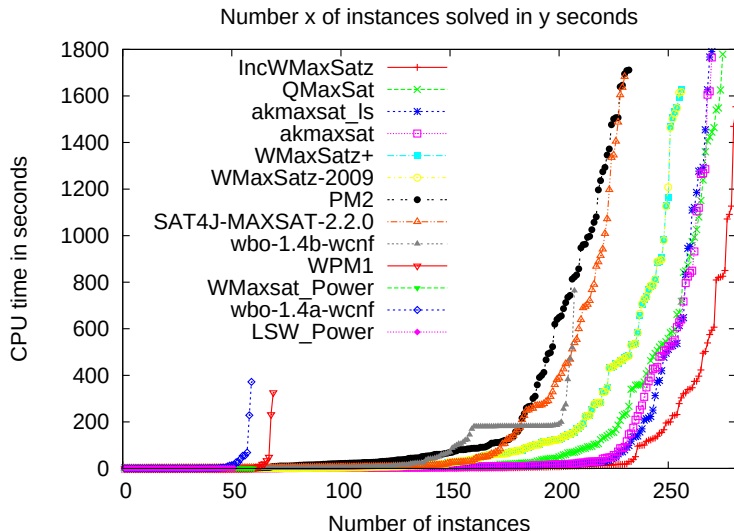
Partial Max-SAT category (Random)



Partial Max-SAT category (Crafted)

Rank	Solver	# Solved (385)	Total time
1	IncWMaxSatz	281	21224.66
2	QMaxSat	275	40512.55
3	akmaxsat_ls	270	27570.98
4	akmaxsat	270	28227.85
5	WMaxSatz+	256	36896.57
6	WMaxSatz-2009	256	36904.74
7	PM2	232	50081.30
8	SAT4J-MAXSAT-2.2.0	230	34948.91
9	wbo-1.4b	207	12385.53
10	WPM1	69	721.16
11	WMaxsat_Power	60	12.51
12	wbo-1.4a	59	938.83
13	LSW_Power	51	9.85

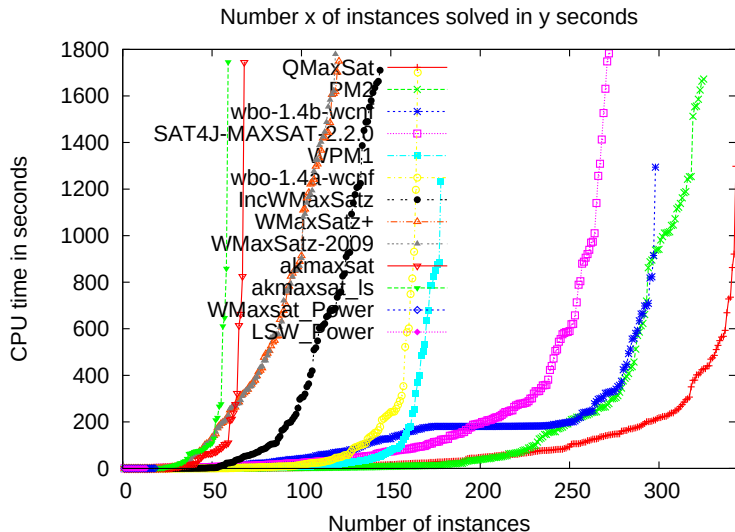
Partial Max-SAT category (Crafted)



Partial Max-SAT category (Industrial)

Rank	Solver	# Solved (497)	Total time
1	QMaxSat	343	31715.10
2	PM2	325	58331.10
3	wbo-1.4b	298	43702.20
4	SAT4J-MAXSAT-2.2.0	272	49221.09
5	WPM1	178	13612.23
6	wbo-1.4a	165	13718.03
7	IncWMaxSatz	144	45952.50
8	WMaxSatz+	121	53284.35
9	WMaxSatz-2009	119	50250.58
10	akmaxsat	68	6614.64
11	akmaxsat_ls	59	6367.70
12	WMaxsat_Power	18	1.71
13	LSW_Power	13	0.91

Partial Max-SAT category (Industrial)



Weighted Partial Max-SAT category (Solvers)

- akmaxsat and akmaxsat_ls
- SAT4J MAXSAT 2.2.0
- IncWMaxSatz
- WMaxsat_Power
- LSW_Power
- wbo 1.4a and wbo 1.4b
- WPM1 and WPM2
- WMaxSatz-2009 and WMaxSatz+

Weighted Partial Max-SAT category (Benchmarks)

Random

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

Crafted

- Random Networks
- Auctions
- PB miplib
- Weighted CSP
- Minimal Encodings

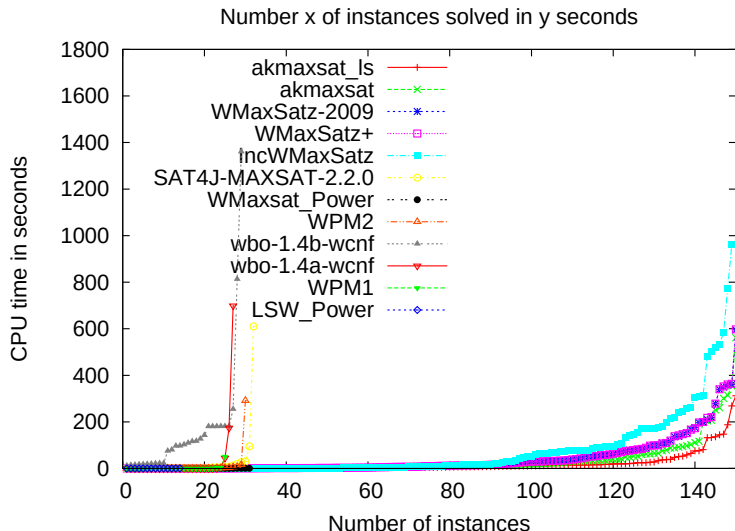
Industrial

- Upgradeability Problem
- Timetabling

Weighted Partial Max-SAT category (Random)

Rank	Solver	# Solved (150)	Total time
1	akmaxsat_ls	150	2931.73
2	akmaxsat	150	5325.69
3	WMaxSatz-2009	150	6732.18
4	WMaxSatz+	150	6737.04
5	IncWMaxSatz	149	10994.98
6	SAT4J-MAXSAT-2.2.0	32	836.85
7	WMaxsat_Power	31	2.84
8	WPM2	30	327.80
9	wbo-1.4b	29	4755.64
10	wbo-1.4a	27	924.06
11	WPM1	25	59.27
12	LSW_Power	14	1.30

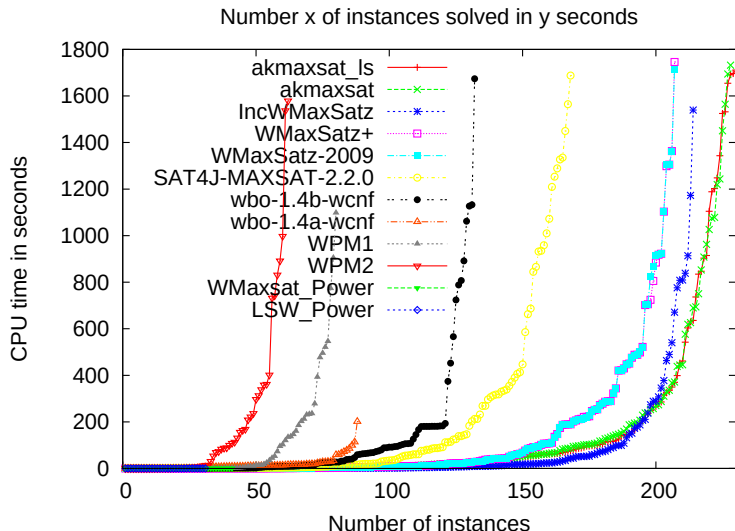
Weighted Partial Max-SAT category (Random)



Weighted Partial Max-SAT category (Crafted)

Rank	Solver	# Solved (378)	Total time
1	akmaxsat_ls	230	33380.89
2	akmaxsat	228	29926.57
3	IncWMaxSatz	214	14842.38
4	WMaxSatz+	207	25223.74
5	WMaxSatz-2009	207	25383.29
6	SAT4J-MAXSAT-2.2.0	168	29309.99
7	wbo-1.4b	132	14308.21
8	wbo-1.4a	88	1539.22
9	WPM1	80	8031.66
10	WPM2	62	11576.82
11	WMaxsat_Power	41	6.56
12	LSW_Power	31	4.70

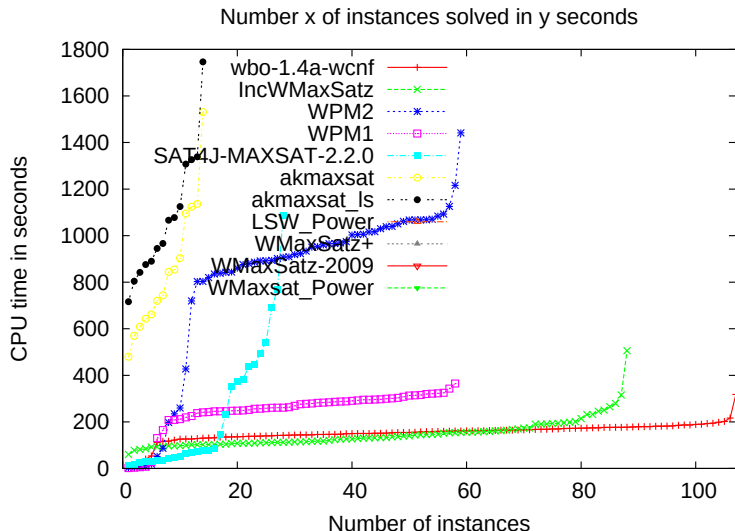
Weighted Partial Max-SAT category (Crafted)



Weighted Partial Max-SAT category (Industrial)

Rank	Solver	# Solved (132)	Total time
1	wbo-1.4a	107	16430.32
2	IncWMaxSatz	88	12940.69
3	WPM2	59	47778.67
4	WPM1	58	14409.93
5	SAT4J-MAXSAT-2.2.0	28	6725.52
6	akmaxsat	14	11914.41
7	akmaxsat_ls	14	15027.78
8	LSW_Power	0	0.00
9	WMaxSatz+	0	0.00
10	WMaxSatz-2009	0	0.00
11	WMaxsat_Power	0	0.00

Weighted Partial Max-SAT category (Industrial)



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 2011](#)