

Max-SAT Evaluation 2008

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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 do more research on Max-SAT
- Gain new insights for future evaluations

Categories

- Max-SAT (Random / Crafted / Industrial)
- Partial Max-SAT (Random / Crafted / Industrial)
- Weighted Max-SAT (Random / Crafted)
- Weighted Partial Max-SAT (Random / Crafted / Industrial)

Computational resources

Experiments performed on a Linux cluster with 2Ghz AMD Opteron processors with 1Gb of RAM provided by the Universitat de Lleida

Solvers

- **Clone**: Knot Pipatsrisawat, Akop Palyan, Mark Chavira, Arthur Choi, Adnan Darwiche
- **IncMaxSatz, IncWMaxSatz**: Han Lin, Kaile Su, Chu Min Li, Josep Argelich
- **LB-SAT, LB-PSAT**: Han Li, Kaile Su
- **Maxsatz**: Chu Min Li, Felip Manyà, Jordi Planes
- **Maxsatzilla**: Paulo Matos, Jordi Planes, Florian Letombe, Joao Marques-Silva
- **MiniMaxSAT**: Federico Heras, Javier Larrosa, Albert Oliveras
- **MSU1.2, MSU4.0**: Joao Marques-Silva, Jordi Planes
- **PMS**: Felip Manyà, Josep Argelich
- **SAT4J MAXSAT**: Daniel Le Berre
- **Toolbar3**: Simon de Givry, Federico Heras, Javier Larrosa, Thomas Schiex
- **W-MaxSatz**: Chu Min Li, Felip Manyà, Josep Argelich
- **wmaxsatz_icss**: Sylvain Darras, Gilles Dequen, Laure Devendeville, Chu Min Li

Benchmarks

- Max-SAT (529 instances) Timeout of 1200 sec.
 - Random (310 instances)
 - Crafted (107 instances)
 - Industrial (112 instances)
- Partial Max-SAT (1398 instances) Timeout of 1200 sec.
 - Random (150 instances)
 - Crafted (298 instances)
 - Industrial (1950 instances)

Benchmarks

- Weighted Max-SAT (340 instances) Timeout of 1200 sec.
 - Random (170 instances)
 - Crafted (170 instances)
- Weighted Partial Max-SAT (1108 instances) Timeout of 1200 sec.
 - Random (150 instances)
 - Crafted (946 instances)
 - Industrial (12 instances)

Max-SAT Category Solvers

- IncMaxSatz
- LB-SAT
- MaxSatz
- Maxsatzilla
- MiniMaxSAT
- MSU1.2
- MSU4.0
- PMS
- SAT4JMAXSAT
- Toolbar3
- W-MaxSatz
- wmaxsatz_icss

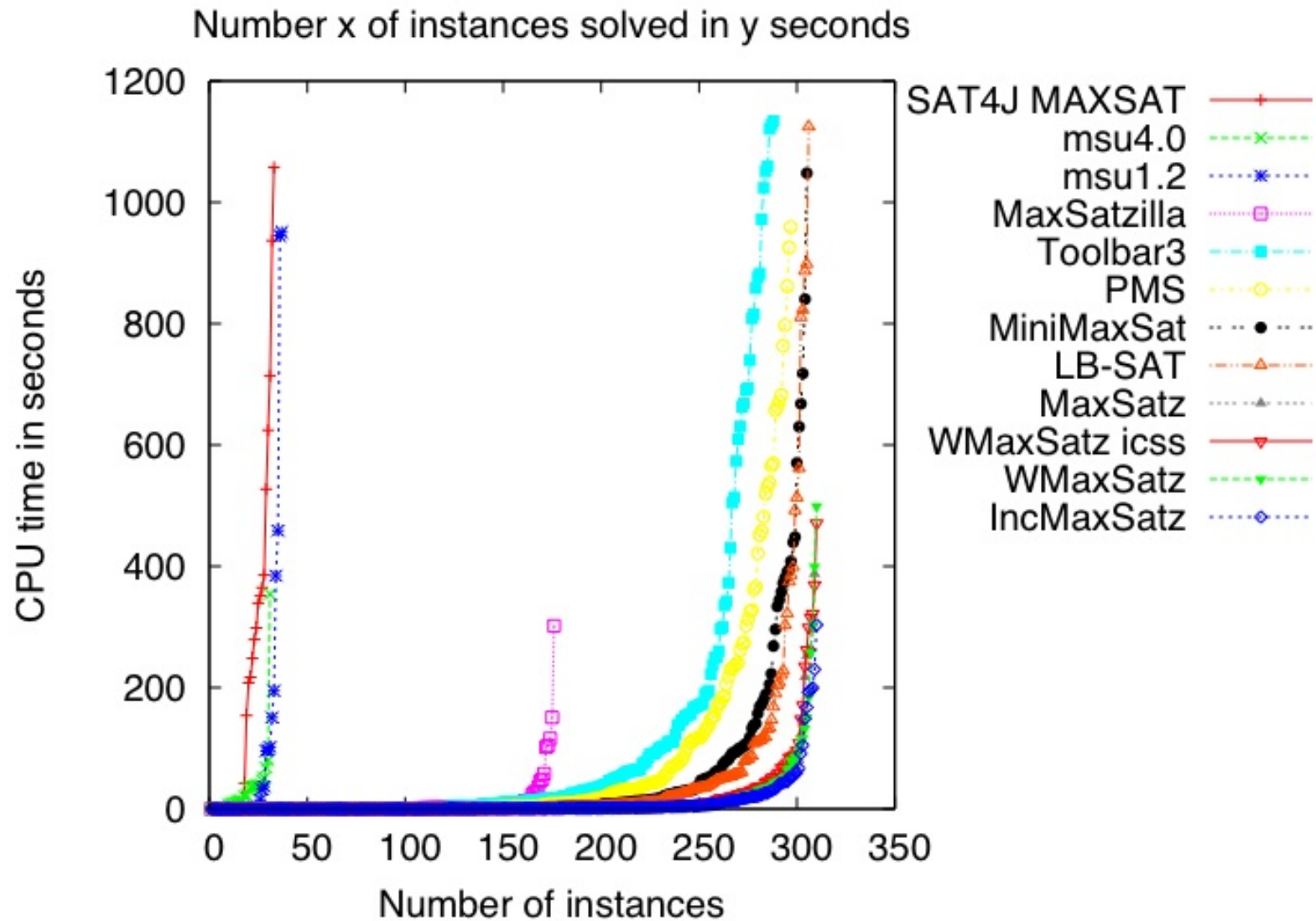
Max-SAT Category Benchmarks

- Random
 - Max-2-SAT instances (from previous evaluations)
 - Max-3-SAT instances (from previous evaluations)
- Crafted
 - Max-Cut instances (from previous evaluations)
- Industrial
 - Instances submitted by Sean Safarpour

Random Max-SAT

Instance set	#	IncMaxSatz	LB-SAT	MaxSatz	Maxsatzilla	MiniMaxSAT	MSU1.2
MAX2SAT/100VARS/	50	1.10 (50)	13.69(50)	0.52 (50)	2.60 (50)	11.97(50)	32.42(3)
MAX2SAT/140VARS/	50	10.48(50)	145.31(47)	4.90 (50)	23.72 (50)	97.23(49)	120.23(8)
MAX2SAT/60VARS/	50	0.03 (50)	0.12 (50)	0.01 (49)	0.25 (50)	0.20 (50)	0.00 (0)
MAX3SAT/40VARS/	40	0.74 (40)	1.22 (40)	1.06 (40)	1.57 (24)	3.34 (40)	243.07(2)
MAX3SAT/50VARS/	40	4.45 (40)	7.84 (40)	6.20 (40)	4.49 (2)	25.76(40)	409.16(4)
MAX3SAT/60VARS/	40	11.84(40)	24.09(40)	16.07(40)	0.00 (0)	73.77(40)	28.84(10)
MAX3SAT/70VARS/	40	45.40(40)	97.43(39)	59.97(40)	0.00 (0)	123.86(36)	0.20 (10)
Instance set	#	MSU4.0	PMS	SAT 4J MAXSAT	Toolbar3	W-MaxSatz	wmaxsatz icss
MAX2SAT/100VARS/	50	0.00 (0)	55.05(50)	0.00 (0)	40.05(50)	1.42 (50)	1.98 (50)
MAX2SAT/140VARS/	50	3.58 (2)	122.76(41)	78.47(2)	189.75(43)	11.42(50)	17.02(50)
MAX2SAT/60VARS/	50	0.00 (0)	0.25 (50)	0.00 (0)	0.73 (50)	0.11 (50)	0.04 (50)
MAX3SAT/40VARS/	40	38.86(5)	9.45 (40)	700.51(4)	7.25 (40)	1.30 (40)	1.19 (40)
MAX3SAT/50VARS/	40	90.50(7)	58.09(40)	416.28(7)	58.46(40)	7.29 (40)	7.07 (40)
MAX3SAT/60VARS/	40	10.32(7)	128.21(40)	91.46(10)	252.76(39)	17.58(40)	18.73(40)
MAX3SAT/70VARS/	40	7.77 (10)	151.07(36)	1.49 (10)	212.75(26)	59.26(40)	72.15(40)

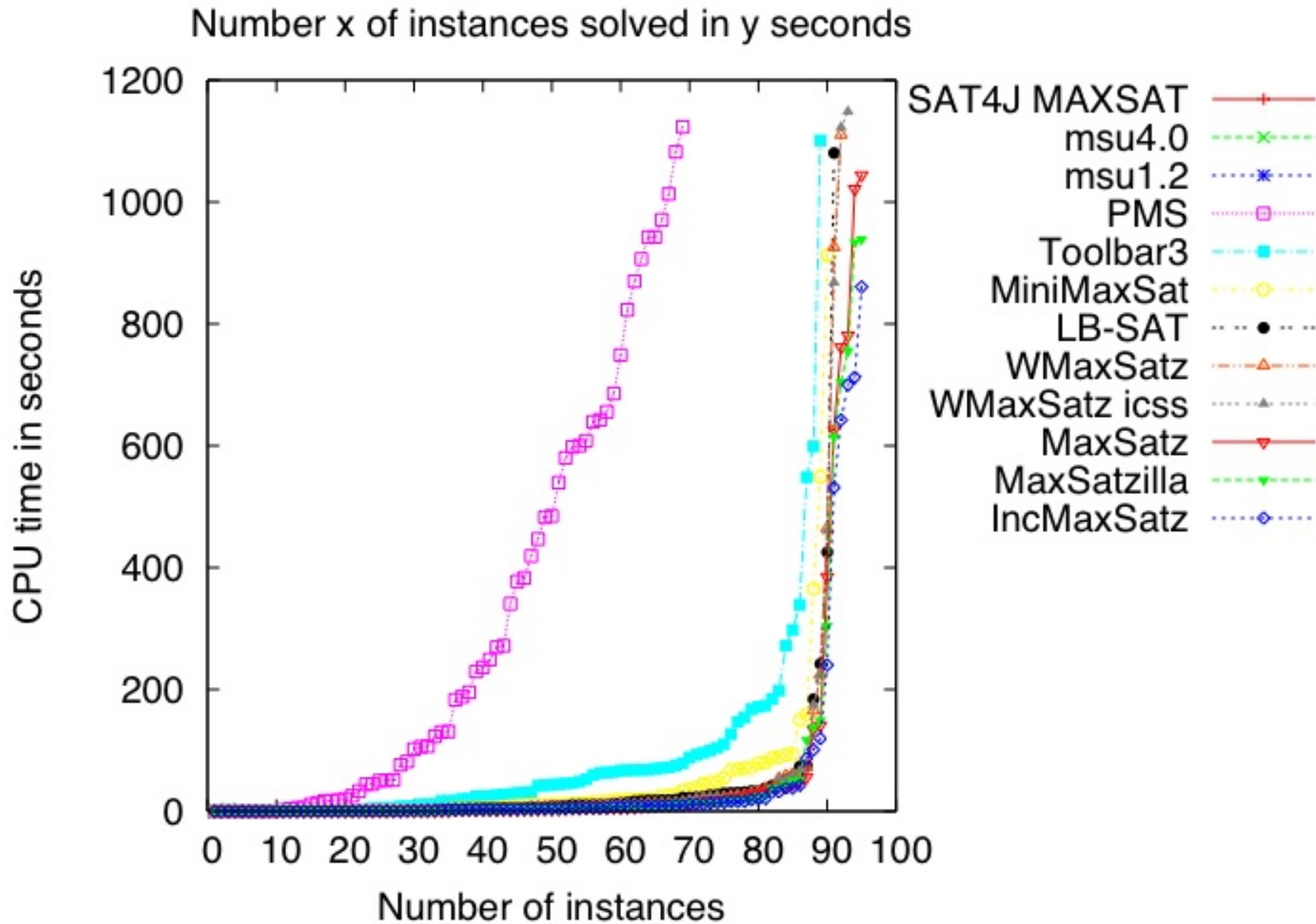
Random Max-SAT



Crafted Max-SAT

Instance set	#	IncMaxSatz	LB-SAT	MaxSatz	Maxsatzilla	MiniMaxSAT	MSU1.2
MAXCUT/DIMACS_MOD/	62	81.86(52)	53.22(48)	103.46(52)	95.51 (52)	65.27(47)	0.28 (4)
MAXCUT/RANDOM/	40	5.43 (40)	10.67(40)	4.52 (40)	5.96 (40)	15.87(40)	0.00 (0)
MAXCUT/SPINGLASS/	5	28.98(3)	7.54 (3)	13.18(3)	45.97 (3))	1.62 (3)	0.68 (2)
Instance set	#	MSU4.0	PMS	SAT 4 J MAXSAT	Toolbar3	W-mMaxSatz	wmaxsatz_icss
MAXCUT/DIMACS_MOD/	62	1.71 (3)	277.62(42)	0.93 (2)	97.76(47)	71.34(49)	92.20(50)
MAXCUT/RANDOM/	40	0.00 (0)	373.81(25)	0.00 (0)	55.90(40)	7.76 (40)	8.51 (40)
MAXCUT/SPINGLASS/	5	0.00 (0)	0.41 (2)	0.00 (0)	5.76 (2)	3.87 (3)	5.95 (3)

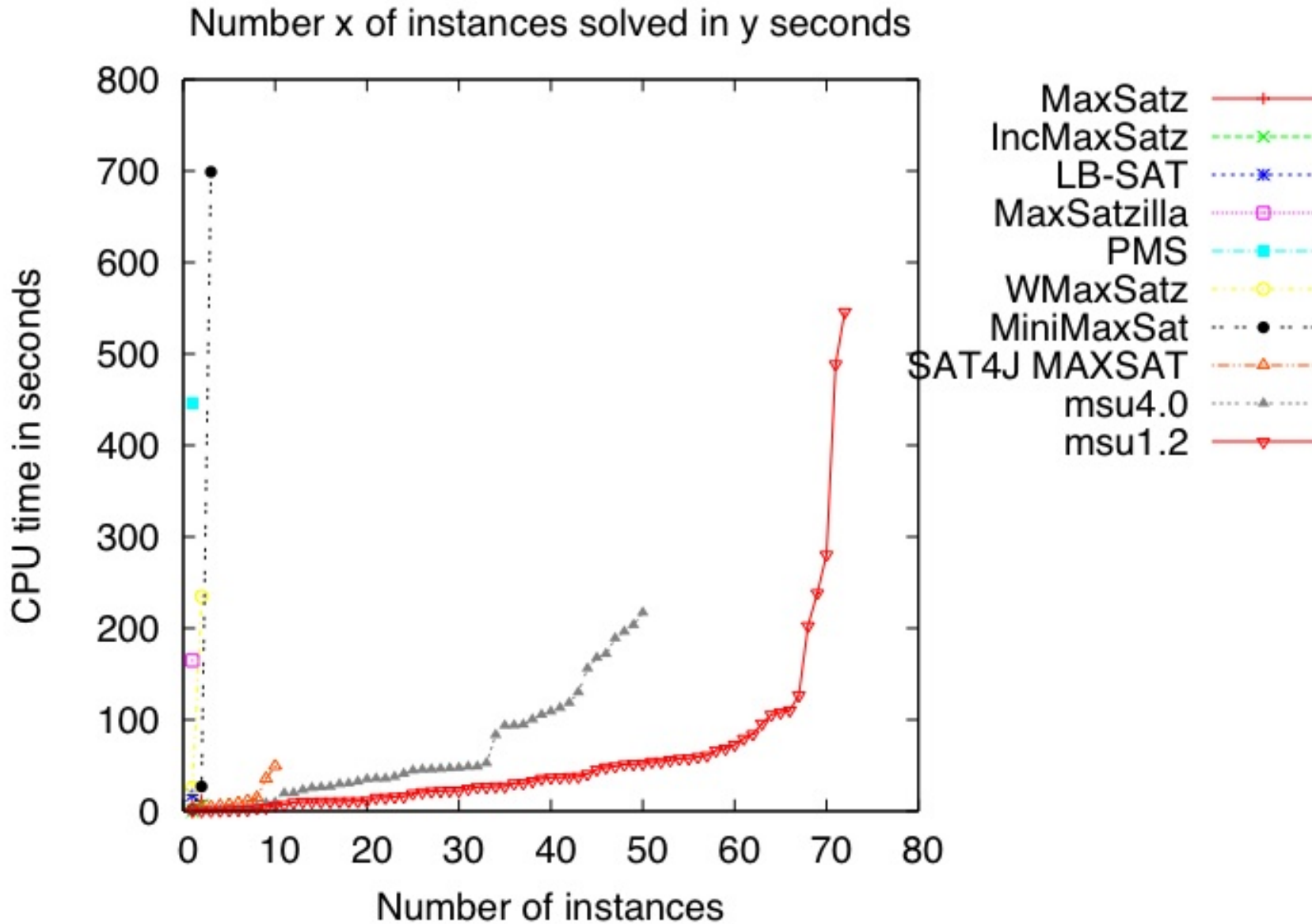
Crafted Max-SAT



Industrial Max-SAT

Instance set	#I	IncMaxSatz	LB-SAT	MaxSatz	Maxsatzilla	MiniMaxSAT	MSU1.2
SeanSafarpour/	112	3.60 (2)	17.58(1)	5.91 (2)	164.73 (1)	242.81(3)	57.54(72)
Instance set	#I	MSU4.0	PMS	SAT4J MAXSAT	Toolbar3	W-MaxSatz	wmaxsatz_icss
SeanSafarpour/	112	64.37(50)	445.98(1)	14.55(10)	0.00 (0)	130.38(2)	0.00 (0)

Industrial Max-SAT



Partial Max-SAT Category Solvers

- Clone
- IncWMaxSatz
- LB-PSAT
- MiniMaxSAT
- MSU1.2
- MSU4.0
- PMS
- SAT4JMAXSAT
- Toolbar3
- W-MaxSatz
- wmaxsatz_icss

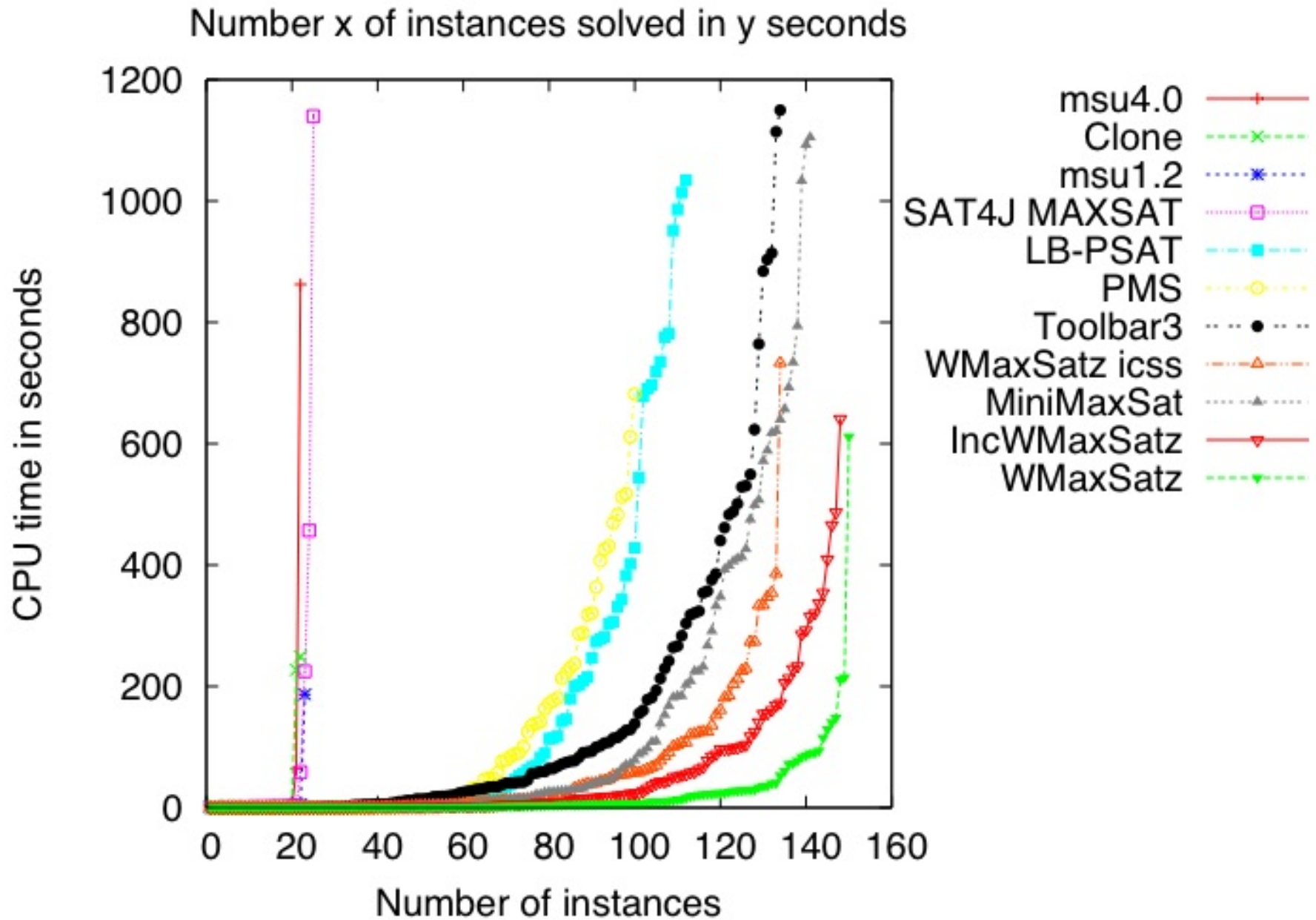
Partial Max-SAT Category Benchmarks

- Random
 - Partial Max-2-SAT (from previous evaluations)
 - Partial Max-3-SAT (from previous evaluations)
- Crafted
 - Max-Clique (from previous evaluations)
 - Max-One (from previous evaluations)
- Industrial
 - Instances submitted by Joao Marques-Silva

Random Partial Max-SAT

Instance set	#	Clone	IncWMaxSatz	LB-PSAT	MiniMaxSAT	MSU1.2	MSU4.0
PMax2SAT/	90	0.00 (0)	39.91(89)	229.92(53)	108.91(83)	0.00 (0)	0.00 (0)
PMax3SAT/	60	23.87(22)	77.71(59)	59.37(59)	155.94(58)	8.64 (23)	42.30(22)
Instance set	#	SAT4J MAXSAT	PMS	Toolbar3	W-MaxSatz	wmaxsatz_icss	
PMax2SAT/	90	3.37 (1)	109.75(41)	135.06(88)	13.27(90)	54.99(74)	
PMax3SAT/	60	79.55(24)	80.79(59)	145.48(46)	34.75(60)	56.24(60)	

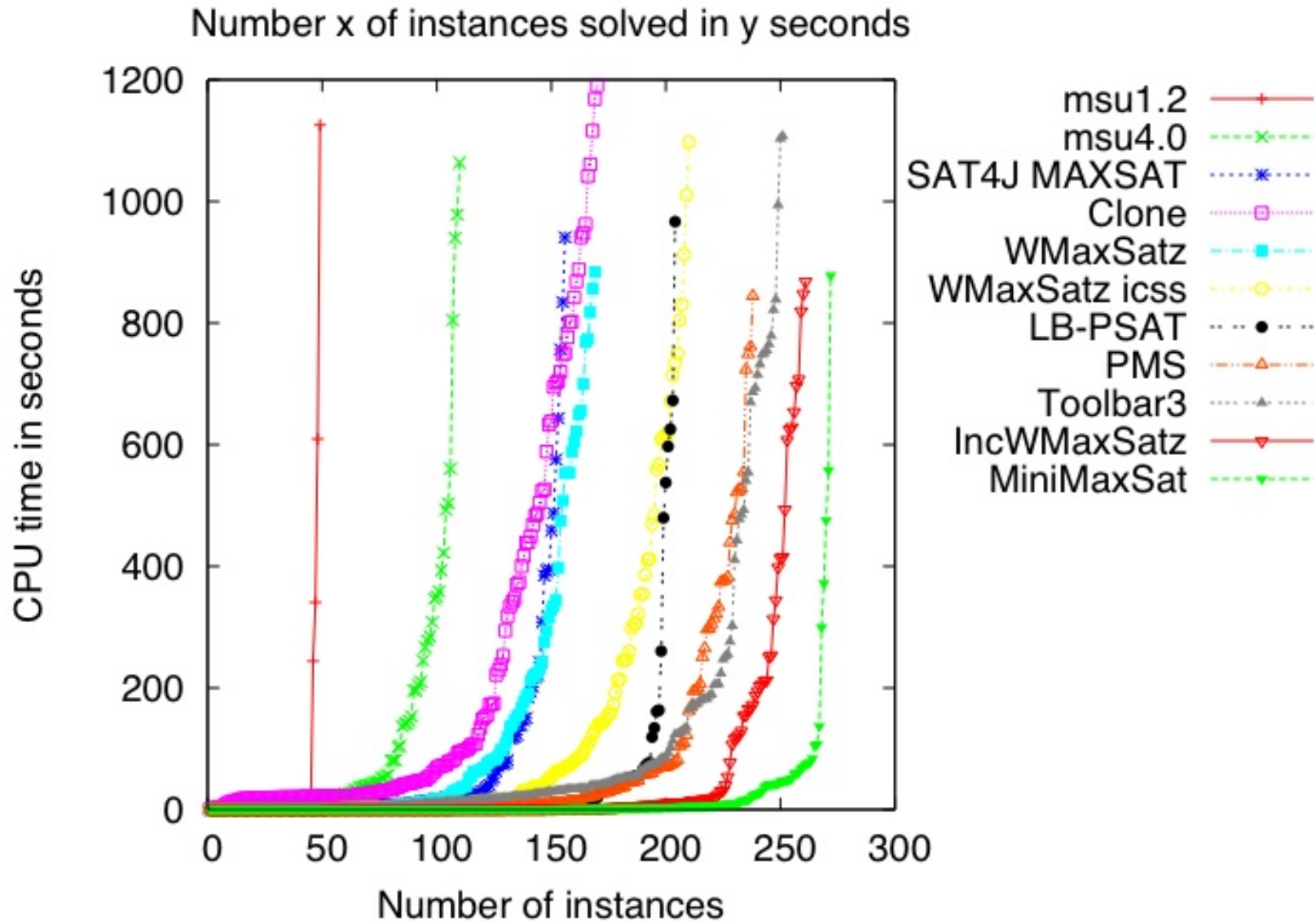
Random Partial Max-SAT



Crafted Partial Max-SAT

Instance set	#I	Clone	IncWMaxSatz	LB-PSAT	MiniMaxSAT	MSU1.2	MSU4.0
MAXCLIQUE/RANDOM/	96	129.92(79)	3.71 (96)	9.77 (96)	2.40 (96)	0.00 (0)	105.97(61)
MAXCLIQUE/STRUCTURED/	62	199.10(14)	132.20(35)	124.40(32)	73.02(36)	4.90 (7)	105.21(13)
MAXONE/3SAT/	80	331.11(46)	0.46 (80)	18.22(74)	1.28 (80)	52.86(40)	118.24(35)
MAXONE/STRUCTURED/	60	163.19(31)	156.09(50)	2.28 (2)	30.48(60)	122.70(2)	3.34 (1)
Instance set	#I	PMS	Toolbar3	SAT4J MAXSAT	W-MaxSatz	wmaxsat_iccs	
MAXCLIQUE/RANDOM/	96	68.11(96)	11.73(96)	113.94(52)	48.33(67)	44.24(80)	
MAXCLIQUE/STRUCTURED/	62	169.41(27)	155.65(31)	50.46(13)	121.85(22)	120.64(22)	
MAXONE/3SAT/	80	4.20 (80)	107.61(80)	96.67(31)	109.50(51)	157.39(75)	
MAXONE/STRUCTURED/	60	88.40(35)	226.73(44)	10.04(60)	218.08(29)	85.31(33)	

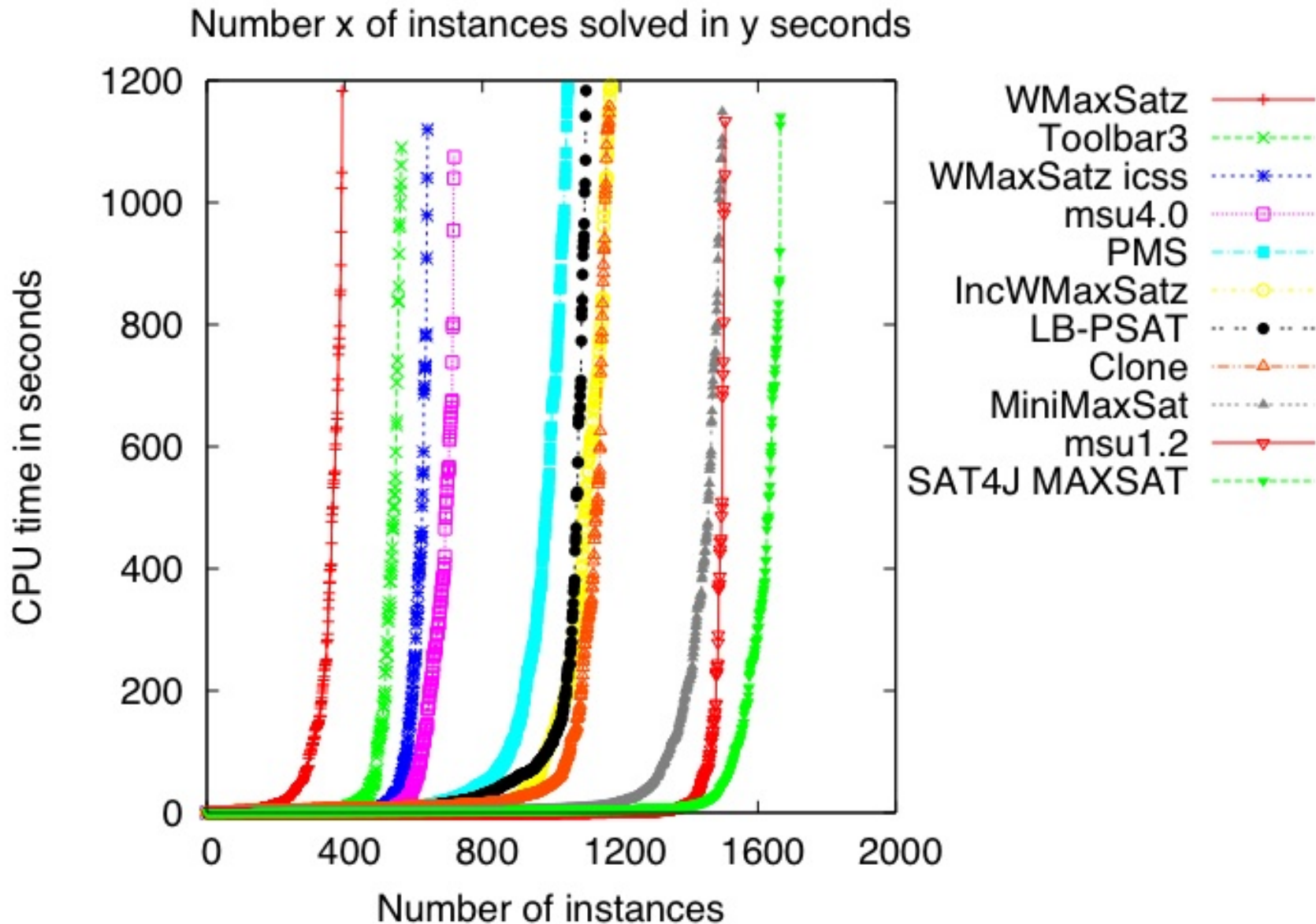
Crafted Partial Max-SAT



Industrial Partial Max-SAT

Instance set	#	Clone	IncWMaxSatz	LB-PSAT	MiniMaxSAT	MSU1.2	MSU4.0
bcp-fir/	59	144.14(8)	227.14(34)	93.90(21)	258.44(14)	49.16(46)	0.00 (0)
bcp-hipp-yRa1/	1183	30.43(858)	51.76(777)	47.64(851)	23.40(977)	7.18 (1105)	0.29 (348)
bcp-msp/	148	72.40(89)	61.61(99)	64.16(32)	48.95(104)	4.84 (25)	22.96(79)
bcp-mtg/	215	42.04(103)	34.76(140)	48.78(163)	25.75(206)	17.51(164)	0.43 (22)
bcp-syn/	74	183.06(23)	100.95(31)	63.46(34)	70.65(28)	51.15(31)	105.24(11)
pbo-mqc/nencdr/	128	0.00 (0)	417.93(29)	0.00 (0)	190.52(60)	50.36(54)	167.53(115)
pbo-mqc/nlogencdr/	128	285.18(84)	306.55(59)	0.00 (0)	194.34(95)	53.01(65)	110.86(128)
pbo-routing/	15	11.08(5)	25.94(5)	0.00 (0)	116.09(13)	2.89 (15)	54.91(15)
Instance set	#	PMS	Toolbar3	SAT 4J MAXSAT	W-MaxSatz	wmaxsatz_icss	
bcp-fir/	59	91.63(12)	110.20(5)	13.36(10)	44.09(1)	13.75(6)	
bcp-hipp-yRa1/	1183	67.93(710)	56.61(418)	12.20(1109)	84.33(270)	45.01(444)	
bcp-msp/	148	70.56(85)	52.07(60)	8.78 (93)	81.33(59)	41.31(87)	
bcp-mtg/	215	73.75(172)	62.58(68)	57.03(196)	25.31(34)	20.49(82)	
bcp-syn/	74	58.37(29)	69.84(14)	67.38(21)	109.08(7)	74.66(21)	
pbo-mqc/nencdr/	128	661.86(4)	0.00 (0)	180.58(102)	645.37(6)	0.00 (0)	
pbo-mqc/nlogencdr/	128	482.98(32)	0.00 (0)	117.66(126)	426.50(14)	0.00 (0)	
pbo-routing/	15	33.32(5)	0.00 (0)	26.45(9)	94.42(2)	18.47(1)	

Industrial Partial Max-SAT



Weighted Max-SAT Category Solvers

- Clone
- IncWMaxSatz
- LB-PSAT
- MiniMaxSAT
- Toolbar3
- W-MaxSatz
- wmaxsatz_icss
- SAT4J MAXSAT

Weighted Max-SAT Category Benchmarks

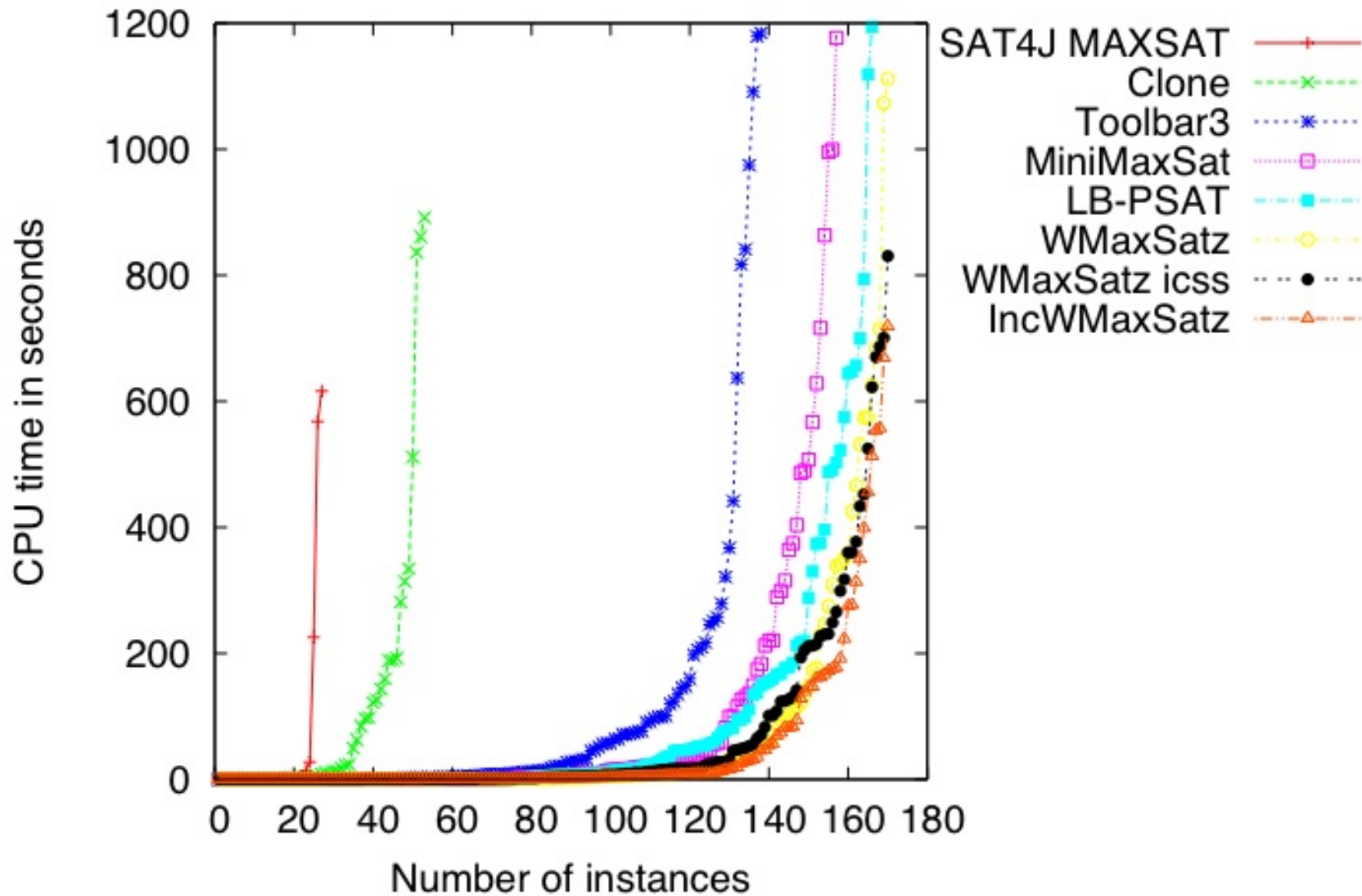
- Random
 - Weighted Max-2-SAT instances (from previous evaluations)
 - Weighted Max-3-SAT instances (from previous evaluations)
- Crafted
 - Instances provided by Ke Xu
 - Ramsey instances (from previous evaluations)
 - Weighted Max-Cut instances (from previous evaluations)

Random Weighted Max-SAT

Instance set	#I	Clone	IncWMaxsatz	LB-PSAT	MiniMaxSAT
WMAX2SAT/	90	98.28(30)	2.19 (90)	24.45(90)	10.58(90)
WMAX3SAT/	80	120.35(23)	100.21(80)	160.28(76)	171.40(67)
Instance set	#I	SAT4J MAXSAT	Toolbar3	W-MmaxSatz	wmaxsatz_icss
WMAX2SAT/	90	52.92(11)	35.72(90)	3.75 (90)	5.83 (90)
WMAX3SAT/	80	56.69(16)	194.49(48)	140.19(80)	131.01(80)

Random Weighted Max-SAT

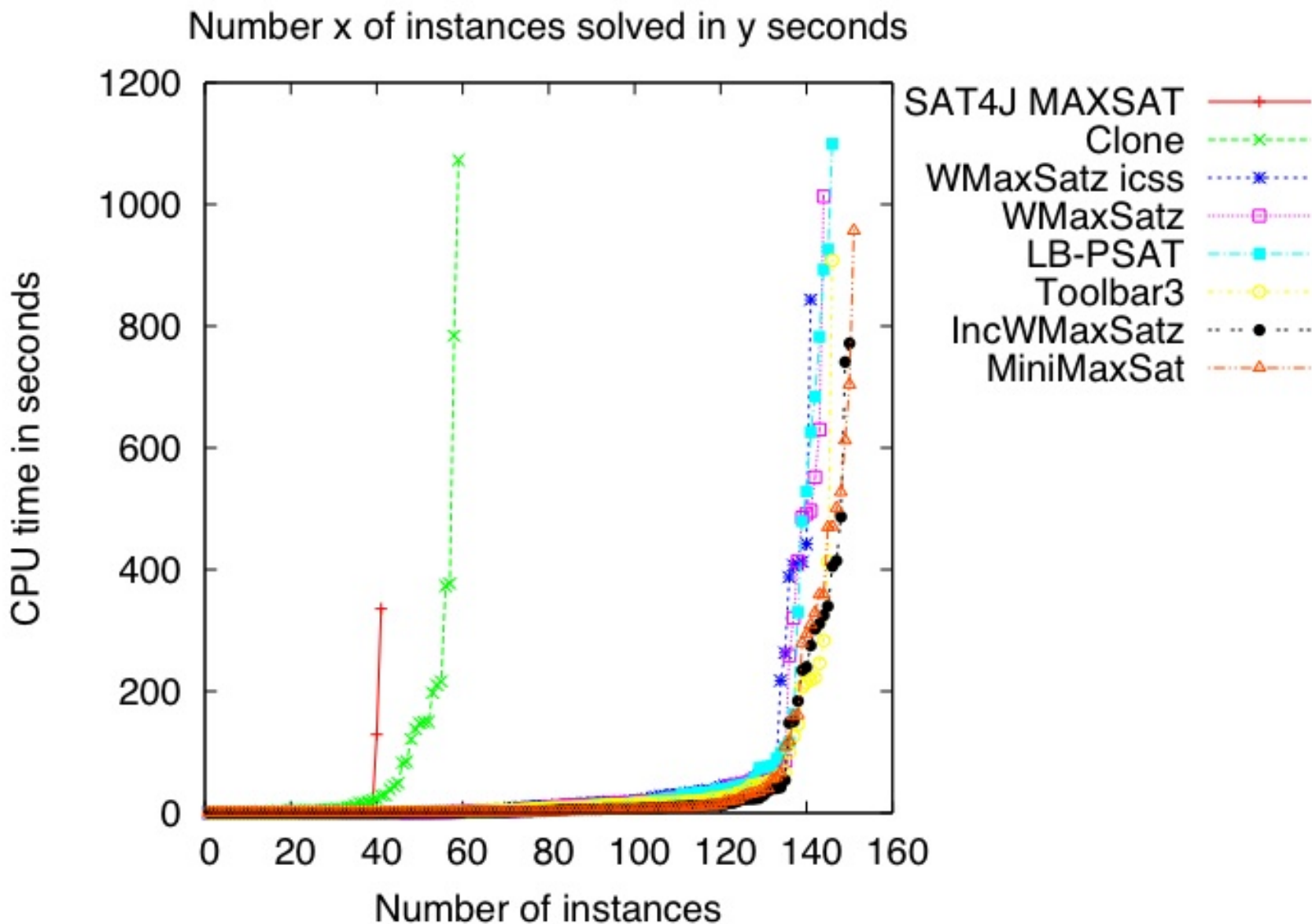
Number x of instances solved in y seconds



Crafted Weighted Max-SAT

Instance set	#I	Clone	IncWMaxsatz	LB-PSAT	MiniMaxSAT
KeXu/	15	72.65(9)	125.33(15)	153.63(12)	167.64(15)
RAMSEY/	48	30.81(27)	22.86(36)	1.63 (37)	12.78(37)
WMAXCUT/DIMACS_MOD/	62	143.83(21)	54.20(55)	106.37(54)	75.63(55)
WMAXCUT/RANDOM/	40	0.00 (0)	7.53 (40)	20.69(40)	5.43 (40)
WMAXCUT/SPINGLASS/	5	2.74 (2)	37.26(4)	2.93 (3)	27.59(4)
Instance set	#I	W-MaxSatz	SAT4J MAXSAT	Toolbar3	wmaxsatz_icss
KeXu/	15	22.11(10)	7.69 (4)	6.61 (10)	22.96(10)
RAMSEY/	48	15.80(37)	15.86(35)	4.90 (37)	2.68 (35)
WMAXCUT/DIMACS_MOD/	62	90.09(55)	0.84 (2)	59.11(56)	74.51(55)
WMAXCUT/RANDOM/	40	17.03(40)	0.00 (0)	16.16(40)	19.96(40)
WMAXCUT/SPINGLASS/	5	1.27 (2)	0.00 (0)	94.86(3)	0.03 (1)

Crafted Weighted Max-SAT



Weighted Partial Max-SAT Category Solvers

- Clone
- IncWMaxSatz
- LB-PSAT
- MiniMaxSAT
- Toolbar3
- W-MaxSatz
- wmaxsatz_icss
- SAT4J MAXSAT

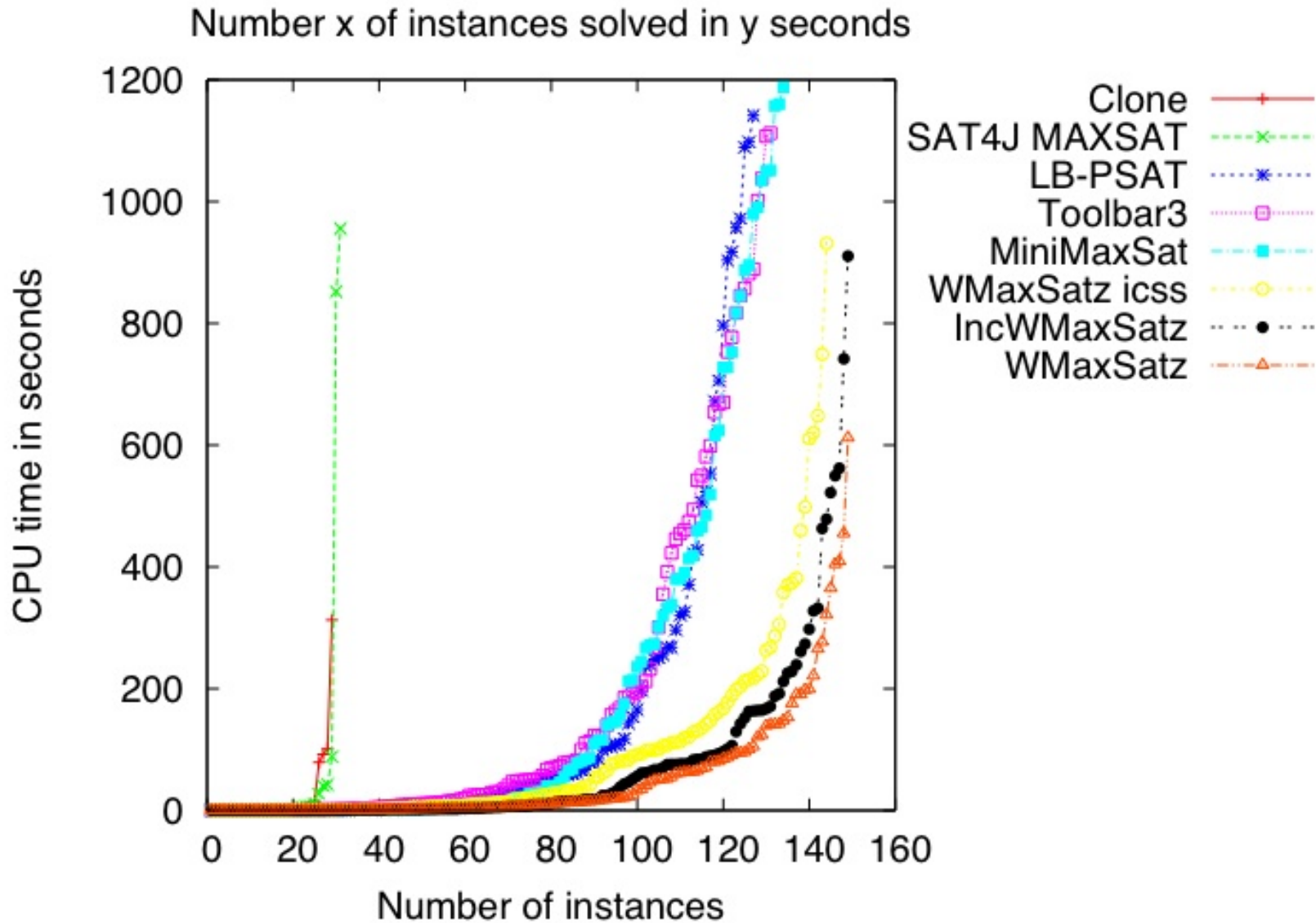
Weighted Partial Max-SAT Category Benchmarks

- Random
 - Weighted Partial Max-2-SAT (from previous evaluations)
 - Weighted Partial Max-3-SAT (from previous evaluations)
- Crafted
 - Auction instances (from previous evaluations)
 - Random Bayesian Network (provided by Knot Pipatsrisawat)
- Industrial
 - Protein instances (provided by Federico Heras)

Random Weighted Partial Max-SAT

Instance set	#I	Clone	IncWMaxsatz	LB-PSAT	MiniMaxSAT
WPMAX2SAT/	90	0.00 (0)	0.00 (0)	226.32(67)	206.02(78)
WPMAX3SAT/	60	23.11(29)	0.00 (0)	39.88(60)	152.80(56)
Instance set	#I	SAT4J MAXSAT	Toolbar3	W-MaxSatz	wmaxsatz_icss
WPMAX2SAT/	90	3.15 (1)	206.72(88)	56.59(89)	107.93(84)
WPMAX3SAT/	60	68.69(30)	105.24(43)	46.21(60)	66.30(60)

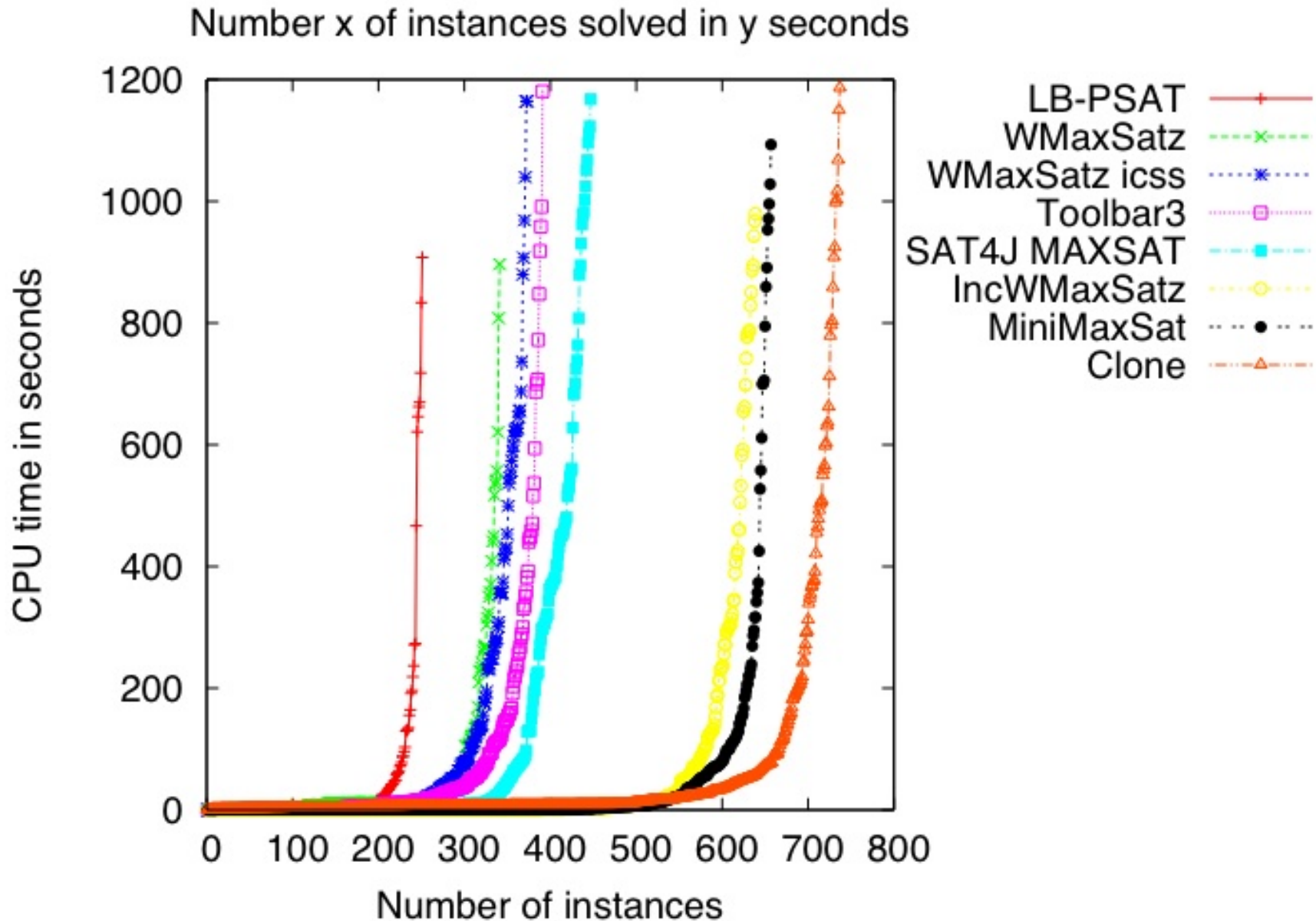
Random Weighted Partial Max-SAT



Crafted Weighted Partial Max-SAT

Instance set	#I	Clone	IncWMaxsatz	LB-PSAT	MiniMaxSAT
AUCTIONS/AUC_PATHS/	88	33.87(88)	8.41 (88)	34.19(63)	29.79(88)
AUCTIONS/AUC_REGIONS/	84	31.26(84)	1.94 (84)	2.00 (77)	1.70 (84)
AUCTIONS/AUC_SCHEDULING/	84	172.04(75)	96.70(81)	46.11(68)	46.21(84)
RANDOM-NET/	350	72.23 (236)	133.08(108)	158.77(13)	129.45(112)
PSEUDO/factor/	186	7.95 (186)	0.07 (186)	107.66(9)	1.16 (186)
PSEUDO/miplib/	16	115.13(5)	14.36(5)	227.00(4)	69.77(5)
QCP/	25	30.98(15)	11.26(20)	19.41(16)	26.20(20)
WCSP/PLANNING/	71	10.33(36)	15.47(55)	23.34(1)	11.09(71)
WCSP/SPOT5/DIR/	21	87.59(6)	25.83(4)	0.00 (0)	3.31 (3)
WCSP/SPOT5/LOG/	21	14.92(6)	0.68 (4)	0.00 (0)	10.04(4)
Instance set	#I	SAT4J MAXSAT	Toolbar3	W-MaxSatz	wmaxsatz_icss
AUCTIONS/AUC_PATHS/	88	496.64(15)	49.19(88)	136.05(51)	181.85(68)
AUCTIONS/AUC_REGIONS/	84	166.47(76)	6.58 (84)	5.63 (72)	5.28 (84)
AUCTIONS/AUC_SCHEDULING/	84	316.81(49)	75.75(82)	61.55(70)	74.61(82)
RANDOM-NET/	350	330.83(13)	128.09(50)	89.73 (22)	29.92(48)
PSEUDO/factor/	186	3.30 (186)	234.43(10)	10.94(115)	0.20 (20)
PSEUDO/miplib/	16	13.00(6)	3.10 (4)	1.64 (2)	1.19 (4)
QCP/	25	6.14 (25)	193.50(12)	14.64(5)	226.71(15)
WCSP/PLANNING/	71	6.55 (71)	23.91(52)	7.63 (4)	1.23 (48)
WCSP/SPOT5/DIR/	21	76.35(3)	129.24(5)	0.00 (0)	14.79(2)
WCSP/SPOT5/LOG/	21	63.76(3)	111.67(4)	0.00 (0)	19.60(2)

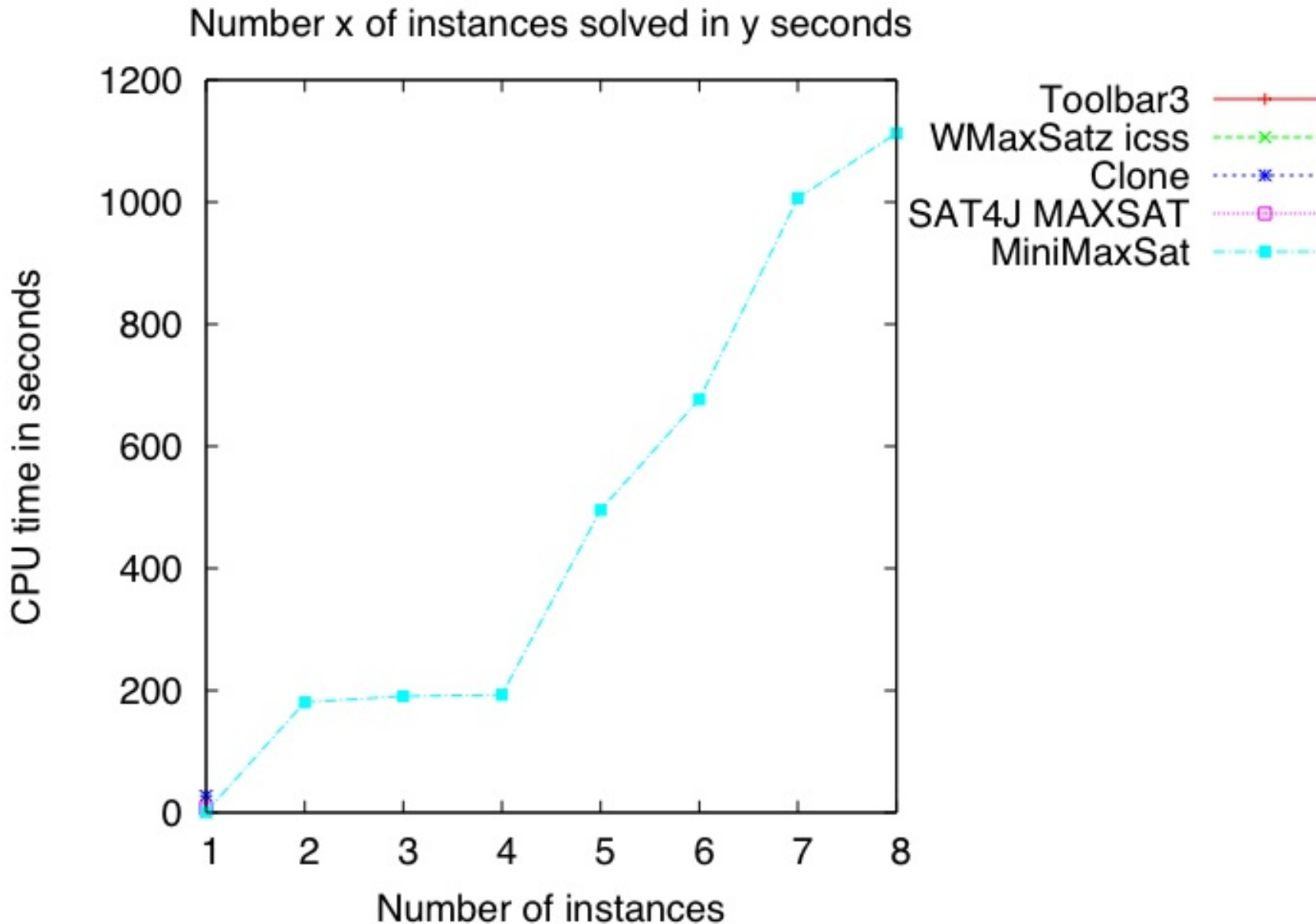
Crafted Weighted Partial Max-SAT



Industrial Weighted Partial Max-SAT

Instance set	#l	Clone	IncWMaxsatz	LB-PSAT	MiniMaxSAT
PROTEIN_INS/	12	27.64(1)	321.70(2)	0.00 (0)	482.12(8)
Instance set	#l	SAT4J MAXSAT	Toolbar3	W-MaxSatz	wmaxsatz_icss
PROTEIN_INS/	12	6.05 (1)	4.10 (1)	0.00 (0)	0.23 (1)

Industrial Weighted Partial Max-SAT



Max-SAT Evaluation 2008

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 2009

