An algorithm for solving satisfiability problem based on the structural information of a formula

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Problems & Ideas

- A local search algorithm for solving satisfiability problems
  - Problem: Given a CNF formula $F = c_1 \Lambda c_2 \cdots \Lambda c_m$ on a set of variables X, our goal is to find a truth assignment on X such that all the clauses in F are satisfied.
  - Incomplete method: Given a truth assignment, the incomplete method repeatedly modifies its value according to some heuristic until it is a solution to the problem.
- Ideas: Principles of minimizing information entropy and maximizing clause weight.
  - Information entropy guided initial assignment of variables.
  - Clause weight induces the choice of optimal unsatisfied clauses.

Main Contributions

- We give a strategy to generate an initial candidate solution.
- We give an unsatisfied clause selection strategy to overcome the local optimum.
- We provide two powerful local search solvers SICCASat and SISparrow2011 for solving SAT.

Table1 : The evaluation results of CCASat, Sparrow2011, and their incorporated versions SICCASat and SISparrow2011 on two benchmarks.

ins_class	*num*	CCASat		SICCASat		Sparrow2011		SISparrow2011	
		suc	*avg_time*	*suc*	*avg_time*	*suc*	*avg_time*	*suc*	*avg_time*
SAT Competition 2009 benchmark									
#2000vars	10	100%	0.8933	100%	0.8395	100%	0.813	100%	0.8888
#4000vars	10	100%	45.3626	100%	2.2958	100%	100.431	100%	45.0984
#6000vars	10	100%	130.3753	100%	10.6605	100%	140.5651	100%	11.6538
#8000vars	10	100%	386.49	100%	12.3963	100%	263.6629	100%	48.8124
#10000vars	10	100%	196.9391	100%	18.6984	100%	7.2677	100%	7.5492
#12000vars	10	100%	211.4341	100%	158.728	100%	74.2676	100%	28.2372
#14000vars	10	100%	1070.321	100%	74.0079	100%	25.1182	100%	28.3766
#16000vars	10	100%	95.4155	100%	42.0787	100%	15.599	100%	15.1189
#18000vars	10	100%	989.8489	100%	47.4333	100%	18.5609	100%	25.4003
#20000vars	10	100%	691.6945	100%	3377.9217	100%	748.5094	100%	149.2539
#22000vars	10	100%	201.4179	100%	242.6377	100%	304.7077	100%	39.4778
#24000vars	10	100%	1170.396	100%	324.9511	100%	1118.803	100%	111.0606
#26000vars	10	100%	340.4849	100%	300.8089	100%	413.8774	100%	69.6288
SAT Competition 2011 benchmark									
#2500vars	10	100%	79.3109	100%	2.3148	100%	87.4325	100%	6.3902
#5000vars	10	100%	53.1205	100%	6.2738	100%	46.4012	100%	18.5914
#10000vars	10	100%	138.8288	100%	30.7403	100%	132.6884	100%	36.0545
#15000vars	10	100%	373.9997	100%	93.9392	100%	336.2462	100%	62.0015
#20000vars	10	95.4%	175.6448	100%	299.6084	95.4%	170.961	100%	75.9902
#25000vars	10	90.5%	305.071	90%	492.866	85.0%	398.6066	100%	109.3485
#30000vars	10	85.5%	390.0942	100%	632.674	80.5%	468.6341	99%	174.2793
#35000vars	10	86.4%	492.2438	80%	1421.242	86.0%	342.4841	93%	330.9443
#40000vars	10	88.0%	447.2176	70%	728.778	84.5%	324.5063	92%	277.8627
#50000vars	10	83.5%	398.3991	50%	374.677	74.0%	458.0928	70%	387.8519