

Contents

Foreword	xvii
Abstract	xix
Acknowledgments	xxi
1 Introduction	1
1.1 Introduction	1
1.2 SAT and Max-SAT problems	2
1.3 Motivation	3
1.4 Objectives	4
1.5 Contributions	5
1.6 Publications	7
1.7 Overview	8
2 SAT algorithms	11
2.1 Basic concepts in SAT	11
2.2 Resolution	12
2.3 The Davis-Putnam procedure	13
2.4 The Davis-Logemann-Loveland procedure	15
2.4.1 Solving techniques for improving DLL	16
2.5 Local search for SAT	24
2.5.1 GSAT algorithm	24
2.5.2 WalkSAT algorithm	25
2.5.3 Other local search algorithms	25
2.6 Summary	26
3 Max-SAT algorithms	27
3.1 Basic concepts in Max-SAT and Max-CSP	27
3.1.1 Basic concepts in Max-SAT	27
3.1.2 Basic concepts in Max-CSP	32
3.2 Branch and bound algorithms	33
3.2.1 Improving the lower bound with underestimations	35
3.2.2 Improving the lower bound with inference	37

3.2.3	Variable selection heuristics	39
3.2.4	Data structures	40
3.3	Complete inference in Max-SAT	40
3.4	Approximation algorithms	41
3.5	Partial Max-SAT and soft constraints	42
3.6	Evaluations of Max-SAT solvers	43
3.7	Summary	47
4	The Soft-SAT formalism	49
4.1	Soft CNF formulas	51
4.2	Soft-SAT algorithms	52
4.2.1	A basic Soft-SAT algorithm	52
4.2.2	Soft-SAT-S	53
4.2.3	Soft-SAT-D	58
4.3	Experimental investigation	60
4.3.1	Solvers	60
4.3.2	Benchmarks and encodings	61
4.3.3	Weighted Partial Max-SAT and Max-CSP encodings	65
4.3.4	Experimental results	66
4.4	Summary	73
5	The Partial Max-SAT formalism	81
5.1	The Partial Max-SAT problem	81
5.2	Partial Max-SAT algorithms	82
5.2.1	A basic Partial Max-SAT algorithm	83
5.2.2	Variable selection heuristic	84
5.2.3	Bounds computation	85
5.2.4	Inference rules	87
5.2.5	Hard learning	92
5.2.6	Soft learning	94
5.2.7	Other learning techniques	95
5.3	Preprocessing techniques	95
5.3.1	Almost common clause rule	96
5.3.2	Variable saturation	96
5.3.3	Learning and restarts	98
5.4	Partial Max-SAT solvers	99
5.4.1	PMS	99
5.4.2	W-MaxSatz	99
5.5	Experimental investigation	100
5.5.1	Experiments with PMS	101
5.5.2	Experiments with W-MaxSatz	106
5.5.3	2007 Max-SAT Evaluation	110
5.5.4	Experiments with preprocessing	117
5.6	Summary	124
6	Conclusions	127