Deductive Databases and Their Applications

ROBERT M.COLOMB The University of Queensland, Australia



Contents

	Preface	ix
1	Introduction	1
1.1	The origins of deductive database technology	1
1.2	Sketch of the technology	2
1.3	Sketch of some applications	3
1.4	Sketch of the mathematical basis	7
1.5	Plan of the book	8
1.6	Further reading	8
1.7	Exercises	8
2	Summary of Prolog	10
2.1	Basics	10
2.2	Computing with a Prolog program	11
2.3	Negated goals	17
2.4	Updates	19
2.5	All solutions	20
2.6	Discussion	21
2.7	Summary	21
2.8	Further reading	21
2.9	Exercises	22
3	Prolog and databases	23
3.1	Prolog and the relational algebra	23
3.2	Persistent Prolog implementation	26
3.3	Relational representation of complex data types	27
3.4	Summary	34
3.5	Further reading	34
3.6	Exercises	34
4	Datalog and bottom-up evaluation	37
4.1	Datalog	37
4.2	Semi-naive bottom-up algorithm	41
4.3	Negation and stratification	43
4.4	Aggregation	46

vi

4.5	Top-down revisited	49
4.6	The artificial intelligence perspective: production rules	50
4.7	Active databases	53
4.8	Structure	53
4.9	Summary	55
4.10	Further reading	55
4.11	Exercises	55
5	Knowledge design	57
5.1	Data, information and knowledge	57
5.2	Modelling knowledge	61
5.3	Designing a knowledge base	65
5.4	Hierarchical thesaurus example	67
5.5	Other forms of knowledge: production rules	71
5.6	Summary	72
5.7	Further reading	72
5.8	Exercises	72
6	Building a knowledge base	76
6.1	Knowledge acquisition	76
6.2	Product of data and information analysis	77
6.3	Building the knowledge model	78
6.4	CASE tool for the knowledge model	79
6.5	The CASE tool	85
6.6	Repository as a deductive database	86
6.7	Summary	87
6.8	Further reading	87
6.9	Exercises	87
7	Knowledge quality	89
7.1	Quality and maintainability	89
7.2	Normalized information	90
7.3	Quality principles for data, information and knowledge	91
7.4	Example	98
7.5	Discussion	98
7.6	Summary	99
7.7	Further reading	99
7.8	Exercises	99
8	Magic sets	100
8.1	Bottom-up evaluation as a practical method	100

8.2	Datalog and relational algebra revisited	100
8.3	Preliminaries: transforming the DDB into canonical form	102
8.4	Magic sets transformation	104
8.5	Linear recursion	111
8.6	Summary	114
8.7	Further reading	114
8.8	Exercises	114
9	Unfolding and folding	116
9.1	Unfolding	116
9.2	Folding	118
9.3	Example of folding and unfolding	119
9.4	Summary	120
9.5	Further reading	120
9.6	Exercises	120
10	Propositional deductive databases	121
10.1	Propositional systems	121
10.2	Unfolding applied to propositional systems	123
10.3	Applications to semi-propositional production systems	126
10.4	Summary	126
10.5	Further reading	127
10.6	Exercises	127
11	Integrity constraints	128
11.1	Updates	128
11.2	Integrity constraints	129
11.3	Integrity constraints as Horn clauses	130
11.4	Effect of updates	131
11.5	Discussion	133
11.6	Summary	135
11.7	Further reading	135
11.8	Exercises	135
12	Non-monotonic reasoning	136
12.1	The problem of non-monotonicity	136
12.2	Belief revision	137
12.3	Assumption-based truth maintenance	141
12.4	Summary	146
12.5	Further reading	146
12.6	Exercises	147

vii

Solutions to exercises	149
References	174
Index	175