

Contents

Preface

iii

1	Introduction	
1.1	Outline of the Thesis	1
1.2	Historical Perspective and Foundations	2
1.3	Parallel Prolog Dialects	6
2	Compilation of Sequential Prolog	
2.1	Sequential Prolog	10
2.2	General Principles of Prolog Compiler Construction	12
2.2.1	Data Typing	14
2.2.2	Runtime Memory Management	15
2.2.3	Compilation of the Unification Algorithm	18
2.2.4	Clause Indexing	19
2.2.5	Tail Recursion Optimization and Mode Declarations	20
3	Pipelined Execution of Sequential Prolog	
3.1	Introduction	21
3.2	A Pipelined Architecture for Prolog	23
3.3	Execution Model	27
3.3.1	Processor-Processor Communication and Synchronization	31
3.3.2	Implementation of Backtracking	37
3.3.3	AND-Parallelism	38
3.4	Summary	40
4	The Occur-Check Problem	
4.1	Introduction	42
4.2	A Variable Classification Scheme	44
4.3	Variables as Structure Arguments	49
4.4	The Occur-Check Problem	53
4.5	Summary	56
5	The Abstract Parallel Prolog Machine	
5.1	Data Representation	57
5.2	Registers and Status Flags	59
5.3	The Parallel Instruction Set	62
5.3.1	Control Instructions	67
5.3.2	Goal Instructions	70
5.3.3	Clause Head Instructions	74
5.3.4	Structure Instructions	78
5.3.5	Clause Control Instructions	83
5.3.6	Fork/Join Instructions	86

5.3.7	Miscellaneous Instructions and Micro-Operations	88
5.3.8	Built-in Predicates	91
6	Simulation	
6.1	Introduction	92
6.2	Simulated Hardware Structures	92
6.2.1	Pipeline Buffer	95
6.2.2	Execution Unit	97
6.2.3	Instruction Fetch Unit	99
6.3	Simulation Results	101
7	Conclusion	
7.1	Contributions	109
7.2	Future Work	109
A	Benchmark Programs	110
B	Compilation Examples	115
	References	125