

---

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Abstract Data Types</b>	<b>5</b>
2.1	Algebraic Specification	5
2.2	Term Rewriting	9
2.3	Equality Functions	10
2.4	Induction	11
<b>3</b>	<b>Process Algebra</b>	<b>13</b>
3.1	Actions	13
3.2	Alternative and Sequential Composition	14
3.3	Parallel Processes	16
3.4	Deadlock and Encapsulation	18
3.5	Process Declarations	21
3.6	Conditionals	22
3.7	Summation over a Data Type	22
3.8	An Example: The Bag	24
3.9	Renaming	25
3.10	Bisimilarity	25
<b>4</b>	<b>Hiding Internal Transitions</b>	<b>29</b>
4.1	Hiding of Actions	29
4.2	Summary	30
4.3	An Example: Two One-Bit Buffers in Sequence	31
4.4	Branching Bisimilarity	34
<b>5</b>	<b>Protocol Specifications</b>	<b>41</b>
5.1	Alternating Bit Protocol	41
5.2	Bounded Retransmission Protocol	45
5.3	Sliding Window Protocol	52
5.4	Tree Identify Protocol	57

## VIII Contents

5.5	Movable Patient Support for an MRI Scanner .....	63
<b>6</b>	<b>Linear Process Equations .....</b>	<b>69</b>
6.1	Linearisation .....	70
6.2	State Space Generation and Storage .....	74
6.3	CL-RSP .....	76
6.4	Invariants .....	77
<b>7</b>	<b>Verification Algorithms on State Spaces .....</b>	<b>81</b>
7.1	Minimisation Modulo Branching Bisimulation .....	81
7.2	Confluence .....	83
7.3	Model Checking .....	86
7.4	Abstraction .....	94
<b>8</b>	<b>Symbolic Methods .....</b>	<b>101</b>
8.1	Cones and Foci .....	101
8.2	Verification of the Tree Identify Protocol .....	104
8.3	Partial Order Reduction .....	107
8.4	Elimination of Parameters and Sum Variables .....	112
8.5	Symbolic Model Checking .....	116
<b>A</b>	<b>The <math>\mu</math>CRL Toolset in a Nutshell .....</b>	<b>125</b>
<b>Solutions to Exercises .....</b>		<b>131</b>
<b>References .....</b>		<b>143</b>
<b>Index .....</b>		<b>149</b>