Contents

Contents vii

List of Figures xi

List of Tables xiii

Foreword xv

I Introductory Concepts 1

1 Introduction 3
1.1 Motivations . . . 4
1.2 Contributions . . . 5
1.3 Structure . . . 9

2 Related Work 11
2.1 Introduction . . . 11
2.2 Agent Theories and Architectures . . . 11
2.2.1 Logic-Based Architectures - *Deductive agents* . . . 14
2.2.2 Reactive architectures - *Reactive agents* . . . 14
2.2.3 Layered Architectures - *Hybrid agents* . . . 16
2.2.4 Practical Reasoning Architectures - *BDI agents* . . . 17
2.2.5 Rao and Georgeff's BDI model . . . 23
2.2.6 Advantages of BDI models . . . 31
2.3 Multi-context Systems . . . 32
2.3.1 Formalization of multi-context systems . . . 33
2.3.2 Multi-context agents . . . 34
2.3.3 Advantages of the multi-context specification of agents . . . 37
2.4 Logics of preference . . . 38
2.4.1 Bipolar representation of preferences . . . 40
2.5 Graded Attitudes in Intentional Agent Architectures . . . 44
2.5.1 Argumentation-based approaches to BDI agents . . . 47
2.6 Conclusions . . . 53

3 Logical Background 55
3.1 Propositional Dynamic logic . . . 55
3.2 $G_\Delta(C)$ and RPL Fuzzy Logics . . . 57

Copia gratuita. Personal free copy http://libros.csic.es

3.2.1 Rational Lukasiewicz Logic 61

II The Graded BDI Agent Model 63

4 The General Framework 65
4.1 Introduction 65
4.2 Multi-context specification 66
4.3 Logical Framework: Many-valued modal approach 67

5 The Belief Context 73
5.1 Introduction 73
5.2 Belief context logics 74
5.3 The BC_{nec} Logic 76
5.4 The BC_{prob} Logic 80
5.5 Conclusions 83

6 Desire and Intention Contexts 85
6.1 Introduction 85
6.2 Desire Context (DC) 87
6.2.1 DC Language 87
6.2.2 Semantics for DC 88
6.2.3 DC Axioms and Rules 90
6.2.4 Consistency Schemas 94
6.3 Intention Context 98
6.3.1 IC Language 98
6.3.2 Semantics and axiomatization for IC 100
6.4 Conclusions 103

7 Functional contexts and Bridge rules 105
7.1 Planner and Communication Contexts 105
7.2 Bridge Rules 106
7.3 How the g-BDI model works 110
7.4 Example 112
7.5 Comparison with Rahwan and Amgoud's approach 114

8 The Socialization of the g-BDI agents 117
8.1 Introduction 117
8.2 Reasoning about other agent attitudes 117
8.3 Trust in an agent society 119
8.3.1 A Social Context to Filter Information 120
8.3.2 Trust in Delegation 123
8.3.3 Conclusions 127

9 Operational semantics for g-BDI Agents 129
9.1 Introduction 129
9.2 Mobile Ambient Calculus 131
9.3 Multi-context Calculus 133
9.4 Operational Semantics 137

© CSIC © del autor o autores / Todos los derechos reservados

9.5 Mapping a g-BDI Agent to the MCC . . . 139
9.5.1 Mapping the Desire context into a Desire ambient . . . 142
9.6 Conclusions . . . 146

III Methodology and a Case-Study 147

10 Case study domain 149
10.1 Introduction . . . 149
10.2 Recommender Agents . . . 150
10.3 Recommender Systems in Travel and Tourism . . . 153
10.4 Case Study: Recommender System on Argentinian Tourism . . . 155

11 Methodology 159
11.1 Introduction . . . 159
11.2 The Development Process of g-BDI Agent-Based Systems . . . 162
11.3 System Analysis and Design Phase . . . 165
11.3.1 Stage I: System Specification and Analysis . . . 165
11.3.2 Stage II: System Architecture Design . . . 169
11.4 Agent Design Phase . . . 174
11.4.1 Stage III: A graded BDI Agent Design . . . 175
11.4.2 Stage IV: Agent Detailed Design . . . 177
11.5 Conclusions . . . 184

12 Implementation 185
12.1 Introduction . . . 185
12.2 Multiagent development . . . 186
12.3 *T-Agent* Implementation . . . 187
12.3.1 Communication Context . . . 188
12.3.2 Desire Context . . . 190
12.4 Belief Context . . . 193
12.4.1 Tourist packages . . . 193
12.4.2 Destination ontology . . . 194
12.4.3 Special Relations in the domain . . . 195
12.4.4 Beliefs on desires fulfillment . . . 196
12.5 Planner Context . . . 198
12.6 Intention Context . . . 199
12.6.1 Estimating the expected satisfaction of desires . . . 200
12.6.2 Computing the intention degrees . . . 203
12.7 Conclusions . . . 204

IV Experimentation and Discussions 205

13 Experimentation 207
13.1 Introduction . . . 207
13.2 Validation . . . 208
13.3 Experimentation . . . 212
13.3.1 Sensitive model analysis . . . 212

Copia gratuita. Personal free copy http://libros.csic.es

13.3.2 Graded vs. non-graded model comparison 216
13.4 Data analysis 220
13.5 Conclusions 223

14 Discussion **225**
14.1 Contributions of this Thesis 225
14.1.1 Contributions respect to BDI architectures 225
14.1.2 Contributions on related fields 227
14.2 Future work 229
14.3 Related publications 230

Bibliography **233**

© CSIC © del autor o autores / Todos los derechos reservados