

Contents

| | |
|---|-----------|
| Foreword | xi |
| 1. Introduction | 1 |
| 1.1. Semantic Web Technologies | 1 |
| 1.2. The Goal of the Semantic Web | 2 |
| 1.3. Ontologies and Ontology Languages | 4 |
| 1.4. Creating and Managing Ontologies | 5 |
| 1.5. Using Ontologies | 6 |
| 1.6. Applications | 7 |
| 1.7. Developing the Semantic Web | 8 |
| References | 8 |
| 2. Knowledge Discovery for Ontology Construction | 9 |
| 2.1. Introduction | 9 |
| 2.2. Knowledge Discovery | 10 |
| 2.3. Ontology Definition | 10 |
| 2.4. Methodology for Semi-automatic Ontology Construction | 11 |
| 2.5. Ontology Learning Scenarios | 12 |
| 2.6. Using Knowledge Discovery for Ontology Learning | 13 |
| 2.6.1. Unsupervised Learning | 14 |
| 2.6.2. Semi-Supervised, Supervised, and Active Learning | 16 |
| 2.6.3. Stream Mining and Web Mining | 18 |
| 2.6.4. Focused Crawling | 18 |
| 2.6.5. Data Visualization | 19 |
| 2.7. Related Work on Ontology Construction | 22 |
| 2.8. Discussion and Conclusion | 24 |
| Acknowledgments | 24 |
| References | 25 |
| 3. Semantic Annotation and Human Language Technology | 29 |
| 3.1. Introduction | 29 |
| 3.2. Information Extraction: A Brief Introduction | 31 |

| | | |
|-----------|---|-----------|
| 3.2.1. | Five Types of IE | 32 |
| 3.2.2. | Entities | 33 |
| 3.2.3. | Mentions | 33 |
| 3.2.4. | Descriptions | 34 |
| 3.2.5. | Relations | 34 |
| 3.2.6. | Events | 34 |
| 3.3. | Semantic Annotation | 35 |
| 3.3.1. | What is Ontology-Based Information Extraction | 36 |
| 3.4. | Applying ‘Traditional’ IE in Semantic Web Applications | 37 |
| 3.4.1. | AeroDAML | 38 |
| 3.4.2. | Amilcare | 38 |
| 3.4.3. | MnM | 39 |
| 3.4.4. | S-Cream | 39 |
| 3.4.5. | Discussion | 40 |
| 3.5. | Ontology-based IE | 40 |
| 3.5.1. | Magpie | 40 |
| 3.5.2. | Pankow | 41 |
| 3.5.3. | SemTag | 41 |
| 3.5.4. | Kim | 42 |
| 3.5.5. | KIM Front-ends | 43 |
| 3.6. | Deterministic Ontology Authoring using Controlled Language IE | 45 |
| 3.7. | Conclusion | 48 |
| | References | 49 |
| 4. | Ontology Evolution | 51 |
| 4.1. | Introduction | 51 |
| 4.2. | Ontology Evolution: State-of-the-art | 52 |
| 4.2.1. | Change Capturing | 53 |
| 4.2.2. | Change Representation | 54 |
| 4.2.3. | Semantics of Change | 56 |
| 4.2.4. | Change Propagation | 58 |
| 4.2.5. | Change Implementation | 59 |
| 4.2.6. | Change Validation | 60 |
| 4.3. | Logical Architecture | 60 |
| 4.4. | Data-driven Ontology Changes | 62 |
| 4.4.1. | Incremental Ontology Learning | 64 |
| 4.5. | Usage-driven Ontology Changes | 66 |
| 4.5.1. | Usage-driven Hierarchy Pruning | 67 |
| 4.6. | Conclusion | 68 |
| | References | 69 |
| 5. | Reasoning With Inconsistent Ontologies: Framework, Prototype, and Experiment | 71 |
| 5.1. | Introduction | 71 |
| 5.2. | Brief Survey of Approaches to Reasoning with Inconsistency | 73 |
| 5.2.1. | Paraconsistent Logics | 73 |

| | |
|---|------------|
| 5.2.2. Ontology Diagnosis | 74 |
| 5.2.3. Belief Revision | 74 |
| 5.2.4. Synthesis | 75 |
| 5.3. Brief Survey of Causes for Inconsistency in the Semantic Web | 75 |
| 5.3.1. Inconsistency by Mis-representation of Default | 75 |
| 5.3.2. Inconsistency Caused by Polysemy | 77 |
| 5.3.3. Inconsistency through Migration from Another Formalism | 77 |
| 5.3.4. Inconsistency Caused by Multiple Sources | 78 |
| 5.4. Reasoning with Inconsistent Ontologies | 79 |
| 5.4.1. Inconsistency Detection | 79 |
| 5.4.2. Formal Definitions | 80 |
| 5.5. Selection Functions | 82 |
| 5.6. Strategies for Selection Functions | 83 |
| 5.7. Syntactic Relevance-Based Selection Functions | 85 |
| 5.8. Prototype of Pion | 87 |
| 5.8.1. Implementation | 87 |
| 5.8.2. Experiments and Evaluation | 88 |
| 5.8.3. Future Experiments | 91 |
| 5.9. Discussion and Conclusions | 91 |
| Acknowledgment | 92 |
| References | 92 |
| 6. Ontology Mediation, Merging, and Aligning | 95 |
| 6.1. Introduction | 95 |
| 6.2. Approaches in Ontology Mediation | 96 |
| 6.2.1. Ontology Mismatches | 97 |
| 6.2.2. Ontology Mapping | 97 |
| 6.2.3. Ontology Alignment | 100 |
| 6.2.4. Ontology Merging | 102 |
| 6.3. Mapping and Querying Disparate Knowledge Bases | 104 |
| 6.3.1. Mapping Language | 106 |
| 6.3.2. A (Semi-)Automatic Process for Ontology Alignment | 108 |
| 6.3.3. OntoMap: an Ontology Mapping Tool | 110 |
| 6.4. Summary | 111 |
| References | 112 |
| 7. Ontologies for Knowledge Management | 115 |
| 7.1. Introduction | 115 |
| 7.2. Ontology Usage Scenario | 116 |
| 7.3. Terminology | 117 |
| 7.3.1. Data Qualia | 119 |
| 7.3.2. Sorts of Data | 120 |
| 7.4. Ontologies as RDBMS Schema | 123 |
| 7.5. Topic-ontologies Versus Schema-ontologies | 124 |
| 7.6. Proton Ontology | 126 |
| 7.6.1. Design Rationales | 126 |

| | | |
|-----------|--|------------|
| 7.6.2. | Basic Structure | 127 |
| 7.6.3. | Scope, Coverage, Compliance | 128 |
| 7.6.4. | The Architecture of Proton | 130 |
| 7.6.5. | Topics in Proton | 131 |
| 7.6.6. | Proton Knowledge Management Module | 133 |
| 7.7. | Conclusion | 135 |
| | References | 136 |
| 8. | Semantic Information Access | 139 |
| 8.1. | Introduction | 139 |
| 8.2. | Knowledge Access and the Semantic WEB | 139 |
| 8.2.1. | Limitations of Current Search Technology | 140 |
| 8.2.2. | Role of Semantic Technology | 142 |
| 8.2.3. | Searching XML | 143 |
| 8.2.4. | Searching RDF | 144 |
| 8.2.5. | Exploiting Domain-specific Knowledge | 146 |
| 8.2.6. | Searching for Semantic Web Resources | 150 |
| 8.2.7. | Semantic Browsing | 151 |
| 8.3. | Natural Language Generation from Ontologies | 152 |
| 8.3.1. | Generation from Taxonomies | 153 |
| 8.3.2. | Generation of Interactive Information Sheets | 154 |
| 8.3.3. | Ontology Verbalisers | 154 |
| 8.3.4. | Ontogeneration | 154 |
| 8.3.5. | Ontosum and Miakt Summary Generators | 155 |
| 8.4. | Device Independence: Information Anywhere | 156 |
| 8.4.1. | Issues in Device Independence | 157 |
| 8.4.2. | Device Independence Architectures and Technologies | 160 |
| 8.4.3. | DIWAF | 162 |
| 8.5. | SEKTAgent | 164 |
| 8.6. | Concluding Remarks | 166 |
| | References | 167 |
| 9. | Ontology Engineering Methodologies | 171 |
| 9.1. | Introduction | 171 |
| 9.2. | The Methodology Focus | 172 |
| 9.2.1. | Definition of Methodology for Ontologies | 172 |
| 9.2.2. | Methodology | 173 |
| 9.2.3. | Documentation | 174 |
| 9.2.4. | Evaluation | 174 |
| 9.3. | Past and Current Research | 174 |
| 9.3.1. | Methodologies | 174 |
| 9.3.2. | Ontology Engineering Tools | 177 |
| 9.3.3. | Discussion and Open Issues | 178 |
| 9.4. | Diligent Methodology | 180 |
| 9.4.1. | Process | 180 |
| 9.4.2. | Argumentation Support | 183 |

| | |
|--|------------|
| 9.5. First Lessons Learned | 185 |
| 9.6. Conclusion and Next Steps | 186 |
| References | 187 |
| 10. Semantic Web Services – Approaches and Perspectives | 191 |
| 10.1. Semantic Web Services – A Short Overview | 191 |
| 10.2. The WSMO Approach | 192 |
| 10.2.1. The Conceptual Model – The Web Services Modeling Ontology (WSMO) | 193 |
| 10.2.2. The Language – The Web Service Modeling Language (WSML) | 198 |
| 10.2.3. The Execution Environment – The Web Service Modeling Execution Environment (WSMX) | 204 |
| 10.3. The OWL-S Approach | 207 |
| 10.3.1. OWL-S Service Profiles | 209 |
| 10.3.2. OWL-S Service Models | 210 |
| 10.4. The SWSF Approach | 213 |
| 10.4.1. The Semantic Web Services Ontology (SWSO) | 213 |
| 10.4.2. The Semantic Web Services Language (SWSL) | 216 |
| 10.5. The IRS-III Approach | 218 |
| 10.5.1. Principles Underlying IRS-III | 218 |
| 10.5.2. The IRS-III Architecture | 220 |
| 10.5.3. Extension to WSMO | 221 |
| 10.6. The WSDL-S Approach | 222 |
| 10.6.1. Aims and Principles | 222 |
| 10.6.2. Semantic Annotations | 224 |
| 10.7. Semantic Web Services Grounding: The Link Between SWS and Existing Web Services Standards | 226 |
| 10.7.1. General Grounding Uses and Issues | 226 |
| 10.7.2. Data Grounding | 228 |
| 10.7.3. Behavioural Grounding | 230 |
| 10.8. Conclusions and Outlook | 232 |
| References | 234 |
| 11. Applying Semantic Technology to a Digital Library | 237 |
| 11.1. Introduction | 237 |
| 11.2. Digital Libraries: The State-of-the-art | 238 |
| 11.2.1. Working Libraries | 238 |
| 11.2.2. Challenges | 239 |
| 11.2.3. The Research Environment | 241 |
| 11.3. A Case Study: The BT Digital Library | 242 |
| 11.3.1. The Starting Point | 242 |
| 11.3.2. Enhancing the Library with Semantic Technology | 244 |
| 11.4. The Users' View | 248 |
| 11.5. Implementing Semantic Technology in a Digital Library | 250 |
| 11.5.1. Ontology Engineering | 250 |

| | |
|---|------------|
| 11.5.2. BT Digital Library End-user Applications | 251 |
| 11.5.3. The BT Digital Library Architecture | 252 |
| 11.5.4. Deployment View of the BT Digital Library | 255 |
| 11.6. Future Directions | 255 |
| References | 257 |
| 12. Semantic Web: A Legal Case Study | 259 |
| 12.1. Introduction | 259 |
| 12.2. Profile of the Users | 260 |
| 12.3. Ontologies for Legal Knowledge | 262 |
| 12.3.1. Legal Ontologies: State of the Art | 263 |
| 12.3.2. Ontologies of Professional Knowledge: OPJK | 265 |
| 12.3.3. Benefits of Semantic Technology and Methodology | 267 |
| 12.4. Architecture | 272 |
| 12.4.1. Iuriservice Prototype | 272 |
| 12.5. Conclusions | 278 |
| References | 278 |
| 13. A Semantic Service-Oriented Architecture for the Telecommunications Industry | 281 |
| 13.1. Introduction | 281 |
| 13.2. Introduction to Service-oriented Architectures | 282 |
| 13.3. A Semantic Service-orientated architecture | 284 |
| 13.4. Semantic Mediation | 286 |
| 13.4.1. Data Mediation | 287 |
| 13.4.2. Process Mediation | 287 |
| 13.5. Standards and Ontologies in Telecommunications | 287 |
| 13.5.1. eTOM | 289 |
| 13.5.2. SID | 289 |
| 13.5.3. Adding Semantics | 290 |
| 13.6. Case Study | 290 |
| 13.6.1. Broadband Diagnostics | 292 |
| 13.6.2. The B2B Gateway Architecture | 292 |
| 13.6.3. Semantic B2B Integration Prototype | 294 |
| 13.6.4. Prototype Implementation | 297 |
| 13.7. Conclusion | 298 |
| References | 299 |
| 14. Conclusion and Outlook | 301 |
| 14.1. Management of Networked Ontologies | 301 |
| 14.2. Engineering of Networked Ontologies | 302 |
| 14.3. Contextualizing Ontologies | 303 |
| 14.4. Cross Media Resources | 304 |
| 14.5. Social Semantic Desktop | 306 |
| 14.6. Applications | 307 |
| Index | 309 |