

# Contents

|                        |  |           |
|------------------------|--|-----------|
| <i>List of Figures</i> | xiii   |           |
| <i>Series Foreword</i> | xv   |           |
| <i>Preface</i>         | xix  |           |
| <b>1</b>               | <b><i>The Semantic Web Vision</i></b>          | <b>1</b>  |
| 1.1                    | Today's Web                                    | 1         |
| 1.2                    | From Today's Web to the Semantic Web: Examples | 3         |
| 1.3                    | Semantic Web Technologies                      | 8         |
| 1.4                    | A Layered Approach                             | 17        |
| 1.5                    | Book Overview                                  | 21        |
| 1.6                    | Summary  | 21        |
|                        | Suggested Reading                              | 22        |
| <b>2</b>               | <b><i>Structured Web Documents: XML</i></b>    | <b>25</b> |
| 2.1                    | Introduction                                   | 25        |
| 2.2                    | The XML Language                               | 29        |
| 2.3                    | Structuring                                    | 33        |
| 2.4                    | Namespaces                                     | 46        |
| 2.5                    | Addressing and Querying XML Documents          | 47        |
| 2.6                    | Processing                                     | 53        |
| 2.7                    | Summary  | 59        |
|                        | Suggested Reading                              | 61        |
|                        | Exercises and Projects                         | 62        |

|          |  |            |
|----------|--|------------|
| <b>3</b> | <b><i>Describing Web Resources: RDF</i></b>      | <b>65</b>  |
| 3.1      | Introduction                                     | 65         |
| 3.2      | RDF: Basic Ideas                                 | 67         |
| 3.3      | RDF: XML-Based Syntax                            | 73         |
| 3.4      | RDF Schema: Basic Ideas                          | 84         |
| 3.5      | RDF Schema: The Language                         | 88         |
| 3.6      | RDF and RDF Schema in RDF Schema                 | 94         |
| 3.7      | An Axiomatic Semantics for RDF and RDF Schema    | 97         |
| 3.8      | A Direct Inference System for RDF and RDFS       | 102        |
| 3.9      | Querying in SPARQL                               | 103        |
| 3.10     | Summary  | 109        |
|          | Suggested Reading                                | 109        |
|          | Exercises and Projects                           | 111        |
| <b>4</b> | <b><i>Web Ontology Language: OWL</i></b>         | <b>113</b> |
| 4.1      | Introduction                                     | 113        |
| 4.2      | OWL and RDF/RDFS                                 | 114        |
| 4.3      | Three Sublanguages of OWL                        | 117        |
| 4.4      | Description of the OWL Language                  | 119        |
| 4.5      | Layering of OWL                                  | 131        |
| 4.6      | Examples   | 135        |
| 4.7      | OWL in OWL                                       | 144        |
| 4.8      | Future Extensions                                | 150        |
| 4.9      | Summary  | 152        |
|          | Suggested Reading                                | 152        |
|          | Exercises and Projects                           | 154        |
| <b>5</b> | <b><i>Logic and Inference: Rules</i></b>         | <b>157</b> |
| 5.1      | Introduction                                     | 157        |
| 5.2      | Example of Monotonic Rules: Family Relationships | 161        |
| 5.3      | Monotonic Rules: Syntax                          | 162        |
| 5.4      | Monotonic Rules: Semantics                       | 164        |
| 5.5      | Description Logic Programs (DLP)                 | 167        |
| 5.6      | Semantic Web Rules Language (SWRL)               | 170        |
| 5.7      | Nonmonotonic Rules: Motivation and Syntax        | 171        |
| 5.8      | Example of Nonmonotonic Rules: Brokered Trade    | 173        |
| 5.9      | Rule Markup Language (RuleML)                    | 177        |
| 5.10     | Summary  | 179        |
|          | Suggested Reading                                | 179        |

|  |            |
|--|------------|
| Exercises and Projects                               | 181        |
| <b>6 Applications</b>                                | <b>185</b> |
| 6.1 Introduction                                     | 185        |
| 6.2 Horizontal Information Products at Elsevier      | 185        |
| 6.3 Openacademia: Distributed Publication Management | 189        |
| 6.4 Bibster: Data Exchange in a Peer-to-Peer System  | 195        |
| 6.5 Data Integration at Audi                         | 197        |
| 6.6 Skill Finding at Swiss Life                      | 201        |
| 6.7 Think Tank Portal at EnerSearch                  | 203        |
| 6.8 e-Learning                                       | 207        |
| 6.9 Web Services                                     | 210        |
| 6.10 Other Scenarios                                 | 219        |
| Suggested Reading                                    | 221        |
| <b>7 Ontology Engineering</b>                        | <b>225</b> |
| 7.1 Introduction                                     | 225        |
| 7.2 Constructing Ontologies Manually                 | 225        |
| 7.3 Reusing Existing Ontologies                      | 229        |
| 7.4 Semiautomatic Ontology Acquisition               | 231        |
| 7.5 Ontology Mapping                                 | 235        |
| 7.6 On-To-Knowledge Semantic Web Architecture        | 237        |
| Suggested Reading                                    | 240        |
| Project  | 240        |
| <b>8 Conclusion and Outlook</b>                      | <b>245</b> |
| 8.1 Introduction                                     | 245        |
| 8.2 Which Semantic Web?                              | 245        |
| 8.3 Four Popular Fallacies                           | 246        |
| 8.4 Current Status                                   | 248        |
| 8.5 Selected Key Research Challenges                 | 251        |
| Suggested Reading                                    | 252        |
| <b>A Abstract OWL Syntax</b>                         | <b>253</b> |
| <b>Index</b>   | <b>261</b> |