Preface

Description logics (DL) are a very successful family of logic-based knowledge representation (KR) formalisms, which provide means for the structured representation of knowledge and inference procedures for reasoning about the represented knowledge. This field (whose former names include: KL-ONE-based KR Languages, Term Subsumption Languages, Terminological KR Languages, Terminological Logics, Concept Languages) has undergone a remarkable evolution in the last 15 years. Whereas up until the late 1980s almost no complete inference procedures were known for non-trivial representation languages, there is now a rich palette of description formalisms with differing expressive power, and for which the formal and computational properties (like expressivity, decidability, complexity, connection to other formalisms) are well-investigated. In addition, modern DL systems are equipped with highly optimized implementations of complete inference procedures, which – despite their high worst-case complexity – perform very well in practice.

This satisfactory state of affairs is, however, reached only for the standard inference problems like the subsumption and the instance problem. In applications of DL systems it turned out that building and maintaining large DL knowledge bases can be facilitated by procedures for other, non-standard inference problems. For example, in applications of the system Classic at AT&T Labs, two such new inference problems have turned up: generating new concepts from individuals and matching concept patterns against concepts. At the time when the research reported in this book started, the work concerning such non-standard inference problems was at its very beginning. There were first results on how to solve these problems, but they were restricted to just one representation language, and the inference procedures were again incomplete. Thus, the goal was to achieve for non-standard inference problems what the DL research of the last 15 years had accomplished for the standard inference problems.

This book is a significant step towards reaching this goal. It concentrates on two of the most prominent non-standard inference problems in description logics: (i) generating concepts from individuals by computing the most specific concept and the least common subsumer; and (ii) matching concept patterns against concepts. It provides complete results on these inference

problems for two different representation languages: one that is very close to the language provided by the CLASSIC system and one that allows for existential quantification. For both languages, the important tool is a structural characterization of the subsumption problem, which is also interesting in its own right. Actually, this brings us back to the early days of DL research, since the incomplete subsumption procedures of those days did use a structural approach. However, the characterizations of subsumption given in this book are sound and complete. Interestingly, for solving non-standard inference problems, the structural approach turned out to be more appropriate than the modern tableau-based approach now used for solving the standard inference problems.

Summing up, this book provides an excellent formal foundation for research in non-standard inferences in description logic, and I hope that it will be followed up by future research on this exciting new topic.

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