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*... à compreensão, apoio e carinho de
Claudia,
Alexandre e
Melina*

Preface

During the last few years, Artificial Intelligence (AI) technology has produced a variety of Knowledge-based Systems (KS). In spite of this apparent success, KS applicability is still extremely limited since appropriate systems for an efficient knowledge base (KB) management do not exist. Current AI techniques cannot provide efficient access to and reliable management of large, shared, or distributed KB, and existing Database Systems (DBS) lack knowledge representation and even the simplest form of reasoning capabilities.

This work addresses the development of a new generation of systems, called Knowledge Base Management Systems (KBMS) with the aim of filling this technological gap, providing the solution to this KS problem. So, it firstly investigates in detail the design process, the architecture, and the working methods of KS in order to point out key characteristics of the field as well as its current limitations, which serve as basis for an exact formulation of KS requirements. Several approaches to satisfy these requirements are then thoroughly analyzed, thereby providing the basic concepts for building KBMS. The work demonstrates that KBMS functionality is directly influenced by the most important aspects of KS development and application, i.e., the needs of the user, knowledge engineering support, and implementation issues, so that KBMS should integrate especial AI and DBS features in order to support knowledge modeling, manipulation, and maintenance. Further, an architectural approach is presented, advocating the division of KBMS into three different layers in which these distinct KS aspects are particularly considered. On the basis of this approach, the design and implementation of the multi-layered prototype KRISYS are thoroughly described. One main philosophy of the system is the idea of abstraction aimed at the independence of knowledge which is provided by treating the KB in a functional way by means of ask and tell operations. A second very important issue is the effective support of the needs of KB design and manipulation, achieved by the integration of descriptive, operational, and organizational aspects of knowledge into an object-centered model. Finally, a number of concepts focus attention on performance requirements. The system provides a framework for the exploitation of the application's locality, guaranteeing fast accesses to the KB. In closing, the work describes the development of KS in a KBMS environment and gives some concluding comments on the impact of this new technology.

This work was conceived while I was a Ph.D. student in the Computer Science Department of the University of Kaiserslautern. It was supported by DAAD, to which I am very grateful. Its development was enabled by Prof. Dr. Theo Härder, whom I thank for the opportunity to carry out this research and for his encouragement during this study, the useful discussions, and his numerous comments on my work. I am also indebted to Prof. Dr. Gerhard Barth for offering to analyze my results and for reporting his remarks.

Colleagues, friends, and undergraduate students helped me a great deal during the years in which I was working on this project and living in Germany. Among several colleagues, especially Andrea Sikeler, Bernhard Mitschang, Klaus Meyer-Wegener, and Stefan Deßloch were always prepared to help. They contributed, by means of their fruitful comments, to clarify and improve important issues. I am very grateful to them. In particular, I would like to thank the several students that participated in our Knowledge Base Management System project whose combined effort resulted in some of the analyses of Knowledge-based Systems requirements as well as in the implementation of KRISYS. I am also very grateful to the many friends, in particular Heike Neu, Yan Weixia, and Noemia Mesquita, who were always ready to listen and to encourage me during difficult situations. Finally, I would like to acknowledge the valuable comments of Ian Litter on the edition of the text.

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Nelson Mendonça Mattos

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