Expert Database Systems
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Expert database systems are database management systems endowed with knowledge and expertise to support knowledge-based applications accessing large shared databases. The various architectures, tools, and techniques needed to build such systems draw upon aspects of AI, database management, and logic programming. In fact, the conceptual confluence of these fields creates a synergy promoting new insights and tools for building intelligent information systems.

System-resident expertise can improve performance by (1) providing intelligent answers, (2) using database semantic integrity constraints for query optimization, and (3) combining knowledge- and data-driven search techniques in efficient inference schemes. Conversely, expertise may reside outside systems in knowledge-based applications that interpret vast quantities of data and provide users with decision-impelling recommendations. Thus, expert-database R&D seeks tools and techniques that make databases “active” reasoning agents and that allow database systems to support AI applications managing and accessing large knowledge/databases.

The articles

Focusing on architectural issues, “RPL: An Expert System Language with Query Power” describes an expert database system that integrates the data-driven inference power of production systems such as OPS5 with data management search and storage capabilities of relational databases. Delcambre’s relational production language (RPL) supports production rules representing OPS5 rules as well as database notions of triggers and relational queries. Since integrating a memory-resident production system with a disk-based database creates a major performance bottleneck, Delcambre proposes a two-level expert database system architecture in which RPL stores rules and data in a relational database and (when inference is required) stages data and knowledge into main memory.

“Logic Approaches for Deductive Databases” explores the roles of logic and logic programming in expert database systems. Highlighting the advantages of using logic as a query language, Leung and Lee classify logic-based expert database system architectures according to a taxonomy of homogeneous versus heterogeneous approaches and tightly versus loosely coupled techniques. Homogeneous approaches imply either that the logic system will be enhanced with data access primitives, or that a database management system will be endowed with deductive inference capabilities. Heterogeneous architectures recognize that each subsystem provides requisite functionality. Allowing them to cooperate in query processing and inference is the main issue. “Tight” and “loose” coupling refers to how much knowledge each system contains regarding internal mechanisms of the other, and how that knowledge is used to improve overall system performance. In addition to describing several prototypical systems, Leung and Lee discuss top-down and bottom-up evaluation, compiled and interpreted techniques, memory management, and query optimization.

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His research interests include semantic data models, query optimization, database support for software engineering environments, and expert database systems. He organized and served as program chair of the International Conferences on Expert Database Systems, and chairs the IEEE Technical Committee on Data Engineering. His address is George Mason University, ISSE Dept., 4400 University Dr., Fairfax, VA 22030.