An Introduction to Database Systems

C.J. Date
• **Part I** (four chapters) provides a broad introduction to the concepts of database systems in general and relational systems in particular. It also introduces the standard database language, SQL.

• **Part II** (six chapters) consists of a detailed and very careful description of the relational model, which is not only the theoretical foundation underlying relational systems but is, in fact, the theoretical foundation for the entire database field.

• **Part III** (four chapters) discusses the general question of database design. Three chapters are devoted to design theory, and the fourth considers semantic modeling and the entity/relationship model.

• **Part IV** (two chapters) is concerned with transaction management (i.e., recovery and concurrency controls).

• **Part V** (eight chapters) shows how relational concepts are relevant to a variety of further aspects of database technology—security, distributed databases, temporal data, decision support, and so on.

• **Part VI** (three chapters) describes the impact of object technology on database systems. Chapter 25 describes object systems specifically; Chapter 26 considers the possibility of a rapprochement between object and relational technologies and discusses object/relational systems; and Chapter 27 addresses the relevance to databases of XML.

**C. J. DATE** is an author, lecturer, researcher, and independent consultant specializing in relational database systems. An active member of the database community for nearly 35 years, C. J. Date devotes the major part of his career to exploring, expanding, and expounding the theory and practice of relational technology. He enjoys a reputation second to none for his ability to explain complex technical material in a clear and understandable fashion.
"[C. J. Date’s] book is the flag bearer of relational theory and mathematical treatment in general...as well as the runaway leader in discussing the SQL standards. It exercises much more respect for careful language and the importance of concepts and principles in gaining mastery of the field."

—CARL ECKBERG, San Diego State University

"[The] 8th Edition is an excellent and comprehensive presentation of the contemporary database field. In particular, Date’s chapters on types, relations, object databases, and object-relational databases together provide an exceptionally clear, self-contained exposition of the object-relational approach to databases."

—MARTIN K. SOLOMON, Florida Atlantic University

"Chris Date is the computer industry’s most respected expert and thinker on database technology, and his book An Introduction to Database Systems continues to be the definitive work for those wanting a comprehensive and current guide to database systems."

—COLIN J. WHITE, President, Intelligent Business Strategies

“This is the best explanation of concurrency that I have seen in literature, and it covers the ground quite thoroughly.”

—BRUCE O. LARSEN, Stevens Institute of Technology

“...both an indispensable read and an indispensable reference. No serious information systems or database practitioner should be without this book.”

—DECLAN BRADY, MICS, Systems Architect and Database Specialist, Fujitsu

“The author’s deep insights into the area, informal treatment of profound topics, open-ended discussions of critical issues, comprehensive and up-to-date contents, as well as rich annotations on bibliography have made the book most popular in the database area for more than two decades.”

—QIANG ZHU, The University of Michigan, Dearborn

“[The book’s] appeal is its comprehensiveness and the fact that it is very up-to-date with research developments. The latter factor is due mainly to [Date’s] involvement with these developments, which gives him a unique opportunity to write about them.”

—DAVID LIVINGSTONE, University of Northumbria at Newcastle
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Scratch Here!

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This book is dedicated to my wife Lindy
and to the memory of my mother Rene—
also to the memory of Ted Codd, who, sadly,
passed away as this book was going to press
Those who cannot remember the past are condemned to repeat it

*Usually quoted in the form:*

Those who don’t know history are doomed to repeat it

—George Santayana

I would like to see computer science teaching set deliberately in a historical framework. . . Students need to understand how the present situation has come about, what was tried, what worked and what did not, and how improvements in hardware made progress possible. The absence of this element in their training causes people to approach every problem from first principles. They are apt to propose solutions that have been found wanting in the past. Instead of standing on the shoulders of their precursors, they try to go it alone.

—Maurice V. Wilkes
C. J. Date is an independent author, lecturer, researcher, and consultant, specializing in relational database technology. He is based in Healdsburg, California.

In 1967, following several years as a mathematical programmer and programming instructor for Leo Computers Ltd. (London, England), Mr. Date moved to the IBM (UK) Development Laboratories, where he worked on the integration of database functionality into PL/I. In 1974 he transferred to the IBM Systems Development Center in California, where he was responsible for the design of a database language known as the Unified Database Language, UDL, and worked on technical planning and externals design for the IBM products SQL/DS and DB2. He left IBM in May, 1983.

Mr. Date has been active in the database field for well over 30 years. He was one of the first people anywhere to recognize the significance of Codd's pioneering work on the relational model. He has lectured widely on technical subjects—principally on database topics, and especially on relational database—throughout North America and also in Europe, Australia, Latin America, and the Far East. In addition to the present book, he is author or coauthor of a number of other database texts, including, from Morgan Kaufmann, Temporal Data and the Relational Model (2003) and, from Addison-Wesley, Foundation for Future Database Systems: The Third Manifesto (2nd edition, 2000), a detailed proposal for the future direction of the field; Database: A Primer (1983), which treats database systems from the nonspecialist's point of view; a series of Relational Database Writings books (1986, 1990, 1992, 1995, 1998), which deal with various aspects of relational technology in depth; and another series of books on specific systems and languages—A Guide to DB2 (4th edition, 1993), A Guide to SYBASE and SQL Server (1992), A Guide to SQL/DS (1988), A Guide to INGRES (1987), and A Guide to the SQL Standard (4th edition, 1997). His books have been translated into several languages, including Braille, Chinese, Dutch, French, German, Greek, Italian, Japanese, Korean, Polish, Portuguese, Russian, and Spanish.

Mr. Date has also produced over 300 technical articles and research papers and has made a variety of original contributions to database theory. For several years, he was a regular columnist for the magazine Database Programming & Design. He also contributes regularly to the website http://www.dbdebunk.com. His professional seminars on database technology, offered both in North America and overseas, are widely considered to be second to none for the quality of the subject matter and the clarity of the exposition.

Mr. Date holds an Honours Degree in Mathematics from Cambridge University, England (BA 1962, MA 1966) and the honorary degree of Doctor of Technology from De Montfort University, England (1994).