



BIBLIOGRAPHY

- Abbey, M., M. Corey and I. Abramson (2002). *Oracle9i: A Beginner's Guide*. London, McGraw-Hill.
- Anahory, S. and D. Murray (1997). *Data Warehousing in the Real World: A Practical Guide for Building Decision-Support Systems*. Harlow, UK, Addison-Wesley.
- ANSI (1975). ANSI/X3/SPARC Study Group on Data Base Management Systems: Interim Report, FDT. *ACM SIGMOD Bulletin* **7**(2).
- Apte, C., B. Liu, E.P.D. Pednault and P. Smyth (2002). Business applications of data mining. *CACM* **45**(8): 49–53.
- Atkinson, M., D. DeWitt, D. Maier, F. Bancilhon, K. Dittrich and S. Zdonik (1990). The object-oriented database system manifesto. In W. Kim, J.-M. Nicolas and S. Nishio (Eds), *Deductive and Object-Oriented Databases*. North-Holland, Elsevier Science.
- Avison, D.E. (1991). *Information Systems Development: A Database Approach*. Oxford, Alfred Waller.
- Bancilhon, F., C. Delobel and P. Kanellakis (Eds) (1992). *Building an Object-Oriented Database System: The Story of O₂*. San Mateo, CA, Morgan Kaufmann.
- Berners-Lee, T. (1999). *Weaving the Web: The Past, Present and Future of the World Wide Web by its Inventor*. London, Orion Business Publishing.
- Berson, A. and S.J. Smith (1997). *Data Warehousing, Data Mining and OLAP*. New York, McGraw-Hill.
- Beynon-Davies, P. (1992). The realities of database design: the sociology, semiology and pedagogy of database work. *Journal of Information Systems* **2**: 207–20.
- Beynon-Davies, P. (1994). Information management in the British National Health Service: the pragmatics of strategic data planning. *International Journal of Information Management* **14**(2 (April)): 84–94.
- Beynon-Davies, P. (1997). The corporate data model: a study of organisational practice. *Journal of Systems and Information Technology* **1**(1 (March)): 47–63.
- Beynon-Davies, P. (1998). *Information Systems Development: An Introduction to Information Systems Engineering*. Basingstoke, Macmillan (now Palgrave).
- Beynon-Davies, P. (2002). *Information Systems: An Introduction to Informatics in Organisations*. Basingstoke, Palgrave (formerly Macmillan).
- Beynon-Davies, P. (2003). *e-Business*. Basingstoke, Palgrave Macmillan.
- Blaha, M. and W. Premerlani (1997). *Object-Oriented Modelling and Design for Database Applications*. Englewood Cliffs, NJ, Prentice-Hall.
- Blaha, M.R., W.J. Premerlani and J.E. Rumbaugh (1988). Relational database design using an object-oriented methodology. *Comm. of ACM* **31**(4): 414–27.
- Bobrowski, S.M. (1998). *Oracle 8 Architecture*. Berkeley, CA, McGraw-Hill.
- Booch, G., J. Rumbaugh and I. Jacobson (1999). *The Unified Modelling Language User Guide*. Reading, MA, Addison-Wesley.
- Brachman, R.J. (1983). What ISA is and isn't: and analysis of taxonomic links in semantic networks. *Computer* **16**(10): 30–6.



- Braithwaite, K.S. (1992). *Information Engineering: Analysis and Administration*. London, CRC Press.
- Brodie, M.L., J. Mylopoulos and T.W. Schmidt (Eds) (1984). *On Conceptual Modelling: Perspectives from Artificial Intelligence, Databases and Programming Languages*. Berlin, Springer-Verlag.
- Bush, V. (1945). As we may think. *Atlantic Monthly*. 176: 101–3.
- Cabena, P., P. Hadjinian, R. Stadler, J. Verhees and A. Zanasi (1997). *Discovering Data Mining from Concept to Implementation*. Englewood Cliffs, NJ, Prentice-Hall.
- Cattell, R.G.G. (1994). *The Object Database Standard: ODMG-93: Release 1.1*. San Mateo, CA, Morgan Kaufmann.
- Cattell, R.G.G. (Ed.) (2000). *The Object Database Standard: ODMG Release 3.0*. San Mateo, CA, Morgan Kaufmann.
- CCTA (1994). *Corporate Data Modelling*. London, HMSO.
- Ceri, S. and G. Peligatti (1984). *Distributed Database Principles and Systems*. New York, McGraw-Hill.
- Checkland, P. (1987). *Systems Thinking, Systems Practice*. Chichester, John Wiley.
- Chen, P.P.S. (1976). The entity–relationship model: towards a unified view of data. *ACM Trans. on Database Systems* **1**(1): 9–36.
- Clark, K.L. (1978). Negation as failure. In H. Gallaire and G. Minker (Eds), *Logic and Databases*. Oxford: OUP.
- CODASYL (1971). *Database Task Group Report*. New York, ACM.
- Codd, E.F. (1970). A relational model for large shared data banks. *Comm. of ACM* **13**(1): 377–87.
- Codd, E.F. (1974). Recent investigations into relational database systems. *Proc. IFIP Congress*.
- Codd, E.F. (1979). Extending the relational database model to capture more meaning. *ACM Trans. on Database Systems* **4**(4): 397–434.
- Codd, E.F. (1982). Relational database: a practical foundation for productivity. *Comm. of ACM* **25**(2).
- Codd, E.F. (1985). Is your DBMS really relational? *Computerworld* 1–9.
- Codd, E.F. (1985). Does your DBMS run by the rules? *Computerworld* 49–64.
- Codd, E.F. (1988). Fatal flaws in SQL. *Datamation* August: 45–8.
- Codd, E.F. (1988). Fatal flaws in SQL: part 2. *Datamation*. Sept.: 71–4.
- Codd, E.F. (1990). *The Relational Model for Database Management: Version 2*. Reading, MA, Addison-Wesley.
- Codd, E.F., S.B. Codd and C.T. Salley (1993). *Providing OLAP (On-Line Analytical Processing) to User-Analysts: An IT Mandate*. Ann Arbor, MI, Arbor Software Corporation.
- Comer, D. (1979). The ubiquitous B-tree. *ACM Computing Surveys* **11**(2): 121–38.
- Conklin, E.J. (1987). Hypertext: an introduction and survey. *IEEE Computer* **2**(9): 17–41.
- Connolly, T.M. and C.E. Begg (2002). *Database Systems: A Practical Approach to Design, Implementation, and Management*. Harlow, UK, Addison-Wesley.
- Dahlbohm, B. and L. Mathiassen (1993). *Computers in Context*. London, NCC/Blackwell.
- Date, C.J. (1987). Twelve rules for a distributed database. *Computerworld* 2–5.
- Date, C.J. (1987). Where SQL falls short. *Datamation* May: 83–6.
- Date, C.J. (1997). *A Guide to the SQL Standard: A User's Guide to the Standard Database Language*. Reading, MA, Addison-Wesley.
- Date, C.J. (2000). *An Introduction to Database Systems*. Reading, MA, Addison-Wesley.
- DBTG (1971). *Report of the Codasyl Database Task Group*, ACM.
- DeWitt, D. and J. Grey (1992). Parallel database systems: the future of high performance database systems. *CACM* **35**(6).
- Eaglestone, B. and M. Ridley (1998). *Object Databases: An Introduction*. Maidenhead, Berkshire, UK, McGraw-Hill.
- Elmasri, R. and S.B. Navathe (2000). *Fundamentals of Database Systems*. Reading, MA, Addison-Wesley.



- Fagin, R. (1977). Multi-valued dependencies and a new normal form for relational databases. *ACM Trans. on Database Systems* **2**(1).
- Fagin, R. (1979). Normal forms and relational database operators. *ACM SIGMOD Int. Symposium on the Management of Data* 153–60.
- Feldman, P. and D. Miller (1986). Entity model clustering: structuring a data model by abstraction. *Computer Journal* **29**(4).
- Ferguson, M. (1993). Parallel query and transaction processing with relational databases. *UKOUG Conference*, Bournemouth, UK.
- Frost, R.A. (1982). Binary-relational storage structures. *Computer Journal* **25**(3): 358–67.
- Frost, R.A. (1983). A step towards the automatic maintenance of the semantic integrity of databases. *Computer Journal* **26**(2): 124–33.
- Gallaire, H. and G. Minker (1978). *Logic and Databases*, New York, Plenum Press.
- Gallaire, H., J. Minker and J.-M. Nicolas (1984). Logic and databases: a deductive approach. *Computing Surveys* **16**(2): 153–85.
- Garcia-Molina, H., J.D. Ullman and J.D. Widom (2002). *Database Systems: The Complete Book*. Harlow, UK, Prentice-Hall.
- Gardarin, G. and P. Valduriez (1989). *Relational Databases and Knowledge Bases*. Reading, MA, Addison-Wesley.
- Gatrell, A.C. (1991). Concepts of space and geographical data. In D.J. Maguire, M.F. Goodchild and D.W. Rhind (Eds), *Geographical Information Systems: Principles*. Harlow, UK, Longman Scientific.
- Gennick, J. (2000). *Sams Teach Yourself PL/SQL in 21 Days*. New York, Sams Publishing.
- Gillenson, M.L. (1987). The duality of database structures and design techniques. *Comm. of ACM* **30**(12): 1056–65.
- Gillenson, M.L. (1991). Database administration at the crossroads: the era of end-user-oriented, decentralised data processing. *Journal of Database Administration* **2**(4): 1–11.
- Goodhue, D.L., L.J. Kirsch, J.A. Quilliard and M.D. Wybo (1992). Strategic data planning: lessons from the field. *MIS Quarterly* March: 11–34.
- Goodhue, D.L., M.D. Wybo and L.J. Kirsch (1992). The impact of data integration on the costs and benefits of information systems. *MIS Quarterly* September: 293–311.
- Graham, I. (1989). Incremental development: review of nonmonolithic life-cycle development models. *Information and Software Technology* **31**(1): 7–20.
- Grant, J. and J. Minker (1992). The impact of logic programming on databases. *Comm of ACM* **35**(3): 66–81.
- Gray, J. (1996). The evolution of data management. *IEEE Computer* 38–46.
- Hammer, M. and D. McCleod (1981). Database description with SDM: a semantic database model. *ACM Trans on Database Systems* **6**(3): 351–86.
- Harel, D. (1988). On visual formalisms. *Comm. of ACM* **31**(5): 514–29.
- Healey, R.G. (1991). Database management systems. In D.J. Maguire, M.F. Goodchild and D.W. Rhind (Eds), *Geographical Information Systems: Principles*. Harlow, UK, Longman Scientific.
- Howe, D. (1981). *Data Analysis for Database Design*. London, Edward Arnold.
- Hudson, D.L. (1991). Approaches to corporate data model development at Sara Lee Corp. *Data Resource Management* **2**(3): 49–55.
- Hull, R. and R. King (1987). Semantic database models: survey, applications and research issues. *ACM Computing Surveys* **19**(3): 201–60.
- Inmon, W.H. (2000). *Building the Data Warehouse*. New York, John Wiley.
- Inmon, W.H., J.D. Welch and K.L. Glassey (1997). *Managing the Data Warehouse*. New York, John Wiley.
- ISO (1987). *Database Language SQL. ISO/IEC 9075:1987*. Geneva, International Standards Organisation.
- ISO (1989). *Database Language SQL with Integrity Enhancement. ISO/IEC 9075:1989*. Geneva, International Standards Organisation.

- ISO (1992). *Database Language SQL. ISO/IEC 9075:1992*. Geneva, International Standards Organisation.
- ISO (1999). *Database Language SQL – Part 2: Foundation. ISO/IEC 9075–2*. Geneva, International Standards Organisation.
- ISO (1999). *Database Language SQL – Part 2: Persistent Stored Modules. ISO/IEC 9075–4*. Geneva, International Standards Organisation.
- Jacobson, I., G. Booch and I. Rumbaugh (1999). *The Unified Software Development Process*. Reading, MA, Addison-Wesley.
- Jarke, M. and J. Koch (1984). Query optimisation in database systems. *ACM Computing Surveys* **16**: 111–52.
- Jones, C.B. and L.Q. Luo (1994). Hierarchies and objects in a deductive spatial database. *6th Int. Symposium on Spatial Data Handling*, Edinburgh, 588–603.
- Kahavi, R., N.J. Rothleder and E. Simoudis (2002). Emerging trends in business analytics. *Communications of the ACM* **45**(8): 45–53.
- Kantardzic, M. (2002). *Data Mining: Concepts, Models, Methods and Algorithms*. Chichester, John Wiley.
- Kent, W. (1978). *Data and Reality*. Amsterdam, North-Holland.
- Kent, W. (1983). A simple guide to five normal forms in relational database theory. *Comm. of ACM* **26**(2).
- King, R. (1988). My cat is object-oriented. In W. Kim and F. Lochovsky (Eds), *Object-Oriented Languages, Applications and Databases*. Reading, MA, Addison-Wesley.
- Klein, H.K. and R.A. Hirschheim (1987). A comparative framework of data modelling paradigms and approaches. *Computer Journal* **30**(1): 8–14.
- KPMG (2002). *Is Britain on Course for 2005?* London: KPMG Consulting.
- Laurini, R. and D. Thompson (1992). *Fundamentals of Spatial Information Systems*. San Diego, CA, Academic Press.
- Loney, K. and M. Theriault (2002). *Oracle9i DBA Handbook*. New York, McGraw-Hill.
- Maguire, D.J. (1991). An overview and definition of GIS. In D.J. Maguire, M.F. Goodchild and D.W. Rhind (Eds), *Geographical Information Systems: Principles*. Harlow, UK, Longman Scientific.
- Marakas, G.M. (2003). *Modern Data Warehousing, Mining, and Visualization: Core Concepts*. Upper Saddle River, NJ, Prentice-Hall.
- Martin, J. and C. McClure (1985). *Diagramming Techniques for Analysts and Programmers*. Englewood Cliffs, NJ, Prentice-Hall.
- Melton, J. and A.R. Simon (1993). *Understanding the New SQL: A Complete Guide*. New York, Morgan Kaufmann.
- Melton, J. and A.R. Simon (2002). *SQL: 1999: Understanding Relational Language Components*. San Francisco, CA, Morgan Kaufmann.
- Microcosm (1994). *Microcosm: A Technical Overview*. University of Southampton, UK.
- Navathe, S.B. and L. Kerschberg (1986). Role of data dictionaries in information resource management. *Information and Management* **10**: 21–46.
- Newell, A. and H.A. Simon (1976). Computer science as empirical inquiry: symbols and search. *Comm of ACM* **19**(3).
- O’Leary, T. (2002). *Microsoft Access 2002*. New York, McGraw-Hill.
- Oracle (1999). *Oracle 8i Administrator’s Guide*. Oracle Corporation.
- Oracle (2000). *Oracle Internet Application Server 8i: Overview Guide*. Oracle Corporation.
- Ovum (1988). *The Future of Databases*. London, Ovum Press.
- Özsu, M.T. and P. Valduriez (1991). *Principles of Distributed Database Systems*. Englewood Cliffs, NJ, Prentice-Hall.
- Özsu, M.T. and P. Valduriez (1992). Distributed database systems: where are we now? *Database Programming and Design* **42**(1).
- Porter, M.E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York, Free Press.

- Rada, R. (1991). *Hypertext: From Text to Expertext*. London, McGraw-Hill.
- Ramakrishnan, R. and J. Gehrke (2003). *Database Management Systems*. Boston, MA, McGraw-Hill.
- Reiter, R. (1978). On closed world databases. In H. Gallaire and J. Minker (Eds), *Logic and Databases*. Oxford: OUP.
- Reiter, R. (1984). Towards a logical reconstruction of relational database theory. In M.L. Brodie, J. Mylopoulos and J.W. Schmidt (Eds), *On Conceptual Modelling: Perspectives from Artificial Intelligence, Databases and Programming Languages*. New York, Springer-Verlag.
- Rich, E. (1984). Natural-language interfaces. *IEE Computer* **17**(9): 39–47.
- Robinson, K.A. (1979). The entity/event modelling method. *Computer Journal* **22**: 270–81.
- Rodgers, U. (1989). Denormalisation: why, what and how? *Database Programming and Design* **2**(12): 46–53.
- Rolland, F.D. (1998). *The Essence of Databases*. Hemel Hempstead, UK, Prentice-Hall.
- Rosenquist, C.J. (1982). Entity life-cycle models and their applicability in information systems development. *Computer Journal* **25**: 307–15.
- Schneiderman, B. (1998). *Designing the User Interface: Strategies for Effective Human–Computer Interaction*. Reading, MA, Addison-Wesley.
- Shave, M.J.R. (1981). Entities, functions and binary relations: steps to a conceptual schema. *Computer Journal* **24**(1).
- Sikora, Z.M. (1997). *Oracle Database Principles*. London, Macmillan (now Palgrave).
- Silberschatz, A., H.F. Korth and S. Sudarshan (2002). *Database System Concepts*. Boston, MA, McGraw-Hill.
- Smith, H.C. (1985). Database design: composing fully normalised tables from a rigorous dependency diagram. *Comm. of ACM* **28**(8).
- Smith, J.M. and D.C.P. Smith (1977). Database abstractions: aggregation and generalisation. *Transactions of Database Systems* **2**(2).
- Sowa, J.F. (1984). *Conceptual Structures: Information Processing in Mind and Machine*. Reading, MA, Addison-Wesley.
- Stamper, R.K. (1973). *Information in Business and Administrative Systems*. London, Batsford.
- Stonebraker, M. (1996). *Object-Relational DBMSs: The Next Great Wave*. San Francisco, CA, Morgan Kaufman.
- Stonebraker, M. and J.M. Hellerstein (Eds) (1998). *Readings in Database Systems*. San Francisco, CA, Morgan Kaufmann.
- Sturmer, G. (1995). *Oracle7: A User's and Developer's Guide*. London, International Thompson Publishing.
- Sussman, R. (1993). Municipal GIS and the enterprise data model. *Int. Journal of Geographical Information Systems* **7**(4): 367–77.
- Sweet, F. (1985). A 14-part series on process-driven database design. *Datamation* Jan.–Nov.
- Teorey, T.J. (1994). *Database Modelling and Design: The Fundamental Principles*. San Mateo, CA, Morgan Kaufmann.
- Tsitchizris, D.C. and F.H. Lochovsky (1982). *Data Models*. Englewood Cliffs, NJ, Prentice-Hall.
- W3C (1999). *HTML 4.01*. World-Wide-Web Consortium.
- W3C (2000). *XML 1.0 2nd Edition*. World-Wide-Web Consortium.
- Weaver, P.L., N. Lambrou and M. Walkley (1998). *Practical SSADM 4+*. London, Pitman.
- Winograd, T. and F. Flores (1986). *Understanding Computers and Cognition: A New Foundation for Design*. Norwood, NJ, Ablex Publishing.
- Winston, P.H. (1984). *Artificial Intelligence*. Reading, MA, Addison-Wesley.
- Winston, M., R. Chaffin and D. Herrmann (1987). A taxonomy of part-whole relations. *Cognitive Science* **11**: 417–44.
- Witten, I.H. and E. Frank (2000). *Data Mining*. San Francisco, CA, Morgan Kaufmann.
- Zloof, M.M. (1975). Query by example. *Proc. NCC* **44**(May).



GLOSSARY AND INDEX

Term	Definition	Pages
A		
Aborted Transaction	A <i>transaction</i> that does not complete successfully. No permanent changes are made to a database by an aborted transaction	405
Abstract Data Type (ADT)	An abstract data type or ADT is a type of <i>object</i> that defines a <i>domain</i> of values and a set of operations designed to work with these values	145–6
Abstract Machine	A model of the key features of some system without any implementation detail	4
Abstraction	The process of modelling ‘real-world’ concepts in a computational medium	24–5
Abstraction Mechanism	A mechanism for constructing hierarchies of <i>object classes</i>	117, 250
Access (Microsoft DBMS)	A popular <i>DBMS</i> originally produced for the desktop market by Microsoft	426, 446–56
Access Mechanism	An algorithm embodied in software established for accessing data	82, 313–15, 395–402
Accommodation	The process of producing a <i>logical model</i> from a <i>conceptual model</i>	232, 236–8, 255, 260, 280–3
Active Data Dictionary	That part of a <i>database system</i> that contains <i>meta-data</i> and is used to control <i>DBMS</i> operations	339
Active Database System	A <i>database system</i> with embedded <i>update functions</i>	148
Additional Integrity	The business rules relevant to some application domain that cannot be specified using the <i>inherent integrity</i> mechanisms of some <i>data model</i>	109–10, 121–2, 304–5, 460
After-Image Log	A history of the new or modified values that result when transactions are applied to a database	414, 416
Aggregate Functions (SQL)	A set of <i>SQL</i> functions that can operate over aggregations of data – Max, Min, Count, Avg	182



Term	Definition	Pages
Aggregation	An <i>abstraction mechanism</i> or process by which an object is used to group together a number of other objects	117, 255–60
AKO (A-Kind-Of)	AKO relates <i>object class</i> to object class. See also <i>Generalisation</i>	252
ANSI/SPARC Architecture	In 1975 the American National Standards Institute Standards Planning and Requirements Committee (ANSI-SPARC) proposed a three-level architecture for DBMS	77–8
API	See <i>Application Programming Interface</i>	
Application Data Model	A blueprint of data requirements	37, 55, 324
Application Development Toolkit	A set of tools for the application developer to build information systems in association with a database system	365–74
Application Programming Interface	A defined interface for connecting application programs to <i>DBMS</i>	371–2
Archiving	The process of moving unused data off a database into some form of storage	378–9
Armstrong's Axioms	A set of rules which can be used to compute new <i>functional dependencies</i> from existing dependencies	280
Assert	An in-built function within <i>Datalog</i>	129
Assertion	Some statement about the characteristics of some <i>UoD</i> . A command in SQL2	127, 174
Association	An <i>abstraction mechanism</i> . Instances of one <i>object</i> are linked to instances of another object	250
Atomicity	A property of a <i>transaction</i> . Atomicity ensures that a transaction either executes completely or is aborted	405
Attribute	A column in a <i>relation</i> . A property of an <i>object</i> or <i>entity</i>	5, 222, 441
Attribution	The process of relating properties to an <i>object</i>	256, 258
Authorisation	The facilities available for enforcing database security	80, 377–8
B		
B2B e-Commerce	The use of <i>e-Commerce</i> in the supply chain	65–6
B2C e-Commerce	The use of <i>e-Commerce</i> in the customer chain	66
Bachman, Charles	The creator of the Integrated Data Store (IDS) at General Electric – one of the first DBMS	40
Backing Store	See <i>Secondary Storage</i>	
Backup	The process of taking a copy of the whole or a part of some database for the purposes of <i>recovery</i>	344, 378–9 423
BCNF	See <i>Boyce–Codd Normal Form</i>	
Behavioural Abstraction	That part of an <i>object model</i> concerned with the specification of behaviour	249, 260–4

Term	Definition	Pages
Behavioural Inheritance	The <i>inheritance</i> of methods	117
Bit	An abbreviation of binary digit – one of the two digits (0 and 1) used in binary notation	384
BLOB	Binary Large Object. A byte stream used to store large objects in databases	433, 521
Block	A group of records treated as a unit on some secondary storage device. A term sometimes treated as a synonym for <i>page</i>	385
Bottom-up Data Analysis	The process of arriving at a logical schema via <i>normalisation</i>	43
Boyce–Codd Normal Form	A stronger normal form than <i>third normal form</i> . A BCNF schema is one in which every <i>functional determinant</i> is a <i>candidate key</i>	281, 284–5
Bracketing Notation	A shorthand notation for recording the structural detail associated with a relational schema	94–5
Browser	A program needed to access and read Web documents	562
B-Tree	A data structure used to build multi-level indexes	399–400
Business Area Data Model	A <i>data model</i> specified for some business area	55
Byte	A set of binary digits considered as a unit	384
C		
Call-level Interface	A type of <i>Application Programming Interface</i> in which subroutine calls to a DBMS library are embedded in some <i>Host Language</i>	371–2
Candidate Key	An attribute or group of attributes capable of acting as a <i>primary key</i>	92–3, 282
Cardinality	The number of attributes in a relation. The number of instances of an <i>entity</i> associated with some other entity.	92, 255, 226–7, 250–1
Chasm Trap	A <i>connection trap</i> . A misconception that the relationship between two entities can be generated by traversing other relationships in a <i>data model</i>	234–5
Checkpointing	Checkpointing is a technique used to limit the amount of searching that needs to be performed against a log file in order to carry out <i>recovery</i> effectively. Checkpointing involves force-writing database buffers to <i>secondary storage</i> at pre-determined intervals	416
Class	See <i>Object Class</i>	



Term	Definition	Pages
Classic Data Model	A term used to encapsulate the hierarchical, network and relational <i>data models</i> . Data models maintaining a fundamental record orientation	37
Classification	Classification involves grouping objects that share common characteristics into an <i>object class</i>	251
Client–Server	An applications architecture in which the processing is distributed between machines acting as clients and machines acting as servers	480–1
Closed World Assumption	The assumption that the only thing known about some <i>UoD</i> is represented in a database	6
Closure	A property of a <i>query language</i> in which the results from one query can be operated upon by another query	104
Clustered File	See <i>Clustering</i>	314, 390–1
Clustering	The process of storing logically related records close together on some <i>secondary storage device</i>	390–1
Clustering Index	An <i>index</i> used to help maintain the physical clustering of a stored file	391
CODASYL Data Model	An acronym for the Conference on Data Systems Languages, a committee that developed standards leading to the COBOL language. The Database Task Group (DBTG) sub-committee of CODASYL developed specifications on which the network data model is based. See <i>Network Data Model</i>	
Codd, E.F.	The creator of the relational data model	40, 270, 458
Codd’s Rules	In the mid-1980s Codd proposed twelve rules for determining whether a DBMS was relational	458–60
Collection	An <i>ODMG object model</i> construct comprising aggregates of objects or literals	432, 439
Collection Type	An <i>SQL3</i> construct allowing multiple values to be stored in columns and enabling <i>nested tables</i>	431–2
Column	See <i>Attribute</i>	
Command-line Interface	A user interface in which instructions are initiated through typed commands	368–9
Commit	A command used to make permanent in a database the results of some <i>transaction</i> . A keyword in <i>SQL</i>	405–6
Complex Data	A term used to refer to data subject to non-standard structure	512–23
Complex Object	An <i>object</i> with inherent hierarchical structure	136, 437
Compound Determinant	A <i>determinant</i> consisting of two or more attributes	279
Computer Aided Information Systems Engineering (CAISE)	The automation of information systems development	366–7

Term	Definition	Pages
Conceptual Data Dictionary	A <i>data dictionary</i> used to represent a <i>conceptual model</i>	338
Conceptual Level	See <i>Conceptual Schema</i>	
Conceptual Model	A model of the 'real world' expressed using constructs such as entities, relationships and attributes	42, 198
Conceptual Modelling	The process of developing a <i>conceptual model</i>	42, 198, 201
Conceptual Schema	A level of the <i>ANSI/SPARC architecture</i>	78
Concurrency	The process by which simultaneous access to a database is enabled for multiple users	15, 406–8
Concurrency Control	That facility provided by the <i>kernel</i> of a DBMS that enables concurrency	80, 408–13
Concurrent Transactions	Two or more transactions that overlap both in terms of time and the data they wish to access	406
Connection Trap	A set of design problems associated with E–R modelling. See also <i>Chasm Trap, Fan Trap</i>	232–5
Consistency	That property of a <i>transaction</i> which ensures that the changes caused by a transaction maintain the database as an accurate reflection of its real world domain	405
Constraint	See <i>Integrity Constraint</i>	
Corporate Data Model	A <i>data model</i> specified for an entire organisation	55, 324
Corporate Data Modelling	The process of developing a <i>corporate data model</i>	324–6
Correlated Subquery	A <i>subquery</i> that executes repeatedly, producing a series of values to be matched against the results of an outermost query	184
Cost-based Optimisation	See <i>Statistically-based Optimisation</i>	
Covering Subclass	Subclasses are covering if no other subclasses other than those specified are possible for a particular superclass	252–3
CPU	Central Processing Unit	499
CREATE INDEX	An <i>SQL</i> command for creating indexes on tables	400–1
CREATE TABLE	The main data definition command in <i>SQL</i>	161
CREATE VIEW	A standard command in <i>SQL</i> for constructing <i>view</i> definitions	349–50
CRUD functions	Create, Read, Update, Delete functions	79, 178
Cursor	A construct used to define both an <i>SQL</i> request and to iterate over rows in a result. A cursor is an embedded <i>SQL</i> construct used to solve the <i>impedance mismatch</i>	370
Customer Chain	The chain of activities that an organisation performs in the service of its customers	64, 66



Term	Definition	Pages
D		
Data	Sets of symbols	6, 19–28, 335
Data Abstraction	The process by which a database attempts to represent the properties of objects in the real world	35
Data Administration	Data administration is that function concerned with the management, planning and documentation of the data resource of some organisation	202, 334–42
Data Administrator	The person or persons tasked with <i>data administration</i> functions in some organisation	55, 58, 322, 335, 344
Data Analysis	The process involved in producing a <i>logical model</i> of some database system	43, 336
Data Analyst	A term frequently used to described the person or persons tasked with <i>requirements elicitation, conceptual modelling</i> and <i>logical database design</i>	336
Data Control	That part of a <i>data model</i> concerned with controlling access to databases and/or facilities of a DBMS	36, 305, 336, 345–53
Data Control Language	That part of a <i>database sublanguage</i> concerned with <i>data control</i>	81
Data Definition	That part of a <i>data model</i> concerned with defining data structures	25, 35, 36, 336
Data Definition Language (DDL)	That part of a <i>database sublanguage</i> concerned with <i>data definition</i>	81
Data Definition Language Compiler	That module of a DBMS concerned with updating the <i>system catalog</i>	83
Data Dictionary	A term used either to denote the <i>system tables</i> of some relational DBMS or to denote a more encompassing representation of the data used by some enterprise	79–81, 238–9, 328, 338–9, 419–20
Data Element	A logical collection of <i>data-items</i>	25
Data Format	A set of constraints defined on a data-item. See also <i>Data Type</i>	25
Data Independence	Buffering data from the processes that use such data	35, 372
Data Integration	A collection of data that displays no <i>redundancy</i>	34, 331–3
Data Integrity	That part of a <i>data model</i> concerned with specifying the business rules appropriate to some application domain	25, 34, 37, 80, 336, 379
Data Integrity Language (DIL)	That part of a <i>database sublanguage</i> concerned with <i>data integrity</i>	81
Data Management	The process of recording and manipulating data. Also used as a collective term for all the functions of a <i>DBMS</i>	38–41

Term	Definition	Pages
Data Management Layer	A layer of an <i>ICT System</i>	76–86
Data Manipulation	That part of a <i>data model</i> concerned with the manipulation of data in data structures	25, 36
Data Manipulation Language (DML)	That part of a <i>database sublanguage</i> concerned with <i>data manipulation</i>	81
Data Mart	A small <i>data warehouse</i>	70, 533–4
Data Mining	Data mining is the process of extracting previously unknown data from large databases and using it to make organisational decisions	70, 528, 547–53
Data Model	An architecture for data or a blueprint of data requirements for some application	14, 25, 36–8, 87–8
Data Modelling	See <i>Conceptual Modelling</i>	
Data Organisation	The way in which data is structured on physical storage devices	383–94
Data Security	The process of ensuring the security of data	34–5, 305, 336, 339–40, 379, 454–5
Data Sharing	The process of ensuring the sharing of data among two or more users or application systems	34, 336
Data Structure	An organised element of some database. A logical collection of <i>data elements</i>	25, 33
Data Subsystem	See <i>Data Management Layer</i>	53, 479
Data Type	A definition for the data appropriate to attributes or data-items	26, 161–3
Data Warehouse	A subject-oriented, integrated, time-variant and non-volatile collection of data used in support of management decision-making	70, 528–9
Data Warehousing	The process of building and managing data warehouses	527–38
Database	An organised pool of logically-related data	33
Database Administration	The activity of managing given database systems	202, 343–54
Database Administration Toolkit	The set of tools available to the <i>database administrator</i> for administering database systems	80–1, 375–80
Database Administrator	A person given responsibility for managing a particular database system or a limited number of database systems	58, 80–1, 322, 344, 376
Database Design	The process of modelling ‘real-world’ constructs in a database system	5, 7



Term	Definition	Pages
Database Development	The entire process of constructing some <i>database system</i>	42–3, 193–4, 324
Database Development Process	The process devoted to the development of database systems. A subprocess of the process of information systems development	195–207
Database Implementation	Taking the decisions of <i>physical database design</i> and implementing them in a chosen DBMS	199–200, 309–20
Database Management System	A suite of computer software providing the interface between users and a <i>database</i> or databases	33
Database Manager	A module of a DBMS concerned with controlling all access to <i>file manager</i> functions	83, 84
Database Segmentation	A <i>data mining</i> technique which involves partitioning a database into a number of segments	550–1
Database Sublanguage	A programming language designed specifically for initiating <i>DBMS</i> functions	158, 160
Database System	A term used to encapsulate the constructs of a <i>data model</i> , <i>DBMS</i> and <i>database</i>	38
Database Task Group (DBTG)	A part of the COBOL programming community chartered to define a standard <i>data definition</i> and <i>data manipulation</i> language	40
Data-item	The atomic construct of some <i>data model</i>	25
Datalog	A variant of <i>Prolog</i> designed for database work	125–42
Datum	A unit of <i>data</i>	6
DBA	See <i>Database Administrator</i>	
DBMS	See <i>Database Management System</i>	
DCL	See <i>Data Control Language</i>	
DDL	See <i>Data Definition Language</i>	
Deadlock	The state in which transactions have locked the data needed by each other	412–13
Decision Support Database	A <i>database</i> used to enable decision-making in some organisation	57
Decomposition	The opposite of <i>aggregation</i> . The process of breaking up an object into its component parts	255
Deductive Data Model	The <i>data model</i> based on formal logic	125–42
Deductive Databases	A database adhering to the <i>deductive data model</i>	126, 133, 522
Default Value	A value declared to be appropriate to be used in the absence of data for some given <i>column</i> in a table	163

Term	Definition	Pages
Degree	The number of <i>tuples</i> in a relation. Also a term used to denote the number of instances relevant to some relationship in the E-R approach	92
Denormalisation	The process of moving back from a fully-normalised data-set to prior normal forms to meet performance requirements	315–16
Dependency	An <i>association</i> between data-items	271–2
Dependency Diagram	See <i>Determinancy Diagram</i>	
Dependent Data-item	A <i>data-item</i> whose values are determined by some other data-item	271–2, 277
Designation	Refers to the symbol(s) by which some concept is known	22
Determinancy	See <i>Dependency</i>	
Determinancy Diagram	A diagram which documents the determinancies between data-items relevant to some application domain. Used in the process of <i>normalisation by synthesis</i>	277
Determinancy Diagramming	The process of producing a <i>determinancy diagram</i>	276–80
Determinant	A <i>data-item</i> which determines the values of some other data-item	371
Deviation Detection	A <i>data mining</i> technique that involves identifying outliers in the population of data	551
Difference	An operator in the <i>relational algebra</i> . A commutative operator that produces a result from two relations in the tuples in the resulting table that are not present in both input tables	101–2
Direct Access	Access to data based on a physical address	385
Disjoint Subclass	Subclasses are disjoint if they do not overlap	253
Disk	A <i>secondary storage</i> device	384–5, 500
Disk Manager	That part of an operating system which translates logical <i>block</i> requests into physical block identifiers	386
Distributed Data	The distribution of data in a database around a network	486–97
Distributed Database Design	The process of designing a distributed database system	494–5
Distributed Database System	A distributed database system is a <i>database system</i> which is fragmented or replicated on the various configurations of hardware and software located usually at different geographical sites within an organisation	478, 487
Distributed DBMS	A <i>DBMS</i> with facilities enabling the distribution of data and/or processing	494
Distributed Processing	The distribution of <i>DBMS</i> functions around a network	477–85



Term	Definition	Pages
Distribution	The distribution of processing or data in some <i>database system</i>	15–16, 478
Distribution Analysis	That part of <i>physical database design</i> concerned with the assignment of processing and/or data to different parts of a computer network. See <i>Distributed Database Design</i>	299
Division	An operator of the <i>relational algebra</i> . Divide takes two tables (one a unary table, the other a binary table) as input and produces one table as output. The resulting table contains tuples where a match is achieved between rows of the unary table and that of the binary table	103–4
DML	See <i>Data Manipulation Language</i>	
Documentary Analysis	A <i>requirements elicitation</i> technique that involves examination of existing organisational documentation	215
Domain	A pool of values from which the actual values represented in an <i>attribute</i> of a <i>relation</i> are taken	93, 173
Domain Integrity	An inherent integrity mechanism in the <i>relational data model</i> concerned with enforcing the concepts of domains	172–3, 304
Domain Name	An agreed string of characters used to add greater meaning to a <i>URL</i>	559
Domain Relational Calculus	A variant of the <i>relational calculus</i> which acts as the foundation for QBE interfaces	105
Duplicated Data	A data value is duplicated when an <i>attribute</i> has two or more identical values	10
Durability	The property of a <i>transaction</i> that ensures all changes caused by a transaction persist in time	405
E		
e-Business	Electronic Business. The conduct of business using information and communication technology. A superset of <i>e-Commerce</i>	62–74
e-Commerce	Electronic Commerce. The conduct of business-to-business commerce using ICT such as that supporting the Internet	63
Electronic Data Interchange (EDI)	A set of standards for the representation and transfer of electronic documentation	65
Electronic Delivery	The delivery of products and services through ICT	67–70
Embedded SQL	An <i>application programming interface</i> in which SQL commands may be embedded in some <i>host language</i> such as C	369–71
Empirics	Branch of semiotics concerned with the physical characteristics of the communication channel	22
Encapsulation	The packaging together of data and procedures within a defined interface	116, 437

Term	Definition	Pages
End-user	An organisational user of database applications	58
End-user Interface	A term used to describe the presentation layer of some information systems application	358–60
End-user Toolkit	The <i>DBMS</i> tools designed for use by end-users	357–64
Entity	Some aspect of the 'real world' which has an independent existence and can be uniquely identified	220–1, 249
Entity Integrity	An inherent rule of the <i>relational data model</i> . Every relation must have a <i>primary key</i> and a primary key should be unique and not null	107, 169–70
Entity Life Histories	A technique used to specify the key events affecting the 'life' of some <i>entity</i>	262
Entity Model	A model of the entities, relationships and attributes pertaining to some application	198, 220, 249
Entity Modelling	See <i>Entity–Relationship Diagramming</i>	
Entity Type	See <i>Entity</i>	220
Entity–Relationship Data Model	A <i>data model</i> , originally proposed by P.P.S. Chen, which utilises three primary constructs: entities, relationships and attributes	42
Entity–Relationship Diagramming	A technique for graphically representing a <i>conceptual model</i> using constructs from the <i>entity–relationship data model</i>	43, 198, 219–45
Equi-join	The equi-join operator is a <i>product</i> with an associated <i>restrict</i> . It combines two tables but only for rows where the values match in the join columns of two tables	97–8
E–R Diagramming	See <i>Entity–Relationship Diagramming</i>	
Ethnography	A <i>requirements elicitation</i> technique that involves immersion in some organisational setting	216
Event	An event is something that happens at a point in time to some defined <i>object</i>	262–3
Exclusivity	A term used in <i>E–R diagramming</i> to describe the situation in which two or more relationships are mutually exclusive	228–9
Export	The process of writing out data from a <i>database</i> in a format that other systems can use	379
Extended-Relational Data Model	See <i>Post-Relational Data Model</i>	115
Extension	A term used to describe the total set of the <i>data</i> in some <i>database</i>	7, 23
Extent	See <i>Extension</i>	
External Level	See <i>External Schema</i>	78
External Schema	A layer in the <i>ANSI/SPARC architecture</i> which describes data and relationships of interest to application systems or end-users	78



Term	Definition	Pages
Extranet	Allowing access to aspects of an organisation's intranet to accredited users	66
F		
Fact	A positive <i>assertion</i> about some <i>UoD</i>	
Factbase	A collection of facts or positive <i>assertions</i>	6, 133
Fan Trap	A <i>connection trap</i> . The incorrect assumption that an entity linking two other entities will act in the capacity of a data bridge between the entities	234
Federated Database System	A federated database system is made up of a number of relatively independent, autonomous databases	493–4
Field	An element of <i>physical data organisation</i> . A <i>record</i> is a collection of fields	385–6
Fifth Normal Form	Generally speaking, a <i>fourth normal form</i> table is in fifth normal form if it cannot be non-loss decomposed into a series of smaller tables	287–8
File	An element of <i>physical data organisation</i>	385–6
File Maintenance Anomalies	A series of problems occurring in unnormalised data-sets	270–1
File Manager	That module of some operating system that translates between the data structures supported by some <i>DBMS</i> and files on disk	82, 386–7
File Organisation	See <i>Data Organisation</i>	
Finite State Machine	A finite state machine is a hypothetical mechanism which can be in one of a finite number of discrete states at one time. Events occur at discrete points in time and cause changes to the machine's state	264
Firewall	A system used to secure an <i>intranet</i> from unauthorised access	66
First Normal Form	A <i>relation</i> is in first normal form if and only if every non-key attribute is functionally dependent upon the primary key	272–3
Foreign Key	An <i>attribute</i> of a relation which references the primary key of some other relation	93
Formal Language	An artificial language constructed for some defined purpose	24
Formalism	See <i>Representation Formalism</i>	
Fourth Generation Language (4GL)	A high-level programming language for application development. Most 4GLs differ from 3GLs in having highly developed data management functions	373
Fourth Normal Form	A <i>relation</i> is in fourth normal form if there are no independent multi-valued dependencies evident in the schema	285–7
Fragment	Some subset of a database <i>schema</i>	487

Term	Definition	Pages
Fragmentation Transparency	A <i>distributed database system</i> displays fragmentation transparency if users are not aware of how data is fragmented	489
Functional Determinancy (or Dependency)	Two data-items, A and B, are said to be in a functionally determinant or dependent relationship if the same value of data-item B always appears with the same value of data-item A	271–2
G		
Generalisation	An <i>abstraction mechanism</i> or process by which a higher-order object is formed to emphasise the similarities between lower-order objects	117, 250
Generalisation Hierarchy	A hierarchy of object classes linked by <i>generalisation</i> relationships and in which each subclass has only one superclass	250
Generalisation Lattice	A collection of object classes linked by <i>generalisation</i> relationships in which subclasses may have more than one superclass	251
Geographical Information System (GIS)	An information system centred around a core of <i>spatial data</i>	518–20
Gigabytes	1,000,000,000 bytes (billion)	384
Grammar	Rules that control the correct use of a language	24
GRANT	A command in <i>SQL</i> for granting data privileges to authorised users of some database	350–1
Graphical User Interface (GUI)	A user interface in which graphical objects such as icons are used to initiate instructions to the application	361–2
H		
Hash Function	See <i>Hashing</i>	389, 504
Hash Partitioning	Hash partitioning is a parallel partitioning strategy which involves placing tuples by applying a <i>hashing</i> function to an attribute in each tuple	504
Hashed File	A form of <i>physical organisation</i> in which records are stored in terms of some hash function	314, 389–90
Hashing	An algorithm for converting logical values to physical addresses	389, 504
Heterogeneous Distributed Database System	A heterogeneous <i>distributed database system</i> is one in which the hardware and software configuration is diverse	493
Heuristic-based Optimisation	See <i>Syntax-based Optimisation</i>	



Term	Definition	Pages
Hierarchical Data Model	A data model in which data structures are arranged in hierarchies of parent-child relationships	37
Homogeneous Distributed Database System	A homogeneous distributed database system is one in which data is distributed across two or more systems, each system running the same DBMS on the same types of hardware under the same operating system	492-3
Homonym	The same term used to denote dissimilar objects or entities	240
Host Language	A term used to refer to a traditional programming language such as C or COBOL in which data management commands can be embedded	369
HTML	Hypertext Markup Language. A standard for marking up documents to be published on the <i>WWW</i>	27, 71, 515, 561-2
HTTP	Hypertext Transfer Protocol. An object-oriented, stateless protocol that defines how information can be transmitted between client and server	557-8
Human Activity System	Systems consisting of people, conventions and artefacts designed to serve human needs	50-1
Hypermedia	Hypermedia is the approach to building information systems made up of nodes of various media (such as text, audio data, video data etc.) connected together by a collection of associative links	68, 559-60
Hypertext	A subset of <i>hypermedia</i> concentrating on the construction of loosely connected textual systems	560
I		
I-Commerce	Internet Commerce. The use of <i>Internet</i> technologies to enable e-Commerce	63
ICT System	A system of hardware, software, data and communication technology. The ICT component of some information system	51-3
Impedance Mismatch	The mismatch between record-at-a-time forms of processing characteristic of procedural programming languages and file-at-a-time forms of processing characteristic of relational <i>DBMS</i>	370
Import	The process in which data is read into a <i>database</i> from some external system	379
Inclusivity	In the E-R approach two relationships are said to be inclusive if one cannot participate in one <i>relationship</i> without participating in the other	228-9
Inconsistent Analysis Problem	A problem caused by the concurrency of <i>transactions</i> - transactions reading the partial results of incomplete transactions	408, 412

Term	Definition	Pages
Index	A mechanism which associates logical values with physical addresses	314–15, 396–7
Index Sequential File	A form of file structure in which the sequence of records is maintained by an <i>index</i>	39–40, 314, 397
Informatics Infrastructure	A specification of the information, information systems and information technology needed by some organisation	56–7
Information	<i>Data</i> set in some meaningful context	6, 19–28
Information and Communications Technology (ICT)	Technology that includes computers and communications designed to enable information systems	51
Information Management System (IMS)	One of the earliest <i>DBMS</i> developed at IBM	40
Information System	An information system is a system of communication between people. Information systems are systems involved in the gathering, processing, distribution and use of information	49–50
Information Systems Development	The process of producing some information system	196–7
Information Systems Planning	The process of defining some information systems architecture	56
Inherent Integrity	The integrity rules built into some data model	107–9, 121, 304
Inheritance	The process by which subclasses acquire the attributes, methods and relationships of its superclass	117, 250, 437
Instance Diagram	A representation of the instances of <i>entities</i> and the <i>relationships</i> between such instances	227–8
Instantiation	The process of defining an instance upon an <i>object class</i>	251
Integrated Data Store (IDS)	One of the earliest <i>DBMS</i> developed at General Electric	40
Integrity	Maintaining the logical consistency of some database. See also <i>Integrity Constraint</i>	9, 339, 404
Integrity Analysis	That part of the <i>physical database design</i> process concerned with the specification of integrity associated with some database application	304–5
Integrity Constraint	A rule for enforcing <i>integrity</i>	10–11, 12, 131–2, 239, 260, 317
Intension	The collection of properties that in some way characterise some phenomena represented as a sign. See also <i>Schema</i>	23, 25



Term	Definition	Pages
Interface (Database)	The intervening system between <i>toolkit</i> products and DBMS <i>kernel</i>	79, 81, 155–6
Interface Subsystem	A layer of an <i>ICT system</i>	53, 479
Internal Schema	A layer in the <i>ANSI/SPARC architecture</i> which describes the way in which data is stored and accessed from secondary storage devices	78
Internal Value-chain	That part of the <i>value-chain</i> concerned with internal activities	64–5
Internet	A set of interconnected global communication networks	68, 555
Interpreted Queries	Queries that are interpreted by the <i>query processor</i> of some DBMS at run-time	423
Interpreted SQL	A form of <i>SQL</i> in which commands are interpreted	368
Intersection	An operator of the <i>relational algebra</i> . Fundamentally the opposite of <i>Union</i> . Produces a result table which contains the tuples common to both input tables	101
Interviews	A <i>requirements elicitation</i> technique which involves a structured conversation between a developer and some stakeholder	214
Intranet	The use of <i>Internet</i> technology within a single organisation	64, 66
ISA	ISA relates objects to object classes. See also <i>Classification</i>	252
Isolation	The property of a <i>transaction</i> that ensures that changes made by one transaction only become available to other transactions after the transaction has completed	405
Isolation Level	A construct in <i>SQL2</i> which allows the DBA to control the balance between <i>concurrency</i> and <i>consistency</i>	415
J		
Join	An operator of the <i>relational algebra</i> which associates data between tables. The operator takes two relations as input and produces one relation as output. See also <i>Equi-join</i> , <i>Natural Join</i> , <i>Product</i>	97–101, 185, 187–8
K		
Kernel	The core data management facilities of a <i>DBMS</i> such as concurrency control	78, 81–4, 381–2, 460
Key	That <i>field</i> or fields within a file used to identify records	388
Kilobyte	1000 bytes	384
L		
Legacy Database System	A database application that was produced some time in the past but which is critically important to some organisation	32

Term	Definition	Pages
Link Analysis	A <i>data mining</i> technique which establishes associations between records in a data-set	551
Location Transparency	A <i>distributed database system</i> displays location transparency if the user is not aware of data being distributed among multiple locations	489
Lock	A mechanism used in <i>concurrency control</i> . A lock can be set on some database element (such as a row) by a user or application system and prevents other users/systems from updating that element	409–10
Locking	A pessimistic form of <i>concurrency control</i>	409–13
Logical Data Dictionary	Logical data dictionaries are used to record data requirements independently of how these requirements are to be met	238–9, 338
Logical Data Independence	Immunity of <i>external schemas</i> to changes in a conceptual schema	78
Logical Database Design	That part of the <i>database design</i> process that produces a logical data model	293, 295–8
Logical Model	An implementation-independent model	42, 198–9, 298
Logical Modelling	The process of producing <i>logical models</i>	42, 198–9, 270
Logical Organisation	The form of <i>data organisation</i> defined in some data model	384
Lost Update Problem	A problem caused by <i>concurrency</i> of transactions – updates being lost in a series of transactions	406–7, 411
M		
Main Memory	See <i>Primary Storage</i>	
Managed Query Environment (MQE)	A form of <i>OLAP</i> tool which allows access via ROLAP or MOLAP	544
Manual Record Manager	The earliest form of data management embodied in traditional forms of writing on physical media	38
Mass Deployment Database	A <i>database</i> used to deliver data to the desktop	58
MDSM	Minimum Data Set Model. A <i>corporate data model</i> produced for the UK National Health Service in the late 1980s.	327–8
Meaning Triangle	A simple model of <i>semantics</i> which includes the designation, extension and intension of a sign	22–3
Megabyte	1,000,000 bytes (million)	384
Meronymic Relation	The range of semantic relations between parts of things and their wholes – after the Greek word ‘meros’ for part	256–60



Term	Definition	Pages
Message	An object-oriented mechanism for activating <i>methods</i>	120, 471
Meta-Data	<i>Data</i> about data. A term particularly used to define the primary property of a <i>data dictionary</i>	336, 338
Method	A defined operation associated with an <i>object</i>	119–20, 261, 442–3, 469, 470
Middleware	That range of software which interposes between client software and server software	483–4
Multi-Database System	See <i>Federated Database System</i>	
Multi-Dimensional OLAP (MOLAP)	A type of <i>OLAP</i> tool which uses array data structures to optimise storage and retrieval on an OLAP server	543
Multi-Media	A term used to describe the handling of diverse and complex media (sound, video etc.) within computing applications	41
Multi-User Access	Access to databases by multiple users	14–15, 455
Multi-Valued Determinancy	Data-item B is said to be non-functionally dependent on data-item A if for every value of data-item A there is a delimited set of values for data-item B	277–8
Multiple Inheritance	Multiple inheritance occurs when a given object class may be a subclass of more than one superclass	251
Multiple Instruction Multiple Data (MIMD) Systems	Parallel architectures built out of cheap and readily available microprocessors and memory	501–4
N		
Natural Join	The natural join operator is a <i>product</i> with an associated <i>restrict</i> followed by a project of one of the join columns	98
Natural Language	A language that has evolved for use in everyday communication	24
Natural Language Interface (NLI)	An interface to a DBMS in which the user expresses queries in a restricted form of English or some other natural language	363–4
Negation	The process of denying an <i>assertion</i> or including a negative assertion	135–6
Nested Relation	An extension to the <i>relational data model</i> proposed for handling complex objects	146–8
Network Data Model	A <i>data model</i> in which data structures are arranged in network-like structures	40
Non-Functional Determinancy/ Dependency	See <i>Multi-Valued Determinancy</i>	277–8
Non-Loss Decomposition	The approach to <i>normalisation</i> in which a relation is decomposed into a number of other relations but without losing the fundamental associations between data-items	271

Term	Definition	Pages
Non-Procedural Query Language	A <i>query</i> language in which the user can specify what is required and not how to achieve the result	105
Normal Form	A stage in the <i>normalisation</i> process	43
Normalisation	Normalisation is the process of identifying the logical associations between data-items and designing a database which will represent such associations but without suffering from <i>file maintenance anomalies</i>	43, 269–91, 295
Normalisation Oath	No repeating, the data-items depend upon the key, the whole key and nothing but the key, so help me Codd	276
N-Tier Applications	Applications in which processing is distributed in terms of <i>N</i> tiers of functionality	482
Null	A special character used in relational systems to represent missing or incomplete information	93–4, 163
O		
O ₂	An OO DBMS adhering to the <i>ODMG</i> standard	426, 467–73
Object	Some real world thing which can be uniquely identified. A package of data and procedures	116, 152, 249, 439, 469
Object Class	An object class is a grouping of similar <i>objects</i>	5, 117, 249, 437, 440, 469–70
Object Life Histories	A variation of the <i>entity life history</i> technique applied to objects	262–4
Object Model	A model of some database expressed using <i>object-oriented</i> constructs	198, 249–50
Object Modelling	The process of developing an <i>object model</i>	43, 198, 215–16
Object-Oriented (OO)	A term applied to programming languages, design methods and database systems to mean providing support for constructs such as <i>objects, classes, generalisation, aggregation</i> etc.	247, 468
Object-Oriented Data Model	The application of <i>object-oriented</i> principles to data modelling	110–24, 521
Object-Oriented DBMS	A DBMS adhering to some or all the principles of the <i>OO data model</i>	436–45, 468
Object-Oriented DBMS Manifesto	A proposal produced in the early 1990s which attempted to define a list of mandatory features for <i>OODBMS</i>	437–8
Object-Relational Data Model	See <i>Post-Relational Data Model</i>	
Observation	A <i>requirements elicitation</i> technique involving observation of work activities relevant to the design of some ICT system	214–15



Term	Definition	Pages
ODBC	Open Database Connectivity. A standard call-level <i>API</i>	372
ODMG	Object Database Management Group	116, 437, 468
ODMG Object Definition Language	A standard <i>DDL</i> for object-oriented DBMS	438, 443
ODMG Object Model	A standard specification of constructs for OO databases	438–43
ODMG Object Query Language	A standard query language for OODBMS	438, 443, 472
OLAP	On-line Analytical Processing. A technology that supports complex analytical processing	70, 528, 539–46
OLTP	On-line Transaction Processing	70, 528
On-line Network Data Managers	A form of data management developed in the mid-1960s reliant on technologies such as tele-processing monitors and early DBMS	39–40
Operational Database	A database used to collect operational data	57
Optionality	See <i>Participation</i>	
ORACLE	The first commercial <i>relational DBMS</i>	426, 457–66, 508–10, 535–6
Ordered File	A form of physical data organisation in which records in a file are ordered in terms of one or more fields	388–9
Outer Join	A form of <i>join</i> in which we wish to keep all the rows in one of the input relations whether or not they match	99–101
Overlapping Subclass	Subclasses that share certain semantics	253
P		
Packet-switched Network	A form of network in which data is routed as data packets	555–6
Page	See <i>Block</i>	
Parallel Database System	Any database system utilising parallel technology	498–511
Partial Subclass	Subclasses are partial if other subclasses of a superclass are possible	252–3
Participation	The involvement of entities in a relationship	225–6, 250–1
Passive Data Dictionary	A <i>data dictionary</i> external to a database and DBMS built to record the complexities of a given database structure for use by application development staff and database administrators (DBAs)	339

Term	Definition	Pages
Performance	That characteristic of a <i>database system</i> concerned with the efficiency of execution and operation	306–7, 379
Persistence	Characteristic of <i>data</i> in which data is held for some duration	6, 437, 470
Physical Data Dictionary	Physical data dictionaries are used to record data structures. The set of <i>system tables</i> at the heart of a relational DBMS is a physical data dictionary	338
Physical Data Independence	The immunity of the <i>conceptual schema</i> to changes made to the physical schema	78
Physical Database Design	The process of producing an implementation plan for some <i>database</i>	292–308, 344
Physical Level	See <i>Internal Schema</i>	
Physical Model	An implementation model for some database	42, 199–200, 311–12
Physical Modelling	The process of producing a <i>physical model</i>	42, 199–200
Physical Organisation	That form of <i>data organisation</i> defined in <i>secondary storage</i> devices	384, 388–93
Physical Schema	See <i>Internal Schema</i>	
Physical Symbol System	A set of physical patterns that are manipulated to generate intelligent action	137–8
Piecemeal Development	The process of planning for and developing <i>database systems</i> on an individual basis without concern for aspects of integration	21–3
PL/SQL	Procedural Language/SQL – <i>ORACLE'S</i> procedural fourth generation language	461–4
Post-Relational Data Model	A term used to encapsulate some of the contemporary extensions to the relational data model such as <i>triggers</i> and <i>stored procedures</i>	143–53
Post-Relational DBMS	Contemporary DBMS adhering to the <i>post-relational data model</i>	427–35, 460
Pragmatics	The study of the general context and culture of communication	21
Precompiler	A software module used prior to the compilation process	84, 371
Predicate	A label applied to some property of a <i>UoD</i> . An element of a <i>Datalog</i> proposition	25, 127
Predictive Modelling	A <i>data mining</i> technique which attempts to learn from data	549–50
Primary Key	An <i>attribute</i> or group of attributes used to uniquely identify the tuples of a relation	92–3, 449–50
Primary Storage	Primary storage includes media that can be directly acted upon by the central processing unit (<i>CPU</i>) of the computer, such as main memory or cache memory. Primary storage usually provides fast access to relatively low volumes of data	384, 499



Term	Definition	Pages
Primitive Data Model	A set of <i>data models</i> in objects are represented as record-structures grouped in file-structures	37
Procedural Query Language	A <i>query language</i> in which a sequence of operations is expressed to satisfy some query	45
Product	Product takes two relations as input and produces as output one relation composed of all the possible combinations of input rows	97
Program-Data Independence	See <i>Data Independence</i>	
Programmed Record Managers	One of the earliest forms of data management developed on stored program computers	39
Project	An operator of the <i>relational algebra</i> . The project operator takes a single relation as input and produces a single relation as output with a subset of the columns from the input relation in the output relation	97
Prolog	Programming in Logic – an Artificial Intelligence language. See also <i>Datalog</i>	130, 134
Propagation Constraints	A constraint detailing what should happen between two tables linked by <i>referential integrity</i>	108–9, 171–2
Property	See <i>Attribute</i>	
Proposition	A fundamental data element in the <i>Deductive Data Model</i> . See also <i>Assertion</i>	126–7
Prototyping	A <i>requirements elicitation</i> technique that involves building part of a system to demonstrate to stakeholders	215–16
Punched-Card Record Managers	A form of data management based on the recording and manipulation of data punched onto card	39
Q		
Query	A retrieval operation expressed against some database	453
Query Decomposition	The process of breaking up a <i>query</i> for execution by a parallel architecture	508–10
Query Function	A function which retrieves <i>data</i> from a database	11, 13–14, 129–30
Query Language	That part of a <i>DML</i> which enables users to express queries against a database	81, 83
Query Manager	That module within a <i>DBMS</i> tasked with managing queries	420–3
Query Optimisation	The process of determining an optimal execution plan for a <i>query</i>	421–3
Query Optimiser	That part of a <i>DBMS</i> which performs <i>query optimisation</i>	422–3, 509
Query Processor	See <i>Query Manager</i>	

Term	Definition	Pages
Query-By-Example (QBE)	A type of <i>interface</i> to a database system originally developed by Moshe Zloof at IBM. The term is now generally used to refer to forms-based retrieval interfaces	360–1
R		
Random Access	See <i>Direct Access</i>	
Range Partitioning	A parallel technique involving clustering tuples with similar attributes together in the same partition	504
Record	A physical <i>data structure</i> composed of fields	385–6
Record Type	A collection of records used to store data relevant to some <i>entity</i>	385
Recovery	The process of copying backed-up data onto a database	80, 344, 379, 415–16
Recursion	The process of self-reference	133–4
Recursive Relationship	A <i>relationship</i> in which an <i>entity</i> is related to itself	229–30
Redundancy	See <i>Redundant Data</i>	10
Redundant Data	A data value is redundant if you can delete it without losing information	34
Reference Type	An SQL3 construct used to define relationships between <i>row types</i>	431
Referent	See <i>Extension</i>	
Referential Integrity	An inherent <i>integrity constraint</i> of the relational data model. Referential integrity states that a foreign key value must either refer to a primary key value somewhere in a database or be null	107–9, 170–1, 450–1
Relation	The primitive data structure in the <i>relational data model</i>	91–2
Relational Algebra	A candidate for the manipulative part of the <i>relational data model</i> . A <i>procedural query language</i>	95–105, 110
Relational Calculus	A candidate for the manipulative part of the <i>relational data model</i> based on the predicate calculus. A <i>non-procedural query language</i>	105–7
Relational Data Model	A <i>data model</i> originally created by E.F. Codd in the 1970s	40–1, 89–112, 133
Relational OLAP (ROLAP)	A form of <i>OLAP</i> tool that utilises conventional RDBMS technology	543–4
Relationship	An <i>association</i> between entities or objects	5, 221, 441–2, 450–1
Replicate	Some copy of the whole of or part of some <i>database</i>	487



Term	Definition	Pages
Replication	The process of producing <i>replicates</i>	489
Replication Transparency	A <i>distributed database system</i> displays replication transparency if users are not aware of there being multiple copies of data	489
Representation Formalism	A set of syntactic and semantic conventions that make it possible to describe things	14
Requirement	Any devised feature of some information system or <i>database system</i>	210–11
Requirements Elicitation	The process of eliciting <i>requirements</i> for some application from key stakeholders	42, 198, 208–18
Requirements Specification	The process of expressing the <i>requirements</i> for some application using the constructs of some representation formalism	208, 212–14
Restrict	An operator in the <i>relational algebra</i> which extracts rows from an input relation matching some condition	95–6
Retract	An in-built function in <i>Datalog</i>	129
REVOKE	A command in <i>SQL</i> for revoking data privileges	350
Role	The distinct meaning applied to a <i>relationship</i> between two entities	231
Rollback	The process of returning to a previous state prior to the execution of some <i>transaction</i>	405–6
Round-Robin Partitioning	The process of assigning <i>tuples</i> to partitions on the basis of entry sequence	502–3
Row	A collection of <i>attribute</i> -values in the relational data model	91
Row Type	An <i>SQL3</i> construct comprising a sequence of column names with associated <i>data types</i>	428–9
Rule	See <i>Integrity Constraint</i>	
Rules Subsystem	A layer of an <i>information technology system</i>	53, 479
Run-time Processor	Part of a <i>DBMS kernel</i> that handles retrieval and update operations expressed against the database	83

S

Schema	A term used to refer to the <i>intension</i> of some database	7, 24–5, 165
Schema Partitioning	The assignment of <i>tuples</i> to partitions on the basis of schema elements	502
Second Normal Form	A relation is in second normal form if and only if it is in <i>first normal form</i> and every non-key attribute is fully functionally dependent on the primary key	273–4

Term	Definition	Pages
Secondary Storage	Secondary storage cannot be processed directly by the <i>CPU</i> . It hence provides slower access than primary storage but can handle much larger volumes of data. Two of the most popular forms of secondary storage are magnetic disk and magnetic tape	384
Security	See <i>Data Security</i>	
Security Analysis	That part of <i>physical database design</i> concerned with the specification of appropriate authorisation rights for a defined user community	305–6
Select	See <i>Restrict</i> . Also a command within SQL	178–88
Semantic Data Model (SDM)	That class of data models that were created with the aim of incorporating more semantics into a <i>data model</i>	37–8, 42, 114–15
Semantic Integrity	The business rules associated with some database application	462–4
Semantic Modelling	See <i>Top-down Data Analysis</i>	
Semantics	The study of the meaning of <i>signs</i>	14, 21, 22–3
Semiotics	The study of <i>signs</i>	21–2
Semi-Structured Data	Data which lacks a <i>schema</i> but in which structure is apparent from the way that data is presented	513–18
Sequential File	See <i>Sequential Organisation</i>	
Sequential Organisation	A form of data organisation in which records are placed in the file in the order in which they are inserted	313, 388
SGML	Standard Generalised Markup Language – a meta-language originally defined for the mark-up of documents	515
Shared Nothing Systems	A form of parallel architecture in which each processor has its own memory	506–7
Sign	Anything which is significant. Generally composed of a <i>designation</i> , concept and referent	20–1
Signifier	See <i>Designation</i>	
Single-Valued Determinancy	See <i>Functional Determinancy</i>	
Snowflake Schema	A variation on a <i>star schema</i> in which each dimension can have its own dimension	535
Socio-technical System	A system of technology used within a system of activity	54–5
Spatial Data	Data containing spatial attributes or relations	518–22
Specialisation	Specialisation is the process of creating a new <i>object class</i> by introducing additional detail to the description of an existing object class	251
SQL	See <i>Structured Query Language</i>	



Term	Definition	Pages
SQL – Data Definition	The data definition commands of <i>SQL</i>	157–67
SQL – Data Integrity	The data integrity commands of <i>SQL</i>	168–76
SQL – Data Manipulation	The data manipulation commands of <i>SQL</i>	177–91
Stakeholder	A group of persons within and without the organisation that may potentially influence the success of some <i>ICT system</i> and/or database system	209
Star Schema	A form of schema design utilised in <i>data warehousing</i> in which a central table of factual data is surrounded by tables of reference data	534–5
Starflake Schema	A middle-ground between a <i>star schema</i> and <i>snowflake schema</i>	535
State	A state is a moment in the life of an <i>object</i> . Also used to describe a moment in the life of some database	6, 7, 263
State Transition Diagram	A graphic technique for representing a <i>finite state machine</i>	264
Static Constraint	A restriction defined on states	10, 305
Statistically-based Optimisation	A form of <i>query optimisation</i> driven by statistics held in the data dictionary	422–3
Stored Procedure	A package of logic resident within some database system	150, 432
Strategic Data Planning	The process which identifies priorities for data systems, particularly using the construct of a <i>corporate data model</i>	55, 322, 323–33
Strong Entity	An <i>entity</i> whose existence does not depend on another entity	232
Structural Abstraction	That part of <i>object modelling</i> concerned with specifying relationships of <i>association</i> , <i>aggregation</i> and <i>generalisation</i>	249–60
Structural Inheritance	The <i>inheritance</i> of attributes and relationships between classes	250
Structured Query Language (SQL)	The standard <i>database sublanguage</i> for relational and non-relational access	43, 114, 158–9
Subquery	A <i>query</i> in SQL nested within another query	182–3
Subtype	An SQL3 construct allowing inheritance between tables. A subtype is defined on one or more supertypes	430–1, 440, 470–1
Supertype	An SQL3 construct allowing inheritance between tables	430–1, 440
Supply Chain	The chain of activities that an organisation performs in relation to its suppliers	64, 65–6
Symmetric Multi-Processor Architecture (SMP)	A form of parallel architecture in which an array of processors shares a common memory	501, 504–5
Synonym	An alternative name provided for a database construct	240

Term	Definition	Pages
Syntactics	That part of <i>semiotics</i> devoted to the study of the structure of signs and sign-systems	21, 24
Syntax	The operational rules for the correct representation of terms and their use in the construction of sentences of a language	14, 24
Syntax-based Optimisation	A form of <i>query optimisation</i> driven by the syntax of the input query	422
Synthesis	The approach to <i>normalisation</i> based around the process of synthesising a fully normalised schema from an analysis of dependencies	276
System	A coherent set of interdependent components which exists for some purpose, has some stability, and can be usefully viewed as a whole	49
System Buffer	Structure of some operating system used for storing and manipulating temporary data	82
System Catalog	See <i>System Tables</i>	83, 166
System Developer	Persons tasked with developing and maintaining <i>ICT systems</i>	58
System Tables	The meta-database at the heart of a relational DBMS	165, 339, 419–20
System/R	The first prototype relational <i>DBMS</i>	90
T		
Table	See <i>Relation</i>	
TableSpace	A construct used in some <i>DBMS</i> to collect a series of related tables together	392
Tag	A code inserted into a document to indicate mark-up	515
TCP/IP	An open system's communication protocol	556–7
Terabyte	1,000,000,000,000 (trillion) bytes	384
Ternary Relationship	A relationship between three or more <i>entities</i>	230
Third Normal Form	A state in which all relations in a database are fully normalised	274–6
Three-Valued Logic	A modification of traditional two-valued logic (true, false) to accommodate the use of nulls in relational systems	93–4
Time (representation of)	Certain data models such as the <i>E–R data model</i> can be used to represent temporal semantics	235–6
Toolkit (Database)	The range of tools either packaged as part of some <i>DBMS</i> or provided by third-party vendors	78, 202–3, 355–6
Top-down Data Analysis	Generally equated with techniques such as E–R diagramming. <i>Data analysis</i> conducted from abstract constructs to schema definition	222



Term	Definition	Pages
Totality	See <i>Cardinality</i>	
Transaction	A logical unit of work. A transaction transforms a database from one consistent state to another consistent state	10, 67, 260, 300, 404–5, 514
Transaction Analysis	A <i>physical database design</i> process in which an analysis of likely transactions impacting upon a database is performed with the aim of designing the database to handle performance implications	301–3
Transaction Log	A stored history of the transactions that have impacted on a database over an established period of time	378, 413–14
Transaction Management	The process of managing multiple <i>transactions</i> impacting upon some database	80, 403–17
Transaction Maps	A transaction map documents the access issues associated with critical transaction types	302–3
Transaction Subsystem	A layer of an <i>information technology system</i> concerned with managing transactions	53, 479
Transition	A movement between two <i>states</i>	264
Transition Constraint	A rule relating given <i>states</i> of a database	11, 305
Transitive Determinancy	Any situation in which A determines B, B determines C and A also determines C	279
Trigger	An action that is automatically executed by a <i>DBMS</i> when the database achieves a certain state	149, 432–3, 463–4
Tuple	See <i>Row</i>	
Tuple Relational Calculus	A variant of the <i>relational calculus</i> on which languages such as <i>SQL</i> are founded	105
Two-Phase Locking	A protocol that guarantees that transactions are serialisable	410–12
U		
UML	Unified Modelling Language. An attempt to develop a standard syntax for <i>object modelling</i>	254
Uncommitted Dependency Problem	A problem caused by the concurrency of transactions – one transaction views the intermediate results of another transaction before that transaction has completed	407, 411
Union	An operator in the <i>relational algebra</i> . Union produces a melding of rows from two original input relations having the same structure	101
Universal Resource Locator	An identifier for a <i>WWW</i> document	71, 558–9
Universal Server	The use of database systems to support both traditional and non-traditional data	71–2

Term	Definition	Pages
Universe of Discourse (UoD)	Term used to described that aspect of the real world being addressed in a database development effort	5, 24–5
Unnormalised Data-set	A data-set subject to <i>update anomalies</i>	270–1
UoD	See <i>Universe of Discourse</i>	
Update Anomalies	See <i>File Maintenance Anomalies</i>	
Update Function	A standard, application-specific operation performed against some database application	11–12, 131
Usage Analysis	A <i>physical database design</i> process in which an analysis is made of likely patterns of usage particularly in terms of retrieval operations	300–1
User Level	See <i>External Schema</i>	
User Name	A name assigned to each user of a <i>DBMS</i>	377
User-Defined Function (UDF)	A function which permits certain users of the database to alter and manipulate <i>UDTs</i>	72
User-Defined Routine	An SQL3 construct that defines methods for manipulating data	430
User-Defined Type (UDT)	A <i>post-relational data model</i> feature. The ability to specify data types for specific, complex data handling. See also <i>abstract data type</i>	72, 429–30
V		
Value-chain	A series of interdependent activities by which an organisation delivers value	64
View	A virtual table or a window into a database. Implemented as a packaged query in <i>SQL</i> . Also a term used to refer to a <i>conceptual model</i> developed for a particular business area	15, 239, 346–9
View Integration	The process by which a number of application data models are integrated to form one uniform <i>data model</i>	42, 198, 239–41
View Modelling	The process of modelling the data <i>requirements</i> of a number of distinct areas of the organisation with the aim of later integration	42, 198, 239–41
Virtual Memory	A memory management scheme which utilises the idea of a virtual address space	499–500
Visual Query Interface	An <i>end-user interface</i> in which queries can be built visually	361–2
Vocabulary	A complete list of the terms of some language	24
Volatility	Term used to describe the degree to which given <i>data structures</i> are subject to update activity	300–1, 495
Volume Analysis	A <i>physical database design</i> process in which estimates are made as to the volume of data needed to be handled in a database	299–300



Term	Definition	Pages
W		
Weak Entity	An entity whose existence depends on the existence of another <i>entity</i>	232
Web-site	A logical collection of <i>WWW</i> documents normally stored on a <i>WWW</i> server	69
Word	See <i>Byte</i>	
Workshops	A <i>requirements elicitation</i> technique involving the structured interaction of developers and other stakeholders around the formulation of requirements	215
WWW	World-Wide-Web. A set of standards for <i>hypermedia</i> documentation. It now has become synonymous with the Internet	41, 66, 71, 554–66
X		
XML	Extensible Markup Language. A formal language used for the definition of <i>semi-structured data</i>	27, 41, 516–18

Most modern organisations need to record data that is relevant to their everyday activities and the most common means of addressing this need is to organise and store data in an electronic database.

This textbook provides an essential introduction to modern database technology and the development of database systems. It focuses on the practicalities of using database systems in the ongoing development of information systems.

The book reflects recent advances and changes in the field and in particular, covers the following areas:

- The kernel functions of the contemporary DBMS: file organisation, access mechanisms and transaction management
- The database development process
- Contemporary database applications such as data warehousing, data mining and online analytical processing
- Use of database systems in e-business
- Strategic data planning, physical database design and database implementation
- Extended relational and object-oriented data management standards

ISBN 1403916012



NCC Education

To learn more about NCC Education, our programmes, affiliations and partnerships please visit our website www.nccedu.com

For any other enquiries please contact one of our regional offices:

UK & Europe - Tel **+44 (0) 161 438 6200** | Africa and the Caribbean - Tel **+27 (0) 21 913 8928**

East Asia - Tel **+86 (0) 10 6518 9327** | Middle East and South Asia - Tel **+971 (0) 4 391 2727**

South East Asia - Tel **+60 (0) 37 710 5755**

www.nccedu.com

Education 
Innovative. Individual. Inspirational.