

Index

• Symbols and Numerics •

- + (addition operator), 60, 149
- * (asterisk)
 - applications, 288
 - as multiplication operator, 60, 149
 - wildcard character, 124, 202
- || (concatenation operator), 60–61, 148
- / (division operator), 60, 149
- = (equal to comparison operator), 63, 178, 232
- > (greater than comparison operator), 63, 178
- >= (greater than or equal to comparison operator), 63
- < (less than comparison operator), 63, 178
- <= (less than or equal to comparison operator), 63
- * (multiplication operator)
 - applying, 149
 - described, 60
- <> (not equal to comparison operator), 63, 178
- () (parentheses), 196
- % (percent sign), 182–184
- [] (square brackets), 155, 176
- (subtraction operator), 60, 149
- _ (underscore character), 182–184
- 1NF (first normal form), 116–117
- 2NF (second normal form), 117–118
- 3NF (third normal form), 49, 118–119
- 4GLs (fourth-generation languages), 75

• A •

- abnormal form, 120
- absolute value expression function (ABS), 157, 160
- abstract data types (ADTs), 37

- access level
 - DBA, 256–257
 - foreign keys, limiting, 68
 - security, database, 255
- Access (Microsoft)
 - applications, creating, 297
 - database table, creating single, 78–79
 - deleting tables, 85–86
 - opening screen, 77
 - platform limitations, 297
 - saving single database table, 80
 - SQL editor, opening, 87
 - SQL statements, entering, 162
- ACID database, 280
- actions, error handler, 350–351
- ActiveX control, 309, 389
- ad hoc query, 22
- adding
 - block of rows to table, 132–135
 - columns, 109
 - data to selected columns, 132
 - one row at a time, 130–132
 - values in specified column (SUM function), 65, 154
- addition operator (+), 60, 149
- ADTs (abstract data types), 37
- aggregate function
 - described, 389
 - with GROUP BY clause, 196
 - operators, 232
- alias, 389
- ALL
 - quantifier, 233–235
 - WHERE clauses, 185–188
- all rows, changing (UPDATE statement), 137
- alphabetical order, displaying in (ORDER BY clauses), 198–199
- ALTER TABLE command
 - constraint violations, detecting, 369
 - data, loading tables with, 49

- ALTER TABLE command (*continued*)
 exact numeric data type, 59
 table structure, altering, 89
- AND
 logical connective, 64, 194–195
 parentheses, using with, 381
- ANSI (American National Standards Institute), 23, 24
- ANY, 185–188, 233–235
- API (application programming interface), 305, 389
- applet, 310–311, 389
- applications
 asterisk (*), 288
 damage during transactions, 67
 described, 287
 embedded SQL, 291–294
 Java applets, 311
 Microsoft Access with SQL, 297–300
 module language, 294–296
 object-oriented RAD tools, 296–297
 ODBC, 305
 problems combining SQL with procedural language, 290
 procedural language strengths and weaknesses, 289
 SQL strengths and weaknesses, 289
 SQL transactions, 274
- approximate numeric data type
 DOUBLE PRECISION, 29, 41
 FLOAT, 29–30, 41, 142
 REAL, 28, 41, 142
- Aristotle, logical system of thought by, 185–186
- array
 collection value expressions, 62
 two-dimensional, of rows and columns (relation), 14
- ARRAY data type, 36–37
- ARRAY XML data, 41, 330–331
- ASENSITIVE keyword, cursors, 340
- assertion, 43, 113, 389
- assignment, compound statement, 352
- asterisk (*)
 applications, 288
 as multiplication operator, 60, 149
 wildcard character, 124, 202
- AT LOCAL keywords, 61
- atom, 142
- atomic
 ACID database requirement, 280
 compound statements, SQL-92/PSM, 346–347, 389
 value of field, 142
- ATOMIC keyword, UNDO error handling, 351
- attribute
 described, 8, 389
 domain of, 18
 entities, associated, 93
 keys, 98
 public versus private, 38
 views with modified, 128–129
- automatic entry of block of rows to table, 132
- average sale, computing, 66
- averaging values in specified column
 described, 65–66, 153
 GROUP BY clause, 196–197
- **B** •
- back end, 389
- backing up data, 281, 382
- bad input data, 110
- base tables, 125
- basic join, 206–208, 393
- BCNF (Boyce-Codd normal form), 116
- beta testing, importance of, 378
- BETWEEN, WHERE clause, 180–181
- BIGINT data type, 27, 41
- blanks, character field, 31, 156–157
- BLOB data type, 41
- block of rows, adding to table, 132–135
- BOOLEAN data type, 32, 41
- Boolean value expressions, 62
- Boyce-Codd normal form (BCNF), 116
- byte, 159
- **C** •
- C program, 346
- cardinality expression function, 157, 159–160
- Cartesian product, 177
- cascade deletions, 106–108

- CASE conditional expressions
 - COALESCE, 170
 - described, 163–164
 - NULLIF, 168–169
 - with search conditions, 164–166
 - with values, 166–168
- CASE . . . END CASE statement, 353–354
- CAST data-type conversions
 - described, 170–171
 - row value expressions, 173–174
 - within SQL, 172
 - between SQL and host language, 172–173
- catalog, 57, 389
- CEIL or CEILING function, 157, 161
- chain of dependency, 267
- character sets
 - languages, 159
 - multitable relational database, 97–98
 - NAMES ARE clause, 295
 - users, granting privileges to, 263–264
 - XML data, mapping, 316
- character string
 - blanks, trimming, 156–157
 - listed, 31–32, 41, 142
 - substring, extracting from source, 154–155
 - value functions, 154
- CHARACTER VARYING (VARCHAR)
 - function, 31, 41, 155
- CHARACTER_LENGTH function, 158
- CHAR_LENGTH expression function, 157
- clients (persons), 375–376
- client/server system, 44–45, 305–306, 389
- CLOB (CHARACTER LARGE OBJECT), 31, 41
- cluster, 389
- COALESCE conditional expression, 170
- CODASYL DBTG database model, 390
- Codd, Dr. E. F. (inventor)
 - normalization, rules of, 35, 116
 - relational database model, origins of, 12
 - repeating groups, 37
- collating sequence, 59, 390
- collations
 - multitable relational database, 97–98
 - users, granting privileges to, 263–264
- collection data types
 - ARRAY, 36–37
 - described, 390
 - multiset, 37, 41
- collection value expressions, 62
- columns
 - adding and deleting, 109
 - adding data to selected, 132
 - adding values in specified (SUM function), 65, 154
 - ALTER TABLE commands, 59
 - averaging values in specified, 65–66, 153
 - constraints, 18–19, 112
 - cursor, ORDER BY clause, 337–338
 - data, adding to selected, 132
 - identifying, 49
 - maximum value in specified, 65, 153
 - in Microsoft Access terminology, 78
 - minimum value in specified, 65, 153
 - multitable relational database, 92–93, 390
 - name join, relational operators, 211–212
 - references, 146–147
 - self-consistent, in array, 14
 - transferring selected between tables, 133–135
 - two-dimensional array, 14
- comma-delimited data entry, 130
- comments, XML, 315, 322–323
- COMMIT statement
 - dirty read, 276, 278
 - protecting data, 279
 - transactions, 66
- comparison operators, 63, 237–239
- comparison predicates, 178–179
- complete logical view, 18
- complexity, database, 9
- composite key, 117, 390
- compound statements, SQL-92/PSM
 - assignment, 352
 - atomic, 346–347, 389
 - conditions, 348–349
 - cursors, 348
 - described, 345–346
 - exceptions, 351–352
 - handling conditions, 349–351
 - variables, 347–348
- computer console, 22

- concatenating XML arguments, 321–322
 - concatenation operator (||), 60–61, 148
 - conceptual view, 18, 390
 - concurrent access, 390
 - conditional join, 211
 - conditional value expressions, 150
 - conditions, compound statements, 348–349
 - consistency, ACID database, 280
 - console, computer, 22
 - constant, value of, 142
 - constraints
 - assertion, 58, 113, 389
 - column, 112
 - data types, SQL, 42–43
 - deferred, 390
 - described, 18–19, 111, 113, 390
 - diagnostics, 366
 - INSERT statement violations, 351, 368–369
 - referenced tables, controlling access with, 68
 - table, 113
 - within transactions, 282–286
 - user access, controlling, 68
 - constructors, structured UDTs, 39
 - containment hierarchy, 48
 - CONTENT predicate, 325
 - conversions, CAST data-type
 - described, 170–171
 - row value expressions, 173–174
 - within SQL, 172
 - between SQL and host language, 172–173
 - CONVERT string value function, 157
 - copying data, 133
 - correlated subqueries
 - with comparison operators, 237–239
 - described, 235
 - HAVING clause, 239
 - IN, 236–237
 - UPDATE, DELETE, and INSERT statements, 240–242
 - CORRESPONDING relational operator, 203–204
 - COUNT function, 64, 152–153
 - crashes, 8
 - CREATE ASSERTION command, 58
 - CREATE command
 - constraints, 58
 - described, 49
 - foreign keys, 100
 - CREATE INDEX command, 89
 - CREATE TABLE command
 - constraints, 58
 - Microsoft Access, inability to use, 87
 - syntax, 88
 - CROSS JOIN relational operator, 210
 - cursors
 - closing, 344
 - compound statements, SQL-92/PSM, 348
 - declaring, 336
 - described, 335–336, 390
 - fetching from single row (FETCH statement), 342–344
 - opening, 340–342
 - ORDER BY clause, 337–338
 - query expression, 337
 - scrollability, 340
 - sensitivity, 339–340
 - updatability clause, 338–339
- D •
- data
 - access alternative, 303
 - DEFERRABLE constraint, 283
 - defined, 8
 - deleting obsolete, 139–140
 - entry methods, 130
 - foreign file, copying block of rows from, 133
 - loading tables with, 49
 - table, creating and filling with, 50
 - transferring, 138–139
 - Data Control Language. *See* DCL; DCL security
 - Data Definition Language. *See* DDL
 - data dictionary, 9
 - data integrity problem areas
 - bad input data, 110
 - data redundancy, 110–111, 390
 - DBMS capacity, exceeding, 111
 - described, 269–273

- importance of recognizing, 109
- malice, 110
- mechanical failure, 110
- modification anomalies, 114, 393
- operator error, 110
- Data Manipulation Language. *See* DML
- data redundancy, 110–111, 390
- data source, 305, 390
- data types, SQL
 - approximate numerics, 28–30
 - BOOLEAN, 32, 41
 - character strings, 30–32
 - collection, 36–37
 - constraints, 42–43
 - datetimes, 32–33
 - described, 390
 - exact numerics, 26–28
 - intervals, 34
 - listed with conforming literals, 40–41
 - null values, 42
 - predefined, 26
 - REF, 37, 41
 - ROW, 35–36, 41
 - UDTs, 37–40
 - XML type, 34–35
- data types, XML, 317
- database
 - constraints, 18–19, 111, 113, 390
 - data dictionary, 9
 - DBMS, 9–10, 391
 - described, 8, 391
 - design considerations, 20
 - domains, 18
 - enterprise, 391
 - flat files, 9–12, 392
 - hierarchical model, 12, 392
 - metadata, 9, 393
 - network model, 12
 - object-relational model, 19–20
 - personal, 391
 - queries, trying, 380
 - record, 8, 394
 - relational model, 12–15
 - retrieval tips, 379
 - schemas, 18, 394
 - size and complexity, 9
 - views (virtual tables), 15–17
 - workgroup, 391
 - database administrator (DBA), 256–257, 391
 - database engine, 391
 - database management system (DBMS)
 - capacity, exceeding, 111
 - described, 9–10, 391
 - database publishing, 306, 391
 - database server. *See* server
 - DATE data types, 32, 41, 142
 - datetime data types, 32–33, 41, 142
 - datetime expressions, DML, 61–62
 - date-time functions, cursors, 341
 - datetime value
 - expressions, 149–150
 - functions, 162
 - days, ordering results by, 199
 - day-time interval, 34, 41, 150
 - DB2 (IBM), 391
 - DBA (database administrator), 256–257, 391
 - DBMS (database management system)
 - capacity, exceeding, 111
 - described, 9–10, 391
 - DCL (Data Control Language)
 - described, 47, 390
 - referential integrity constraints, data and, 70–72
 - transactions, 66–67
 - users and privileges, 67–70
 - DCL (Data Control Language) security
 - database, 256
 - delegating responsibility for, 72
 - DDL (Data Definition Language)
 - catalog, ordering by, 57
 - containment hierarchy, 48
 - CREATE command, 58–59
 - described, 47, 86, 390
 - index, creating, 88–89
 - index, deleting, 90
 - Microsoft Access, 87
 - planning, 48–49
 - portability considerations, 90
 - schemas, collecting tables into, 56
 - table structure, altering, 89
 - tables, creating, 49–50, 87–88
 - tables, deleting, 89–90
 - views, 51–56
 - DECIMAL data type, 28, 41

- decimal point, number containing, 28
 - default transaction, 275
 - DEFERRABLE constraint, 283
 - deferred constraints, 390
 - DELETE statement
 - access, limiting, 68
 - correlated subqueries, 240–242
 - cursor sensitivity, 339
 - fetching from single row (FETCH statement), 343–344
 - table columns, 59
 - deleting
 - columns, 109
 - DDL index, 90
 - DDL table, 89–90
 - duplicate rows, 202
 - Microsoft Access tables, 85–86
 - obsolete data, 139–140
 - obsolete rows from table, 262
 - deletion anomaly, 114, 391
 - deletions
 - cascading, 106–108
 - privileges, 359
 - departmental database, 9
 - descriptor, 391
 - diagnostics area
 - DBMS, 391
 - error handling, 366–368
 - DIAGNOSTICS SIZE, error handling, 275
 - dirty read, 276, 278
 - distinct types, UDTs, 38–39, 329
 - DISTINCT, WHERE clause, 189
 - distributed data processing, 391
 - division operator (/), 60, 149
 - DK/NF (domain-key normal form), 116, 119–120
 - DML (Data Manipulation Language)
 - AVG set function, 65–66, 153
 - Boolean value expressions, 62
 - collection value expressions, 62
 - COUNT set function, 64, 152–153
 - datetime and interval value expressions, 61–62
 - described, 47, 59, 390
 - logical connectives, 64
 - MAX set function, 65, 153
 - MIN set function, 65, 153
 - numeric value expressions, 60
 - predicates, 63
 - reference value expressions, 63
 - row value expressions, 62
 - string value expressions, 60–61
 - subqueries, 66
 - SUM set function, 65, 154
 - user-defined type value expressions, 62
 - DOCUMENT predicate, XML data, 325
 - documentation, importance of, 378
 - domain
 - described, 18, 391
 - INSERT statement problems, 105
 - integrity, 391
 - users, granting privileges to, 263–264
 - XML data, mapping to, 328–329
 - domain-key normal form (DK/NF), 116, 119–120
 - dormant, 146
 - DOUBLE PRECISION approximate numeric data type, 29, 41
 - driver, 392
 - driver
 - DLL, 305
 - ODBC, 304
 - driver manager, 305, 391
 - DROP command, 49, 71
 - DROP domains, 264
 - DROP TABLE command, 59, 89–90
 - duplicate rows, eliminating, 202
 - duplicating primary keys, constraint violation, 351
 - durability, ACID database, 280
- E ●**
- effects, error handler, 350–351
 - embedded SQL, 145, 291–294
 - end points, using with BETWEEN predicate, 180
 - enterprise database, 9
 - entities
 - attributes, associated, 93
 - integrity, multitable relational database, 104–105, 392
 - ENVIRONMENT_NAME field, diagnostics, 370
 - equal to comparison operator (=), 63, 178, 232
 - equi-join relational operators, 208–210

- error handling
 - conditions, 348–349
 - constraint violation information, 368–369
 - diagnostics detail area, 366–368
 - diagnostics header area, 364–366
 - exception handling, 371–372
 - existing table, adding constraints, 369
 - importance of, 382
 - interpreting `SQLSTATE` information, 370
 - number prepared to save information (`DIAGNOSTICS SIZE`), 275
 - `SQLSTATE`, 361–363
 - `WHENEVER` clause, 363–364
 - escape characters, 159
 - Euros, 39
 - exact numeric data type
 - `ALTER TABLE` command, 59
 - `BIGINT`, 27, 41
 - `DECIMAL`, 28, 41
 - `DROP TABLE` command, 59
 - `NUMERIC`, 27–28, 41
 - `SMALLINT`, 27, 41
 - `EXCEPT` relational operator, 205–206
 - exceptions, conditions that aren't handled, 351–352
 - executing SQL statements, granting users privileges to, 264–265
 - existence test, nested queries, 235–236
 - `EXISTS`
 - nested query, 235–236
 - `WHERE` clauses, 188–189
 - `EXIT` effect, error handling, 351
 - exponential function value expression
 - function (`EXP`), 157, 160
 - expressions, 141
 - eXtensible Markup Language. *See* XML data
 - extensions
 - ODBC client, 308–309
 - ODBC server, 307–308
 - portability considerations, 90
 - extract expression function (`EXTRACT`), 157, 158
- **F** •
- Fagin, Ronald (DK/NF inventor), 116
 - feedback, clients, 376
 - fetching from single row (`FETCH` statement)
 - orientation of scrollable, 343
 - positioned `DELETE` and `UPDATE` statements, 343–344
 - syntax, 342–343
 - field
 - as column in Microsoft Access terminology, 78
 - described, 142
 - fixed length, 11
 - null values, 42
 - single field, extracting (`EXTRACT` function), 158
 - file server, 392
 - filtering comparison predicates, 178–179
 - 1NF (first normal form), 116–117
 - fixed length field, 11
 - flat file system, 9, 133
 - `FLOAT` data type, 29–30, 41, 142
 - floating-point number, 28
 - floor value expression function (`FLOOR`), 157, 161
 - flow of control statements, 353–356
 - foreign data file, copying block of rows from, 133
 - foreign keys
 - access, limiting, 68
 - `CREATE` command, 100
 - hackers, corrupting database with, 71
 - multitable relational database, 100, 392
 - referential integrity rules, 192
 - forest, 392
 - forms, data entry by, 130
 - fourth-generation languages (4GLs), 75
 - `FROM` clause, 175–176, 177
 - front end, 125, 392
 - full outer joins, 216
 - function calls, 304, 358
 - functional dependency, 117, 392
 - functions
 - datetime value, 162
 - described, 141
 - numeric value, 157–161
 - recursion, 243
 - set, summarizing with, 151–154
 - stored, 358
 - string value, 154–157

• G •

- German character set, 97–98
- GRANT DELETE statement, 69, 70
- GRANT INSERT statement, 69, 70
- GRANT REFERENCES statement, 68, 69, 71
- GRANT SELECT statement, 69–70
- GRANT statement, 68, 258–259
- GRANT UPDATE statement, 69, 70, 72
- GRANT USAGE statements, 68–69
- GRANT, using with REVOKE, 268
- greater than comparison operator (>), 63, 178
- greater than or equal to comparison operator (>=), 63
- Greenwich Mean Time, 149
- GROUP BY clause
 - aggregate function, 196
 - clause restrictions, monitoring, 381
 - data summaries, importance of using, 380–381
 - described, 175–176, 196–197
 - ORDER BY clauses versus, 198
 - subqueries, 239

• H •

- hackers, corrupting database with foreign key, 71
- handling conditions
 - handler actions and handler effects, 350–351
 - handler declarations, 350
 - knowledge gained, 349–350
- handling errors
 - conditions, 348–349
 - constraint violation information, 368–369
 - diagnostics detail area, 366–368
 - diagnostics header area, 364–366
 - exception handling, 371–372
 - existing table, adding constraints, 369
 - importance of, 382
 - interpreting SQLSTATE information, 370
 - number prepared to save information (DIAGNOSTICS SIZE), 275
 - SQLSTATE, 361–363
 - WHENEVER clause, 363–364
- hard drive crash, 8

- hard-coded database structure, 13
- hardware
 - computer console, 22
 - single-precision circuitry, 29–30
 - transactions, damage during, 67
- HAVING clause
 - correlated subqueries, 239
 - with GROUP BY clause, 175–176, 197–198
- helper applications, ODBC client, 309
- hierarchical database model, 12, 110, 392
- host language, CAST data-type conversions, 172–173
- host variable, 145, 392
- HTML (HyperText Markup Language)
 - applets, embedded, 310–311
 - database publishing, 306
 - described, 392

• I •

- IBM
 - relational database model, invention of, 12
 - SQL, origins of, 23
- ID columns, result of union joins, 220
- identifiers, mapping to XML data, 316–317
- IF...THEN...ELSE...END IF statement, 352–353
- impedance mismatch, 38
- implementation, 23, 392
- implicit transaction-starting statement, 278
- IN keyword
 - correlated subqueries, 236–237
 - subqueries introduced by, 228–229
- IN predicate, WHERE clauses, 181–182
- inconsistent date, keeping out, 108
- indexed sequential access method (ISAM), 305
- indexes
 - benefits of using, 102–103
 - creating, 88–89
 - deleting, 90
 - described, 101–102, 392
 - effective, creating, 84–85
 - maintaining, 103
 - RAD, creating, 82–85
 - SQL support, 100
- information schema, 57, 392
- inner join, 212–213

INSENSITIVE keyword, cursors, 339
 INSERT statement
 constraint violations, 351, 368–369
 copying data from table, 134–135
 correlated subqueries, 240–242
 cursor sensitivity, 339
 domain integrity concerns, 105
 privileges, 359
 table columns, 59
 user access, limiting, 68, 260
 insertion anomaly, 392
 INTEGER data type, 26–27, 41
 integrity, referential
 constraints, DCL, 70–72
 foreign keys, 192
 multitable relational database,
 106–108, 394
 interface
 client computer, 44–45
 ODBC, 304
 SQL, 289
 Internet
 described, 392
 ODBC, 306–309
 SQL, 45–46
 INTERSECT relational operator, 204–205
 intervals
 DML value expressions, 61–62
 SQL data types, 34
 time, overlapping (`OVERLAPS`
 predicate), 190
 intranet
 described, 392
 ODBC, 309
 SQL, 45–46
 IPX/SPX, 393
 ISAM (indexed sequential access
 method), 305
 ISO/IEC international standard SQL, 20, 24
 isolation
 ACID database, 280
 levels, 276–278
 ITERATE statement, 356–357

• J •

Java, 393
 JavaScript, 393
 joining text strings, 60–61

joins
 basic, 206–208, 393
 Cartesian product, 177
 column-name, 211–212
 conditional, 211
 described, 393
 double-checking, 380
 inner, 212–213
 left outer, 213–215
 natural, 210–211
 right outer, 215–216
 union, 216–223

• K •

keys, 98. *See also* foreign keys; primary
 keys; UNIQUE key

• L •

language
 character sets, 159
 non-English, converting, 97
 sublanguage versus, 44
 two, mixing with preprocessor, 293
 LEAVE statement, 355
 length expression functions
 (`CHAR_LENGTH`,
 `CHARACTER_LENGTH`,
 `OCTET_LENGTH`), 157
 less than comparison operator (`<`), 63, 178
 less than or equal to comparison operator
 (`<=`), 63
 letter sets. *See* character sets
 LIKE
 WHERE clauses, 182–184
 wildcard characters, 182
 literals
 data types listed with conforming, 40–41
 values, 142–144
 LN natural logarithm value expression
 function, 157, 160
 locking database objects, 280
 log file, transactions, 66–67
 logarithm, natural, 160
 logical connectives
 AND, 194–195
 described, 393
 DML, 64

logical connectives (*continued*)

NOT, 195–196

OR, 195

logical schema, 56

LOOP . . . ENDLOOP statement, 354–355

LOWER string value functions, 156

• M •

maintaining indexes, 103

major entities, 92

malice, data integrity problems, 110

manipulating data

block of rows to table, 132–135

deleting obsolete data, 139–140

described, 123

one row at a time, 130–132

retrieving, 124–125

selected columns, adding to, 132

transferring data, 138–139

updating existing data, 135–138

updating views, 129

views, creating, 125–126

views from tables, 126–127

views with modified attribute, 128–129

views with selection condition, 127–128

mantissa, 29

mapping

character sets, 316

data types, 317

described, 393

domain to, 328–329

identifiers, 316–317

tables, 318

MATCH clause

described, 190–191

referential integrity, 192–193

maximum value in specified column

(MAX function), 65, 153

mechanical failure, data integrity

problems, 110

MERGE statement, transferring data,

138–139

metadata, 9, 393

method, object-oriented RAD tools, 296

Microsoft Access

applications, creating, 297

database table, creating single, 78–79

deleting tables, 85–86

opening screen, 77

platform limitations, 297

saving single database table, 80

SQL editor, opening, 87

SQL statements, entering, 162

Microsoft Office Online panel, 77

minimum value in specified column

(MIN function), 65, 153

modification abnormalities, normalizing,
114–115

modification anomalies

correlated subqueries, 242

deletion anomalies, 114, 391

described, 393

modifying clauses, 175–177

modifying table data, 261

module language, 294–296, 393

modules, SQL-92/PSM, 359–360

modulus value expression function (MOD),
157, 160

multiple rows, changing (UPDATE
statement), 136

multiplication operator (*)

applying, 149

described, 60

multiset data types, 37, 41

multiset XML data, 41, 331–332

multitable relational database. *See also*
normalizing multitable relational

database

columns, 109, 390

constraints, 111–113

data integrity problem areas, 109–111

design steps, 91–92

domain integrity, 105–106

domains, character sets, collations, and
translations, 97–98

entity integrity, 104–105, 392

foreign keys, 100, 392

indexes, 100–103

keys, advantages of using, 98

objects, defining, 92, 393

primary keys, 49, 98–99, 394

referential integrity, 106–108, 394

tables and columns, identifying, 92–93

tables, defining, 93–97

multitable views, 51

mutator function, 39, 393

• **N** •

NAMES ARE clause, 295
 NATIONAL CHARACTER, NATIONAL CHARACTER VARYING, and NATIONAL CHARACTER LARGE OBJECT character strings, 31–32
 natural join, 210–211
 natural logarithm value expression function (LN), 157
 needs, assuming clients know, 375–376
 nested queries
 ALL, SOME and ANY quantifiers, 233–235
 copying data from table, 134
 described, 225–226, 393
 existence test, 235–236
 sets of rows, returning, 227–230
 single value, returning, 230–233
 subqueries, 226
 NetBEUI, 393
 network database model, 12, 393
 non-English languages, converting, 97
 non-existent values, 42
 nonprocedural language, SQL as, 21–22
 nonrepeatable read isolation level, 276–277
 normalizing multitable relational database
 abnormal form, 120
 described, 393
 DK/NF, 119–120
 1NF, 116–117
 modification abnormalities, 114–115
 normal forms, intention of, 35
 2NF, 117–118
 3NF, 49, 118–119
 NOT DEFERRABLE constraint, 282
 not equal to comparison operator (<>), 63, 178
 NOT EXISTS nested query, 236
 NOT IN keyword, subqueries introduced by, 229–230
 NOT IN predicate, WHERE clauses, 181–182
 NOT LIKE, WHERE clauses, 182–184
 NOT LIKE wildcard character, 182
 NOT logical connective, 64, 195–196
 NOT NULL constraint
 columns, applying, 112
 one-to-many relationship, 53
 primary keys, 99, 104
 NOT, using parentheses with, 381

null values
 average sale, computing, 66
 reasons for using, 152
 SQL data types, 42
 XML data, handling, 318–319
 NULL, WHERE clauses, 184–185
 NULLIF, CASE conditional expressions, 168–169
 number of characters in character string (CHARACTER_LENGTH), 158
 NUMERIC data type, 27–28, 41
 numeric value expressions, 60, 149
 numeric value functions
 ABS, 160
 CARDINALITY, 159–160
 CEIL or CEILING, 161
 CHARACTER_LENGTH, 158
 EXP, 160
 EXTRACT, 158
 FLOOR, 161
 listed, 157
 LN, 160
 MOD, 160
 OCTET_LENGTH, 159
 POSITION, 158
 POWER, 160–161
 SQRT, 161
 WIDTH_BUCKET, 161

• **O** •

object database, 19
 object model, 7
 object-oriented programming (OOP), 37
 object-oriented RAD tools, 296
 object-relational database model, 19–20
 objects
 locking database, 280
 multitable relational database, defining, 92, 393
 observer functions, SELECT statements, including, 39
 observers, structured UDTs, 39
 obsolete data, deleting, 139–140
 obsolete rows, privilege of deleting from table, 262
 OCTET_LENGTH expression function, 157, 159
 ODBC. *See* Open DataBase Connectivity

- Office (Microsoft) Online panel, 77
 - ON clause, 219, 223
 - one-to-many relationships, 53, 96
 - online application processing (OLAP), 161
 - OOP (object-oriented programming), 37
 - Open DataBase Connectivity (ODBC)
 - client/server environment, 305–306
 - components, 304–305
 - data access alternative, 303
 - described, 393
 - interface, 304
 - Internet, 306–309
 - intranet, 309
 - JDBC, 310–311, 393
 - OPEN statement, 341–342
 - opening
 - cursors, 340–342
 - Microsoft Access screen, 77
 - operand, 156
 - operator error, data integrity
 - problems, 110
 - operators, relational. *See* relational operators
 - OR
 - logical connective, 64, 195
 - parentheses, using with, 381
 - Oracle, 12, 23, 394
 - ORDER BY clauses
 - alphabetical order, displaying in, 198–199
 - cursors, 337–338
 - with GROUP BY clauses, 175–176
 - GROUP BY clauses versus, 198
 - outer joins
 - full, 216
 - left, 213–215
 - right, 215–216
 - OVERLAPS, time intervals, 190
- p •**
- parameters, 145, 394
 - parent-child table relationships,
 - 13, 106–108
 - parentheses (()), 196
 - PARTIAL rules, 194
 - percent sign (%), 182–184
 - performance, 103, 277
 - Persistent Stored Molecules. *See* SQL-92/PSM
 - personal database, 9
 - phantom read isolation level, 277, 278
 - physical schema, 56
 - planning, DDL, 48–49
 - platforms
 - Microsoft Access limitations, 297
 - scalable DBMS, 9
 - portability, DDL, 90
 - position expression function (POSITION),
 - 157, 158
 - power function value expression function (POWER), 157, 160–161
 - power to grant privileges, 265–266
 - precision, number, 27, 394
 - predicates
 - described, 394
 - DML, 63
 - in WHERE clauses, 178–179
 - XML data, 324
 - preprocessor, mixing languages with, 293
 - preserving duplicate rows, 203
 - previous session, 146
 - primary keys
 - duplicating, constraint violation, 351
 - multitable relational database,
 - 49, 98–99, 394
 - NOT NULL constraint, 99, 104
 - RAD tool, identifying, 49, 82
 - referential integrity rules, 192
 - private attributes, 38
 - privileges, granting to users. *See* users, granting privileges to
 - procedural language
 - described, 394
 - problems combining SQL with, 290
 - SQL isn't, 21
 - strengths and weaknesses, 289
 - programs. *See* applications
 - project scope, ignoring, 376
 - protecting data
 - ACID database, 280
 - backing up data, 281
 - COMMIT, 279
 - constraints within transactions, 282–286
 - default transaction, 275
 - implicit transaction-starting statement, 278
 - isolation levels, 276–278
 - locking database objects, 280

principles, 273
 ROLLBACK, 279
 savepoints and subtransactions, 281–282
 SET TRANSACTION, 278–279
 SQL transactions, using, 274–275
 threats to data integrity, 269–273
 public access level, database security,
 257–258
 public attributes, 38

• Q •

queries. *See also* nested queries; recursive queries
 described, 22, 394
 joins, double-checking, 380
 subselects, checking, 380
 Query Analyzer, SQL, 162
 query expression, 337

• R •

RAD (rapid application development) tool
 deleting a table, 85–86
 described, 75, 394
 index, creating, 82–85
 object-oriented tools, 296–297
 primary key, identifying, 49, 82
 table, creating with Design View, 77–80
 table structure, altering, 80–82
 track, deciding what to, 76–77
 range check, 110
 range, value out of, 42
 RDBMS (relational database management system), 23
 READ UNCOMMITTED isolation level,
 276, 278
 REAL data type, 28, 41, 142
 record, 8, 14, 394
 recursive queries
 airline flight problem outlined, 247–248
 described, 243–244, 246
 other uses, 252
 problem, 244
 saving time, 249–252
 series, 248–249
 termination condition, 245–246
 redundancy, 270

REF data type, 37, 41
 reference type, 359, 394
 reference value expression, 63
 referenced tables
 controlling access with constraints, 68
 related tables, privileges for, 262–263
 references, column, 146–147
 referential integrity
 constraints, DCL, 70–72
 foreign keys, 192
 multitable relational database,
 106–108, 394
 register sizes, numerics, 28
 related tables, granting users privileges
 for, 262–263
 relation
 among tables, referential integrity, 106
 defined, 14, 394
 tables, correspondence to, 14
 relational database management system
 (RDBMS), 23
 relational model, 7, 12
 relational operators
 basic join, 206–208, 393
 column-name join, 211–212
 conditional join, 211
 CORRESPONDING, 203–204
 CROSS JOIN, 210
 equi-join, 208–210
 inner join, 212–213
 INTERSECT, 204–205
 natural join, 210–211
 ON versus WHERE clauses, 223
 outer join, 213–216
 UNION, 201–203
 UNION ALL, 203
 union join, 216–223
 Relational Software, Inc., 23
 REPEATABLE READ isolation level,
 277, 278
 repeating groups, 37
 REPEAT...UNTIL...END REPEAT
 statement, 356
 reports, monthly or quarterly, 103
 reserved words
 described, 394
 SQL, 25
 SQL:2003, 385–388

- set functions
 - AVG, 153, 196–197
 - COUNT, 64, 152–153
 - MAX, 153
 - MIN, 153
 - returning rows, 227–230
 - SUM, 154
 - summarizing, 151–154
 - uses, 151–152
- SET TRANSACTION statement,
 - 275, 278–279
- SIMILAR, WHERE clauses, 184
- single field, extracting (EXTRACT function), 158
- single-precision hardware circuitry, 29–30
- single-table view, 51–52
- size, database, 9
- slower read, 277
- SMALLINT data type, 27, 41
- software. *See* applications
- SOME quantifier, 185–188, 233–235
- source type, 38
- special variables, 146
- spreadsheets, electronic, 14
- SQL. *See also* data types, SQL
 - client, 44–45
 - commands, 24–25
 - editor, opening in Microsoft Access, 87
 - extracting information from database,
 - 22–23
 - history, 23–24
 - on Internet/intranet, 45–46
 - as nonprocedural language, 21–22
 - procedural language, problems
 - combining, 290
 - reserved words, 25
 - server, 43–44
 - statements, entering with Microsoft Access, 162
 - strengths and weaknesses, 289
 - as sublanguage, 22
 - users, granting privileges to execute statements, 264–265
- SQL-86, 23, 340
- SQL-89
 - adoption, 23
 - cursor scrollability, 340
 - UNIQUE rule, 194
- SQL-92, 23
- SQL-92/PSM (Persistent Stored Modules).
 - See also* compound statements, SQL-92/PSM
 - described, 345
 - flow of control statements, 352–357
 - privileges, 359
 - stored functions, 358–359
 - stored modules, 359–360
 - stored procedures, 357–358
- SQL:2003
 - core commands, 24–25
 - reserved words, 385–388
 - as standard for book, 24
 - XML data type, introduction of, 314
- square brackets ([]), 155, 176
- square root value expression function (SQRT), 157, 161
- stored functions, 358–359
- stored modules, 359–360
- stored procedures, 357–358
- storing data, 8
- string. *See also* character string
 - percent sign or underscore, searching, 183–184
 - value expressions, 60–61, 148
 - value functions, 154–157
 - XML, parsing, 323
- Structured English QUery Language (SEQUEL), 22, 394
- structured UDTs
 - constructors, 39
 - example, 40
 - mutator function, 39, 393
 - observers, 39
 - subtypes and supertypes, 39
- sublanguage, 22, 44, 390
- subqueries. *See also* correlated subqueries
 - baseball statistics example, 234–235
 - DML, 66
 - EXISTS predicate, 188–189
 - GROUP BY, 239
 - IN keyword, introduced by, 228–229
 - nested queries, 226
- subselect method, 134, 380
- SUBSTRING string value function, 154–155
- subtraction operator (-), 60, 149
- subtransactions, 281–282

- subtypes, structured UDTs, 39
- SUM function, 65, 154
- summarizing data, baseball statistics
 - example, 380–381
- Sun Microsystems, 310
- super user, 257
- supertypes, structured UDTs, 39
- system architecture, using favorite, 377
- SYSTEM_USER variable, 146

• T •

- tables. *See also* views (virtual tables)
 - ALTER TABLE statement, 59
 - automatic entry of block of rows, 132
 - CREATE TABLE statement, 58
 - DDL, 49–50, 56, 87–88
 - deleting, 85–86
 - designing in isolation, 377
 - existing, adding constraints, 369
 - identifying, 49
 - multitable relational database, 92–97
 - RAD, creating with Design View, 77–80
 - referenced, controlling access with
 - constraints, 68
 - relation among, referential integrity, 106
 - restrictions for multiple (assertions), 113
 - saving single database, 80
 - structure, altering in DDL, 89
 - transferring all rows between, 133
 - transferring selected columns and rows, 133–135
 - users, granting privileges to modify, 261
 - XML data, 318, 326–327
- technical factors, considering only, 376
- temporary table declaration clause, 295
- termination condition, recursive queries, 245–246
- testing, importance of beta, 378
- text strings, joining two, 60–61
- 3NF (third normal form), 49, 118–119
- time intervals, overlapping (OVERLAPS predicate), 190
- TIME WITH TIME ZONE data type, 33, 41
- TIME WITHOUT TIME ZONE data type, 32–33, 41

- TIMESTAMP WITH TIME ZONE data types, 33, 41, 142
- TIMESTAMP WITHOUT TIME ZONE data type, 33, 41, 142
- transaction interaction trouble, 271–272
- transaction processing, 270
- transactions
 - constraints within, 282–286
 - DCL, 66–67
 - log file, 66–67
- transferring all rows between tables, 133
- transferring data, 138–139
- transitive dependency, 118
- TRANSLATE string value function, 157
- translation tables, 59
- translations
 - multitable relational database, 97–98
 - users, granting privileges to, 263–264
- TRIM string value functions, 156–157
- truth test, Boolean value expressions, 62
- tuple, 14
- two-dimensional arrays, 14

• U •

- UDTs (user-defined types)
 - benefits of using, 62
 - described, 37–38, 41
 - distinct types, 38–39
 - structured types, 39–40
- underscore character (`_`), 182–184
- UNDO error handling, 351
- UNION ALL relational operator, 203
- union join relational operator, 216–223
- UNION relational operator, 133, 134, 201–203
- union-compatible tables, 201–202
- UNIQUE key
 - entity integrity, 104–105
 - referential integrity, 192, 193
- UNIQUE rule, SQL-89, 194
- UNIQUE, WHERE clauses, 189
- uniqueness, need for, 98
- Universal Time Coordinated (UTC), 149
- updatability clause, cursors, 338–339
- update anomalies, 106

UPDATE statement
 access privileges, 68
 all rows, changing, 137
 altering tables, 59
 correlated subqueries, 240–242
 cursor sensitivity, 339
 domain integrity concerns, 105
 fetching from single row, 343–344
 multiple rows, changing, 136
 privileges, 359
 single row, changing, 135–136
 stored functions, 358–359
 updating views, 129
 UPPER string value functions, 156
 U.S. dollar, 39
 user interface
 client computer, 44–45
 SQL, 289
 user name, 260
 user-defined types (UDTs)
 benefits of using, 62
 described, 37–38, 41
 distinct types, 38–39
 structured types, 39–40
 users, granting privileges to
 constraints, applying, 18–19
 DCL, 67–70
 deleting obsolete rows from table, 262
 deletions, 359
 domains, character sets, collations,
 and translations, 263–264
 executing SQL statements, 264–265
 GRANT and REVOKE, using together, 268
 GRANT statement, 258–259
 inserting data, 260
 mapping tables, 318
 modifying table data, 261
 power to grant, granting, 265–266
 referencing related tables, 262–263
 retrieval, controlling, 381
 revoking, 266–267
 roles, 260
 schema, 68
 viewing data, 260–261
 UTC (Universal Time Coordinated), 149

• U •

VALID predicate, XML data, 326
 value expressions. *See also* CASE
 conditional expressions
 conditional, 150
 datetime, 149–150
 described, 147–148
 numeric, 149
 string, 148
 value functions, character strings, 154
 values
 CASE conditional expressions, 166–168
 column references, 146–147
 listed, 141
 literal, 142–144
 row, 142
 special variables, 146
 variables, 144–145
 VARCHAR (CHARACTER VARYING)
 function, 31, 41, 155
 variables
 compound statements, SQL-92/PSM,
 347–348
 values, 144–145
 views (virtual tables)
 creating, 125–126
 database, 15–17
 DDL, 51–56
 with modified attribute, 128–129
 multitable, 51
 security, database, 129
 SELECT statements, 125
 with selection condition, 127–128
 from tables, 126–127
 updating, 129
 users, granting privileges to, 260–261

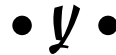
• W •

WHERE clause
 ALL, SOME, ANY, 185–188
 BETWEEN, 180–181
 comparison predicates described, 179
 with DELETE statement, 139–140

WHERE clause (*continued*)
described, 175–179
DISTINCT, 189
EXISTS, 188–189
IN and NOT IN predicates, 181–182
LIKE and NOT LIKE, 182–184
MATCH, 190–193
ON clause versus, 223
NULL, 184–185
OVERLAPS, 190
restricting rows, 134
SELECT statements, 124
SIMILAR, 184
UNIQUE, 189
with UPDATE statement, 135, 137
WHILE...DO...END WHILE
statement, 355
width bucket function, 157, 161
wildcard characters
asterisk (*), 124, 202
LIKE or NOT LIKE, 182
WITH GRANT OPTION clause, 265–266
wizard, Microsoft Access, 78
words, reserved
described, 394
SQL, 25
SQL:2003, 385–388
workgroup database, 9



XML data
ARRAY, 41, 330–331
character sets, mapping, 316
data types, mapping, 317
distinct UDT, 329
domain, mapping to, 328–329
forest, 392
functions, 322–326
identifiers, mapping, 316–317
multiset, 41, 331–332
null values, handling, 318–319
predicates described, 324
ROW, 329–330
schema, generating, 319–320
SQL, relating with, 313–314
tables, 318, 326–327
types, 34–35, 314–315
XQuery expression, 323–324



year-month interval, 34, 150