

INDEX

A

access path, 75, 290, 294, 326
ADDAUTLE (Add Authorization List Entry)
 command, 465
ADDPFTRG (Add Physical File Trigger)
 command, 396–398
 ALWREPCHG (Allow repeated change)
 parameter, 398, 400
 RPLTRG (Replace trigger) parameter, 397
 TRGEVENT (Trigger event) parameter, 397,
 399
 TRGTIME (Trigger time) parameter, 397, 399
 TRGUPDCND (Trigger update condition)
 parameter, 398
%ADDR built-in function, 409
aggregate functions, 176–181, 187, 189, 190,
 191
AJAX, 336, 352
ALCOBJ (Allocate Object) command, 418, 419,
 421, 422, 425
 uses, 419
 WAIT parameter, 422
alias, 150–151, 171–172, 222–225, 239, 438
 column name, 222
 table name, 222, 284
ALIAS keyword, 311
ALL operator, 255–256, 257
ALLOCATE clause, 1–3–105
ALTER TABLE statement, 106, 119, 120, 197
ambiguous errors, 224–225
AND operator, 133, 160, 162, 324
ANY operator, 255, 256–257
apostrophe (single quote), 198, 392
application object, 72
arithmetic, 187
arithmetic operators, 154
array
 used for null indicator, 317
AS clause, 150, 151, 192, 223, 266, 274, 282
ASCII, 81
associative entity, 37–39
asterisk (*), 144, 240, 260, 262, 274
ATOMIC keyword, 385
attribute, 8, 15
 column, 116–117
 default value, 23
 derived, 23
 direct, 23
 documenting, 23–25
 entity, 19, 20–25

 multivalued, 38
 optional, 21–22
 representation in ERD, 21
 required/mandatory, 21
 time-dependent, 22
 volatile, 21
audit trail, 76
AUT parameter, 448, 449
authority, 443–450
 checks performed for an authorization list,
 465–466
 defined, 442
 public, 448–450
 special, 443–444
 specific, 443, 444–446
authorization ID, 441
authorization list, 463–466, 469
 guidelines, 466
AVG function, 177, 180, 187, 191, 264

B

BASED keyword, 406
BEGIN/END delimiters, 377, 385
BETWEEN operator, 133, 162–163, 287
BIGINT data type, 84
blocking factor, 415
Boolean data type, 84, 89
 representing using a check constraint, 139–
 140
business model, 9
business rules/policies, 15, 70, 138

C

CALL statement, 371, 377
candidate key, 25–27, 60, 61, 73–74, 117
carat (^) symbol, 79, 80
cardinality, 28–32
 categories, 28–29
 possible combinations, 29–30
 defined, 29
 many-to-many, 29
 one-to-many, 28, 29
 one-to-one, 28, 29
 rules, 29
 representation in ERD, 29
Cartesian product, 235
CASCADE option, 126–130, 211
cascading updates and deletes, 118
CASE function, 181–182

- CASE statement, 381
- CHAR data type, 84, 102, 104, 380
- character functions, 172–174
- check constraint, 132–141, 209, 212, 286, 390,
 - 411, 412, 413, 414
 - adding, 141
 - benefit of, 138
 - defined, 132
 - defining, 133, 140
 - examples, 135–138
 - expressions in, 138
 - guidelines, 133
 - removing, 141
 - semantics, 139–140
 - table-level, 140–141
- check option, 285–286
- CHGAUT (Change Authority) command, 444, 446, 447
- CHGLIB (Change Library) command
 - CRTAUT parameter, 449, 450
- CHGOBJPGP (Change Object Primary Group) command, 463
- CHGUSRPRF (Change User Profile) command
 - GRPPRF parameter, 461
 - SPCAUT parameter, 443
 - SUPGRPPRF parameter, 461
- clause, 93
- CLOSE statement, 327
- Codd, Edgar, 2
- coding suggestions, 192, 212, 318, 358–359, 368, 415
- colon (:), 301, 324
- column, 10
 - adding, 106
 - aliases, 150–151
 - assigning a default value, 198–199, 206
 - attributes, 116–117
 - changing the data type of, 106
 - computed, 154–55
 - constraints, 117
 - data type, 116
 - data format, 116
 - defined, 3, 78
 - default value, 72, 73, 101–102, 117, 198–199, 206
 - deleting, 106
 - derived, 170–171
 - design information specified for, 71
 - determinant, 59
 - explicit default, 198–199
 - explicit name, 196–197, 312
 - implicit name, 197–198
 - length, 116
 - naming rules, 97
 - not-applicable, 72–73
 - null, 117, 200
 - null-capable, 72–73, 192, 206
 - possible values, 116
 - qualifying name of, 225
 - range, 117
 - renaming, 287
 - renaming in a view, 276–277
 - reordering, 287
 - special values or placeholders for, 72
 - specifying values, 107–111
 - unknown, 72–73
 - updating with a value from a subquery, 207–208
- COMMENT ON statement, 452, 453
- comments, 100
- COMMIT parameter, 426, 427, 428, 429
 - *ALL value, 426
 - *CHG value, 426
 - *CS value, 426
 - *RR value, 426
- COMMIT statement, 330, 385, 425, 426, 428, 429–431
- commitment control, 364, 385, 409, 410–413, 425, 426–436, 432
 - activation-group-level, 428–429
 - determining environment to use, 428–429
 - example, 430
 - job-level, 428–429
 - row locking with, 433–436
- comparison operators, 156–157
- compilation, 366, 367–368
- compound condition, 161
- computed column, 154–155
- computed value, 158–160
- CONCAT operator, 152–53, 389
- concatenated key, 25–27, 54–63
- conceptual data model, 8, 9, 15–48, 69, 70, 71
 - items specified by, 15
- CONSTRAINT clause, 73
- constraint, 10, 73, 74, 99–100, 115–142, 397,
 - check, 70, 89, 119, 132–141, 209, 212, 390, 411, 412, 413, 414
 - defined, 99, 115
 - errors, 209–210
 - foreign key, 119, 122–132, 209–210, 211–212, 293, 399, 411, 412, 413, 414, 458
 - how DBMS uses, 115
 - integrity, 115
 - interaction with triggers, 410–415
 - name, 120
 - NOT NULL, 119, 120
 - DBMS checking order for, 131

- primary key, 99–100, 119–120, 209, 212, 293, 294, 411, 412, 413, 414
- types, 118–119
- unique, 99–100, 119, 121–122, 209, 212, 293, 294, 411, 412, 413, 414
- CONTINUE keyword, 385, 386
- COPY statement, 318
- /COPY compiler directive, 318
- correlated subqueries, 258–262
 - vs. uncorrelated, 258
 - using WHERE clause with, 258–260
- COUNT function, 177–178, 179, 180, 187
- CREATE ALIAS statement, 454
- CREATE DISTINCT TYPE statement, 454
- CREATE FUNCTION statement, 390, 391–393, 438, 450, 460
 - CALLED ON NULL INPUT clause, 392
 - clauses that can be used with, 391–393
 - EXTERNAL NAME clause, 392
 - PARAMETER STYLE GENERAL clause, 393
 - PARAMETER STYLE SQL clause, 392
 - RETURNS NULL ON NULL INPUT, 392
 - SPECIFIC clause, 393
- CREATE INDEX statement, 76, 293–296
- CREATE PROCEDURE statement, 372, 373, 377, 380, 391, 450, 460
 - CONTAINS SQL clause, 375
 - DETERMINISTIC clause, 375
 - EXTERNAL NAME clause, 375
 - LANGUAGE clause, 374
 - MODIFIES SQL DATA clause, 375
 - NO SQL clause, 375
 - NOT DETERMINISTIC clause, 375
 - PARAMETER STYLE clause, 375
 - PARAMETER STYLE SQL clause, 373
 - READS SQL DATA clause, 375
 - SPECIFIC clause, 373
 - SQL clause, 376
- CREATE SCHEMA statement, 94, 449, 450
- CREATE TABLE statement, 73, 96–98, 104, 119, 197, 199, 200, 293, 294, 311, 380, 438, 455
 - and "cascade" delete rule, 73
 - and support for foreign key rules, 73
- CREATE TRIGGER statement, 396
- CREATE UNIQUE INDEX statement, 294
- CREATE VIEW statement, 197, 269, 274, 283, 285, 293
- cross join, 216, 220, 235–238
- crow's foot, 30, 32–33, 36
- CRTAUTL (Create Authorization List)
 - command, 464
- CRTCMOD (Create C Module) command, 379
- CRTLFL (Create Logical File) command
 - AUT parameter, 448
- CRTLIB (Create Library) command
 - AUT parameter, 448
 - CRTAUT parameter, 449, 450, 469
- CRTPF (Create Physical File) command
 - AUT parameter, 448
- CRTPGM (Create Program) command, 367, 379
 - AUT parameter, 448
- CRTSQLCI (Create SQL ILE C Object)
 - command, 379
- CRTSQLPKG (Create SQL Package) command, 367
- CRTSQLRPGI (Create SQL ILE RPG)
 - command, 361–365, 368
 - ALWBLK parameter, 365, 368
 - ALWCPYDTA parameter, 330, 364–365, 368, 390
 - CLOSQLCSR parameter, 365
 - COMMIT parameter, 364, 365
 - COMPILEOPT parameter, 365
 - DATFMT parameter, 364, 368
 - DATSEP parameter, 364
 - INCFILE parameter, 364, 418
 - OBJ parameter, 363
 - OBJTYPE parameter, 361, 363, 367
 - OPTION parameter, 363, 364, 367, 368
 - parameters, 362–363
 - prompt screen, 365–366
 - RDB parameter, 364, 367
 - SRCFILE parameter, 363
 - TEXT parameter, 363, 368
 - TIMFMT parameter, 364, 368
 - TIMSEP parameter, 364
 - TOSRCFILE parameter, 368
- CRTSRVPGM (Create Service Program)
 - command, 368
 - AUT parameter, 448
- CRUSRPRF (Create User Profile) command, 441, 443, 461
 - GRPPRF parameter, 461
 - SPCAUT parameter, 443
 - SUPGRPPRF parameter, 461
- CURRENT_DATE keyword, 202
- cursor, 321–360, 373, 383
 - closing, 327, 344, 358
 - coding suggestions, 358–359
 - controlled by DOW loop, 343
 - declaring, 322–325, 358
 - defined, 321
 - defining and using, 322–327
 - differences between view and, 74
 - dynamic, 345–350
 - embedded, 74–75, 293, 431
 - enabling for update operations, 328–330
 - fetching next row from, 327

- performance, 359
 - processing multiple rows from, 343
 - read-only, 328, 364, 368
 - reading by key value with, 332
 - sample application, 336–344
 - scrollable, 332–333
 - as substitute for view, 74
 - using to retrieve the prior row, 332–333
- D**
- data, 77, 81
 - Data Definition Language (DDL), 93
 - data dictionary, 5, 19
 - data hierarchy, 77–87
 - data integrity, 12, 116–117, 138, 286, 395
 - Data Manipulation Language (DML), 93, 388
 - data model, 3–4, 6, 7–8, 10–11, 70
 - conceptual, 8, 9, 15–48, 69, 70
 - as contract between end users and designers, 16
 - example, 3
 - logical, 9
 - vs. physical design, 10–11
 - purpose, 4, 8
 - data modeling. *See* data model
 - data retrieval tools, 75
 - data type, 42
 - Boolean, 84, 89
 - character, 83, 84, 85, 102–105
 - column attribute, 116
 - common, 84
 - conversion between, 192
 - date, 84, 89
 - defined, 83
 - integer, 84, 88–89
 - numeric, 84, 85–88
 - timestamp, 84, 89–90
 - database
 - access control, 75–76
 - backup and recovery, 12
 - column-level approach to access, 455
 - concepts, 1–14
 - constraints, 115–142
 - defined, 1, 81
 - design. *See* database design
 - deployment, 5
 - development process, 4–12
 - implementation, 4, 10, 11–12
 - integrity, 395
 - introduction to, 1–3
 - maintenance, 12
 - objects, 441–442
 - operation, 12
 - performance, 12
 - security, 12, 441–470, 469–470
 - tables, representing, 50–51
 - terminology, 2–3
 - testing and evaluation, 12
 - database design, 4, 7–11
 - conceptual, 8–9, 15–48
 - decisions, 70
 - defined, 3
 - importance of, 3–4
 - logical, 8, 9
 - physical, 4, 9–11, 69–114, 70
 - process, 4–12
 - database design process
 - database design phase, 4, 7–11
 - database implementation phase, 4, 12
 - database maintenance phase, 5, 12
 - database planning phase, 4–5
 - DBMS selection phase, 4, 11
 - operation phase, 5, 12
 - requirements analysis phase, 4, 6–7
 - testing and evaluation phase, 5, 12
 - database management system (DBMS)
 - defined, 1
 - introduction to, 1–3
 - selection, 4, 11
 - date
 - specifying a default, 202
 - date and time arithmetic, 184–187
 - date duration, 186
 - date formats, 89, 184–188
 - DATE data type, 84, 89
 - DATFMT parameter, 185
 - DATESP parameter, 185
 - days duration, 186
 - DAYS function, 185–186
 - DAYS keyword, 186
 - DB2, 1, 2
 - database approach, 2
 - defined, 2
 - family of products, 2
 - DB2 for i, 2
 - DB2 for Linux, UNIX and Windows, 2
 - DB2 for z/OS, 2
 - DECIMAL data type, 84, 85, 86–88, 187
 - DECIMAL function, 175–176, 275
 - DECLARE CURSOR statement, 322–323, 326, 332, 334, 345, 383, 428, 431
 - DEFAULT keyword, 102, 199, 206, 275
 - default values, 72, 73, 101–102, 110–111, 198–199, 206

DELETE statement, 195, 210–212, 259, 260, 282, 300, 308, 314–315, 329, 344, 358, 395, 426, 429
 defined, 314
 positioned, 334–335
 delete-update-insert rules, 33, 125–126
 dependency, 57, 59–60
 determinant, 59, 61, 64
 diagrams, 7, 8. *See also* entity relationship diagram (ERD)
 "dirty read," 432
 DISTINCT keyword, 148–149, 178, 282
 execution in SELECT statement, 189
 distinct type, 438
 controlling access to, 455
 privileges, 450, 452–453, 459–460
 distributed data program, 367
 distributed processing, 371
 DLCOBJ (Deallocate Object) command, 419, 425
 releasing more than one lock with, 422
 domain, 22
 DOW loop, 343
 DROP FUNCTION statement, 439
 DROP INDEX statement, 296
 DROP PROCEDURE statement, 376, 439
 DROP TABLE statement, 106, 211, 315
 duration
 date vs. days, 186
 labeled, 186
 DYNAMIC SCROLL option, 332–333, 335, 358
 dynamic SQL statement, 344–351, 351

E

EBCDIC, 81–83
 digit portion, 83
 zone portion, 83
 EDTOBJAUT (Edit Object Authority)
 command, 446, 459, 464
 ELSE clause, 381
 ELSEIF clause, 381
 embedded SQL, 299–320, 373, 426, 427
 defined, 299
 using comments with, 302
 ENDCMTCTL (End Commitment Control)
 command, 426
 entity, 8, 15, 18–19
 associative, 37–39
 attributes, 19, 20–25
 discovery, 18
 hierarchies, 44
 identifying, 18–20
 instance, 19

integrity, 116, 117–118
 intersection, 37–39
 names, 50
 subtypes, 44–46
 unique identifier, 25–27
 entity integrity, 116, 117–118
 entity relationship diagram (ERD), 8, 15–48, 71
 case study, 17–18
 defined, 16
 goals of, 16
 representation in ERD, 21
 steps to develop, 18
 things to record about, 19–20
 entity relationship model (ERM), 8, 9
 error handling, 302–307, 318, 358
 %ERROR built-in function, 402
 *EUR data format, 185
 evaluation, specifying order of, 162
 event, 15
 exception join, 232–235
 left, 232, 234
 right, 232, 234–235
 EXEC SQL precompiler directive, 300, 323
 EXECUTE statement, 329–330, 347, 348, 365
 EXECUTE IMMEDIATE statement, 329–330, 344, 347, 365
 EXISTS operator, 260–261
 EXIT keyword, 385, 386
 explicit column names, 196–197, 312
 explicit default value, 198–199
 expressions, 138
 external data structure, 309–310

F

FETCH statement, 308, 325, 326–327, 332, 334, 364, 381, 383
 multiple-row, 364
 positioning keywords, 333
 without INTO clause, 334
 FETCH CURRENT statement, 335
 FETCH NEXT statement, 327, 333
 FETCH PRIOR statement, 333
 field, 3, 78
 file, 78
 FLOAT data type, 380
 FOR loop structure, 382
 FOR READ ONLY clause, 328, 328, 330, 358
 FOR UPDATE OF clause, 328–330, 334, 358
 foreign key, 32–35, 37, 50, 70, 73–74
 actions, 126
 constraints, 122–132, 209–210, 211–212, 293, 399, 411, 412, 413, 414, 415, 458

- defined, 55
- FK abbreviation for, 32
- null values and, 55
- overlapping, 131
- purpose of, 32
- relationships, 123
- rules, 73

foreign key constraint, 122–132, 209–210, 211–212, 293, 399, 411, 412, 413, 414, 415, 458

- considerations, 126–127
- defined, 123
- defining, 123
- delete-update-insert rules and, 125–126
- avoiding for read-only tables, 132

FROM clause, 143, 144, 204, 251, 275, 322

- execution in SELECT statement, 189

full outer join (full join), 227, 232

fullselect, 245

function, 171–187, 438

- aggregate, 171, 176–77
- CASE, 181–184
- character, 171–174
- COUNT, 177–178
- date, 288
- date and time arithmetic, 184–186
- external, 389–393
- numeric, 171, 174–176
- scalar, 389, 390
- sourced, 389–393
- SQL, 389–393
- user-defined, 389–393

functional dependency, 51–52, 59–60

G

GET DIAGNOSTICS statement, 388

GRANT statement, 75, 441, 450, 455, 456–458, 459–461

- ALL keyword, 457
- FUNCTION keyword, 460
- ON keyword, 457
- PROCEDURE keyword, 460
- PUBLIC keyword, 457
- SPECIFIC FUNCTION keyword, 460
- SPECIFIC PROCEDURE keyword, 460
- TO keyword, 457
- and WITH GRANT OPTION clause, 457

GROUP BY clause, 144, 181, 187–191, 192, 204, 251, 275, 282, 322, 390

- execution in SELECT statement, 189
- using with a view, 281–282

group profile, 461–463, 469

grouping column, 187, 189, 190

GRTOBJAUT command, 75, 446, 447, 448, 464–465

H

HAVING clause, 144, 181, 187–191, 192, 204, 251, 266, 275, 282, 322

- execution in SELECT statement, 189
- search condition for, 189

hexadecimal characters, 82

HOLD keyword, 425, 431

host variable, 270, 300, 301–302, 308, 309, 316, 318, 331, 344, 348, 359

- defined, 301, 324
- used in a cursor declaration, 325
- using in WHERE clause, 324–325

HOURS keyword, 186

HTML, 337

HTML5, 351

I

IBM, 1

IBM Data Studio, 93–94

- Data Source Explorer pane, 93
- editor pane, 93
- messages pane, 95, 98
- SQL Results pane, 94

IBM DB2 Query Manager and SQL Development Kit, 379

IBM i, 2

IBM Navigator for i, 106, 107, 111, 112, 396

ILE C, 379

ILE RPG, 299

implicit column names, 197–198

implicit insert, 200

IN operator, 133, 166, 253–254, 287

INCLUDE statement, 318, 362, 364, 417–418

index, 2, 10, 289–296, 438

- accessing data using, 290–293
- additional, 76–77
- compared to a book index, 291
- created by DBMS, 293
- creating, 293–296
- defined, 76, 290
- design considerations, 77
- dropping, 296
- good candidates for, 76
- and performance, 76–77, 294, 295–296
- purpose, 289
- retrieval of rows using, 291–293
- temporary, 77

indicator variable, 348, 381

information, 77

inner join, 216, 217–227, 236

syntax, 217
 using WHERE clause for, 220–221
 using WHERE clause with, 226–227
INNER keyword, 217
INSENSITIVE clause, 330, 358
INSERT statement, 102, 107–111, 132, 195–204,
 212, 259, 260, 282, 285, 300, 311–312, 335,
 344, 381, 395, 426, 429
 block, 364
 defined, 311
 embedded, 312
 multiple-row, 202–204
 instance, 19
INSTEAD OF trigger, 312
INTEGER (INT) data type, 84, 85, 88–89, 92,
 192
 integrity
 data, 12, 116–117, 138, 286, 395
 database, 395
 entity, 116, 117–118
 referential, 32, 33, 55–56, 116, 118, 122–123
 rules, 115, 286
 transaction, 426–436
 integrity constraint, 73, 74, 115
 errors, 209–210
 categories of, 116
 International Standards Organization (ISO),
 89
 intersection entity, 37–39
INTO clause, 308–311
 *ISO date format, 89, 184, 185, 187, 364
IS NOT NULL clause, 137, 180–181, 219, 253
IS NULL clause, 137, 219
 isolation level, 364, 425, 426, 427–428
 None, 432, 424
 Read Committed, 432, 433–435
 Read Uncommitted, Read Write, 432, 433–
 435
 Repeatable Read, 432, 433–435
 Serializable, 432, 433–435

J

Java Database Connectivity (JDBC), 372, 373,
 376
 *JIS date format, 185, 187
 jQuery, 337
 join, 2, 215–240
 cross, 216, 220, 235–239
 defined, 215
 exception, 216, 232–235
 full/full outer, 216, 227, 232
 inner, 216, 217–227
 left exception, 216, 232, 234

 left/left outer, 216
 outer, 216, 227–240, 258
 right exception, 216, 232, 234–235
 right/right outer, 216
 self, 216, 239–240
 in subqueries, 263–264
 types, 216
 using with a view, 283–284
JOIN keyword, 215, 216, 217
 journal, 94
 journal receiver, 94
 journaling, 76
 JavaScript Object Notation (JSON), 337, 351

K

key
 candidate, 25–27, 60, 61, 73–74, 117
 concatenated, 25–27, 54–63
 constraints, 119–120, 122–132
 foreign, 32–35, 37, 50, 55, 70, 73–74, 123
 primary, 26, 35, 50, 53, 55, 73–74, 117–118,
 216, 290
 used by index, 290
 key field, 290, 292
 keyword, 93

L

LABEL ON statement, 453
 labeled duration, 186
LCASE function, 174
LEAVE statement, 382, 383, 384
 left exception join,
 left outer join (left join), 227, 228–230
 library, 3
LIKE operator, 133, 164–165, 192
 literals, 153, 186
 lock
 changing the type of, 422
 combinations, 421
 default, 423
 *EXCL, 420, 421, 424
 *EXCLRD, 420, 421, 424, 433
 explicit, 418, 424
 mode rules, 424–425
 object, 418, 419–425, 432
 releasing more than one, 422
 row, 425, 431, 433–436
 *SHRNUP, 420, 421, 424, 433
 *SHRRD, 420, 421
 *SHRUPD, 420, 421
 table, 419, 423–425, 431
 lock level, 364
 locking. *See also* lock, lock level

- default, 418
 - how DBMS uses, 418
- LOCK TABLE statement, 418, 419, 420, 422, 423–425
 - examples, 424
- logical database design, 9
- logical modeling, 9, 16
- logical file, 3
- logical unit of work, 429
- LOOP loop structure, 382
- LOWER function, 174

M

- major sort column, 167
- MAX function, 177
- MIN function, 177
- minor sort column, 167
- mandatory attribute, 21
- many-to-many relationship
 - defined, 29
 - eliminating, 37–39
 - example, 37, 38
- MICROSECONDS keyword, 186
- Microsoft, 1, 2
- MINUTES keyword, 186
- modeling, 7–10, 15–48. *See also* data model
 - multivalued dependency, 61
 - multivalued fact, 61
- monitorSQL procedure, 306–307, 342–343
- MONMSG (Monitor Message) command, 422
- MONTHS keyword, 186
- MySQL, 2

N

- name, 436–439
 - qualified, 438–439
 - SQL, 436–439
 - specific, 438
 - system, 436–437
 - unqualified, 438–439
- named relationship, 39–42
- naming standards/conventions, 5–6, 120, 363, 368, 436–439
- nested query blocks, 268–271
- nested view, 265–270
 - cases where essential, 266–268
- NEXT keyword, 332
- NO ACTION option, 126–130
- non-key dependency, 57
- normal form, 49–66
 - Boyce-Codd normal form (BCNF), 50, 59–61

- first normal form (1NF), 49, 50, 52–53, 54, 62–63
- fourth normal form (4NF), 50, 61
- second normal form (2NF), 49, 50, 54–57, 63–64
- third normal form (3NF), 49, 50, 57–59, 64–65
- normalization, 9, 16, 49–67
 - defined, 49
 - example, 62–65
 - purpose of, 49
 - results of, 49
 - steps, 50
 - normalized table, 52
- NOT operator, 133, 160–161, 163, 261
- NOT EXISTS operator, 261–262
- NOT NULL, 101, 120, 137, 159, 199, 200, 275
- NOT FOUND keyword, 385, 386
- NULL, 100–101, 133, 159, 200–201
- null condition, 157–158
- null dates, 186
- null indicator, 309, 316–317, , 381
 - using an array for, 317
- null value, 100–101, 110, 316–317
 - role in the relational database model, 117
- null-capable columns, 72–73, 147, 192, 381
 - setting to null, 206
- numeric functions, 174–176

O

- object, 441–442
 - allocation, 419
 - authorization, 419
 - controlling access to, 454–455
 - lock, 418, 419–425, 432
 - names, 436–439
 - organizing into schemas, 72
 - ownership, 443
 - sharing, 419
 - types, SQL and system, 437, 442
- ON DELETE clause, 128–131
- ON DELETE CASCADE clause, 399, 414, 415
- ON DELETE NO ACTION clause, 414
- ON DELETE RESTRICT clause, 414, 415
- ON DELETE SET DEFAULT clause, 399, 414, 415
- ON DELETE SET NULL clause, 399, 414, 415
- ON UPDATE clause, 128–131
- ON UPDATE CASCADE clause, 412
- ON UPDATE NO ACTION clause, 412, 413
- ON UPDATE RESTRICT clause, 412, 413
- open data path, 425
- Open Database Connectivity (ODBC), 372, 373, 376

OPEN statement, 326, 345
 OPTIMIZE clause, 331
 OPTIMIZE FOR n ROWS, 359
 optional attribute, 21
 optionality, 28–32
 defined, 29
 possible combinations, 29–30
 representation in ERD, 29
 OR operator, 133, 160, 162, 166–167
 Oracle, 1, 2
 ORDER BY clause, 144, 167–171, 204, 251, 275,
 322, 325, 329, 335, 390
 outer join, 216, 227–240, 258
 full, 227, 232
 left, 227, 228–230
 right, 227, 230–231
 OUTER keyword, 232
 OVRDBF (Override with Database File)
 command, 415

P

package, 3, 367
 controlling access to, 455
 privileges, 450, 453, 461
 packing, 86, 87
 parameter marker, 348
 parentheses, 162
 partial dependency, 54, 63–64
 percent sign (%), 164
 performance, 12, 76–77, 104, 105, 191, 192,
 286, 294, 295–296, 328, 329, 359, 368, 372
 phantom updates, 285, 432
 physical database design, 4, 10–11, 69–114
 defined, 69
 physical file, 3
 physical modeling, 10–11
 planning, 4, 5–6
 pointer field, 291, 293
 positioned UPDATE/DELETE, 334–335, 359
 precompilation, 366, 367
 PREFIX keyword, 405
 PREPARE statement, 346–347
 primary group, 463
 primary key, 26, 35, 50, 53, 55, 73–74, 119–120,
 290
 concatenated, 54, 63
 constraints, 99–100, 119–120, 209, 212, 293,
 294, 411, 412, 413, 414
 defined, 54, 117
 PK abbreviation for, 26
 required to be unique, 117
 with WHERE clause, 157
 privileges, 450–456

ALTER, 452, 453
 column-level, 456
 defined, 450
 distinct type, 450, 452–453, 459–460
 EXECUTE, 452, 453
 package, 450, 453, 461
 stored procedure, 450, 452–453, 460
 table, 450, 451, 454, 457–459
 user-defined function, 450, 452–453, 460–
 461
 view, 450, 451–452, 454, 455, 457–459
 program adopted authority, 75–76, 380, 466–
 469, 470
 defined, 467
 example, 467
 programs
 controlling access to, 455
 creating SQL, 361–369
 public authority, 448–450, 469
 default for new objects, 449–450
 defined, 448
 recommended setting, 448

Q

QCRTAUT system value, 449, 450, 454
 QSECURITY system value, 469
 QSqJrn journal, 94
 qualified data structure, 310–311
 qualified name, 100
 question mark (?), 345, 348
 query
 inner, 249, 252
 multiple-table, 215–248
 outer, 249, 252
 single-table, 143–194
 stored, 273
 quotation marks, 198, 222

R

Rational Developer for Power (RDp), 361
 record, 3
 record blocking, 368
 recursive calls, 410
 recursive relationship, 43–44
 redundancy, 56–57
 referential integrity, 32, 33, 55–56, 116, 122–
 123
 defined, 118
 relation, 8
 relational database, 71
 relational database management system
 (RDBMS), 1
 relational database model, 2, 29, 78, 117, 118

relational schema, 50–51
relationship, 15, 28, 70
 defined, 28
 identifying, 36
 matrix, 40
 named, 39–42
 non-identifying, 35–36
 recursive, 43–44
 representation in ERD, 28, 36
 stored on disk, 78
 strength of, 35–36
 strong, 36
 two perspectives of, 28
 weak, 35–36
relative column number, 169–171
relative record number, 293
RENAME statement, 436, 438
renaming a database object, 112
REPEAT loop structure, 382, 383
repeating group, 52
required attribute, 21
requirements analysis, 4, 6–7
RESIGNAL statement, 387
RESTRICT option, 126–130
result set, 321
RETURN expression statement, 391
RETURNS clause, 391
REVOKE statement, 441, 450, 455, 458–461
RIGHT function, 391
right outer join (right join), 227, 230–231
RMVPFTRG (Remove Physical File Trigger)
 command, 398–399
ROLLBACK statement, 330, 385, 425, 426, 428,
 429–431
ROUND function, 174–175
routing step, 419, 420–423, 425
row
 defined, 3, 78, 80
 deleting a set of from a table, 211
 deleting from a table, 210
 deleting from multiple tables, 211–212
 hex and character representation of, 91–92
 inserting with null values, 200–201
 lock, 425, 431, 433–436
 sample data, 91
 stored on disk, 80
 updating a set of, 205
row-at-a-time processing, 321
ROW_COUNT special register, 388
RPGLE, 299
RUNSQLSTM (Run SQL Statements) command,
 380, 426, 438
RVKOBJAUT (Revoke Object Authority)
 command, 447, 448, 459

S

schema, 9, 71, 72–73, 438
 changing the default, 95
 controlling access to, 454
 creating, 94–95
 defined, 3, 94
 organizing objects into, 72
 used to group objects, 72
SCROLL option, 332–333, 358
scrollable cursor, 332–333
search condition, 155
SECONDS keyword, 186
security, 12, 274, 372, 380, 441–470
 column-level, 75
 principles and guidelines, 469–470
 specifying implementation, 75–76
SELECT statement, 111, 143–187, 204, 260, 300,
 308, 381
 conceptual ordering of, 189–190
 duplicate rows and, 148–149
 literals with, 153
 nested, 204, 258, 323
 null values and, 147–148
 parts of, 144
 purpose, 143
 to build a cursor in a program, 321–322
 to select multiple columns from a table,
 146–147
 to select one column from a table, 145–146
 simplest form of, 144
 syntax, 143
SELECT INTO statement, 308–311, 317, 318
self-join, 216, 239–240
semicolon (;), 94, 300, 323, 380
SEQONLY(*YES n) parameter, 415
service program, 268, 467
 controlling access to, 455
SET clause, 221, 204, 208–209, 212, 359
SET DEFAULT option, 129–131
SET NULL option, 126–130
set operators, 240–245
SET OPTION statement, 364, 427, 429
SET OPTION COMMIT statement, 427, 428
SET SCHEMA command, 95, 100
 SHARE keyword, 424
SET TRANSACTION ISOLATION LEVEL
 statement, 427, 428
SIGNAL statement, 387
signature, 438
SMALLINT data type, 84, 89
sort order, 168–169
SOURCE clause, 390
special authority, 443–444
 *ALLOBJ, 444, 447

- *AUDIT, 444
- data, 444
- defined, 443
- field, 444
- *IOSYSCFG, 444
- *JOBCTL, 444
- object, 444
- *SAVSYS, 444
- *SECADM, 444
- *SERVICE, 444
- *SPLCTL, 444
- specific authority, 443, 444–446
 - *ADD (data authority), 445, 454
 - *ADD (field authority), 445
 - *ALTER, 445
 - *AUTLMGT, 445
 - defined, 444
 - *DLT, 445
 - *EXECUTE, 445, 454
 - *MGT, 445
 - *OBJALTER, 445
 - *OBJEXIST, 445
 - *OBJMGT, 445, 447, 459
 - *OBJOPR, 445, 459
 - *OBJREF, 445
 - *READ (data authority), 445
 - *READ (field authority), 445
 - *REF, 445
 - *UPD, 445
 - *UPDATE, 445
- SPECIFIC clause, 438
- specific name, 438–439
- SQL catalog, 94, 376
- SQL Communication Area (SQLCA), 303–306, 235, 388
- SQL naming, 436–439
- SQL package, 3, 367, 467
- SQL precompiler, 300, 303, 323, 364, 367, 418, 427
- SQL Procedural Language (SPL), 371, 377–389, 390, 439
 - assignment, 380
 - compound statements, 385
 - conditional statements, 381–382
 - conditions and condition handlers, 385–386
 - creating a *PGM object from, 379–380
 - declarations, 380
 - diagnostic feedback, 388–389
 - language features, 380–389
 - loop control structures, 382–384
 - signaling user-defined warnings and exceptions, 387
 - SQL data definition and manipulation statements, 281
 - SQL Server, 1, 2
 - SPECIFIC clause, 390
 - SQLCA data structure, 303–306, 345
 - SQLCODE, 302, 305, 206
 - SQLERRMC variable, 387
 - SQLEXCEPTION keyword, 385, 386
 - SQLSTATE variable, 302–303, 306–307, 318, 342, 343, 346, 376, 385, 386, 387, 388, 393, 402, 425
 - SQLWARNING keyword, 385, 386
 - %STATUS built-in function, 402
 - static statement, 300, 344
 - stored procedure, 73, 74, 371–393, 390, 438, 467
 - atomic, 385
 - controlling access to, 455
 - defined, 371
 - implemented with SPL, 377–378
 - privileges, 450, 452–453, 460–461
 - as substitute for view, 74
 - table-access, 74
 - STRCMTCTL (Start Commitment Control)
 - command, 426
 - LCKLVL parameter, 426
 - STRSQL (Start SQL) command, 426
 - Structured Query Language (SQL)
 - advanced retrieval capabilities, 263–264
 - basic statement types, 93
 - catalog, 94, 376
 - checking syntax, 98, 107
 - coding style, 98
 - comments, 100
 - condition, 157
 - creating programs, 361–369
 - cursor, 321–360
 - dynamic, 93, 344–351
 - embedded, 299–320, 373, 426, 427
 - error handling, 302–307, 318, 358
 - introduction to, 93
 - naming, 436–439, 450
 - package, 367
 - privilege, 450–453
 - queries, 143–194
 - running commands and scripts, 93–94, 98–99, 107
 - saving scripts, 106–107
 - terminology, 3, 93
 - translation process, 366–368
 - user-defined functions, 389–393
 - subquery, 207–208, 249–271, 274
 - correlated, 258–262
 - defined, 249
 - multiple-row, 249, 253–257
 - single-row (single-value), 249–253

- uncorrelated, 258
- SUBSTR function, 164, 275, 389, 390
- subtype, 44–46
- SUM function, 177, 178–179
- statement, 93
- Sybase, 1
 - syntax check, 98
- System i, 2
- system naming, 436–437, 450
- systems analysis, 6

T

- table, 9, 12, 438
 - adding data to, 107–111
 - adding rows to, 195
 - altering, 106
 - base, 273
 - child, 123
 - clearing, 211
 - conceptual view of, 78
 - controlling access to, 454
 - creating, 69–114
 - defined, 3, 78, 80
 - deleting, 106, 211
 - deleting a row from, 210
 - deleting a set of rows from, 211
 - dependent, 123
 - design information specified for, 71
 - displaying data in, 111
 - displaying description, 111
 - dropping, 106, 211
 - examples, 80
 - in physical database design, 10
 - joining several, 245
 - joining to itself, 288
 - layout, 78–79
 - lock, 419, 425, 431
 - methods of representing, 50–51
 - naming rules, 97
 - normalized, 52
 - parent, 123
 - privileges, 450, 451, 454, 457–459
 - restricting access to, 418–425
 - restricting access to rows within, 425
 - sample data, 90–92
 - stored on disk, 78
 - updating, 195–213
- table form, 50–51
- table-access routine, 73, 74
- terminology
 - SQL, 3, 93
 - non-SQL, 3
- time and date arithmetic, 184–187
- timestamp data type, 84, 89–90, 187
- transaction, 429
- transitive dependency, 57
- trigger, 395–416
 - adding, 396–398
 - buffer, 400
 - conditions, 396
 - defined, 395
 - INSTEAD OF, 312
 - interaction with constraints, 410–415
 - removing, 398–399
- trigger buffer, 400
 - layout, 400–401
 - sample program, 402–404, 404–409
 - soft-coding, 404–409, 415
 - TbBufLen parameter, 409
 - TbAftOfs parameter, 408
 - TbBfrOfs parameter, 408
- trigger program, 73–74, 75, 128, 395, 428. *See also* trigger, trigger buffer
 - advantage, 395
 - after, 397, 398, 399, 400, 402, 411, 412, 413, 414
 - before, 397, 398, 399, 400, 402, 411, 412, 413, 414
 - coding, 400–409
 - coding suggestions, 415
 - considerations, 409–415
 - sample, 402–404, 404–409
- TRIM function, 172
- two's complement notation, 89

U

- UNION operator, 204, 240–245, 251, 322
- UNION ALL operator, 242–243
- union-compatible, 256
- UCASE function, 173
- underscore (_) character, 164
- UNDO keyword, 385, 386
- unique constraint, 121–122, 209, 212, 293, 294, 411, 412, 413, 415
- unique identifier (UID), 25–27, 32, 35, 70
 - composite, 37, 38
 - unqualified name, 100
- UNIQUE keyword, 294
- UNIQUE WHERE NOT NULL, 294
- UPDATE statement, 75, 132, 195, 204–210, 198, 199, 209, 210, 212, 259, 260, 280, 282, 285, 299, 300, 301, 308, 313–314, 321, 329, 344, 358, 381, 384, 395, 398, 412, 413, 426, 429, 433
 - defined, 313
 - positioned, 334–335, 359

UPPER function, 173
 USEADPAUT (Use Adopted Authority)
 command, 468
 user profile, 71, 72, 442
 defined, 441
 user-defined function, 389–393, 467
 controlling access to, 455
 privileges, 450, 452–453, 460–461
 USING clause, 345, 348
 *USA date format, 184, 185

V

VALUES clause, 107–111, 196, 199, 200
 VARCHAR data type, 84, 102–103
 variable, 77–78
 view, 10, 74, 270, 273–289, 318, 419, 438, 466
 advantages, 274
 controlling access to, 454
 creating, 274–276
 defined, 3, 273
 differences between cursors and, 74–75
 nested, 265–270
 options for implementing, 74–75
 privileges, 450, 451–452, 454, 457–459
 renaming columns in, 276–277
 restricting rows in, 278
 specifying implementation for, 74–75
 as target of multiple-row insert, 204
 updatable, 195, 285
 uses for, 273–274
 using GROUP BY with, 281–282
 using joins with, 283–284
 using to update data, 280–281

 using WHERE clause with, 278–279
 volatile attribute, 21

W

Web application SQL1201, 336–344
 Web application SQL1202, 351–358
 WHEN clause, 182–184
 WHERE clause, 144, 155–167, 181, 187, 191, 192,
 195, 204, 212, 217, 258, 266, 275, 322, 323,
 324, 334
 computed value with, 158–160
 execution in SELECT statement, 189
 host variable references in, 301
 null condition in, 157–158
 restricting rows in a view with, 278
 used for inner join, 220–221
 using host variables in, 324–325
 using with a view, 278–79
 with a primary key, 157
 WHILE loop structure, 382, 383
 wildcard symbol, 164
 WITH clause, 268
 WITH CHECK OPTION clause, 285–286
 WITH DEFAULT clause, 102
 WITH GRANT OPTION clause, 450, 457, 459
 WITH HOLD clause, 330–331, 431
 WITH LOCAL CHECK OPTION clause, 285–286
 WRKAUT (Work with Authority) command,
 444, 446, 447

Y

YEARS keyword, 186