INDEX

Symbols

−− (shortcut operator), 38, 39
$ character, 31
% (remainder operator), 35, 60
%=, 40
%b, 84
%c, 84
%d, 84
%e, 84
%f, 84
%s, 84
& symbol, 1159
& (unconditional AND operator), 70, 89
&& (and), 69, 89
  truth table for, 69
* (multiplication) operator, 35
* (multiplication operator), 60
* (multiplication), in SQL, 1104
*=, 40
^ (exclusive or), 69
  truth table for, 69
| (unconditional OR operator), 70, 89
|| (or), 69, 89
  truth table for, 69
+ (addition operator), 35, 60
+ (addition), SQL, 1104
+ (concatenation operator), 30, 44
+ symbol, 1159
++ (shortcut operator), 38, 39
++ (var operator), 39
++x (preincrement operator), 39
+=, 40
+= (shortcut operator), 38, 45
< (less than), 68, 89
<= (less than or equal to), 68, 89
−=, 40
/=, 40
= (assignment operator), 40, 1159
!= (not equal to), 68, 89
== (comparison operator), 68, 264
  `equals` method vs., 323
> (greater than), 68, 89
>= (greater than or equal to), 68, 89
/ (division operator), 35, 60
  in SQL, 1104
! (not), 69, 89
  truth table for, 69
- (subtraction operator), 35, 60
  in SQL, 1104
: symbol, 84
? symbol, 84, 1159

A

abs method, `Math` class, 144
Absolute file name, 284
`AbstractBorder` class, 952
Abstract classes, 212, 342
  abstract methods, 342
  compared to regular classes, 344
  defined, 342–346
  defining constructors of, 344
  interfaces vs., 350–352
  superclass of, 344
  as types, 344
  without abstract method, 344
Abstract methods, 342, 344
  in abstract classes, 344
  defined, 344
`abstract` (modifier), 21
Abstract Windows Toolkit (AWT):
  defined, 401
  Swing vs., 401
`AbstractAction`, 979
`AbstractButton`, 492, 971, 1015
`AbstractCollection` class, 390
  `Collection` interface, 715–716
Abstraction, 372, 377
`AbstractList` class, `List` interface, 724
`AbstractListModel`, 1029
`AbstractMap` class, 733–734
`AbstractSequentialList` class, 724
`AbstractSet` class, 390
`AbstractSpinnerModel`, 1018–1019
`AbstractTableModel`, 1051
Access, 1176
  batch updates, 1131
  BLOB/CLOB, 1150
  tutorial, 1099
Access order, 734
Accessibility modifiers, 320–321
Accessor, 230, 249
Accessor (get) methods, and JavaBeans, 898
AccountWithoutSync.java, 787–789
AccountWithSyncUsingLock.java, 791–792
acme.jar, 1196
`action` attribute, <form> tag, 1172
Action events:
  handling, 472–473
  TestActionEvent.java, 473
`Action` interface, 978–982
  UML class diagram, 979
`actionCommand` property, 1015
`ActionEvent`, 466, 467–468
  `addActionListener`, 468
ActionInterfaceDemo.java, 980–982
`ActionListener` interface, 342, 465, 467, 468, 1011
  `actionPerformed` method, 363, 468, 901
`actionPerformed` handler, 971
`actionPerformed` method, 363, 468, 901
  `ActionListener` interface, 363
Actions, JSP, 1211
Activation, 390
Actual parameter, 130
Ada, 8–9
`add` method, `Container` class, 405
`addActionListener` method, 468, 485
`addActionListener(listener)`, 363
`addAll` method, 715
  `Collection` interface, 715–716
`addBatch` method, `Statement` interface, 1131
Addition (+) operator, 35
AdditionTutor.java, 72
`addLayoutComponent` method, 938–939
`addMatrix` method, `GenericMatrix` class, 706
Address book (case study), 623–629
  address components, 624
  AddressBook.java, 625–629
  address.dat, 624
  fixed-length record, 624
  FixedLengthStringIO.java, 624–625
AddressBook.java, 625–629
address.dat, 624
Address.java, 379–380
`addStudent` method, 244–245
`addXListener`, 468
`AdjustmentEvent`, 466, 467, 516
`AdjustmentListener` interface, 467
`adjustmentValueChanged` method, `AdjustmentListener` interface, 516
Advanced data structures, 28
Advanced Java database programming, 1125–1156
  batch processing, 1130–1135
  `RowSet` interface, 1145–1150
  scrollable and updateable result set, 1135–1145
  universal SQL client, 1126–1130
Advanced math learning tool (example), 97–98
Aggregated class, 374
Aggregating object, 374
Aggregation, 374
  defined, 374
  representation of, 374
Algorithm efficiency, 743–768
  average-case analysis, 745
  best-case analysis, 744–745
  Big O notation, 744–745
  binary search, analyzing, 745
  bubble sort algorithm, 747–748
  common growth functions:
    change of growth rates, 746
    comparing, 746–747
  constant time, 745
  estimating, 744–747
    execution time, 744
    growth rate, 744
  exponential algorithm, 746
  external sort, 759–765
  heap sort, 755–759
  insertion sort, analyzing, 746
  large input size, 745
  merge sort, 749–754
  multiplicative constants, ignoring, 747
  non-dominating terms, ignoring, 747
  quadratic algorithm, 748
  quick sort, 752–755
  selection sort, analyzing, 745–746
  Towers of Hanoi problem, 746
  worst-case analysis, 745
Algorithms, 2, 28
`align` attribute:
  <applet> tag, HTML, 540
  <img> tag, 1195
`alt` attribute:
  <applet> tag, HTML, 540
  <img> tag, 1195
Ambiguous invocation, 139
Anchor component, 937
Anchor edge, 937
Animation:
  using the `Timer` class, 482–485
    AnimationDemo.java, 483
    ClockAnimation.java, 484
Anonymous inner class, 471–472
  anonymous adapter advantages, 472
  defined, 471
  SimpleEventDemoAnonymousInnerClass.java, 472
Anonymous objects, 218
Apache, 1159

Applet class, 536–538, 564–565, 1157
  destroy method, 538, 565
  flow of control of, 537
  getParameter method, 565
  init method, 537
  no-arg constructor, 537
  param attribute, 565
  start method, 537
  stop method, 537
  subclass of, 536
Applet clients, 826–829, 834, 856
  AppletClient.java, 828–829
  CountServer.java, 827–828
Applet Viewer, 563
<applet> tag, HTML, 539–544, 546, 564–566
  align attribute, 540
  alt attribute, 540
  archive attribute, 540
  codebase attribute, 540
  hspace attribute, 540
  syntax for, 537, 539
  syntax of, 539
  vspace attribute, 540
AppletClient.java, 828–829
Applets, 14, 17, 535–574
  adding a component to, 538
  audio, playing, 559–560
    DisplayImagePlayAudio.java, 559–560
  bouncing ball application, 554–557
    UML class diagram, 555
  bytecode, 565
  content pane delegation feature, JDK 1.5, 405, 538
  defined, 535
  demos, 544
  enabling to run as applications, 544–546
  LoanApplet.java, 542–543
    with main method, 545–546
    public modifier, 543
  and main method, 536, 545–546, 549
  multimedia animations, 560–562
  passing strings to, 546–550
  security restrictions, 544–545
  TicTacToe game, 550–554
  trusted, 545
  URL class, 557–560
  viewing:
    using the applet viewer utility, 540–541
    from a Web browser, 541–542
Appletviewer, 540
Application program interface (API), 16
Application programs, 10
Application scope, 1232
application value, scope attribute, 1220
application variable, JSP, 1214
Approximations, 36
archive attribute, <applet> tag, HTML, 540
Archiving/archive files, 562–564
Arcs:
  DrawArcs.java, 436–437
  drawing, 436–438
  negative degrees, 437
Arguments, 130, 135–139
Arithmetic expressions, 37–38, 89
Arithmetic operators, SQL, 1104
ArithmeticException, 582
Arithmetic/logic unit, CPU, 5
Array initializers, 172
Array limitation, 660–661
Array lists, 663–668
  MyArrayList.java, 664–667
  TestList.java, 667–668
Array of reference variables, 237
Array variables:
  declaring, 170
    syntax for, 170
arraycopy method, 178, 356
ArrayIndexOutOfBoundsException, 175, 578, 586
ArrayList class, 315–318, 375–376, 694–695, 724–726
  trimToSize() method, 724–725
  UML class diagram, 695, 724
Arrays, 169–209, 237, 660, 661
  array variables vs., 170
  basics of, 170–177
  conversions between strings and, 268–269
  copying, 177–178
  creating, 170–171
  default values, 171
  defined, 170
  indexed variables, 171
  initializers, 172
  length, 171
  multidimensional, 199–201
  as objects, 217
  passing to methods, 179–181
  processing, 172–173
    foreach loops, 174
  ragged, 194–195
  returning from a method, 181–185
  searching, 185–188
    binary search approach, 186–188
    linear search approach, 186
  serializing, 620
  size, 171
  sorting, 188–191
    insertion sort, 190–191
    selection sort, 188–190
  testing (example), 174–175
  two-dimensional, 192–199
Arrays class, 191–192
Arrays of objects, 237–239
  sorting, 360–361
Arrays.asList(T... a) method, 728
Arrays.sort method, 362
Arrow keys, 7
Ascent, 440
ASCII (American Standard Code for Information Interchange), 42
  ASCII character set, 612
  ASCII code, 607, 612
asList method, 726
Assembler, 8
Assembly languages, 8
Assembly programs, 8
AssertionError class, 594
  Error class, 581
Assertions, 593–595
  declaring, 593–594
  defined, 593
  example of using, 594–595
  reaffirming, 595
  running programs with, 594
  using, 595
Assigning grades (example), 176–177
Assigning values, 30, 33
AssigningGrade.Java, 176–177
Assignment expressions, 32
Assignment operator (=) 32, 40
Assignment statements, 32–33
Association, 373–374
  dependency vs., 376
  illustration of, 373
  implementation, 374
  multiplicity, 373
Associativity, 86–87
Attributes, 1095
Attributes, HTML, 539
autoFlush attribute, page directive, 1216
Automatic scrolling, 943
Average-case analysis, 745
await() method, 793
AWTError subclass, Error class, 581
AWTException, 581

B

Backslash (/), 280
  escape sequences and, 43
  in file names, 285
Backward compatibility, and raw type, 699
BallControl.java, 556–557
Ball.java, 555–556
Base, 11
Base case, 640
Base class, 302, 331
BASIC, 8–9
Basic computer skills, 2
Batch processing, 1130–1135
  CopyFileToTable.java, 1131–1135
Bean components, *See* JavaBeans, components
Beans, *See* JavaBeans
Best-case analysis, 744–745
Best-case input, 744–745
between-and operator, 1102–1103
BevelBorder class, 952–953
Big O notation, 744–745
BigDecimal class, 359
BigInteger class, 359
Binary codes, 7
Binary digits, 5
Binary files:
  advantage of, 606
  defined, 606
Binary I/O, 605–634
  characters and strings in, 612–614
  classes, 606
  and conversions, 606
  efficiency of, 606
  TestFileStream.java, 610
  text I/O vs, 606–608
Binary numbers, 11
  conversion between decimal numbers and, 11–12
Binary operator, 36, 89
Binary search algorithm, 745
Binary search, analyzing, 745
Binary search approach, 186–188
Binary search trees, 678
  inserting an element into, 678–679
Binary trees, 660, 677–683
  binary search trees, 678
    inserting an element into, 678–679
  BinaryTree class, 680–682
  BinaryTree.java, 680–682
  complete, 683
  leaf, 678
  left (right) child of a node, 678
  left subtree, 677–678
  representing, 678
  right subtree, 677–678
  root, 677
  TestBinaryTree.java, 682–683
  tree traversal, 679–680
binarySearch method, 192
  and lists, 727
BinarySearch.java, 187–188, 745
BinaryTree class, 680–682

BinaryTree.java, 680–682
bind method, 1246
BirthDate class, 232–233
Bits, 5, 11
Bitwise operations, 71
Blind extensions, classes, 306
BLOB (Binary Large OBject), 1150
Block styles, 56–57
Blocked state, threads, 803
Blocking queues, 799–801
  ConsumerProducerUsingBlockingQueue.java, 800–801
Blocks:
  Java, 21
  nested, 141–142
BlueJ, 17
<body> tag, HTML, 539
boolean accessor, 230
Boolean class, 270, 356–357
boolean data type and operations, 68–69
Boolean literals, 71
Boolean operators, 69, 89
  SQL, 1102
Boolean types, 28
boolean value, testing, 77
Boolean variable, 68
boolean variable, assigning, 77
boolean wasNull() method, 1136
Border interface, 952
BorderDemo.java, 956–959
BorderLayout manager, 410–412
  defined, 410
  hgap property, 412
  ShowBorderLayout.java, 410–411
  UML class diagram, 410
  vgap property, 412
Borders, sharing, 418
Borland Interbase, 1099
Borrower.java, 381–382
BorrowLoan.java, 382
Bottom-up implementation, 149–151
BounceBallApp.java, 557
Bouncing ball application, 554–557
  BallControl.java, 556–557
  Ball.java, 555–556
  BounceBallApp.java, 557
  UML class diagram, 555
Bounded generic type, 699
Bounded wildcards, 701
BoundedTypeDemo.java, 699
Boxing, 362
BoxLayout manager, 930–933
  fillers, 931
  ShowBoxLayout.java, 932–933
Breadth-first traversal, 680
break (keyword), 83, 89, 113–114
  omitting, 83
break statement, 81, 101, 115–116
Browsers, *See* Web browsers
BrowseTable.jsp, 1236–1237
Bubble sort:
  defined, 747
  illustration, 747
  time, 748–749
Bubble sort algorithm, 747–748
  improved, 748
BubbleSort.java, 748
buffer attribute, page directive, 1216
BufferedImage class, 1199
BufferedInputStream, 614–615, 630
BufferedOutputStream, 614–615, 630
Bugs, 58–59
Built-in monitor, Java, 796–797
Bus, 4
ButtonDemo.java, 496–497
ButtonGroup, 501
ButtonModel, 1015
Buttons, 492–498
  AbstractButton, 492
  alignments, 494
  ButtonDemo.java, 496–497
  defined, 492
  horizontal alignment, 494
  horizontal text position, 495
  icons, 492–494
  JButton class, 493
  pressed icons, 492–494
  rollover icons, 492–494
  TestButtonIcons.java, 493–494
  types of, 492
  using (example), 495–498
  vertical alignment, 494
  vertical text position, 495
byte, 32, 34, 89
Byte class, 270, 356
Bytecode, 9, 19, 565
Bytecode verifier, 20
Bytes, 5
  address, 5
byteValue() method, 357

C

C, 8–9
C#, 8
C++, 8–9
Cable modem, 7, 816
Cached pools, 786
CacheRowSet, 1145
Calculator.java, 279
Calendar class, 148, 345–346, 375–376, 864
  add(field, amount) method, 347
  constructing calendars, 346
  getActualMaximum(field) method, 347
  get(int field) method, 347
  gettime() method, 347
  set(int field, value) method, 347
  UML class diagram, 345
CalendarApp.java, 874–875
CalendarPanel.java, 871–873
Call stacks, 133
CallBackImpl.java, 1261
CallBack.java, 1257
Callbacks, defined, 1255–1256
Called method, 131, 158
Calling object, 217
CancelListenerClass, 365
cancelRowUpdates() method, 1136
Candidate key, 1096–1097
capacity() method, StringBuffer class, 275
CardLayout manager, 921–924
  defined, 921
  methods, 921
  ShowCardLayout.java, 922–924
  UML class diagram, 922
Case sensitivity, of Java, 21, 31
Casting, 40–41, 60
  between char and numeric types, 43–44
  demonstrating, 314–315
  loss of precision, 41
  and object member access operator (.), 315
  syntax, 40
Casting objects:
  casting analogy, 314
  downcasting, 314
  explicit casting, 313
  implicit casting, 313
  and instanceof Operator, 313–315
  upcasting, 313–314
catch block, 580, 585
  finally clause and, 589
catch (keyword), 580
Catching an exception, 582
CD drives (CD-R, CD-RW, and DVD), 6
CD-ROMs, 239
CD-Rs, 6
CD-RWs, 6
CDs, 4
Cell class, 551, 554, 1257, 1265
Central processing unit (CPU), 4–5, 239
  arithmetic/logic unit, 5
  components of, 4–5
  control unit, 4–5
  speed of, 5
CGI programs, 1158–1160
Chained exceptions, 591–593
ChainedExceptionDemo.java, 591–593
char, 32, 41, 89
  increment/decrement, 42
  operand, 145
char literal, 41
Character class, 270–273, 275, 292, 356–357, 357
  constructor/methods, 270–273
Character data type, 41–42
Character encoding, 42, 606, 888–889, 1176, 1227
  EncodingDemo.java, 889
  and internationalization, 888–889
Character literal, 41
Characters, 59
  comparing, 68
charAt(index) method, 265
charAt(int) method, StringBuffer class, 275
charValue method, 267
Check box menu items, creating, 969
Check boxes, 400, 498–501
  CheckBoxDemo.java, 499–500
  toggle button, 498
checkbox input type, 1171
checked attribute, <input> tag, 1172
Checked exceptions, 582
CheckPalindrome.java, 270
Child class, 302, 331
Choice lists, *See* Combo boxes
Circle class, 214, 215–218, 224, 227, 232, 236, 238, 252
  and GeometricObject class, 302
  methods, 305
Circle1.java, 219–220
Circle2.java, 225
Circle3.java, 230–231
circleArray, 237
CircleControl (model example, 1008–1009
  CircleController.java, 1012–1013
  CircleModel.java, 1009–1011
  properties of, 1008–1009
  UML class diagram, 1009
Circle.java, 304–305, 344
CircleModel.java, 1009–1011
CircleView, 1008, 1009, 1011
  CircleView.java, 1011–1012
  UML class diagram, 1011
CircleWithException.java, 587–589
Clarity, in class design, 387
Class abstraction, 239
Class block, 21
Class contract, 239
Class design guidelines, 387–390
  clarity, 388
  cohesion, 387

Class design guidelines (*Continued*)
completeness, 389
consistency, 387–388
encapsulation, 388
inheritance vs. aggregation, 389–390
instance vs. static, 389
common design error, 389
interfaces vs. abstract classes, 350–352, 390
naming consistency, 387–388
naming conventions, 387
no-arg constructor, 388
`private` constructor, 388
`protected` constructor, 388
separating responsibilities, 387
Class diagram, 215
Class directory path, 156
Class encapsulation, 239
Class files, archiving, 156
`class` keyword, 25, 28
Class loader, 20
Class names, 17
Class operations, coherent purpose, 387
Class role, 390
`ClassCastException`, 314, 349, 697
Classes, 216
attributes/methods, describing, 378
declaring, 218–220
identifying, 377
and inheritance, 377
Java, 21, 214
from the Java library, 221–222
main class, 214
naming, 55, 56
and objects, 214
reuse of, 330, 372, 378, 407
variables, 235
classes12.jar, 1107–1108, 1177
`ClassName.staticVariable`, 227, 236
`ClassNotFoundException`, 581, 596, 618, 620, 1251
`classpath`, 155
`clear` method, 667, 716, 733, 1029
`clear()` method, `Collection` interface, 716
`clear` method, `Map` interface, 733
Client, 230, 375
Client program, 147, 231, 777, 817–819, 822, 824, 827, 1244
RMI, 1245, 1252
Client, RMI, 1244
Client sockets, 817
Client.java, 820–822
Client/server computing, 816–822
applet clients, 826–829, 834, 856
client sockets, 817
example of, 818–822
server sockets, 816–817
socket-based communication, 816
sockets, 816, 818
data transmission through, 818
CLOB (Character Large OBject), 1150
Clock speed, 5
Clock with audio (case study), 782–785
ClockWithAudio.java, 782–784
ClockWithAudioOnSeparateThread.java, 784–785
ClockAnimation.java, 484
`clone` method, 324–325, 355
`CloneNotSupportedException`, 322
`Object` class, 324–325
`Cloneable` interface, 325, 354–356, 874
implementing, 354
`cloneCalendar`, 874
`CloneNotSupportedException`, 355, 581
COBOL, 8–9, 214
Code Warrior (Metrowerks), 17
`codebase` attribute, `<applet>` tag, HTML, 540
Coding, 28, 372, 378
Cohesion, in class design, 388
Collection, defined, 714
`Collection` interface, 390
`AbstractCollection` class, 715–716
`addAll` method, 715–716
basic operations provided by, 715
`clear()` method, 716
`contains` method, 716
`containsAll` method, 716
`isEmpty` method, 716
`java.lang.UnsupportedOperationException`, 716
query operations, 716
`remove` method, 716
`removeAll` method, 716
`retainAll` method, 716
set operations, 716
`size` method, 715
`toArray()` method, 716
UML class diagram, 715
Collection objects, 660
Collections:
defined, 714
singleton, 737–738
static methods for, 726–729
unmodifiable, 737–738
`Collections` class, 726–727, 737–738, 746
UML class diagram, 726–728
`Collections` class class, 737–738
`Color` class, 403, 412–413
Color constants, 412–413
ColorDialog.java, 989–991
`cols` attribute, <textarea> … </textarea> tags, 1172
Column alias, 1103
Column model, `JTable`, 1046
Combo boxes, 509–512
cell rendering, 1036–1037
ComboBoxDemo.java, 510–512
defined, 1035
`JComboBox`, 509–511
ComboBoxCellRendererDemo.java, 1037–1038
ComboBoxDemo.java, 510–512
`ComboBoxModel` interface, 1036
UML class diagram, 1036
Command-line arguments, 277–279
passing strings to the `main` method, 277–279
processing, 278–279
Command-line debugger (jdb), JDK, 58
Comments, 20–21, 55
defined, 20
JSP, 1212
`commit()` method, 1110
Common Gateway Interface (CGI), 1158
Communication devices, 4, 7
`com.mysql.jdbc.Driver`, 1108
`Comparable` interface, 348, 360, 360–361, 383, 387, 390, 392, 395, 735
declaring classes to implement, 348
`ComparableRectangle.java`, 348–349
`Comparator` interface, 721–723, 735
`compare` method, 722
GeometricComparator.java, 721–721
TestTreeSetWithComparator.java, 722–723
`compare` method, 722
`compareTo` method, 265, 292, 348, 355, 694
Comparison operators, 68
SQL, 1102
Compilation errors, 57, 60
Compiler, 9, 34, 312
Java, 19
Compiling vs. interpreting, 9
Complete binary trees, 683
`Component` class, 413, 446, 466
and `ImageObserver` interface, 451
`setFont` method, 413
Component classes, 402
Component events, 484
`ComponentAdapter`, 476
`ComponentEvent`, 466
`ComponentListener` interface, 467
`ComponentAdapter`, 476
Components, *See also* JavaBeans, components
naming convention for, 492
Composition, 320, 374, 675
and object-oriented design, 374
`CompoundBorder` class, 952–953
ComputeArea.java, 28, 29–30, 68
ComputeChange.java, 49–50
`computeFactorial` method, 1219
ComputeFactorial.java, 637–638
ComputeFactorial.jsp, 1218–1219
ComputeFibonacci.java, 639–640
ComputeLoan., 1214–1215
ComputeLoan1.jsp, 1216–1217
ComputeLoan2.jsp, 1223–1224
ComputeLoanAlternative.java, 54–55
ComputeLoan.java, 47–48
ComputeLoan.jsp, 1215
Computer programming, defined, 4
Computer programs, 7–8
Computers:
clock speed, 5
components of, 4
defined, 4
ComputeTax.java, 198–199
ComputeTaxWithMethod.java, 140–141, 198
ComputeTaxWithSelectionStatement.java, 79–80, 198
Computing loan payments, 46–47
`concat` method, 292
Concatenating strings, 30, 44–45, 226
Concatenation operator (+), 30
Concrete classes, 715
`CONCUR_READ_ONLY` constant, 1135
`CONCUR_UPDATABLE` constant, 1135
`ConcurrentModificationException`, 805
`Condition` interface, 793
Conditional AND operator, 70, 89
Conditional expressions, 83–84
Conditional operator, 84
Conditional OR operator, 70, 89
`config` variable, JSP, 1214
Confirmation dialog:
controlling a loop with, 98–99
defined, 982
Confirmation dialogs, 983–985
defined, 983
Conflict interfaces, 342
Connected `RowSet` object, 1145
`Connection` interface, 1110, 1113, 1116, 1120
Consistency, in class design, 387–388
Console, getting input from, 52–53
Console output, 17
formatting, 84–86
Constant time, 745
Constants, 33–34
benefits of, 34
naming, 34, 55
static, 224–228
Constructor chaining, 307–308
Constructors, 214, 331
default constructor, 216
name of, 216
`new` operator, 216

no-arg (no-argument) constructors, 216
overloading, 216
and return type, 216
and void keyword, 216
ConsumerProducer.java, 797–799
ConsumerProducerUsingBlockingQueue.java, 800–801
Container class, 403, 405, 415, 466, 544
add method, 918, 939
Container classes, 403
Container objects, 660
ContainerAdapter, 476
ContainerEvent, 466–467, 918
ContainerListener interface, 467
ContainerAdapter, 476
Containers, 400–406
alignmentX (alignmentY) property, 920
defined, 290
maximumSize property, 920
minimumSize property, 920
preferredSize property, 920
size of a component in, 920
Swing container structures, 918–920
contains method, Collection interface, 716
containsAll method, Collection interface, 716
containsKey method, Map interface, 733
containsValue method, Map interface, 733
Content pane, defined, 405
Content pane delegation, 405
Contention, 779
contentPane property:
JApplet, 919
JFrame, 989
contentType attribute, page directive, 1216
Context menu, 975, 1001
Contiguous selection, 512, 1026, 1078
continue (keyword), 113–114
Contract, class, 239
Control statements, 108
Control unit, CPU, 4–5
Control variable, 103
Controller, 1008
Convenience adapters, 476, 485
Convenience classes, 390, 661
Converting operands, 40–41
Cookie class, 1189
Cookies, 1167, 1180, 1201, 1213
session tracking using, 1185–1190
copy() method, and lists, 726
CopyFile.java, 806–807, 807–808
CopyFileToTable.java, 1131–1135
Copy.java, 615–616
CornerPanel class, 947
CountEachLetter.java, 272–273
Count.java, 1220–1221
revised version, 1221–1222
Count.java (revised version), 1221–1222
countLetters method, 272–273
CountLettersInArray.java, 182–183
CountOccurrenceOfWords.java, 736–737
Country codes, 862–863
CountServer.java, 827–828
Course class, 243–245
implementation, 244–245
Course.java, 244–245
CourseWithEnrollmentEvent.java, 908–910
CPU, *See* Central processing unit (CPU)
createCircleArray method, 238
Critical region, 789, 792
Currency format, 877, 892
currentDirectory property, JFileChooser, 995
CurrentTime servlet, 1169
CurrentTime.java, 1169–1170
currentTimeMillis method, System class, 50–51
cursorMoved(RowSetEvent), 1149
cursorSetChangeed(RowSetEvent), 1149
Custom dialogs, creating, 989–92
Custom exception classes, creating, 342–343, 592–593
Custom interfaces, creating, 342–343
Custom layout managers, creating, 938–943
Custom stack class, 319–320
Custom table renderers and editors, 1062–1065
CustomFrame class, 330
CustomFrame.java, 330
CustomTableCellRenderEditorDemo.java, 1064–1065

D

Data field encapsulation, 214, 229–232
Data fields, 214, 235
hiding, 325–327
Data structures, defined, 660
Database, defined, 1094
Database management system (DBMS), 1094
Database programming, in servlets, 1180
Database systems:
components of, 1094
defined, 1094
JDBC, 1106–1113
relational, 1094–1098
Structured Query Language (SQL), 1098–1106
Database table browsing (case study), 1232–1238
BrowseTable.jsp, 1236–1237
DBBean.java, 1233–1235
DBLogin.html, 1235
DBLoginInitialization.jsp, 1235–1236
Table.jsp, 1236
DatabaseMetaData interface, 1116–1117, 1120
databaseURL, 1108
for an Access database, 1108–1109
for a MySQL database, 1108–1109
for an Oracle database, 1109
Datagram programming, 851–856
Datagram socket programming, 816
Datagram sockets, 816
constructing, 850–856
creating, 850
DatagramClient.java, 854–855, 854–856
DatagramPacket class, 850–851
Datagrams, defined, 850
DatagramServer.java, 852–853
DatagramSocket class, 851
DataInputStream, 611–612, 818
using, 613
DataOutputStream, 611–612, 818
using, 613
Date class, 222–223, 285, 864
DateFormat class, 865–875, 1228
DateFormatSymbols class, 866–875
FULL constant, 865
LONG constant, 865
MEDIUM constant, 865
SHORT constant, 865
SimpleDateFormat class, 865–866
UML class diagram, 865
DateFormatSymbols class, 866–875
UML class diagram, 866
dateStyle method, 865
DBBean.java, 1233–1235
DBLogin.html, 1235
DBLoginInitialization.jsp, 1235–1236
Deadlocks:
avoiding, 803
defined, 803
resource ordering, 803, 809
Debugging, 58–59, 372, 578
in integrated development environment (IDE), 58
Decimal number system, 11
Decimal numbers, 11
conversion between binary numbers and, 11–12
conversions between hexidecimal numbers and, 12–13
DecimalFormat Class, 877–878
Declarations, JSP, 1211
Declared type of the reference variable, 312
Declaring an exception, 587–589
Declaring variables, 30, 31–32
Decrement operators, 38–39, 60
Deep copy, 355
Default constructor, 216
Default field values, 220
Default modifiers, 228
DefaultButtonModel, 1015
DefaultCellEditor, 1065, 1084
DefaultComboBoxModel, 1036–1037
DefaultListModel, 1029–1030
DefaultListSelectionModel, 1026
DefaultMutableTreeNode, 1069
DefaultTableColumnModel, 1053
DefaultTableModel, 1051
DefaultTreeCellEditor, 1069
DefaultTreeCellRenderer, 1069, 1084
DefaultTreeModel, 1069, 1073–1074
DefaultTreeSelectionModel, 1078
Delegation-based model, 900
Delete key, 7
delete method, strBuf, 274
deleteRow() method, 1136
Delphi, 8–9
Dependency, 375–376
association vs., 376
Dependent component, 937
Dependent edge, 937
Deployment, 373
deposit method, 789
Deprecated methods, 777
Depth-first traversal, 680
defined, 680, 1074
dequeue(o) method, 677
Derived class, 302
Descent, 440
Descriptive identifiers, 31
Descriptive names:
full, 56
variables, 29
Deserialization, 619
destroy method:
Applet class, 538, 565
Servlet interface, 1165
DiagonalLayout.java, 940–942
dialogTitle property, JFileChooser, 994
dialogType property, JFileChooser, 994
Dialup, 816
Dialup modem, 7
Dimension class, 402, 403, 942
Directives, JSP, 1211, 1215–1219
Directories, packages, 154–155
Directory path, 284
Disconnected RowSet object, 1145
Discontiguous selection, 1078
disjoint method, and lists, 726, 729
Disk drives, 6
Disks, 4
types of, 6
DisplayClock.java, 447–448
DisplayFigure.java, 948–949
displayGeometricObject method, 345
DisplayImage.java, 452
DisplayImagePlayAudio.java, 559–560

DisplayImageWithURL.java, 558–559
Displaying the current time (example), 50–51
DisplayMessageApp.java, 548–549
DisplayMessage.html, 547
DisplayMessage.java, 547–548
displayObject method, 314–315
DisplayTimeForm.jsp, 1226–1227
DisplayTime.java, 35–36
DisplayTime.jsp, 1227
distinct keyword, SQL, 1104
Distinct tuples, sorting, 1104
Distributed Java system, 1244
"Divide and conquer" strategy, 147
Divider, 949
Division (/) operator, 35
Division by zero, and runtime errors, 57
Documentation, 55–57
doDelete method, 1166
doGet method, 1157, 1166
doLayout() method, 412, 921
Domain constraints, 1096
Domain Name Servers (DNS), 816
Domain names, 816
doOptions method, 1166
doPost method, 1166
doPut method, 1166
dot operator (.), 217
Dot pitch, 7
  monitors, 7
doTrace method, 1166
double, 32
double, 34, 89, 143–144
  float vs., 37
Double class, 270, 356–357
  parseDouble method, 359
Double precision, 34
Double.parseDouble method, 46
doubleValue() method, 356–357
do-while loops, 100–101, 111, 118
Downcasting, 314
draw3DRect method, 432
DrawArcs.java, 436–437
drawImage method, Graphics class, 451–452
drawLine method, 431
drawOval method, 432
drawPolygon method, 439
DrawPolygon.java, 439–440
drawRect method, 431–432
drawRoundRect method, 431
drawString method, 431
  Graphics class, 428
Drives, defined, 6
DrJava, 17
Drop-down lists, *See* Combo boxes
DSL (digital subscriber line), 7, 816
DVDs, 6
Dynamic binding, 311–313
  benefits of, 313
  defined, 312
Dynamic web contents, 17, 1158–1159, 1210

E

Eclipse, 18, 58, 78, 97, 133, 175, 220, 898, 1011, 1163
Eclipse Open Source (IBM), 17
editable property, JTree, 1084
Elements, defined, 714
else clause, matching with if clause, 76
Email programs, 4
empty() method, Stack class, 730
EmptyBorder class, 952–953
Encapsulation, 147, 159, 386–387, 388
  class, 239
Encoding, 42
Encoding scheme, 42
EncodingDemo.java, 889
End tag, HTML, 539
End-of-line style, 56–57
Enhanced for loop, 174
enqueue(o) method, 677
EnrollmentEvent.java, 908
EnrollmentListener.java, 908
entrySet() method, Map interface, 733
Enumeration interface, 729
equalArea method, 345, 698
equals method, 192, 264, 265, 292, 322–323
  Object class, 322–323
equalsIgnoreCase method, String class, 265
Error class, 581
  examples of subclasses of, 581
Error pages, using (example), 1217–1219
  ComputeFactorial.jsp, 1218–1219
  FactorialInputError.jsp, 1219
  FactorialInput.html, 1218
errorPage attribute, page directive, 1216
Escape sequences, for special characters, 43
EtchedBorder class, 952–953
Evaluation rule, 88
Event classes, 900
Event dispatcher thread, defined, 781
Event listener interface, 900
  defined, 900
Event objects, 900
Event pair, 900
Event registration, 898
  JavaBeans, 898
Event set, 900
  custom, creating, 906–911
    CourseWithEnrollmentEvent.java, 908–910
    EnrollmentEvent.java, 908
    EnrollmentListener.java, 908
    TestCourseWithEnrollmentEvent.java, 910–911
Event-driven programming:
  animation using the Timer class, 482–485
  defined, 464
  events, defined, 465
  getSource() instance method, EventObject class, 465
  key events, 479–482
  listeners, 465–477
  mouse events, 477–479
  SimpleEventdemo.java, 464
  source component, 465
  source object, 465
  Window events, handling, 474–475
EventListener interface, 900
EventObject class, 485
Events, defined, 465, 900
Ever-waiting threads, 796
Exception class, 592
  examples of subclasses of, 581
Exception classes, 581
Exception handlers, order of, 585
Exception handling, 212, 575–603
  catching an exception, 587–589
  CircleWithException.java, 587–588
  declaring exceptions, 587–589
  defined, 578
  exception handler, 584–585
    order of, 585
  exception message, 587
  ExceptionDemo.java, 578
  finally clause, 589–590
  HandleExceptionDemo.java, 579–580
  and multiple threads, 589
  overview of, 578–580
  stack trace, 579
  TestCircleWithException.java, 588
  TestException.java, 586–587
  throwing an exception, 587–589
  understanding, 582–589
  using, 584–585
ExceptionDemo.java, 578
Exceptions:
  chained, 591–592
    ChainedExceptionDemo.java, 591–592
  checked, 582
    catching/declaring, 582
  compared to events, 578
  custom exception classes, creating, 342–343, 592–593
  defined, 578, 580
  Exception class, 581
  integer overflow, 582
  rethrowing, 591
  runtime, 581
  unchecked, 582
  when to use, 590–591
executeBatch method, 1131
executeQuery method, Statement interface, 1136
executeUpdate method, 1130
Executor interface, 785–786
  UML class diagram, 785
ExecutorDemo.java, 786
Executors class, 786
ExecutorService interface, 785–786
exitMenu, 974
Explicit casting, 43, 313
Exponent methods, Math class, 143
Exponential algorithm, 746
Expressions, 32
  assignment, 32
Expressions, JSP, 1211
Extended class, 302, 331
extends (reserved word), 305
External sort, 759–765
  CreateLargeFile.java, 760
  first half segments, copying, 762
  initial sorted segments, creating, 761–762
  large binary file, creating, 760
  merging all segments, 762–763
  merging two segments, 763
  SortLargeFile.java, 763–765

F

factorial method, 640
  and recursion, 637–638
FactorialBean.java, 1224–1225
FactorialBean.jsp, 1225
FactorialInputError.jsp, 1219
FactorialInput.html, 1218
Factorial.jsp, 1212, 1219
Factorials, 638–639
  ComputeFactorial.java, 637–638
FahrenheitToCelsius.java, 38
Fail-fast, 805
Fairness policies, locks, 791
Fall-through behavior, 83
Fibonacci, Leonardo, 638
Fibonacci numbers:
  ComputeFibonacci.java, 639–640
  and recursion, 638–640
FigurePanel class, 432–436, 948
  FigurePanel.java, 434–435
  implementation, 432
  TestFigurePanel.java, 433
  UML class diagram, 433
FigurePanel.java, 434–435
File class, 283–286, 292
File copying program (case study), 615–616
File path character, 418

File pointer, 622
FileInputStream, 609–611
  UML class diagram, 609
Filename, 285
FileOutputStream, 609–611
  UML class diagram, 609
Files, naming conventions, 418
fill method, 192
  and lists, 728
fill3DRect method, 432
Fillers, 931
fillOval method, 432
fillRect method, 431
fillRoundRect method, 431
Filter streams, defined, 611
FilterInputStream class, 611
FilterOutputStream class, 611
final (keyword), 321, 332
Final local variable, 322
final (modifier), 21, 33
FinalizationDemo.java, 323–324
finalize method, 322, 323–324
  Object class, 322
finally clause, 589–590
  FinallyDemo.java, 590
  and I/O programming, 590
finallyDemo.java, 590
FindGrade.java, 1111–1112
FindGradeUsingPreparedStatement.java, 1114–1116
FindSalesAmount.java, 110–111
FindUserTables.java, 1117–1118
Fire event, 465
firstKey() method, SortedMap interface, 733–734
FirstServlet.java, 1161
Fixed-length record, 624
FixedLengthStringIO.java, 624–625
FlashingText.java, 780
float, 32, 34, 89
Float class, 270, 356
floatable property, JToolBar, 977
Floating-point literals, 37
Floating-point numbers, 34, 59
floatValue() method, 356–357
Floppy disks, 6, 239
FlowLayout class, 291
FlowLayout manager, 290, 406–408, 436
  components/properties for specifying horizontal/vertical gap between components, 920
FocusAdapter, 476
Focused components, 482
FocusEvent, 466, 467
FocusListener interface, 467
  FocusAdapter, 476
Font class, 403, 413
FontMetrics class, 403, 440–442
for loop, 102–104, 118, 237
  adding semicolon at end of for clause before the loop body, 103
  control variable, 103
  loop-continuation-condition in, omission of, 103–104
  nested, 105–106
  syntax for, 102
foreach loops, 174, 718
Foreign key constraints, 1097
  defined, 1096
<form> … </form> tags, 1172
Formal parameters, method header, 130
Format class, 155–156
Format.java, 155–156
FormatString.java, 289
Formatter class, 289
Formatting numbers, 41
FORTRAN, 8
Fractals, 646–649
  defined, 646
  Sierpinski triangle:
    creation of, 646
    defined, 646
    SierpinskiTriangle.java, 647–648
Frames, 403–406
  adding components to, 405
  creating, 403
  MyFrame.java, 404
  MyFrameWithComponents.java, 405
Framework-based programming:
  defined, 392
  using Java API, 392
frequency method, and lists, 726
FULL constant, DateFormat class, 865
Function keys, 7
Functions, 130–131

G

Garbage, defined, 222
Garbage collection, 177, 222, 323–324
Generic instantiation, 694
Generic programming, 311–313, 350, 356, 362, 365
  defined, 313
Generic reference types, 694
GenericMatrix class, 705–710
  addMatrix method, 705–706, 706
  GenericMatrix.java, 706–708
  IntegerMatrix.java, 708
  multiplyMatrix method, 705–706
  RationalMatrix.java, 708–709
  TestIntegerMatrix.java, 709
  TestRationalMatrix.java, 709–710
  UML class diagram, 706
GenericMatrix.java, 706–708
GenericMethodDemo.java, 698, 699
Generics:
  actual concrete type, 694
  bounded generic type, 699
  declaring generic classes and interfaces, 695–698
  formal generic type, 694
  generic class constructor, 697
  generic class parameter vs. generic method parameter, 699
  generic instantiation, 694
  generic methods, 698–699
  generic type limitation, 697
  generic types, benefits of using, 697
  GenericMatrix class, 705–710
  GenericMethodDemo.java, 698
  GenericStack.java, 696–697
  motivations, 694–695
  multiple generic parameters, 698
  raw types:
    and backward compatibility, 699–700
    unsafe, avoiding, 703–705
  wildcards, 701–703
GenericServlet class, 1166
GenericServlet class, UML class diagram, 1167
GenericSort.java, 360–362
GenericSortNew.java, 705
GenericStack.java, 696–697
GeometricComparator.java, 721–722
GeometricObject class, 302, 302–306, 309–310, 390
  abstract class, 344
  getArea() method, 302
  getDiameter() method, 302
  getPerimeter() method, 302
  toString() method, 302
  toString method, 309
  UML class diagram, 343
  using, 344
GeometricObject.java, 303–304, 342–343, 344
get method, 214
get method, 378
GET method, 1159–1160
getAllFonts() method, 413
getArea method, 214–220, 227
getArea() method, GeometricObject class, 302
getAvailableFontFamilyNames() method, 413
getAvailableIDs() method, TimeZone class, 864
getAvailableLocales() method, Locale class, 864
getBirthDate() method, 232–233
getChars method, 268
getClass method, 325
getColumnCount method, 1130
getColumnName() method, 1130
getConnection(databaseURL), DriverManager class, 1108
getContentPane() method, 405, 919
getCurrencyInstance, 876, 890
getCurrencyInstance method, NumberFormat.getInstance(), 877, 890
getData method, 850
getDateCreated() method, 302–303, 309
getDateTimeInstance method, 865
getDiameter() method, GeometricObject class, 302
getElementAt method, 1029
getGraphics() method, 429
getHeight() method, 442
getInitParameter, ServletConfig interface, 1166
getInitParameterNames, ServletConfig interface, 1166
getInputStream() method, 818
getInstance, 876, 890
getKeyChar() method, KeyEvent, 482
getKeyCode() method, KeyEvent, 482
getKeyStroke method, KeyStroke class, 970
getLeadSelectionPath() method, 1078
getMessage() method, 583, 586, 592
getMetaData method, 1130
getMonthName, 148
getNumberInstance, 876, 890
getNumberOfDaysInMonth, 148, 149
getNumberOfObjects(), 224–225, 231
getOutputStream() method, 818
getParameter method, Applet class, 563, 565
GetParameters.java, 1173–1174
getPercentInstance, 876, 890
getPercentInstance(), NumberFormat.getInstance(), 877, 890
getPerimeter() method, GeometricObject class, 302
getPreferredSize() method, 436
getRadius method, 224, 231
GetRegistrationData.jsp, 1231
getSelectedItem method, 1036
getSelectionPaths() method, 1080
getServletContext, ServletConfig interface, 1166
getServletName, ServletConfig interface, 1166
getSize method, 320, 1029
getSource() instance method, EventObject class, 465
getStackTrace() method, 585–586
getStartDay, 148
getString method, 883
getStudents() method, 244–245
Getter, 230, 249
getTime() method, 222

getTimeInstance method, 865
getTimeZone(id) method, 864
getTotalNumberOfDays, 148
getTotalNumberOfDays(int year, int month), 149
getWidth() method, 442
getWriter method, 1170
GIF (Graphics Interchange Format), 418
GifEncoder class, 1198
Gigahertz (GHz), 5
Glue, 931–932
Gosling, James, 14, 24
GradeExam.java, 197
Graphical notations, 213, 373, 393
Graphical user interface (GUI), 525
  defined, 492
Graphics, 425–462
  arcs, drawing, 436–438
  draw3DRect method, 432
  drawing on panels, 430–431
  drawLine method, 431
  drawOval method, 432
  drawRect method, 431–432
  drawRoundRect method, 431
  drawString method, 431
  FigurePanel class, 432, 432–436
  fill3DRect method, 432
  fillOval method, 432
  fillRect method, 431
  fillRoundRect method, 431
  FontMetrics class, 440–442
  getGraphics() method, 429
  graphical coordinate systems, 426
  Graphics class, 403
  images, displaying, 451–452
    DisplayImage.java, 452
  MessagePanel class, 442–446
  paintComponent Method, 429
  polygons, 438–440
  polylines, 438–440
  StillClock class, 447–451
  TestPaintComponent.java, 429–430
Graphics class, 403
  defined, 426–427
  drawString method, 428
  setColor method, 446
  setFont method, 446
  UML class diagram, 427
Graphics object, 427
GraphicsEnvironment class, 413
Greatest common divisor, finding (example), 108–109
GreatestCommonDivisor.java, 108–109
Greedy match, 283
GregorianCalendar class, 148, 345–346, 870
GridBagConstraints object, constructing, 926
GridBagLayout manager, 408–410, 436, 924–928
  adding a component to the container of, 926
  anchor, 925
  defined, 924
  display area, 924
  filling, 925
  GridBagLayout() constructor, 924
  growth weight, 925
  insets, 926
  location, 925
  padding, 926
  properties for specifying horizontal/vertical gap between columns/rows, 920
  ShowGridBagLayout.java, 927–928
  ShowGridLayout.java, 409–410
  size, 925
  using, 926–927
Grouping patterns, 280–282
Growth rate, algorithms, 744
GUI classes:
  classification of, 402
  as JavaBeans components, 899
GUI components, 330–331, 400–401
  common features of, 415–418
  inheriting, 330–331
  pluggable look-and-feel feature, 960–961
  TestSwingCommonFeatures.java, 416–417
GUI event dispatcher thread, 781
GUI events, handling, 363–364
GUI helper classes, 403
GUI programming, getting started with, 400–427

H

HandleASession class, 839, 841–842
HandleEvent.java, 363–364
HandleExceptionDemo.java, 579–580
Handlers, 467, 486, 900
Hand-tracing a program, 58
Hard disks, 6
Hardware, defined, 4
Has-a relationship, 320, 390
hashCode method, 323, 717
  Object class, 323
HashMap class, 716–718
HashSet class, 716–718
  Set interface, 716–718
  TestHashSet.java, 717–718
Hashtable, 735
hasNext() method, Iterator interface, 724
<head> tag, HTML, 539
headMap() method, SortedMap interface, 734
Heap sort, 755–759
  analysis, 759–760
  HeapSort.java, 758–759
  height of a heap, 759
  implementation, 758–759
  initial heap, creating, 757–758
  makeHeap method, 759
  merge sort vs., 759
  method for making a heap, 758
  rebuildHeap method, 759
  rebuilding a heap:
    algorithm for, 758
    method for, 757
  sorting an array from a heap, 756–757
Heap.java, 686–687
Heaps, 660, 683–689
  adding a new node, 684, 687
  defined, 683
  Heap class, 685–687
  new node, adding, 684–685
  removing the root, 684, 687
  representing, 684
  root, removing, 684
  TestHeap.java, 687–688
Heavyweight components, 401
Height, 440
Helper classes, 402
Hertz (Hz), 5
Hexadecimal numbers, 11
  conversions between decimal numbers and, 12–13
hgap property, BorderLayout manager, 412
Hidden variables, 236
HidingDemo.java, 326–327
High-level languages, 8–9
Histogram.java, 523–524
Hoare, C. A. R., 752
HoldComponents.java, 290
Horizontal alignment, buttons, 494
Horizontal text position, buttons, 495
Horizontal wrap layout, lists, 1026
House class, 355–356
House.java, 354–355
hsbPolicy parameter, JScrollPane, 944
hspace attribute, <applet> tag, HTML, 540
HTML:
  <applet> tag, 539–544
    syntax for, 539
  <title> tag, 539
  attributes, 539
  <body> tag, 539
  defined, 539
  end tag, 539
  <head> tag, 539
  <html> tag, 539
  start tag, 539
  tags, 539
HTML files, placing, 1172
HTML forms, 1159, 1170–1176
  defined, 1170
  <form> … </form> tags, 1172
  <input> tag, 1172
  <label> … </label> tags, 1172
  obtaining current time based on locale and time zone, 1174–1176
  obtaining parameter values from, 1172–1174
  <option> … </option> tags, 1172
  <select> … </select> tags, 1172
  Student_Registration_Form.html, 1171
  <textarea> … </textarea> tags, 1172
HTML/XHTML tutorial, 1170
HttpServlet class, 1157, 1166, 1213
  doDelete method, 1166
  doGet method, 1166
  doOptions method, 1166
  doPost method, 1166
  doPut method, 1166
  doTrace method, 1166
  UML class diagram, 1167
HttpServletRequest interface, 1166–1167, 1213
  UML class diagram, 1167
HttpServletResponse interface, 1168, 1213
  UML class diagram, 1168
HttpSession interface, 1190–1195
  RegistrationWithHttpSession.java, 1190–1195
  UML class diagram, 1101
Hypertext Markup Language (HTML), 14
Hyper-Text Transport Protocol (HTTP), defined, 1180

I

IBM DB2, 1099
IBM Informix, 1099
icon property, 970
iconImage property, JFrame, 919
Icons, 492–494
  sharing, 418
Identifiers, 30–31
IdentifyHostNameIP.java, 823
IEEE 754 standard, 34
if ... else statements, 74–75, 89
if statements, 73, 89, 131
  if ... else statements, 74–75
  nested, 76–78
  simple, 73–74
IllegalArgumentException, 412, 582, 582–583, 587, 589
IllegalMonitorStateException, 796–797
Image file format, 418
Image files, naming, 418
Image icons, 418–419, 970–971
  borders/icons, sharing, 418
  sharing borders and, 419
  TestImageIcon.java, 418–419
ImageContent.java, 1195–1196

ImageContentWithDrawing.java, 1197–1199
ImageIcon class, 947
ImageObserver interface, 451
ImageViewer class, 452–455
  ImageViewer.java, 454–455
  SixFlags.java, 453–454
  stretchable image, 452
  UML class diagram, 453
ImageViewer.java, 454–455
<img> tag, 1195–1196, 1199
Immutable class, 232–233, 358–359
Immutable objects, 232–233
Immutable strings, 263–264
Implementation, software development process, 372
implements (keyword), 350
Implicit casting, 43, 313
import attribute, page directive, 1216
Import on demand declaration, 157
Improved math learning tool (example), 80–81
include directive, 1216
Increment operators, 38–39, 60
Incremental development and testing, 30
Indentation, 56, 76
  indent code, 56
Index, 171, 173, 175, 193
Indexed variables, 171
indexOf method, 267–268
IndexOutOfBoundsException, 580, 582, 586
InetAddress class, 822–823
  IdentifyHostNameIP.java, 823
Infinite loops, 97
Infinite recursion, 637
Information hiding, 147, 159
Inheritance, 301–339, 376, 608, 675
  aggregation vs., 389–390
  and classes, 377
  defined, 302
  GUI components, 330–331
  multiple, 342
  single, 342
init method:
  Applet class, 565
  Servlet interface, 1165
Initial capacity, 275
Initial heap, creating, 757–758
Initialization blocks, 327–330
InitializationDemo.java, 328–329
Initializers, 172
Inner class, 485
  anonymous, 471–472
  combining dependent classes into a primary class, 485
  declaring, 470
  defined, 469
  objects of, 470
  SimpleEventDemoInnerClass.java, 470–471
  static, 470
Inner class listeners, 469–471
InnerClass class, 469–470
Inorder traversal, 679
Input and output devices, 4, 6–7
  keyboard, 6–7
Input dialogs, 45–46, 985–986
  defined, 982, 985
Input errors, 57
Input stream, 606
<input> tag, 1172
InputEvent class, 477
InputMismatchException, 579
InputStream class, 608–609
InputStream class, 818
  UML class diagram, 608
Insert key, 7
Insertion order, 734
Insertion sort algorithm, 746
Insertion sort, analyzing, 746
InsertionSort.java, 191, 746
insertRow() method, 1136
Insets class, 942
Instance, 214
Instance methods, 217
  overriding, 309
Instance variable, 217, 224
instanceof operator, 314
Instantiation, 214
int, 32, 34, 89
Integer class, 270, 356–357
  parseInt method, 359
Integer division, 35, 60
Integer literals, 36–37
Integer overflow exceptions, 582
Integer vs. decimal division, 38
IntegerMatrix class, 706
IntegerMatrix.java, 708
Integer.parseInt method, 46
Integers, 34, 59
Integrated development environment (IDE), 17, 175
  debugging in, 58, 78, 97, 133, 220
Integrity, relational database systems, 1094
Integrity constraints, 1095–1098
  defined, 1095
  domain constraints, 1096
  enforcing, 1097–1098
  foreign key constraints, 1097
  primary key constraints, 1096–1097
  types of, 1096
Interfaces, 212, 347–356
  abstract classes vs., 350–352
  accessing constants, 341
  Cloneable interface, 354–356
  compiling, 348
  conflict, 342
  custom, creating, 342–343
  declaring, syntax for, 348
  defined, 347
  and generic programming, 350
  marker, 354
intern method, 264
Internal frames, creating, 999–1000
International character encoding, 1176
International clock:
  calendar, displaying, 870–875
    CalendarApp.java, 874–875
    CalendarPanel.java, 871–873
    showDayNames method, 873
    showDays method, 873
    showHeader method, 873
  displaying, 867–870
  WorldClockApp.java, 870
  WorldClockControl.java, 868–869
  WorldClock.java, 867–868
International time, displaying, 1225–1228
  DisplayTimeForm.jsp, 1226–1227
  DisplayTime.jsp, 1227
  TimeBean.java, 1226
Internationalization, 861–894
  Calendar class, 864
  character encoding, 888–889
  common country codes, 863
  common language codes, 863
  Date class, 864
  DateFormat class, 865–875
  international clock, displaying, 867–870
  Java features supporting, 862
  Locale class, 862–864
  numbers, formatting, 875–881
  ResourceBundle class, 862, 882, 890
  TimeZone class, 864–865
  Unicode, 862–864
Interned strings, 263–264, 292
Internet, defined, 14, 816
Internet Protocol (IP), 816
  address, 816
Internet Service Provider (ISP), 816
Inter-relational, defined, 1096
interrupt() method, 804
InterruptedException, 778
intValue() method, 356–357
InvalidRadiusException.java, 592–593
I/O (input/output), 575–603
  and Java, 606
IOException, 580–581, 581, 583, 585, 590, 592
IP address, 816
is null operator, 1102–1103
Is-a relationship, 320, 342, 376
  non-extensible is-a, 377
isAlive() method, 804
isEmpty method, 320
  Collection interface, 716
  Map interface, 733
isErrorPage attribute, page directive, 1216
isFocusable property, 482
Is-kind-of relationship, 342, 390
isLeapYear, 149
isLeapYear(int year) method, 151
isLetterOrDigit(ch) method, 271
isLetterOrDigit(ch) method, 275
isPalindrome method, 641–642
isThreadSafe directive, 1216
ItemEvent, 466, 467, 509
ItemListener interface, 467
Iteration, recursion vs., 649
Iteration of a loop, 96
Iterator interface, 729
  hasNext() method, 724
  next() method, 724
  remove() method, 716
  UML class diagram, 715
iterator method, 716

J

jakarta-tomcat-5.5.9.zip, 1159
JApplet, 402, 403, 538, 919–920
JApplet, 538
Java, 8
  applets, 14, 17, 535–574
    using Swing components in, 538
  application program interface (API), 16
  blocks, 21
  built-in monitor, 796–797
  bytecode file, 19
  case sensitivity of, 21, 31
  class names, 17
  classes, 21
  console output, 17
  design characteristics, 14
  history of, 14, 16
  language specification, 16
  main method, 17
  methods, 22
  modifiers, 21
  programs:
    case sensitivity of, 19
    comments, 20–21
    creating, compiling, and executing, 18–20
    reserved words (key words), 21
  statements, 21
  Student.java, 829–830, 1229–1230
  StudentServer.java, 833–834
  syntax rules, 18
  versatility, 14–15
  wrapper classes, 270, 358
Java 2 Enterprise Edition (J2EE), 16

Java 2 Micro Edition (J2ME), 16
Java 2 Standard Edition (J2SE), 16
Java archive file format (JAR), 563
Java bytecode, 9
Java Coding Style Guidelines, 55
Java Collection Framework, 714–743
  Comparator interface, 721–723
  defined, 714
  design of, 715
  lists, 723–726
  maps, 733–737
  priority queues, 731–733
  queues, 731–733
  relationships of the interfaces and classes in, 714
  sets, 716–721
  singleton and unmodifiable collections and maps, 737–738
  Stack class, 729–730
  Vector class, 729–730
Java Collections Framework, 390, 661
  defined, 714
Java database programming, 1093–1123
  advanced, 1125–1156
Java Development Toolkit (JDK), 16–17
  command-line debugger (jdb), 58
  foreach loop, 174, 718
  javadoc command, 21
  PriorityQueue class, 732
  and supplementary characters, 42
Java development tools, defined, 17
Java directory separator (/), 285
Java event model:
  elements, 900
  event classes, 900
  event listener interface, 900
  event pair, 900
  event set, 900
    custom, creating, 906–911
  listener components, 901–902
  review, 900–902
  source components, 900–901
    custom, creating, 902–906
    TestSourceListener.java, 901–902
Java GUI API, 404–405
Java I/O programming, illustration of, 606–607
Java language specification, defined, 17
Java programming, 108
Java programming-development process, 18
Java projects:
  archived projects, running, 563–564
  manifest file, 563
  packaging and deploying, 562–564
Java Runtime Environment (JRE), 563
Java servlets, 15, 17
Java source file, 19
Java style, 960
Java Virtual Machine (JVM), 9, 312, 1160
JAVA_HOME environment variable, 1163
java.applet.Applet, 536, 538, 559
java.awt package, 291, 401, 403
java.awt.Applet class, 918
java.awt.Color class, 412
java.awt.Component, 412, 416, 420, 501, 899, 911, 918, 928, 961
java.awt.Container, 405, 415–416, 918, 921, 939
java.awt.Dialog class, 918, 992
java.awt.event package, 465
java.awt.event.ActionListener interface, 342
java.awt.event.ContainerEvent, 918
java.awt.Frame class, 408, 918
java.awt.GraphicsEnvironment, 413
java.awt.Panel, 401
java.awt.Point, 477
java.awt.Window, 401
JavaBeans:
  accessor (get) methods, 898
  class as JavaBeans component, 1219
  component, creating an instance for, 1219
  components, 898
    defined, 898
    minimum JavaBeans component requirements, 898
  ComputeLoan2.jsp, 1223–1224
  Count.java, 1220–1221
  Count.java (revised version), 1221–1222
  defined, 898
  event registration, 898
  FactorialBean.java, 1224–1225
  FactorialBean.jsp, 1225
  international time, displaying, 1225–1228
    DisplayTimeForm.jsp, 1226–1227
    DisplayTime.jsp, 1227
    TimeBean.java, 1226
  mutator (set) methods, 898
  properties of:
    associating with input parameters, 1223–1232
    and data fields, 899
    getting/setting, 1222–1223
  property-naming patterns, 899
  and Serializable interface, 898
  student registration:
    GetRegistrationData.jsp, 1231
    StoreData.java, 1228–1229
    StoreStudent.jsp, 1231–1232
  syntax for creating a bean, 1220
  TestBeanScope.jsp, 1221
  using in JSP, 1219–1222
javac, 563
javadoc command, JDK, 21
javadoc comments, 21, 55
java.io.File class, 284, 288
java.io.FileNotFoundException, 609
java.io.IOException, 610
java.io.Reader class, 289
java.io.Writer class, 289
java.lang package, 392, 1215
java.lang.Class, 325
java.lang.Cloneable interface, 354–356
java.lang.Comparable interface, 342, 348, 694, 699
java.lang.Math, 154
java.lang.Number class, 580
java.lang.Object class, 302, 310, 331, 356
java.lang.String class, 262–263, 283
java.lang.StringBuffer class, 273
java.lang.Throwable class, 585–586, 592, 596
java.lang.UnsupportedOperationException, 716
  Collection interface, 716
java.net.BindException, 817, 822
java.net.ConnectException, 822
java.net.URL class, 558
java.rmi.Remote interface, 1244
JavaServer Pages (JSP), 15, 1209–1241
  actions, 1211
  application variable, 1214
  browsing database tables (case study), 1232–1238
    BrowseTable.jsp, 1236–1237
    DBBean.java, 1233–1235
    DBLogin.html, 1235
    DBLoginInitialization.jsp, 1235–1236
    Table.jsp, 1236
  comments, 1212
  ComputeLoan.html, 1214–1215
  ComputeLoan.jsp, 1215
  config variable, 1214
  declarations, 1211
  defined, 1210
  directives, 1211, 1215–1219
  error pages, using (example), 1217–1219
    ComputeFactorial.jsp, 1218–1219
    FactorialInputError.jsp, 1219
    FactorialInput.html, 1218
  exceptions, 1232
  expressions, 1211
  Factorial.jsp, 1212
  forwarding requests from, 1232
  importing classes (example), 1216–1217
    ComputeLoan1.jsp, 1216–1217
  include directive, 1216
  JSP files, storing, 1210
  JSP implicit objects, 1213
  JSP tags, 1210
  out variable, 1213
  page directive, 1216
  page variable, 1214
  pageContext variable, 1214
  predefined variables, 1213–1215, 1238
  processing of, 1211
  request variable, 1213
  response variable, 1213
  scripting constructs, 1211, 1211–1213
    syntax, 1237–1238
  scripting elements, 1211
  scriptlets, 1211, 1213
  session variable, 1213
  tablib directive, 1216
  translated into a servlet, 1211
  using JavaBeans in, 1219–1222
java.swing.ButtonGroup, 501
java.swing.event package, 465
java.text.DateFormat, 864–865, 890
java.text.DateFormatSymbols, 866
java.text.ParseException, 877
java.util package, 392
java.util.ArrayList, 316–319, 695, 805, 905, 910, 1029
java.util.Arrays, 191–192, 362, 744, 752
java.util.Calendar, 345
java.util.Calendar, 345
java.util.Collections, 744
java.util.Comparator interface, 721
java.util.ConcurrentModificationException, 805
java.util.date, 222–223, 243
java.util.EventListener, 900
java.util.EventObject, 465, 484, 900
java.util.Formatter, 289
java.util.GregorianCalendar, 345
java.util.Hashtable, 734
java.util.InputMismatchException, 579
java.util.Observable class, 1008
java.util.Observer interface, 1008
java.util.Random, 223
java.util.Scanner, 289
java.util.Stack, 730, 805
java.util.TimeZone, 864
javax.servlet, 1164
javax.servlet.http, 1164
javax.servlet.http.Cookie, 1185
javax.swing package, 392, 402
javax.swing.AbstractButton, 492
javax.swing.BorderFactory class, 954
  UML class diagram, 954
javax.swing.event package, 515
javax.swing.event.ListSelectionEvent, 513
javax.swing.event.ListSelectionListener interface, 513

javax.swing.JApplet, 538
javax.swing.JComponent, 921
javax.swing.JGlassPane, 919
javax.swing.JLayeredPane, 919, 961
javax.swing.JRootPane, 919, 961
javax.swing.JTable, 1046
javax.swing.SwingConstants interface, 495
javax.swing.Timer, 482
javax.swing.tree, 1069
javax.swing.UIManager, 960
JBuilder (Borland), 17, 18, 58, 78, 97, 133, 175, 220, 898, 1011, 1163
JButton, 247–248, 400, 405, 415, 466, 468, 493, 898, 900–901, 1015, 1016
JCheckBox, 400, 466, 498, 1016
JCheckBoxMenuItem, 1001
  adding to a JMenu, 968–969
JColorChooser, 992–994
  color preview panel, 993
  flexibility of, 994
  tabbed pane, 993
JComboBox, 247–248, 400, 402, 466, 509–511, 1035–1038
  ComboBoxCellRendererDemo.java, 1037–1038
  defined, 1036
  events generated by, 509–510
  UML class diagram, 509, 1036
JComponent, 402, 431, 952
  extending, 431
JCreator LE, 17
JDBC, 1106–1113
  accessing a database from a Java applet, 1111–1113
  accessing the database, steps in, 1106
  classes12.jar, 1107–1108
  Connection interface, 1113, 1116, 1120
  DatabaseMetaData interface, 1116–1117, 1120
  defined, 1106
  developing database applications using, 1107–1108
  drivers, 1108
    loading, 1107–1108
  FindGrade.java, 1111–1112
  image retrieval, 1150
  image storage, 1150
  interfaces and classes, 1106
  JDBC 2 standard, 1126
  JDBC 3 standard, 1126
  mysqljdbc.jar, 1107–1108
  ResultSet, processing, 1109–1110
  ResultSetMetaData interface, 1116
  retrieving metadata, 1116–1119
  SimpleJDBC.java, 1110
  statements:
    creating, 1109
    executing, 1109
  StoreAndRetrieveImage.java, 1151–1153
  storing and retrieving images in, 1150–1153
  URLs, 1108
JDBC-ODBC driver, 1177
JdbcRowSet, 1145
JDialog, 403
JEdit, 17
JEditorPane, 836–838
JFileChooser, 994–998
  properties of, 994–995
JFrame, 247–248, 290, 402, 403, 415, 417, 544, 919–920
  content pane, 405
  contentPane property, 919
  iconImage property, 919
  jMenuBar property, 919
  properties of, 1000
  resizable property, 919
  title property, 919
  UML class diagram, 404
JGlassPane, 919
JGrasp, 17
JInternalFrame, properties of, 1000
JLabel, 400, 503, 538
  constructors/methods, 503
  UML class diagram, 503
JLayeredPane, 919, 961, 1000
jlblBanner, 428
JList, 247–248, 402, 466, 512–513, 1024–1029
  constructors, 1025
  JList.HORIZONTAL_WRAP, 1026
  JList.VERTICAL, 1025
  JList.VERTICAL_WRAP, 1026
  layoutOrientation property, 1025–1026
  list cell renderer, 1032–1035
  list layout orientations, 1025–1026
  list model, 1025, 1029–1032
  list models, 1029–1032
  list properties demo, 1027
  list-selection model, 1025
  methods, 1025
  properties, 1025
  selection modes, 512–513
  selectionMode property, 1026
  selectionModel property, 1026
  UML class diagram, 512, 1025
JMenu, 402
JMenuBar, 1001
  defined, 968
jMenuBar property, JFrame, 919
JMenuItem, 466, 1001
join() method, 779
JOptionPane:
  defined, 22
  dialogs, 982–988
    creating (example), 982–989
  showInputDialog method, 45, 52
  showMessageDialog method, 22–23, 130
JOptionPaneDemo.java, 986–988
JPanel, 402, 403, 413–414, 430, 451, 479, 920, 947, 1011
  defined, 403
JPasswordField, 506
JPEG (Joint Photographic Experts Group), 418
JPopupMenu, 974
JProgressBar, 402, 805–808
  CopyFile.java, 807–808
  UML class diagram, 806
JRadioButton, 247–248, 400, 402, 466, 501
  UML class diagram, 501
JRadioButtonMenuItem, 969–970, 1001
JRootPane, 919, 961
JScrollBar, 466, 515–518
  properties of, 516
  UML class diagram, 516
JScrollPane, 943–947
  CornerPanel class, 947
  defined, 943
  hsbPolicy parameter, 944
  ScrollMap.java, 945–947
  setCorner() method, 944
  UML class diagram, 945
  viewport, 943–944
  vsbPolicy parameter, 944
JSlider, 518–521
  features of, 521
  UML class diagram, 519
JSP, *See* JavaServer Pages (JSP)
JSP files, storing, 1210
JSP implicit objects, 1213
JSP tags, 1210
JSpinner, 1016–1018
  defined, 1016
  methods, 1017–1018
  sequence value, 1017
  UML class diagram, 1017
JSplitPane, 949–952
  defined, 949
  divider, 949
  ShowLayout.java, 949–951
  UML class diagram, 951
JTabbedPane, 947–949
  defined, 947
  DisplayFigure.java, 948–949
  ease of use, 948
  UML class diagram, 948
JTable, 1008, 1016, 1019, 1046–1068, 1136, 1144, 1156
  column model, 1046
  constructors, 1047
  defined, 1046
  JTableHeader class, 1046
  list-selection model, 1046
  methods, 1047
  properties, 1047
  and scrolling, 1046
  table data model, 1051
  table model, 1046
  TableColumn class, 1046
  TablePropertiesDemo.java, 1048–1050
  TestTable.java, 1047–1048
  UML class diagram, 1047
JTableHeader, 1054–1055
  UML class diagram, 1055
JTextArea, 402, 506
JTextComponent, 504, 506
JTextField, 400, 402, 466, 504, 506
JToggleButton, 498, 1016
JToolBar, 976–978
JToolBar:
  floatable property, 977
  orientation property, 977
JTree, 1008, 1016, 1068–1085
  constructors, 1069–1070, 1072
  defined, 1068
  editable property, 1084
  leaf, 1069
  methods, 1069–1070
  nonleaf node, 1069
  properties, 1069–1070
  root, 1069
  and scrolling, 1072
  SimpleTreeDemo.java, 1070–1072
  subtrees, 1069
  supporting interfaces and classes, 1069
  tree events, 1085
  treelike hierarchy, 1068
  trees, 1069
    data representation of, 1069
  UML class diagram, 1070
JViewport, 943
JVM (Java Virtual Machine), 9

K

Key events, 479–482, 484
  key constants, 481
  KeyboardPanel class, 482
  KeyEventDemo.java, 480
Key K, 1097
Key words, 21
KeyAdapter, 476
Keyboard, 6–7
Keyboard accelerators, 970–971
Keyboard mnemonics, 970–971
KeyEvent, 466, 467

KeyListener interface, 467
  KeyAdapter, 476
keyPressed handler, 479
keyReleased handler, 479
Keys, 882–883
keySet method, Map interface, 733
KeyStroke class, getKeyStroke method, 970
KeyStroke object, setAccelerator method, 970
keyTyped handler, 480
Keywords, SQL, 1098
Koch snowflake, 655

L

<label> … </label> tags, 1172
Labels, 503–504
  breaking with, 115–116
Language, relational database systems, 1094
Language codes, 863
lastIndexOf method, 267
lastKey() method, SortedMap interface, 734
lastModified() method, 285
Layout managers, 290, 406–412
  BorderLayout manager, 410–412
  BoxLayout manager, 930–933
  CardLayout manager, 921–924
  custom, creating, 938–943
    DiagonalLayout.java, 940–942
    ShowDiagonalLayout.java, 942–943
  defined, 406
  FlowLayout manager, 406–408
  GridBagLayout manager, 924–928
  GridLayout manager, 408–410
  OverLayout manager, 933–936
  properties of, 920
  SpringLayout manager, 936–938
  using no layout manager, 928–930
    ShowNoLayout.java, 929–930
layout property, Container class, 918
layoutContainer method, 938–939, 943
LayoutManager interface, 403, 938–939, 943, 961
layoutOrientation property, 1025–1026
Lead path, 1078
Leading, 440
Leap year, determining (example), 71–72
LeapYear.java, 68–69
Learning Java Effectively with JBuilder/NetBeans/Eclipse, 59, 175, 220
Left-associative, 86
Length, arrays, 171
length() method, 265–266
  StringBuffer class, 275
Life-cycle methods, 1165
Lifeline, 390
Lightweight components, 401
like operator, 1102–1103
Line comment, 20
Line separator, 286
Linear search, and large arrays, 185
Linear search approach, 186
linearSearch method, 186
LinearSearch.java, 186
LineBorder class, 952–953
Lines, drawing, 431–432
lineWrap property, 509
LinkageError subclass, Error class, 581
Linked lists, 668–675
  MyLinkedList.java, 669–672
  nodes, 668
Linked structure, 661
LinkedHashMap class, 734–736, 739, 742
LinkedHashSet class, 714, 718–719, 738
  Set interface, 718–719
  TestLinkedHashSet.java, 718–719
LinkedList class, 724–726
  defined, 724
  TestArrayAndLinkedList.java, 725–726
  UML class diagram, 725
LinkedList queue, 731
List cell renderer, 1032–1035
  ListCellRendererDemo class, 1032
  ListCellRendererDemo.java, 1034–1035
List interface, 723–724
  AbstractList class, 724
  add() method, 723
  addAll() method, 723
  ArrayList class, 724–726
  indexOf() method, 723
  lastindexOf() method, 723
  LinkedList class, 724–726
  listIterator() method, 723
  remove() method, 723
  UML class diagram, 723
List layout orientations, 1025–1026
List models, 1025, 1029–1032
  ListModelDemo.java, 1031–1032
List properties demo, ListPropertiesDemo.java, 1027–1028
ListCellRenderer interface, 1032–1035, 1036
  ListCellRendererDemo.java, 1034–1035
  MyListCellRenderer.java, 1033–1034, 1037
ListDataListener, 1029
ListDemo.java, 514–515
Listener components, 901–902
Listeners, 363, 465–477, 486
  ActionListener interface, 467
  defined, 465, 900
  inner class, 469–471
  listener interface adapters, 476
  MouseMotionListener interface, 467
  registration methods, 468
  Window events, handling, 474–475
  XEvent, 467
  XListener interface, 467
ListIterator interface, 723
  add() method, 723
  hasnext() method, 724
  next() method, 724
  nextIndex() method, 724
  previous() method, 724
  previousIndex() method, 724
  UML class diagram, 723
ListModel interface, 1036
  methods defined by, 1029
  UML class diagram, 1030
ListResourceBundle class, 882, 888
Lists, 28, 512–515, 659–675, 714
  array lists, 663–668
  ascending order, 726–7
  and binarySearch method, 727
  and copy() method, 728
  defined, 512, 660, 661
  descending order, 726–727
  and disjoint method, 726, 729
  and fill() method, 728
  and frequency method, 726
  Java Collection Framework, 723–726
  JList, 512
  linked lists, 668–675
  ListDemo.java, 514–515
  and max method, 729
  and min method, 729
  MyAbstractList.java, 662–664, 666–668
  MyList.java, 661–662
  and nCopies() method, 728
  operations of, 660
  and reverse method, 728
  scrolling, 513
  and shuffle() method, 728
  sorting comparable elements in a list, 726
  static methods for, 726–729
  TestList.java, 667–668
List-selection model, 1025
  JTable, 1046
ListSelectionEvent, 466, 515
ListSelectionListener interface, 515
ListSelectionModel interface, 1026
Literals, 36
  defined, 36
Loan class, 239–240, 1216–1217
  implementation, 241–243
Loan payments, computing, 46–47
LoanApplet.html, 543–544
LoanApplet.java, 542–543
  with main method, 545–546
  public modifier, 543
Loan.java, 241–242
Local area networks (LANs), 7, 816
Local object types, 1245–1246
Local objects, 1244
Local variables, 235
  defined, 141
  scope of, 141–142
Locale class, 862–864, 880
  country, 862
  getAvailableLocales() method, 864
  language, 862
  locale property in Component class, 862
  locale-sensitive operation, 864
  predefined locale constants, 864
  UML class diagram, 863
  variant, 862
Locale-sensitive operation, 880
LocateRegistry class, 1246
Locks, 790–796
  AccountWithSyncUsingLock.java, 791–792
  fairness policies, 791
  ReentrantLock class, 791
Logarithmic algorithm, 745
Logic errors, 58, 60, 578
  debugging, 58
Logical operators, 69
long, 32, 34, 37, 89
Long class, 270, 356
LONG constant, DateFormat class, 865
Long string, breaking, 30
longValue() method, 356–357
Loop body, 96
Loop statements, 39
loop-continuation-condition, 96–97, 118
  omission of, in for loop, 103–104
Loops, 95–127
  case studies, 108–113
  controlling a confirmation dialog, 98–99
  controlling with a sentinel value, 99–100
  defined, 96
  do-while loop, 100–101, 111
  infinite, 97
  iteration of, 96
  for loop, 102–104
  nested, 105
  while loop, 96–100
Lower bound wildcards, 701

M

Machine languages, 7
Main class, 215
Main memory, 4
main method, 17, 22, 130, 132–134, 136, 144, 149
  and applets, 536, 545–546, 549
Main window, 521

Maintenance, 373
makeHeap method, 759
MalformedURLException, 834
Manifest file, 563
Map, 714
Map interface, 733–737
  AbstractMap class, 733–734
  query methods, 733
  TestMap.java, 735–736
  UML class diagram, 734
  update methods, 733
Maps, 733–737
  singleton, 737–738
  unmodifiable, 737–738
Marker interfaces, 354
matches method, String class, 280
Matching a method signature vs. binding a method implementation, 312
Math class, 142–143, 142–145, 321
  exponent methods, 143
  min, max, and abs methods, 144
  random method, 144
  rounding methods, 143–144
  trigonometric methods, 142
Math subtraction learning tool program, 97–98
MatteBorder class, 952–953, 959
max method, 131, 133, 348, 729
  and lists, 729
  Math class, 144
Max1.java, 700
maximumsize property, Container class, 920
Max.java, 699
maxlength attribute, <input> tag, 1172
mbps (million bits per second), 7
MEDIUM constant, DateFormat class, 865
Megabytes (MB), 5
Megahertz (MHz), 5
Memory, 5–6, 10–11
  main memory, 4
Memory chips, 5
Memory unit, 5
MenuDemo.java, 971–974
Menus, 968–976
  associating with the menu bar, 968
  check box menu items, creating, 969
  creating, 968–970
  defined, 968, 1001
  image icons, 970–971
  keyboard accelerators, 970–971
  keyboard mnemonics, 970–971
  menu items, 968–969
  popup, 974–976
  radio button menu items, creating, 969–970
  sequence of implementing, in Java, 968
  submenu items, creating, 969
  using, 971–974
Merge sort, 749–754
  heap sort vs., 759
  illustration, 749–754
  MergeSort.java, 750–751
  merging two arrays, method for, 749–750
  quick sort vs., 759
  time, 751–752
  time analysis, 751
Merge sort algorithm, 749
MergeSort.java, 750–751
Message dialog box, displaying text in, 22–23
Message dialogs, 983
  defined, 982
MessagePanel class, 442–446, 495, 899
  MessagePanel.java, 444–446
  reuse of class, 446
  TestMessagePanel.java, 442–443
  UML class diagram, 443
MessagePanel.java, 444–446, 498
Metadata, retrieving, 1116–1119
  database metadata, 1116–1117
  database tables, obtaining, 1117–1118
  ResultSetMetaData interface, 1116, 1118–1119
Metal style, 959–960
Meta-object, 325
Method abstraction, 130, 153, 159
  defined, 146
  and stepwise refinement, 146–154
method attribute, <form> tag, 1172
Method block, 21
Method body, 130–131, 147
Method declaration, 130
Method invocation, 391
Method name, 130, 132, 158
Method overloading, 137
Method overriding, 309, 331
Method signature, 131, 133, 135, 137, 147, 158
Methods, 214
  abstraction, 130, 146–154
  ambiguous invocation, 139
  called method, 131, 158
  calling/invoking, 131–133
  computing taxes with (case study), 139–141
  creating, 130–131
  functions, 130
  invoking, 133, 138
  method body, 130–131, 147
  method declaration, 130
  method header, 158
    formal parameters, 130
  method name, 130, 132, 158
  method signature, 131
  modifiers, 130
  naming, 55
  nonvoid method, 130
  overloading, 138
  parameters, 130
  procedures, 130
  return value type, 130, 158
  returnValueType, 130
  reusing, 133
  static, 23, 224
  static modifier, 130
  stepwise refinement, 147
  syntax, 130
  void method, 130
Microsoft Internet Information Server, 1159
min method, and lists, 729
min method, Math class, 144
minimumsize property, Container class, 920
MissingResourceException, 883
MixedContent.java, 1199–1200
mnemonic property, 970, 1015
Modal, use of term, 988
Model, components of, 1008
model property, 1015
Modeling behavior:
  object-oriented design, 390–392
    sequence diagrams, 390–391
    statechart diagrams, 391–392
Model-view-controller (MVC) approach, 1008–1014
  benefits of, 1008
  MVCDemo.java, 1013–1014
  variations, 1014–1015
Modems, 4
Modifier key, 7
Modifiers, 21, 130, 158
ModifyTree.java, 1081–1083
Monetary units, counting (example), 48–49
Monitors, 4, 6–7
  built-in, 796–797
Motif:
  popup menus in, 1001
  style, 959–960
Mouse, 4, 6–7
Mouse events, 477–479, 484
  MouseEvent class, 477
  MoveMessageDemo.java, 478–479
  moving a message on a panel using a mouse, 477–479
  Point class, 477
MouseAdapter, 476
mouseDragged method, 479
MouseEvent, 466
MouseEvent, 466, 467, 477, 479
MouseListener interface, 467, 477, 479
  MouseAdapter, 476
MouseMotionAdapter, 476
MouseMotionListener interface, 467, 477, 479, 486
  mouse-motion handlers, 479
  MouseMotionAdapter, 476
mouseMoved method, 479
mousePressed method, 975
mouseReleased method, 975
MovableMessagePanel class, 479
MoveMessageDemo.java, 478–479
moveToInsertRow() method, 1136
MovingMessagePanel class, 483–484
MS Access, 1099
Multidimensional arrays, 199–201
Multimedia animations, 560–562
multiple attribute, <select> … </select> tags, 1172
Multiple clients, 823–826
  MultiThreadServer.java, 824–826
Multiple declarations, 141
Multiple document interface (MDI), 999, 1001
Multiple generic parameters, 698
Multiple inheritance, 342
Multiple threads, and exception handling, 589
Multiple windows, creating, 521–525
  Histogram.java, 523–524
  MultipleWindowsDemo.java, 522–523, 525
MULTIPLE_INTERVAL SELECTION value:
  selectionMode property, 1026
  selectionModel property, 1026
Multiple-choice test, grading (example), 196–197
Multiple-interval mode, JList, 512–513
MultipleWindowsDemo.java, 522–523, 525
Multiplication (*) operator, 35
Multiplicity, 373
multiplyMatrix method, GenericMatrix class, 705–706
Multiprocessing, 11
Multiprogramming, 11
multiSelectionEnabled property, JFileChooser, 995
Multithreading, 11, 774
  benefits of, 774
  defined, 774
  in single-processor systems, 774
MultiThreadServer.java, 824–826
MutableComboBoxModel interface, 1036
MutableTreeNode interface, 1069
Mutator, 230, 249
Mutator (set) methods, and JavaBeans, 898
MVCDemo.java, 1013–1014
MyAbstractList.java, 662–664, 666–668
MyArrayList.java, 664–667
myCircle, 216–220, 231–234, 252
MyFrame.java, 404
MyFrameWithComponents.java, 405
MyImageCellRenderer.java, 1063
MyLinkedList.java, 669–672

MyListCellRenderer.java, 1037
MyList.java, 661–662
MyPriorityQueue.java, 688
MyQueue.java, 675–676
MySQL, 1176
  batch updates, 1131
  databasename command, 1100
  default databases, 1099
  mysql database, 1099–1100
  starting, 1099
  stopping, 1099
  test database, 1099
  tutorial, 1099
mysqljdbc.jar, 1107–1108
MyStack class, 319–320
  UML class diagram, 696
MyStack.java, 319–320

N

name attribute:
  <input> tag, 1172
  <select> … </select> tags, 1172
  <textarea> … </textarea> tags, 1172
Name.java, 379
Naming conventions, 55–56
  SQL, 1098
Narrowing a type, 40, 60
native modifier, 322, 355
nCopies() method, and lists, 728
Nested blocks, 21, 141–142
Nested class, 485
  defined, 469
Nested if statements, 76–78
Nested loops, 105
Nested parentheses, in numeric expressions, 38
NetBeans, 898, 1011
NetBeans Open Source (Sun), 17, 18, 58, 78, 97, 133, 175, 220, 1163
Netscape Enterprise Server, 1159
Network interface cards (NICs), 4, 7
Network programming, 816
Networking, 815–860
  applet clients, 826–829
  case studies, 838–850
  client/server computing, 816–822
  datagram sockets, 816, 850–856
  distributed TicTacToe games, 838–850
  InetAddress class, 822–823
  Internet Protocol (IP) address, 816
  JEditorPane class, 836–838
  multiple clients, 823–826
  stream sockets, 816
  Transmission Control Protocol (TCP), 816
  User Datagram Protocol (UDP), 816
  Web servers, retrieving files from, 834–836
  WebBrowser.java, 837–838
new GregorianCalendar(), 345
new operator, 170, 172, 201, 216–7, 249, 344, 364, 392, 408
  and arrays, 217
  and constructors, 216
new Scanner(File), 288
New state, threads, 803
newCondition() method, 791, 793, 795–6
newDeposit condition, 793
newFixedThreadPool(int) method, 786
NewPanel class, 430
NewRecordDialog.java, 1143–1144
next() method, Iterator interface, 724
nextInt method, Scanner class, 579
Next-line style, 56
NICs, *See* Network interface cards (NICs)
no-arg constructor, 388
  and wrapper classes, 358
NoClassDefFoundError exception, 20
Nodes, linked lists, 667–675
Nonalphanumeric characters, ignoring when checking palindromes, 275–277
Non-extensible is-a relationship, 377
Nonleaf node, 1069
Nonserializable fields, 619
Nonvoid method, 130
NoSuchMethodError, 20
NotePad (Windows), 18–19
NotSerializableException, 619
npoints data field, 438
null values, 220–221
NullPointerException, 221, 578, 582
Number class, 356, 359
NumberFormat class, 875–876, 890
  UML class diagram, 876
NumberFormatDemo.java, 878–881
NumberFormat.getInstance(), 876
  getCurrencyInstance method, 877, 890
  getPercentInstance(), 877, 890
numberOfObjects, 224–226
Numbers:
  currency format, 877
  DecimalFormat Class, 877–878
  formatting, 875–881
    example of, 878–881
    NumberFormatDemo.java, 878–881
  NumberFormat class, 875–876, 890
  parsing, 359–360, 877
  percent format, 877
  plain number format, 876
  resource bundles, 881–888
Numeric data types, 34, 34–40
Numeric errors, minimizing, 106–108
Numeric expression, writing in Java, 37–38
Numeric keypad, 7
Numeric literals, 36–37
  floating-point literals, 37
  integer literals, 36–37
  literals, defined, 36
  scientific notations, 37
Numeric operators, 35, 60
  on characters, 44
  in a Java expression, 38
Numeric type conversions, 40–41
Numeric wrapper classes, 358–359
  constants, 358
  constructors, 358
  conversion methods, 358–359
  static valueOf methods, 359

O

Oak, 14
Object class, 302, 310–312, 355
  methods in, 322–325
    clone method, 324–325
    equals method, 322–323
    finalize method, 322
    getClass Method, 325
    hashCode method, 323
  toString() method, 310–311
Object I/O, 617–620
  TestObjectInputStream.java, 618
  TestObjectOutputStream.java, 617–618
Object member access operator, 217
Object reference variables, 216
Object serialization, 619
ObjectInputStream, 617
Object-oriented design, 371–396
  aggregation, 374
  association, 373–374
    dependency vs., 376
  case study, 377–382
    Rational class, 382–387
  class design guidelines, 387–390
  composition, 374
  dependency, 375–376
  framework-based programming using Java API, 392
  inheritance, 376
  modeling behavior, 390–392
    sequence diagrams, 390–391
    statechart diagrams, 391–392
Object-oriented programming (OOP), 211–259
  defined, 214
ObjectOutputStream, 617
  UML class diagram, 617
objectRefVar.dataField, 217
objectRefVar.method, 217
objectRefVar.methodName, 220
Objects, 214, 216
  accessing data and methods of, 217–218
  accessing via reference variables, 216–222
  arrays as, 217
  behavior, 214
  and classes, 214
  creating, 218–220
  defined, 214
  defining classes for, 214–16
  establishing relationships among, 377
  identifying, 377
  invoking methods on, 214
  lifecycle of, and statechart diagrams, 392
  object reference variables vs., 217
  sending/receiving, 829–834
  state, 214
  using classes from the Java library, 222–224
    Date class, 222–223
    Random class, 223–224
Observable class, 1008
Observer inferface, 1008
Octal numbers, 14
ODBC data source, creating, 1108
Off-by-one error, 175
OKListenerClass, 365
OOP, *See* Object-oriented programming (OOP)
Open file dialog, 994
Operand evaluation order, 87–88
Operating systems (OSs):
  allocating and assigning system resources, 10
  controlling and monitoring system activities, 10
  defined, 10
  scheduling operations, 10–11
operationMenu, 974
Operator associativity, 86–87
Operator precedence, 86–87
Option dialogs, 986–988
  defined, 982
<option> … </option> tags, 1172
Optional GUI sections, 212
Oracle, 1176
  batch updates, 1131
  tutorial, 1099
oracle.jdbc.driver.OracleDriver, 1108
order by clause, SQL, 1105
orientation property, JToolBar, 977
Original Unicode, 42
OSs, *See* Operating systems (OSs)
out variable, JSP, 1213
Outdated methods, 777
OuterClass class, 469–470
Output devices, 4, 6–7
Output stream, 606
OutputStream class, 608–609, 818
  UML class diagram, 609
Ovals, drawing, 431–432
Overhead, 649

OverlayLayout manager, 933–936
OverLayout manager, 933–936
ShowOverLayLayout.java, 934–936
Overloading methods, 137–141, 310
Override accessible instance method, 309
Overriding vs. overloading, 310

P

pack() method, 505
package-access, 228
package-private, 228
Packages, 154–158
directories, 154–155
hierarchical nature of, 154
package-naming conventions, 154
putting classes into, 155–156
reasons for using, 154
using classes from, 156–157
Packets, 850
page directive, 1216
Page down key, 7
Page up key, 7
page value, scope attribute, 1220
page variable, JSP, 1214
pageContext variable, JSP, 1214
paintComponent method, 429, 451, 479, 1011
invoking directly, 435
protected visibility, 430
super.paintComponent(g), 430
PalindromeIgnoreNonAlphanumeric.java, 276–277
Palindromes:
checking, 269–270
ignoring nonalphanumeric characters at time of, 275–277
Panels:
TestPanels.java, 414–415
using as subcontainers, 413–415
Paragraph comment, 20
Parallel processing, 11
param attribute, Applet class, 565
Parameter list, 130, 138, 158
Parameter order association, 135
Parameters, 130, 158
defined, 130
method, scope of, 141
Parent class, 302, 331
Parentheses:
array elements and, 171
order of evaluation and, 89
parseDouble method, Double class, 46
Double class, 359
parseInt method, Integer class, 46
Parsing numbers, 359–60, 877
Pascal, 8
Pass by value, defined, 135
Passing arrays to methods, 179–181
Passing objects to methods, 233–234
Passing parameters, 1245–1246
Passing parameters by values, 135–137
peek() method, 320
Stack class, 730
Peers, 401
Percent format, 877
Perl language, 1159
Person.java, 380–381
Pivot, 752
Pixels, 7, 405
Plain number format, 876
Pluggable look-and-feel feature, 960–961
PNG (Portable Network Graphics), 418
Point class, 477, 649
Polygon class, 438–439
drawPolygon method, 439
drawPolyline method, 439
Polygon object, 438
Polygons, drawing, 438–440
polyLine method, 439
Polylines, drawing, 438–440
Polymorphism, 311–313
defined, 312
demonstrating, 314–315
and generic programming, 313
PolymorphismDemo.java, 311–312
pop() method, 320
Stack class, 730
pop(o) method, 677
Popup menus, 974–976
defined, 974
PopupMenuDemo.java, 975–976
showing, 974–976
simplifying, 976
Popup triggers, 974–976, 1001
POST method, 1159–1160
Postdecrement operator, 39
Postincrement operator, 39
Postorder traversal, 679
Post-test loops, 104
pow(a, b) method, Math class, 47
Precedence rule, 86–87
Predecrement operator, 39
Predefined variables, 1213–1215, 1238
preferredsize property, Container class, 920
Preincrement operator, 39
Preorder traversal, 680
PreparedStatement interface, 1113–1116
FindGradeUsingPreparedStatement.java, 1114–1116
and RowSet, 1147
Pressed icons, 492–494
Pre-test loops, 104
Primary key, 1097
Primary key constraints, 1096–1097
Prime numbers, displaying (example), 116–117
PrimeNumber.java, 117–118
Primitive data types, 28, 34, 60, 88, 1245
processing values as objects, 356–357
variables of, 221–222
print method, println method vs., 53
printAreas method, 234
printCalendar problem, 148
PrintCalendar.java, 148–154
implementation details, 151–154
PrintChar class, and Runnable, 777
printCircle method, 233–234
printCircle method, 233–234
printCircleArray, 239
Printers, 4, 6–7
PrinterWriter class, 289
printf method, 84–85
printGrade method, 134–135
println method, 22, 52, 135
printMonth, 149–150
printMonthBody, 148
printMonthTitle, 148
printNum class, 777
PrintPyramid.java, 112–113
printStackTrace() method, 585–586, 590
PrintWriter class, writing data using, 286–287, 292
Priority queues, 688–689, 731–733
defined, 688
MyPriorityQueue.java, 688
TestPriorityQueue.java, 688–689
PriorityQueue class, 732
PriorityQueueDemo.java, 732–733
Private constructor, 229
Private data fields, 228
in a superclass, 309
private (modifier), 21, 228, 320–321
Procedural languages, 214
Procedural programming, 214
Procedures, 130–131
processSQLNonSelect() method, 1130
processSQLSelect method, 1130
Producer/consumer (case study), 797–799
ConsumerProducer.java, 797–799
Program control, 113, 118, 158
Programming:
usefulness of remainder in, 35
using a native machine language, 7–8
Programming errors, 57–58, 60
Programming languages, 30
coding, 28
Programming style, 55–57
defined, 55
Programs, 7–8
Progress bar, defined, 805–808
Properties, 214
Property-naming patterns, JavaBeans, 899
PropertyResourceBundles, 888
protected (modifier), 332, 355
data and methods, 21, 320–321
Pseudocode, 68
public (modifier), 21, 228
push() method, Stack class, 730
push(o) method, 677
put method, Map interface, 733
putAll method, Map interface, 733
Pyramid of numbers, displaying (example), 111–112

Q

Quadratic algorithm, 748
Quantifiers, 280
Query string, 1159
Queue interface, 731–733
element method, 731
offer method, 731
peek method, 731
poll method, 731
remove method, 731
UML class diagram, 731
Queues, 660, 675–677, 731–733
defined, 675
LinkedList class, 731
MyQueue.java, 675–676
operations, 731
priority, 688–689
PriorityQueue class, 732
PriorityQueueDemo.java, 732–733
Queue interface, 731–733
TestQueue.java, 731–732
TestStackQueue.java, 676–677
Quick sort, 752–755
algorithm, 752
average-case time, 757
best-case time, 757
defined, 752
illustration, 752
merge sort vs., 757
partition illustration, 756
partition method, 753–755
partition time, 757
partitioning, 752
pivot, 752
QuickSort.java, 756–757
time, 757
worst-case time, 757

R

Race condition, 789
Radio button menu items, creating, 969–970

Radio buttons, 501–503
  JRadioButton, 501
  RadioButtonDemo.java, 502–503
radio input type, 1172
radius, 214–217
Radix, 11
Ragged arrays, 194–195
RAM (random-access memory), 5
Random access files, 621–623
  file pointer, 622
  read-only streams, 621
  TestRandomAccessFile.java, 622–623
  write-only streams, 621
Random characters, generating (case study), 145–146
Random class, 223–224
random method, 81
  Math class, 144
RandomAccessFile class, 621
  UML class diagram, 621
RandomCharacter.java, 146
Rational class, 372, 382–387
  encapsulation, 386–387
  as immutable class, 387
  Rational.java, 384–386
  TestRationalClass.java, 384
Rational number, defined, 382
Rational.java, 384–386
RationalMatrix class, 706
RationalMatrix.java, 708–709
Raw type, 699
  Max1.java, 700
  Max.java, 699
  unsafe, avoiding, 703–705
readBoolean method, 621
readChar method, 621
ReadData.java, 287–288
readDouble method, 621
readInput, 149
readInt method, 621–622
Read-only property, 900
Read-only streams, 621
readUTF method, 612, 621
Ready state, threads, 803
rebind method, 1246
rebuildHeap method, 759
Rebuilding a heap:
  algorithm for, 758
  method for, 757
receive(packet) method, 851
  DatagramSocket class, 851
Rectangle class, 302
  and GeometricObject class, 302
Rectangle.java, 305, 344
Rectangles, drawing, 431–432
Recursion, 2, 635–655
  base cases, 640
  binary search, 642–643
  characteristics, 640
  defined, 636, 649, 650
  factorials, 638–639
    ComputeFactorial.java, 637–638
  Fibonacci numbers, 638–640
  fractals, 646–649
    defined, 646
  if-else, 640
  infinite, 637
  isPalindrome method, 641–642
  iteration vs., 649
  overhead, 649
  palindrome using a helper method, 641–642
  recursive binary search method, 643
  recursive call, 636, 640, 641
  recursive helper methods, 636, 641–643
    defined, 642
  recursive palindrome method, 641
  reduction, 640
  selection sort, 642
    recursive sort method, 642
  thinking recursively, 641
  Tower of Hanoi problem, 643–646
Recursive call, 636, 640, 641
Recursive method, defined, 636, 650
ReentrantLock class, 791
Reference data fields, 220–221
Reference types, 44, 216
  variables of, 221–222
Reference variables, 216–222
  accessing an object's data and methods, 217–18
  accessing objects via, 216–222
  classes, declaring, 218–220
  differences between variables of primitive types and reference types, 221–221
  reference data fields and the null value, 220–221
regionMatches method, String class, 265
RegisterStudent3TierServer.java, 1255
RegisterWithRMIServer.java, 1249
Registration.html, 1182
Registration.java, 1182–1185
RegistrationWithCookie.java, 1186–1189
RegistrationWithHttpSession.java, 1190–1195, 1191–1195
Registry class, 1246
Regular expressions, 269, 279–280
  frequently-used, 281
  syntax, 280
Relational database systems, 1094–1098
  attributes, 1095
  components of, 1094
  integrity, 1094
  integrity constraints, 1095–1098
  language, 1094
  relational model, 1094–1095
  relational structures, 1094
  structure, 1094
  tables, 1095
  tuples, 1095
Relational operators, 68
Relationships, 320
Relative file names, 285
Relative URL, using, 1172
Reluctant match, 283
Remainder, usefulness in programming, 35
Remainder (%) operator, 35
Remote interface, 1244
Remote Method Invocation (RMI), 1243–1267
  basics of, 1244–1246
  client, 1244
  client program, 1244
  defined, 1244
  developing three-tier applications using, 1253–1255
  how it works, 1244
  JDK1.5, 1245
  local object types, 1245–1246
  local objects, 1244
  passing parameters, 1245–1246
  primitive data types, 1245
  remote object types, 1246
  remote objects, 1244
  retrieving student scores from an RMI server (example), 1246–1252
    RegisterWithRMIServer.java, 1249
    StudentServerInterfaceClient.java, 1250–1251
    StudentServerInterface.java, 1248, 1248–1249
  RMI applications, developing, 1246–1252
  RMI callbacks, 1255–1265
    CallBackImpl.java, 1261
    CallBack.java, 1257
    TicTacToeClientRMI.java, 1261–1264
    TicTacToeImpl.java, 1258–1260
    TicTacToeInterface.java, 1256–1257
  RMI registry, 1244, 1246
  server, 1244
  server implementation, 1244
  server object, 1244
  server object interface, 1244
  server skeleton, 1244
  server stub, 1244
  socket-level programming vs., 1252
Remote object types, 1246
Remote objects, 1244
remove method, 939
  Collection interface, 716
remove method, Container class, 405
remove() method, Iterator interface, 716
remove method, Map interface, 733
Remove Selected Nodes button, 1081, 1083
removeAll method, Collection interface, 716
removeLayoutComponent, 939
repaint method, 435, 479
replace method, 267, 274
  strBuf, 274
replaceAll method, 282
replaceFirst method, 282
ReplaceText class, 288–289
request parameter, doGet method, 1161
request value, scope attribute, 1220
request variable, JSP, 1213
requestFocusInWindow() method, 505
Requirements specification, 372
Reserved words (key words), 21
resizable property, JFrame, 919
Resolution, 405
  monitors, 7
Resource bundles, 881–888
  defined, 882
  key/value pairs, 881
  naming conventions, 882
  resource chain, 882
  ResourceBundle class, 862, 882, 890
  ResourceBundleDemo.java, 884–888
Resource ordering, 803, 809
  deadlocks, 803, 809
ResourceBundle class, 862, 882, 890
response parameter, doGet method, 1161
response variable, JSP, 1213
ResultSet:
  constants, 1135
  methods, 1136
  processing, 1109–1110
resultSetConcurrency, 1135
ResultSetMetaData interface, 1116, 1118–1119
resultSetType, 1135
retainAll method, Collection interface, 716
return statement, 130
  nonvoid method, 130–134
  void method, 134–135
Return value type, 130, 158
returnValueType, 130
revalidate() method, 921, 947
reverse method:
  and lists, 728
  strBuf, 274
RGB model, 412
Right-associative, 87
Rigid area, 931
RMI applications, developing, 1246–1252
RMI callbacks, 1255–1265

RMI registry, 1244, 1246
rollback() method, 1110
Rollover icons, 492–494
rootVisible property, 1069, 1070
Rounding methods, Math class, 143–144
rowChanged(RowSetEvent), 1149
rowHeight property, 1070
rows attribute, <textarea> … </textarea> tags, 1172
Rows/columns, modifying, 1055–1060
RowSet interface, 1145–1150
  CacheRowSet, 1145
  connected RowSet object, 1145
  disconnected RowSet object, 1145
  get and set methods, 1145
  JDBC driver support, 1145
  JdbcRowSet, 1145
  metadata, obtaining, 1147
  and PreparedStatement, 1147
  RowSetPreparedStatement.java, 1147
  scrolling and updating, 1148
  SimpleRowSet.java, 1146
  versions of, 1145
RowSetEvent, 1149–1150
RowSetListener, 1149
RowSetPreparedStatement.java, 1147
run() method, Runnable interface, 774
Runnable interface, 774–775
Runnable object, 774
Running state, threads, 803
Runtime errors, 57–58, 60, 578
  finding/correcting, 58
  reasons for, 578
Runtime exceptions, 581
RuntimeException, 581, 596
  examples of subclasses of, 582

S

Sales amount, finding (example), 109–110
SalesTax.java, 41
Save file dialog, 994
Scanner class, 52–53, 262, 286, 288–289, 292, 579
  console input using, 52
  methods, 52–53
  reading data using, 287–289
  and whitespace, 288
Scientific notation, literals, 37
scope attribute, 1221
Scope of a local variable, 141–142
Scope of variables, 141–142, 235
Scripting constructs, 1211, 1211–1213
  syntax, 1237–1238
Scripting constructs, JSP, 1211–1213
Scripting elements, JSP, 1211
Scriptlets, 1211, 1213
Scroll bars, 515–518
  JScrollBar, 515–518
  ScrollBarDemo.java, 517–518
Scrollable and updateable result set, 1135–1145
ScrollBarDemo.java, 517–518
ScrollMap.java, 945–947
ScrollUpdateRowSet.java, 1148–1149
search() method, Stack class, 730
Searching, defined, 185
<select> … </select> tags, 1172
selectedFile property, JFileChooser, 995
selectedFiles property, JFileChooser, 995
Selection sort, 642
Selection sort algorithm, 744–745
Selection sort, analyzing, 745–746
Selection statements, 67–94
selectionMode property, 1026
selectionModel property, 1026
SelectionSort.java, 188–189, 188–190, 745
Self-Test Web site, 15
Semaphores, 801–802
  New Account Inner Class, 802
  Semaphore class, 802
Semicolon, 21
send(packet) method, DatagramSocket class, 851
Sentinel value, 99–100
SentinelValue.java, 99–100
Sequence diagrams, 390–391
Sequential forward reading, 1135
Serializable interface, 619–620
  deserialization, 619
  duplicate objects, 619
  and JavaBeans, 898
  as marker interface, 619–620
  nonserializable fields, 619
  NotSerializableException, 619
  object serialization, 619, 630
  transient keyword, 619
Serializable, use of term, 618
Serialization, 619
Serializing arrays, 620
  TestObjectStreamForArray.java, 620
Server implementation, RMI, 1244
Server object interface, RMI, 1244
Server object, RMI, 1244
Server, RMI, 1244
Server skeleton, RMI, 1244
Server sockets, 816–817
Server stub, RMI, 1244
Server.java, 819–820
service method, Servlet interface, 1165
Servlet API, 1164–1168
  GenericServlet class, 1166
  HttpServlet class, 1166
  HttpServletRequest interface, 1167
  HttpServletResponse interface, 1168
  Servlet interface, 1165
  ServletConfig interface, 1166
  ServletRequest interface, 1167
  ServletResponse interface, 1168
  session tracking using, 1190–1195
Servlet container, 1160
Servlet engine, 1160, 1163, 1168–1169
Servlet interface, destroy method, 1165
Servlet server, 1160
servlet-api.jar, 1161
ServletConfig interface, 1166
  UML class diagram, 1167
ServletRequest interface, 1166–1167
  UML class diagram, 1167
ServletResponse interface, 1168
  UML class diagram, 1168
Servlets, 15, 17, 1157–1208, 1210–1213
  benefits inherent in, 1160
  Common Gateway Interface (CGI), 1158–1160
  compared to applets, 1160, 1168
  compiling, 1161–1162
  connecting to a database from, 1176
  creating, 1160–1170, 1168–1170
  CurrentTime.java, 1169–1170
  database programming in, 1176–1180
    SimpleRegistration.java, 1178–1180
  defined, 1158
  FirstServlet.java, 1161
  GET and POST methods, 1159–1160
  getWriter method, 1170
  mapping to a URL, 1162–1163
  running, 1164
  sending images from, 1195–1200
    ImageContent.java, 1195–1196
    ImageContentWithDrawing.java, 1197–1199
    MixedContent.java, 1199–1200
    sending image from files, 1195–1196
    sending images and text together, 1199–1200
    sending images from the Image object, 1196–1199
  session tracking, 1180–1195
  setContentType method, 1170
  web.xml, 1162
Session, defined, 1180
session attribute, page directive, 1216
Session scope, 1232
Session tracking, 1180–1195
  defined, 1180
  using cookies, 1185–1190
    RegistrationWithCookie.java, 1186–1189
  using hidden values, 1180–1185
    Registration.html, 1182
    Registration.java, 1182–1185
  using the Servlet API, 1190–1195
session value, scope attribute, 1220
session variable, JSP, 1213
Set, 714
Set interface, 716–721
  defined, 716
  and duplicate elements, 716
  HashSet class, 716–718
  LinkedHashSet class, 718–719
  TreeSet class, 717, 719–721
  UML class diagram, 717
set method, 378
setAccelerator method, 970
setAttribute method, 1194, 1201
setAutoCommit(false) method, 1110
setBackground method, Component class, 446
setBorder method, 959
setCharAt method, 274
setColor method:
  FigurePanel class, 434
  Graphics class, 446
setColumns method, 412
setContentPane() method, 919
setContentType method, 1170
setCorner() method, JScrollPane, 944
setData method, 850
setDefaultCloseOperation, 248
setDelay method, 482, 556
setFont method, 413
  Component class, 413
  Component class, 413
  Graphics class, 446
  MessagePanel class, 500
setForeground method, Component class, 446
setHgap method, 412
setInverted method, 521
setLayout method, 920, 931, 938
setlength() method, StringBuffer class, 275
setLength(int) method, StringBuffer class, 275
setLocation method, 248
setLookAndFeel method, 960
setMaximumFractionDigits method, 876
setMaxInactiveInterval method, 1191, 1194
setMinimumFractionDigits method, 876
setPriority method, Thread class, 779
setRadius method, 224, 231
setRows method, 412
Sets, 28, 716–721
  HashSet class, 716–717
  LinkedHashSet class, 718–719
  TestHashSet.java, 717–718
  TestLinkedHashSet.java, 718–719
  TestTreeSet.java, 720
  TreeSet class, 719–720
setSelectedItem method, 1036

setSelectionMode(int mode) method, TreeSelectionModel interface, 1078
setSize method, 248
Setter, 230, 249
setTime(Date) method, 376
setTimeZone method, 864
setTitle method, 248
setVgap method, 412
setVisible, 248
Shallow copy, 355
short, 32, 34, 89
Short class, 356
SHORT constant, DateFormat class, 865
Short-circuit AND operator, 70, 89
Short-circuit evaluation, 70–71
Short-circuit OR operator, 70, 89
Shortcut operators, 38–39
shortValue() method, 356–357
show method, 976
Show Paths button, 1079
ShowBorderLayout.java, 410–411
ShowBoxLayout.java, 932–933
ShowCardLayout.java, 922–924
showConfirmDialog method, 984
ShowCurrentTime.java, 51–52
showDayNames method, 873
showDays method, 873
ShowDiagonalLayout.java, 942–943
ShowGridBagLayout.java, 927–928
ShowGridLayout.java, 409–410
showHeader method, 873
showInputDialog method, JOptionPane class, 42, 45, 52
ShowInternalFrame.java, 999–1000
ShowLayout.java, 949–951
showMessageDialog method, 984
  JOptionPane class, 22–23
ShowNoLayout.java, 929–930
showOptionDialog method, 986
ShowOverLayLayout.java, 934–936
showPopup method, 976
showRootHandles property, 1070
ShowSpringLayout.java, 937–938
shuffle() method, and lists, 728
shutdown command, Tomcat, 1163
Sierpinski triangle:
  creation of, 646
  defined, 646
  SierpinskiTriangle.java, 647–648
SierpinskiTriangle.java, 647–648
SierpinskiTrianglePanel, 649
signal() method, 793
signalAll() method, 793
Silicon semiconductor chips, 5
Simple if statements, 73–74
Simple math learning tool (example), 72
Simple programs, writing, 17–18, 28–30
SimpleDateFormat class, 865–866
SimpleEventDemoAnonymousInnerClass.java, 472
SimpleEventDemoInnerClass.java, 470–471
SimpleEventdemo.java, 464
SimpleJDBC.java, 1110
SimpleRegistration.html, 1177–1178
SimpleRegistration.java, 1178–1180
SimpleRowSet.java, 1146
SimpleSpinner.java, 1018
SimpleTreeDemo.java, 1070–1072
Single inheritance, 342
Single precision, 34
Single selection, 1078
Single selection mode, JList, 512
SINGLE_INTERVAL SELECTION value:
  selectionMode property, 1026
  selectionModel property, 1026
SINGLE_SELECTION value:
  selectionMode property, 1026
  selectionModel property, 1026
Single-interval mode, JList, 512
SingleThreadModel interface, 1216
Sinking sort, defined, 747
SixFlags.java, 453–454
size attribute:
  <input> tag, 1172
  <select> … </select> tags, 1172
size method:
  AbstractSet class, 716
  Collection interface, 715
  Collection interface, 715
  Map interface, 733
sleep(long) method, Thread class, 778
Sliders, 518–521
  JSlider, 518–521
  SliderBarDemo.java, 520–521
Socket-based communication, 816
Socket-level programming., RMI vs., 1252
Sockets, 816, 818
  data transmission through, 818
SoftBevelBorder class, 952–953
Software, 6, 7, 11
  application, 10
  defined, 4
Software development process, 372–374
  deployment, 373
  implementation, 372
  maintenance, 373
  requirements specification, 372
  system analysis, 372
  system design, 372
  testing, 372
sort method, 192
Sorted tuples, displaying, 1104–1105
SortedMap interface, 733–734
Sorting, reasons for studying, 744
Sorting algorithms, 2, 744
Sorting arrays, 188–191
  insertion sort, 190–191
  selection sort, 188–190
SortLargeFile.java, 763–765
Source component, 465
Source components, 900–901
  custom, creating, 902–906
Source directory path, 156
Source object, 465, 486
Source objects, 363, 900
Source program, 9
Spacing, 56
Speed, CPU, 5
Spinner editors, 1021–1022
Spinner models and editors, 1016–1017
  AbstractSpinnerModel, 1018–1019
  SimpleSpinner.java, 1018
  SpinnerModelEditorDemo.java, 1022–1024
  using (example), 1022–1024
SpinnerDateModel, 1020–1021
  UML class diagram, 1021
SpinnerListModel, 1018–1019
SpinnerModel interface, 1017
  UML class diagram, 1017
SpinnerNumberModel, 1020
  UML class diagram, 1020
split method, 283
Spring class, 936
Spring, defined, 936
SpringLayout manager, 936–938
SpringLayout manager, 936–938
SpringLayout manager:
  creating, 936
  defined, 936
  ShowSpringLayout.java, 937–938
SQL, *See* Structured Query Language (SQL)
SQLClient.java, 1126–1130
sqrt method, 144
src attribute, <img> tag, 1195
Stack class, 319–320, 729–730
  defined, 730
  UML class diagram, 730
Stack trace, 579
StackOfIntegers class, 245–247, 246–247
  implementation, 246–247
Stacks, 28, 133, 159, 660, 675–677
  composition, 675
  defined, 245, 675
  inheritance, 675
  insertion and deletion operations, 675
Standard output object, 22
start method, Applet class, 537, 565
Start tag, HTML, 539
startup command, Tomcat, 1163
Starvation, 779
State, 214, 391
stateChanged method, ChangeListener interface, 519
Statechart diagrams, 391–392
Statement interface:
  addBatch method, 1131, 1153
  executeQuery method, 1136
Statement labels, and breaking with labels, 115–116
Statements, Java, 21
States, threads, 803–804
Static constants, 224–228
Static import, 227
Static inner class, 470
static (keyword), 220
Static methods, 23, 224, 224–228
  hiding, 325–327
static (modifier), 21
Static variables, 224–228
  defined, 224
Static web contents, 1158–1168
Statics methods:
  for collections, 726–729
  for lists, 726–729
Stepwise refinement, defined, 147
StillClock class, 447–451, 484
  angle for the hour hand, 448
  DisplayClock.java, 447–448
  implementation, 449–450
  position of the minute hand, 448
  as reusable class, 451
  StillClock.java, 449–450
  UML class diagram, 447
stop method, Applet class, 537, 565
Stopping condition, 640
Storage devices, 4, 6, 11
  CDs and DVDs, 4, 6
  disks, 6
  tapes, 4, 6
  USB flash drives, 6
StoreAndRetrieveImage.java, 1151–1153
StoreData.java, 1228–1229
StoreStudent.jsp, 1231–1232
strBuf, 274
Stream sockets, 816
Streams, closing, 610
String class, 262–270, 291, 321, 390
  constructors, 262–263
  encapsulating string, 266
  equalsignorecase method, 265
  methods, 262
  regionmatches method, 265
  substring method, 267, 292
String concatenation operator, 30
String literal, 41, 266
String object, 263, 270

String representation, 311
String type, 44–45
String value, 262
String variable, 262
StringBuffer class, 262, 273–277, 292, 321
  capacity() method, 275
  charAt(int) method, 275
  length() method, 275
  setlength() method, 275
  toString() method, 275
StringBuilder class, 262, 273–274, 292
  append method, 274
  delete methods, 274
  insert method, 274
StringIndexOutOfBoundsException, 266, 578
Strings:
  comparisons, 264–265
  concatenation, 266
  constructing, 262
  conversions, 267
  conversions between arrays and, 268–269
  converting characters and numeric values to, 269–270
  converting to numbers, 46
  counting each letter in, 271–272
  defined, 262
  drawing, 431–432
  formatting, 84–86
  immutable, 263–264
  interned, 263–264
  length, 265–266, 275
  matching, 280
  replacing, 282–283
  splitting, 282–283
  string index range, 266
  substrings:
    finding in, 267–268
    obtaining, 267
StringTokenizer class, 280
Strong is-a relationship, 342, 376, 390
Structure, relational database systems, 1094
Structured Query Language (SQL), 1098–1106
  arithmetic operators, 1104
  between-and operator, 1102–1103
  Boolean operators, 1102
  column alias, 1103
  comparison operators, 1102
  defined, 1098
  deleting records, 1101
  distinct keyword, 1104
  inserting data, 1101
  is null operator, 1102–1103
  keywords, 1098
  like operator, 1102–1103
  naming conventions, 1098
  order by clause, 1105
  PreparedStatement interface, 1113–1116
  queries, 1101–1102
  tables:
    creating/dropping, 1098
    joining, 1105–1106
  tuples:
    distinct, displaying, 1104
    sorted, displaying, 1104–1105
  universal SQL client, 1126–1130
  updating data, 1101
  using on a relational database, 1099–1100
Strut, 931
Stub, 149
Student class, 232–233
Student registration:
  GetRegistrationData.jsp, 1231
  StoreData.java, 1228–1229
  StoreStudent.jsp, 1231–1232
Student scores, computing (example), 200–201
Student_Registration_Form.html, 1171
Student3TierImpl.java, 1253–1255
StudentClient.java, 830–833
Student.java, 829–830, 1229–1230
StudentServerInterfaceClient.java, 1250–1251
StudentServerInterface.java, 1248, 1248–1249
StudentServer.java, 833–834
Subclasses, 302–306, 331
  method overriding, 309
Subinterfaces, 341
Submenu items, creating, 969
Subproblems, 147–149
substring method, 292
  String class, 267
Substrings:
  finding in strings, 267–268
  obtaining, 267
Subtraction (−) operator, 35
SubtractionTutor.java, 81, 97–98
SubtractionTutorLoop.java, 97–98
Subtrees, 1069
Subtype, 302
Subwindows, 521
Sun Java Web site, 16
Sun Microsystems, 16
super (keyword), 307, 332
Superclasses, 302–306, 331
  calling methods, 308–309
  constructor chaining, 307–308
  constructors, calling, 307
  private data fields in, 309
super.clone() method, 356
Superkey, 1096
super.paintComponent(g), 430
Supertype, 302
Supplementary characters, 42
Supplementary Unicode, 42, 607
Supplier, 375
swap method, 135–136
Swing, AWT vs., 401
Swing borders, 952–959
  Abstract Border class, 952
  BevelBorder class, 952–953
  BorderDemo.java, 956–957
  CompoundBorder class, 952–953
  defined, 952
  EmptyBorder class, 952–953
  EtchedBorder class, 952–953
  javax.swing.BorderFactory class, 954
  LineBorder class, 952–953
  MatteBorder class, 952–953, 959
  SoftBevelBorder class, 952–953
  TitledBorder class, 952, 954, 959
Swing components:
  defined, 401
  model properties, 1016
  prefix *J*, 401
  simple, lack of models for, 1016
Swing container structures, 918–920
Swing GUI component:
  defined, 405, 1015
  TestSwingCommonFeatures.java, 416–417
Swing user interface components, implementation of, 1008
SwingConstants interface, 495
switch statements, 81–83, 89
  rules for, 82–83
Sybase, 1099
Synchronization wrappers, synchronizing statements, 789–790
Synchronized block, 790
Synchronized collections, 804–805
  Collections class, 804
  defined, 804
  synchronization wrappers, 804–805
synchronized keyword, 789–790
Syntax errors, 57, 60, 578
  finding/correcting, 58
Syntax rules, Java, 18
System analysis, 372
System design, 372
System errors, 581
System.currentTimeMillis method, 51
System.in, 52
System.out, 52
System.out.print method, 147
System.out.println method, 17–18, 21–23, 29, 52

T

Table data model, 1051
Table model, JTable, 1046
Table model events, 1065–1068
  TableEventsDemo.java, 1066–1068
Table renderers and editors, 1060–1062
  custom, 1062–1065
TableCellEditor interface, 1046
TableCellRendererEditorDemo.java, 1061–1062
TableColumn class, 1053–1054
  UML class diagram, 1054
TableColumnModel interface, 1053
  methods, 1054
  UML class diagram, 1053
TableEditor.java, 1138–1143
TableEventsDemo.java, 1066–1068
Table.jsp, 1236
TableModel interface, 1051–1053
  UML class diagram, 1052
TableModelDemo.java, 1056–1060
TableModelEvents, 1051
TablePropertiesDemo.java, 1048–1050
Tables:
  joining, 1105–1106
  relational database systems, 1095
tablib directive, 1216
Tag names, HTML, 539
Tags, HTML, 539
tailMap() method, SortedMap interface, 734
Tape drives, 6
Tasks:
  creating, 774–777
  defined, 774
TaskThreadDemo.java, 776–777
Tax computation (example), 78–80, 139–141
  with methods, 139–141
temp.dat, 610
Temp.txt, appending to text file, 611
10BaseT, 7
Ternary operator, 84
TestActionEvent.java, 473
TestArrayAndLinkedList.java, 725–726
TestArray.java, 174–175
TestArrayList.java, 317–318
TestArrayListNew.java, 704
TestBeanScope.jsp, 1221
TestBinaryTree.java, 682–683
TestBoolean.java, 70
TestBreak.java, 114
TestButtonIcons.java, 493–494
TestCenterMessage.java, 441–442
TestCircle1.java, 218, 218–219
TestCircle2.java, 226
TestCircle3.java, 231–232
TestCircleRectangle.java, 306
TestCircleWithException.java, 588
TestColorDialog.java, 991–992
TestContinue.java, 114–115
TestCourse.java, 244

TestCourseWithEnrollmentEvent.java, 910–911
TestDatabaseMetaData.java, 1116–1117
TestDataStream.java, 613
TestDiagonalLayout class, 943
TestDo.java, 101
TestException.java, 586–587
TestFigurePanel.java, 433
TestFileClass.java, 285–286
TestFileStream.java, 610
TestFormatClass.java, 157–158
TestFrame.java, 247–248
TestGeometricObject.java, 345
TestGetGraphics, 427
TestGetGraphics.java, 428–429
TestHashSet.java, 717–718
TestHeap.java, 687–688
TestImageIcon.java, 418–419
Testing, 372
TestIntegerMatrix.java, 709
TestLinkedHashSet.java, 718–719
TestList.java, 667–668
TestLoanClass.java, 240–241
TestMap.java, 735–736
TestMax.java, 132
TestMessagePanel.java, 442–443
TestMethodOverloading.java, 137–138
TestMultiplicationTable.java, 106
TestObjectInputStream.java, 618
TestObjectOutputStreamforArray.java, 620
TestObjectOutputStream.java, 617–618
TestObjectStreamForArray.java, 620
TestPaintComponent.java, 429–430
TestPanelDrawing.java, 430–431
TestPanels.java, 414–415
TestPassArray.java, 180–181
TestPassByValue.java, 136–137
TestPassObject.java, 233–234
TestPolymorphismCasting.java, 315
TestPriorityQueue.java, 688–689
TestQueue.java, 731–732
TestRandomAccessFile.java, 622–623
TestRandomCharacter.java, 146
TestRationalClass.java, 384
TestRationalMatrix.java, 709–710
TestResultSetMetaData.java, 1118–1119
TestRowSetEvent.java, 1149–1150
TestScanner.java, 53
TestSourceListener.java, 901–902
TestStackOfIntegers.java, 246
TestStackQueue.java, 676–677
TestSum.java, 106–107
TestSwingCommonFeatures.java, 416–417
TestTableColumnModel.java, 1053–1054
TestTableEditor.java, 1136, 1137–1138
TestTable.java, 1047–1048
TestTableModel.java, 1051–1052
TestTreeModel.java, 1073–1074
TestTreePath.java, 1079–1080
TestTreeSet.java, 720
TestTreeSetWithComparator.java, 722–723
TestVoidMethod.java, 134
TestWindowEvent.java, 474–476
Text areas, 506–509
  TextAreaDemo.java, 507–508
Text editors, using to create/edit Java source code files, 17
Text fields, 504–506
  JPasswordField, 506
  JTextComponent, 504
  JTextField, 504
  TextFieldDemo.java, 504–505
Text files, 606
text input type, 1172
Text I/O, 286–289
  binary I/O vs., 606–608
  classes, 606
  efficiency of, 606
  PrintWriter class, writing data using, 286–287, 606
  Scanner class, reading data using, 287–289
  simplifying, 289
<textarea> … </textarea> tags, 1172
TextEditor.java, 995–998
TextPad Editor, 17
this (keyword), 236–237
Thread class, 777–779
  deprecated (outdated) methods, 777
  InterruptedException, 778
  join() method, 779
  separating task from thread, 777
  setPriority method, 779
  sleep(long) method, 778
  UML class diagram, 777
  yield() method, 777
ThreadCooperation.java, 794–795
Threads:
  concept of, 774
  cooperation among, 792–796
    example, 793
    ThreadCooperation.java, 794–795
  creating, 774–777
  defined, 774
  finished, 804
  starting, 775
  states, 803, 803–804
  synchronization, 787–796
    AccountWithoutSync.java, 787–789
    synchronized block, 790
    synchronized keyword, 789
    synchronizing statements, 789–790
    using locks, 790–796
  TaskThreadDemo.java, 776–777
  thread pools, 785–786
  time-sharing, 775
Thread-safe, use of term, 789
Three-tier applications:
  developing using RMI, 1253–1255
  RegisterStudent3TierServer.java, 1255
  Student3TierImpl.java, 1253–1255
throw (keyword), 587
Throwable class, 580
  methods in, 580
throwfor method, Scanner class, 579
Throwing an exception, 587–589
throws (keyword), 587
TicTacToe game, 550–554
  incremental development and testing, 554
TicTacToeClient class, 845–849
TicTacToeClient.java, 845–849
TicTacToeClientRMI.java, 1261–1264
TicTacToeConstants interface, 839–840
TicTacToeConstants.java, 839–840
TicTacToeImpl.java, 1258–1260
TicTacToeInterface.java, 1256–1257
TicTacToeServer class, 840–845
TicTacToeServer.java, 840–845
TimeBean.java, 1226
TimeForm.java, 1175–1176
Timer class:
  animation using, 482–485
  UML class diagram, 482
Timer object, 482
Time-sharing, 775
timeStyle method, 865
TimeZone class, 864–865
TimeZone class, 864–865, 1228
  getAvailableIDs() method, 864
title property, JFrame, 919
<title> tag, HTML, 539
TitledBorder class, 952, 954, 959
toArray() method, Collection interface, 716
toCharArray method, 268
Toggle button, 498
toLowerCase method, 267, 273
Tomcat, 1159, 1210
  context root directory, creating, 1161
  and port 8080, 1163
  restarting, 1170
  servlet engine, starting, 1163
  shutting down, 1163
  starting/stopping, 1163–1164
  tutorial, 1159
  webapps directory, 1161
Tool tip, 415
ToolBarDemo.java, 977, 977–978
Toolbars:
  defined, 976
  floatable buttons, 977
Top-down design, 148–149
Top-down implementation, 149–151
toString() method, 222, 256, 302–306, 309–313, 320, 322, 332, 333–334, 339, 586, 589
  GeometricObject class, 309
  Object class, 310–311
  signature of, 310
  StringBuffer class, 275
  toString() method, 275
TotalArea.java, 237–238
totalNumberOfDays, 148, 149, 151
TotalScore.java, 200–201
toUpperCase method, 267
Tower of Hanoi problem, 643–646
  goal of, 645
  TowersOfHanoi.java, 645–646
Towers of Hanoi problem, 746
TowersofHanoi.java, 645–646
TowersOfHanoi.java, 746
transient keyword, 619
Transistors, 5
Transition, 391
Transmission Control Protocol (TCP), 816
Tree events, 1085
Tree model, creating, 1077
Tree node rendering and editing, 1084–1085
Tree nodes, 1078
Tree selection modes, 1078
Tree traversal, 679, 679–680
TreeCellRenderer interface, 1084
TreeExpansionEvent, 1085
TreeExpansionListener, 1085
TreeMap class, 734–735
TreeModel interface, 1069, 1073–1074
  TestTreeModel.java, 1073–1074
  UML class diagram, 1073
TreeNode interface, 1069
  UML class diagram, 1076
TreeNode root, 1077
TreeNodeDemo.java, 1074–1075
TreePath, 1069, 1077–1080
TreePath:
  defined, 1069
  obtaining tree paths, 1078
  TestTreePath.java, 1079–1080
  UML class diagram, 1077
Trees:
  data representation of, 1069, 1085
  modifying, 1077, 1080–1083
  ModifyTree.java, 1081–1083
  nonleaf node, 1069
  subtrees, 1069
  tree node rendering and editing, 1084–1085
TreeSelectionEvent, 1085
TreeSelectionListener interface, 1085
TreeSelectionModel interface, 1078

bypassing, 1078
setSelectionMode(int mode) method, 1078
UML class diagram, 1078
TreeSet class, 716, 719–721, 726
SortedSet interface, 719
TestTreeSet.java, 720
UML class diagram, 717
Trigonometric methods, 142
Math class, 142
trim() method, 267
trimtosize() method, ArrayList class, 724–725
trimToSize() method, ArrayList class, 724–725
Trusted applets, 545
try (keyword), 580
try-catch block, 355, 579, 778
Tuples, 1095
distinct, displaying, 1104–1105
sorted, displaying, 1104–1105
TwoButtons.java, 291
Two-dimensional arrays, 192–199
creating, 193–194
declaring variables of, 193–194
multiple-choice test, grading (example), 196–197
obtaining the lengths of, 194
processing, 195–196
ragged arrays, 194–195
type attribute, <input> tag, 1172
Type casting, 40
TYPE_FORWARD_ONLY constant, 1135
TYPE_SCROLL_INSENSITIVE constant, 1135
TYPE_SCROLL_SENSITIVE constant, 1135

U

UDP (User Datagram Protocol), 816, 850
UML class diagram, 215
UML (Unified Modeling Language), 215
Unary operator, 36
Unbounded wildcards, 701
Unboxing, 362–363
Unchecked exceptions, 582
Unconditional AND operator, 70, 89
Unconditional Boolean operators:
conditional Boolean operators vs., 70–71
Unconditional OR operator, 70, 89
Unicode, 42, 68, 862–864, 890
lowercase/uppercase letters, 44
Unicode character set, 612
Unified Modeling Language (UML), 372
Universal SQL client, 1126–1130
SQLClient.java, 1126–1130
UNIX, classpath variable, 155
Unix epoch, 51
Unsafe raw types, avoiding, 703–705
GenericSortNew.java, 705
TestArrayListNew.java, 704
UnsupportedLookAndFeelException, 960
Upcasting, 313–314
updateRow() method, 1136
updateString method, 888
URL:
accessing by class code, 558
defined, 558
query string, 1159
URL class, 557–560
USB flash drives, 6
UseCustomFrame.java, 330–331
UseFlowLayout.java, 290–291
User Datagram Protocol (UDP), 816
User interface (UI), 491–533
buttons, 492–498
check boxes, 498–500
combo boxes, 509–512
labels, 503–504
lists, 512–515
multiple windows, creating, 521–525
radio buttons, 501–503
scroll bars, 515–518
sliders, 518–521
text areas, 506–509
text fields, 504–506
UTF-8 scheme, 612
format, advantage of, 612–613

V

validate() method, 412, 939
value attribute, <input> tag, 1172
valueChanged method, TreeSelectionListener interface, 1085
valueOf method, 269
var−− operator, 39
var++ operator, 39
VarargsDemo.java, 185
Variable declaration, 31, 33
Variable-length argument lists, 185
Variables, 28–29, 31–32
classes, 235
declaring, 28
declaring and initializing, in one step, 32–33
defined, 29
as expressions, 32
instance, 217, 224
naming, 55
of primitive types and reference types, differences between, 221–222
scope of, 141–142
static, 224, 224–228
uses of, 31–32
Vector class, 318, 729–730
defined, 729
UML class diagram, 730
Vertical alignment, buttons, 494
Vertical layout, lists, 1026
Vertical text position, 495
Vertical wrap layout, lists, 1026
vgap property, BorderLayout manager, 412
ViewController, 1014
Viewport, 943–944
ViewRemoteFile.java, 835–836
VirtualMachineError subclass, Error class, 581
Visibility modifiers, 228–229, 320–321
visibleRowCount property, 1026
Visual Basic, 8–9
void keyword, and constructors, 216
void method, 130
example, 134–135
vsbPolicy parameter, JScrollPane, 944
vspace attribute, <applet> tag, HTML, 540

W

WAR files, 1163
Weak is-a relationship, 376, 390
represented using interfaces, 376
Web archive file (WAR), 1163
Web browsers, 4, 10, 14, 24–25
Web development tools, 1163
Web pages:
dynamic web contents, 17, 1158–1159, 1210
static web contents, 1158–1168
Web servers, retrieving files from, 834–836
WebBrowser.java, 837–838
web.xml, 1162, 1162–1163
WelcomeApplet.html, 538–541
WelcomeInMessageDialogBox.java, 22–23
while loop, 96–100, 118
Whitespace, 54, 280
and Scanner class, 288
Widening a type, 40, 60
Wildcards, 701–703
bounded, 701
lower bound, 701
unbounded, 701
WildCardDemo1.java, 701
WildCardDemo2.java, 702
WildCardDemo3.java, 702
Window class, 466
Window events, 484
handling, 474–475
TestWindowEvent.java, 474–476
windowActivated handler, 476
WindowAdapter, 476
WindowEvent, 466, 467
WindowListener interface, 467
WindowAdapter, 476
Windows:
creating, 247–248
popup menus in, 1001
Windows 98, classpath variable, 155
Windows Calculator, 12
Windows, creating, 247–248
Windows NT/2000/XP, classpath variable, 155
Windows operating system, 9
WinZip, 563
Word characters, 280
Word processors, 4, 10, 24
Words, occurrences of, 736–737
CountOccurrenceOfWords.java, 736–737
World Wide Web, defined, 14
WorldClockApp.java, 870
WorldClockControl.java, 868–869
WorldClock.java, 867–868
Worst-case analysis, 745, 766
Wrapper class types, automatic conversion between primitive types and, 362–363
Wrapper classes, 270, 358
immutable instances of, 358
and no-arg constructor, 358
wrapStyleWord property, 509
writeBoolean method, 621
writeBytes method, 612
writeChar method, 621
writeChars method, 612
WriteData.java, 286–287
writeDouble method, 621
writeInt method, 621
Write-only property, 900
Write-only streams, 621
writeUTF method, 621
writeUTF(String s) method, 612

X

x−− (postdecrement operator), 39
−−x (predecrement operator), 39
x++ (postincrement operator), 39
xCoordinate, 442
XEvent, 467
XListener interface, 467
xpoints data field, 438

Y

yCoordinate, 442
yield() method, 778
Thread class, 778
ypoints data field, 438

Z

0-based indices, 171
Zeros and ones, 5, 11