"/ (comments), 33
/*/ (comments), 33
3G, 274
4G, 275

A

abs( ) function, 73
AC (alternating current), 46
voltage and, 47
Adafruit Si1145 library, 384–388
ADC (Analog to Digital Converter), 67–68, 295
addresses
IP addresses, 153
MAC address, 153
retrieving, 176
ad-hoc mode for wireless, 171
advanced libraries, 410–413
amperage, 47, 48
analog I/O, 67–68
  analogRead( ) function, 68
  analogWrite( ) function, 68
  microcontrollers and, 67–68
analog systems, 5
analogRead( ) function, 68, 353
analogWrite( ) function, 59–60, 68
archives versus installers, 27

Arduino
capabilities, 22–23
counterfeits, 9
as Ethernet client, 157–158
  fetching example program, 161–162
  sending/receiving data, 158–161
as Ethernet server, 163–165
  sketch example program, 165–167
open source, 20
as Open Source Hardware project, 7
original, 9
software download, 27–28
Arduino board, original, 7
Arduino Due, 13–14, 37
SPI on, 123–125
USB and, 325–237
Arduino Esplora, 18
  TFT, 229
Arduino Ethernet, 11
Arduino Ethernet Shield, 21
Arduino GSM Shield, 22
Arduino language, I/O functions,
  digital I/O, 65–67
Arduino Leonardo, 10–11
Arduino Mega 2560, 11–12
Arduino Micro, 13
Arduino Mini, 13
Arduino Motor Shield, 21
Arduino Playground, 29
Arduino Pro, 16
Arduino project, 7–8
Arduino Robot, 16–17, 348–349
Arduino Tre, 19
Arduino Uno, 10
  voltage regulator, 47
Arduino WiFi Shield, 22
Arduino Wireless SD Shield, 21
Arduino Yún, 18–19
Arduino Zero, 19
ARM technology, 6
array data type, 37
ASCII, keyboards, 324
ATmega series, 8
Atmel (Advanced Technology for
  Memory and Logic), 5
  megaAVR, 8
  microcontrollers for Arduino, 7
Atmel 8-bit AVR, 7
Atmel AVR, 5–7
attach( ) function, 264–265
attached( ) function, 245
attachGPRS( ) function, 283
attachInterrupt( )
  function, 77–78
ATTiny series, 8–9
audio, 292
  ADC (Analog to Digital
  Converter), 295
  DAC (Digital to Analog
  Converters), 294, 295
digital
  creating, 296
  playing, 296–297
  sound files, 292–294
  storage, 296
effective sampling rate, 293
frequencies, 293
waves, 292–293
audio tones
  noTone( ) function, 69
tone( ) function, 69
autoscroll( ) function, 198
available( ) function, 91–92

B
BASIC Stamp, 7
baud rate, 83–84
begin( ) function, 91, 94,
  155, 174–175
beginSD( ) function, 354–355
beginSpeaker( ) function, 356–357
beginTFT( ) function, 354–355
bipolar stepper motors, 255–256
bits
  reading, EEPROM library, 105–107
  writing, EEPROM library, 105–107
Blink, 29–33
blink( ) function, 197
Blum, Jeremy, Exploring
  Arduino, 26
boolean data type, 36
bootloaders, 33
breadboards, 23, 56
  connection points, 57
  Fritzing, 396
  shields, 395–398
  solderless, 57
  strips, 57
break statement, 40
breakdown voltage, 54
Bridge library, 361–364
  example application, 369–373
  FileIO library, 366–367
  Process class, 364–366
  YunClient, 368
  YunServer class, 367–368
bus speed, I2C protocol, 147–148
buttons, Esplora library, 339–340
buzzer, Esplora library, 340–341
byte data type, 37
bytes
  reading, 92
    EEPROM library, 104–105
  multiple, 92–93
  writing, EEPROM library, 104–105
C
C++ classes, 383, 410
cabling, Ethernet, 151
callbacks, 141
   Firmata library, 264–266
capacitors, 53–54
   decoupling, 54
   farad, 54
CD drives, 209
channels, Wi-Fi, 172
char data type, 36
circle() function, 231–232
circuits (electrical), 46
classes
   C++, 383, 410
      SoftwareSerial, 99
clear() function, 196
clearScreen() function, 355
closed source libraries, 417–418
CodeBlocks, 29
coding styles, 416–417
color, TFT library, 232
comments, 30, 33
   libraries, 413–414
config() function, 178
connect() function, 157–158
connection points, breadboards, 57
connectServer() function, 86
constrain() function, 73
constructors, 411
control board (Robot library)
   controls, 350–351
      LCD screen, 354–356
      music, 356–357
      robot personalization, 353–354
      sensor reading, 351–353
control structures, 38–41
cooperative multitasking, 309–311
cos() function, 76
CPOL (Clock Polarity), 123
createChar() function, 199
Creative Commons Attribution
   Share-Alike license, 29
CRT (cathode ray tubes), 226–227
cruise ship analogy for analog
   I/O, 67
CS (Chip Select), 118
cursor, LiquidCrystal library, 196–197
D
DAC (Digital to Analog Converters),
   294, 295
data
   available() function, 91–92
   reading
      begin() function, 94
      bytes, 92–93
      end() function, 94
      parsing data, 93–94
      peek() function, 93
      starting communications, 91
   sending, 90
data bits, 85
data encapsulation, 85
data types
   array, 37
   boolean, 36
   byte, 37
   char, 36
   double, 37
   float, 37
   int, 37
   long, 37
   short, 37
   String, 37
   string, 37
   unsigned char, 36
   unsigned int, 36
   unsigned long, 37
   void, 36
   word, 37
datalogging shields, 213–214
DC (direct current), 46
   voltage and, 47
DDR, 101–102
debugging, output and, 86–87
debugPrint() function, 355
declaring functions, 407–408
declaring variables, 34
decoupling capacitors, 54
delay( ) function, 70–71
delay function, 35
delayMicroseconds( )
  function, 71
detach( ) function, 245
detachInterrupt( ) function, 78
DHCP leases, renewing, 156–157
DHT11, 179–189
digital audio
  creating, 296
  example program, 298–303
  playing, 296–297
  sketch, 300–303
  storing, 296
digital I/O
  digitalRead( ) function, 66–67
  digitalWrite( ) function, 67
  INPUT pins, 66
  INPUT_PULLUP pins, 66
  OUTPUT pins, 66
  pinMode( ) function, 66
  voltage and, 65
digital sound files, 292–294
digitalRead( ) function,
  66–67, 353
digitalWrite( ) function,
  67, 308, 353
diodes, 54–55
  laser, 55
  LEDs (light-emitting diodes), 55–56
  Schottky diodes, 55
  Tunnel diodes, 55
  Zener diodes, 54–55
DIP (Dual In-Line Package) chips, 57
disconnect( ) function, 177–178
displayLogos( ) function, 355
DMA (Direct Memory Access), 5
DNS (Domain Name Service), 153
double data type, 37
downloads, Arduino software, 27–28
DRAM (Dynamic RAM), 102
drawBMP( ) function, 355
drawCompass( ) function, 355
Dual Scan (DSTN), 227

E
  Eclipse, 29
  EDGE (Enhanced Data rates
    for GSM Evolution), 274
  editor, 28
  EEPROM (Electronically Erasable
    Programmable Read-Only
    Memory), 5, 103
    Arduinos and, 103–104
    example program, 110–113
    library, 104
      reading bits, 105–107
      reading bytes, 104–105
      reading strings, 107–108
      values, reading/writing, 108–110
      writing bits, 105–107
      writing bytes, 104–105
      writing strings, 107–108
      nonvolatile memory, 114
      storage, preparation, 113–114
effective sampling rate, audio, 293
  EIA (Electronic Industries
    Association), 50
electricity, 46
    amperage, 47, 48
    circuits, 46
    Ohm’s law, 49
    resistance, 47, 48
    voltage, 47–48
electronic components, 23, 49–50
    breadboards, 56–57
    capacitors, 53–54
    diodes, 54–55
    LEDs, 55–56
    inputs, 57–58
    outputs, 57–58
    resistors
      usage, 52–53
      values, 50–52
tolerance, 47
transistors, 56
electronics, 45–46
electricity and, 46
embedded systems, debugging and, 86–87
encapsulation, 85
encryption
types, 177
WEP, 173
Wi-Fi, 172–173
WPA2, 173
end() function, 94
EPROM (Electrically Programmable Read Only Memory), 102
chip reprogramming, 102
Esplora, 336–337
Esplora library
buttons, 339–340
buzzer, 340–341
example program, 342–344
LCD module, 342
RGB LED, 337–338
sensors, 338–339
TinkerKit, 341–342
Ethernet
Arduino as client, 157–158
fetching example program, 161–162
sending/receiving data, 158–161
Arduino as server, 163–165
sketch example program, 165–167
cables, 151
hubs, 151–152
library
importing, 154–155
starting, 155–157
overview, 150–151
PoE, 152
switches, 151–152
EthernetClient object, 157–158
examples, libraries, 415
Exploring Arduino (Blum), 26
external libraries, 381–383

F
farad, 54
FAT (File Allocation Table), 213
fetching, example program, 161–162
FileIO library, 366–367
files
digital sound files, 292–294
SD library
closing, 216–217
opening, 216–217
reading, 217–218
writing, 217–218
source files, 25
filesystem, SD cards, 212
Firmata, 262
Firmata library, 262
callbacks, 264–266
messages
receiving, 263–264
sending, 263
Firmata protocol
example program, 268–269
SysEx, 266–267
Flash memory, 210–211
Arduinos and, 103
float data type, 37
floppy disks, 208–209
folders, SD library, 218–219
for loop, 41
frequencies, audio, 293
Fritzing, 22
breadboards, 396
schematics, 398–402
functions, 34, 42
abs(), 73
analogRead(), 68, 353
analogWrite(), 59–60, 68
attach(), 264–265
attached(), 245
attachGPRS(), 283
attachInterrupt(), 77–78
autoscroll(), 198
available(), 91–92
begin(), 91, 94, 155, 174–175
Index □ F

beginSD( ), 354–355
beginSpeaker( ), 356–357
beginTFT( ), 354–355
blink( ), 197
circle( ), 231–232
clear( ), 196
clearScreen( ), 355
config( ), 178
connect( ), 157–158
connectServer( ), 86
constrain( ), 73
cos( ), 76
createChar( ), 199
debugPrint( ), 355
declarations, 407–408
delay, 35
delay( ), 70–71
delayMicroseconds( ), 71
detach( ), 245
detachInterrupt( ), 78
digitalRead( ), 66–67, 353
digitalWrite( ), 67, 308, 353
disconnect( ), 177–178
displayLogos( ), 355
drawBMP( ), 355
drawCompass( ), 355
end( ), 94
getKey( ), 328
getModifiers( ), 328–329
g getTimeStamp( ), 372
getVoiceCallStatus( ), 281–282
g getXChange( ), 329–330
g getYChange( ), 329–330
hangCall( ), 282
interrupts( ), 78
isDirectory( ), 219
keyboardRead( ), 352
loop( ), 35, 130, 164
maintain( ), 156–157
map( ), 73–74
max( ), 72–73
micros( ), 71–72
millis( ), 71
min( ), 72
motorsStop( ), 351
noAutoscroll( ), 198
noBlink( ), 197
noCursor( ), 197
noInterrupts( ), 78
noTone( ), 69, 341
parameters, 34
parseFloat( ), 94
parseInt( ), 94
peek( ), 93
pinMode( ), 34, 66
playfile( ), 302–303
pointTo( ), 351
pow( ), 74
print( ), 88–90, 158, 195–196
println, 90
println( ), 158
processInput( ), 264
pulseIn( ), 70
random( ), 74–75
read( ), 104–105, 216–217
readAccelerometer( ), 339
readButton( ), 340
readBytes( ), 92–93
readIR( ), 383
readProx( ), 383
readSlider( ), 338–339
readVisible( ), 383
readTemperature( ), 338–339
readUV( ), 383
receiveData( ), 144
robotNameRead( ), 353–354
robotNameWrite( ), 353–354
RSSI( ), 177
scanNetworks( ), 176–177
SD.begin( ), 215–216
sendAnalog( ), 263
sendData( ), 144
sendDigitalPort( ), 263
sendEmail( ), 189–190
setBitOrder( ), 122
setClockDivider( ), 122, 123
setDataMode( ), 122
setup( ), 35
sin( ), 76
sqrt( ), 74
SSID( ), 177
stop( ), 158
stringCallback( ), 265
tan( ), 76
tone( ), 69, 295, 340–341
updateIR( ), 352
userNameWrite( ), 354
Wire.available( ), 142
Wire.beginTransmission( ), 146
Wire.endTransmission( ), 146
Wire.onReceive( ), 141–142
Wire.onRequest( ), 142
Wire.read( ), 142
Wire.requestFrom( ), 146
write( ), 90, 104–105, 196, 199, 218
WriteBlue( ), 338
WriteGreen( ), 338
WriteRed( ), 338
writeRGB( ), 337–338

G
getKey( ) function, 328
getModifiers( ) function, 328–329
g getTimeStamp( ) function, 372
gVoiceCallStatus( )
    function, 281–282
gXChange( ) function, 329–330
gYChange( ) function, 329–330
GitHub, 379
GPRS (General Packet Radio Service), 274, 282–284
graphics, TFT library, 231–233
GSM, 272
    Arduino and, 276
    EDGE, 274
    GPRS, 274
    mobile data network, 272–273
GSM class, 278–279
GSM library, 276–278
e xample application, 285–288
GPRS, 282–284
GSM class, 278–279
modem class, 284
sketch, 286–288
SMS class, 279–281
VoiceCall class, 281–281

H
.h files, 406
hangCall( ) function, 282
hardware
    LED connections, 60
    LiquidCrystal library, 200–201
    Scheduler library, 314–315
    shields, 392–393
    stepper motors, 255
    TFT library example, 234
    USBH library, 331–332
    Wi-Fi, 181–182
    header files, libraries, 406–407
    hot pluggable devices, 323
    hubs, 151–152
    USB, 325

I
I2C devices, 134–135
I2C pins, 137
I2C protocol, 135–136
    address, 136–137
    bus speed, 147–148
    communication, 137–139
        master communication, 139–141
        slave communication, 141–147
    example program, 142–146
    shields, 148
    voltage, 147
ICSP header, SPI bus, 120–121
IDE (Integrated Development Environment), 8, 25
    format organization, 381
    installation, 26
        software download, 27–28
        software, 28
IEEE (Institute of Electrical and Electronics Engineers), 171
if statement, 38–39
    switch/case, 39–40
if...else statement, 38–39
importing libraries, 379–381, 408–409
infrastructure mode, 172
INPUT pins, 66
INPUT_PULLUP pins, 66
inputs, digital pins, 57–58
installation, IDE, 26
    software download, 27–28
installers versus archives, 27
int data type, 37
int keyword, 34
interrupts, 76–77
    attachInterrupt( ) function, 77–78
    detachInterrupt( ), 78
interrupts() function, 78
noInterrupts() function, 78
interrupts() function, 78
I/O functions
    analog I/O, 67–68
        analogRead( ) function, 68
        analogWrite( ) function, 68
    digital I/O
        digitalWrite( ) function, 67
        INPUT pins, 66
        INPUT_PULLUP pins, 66
        OUTPUT pins, 66
        pinMode( ) function, 66
    voltage and, 65
pulses, 69–70
IP addresses, 153
ISA cards, 4
isDirectory( ) function, 219
ISR (Interrupt Service Routine), 77

K
Kdevelop, 29
keyboardRead( ) function, 352
keyboards
    return codes, 352
    USB, 324–325
    USBH library, 327–329
keywords
    int, 34
    void, 34

L
laser diodes, 55
LCD (liquid crystal display), 192–194, 227
Esplora, 337
LCD module, Esplora library, 342
LCD screen, Robot library, 354–356
led variable, 59–60
LEDs (light-emitting diodes), 23, 55–56
    connecting
        calculation, 58–59
        hardware, 60
        software, 59–60
        Esplora, 336–337
        resistors, 58–59
libraries, 42, 405–406
    Adafruit Si1145, 384–388
    advanced, 410–413
    advantages, 378
    Bridge, 361–373
    closed source, 417–418
    coding styles, 416–417
    comments, 413–414
    distributing, 417
    EEPROM, 104–110
        reading bytes, 104–105
        writing bytes, 104–105
    Esplora, 337–344
Ethernet
  importing, 154–155
  starting, 155–157
example library, 418–427
external, using, 381–383
FileIO, 366–367
Firmata, 262–266
function calls, 406
GitHub, 379
GSM, 276–288
  .h files, 406
header files, 406–407
importing, 379–381, 408–409
  using imported, 381–383
LiquidCrystal, 194–204
locating, 378–379
README file, 415–416, 427
Robot, 346–360
Scheduler, 306–309
SD, 215–224
Servo, 244
sketches and, 378
SoftwareSerial, 98–99
source files, 406–407
SPI, 121–122
TFT, 228
third-party, 377
  example application, 384–388
USBHost, 327–334
WiFi, 174–189
LilyPad Arduino, 14–15
liquid crystal display. See LCD
  (liquid crystal display)
LiquidCrystal library
  cursor, commands, 196–197
  example program, 199–204
importing, 194
  scrolling, 197–198
text
  custom, 198–199
  orientation, 197
writing, 195–196
LiquidCrystal object, 194
Logo programming language, 347
long data type, 37
loop( ) function, 35, 130, 164
loops
  for, 41
  while, 41
M
MAC address, 153
  begin( ) function, 155
retrieving, 176
maintain( ) function, 156–157
map( ) function, 73–74
master communication, I2C protocol, 139–141
mathematical functions
  abs( ), 73
  constrain( ) function, 73
  map( ), 73–74
  max( ), 72–73
  min( ), 72
  pow( ), 74
  random( ), 74–75
  sqrt( ), 74
max( ) function, 72–73
memory
  EEPROM, 103
  Flash, 103
  nonvolatile, 101–102
    EEPROM, 114
  RAM, 103
  volatile, 101–102
messages, Firmata library, 263–264
mice
  USB, 325
  USBH library, 329–330
microcontrollers, analog I/O and, 67–68
micros( ) function, 71–72
micro-SD cards, 20–21, 211–212
micro-USB, 326
MIDI sound cards, 292
\texttt{millis()} function, 71
\texttt{min()} function, 72
MISO (Master In-Slave Out), 118
mobile computing, 170
mobile data network
  3G, 274
  4G, 275
  GSM, 272–274
  modems, 275
modems, 275
monitors
  CRTs, 226–227
  DSTN (dual-scan supertwist nematic), 227
  LCD, 227
  TFT (Thin Film Transistor), 227–228
MOSI (Master Out-Slave In), 118
motor board (Robot library), 357–358
\texttt{motorsStop()} function, 351
multimeters, 23
multitasking, 307–308
  cooperative, 309–311
music
  Arduino Due, 294–297
  Robot library, 356–357

N
\texttt{noAutoscroll()} function, 198
\texttt{noBlink()} function, 197
\texttt{noCursor()} function, 197
\texttt{noInterrupts()} function, 78
nonvolatile memory, 101–102
  EEPROM, 114
\texttt{noTone()} function, 69, 341

O
objects, \texttt{EthernetClient}, 157–158
Ohm, 48–49
Ohm’s law, 49
open source, 20
OpenWRT, 363
output, debugging and, 86–87
output, \texttt{digital pins}, 57–58
\texttt{OUTPUT pins}, 66

P
packets, 152
parameters, 34
parity, 85–86
\texttt{parseFloat()} function, 94
\texttt{parseInt()} function, 94
parsing data, 93–94
PBASIC, 7
PCB (Printed Circuit Board), 402–404
PCI bus, 5
\texttt{peek()} function, 93
peripherals, USB and, 322–323
\texttt{pinMode()} function, 34, 66
\texttt{playfile()} function, 302–303
playing digital audio, 296–297
PoE (Power over Ethernet), 152
\texttt{pointTo()} function, 351
polling, 77
ports, 153–154
\texttt{pow()} function, 74
power supply, 23
  load, 46
\texttt{print()} function, 88–90, 158, 195–196
\texttt{println()} function, 158
\texttt{println} function, 90
\texttt{processInput()} function, 264
programming. \textit{See also} sketches
  bootloader, 33
  embedded systems, 25
  Logo, 347
PS/2 interface, 322–323
\texttt{pulseIn()} function, 70
pulses, reading, 69–70
PWM (pulse-width modulation), 68
  servo motors and, 243

R
RAM (Random Access Memory), 6
  Arduinos and, 103
random(), function, 74–75
\texttt{read()} function, 104–105, 216–217
readAccelerometer( ) function, 339
readButton( ) function, 340
readBytes( ) function, 92–93
reading data
  begin( ) function, 94
  bytes, 92
    multiple, 92–93
  end( ) function, 94
  parsing, 93–94
  peek( ) function, 93
  starting communications, 91
readIR( ) function, 383
README file, 415–416, 427
readProx( ) function, 383
readSlider( ) function, 338–339
readTemperature( ) function,
  338–339
readUV( ) function, 383
readVisible( ) function, 383
receiveData( ) function, 144
registers, 137
resistance, 47, 48
resistors, 23
  LEDs and, 58–59
  usage, 52–53
  values, 50
    color code, 51–52
    identifying, 50–52
resolution
  ADC, 67–68
  DAC (Digital to Analog Converter), 295
LCD, 194
  TFT screen preparation, 229–230
RGB LED, Esplora library, 337–338
Robot library, 346–348
  control board
    controls, 350–351
    LCD screen, 354–356
    music, 356–357
    robot personalization, 353–354
    sensor reading, 351–353
    example program, 358–360
    motor board, 357–358
  sketch, 359–360
robotNameRead( ) function, 353–354
robotNameWrite( ) function, 353–354
RS-232, SPI comparison, 119
RSSI (Received Signal Strength Indication), 173
RSSI( ) function, 177
RX (receive wire), 83
S
  scan codes, 324
  scanNetworks( ) function, 176–177
Scheduler library, 306–307
  example program, 313–319
  hardware, 314–315
  importing, 308–309
  multitasking, 307–308
    cooperative, 309–311
    noncooperative functions, 311–313
    sketch, 315–319
  schematics, shields, 398–402
  Schottky diodes, 55
  SCLK (serial clock), 118
  scrolling, LiquidCrystal library, 197–198
SD (Secure Digital), 208–211
  CD drives, 209
  datalogging shields, 213–214
  flash memory, 210–211
  floppy disks, 208–209
  speed, 213
  USB (Universal Serial Bus), 209–210
SD cards, 211–212, 219
  Arduino accepted, 214
  capacity, 212–213
  clusters, 220
  connecting, 215–216
  limitations, 214–215
  micro-SD cards, 20–21
  TFT library, 232–233
SD library
  advanced usage, 220
  card operations, 219
  cards, connecting, 215–216
example program, 220–224
files  
  closing, 216–217  
  opening, 216–217  
  reading, 217–218  
  writing, 217–218  
folder operations, 218–219  
importing, 215  
sketch, 220–223
SD.begin( ) function, 215–216
sendAnalog( ) function, 263
sendData( ) function, 144
sendDigitalPort( ) function, 263
sendEmail( ) function, 189–190
sending data, 90
sending text, 88–90
sensors  
  Esplora library, 338–339  
  Robot library, 351–353
serial connections  
  example program, 95–98  
  starting, 87–88
serial devices, 82
serial ports, 82–83
  debugging and, 86–87
  RX (receive wire), 83  
  TX (transmit wire), 83
Servo library, 244
servo motors  
  connecting, 243–244  
  disconnecting, 245
example application, 246–250
moving, 244–245
overview, 242–243
precision, 246
PWM (pulse width modulation), 243
safety, 246
schematic, 248–249
sketch, 249–250
setBitOrder( ) function, 122
setClockDivider( ) function, 122, 123
setDataMode( ) function, 122
setup( ) function, 35
shields, 20–21
Arduino Ethernet Shield, 21
Arduino GSM Shield, 22
Arduino Motor Shield, 21
Arduino WiFi Shield, 22
Arduino Wireless SD Shield, 21
breadboard, 395–398
creating, 391–392
  components, 394–395
  hardware, 392–393
  initial idea, 392
  types, 394
Fritzing, 22
PCB (Printed Circuit Board), 402–404
schematic, 398–402
software, 393–394
short data type, 37
sin( ) function, 76
sketches, 26
  Blink, 29–33
  Bridge library, 370–371
  comments, 33
  digital audio, 300–303
  digital thermometer, 128–130
  editor, 28
  empty, 28
  first, 29–33
  GSM, 286–288
  libraries and, 378
  Robot library, 359–360
  Scheduler library, 315–319
  stepper library, 258–259
  TFT, 234–239
  uploading, 30–32
  USBH library, 332–334
slave (communication), 141–147
SMS class, 279–281
software  
  downloading, 27–28
  LED connections, 59–60
  LiquidCrystal sketch, 201–204
  running, 28
shields, 393–394
SoftwareSerial class, 99
SoftwareSerial library, 98–99
solderless breadboards, 57
solid state, 56
source code, 25
  closed source libraries, 417–418
source files, 25
  libraries, 406–407
SPI (Serial Peripheral Interface), 118
Arduino Due, 123–125
clock modes, 122
  communications, 120
  configuration, 119–120
  example program, 125–132
  RS-232 comparison, 119
  sketch, 128
SPI bus, 118
  Arduino and, 120–121
  configuration, 122
SPI library, 121–122
  sqrt( ) function, 74
SS (Slave Select), 118
SSID (Service Set ID), 173
  connecting to, 175
  SSID( ) function, 177
statements
  break, 40
  if, 38–39
  if...else, 38–39
stepper library, 256–259
  sketch, 258–259
stepper motors, 254
  bipolar, 255–256
  controlling, 254–256
  example project, 257–259
  hardware, 255
  unipolar, 255–256
stop( ) function, 158
stop bits, 86
storage
  digital audio, 296
  EEPROM, 113–114
  floppy disks, 208–209
String data type, 37
string data type, 37
  stringCallback( ) function, 265
strings
  reading, EEPROM library, 107–108
  writing, EEPROM library, 107–108
strips, breadboards, 57
surface-mounted components, 384
switch/case, 39–40
switches, 151–152
SysEx, 266–267

T
tan( ) function, 76
TCP/IP protocol, 152
  DNS (Domain Name Service), 153
  IP addresses, 153
  MAC address, 153
  ports, 153–154
text
  LiquidCrystal library, 195–196
    custom, 198–199
    orientation, 197
  sending, 88–90
  TFT library, 230–231
TFT (Thin Film Transistor)
  Arduino Esplora, 229
    overview, 227–228
  TFT library, 228–231
    color, 232
    example application, 233–239
    graphic images, 232–233
    graphics, 231–232
    hardware, 234
    initialization, 228–229
    screen preparation, 229–230
    sketch, 234–239
    text, 230–231
thermocouple, 125
third-party libraries, 377
  example application, 384–388
time functions
  delay( ), 70–71
  delayMicroseconds( ), 71
  micros( ), 71–72
  millis( ), 71
TinkerKit, 341–342
tolerance of electrical components, 47

tone() function, 69, 295, 340–341

transistors, 56

trigonometry, 75–76

cos() function, 76

sin() function, 76

tan() function, 76

Tunnel diodes, 55

TX (transmit wire), 83

U

UART (Universal Asynchronous Receiver/Transmitter)

baud rate, 83–84

data bits, 85

parity, 85–86

serial connections, starting, 87–88

stop bits, 86

unipolar stepper motors, 255–256

unsigned char data type, 36

unsigned int data type, 37

unsigned long data type, 37

updateIR() function, 352

uploading, sketches, 30–32

USB (Universal Serial Bus), 82–83, 209–210

Arduino Due, 325–237

hubs, 325

keyboards, 324–325

mice, 325

micro-USB connectors, 326

peripherals and, 322–323

PS/2 interface and, 322–323

USB OTG (USB On-The-Go), 324

USB protocol, 323–324

USBH library, 327

example program, 330–334

keyboards, 327–239

mice, 329–330

sketch, 332–334

USBHost, 322

userNameWrite() function, 354

V

variables, 36–37

declarations, 34

led, 59–60

VLB (VESA Local Bus) bus, 4–5

VoiceCall class (GSM), 281–281

void data type, 36

void keyword, 34

volatile memory, 101–102

voltage, 47–48

breakdown voltage, 54

digital I/O and, 65

I2C protocol, 147

tunnel voltage drop, 52

W

WaveLAN, 171

waves, digital audio, 292–293

wear leveling, 114

web servers, connecting to, 159–161

WECA (Wireless Ethernet Compatibility Alliance), 171

WEP encryption, 173

WEP network, connecting, 175

while loop, 41

Wi-Fi, 171

ad-hoc mode, 171

channels, 172

encryption, 172–173

infrastructure mode, 172

RSSI (Received Signal Strength Indication), 173

SSID (Service Set ID), 173

topology, 171–172

Wi-Fi Alliance, 171

WiFi library

client connections, 178–179

configuring, 177–178

connecting, 177–178

downloading, 179–189

hardware, 181–182

importing, 174

initializing, 174–175
network scanning, 176–177
sensor sketch, 182–189
server, 179
WiFi shield, testing for, 175–176
Wire.available( ) function, 142
Wire.beginTransmission( )
  function, 146
Wire.endTransmission( )
  function, 146
Wire.onReceive( ) function, 141–142
Wire.onRequest( ) function, 142
Wire.read( ) function, 142
Wire.requestFrom( ) function, 146
word data type, 37
WPA2 encryption, 173
WPA-2 Personal network, connecting, 175
write( ) function, 90, 104–105, 196, 199, 218
writeBlue( ) function, 338
writeGreen( ) function, 338
writeRed( ) function, 338
writeRGB( ) function, 337–338
X-Y-Z
XMEGA series, 9
YunClient, 368
YunServer class, 367–368
Zener diodes, 54–55