

index

Numbers

3D photography, 124–126
55chkloop My Block, 118–119

A

Academy content, 10
Action data plug, 42
Adjusted Decibels (dBa) mode, for Sound Sensor, 38
alerts, Sound block for, 32
Alpha Rex walking robot, assemblies, 48
ambient light, Light Sensor measurement of, 35
anti-theory music robot. *See* BenderBot (anti-theory music robot)
arrays, 24
assemblies
 inventory of, 48
 listing limitations of, 49
Auto mode, 78
availability of parts, and design feasibility, 51

B

backtracking wire, 17
Basic Theremin program, 248
Beach Buggy Chair, 101
 building, 102–114
 power connections, 113
 programming, 115–121
 55chkloop My Block, 118–119
 motormove60 My Block, 115–117
 motorstop My Block, 119
 putting pieces together, 120
 tightrotate My Block, 117–118
 troubleshooting, 121
BeatBox program, 246
BenderBot (anti-theory music robot), 233
 building, 234–243

 programming, 244–245
 Basic Theremin, 248
 BeatBox, 246
 Chance, 248
 Tremolo, 247
 wiring, 244
Bent Music, 233
blocks, 11, 13. *See also individual block names*
 cloning, 13
 for Light Sensor, 35
 for Sound Sensor, 36–38
 for Touch Sensor, 38–39
 for Ultrasonic Sensor, 40
 web page with information about, 10
Bluecores, 80
Bluetooth (BT), 4, 59
 default password on NXT, 65
 different types, 61
 dongle, 61
 making connection, 60
 with PowerPC Mac, 61
 with Windows PC, 62–63
 messaging under program control, 67–68
 network limitations, 80
 NXT connected via, 64
 as problem solver, 60
 robot response to, 41–42
 Search menu, 66
 for sending win or loss notification, 228
 troubleshooting, 66
 turning on, 60
boundary plugs, 18
brainstorming, design concepts, 50
branching sequences, 12
broadcast system, infrared system as, 59
broken wire, 17
 problem solving, 21–22
BT. *See* Bluetooth (BT)
building parts, inventory of, 45
Button data plug, 42
buttons, enabling on NXT brick, 41

C

CAD (computer-aided design) software. *See* computer-aided design (CAD) software
Cage, John M., 233
Carnegie Mellon University, Robotics Academy, 7
Chance program, 248
chassis types
 inventory of, 49
 listing functions, 49
 listing limitations of, 50
circuit-bending, 233
Class 2 chip, in NXT, 60
Clague, Kevin, 72
cloning blocks, 13
color detection, Light Sensor and, 35
Comment tool, 15–16, 28
 for plug names, 75
 and summary of program, 28, 29
comments, 16, 24, 27–28
Compare block, 75
 for Less than comparison, 287
 and negative command, 77
 for ScanBot, 278, 283
computer-aided design (CAD) software, 335–338
 documentation, 336
 reasons to use, 335
computers, connecting the NXT to, 60
configuration panels
 Light Sensor block, 35
 Loop block, 41
 Move block, 142
 Sound block, 96
 Switch block, 96
 Wait block, 41
connection number, 65
connections, with Bluetooth, 60
construction pieces, 3, 6
Control menu (Wait block configuration panel), selecting Sensor from, 30
Controller, 61

converter cable, 332–333
cost
 and design feasibility, 51
 RIS vs. NXT set, 4
counterweight, for balancing robotic arm, 144
CraneBot (grabber robot), 143
 building, 145–168
 grippers, 143
 programming, 168–170
 robotic arm, 144
Create My Block symbol, 116
crowbar, 24, 97
 removing, 24
cycle, 18
 and broken wire, 17

D

data dependency, 19
 rule, 20
data plugs. *See also individual data plug names*
 label on, 20
 reference chart, 42–43
data wires, for My Blocks, 17
da Vinci, Leonardo, 45
db mode, for Sound Sensor, 38
dbA mode, for Sound Sensor, 28
dead reckoning, 233
debugging. *See problem solving*
debugging tool, waiting as, 29
decibel settings, for Sound Sensor, 38
default Bluetooth password, on NXT, 65
default state, for block, 13
Degrees data plug, 42
deleting unused files, 22
dependency, 18
 data, 19
design
 concepts, 50–51
 cycle, 52
differential drive robot, 69
Direction data plug, 42
disabilities, vehicles for people with, 121
Display block, 24, 32, 268
 for ScanBot, 272, 277, 281
 for tracking Random block's generated values, 33
Distance data plug, 42

do while construction, 14
documentation
 with Comment tool, 27–28
 for program, 10
dongle, 61
drag and drop, comments, 28
Dynamic Block Update, 23, 244

E

editing mode, for comments, 28
Education version of NXT Base Set, 331–332
 advantages of, 332
electronic NXT parts, 4–5
 size of, 4
empty mailboxes, 76
execution sequences, 12

F

feasibility of design, 50
Fey, Charles, 172
file transfer, 67
firmware, 22
 redownloading, 23
First LEGO League (FLL), 23, 59, 64
flashing light in Slot Machine, programming, 229
Flat view, option for Switch structure, 14
FLL (First LEGO League), 23, 59, 64
flowchart, for execution sequences, 12
fruit machines, 172

G

Generate light data plug, 42
global variables, 25
grabber robot. *See CraneBot (grabber robot)*
graphical programming language, 9
gray wire, “broken,” 17
Greater than/Less than data plug, 42
groups
 combining small parts into, 47
 listing limitations of, 48

H

Hansen, John, 7
hardware
 and feasibility of design, 51
 inventory of small parts, 45–46

Hassenpin piece, 6
Hassenplug, Steve, 20, 60
help, built-in, 10
Help menu, Contents and Index option, 10
Help pane, 10, 11
hidden system files, deleting, 22
HiTechnic, 5

I

icons, for My Blocks, 116–117
images, deleting unused, 22
image-scanning robot. *See ScanBot (image-scanning robot)*
Import tool, 23
infrared (IR) signals for RCX, problems with, 59, 65
initialization code, 71
Inner Loop Configuration panel, Control parameter, 93
Intensity data plug, 42
internal sensors, 41
Internet, My Blocks libraries on, 7
inventory, of small hardware parts, 45–46

J

Jessiman, James, 335
junk messages, detecting and ignoring, 76

K

King, Jason, 21

L

label
 on data plug, 20
 for wire, 15
LabVIEW, 9
 Toolkit, 24
 tunnels in, 18
language, commands for speed, 70
LCD, Display block and, 32
LDraw, 335, 336
 Complete Updates library, 336
 adding parts to, 337–338
 downloading and installing, 336
 Parts Tracker, 337
LDView, 336
 downloading and installing, 337
Legacy blocks, 23

- LEGO building parts
 - inventory of, 48
 - listing limitations of, 49
 - LEGO NXT open source software
 - architecture, 51
 - lever on Slot Machine, 172
 - libraries, of My Blocks, 7
 - Light Sensor block, 35
 - configuration panel, 35
 - Light Sensors, 5, 35–36
 - and measurement of reflected light, 35
 - native functions of, 47
 - for ScanBot, 250, 276
 - on Slot Machine, 174
 - light threshold, for ScanBot, 271, 289
 - Light Threshold Variable block, for ScanBot, 273, 274
 - line of sight, for infrared signal, 59
 - listening, for loud sound, 120
 - lithium battery pack, 331
 - local variables, 25
 - Logic block
 - for ScanBot, 269
 - Venn diagram on, 13
 - Logic data plug
 - in, 42
 - out, 42
 - Logic type variable, 267
 - logic wire, 11
 - Loop block, 13–16, 31
 - configuration panel, 41
 - for Light Sensor, 35, 36
 - and lost cues, 37
 - for ScanBot, 277
 - as Sound Sensor, 120
 - for Touch Sensor, 39
 - for Ultrasonic Sensor, 40
 - for waiting for pressed button, 268
 - Loop structure, 93
 - executing multiple times, 14
 - parallel sequence within, 24
 - waiting for sequence in, 14
 - loop until construction, 14
- M**
- Mac, Bluetooth connection on, 61
 - Magic Light, 244
 - Mailbox data plug, 43
 - mailbox number, 65
 - mailboxes, overflow or empty, 76
 - maintenance, 52
 - manual mode, 78
 - manufacturer's specifications, and design feasibility, 51
 - Marty (performance art robot), 291
 - additional ideas, 329
 - building, 293–312
 - left motor subassembly, 293–295
 - left rail, 304–306
 - pen grip, 300–304
 - pen housing, 307–311
 - putting pieces together, 311–312
 - right motor subassembly, 295–298
 - right rail, 305–306
 - two-wheeled chassis, 298–299
 - design challenges, 291–292
 - programming, 312–318
 - first drawing, 312–313
 - mbBackward My Block, 316
 - mbForward My Block, 314–316
 - mbPenDown My Block, 313–314
 - mbPenUp My Block, 314
 - mbPolygon, 319–320
 - mbStar, 322
 - mbTurnLeft, 316–318
 - mbTurnRight, 318
 - mbZigzag, 323–324
 - MegaRandom, 325–326
 - RandomPolygon, 321
 - RandomStar, 323
 - RandomZigzag, 324
 - SpiralCurve, 328
 - SpiralStraight, 327
 - tweaking, 313
 - troubleshooting, 329
 - master NXT bricks, 65, 79
 - Master USB port, 22
 - Math block, for ScanBot, 272, 274, 280, 285
 - memory
 - running out of, 22–24
 - stretching, 22–23
 - Message received data plug, 43, 76
 - microcomputer. See NXT bricks
 - MINDSTORMS robotics
 - beginnings, 3
 - NXT Base Set versions, reasons for two, 331–332
 - Mini Block Library, 244
 - Mini Blocks, 23–24
 - missing input, and broken wire, 17
 - MLCad, 336
 - Motor block
 - dropping orphan, 97
 - Port data plug of, 94
 - for ScanBot, 276, 284, 286–287
 - sign of power plug, 75
 - motor control scheme, 76
 - Motor Sensor block, feedback boxes in
 - configuration pane, 64
 - motormove60 My Block, 115–117
 - motors
 - power settings for, 116
 - rotation degree settings, 121
 - Rotation Sensor for, 41
 - for Slot Machine, 222
 - motorstop My Block, 119
 - Move block, 13, 27, 70
 - configuration panel, 142
 - multicase Switch structure, 14
 - multiplexing switch, 72, 73
 - multitasking, 13
 - music theory, 233
 - My Block library, 118
 - My Blocks, 6–7, 11, 16–17
 - 55chkloop, 118–119
 - code reading Rotation Sensor as, 74
 - data wires for, 17
 - editing, 20
 - libraries on the Internet, 7
 - mbBackward, 316
 - mbForward, 314–316
 - mbPenDown, 313–314
 - mbPenUp, 314
 - mbPolygon, 319–320
 - mbStar, 322
 - mbTurnLeft, 316–318
 - mbTurnRight, 318
 - mbZigzag, 323–324
 - MegaRandom, 325–326
 - motormove60, 115–117
 - motorstop, 119
 - nesting, 20
 - RandomPolygon, 321
 - RandomStar, 323
 - RandomZigzag, 324
 - Resolution Switch, 268–270
 - ripping, 20
 - SpiralCurve, 328
 - SpiralStraight, 327
 - Threshold Selector, 271–273

My Blocks, *continued*
tightrotate, 117–118
for wiring wait value, 19–20
My Bluetooth Places folder, 62

N

names
for blocks, displaying, 118
for motor block, 116
for plugs, 75
for variables, 25
native functions of parts, 47
navigation pane, 10
NBC (NeXT Byte Codes) programming
language, 7
negative command, and Compare block, 77
nesting, My Blocks, 20
networking
limitations, 80
NXT-to-NXT, 65–66
setup, 66–67
NeXT Byte Codes (NBC) programming
language, 7
noise from robot, and Sound Sensor, 36
Not eXactly C (NXC) programming
language, 7
Number data plug
in, 43
out, 43
Number to Text block, 33
for ScanBot, 271, 275
Number type variable, 267
number wire, 11
NXC (Not eXactly C) programming
language, 7
NXT bricks, 4, 46
communicating with, 67
connection between, 60
enabling buttons on, 41
master, 65, 79
motors, 5
networking, 65–66
setup, 66–67
passkey for, 61
slave, 65
NXT Buttons Sensor, 41
NXT-G programming language, 6–7
onscreen display of, 9
software not included with Education
version, 331

NXT internal clock, 41
NXT kit, vs. RIS, 3–4
NXT STEP blog, The, xvii
NXT window, 22
NXTasy, 22

O

one-armed bandits, 172
open space, finding direction with, 118
organization, 14
orphan Motor block, dropping, 97
overflow mailboxes, 76

P

palette, internal sensors on, 41
parallel sequence, 12
within Loop or Switch structure, 24
Motor blocks on, 115
order of executing, 99
synchronizing beams, 19
passkey
for Bluetooth connection, 61
default, on NXT, 65
window, 62
pay-off mechanism in Slot Machine, 173
programming, 230
payout line on Slot Machine, 172
pen in Marty
grip, 300–304
housing, 307–311
performance art robot. *See* Marty
(performance art robot)
PhotoBot (3D photo assistant robot), 123
building, 127–139
programming, 140–142
pinning open structures, 24
platform for robot, choosing, 69
plugs
choosing names for, 75
matching wires with, 17
Pointer tool, 28
poker machines, 172
polygons, 319
Port data plug, 43
of Motor block, 94
post office metaphor, 79
power level, 70
power settings, for motors, 116
PowerPC Mac, Bluetooth connection on, 61

problem solving
Beach Buggy Chair, 121
broken wire, 21–22
Marty (performance art robot), 329
drawing short lines, 315
running out of memory, 22–24
ScanBot, 289
Sound block, 31–32
Sound Sensors, 36
text on LCD for, 32
program, 7
Comment tool for summary, 28, 29
documentation for, 10
program control, Bluetooth messaging
under, 67–68
programming
built-in guide, 10
remote control, 70–72
reusing sequences, 6, 16–17. *See also*
My Blocks
tutorials, 7
programming language NXT-G, 6–7
programming sheet, 11
programs, deleting unused, 22
prototype, 50, 51
testing, 52

R

Random block, 33, 94
Display block for tracking generated
values, 33
RandomPolygon My Block, 321
RandomStar My Block, 323
RandomZigzag My Block, 324
RaSPy (Rock, Scissors, Paper–playing
robot), 83
building, 83–92
programming, 93–99
Raw value data plug, 43
RBT file, vs. RXE file, 67
RCX, 22
infrared signals for, problems with,
59, 65
standard “message” length, 59
Receive Message block, 67–68, 75, 76
Receive Message Sensor, 41
receiver for movement commands, 75–76
recursive programming, absence of, 20
reels on Slot Machine, 172
method for confirming state of, 227

- reflected light, Light Sensor
 - measurement of, 35
 - regular polygons, 319
 - remote control
 - choosing platform, 69
 - control system definition, 70
 - future options, 77
 - programming, 70–72
 - receiver for movement commands, 75–76
 - tuning program, 77
 - Remove Bad Wires tool, 21–22
 - removing crowbar, 24
 - repairs, 52
 - Reset data plug, 43
 - Resolution Switch My Block, 268–270
 - Retail version of NXT Base Set, 331–332
 - advantages of, 331–332
 - reusing code, 6, 16–17. *See also* My Blocks
 - ripping My Blocks, 20
 - RIS (Robotics Invention System), 3
 - vs. NXT kit, 3–4
 - ROBOLAB software, 6
 - RobotC programming language, 7
 - Robotics Academy, Carnegie Mellon University, 7
 - Robotics Invention System (RIS), 3
 - vs. NXT kit, 3–4
 - rotation degree settings, for motors, 121
 - Rotation Sensor, 5, 41
 - code reading, as My Block, 74
 - mailing reading to another NXT, 73–74
 - Rotation Sensor block, feedback boxes in
 - configuration pane, 64
 - RXE file, vs. RBT file, 67
- S**
- scan resolution, Variable block for, 270
 - ScanBot (image-scanning robot), 249
 - building, 250–267
 - programming, 267–288
 - decision to scan next row, 281–288
 - displaying updated threshold, 274–276
 - increasing threshold, 273–274
 - main program, 276–282
 - Math block, 272, 274, 280, 285
 - Motor block, 276, 284, 286–287
 - Number to Text block, 271, 275
 - Resolution Switch My Block, 268–270
 - Sensor blocks, 268–269, 278
 - Sound block, 281
 - Threshold Selector My Block, 271–273
 - variables, 267
 - troubleshooting, 289
 - using, 289
 - scope of variables, 25
 - scorekeeping, by RaSPy, 99
 - screen space, using crowbar to create, 24
 - security, for Slot Machine, 233
 - Send Message block, 67
 - Sensor blocks, for ScanBot, 268–269, 278
 - Sensor pull-down menus, 41
 - sensors in NXT system, 5, 35. *See also individual sensor names*
 - Light Sensors, 5, 35–36
 - configuration panel, 35
 - and measurement of reflected light, 35
 - native functions of, 47
 - for ScanBot, 250, 276
 - on Slot Machine, 174
 - receiving input from, 4
 - for Slot Machine, 222
 - Sound Sensors, 5, 30, 33, 36–38
 - on Beach Buggy Chair, 113
 - Wait blocks as, 120
 - Timer Sensor, 41
 - Touch Sensors, 5, 38–39, 93
 - as default, 30
 - in Education version, 332
 - native functions of, 47
 - on Slot Machine, 174
 - Wait block for, 140
 - Ultrasonic Sensors, 5, 33, 39–40, 78
 - on Beach Buggy Chair, 113
 - finding direction with open space, 118
 - limitations of, 121
 - native functions of, 47
 - and round object detection, 169
 - software-enhanced functions of, 47
 - sequence beams, 11, 12, 18
 - synchronizing parallel, 19
 - servo motors, 5
 - settings, using comments to track, 28
 - shapes, for NXT robots, 3
 - shuttle, 124
 - slave NXT bricks, sending messages
 - between, 65
 - Slave USB port, 22
 - Slot Machine robot, 171
 - building, 175–222
 - connecting motors and sensors, 222
 - complete machine, 173–174
 - definition, 172
 - general program flow
 - game controller, 223
 - result controller, 224
 - hardware challenges, 172–173
 - history, 172
 - possible enhancements, 232
 - programming, 224–230
 - canceling, 228
 - checking reels' state, 227
 - flashing light, 229
 - game controller, 224–228, 229
 - pay-off mechanism, 173, 230
 - pocketing coins, 225
 - recording inserted coins, 228
 - resetting reels, 225
 - result controller, 229–230
 - sending win or loss Bluetooth notification, 228
 - turning reels, 226
 - updating store, 230–231
 - running programs, 231
 - security, 233
 - small hardware parts
 - combining into groups, 47
 - inventory of, 45–46
 - listing limitations of, 47
 - sample worksheet, 46
 - software
 - feasibility of design, 51
 - not included with Education version, 331
 - software-enhanced functions, of Ultrasonic Sensors, 47
 - sound
 - files
 - creating custom, 244
 - deleting unused, 22
 - memory consumption of, 23
 - listening for, 120
 - signals, 39
 - techniques for generating, 244

- Sound block, 13, 95
 - configuration panel, 96
 - for ScanBot, 281
 - troubleshooting, 31–32
- Sound Sensor block, 36, 37
- Sound Sensors, 5, 30, 33, 36–38
 - on Beach Buggy Chair, 113
 - using Wait block as, 120
- source plug, for wire, 17
- speaker, 4
- speech, by robot, 95
- SpiralCurve My Block, 328
- SpiralStraight My Block, 327
- Standard Decibels (db) mode, for Sound Sensor, 38
- Starting Point, in Help window, 10
- stereo-optic vision, 124
- stretching memory, 22–23
- structures, pinning open, 24
- studless construction, 3, 6
- studs, 3
- subroutines
 - My Blocks as, 16
 - variables within, 25
- summary of program, with Comment tool, 28, 29
- Switch block, 12
 - configuration panel, 96
 - for Light Sensor, 35, 36
 - for ScanBot, 270, 272, 279, 283
 - for Sound Sensor, 38
 - for speech, 95
 - for Touch Sensor, 39
 - for Ultrasonic Sensor, 40
- Switch on Button structure, 78
- Switch structure, 11, 71
 - Flat view option for, 14
 - multicase, 14
 - parallel sequence within, 24
 - wires feeding out of, 72
- synchronizing parallel sequence beams, 19

T

- tabbed view, 14
- TECHNIC pieces, 3, 6
- technology limitations, and design feasibility, 51
- test pad, 332
- testing
 - comments to track, 28
 - prototype, 52

- Text data plug
 - in, 43
 - out, 43
- text on LCD, for debugging, 32
- Text type variable, 267
- theremin, 244
- 3D photo assistant robot (3D PhotoBot), 123
 - building, 127–139
 - programming, 140–142
- 3D photography, 124–126
- Threshold Selector My Block, for ScanBot, 271–273
- ticket in, ticket out machines, 172
- tightrotate My Block, 117–118
- time limitations, and design feasibility, 51
- Timer Sensor, 41
- Timer value data plug, 43
- Toshiba Bluetooth dongle, 65
- Touch Sensor block, 38
- Touch Sensors, 5, 38–39, 93
 - as default, 30
 - in Education version, 332
 - native functions of, 47
 - on Slot Machine, 174
 - using Wait block for, 140
- “toy language,” NXT-G as, 9
- Tremolo program, 247
- TriBot, 69, 70, 77, 143, 291
- trigger, voice as, 30
- Trigger point data plug, 43
- troubleshooting. *See* problem solving
- tunnels, in LabVIEW, 18
- turning space, for robot in corner, 117
- type mismatch, 17

U

- Ultrasonic Sensor block, 40
- Ultrasonic Sensors, 5, 33, 39–40, 78
 - on Beach Buggy Chair, 113
 - finding direction with open space, 118
 - limitations of, 121
 - native functions of, 47
 - and round object detection, 169
 - software-enhanced functions of, 47
- University of Pittsburgh, Department of Rehabilitation Science and Technology, 121
- unused files, deleting, 22
- USB ports
 - plugging Bluetooth into, 61
 - types, 22
- user trigger, Wait block as, 30

V

- value in wire, vs. Variable block, 17
- Variable block, 19, 25
 - control of, 26
 - for ScanBot, 269, 272, 278, 280, 284
 - vs. value in wire, 17
- variables, 25–26
 - for ScanBot, 267, 276
 - for Slot Machine game controller, 224
 - for Slot Machine result controller, 229
 - solutions using, 19
- vehicles for people with disabilities, 121
- view
 - tabbed, 14
 - of 3D photograph, 126
- Visibility setting, for Bluetooth, 60
- voice
 - recognition, 38
 - as trigger, 30

W

- Wait block, 19, 27
 - configuration panel, 41
 - for Light Sensor, 35, 36
 - for ScanBot, 286
 - for sound detection, 37
 - as Sound Sensor, 120
 - for Touch Sensor, 140
 - for Ultrasonic Sensor, 40
- Wait for Message block, 76
- waiting, as debugging tool, 29
- Wav2rso, 244
- web resources, on Mini Blocks, 23
- Windows PC, Bluetooth connection on, 62–63
- wireless communication, robot response to Bluetooth, 41–42
- wires, 11, 14–15
 - “broken” gray, 17
 - problem solving, 21–22
 - converter cable, 332–333
 - forcing NXT-G to organize, 15
 - for information flow, 17
 - manually organizing, 15
 - matching with plugs, 17
 - as temporary variables, 25
- work area, 11

Y

- Yes/No data plug, 43