A
absolute value, 97
AddColorCount My Block, 184–185
adding labels to a displayed value, 141–142
algorithm, 82
  control algorithm, 152
ambient light, measuring, 55
And logic operation, 159
AroundTheBlock program, 44–46
array, 175–177
  creating, 175–176
  elements in, 175
  empty, 175
  indices and, 175
  length of, 175
Array Operations block, 176–177, 178
  Length mode, 176
  Read At Index mode, 176–177
  Write At Index mode, 177
  Append mode, 177
ArrayTest program, 177–179
art, and engineering, 3
assumptions, in program design, 84
Auto-ID, 42, 52
automatic routing of date wires, 96
B
Back button, 165
back-up copies, of programs, 9
beeping, while backing up, 66–67
binning, 111–112
blocks. See also specific block names
  connecting with data wires, 95
  copying, 394
  modes, 7
  running, 7
  selecting, 137, 138
BlockStartTest program, 224–225
Brick. See EV3 Intelligent Brick
  Brick Button block, 165–166, 167
  Brick buttons, 164, 165–166, 179, 188, 198–200
  Brick Status Light, 168–169, 190, 226
  Brick Status Light block, 168–169
bugs, in programs, 10
Bumped (Touch Sensor state), 52
BumperBot program, 52–54, 61, 159–160
  BumperBot2 program, 66–67
  BumperBot3 program, 78–80
  busy loop, 220
  Button ID, 165
  ButtonCommand program, 179–181
  buttons. See Brick buttons
Chime My Block, 137–139
clearing the screen, 10, 172
CoastTest program, 48–49
Color Sensor, 54–56
  in Ambient Light Intensity mode, 55
  in Color mode, 54
  color values, 54, 183
  connecting to the TriBot, 24–25, 30
  in Reflected Light Intensity mode, 55
Color Sensor block, 112
  Calibrate modes, 236
ColorCopy program, 169
ColorCount program, 182–187
  adding a menu to, 198–205
ColorToText My Block, 183–184
  comma-separated values (CSV), 209, 210
  comments, 11–12
  adding, 11–12
  comment tool, 11
  and the Switch block, 74
  tips for working with, 12
Compare block, 129, 190
Constant block, 134
Content Editor, 6
Context Help, 12, 98
color values, 54, 183
color values, 54, 183
color values, 54, 183
colored Copy program, 169
colored Text program, 182–187
copying, 394
crashing, 9
Debug Mode, 9
debugging, 10, 96, 169, 179
  and My Blocks, 146
  a single block, 44
  using Sound blocks, 91
derivative term, 238
detecting
  an obstacle, 53
  a person, 63
Display block, 10, 170
  clearing the screen, 10, 172
drawing, 171
  circles, 171
  lines, 171, 172
  points, 171
  rectangles, 171, 172
data collection. See data logging
data logging, 209–218, 230
data logging, 209–218, 230
data logging, 209–218, 230
data logging, 209–218, 230
data logging, 209–218, 230
data types, 99, 176
data wires, 93–96
data wires, 93–96
  and arrays, 176–177
  and data types, 99, 176
data wires, 93–96
  and arrays, 176–177
  and data types, 99, 176
del10onging, 95
displaying the value, 96, 177
drawing, 95
drawing, 95
drawing, 95
drawing, 95
drawing, 95
drawing, 95
drawing, 95
for sensors, 209
timestamp, 212
timestamp, 212
time stamp, 212
timestamp, 212
time stamp, 212
timestamp, 212
time stamp, 212
timestamp, 212
time stamp, 212
timestamp, 212
time stamp, 212
timestamp, 212
time stamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestamp, 212
timestam...
Display block, continued
images, 170
controlling location of, 170
previewing, 170
text, 10, 100–101
and the ColorCount program, 184,
186, 198–199
X and Y values, 170
DisplayTimer program, 154–155
DisplayNumber My Block, 144–146
DoorChime program, 62–63, 64
adding lights to, 220–223
creating Chime My block from, 137–139
Download and Run buttons, 6–7, 7, 9
downloading a program, 6–7
drawing. See Display block

E
ending a program
with the Back button, 165
with the Stop Program block, 220
eering, 3
Error value, 152–153
EV3 Intelligent Brick, 2
EV3 set, 1
building pieces, 2
editions, 1
EV3Sketch program, 172, 173
EV3 software, 3, 5–7, 6
EV3 timers, 153–155
Exclusive Or (XOR) logic operation, 159
Eyes program, 170–171

F
File Access block, 193–194
modes in, 193–194
and data types, 194
FileReader program, 196–198
File Read Error, 194
files, 193–207
closing, 194
copying, 194, 206
creating, 193–194
deleting, 194, 206
downloading, 206
end of, 198
errors, 194
managing, 205–206
names, 193, 194
reading, 194, 198
uploading, 206, 210
and Windows, 207
writing, 193–194, 198
FileTest program, 198
firmware, 3, 206
updates to, 3
floor function, 150, 180–181

G
Gain value, 152–153
gears, 39, 47
GentleStop program, 93–95, 95, 106–107
GyroPointer program, 161–162
Gyro Sensor, 64–65, 120, 161
in Angle mode, 65
connecting to the TriBot, 26, 30
in Rate mode, 64
in Reset mode, 65
GyroTurn program, 65, 66

H
hardware, 3
Hardware page, 6
tabs, 6, 7
HelloDisplay program, 10–11
Hello program, 8–9
help file, 4, 9, 98
hertz, 98
HiTechnic, 2, 218

I
IDE (integrated development environment), 3
Infrared Remote, 60
Infrared Sensor, 60, 162
in Beacon Heading mode, 60–61
in Beacon Proximity mode, 60–61
connecting to the TriBot, 23–24, 29
in Proximity mode, 60
in Remote mode, 61
Infrared Sensor block, 94–95
Integral term, 238–239
integrated development environment
(IDE), 3
Invert Motor block, 47–48
IsItBlue program, 56–58

L
Large Motor block, 46
LEGO Education, 218, 245
Lift Arm, 32, 47
building instructions, 33–37
LiftArm program, 47
LightPointer program, 129–133
LightTest program, 230–231
LineFinder program, 58–59
LineFollower program, 70–74
with PID control, 235–242
with proportional control, 152–153
simplifying, 111–112
LineFollowerCal program, 233–235
Load_CC My Block, 205
Lobby screen, 5
LogData My Block, 212, 230
Logic block, 158–159
logic operations, 159
LogicToText My Block, 140–143
LogicToText program, 108
Logic value, 99, 159
loop body, 76–77
Loop block, 45, 76–77
and checking two conditions, 159–160
control options, 76
and data wires, 115
Loop Index, 116–117, 181
modes in, 76–77
Logic mode, 115–116
and multiple sequences, 226–227
resizing, 70
and restarting a loop, 116
LoopCountTest program, 225–226
LoopIndexTest program, 116–117
Loop Interrupt block, 78–80, 200
and synchronizing sequences, 226, 228
LoopStartTest program, 224–225

M
Math block, 97
in Advanced mode, 148, 149–151
errors in, 150–151
functions, 150
maze, solving, 82
following a wall, 85–87
going through an opening, 89–91
turning a corner, 87–89
Medium Motor block, 46
memory, managing, 205–206
Memory Browser, 205–206
MemoryGame Program, 188–190
saving the high score, 195–196
menu
adding to ColorCount program, 198–205
on EV3 Brick, 43
Mindsensors, 3, 218
modulo operator, 150, 181, 200
More Information link, 12
Motor Rotation block, 96–98, 209–218
in Reset mode, 66
Motor Rotation Sensor, 66–67, 172
motors, 2
large, 39
medium, 39
Move Steering block, 39–42
Brake at End parameter, 41–42
determining duration, 41, 43
degrees and rotations, 41
modes in, 40
problem with coating, 48–49
Port parameter, 42
Power parameter, 41
steering, 40–41, 214
following a curve, 44–45
moving forward, 42
turning, 43–44
and testing the Current Power, 214
Move Tank block, 46
multiple sequences, 219–227
and My Blocks, 226
problems with, avoiding, 226–227
and program flow, 223–226
synchronizing, 226
multitasking, 219
My Blocks, 137–148. See also specific My Block names
Builder window, 137, 138, 141–142, 144
copying, 139
creating, 137–139
and data wires, 140
and debugging, 146
deleting, 139
editing, 139
icons, 137, 141, 142
and multiple sequences, 226
palette, 139
and parameters, configuring, 140–144, 146
and variables, 146–148
MyBlockTest program, 226, 227

N
normalizing data, 235
Not logic operation, 159
Numeric value, 99

O
odometer, 220, 221
off–by–one errors, 117
online community. See websites
Or logic operation, 159

P
parameters, 7
persistence of files, 193
PID (proportional–integral–derivative) control, 229–230
in the LineFollower program, 236–242
pixel, 170
Port View, 42–43, 48–49, 55–56
PowerSetting program, 166–168
Pressed (Touch Sensor state), 52
program flow, for multiple sequences, 223–226
Programming Canvas, 6
Programming Palettes, 6
programs. See also specific program names
assumptions, 84
copying, 74–75
downloading, 9
naming, 8–9
qualities of a good program, 3–4
requirements, 82–84
running, 9
writing, 7
Project Properties page, 9–10
for managing
My Blocks, 139
variables, 128–129
proportional controller, 152, 230–233
in the LineFollower program, 235–236
proportional–integral–derivative (PID) control, 229–230
in the LineFollower program, 236–242
pseudocode, 81–82

R
Random block, 157
Range block, 160
RedOrBlueCount program, 124–128
RedOrBlue program, 74–76
reflected light, measuring, 55
Released (Touch Sensor state), 52
requirements, program, 82–84
right–hand rule algorithm, 82
Round block, 156
round function, 150
Run Selected button, 7, 44

S
Save_CC My Block, 204, 205
saving projects, 8–9
ScrollDisplay My Block, 146–148
SelectOption My Block, 200–202
Sensor blocks, 94
advantages of, 108
sensors, 2, 51. See also specific sensor names
Change mode, 52
Compare mode, 52
Port View, 55–56
selecting a port, 52
sequence plug, 137, 222
sequence wire, 222
SimpleMove program, 40, 40
software, 3
Sound block, 7, 7
controlling
tone, 8, 98
volume, 7, 96–97
and debugging, 91
playing
a sound file, 7–8, 185–186
a tone, 8
SoundMachine program, 96–98
source code, 3
for example programs, 4
SpiralLineFinder program, 118–120
square root function, 98, 150
Start block, 7
and multiple sequences 219–220
SteeringTest program, 215–220
Stop Program block, 220

INDEX 249
Switch block, 56, 69–70
    cases, 69
        adding, 75–76
        default, 56, 76
        removing, 75
    and comments, 74
    condition setting, 69
    and data types, 105
    and data wires, 105
        connecting, 105
        passing data in, 107
        passing data out, 108
    Flat and Tabbed View, 74, 107
    more than two choices, 72–73
    and multiple sequences, 227
    nested, 74
    resizing, 70
    value modes, 105–106, 181

T
TagAlong program, 160–161
Text block, 100
    and the DisplayTimer program 154–155
Text value, 99, 101
ThereAndBack program, 43–44
    three-state controller, 152
Threshold value, 59
Timer block, 154
    and the LogData My Block, 212
timers, EV3, 153–155
timestamp, 212
time to text, converting, 154–155
Time values, 154–155, 156
Tofrodos, 207
Touch Sensor, 51–52
    building bumper for TriBot, 26–28
    attaching cables, 29
TriBot
    building instructions, 13–31
    attaching cables, 29–30
    Color Sensor, alternate placement of, 30–31
    Infrared or Ultrasonic Sensor, alternate placement of, 31
    truth table, 159
    tuning a controller, 152–153, 235, 242

U
Ultrasonic Sensor, 62, 85
    connecting to the TriBot, 23–24, 29
    in Distance modes, 62
    in Presence/Listen mode, 62
    range of, 62
Ultrasonic Sensor block, 94
USB, connecting TriBot with, 9
Undo, 8

V
Variable block, 123–124
variables, 123
    creating, 125–126, 130
    and data types, 124
    deleting, 129
    initializing, 125–126, 132
    managing, 128–129
    and My Blocks, 146
    naming, 125
VerifyLightPointer program, 216–217
Vernier, 2, 218

W
Wait block, 10–11
    adding time, 11
    and Color Sensor, 54–55
    and Infrared Sensor, 60–61, 64
    and Gyro Sensor, 64–65
    and Motor Rotation Sensor, 66
    and Touch Sensor, 52
    and Ultrasonic Sensor, 62
WaitForButtons My Block, 189
WallFollower program, 81–92
    improving with PowerSetting program, 166–168
websites, EV3, 4, 245
Wi-Fi, connecting TriBot with, 9

X
XOR (Exclusive Or) logic operation, 159
The Art of LEGO MINDSTORMS EV3 Programming is set in Chevin. The book was printed and bound by Lake Book Manufacturing in Melrose Park, Illinois. The paper is 70# Orion Satin.
updates and downloads

Visit http://www.nostarch.com/artofev3programming for updates, errata, and downloadable versions of the programs.

More no-nonsense books from no starch press

The LEGO® MINDSTORMS® EV3 Laboratory
Build, Program, and Experiment with Five Wicked Cool Robots!
by DANIELE BENEDETTI
OCTOBER 2013, 432 PP., $34.95
ISBN 978-1-59327-533-4

The LEGO® MINDSTORMS® EV3 Discovery Book
A Beginner's Guide to Building and Programming with Robots
by LAURENS VALK
JUNE 2014, 396 PP., $34.95
ISBN 978-1-59327-532-7
full color

The Unofficial LEGO® Technic Builder's Guide
by PAWEŁ "SARIEL" KMIĘC
NOVEMBER 2012, 352 PP., $29.95
ISBN 978-1-59327-434-4
full color

The LEGO® Technic Idea Book: Simple Machines
by YOSHIHITO ISOGAWA
OCTOBER 2010, 168 PP., $19.95
full color

The Art of LEGO® Design
Creative Ways to Build Amazing Models
by JORDAN SCHWARTZ
JUNE 2014, 288 PP., $24.95
full color

LEGO® Space
Building the Future
by PETER REID and TIM GODDARD
NOVEMBER 2013, 216 PP., $24.95
ISBN 978-1-59327-521-1
full color, hardcover

800.420.7240 or 415.863.9900 | sales@nostarch.com | www.nostarch.com