

# **LEGO® MINDSTORMS® NXT-G Programming Guide**



**James Floyd Kelly**

**Apress®**

## **LEGO® MINDSTORMS® NXT-G Programming Guide**

**Copyright © 2007 by James Floyd Kelly**

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN-13 (pbk): 978-1-59059-871-9

ISBN-10 (pbk): 1-59059-871-7

Printed and bound in the United States of America 9 8 7 6 5 4 3 2 1

Trademarked names may appear in this book. Rather than use a trademark symbol with every occurrence of a trademarked name, we use the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

Lead Editors: Jim Sumser/Jonathan Hassell

Technical Reviewer: Fay Rhodes

Editorial Board: Steve Anglin, Ewan Buckingham, Gary Cornell, Jonathan Gennick, Jason Gilmore, Jonathan Hassell, Chris Mills, Matthew Moodie, Jeffrey Pepper, Ben Renow-Clarke, Dominic Shakeshaft, Matt Wade, Tom Welsh

Project Manager: Richard Dal Porto

Copy Edit Manager: Nicole Flores

Copy Editor: Heather Lang

Assistant Production Director: Kari Brooks-Copony

Senior Production Editor: Laura Cheu

Compositor: Ellie Fountain

Proofreader: April Eddy

Indexer: Broccoli Information Management

Artist: Kinetic Publishing Services, LLC

Cover Designer: Kurt Krames

Manufacturing Director: Tom Debolski

Distributed to the book trade worldwide by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax 201-348-4505, e-mail [orders-ny@springer-sbm.com](mailto:orders-ny@springer-sbm.com), or visit <http://www.springeronline.com>.

For information on translations, please contact Apress directly at 2855 Telegraph Avenue, Suite 600, Berkeley, CA 94705. Phone 510-549-5930, fax 510-549-5939, e-mail [info@apress.com](mailto:info@apress.com), or visit <http://www.apress.com>.

The information in this book is distributed on an “as is” basis, without warranty. Although every precaution has been taken in the preparation of this work, neither the author(s) nor Apress shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this work.

The source code for this book is available to readers at <http://www.apress.com> in the Source Code/Download section.

*For Dan, Belle, Sarah, and Jake—my “Texas family”*

# Contents at a Glance

About the Author .....	xi
About the Technical Reviewer.....	xiii
Acknowledgments.....	xv
Introduction .....	xvii

■ <b>CHAPTER 1</b>	Robots and Programs .....	1
■ <b>CHAPTER 2</b>	Program Structure .....	7
■ <b>CHAPTER 3</b>	Hello World! .....	11
■ <b>CHAPTER 4</b>	Get Movin'.....	21
■ <b>CHAPTER 5</b>	Record and Play Back.....	29
■ <b>CHAPTER 6</b>	Make Some Noise! .....	33
■ <b>CHAPTER 7</b>	Wired! .....	39
■ <b>CHAPTER 8</b>	True or False?.....	47
■ <b>CHAPTER 9</b>	Feedback .....	53
■ <b>CHAPTER 10</b>	Wait for It!.....	63
■ <b>CHAPTER 11</b>	Round and Round .....	71
■ <b>CHAPTER 12</b>	Decisions, Decisions.....	83
■ <b>CHAPTER 13</b>	Stop It .....	95
■ <b>CHAPTER 14</b>	Pick a Card, Any Card .....	99
■ <b>CHAPTER 15</b>	Apples and Oranges .....	105
■ <b>CHAPTER 16</b>	Inside or Out? .....	115
■ <b>CHAPTER 17</b>	Yes? No? Maybe? .....	125
■ <b>CHAPTER 18</b>	Title = Anything You Like .....	133
■ <b>CHAPTER 19</b>	Basic Text.....	147
■ <b>CHAPTER 20</b>	Basic Math .....	151
■ <b>CHAPTER 21</b>	Staying Alive.....	155

■ CHAPTER 22	Your Own Filing Cabinet . . . . .	157
■ CHAPTER 23	Calibration . . . . .	163
■ CHAPTER 24	Get Reset . . . . .	167
■ CHAPTER 25	Messages . . . . .	171
■ CHAPTER 26	My Block Is Your Block . . . . .	177
■ APPENDIX	Math Basics for NXT . . . . .	185
■ INDEX	. . . . .	189



# Contents

About the Author .....	xi
About the Technical Reviewer.....	xiii
Acknowledgments.....	xv
Introduction .....	xvii
■ <b>CHAPTER 1   Robots and Programs .....</b>	<b>1</b>
What Is a Robot? .....	1
What Is a Program? .....	1
NXT-G .....	4
■ <b>CHAPTER 2   Program Structure.....</b>	<b>7</b>
What Do I Mean by Structure? .....	7
■ <b>CHAPTER 3   Hello World! .....</b>	<b>11</b>
The DISPLAY Block .....	11
Data Hubs .....	16
■ <b>CHAPTER 4   Get Movin' .....</b>	<b>21</b>
The MOVE block .....	21
Moving Forward and Backward .....	22
Stopping .....	24
Steering .....	24
Power Settings .....	25
Duration Settings .....	25
Braking and Coasting .....	27
■ <b>CHAPTER 5   Record and Play Back.....</b>	<b>29</b>

<b>CHAPTER 6</b>	<b>Make Some Noise!</b>	33
	The SOUND Block	33
	Action Settings	34
	Note Settings	34
	Control Settings	35
	Function Settings	35
	Volume Settings	35
	Wait Settings	35
<b>CHAPTER 7</b>	<b>Wired!</b>	39
	Passing Around Information	39
<b>CHAPTER 8</b>	<b>True or False?</b>	47
	One or the Other	47
<b>CHAPTER 9</b>	<b>Feedback</b>	53
	What's Your Condition?	53
	Configuring the Sensors	54
	NXT Touch Sensor	55
	RIS Touch Sensor	56
	NXT Sound Sensor	57
	NXT Light Sensor	57
	RIS Light Sensor	58
	NXT Ultrasonic Sensor	58
	NXT Rotation Sensor	59
	RIS Rotation Sensor	59
	RIS Temperature Sensor	60
	Other Input Types	60
	Using the Blocks	61



<b>CHAPTER 10</b>	<b>Wait for It!</b>	63
	The WAIT Block	63
	The LIGHT SENSOR WAIT Block	66
	The NXT BUTTONS WAIT Block	66
	The ROTATION SENSOR WAIT Block	67
	The SOUND SENSOR WAIT Block	67
	The TIMER WAIT Block	68
	The TOUCH SENSOR WAIT Block	69
	The ULTRASONIC SENSOR WAIT Block	69
<b>CHAPTER 11</b>	<b>Round and Round</b>	71
	Do It Again and Again and Again....	71
	Nested Loops	78
<b>CHAPTER 12</b>	<b>Decisions, Decisions</b>	83
	Left or Right? Door 1 or Door 2?	83
<b>CHAPTER 13</b>	<b>Stop It</b>	95
	The STOP Block	95
<b>CHAPTER 14</b>	<b>Pick a Card, Any Card</b>	99
	The RANDOM Block	99
	The NUMBER TO TEXT Block	101
<b>CHAPTER 15</b>	<b>Apples and Oranges</b>	105
	The COMPARE Block	105
<b>CHAPTER 16</b>	<b>Inside or Out?</b>	115
	The RANGE Block	115
<b>CHAPTER 17</b>	<b>Yes? No? Maybe?</b>	125
	The LOGIC Block	125

■ <b>CHAPTER 18</b>	<b>Title = Anything You Like</b> .....	133
	The VARIABLE Block .....	133
■ <b>CHAPTER 19</b>	<b>Basic Text</b> .....	147
	The TEXT Block .....	147
■ <b>CHAPTER 20</b>	<b>Basic Math</b> .....	151
	The MATH Block .....	151
■ <b>CHAPTER 21</b>	<b>Staying Alive</b> .....	155
	The KEEP ALIVE Block .....	155
■ <b>CHAPTER 22</b>	<b>Your Own Filing Cabinet</b> .....	157
	The FILE ACCESS Block .....	157
■ <b>CHAPTER 23</b>	<b>Calibration</b> .....	163
	The CALIBRATE Block .....	163
■ <b>CHAPTER 24</b>	<b>Get Reset</b> .....	167
	The RESET MOTOR Block .....	167
■ <b>CHAPTER 25</b>	<b>Messages</b> .....	171
	The SEND MESSAGE Block .....	171
■ <b>CHAPTER 26</b>	<b>My Block Is Your Block</b> .....	177
	Creating a My Block .....	177
■ <b>APPENDIX</b>	<b>Math Basics for NXT</b> .....	185
	Converting Between Degrees and Rotations. ....	185
	Converting Degrees and Rotations into Distances .....	186
	The X/Y Coordinate System in NXT .....	188
■ <b>INDEX</b> .....		189