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Third Edition

Programming Arduino®

Getting Started with Sketches

- New chapter on Arduino-compatible boards
- Includes the Arduino Web Editor
- Fully revised for Arduino IDE 1.8

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Programming Arduino®

Getting Started with Sketches

THIRD EDITION

Simon Monk

New York Chicago San Francisco
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To my boys, Stephen and Matthew, from a very proud Dad.

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About the Author

Simon Monk has a bachelor's degree in cybernetics and computer science and a doctorate in software engineering. He has been an active electronics hobbyist since his school days and is an occasional author in hobby electronics magazines. Dr. Monk is also author of some 20 books on Maker and electronics topics, especially Arduino and Raspberry Pi. Simon also designs products for MonkMakes Ltd. https://monkmakes.com

You can find out more about his books at http://simonmonk.org. You can also follow him on Twitter, where he is @simonmonk2.

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PREFACE

The first edition of this book was published in November 2011 and has been Amazon's highest ranking book on Arduino.

The Arduino Uno is still considered to be the standard Arduino board. However, many other boards, including both official Arduino boards (like the Leonardo, Nano, and Pro Mini) and other Arduino-compatible devices like the Raspberry Pi Pico, ESP32-based boards, and numerous Feather boards from Adafruit have also appeared.

The Arduino software is available for so many families of microcontroller, that it has become the environment of choice for many embedded programmers.

This edition also addresses the use of Arduino in Internet of Things (IoT) projects and the use of various types of display including OLED and LCD.

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INTRODUCTION

Arduino interface boards provide a low-cost, easy-to-use technology to create microcontroller-based projects. With a little electronics, you can make your Arduino do all sorts of things, from controlling lights in an art installation to managing the power on a solar energy system.

There are many project-based books that show you how to connect things to your Arduino, including *30 Arduino Projects for the Evil Genius* by this author. However, the focus of this book is on programming the Arduino and Arduino-compatible boards using the Arduino IDE.

This book will explain how to make programming the Arduino simple and enjoyable, avoiding the difficulties of uncooperative code that so often afflict a project. You will be taken through the process of programming the Arduino step by step, starting with the basics of the C programming language that Arduinos use.

So, What Is Arduino?

The word “Arduino” has come to mean both the hardware and a software environment for programming microcontroller boards. Because microcontroller boards come in all shapes and sizes, our standard board will be the most popular official Arduino board, the Arduino Uno.

The Arduino Uno is a small microcontroller board with a universal serial bus (USB) plug to connect to your computer and a number of connection sockets that can be wired to external electronics such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, and more. They can be powered either through a USB connection from the computer, a battery, or from a power supply. They can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently.

The board design of official Arduino boards and many Arduino-compatible boards is open source. This means that anyone is allowed to make Arduino-compatible boards. This competition has led to low costs for the boards and all sorts of variations on the “standard” boards.

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The basic boards are supplemented by accessory shield boards that can be plugged on top of the Arduino board.

The software for programming your Arduino is easy to use and also freely available for Windows, Mac, and Linux computers. There is also a browser-based version of the software.

What Will I Need?

This is a book intended for beginners, but it is also intended to be useful to those who have used Arduino for a while and want to learn more about programming the Arduino or gain a better understanding of the fundamentals. As such, this book concentrates on the use of the Arduino Uno board, apart from Chapter 10 that uses an ESP32 Arduino-compatible board; however, almost all of the code will work unmodified on all the Arduino models and various Arduino-compatible microcontroller boards.

You do not need to have any programming experience or a technical background, and the book's exercises do not require any soldering. All you need is the desire to make something.

If you want to make the most of the book and try out some of the experiments, then it is useful to have the following on hand:

- A few lengths of solid core wire
- A cheap digital multimeter

Both are readily available for a few dollars from a hobby electronics store or online retailer such as Adafruit or Sparkfun. You will of course also need an Arduino, ideally an Arduino Uno and for Chapter 10, a low-cost ESP32 Arduino-compatible such as the Lolin32 Lite.

If you want to go a step further and experiment with displays, then you will need to buy those too. See Chapters 9 and 10 for details.

Using This Book

This book is structured to get you started in a really simple way and gradually build on what you have learned. You may, however, find yourself skipping or skimming some of the early chapters as you find the right level to enter the book.

The book is organized into the following chapters:

- **Chapter 1: Getting Started** Here you conduct your first experiments with your Arduino board: installing the software, powering it up, and uploading your first sketch.
- **Chapter 2: C Language Basics** This chapter covers the basics of the C language; for complete programming beginners, the chapter also serves as an introduction to programming in general.
- **Chapter 3: Functions** This chapter explains the key concept of using and writing functions in Arduino sketches. These sketches are demonstrated throughout with runnable code examples.
- **Chapter 4: Arrays and Strings** Here you learn how to make and use data structures that are more advanced than simple integer variables. A Morse code example project is slowly developed to illustrate the concepts being explained.
- **Chapter 5: Input and Output** You learn how to use the digital and analog inputs and outputs on the Arduino in your programs. A multimeter will be useful to show you what is happening on the Arduino's input/output connections.
- **Chapter 6: Boards** In this chapter we will look at the wide range of Arduino and Arduino-compatible boards to help you choose the right board for your project.
- **Chapter 7: Advanced Arduino** This chapter explains how to make use of the Arduino functions that come in the Arduino's standard library and some other more advanced features of Arduino programming.
- **Chapter 8: Data Storage** Here you learn how to write sketches that can save data in electrically erasable programmable read-only memory (EEPROM) and make use of the Arduino's built-in flash memory.
- **Chapter 9: Displays** In this chapter, you learn how to interface an Arduino with displays and to make a simple USB message board.
- **Chapter 10: Arduino Internet of Things Programming** You learn how to make the Arduino behave like a web server and communicate with the Internet using services.

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Resources

This book is supported by an accompanying web page.

www.arduinobook.com

There you will find all the source code used in this book as well as other resources, such as errata.

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