No bigger than a postage stamp and priced at just $50, the tiny but mighty Intel Edison is comparable in power to an entry-level Windows 8 tablet. Makers love it for its versatility as a communications device, for its applications to wearable technology, and for its ability to connect with the world.

Running a Linux-based operating system and Arduino compatible, the Edison is Internet of Things-ready and wants to be the brains of your next project! Written by an Intel research scientist, this book introduces the Edison, explains its many possibilities, and lays out the foundation for a beginning Maker to start using it immediately.

With Make: Getting Started with Intel Edison, you’ll learn to:

» Use Computer Vision tools to recognize faces and objects
» Create your own MP3 player and audio recorder
» Recognize and decipher human speech—make your own Siri or Echo!
» Code in Python on the Edison
» Connect external devices with I2C and SPI
» Install additional software packages with opkg

This book introduces you to the wide world of possibilities that the tiny Edison contains. You’ll find complete installation instructions, an introduction to the Arduino-based programming environment, and a guide to getting started with Python programming on the Edison. You’ll also discover how to work with sensors, add Bluetooth to your project, and connect to the Internet with WiFi.
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Intel Edison is ... well, it’s hard to say. Intel Edison is so many different things. If someone told you about Edison 10 years ago, you would have thought that person was utterly insane.

At its core, Intel Edison is a very powerful and cheap little computer. Priced at around $50 USD, this dual-core Atom processor is comparable to an entry-level Windows 8 tablet. At only a small fraction of the cost, it contains all the software amenities of modern-day computing. The system contains 1 GB of memory and 4 GB of storage to handle heavy computational tasks and data logging.

Intel Edison is a communications device. It comes integrated with Bluetooth and WiFi capabilities and preinstalled software to run both.

Intel Edison is a hardware development platform. It contains an Intel Quark microcontroller that allows you to program and control connected devices and circuits. It’s also Arduino-compatible, meaning the vast majority of shields, code examples, and libraries that have been specifically designed for Arduino will work as is with Edison, too.

Finally, Intel Edison is an embedded device, designed for the Internet of Things (IoT) and wearable technology. Even though Intel Edison is a computer, communications device, and hardware development platform, it weighs only eight grams, is approximately the size of a postage stamp, and can run in low power modes.

While on the subject, it’s worth taking a moment to discuss what Edison is not. Although Edison is a standalone computer
running a full Linux operating system, it’s meant to be the brains of your connected and wearable devices—not a laptop or desktop in the traditional sense. For this reason, Edison does not interface with a display, keyboard, or mouse on its own; you connect to Edison through a host computer and load your software directly on the module. Edison is not a great choice if you’re looking to build a home media console or old-school arcade game (though both could still be done, with a lot of work), but it’s a great candidate for a personal assistant, smart watch, automated robot, smart-home controller, or basically any other electronic system you can imagine. What will you make?

---

**Total Cost**

The Edison module alone costs around $50, and if you add the accompanying components to complete every exercise in this book, the total cost is around $200. For a complete materials list, see Appendix A.

---

**What You Can Do with It**

As you can see, Intel Edison is a versatile platform that can be used for a great many applications:

*Learn about computers*

Edison is a great and inexpensive way to learn more about computers at the lowest level. With Edison, you can learn Linux, configure your operating system, learn about kernels and builds, and install and program drivers for your accessories. You can learn about WiFi and Bluetooth networking by programming Edison to be a dynamic wireless hotspot or Bluetooth beacon. Chapter 2 provides an introduction to Linux and the specific operating system (OS) on Edison. Chapter 3 and Chapter 4 touch on Bluetooth commands.

*Learn to program*

Edison is an amazing tool for learning to program; it comes preloaded with many different compilers and interpreters,
and installing more is a breeze. From Chapter 4 onward, this book focuses mainly on programming in Python, but Edison also supports Java, node.js, C, C++, and many more languages. Even Arduino programming is expanded with Edison. Standard Arduino programs consist of compiled C++ based on the avrlibc library, but Edison exposes the Arduino IDE to the full C++ standard programming environment. With these additional libraries, you can make system calls and tap into the power of Linux within your Arduino sketches, making Arduino for Edison a powerful tool. You’ll see how in Chapter 3.

Make
You can use Edison to program your electronics projects. Edison and its accompanying ecosystem support the same inputs and outputs (I/Os) as the Arduino Uno and integrate seamlessly with almost any existing Arduino project (more on this in Chapter 1 and Chapter 3). With its size, connectivity, and computing power, you can build elaborate and computationally heavy systems that interface directly with the web or store data on board. In Chapter 3, you’ll create a range of electronic circuits powered by Edison and program them using the Arduino IDE. Because programming electronics on Edison is not limited to the Arduino IDE, you recreate these same projects in Chapter 4 by programming them in Python. After that, you’ll interface some of these electronics with other computational tasks, leveraging the full power of Edison.

Go to market
Edison was created specifically to lower the barrier to entry for makers hoping to take their ideas and prototypes all the way to product. Edison interfaces with a variety of breakout boards (discussed in Chapter 1), allowing you to rapidly prototype on one while resting assured that your final design will work on another. In this way, you can develop and program without worrying about the final form factor; Edison will handle this for you.
What’s Been Done with It

Sometimes it’s hard to decide what to do with such an interesting new device, especially one with such a range of options. Although Edison has been, at the time of this writing, in production for under a year, a wealth of amazing projects have already been created and you can look to for inspiration:

- Intel’s project gallery
- Hackster’s gallery
- Intel’s Make It Wearable finalists
- Hackaday.io

Who This Book Is For

This book is an introductory tutorial for Intel Edison. It is meant to showcase the versatility of the product and therefore spans a wide range of topics, from Linux to hardware interfaces to Python programming. You don’t need experience in any of these topics to get started, just a little curiosity and a desire to build new things. The only thing you’ll need are some basic computer skills: the ability to move and manipulate files, search within your computer, and install software.

The aim of this book is to help you get started designing, building, and programming end-to-end systems with Edison. This book is in no way a comprehensive guide to systems engineering or computer science—there are many resources available should you want to delve deeper into either of those topics. Instead, this book is meant to inspire you, so that you can take your ideas and concepts very quickly to reality.

Conventions Used in This Book

The following typographical conventions are used in this book:

**Italic**

- Indicates new terms
- URLs
- Email addresses
- Filenames
- File extensions
Constant width
Used for program listings, as well as within paragraphs to refer to program elements such as variable or function names, databases, data types, environment variables, statements, and keywords.

Constant width bold
Shows commands or other text that should be typed literally by the user.

Constant width italic
Shows text that should be replaced with user-supplied values or by values determined by context.

This element signifies a tip, suggestion, or a general note.

This element indicates a warning or caution.

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We have a web page for this book, where we list errata, examples, and any additional information. You can access this page at: http://bit.ly/gsw-intel-edison.

To comment or ask technical questions about this book, send email to bookquestions@oreilly.com.

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Second, to my bosses, Jeff Ota and Lakshman Krishnamurthy, who give me the time and freedom to play with Edison as a part of my actual job. To the remainder of the team, who challenge me every day to build something cool and do something with my life—thank you guys, too.

Super special thanks to my technical editors, Jason Wright (two thank yous!) and Esther Kim, for just being amazing people and friends and putting up with the many edits that this book needed. To Jonathan and Julija for playing the role of my non-technical editors and working through all the examples in the book (and also putting up with my needed edits).

Finally, thanks to my parents for letting me be a very curious child and indulging my need to take everything apart. And to my beautiful wife Kelsey, for tolerating my endless string of electronic and coding projects and my tendency to leave half-finished projects all over our otherwise clean house. I love you.
1/Introduction to Edison

The Intel Edison is an ultra-small computing platform that will change the way you look at embedded electronics. It’s a powerful and adaptable piece of hardware that is compatible with a wide range of cutting-edge software solutions. Basically, Intel Edison is an entry-level Windows 8 tablet the size of a postage stamp that is sold for around $50 USD.

Intel Edison really shines for its small form and integrated wireless communications. For this reason, Edison is intended for embedded and connected devices. However, you’ll see throughout this book that Edison’s incredible computing power and flexible inputs and outputs enable a wide range of applications, from smart homes to self-driving robots to personal assistants.

So far we’ve been talking about the hardware inside the Intel Edison, but you’ll be working with the integrated Intel Edison
compute module. This module is shown in Figure 1-1 and can be accessed via a 70-pin connector on the bottom of the board (shown on the right side of Figure 1-1). While this connector is small and versatile, allowing developers to build custom boards that easily mate with the module, it is not meant for direct access. For this reason, a variety of breakout boards exist to help you get started. These boards break out the functionality of your Edison to a larger module that’s easier to access.

![Figure 1-1. The front and back of the Intel Edison compute module](image)

**Figure 1-1. The front and back of the Intel Edison compute module**

### Tour of Breakout Boards

If you’re reading this book, there’s a good chance that you’ve already purchased your Intel Edison compute module and an accompanying breakout board. While the compute module itself is standard, each breakout board is unique and will change the way you prototype and interface with Edison. For ease of use in this book, I’ll be using the _Arduino Breakout Board_. This board is an Arduino-compatible breakout for Edison. I’ll discuss what this means later in this chapter and a lot more in Chapter 3.

If you’ve not yet purchased this kit, then head over to one of the following retailers where you can buy your board. The cost is approximately $100 USD:

- **Maker Shed**

- **SparkFun**
  [https://www.sparkfun.com/products/13097](https://www.sparkfun.com/products/13097)
You might notice that the product pages all include an Intel Edison compute module with the Arduino breakout. Unfortunately, it is not possible to buy the breakout separately; the Arduino breakout always comes paired with an Edison. If you’ve already purchased a compute module or other breakout board, save it to later migrate your project to a smaller form factor. The Arduino board is the largest of the breakouts and is great for first-round prototypes.

The only other items necessary for getting started are two microUSB cables. Edison requires high-quality microUSB cables for powering the board; substandard cables (like the ones you often get for charging cell phones and other electronics) just won’t cut it, especially if you’re supplying power directly to the Edison via USB. MicroUSB cables can be found easily on Amazon or many other sites if you don’t have them already. Spend a few extra dollars for the good ones.

At the beginning of subsequent chapters, I’ll highlight any other hardware that’s necessary to follow along. The full parts list for the entire book can be found in Appendix A.

**The Arduino Breakout Board**

The Arduino breakout with important labeled components is shown in Figure 1-2.
Figure 1-2. Intel Edison Arduino Breakout Board with labeled components

These important components are:

1. Female 70-pin connector. This connector mates with the male 70-pin connector on the back of the Edison compute module.

2. Buttons. These integrated buttons allow you to mechanically reset or power cycle your Intel Edison or the Arduino breakout.

3. MicroSD slot. While Intel Edison does come with 4 GB of integrated storage, the SD card slot gives the flexibility of adding additional storage to the system.

4. Barrel jack for power. This provides one option for powering your Edison. The barrel jack is the standard interface for a wall adapter power supply, which can be purchased for a few dollars on Amazon or SparkFun. Any supply between 7V and 15V with 500 mA or more will do. Alternatively, a battery with a barrel jack connector will also work, so long as it’s in the same voltage range and can supply at least 500 mA continuously.

5. External USB port. Intel Edison has one full-size USB 2.0 port, selectable via the mechanical microswitch (labeled 6 in Figure 1-2). This port can be used to connect to peripheral devices.
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About the Author

Stephanie Moyerman is a research scientist in the New Devices Group at Intel. Her work focuses on innovation and proof of concept demonstrations for wearable technology. She graduated with a Ph.D in astrophysics from the University of California, San Diego in 2013. Before that, she attended Harvey Mudd College and received dual B.S. degrees in math and physics.

Outside of work, Stephanie’s favorite activity is judo. She’s been a junior and collegiate national champion and has been ranked as high as #5 in the United States. She also enjoys surfing, wakeboarding, running, glass blowing, spoiling her dog, and—of course—making.

Colophon

The cover photo was taken by Brian Jepson. The cover fonts are Benton Sans Bold, Benton Sans Light, and Soho Pro. The text font is Benton Sans, the display font is Serifa, and the code font is TheSansMono Condensed Regular.