

Chapter 1

Get to know your Raspberry Pi

Get fully acquainted with your new credit-card-sized computer by taking a guided tour of the Raspberry Pi. Discover its numerous components and what they do



The Raspberry Pi is a remarkable device: a fully functional computer in a tiny and low-cost package. Whether you're looking for a device you can use to browse the web or play games, are interested in learning how to write your own programs, or are looking to create your own circuits and physical devices, the Raspberry Pi – and its amazing community – will support you every step of the way.

The Raspberry Pi is known as a *single-board computer*, which means exactly what it sounds like: it's a computer, just like a desktop, laptop, or smartphone, but built on a single *printed circuit board*. Like most single-board computers, the Raspberry Pi is small – roughly the same footprint as a credit card – but that doesn't mean it's not powerful: a Raspberry Pi can do anything a bigger and more power-hungry computer can do, though not necessarily as quickly.

The Raspberry Pi family was born from a desire to encourage more hands-on computer education around the world. Its creators, who joined together to form the non-profit Raspberry Pi Foundation, had little idea that it would prove so popular: the few thousand built in 2012 to test the waters were immediately sold out, and millions have been shipped all over the world in the years since. These boards have found their ways into homes, classrooms, offices, data centres, factories, and even self-piloting boats and spacefaring balloons.

Various models of Raspberry Pi have been released since the original Model B, each bringing either improved specifications or features specific to a particular use-case. The Raspberry Pi Zero family, for example, is a tiny version of the full-size Raspberry Pi which drops a few features – in particular the multiple USB ports and wired network port – in favour of a significantly smaller layout and lowered power needs.

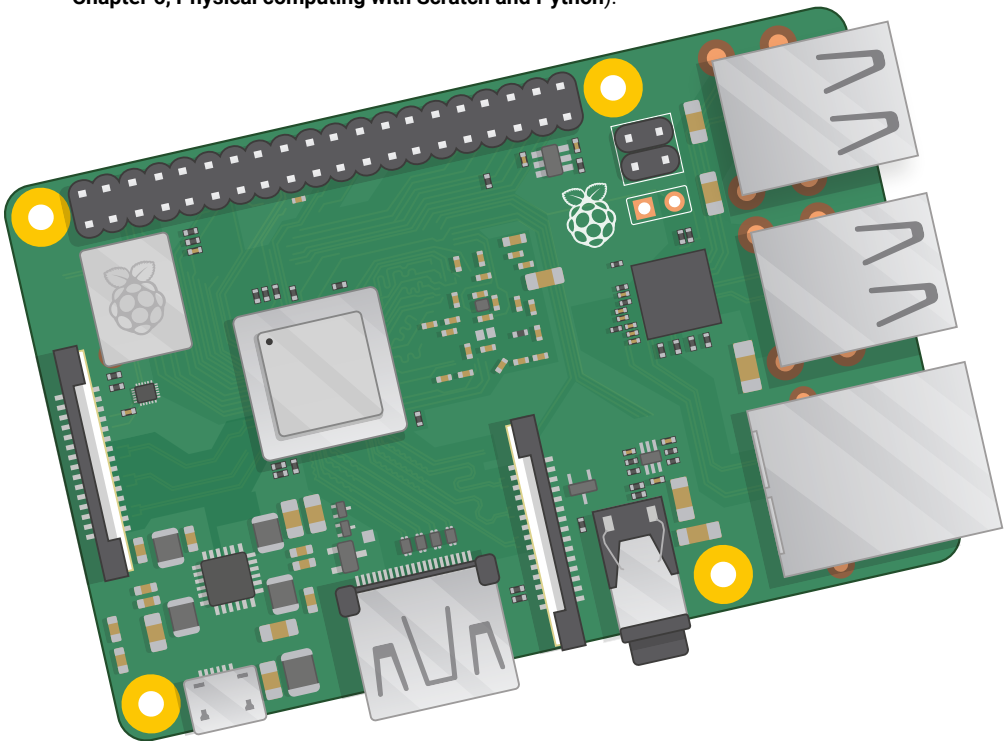
All Raspberry Pi models have one thing in common, though: they're *compatible*, meaning that software written for one model will run on any other model. It's even possible to take the very latest version of the Raspberry Pi's operating system and run it on an original pre-launch Model B prototype. It will run more slowly, it's true, but it will still run.

Throughout this book you'll be learning about the Raspberry Pi 3 Model B+, the latest and most popular version of the Raspberry Pi. What you learn, though, can be easily applied to other models in the Raspberry Pi family, so don't worry if you're using a different version.

A guided tour of the Raspberry Pi

Unlike a traditional computer, which hides its inner workings in a case, a Raspberry Pi has all its components, ports, and features out on display – although you can buy a case to provide extra protection, if you'd prefer. This makes it a great tool for learning about what the various parts of a computer do, and also makes it easy to learn what goes where when it comes time to plug in the various extras – known as *peripherals* – you'll need to get started.

Figure 1-1 (overleaf) shows the Raspberry Pi as seen from above. When you're using a Raspberry Pi with this book, try to keep it turned the same way as in the picture; if it's turned around it can get confusing when it comes to using things like the GPIO header (detailed in **Chapter 6, Physical computing with Scratch and Python**).





◀ **Figure 1-1:** The Raspberry Pi 3 Model B+

While it may look like there's a lot packed into the tiny board, the Raspberry Pi is very simple to understand – starting with its *components*, the inner workings that make the device tick.

The Raspberry Pi's components

Like any computer, the Pi is made up of various different components, each of which has a role to play in making it work. The first, and arguably most important, of these can be found just above the centre point on the top side of the board (**Figure 1-2**), covered in a metal cap: the *system-on-chip* (SoC).



▶ **Figure 1-2:** The Raspberry Pi's system-on-chip (SoC)

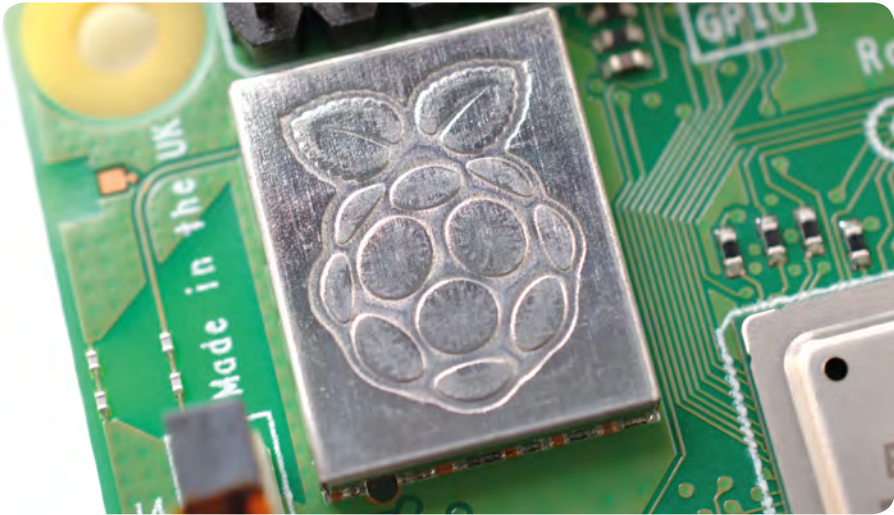
The name system-on-chip is a great indicator of what you would find if you prised the metal cover off: a silicon chip, known as an *integrated circuit*, which contains the bulk of the Raspberry Pi's system. This includes the *central processing unit* (CPU), commonly thought of as the 'brain' of a computer, and the *graphics processing unit* (GPU), which handles the visual side of things.

A brain is no good without memory, however, and on the underside of the Raspberry Pi you'll find exactly that: another chip, which looks like a small, black, plastic square (**Figure 1-3**). This is the Pi's *random access memory* (RAM). When you're working on the Pi, it's the RAM that holds what you're doing; only when you save your work will it be written to the microSD card. Together, these components form the Pi's volatile and non-volatile memories: the volatile RAM loses its contents whenever the Pi is powered off, while the non-volatile microSD card keeps its contents.



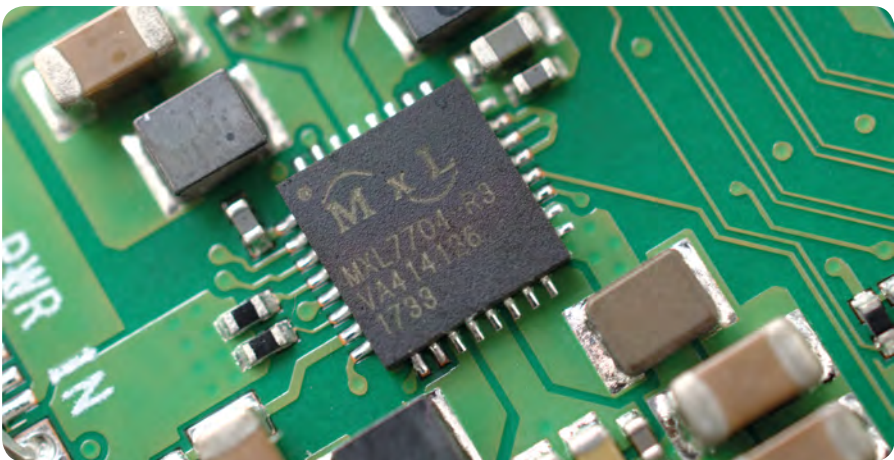
▲ **Figure 1-3:** The Raspberry Pi's random access memory (RAM)

Turning the board over again you'll find another metal lid to the upper-right, this one featuring an etched Raspberry Pi logo (**Figure 1-4**, overleaf). This covers the *radio*, the component which gives the Raspberry Pi the ability to communicate with devices wirelessly. The radio itself acts as two main components, in fact: a *WiFi radio*, for connecting to computer networks; and a *Bluetooth radio*, for connecting to peripherals like mice and for sending data to or receiving data from nearby smart devices like sensors or smartphones.



▲ **Figure 1-4:** The Raspberry Pi's radio module

Another black, plastic-covered chip can be seen to the bottom edge of the board, just behind the middle set of USB ports. This is the *network and USB controller*, and is responsible for running the Ethernet port and the four USB ports. A final black chip, much smaller than the rest, can be found a little bit above the micro USB power connector to the upper-left of the board (**Figure 1-5**); this is known as a *power management integrated circuit (PMIC)*, and handles turning the power that comes in from the micro USB port into the power the Pi needs to run.



▲ **Figure 1-5:** The Raspberry Pi's power management integrated circuit (PMIC)

Don't worry if this seems like a lot to take in; you don't need to know what each component is or where to find it on the board in order to use the Raspberry Pi.

The Raspberry Pi's ports

The Raspberry Pi has a range of ports, starting with four *Universal Serial Bus (USB) ports* (**Figure 1-6**) to the middle and right-hand side of the bottom edge. These ports let you connect any USB-compatible peripheral, from keyboards and mice to digital cameras and flash drives, to the Pi. Speaking technically, these are known as USB 2.0 ports, which means they are based on version two of the Universal Serial Bus standard.



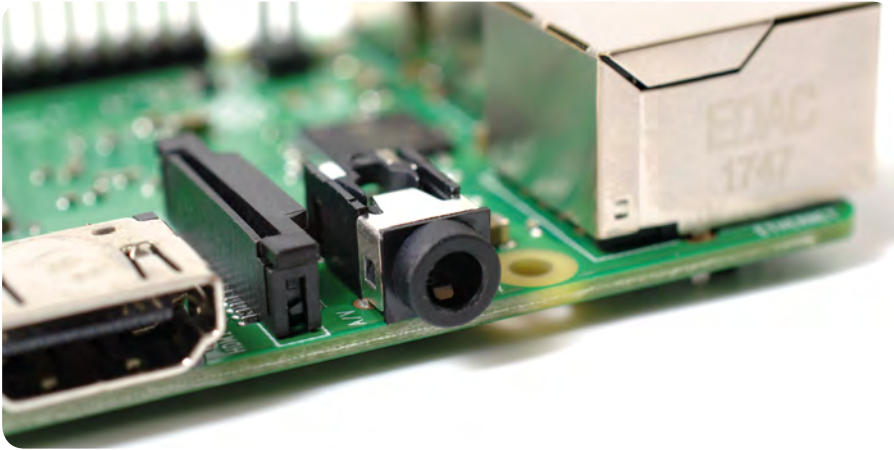
▲ **Figure 1-6:** The Raspberry Pi's USB ports

To the left of the USB ports is an *Ethernet port*, also known as a *network port* (**Figure 1-7**). You can use this port to connect the Raspberry Pi to a wired computer network using a cable with what is known as an RJ45 connector on its end. If you look closely at the Ethernet port, you'll see two light-emitting diodes (LEDs) at the bottom; these are status LEDs, and let you know that the connection is working.



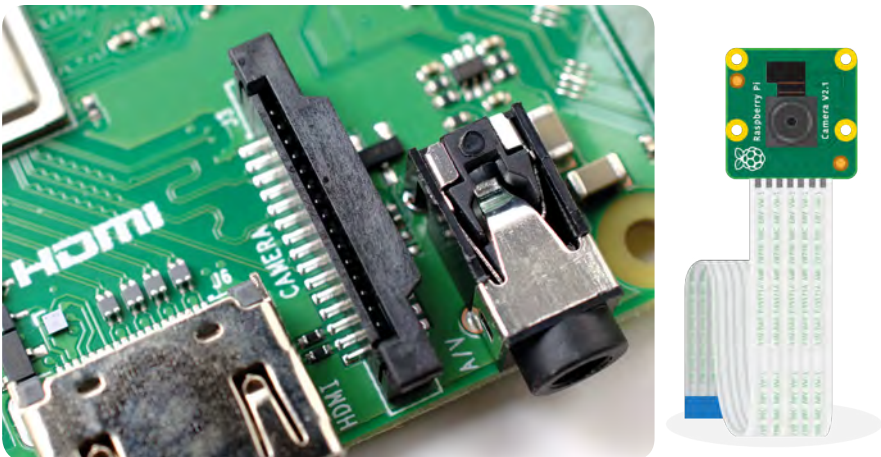
▲ **Figure 1-7:** The Raspberry Pi's Ethernet port

Just above the Ethernet port, on the left-hand edge of the Raspberry Pi, is a 3.5 mm *audio-visual (AV) jack* (**Figure 1-8**). This is also known as the *headphone jack*, and it can be used for that exact purpose – though you’ll get better sound connecting it to amplified speakers rather than headphones. It has a hidden, extra feature, though: as well as audio, the 3.5 mm AV jack carries a video signal which can be connected to TVs, projectors, and other displays that support a *composite video signal* using a special cable known as a *tip-ring-ring-sleeve (TRRS)* adapter.



▲ **Figure 1-8:** The Raspberry Pi's 3.5 mm AV jack

Directly above the 3.5 mm AV jack is a strange-looking connector with a plastic flap which can be pulled up; this is the *camera connector*, also known as the *Camera Serial Interface (CSI)* (**Figure 1-9**). This allows you to use the specially designed Raspberry Pi Camera Module (about which you'll learn more in **Chapter 8, The Raspberry Pi Camera Module**.)



▲ **Figure 1-9:** The Raspberry Pi's camera connector

Above that, still on the left-hand edge of the board, is the *High-Definition Multimedia Interface (HDMI) port* (**Figure 1-10**), which is the same type of connector you'll find on a games console, set-top box, and TV. The multimedia part of its name tells you that it carries both audio and video signals, while high-definition tells you that you can expect excellent quality. You'll use this to connect the Raspberry Pi to your display device, whether that's a computer monitor, TV, or projector.



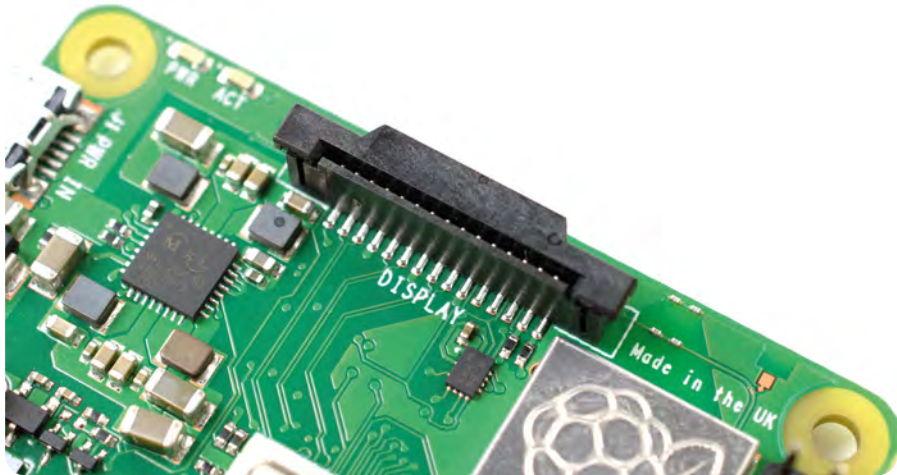
▲ **Figure 1-10:** The Raspberry Pi's HDMI port

Above the HDMI port is a *micro USB power port* (**Figure 1-11**), which you'll use to connect the Raspberry Pi to a power source. The micro USB port is a common sight on smartphones, tablets, and other portable devices. So you could use a standard mobile charger to power the Pi, but for best results you should use the official Raspberry Pi USB Power Supply.

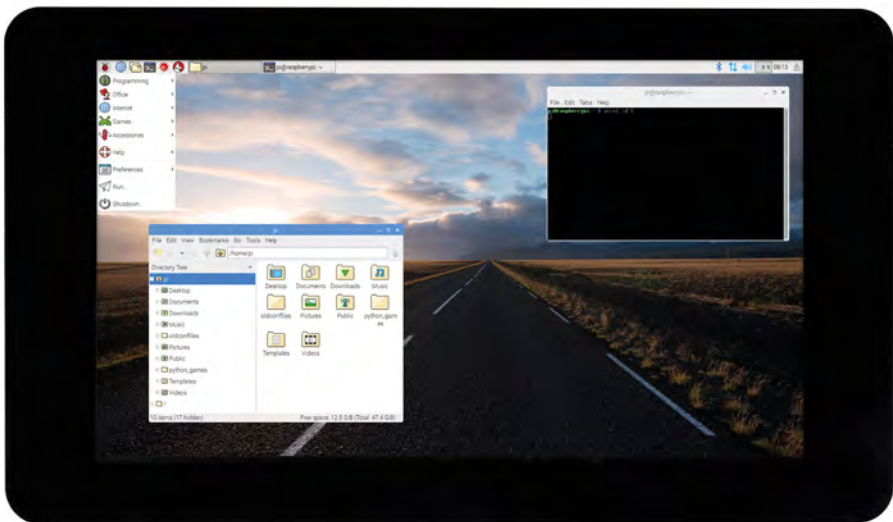


▲ **Figure 1-11:** The Raspberry Pi's micro USB power port

At the top edge of the board is another strange-looking connector (**Figure 1-12**), which at first glance appears to be identical to the camera connector. This, though, is the exact opposite: a *display connector*, or *Display Serial Interface (DSI)*, designed for use with the Raspberry Pi Touch Display (**Figure 1-13**).



▲ **Figure 1-12:** The Raspberry Pi's display connector (DSI)



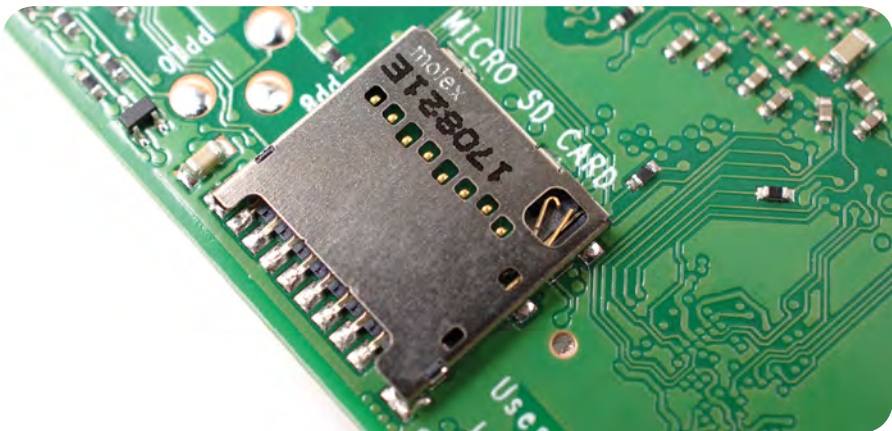
▲ **Figure 1-13:** The Raspberry Pi Touch Display

At the right-hand edge of the board you'll find 40 metal pins, split into two rows of 20 pins (**Figure 1-14**). This is the GPIO (general-purpose input/output) header, a feature of the Raspberry Pi used to talk to additional hardware from LEDs and buttons all the way to temperature sensors, joysticks, and pulse-rate monitors. You'll learn more about the GPIO header in **Chapter 6, Physical computing with Scratch and Python**. Just below and to the left of this header is another, smaller header with four pins: this is used to connect the Power over Ethernet (PoE) HAT, an optional add-on which lets the Raspberry Pi receive power from a network connection rather than the micro USB socket.



▲ **Figure 1-14:** The Raspberry Pi's GPIO header

There's one final port on the Raspberry Pi, but you won't see it on the top. Turn the board over and you'll find a microSD card connector on the opposite side of the board to the display connector (**Figure 1-15**). This is the Raspberry Pi's storage: the microSD card inserted in here contains all the files you save, all the software you install, and the operating system that makes the Raspberry Pi run.



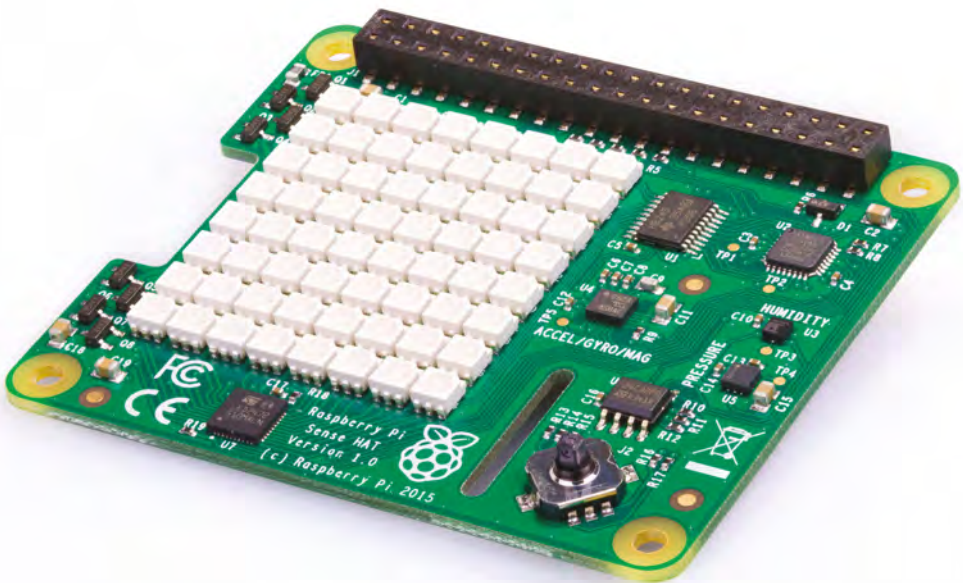
▲ **Figure 1-15:** The Raspberry Pi's microSD card connector

The Raspberry Pi's peripherals

A Raspberry Pi by itself can't do very much, just the same as a desktop computer on its own is little more than a door-stop. To work, the Raspberry Pi needs peripherals: at the minimum, you'll need a microSD card for storage; a monitor or TV so you can see what you're doing; a keyboard and mouse to tell the Pi what to do; and a 5 volt (5V) micro USB power supply rated at 2.5 amps (2.5 A) or better. With those, you've got yourself a fully functional computer. You'll learn how to connect all these peripherals to your Raspberry Pi in **Chapter 2, Getting started with your Raspberry Pi**.

Those aren't the end of the peripherals you can use with your Pi, though. Official accessories produced by the Raspberry Pi Foundation include: the Raspberry Pi Case, which helps protect the Pi while you're using it without blocking your access to its various ports; the Camera Module, detailed in **Chapter 8, The Raspberry Pi Camera Module**; the Raspberry Pi Touch Display, which connects to the display port and provides both a video display and a tablet-style touchscreen interface; and the Sense HAT (**Figure 1-16**), a clever multifunctional add-on which is detailed in full in **Chapter 7, Physical computing with the Sense HAT**.

A wide assortment of third-party accessories are also available, ranging from kits to turn a Raspberry Pi into a laptop or tablet, to add-ons which give it the ability to understand your speech and even talk back to you. While it's tempting to run out and fill a shopping trolley, though, remember that you'll need to learn to walk with your Raspberry Pi before taking on the hardware equivalent of a marathon!



▲ **Figure 1-16:** The Sense HAT

