CHEAT SHEET: RASPBERRY PI

TechRepublic

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Raspberry Pi: A cheat sheet

Everything you need to know about the tiny, ultra-cheap computer that has taken the world by storm.

BY NICK HEATH

The Raspberry Pi's success defied expectations. Conceived as an affordable computer for getting kids to learn how to code, its creators thought they'd sell 1,000. They've now sold more than 30 million.

In March 2020 alone, the company shipped a staggering 640,000 units--its second-highest sales month on record. And with the arrival of the 8GB Model B, the humble, single-board Raspberry Pi is beginning to take on the mainstream PC market with increasing gusto.

Needless to say, this British-designed, credit card-sized computer has been nothing short of a cultural phenomenon. This cheat sheet explains why.

QUICK SUMMARY

- **What is the Raspberry Pi?** A credit card-sized computer that costs as little as $5, which spawned a community of millions of amateur developers and hardware hackers.
- **What does the Raspberry Pi do?** A lot. Despite its low-cost, the Pi can be run as no-frills PC, a pocketable coding computer, a hub for homemade hardware and more.
- **Why does the Raspberry Pi matter?** The Pi is a great machine for stoking interest in programming among schoolchildren worldwide and helping create the next generation of developers.

The latest version of the Raspberry Pi, which came out earlier this year.

IMAGE: MATT RICHARDSON MRICHARDSON23@GMAIL.COM

- **Who does the Raspberry Pi affect?** Anyone with the inclination to pick up a Pi and start tinkering.
- **What are the Raspberry Pi's competitors?** Some boards beat the Pi 4 on specs, such as the Rock Pi 4, and others on price, but few have the Pi's breadth of software and community support.
- **When is the Raspberry Pi available?** Right now. More than 30 million Pi boards have sold since the machine's launch in 2012 and demand has boosted by the release of the Raspberry Pi 4 Model B.
- **Where is the Raspberry Pi being used?** All over the world, with the Pi's official forums supporting a community of more than 260,000 active users.
- **Who is making it happen?** A not for profit charity on a mission to get the world interested in how computers work.
- **How can I get the Raspberry Pi?** Online from Raspberry Pi official resellers.

WHAT IS THE RASPBERRY PI?

The Raspberry Pi is a family of credit card-sized single board computers that have become the best-selling UK computers of all time.

Key to the Pi's success has been its price. It's not the most powerful machine in the world, but for less than $60 it offers a computer that can be used to build homebrew electronics and put together a vast range of devices on a budget.

The charitable foundation behind the Pi hasn't rested on its laurels, upgrading the Pi's specs three times since launch, while keeping the price at $35 - $55. In that time, the Pi's processing power has grown more than tenfold, putting the Pi into the category of a machine that could be used as an everyday PC. In hard specs, the top-end model, the Raspberry Pi 4 Model B, has a 1.5 GHz quad-core, 64-bit Arm Cortex A72-based, quad-core processor, up to 8GB RAM, a VideoCore VI capable of 4K video playback, 802.11ac Wi-Fi and Gigabit Ethernet, and two USB 2.0 and two USB 3.0 ports.

WHAT DOES THE RASPBERRY PI DO?

The Pi was created as an affordable machine that would help kids learn how computers work but has arguably become far more than that.

You can use the Pi as a desktop PC replacement, particularly if you choose the top-end 8GB Raspberry Pi 4 Model B, though there's a myriad of possible uses for the board.

Media center, file server, weather station, virtual assistant, smart home hub, 'high performance' clusters, virtual desktop thin client, robot brain, Lego-powered book scanner, retro games console, eye-in-the-sky, drone guidance, low-cost ventilator -- you name it, someone's done it.

If none of these take your fancy then there's always the option of using the wealth of programming-oriented software bundled with the Pi's official Raspberry Pi OS - formerly Raspbian--to learn about coding and hardware hacking.

The Pi has been the bedrock of some spectacular creations and has even made the trip to the International Space Station.

Setting up the Pi is slightly different, and possibly slightly more complex, than your average computer desktop, though not by much. There are easy to follow guides online, and the NOOBS (New Out-Of-Box Software) installer makes getting the computer up and running relatively easy.

Depending on what you want to do, NOOBS can install various operating systems, for example, Raspberry Pi OS for a desktop PC, or the software OSMC for a media center. Once set up with the Pi's official OS, you have all the basics you'd expect from a desktop PC, such as a word processor, web browser, and email client, and are able to choose more apps from the Recommended Software menu. On first boot, Raspberry Pi OS also presents users with a setup wizard that handles Wi-Fi connectivity and other initial tasks.

The price of the Pi is a bone of contention for some, who point out that while the board itself sells from $35, getting a Pi up and running requires a keyboard, likely a mouse, screen, power supply and SD card. The cost of this equipment adds up to more than that of the Pi itself, however, as the charitable foundation that makes the Pi rightly point out, most households have some, if not all, of this equipment. The Pi's variety of display ports also means it can use old and new TVs, as well as monitors, as a display.

As the Pi's specs have improved, and the community has discovered new ways of tapping its hardware, so people have found new uses for the board. The Pi already runs a plethora of Linux-based operating systems but the stable of OSes it can run is expanding all the time, and already runs the gamut from the venerable RiscOS through to work-in-progress versions of Android to the Chromium OS-based FlintOS.

You can even get a form of Microsoft Windows to runs on the board. The Pi runs Windows 10 IoT Core, a cut-down version of Windows 10, not designed to run a desktop PC but instead to help hardware hackers prototype Internet of Things (IoT) appliances using the Pi.

RASPBERRY PI: MODELS AND TECH SPECS

Not only are there four different generations of Pi, but a variety of models. The Raspberry Pi 4 is available as the Model B, while the 3 is sold as the Model A, Model B and Model B+, basically an overclocked Model B with faster Wi-Fi. Meanwhile, the Raspberry Pi 2 is available as a Model B, and the Raspberry Pi 1 as the Model B and the lesser specced Model A. The Model A lacks Ethernet, has less memory than the B and only has one USB port. However, it sells for the lower price of $25 and draws less power.

Generally, the Pi 4 Model B is the better choice than the Pi 3, as it offers better specs for the same price. However, the Pi 1, while a good deal less powerful, is cheaper than the Pi 3, and also available in the more compact, less power hungry Model A configuration.

And if you thought $35 was as cheap as a useful computer could be, then think again. The even more diminutive Pi Zero is priced at just $5. Despite costing less than a Big Mac meal, the Pi Zero can do useful work, with tech specs slightly better than those of the original Raspberry Pi Model B that launched in 2012.

The Pi Zero's price, tiny size, and low power consumption means it has obvious limitations compared to its bigger siblings. It only has one USB On The Go port and the original Pi Zero lacks network connectivity. However, the $10 Raspberry Pi Zero W supports 802.11b/g/n Wi-Fi and Bluetooth 4.0. The Pi Zero is less suited to being used as a PC and more to being packed into a standalone IoT device or automated appliance, such as a weather station, where space is at a premium or minimal power draw is needed. If you want to hook the Zero up to homemade circuit boards and other DIY hardware, however, you'll have to solder the pins onto the board's unpopulated GPIO header.

Here's a quick spec overview of each Raspberry Pi model:

The Raspberry Pi 4 Model B uses a 1.5GHz 64-bit quad-core Arm Cortex-A72 CPU, has three RAM options (2GB, 4GB, 8GB), gigabit Ethernet, integrated 802.11ac/n wireless LAN, and Bluetooth 5.0.

The Raspberry Pi 3 Model B+ uses a 1.4GHz 64-bit quad-core Arm Cortex-A53 CPU, has 1GB RAM, gigabit Ethernet, integrated 802.11ac/n wireless LAN, and Bluetooth 4.2.

The Raspberry Pi 3 Model B uses a 1.2GHz 64-bit quad-core Arm Cortex-A53 CPU, has 1GB RAM, integrated 802.11n wireless LAN, and Bluetooth 4.1.

The Raspberry Pi 2 shares many specs with the Raspberry Pi 1 B+, and originally used a 900MHz quad-core Arm Cortex-A7 CPU and has 1GB RAM. More recent versions of the Raspberry Pi 2 use a 900MHz Arm Cortex-A53 CPU.

The Raspberry Pi Model B+ is the final revision of the original Raspberry Pi 1. It has 512MB RAM, four USB ports, 40 GPIO pins, and an Ethernet port.

The Raspberry Pi Model A+ is the low-cost variant of the Raspberry Pi 1. It has 512MB RAM, one USB port, 40 GPIO pins, and no Ethernet port.

The Raspberry Pi Zero and **Raspberry Pi Zero W/WH** are half the size of the Model A+ and feature a 1GHz single-core CPU and 512MB RAM, mini-HDMI and USB On-The-Go ports and a camera connector. The Raspberry Pi Zero W also has integrated 802.11n wireless LAN and Bluetooth 4.1. The Raspberry Pi Zero WH is identical to the Zero W, but comes with a pre-soldered header.

WHY DOES THE RASPBERRY PI MATTER?

The Pi is a great machine for learning about how to get to grips with computers and is available at a price that makes it hugely accessible.

The machine's official Raspberry Pi OS is loaded with tools for learning how to program, from the drag-and-drop coding offered by Scratch to various aids for writing and debugging the programming language Python and Java. Work continues to improve how the OS performs and looks, including a visual overhaul with the release of the Pixel desktop, ongoing upgrades to the performance of the Chromium browser, new startup wizards, and a greater range of software verified to work well on the Pi. But as the abundance of Pi-powered electronics suggests, the board will let you dabble in more than just software.

If you want to break out the soldering iron and start learning about breadboards (think pluggable circuit boards rather than freshly cut loaves) then the Pi's also got you covered.

For hardware hacking, the Pi is equipped with 40 general purpose input/output pins, electrical channels that allow the board to communicate with other computers or electronics and are the key to the Pi's use in some of the more ambitious hardware projects involving robots and drones. Getting started with hardware is relatively easy, thanks to the abundance of starter kits that bundle the boards and other electronics you need.

Today, the Pi is much more than just a cheap, tiny board running Linux, thanks to an ecosystem of products -- some official, some unofficial -- that extend what the board can do, from the official, $50 High Quality Camera, to add-on boards that combine the Pi with the Arduino prototyping platform.

Various third parties have built new Pi-powered creations aimed at furthering the foundation's mission of educating a new generation about computing -- whether it's the Pi-Top, a build it yourself Pi-powered laptop with a neon green case, or the kid-friendly computer kit Kano.

WHO IS THE RASPBERRY PI FOR?

The board has proven to be a firm favorite, not only with the community of amateur hackers who leaped on the Pi after its release, but also many schoolchildren worldwide.

More recently, the Pi has transcended its roots as a hobbyist darling and is beginning to be used by businesses to drive appliances and prototype electronics, as well as for industrial control, such as factory automation and DevOps monitoring, and as a desktop thin client. The Raspberry Pi 4 Model B saw popularity skyrocket during the 2020 coronavirus pandemic, as consumers scrambled to find affordable solutions for working and learning from home. At the same time, enterprising medical researchers in Columbia began experimenting with Raspberry Pi boards to determine whether they could offer a low-cost means of powering ventilators for treating COVID-19 patients.

To complement its use by business, the foundation released the Raspberry Pi compute module, which packs the processor and memory of the Pi onto a slim board the size of a memory module. The idea of the compute board is to make it easier to build a custom appliance around the Pi, as the compute module can be plugged into a baseboard with all of the necessary peripheral circuitry. A version of the compute module based on the Raspberry Pi 3 was released early in 2017.

WHAT ARE THE RASPBERRY PI'S COMPETITORS?

While the Pi wasn't the first single board computer, its success helped spawn a host of competitors.

These challengers typically replicate the board's design but either at a higher spec, such as the RockPi 4C, Hardkernel Odroid-C4, or at a lower price, such as the Orange Pi.

Boards like the Odroid-C4 expose the fact the Pi doesn't necessarily offer the best bang for your buck in this ultra-low price range. The flipside is that most of these Raspberry Pi rivals don't enjoy the range of good quality software and strong community support that has grown up around the Pi since it launched eight years ago. Buying a Pi also has the advantage of supporting the Raspberry Pi Foundation, a charity committed to furthering computer science education. Also, spec sheets don't always tell the whole story, with boards that look more powerful on paper not always performing as expected, due to a bottleneck or poor component choice.

There are also boards that are sometimes pitched as competitors to the Pi, but which instead complement the Pi's strengths. Examples include Arduinos, which are microcontroller boards suited to simple repetitive tasks controlling other electronic hardware, rather than the general-purpose computing tasks the Pi can handle.

WHEN IS THE RASPBERRY PI AVAILABLE?

Now and for the foreseeable future. More than 30 million Pi boards have sold since the machine's launch in 2012, with little sign of demand letting up.

The recent release of the 8GB model of the Raspberry Pi 4 Model B should further fuel the already impressive sales, while the Pi's range of form factors is helping it break into new markets.

WHERE IS THE RASPBERRY PI BEING USED?

Across the globe. What made the Pi a massive success and continues to make it a great choice for learning about machines today, is the strength of its community worldwide. The Pi is sold in many countries and the Raspberry Pi forums have more 305,000 members who share tips and help each other out with projects and troubleshooting.

The Pi not only has an official website full of mods and hacks for people to get started, but there is also an official magazine that publishes news and new projects.

WHO IS MAKING IT HAPPEN?

A UK-based, not for profit charity called the Raspberry Pi Foundation.

The foundation's mission is to advance computer science education, and on that front, its flagship machine has certainly made an impact.

Not only is the Pi used in schools, its availability has also coincided with an almost tripling in the number of people applying to study computer science at Cambridge. This bubbling up of interest is a major victory for the foundation's founder and board co-creator Eben Upton. The Pi was partly born out of a desire to address the dwindling trickle of candidates applying to study computer science at Cambridge in the mid-2000s. Upton described the shrinking intake for one of the best computer science courses in the country as an 'Oh shit' moment that led him to begin designing the board.

The success of the Pi has allowed the foundation to employ about a large number of staff, focused on creating teaching resources and running outreach projects with schools and at shows, while the foundation's subsidiary Raspberry Pi Trading focuses on the engineering and selling new boards and official products.

HOW CAN I GET THE RASPBERRY PI?

Easily. The Pi is available online from Raspberry Pi official resellers, as well as the official Raspberry Pi store in Cambridge in the UK and Micro Center stores in the US.

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