RASPBERRY PI: A GUIDE FOR THE GIFTED

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README.MD

This is a QR code:

If you know about QR codes, move along to the next bits.

QR stands for quick response. Like a bar code, it's meant to make information easily accessible for processing - by human or machine.

We take a cue here from innovative educators looking for ways to deliver a personal, multimedia-rich reading experience to our school age-childen.

With a QR code, I can convey a set of instructions, supplemental materials, bits of code - some extraordinary amounts of information in less than 100 square pixels. The code to the left is intended to provide some insight into the design decisions that had to be made to create and deliver the Raspberry Pi. It's a video introduction from Cambridge given by Eben Upton, Raspberry Pi's lead developer. Via YouTube, Upton offers a short description of the device and the intentions that informed its design.

Could we get along without? Surely. We aren't naive enough to believe this will revolutionize print. We fell for that once in the 1990s when "hypertext" seemed capable of so much.

To benefit from QR codes, we need a device capable of decoding them. Smart phones with cameras come immediately to mind: apps are available for iOS and Android phones to both decode and generate QR codes. We can also generate QR codes at various sites around the web or from our PCs, if we install the right free software.

Once you download a capable app up to your phone, launch it and point your camera at a QR code; when it manages to get a lock on the code, it should process the information and deliver it in the best way it's been taught.

TARGET AUDIENCE

This book is intended for loved ones who have received Raspberry Pis as gifts, expressed their appreciately kindly, and later realized they have never been understood properly and this is just another example, thank you.

It's intended for readers who browse and search the Web with some degree of confidence, predominantly, with success. It's for readers who aren't uncomfortable with the choice to "save" or "save as." When things get rolling, we stop to work through dealing with compressed files with Winzip or Winrar. But really, we expect readers to be comfortable with such utilities.

This is not for readers with vast repositories of disposable income: What we try to do is done with finesse and ease in books already available for the Raspberry Pi. If it helps, the draft title involved, at different points, the words *penurious* and *thrifty*. At every turn we're looking for ways to assure ourselves and our readers that the $35 price point of the Raspberry Pi isn't ridiculously misleading. On the contrary, we find that hacking is just a few dollars away for readers with home networks.

WORK IN PROGRESS

This work isn't finished. At the rate people are innovating with and around this technology, it never will be.

To do:

- Articulated projects list
- Tutorials for Mortals (including xbmc, SSH tunneling)
- Raspberry Pi operating systems
- Operating System Fundamentals
- Alternatives to Linux
- Appendix: Raspberry Pi Resources

NEARLY FREE TO SHARE, NEARLY FREE TO REMIX

PREFACE

1. IT'S THE NEW BLACK
2. COMPELLING READING, TOO
3. FEATURES
4. LOOKING FORWARD

1. IT'S THE NEW BLACK

The Raspberry Pi is a credit-card sized, $35 computer produced in the UK by a non-profit foundation committed to reforming computer science and engineering for school-age children.

by a 9-year old

However, because of its extensibility, price-point, and flexibility, Raspberry Pi proved an international favorite of creative hackers and makers since its initial release in March of 2012. In fact, at a December talk in DC, product representative and engineer Rob Bishop announced that the Raspberry Pi foundation anticipated a million sales by March 2013; in the first week of December 2012, a tweet from the Raspberry Foundation indicated that 800,000 units had already been sold.

2. COMPELLING READING, TOO

Not only does the Raspberry Pi promote programming and engineering, it also gets people to read. Two Raspberry Pi books have impressively high Amazon rankings in the UK and the US.

Programming the Raspberry Pi: Getting Started with Python by Simon Monk (2012)

In the UK, as of mid-December:

- #1 in Higher Education of Engineering
- #1 in Electronics Engineering
- #1 in Engineering Teaching Aids

In the US, as of mid December:

- #1 in Linux Operating Systems
- #1 in Python Programming

The Raspberry Pi User Guide by Eben Upton and Gareth Halfacree (2012)

In the UK, as of mid December:

- #1 in Computer Hardware

In the US, as of mid-December:

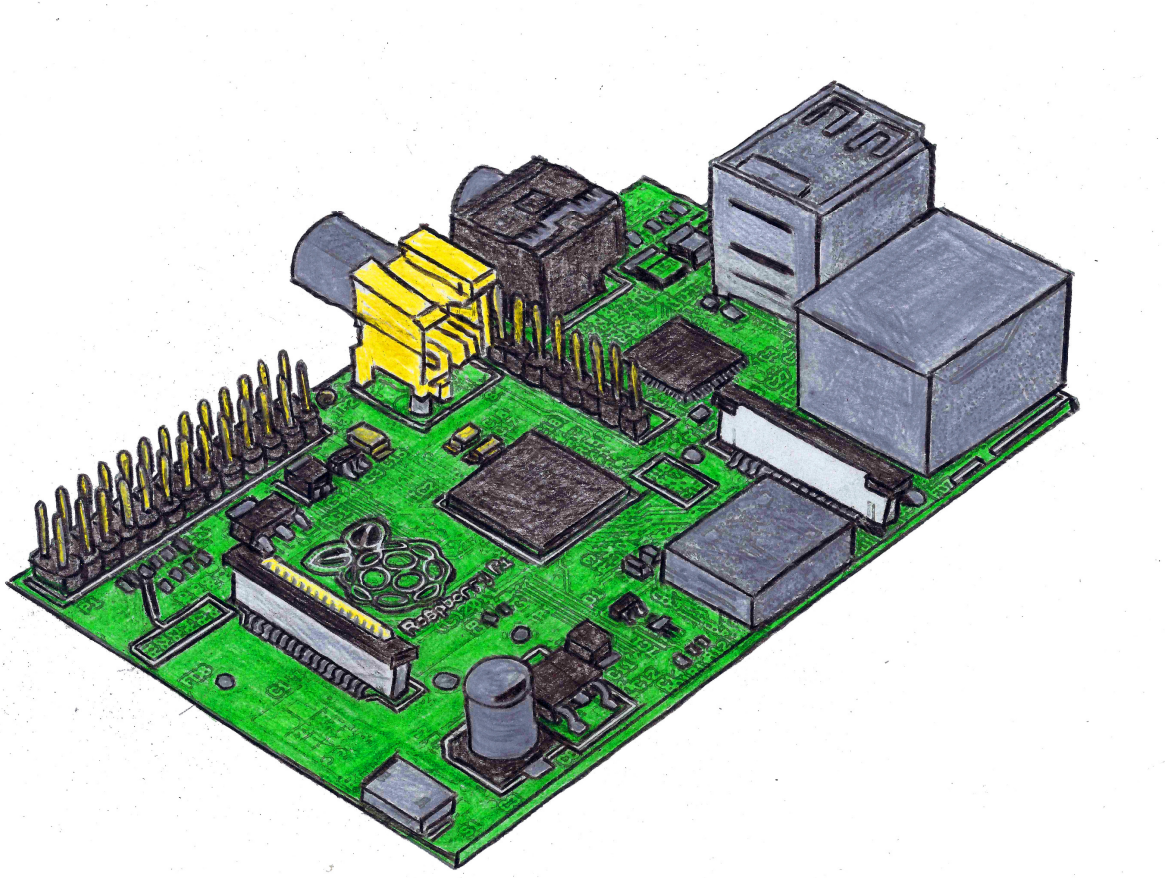
- #3 in Computer Programming Language and Tools
- #6 in Computer Hardware

Scan the bibliography, "Additional Reading," in the appendices for more information about these and other relevant titles.

3. FEATURES

The Raspberry Pi relies on processor technology (ARM11) more akin to mobile devices than to PCs running Microsoft or Mac OSX familiar to many. To put this into perspective, expect a computer with the speed of a Pentium III PC, but with XBOX quality graphics rendered for high definition displays. The $35 model includes 2 USB 2.0 ports, a 10/100 Ethernet port, HDMI and composite (RCA) video output, and a 1/8" phone plug that provides stereo audio output. The most recent Raspberry Pis feature 512MB of memory (RAM) shared between the CPU and GPU. SD cards provide secondary storage for the Raspberry Pi via an onboard SD card port.

The USB ports provide plenty of extensibility, especially with a powered USB 2.0 hub. Many of the most innovative Raspberry Pi projects take advantage of another board feature: a GPIO pin array. This feature makes the Raspberry Pi a very flexible and programmable brain for home automation and robotics projects, for example.



Raspberry Pi Model B (256) in colored pencil by Sabre Goldman

4. LOOKING FORWARD

To give these features some material perspective, consider the following Raspberry Pi use cases:

- upgrade a TV that accepts either composite video or HDMI into a networked smart TV and streaming media center;
- automate your home electronics to save on your power bill;
- create a versatile web server for your home to serve as a personal dropbox, blog, streaming audio server, portfolio, photo gallery, e-book library;
- build a weather data tracking center;
- create a surveillance system with motion detection;
- assemble a gaming center capable of running games intended for everything from arcade cabinets and early consoles like Atari and Sega to 3D first-person shooters like Quake III: Arena.

At the rapid pace users tend to get moving with the Raspberry Pi, keep in mind that these once-innovative solutions have become almost cliched since the Raspberry Pi was released in March 2012. Where the Raspberry Pi really excels is provoking users to learn, innovate, and produce solutions to everyday problems. And because your hacking is authentic and motivation intrinsic, you'll hardly notice your increasing mastery:

- the endorsed operating system for the Raspberry Pi is called Raspbian, a remix of Debian, which in turn is a flavor GNU/Linux;
- if you spend any time at all with Raspbian, expect to pick up linux commands;
- before long, you'll find yourself producing shell scripts that combine commands you use frequently;
- routine tasks can then be automated and scheduled to run without you;
- Raspbian comes complete with Scratch, a visual programming language developed at MIT that introduces high level programming skills through the simple arrangment of blocks - if you're five or older, you'll have your first game complete in minutes;
- Python, a language popular for its proximity to natural language, is included both as an educational tool and as an essential utility;
- Once the Raspberry Pi is interfacing with the material world - whether by sensing motion, humidity, temperature or by remotely controlling home media, motors, or vehicles, you will be surprised to find you're not only a programmer and systems administrator, but also an electrical engineer.

GETTING STARTED

5. TAKING STOCK
6. PREVENTATIVE MAINTENANCE: THE CASE FOR A CASE
7. CASES AND CASES
8. PREPARATION
9. SYSTEM CONFIGURATION
10. COMMAND LINE AND GRAPHICAL USER INTERFACES
11. USER ADMINISTRATION
12. REMOTE COMPUTING

5. TAKING STOCK

The Raspberry Pi is flexible, versatile, and agile. Before first use, it may be more ideal to complete personality test than to complete a shopping list.

For example, the Raspberry Pi will function happily if the following minimal requirements are met:

- Raspberry Pi ($35 + shipping)
- 2GB SD Card w/ operating system ($3)
- AC to DC power adaptor providing 5 volts at 1 amp through a micro-USB adaptor ($3-5)

Only the first item of the list is simply addressed. After that, everything's contingent. If you have PC, a local area network, a spare LAN point or wireless Ethernet, and want to do this on the cheap, see the section entitled Remote Computing below.

SD CARD FOR SECONDARY STORAGE

Consider four factors when it comes to dealing with this absolute requirement:

1. storage capacity or size, measured in gigabytes (GB);
2. class (class four to class ten; usually correlates to transfer speed);
3. documented track record with the Raspberry Pi.

2GB has probably never really been seriously attempted because it's entirely impractical given the size of the operating system: Raspbian is just shy of 2GB. A 2GB card therefore leaves very little space with which either the user or the computer can do anything meaningful. A 4GB card leaves 2GB to work with: that's a lot of room for code. It's not a comfortable fit for multimedia: given, it's about two thousand minutes of music moderately encoded; however, it won't hold a complete movie encoded for high definition. That would be a shame, given Raspberry Pi's video capabilities. 8, 16, 32, 64GB SD cards are all viable options: if you're going for a streaming media center or an arcade emulator, you'll find yourself wanting to migrate to 64GB before you know it.

(External traditional hard drives with USB 2.0 interfaces are an outstanding and cost efficient alternative to SDHC cards, particularly if you're experimenting with multimedia, servers, etc. The drawback is one we're still accustomed to: traditional hard drive data are easily damaged by electromagnetic interference or vibrations.)

If tweets are any indication, then people's impressions of the Raspberry Pi are largely contingent on the class (transfer speed) of the SD card they've chosen. People with class 10 cards pay more, but find they spend more time being productive and less time being frustrated and out of patience. Choose a card class based on your lifestyle:

- Are you patient?
- Are you used to computer less than three-years old?
- Do you have the luxury of spending more than $1 per GB?
- Are you a competitive shopper?

Checking hardware for Raspberry Pi compatibility is best practice, whether you're shopping for a wireless adaptor or for an SD card. To check for SD-card compatibility, see elinux's section on the subject: http://elinux.org/RPi_VerifiedPeripherals#SD_cards.

Where we teach, the Raspberry Pis are stocked with class 6, 8GB SDHC cards. At home, we put the extra cash into speed over size every time: anything less than class 10 is intolerable to our lifestyles.

SD COMPATIBLE CARD READER

To get started, you'll need a card reader compatible with SD cards connected to a PC or Mac with internet access. Without one, you can't write the downloaded operating system to the SD card for use with the Raspberry Pi.

Card readers come in several forms: some laptops and towers have them built in to the case. Some without built-in solutions install readers in their towers: typically, internal card readers fit in 3.5" drive bays and connect to the power supply and SATA bus (and sometimes to a USB 2.0 header). For a less permanent and more portable and frugal solution, external card readers that connect to a computer's USB 2.0 ports are available quite cheaply for competitive shoppers (spotted for as low as $1.99 at a retailer; solutions at Target were extraordinarily overpriced by comparison).

POWER SUPPLY UNIT (PSU)

Like a full PC PSU, a Raspberry Pi PSU does two things:

1. it transforms alternating current (the power drawn from the wall socket) into direct current (the power provided by batteries, for example);
2. it reduces voltage from 120 (in the US) to a much smaller number.

Early adopters very patiently worked out power supply compatibility by trial and error. If the Twitterverse is to be trusted, an unstable and unreliable Raspberry Pi usually points to skimping on either the PSU or the SD card.

Here's what we know: The Raspberry Pi likes 5 volts and at least 1 ampere of current. We were early adoptors that had no trouble with PSUs; our first and last choice was an HTC phone charger with a USB port. The HTC solution works and works on the cheap: OEM HTC chargers with USB to micro-USB cables sell for between $4 and $5 (without shipping).

For a catalog of compatibility-confirmed PSUs, check in at the elinux list of verified peripherals at http://elinux.org/RPi_VerifiedPeripherals#Power_adapters.

INPUT DEVICES: MOUSE AND KEYBOARD

This too is about lifestyle and personality. Here's an inventory to help identify your needs; put one beside each true statement:

- I enjoy video games.
- Memories of the Commodore VIC-20, C64, Apple IIc, or IBM PC-AT trouble my sleep.
- Typing is only one of the things I do slowly.
- Using two devices to accomplish one thing seems efficient to me.
- Moving my hand from one device to another and then back is faster than using a single device.
- I prefer sticker books over sentences.

When you finish, tally your score. If you scored 1 or above, you'll be most comfortable with a mouse and keyboard combination. If you scored a zero, you may get along with just a keyboard.

Enthusiastic learners with obsessive personality quarks may not want to skimp on input devices: common to gamers and novelists is a refined taste for keyboards: The IBM Model M would fix either.

Sadly, this legendary keyboard, dubbed the "IBM Clicky Keyboard" stopped being manufactured long before the USB bus was conceived. Don't despair: the IBM Clicky Keyboard's legacy is kept alive by companies like Unicomp, who offer a tactile experience reminiscent of the Model M and outfitted with a USB adaptor. They're available for between $80 and $100 at http://www.pckeyboard.com/.

This is not a solution for people who drink coffee or eat cheezy poofs while they work. We look

for disposable solutions.

Really enthusiastic learners should look for a wireless keyboard and mouse combo (such as the Logitech MK320): a wireless (RF) solution that requires one rather than two USB slots: between now and The Intervention, you'll be accumulating more and more devices with USB interfaces in what you will soon call your Lab. Wireless solutions tend to discourage clutter, spills, and dust bunnies.

More expendable solutions are cheap, generic, USB-cabled mouse and keyboard combos. The best Newegg.com could offer was a $13 solution. At the time of this writing, Tigerdirect.com did much better with a $9 Inland solution. You can save on shipping if you're lucky enough to live in a state with a Microcenter, where an Inland keyboard is available off the shelf for $9.

Elinux hosts a catalog of compatible and incompatible keyboards at http://elinux.org/RPi_VerifiedPeripherals#USB_Keyboards. Mouse compatibility is cataloged here: http://elinux.org/RPi_VerifiedPeripherals#USB_Mouse_devices.

DISPLAY SOLUTIONS

A temporary case solution is most people's first Raspberry Pi hack. Our first hack was a display solution, since we didn't have access to displays with HDMI technology. Our only composit video resource was in the living room; to use the Raspberry Pi, one of us would have to sit absurdly close to the TV or the Raspberry Pi would have to be suspended by an RCA cable on one end and a USB cable on the other while we hacked uncomfortably from the couch. Since an HDMI display wasn't in the budget, two options remained:

- an HDMI to VGA (15-pin) convertor;
- Repurpose a composite capable monitor intended for use on a car dashboard.

Both options cost another $30 - $40. (The cheapest HDMI solution is a tiny high-defintion TV for $99). The verdict was still out by other early adoptors on the first option. So I bought a 7" TFT display with RCA inputs that was intended to be powered by a car battery. So we hacked together a power transformer and booted our Raspberry Pi. If we were working on hacking together a tiny jukebox, then we'd have needed powered speakers as well. Financially speaking, the sane choice is the $99 HD TV and a $3 cable. But damn we had a good learning experience hacking together that display solution.

If you have an HDMI capable display, you're set. If you want one, Amazon has a tiny Coby TV for about $99 that's survived since September in our school. Best Buy has a competing brand for the same price. Target sometimes has am HDMI Panasonic available for $99. A true HDMI solution helps you experience first hand what it's like to program a device capable of rendering blu-ray quality video at 1080p. Choosing an HTMI TV over an HDMI monitor is cheaper, and you get audio delivered to an audio capable display.

While Raspberry Pi has ridiculous video power, don't go overboard on an HDMI cable. Some cables are network capable. That's unnecessary in this case and should save some dollars. I've spent $3 on an HDMI cable and I've spent $12 on an HDMI cable. I haven't noticed a difference, but I also haven't tried audio through the cables.

HDMI from the Raspberry Pi can be converted to VGA for use with legacy monitors. A few months ago, we would have used a boxy conversion box like the one here: http://thepihut.com/products/hdmi-to-vga-converter-for-the-raspberry-pi. However, a device called Piview was recently released by Element14, one of the two authorized Raspberry Pi suppliers. It seems to be a hit in the Twitterverse. More information about Piview is available from Element14 at this URL: http://www.element14.com/community/docs/DOC-48883/l/pi-view-hdmi-to-vga-adapter-cable-for-raspberry-pi-computer-board. It's available for order in the US from Newark.com: http://www.newark.com/element14/piview/cable-assembly-hdmi-to-vga-raspberry/dp/07W8937 (see QR code).

And finally, if it comes to it, you can use any display device with a phono/composite/RCA input. It's usually yellow and silver and found on older TV sets, VCRs, and cable boxes.

AUDIO

If your display solution is an HDMI TV or monitor with speakers, you're set since HDMI is apparently capable of carrying audio. Otherwise, you'll need to use the stereo, 1/8" audio output on the Raspberry Pi.

If you have powered speakers like the ones intended for PCs and MP3 players, you're set. If you are using composite video, you can use a y adaptor with a 1/8" stereo phone jack on one end and a red RCA (phono) jack at one fork and a white (phono) jack at the other fork. A splitter fit for this purpose shouldn't be more than $2 but probably is nevertheless. Buying the parts for a DIY cable solution will probably cost you more from Radio Shack.

SHARING RESOURCES

If you have a perfectly good set of computer hardware, but it's being put to good use for your > $400 PC, there's a frugal solution: Look into KVM (keyboard, video, mouse) switches that suit your needs. Especially consider KVM multimedia switches that support audio (in case you're not using HDMI and an audio-capable display). IOGear and TrendNET KVM solutions are compatible in our experience. Shop for USB switches, not PS/2 switches; match the display input and output to your monitor's requirements. If it's a VGA monitor, look into using Piview (discussed above) in conjunction with a KVM switch.

NETWORKING

A powerful, versatile, fast, and compatible USB wifi adaptor will be available to diligent shoppers for $15 or less. It's unnecessary.

The Raspberry Pi has an onboard, wired Ethernet (10/100 mb/s) port than can be plugged into an existing network for the cost of a compatible (cat 5) network cable ($3).

A wired solution is convenient in some settings and inconvenient in others. Setting aside for a moment portability and the fact that wires breed and encourage spills, one compelling argument for having a compatible and versatile wireless adaptor remains: becoming a student of network engineering. It provides an opportunity to learn how to build a DIY firewall, router, switch, or wireless access point.

A diligent shopper can find a compatible, fast, and powerful solution for about $13. We look for adaptors that support AP (access point) mode so we can explore Raspberry Pi's power to act as a wireless access point or router. Tenda model W322U v2.0 is compatible and supports AP mode. TP-Link's TL-WN721N model also supports AP mode; it was once $13 at both Amazon.com and off the shelf at Microcenter; a week before I sat down to write this, it was over $19 at both shops; today it's $12.95 with free shipping. Note that neither the Tenda nor the TP-Link listed are cataloged at elinux as of this writing.

6. PREVENTATIVE MAINTENANCE: THE CASE FOR A CASE

Sometimes computer hardware survives despite ridiculous odds. When equipment does survive, it's often because we invested money into putting protective measures in place. An example of this in action is when we purchase more expensive desktop speakers than we can immediately justify; there's a good chance that extra money is well invested in magnetic shielding to protect your precious data.

Consider, for example, the most valuable component of the PC: the very delicate hard drive that keeps, now more than ever, every relic of your productivity accessible to you - photos, documents, videos...It's not the most expensive component of the PC, but it is the most valuabe.

Inside the drive casing is at least one spinning platter. A nearly inperceptible cushion of vaccuum keeps this platter from touching the magnetic head that glides over it as it reads and writes data. An already delicate situation gets aggravated when we buy cheap hardware, such as cooling fans that cause vibrations, or discount PC speakers that we set beside the hard drive without thinking. When my data survives this scenario, or vaccum chugging away in front of the computer case, I'm thankful that somewhere along the line, I invested in something that took precaution against environmental threats.

Granted, the Raspberry Pi has no hard drive. Not until you add one via the USB interface. In the meantime, the lesson here is still relevant because the same environmental threats endanger the Raspberry Pi:

- moisture
- extreme temperatures
- electromagnetic interference (EMI)
- electrostatic discharge (ESD)
- physical trauma, physical pressure, vibration

It takes a shock with an imperceptable fraction of the power you feel when someone with socked feet charges up on the carpet and touches you to ruin a microchip like those on the Raspberry Pi. Hence the silvery bag the Raspberry Pi came stuffed in.

There are more threats when we consider peripheral devices: dust and smoke.

On the one hand, what's at stake, really? $35 and some sum for shipping? Set aside for a moment the fact that suppliers can't keep up with demand and the Raspberry Pi is not easy to find at the $35 in question. (To see power of high demand and short supply in action, have a look at what a Raspberry Pi Model B 512 goes for on Amazon and Ebay.)

Let's take a look at what's lost by each kid to whom we deny access to a device like the Raspberry Pi: the promise of an opportunity to participate in shaping the digital commons in which our lives are increasingly immersed and by which our experiences are increasingly defined. Missing an opportunity to engineer our cultures and experiences rather than being subjected to them has high stakes.

No, the Raspberry Pi in front of me as I write this is not in a case. Nevertheless I will be disproportionately pissed if grab it wrong or sneeze on it.

7. CASES AND CASES

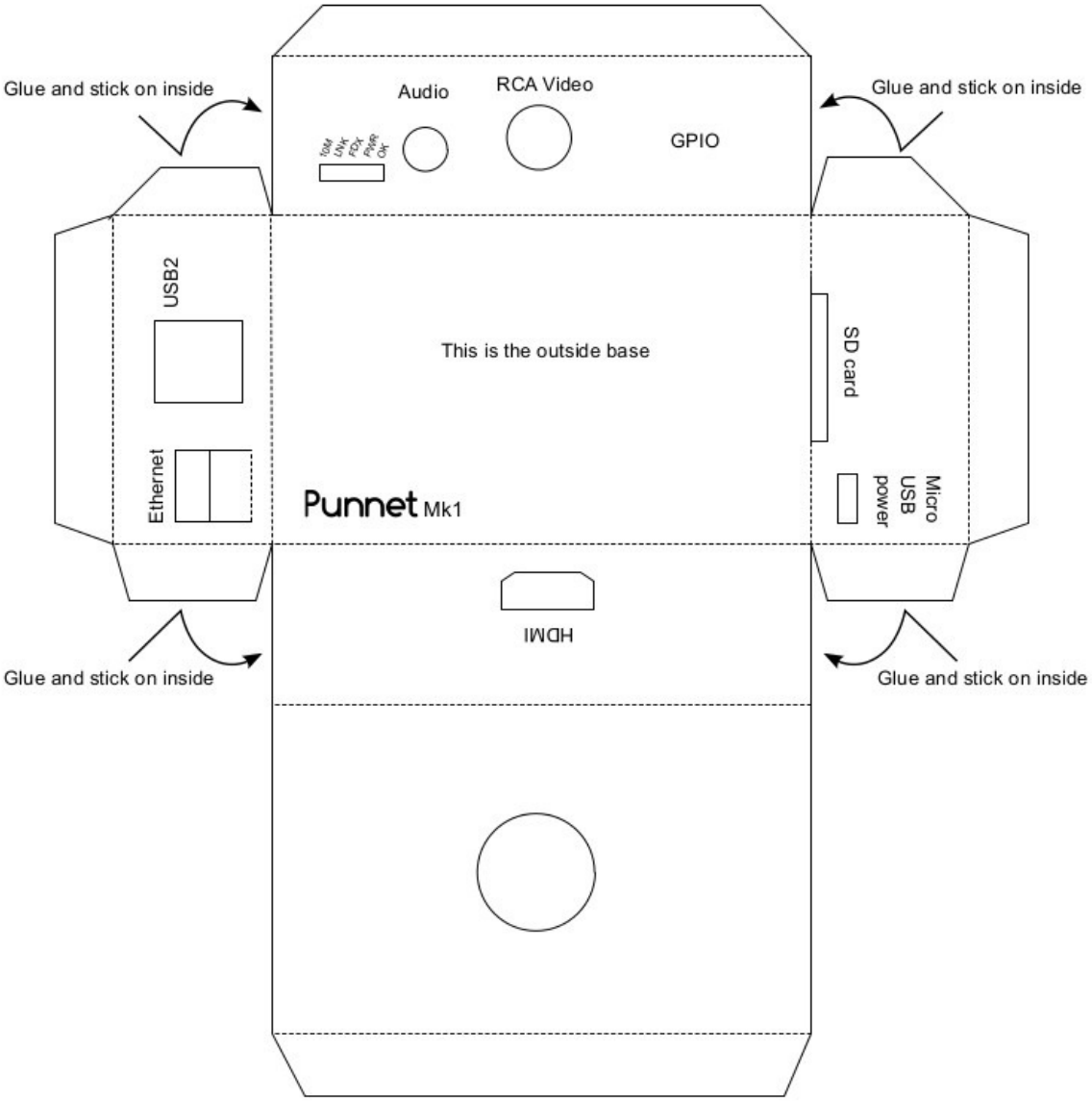
Once you get your Raspberry Pi and fall in love with its diminutive size, you will to keep it forever. Luckily, there exists dozens of durable cases that you can buy and dozens of cases you can make.

Take note, that there's nothing about the Raspberry Pi that isn't deliberate. It's true that shipping the Raspberry Pi in the nude keeps costs down; but the decisions about *where* and *how* to keep costs down is made very deliberately: by shipping the device in the nude, the Raspberry Pi Foundation intends to provoke curiousity, motivate hackers, and drive innovation.

DIY SOLUTIONS

PUNNET CASE

A home printable card case. A very nice and simple case that be easily downloaded and customized with any graphic. Needs: is card stock, glue and a craft knife



Punnet MK1

RASPBERRY PI FOLD-UP CASE

A home printable clear case. A simple case that protects whole allowing you to view the splendor of your Raspberry Pi with down loadable and easy to follow instructions. Needs: thick acetate paper and a craft knife

LEGO CASE

The possibilities are endless. A case that can take on any life form you want. You can download specifications of another person's design, or use Lego Digital Designer and come up with your own creation. Needs: size specifications: **85.60mm x 53.98mm x 17mm** and Legos

3D CASE

Design your own 3D printable case. You can download a template or design your own case. Needs: 3D printer

WHO-KNOWS? CASE

With a Mounting Hole Template from Raspberry Pi Spy you can create a Raspberry Pi case out of just about anything. Need inspiration, google Raspberry Pi case ideas and you will be amazed.

CHEAP AND COOL TO OWN

THERE ARE OVER 35 CASES FOR UNDER $20.00. THERE'S BOUND TO BE ONE YOU LIKE SOMEWHERE.

ADAFRUIT PIBOX

Simple and clear - $14.95.

ADAFRUIT PIBOWS

Fun to assemble and come in a variety of colors - $19.95.

CYNTECH RASPBERRY PI COLORED ENCLOSURE

A raspberry color solid case - $12.50

MODMY PI CASES

Comes in a variety of colors and made of ABS plastic - $9.61. If you do not care about the color, it is even cheaper - $4.79.

BRAMBLE PI

Laser cut finger jointed wooden case - $15.95.

EXPENSIVE BUT COOL CASE

- **Aluminum Raspberry Pi Case**: Protects and helps keep your Raspberry Pi cool - $69.95

8. PREPARATION

Unless you're and a fairly sophisticated home network engineer, here's the minimum needed to get started:

- USB Keyboard
- SD Card (4GB)
- Power supply (.5 v, 1a) with mico-usb connector
- SD card reader/writer connected to a PC with internet access
- Display connected to composite (RCA) video out or HDMI
- A PC with an SD compatible card reader, access to the internet, and winzip or similar software

Ideally you'll also have the following:

- Cat 5 ethernet cable connected switch or hub or router capable of providing a connection to the internet
- USB Mouse
- Compatible USB wireless network interface
- Powered USB hub

WRITE THE OPERATING SYSTEM TO THE SD CARD

To create the imaged SD card, you'll need to start from a PC or Mac that has internet connectivity and an SD card reader.

Start by downloading the compressed Raspbian image at http://downloads.raspberrypi.org/images/raspbian/2012-10-28-wheezy-raspbian/2012-10-28-wheezy-raspbian.zip. To save typing, go to http://raspberrypi.org, click the downloads link on the top navigation bar and look for Raspbian Wheezy. There are two downloads available, a torrent file and a zip file. Choose the zip file (right click on the link, select save link as and save the zip file to your desktop.

Assuming you're using a Windows machine, download Win32DiskImager from https://launchpad.net/win32-image-writer/+download. Right click on win32diskimager-binary.zip, which, at the time of this writing, is the second download listed on the page. Select Save Link As and save the .zip file to your desktop (if you're handy getting around the filesystem, save it to where ever you like to keep downloads).

When the download finishes, you should have win32diskimager-binary.zip. This is several files bound together and compressed. To decompress the contents, you'll need to have a utility like WinZip installed. If you don't have Winzip or a similar utility, don't despair. A free trial is available here: http://www.tucows.com/preview/194294. We preferred winrar (available at http://win-rar.com/predownload.html?spV=true&f=wrar420.exe). Download the utility of your choice. Just remember, you're on the very verge of having vast repositories of software available to you for free, truly. This may be your last piece of downloaded trialware, nagware, or spyware.

Once the decompression utility is installed, right-click on the file named something like 2012-MM-DD-raspbian.zip (should be on your desktop). Right click and choose the wisest option along the lines of extract here, unzip here, decompress here. With winrar, the option is called "extract to 2012-mm-dd-raspbian." Things always go smoothly, so there should now be a either a folder on your desktop for Raspbian or a file on your desktop named as above but ending in .img.

Go through the same process for win32diskimager. Open the decompressed folder (double click). Insert your SD card into the card reader.

If and only if your card reader is connected and your card is in place - run win32diskimager.exe (double click again).

There's a button at the top right of the rather compact user interface for browsing for an image. Point it to your new Raspbian .img file on the desktop. Below it, select your card reader and SD

card should already displayed. If it isn't, try to select it from the drop-down box. If it doesn't, start again: exit the program, eject the card, unplug the card reader, and then do it over: plug in the card reader, insert the card, and start Win32DiskImager. Once the software recognizes the card, you're ready to write the image to it. Click the "write" button and wait (wait time depends on the class/speed of your card).

ELEMENT14'S GETTING STARTED GUIDE

One of the ways Raspberry Pi Foundation keeps costs down is by shipping the devices completely in the nude; by now it's clear: there's a potentially complex and powerful board with no instructions. Those who receive Raspberry Pi's are pointed to Element14's terse getting started guide. It's included here in full. Note that there's no declaration of copyright on this document: we hereby credit Element14 for the documentation and appreciate that they've made it available to members.

GETTING STARTED WITH YOUR RASPBERRY PI - IMPORTANT INSTRUCTIONS

You now have your very own Raspberry Pi computer and I'm sure you can't wait to get started with it.

Unlike a regular PC, Raspberry Pi is supplied without an Operating System. There are just a few steps needed to started with your Pi, so just follow them here:

1. You need an **SD Card** that can be plugged into your Raspberry Pi. This card will store the Operating System and any files that you might choose to save when you use your computer. We recommend a minimum of 2GB for the Operating System. Larger is better.

2. Using your normal computer, go to **www.element14.com/raspberrypi**, and seek out the **Looking For An Operating System To Run On Your Raspberry Pi** section. Click the button called **"Download Center"**.

3. If you have an Operating System preference, please select and download it. If not, we recommend you get started with **Debian for ARM**.

4. The downloaded file may be **compressed** (for example, .zip, .tar, .gzip), and if it is, it will need to be decompressed before you can use it. You can use a free tool like **PeaZip** to decompress the file, available at **www.peazip.org**, in both Windows and Linux versions. The resulting file can be very large – usually several hundred MB.

5. When you have done this, you get a single file called an Image File, or **.img**. This is a snapshot of what needs to be written to the SD Card. It includes the special disk formatting that Linux uses instead of **FAT32** or **NTFS** for Windows.

6. Next, you need a tool to install the .img file to the SD Card. A popular tool is called **Win32DiskImager**, available at this address **https://launchpad.net/win32-image-writer.** Simply download this program file and follow the instructions to install it on your Windows computer. A Linux command line alternative is called **dd**.

7. Follow the instructions provided with **Win32DiskImager** or **dd** for writing the Operating System to your SD Card. This process will require the SD Card to be inserted into a SD Card slot on your computer, and for you to know where you saved the **.img** file on your computer. The write process itself should only take a few minutes.

   Caution: make sure you select the correct device to write the Operating System to. Remove the card and reinstall it a couple of time, to make sure. Some tools will allow you to select your main

computer hard drive - selecting this will result in data loss very quickly. Be careful!

8. **Win32DiskImager** or **dd** will tell you when this process has been completed and when it has, remove the SD Card. Now insert it into the SD

Above is the first page of Element14's "Getting Started with your Raspberry PI - Important Instructions. It's almost certainly their 2012 intellectual property.

card slot of your Raspberry Pi. It is worth keeping the Operating System file on your computer for future rewrites to your SD Card, just in case.

9. Now, connect you Raspberry Pi to a normal keyboard and mouse via it's USB ports, a TV or computer monitor via its HDMI connector, to your network (if required) using an Ethernet cable to your local router, and finally either to a mobile phone charger with a Micro USB plug, or to another USB socket with a **USB Type A to Micro USB** lead.

10. The **small red indicator** will light up on the Raspberry Pi, indicating the main chip has started up, and then a **small green indicator** will begin to flash, indicating data is being read from/written to the SD Card. The TV/monitor (provided it's switched on of course) will begin to show the Linux boot sequence.

11. Finally, log in using the preset username and password for the Operating System you chose. For Debian, this is **pi** and **raspberry** respectively (in the latest version of the Debian OS. The pervious password was **suse**). Now you have full access to the Operating System. **N.B. When you type the password, you won't see the characters appearing - this is part of Linux security!**

12. For most Linux distributions with a graphics environment which doesn't start automatically, the **Graphical Environment** can usually be started with the command **startx.** If there is a need to override the system, use the command **sudo** before the normal linux command. For e.g. sudo startx

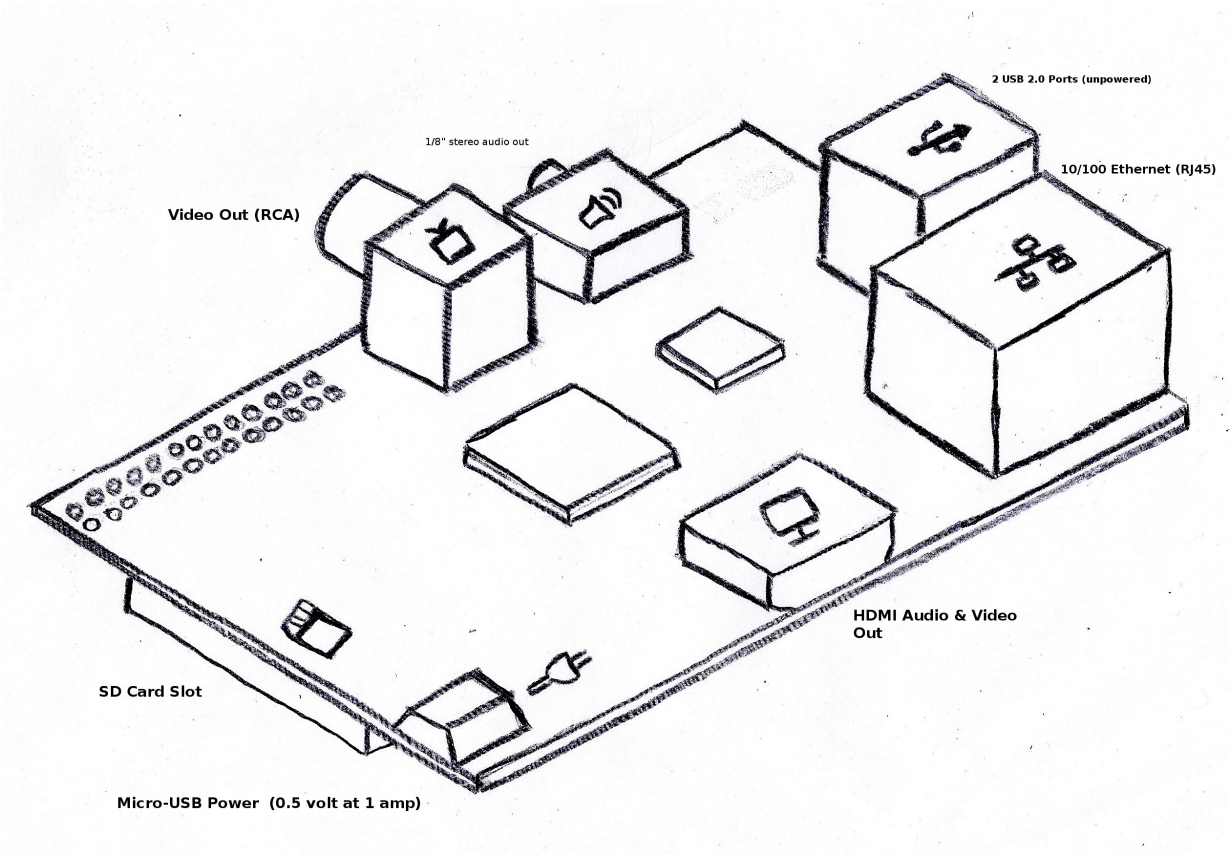
After that – its' up to you! Let us know what YOU do with your Pi.

Note on display:

- The Raspberry Pi will operate either with a TV with a HDMI interface using a HDMI-HDMI lead, or an older style TV with a SCART or phono Composite Video input, using a phono (usually coloured yellow) to SCART lead.
- For DVI computer monitors, it is possible to use either a HDMI-DVI lead, or a HDMI-HDMI cable together with a HDMI-DVI adaptor.

Above is the first page of Element14's "Getting Started with your Raspberry PI - Important Instructions. It's almost certainly their 2012 intellectual property.

CONNECTIONS



Raspberry Pi in pencil and colored pencil by Sabre Goldman

Element14 has already covered the next steps, but let's step through them:

1. Connect the display to either the HDMI port or the RCA output;
2. If you have a powered USB 2.0 hub, connect it to the Raspberry Pi (highly recommended);
3. Connect your USB input devices (mouse and keyboard) either to the USB hub or directly to the Raspberry Pi;
4. Connect RJ45 from a hub or switch to the Raspberry Pi's Ethernet port, or slide a wireless network adaptor into an available USB 2.0 port (one reason a USB hub is recommended);
5. Slide the SD card into the SD card port of the Raspberry Pi;
6. Plug in the power supply unit (PSU) and plug its micro-usb connect into the Raspberry Pi.

A couple of preliminary notes to keep in mind.

The SD card port is on the bottom side of the Raspberry Pi. It is not especially durable. When the

Raspberry Pi is right-side up, the label of the SD card should be facing down. Be mindful.

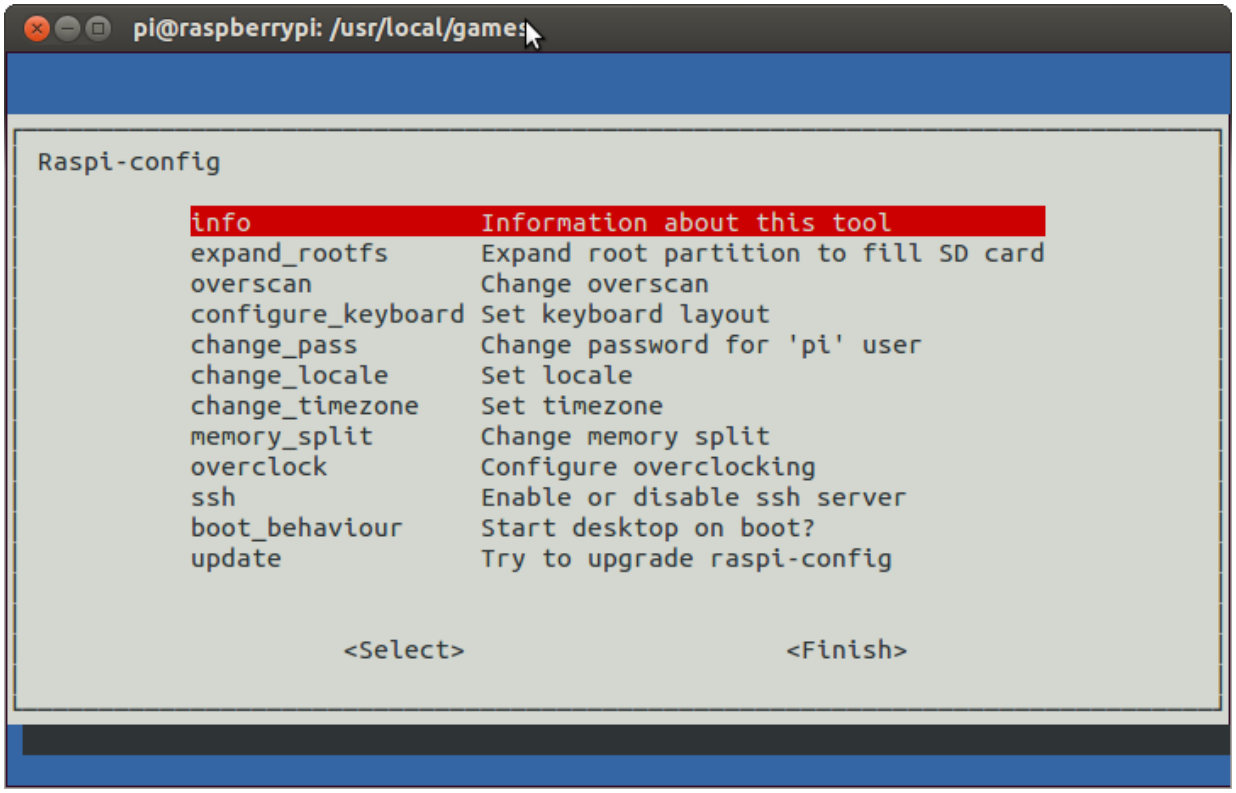
If the Raspberry Pi is in it's birthday suit, be mindful of conductive materials when deciding where to set it down. Metal and Moisture can cause short circuits. Magnetic fields (like the ones caused by speakers) may corrupt flash media like the SD card your Raspberry Pi relies on.

The Raspberry Pi has small array of LEDs to communicate with. As soon as the two minimal requirements are met (power and an SD card), two or more LEDs should begin emitting light. If the only LED lit up is red, there is a problem. Remove the micro-usb connection to the power supply.

If the LEDs are blinking, a stream of information about the boot process should be scrolling your display.

9. SYSTEM CONFIGURATION

The most recent version of Raspbian boots immediately to a utility called *raspi-config*. This utility is part of Raspbian's unique spin on Linux and makes getting started with the Raspberry Pi much easier for people with little or no Linux experience.



Start by configuring your keyboard. It's tricky two we're two countries seperated by a common language. Select configure_keyboard (wait a moment, patiently); set it for generic 104-key keyboard, unless you have a model that's listed. Navigate your way to US English; there's an opportunity to be more specific if you choose. Then 4 dialogs will ask you questions in a row. I simply hit enter to get through all four dialogs. When you finish, you'll be back at Raspi-config.

Next set locale: Select change_locale, and scroll down until you see an option with an asterisk. Press the space bar to deselect the locale. Then scroll in search of something the effect of US-engl-UTF8. Press space bar to select and save your setting (be patient as it does it stuff). You'll be asked whether to make your choice apply system wide; unless you have a reason not to, go ahead and do it.

SSH is enabled by default, so there's no reason to change it, unless you want to be sure it's staying set to serve at boot. This guide assumes SSH is enabled.

Set the time zone. Here's another way the Foundation keeps costs down: the Raspberry Pi has no real time hardware clock. Some may have noticed that computer motherboards have batteries. That's, in part, to keep the real time clock enabled going even when the computer is powered down. As long as the Raspberry Pi has a connection to the internet (or a network with an ntp server), it will keep time and not cause problems. Later, we'll point to a tutorial with which you can build a real time clock for your Raspberry Pi.

Boot_behaviour is a matter of how far out you want to go and in what direction. Starting the GUI manually is a simple matter: enter `startx` at the command line. I prefer to start in command line for several reasons - the most important of which is that I know better than the computer whether I'll be using the GUI and have would be waiting in vain for it to start.

It's unusual for an operating system committed to security to come with a default password, but

nevertheless Raspbian does. It would be really bad form to leave pi's password as *raspberry*. It can be changed here and now. The default password will be addressed again later in the chapter called *User Administration.*

Memory_split: if you're a gamer or planning to do much in a windowed environment, set aside some RAM for video processing: 256MB or less. Or so. I offer video just enough memory that it can provide me a tolerable graphical user interface if my work calls for it. Sometimes I use raspi-config and change this setting for a session or two.

Overclock, the hackers delight. it's possible to overclock the Raspberry Pi's processor without voiding the warranty. You may, however, corrupt your SD card. There's a suspected correlation between corrupted SD cards and overclocked Raspis. Overclocking adds to the watts Raspberry Pi draws; you may be able to feel warmth coming from the Raspberry Pi's processor after overclocking a while. Processor speed is very much contingent on temperature. If you like your Raspberry Pi in turbo mode, consider searching the Web for Raspberry Pi heatsink. I overclock when I anticipate starting processor intensive tasks, like compiling software.

When you've finished with configurations, use tab to select *finish* and press enter. If you changed the memory_split or chose to overclock, your Raspberry Pi will reboot immediately.

10. COMMAND LINE AND GRAPHICAL USER INTERFACES

This bit assumes that the graphical user interface, LXDE, has been started - whether automatically or with the `startx` command.

The mouse was invented; moments later a justification for the mouse was needed. That is when the graphical user interface, or GUI, emerged.

THE COMMAND LINE INTERFACE AND THE SHELL

Operating systems, whether Android, Microsoft, Apple, or Linux, share 5 fundamental functions. One of them is providing an interface between a human and the computer (HCI). GUI's trade in icons that represent commands or files. Command line interfaces, or CLIs, work through verbal input and output. In even the newest Microsoft environments, the CLI is still there (mostly to keep bearded people quiet); it's a relic from Microsoft's first OS, DOS, and can be found by opening the start menu and typing `cmd` in the text field.

In Raspbian, there are three immediate ways to access the command line interface. The most common way is to open LXTerminal from the LXDE desktop. Simply double-clicking should open a windowed terminal; if you haven't got the rhythm yet (I don't), simply right click the LXTerminal icon and select "Open." Let's enter a simple command: `date`. Here, a command is communicated in relatively clear English (input); the computer processes the request and returns output: mine reports `Sat Dec 15 16:15:41 EST 2012`. Note that would not quite be the way we write in the States, or for that matter how it's conventionally written in the UK. What's off about this output is its syntax.

Grammatically speaking, syntax is the order in which we express words to communicate verbally. Syntax is something shared by similar human languages and that contrasts with disimilar human languages. And so it goes with human computer interfaces, whether programming languages or command line interfaces.

With Microsoft's *cmd* shell, there is no alternative. However, in Raspbian (and every other Linux distro), there are different shell languages, or ways of communicating with the computer from the command line, each with different purposes and some with very different syntaxes. Bash is the default and the most common; bourne and zsh and dash share a lot with bash, but are nevertheless different. Korne and csh, for example, are quite different.

Whatever shell you choose (this guide assumes bash), there is help available.
The command `date` is much more powerful than we've taken for granted here. What matters in the next few sentences in that you learn the ins and outs of dating, but rather the strategies by which we learn about it.

ASKING THE SYSTEM FOR HELP

A majority of Linux commands - especially the most established and traditional - offer help in at least 3 ways. The most thorough reference for a command is its *manual* page, if it has one. We request the manual page from the prompt with the command `man` (it gets better) followed by the command in question. So we'd enter:

```
man date
```

Navigate the man page by pressing the space bar or using the Page Up and Page Down keys. If you're following along, you've noticed there's a fair bit the date command can do, and it's all documented in 204 lines. (Press `q` to exit the man page.)

At the end of the man page for date, it mentions that you can see more detail by entering `info coreutils 'date invocation'`. As you'll see, this command returns even more detailed information.

Man pages are a labor of love and are not to be criticized (would you want to write the manual page for the date command?). If they were to be criticized, we would probably talk about lack of white space and uninviting format. There are ways to get to just the section of a man page you need, but nevertheless there's a lot of verbal information packed together.

So realizing this is the case, rather than criticize the man pages, we develop alternatives. Try each and see which works best for you. Here's the question: how do I find out just the timezone the system thinks it's in?

- `apropos -e date` (surveys man pages for an exact match)
- `date -h` (invalid option in this case; this is a short version of the command line that follows)
- `date --help` (the long, endorsed version of -h)

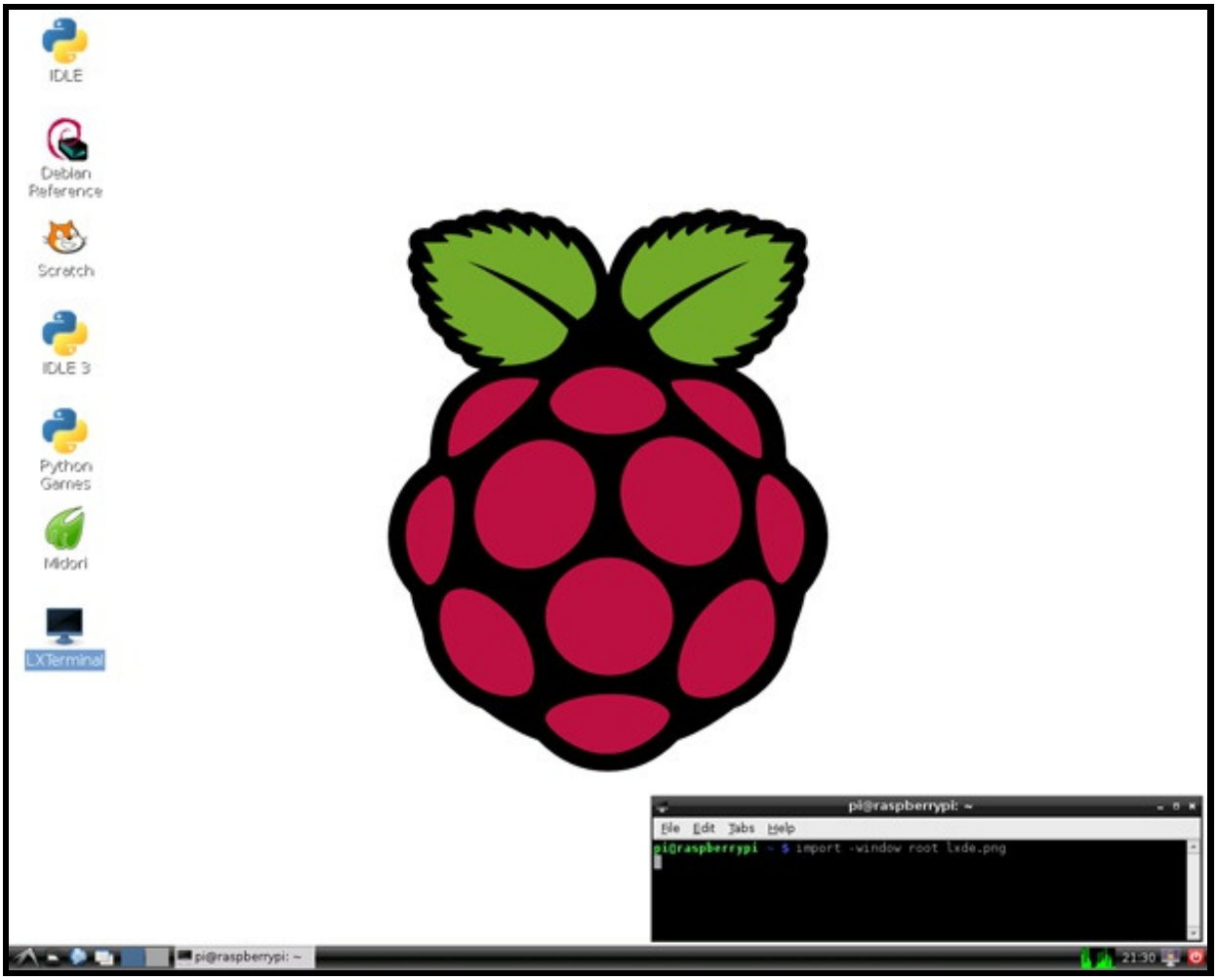
That's a devestatingly poor example, while you may be as baffled now as you were before that exercise, take this away from the experience: following a command with `--help` will almost always return more concise help than the man page. It will also be less thorough.

Some commands will return usage information if the shell interpreter has reason to believe you're green. This doesn't work with our example, but try this one: `adduser.` Note the result is the same as if you typed `adduser -h` or `adduser --help`.

Also to find out whether the Raspberry Pi knows even what time zone it's in, try this command: `date -%Z`

If you and the Raspberry Pi don't agree on the time zone, stop everything and return the chapter on raspi-config (`sudo raspi-config` if you want to fix it now).

GRAPHIC USER INTERFACES AND WINDOWS ENVIRONMENTS



Raspbian's Default Desktop Environment, LXDE (with LXTerminal open)

As with *cmd* in Microsoft Windows, the user has no choice GUIs in Windows: Mic

rosoft's operating system is the GUI - both are inextricably bound up in one another.

As with shells in the Linux CLI, the Linux GUI can be changed to suit your needs, desires and circumstances.[1] As it happens, Raspbian comes with LXDE as its window environment (until recently, this what we ran on our student desktops with Ubuntu, a Linux distro with which Raspbian has much in common). LXDE has a reputation for being lightweight - that is, it's easy on resources such as memory. That and its similarity to other interfaces users may be more familiar with probably make LXDE a great choice for the Raspberry Pi. There are other great choices: XFCE similarly resembles Microsoft Windows while being easy on resources. Awesome (really, it's called Awesome) is extraordinarily lightweight - a favorite of some of the most efficient coders we've met. Awesome, however, doesn't resemble Microsoft Windows or Mac OS X - or really much else, for that matter. As a result, there's a learning curve. Later we'll take a moment to explore what's involved with switching windows managers.[2]

1. Whatever the windowed desktop, your Linux GUI is almost definitely relying on the X windows system. ^
2. Two very differently successful books are especially relevant to this chapter: 1) Kiddle, Oliver, Jerry D. Peck, and Peter Stephenson. From Bash to Z Shell: Conquering the

Command Line. Berkeley, CA: Apress, 2005. Print. (A guide to getting around the command line with a variety of shells.) 2) Stephenson, Neal. In the Beginning ...was the Command Line. New York: Avon, 1999. Print. (Great essay on the development of competing operating systems; I'm not overstating my case on this one. Stephenson is really very good.) ^

11. USER ADMINISTRATION

Unlike most operating systems, Raspbian comes with a user account enabled and protected by a default password. This was a tactical decision that surely took into account that it's a significant security threat. Let's take care of that.

LOGGING IN

The first time Rapbian boots, it launches directly into raspi-config and then prompts the user patiently for input. That won't happen again. Next time, credentials will be required.

The default credentials follow:

- username/login: *pi*
- password: *raspberry*

OK, it's a little secure: raspberry isn't easy to spell. For me, for instance.

Depending on what choices you made in raspi-config, you'll be logged into either the command line or the graphical user interface (LXDE in this case).

DEFINING YOUR OWN PASSWORD

If you're in a windowed interface, you need a terminal. Launch lxterminal by double-clicking the icon just very right; if that doesn't work, use the right-mouse button to right-click on the icon and select *open*.

At the prompt, type *passwd* and press enter.

1. Suddenly security matters: you'll be prompted for your current password; type *raspberry* and press enter.
2. The next prompt is to define a new password: (before you continue: make sure you set caps locks to off and num lock to the way you intend it be forever.) Enter your new password. You won't be able to see what you typed (because we're in the sane world where security actually matters). If there's no question of what keys your fingers hit, press enter. If you want to be sure, backspace ten times, think about what you've done, and start over with your eyes on your fingers.
3. The last prompt is to confirm the password: retype the password exactly as you entered it the first time.

Now your username in pi and your password is your own. Not good enough.

ADD A USER TO THE SYSTEM

Create an account for yourself. Two methods work for this and they are easily confused. To create a user with interactive prompting, we'll use the command *adduser*.

Try `adduser` and press enter.

That should fail. As a mild-mannered user, you don't have the power to create accounts. Now try this:

```
sudo adduser some_name
```

Replace `some_name` in the line above with the one-word username that will delight you. It should be one word and should probably not include symbols. There no such thing as simply "changing" a username you've become disenchanted with. You can't just break up with a username. Not pleasantly, anyway.

Sudo is a tool that temporarily makes you root, superuser, or administrator if you wish. Think of your mild-mannered user suddenly dawning a cape and watching over the City. A user with sudo

privileges has unlimited power, but must go through extra steps to exercise it. Prefacing a command with sudo gives you a moment to pause on reflect. Why is root privilege so precious? This command (theoretically) will wipe the entire system, including every user's photos, manuscripts, emails, music, videos, software...everything:

```
rm -r /
```

Back to the command line: As you see, adduser is interactive, prompting the privileged user to enter information to be associated with the new account. Some of the information is required, and some of it is useless for your purpose. Don't ignore the prompt for the user's full name: just do it or the system will have trouble addressing you appropriately.

Next you're prompted for information that's more appropriate for a school or office setting: press enter to skip every question except for the one about the password: enter the password for your real account purposefully and mindfully; repeat it confirmation.

Use this interactive process to add another user if you like: `sudo adduser username`

ALLOW SUDO WITH USERMOD

Don't take your username to prom yet, though. Remember back when you liked the username pi, and got comfortable with it? Well, remember, at least, that there was a cape you could put on to feel powerful in some small way? You want that for your user account.

A few tactics will give a user sudo access. We'll try this one (assuming you followed instructions and are still logged in as pi):

`sudo usermod -g sudo` Substitute *username* for the name of your account (the one you made a moment ago. Do you need a rest? In a moment.

You'll be asked for your password; that's the system confirm that you really really want to do a command that could ruin all the things. Type pi's password (used to be *raspberry*) and press enter.

usermod is a command a user with root privileges/sudo access can use to modify an account: -g is short for group; *sudo* is the name of the group with which *username* is to be joined. In otherwords, I am root, and I want to make a member of the priveleged class of superusers. In a subsequent chapter, we'll make users in bulk with a script.

A PEAK UNDER THE HOOD

Let's conclude by exploring user and password information by looking at two files: /etc/passwd and /etc/shadow.

If you haven't already, log out of pi's account. You won't be needing it again unless you forget your password (if you forgot pi's password, hope you have data backed up. You'll be making a new SD card and starting from scratch). Login in with your fresh, minty personal account that you endowed with sudo privileges.

If you're at the command line (cli), excellent. If you're in the windowed environment (GUI, graphical user interface) open lxterminal as described above.

At the prompt, enter the following:

```
sudo tail /etc/password
```

You should see ten lines of account information. Here's what the line says: recognize that I am really powerful; with that power, show me the last ten lines[1] of the file called *passwd* in the folder called *etc* (users accustomed to Microsoft or Macintosh know folders; they were once known to those systems as *directories*. In Linux, they still are. Each line should contain a sequence of information seperated by colons. Among that information is the username, a unique, numerical identifier, and the path to the user's private home ~~folder~~ directory. Note the final information in the line for, say pi: "/bin/bash." That specifies the shell language assigned to the user's account: pi is using the bash shell, the most popular and

available shell in Linux distros. You two, are using bash: it's the default shell.

So the name of the file is misleading: there is no password information here. Your password is not sitting in a plaintext file in plain site. Or is it?

Now use the same command to peak into /etc/passwd: `sudo tail /etc/shadow.` As with /etc/password, each line starts with a username followed by data seperated by colons again. /etc/passwd might have been foreign and unpleasant, but it wasn't trulty cryptic. /etc/shadow actually contains the passwords of your new account, pi's account, and any other protected and enabled account (there shouldn't be anymore, for what it's worth). The passwords are actually hashed or encrypted. So even a root user with access /etc/shadow won't grok your password without breaking a significant sweat. Later, we'll pit your password against jacktheripper, a brute force hacking tool to whether or not whatever sense of security you have is deserved.

1. sudo tail -100 /etc/passwd would show the final 100 lines of the file passwd in the directory called etc. By default, tail shows the final 10 lines. A similar utility is called head: sudo head /etc/passwd shows (by default) the first 10 lines of the file. Maybe you'd like to see the whole file? To display a file, use the cat command: sudo cat /etc/passwd. ^

12. REMOTE COMPUTING

DISCOVERING THE RASPBERRY PI AT FIRST BOOT

Download and install Advance IP Scanner for Windows from http://www.advanced-ip-scanner.com/. I'm skeptical about this because it's freeware, which is a wholly different thing from Free Software, the world you're stepping into and, with luck, may be contributing to in the very near future.

The hardest thing about the installation is deciding whether you want an icon on your desktop.

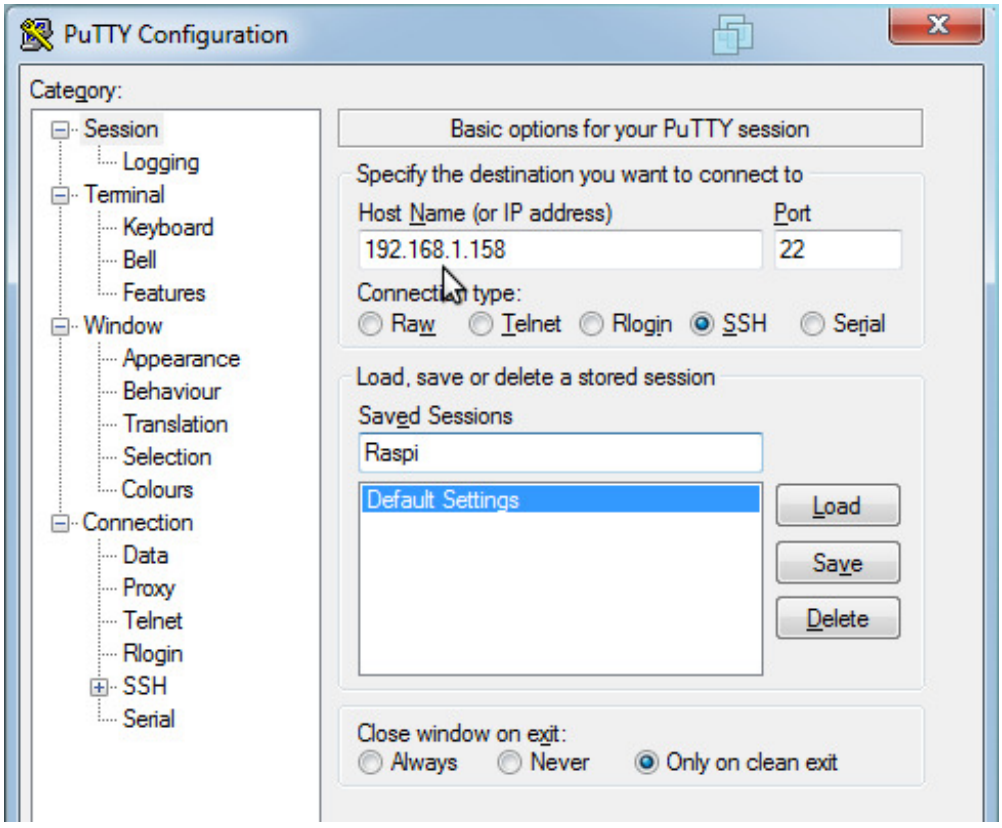
When the installation finishes, launch Advanced IP Scanner. Our goal is to identify Raspberry Pi's IP address: it's unique address on the local area network. Our method is to scan the local area network to identify a computer running an SSH server on port 22. Assuming the network isn't eloborate and that no other computer on the network is serving SSH, it should work a charm given about 5 minutes to look around.

Hopefully, next time you look things will be much simpler than we anticipated. After a default scan, the software lists each device on the network by hostname, IP address, manufacturer of the network device, and MAC address.

The illustration makes clear that we needn't do a port scan to discover an SSH server: the scanner found the MAC address and used that information to find the manufacturer. In the example above, Raspberry Pi has an IP address of 192.168.1.158. Because Raspbian is configured to receive an assigned address dynamically, you can be sure that this address will change. Maybe not today; maybe not tomorrow, but someday and then...

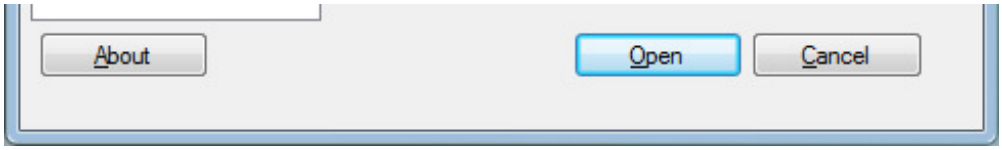
CONNECTING VIA SSH CLIENT

To connect to the Raspberry Pi via SSH from Windows, you'll need to download a client. One highly regarded client is PuTTy, avaiiable hassle free from http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html. Look for the link to PuTTy.exe, download, and install. When the installation is complete, launch PuTTy.



Enter the IP address of the Raspberry Pi in the Hostname (or IP address) field. If you prefer to not enter it every time you want to connect, name your Raspberry Pi and then hit the save button. Either way, the next step comes with the connect button.

Because SSH is committed to security, PuTTy will warn that it doesn't know just who it is you're connecting to and that it can't be sure of their intentions. You want to proceed.



You're provisionally connected and met with two prompts: enter *pi* at the *login as*: prompt. Pi's password is *raspberry*. It's not spelled like it sounds. Now you have complete control of the Raspberry Pi.

With that control, we need to install a package that will allow you to access Raspberry Pi's window environment (LXDE) remotely. One package provides a VNC server, the other an RDP server (sort of). Although they both allow desktop sharing, they have different feature sets. Research RDP and VNC on Wikipedia, then install one, the other, or both.

Before installing anything, always update the list of packages available to you through Raspbian's immense software reporitory:

```
sudo apt-get update #updates the repository information; be patient.[1]
```

Then install one, the other, or both:

```
sudo apt-get install xrdp #installs xrdp

sudo apt-get install tightvnc #installs vnc server

sudo apt-get install tightvnc xrdp #installs both
```

RUNNING THE CONFIGURATION TOOL REMOTELY

Now that that's taken care of, it's time to configure the Raspbian with it's unique tool, raspi-config. Raspi-config automatically launches on first boot and appears on the display. Since we've accessed via remote terminal, we can't see that. So we run raspi-config manually:

```
sudo raspi-config
```

Set the keyboard configuration first, then locale (use the space bar to put an asterisk beside US-eng-UTF8 in the States; In the UK, the default should be fine. Finally, set the time zone.

See the chapter on configuration for clarification.

Don't change the option for ssh. SSH is serving fine and we don't want to cripple a working system.

You must change the user *pi's* password, but wait to use that to learn user administration.

MACGYVER STYLE

It's been proven that the Raspberry Pi can draw power from a PCs powered USB port. Raspberry Pi Foundation has chosen to discourage this method, insisting that the pi could burn up, act inconsistently, or just not work. Nevertheless Interlockroc.org has blogged about their experience with it and call it the Macgyver solution. On a blog post, they detail their procedure, which involves tightvnc and internet connection sharing as well.

I'm not deterred by the Foundation's warning. I've been meaning to power Raspis via PC for ages; when a student confirmed for me that it worked without hitch, I set it on a back burner.

1. The # symbol, or hash, represents comments in shell scripting - or it least in bash, dash and similar shells. The interpreter ignores comments as it processes the code. In that

tradition, in these cases, they simply mean enter everything before the hash - the rest is commentary. ^

APPENDICES

13. PROJECTS
14. ADDITIONAL READING

13. PROJECTS

ACCESS YOUR PI FROM YOUR PHONE AND YOUR HOMES AWAY FROM HOME

Configure NAT or port forwarding to allow secure access to your Raspberry Pi from outside your home by PC, by smart phone, etc. To do this, you

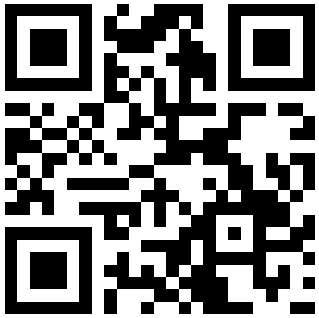
- first need to configure a fixed IP on your Raspberry Pi. That should probably be done anyway;
- should next instruct your router to forward incoming requests on port 22 to the Raspberry Pi's address (look up your router at http://portforward.com/ for suppor;
- must confirm that both accounts, your account and pi's account, have strong passwords: test potential passwords here: http://www.microsoft.com/en-gb/security/pc-security/password-checker.aspx
- May alternatively generate a highly secure password that will be impossible to remember. Make note of it and keep it with you. You can generate a password on the web or from the command line. See http://www.newpasswordgenerator.com.

FIRST PERSON SHOOTING GALLERY

id Software are good folks: they opened the source to their game engines. While the game data is still protected by copyright, demo game data is available. People have worked hard to make id Software's signature games run on Raspberry Pi; Quake III: Arena is especially stunning. But don't stop there: Quake II, Descent I, and Descent II are available. What you'll learn: compiling software, installing precompiled binaries, installing packages with the package manager, and downloading from the web with the command line. Shea Silverman's blog has tutorials for these and other gaming challenges. See Shea Silverman's page at http://blog.sheasilverman.com/raspberry-pi-emulation/.

BUILD AN FM TRANSMITTER

Who'd have thought all it would take is a single wire to turn a Raspberry Pi into an FM transmitter? That's what the Imperial College Robotics Society discovered. Here's video and some code:



EXPERIMENT WITH DESKTOP ENVIRONMENTS

- Install and explore a viable and capable alternative to LXDE: the very popular XFCE. Like LXDE, it is svelte and maintains some resemblence to more familiar GUIs.
- Research, install, and explore Awesome.

WEATHER STATION

One use for the GPIO pin array on the Raspberry Pi is to interface with its environment via sensors. Depending on how capable an electrician you are, you can put together a capable whether station for between $10 and $20 dollars. https://github.com/ghoulmann/rpi-thermometer is a solution that relies on a single "1-wire" temperature sensor and groks the local outside temperature from the internet. It then plots a graph contrasting the two temperatures and displays as a web page. This isn't the most frugal choice of hardware: it's a USB solution that requires no assembly. With a few alterations, the code will work with more DIY-principled hardware choices.

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