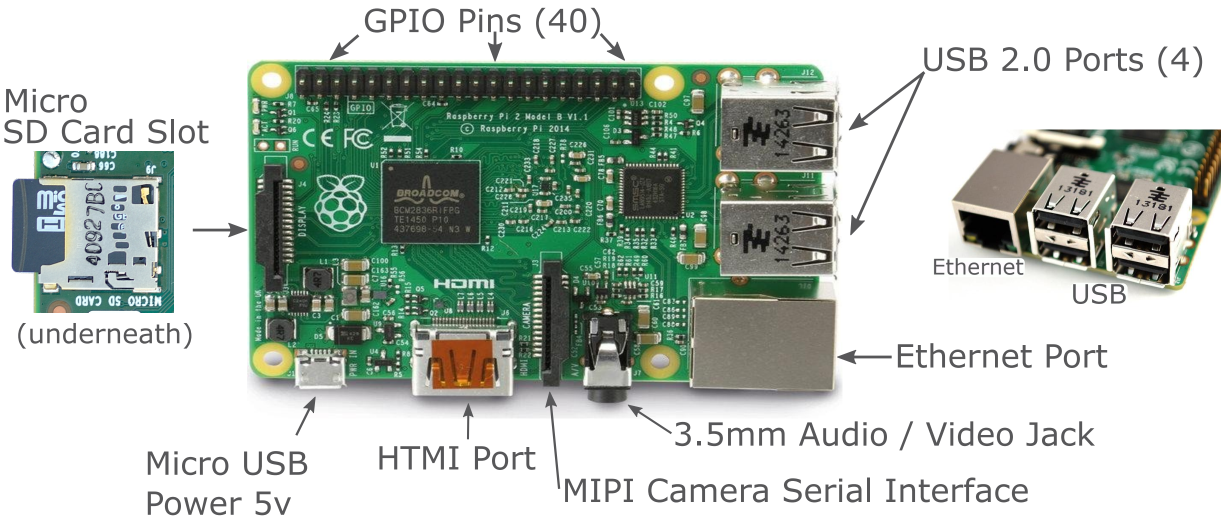
Getting Started

Card 1 of 9

I'm Learning: Raspberry Pi

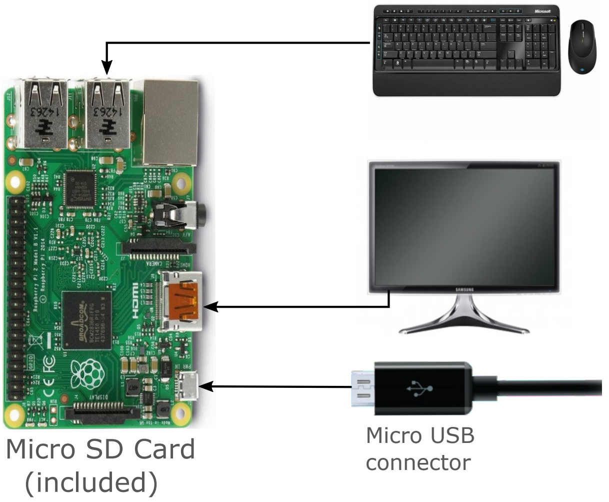
1 Raspberry Pi 2 B+ Features:



Tech Specs

Processor:	900MHz quad-core Arm Cortex-A7
Memory:	1GB RAM

2 Getting Started - You'll Need to Connect the Following:



1. Keyboard / Mouse
   Connect via USB

2. Monitor / Television
   Connect via HDMI
   VGA and other monitors will need an adapter.

3. USB Power Supply
   5 volt USB Hub or phone charger

Handle the Pi by its edges. Do not touch the bare metal circuitry!

Connect this last!
The Pi will start up as soon as it gets power.

Booting Up

Card 1 of 9

I'm Learning: Raspberry Pi

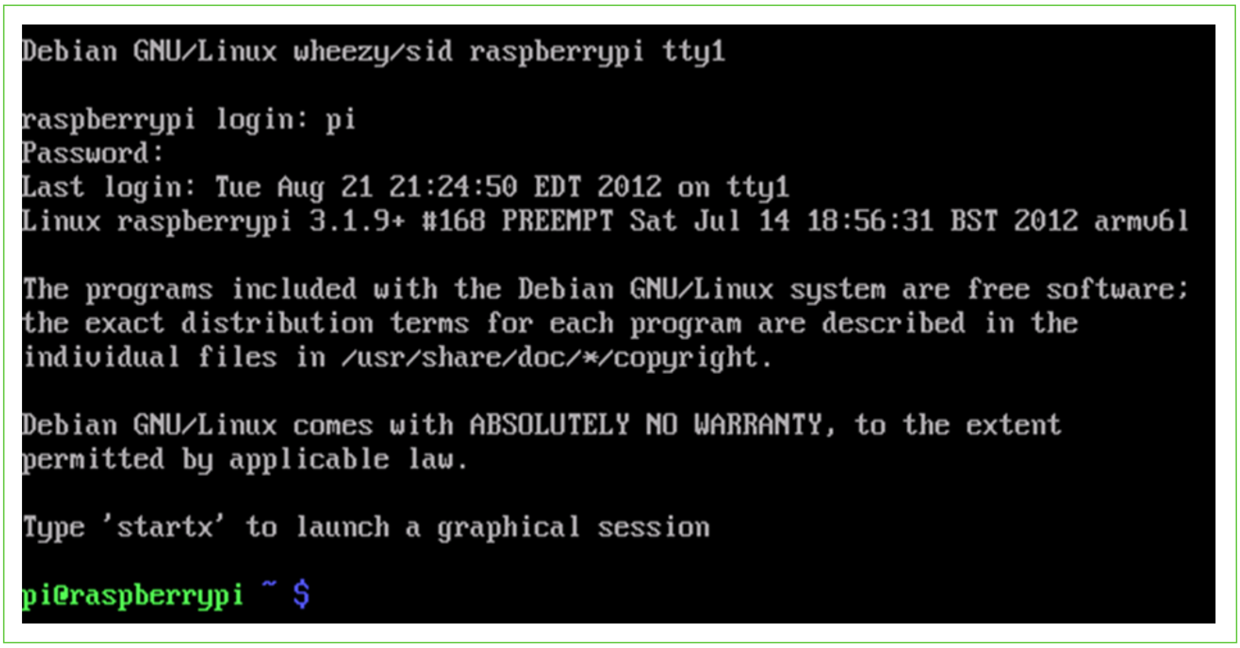
3 The Raspberry Pi Immediately Starts to Boot When Powered.

4 Log In at the Command Prompt:

username: **pi**

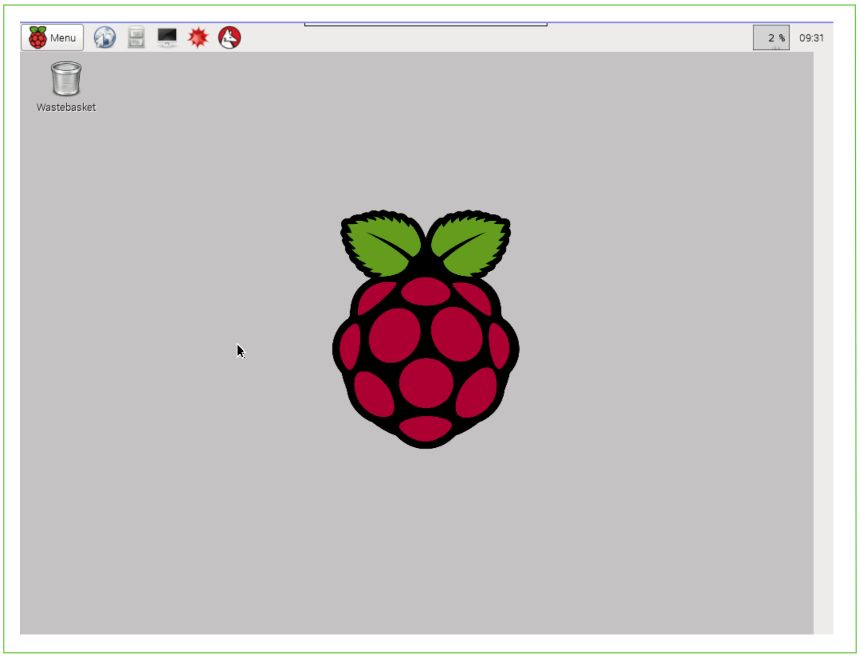
password: **raspberry**

Note: The password characters will not show.



```
Debian GNU/Linux wheezy/sid raspberrypi tty1

raspberrypi login: pi
Password:
Last login: Tue Aug 21 21:24:50 EDT 2012 on tty1
Linux raspberrypi 3.1.9+ #168 PREEMPT Sat Jul 14 18:56:31 BST 2012 armv6l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

Type 'startx' to launch a graphical session

pi@raspberrypi ~ $
```

5 Type `startx` at the command prompt to launch the desktop:



Congratulations! You are now ready to have fun with the Pi.

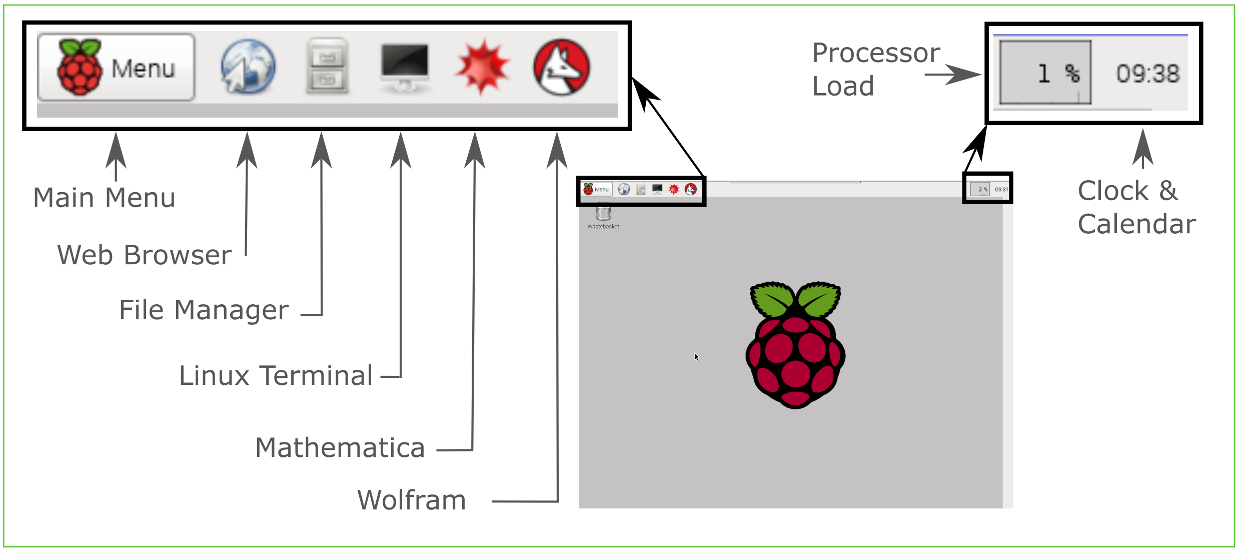
RASPBERRY PI

The Raspbian Desktop

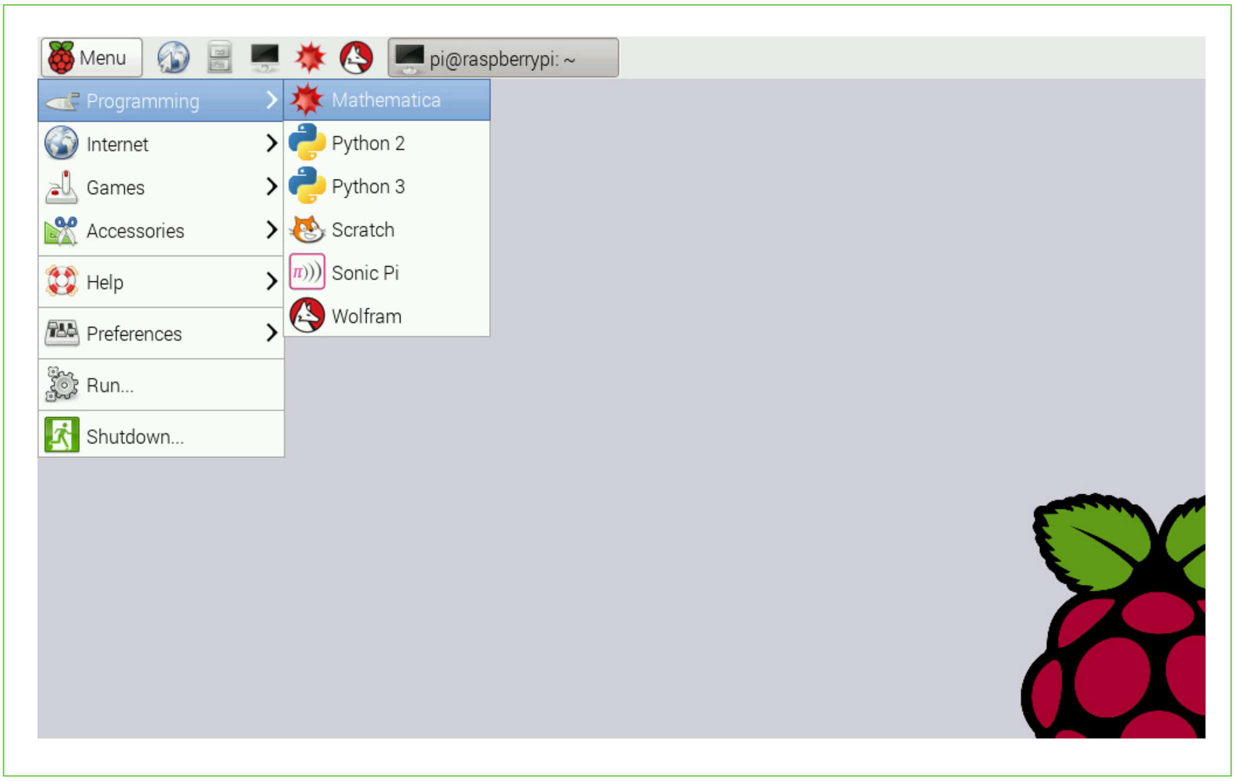
Card 2 of 9

I'm Learning: Raspberry Pi

1 Lets Explore the Raspian Desktop:



2 Click on the Main Menu Button and Explore the System:



We will be playing with most of these programs!

CoderDojo

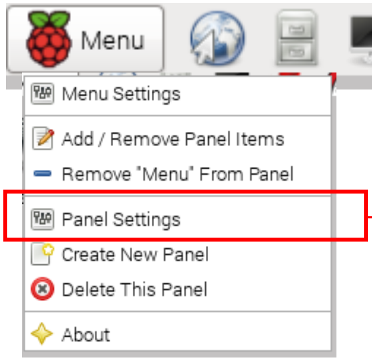
Customize Your System

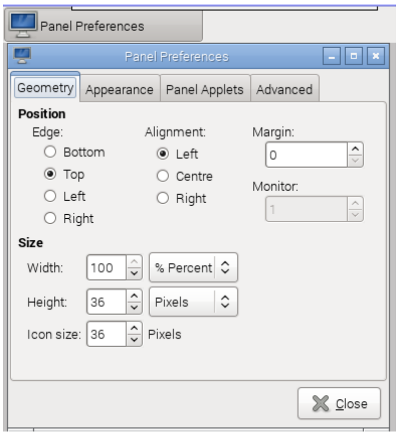
Card 2 of 9

I'm Learning: Raspberry Pi

3 Move the Menu Bar to Another Place:

Right click on the menu button and choose "Panel Settings":





Position

Edge: ○ Bottom ● Top ○ Left ○ Right

Alignment: ● Left ○ Centre ○ Right

Margin: 0

Monitor: 1

Size

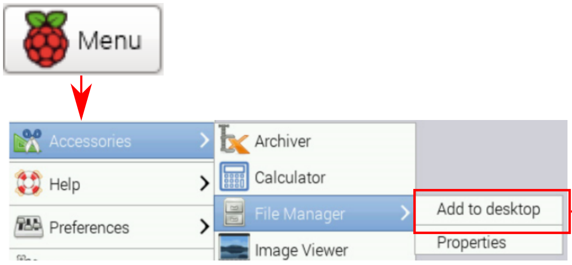
Width: 100 % Percent

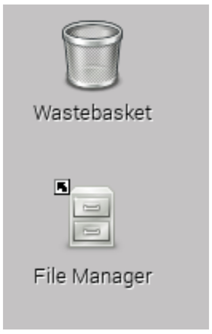
Height: 36 Pixels

Icon size: 36 Pixels

4 Add Your Favorite Programs to the Desktop:

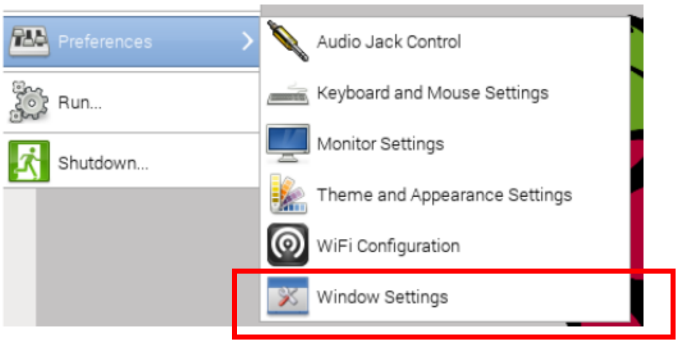
Choose any program from the main menu and then right click to add its icon to the desktop:

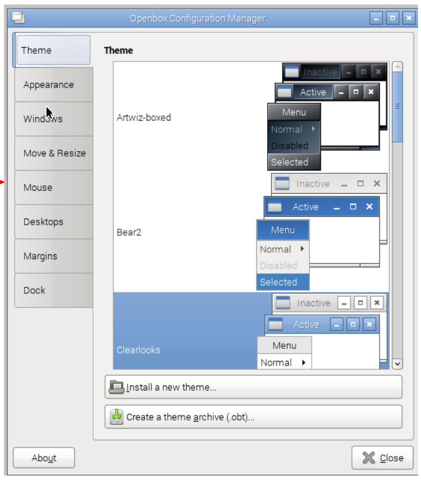




5 Change the Desktop Theme:

Choose "Preferences" from the main menu and then click on "Window Settings":





The File System

Card 3 of 9

I'm Learning: Raspberry Pi

1 Lets Explore the Raspian File System:

Open the File Manager:

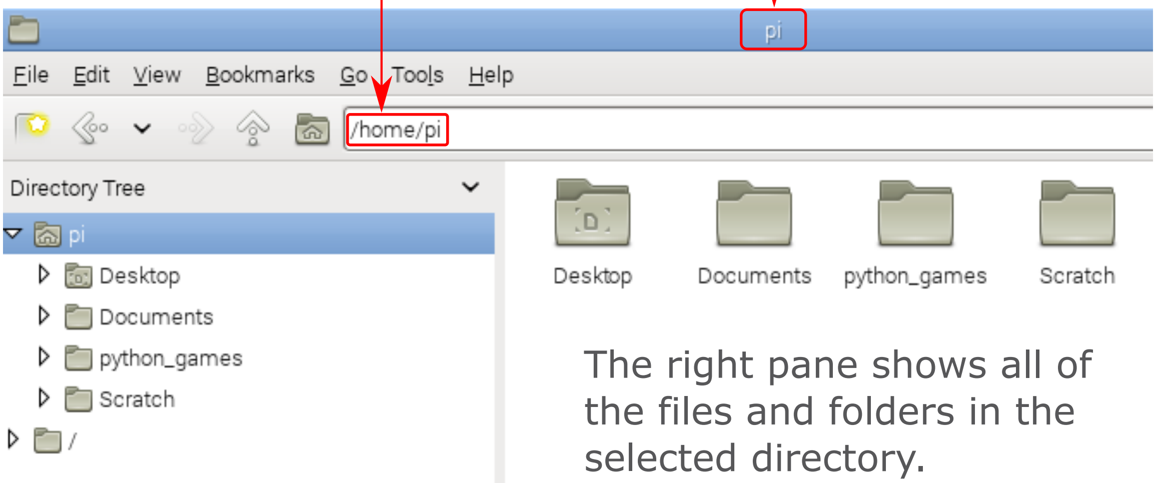
The File Manager automatically opens up and goes to your **home directory**:

Challenge: Is there more than one way to do this?

You have logged in as user "pi", remember? Your **home directory** is your user name. So your **home directory** is named "pi":

The address bar shows the path to the current directory:

The title bar shows the current directory:



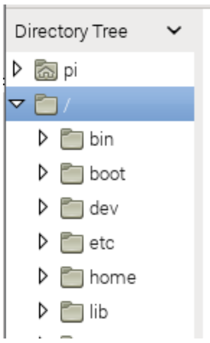
The right pane shows all of the files and folders in the selected directory.

The left pane shows all of the folders on the system.

2 The Root Directory '/'

The top level directory is called the "root" and has the symbol '/'. All of the directories and folders on the system live below the root.

Challenge: Can you find your home directory under the root? Hint: Look at the address bar to find the path to your home directory.

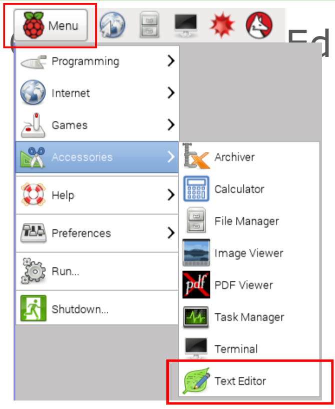


The File System

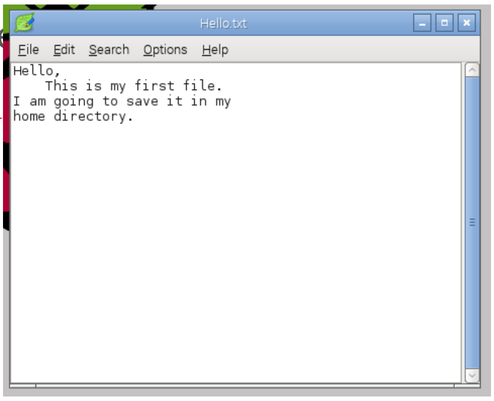
Card 3 of 9

I'm Learning: Raspberry Pi

3 Activity: Create a New File in Your Home Directory

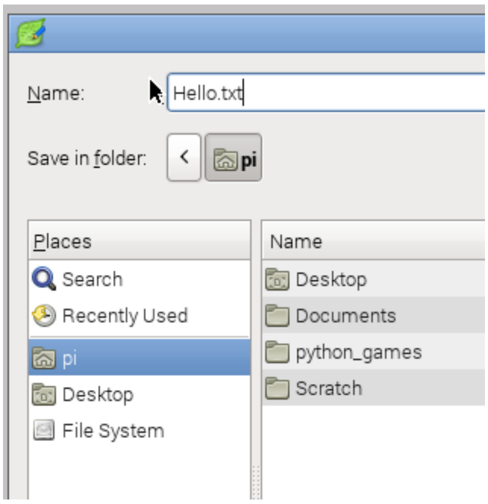


Editor and create



```
Hello,
    This is my first file.
I am going to save it in my
home directory.
```

Save the file in your home directory. Name it "Hello.txt":



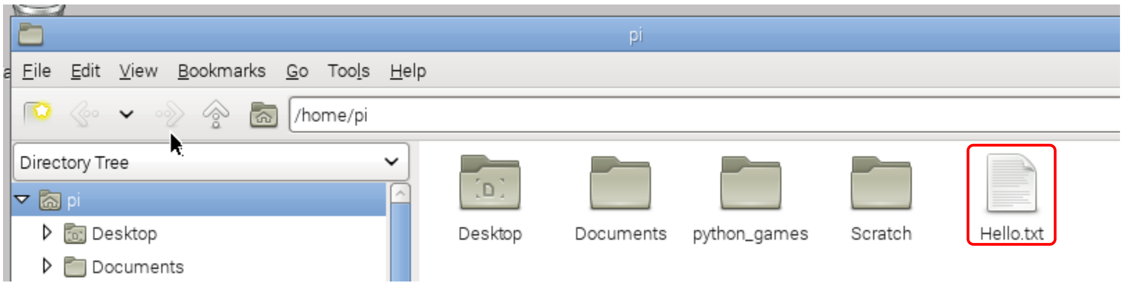
Name: Hello.txt

Save in folder: pi

! Remember:

The home directory has the same name as the user name. Since you logged in as user "pi", your home directory is:
/home/pi

See the file appear in your home directory in the File Manager:



RASPBERRY PI

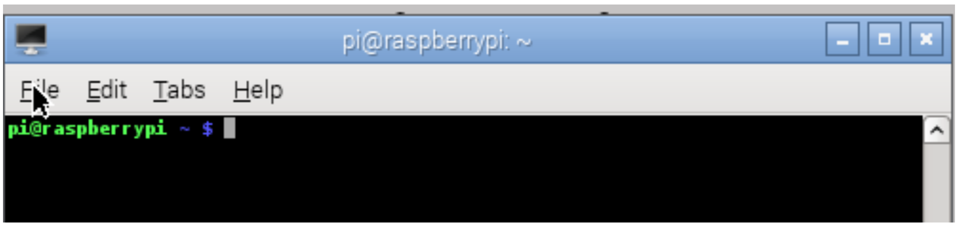
The Linux File System

Card 4 of 9

I'm Learning: Raspberry Pi

1 Lets Explore the Linux File System:

Open the Linux command line. The app name is "LXTerminal".

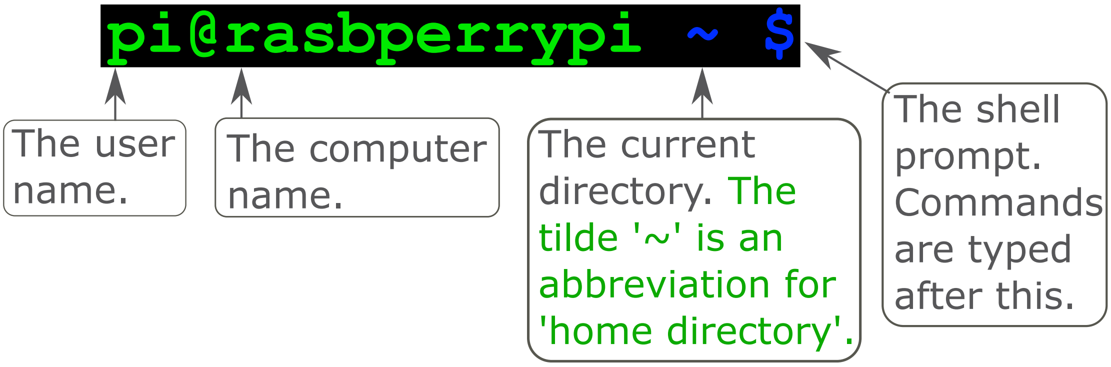


```
pi@raspberrypi ~ $
```

You are presented with the command prompt. This is your way of telling the Raspberry Pi what to do. Also, it is the Raspberry Pi's way of telling you about itself – but only when you ask it.

You have to type in commands at the prompt. At first this seems hard, but don't worry. Programmers have invented all kinds of ways to avoid typing! We will learn how to avoid typing later.

The command prompt contains three pieces of information:



```
pi@rasbperrypi ~ $
```

The user name.

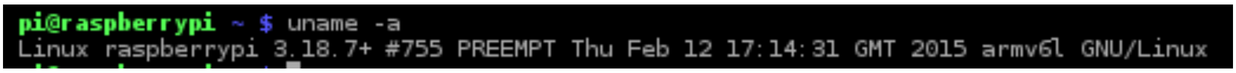
The computer name.

The current directory. The tilde '~' is an abbreviation for 'home directory'.

The shell prompt. Commands are typed after this.

2 Find Out Which Version of Linux is Running on the Pi

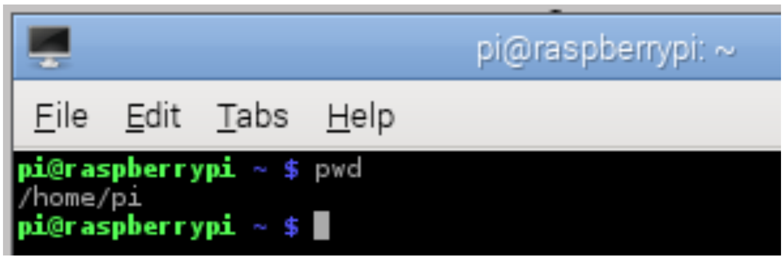
To find out which version of Linux is running on the Pi, type in the command: **uname -a**



```
pi@raspberrypi ~ $ uname -a
Linux raspberrypi 3.18.7+ #755 PREEMPT Thu Feb 12 17:14:31 GMT 2015 armv6l GNU/Linux
```

3 File Paths

LXTerminal automatically starts up in your home directory. To see this type in the command: **`pwd`**



```
pi@raspberrypi ~ $ pwd
/home/pi
pi@raspberrypi ~ $ █
```

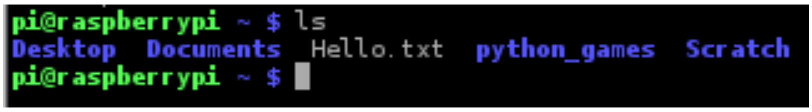
'pwd' stands for Print Working Directory. As you can see the output of the command is the path of your home directory.

Many Linux commands work with file paths so lets have a closer look at them.

A file path consists of a series of directory names which are separated by forward slashes '/'.

A file path can end with a directory:
`/home/pi` - This points to a directory: 📁
or end with a file name:
`/home/pi/Hello.txt` - This points to a file: 📄

After the directory path is printed LXTerminal is ready for the next command. Type **`ls`** and see the output:



```
pi@raspberrypi ~ $ ls
Desktop  Documents  Hello.txt  python_games  Scratch
pi@raspberrypi ~ $ █
```

The entries in blue are directories and the entries in white are files. You can see your "Hello.txt" file there. Compare this output with the visual output of the File Manager.

Congratulations! You now understand the Linux file system from the command line and also visually by using the File Manager.

Linux Commands

Card 5 of 9

I'm Learning: Raspberry Pi

1 Linux File System Commands:

The `ls` Command:

```
pi@raspberrypi ~ $ ls
```

The **`ls`** command lists the contents of a directory. It can be used to get detailed information about the files in a directory.

Here are some ways to use the **`ls`** command. The '$' sign is the command prompt, you don't have to type it:

Try these command options:

- $ **`ls`** - list the contents of the current directory
- $ **`ls -l`** - list the contents with file and dir info
- $ **`ls /usr/bin`** - list the contents of directory '/usr/bin'

How to get help with a command:

To find all about any Linux command just type '**`--help`**' after the command. For example:

$ **`ls --help`**

If you want to know even more about the command, type:

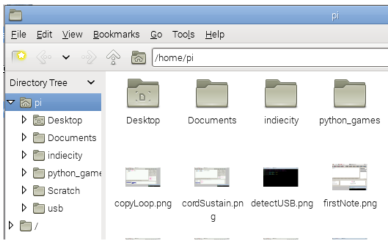
$ **`man ls`** - You'll get the manual page for the command. Type 'q' or 'ctrl-c' to exit when finished reading.

Challenge: Use the 'ls' command help and man page to:

- Show the file sizes in a directory in human readable form.
- Show all files in your home directory (some files are hidden).
- Find out the size of the file /usr/bin/scratch.

Try this:

Navigate around the file system using the File Manager then get detailed information on files in a directory using the **`ls`** command.



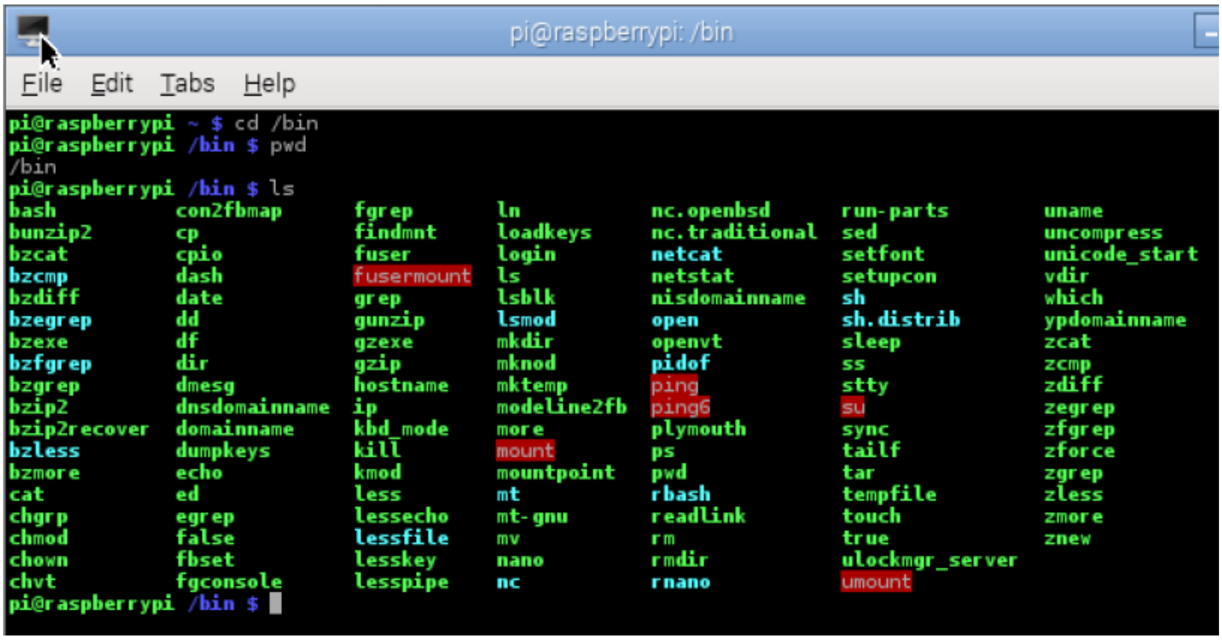
3 The **cd** Command

The cd command allows you to go to any directory. It stands for "change directory". Examples:

$ **cd /bin** - change to the /bin directory.

$ **pwd** - print the working directory (the current directory).

$ **ls** - list the files in the current directory.



```
pi@raspberrypi ~ $ cd /bin
pi@raspberrypi /bin $ pwd
/bin
pi@raspberrypi /bin $ ls
bash          con2fbmap      fgrep       ln           nc.openbsd     run-parts        uname
bunzip2       cp             findmnt     loadkeys     nc.traditional sed              uncompress
bzcat         cpio           fuser       login        netcat         setfont          unicode_start
bzcmp         dash           fusermount  ls           netstat        setupcon         vdir
bzdiff        date           grep        lsblk        nisdomainname  sh               which
bzegrep       dd             gunzip      lsmod        open           sh.distrib       ypdomainname
bzexe         df             gzexe       mkdir        openvt         sleep            zcat
bzfgrep       dir            gzip        mknod        pidof          ss               zcmp
bzgrep        dmesg          hostname    mktemp       ping           stty             zdiff
bzip2         dnsdomainname  ip          modeline2fb  ping6          su               zegrep
bzip2recover  domainname     kbd_mode    more         plymouth       sync             zfgrep
bzless        dumpkeys       kill        mount        ps             tailf            zforce
bzmore        echo           kmod        mountpoint   pwd            tar              zgrep
cat           ed             less        mt           rbash          tempfile         zless
chgrp         egrep          lessecho    mt-gnu       readlink       touch            zmore
chmod         false          lessfile    mv           rm             true             znew
chown         fbset          lesskey     nano         rmdir          ulockmgr_server
chvt          fgconsole      lesspipe    nc           rnano          umount
pi@raspberrypi /bin $ 
```

4 The Complete List of Linux Commands

Notice the contents of the **/bin** directory above. This is where most Linux system commands live. To find help on any command just type in $ ***<command>*** **--help** or $ **man** ***<command>***

5 How To Avoid Typing the Same Commands Over and Over

Use the **up** and **down** arrow keys to print the commands you've typed in the past:

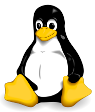
To see the entire command history run the command $ **history**
Each command in the history list has a number. To run that command again type $ **!*<command_number>*** i.e. $ **!42**

CoderDojo

Linux Commands

Card 6 of 9

I'm Learning: Raspberry Pi



1 Copy and Move Files

The cp Command:

```
cp SOURCE DEST
```

Copies a file from the source to the destination:
Examples:

```
$ cp myfile myfile.bak
```

File 'myfile' is backed up by making a copy named myfile.bak

```
$ cp myfile ~/my-backups/myfile.bak
```

The file 'myfile' is backed up by copying it to myfile.bak in the **my-backups directory** below the home dir.

The mv Command:

```
mv SOURCE DEST
```

Moves a file from the source to the destination:
Example:

```
$ mv originalFile newFile
```

The file 'originalFile' is moved to 'newFile'.
The file 'originalFile' no longer exists.

2 Run Commands as Super User

The sudo Command:

```
sudo COMMAND
```

Runs the command with super user privilages. 'sudo' stands for 'super user do'. The super user on Linux systems is usually named 'root'. Many commands on the Linux system such as installing new software cannot be run by normal users.
Try these commands:

```
$ ls /root
$ sudo ls /root
```

- `ls /root` - will return 'permission denied'.
- `sudo ls /root` - will allow you to see files in the dir.

3 Search for Files

The **find** Command

```
find STARTING-DIR -name FILENAME
```

Finds all files and directries named FILENAME. The search starts in the STARTING-DIR directory:
Examples:

```
$ sudo find / -name scratch
```

Finds all files and dirs named 'scratch' starting from the root directory. Since the search starts at the root the entire file system is searched.

The asterisk is a "wild card". It matches all character combinations.

```
$ sudo find . -name "*.py"
```

Finds all python source code files starting from the current directory. Try these commands:

```
$ cd ~                          - change to home dir
$ sudo find . -name "*.py"      - find all python code files
```

4 Mount a USB Flash Drive

- Make a directory to mount the USB drive. Create it below your home directory:

```
$ cd ~
$ mkdir usb
```

- The first USB flash drive on a Linux system is usually called "sda1". Mount the flash drive to the usb directory:

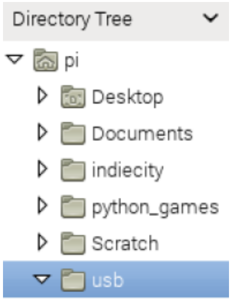
```
$ sudo mount /dev/sda1 usb -o uid=pi,gid=pi
```

Set owner to user, group pi

- You will now be able to see the files on the USB drive:

```
$ ls usb
```

- You can browse the USB drive using the File Manager:



- Unmount the drive with the command:

```
$ sudo umount -f /dev/sda1
```

CoderDojo

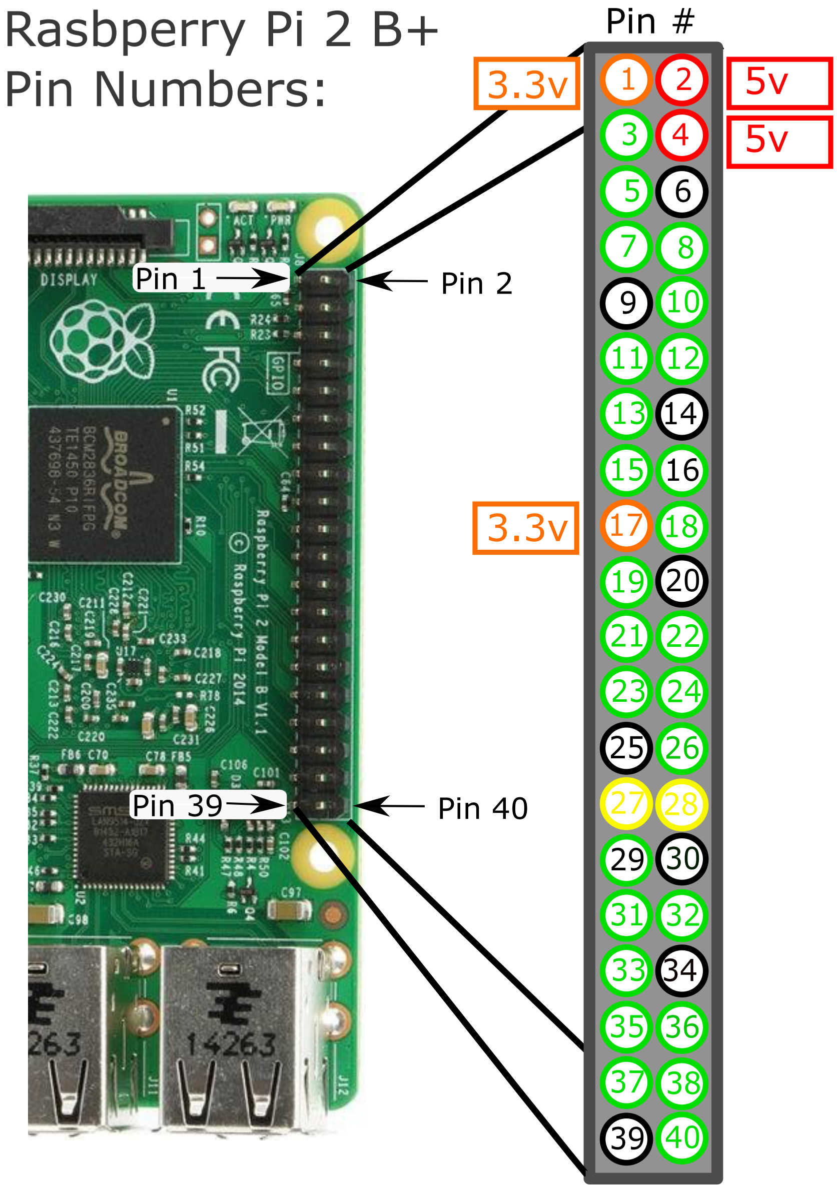
GPIO
Card 7 of 9
I'm Learning: Raspberry Pi

Raspberry Pi GPIO Pin Layout

GPIO pins allow the Raspberry Pi to interact with the physical world. GPIO stands for General Puropse Input Output. The Raspberry Pi 2 B+ has a total of 40 pins along its side. There are 26 GPIO pins, 4 power pins, 8 ground pins, plus two ID EEPROM pins.

Study the pin diagaram below carefully, Notice the power pin locations. We will write a program which will enable the Pi to control LED lights.

Rasbperry Pi 2 B+
Pin Numbers:



Power Pins

1 17 : 3.3volt
2 4 : 5 volt

Caution:

Your Pi can die!

If you accidentally connect a power pin to the wrong place it can cause electrical damage.

○ Ground Pins
Complete the circuit

○ GPIO Pins
General Purpose IO
They can be set to:
Input
Output
PWR

Set Up One LED

We'll connect the Red LED to the 3.3 volt power pin to test it first:

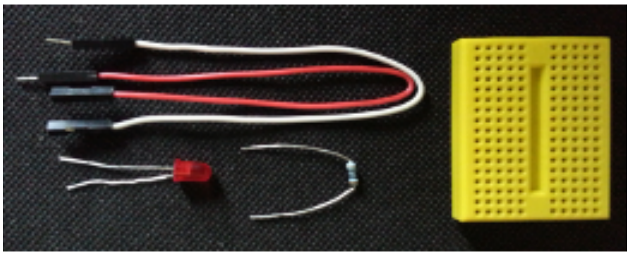
1 What You'll Need

Breadboard

270 Ohm Resistor

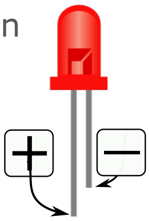
A Red Light Emitting Diode (LED)

2 Male - Female Jumper wires

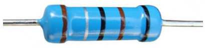


2 LED and Resistor Info:

Current must flow through an LED in one direction. The positive side of the LED is marked by a longer wire:

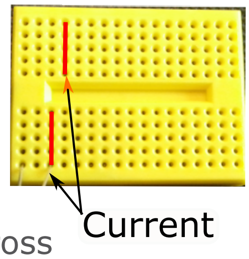


Current can flow both ways through a resistor:



3 The Breadboard

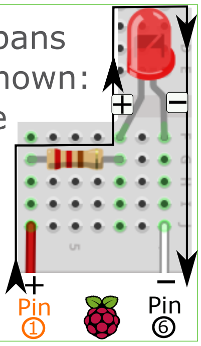
The beadboard allows electronic parts to be connected to one another. Electric current flows along columns as shown in red.



Current doesn't flow across the gap in the middle nor between rows.

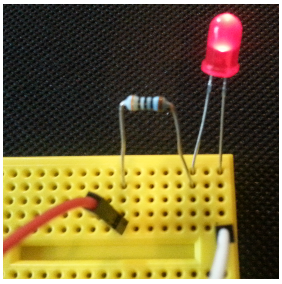
4 Wiring Diagaram

Place the LED so that it spans **across** two columns as shown: Place in the resistor in the **row below** the LED. Be sure the right wire of the resistor shares the same column as the left LED wire:



5 Wire the Board:

Connect the white ground wire (-) and red power wire (+) to the columns shown on the board. Remember which LED wire is ground?

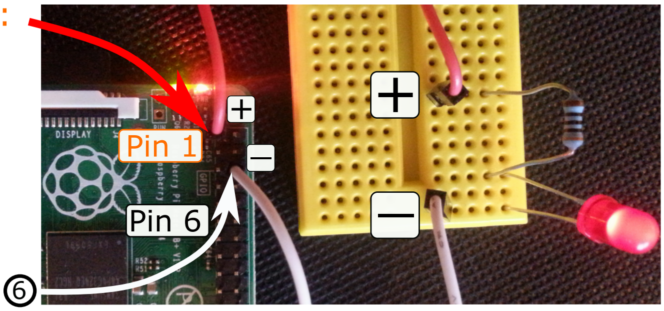


6 Connect Wires to the Raspberry Pi:

Connect the red **power** wire (+) to pin①:

In this photo the circuit is connected to power pin 1 to make sure that the LED lights up OK. Next, we will connect the power wire to GPIO pin 7 and turn the LED on and off with code!

Connect the white **ground** wire (-) to pin⑥



RASPBERRY PI

CoderDojo

GPIO Programming

Card 8 of 9

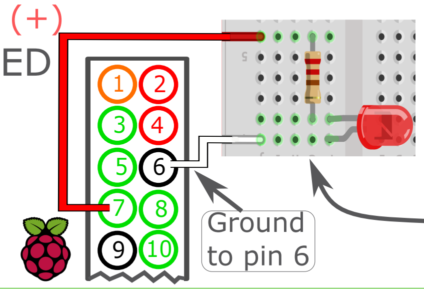
I'm Learning: Raspberry Pi

Write Code to Make the LED Blink

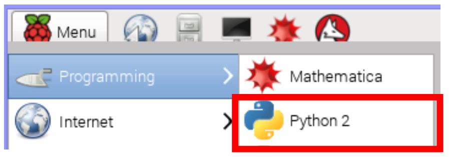
We're going to write a program to turn the LED on and off. This is done by controlling the output value of a GPIO pin. We'll write a program to set the output value of the GPIO ⑦ pin to high or low.

1 Place the Power Pin to GPIO⑦

Place the power wire (+) on pin GPIO⑦. The LED will be turned off by default. We will write code to turn it on (and off).



2 Start up Python 2



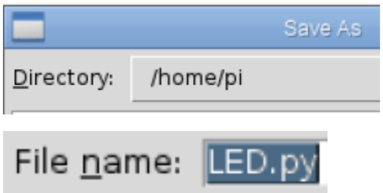
See Sushi card 7 about how to build this circuit.

3 Type in This Code:

```
import RPi.GPIO as GPIO
import time

pin7 = 7
GPIO.setmode(GPIO.BOARD)
GPIO.setup(pin7, GPIO.OUT)

GPIO.output(pin7, GPIO.HIGH)
time.sleep(1)
GPIO.output(pin7, GPIO.LOW)
time.sleep(1)

GPIO.cleanup()
```

4 Save:

Save the file as "LED.py" in your home directory:



Directory: /home/pi

File name: LED.py

5 Run!

Start up LXTerminal and run your program by typing the command:

```
~$ sudo python LED.py
```

The LED will blink once.
See Sushi card 4 about Linux commands.

6 Make the Lights Blink Forever:

Place the on/off code in a 'while' loop.
Indent the body of the loop with a tab!
Run the code again and watch.
Type Ctrl+C in LXTerminal to stop the loop.

```
while True:
    GPIO.output(pin7, GPIO.HIGH)
    time.sleep(1)
    GPIO.output(pin7, GPIO.LOW)
    time.sleep(1)
```

CoderDojoSushi

GPIO

Card 8 of 9

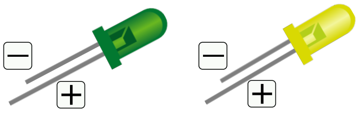
I'm Learning: Raspberry Pi

Make a Set of Traffic Lights

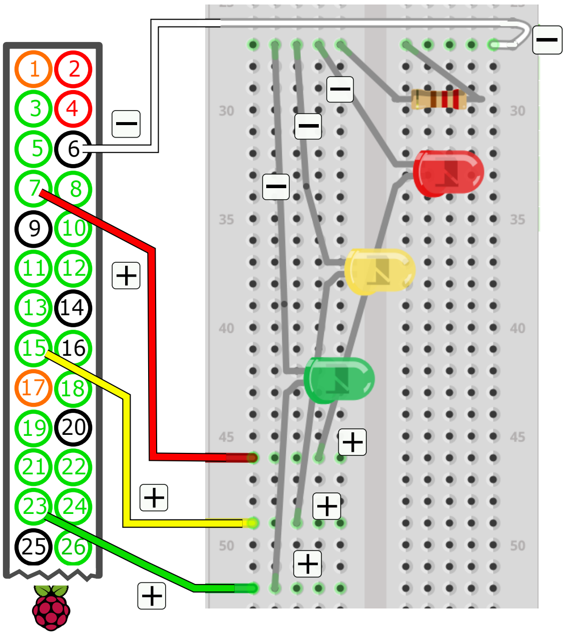
Lets connect 3 LEDs to the Raspberry Pi and control them with code

1 What You'll Need

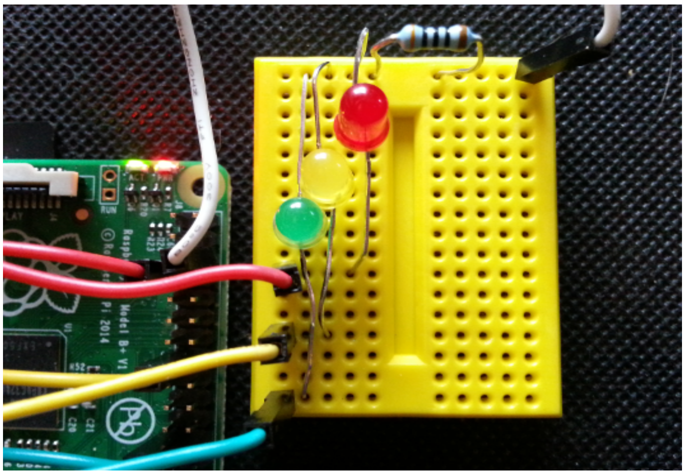
The same materials required for the single LED **plus** 1 green and 1 yellow LED:



2 Wiring Diagram:



3 Wire Up!



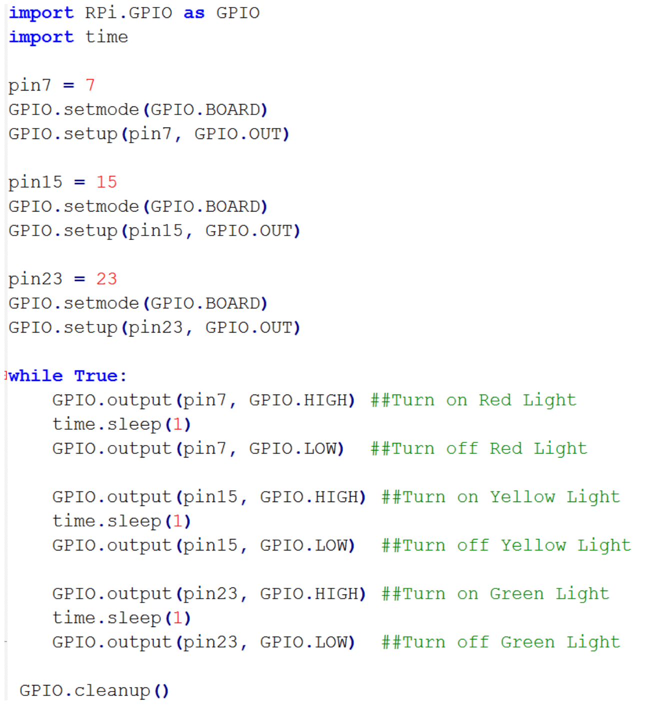
GPIO pins **7**, **15**, and **23** can be coded to supply power to their corresponding LED. All 3 LEDs share the same resistor and ground pin **6**.

4 Code Up in Python!

The code on the right configures pins **7**, **15**, and **23** to be output pins and then runs a loop which sets the power high and low for each LED/pin in a sequence.

Save this file as **3lights.py** to the home dir '**~**' and run it from the command line:

```
~$ sudo python 3lights.py
```



```
import RPi.GPIO as GPIO
import time

pin7 = 7
GPIO.setmode(GPIO.BOARD)
GPIO.setup(pin7, GPIO.OUT)

pin15 = 15
GPIO.setmode(GPIO.BOARD)
GPIO.setup(pin15, GPIO.OUT)

pin23 = 23
GPIO.setmode(GPIO.BOARD)
GPIO.setup(pin23, GPIO.OUT)

while True:
    GPIO.output(pin7, GPIO.HIGH) ##Turn on Red Light
    time.sleep(1)
    GPIO.output(pin7, GPIO.LOW)  ##Turn off Red Light

    GPIO.output(pin15, GPIO.HIGH) ##Turn on Yellow Light
    time.sleep(1)
    GPIO.output(pin15, GPIO.LOW)  ##Turn off Yellow Light

    GPIO.output(pin23, GPIO.HIGH) ##Turn on Green Light
    time.sleep(1)
    GPIO.output(pin23, GPIO.LOW)  ##Turn off Green Light

 GPIO.cleanup()
```

RASPBERRY PI

CoderDojo

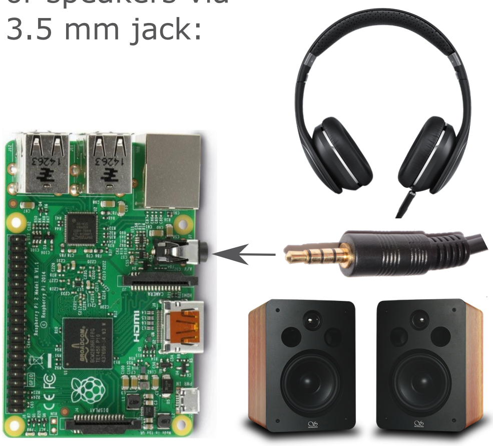
Sonic Pi

Card 9 of 9

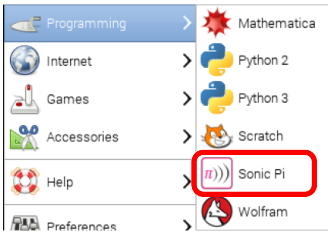
I'm Learning: Raspberry Pi

1 Make Music With Code wth Sonic Pi

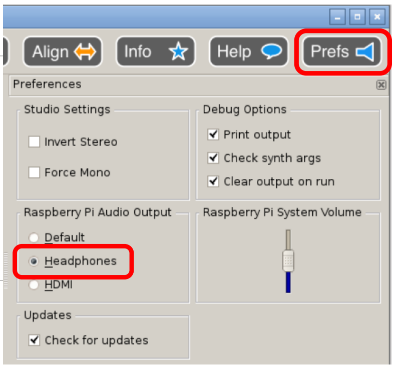
Connect headphones or speakers via 3.5 mm jack:



Start up Sonic Pi:



Go to **Prefs** and set the "Raspberry Pi Audio output" to **headphones**:



Preferences

Studio Settings
- □ Invert Stereo
- □ Force Mono

Debug Options
- ☑ Print output
- ☑ Check synth args
- ☑ Clear output on run

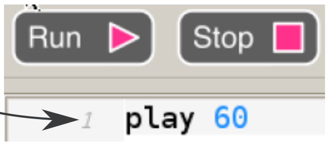
Raspberry Pi Audio Output
- ○ Default
- ● Headphones
- ○ HDMI

Raspberry Pi System Volume

Updates
- ☑ Check for updates

2 Play your First Note

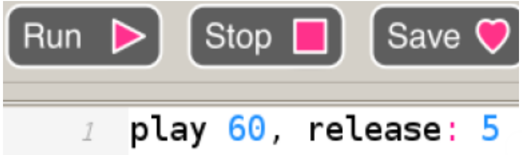
Type in "**`play 60`**" and hit the "Run" button. The note will play for 1 second:
Try This: use different numbers and see what sounds they make.



```
play 60
```

3 Sustain the Note

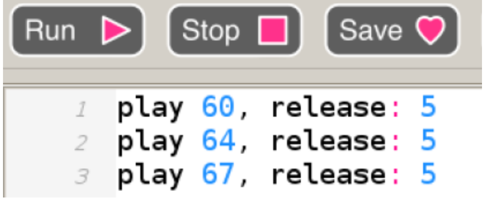
You can make the note play longer by coding how many seconds to wait before releasing the note. You can add "**`release 5`**" to sustain the note for 5 seconds. Don't forget the comma:



```
play 60, release: 5
```

4 Make a Chord

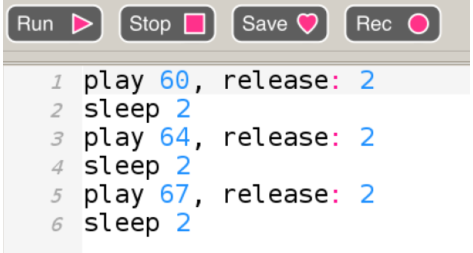
Play three notes together to make a chord. Notice that the notes play all at once.
Challenge: How can you make the notes play one at a time?



```
play 60, release: 5
play 64, release: 5
play 67, release: 5
```

5 Play One Note At a Time

To play notes one at a time "sleep" for the same amount of time as note is being sustained. Here the notes are being played for 2 secs so we sleep for 2 secs:

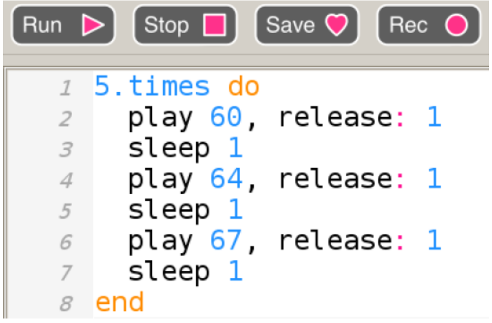


```
play 60, release: 2
sleep 2
play 64, release: 2
sleep 2
play 67, release: 2
sleep 2
```

6 Play Notes in a Loop

Music makes use of repetition. We can repeat notes by using loops.

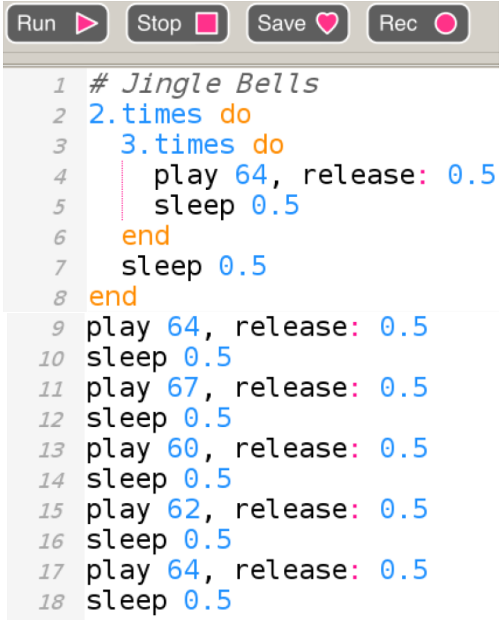
This loop plays the notes 5 times. Can you spot how the notes were made to play faster?



```
5.times do
  play 60, release: 1
  sleep 1
  play 64, release: 1
  sleep 1
  play 67, release: 1
  sleep 1
end
```

7 Let's Code Up a Tune

We now know enough to code up "Jingle Bells":



```
# Jingle Bells
2.times do
  3.times do
    play 64, release: 0.5
    sleep 0.5
  end
  sleep 0.5
end
play 64, release: 0.5
sleep 0.5
play 67, release: 0.5
sleep 0.5
play 60, release: 0.5
sleep 0.5
play 62, release: 0.5
sleep 0.5
play 64, release: 0.5
sleep 0.5
```

8 MIDI and Musical Notes

We had used MIDI values in our code to make sounds. MIDI values correspond to actual music notes.

Try this: Replace the MIDI values with the music notes found in the table on the left. Does it play the same?

MIDI Value	Music Note
60	C
62	D
64	E
65	F
67	G
69	A
71	B