Accessing GPIO pins of R-Pi

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Contents

1 Objective

In this tutorial we will learn how to write simple programs to access GPIO pins in an R-Pi.

2 Prerequisites

- Python programming skills
- Basic terminal commands

3 Hardware Requirement

1. Raspberry Pi (I will be using Version 2 Model B)
2. Power adapter
3. Connecting wires
4. LED
5. Push button
6. Resistor (330 ohms)
7. Bread board

4 Software Requirement

1. PyScripter (version 2.7 or above)
2. Mobaxterm (for windows users)

5 Theory and Description

The Raspberry Pi 2 Model B is the second generation Raspberry Pi. Compared to the Raspberry Pi 1 it has:

- A 900MHz quad-core ARM Cortex-A7 CPU
- 1GB RAM

Like the (Pi 1) Model B+, it also has:

- 4 USB ports
- 40 GPIO pins
- Full HDMI port
- Ethernet port
- Combined 3.5mm audio jack and composite video
- Camera interface (CSI)
- Display interface (DSI)
- Micro SD card slot
- VideoCore IV 3D graphics core
- Because it has an ARMv7 processor, it can run the full range of ARM GNU/Linux distributions, including Snappy Ubuntu Core, as well as Microsoft Windows 10. [2]

Expansion Header

The Raspberry Pi 2 Model B board contains a single 40-pin expansion header labelled as 'J8' providing access to 26 GPIO pins. (Pins 1, 2, 39 and 40 are also labelled below.)

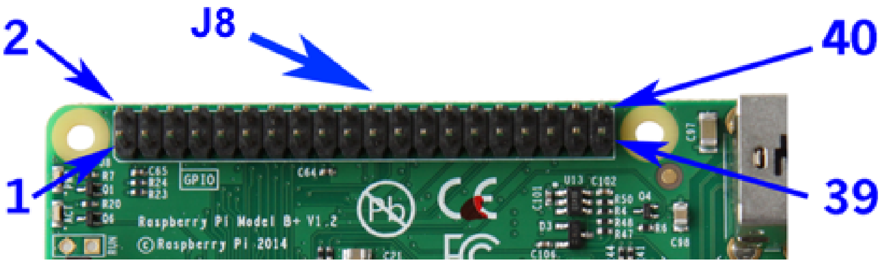


Figure 1: [3]

The diagram below illustrates the pin out diagram of Raspberry Pi 2:

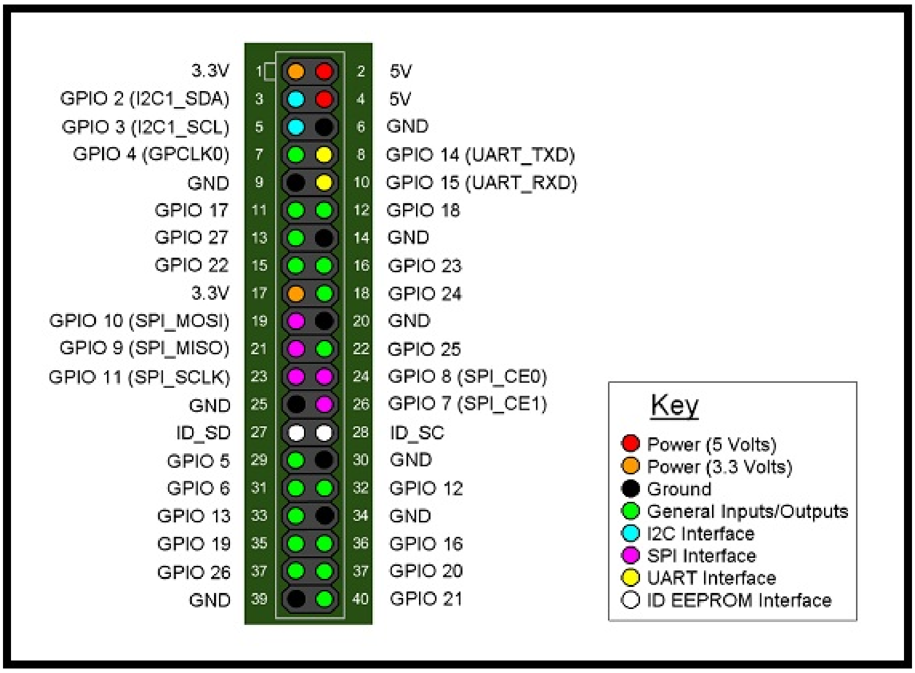


Figure 2: [4]

You must have noticed that the board contains pins named as GPIO (that are used for interfacing input and output devices) and hence in order to refer to the R-Pi pins there exists two modes:

1. **BCM mode:** Referring the pins with the GPIO number

2. **Board mode:** Referring the pins using the IC pin numbers.

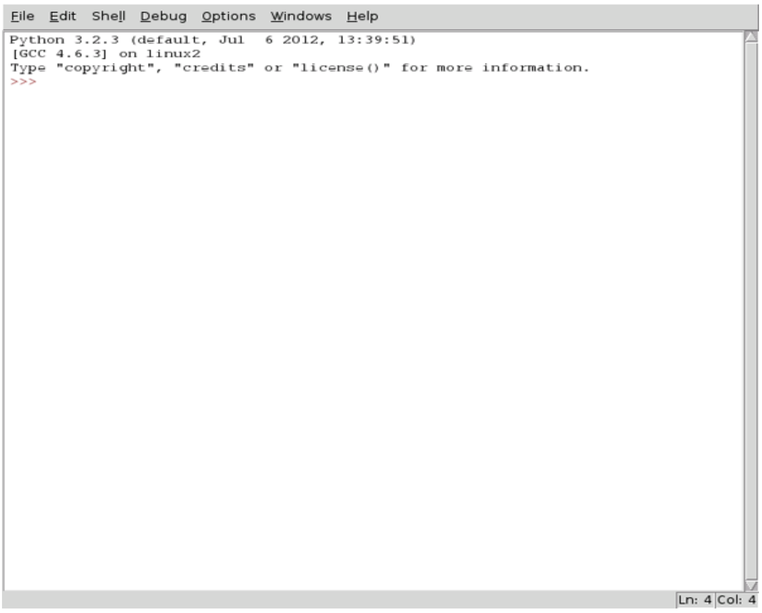
Raspbian comes preloaded with Python, the official programming language of the Raspberry Pi and IDLE 3, a Python Integrated Development Environment. And hence we can directly program the Pi using Python. Although we can even program the Pi using C language (but i will be using Python language in this tutorial).

Different methods to program an R-Pi

Before we write a code to access GPIO pins of the Pi let's understand the different ways to program Pi.

1. GUI based programming using IDLE3. In order to do so follow these steps:

    - First, load up IDLE 3 by double-clicking the icon on your LXDE desktop(either on the monitor or using Mobaxterm as explained in the previous tutorial based on establshing a SSH connection).



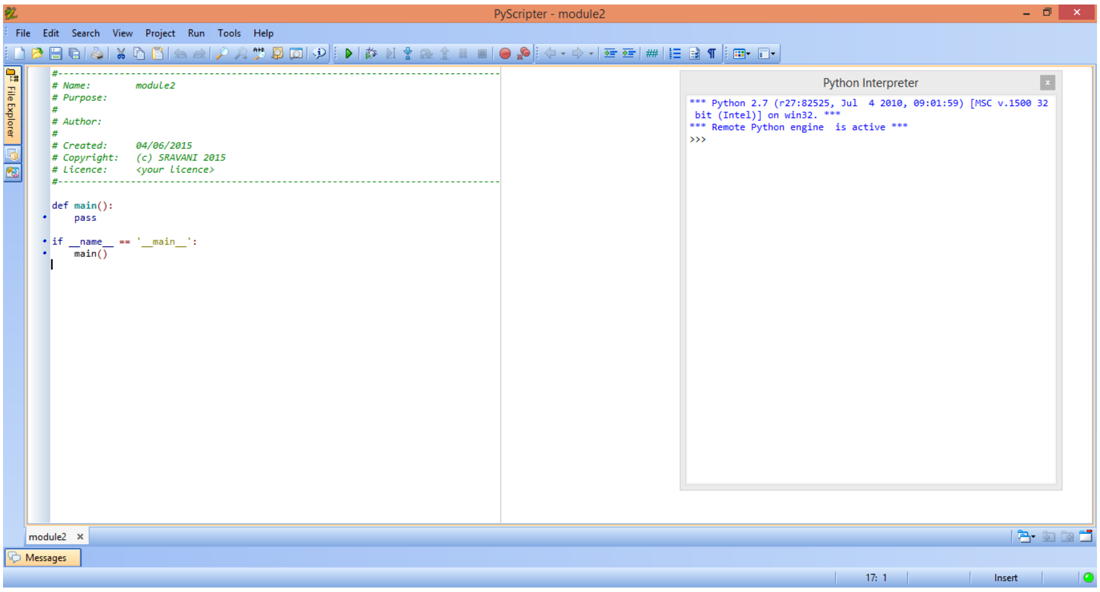
```
Python 3.2.3 (default, Jul  6 2012, 13:39:51)
[GCC 4.6.3] on linux2
Type "copyright", "credits" or "license()" for more information.
>>>
```

Figure 3: [1]

    - Click File,New Window, which will then bring up a new blank window which you can type in.
    - Now click File,Save As and save your file in the desired folder.
    - Click Run, and then Run Module or simply press F5.

2. Terminal based programming:

    - Using PyScripter and MobaXterm: PyScripter is a free and open-source Python IDE used for programming in Python.In order to download PyScripter use the following link `https://code.google.com/p/pyscripter/` (I use version 2.5.3).



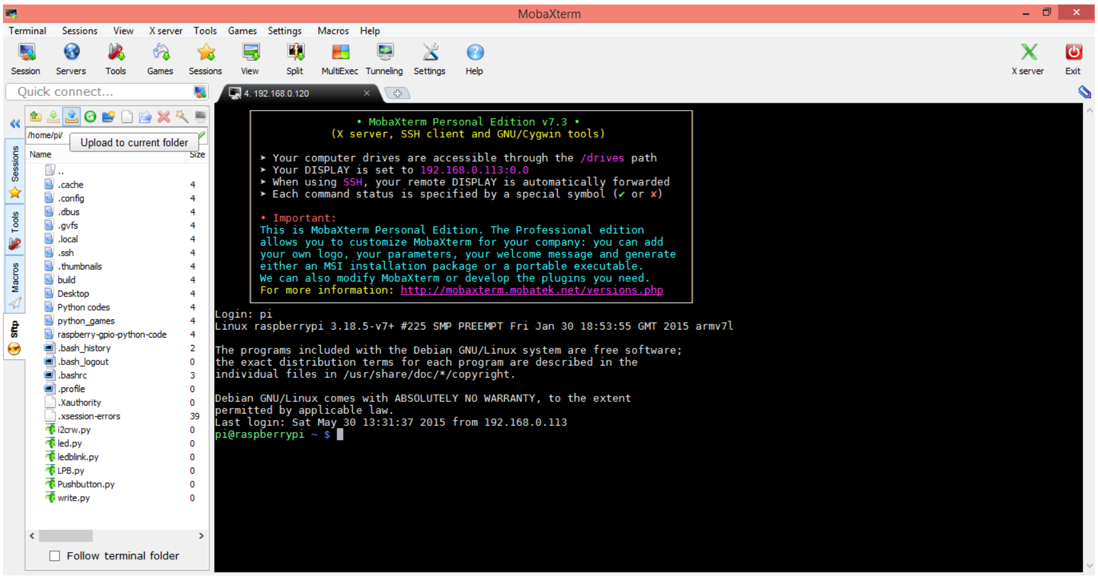
```
#-------------------------------------------------------------------------------
# Name:        module2
# Purpose:
#
# Author:
#
# Created:     04/06/2015
# Copyright:   (c) SRAVANI 2015
# Licence:     <your licence>
#-------------------------------------------------------------------------------

def main():
    pass

if __name__ == '__main__':
    main()
```

```
*** Python 2.7 (r27:82525, Jul  4 2010, 09:01:59) [MSC v.1500 32
 bit (Intel)] on win32. ***
*** Remote Python engine  is active ***
>>>
```

(a) Open the application. You will see a window like this:

(b) Delete the text already present and type your program. Once you finish typing the program goto File ¿ Save As and save the program.

(c) Now open MobaXterm. On the left side you can see the files in /home/pi/ directory and you also have some small icons on the toolbar. Click on the icon 'Upload to current folder' as shown:



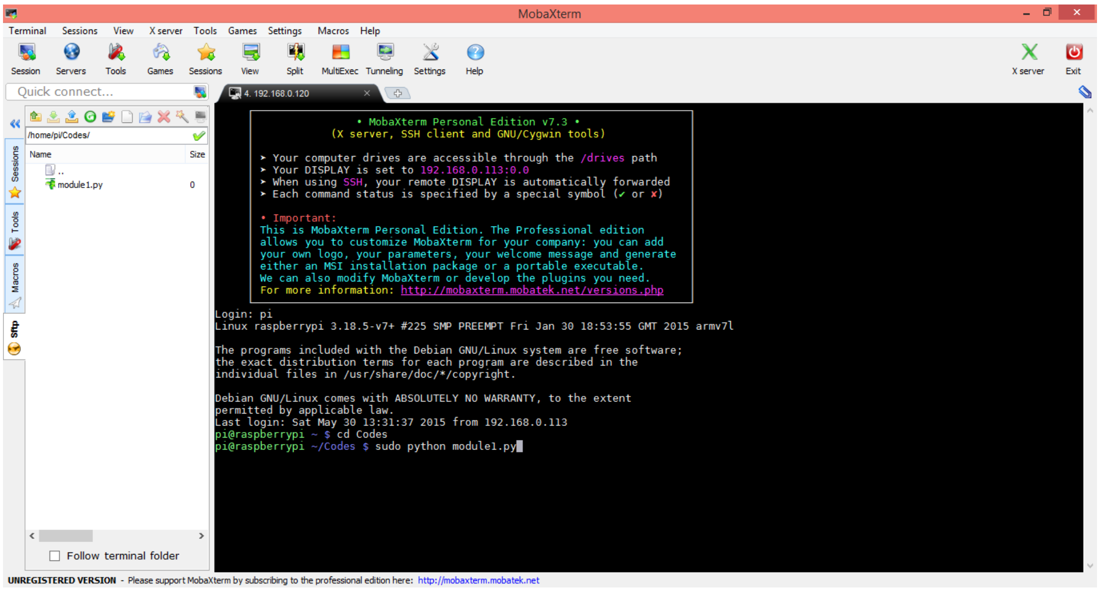
/home/pi/

Name	Size
..	
.cache	4
.config	4
.dbus	4
.gvfs	4
.local	4
.ssh	4
.thumbnails	4
build	4
Desktop	4
Python codes	4
python_games	4
raspberry-gpio-python-code	4
.bash_history	2
.bash_logout	0
.bashrc	3
.profile	0
.Xauthority	0
.xsession-errors	39
i2crw.py	0
led.py	0
ledblink.py	0
LPB.py	0
Pushbutton.py	0
write.py	0

```
                    • MobaXterm Personal Edition v7.3 •
                 (X server, SSH client and GNU/Cygwin tools)

    ➤ Your computer drives are accessible through the /drives path
    ➤ Your DISPLAY is set to 192.168.0.113:0.0
    ➤ When using SSH, your remote DISPLAY is automatically forwarded
    ➤ Each command status is specified by a special symbol (✓ or ✗)

    • Important:
    This is MobaXterm Personal Edition. The Professional edition
    allows you to customize MobaXterm for your company: you can add
    your own logo, your parameters, your welcome message and generate
    either an MSI installation package or a portable executable.
    We can also modify MobaXterm or develop the plugins you need.
    For more information: http://mobaxterm.mobatek.net/versions.php

Login: pi
Linux raspberrypi 3.18.5-v7+ #225 SMP PREEMPT Fri Jan 30 18:53:55 GMT 2015 armv7l

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.
Last login: Sat May 30 13:31:37 2015 from 192.168.0.113
pi@raspberrypi ~ $
```

(d) Upload that file wherein you have written your python program. Note: You can either upload your files to the home directory i.e. /home/pi/ or else you can create a new directory using the icons on the toolbar as illustrated before and upload your python file over there.

(e) After you have uploaded the code then type the following command on the terminal to execute the code *python filename.py*. In case you have uploaded the file to a directory other than home directory then change the path by typing *cd directoryname* and then *sudo python filename.py* (Note: In order to execute files form any directory other than home directory dont forget to use *cd* command before your directory name and textitsudo python command before your file name that you want to execute.)



```
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Last login: Sat May 30 13:31:37 2015 from 192.168.0.113
pi@raspberrypi ~ $ cd Codes
pi@raspberrypi ~/Codes $ sudo python module1.py
```
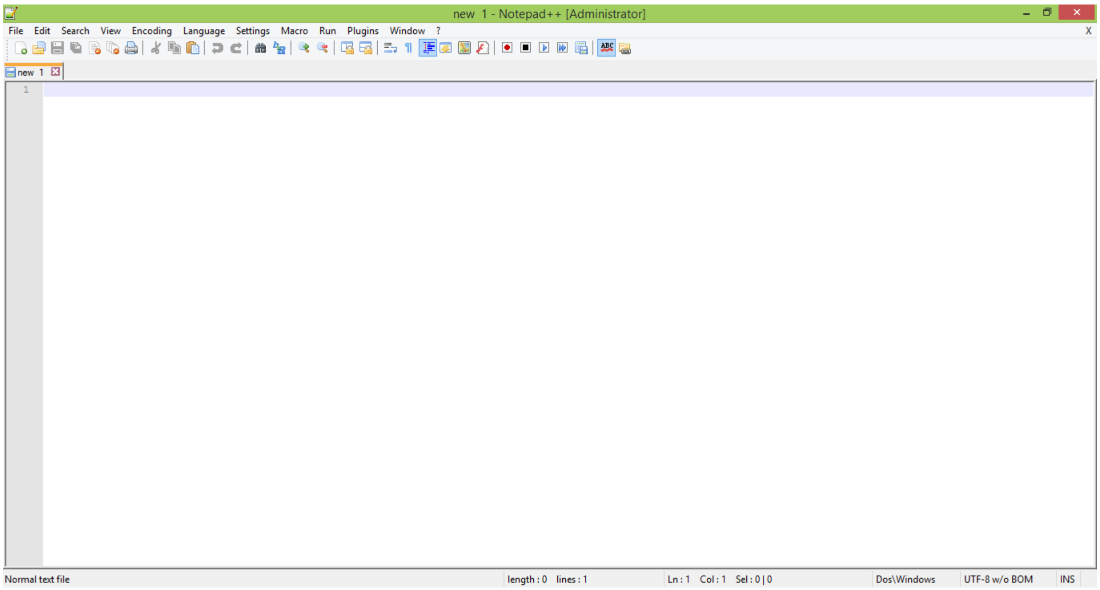

UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: http://mobaxterm.mobatek.net

- Using Notepad++ and LXTerminal(or MobaXterm): Notepad++ is a source code and a Windows text editor that is widely used by programmers.(It is more efficient than other text editors because it prompts you with indentation related errors that count in python programming)

  (a) Open the application and a create a new file.


new 1 - Notepad++ [Administrator]
File Edit Search View Encoding Language Settings Macro Run Plugins Window ?
new 1
1
Normal text file
length : 0 lines : 1
Ln : 1 Col : 1 Sel : 0 | 0
Dos\Windows
UTF-8 w/o BOM
INS

(b) Type your python code and then save it as filename.py

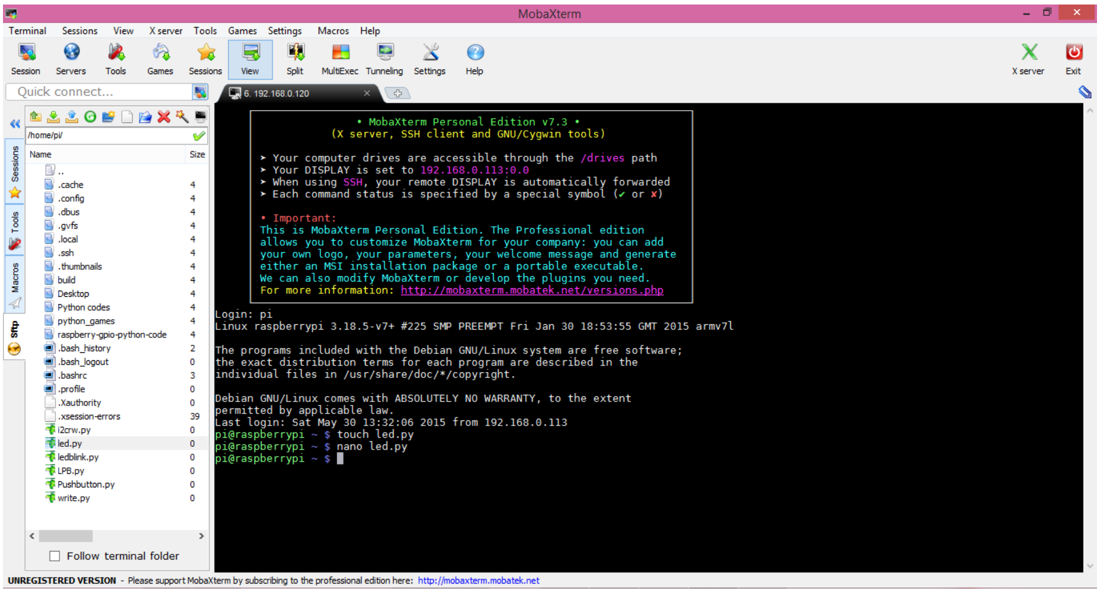
(c) After that follow the steps(3-5) mentioned in the above method i.e using PScripter and MobaXterm.

- Using MobaXterm(for remote operation) or LXTerminal: In this method we can create a python file on the terminal window in the following way:

  (a) Open the MobaXterm or LXTerminal.

  (b) Type the command *touch filename.py* to create a file in a directory say home directory

  (c) Once the file is created in order to edit it type the command *nano filename.py*


MobaXterm
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Settings Help
X server Exit
Quick connect...
6. 192.168.0.120
Sessions Tools Macros Sftp
Follow terminal folder
UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: http://mobaxterm.mobatek.net

/home/pi/

Name	Size
..	
.cache	4
.config	4
.dbus	4
.gvfs	4
.local	4
.ssh	4
.thumbnails	4
build	4
Desktop	4
Python codes	4
python_games	4
raspberry-gpio-python-code	4
.bash_history	2
.bash_logout	0
.bashrc	3
.profile	0
.Xauthority	0
.xsession-errors	39
i2crw.py	0
led.py	0
ledblink.py	0
LPB.py	0
Pushbutton.py	0
write.py	0

```
          • MobaXterm Personal Edition v7.3 •
        (X server, SSH client and GNU/Cygwin tools)

 ➤ Your computer drives are accessible through the /drives path
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Linux raspberrypi 3.18.5-v7+ #225 SMP PREEMPT Fri Jan 30 18:53:55 GMT 2015 armv7l

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permitted by applicable law.
Last login: Sat May 30 13:32:06 2015 from 192.168.0.113
pi@raspberrypi ~ $ touch led.py
pi@raspberrypi ~ $ nano led.py
pi@raspberrypi ~ $ 
```
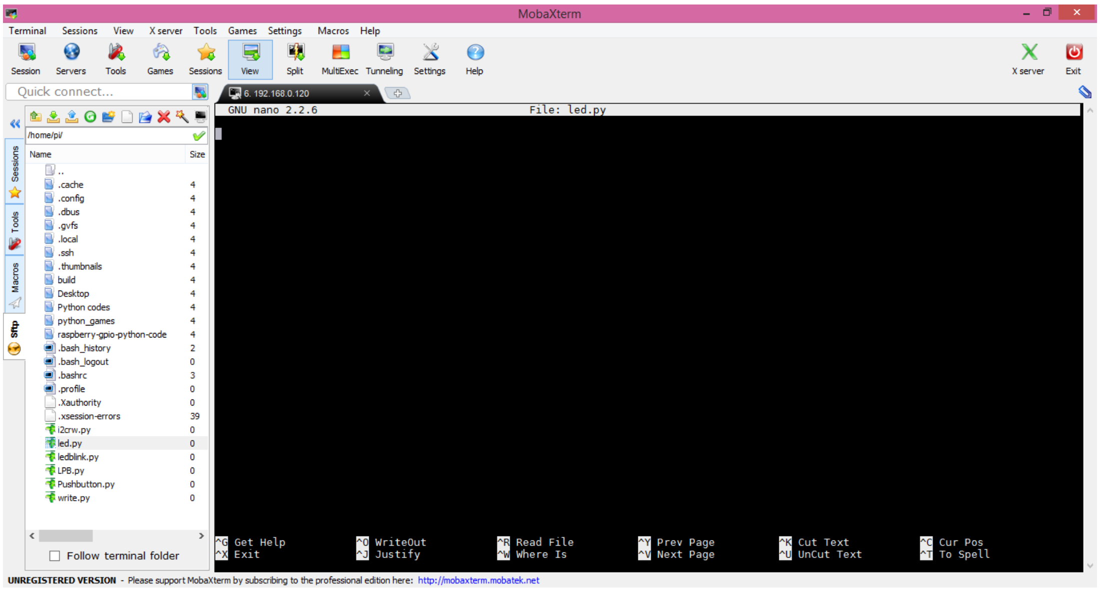

(d) A blank file opens as shown


MobaXterm
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Settings Help
X server Exit
Quick connect...
6. 192.168.0.120
Sessions Tools Macros Sftp
Follow terminal folder
UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: http://mobaxterm.mobatek.net

/home/pi/

Name	Size
..	
.cache	4
.config	4
.dbus	4
.gvfs	4
.local	4
.ssh	4
.thumbnails	4
build	4
Desktop	4
Python codes	4
python_games	4
raspberry-gpio-python-code	4
.bash_history	2
.bash_logout	0
.bashrc	3
.profile	0
.Xauthority	0
.xsession-errors	39
i2crw.py	0
led.py	0
ledblink.py	0
LPB.py	0
Pushbutton.py	0
write.py	0

```
  GNU nano 2.2.6                        File: led.py



^G Get Help     ^O WriteOut     ^R Read File    ^Y Prev Page    ^K Cut Text     ^C Cur Pos
^X Exit         ^J Justify      ^W Where Is     ^V Next Page    ^U UnCut Text   ^T To Spell
```

(e) Type the required code and save the contents by typing *Ctrl* + *X*, *Y*(to save the file type Y)

(f) Then press enter to exit the editor onto terminal window.

(g) You can now execute the file by using the command *sudo python filename.py*(Don't forget to change the directory if your file is not saved in the home directory.PLease refer the steps mentioned before in the document)

> Note: Just in case you want to view the contents of the file on the terminal window type *cat filename.py*

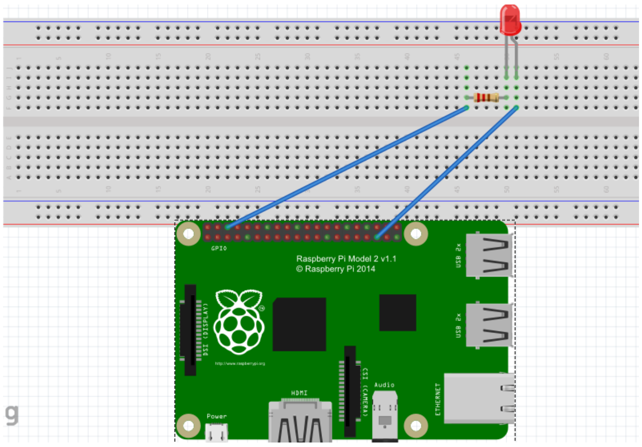
Now we are all set to write basic programs to access GPIO pins in your R-Pi

6 Experiment

In order to access GPIO pins we need to use the Rpi.GPIO package which is usually present in the Python libraries. (but if you are using an R-Pi 2 please ensure that the version of this package is greater than 0.5.10)

6.1 Interfacing an LED with R-Pi

Setting up the Hardware



As shown in the figure :

- Anode of the LED is connected to pin no. 18
- Cathode of the LED is connected to a resistor(330 ohms) which is in turn connected to GND pin on R-Pi 2.

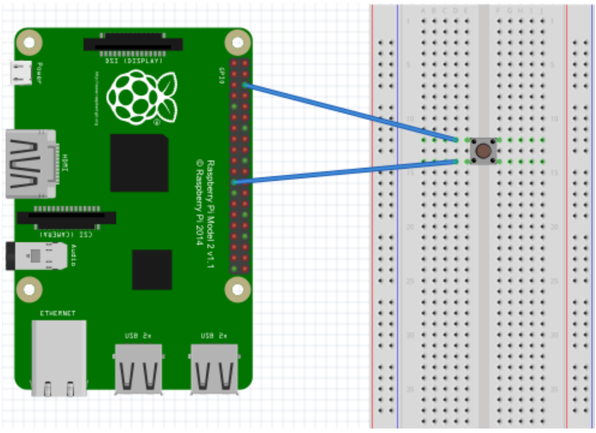
Note: Please refer the theory section for the pin description of R-Pi 2.

Code

```
import RPi.GPIO as GPIO # module to control Pi GPIO channels
import time

# Function name :blink()
# Input : Pin number
# Output : Alternating high and low logic levels on the pin
# Example call: blink(pin)
def blink(pin):
        GPIO.output(pin,GPIO.HIGH)
        time.sleep(1) # to see the blinking effect clearly
                      # we give a delay
        GPIO.output(pin,GPIO.LOW)
        time.sleep(1)
        return

# to use Raspberry Pi board pin numbers
GPIO.setmode(GPIO.BOARD)

# set up GPIO output channel i.e. on pin 12
GPIO.setup(35, GPIO.OUT)

# blink GPIO18 10 times
for i in range(0,10):
        blink(35) # call

#to clean up all the ports used
GPIO.cleanup()
```

6.2 Interfacing a Push button with R-Pi

Setting up Hardware As shown in the figure :



- One pin of the push button is connected to Ground
- The other pin of the push button is connected to pin no. 12

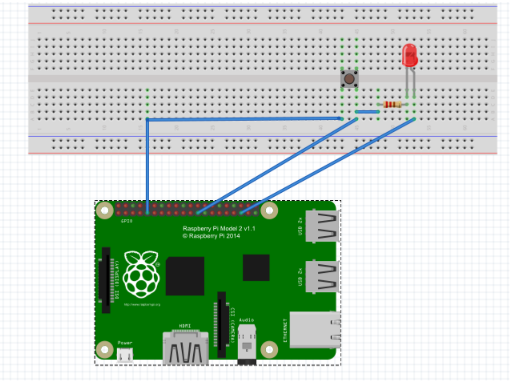
Note: Please refer the theory section for the pin description of R-Pi 2.
Also ensure that the push button pins you connect to R-Pi shoudlnt be shorted.

Code

```
import RPi.GPIO as GPIO # module to control Pi GPIO channels
import time

# to use Raspberry Pi board pin numbers
GPIO.setmode(GPIO.BOARD)

GPIO.setup(23, GPIO.IN, pull_up_down=GPIO.PUD_UP) # the input pin(12) is
# normally pulled up to 3.3V therefore when we press the button a logic
# low or false value is returned at this pin

while True:
    input_state = GPIO.input(23) # a variable to measure the
                                 # logic state of the input pin
    if input_state == False:
        print('Button␣Pressed')
        time.sleep(0.2) # this is the min debouncing delay that
                        # we give in order to ensure that the
                        # switch is definitely pressed
```

6.3 Controlling an led using a push button.

Setting up Hardware As shown in figure:



- One pin of the push button is connected to Ground(Pin 9)
- The other pin of the push button is connected to pin no. 23
- The anode of led is connected to pin 35 of raspberry pi
- The cathode of led is connected to the the resistor of 300 ohms which is then connected to the pin 23

Note: Please refer the theory section for the pin description of R-Pi 2. Also ensure that the push button pins you connect to R-Pi shoudlnt be shorted.

Code

```
import RPi.GPIO as GPIO # module to control Pi GPIO channels
import time
# to use Raspberry Pi board pin numbers
#GPIO.cleanup()
GPIO.setmode(GPIO.BOARD)

GPIO.setup(23, GPIO.IN, pull_up_down=GPIO.PUD_UP) # the input pin(12) is
# normally pulled up to 3.3V therefore when we press the button a logic
# low or false value is returned at this pin
GPIO.setup(35,GPIO.OUT)

while True:
    input_state = GPIO.input(23)# a variable to measure the
    # logic state of the input pin

    if input_state == False:
```

```
GPIO.output(35,GPIO.HIGH)
#print('Button Pressed')

                                 # this is the min debouncing delay that
                                # we give in order to ensure that the
                                # switch is definitely pressed
```

7 References

1. `http://www.engadget.com/2012/09/04/raspberry-pi-getting-started-guide-how-to/`

2. `https://www.raspberrypi.org/products/raspberry-pi-2-model-b/`

3. `http://pi4j.com/images/j8header-photo.png`

4. `http://data.designspark.info/uploads/images/53bc258dc6c0425cb44870b50ab30621`