Python Virtual Environment Usage on Raspberry Pi

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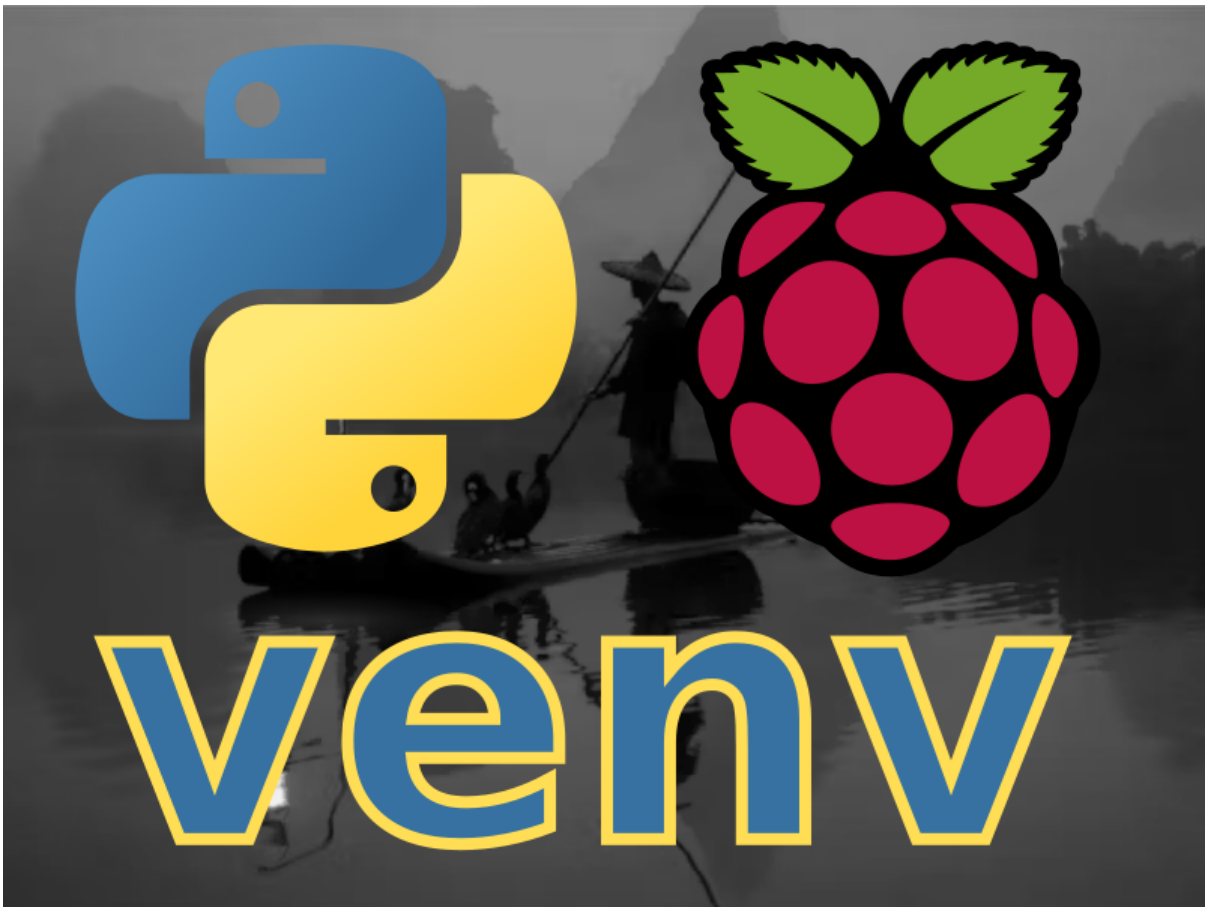

https://learn.adafruit.com/python-virtual-environment-usage-on-raspberry-pi

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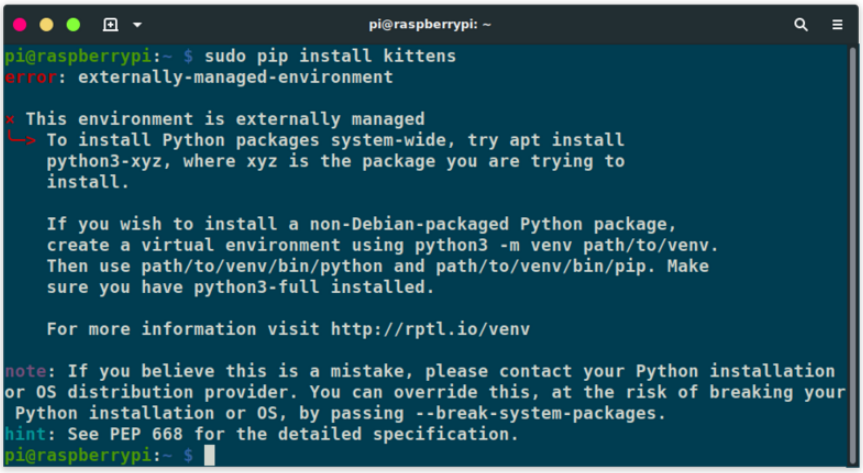
Overview



Starting with the October 10, 2023 Bookworm release (https://adafru.it/199D) of the Raspberry Pi OS (https://adafru.it/XMd), the use of Python Virtual Environments (https://adafru.it/199E) (venv) when pip installing packages is required. **No more sudo pip**. This will break things and require learning new things. Yeah.

This guide tries to help with this transitional pain by covering basic venv usage on Raspberry Pi's.

Why This Change?

This change is being done to protect the system level Python installation. This is not a new issue and using venv has long been the recommended solution. We've just been slow to adopt this on Raspberry Pi boards.

The main issue is this - when Python modules are installed using `pip`, they get installed into the system level Python installation. This can potentially break the system level installation.

Read the PEP for more details:

PEP 668

https://adafru.it/199F

Using a virtual environment, the pip installed packages get placed there instead of at the system level.

Nomenclature

In this guide, **venv** is used as short hand for Python Virtual Environment in general. It's also the name of the Python module used to create new Virtual Environments.

Python "modules" may also be referred to as libraries or packages. They're the thing that gets install via pip.

Also, "Python" here always means Python 3. Code examples may show either `python` or `python3`. The commands should be equivalent.

Installing venv

Raspberry Pi OS's should already have Python installed. However, the venv module itself may or may *not* be included as part of the OS image along with the Python install. If you get errors when running the venv setup, then you may need to install the venv module:

```
sudo apt install python3-venv
```

Basic Venv Usage

This part of the guide is generic and covers basic virtual environment usage. However, it is Linux specific since we are focusing on Raspberry Pi usage.

The basic steps are:

- **Create** the venv - this is done once (per venv)
- **Activate** the venv - this is done every time a venv is to be used
- **Use** the venv - run your Python code here
- **Deactivate** the venv - optional

Create the venv

To create a new virtual environment, use the venv (https://adafru.it/19a0) module and give it the name for the virtual environment.

```
python3 -m venv foobar
```

The virtual environment name can be any valid name. A lot of tutorials show "venv" or ".venv" for the name. That's fine but tends to imply that name is important. It's not. So here we are intentionally picking something silly, `foobar`, to be clear that the virtual environment name is just a name.

So what did that command do? It created a new folder with the virtual environment name and set up a folder structure that mimics the layout the Python interpreter expects.

```
pi@raspberrypi:~ $ python3 -m venv foobar
pi@raspberrypi:~ $ ls
foobar/
pi@raspberrypi:~ $ ls foobar/
bin/  include/  lib/  pyvenv.cfg
pi@raspberrypi:~ $
```

Activate the venv

The main way to use the virtual environment is by "activating" it. This is done by "sourcing" the `activate` script found in the virtual environments **bin** folder.

```
source foobar/bin/activate
```

The prompt should change to include the virtual environments name. This both helps indicate a venv is in use (active) and which one.

```
pi@raspberrypi:~ $ source foobar/bin/activate
(foobar) pi@raspberrypi:~ $
```

Use the venv

Once the virtual environment has been activated, Python usage proceeds in the normal fashion. Running `python` or `pip` will be done in the context of the virtual environment.

Modules installed with pip will be placed in the local venv folders - **sudo should not be used**.

```
(foobar) pi@raspberrypi:~ $ pip list
Package    Version
---------- -------
pip        23.0.1
setuptools 66.1.1
(foobar) pi@raspberrypi:~ $ pip install click
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Collecting click
  Downloading https://www.piwheels.org/simple/click/click-8.1.7-py3-none-any.whl
```

```
(97 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 97.9/97.9 kB 47.2 kB/s eta 0:00:00
Installing collected packages: click
Successfully installed click-8.1.7
(foobar) pi@raspberrypi:~ $ pip list
Package    Version
---------- -------
click      8.1.7
pip        23.0.1
setuptools 66.1.1
(foobar) pi@raspberrypi:~ $
```

Running Python will have access to the pip installed modules of the venv.

```
(foobar) pi@raspberrypi:~ $ python
Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
&gt;&gt;&gt; import click
&gt;&gt;&gt;
```

Deactivate the venv

If you ever want to "turn off" the virtual environment and return to the regular state, the `deactivate` command can be used.

```
deactivate
```

This is not a Linux command. This "command" is a shell function that was defined in the `activate` script when it was originally sourced. It simply undoes what the activate script did.

```
(foobar) pi@raspberrypi:~ $ deactivate
pi@raspberrypi:~ $
```

More Venv Details

Let's start looking a little more under the hood at how Python venv actually works. This will help to better understand the various options for using venv on Raspberry Pi.

What did the activate script do?

A Python venv is "activated" by running the aptly named `activate` script found in the venv bin folder. It's just a shell script, so it is a plain text file you can open in any text editor. It's not crazy long or complex, only about 70 lines of shell code - half of which define the `deactivate` function.

This script does some cute things like change the prompt to include the venv name. However, the key thing done is to alter the `PATH` variable such that **the venv Python path shows up before the system path**.

Observe the behavior before activating the venv:

```
pi@raspberrypi:~ $ which python
/usr/bin/python
pi@raspberrypi:~ $ echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/local/games:/usr/
games
pi@raspberrypi:~ $
```

There is no mention of the venv in `PATH` and as a result the python command is finding the system level installation in `/usr/bin`. (pip would have similar behavior)

Now activate the venv:

```
pi@raspberrypi:~ $ source foobar/bin/activate
(foobar) pi@raspberrypi:~ $
```

And note the change in behavior:

```
(foobar) pi@raspberrypi:~ $ which python
/home/pi/foobar/bin/python
(foobar) pi@raspberrypi:~ $ echo $PATH
/home/pi/foobar/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/
usr/local/games:/usr/games
(foobar) pi@raspberrypi:~ $
```

The python command is now pointing to the venv installation. This is a result of `/home/pi/foobar/bin` being added to `PATH`. The paths in `PATH` are searched in order, left to right. So by having the venv path before the system path, the venv is found first.

Why was activate "sourced"?

Shell scripts are usually "run". But above we instead "sourced" the `activate` script. Why was that done? It has to do with context. When a script is "run", it gets launched in a new shell context, and when the script is done, that context goes away. However, when a script is "sourced", it is run in the current context.

This is important for things like environment variables, which can be set and accessed very simply in bash:

```
pi@raspberrypi:~ $ FOO=23
pi@raspberrypi:~ $ echo $FOO
23
pi@raspberrypi:~ $
```

Now consider this simple script, called **test.sh**, which similarly sets a variable:

```
pi@raspberrypi:~ $ ls -l test.sh
-rwxr-xr-x 1 pi pi 7 Oct 23 11:50 test.sh
pi@raspberrypi:~ $ cat test.sh
BAR=42
pi@raspberrypi:~ $
```

If this script is "run", the `BAR` variable does not persist:

```
pi@raspberrypi:~ $ ./test.sh
pi@raspberrypi:~ $ echo $BAR

pi@raspberrypi:~ $
```

However, if the script is "sourced", the `BAR` variable does persist:

```
pi@raspberrypi:~ $ source test.sh
pi@raspberrypi:~ $ echo $BAR
42
pi@raspberrypi:~ $
```

Since "activating" a Python virtual environment needs to alter the current context, the `activate` script should be sourced, not run.

In bash, . is a shortcut for source.

Use without activating

Activating a Python venv is really just a convenience. It's possible to use a venv **without activating it** by explicitly invoking the Python interpreter found in the venv. **This is done by using absolute paths.**

To demonstrate, let's use this simple Python script, called **test.py**, that tries to import the click module:

```
import click
print("Done.")
```

The **click** module is pip installed into the `foobar` venv:

```
(foobar) pi@raspberrypi:~ $ pip install click
Looking in indexes: https://pypi.org/simple, https://www.piwheels.org/simple
Collecting click
  Downloading https://www.piwheels.org/simple/click/click-8.1.7-py3-none-any.whl
(97 kB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 97.9/97.9 kB 47.2 kB/s eta 0:00:00
Installing collected packages: click
Successfully installed click-8.1.7
(foobar) pi@raspberrypi:~ $ pip list
Package    Version
---------- -------
click      8.1.7
pip        23.0.1
setuptools 66.1.1
(foobar) pi@raspberrypi:~ $
```

So running with the venv activated has the expected output:

```
(foobar) pi@raspberrypi:~ $ python test.py
Done.
(foobar) pi@raspberrypi:~ $
```

However, if the venv is deactivated, the script fails:

```
(foobar) pi@raspberrypi:~ $ deactivate
pi@raspberrypi:~ $ python test.py
Traceback (most recent call last):
  File "/home/pi/test.py", line 1, in &lt;module&gt;
    import click
ModuleNotFoundError: No module named 'click'
pi@raspberrypi:~ $
```

This is because **click** was only installed in the `foobar` venv. Once deactivated, we are back to using the system level install, which does not have **click** installed.

However, by using an **absolute path** to the venv, it works again:

```
pi@raspberrypi:~ $ /home/pi/foobar/bin/python test.py
Done.
pi@raspberrypi:~ $
```

Virtual Environment Configuration

A file named `pyvenv.cfg` that lives in the **venv** folder controls some basic virtual environment configuration.

```
pi@raspberrypi:~ $ ls foobar/
bin/  include/  lib/  pyvenv.cfg
```

This file contains a simple list of key = value pairs.

```
home = /usr/bin
include-system-site-packages = false
version = 3.11.2
executable = /usr/bin/python3.11
command = /usr/bin/python3 -m venv /home/pi/foobar
```

Probably the most important one is the `include-system-site-packages` option. This does pretty much what it says. If set to `true`, then the venv has access to modules (aka libraries, aka packages) installed at the system level. The default is `false`.

For example, `gpiozero` is usually pre-installed at the system level on most Raspberry Pi's:

```
pi@raspberrypi:~ $ python
Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
&gt;&gt;&gt; import gpiozero
&gt;&gt;&gt;
```

But with the default `false` setting of `include-system-site-packages`, the foobar venv does not have access to it:

```
pi@raspberrypi:~ $ source foobar/bin/activate
(foobar) pi@raspberrypi:~ $ python
Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
&gt;&gt;&gt; import gpiozero
Traceback (most recent call last):
  File "&lt;stdin&gt;", line 1, in &lt;module&gt;
ModuleNotFoundError: No module named 'gpiozero'
&gt;&gt;&gt;
```

If the **pyvenv.cfg** in the foobar venv folder is changed to (only change is false to true):

```
home = /usr/bin
include-system-site-packages = true
version = 3.11.2
executable = /usr/bin/python3.11
command = /usr/bin/python3 -m venv /home/pi/foobar
```

Then the venv does have access:

```
pi@raspberrypi:~ $ source foobar/bin/activate
(foobar) pi@raspberrypi:~ $ python
Python 3.11.2 (main, Mar 13 2023, 12:18:29) [GCC 12.2.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
&gt;&gt;&gt; import gpiozero
&gt;&gt;&gt;
```

Enabling access to system site packages can also be done when initially creating the venv by using the `--system-site-packages` command line argument:

```
python3 -m venv --system-site-packages foobar
```

Most setups will likely want to enable the --system-site-packages feature.

Pip vs. apt

So there is **pip** for installing Python stuff. And there is also **apt** and **apt-get** that also get used for "installing stuff". Keep in mind these are two totally separate package management tools. Pip is specific to Python while apt and apt-get are operating system tools. So while activating a Python venv will change the behavior of pip installs (they'll go into the venv), there is no change to apt and apt-get behavior. **Using apt/apt-get with or without a venv active will have the same behavior.**

Usage With sudo

Now things are getting more Raspberry Pi specific. Sometimes elevated privileges are needed to access certain hardware on the Raspberry Pi (ex: /dev/mem). The typical way to do this is by invoking the Python script using sudo. However, **sudo usage with virtual environments requires some special attention**.

It's not as simple as sudo make me a sandwich (https://adafru.it/19a1).

NeoPixel Example

Let's use a simple NeoPixel script as an example, since NeoPixels generally require running with sudo. Here's the simple NeoPixel code we want to run, which we will call **neo_test.py**:

```
import board
import neopixel

pixels = neopixel.NeoPixel(board.D18, 10)

pixels.fill(0xADAF00)
```

We start with a Raspberry Pi setup with Blinka:

Installing Blinka on Raspberry Pi

https://adafru.it/Deo

For this example, Blinka is installed into a venv called blinka (remember venv names are just names) using the manual process. (https://adafru.it/Deo)

```
pi@raspberrypi:~ $ python3 -m venv blinka
(blinka) pi@raspberrypi:~ $ source blinka/bin/activate
(blinka) pi@raspberrypi:~ $ pip3 install --upgrade adafruit-blinka
```

And then the NeoPixel library is also installed:

```
(blinka) pi@raspberrypi:~ $ pip3 install adafruit-circuitpython-neopixel
```

If we try running **neo_test.py** without sudo, we get a permission error:

```
(blinka) pi@raspberrypi:~ $ python3 neo_test.py
Can't open /dev/mem: Permission denied
Traceback (most recent call last):
  File "/home/pi/neo_test.py", line 6, in &lt;module&gt;
    pixels.fill(0xADAF00)
  File "/home/pi/blinka/lib/python3.11/site-packages/adafruit_pixelbuf.py", line
216, in fill
    self.show()
  File "/home/pi/blinka/lib/python3.11/site-packages/adafruit_pixelbuf.py", line
204, in show
    return self._transmit(self._post_brightness_buffer)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/home/pi/blinka/lib/python3.11/site-packages/neopixel.py", line 180, in
_transmit
    neopixel_write(self.pin, buffer)
  File "/home/pi/blinka/lib/python3.11/site-packages/neopixel_write.py", line 42,
in neopixel_write
    return _neopixel.neopixel_write(gpio, buf)
           ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
  File "/home/pi/blinka/lib/python3.11/site-packages/adafruit_blinka/
microcontroller/bcm283x/neopixel.py", line 78, in neopixel_write
    raise RuntimeError(
RuntimeError: NeoPixel support requires running with sudo, please try again!
swig/python detected a memory leak of type 'ws2811_t *', no destructor found.
(blinka) pi@raspberrypi:~ $
```

The error message says to run with sudo, so let's try that:

```
(blinka) pi@raspberrypi:~ $ sudo python3 neo_test.py
Traceback (most recent call last):
  File "/home/pi/neo_test.py", line 1, in &lt;module&gt;
    import board
ModuleNotFoundError: No module named 'board'
(blinka) pi@raspberrypi:~ $
```

That just throws a different error. And it is confusing. Now it can't find board? What's going on?

The general issue is that sudo launches a new environment when invoked. So the script is running in that new environment, which generally does not known about the virtual environment. That's why the board module (which is part of Blinka installed in the venv) can not be found.

So how do we get around this?

Option 1 - Invoke with sudo passing environment

The `sudo` command has the appealing `-E` option which allows users to "preserve the existing environment variables". Since most of the magic with a venv comes from its altering of the `PATH` environment variable, it seems like this should work. But it doesn't:

```
(blinka) pi@raspberrypi:~ $ sudo -E python3 neo_test.py
Traceback (most recent call last):
  File "/home/pi/neo_test.py", line 1, in &lt;module&gt;
    import board
ModuleNotFoundError: No module named 'board'
(blinka) pi@raspberrypi:~ $
```

The `-E` did not preserve everything. As a result, the system level Python install ends up being used:

```
(blinka) pi@raspberrypi:~ $ sudo which python3
/usr/bin/python3
(blinka) pi@raspberrypi:~ $ sudo -E which python3
/usr/bin/python3
```

To get around this, the `env` command can be use inline to allow specifying the `PATH` variable be explicitly copied into the invoking environment:

```
(blinka) pi@raspberrypi:~ $ sudo -E env PATH=$PATH which python3
/home/pi/blinka/bin/python3
```

Now it's finding the Python in the venv path. Using this to run the script works:

```
(blinka) pi@raspberrypi:~ $ sudo -E env PATH=$PATH python3 neo_test.py
(blinka) pi@raspberrypi:~ $
```

Make an Alias

The command `sudo -E env PATH=$PATH python3` is a bit klunky. To make invoking this easier, an alias can be used.

```
alias supy='sudo -E env PATH=$PATH python3'
```

The name `supy` can be changed to whatever you want. Adding it to **.bashrc** or **.bashrc_aliases** will make the alias available with every login. Once the alias is set, can then use it:

```
(blinka) pi@raspberrypi:~ $ supy neo_test.py
```

Option 2 - Use absolute paths

As mentioned previously, a venv can be used **without activating** by using **absolute paths** to point to the venv's Python install. This also works with sudo.

An easy way to get the absolute path is to activate the venv and check that way:

```
pi@raspberrypi:~ $ source blinka/bin/activate
(blinka) pi@raspberrypi:~ $ which python3
/home/pi/blinka/bin/python3
```

And then all that is needed is to invoke with sudo using that absolute path. To demonstrate, first **deactivate** the venv:

```
(blinka) pi@raspberrypi:~ $ deactivate
pi@raspberrypi:~ $
```

Now use sudo and the absolute path, **no extra parameters are needed**:

```
pi@raspberrypi:~ $ sudo /home/pi/blinka/bin/python3 neo_test.py
pi@raspberrypi:~ $
```

Make an Alias

An alias can be made for this as well:

```
alias supy='sudo /home/pi/blinka/bin/python3'
```

Keep in mind the virtual environment is baked into the absolute path. So this command invokes with that specific virtual environment.

But once set, the alias can be used:

```
pi@raspberrypi:~ $ supy neo_test.py
pi@raspberrypi:~ $
```

Note that the virtual environment is not active in the above example.

Automatically Running at Boot

Now let's see how a Python script can be run in a virtual environment at boot time. This can be done by creating a normal systemd unit file and being careful to use **absolute paths**.

See this guide for more details about writing and enabling a systemd service:

systemd: Writing and Enabling a Service

https://adafru.it/jXa

This example assumes Blinka has been installed on the Pi in a venv named `blinka` and that the NeoPixel library (https://adafru.it/Cr-) has been pip installed into that venv.

Installing Blinka on Raspberry Pi

https://adafru.it/Deo

Here's an example NeoPixel script that will run a little spin animation on 12 RGBW NeoPixels attached to pin 18 on the Pi's GPIO header.

Save this as **neopix_spinner.py** in the **/home/pi** directory.

```
import time
import board
import neopixel

NEO_PIN = board.D18
NUM_PIXELS = 12
COLOR = 0xADAF00
DELAY = 0.1

pixels = neopixel.NeoPixel(NEO_PIN, NUM_PIXELS, pixel_order="GRBW")

while True:
    for p in range(NUM_PIXELS):
        pixels.fill(0)
        pixels[p] = COLOR
        time.sleep(DELAY)
```

To access Python installed in the blinka venv, the absolute path is `/home/pi/blinka/bin/python3`. The script is saved to `/home/pi/neopix_spinner.py`.

Do a test run from the command line to make sure it works:

```
pi@raspberrypi:~ $ sudo /home/pi/blinka/bin/python3 /home/pi/neopix_spinner.py
```

This command should not return since the program uses an infinite loop to spin forever. However, if you actually have NeoPixel hardware connected, it should be lighting up. Pressing `<CTRL><C>` will break out of the code and return to the prompt.

```
pi@raspberrypi:~ $ sudo /home/pi/blinka/bin/python3 /home/pi/neopix_spinner.py
^CTraceback (most recent call last):
  File "/home/pi/neopix_spinner.py", line 16, in &lt;module&gt;
    time.sleep(DELAY)
KeyboardInterrupt

pi@raspberrypi:~ $
```

Now to create and enable a systemd unit file to run this. Use sudo with a text editor to create a file named `/lib/systemd/system/neopixel.service` with the following contents:

```
[Unit]
Description=NeoPixel Spinner

[Service]
ExecStart=/home/pi/blinka/bin/python3 /home/pi/neopix_spinner.py

[Install]
WantedBy=multi-user.target
```

Note that sudo is *not* used inside the systemd unit file.

With this approach, the venv does not need to be "activated".

Now run the following commands to enable and start the neopixel service:

```
sudo systemctl enable neopixel
sudo systemctl start neopixel
```

If these commands run as expected, they don't generate much output:

```
pi@raspberrypi:~ $ sudo systemctl enable neopixel
Created symlink /etc/systemd/system/multi-user.target.wants/neopixel.service → /lib/
systemd/system/neopixel.service.
pi@raspberrypi:~ $ sudo systemctl start neopixel
pi@raspberrypi:~ $
```

But the NeoPixels should be lighting up now. Further, this process should run everytime the Pi is booted.

If you want to stop the script from running at boot, then **stop** (stops current execution) and **disable** (removes sym link used to boot at start) the service:

```
sudo systemctl stop neopixel
sudo systemctl disable neopixel
```

The status can be checked using **status**.

```
pi@raspberrypi:~ $ sudo systemctl status neopixel
● neopixel.service - NeoPixel Spinner
     Loaded: loaded (/lib/systemd/system/neopixel.service; enabled; preset: enabled)
     Active: active (running) since Mon 2023-10-23 16:58:53 PDT; 1s ago
   Main PID: 900 (python3)
      Tasks: 1 (limit: 1586)
        CPU: 124ms
     CGroup: /system.slice/neopixel.service
             └─900 /home/pi/blinka/bin/python3 /home/pi/neopix_spinner.py

Oct 23 16:58:53 raspberrypi systemd[1]: Started neopixel.service - NeoPixel Spinner.
pi@raspberrypi:~ $
```

Other Ideas

Automatically enabling venv at login

If your main use for a Raspberry Pi is running Python scripts, then needing to activate a virtual environment every time can get tedious. By adding the venv activation to your `.bashrc` file, it will be activated everytime you log in.

For example, if a venv named `foobar` has been previously created, add this line to the end of your `.bashrc` file:

```
source ~/foobar/bin/activate
```

The venv will activate along with the changed prompt with each login.

Using Debian Packages instead of Python Modules

There are two general ways to install Python modules:

- **pip** - This is the Python specific tool for installing Python modules
- **apt** - This is the operating system tool for installing system level packages (**apt-get** is generally the same)

Using sudo with apt is OK. In fact, it's generally required since the packages will be installed in system level protected folder locations. However, **using sudo with pip is potentially dangerous**. So pip installing modules to the system level (via sudo) is generally not recommended. But many Python modules are available as OS (Debian) packages (https://adafru.it/19a2). Therefore, it is possible, and OK, to sudo apt install these Python modules.

For example, to install PIL/Pillow (https://adafru.it/FUR):

```
sudo apt install python3-pil
```

This will make PIL/Pillow available to anyone running Python on the setup. However, the OS packages will generally be older release versions than available via pip. And maybe that's OK? This is something you will have to determine for your specific use case.

Disabling Prompt Change

If you don't want the venv name to show up in the prompt, it can be disabled by setting the environment variable `VIRTUAL_ENV_DISABLE_PROMPT` **before** activating the venv.

```
pi@raspberrypi:~ $ VIRTUAL_ENV_DISABLE_PROMPT=1
pi@raspberrypi:~ $ source foobar/bin/activate
pi@raspberrypi:~ $ which python
/home/pi/foobar/bin/python
pi@raspberrypi:~ $
```

This can be done interactively as shown above or placed in **.bashrc** so it's active with every login.

> This is potentially confusing since it makes it less obvious which "Python" is actually running.

Hide the venv folder

This is simple - just add a `.` to the start of the venv name. This takes advantage of the Linux behavior treating dot files as hidden and not showing them by default with `ls`. In a lot of guides, the name `.venv` is used, but it's up to you what to call it. It's just the name you'll use when activated or referring to the venv.

This is entirely cosmetic.

That --break-system-packages option

This option can be used with **sudo pip** to force the installation despite the warning. However, this is not recommended. It should be possible to do everything using venv.

Return to the "good 'ole days"

If you're totally against venv's and don't care about possibly breaking your system's Python setup and just want to continuing doing things like you used to, then system wide pip installs can be re-enabled (undisabled?) by deleting a file named **EXTERNALLY-MANAGED** found in the system's Python setup. This is really just the same as using the --break-system-packages option mentioned above.

For example, on a freshly booted Pi running Bookworm, the file can be found at:

`/usr/lib/python3.11/EXTERNALLY-MANAGED`

So just sudo rm it:

```
sudo rm /usr/lib/python3.11/EXTERNALLY-MANAGED
```

Now you can sudo pip install all you want. At least until it finally corrupts the Python setup.

Multiple venvs

Keep in mind that more than one venv can be created. Each just ends up being its own folder with all the venv contents inside. This can come in handy when dealing with module conflicts or specific requirements. Like FooEditor requires PyQt5 5.9.2 *only* while BarEditor requires PyQt 5.12.1 *only*. A venv can be setup for each to keep the PyQt module installs separate.

TLDR

- **NO** = `sudo pip`
  - **NEVER RUN PIP WITH SUDO**
- **YES** = `sudo apt` or `sudo apt-get`
  - installing Debian packages is OK
  - many Python modules are available as Debian packages
- **YES** = `sudo /absolute/path/to/venv/bin/python foo.py`
  - invoking Python with sudo is OK

    - this is required in some situations to access underlying hardware (ex: neopixel)

- PEP 668 (https://adafru.it/199F)
- xkcd 1987 (https://adafru.it/19a3)