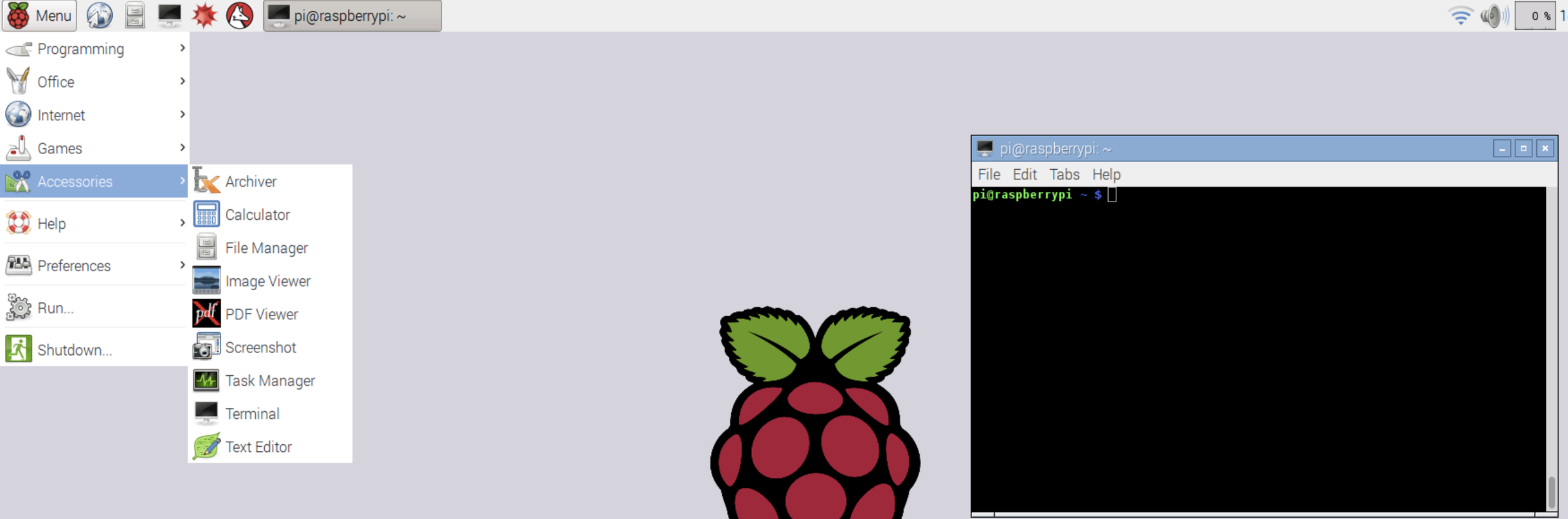


Intro to Robotics with Raspberry Pi!

Section 1. General Concepts – Linux fundamentals

Outline

Linux Fundamentals

Getting Started with Linux

Desktop Environments and Shells

Remote Login with SSH

Remote Login with VNC

Navigating Linux and Using Python Within

Using Python on the Raspberry Pi

From the Mac OS Terminal

From VNC Using the LXTerminal

From VNC Using an IDE

Python Applications

Python Web Application Using Flask

Python Dataviz Application

Python Programs to Control Hardware

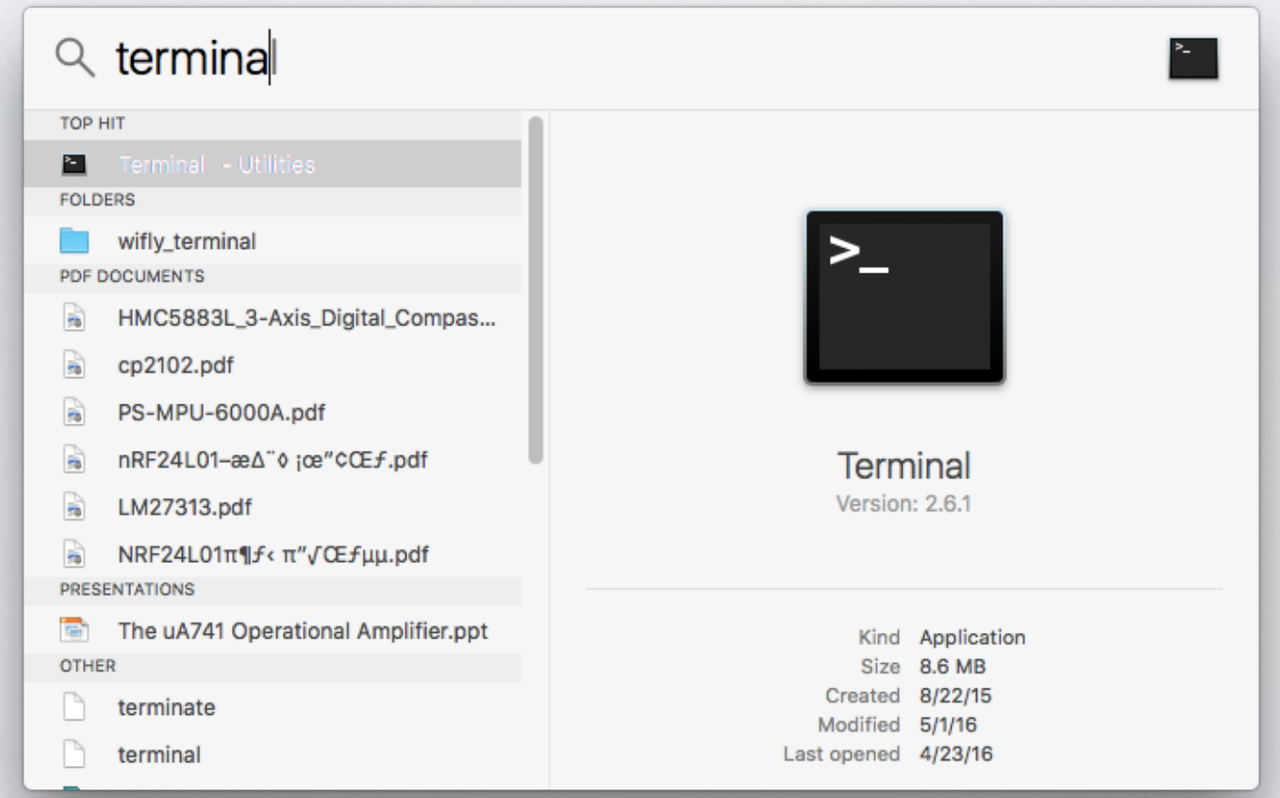
Blinking an LED

Blinking multiple LEDs

Getting Started with Linux

Desktop Environments and Shells

- A **desktop environment** is a collection of software that provides a standard look and feel: Mac OS, Windows, GNOME.
- A **shell** is a user interface for access to an operating system's services.
- Shells can either be **graphical** or **text-based**.
- OS X's **Terminal.app** allows us to access the system's text-based shell.



Example Uses of Text Shells

- Applications (programs) can be used via a graphical or text-based **shell**.

- A **terminal emulator** is an application that allows us to interact with the text-based shell.

- Commonly used programs inside a terminal emulator include:

```
say Hello Disney Interactive!
```

```
vi
```

```
ssh
```

```
wget
```

```
python
```

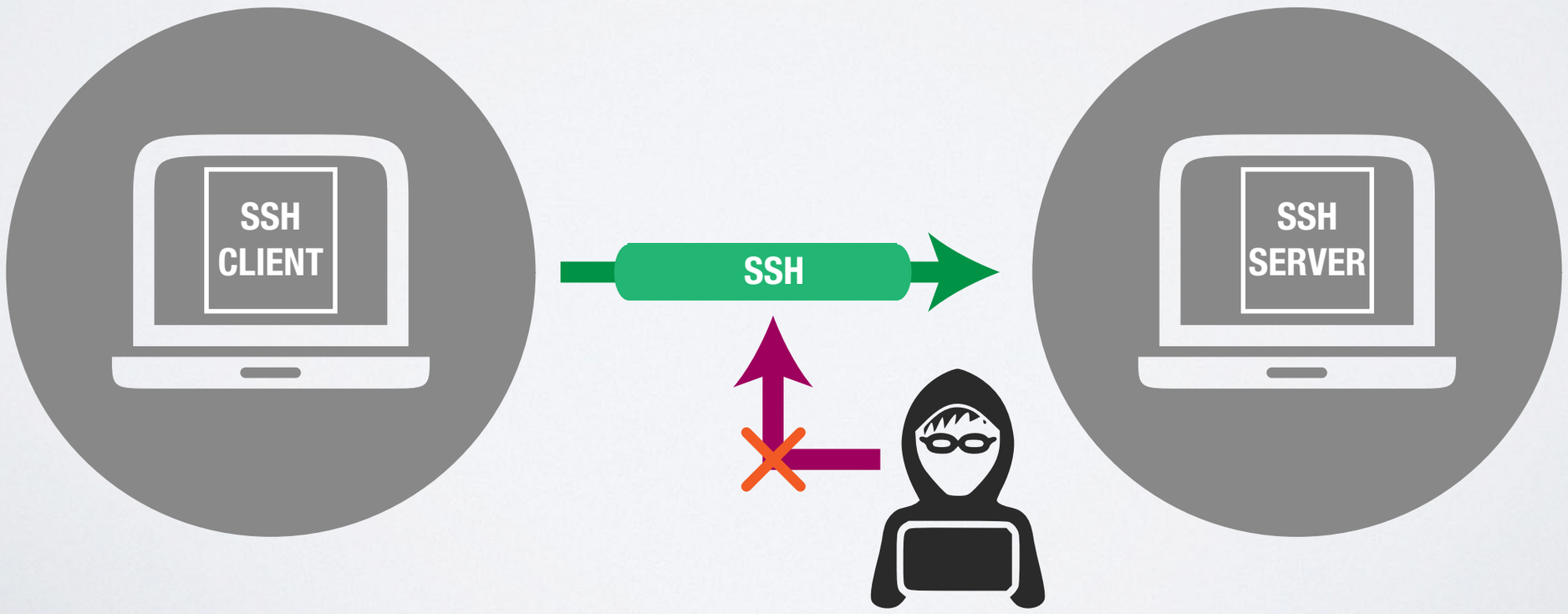
```
python filename.py
```

Remote Login with SSH

```
ssh
```

- Secure Shell (SSH) is an encrypted network protocol that allows remote login and other network services to operate securely over an unsecured network.

- Both OS X and the Raspberry Pi OS have the necessary SSH programs installed.

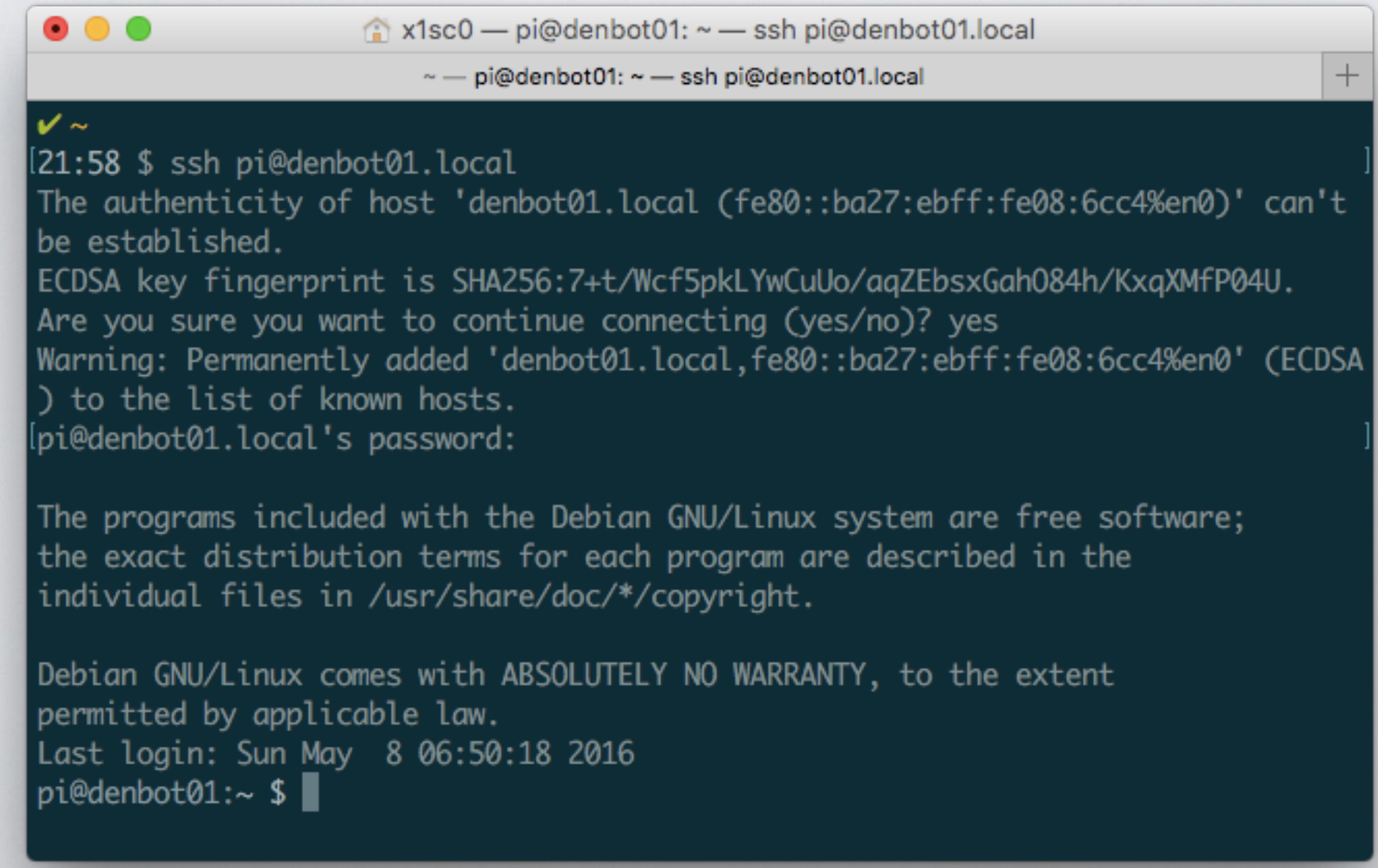


Remote Login with SSH

- Using the Terminal app let's log in to our Raspberry Pi:

```
ssh pi@denbotNN.local
```

- **pi** is the name of the default user. Default password is **raspberry**.
- **NN** should be the number of your PyDen Bot!



Remote Login with SSH

- You're in! All the commands you now type are executed on the **Raspberry Pi**'s processor!
- Many of the programs we can use on our Mac's OS can also be run on the Raspberry Pi's OS.

```
vi
```

```
ssh
```

```
wget
```

```
python
```

```
python filename.py
```

- We can close the 'session' by entering:

```
exit
```

Remote Login with VNC

- Thankfully, we can also establish a GUI (Graphical User Interface)-based connection!

- Virtual Network Computing (VNC) is a graphical desktop sharing system that allows remote control another computer.

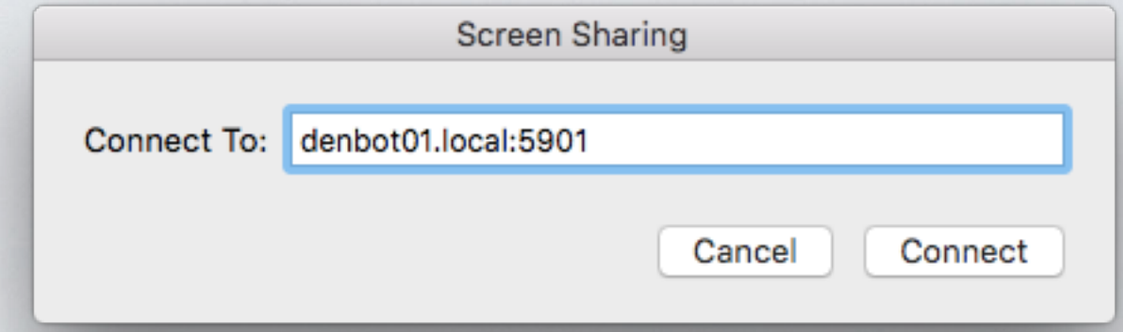
- Both OS X and the Raspberry Pi OS have the necessary VNC programs installed.

- On the terminal enter (ensure you're logged out of your Raspberry Pi!):

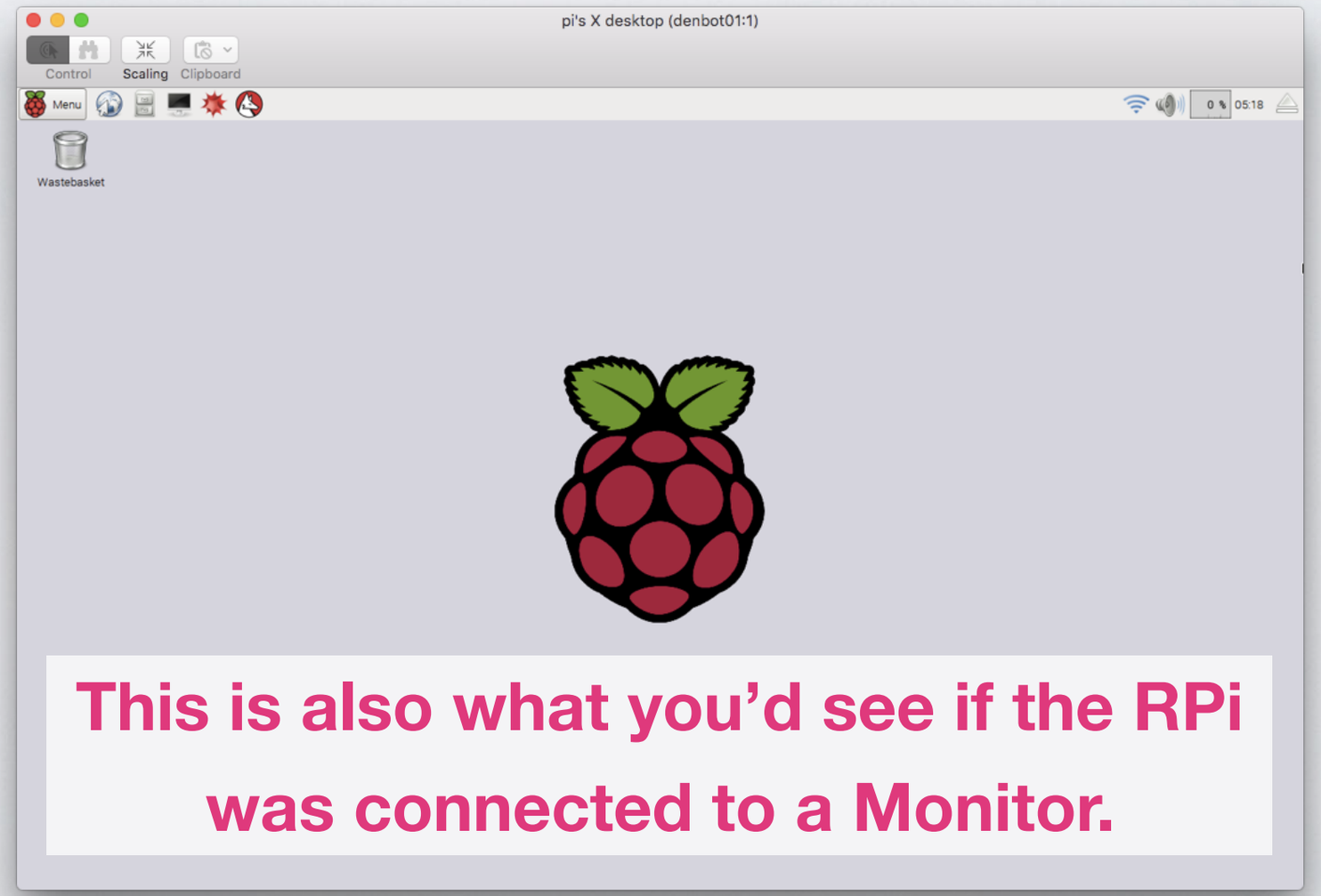
```
open -a /System/Library/CoreServices/Applications/Screen\ Sharing.app
```

Remote Login with VNC

- Inside the field enter your PyDen Bot name (e.g., denbot01.local:5901):



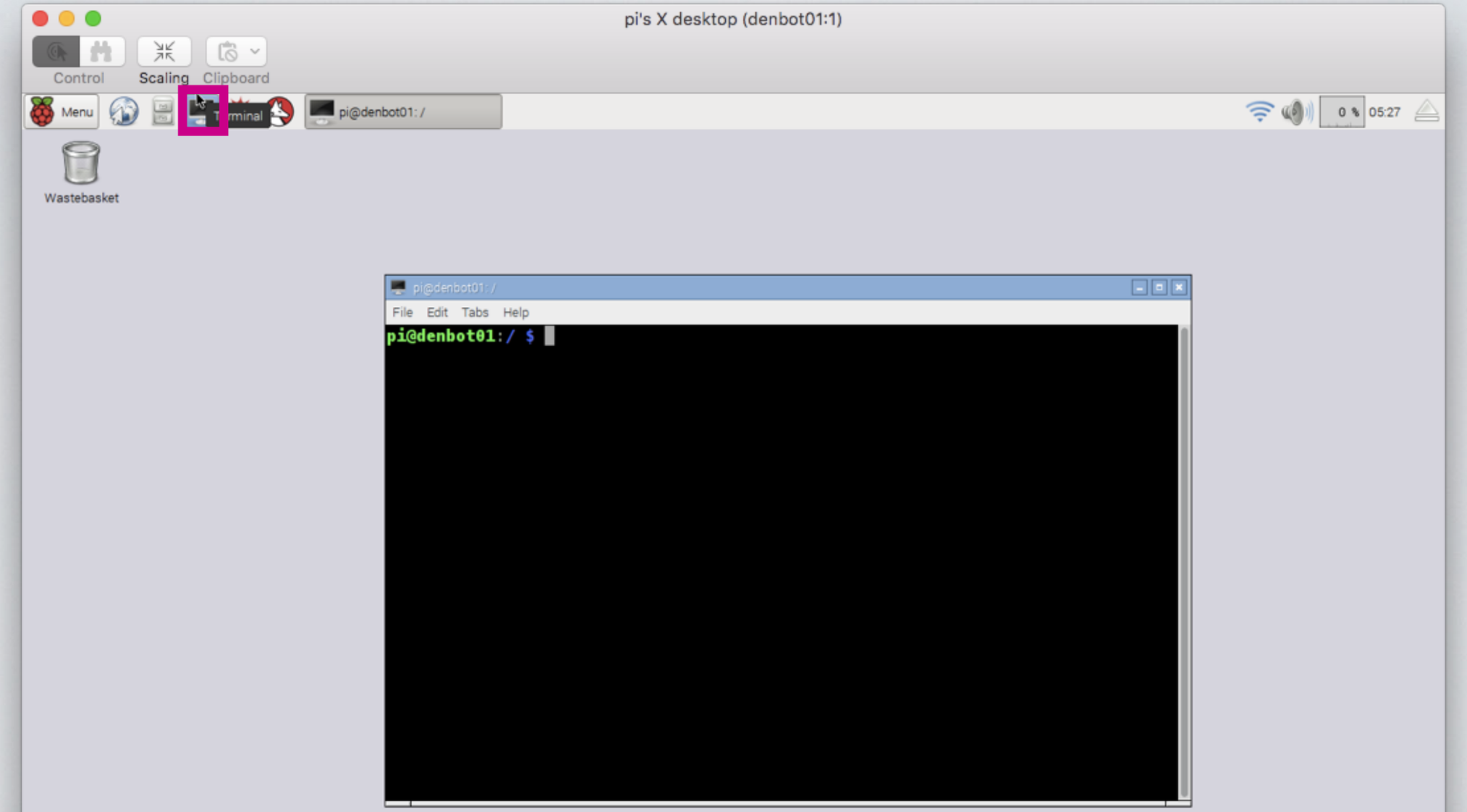
*5901 is the port where the Raspberry Pi listens for incoming VNC connections. Default password is **pidenbot**.



This is also what you'd see if the RPi was connected to a Monitor.

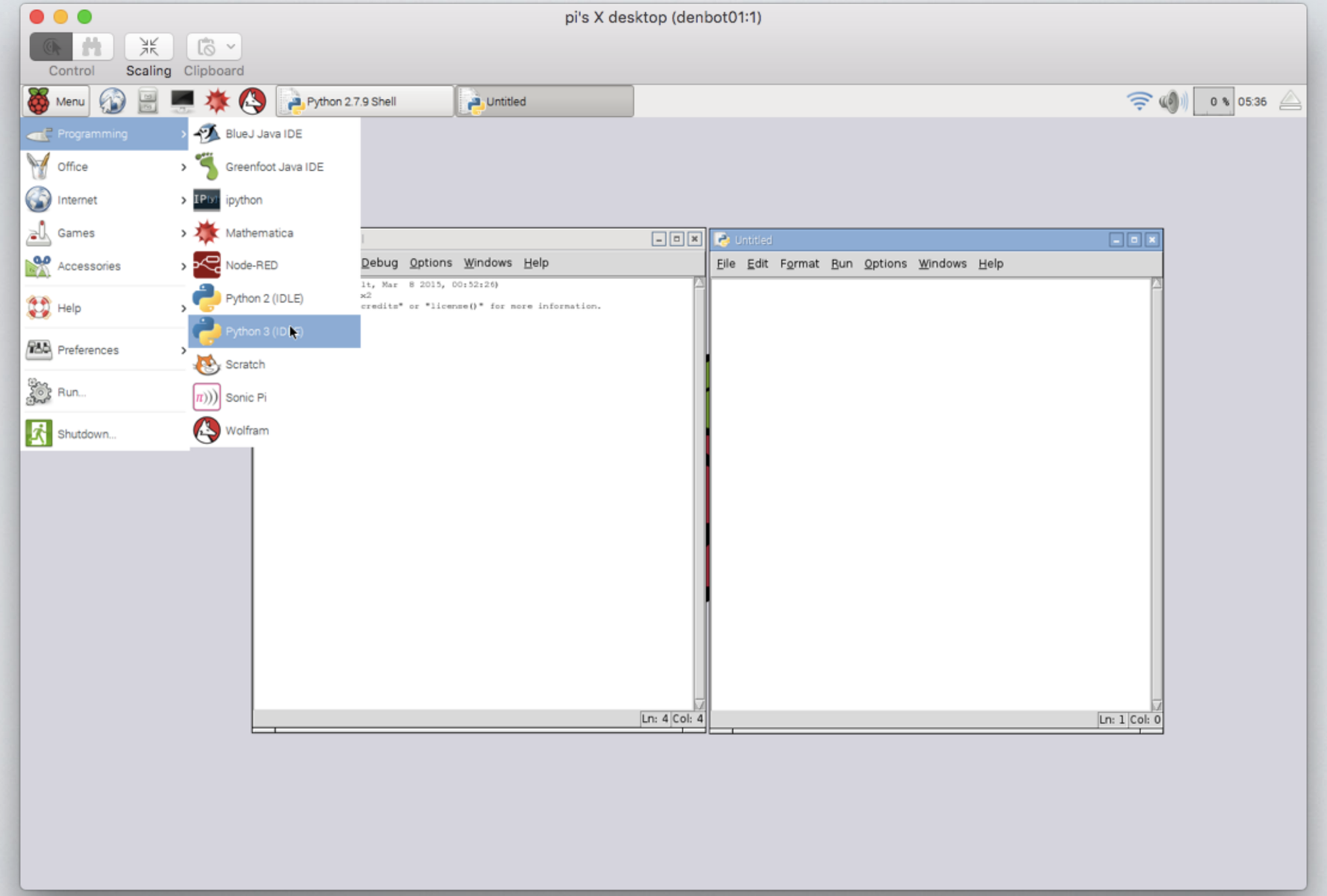
Linux Fundamentals

- The Raspberry Pi OS (Raspbian) also has a **Terminal emulator** (**LXTerminal**) we can use!



Using Python in Raspbian

- An Integrated Development Environment for Python (IDLE) is pre-installed in Raspbian (though not used in this class (-:).



Using Python on the Raspberry Pi

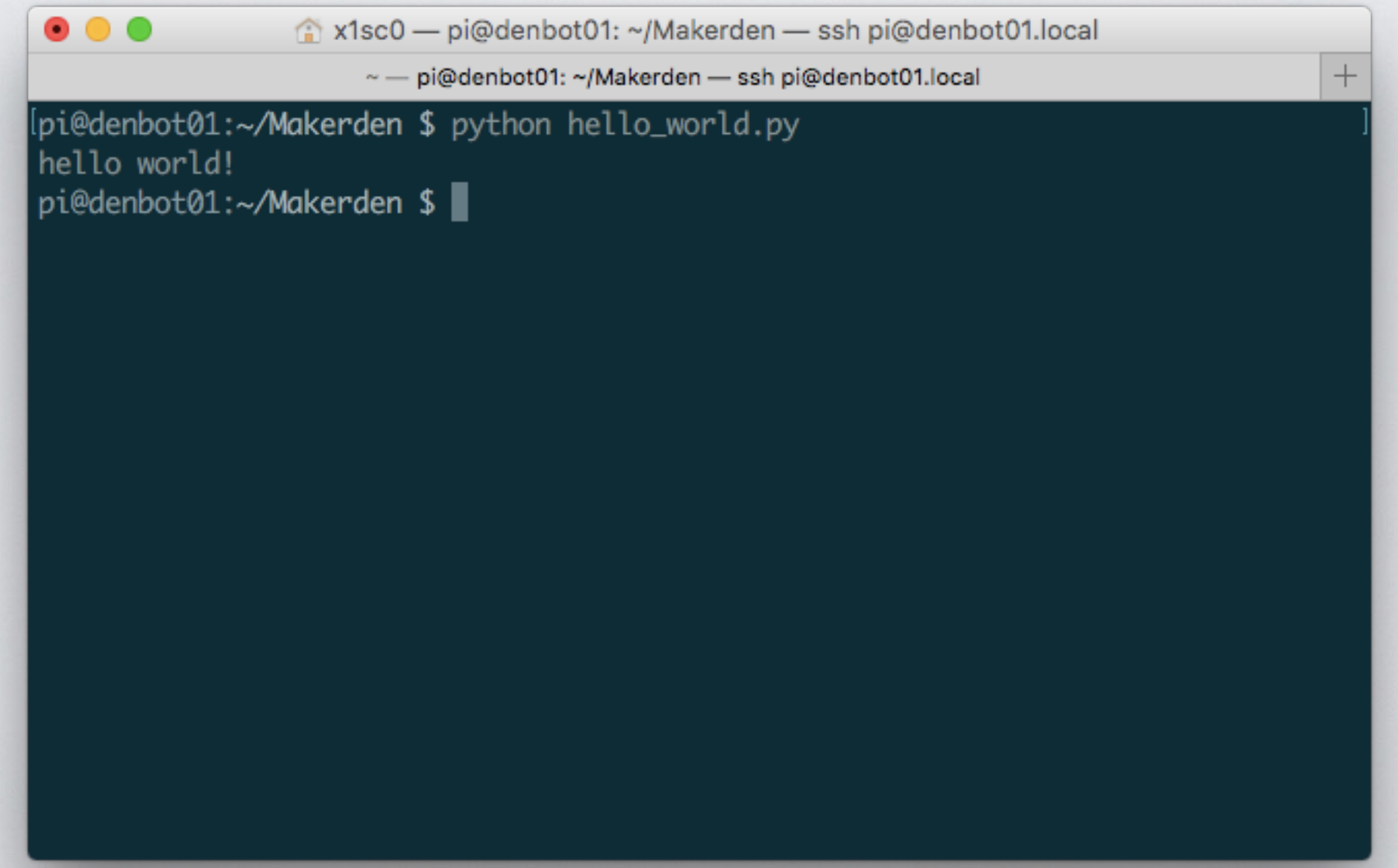
Using Python On The Raspberry Pi

- We've got many options for writing and running Python scripts on the Pi.

1. Connecting via **SSH** and using command-line tools (Mac OS Terminal).

```
cd ~/Makerden
```

```
nano hello_world.py
```



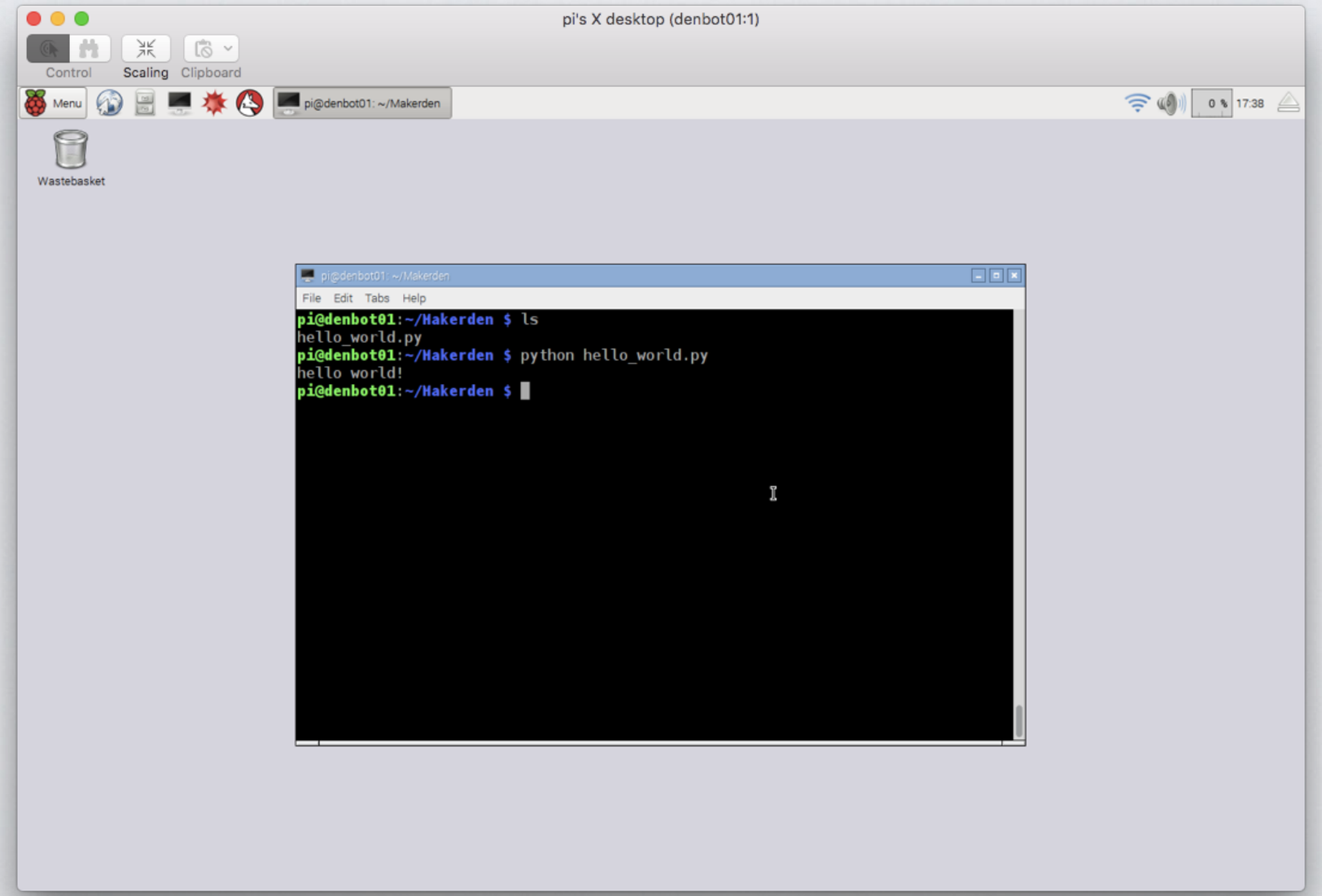
Using Python On The Raspberry Pi

- We've got many options for writing and running Python scripts on the Pi.

2. Connecting via **VNC** and using command-line tools (Raspbian Terminal).

```
cd ~/Makerden
```

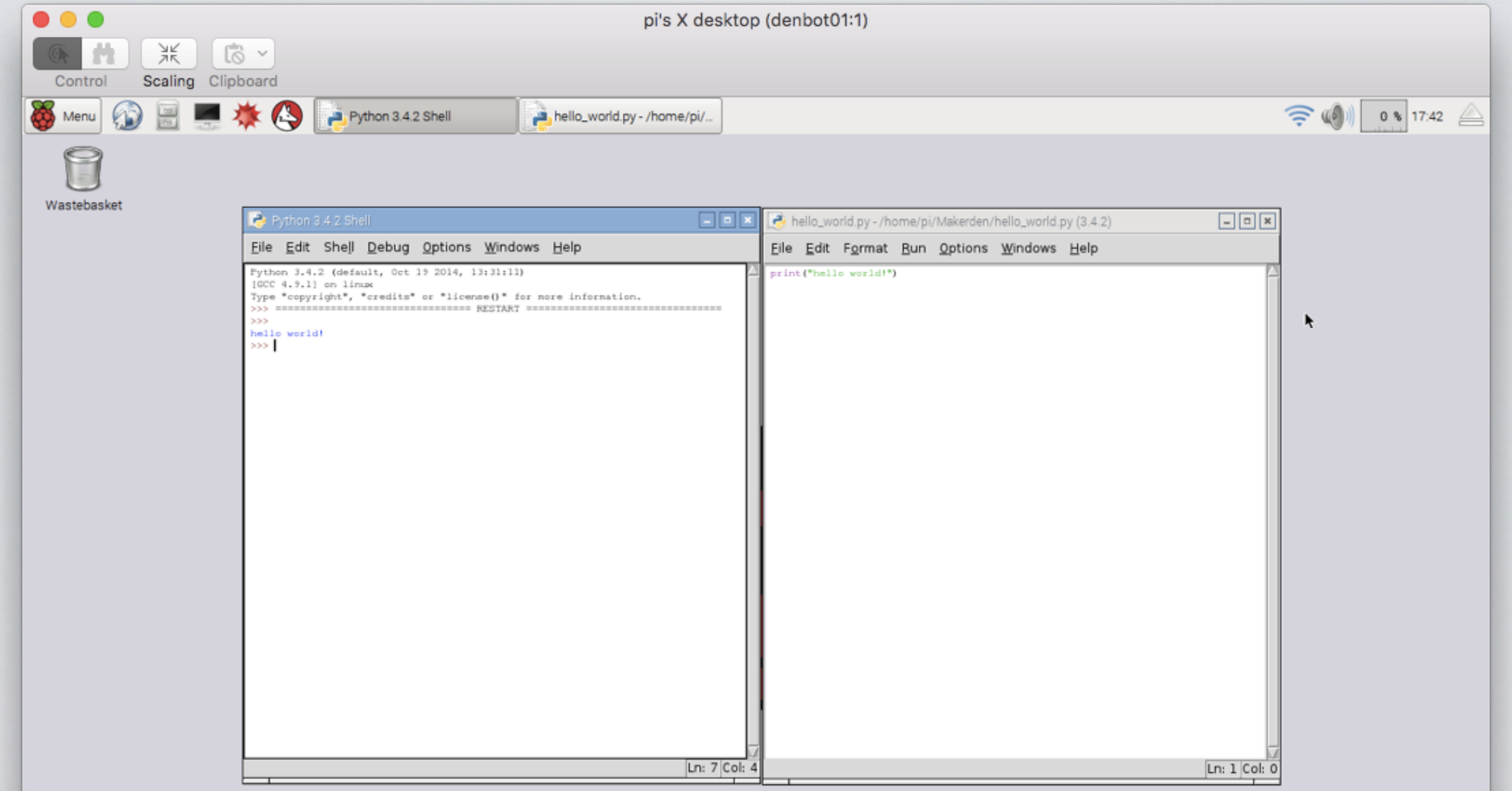
```
nano hello_world.py
```



Using Python On The Raspberry Pi

- We've got many options for writing and running Python scripts on the Pi.

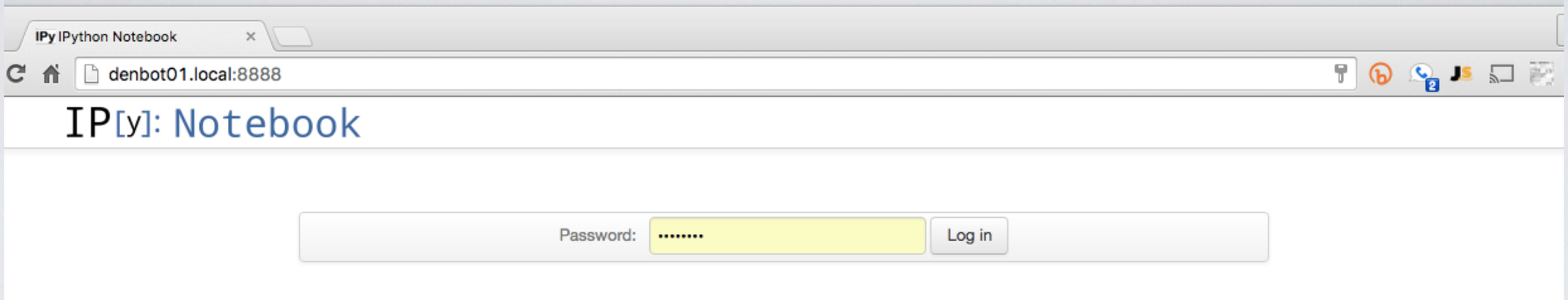
3. Connecting via VNC and using **Python IDE** (Raspbian).



Using Python On The Raspberry Pi

- We've got many options for writing and running Python scripts on the Pi.

4. Using iPython notebook server! (what we'll be using)

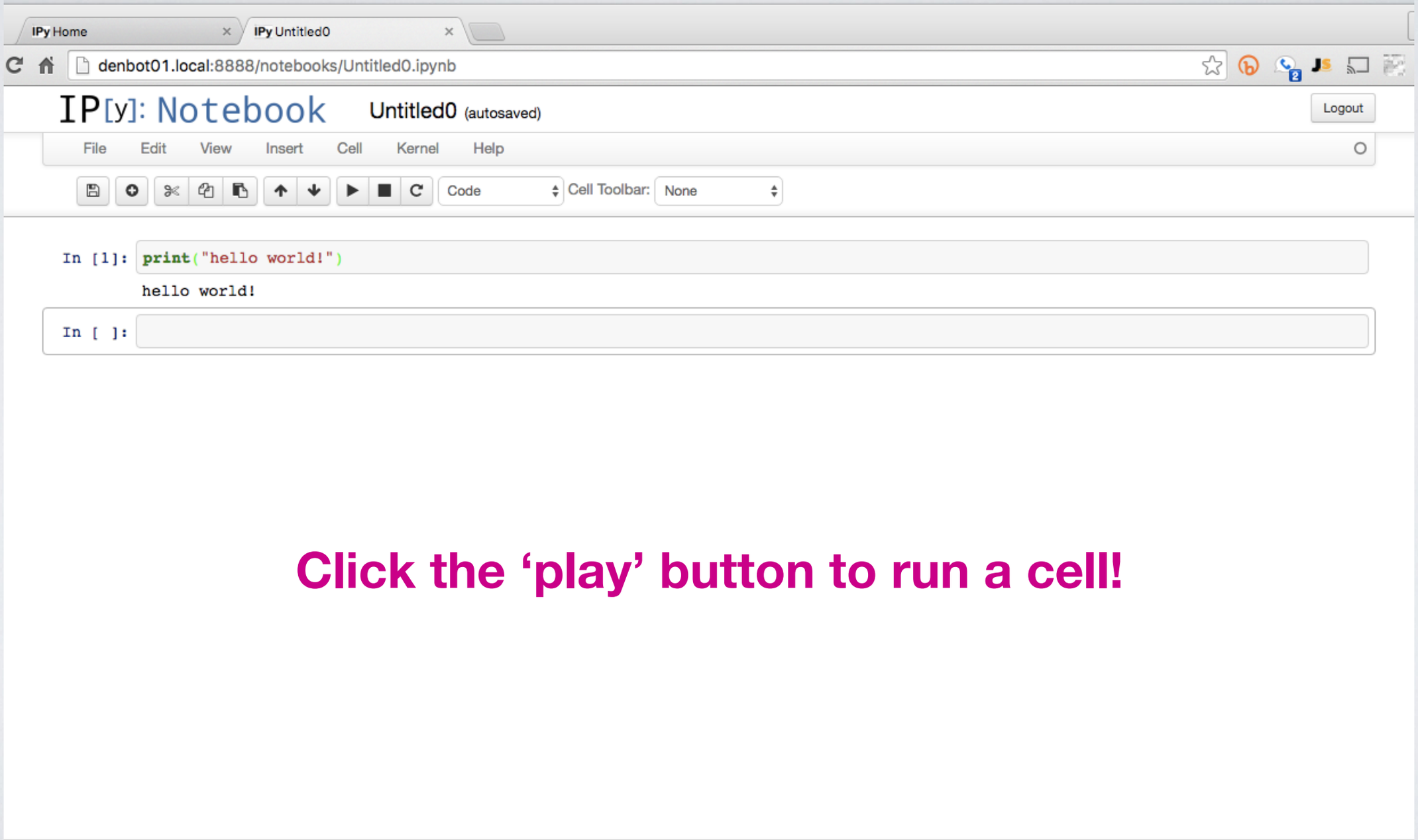


Navigate to: http://denbotNN.local:8888

Default password: pidenbot

Using Python On The Raspberry Pi

- iPython notebook will work with its own file format (extension .ipynb)
- Choose **`File → Download as → Python (.py)`** to convert.



Click the ‘play’ button to run a cell!

Writing Python Programs On iPython Notebook

The Python Package Index (PyPI)

- The Python Package Index is a repository of software for the Python programming language.

https://pypi.python.org/pypi

python™

search

» Package Index

PACKAGE INDEX »
Browse packages
Package submission
List trove classifiers
List packages
RSS (latest 40 updates)
RSS (newest 40 packages)
Python 3 Packages
PyPI Tutorial
PyPI Security
PyPI Support
PyPI Bug Reports
PyPI Discussion
PyPI Developer Info

ABOUT »
NEWS »
DOCUMENTATION »
DOWNLOAD »
COMMUNITY »
FOUNDATION »
CORE DEVELOPMENT »

PyPI - the Python Package Index

The Python Package Index is a repository of software for the Python programming language. There are currently **67937** packages here.
To contact the PyPI admins, please use the Support or Bug reports links.

Not Logged In
Login
Register
Lost Login?
Use OpenID

Status
Nothing to report

Get Packages

To use a package from this index either "pip install *package*" (get pip) or download, unpack and "python setup.py install" it.

Package Authors

Submit packages with "python setup.py upload". The index hosts package docs. You may also use the web form. You must register. Testing? Use testpypi.

Infrastructure

To interoperate with the index use the JSON, OAuth, XML-RPC or HTTP interfaces. Use local mirroring or caching to make installation more robust.

Updated	Package	Description
2015-10-21	toil 3.1.0a1.dev48	Pipeline management software for clusters.
2015-10-21	django-knob 1.1	A Django reusable application that performs remote configurations on multiple devices, distributing the operations using Celery.
2015-10-20	song2 0.1.0	Typesafe/Immutable schema for dict object
2015-10-20	django-influxdb-metrics 1.2.1	A reusable Django app that sends metrics about your project to InfluxDB
2015-10-20	luigi-monitor 0.2.2	Send summary messages of your Luigi jobs to Slack.
2015-10-20	flask-autorouter 0.1.1	a utility for generating flask URL routing
2015-10-20	django-templatetags 1.1	Custom template tags for notification
2015-10-20	djangorecipe 2.1.2	Buildout recipe for Django
2015-10-20	SciSalt 1.6.1	Tools to make scientific data analysis easier

The Python Package Index (PyPI)

- Let's install a couple of 3rd-party modules using the program **pip**.

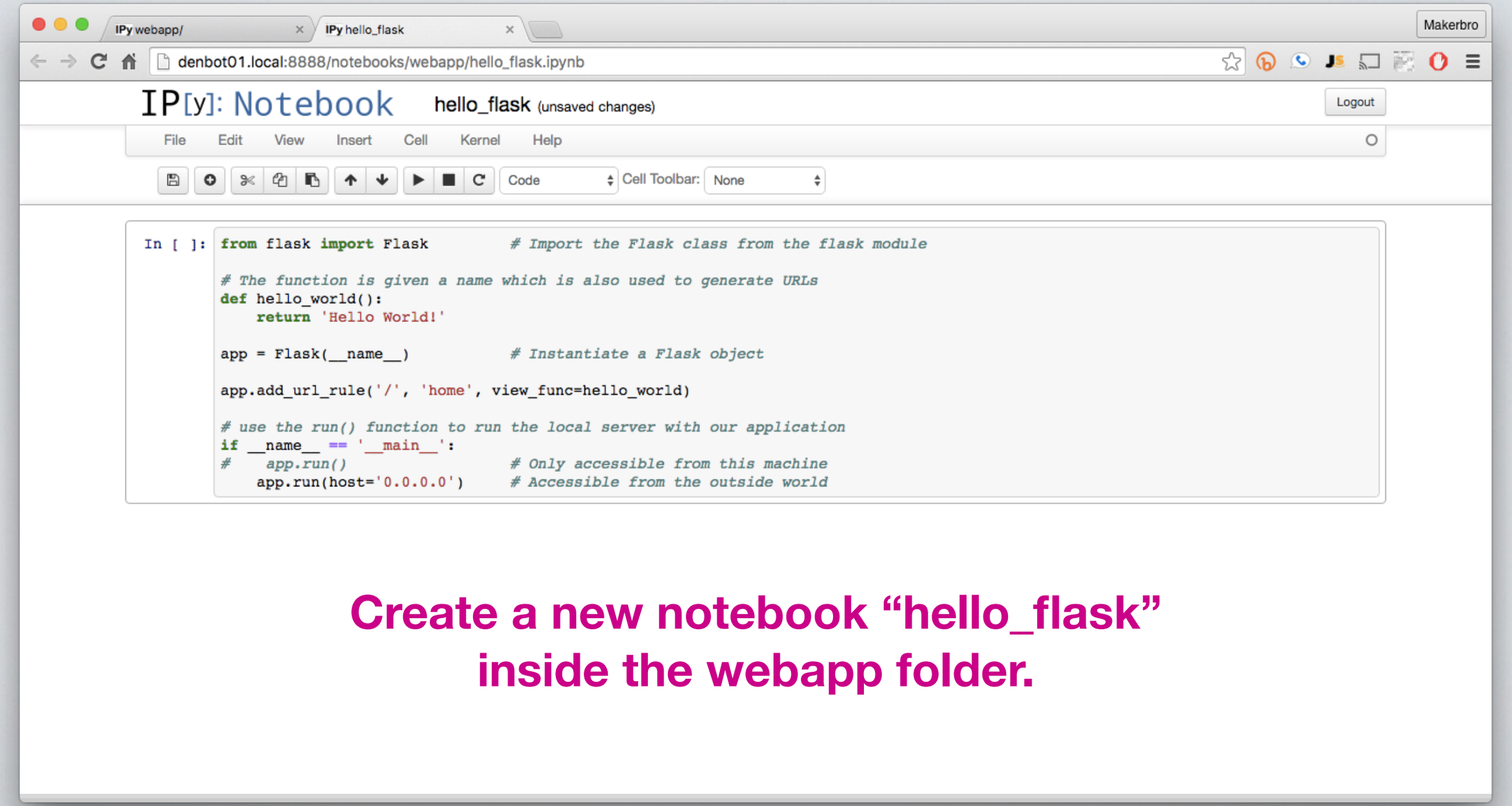
```
sudo apt-get update && sudo apt-get install python-dev python-pip
```

```
sudo pip install flask matplotlib werkzeug itsdangerous jinja2
```

*These steps might've already been completed by your instructor (-:

Python Web Application Using Flask

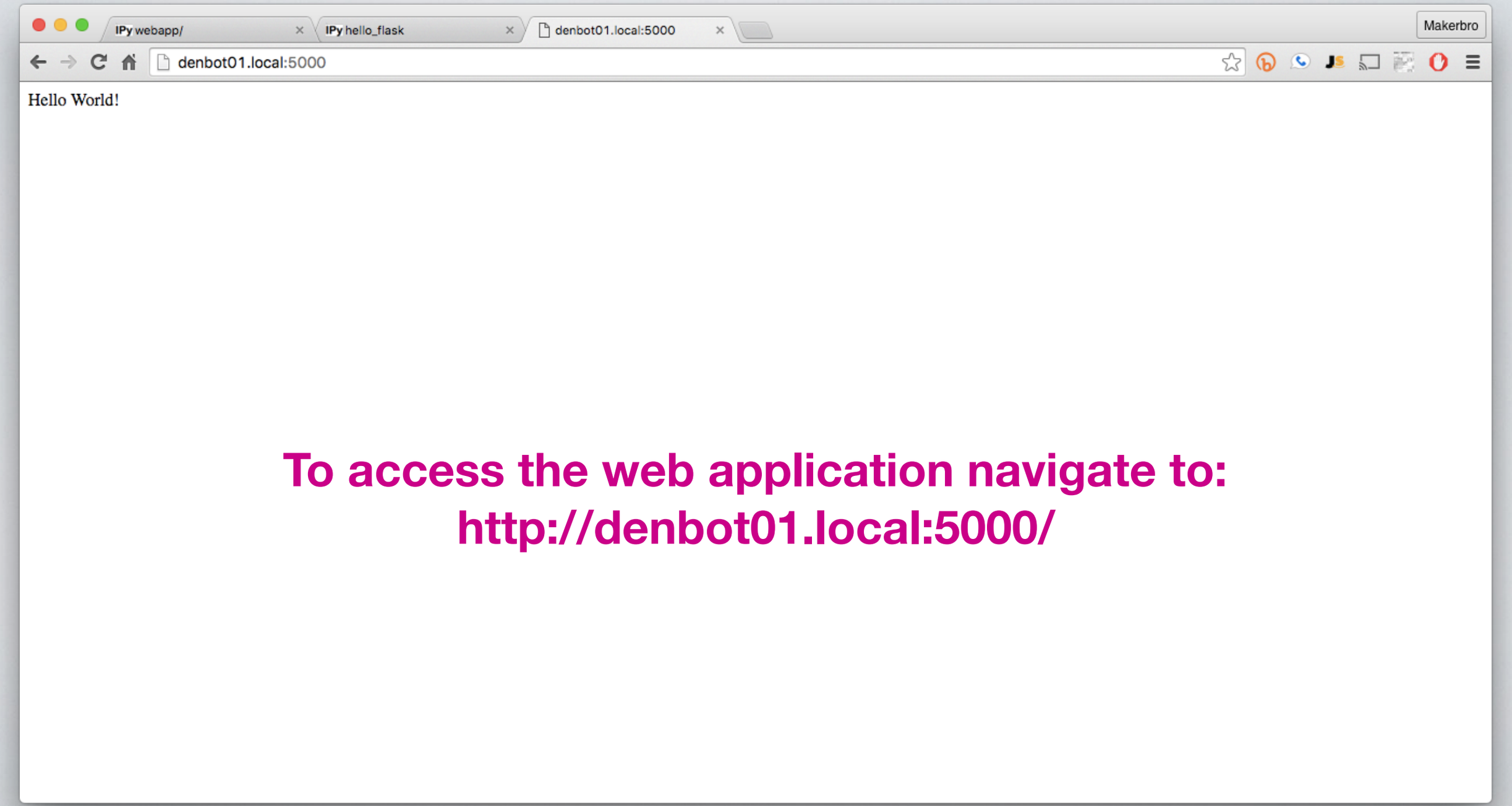
- With the necessary modules installed, let's use them to build a simple **web application**!



Create a new notebook "hello_flask" inside the webapp folder.

Python Web Application Using Flask

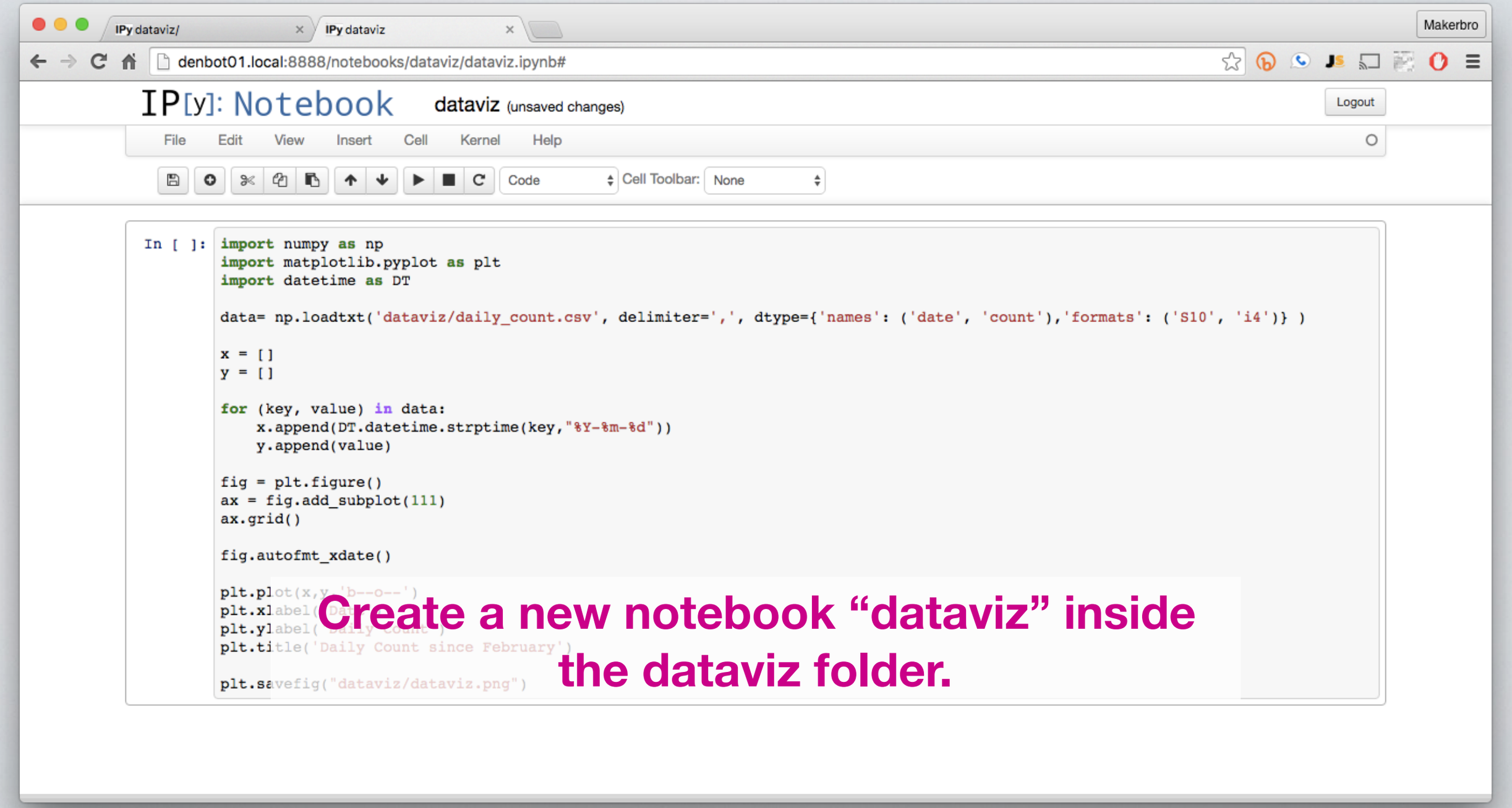
- With the necessary modules installed, let's use them to build a simple **web application**!



To access the web application navigate to:
http://denbot01.local:5000/

Python Dataviz Application Using Matplotlib

- With the necessary modules installed, let's use them to **plot data** in a **.csv** file!

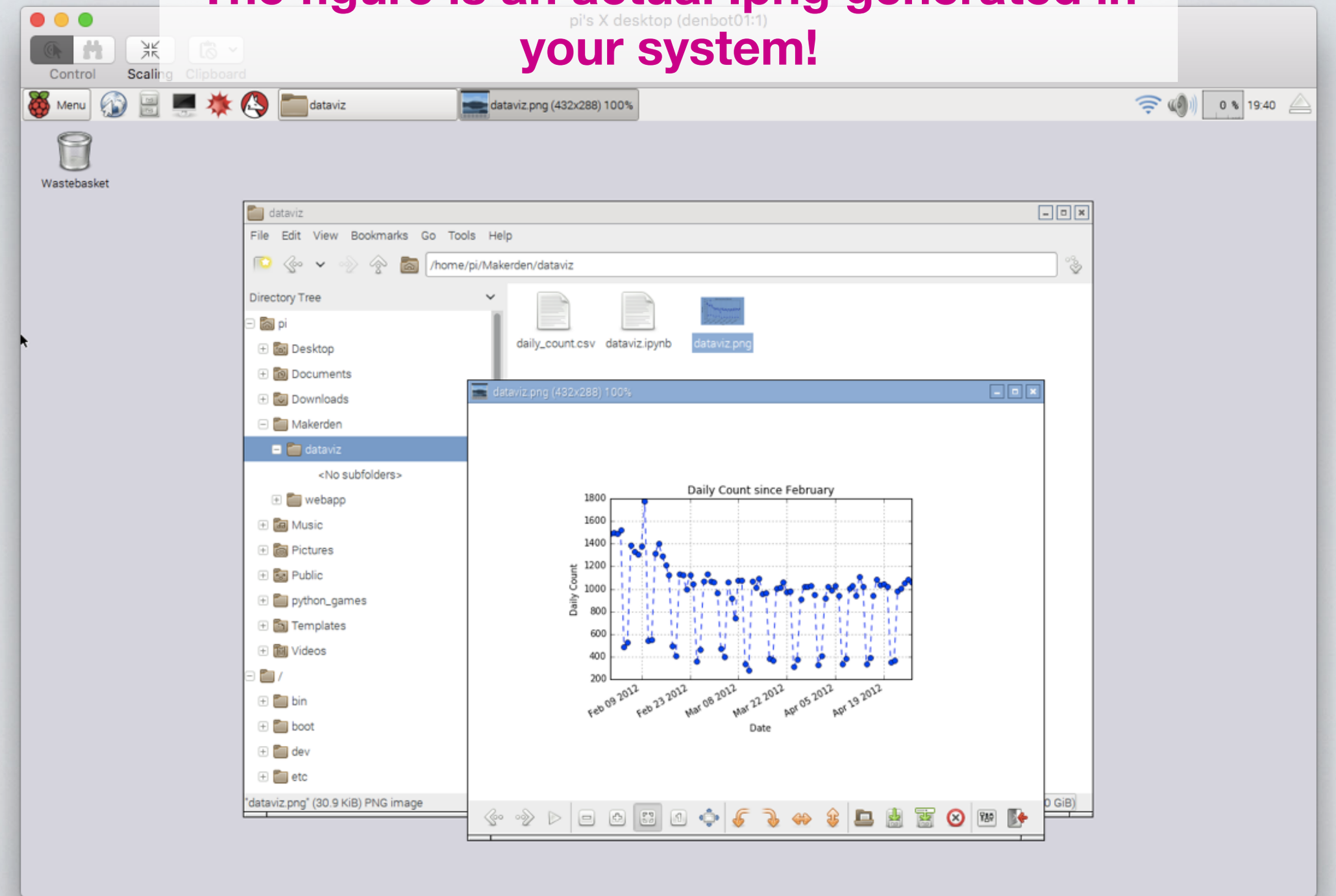


Create a new notebook "dataviz" inside the dataviz folder.

Python Dataviz Application Using Matplotlib

- With the necessary modules installed, let's use them to **plot data** in a **.csv** file!

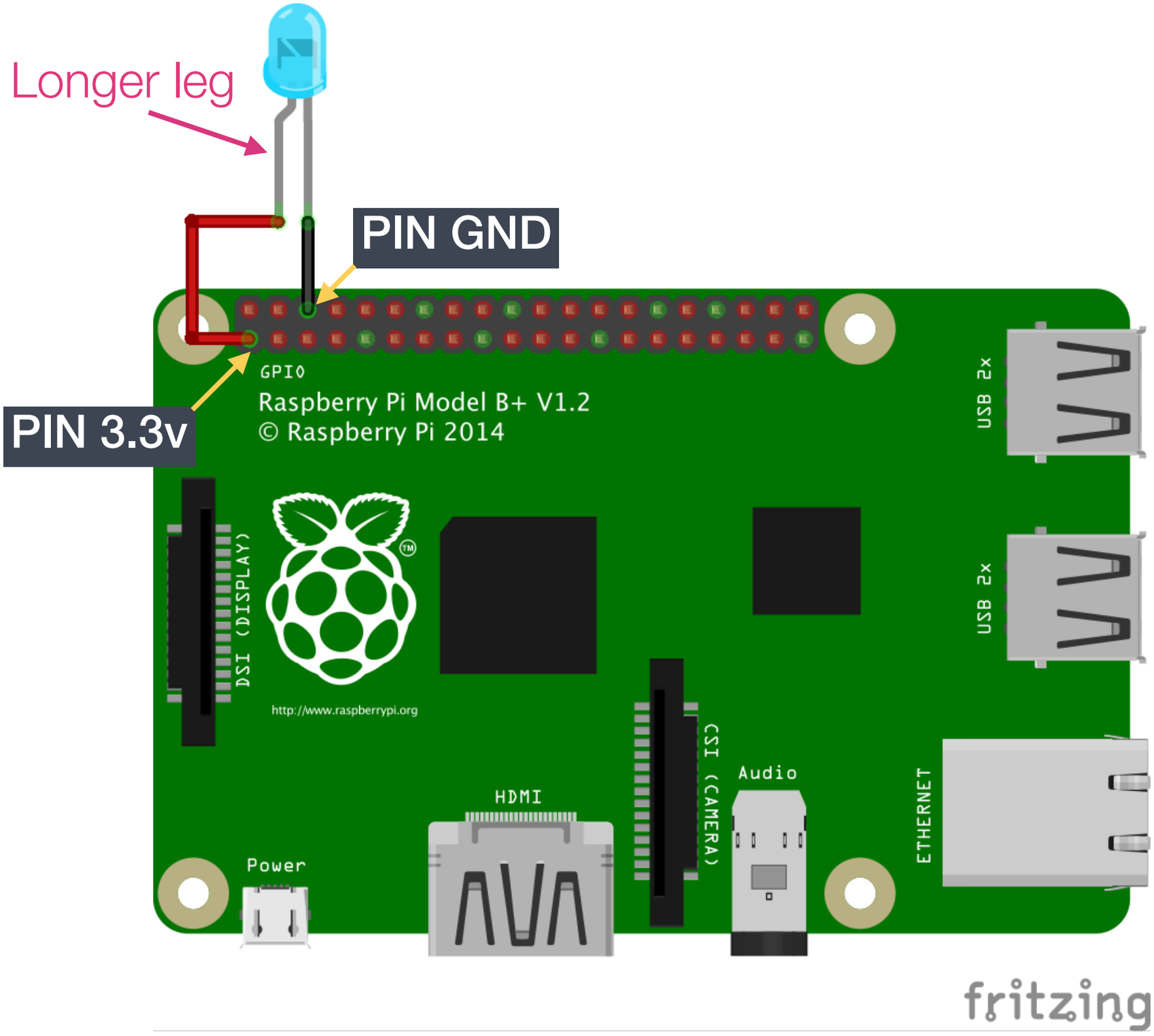
The figure is an actual .png generated in your system!



Writing Python Programs To Control Low-Level Hardware

Wiring Your First Circuit

- Let's jump right into the deep-end and wire our first circuit!



Raspberry Pi2 GPIO Header

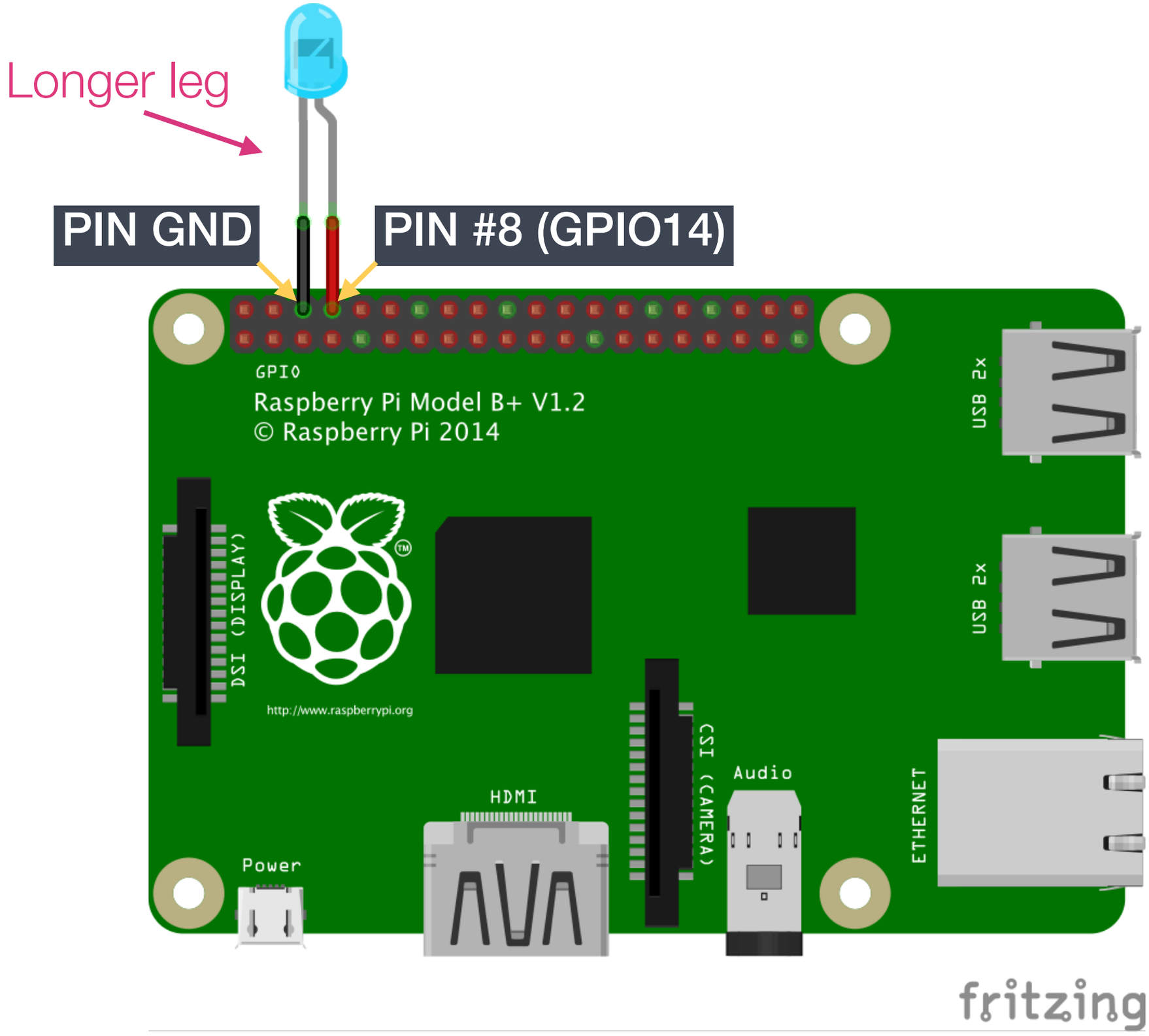
Pin#	NAME	NAME	Pin#
01	3.3v DC Power	DC Power 5v	02
03	GPIO02 (SDA1 , I²C)	DC Power 5v	04
05	GPIO03 (SCL1 , I²C)	Ground	06
07	GPIO04 (GPIO_GCLK)	(TXD0) GPIO14	08
09	Ground	(RXD0) GPIO15	10
11	GPIO17 (GPIO_GEN0)	(GPIO_GEN1) GPIO18	12
13	GPIO27 (GPIO_GEN2)	Ground	14
15	GPIO22 (GPIO_GEN3)	(GPIO_GEN4) GPIO23	16
17	3.3v DC Power	(GPIO_GEN5) GPIO24	18
19	GPIO10 (SPI_MOSI)	Ground	20
21	GPIO09 (SPI_MISO)	(GPIO_GEN6) GPIO25	22
23	GPIO11 (SPI_CLK)	(SPI_CE0_N) GPIO08	24
25	Ground	(SPI_CE1_N) GPIO07	26
27	ID_SD (I²C ID EEPROM)	(I²C ID EEPROM) ID_SC	28
29	GPIO05	Ground	30
31	GPIO06	GPIO12	32
33	GPIO13	Ground	34
35	GPIO19	GPIO16	36
37	GPIO26	GPIO20	38
39	Ground	GPIO21	40

Rev. 1
26/01/2014

http://www.element14.com

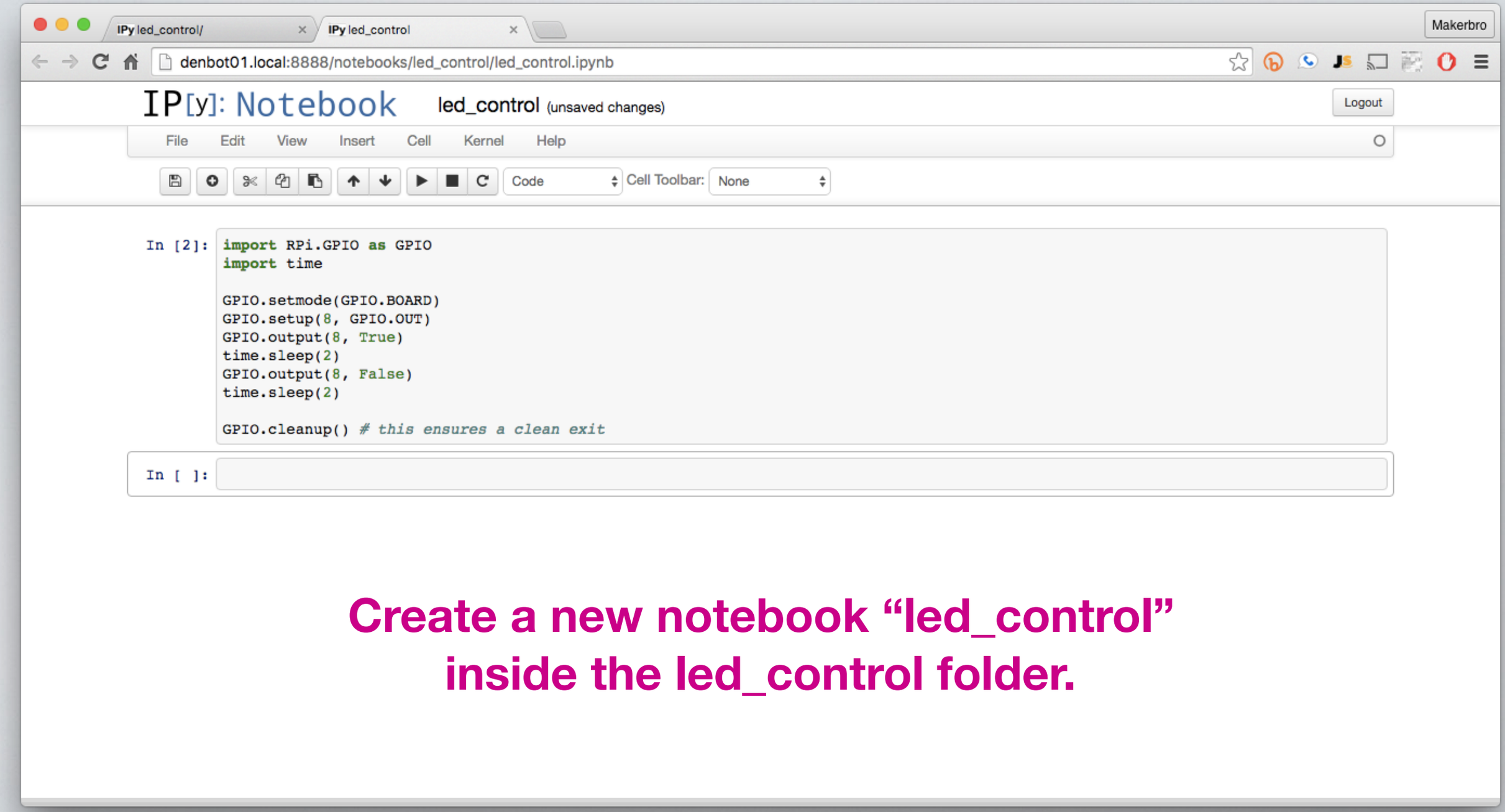
Wiring Your First Circuit

- Let's jump right into the deep-end and wire our first circuit!



Python LED Control Using RPi.GPIO

- With the necessary modules installed, let's use them to **<u>blink</u>** an LED!



Create a new notebook "led_control" inside the led_control folder.