

Department of Electrical Engineering City University of Hong Kong

EE4090/EE4097 Engineering Training Module 2 (M2) Raspberry PI and IoT

Introduction

Timeline

Day1 & Day2:

- Introduction of the workshop
- Introduction of the Raspberry Pi
- Setup the TeamViewer and remote access to Raspberry Pi
- Study about Thonny Python IDE in Raspberry Pi
- Study about Terminal in Raspberry Pi
- Setup the Camera and complete the examples
- Study about “Object detection” with Raspberry Pi
- Demonstrate “Object detection” program to technical staff

Timeline

Day3:

- Setup the Sense HAT and complete the examples
- Finish the “Snake Game” with the Sense HAT
- Finish the “Random Arrow Game” with the Sense HAT
- Demonstrate the result to technical staff
- Submit your python code of challenges to Canvas

Timeline

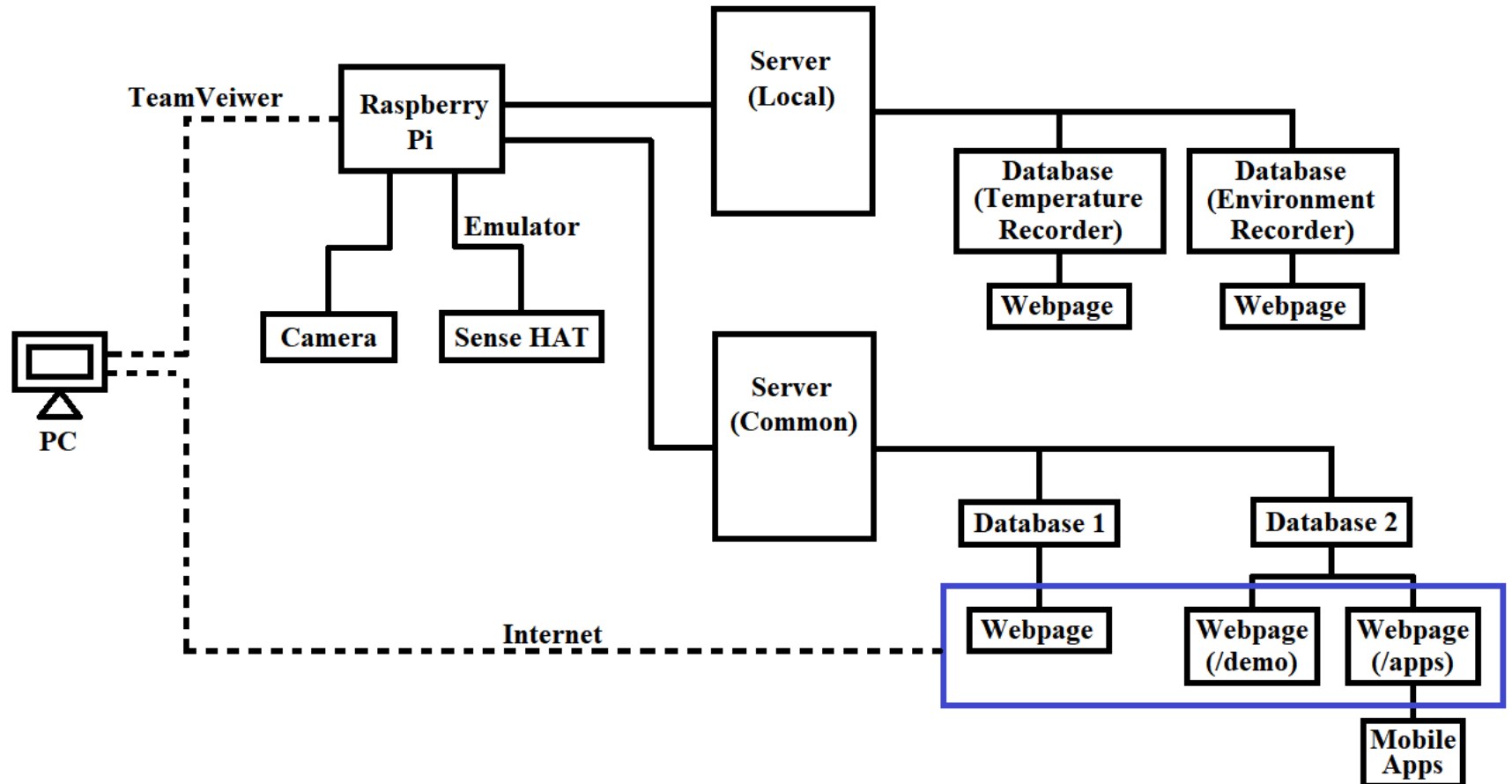
Day4 & Day5:

- Setup a local database server in Raspberry Pi for “Temperature Recorder”
- Build a web page to monitor the local database server
- Demonstrate the result to technical staff
- Submit your python and php code of local database and web page to Canvas
- Finish the Iot Assignment for “Environment Recorder”
- Build a web page and mobile application to monitor the result
- Demonstrate the result of your Iot Assignment to technical staff
- Submit the result of web page and mobile application to Canvas

Outcomes for the whole week

- Able to use TeamViewer to access Raspberry Pi
- Able to do programming in Raspberry Pi
- Able to use camera for object recognition
- Able to implement projects with Sense HAT
- Able to set up a database server in Raspberry Pi
- Able to implement a IoT project using Raspberry Pi
- Able to monitor the data using web page and mobile applications

Overview



Canvas Submission and Demonstration

| Deadline | Tasks |
|----------|---|
| Day 2 | Submit a video that at least 10 seconds about the result of “Object detection” |
| Day 3 | Demonstrate the result of “Snake Game” and “Random Arrow Game” Submit your python code of “Snake Game” and “Random Arrow Game” to Canvas |
| Day 4 | Demonstrate your local database and web page of the “Temperature Recorder” Submit your python and php code of the “Temperature Recorder” to Canvas |

Canvas Submission and Demonstration

| Deadline | Task |
|----------|--|
| Day 5 | <p>IoT Assignment</p> <p>Stage 1: Demonstrate your local database and web page for the “Environment Recorder”</p> <p>Submit your python and php code of the “Environment Recorder” to Canvas</p> <p>Stage 2: Demonstrate your result of “Environment Recorder” in the common database</p> <p>2</p> <p>Submit your python code of the “Environment Recorder” to Canvas</p> <p>Stage 3: Submit a photo of your Android Emulator</p> |

Canvas Submission and Demonstration

- **Demostration**

If you are ready to demo, tell the technical staff your assigned Pi No. and they will inspect your Raspberry Pi.

- **Submission**

Submit one zip file each day and include all your document. You can copy your code(.py or .php) to .txt file and zip it, then upload to Canvas. You must submit your document before the deadline by each day.

Canvas Submission and Demonstration

- **Logbook**

Student need to submit a logbook after each training module. You can find the logbook in Canvas. The due date for the logbook is **Day 5 7:00pm**.

- **Quiz**

Student need to complete the quizzes everyday to fulfill the attendance check. You will need to complete the quizzes **twice a day**, total 10 quizzes. The quizzes will start randomly during the workshop.

Raspberry Pi

- Raspberry Pi is a computer that: **low cost, credit-card sized**
- Can plug in a computer monitor, TV, keyboard and mouse
- Enables people of all ages to explore computing
- Learn how to program in languages like: Scratch, **Python**
- Capable of doing everything a desktop computer can do, including:
 - Browsing the internet
 - Playing high-definition video
 - Making spreadsheets
 - Word-processing
 - Playing games

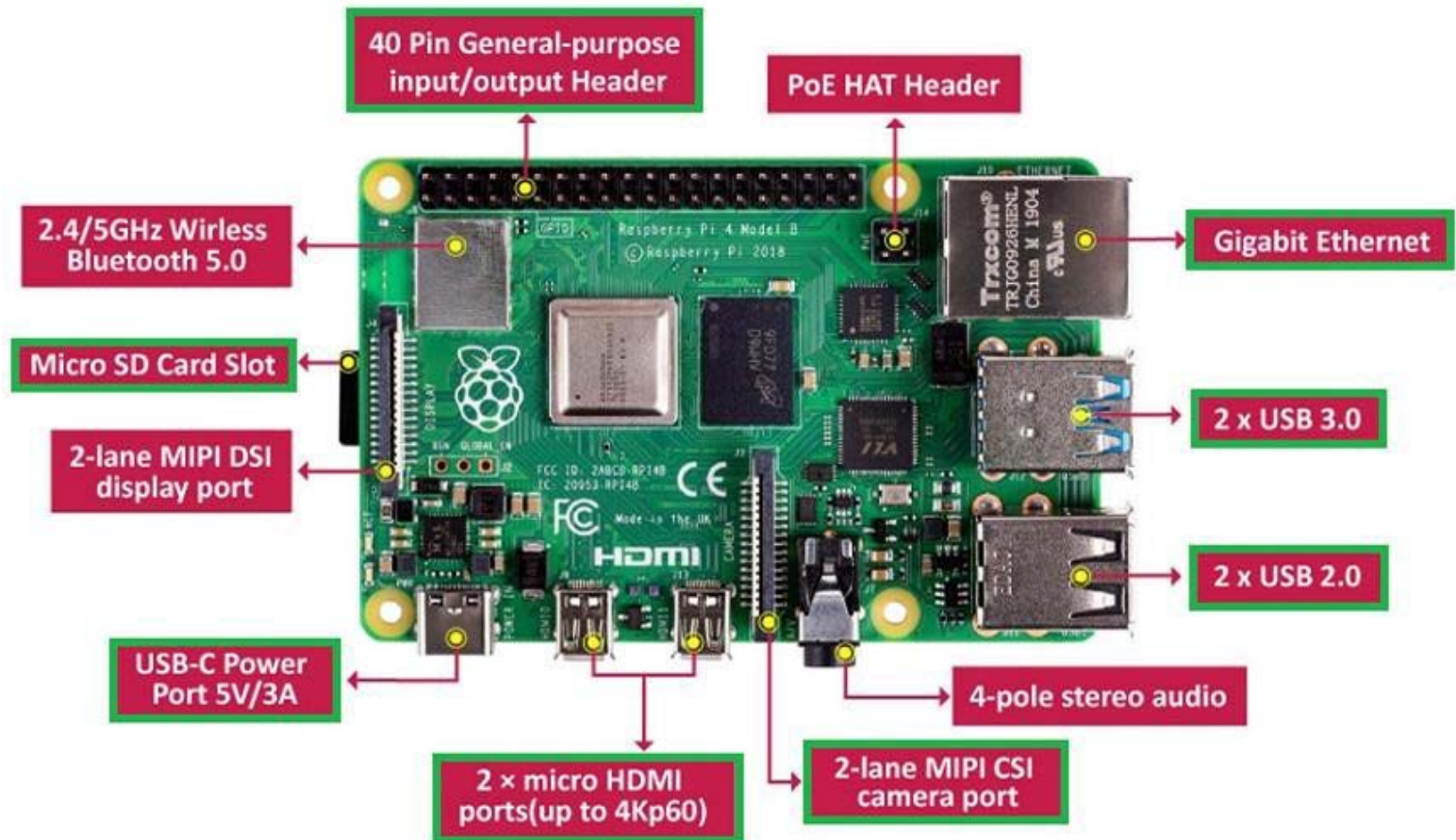
What can you do with Raspberry Pi?



<https://www.youtube.com/watch?v=dWiWV4yBAI4>

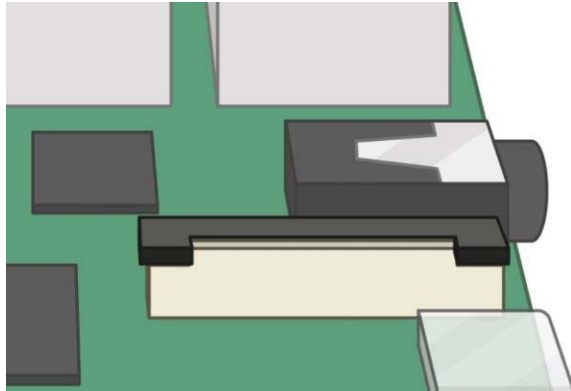
Hardware Aspect of Raspberry Pi

Introduction of the Raspberry Pi Board

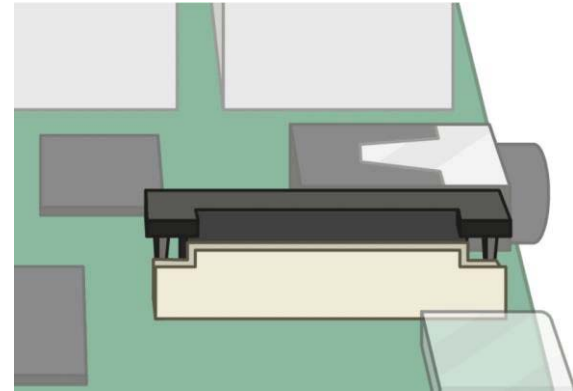


How to install your camera?

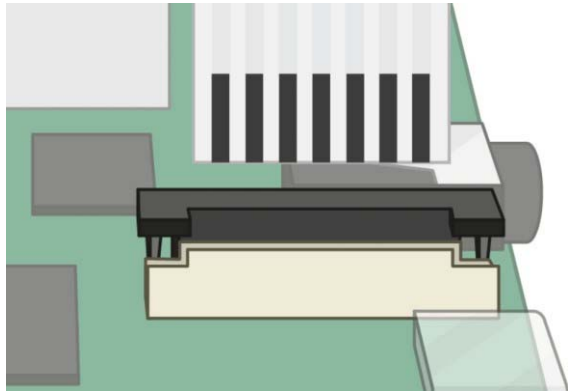
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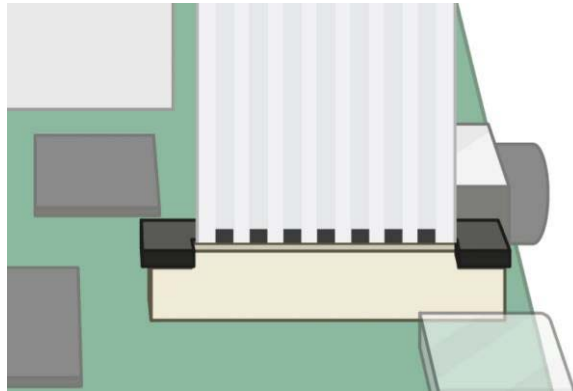
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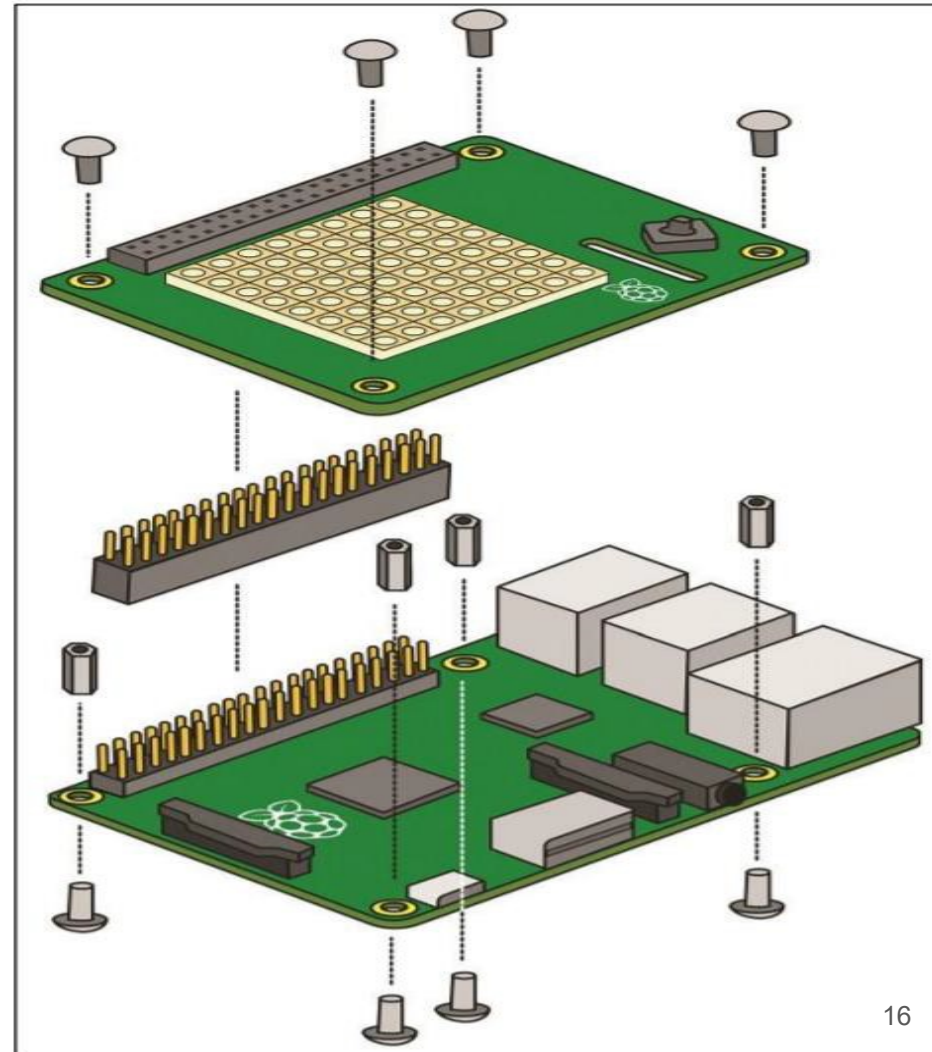
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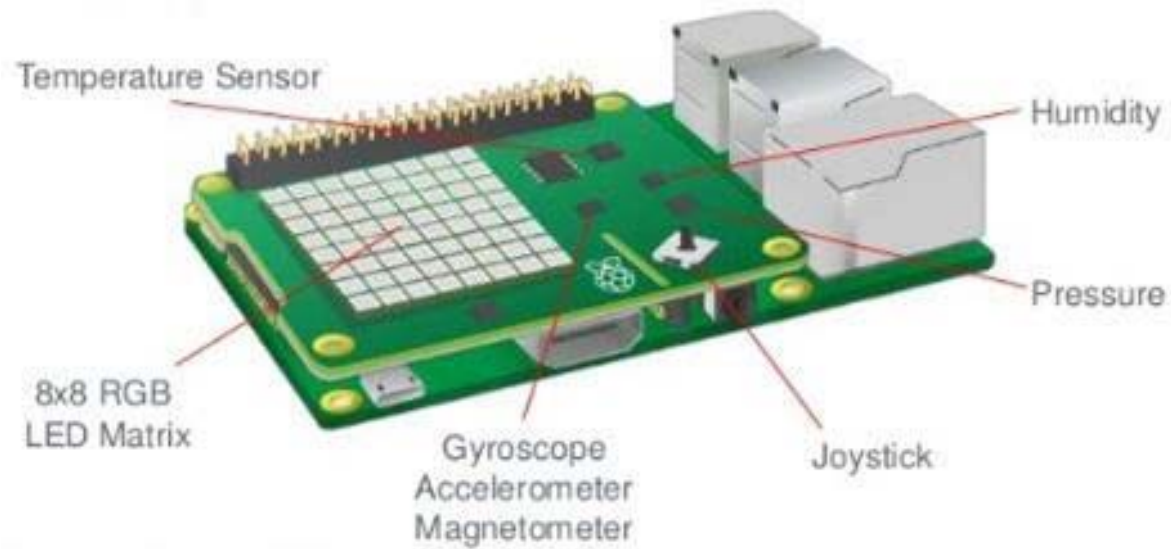
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How to install Sense HAT?



Introduction of the Sense HAT Board



What is TeamViewer?



- TeamViewer is a comprehensive, **remote access**, **remote control** and remote support solution that works with almost every desktop and mobile platform, including Windows, macOS, Android, and iOS.
- Provide **lower bandwidth** performance.
- Allow multi-user to access one computer at the same time.
- TeamViewer lets you remote into computers or mobile devices located anywhere in the world and use them as though you were there.

What is Graphical User Interface (GUI)?

- It is a form of user interface that allows users to interact with electronic devices through graphical icons and audio indicator
- GUIs were introduced in reaction to the perceived steep learning curve of **command-line interfaces** (CLIs), which require commands to be typed on a computer keyboard
- The actions in a GUI are usually performed through direct manipulation of the graphical elements
- For example, the desktop of your Raspberry Pi is a GUI.

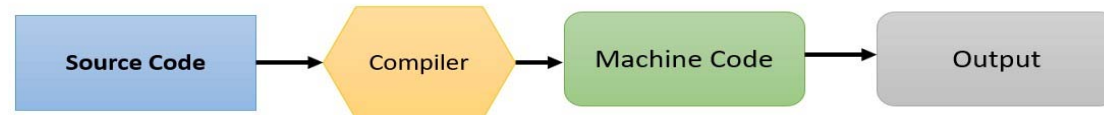
Python

What is Python?



- Python is an **interpreted language**
- Python scripts are first compiled to some bytecode, and that bytecode is interpreted
- We don't need to run a separate compile step (i.e. translate our program into machine code) in order to run our program
- We can even run the interpreter in what's known as interactive mode
- This will allow us to test out commands one line at a time

How Compiler Works



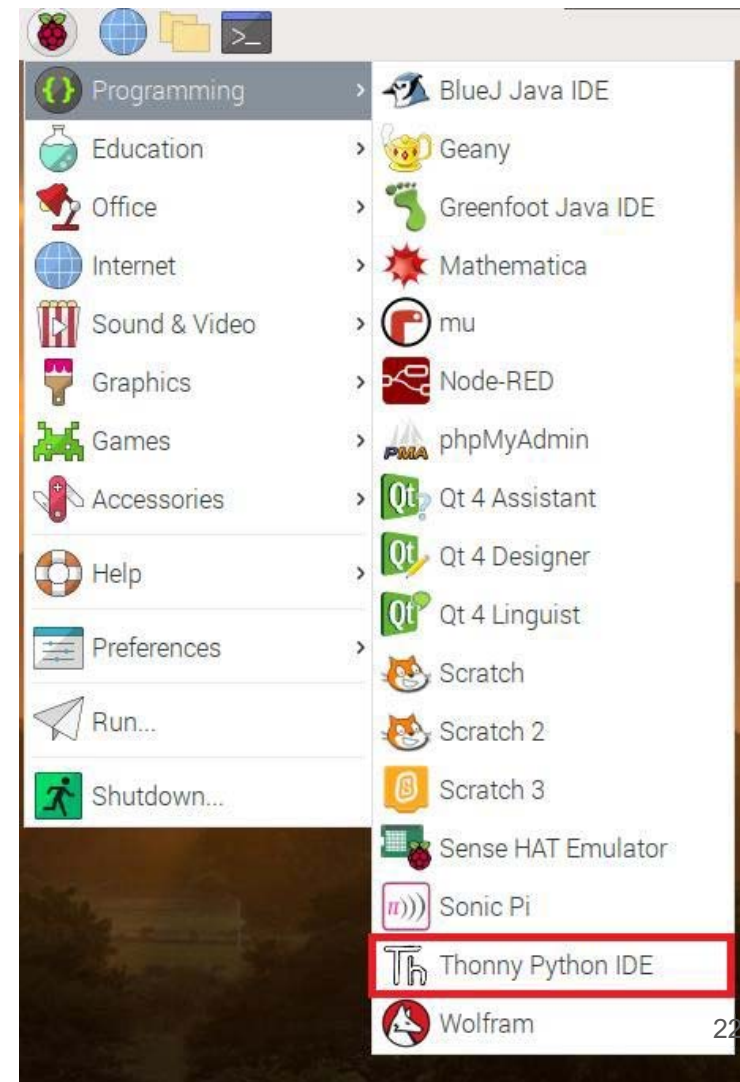
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How Interpreter Works



Introduction of Thonny Python IDE

- Easy to get started
- Simple and clean GUI
- Beginner friendly system shell
- Highlights syntax errors
- Simple debugger
- No-hassle variables



Terminal

What is Terminal?

- The terminal also called Command Prompt or Shell
- Allows a user a great deal of control over their system
- A Command-line interfaces (CLIs) which allow a user to directly manipulate their system through the use of commands
- These commands can be chained together and/or combined together into complex scripts
- It can potentially complete tasks more efficiently than much larger traditional software packages

Command Line Table

- Find out more using command line in the links below:

<https://www.raspberrypi.org/documentation/linux/usage/commands.md>

<https://www.howtogeek.com/412055/37-important-linux-commands-you-should-know/>

| Networking Commands | |
|------------------------|------------------------------|
| wget URL | download a file from an URL |
| ssh user@server | connects to a server |
| scp | copy files between computers |

| File system Commands | |
|--------------------------|--|
| ls | lists directories and files |
| ls -a | lists all files including hidden files |
| ls -lh | formatted list including more data |
| ls -t | lists sorted by date |
| pwd | returns path to working directory |
| cd dir | changes directory |
| cd .. | goes to parent directory |
| cd / | goes to root directory |
| cd | goes to home directory |
| touch file_name | creates an empty file |
| cp file file_copy | copy a file |
| cp -r | copy files contained in directories |
| rm file | deletes a file |
| rm -r dir | deletes a directory and its files |
| mv file1 file2 | moves or renames a file |
| mkdir dir_name | creates a directory |
| rmdir dir_name | deletes a directory |
| locate file_name | searches a file |
| man command | shows commands manual |
| top | shows process activity |
| df -h | shows disk space info |
| apt-get install | installs applications in linux |

Camera Module

What is Raspberry Pi NoIR Camera v2?

- The official “**night vision**” camera board released by the Raspberry Pi Foundation
- It attaches to Raspberry Pi by way of one of the small sockets on the board upper surface and uses the dedicated **Camera Serial Interface** (CSI), designed especially for interfacing to cameras
- The NoIR Camera has **No InfraRed** (NoIR) filter on the lens which makes it perfect for doing Infrared photography and taking pictures in **low light** (twilight) environments
- 8 megapixel native resolution sensor-capable of 3280 x 2464 pixel static images



Object Detection

- A computer technology related to **computer vision** and **image processing** that deals with detecting a certain class (such as humans, buildings, or cars) in digital images and videos.
- Well-researched domains of object detection include **face detection** and **pedestrian detection**.
- Object detection has applications in many areas of computer vision, including **image retrieval** and **video surveillance**.

