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

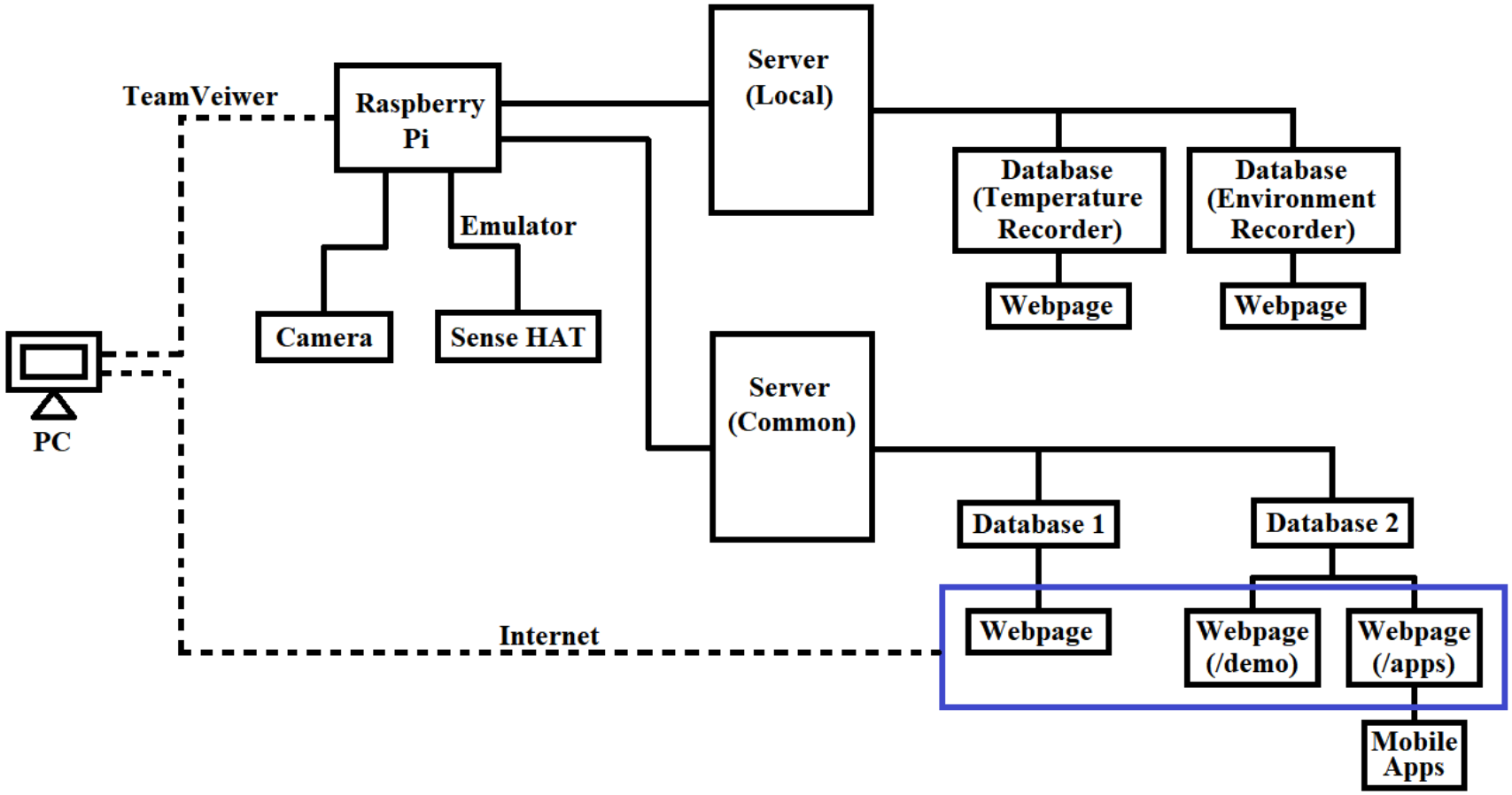
Day4 & Day5:

- 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 Recoder”
- 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


TeamVeiwer
Raspberry Pi
Server (Local)
Database (Temperature Recorder)
Database (Environment Recorder)
Webpage
Webpage
Emulator
Camera
Sense HAT
PC
Server (Common)
Database 1
Database 2
Webpage
Webpage (/demo)
Webpage (/apps)
Mobile Apps
Internet

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	IoT Assignment **Stage 1:** Demonstrate your local database and web page for the "Environment Recorder" Submit your python and php code of the "Environment Recorder" to Canvas **Stage 2:** Demonstrate your result of "Environment Recorder" in the common database 2 Submit your python code of the "Environment Recorder" to Canvas **Stage 3:** Submit a photo of your Android Emulator

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

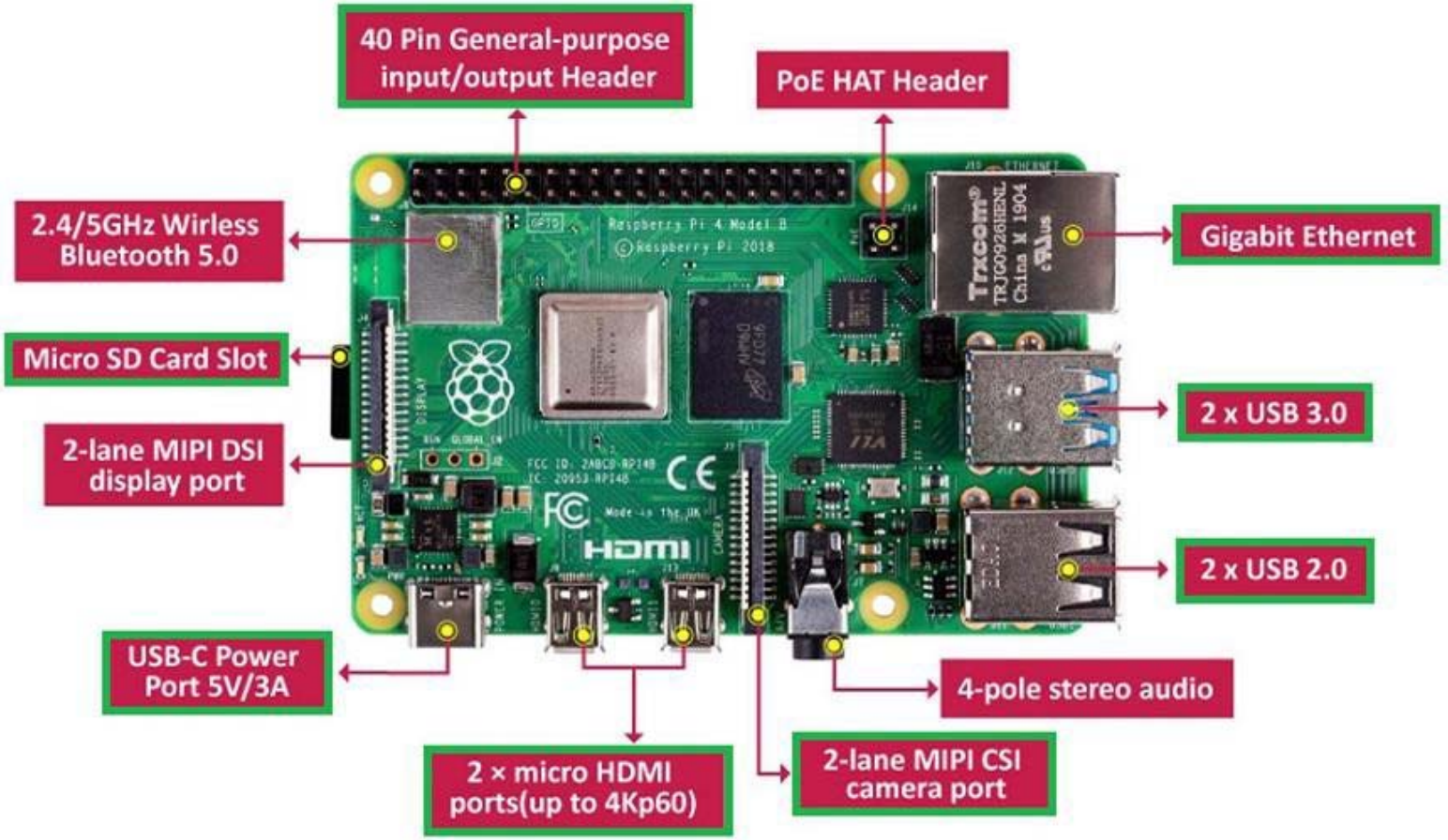
- Raspberry Pi is a computer that: **low cost**, **credit-card sized**
- Can plugs in a computer monitor, TV, keyboard and mouse
- Enables people of all ages to explore computing
- Learn how to program in languages like: Scratch, **Python**
- Capable of doing everything a desktop computer can do, including:
  - 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

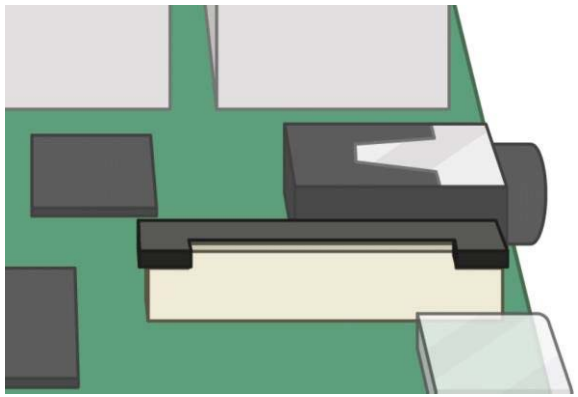
Hardware Aspect of Raspberry Pi

Introduction of the Raspberry Pi Board



How to install your camera?

1.



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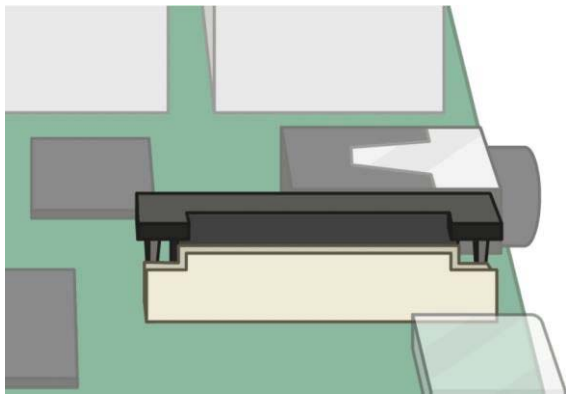

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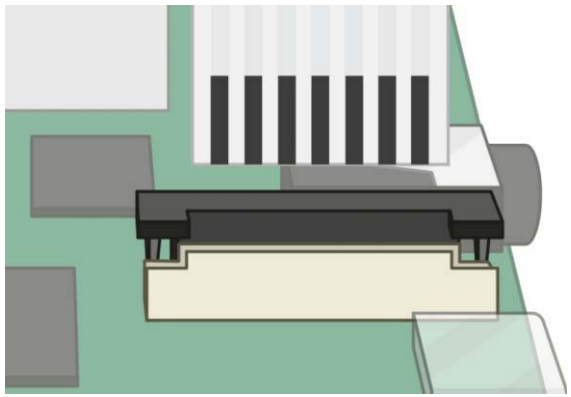

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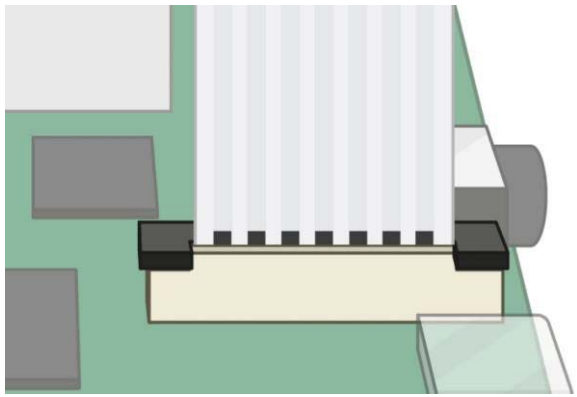
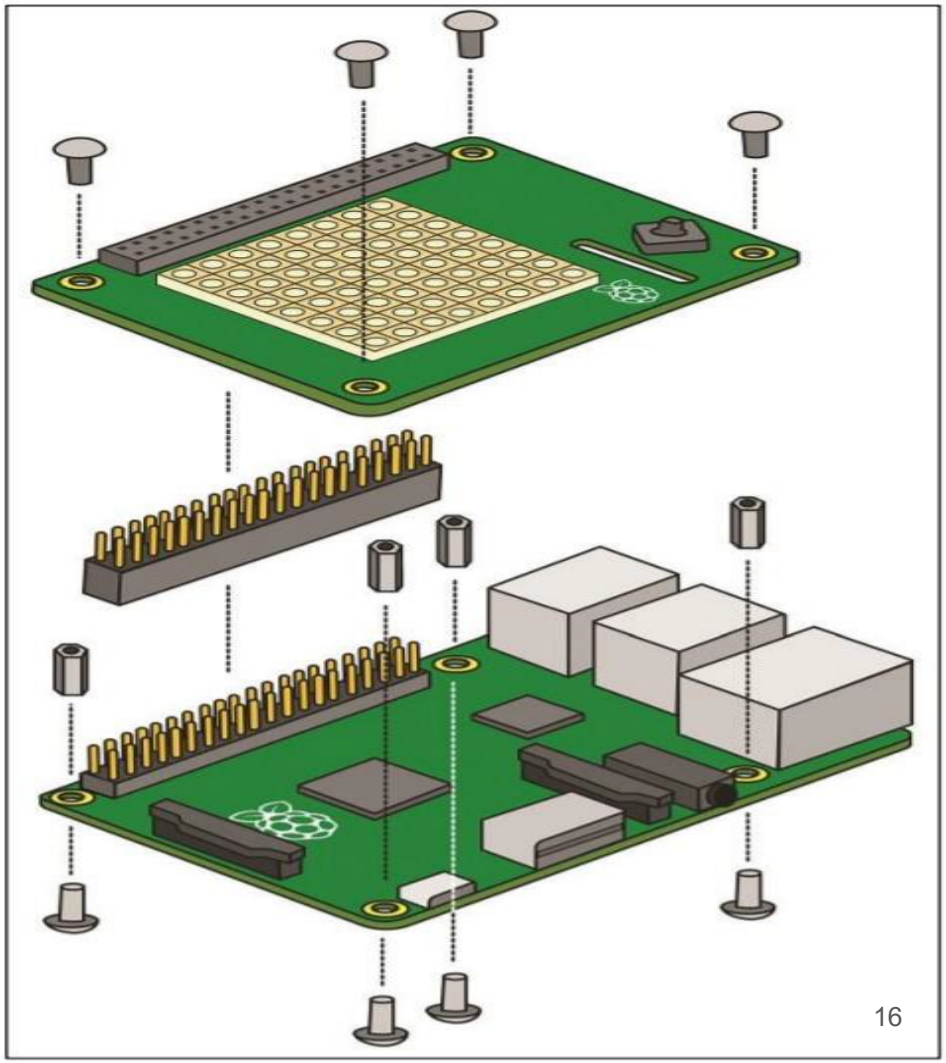
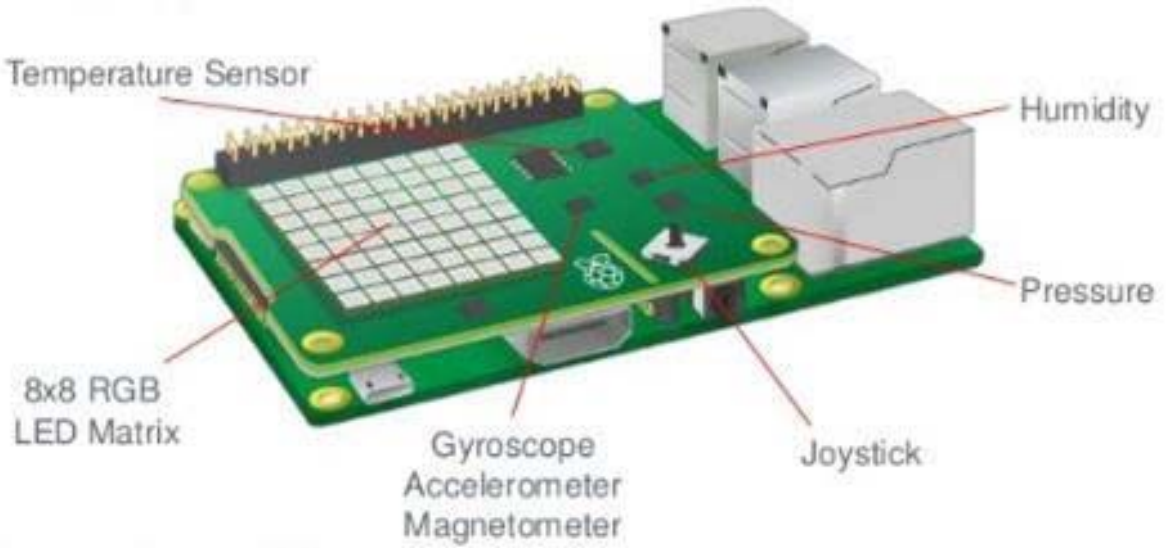


How to install Sense HAT?



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.

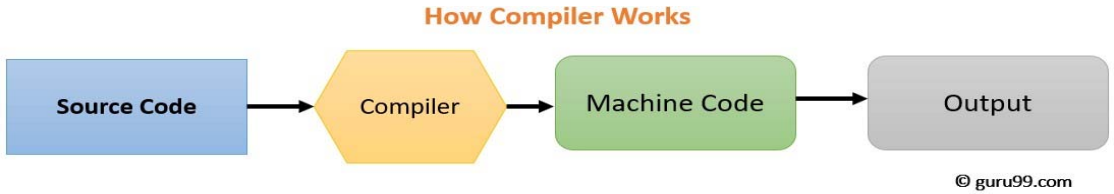
What is Graphical User Interface (GUI)?

- 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

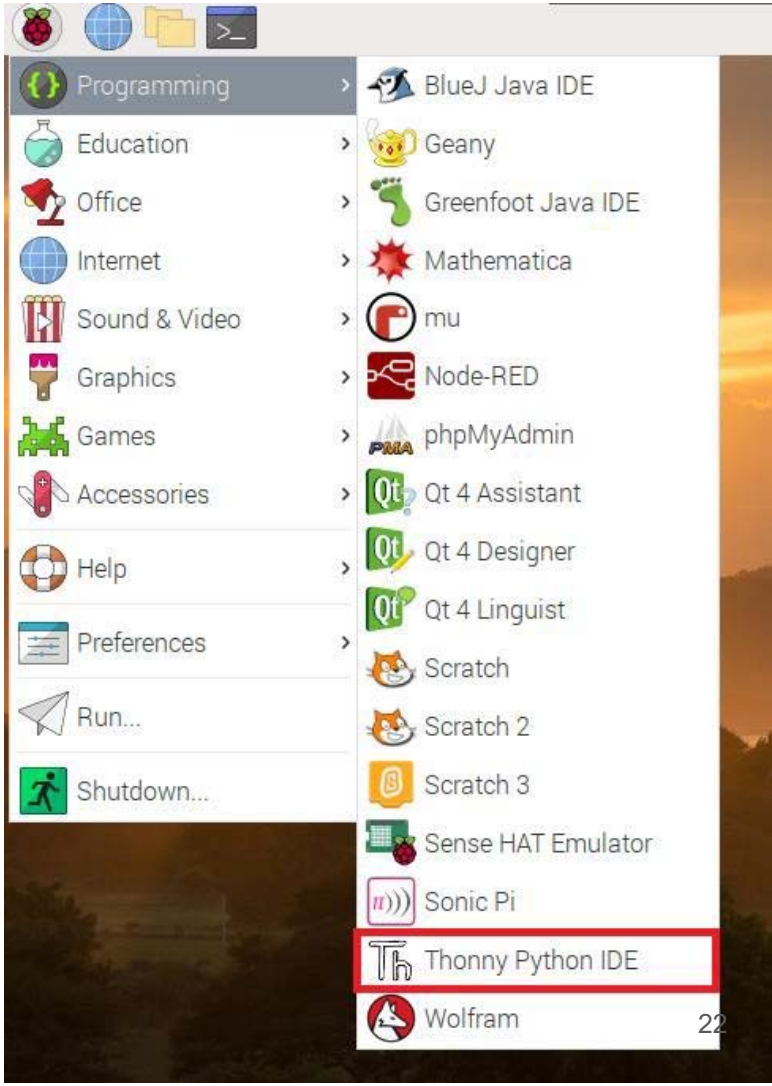
What is Python?

- 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



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/

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 en 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

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

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**.