ARDUINO AND RASPBERRY PI COOKBOOK

A workshop conducted for IEDC.

CONTENTS

- Microprocessor vs Micro-controller vs System on Chip(SoC).

- Arduino

- Raspberry Pi

- Python

MIRO-CONTROLLER VS MICROPROCESSOR VS SYSTEM ON CHIP(SOC)

- Micro-controller: Processor, memory and peripherals integrated in an IC. Mostly used in embedded system due to its low capacity. Used for specific purposes.

- Microprocessor: Central processing unit. Needs memory and other peripherals to work.

- System on Chip (SoC): Integrates different architectures into a chip to form a complete system. A SoC has CPU, GPU, DDR controller, wifi and many more.
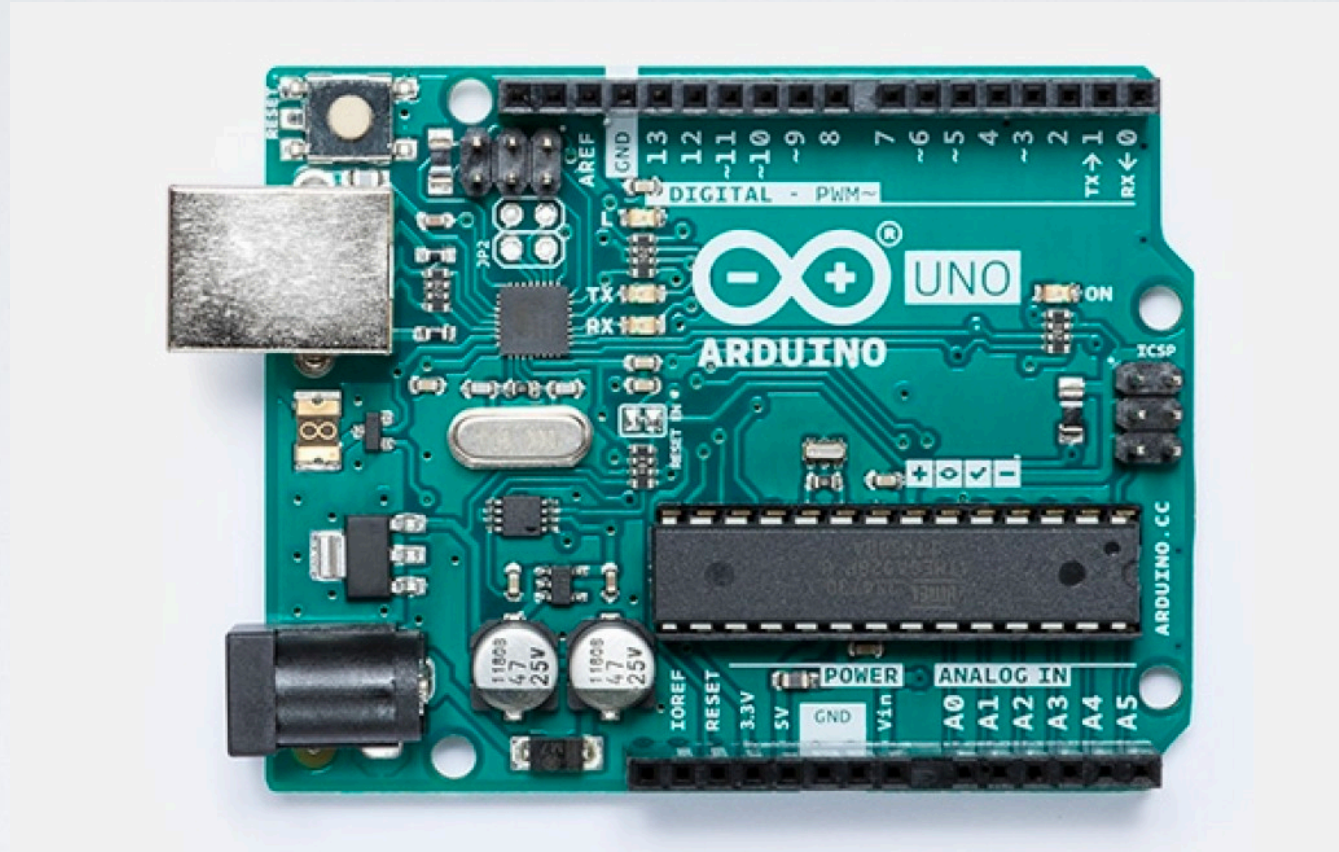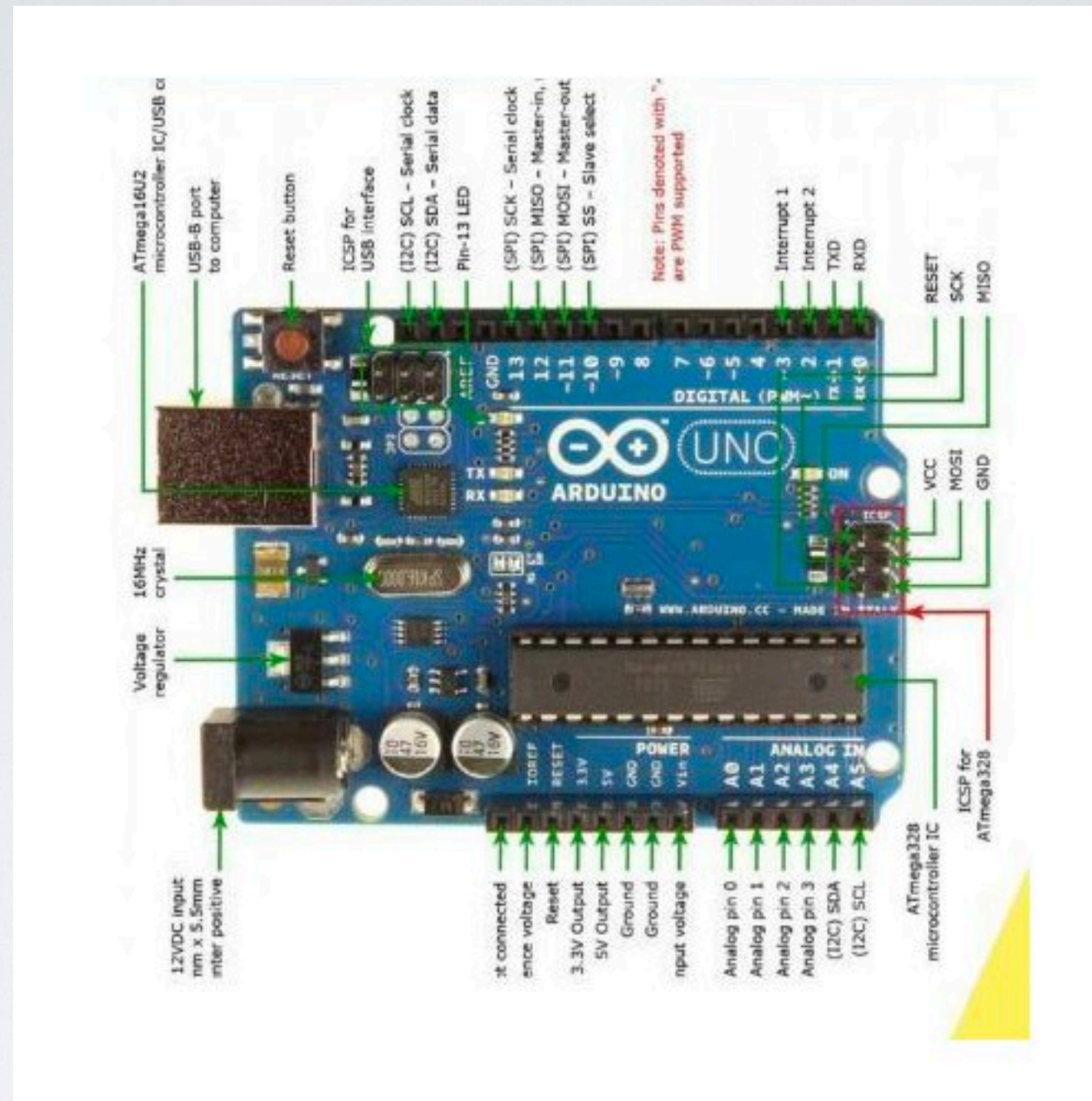
ARDUINO

UNO

WHAT IS A ARDUINO UNO?

- Microcontroller board

- Developed by Arduino.

- Equipped with sets of digital and analog pins for sensors and expansion boards (Shields)

ARDUINO UNO COMPONENTS

Basic components present in Arduino UNO.

ARDUINO UNO SPECS

- Microcontroller : Atmega328

- Digital I/O Pins : 14

- Analog I/O Pins : 6

- Flash memory : 32 KB (0.5 KB used by boot loader)

- SRAM : 2KB

- EEPROM : 1KB

- Clock Speed : 16 MHz

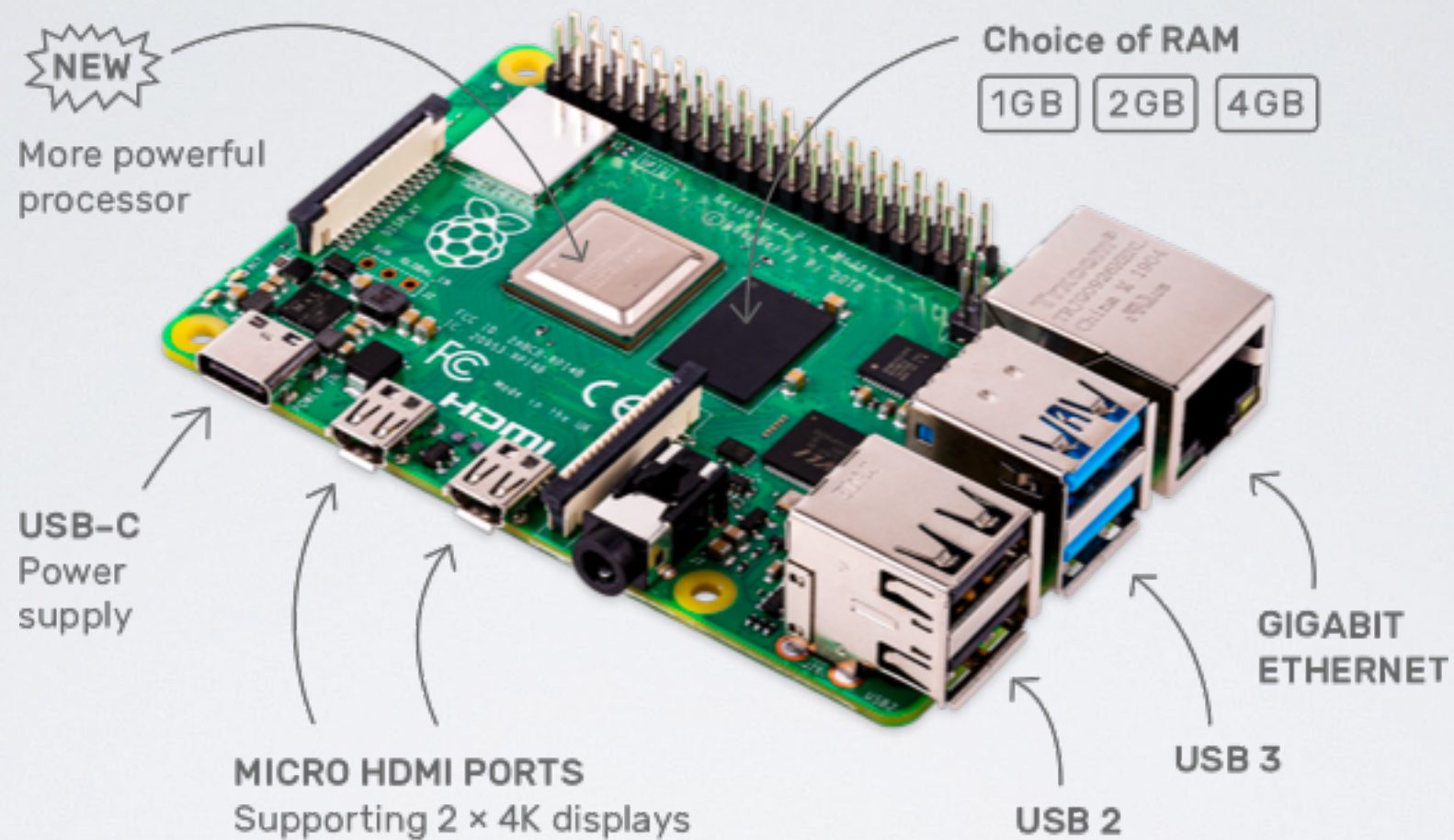# OTHER ARDUINO MODELS
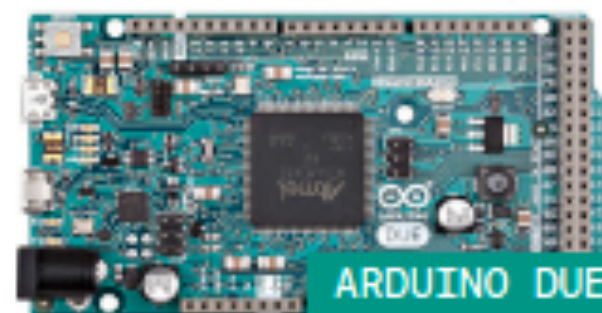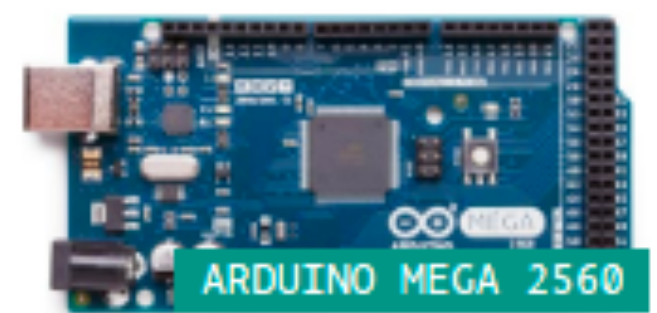
RASPBERRY PI

A Raspberry Pi Model B

WHAT IS A RASPBERRY PI?

- Single board computer.

- Developed by Raspberry Pi Foundation (based in UK).

- Introduced to teach at High Schools and colleges and also for programming enthusiastic children who can't afford computers.

- Inspired from SheevaPlug.

NEW
More powerful processor

Choice of RAM
1GB 2GB 4GB

USB-C
Power supply

MICRO HDMI PORTS
Supporting 2 × 4K displays

USB 2

USB 3

GIGABIT ETHERNET

PI 4 COMPONENTS

Basic components present in Pi 4.

PI 4 SPECS

- CPU: Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz

- Memory: 1GB, 2GB or 4GB LPDDR4-2400 SDRAM (depending on model)

- Network: Gigabit , 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE

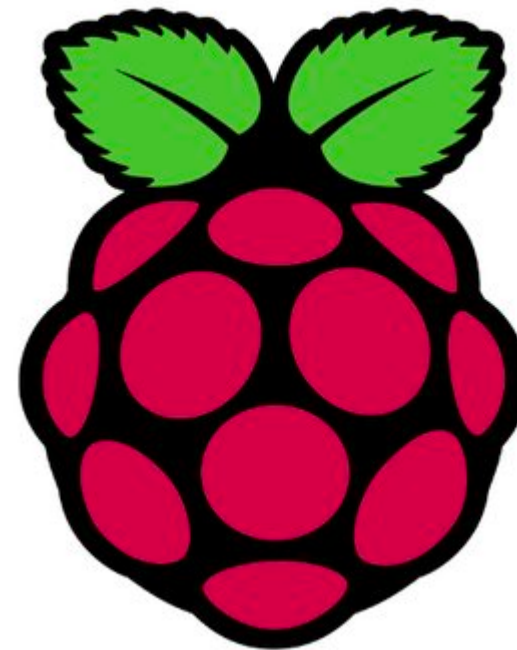- Peripherals: Raspberry Pi standard 40 pin

CONTINUE..

- HDMI – 2 × micro-HDMI ports (up to 4kp60 supported)

- Storage – Micro-SD card slot for loading operating system and data storage

- Display port – 2-lane MIPI DSI

- Camera port – 2-lane MIPI CSI

PI VERSIONS AND WHICH IS PERFECT FOR YOU?

- Pi 1

- Pi 2

- Pi 3

- Pi 4

- Pi zero

OS FOR RASPBERRY PI

Raspbian
Dietpi
Retropie
Windows

HEADLESS OR WITH HEAD

WPA_SUPPLICANT.CONF

- Add the following lines in the file.

ctrl_interface=DIR=/var/run/wpa_supplicant GROUP=netdev

update_config=1

network={

ssid="YOUR_NETWORK_NAME"

psk="YOUR_PASSWORD"

key_mgmt=WPA-PSK

}

HEADLESS AND WITH HEAD CONNECTION

- A headless device can be controlled through network using VNC or SSH.

- With head device has a monitor, keyboard and a mouse.

WORKING REMOTELY

- For desktop experience, we use VNC viewer.

- Make sure to enable VNC on Pi. VNC can be enabled via the command raspi-config.

- Install VNC viewer on your computer or laptop and make sure the pi and the host computer or laptop are on same network.

CONTINUE
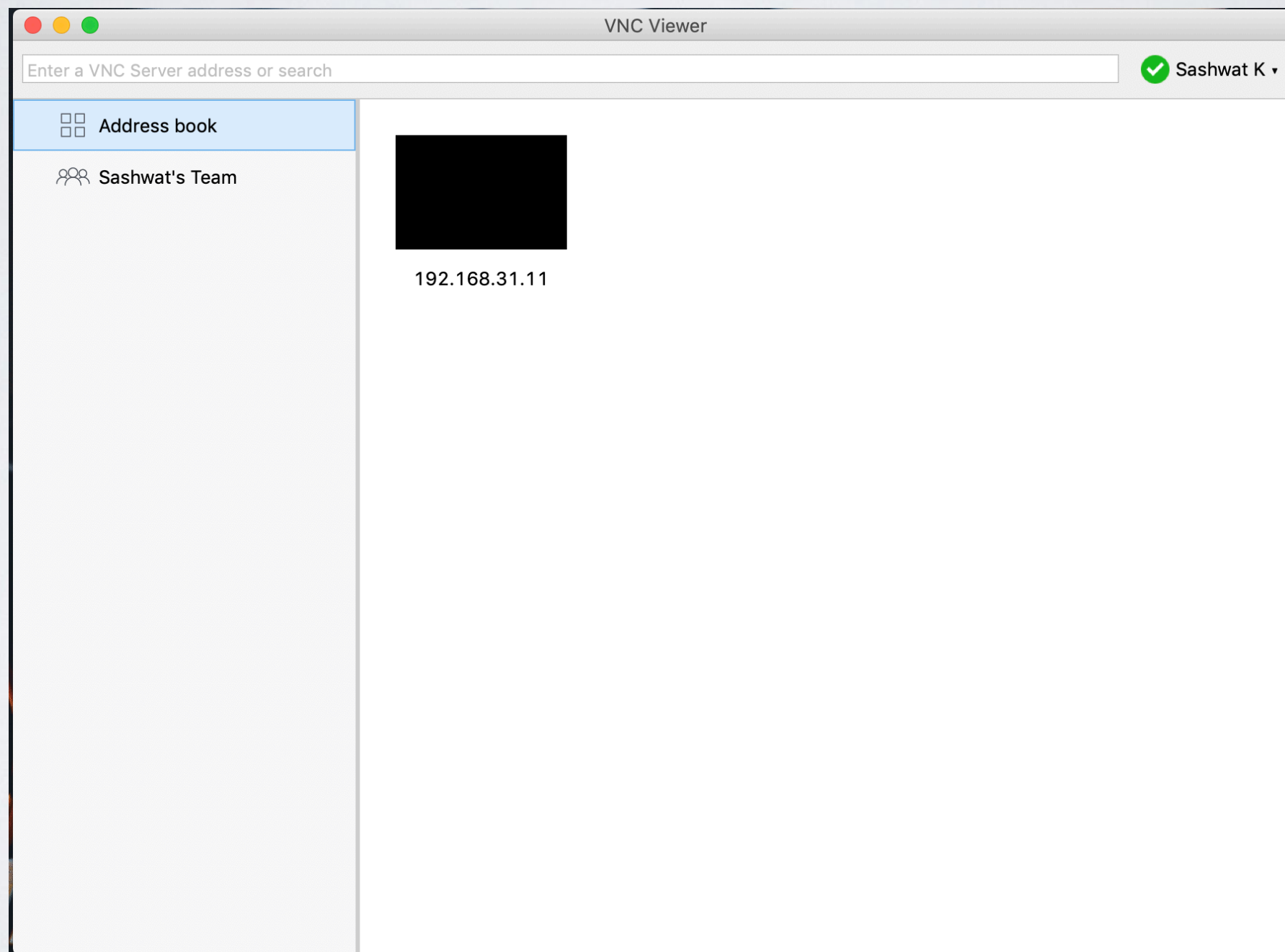
WORKING REMOTELY

- For shell experience, we will use ssh.

- Install putty on windows for using ssh.

- If on linux, just type ssh@ipaddress on shell.

CONTINUE..

BASIC LINUX

We will learn linux basics and some important commands
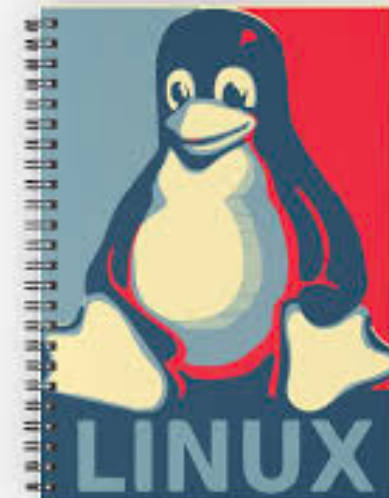
LINUX FILE SYSTEM
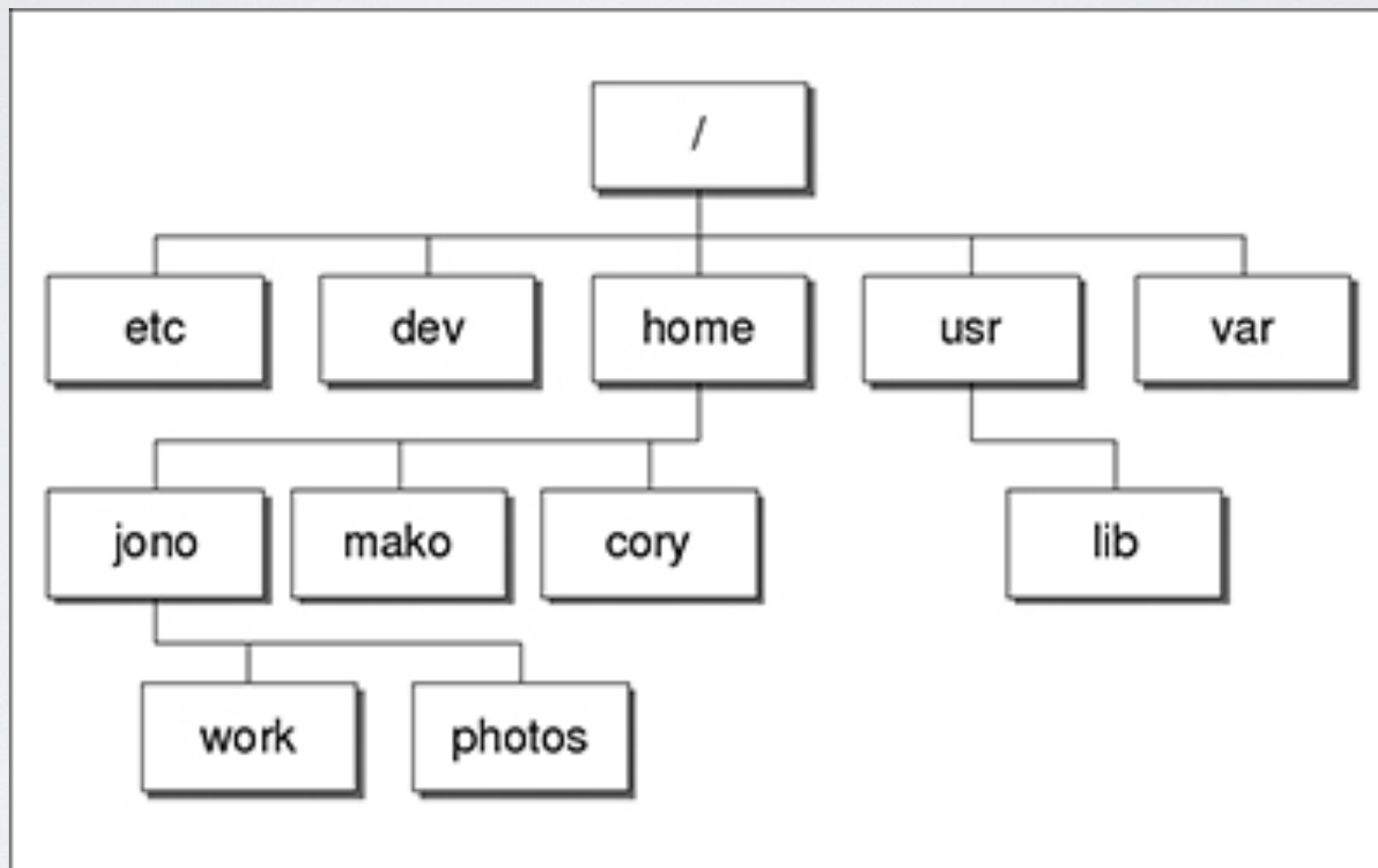
LINUX COMMANDS

- Current directory: pwd

- View files: ls (for hidden files use ls -a)

- Enter a folder: cd folder-name

- Create a folder: mkdir folder-name

- Delete a folder: rmdir or rm -r

CONTINUE..

- Create a file: touch file-name.extension

- Know about a command: man command-name

- Copy file: cp file-origin-directory file-destination-directory

- Move file: mv file-origin-directory file-destination-directory

- Add data to file: echo "text" >> filename.extension

CONTINUE..

- Display content in a file: cat file-name.extension

- Edit a file: nano file-name.extension (You might have to install it)

- Do actions with SU permission: sudo command

- Unzip a file: unzip file-name.zip

CONTINUE..

- For linux distro info : uname -a

- Package installer: apt (for Debian based)

- Update repo: apt update

- Upgrade systems: apt upgrade

CONTINUE..

- Change permissions: chmod

  - Eg: to make a file executable, we add chmod +x file-name.extension

- Know your name in network: hostname

- To connection to server: ping ip-address

- Get history of all the commands used: history

INTRODUCTION TO PYTHON

- Interpreted High level language.

- Introduced to 1991

- Wide range of usage (from web development to software development and many more).

WHY PYTHON?

- Platform independent.

- Easy syntax (english like).

- Helps to reduce code size.

- Any coding approach possible (Procedural, object-oriented or functional).

INSTALLING PYTHON

- Python already installed.

- Check python version

  - python -v

PYTHON PIP

- A package manager for python.

- Is used to install any library on python.

- Already installed.

- For installing a library, use pip install library-name

PYTHON SYNTAX

- Printing data into screen

  - print("Raspberry Pi")

- Variables in python

  - variable_name

- Input data from users

  - input()

PYTHON EXAMPLE

print("Raspberry Pi")

c=str(input())

print(c)

PYTHON VARIABLES

X = 1 #number

Y = "Akhil" #string

print(x) #printing values

#concatination

Z = "the geek"

print(x + "," + y)

PYTHON CONDITIONS

- If .. else

    - a = 10

    - b = 20

    - if b > a:

        - print("b is greater than a")

- If .. elseif a.k.a elif

    - a = 20

    - b = 20

    - if b > a:

        - print("b is greater than a")

    - elif a == b:

CONTINUE..

- We can add more conditions using AND, OR

  - a > b and c > a

  - a > b or c > a

PYTHON LOOPS

- Used to run a set of codes till condition breaks.

- There are two loops in python:-

  - For

  - While

CONTINUE..

- For loop

  - friends = ["Akhil", "Jishnu", "subin"]

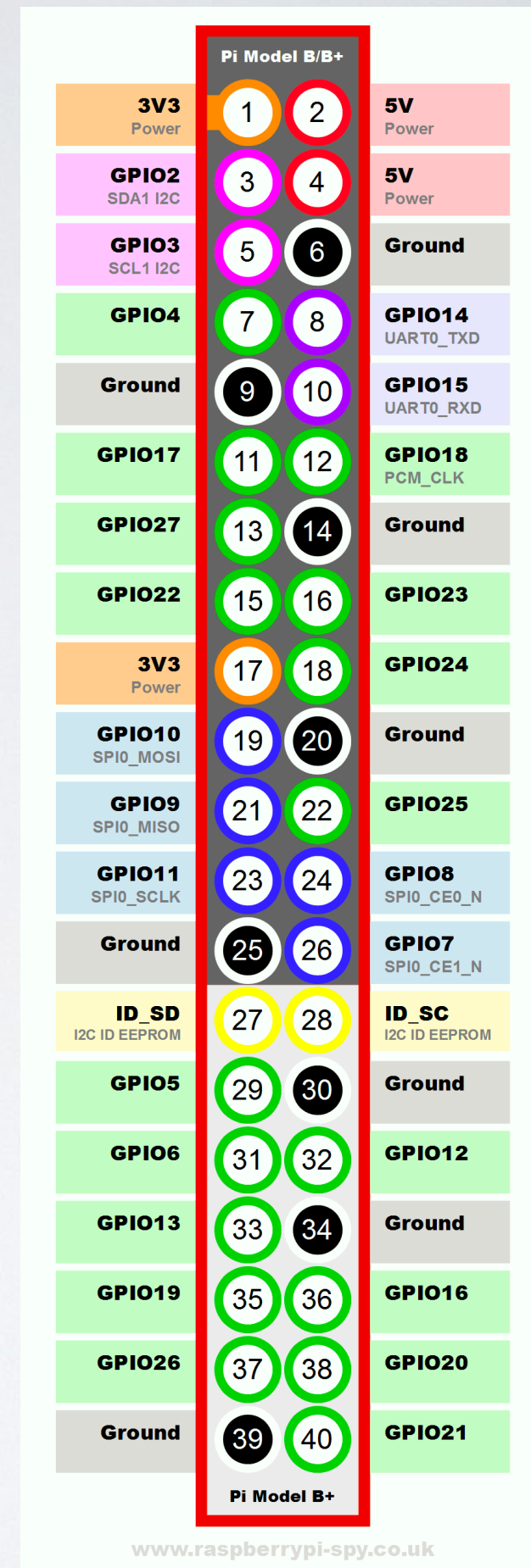 - for x in friends:

    - print(x)

CONTINUE..

- While loop

  - i = 1

  - while i < 5 :

    - print(i)

    - i += 1

PYTHON ARRAYS

- List : ordered, changeable, duplicate members possible.

- Tuple: ordered, unchangeable, duplicate members possible.

- Set: unordered, unindexed, no duplicate members.

- Dictionary: unordered, changeable, indexed, no duplicate members

PI GPIO PINS

The GPIO pins can be used to connect the Pi to different sensors. These pins read values from the sensors.

Pi Model B/B+

3V3 Power	1	2	5V Power
GPIO2 SDA1 I2C	3	4	5V Power
GPIO3 SCL1 I2C	5	6	Ground
GPIO4	7	8	GPIO14 UART0_TXD
Ground	9	10	GPIO15 UART0_RXD
GPIO17	11	12	GPIO18 PCM_CLK
GPIO27	13	14	Ground
GPIO22	15	16	GPIO23
3V3 Power	17	18	GPIO24
GPIO10 SPI0_MOSI	19	20	Ground
GPIO9 SPI0_MISO	21	22	GPIO25
GPIO11 SPI0_SCLK	23	24	GPIO8 SPI0_CE0_N
Ground	25	26	GPIO7 SPI0_CE1_N
ID_SD I2C ID EEPROM	27	28	ID_SC I2C ID EEPROM
GPIO5	29	30	Ground
GPIO6	31	32	GPIO12
GPIO13	33	34	Ground
GPIO19	35	36	GPIO16
GPIO26	37	38	GPIO20
Ground	39	40	GPIO21

Pi Model B+

www.raspberrypi-spy.co.uk

USING GPIO PINS THROUGH PYTHON

- Installation: already installed.

- If not,

    - sudo pip install RPi.gpio

- Two types of numbering:-

    - Physical numbering

    - Broadcom numbering

CONTINUE..

- Output information

    - import RPi.gpio as GPIO

    - print(GPIO.RPi_INFO)

SAMPLE PYTHON GPIO PROGRAM

```python
import RPi.GPIO as GPIO  #import library

GPIO.setmode(GPIO.BCM) #setting pinmode

GPIO.setup(4, GPIO.OUT) #setting up pin

GPIO.output(4, GPIO.HIGH) #output

a = GPIO.input(19)
```

MAJOR PROJECTS IN PI

- Google Assitant and Amazon Alexa on Pi.

  - https://beebom.com/how-build-smart-speaker-alexa-google-assistant/

- Mini laptop using Pi.

  - https://electronicsforu.com/videos-slideshows/videos/constructing-laptop-using-raspberry-pi-3

CONTINUE..

- Surveillance Camera

  - https://electronicsforu.com/videos-slideshows/smart-wireless-surveillance-monitoring-using-raspberry-pi

- Home security

  - https://gist.github.com/Sashuu6/14139586183a959579148f6d90fbd1a0

MAJOR PROJECTS IN PI

- Pi power off switch

    - https://github.com/Sashuu6/raspberry-pi-shut-down-switch

- And many more

"Thank you"

–Sashwat K