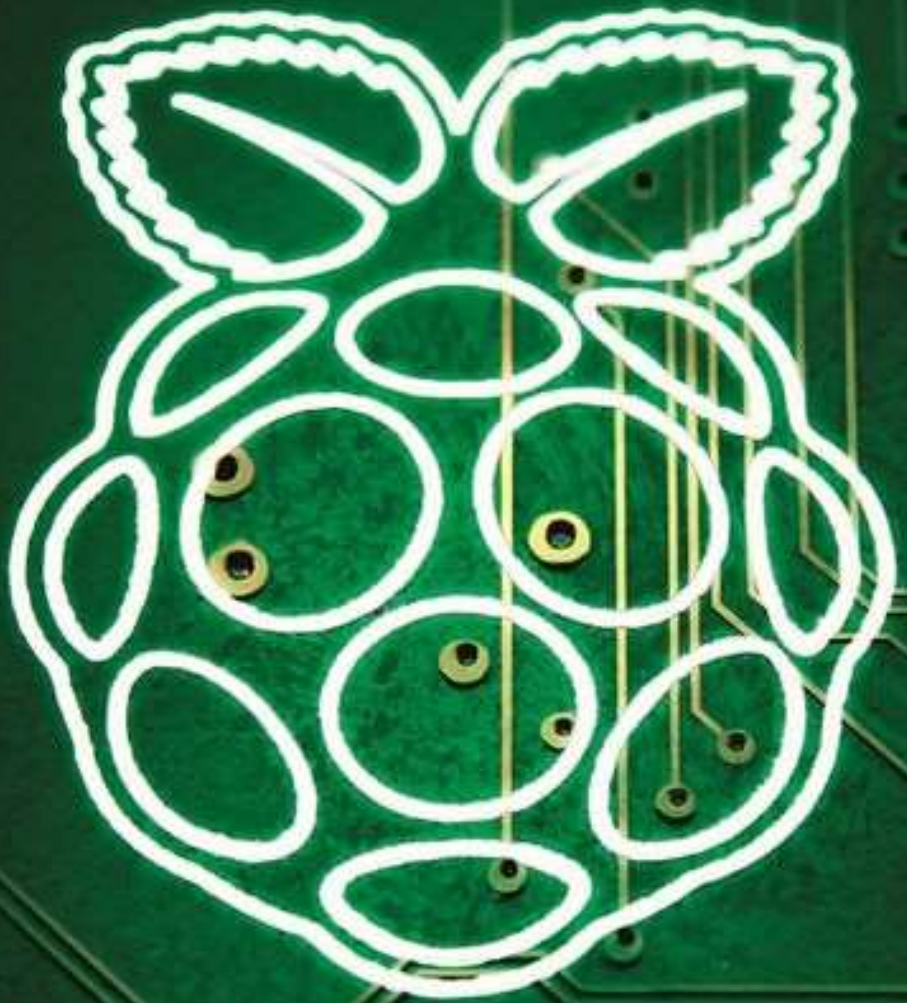
An Introductory Session on

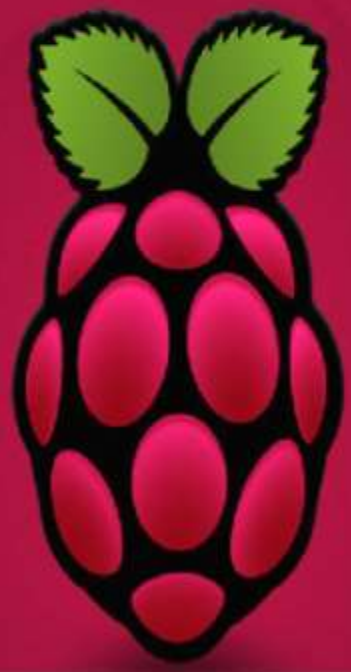


Raspberry-Pi

By Team B.M.E.S.

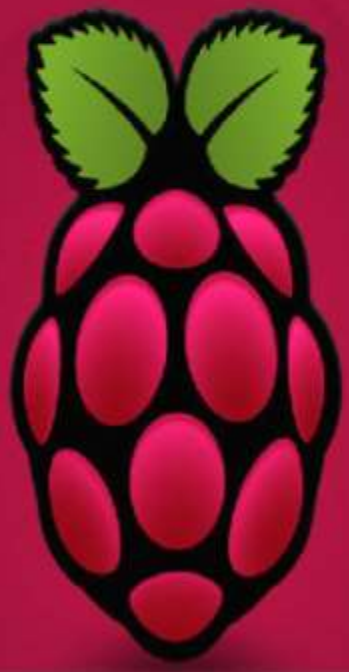
What is Raspberry Pi ?

- Credit card **size single board computer or a Programmable PC**
- Developed in U.K. by Raspberry - Pi foundation in 2009
- Concept Initiated by **Eben Upton** who works at Broadcom
- Supported by "University of Cambridge Computer Laboratory & Broadcom"
- To promote the **study of basic computer science** in schools & **to develop interest** among kids and adults
- Has been **a revolution in the market** with over **3 million units** sold
- Video Demo (www.raspberrypi.org)



Why Raspberry Pi ?

- Very Low Cost (**$25 – Rs 1550/-** for Model **A** & **$35 – Rs 2200/-** for Model **B/B+**)
- Great tool for **Learning Programming**, Computers & Concepts of **Embedded Linux**, etc
- Support for **all Age Groups** (School Children, College Undergraduates, Professional Developers, Programmers)
- Supports & runs **Free** and **Open Source** Linux OS
- Consumes **less than 5W** of Power
- Supports **Full HD Video** Output (1080p), Multiple USB Ports , etc
- Fun to learn & explore. You are limited by your imagination

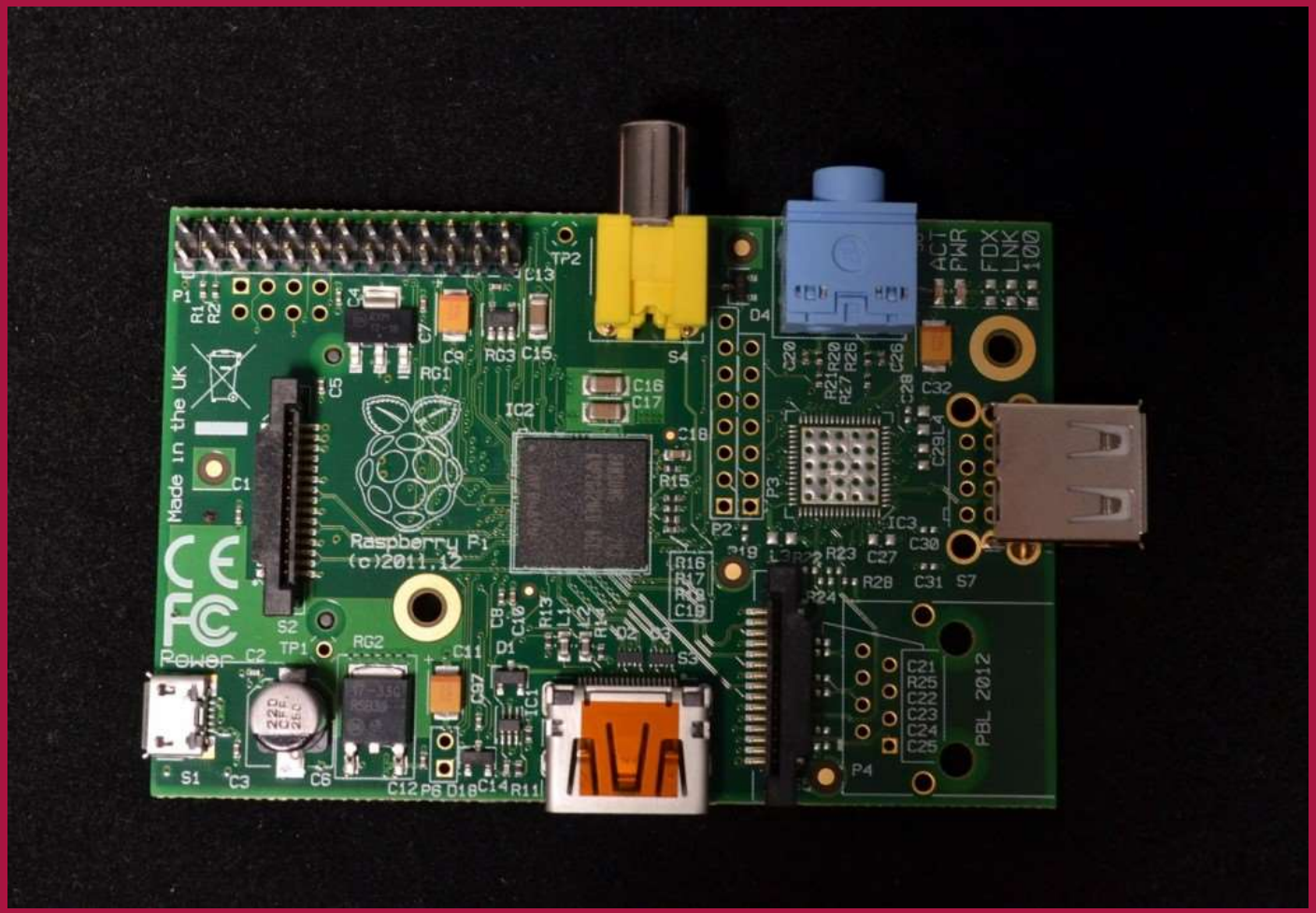


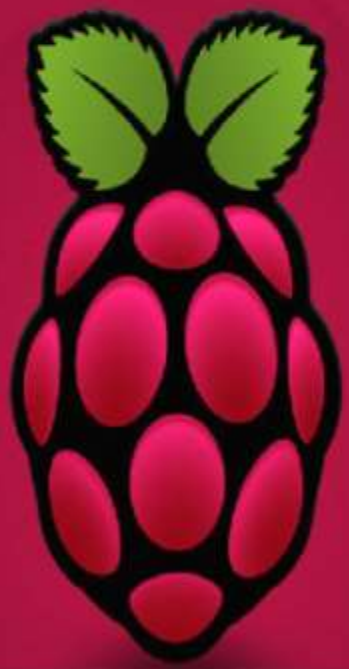
Raspberry Pi – Models

- **3 Main Models/Versions** released till date with Model B+ being the latest in the series.

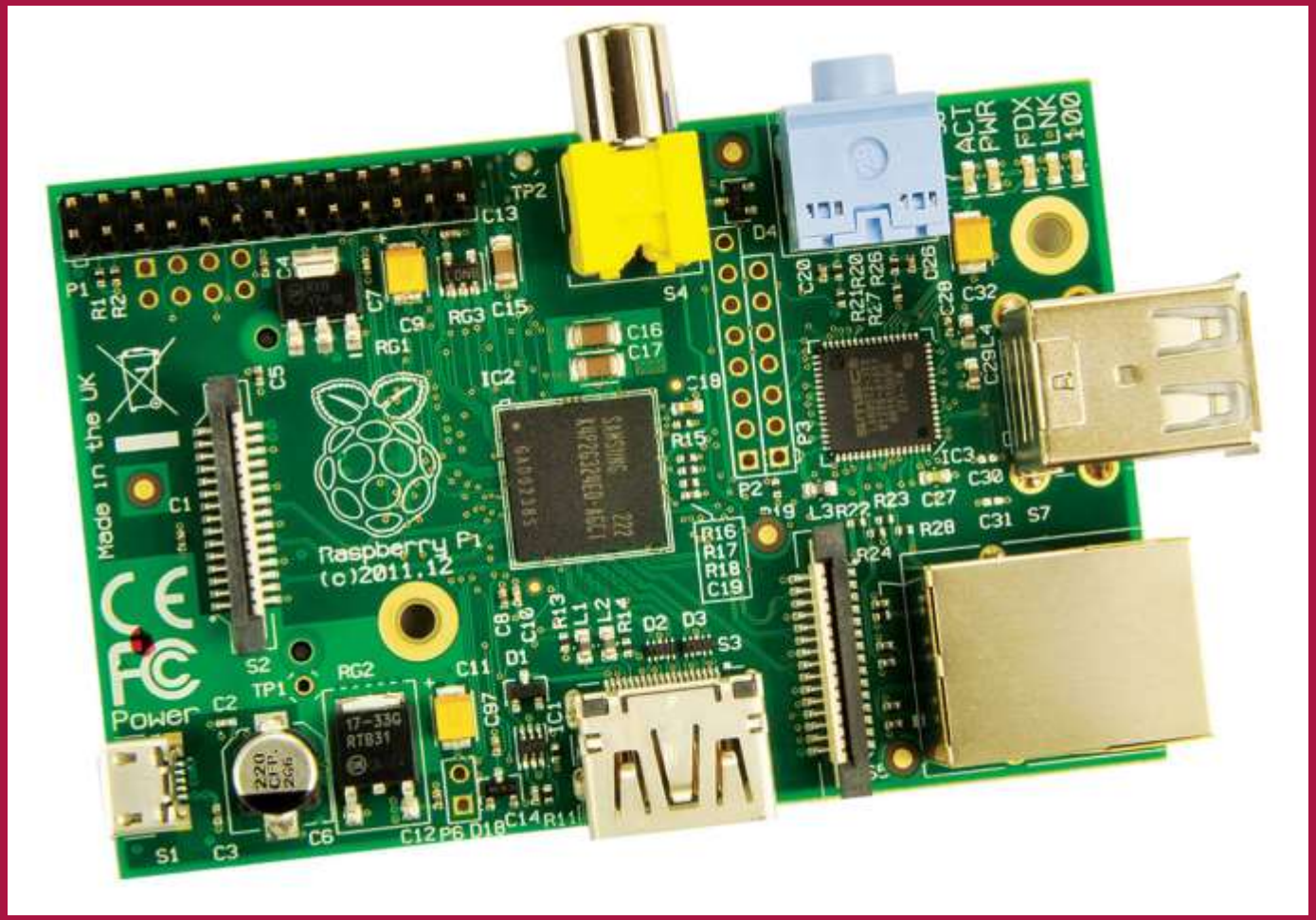
	Model B+	Model B	Model A
Chip	Broadcom BCM2835 SoC full HD multimedia applications processor	Broadcom BCM2835 SoC full HD multimedia applications processor	Broadcom BCM2835 SoC full HD multimedia applications processor
RAM	512 MB SDRAM @ 400 MHz	512 MB SDRAM @ 400 MHz	256 MB SDRAM @ 400 MHz
Storage	MicroSD	SDCard	SDCard
USB 2.0	4x USB Ports	2x USB Ports	1x USB Port
Power Draw / voltage	600mA up to 1.8A @ 5V	750mA up to 1.2A @ 5V	600mA up to 1.2A @ 5V
GPIO	40	26	26

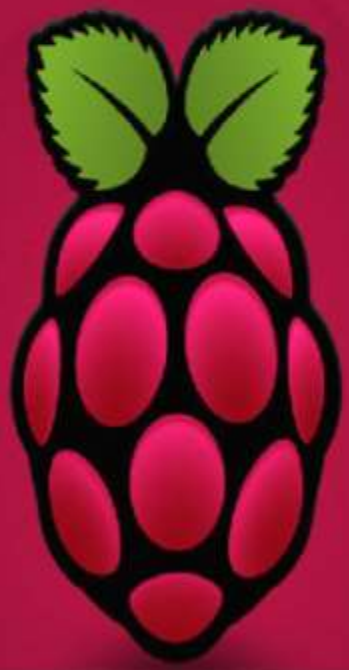
Raspberry Pi (Model A)



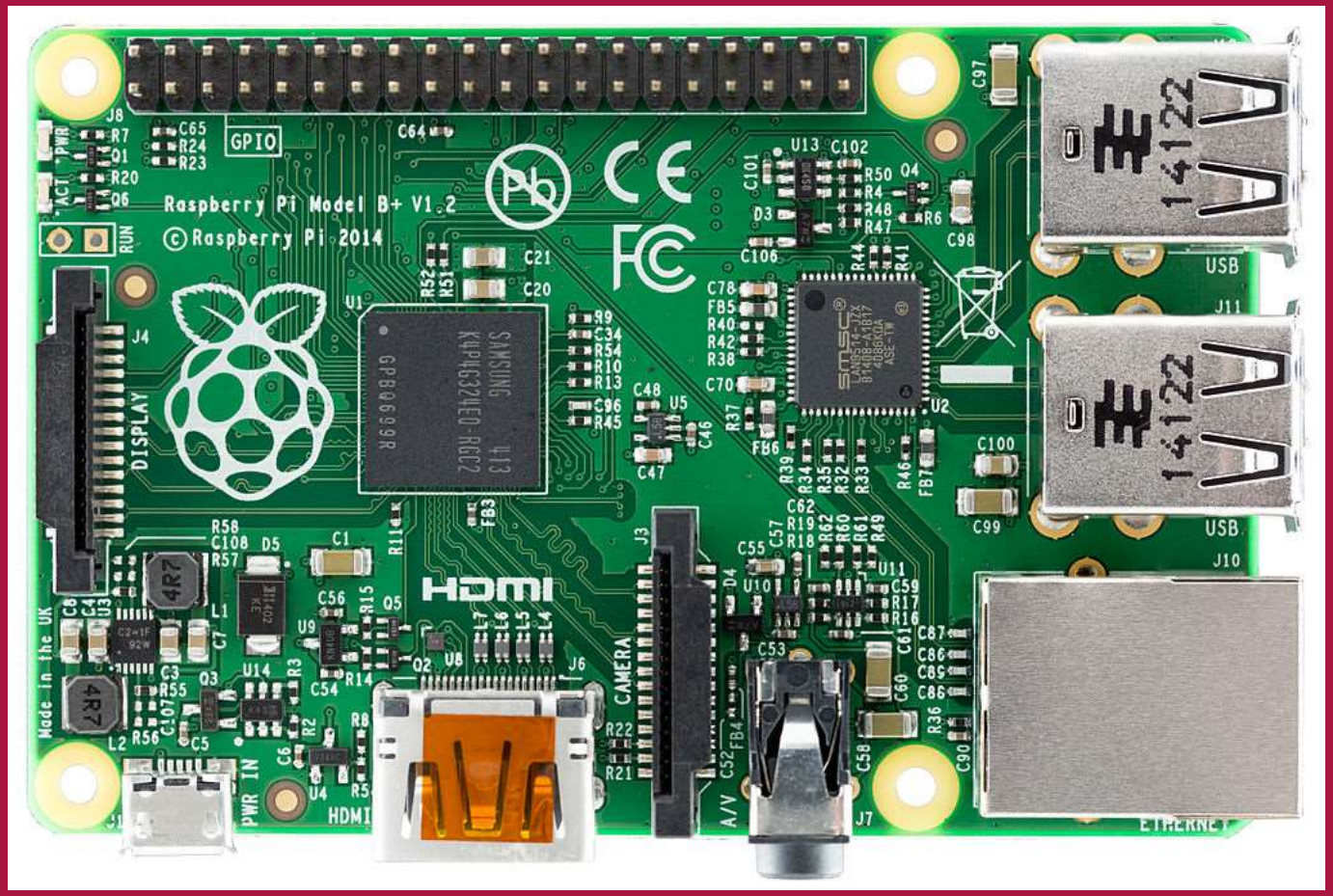


Raspberry Pi (Model B)





Raspberry Pi (Model B+)



Technical Specs.

- **Processor** : Broadcom BCM2835 SoC (System on Chip)
- **Core** : ARM11 (700 MHz ARM1176JZF-S)
- **Memory (RAM)** : 256 Mb (Model A) or 512 Mb (Model B/B+)
- **GPU** : Broadcom Videocore IV
- **USB 2.0** : 1 (Model A) / 2 (Model B) / 4 (Model B+)
- **On Board Storage** : SD Card (Model A/B) / Micro SD (Model B+)
- **Video Input** : Camera Support via CSI Connector
- **Video Output** : Composite Video (RCA) or HDMI or LCD Support via DSI

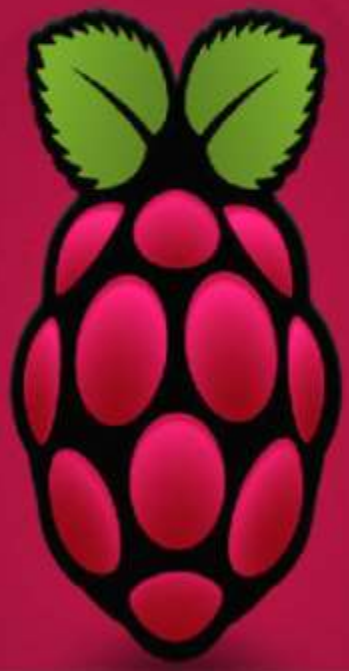
Technical Specs. (Cont.)

- **Networking** : 10/100 Mbit/s Ethernet Support on Model B/B+
- **Audio Outputs** : 3.5 mm Jack
- **I.O. Lines** : **26 Pin GPIO** Connector on Model A/B and **40 Pin GPIO** Connector on Model B+ (GPIO, UART, SPI, I2C, Power Rails, I2S, etc)
- **Power Source** : 5V/2A DC Adapter via **Micro USB**
- **Power Ratings** : 300 mA (1.5W – Model A), 700 mA (3.5W – Model B) & 600 mA (3W – Model B+)
- **Operating Systems** : Raspbian, Debian, Pidora, Fedora, OpenELEC, ArchLinux ARM, FreeBSD,etc

Raspberry Pi VS PC

Raspberry Pi & PC

=

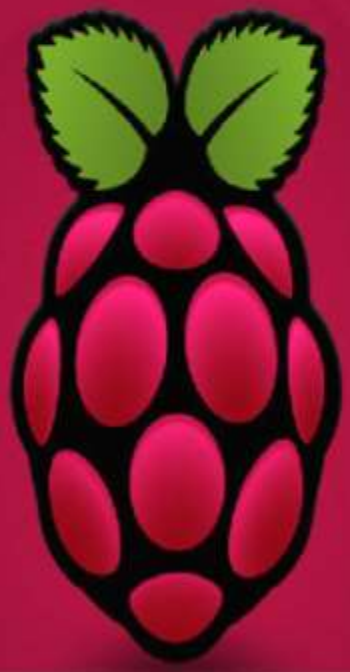


Raspberry Pi VS PC

Compare Raspberry Pi and a PC

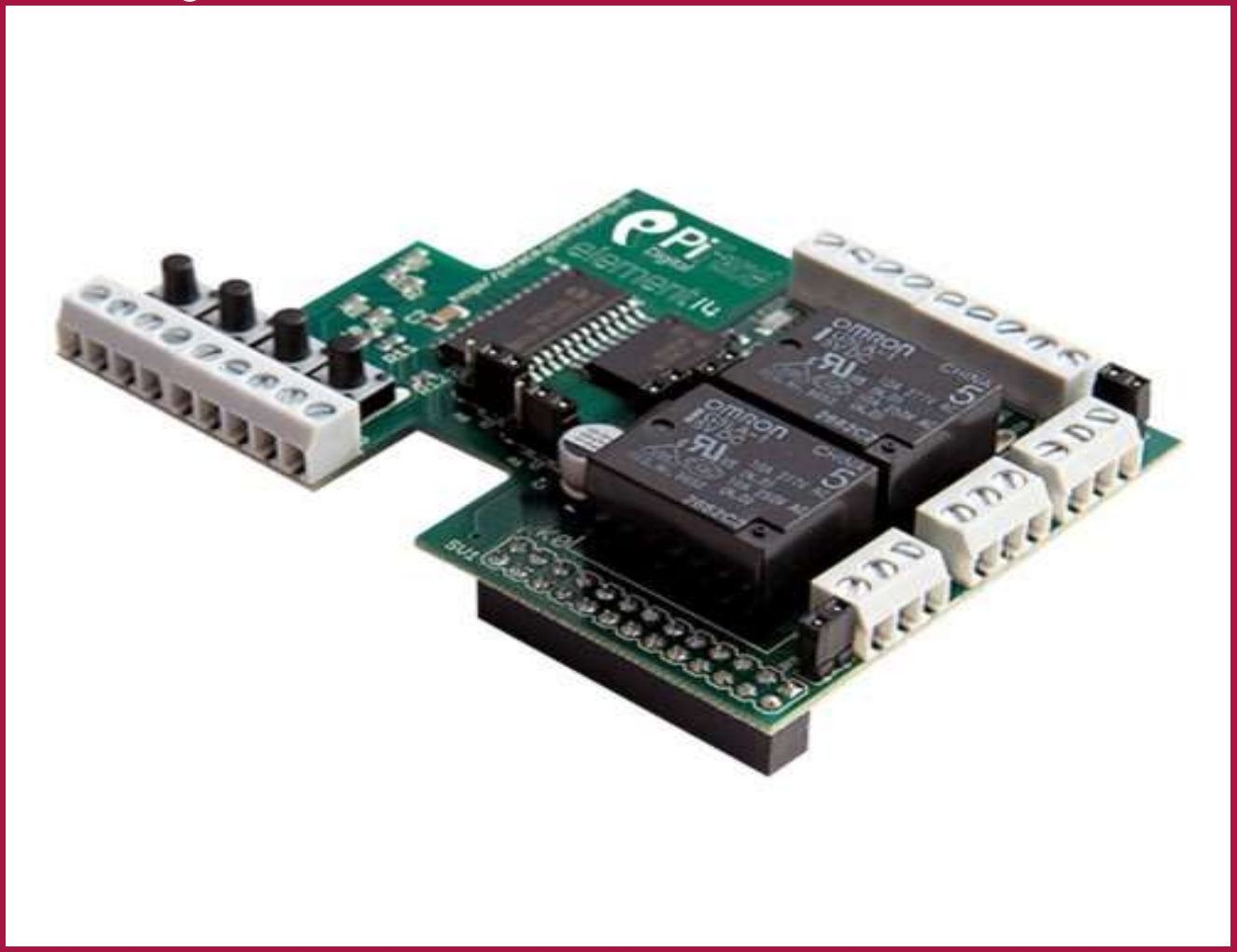
Components	Laptop or PC	Raspberry Pi Ver B
Processor	Intel 2.2 Ghz,Dual Core	700 Mhz,Single Core Arm 11
RAM	6GB	512 MB
Graphics	Intel HD 3000	Dual core video core IV
Ethernet	Yes	Yes
USB 2.0	Yes	Yes
Video O/P	VGA ,HDMI	Composite RCA HDMI
Audio O/P	Yes	Yes
Storage	500 GB Harddisk	32 GB SD Card
Operating System	Linux/Windows	Only Linux
Dimensions	14 inch laptop	8.6x5.4x1.7 cm

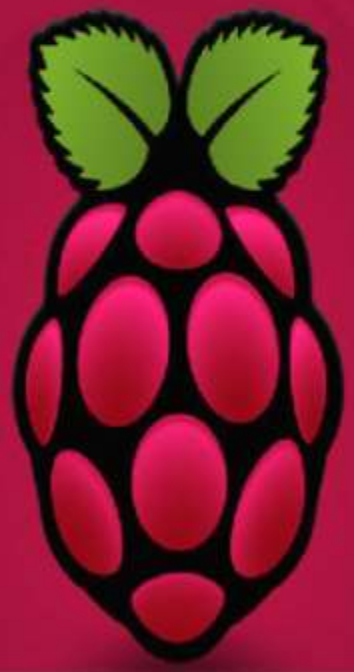
Questions ?



Raspberry Pi - Projects

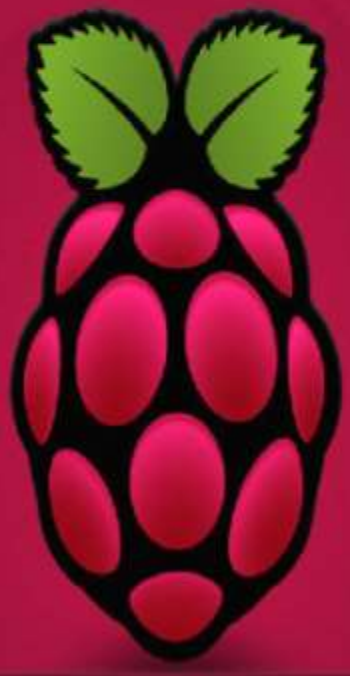
1) **Pi-Face** : Hardware + Sensors + Electronics Interfacing.





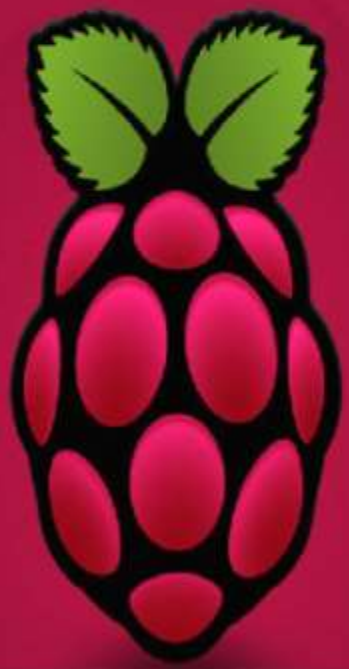
Raspberry Pi - Projects

2) **Raspberry Pi Wall Mounted Google Calendar –**
On Instructables



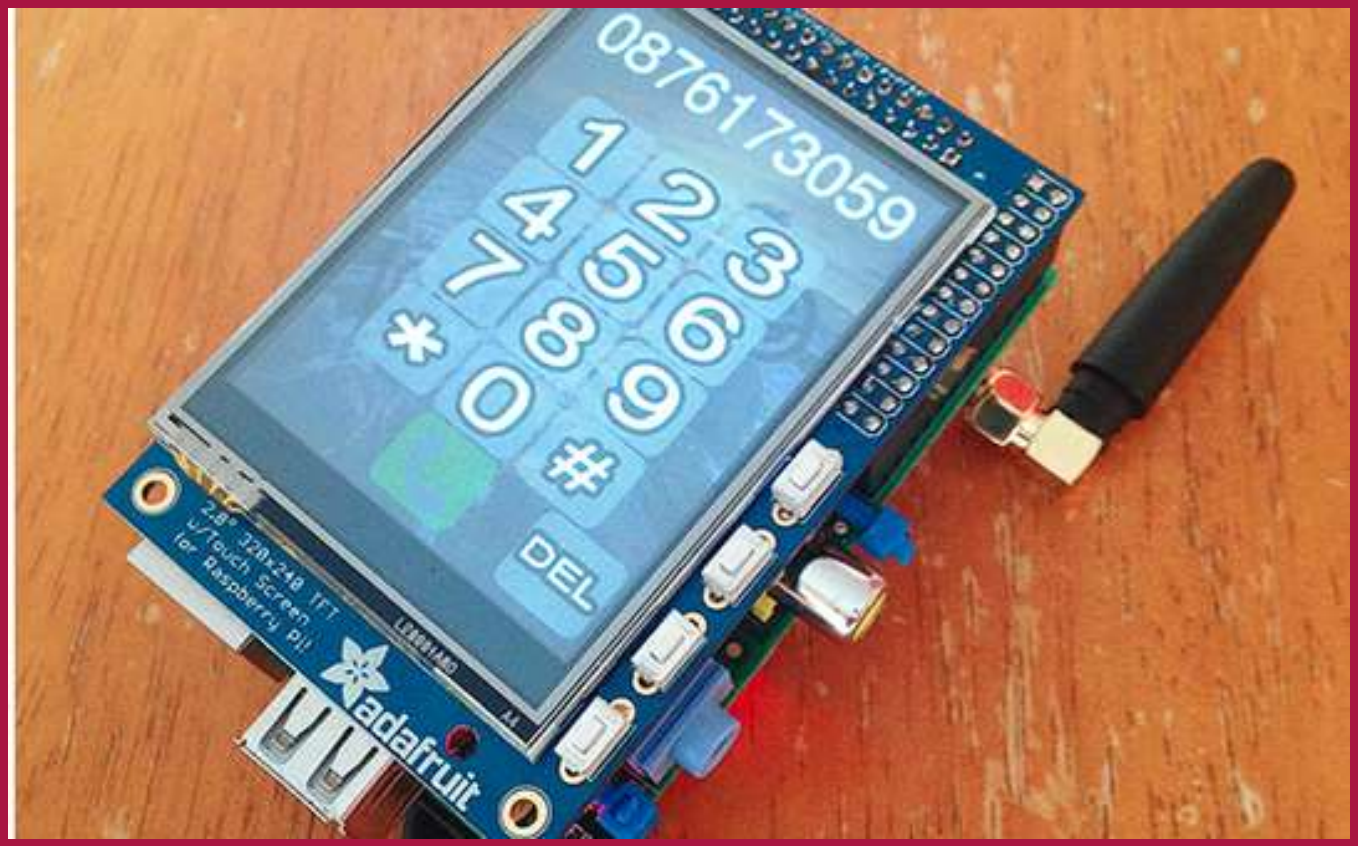
Raspberry Pi - Projects

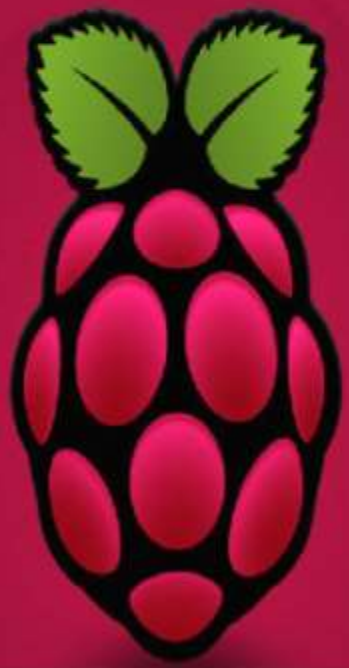
3) **PiPad**: Tablet Using Raspberry Pi



Raspberry Pi - Projects

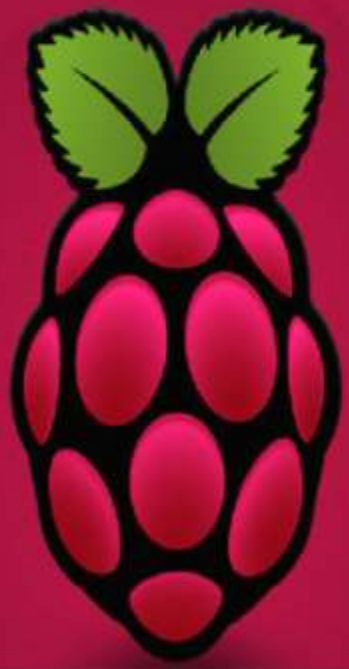
4) **PiPhone** : Using Raspberry Pi





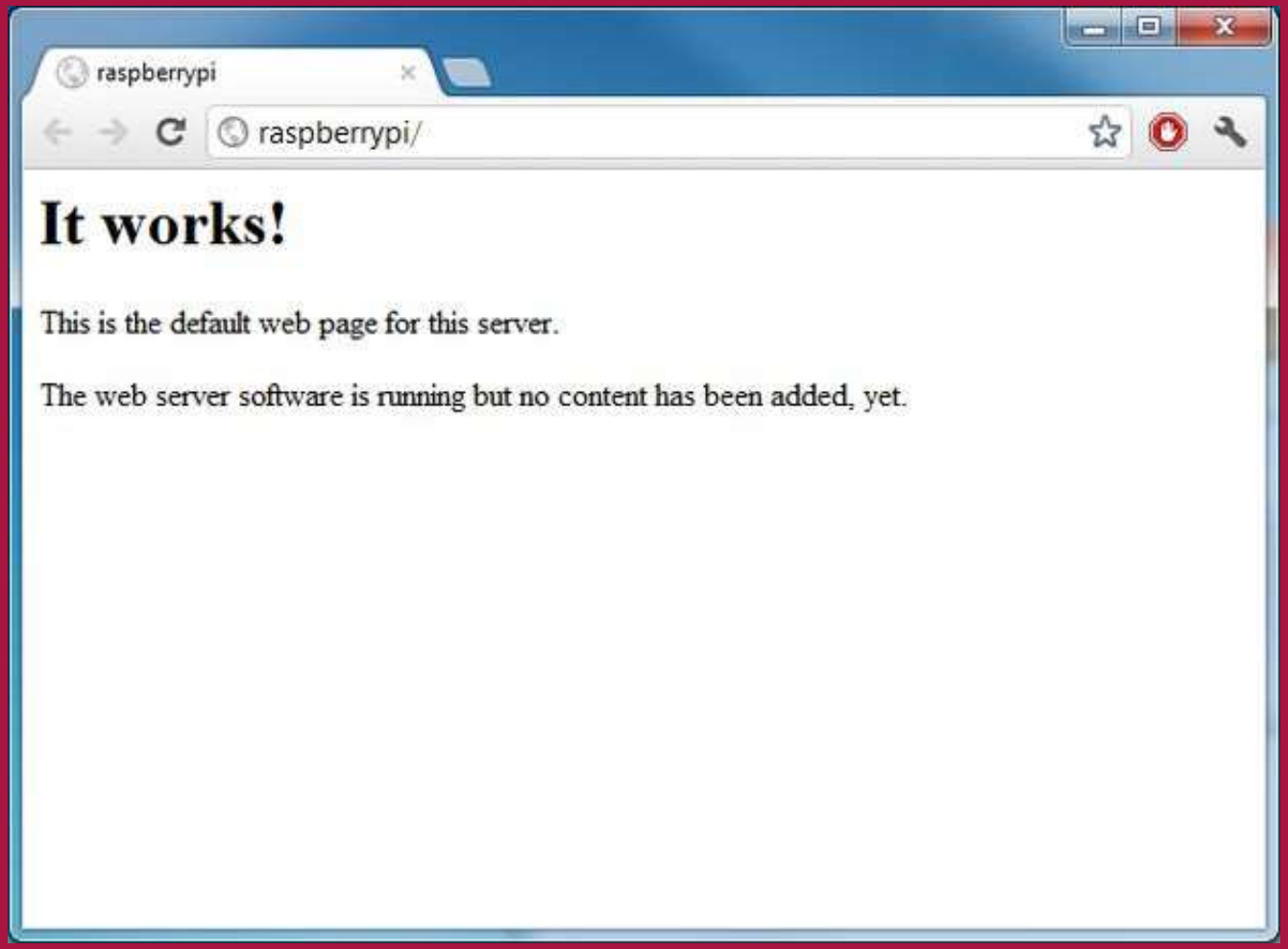
Raspberry Pi - Projects

5) **Pi as a Media Centre** : Using Open Source **XBMC**



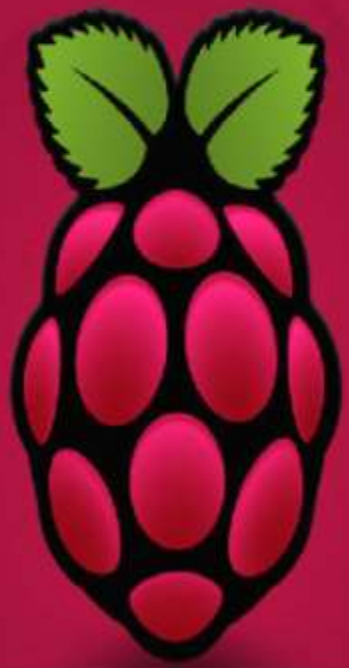
Raspberry Pi - Projects

6) Running a **Web server** on Raspberry Pi



Raspberry Pi - Projects

7) **Games** on Raspberry Pi

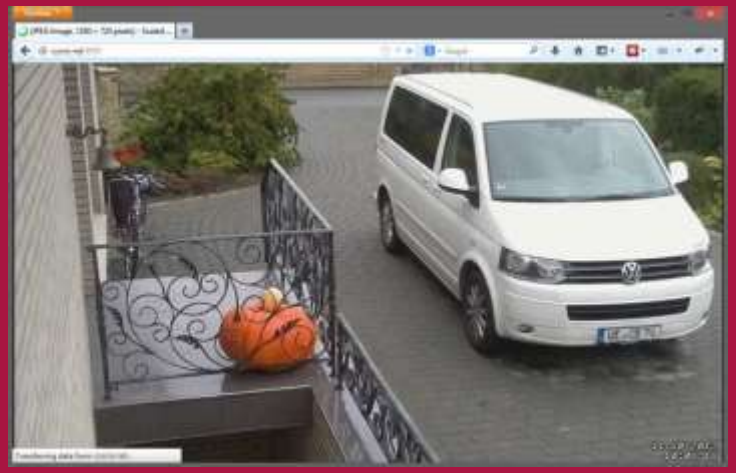


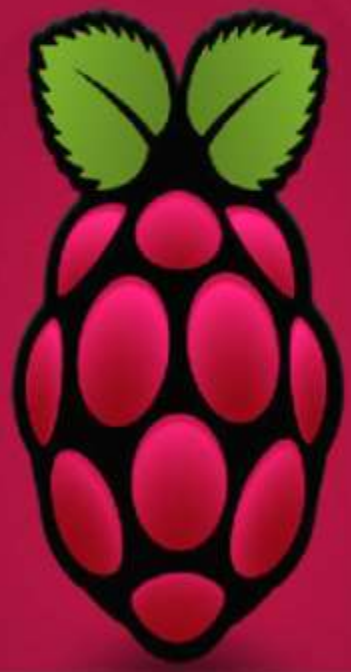
Raspberry Pi - Projects

8) **Iridis-Pi** : Supercomputer using Raspberry Pi (64 Processors, 1 TB of Memory

Raspberry Pi - Projects

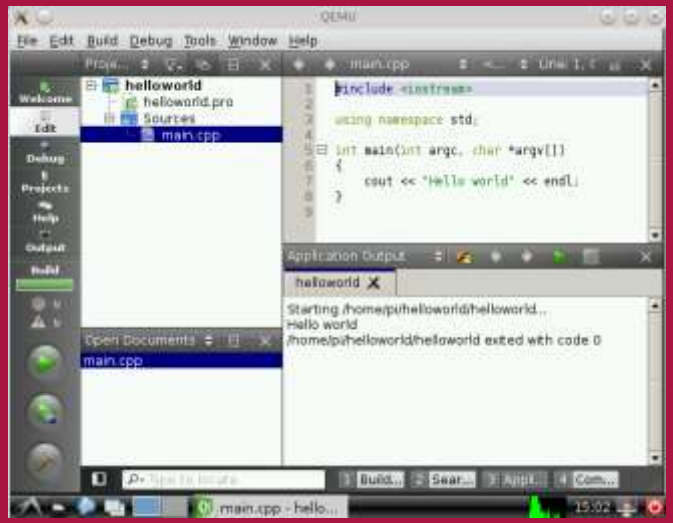
9) Low **Cost HD Surveillance Camera**

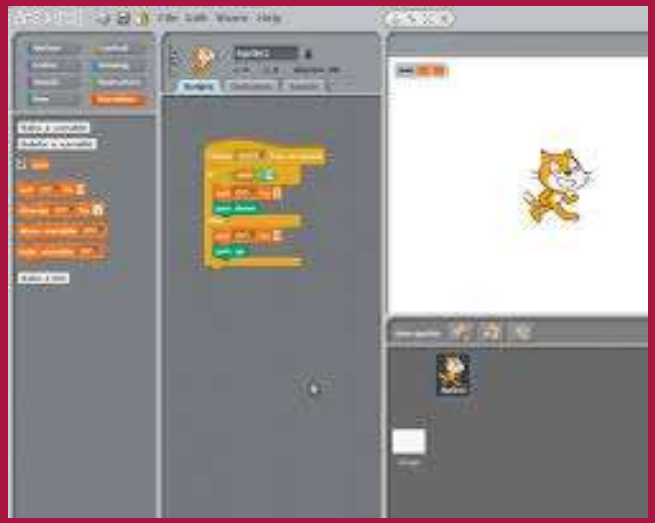


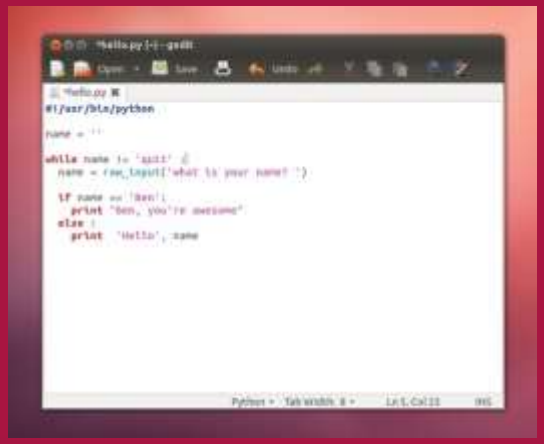


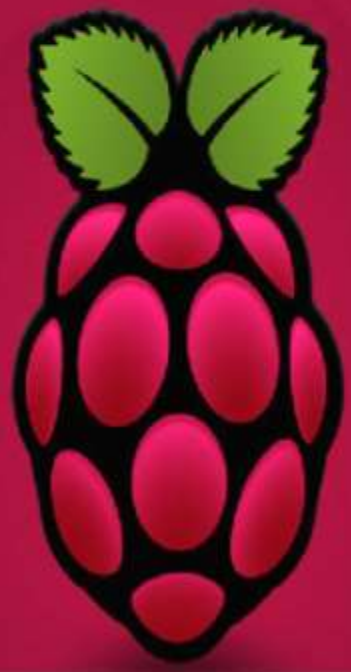
Raspberry Pi - Learning

10) **Learning Programming** : Learn Python, C/C++, Java, Ruby, Basic, etc.



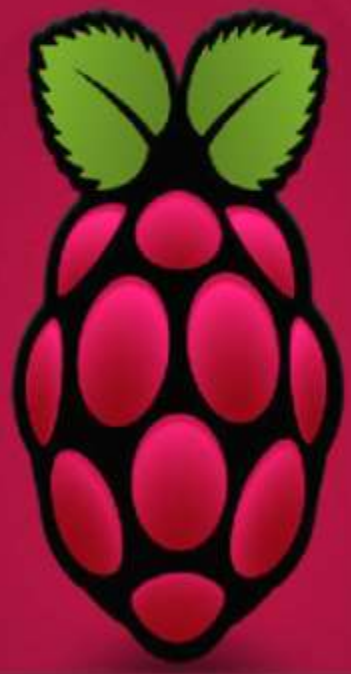




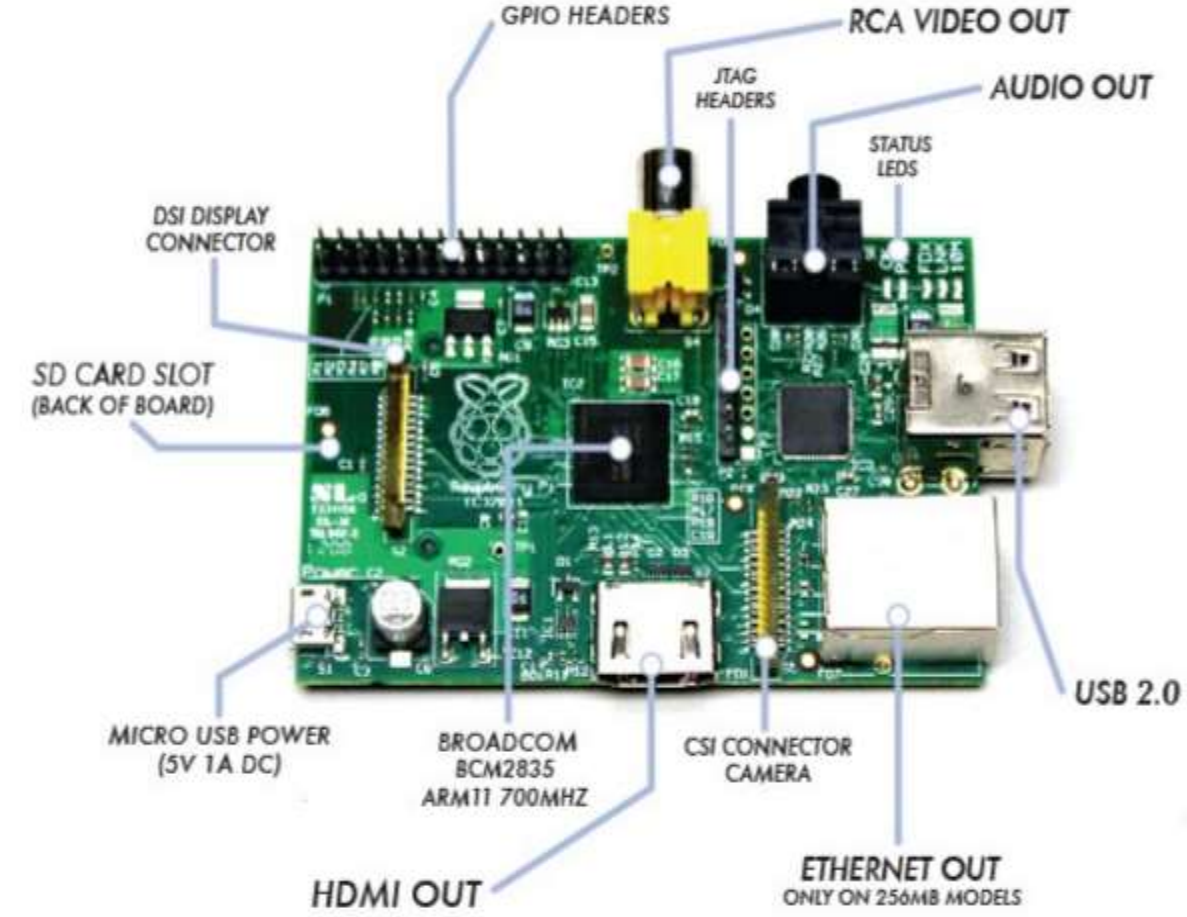


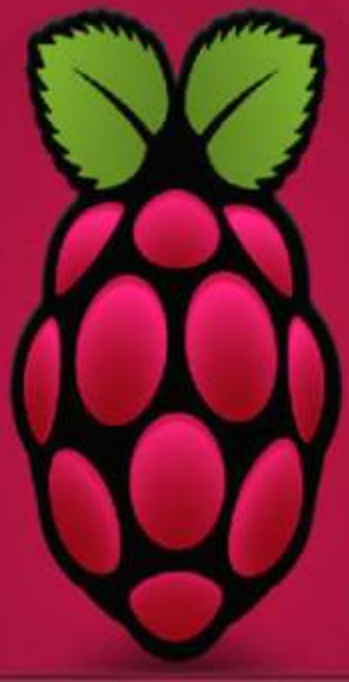
Raspberry Pi - Setup

- **Raspberry Pi :** Model A/B/B+ (recommended B+)
- **Power Source :** 5V/2A DC Micro USB Adapter
- **Display :** VGA Monitor/HDMI Screen or TV/LCD
- **SD Card : Minimum 4 GB** (8GB - Class 4 recommended)
- **USB Mouse and Keyboard**
- **Internet (If required)** : Wi-Fi Dongle/ via Ethernet
- **Audio** : 3.5 mm Stereo Input

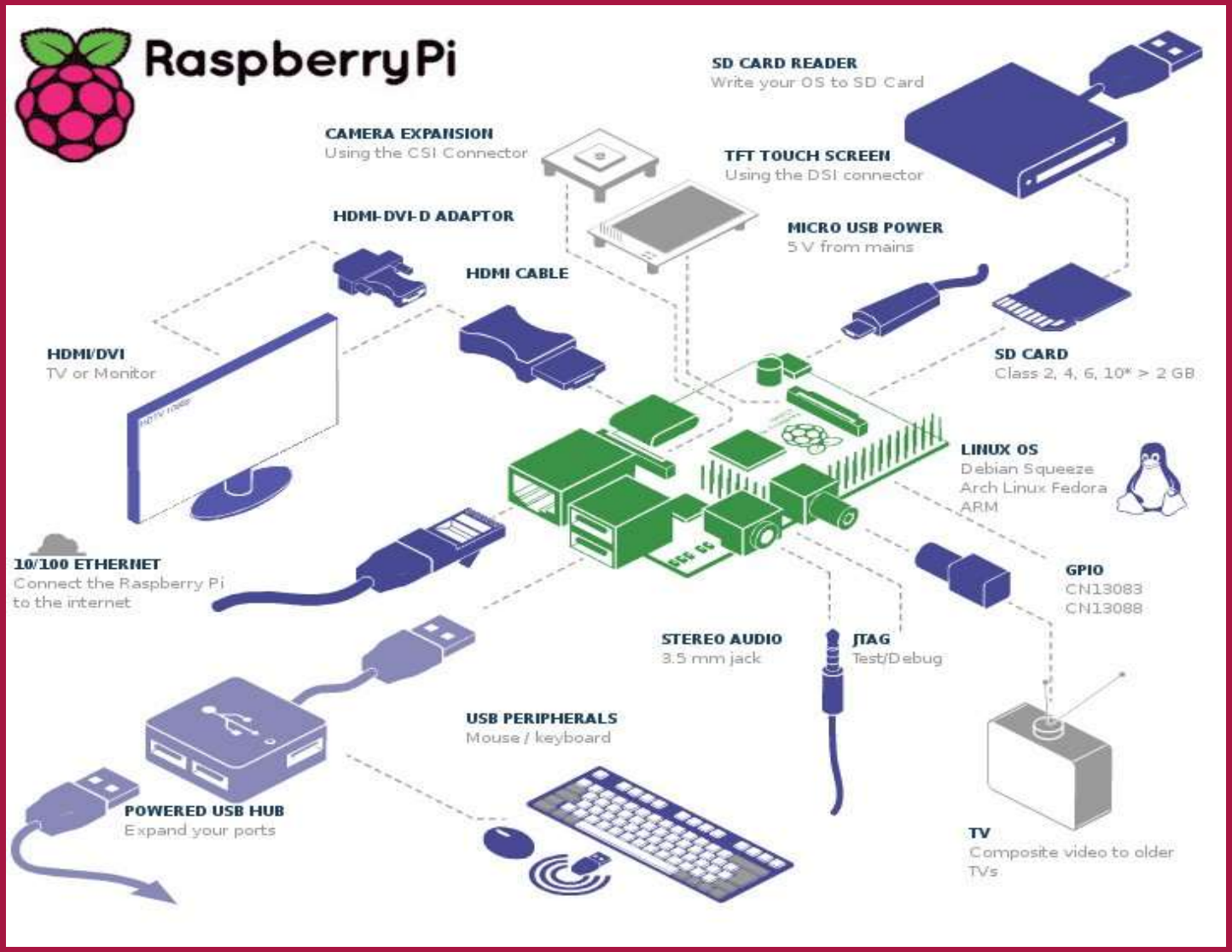


Raspberry Pi - Setup





Lets Boot it up !



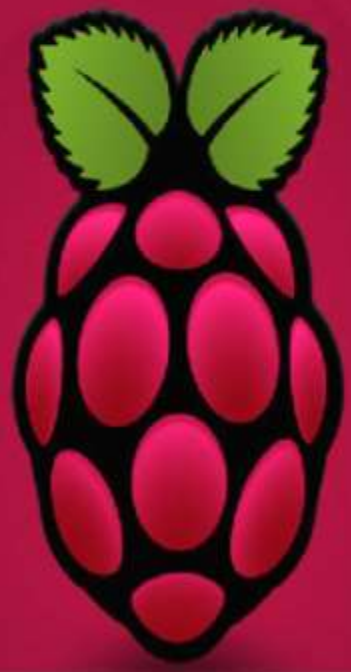
Handle with Care

- The Raspberry Pi was built to be used, but not abused. Every P.C.B. should be handled with care.

- **Handle the Pi only by the edges** of the board itself. **Avoid touching or holding** any of the components on the board.

- **Rough Handling** can cause solder points to fail and may result in **short circuits**, but be careful with the GPIO pins as well.

- While connecting Hardware, double check the connections and then power it up. Raspberry Pi GPIO's are **not 5V tolerant**.



Preparing a SD Card

- Format a SD card that is 4GB or larger as FAT.
  Use the Tool – **SDFormatter** (How ?)

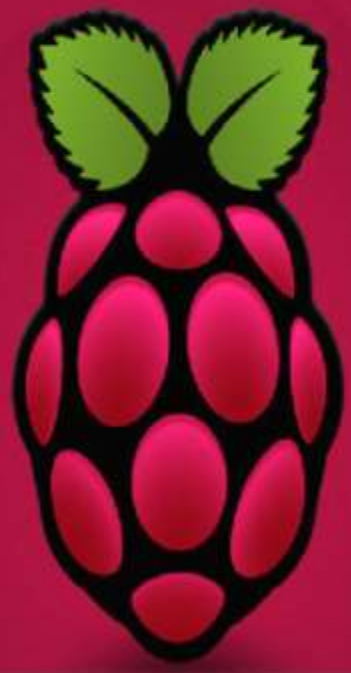
- **Download and extract** the files from the **NOOBS** zip file.

- **Copy** the extracted files onto the SD card that you just formatted so that this file is at the root directory of the SD card.

- When this process has finished, **safely remove the SD card** and insert it into your Raspberry Pi and Power it up.

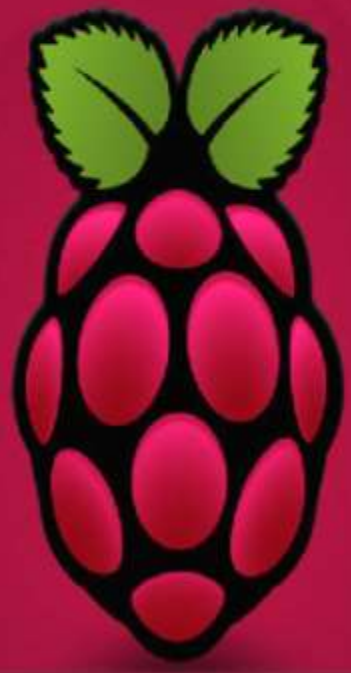
- Raspberry Pi will boot, and a window will appear with a list of **different operating systems** that you can install. We recommend that you use **Raspbian** – tick the box next to Raspbian and click on Install.

- Wait for it to finish. (15 – 20 mins)



First Boot Up

- When the install process has completed, the Raspberry Pi configuration menu (**raspi-config**) will load.
- Here you are able to set the time and date for your region and enable a Raspberry Pi camera board, or even create users.
- To enter the Graphical environment enter the Command **startx**
- Default Login ID : **pi**, Default Password : **raspberry**



Time for a Quiz !

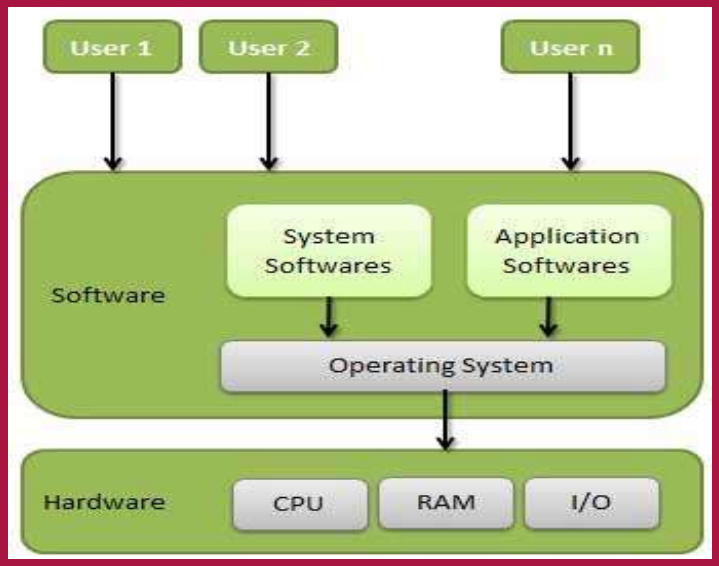
- Answer the Following Question by sending a SMS on **+91-7838079707** or **+91-9910899063**

Q1) Full name of Main **Raspberry Pi (Foundation) Founder**.

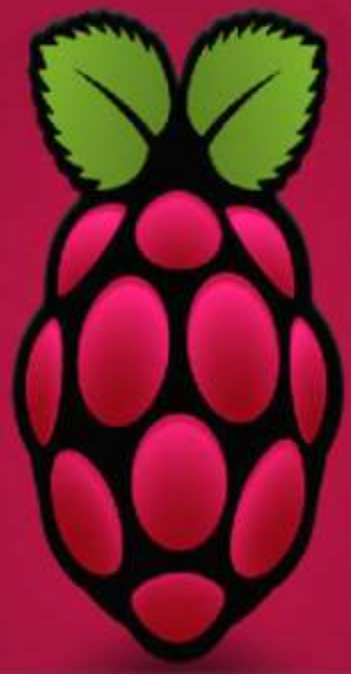
Q2) Processor in Raspberry Pi and **recommended O.S**.

The **first 2 correct answers** get a '**SWEET'** prize.

Operating System

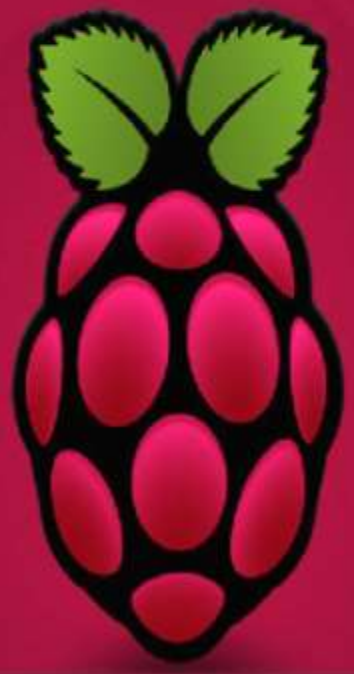


- A **System Program** that **controls** the execution of **Application Programs** and is an interface b/w Applications & Hardware.
- It manages **System Memory** and **Other resources** of the system.
- It makes computer **convenient to use** and allows system resources to be used in an efficient manner.



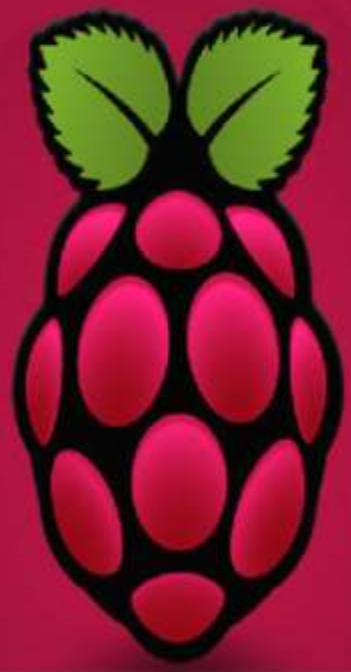
GNU/Linux

- **Raspbian** is **a free operating system** based on **Debian** optimized for the Raspberry Pi hardware.
- Debian is one of the **most popular Linux Distribution** or **Flavour or Distro**.
- **GNU/Linux** – **Free**, **Open Source**, UNIX **like Operating System** that runs on diverse computing Hardware Platforms.
- It has Ample Support for Software development, whether kernel or applications.
- **GNU** : Provides the shell, library, compilers
- **Linux** : Provides the Kernel
- Examples of **Major Free Distros** : Fedora, Ubuntu, Mandriva, Suse, etc



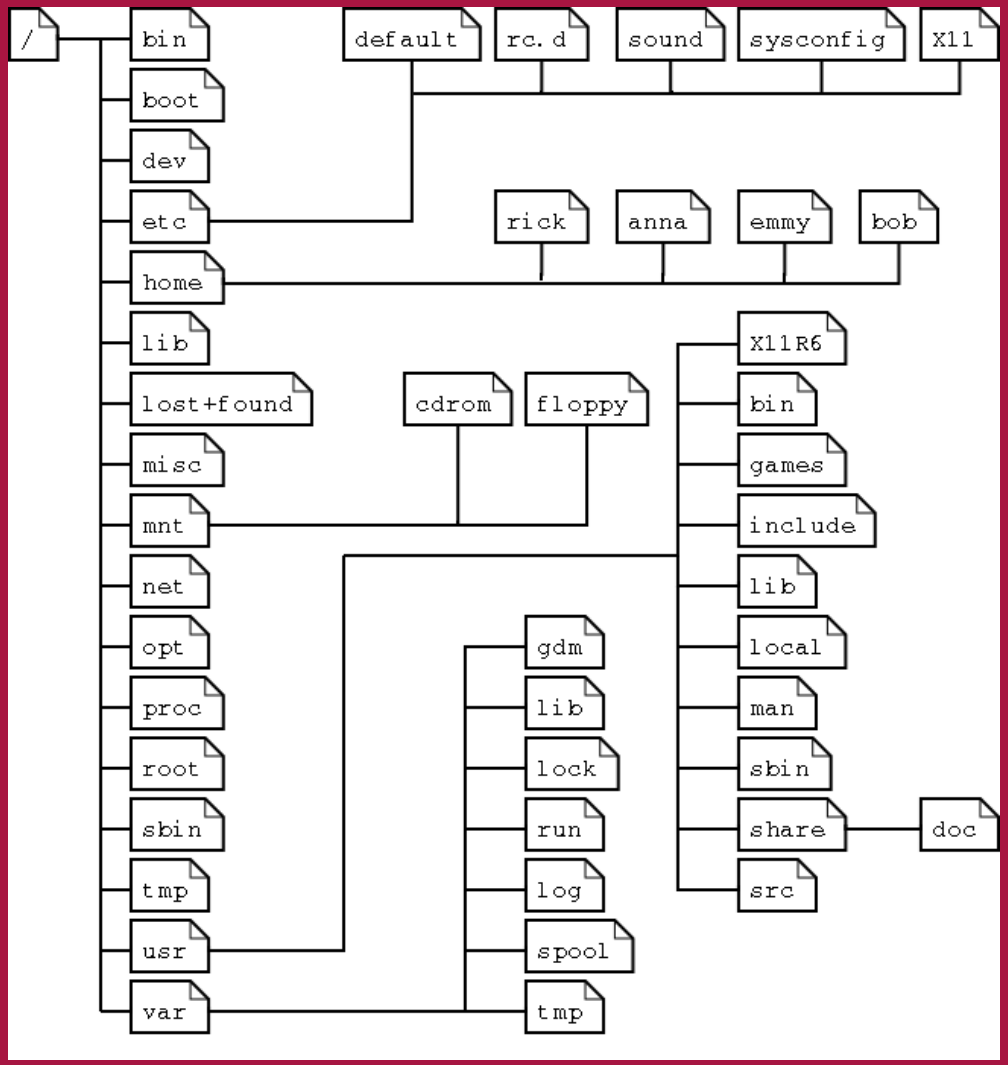
Embedded Linux

- **Linux** running on **Embedded Systems**.
- Due to its **low cost and ease of customization**, Linux has been shipped in many consumer devices.
- Even **Android** is a **Linux Based Operating System** which is the **leading OS platform** in Smartphone, Tablet Market.
- Other examples include **Set Top Boxes**, **Wireless Routers**, **smart TV's**, **Industrial Automation**, **PDA's**, etc.
- It has immense **scope** and endless **opportunities** .
- The advantages of embedded Linux are **multiple suppliers** for software, development and support; **no royalties or licensing fees**; a **stable kernel**; the ability to read, modify and redistribute the source code.



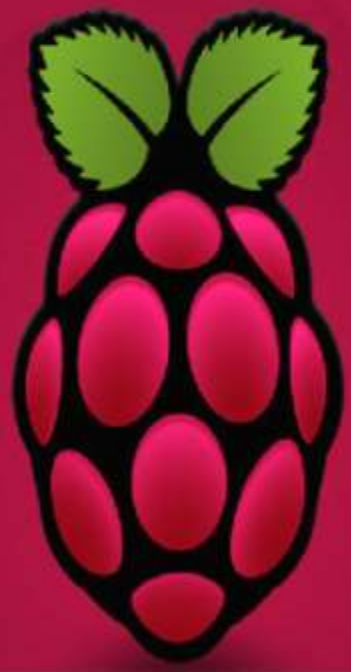
Linux File System

- The arrangement of Files in Linux.



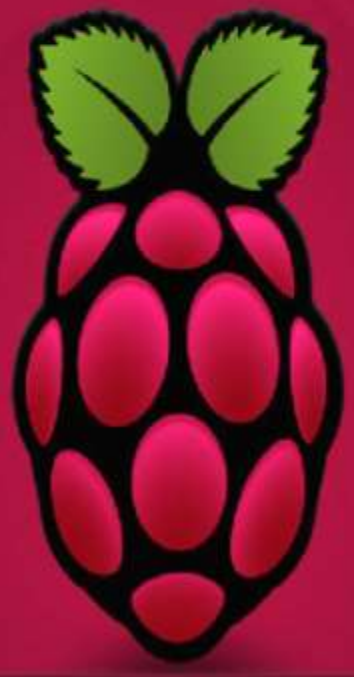
Directory Description

- bin : Essential command binaries
- boot : Static files of the boot loader
- dev : Device files
- etc : Host-specific system config
- home : User login and data folders
- lib : Essential shared libraries and kernel modules
- mnt : Mount point for mounting a file system or media
- opt : Add-on application software packages
- proc : Virtual folder that has information about system



Directory Description

- root : Home folder of the Linux super user
- sbin : Essential system binaries
- tmp : Temporary files
- usr : Secondary hierarchy
- var : Variable data



Linux Shell

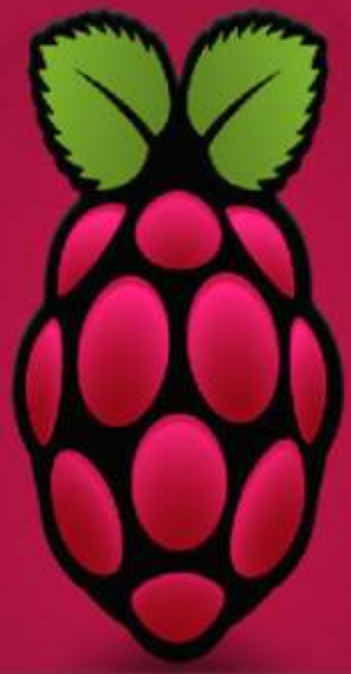
- To interact with the Operating System or Hardware we need to enter some commands in the “**Shell”**.

- Simply put, the **shell is a program** that takes your commands from the keyboard and gives them to the operating system to perform.

- In the old days, it was the only user interface available on a Unix computer.

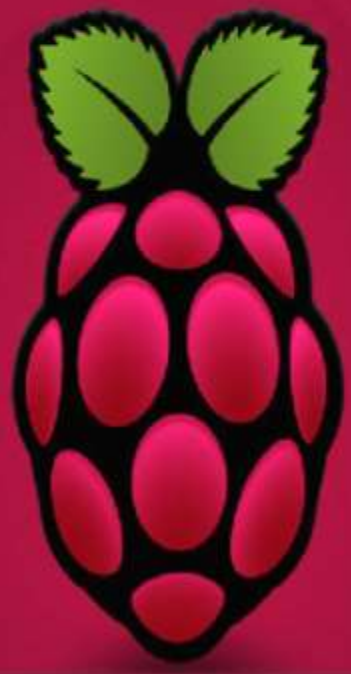
- Nowadays, we have ***graphical user interfaces (GUIs)*** in addition to ***command line interfaces (CLIs)*** such as the shell.

- In GUI, we have **"terminal emulators”** or **“consoles”** which are programs that put a window up and let us interact with the shell.



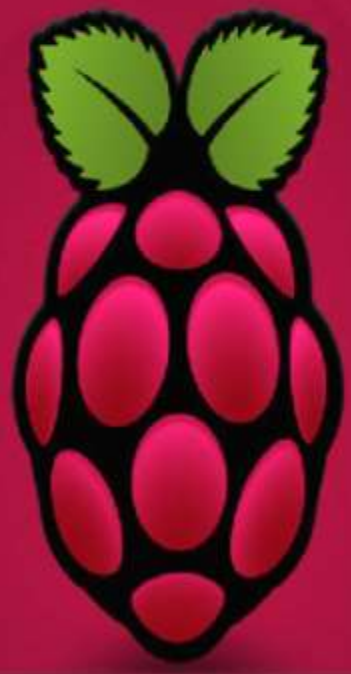
Important Commands

- **1) ls**
- "ls" command displays the list of files present in a given directory.
- **2) cd**
- "cd" or change directory command allows the user to traverse through the directories and file paths.
- **3) cp**
- "cp" command is used to copy file(s) from a source to a destination.
- 4) **mv**
- Move files from source to destination.



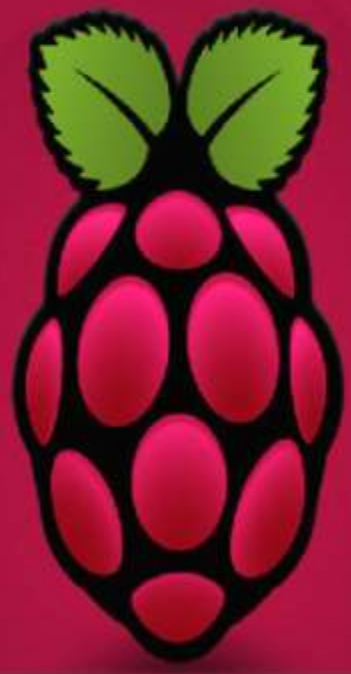
Important Commands

- **5) rm**
- "rm" command is used to remove file/files.
- **6) mkdir**
- "mkdir" command is used to make a new directory or folder in the current path.
- **7) rmdir**
- "rmdir" command is used to remove a directory or folder in the current path.
- **8) clear**
- "clear" command is used to clear the contents on the terminal window.



Important Commands

- **9) cat**
- “cat” command is used to concatenate and output the contents of the given files.
- **10) pwd**
- “pwd” command is used to check the present working directory.
- **11) sudo**
- “sudo” allows users to run programs with the security privileges of super user or root or administrator.
- **12) chmod**
- “chmod” allows users to change access modes on files.



Remote Login (ssh)

- **Secure Shell (ssh)** is a network protocol which allows **remote control of Raspberry Pi** from another computer over the network.
- Provides access to the **Command Line** and not to the Full Desktop Environment.
- You can enable or disable the **SSH server** on your Raspberry Pi (it is enabled by default).
- To **Enable SSH**, in the Terminal, enter **sudo raspi-config**, **enable** the **ssh**, finish and exit the menu.
- Use a third-party **SSH client software** on your Windows System (like **puTTy** or **TeraTerm**) and access Raspberry Pi by entering it's I.P. Address, user (pi) and password (raspberry).
- To check Raspberry Pi's I.P. Address, enter **ifconfig** in the terminal.

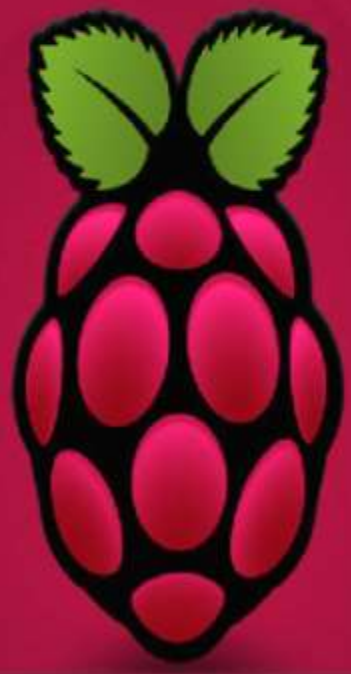
Desktop Sharing (VNC)

- VNC (**Virtual Network Computing**) is a **graphical desktop sharing system** that allows you to remotely control the desktop interface of one computer from another.

- It **transmits** the **keyboard and mouse events** from the controller, and receives updates to the screen over the network from the remote host.

- This one is **D.I.Y.** and **T.I.Y.**.

- Links on the Text file with the steps.



Programming on R.Pi

- Raspberry Pi supports several Programming Languages like : **Python, C, C++, JAVA, Perl, HTML5, JavaScript, JQuery,** etc.
- **Python** is supported as the **principal or main** user programming language.
- **Extremely powerful** and **flexible language.**
- Can also be used to **control hardware** on the Pi.
- **Demo of Python Program on IDLE.**
- **Demo of C Program on Raspberry Pi.**
- Compiled using **gcc** (GNU Compiler Collection)
- Learning Programming = Practice Writing Programs

GPIO on Raspberry Pi

- **26 GPIO** Header in Model A/B and **40 GPIO** Header in Model B
- These pins are a **physical interface** between the Pi and the outside world.
- Out of **26**, **8** are dedicated IO Lines, **2** are for UART, **4** are for SPI (+1 for Another Chip Select) , and another **2** for the I2C Interface (Total 17 out of 26)
- Rest are **Supply Rails**.
- Model B+ has **9 additional GPIO** including a extra SPI (Total 17 + 9 = 26 out of 40)
- **WiringPi** : Easy to use **C Library** for accessing the **GPIO Lines** via Programming (**Arduino Style Programming**)

Raspberry Pi
GPIO Cheat Sheet

CYNTECH COMPONENTS
ELECTRO-MECHANICAL SPECIALISTS

PIMORONI

I²C

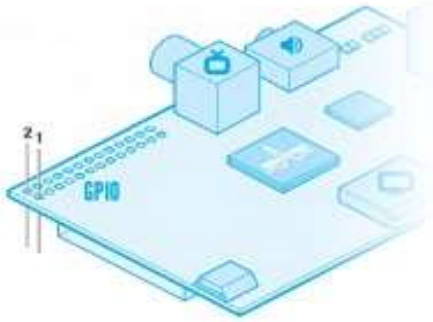
A low-speed interface used to communicate with multiple simple devices and sensors via a two-wire interface.

Inter-Integrated Circuit (I²C) is a serial bus interface which supports multiple devices and only requires two wires for communication (no separate clock or device select needed). It is, however, limited to relatively low speeds (usually 10-100kbit/s).

CLK

Clock signals are used to provide a pulse that can synchronise different parts of a system that perform actions which are time sensitive to each other.

GPCLK0 is a general purpose clock that generates a square-wave clock signal up to a maximum frequency of around 75MHz.



UART

The UART pins on the Raspberry Pi are primarily provided for access to the serial console which is a relatively advanced feature that most people won't need to use.

Universal Asynchronous Receiver/Transmitter (UART) is a method of transmitting data over a serial connection. Both of the communicating devices contains a shift register that converts the bytes of data being transmitted into a stream of bits.

PWM

Provides an 'analogue-style' supply that can be used for controlling motors and LEDs.

With PWM (pulse-width modulation) the amount of power supplied to the device is controlled by switching the supply on and off very quickly, typically thousands of times a second.

			3V3	1	2	5V0
	I²C	GPIO 2	SDA0	3	4	5V0
		GPIO 3	SCL0	5	6	GND
	CLK	GPIO 4	GPCLK0	7	8	TXD (GPIO 14) — UART
			GND	9	10	RXD (GPIO 15) — UART
		GPIO 17	P17	11	12	PWM (GPIO 18) — PWM
		GPIO 27	P27	13	14	GND
		GPIO 22	P22	15	16	P23 (GPIO 23)
			3V3	17	18	P24 (GPIO 24)
	SPI	GPIO 10	MOSI	19	20	GND
		GPIO 9	MISO	21	22	P25 (GPIO 25)
		GPIO 11	SCLK	23	24	CE0 (GPIO 8)
		GND	GND	25	26	CE1 (GPIO 7)

Original (Rev 1) Raspberry Pi users:
The original Raspberry Pi had slightly different GPIO pin numbering. GPIO 2 was GPIO 0, GPIO 3 was GPIO 1, and GPIO 27 was GPIO 21.

SPI

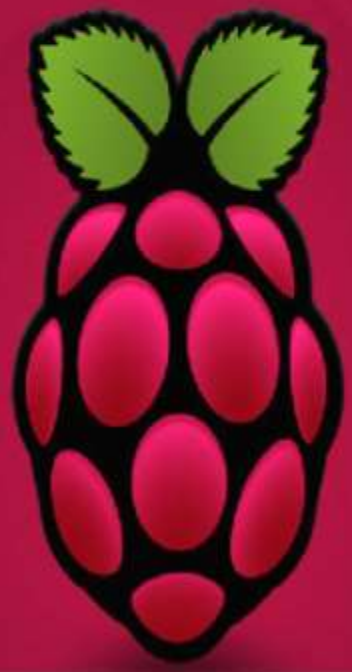
Often used to read more complicated sensors, drive simple displays, or communicate between devices.

Serial Peripheral Interface Bus (SPI) is a synchronous full-duplex (two way) serial connection. Communication happens between a master device and slave device with the master device providing synchronisation.

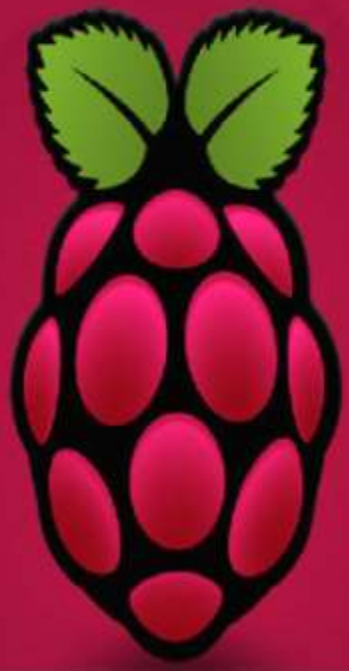
The data is transmitted on the MOSI (master-out, slave-in) and MISO pins (master-in, slave-out) pins. Each transmission is synchronised by a clock pulse on SCLK.

Let’s Do Blinky !

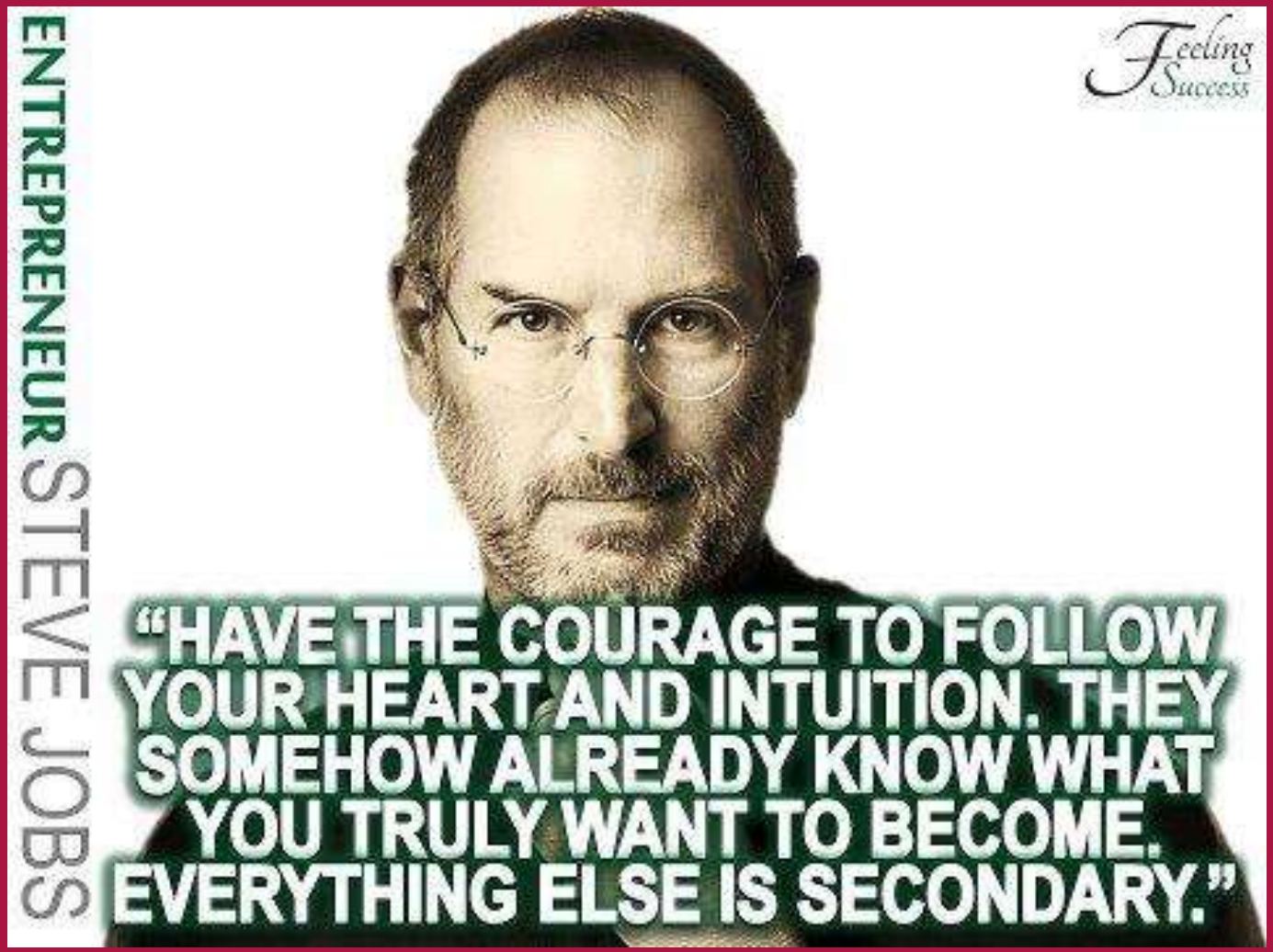
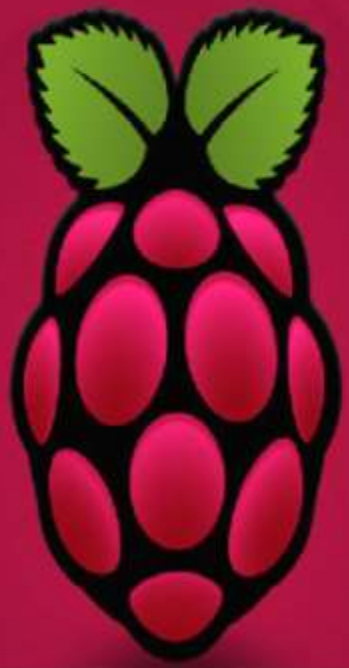
- **GPIO on Raspberry Pi are not 5V tolerant.**
- Examples.
- LED Blinky.



Questions and Doubts ?



Thank You !


ENTREPRENEUR STEVE JOBS
Feeling Success
"HAVE THE COURAGE TO FOLLOW YOUR HEART AND INTUITION. THEY SOMEHOW ALREADY KNOW WHAT YOU TRULY WANT TO BECOME. EVERYTHING ELSE IS SECONDARY."