UNIT-3:

- Introduction to Python Programming
- Introduction to Raspberry Pi
- Interfacing Raspberry Pi with basic Peripheral
- Implementation of IoT with Raspberry Pi

UNIT-3 :

* Introduction to Python Programming

→ It as a Popular Programming language.
→ Guido van Rossum developed Python.
→ It is released in 1991.
→ It as a high-level language.
→ It is interpreted language.
→ It is dynamically-typed language.

Applications

→ Web development
→ Software development.
→ Machine learning.

Features of Python

→ Simple Syntax
→ Interpreted language.
→ Cross-Platform
→ Dynamically-typed
→ Portable.
→ Opensource and free
→ Object-oriented Programming (OOPS)
→ Versatile & Multi-Purpose
→ Case Sensitive [a=10, A=5 } both are different]

1. Simple Syntax:

→ It has simple syntax.
→ easy to learn
→ easy to read & write.

2. Interpreted Language

→ Code is executed line by line.
→ So, it makes debugging easier.

3. Cross-Platform

→ Works on various Operating systems
-like windows, Linux, mac etc.

4. Dynamically-typed

→ No need to declare the variable type.
→ Python automatically detects them.

5. Portable

→ Python code can run on any system.
→ Wrote once, run anywhere.

6. Open source and free

→ We can download and use Python for free.
→ It allows to use & modify it.
→ It is freely available.

7. Object-oriented Programming (OOPs)

→ It supports OOPs concepts
-like classes & objects.

8. Versatile & Multi-Purpose:

→ We can use Python for :- Web development
- ML
- automation
- Scripting
- Data Analysis

* Introduction to Raspberry Pi

→ Raspberry Pi is a small, affordable, & powerful single-board computer.
→ It is developed by the Raspberry Pi Foundation.
→ It is widely used in projects
  -related to electronics, programming & IoT
→ It is low-cost.
→ It supports Wi-Fi, Bluetooth, USB, Ethernet & more.
→ It uses python languages.
→ But it also supports C, C++, Java & others.

Applications

→ IoT Projects
→ Robotics
→ Home automation
→ Educational Purpose

→ It is versatile & powerful.
→ It consume low power.

→ Here data forwarding & traffic.

*Introduction to Raspberry Pi

→ It is a small, affordable computer (credit card-sized)
→ It is used for learning programming
  - building electronics projects
  - & IoT development.
→ It is low-cost.
→ It is powerful.
→ It supports Linux OS
→ It has GPIO (General Purpose Input/Output) pins.
  -to connect sensors & devices
→ Great for real-time data processing in IoT.

Common Raspberry Pi Models

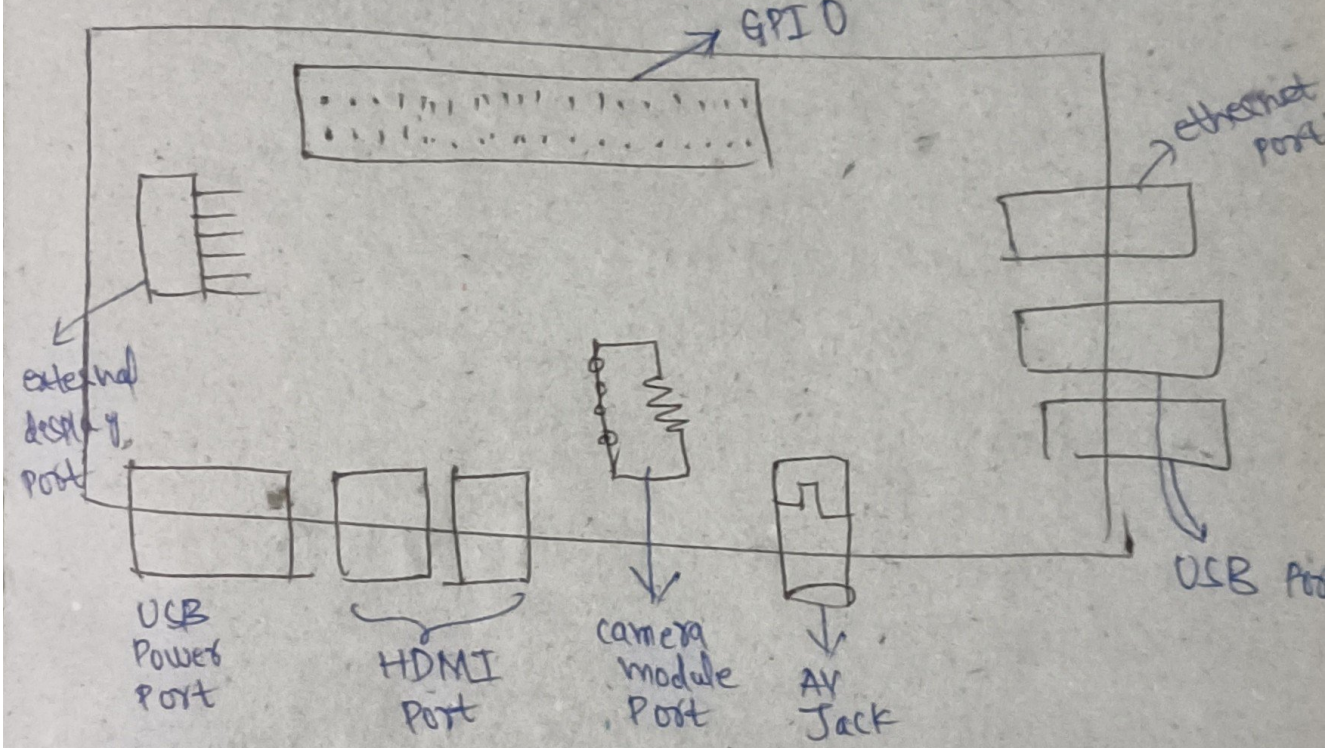
- Raspberry Pi 4 Model B (most powerful, good for multitasking)
- Raspberry Pi 3 Model B+ (Balanced for IoT projects)
- Raspberry Pi Zero (Ultra small, low-cost version)

→ It is developed by the Raspberry Pi Foundation
→ It looks like a credit-card-sized board
→ It works like a mini PC.
→ ~~It has USB ports, HDMI, audio jack, W~~
→ It has - USB ports
  - HDMI
  - audio Jack
  - Wi-Fi
  - Bluetooth
  - micro SD card slot

→ It can be Programmed using Python, C, Java, Node.js & more.

→ It is widely used in :- - IOT Projects
- Robotics
- automation
- Weather stations etc.

→ It acts as a bridge b/w physical devices (sensors) & internet in IoT systems



1. GPIO
2. Ethernet Port
3. Two USB 3.0 & Two USB 2.0 Port
4. AV Jack
5. Camera module Port
6. HDMI Port
7. USB power Port
8. external display port
9. Micro SD Card slot
10. PIN (40 PIN)

1. GPIO Pins (40 pins)

→ It contains 40 pins
→ used to connect sensors, LED's & devices

2. Ethernet Port

→ for wired internet connection
→ used to connect the Raspberry Pi to the internet.

3. USB Ports

→ For connecting keyboard, mouse, USB drives etc.
→ USB 3.0 is fastes than USB 2.0

4. AV Jack

→ Used to connect speakers
(or) older video devices

5. Camera Module Port

→ A special port
→ To connect the offical Raspberry Pi Camera

6. HDMI Port

→ used to connect a monitor or TV for display

7. External Display Port

→ used to connect the offical raspberry Pi touchscreen display.

8. MicroSD card slot

→ works like hard disk
→ Stores the OS & files

* Interfacing raspberry Pi with basic Peripherals

→ Interfacing means connecting external devices to a system
  * devices - Peripherals
  * system - Computer or Raspberry Pi
  ∴ So they can communicate & work together.

⇒ Interfacing = Making connections b/w Raspberry Pi & other devices.

Eg: Connecting an LED, sensor to raspberry Pi

Purpose of Interfacing:

→ To control external devices (like sensors, LEDs)
→ To receive input from devices (camera, button)
→ To display output (monitor, LCD, speaker)
→ To create smart systems
  like home automation, weather stations, etc.

Types of Interfacing with Raspberry Pi

1) Input Devices - Keyboard, mouse, sensors
2) Output Devices - Monitor, speaker, LEDs
3) Communication Devices - WiFi, Ethernet, USB

Basic Peripherals & their interfaces:

1. Power Supply:
- Raspberry Pi is powered using a 5V USB adapter.
- This is essential to boot the system.

2. MicroSD Card:
- It acts as the main storage.
- It contains the OS.
- It is inserted into the SD card slot.

3. Monitor:
- A monitor is connected using the HDMI Port.
- It shows the UI & terminal.

4. Keyboard and Mouse:
- Connected to the USB Ports
- Help in entering commands & controlling the Pi

5. Internet (Wi-Fi or Ethernet)
- Raspberry Pi has built-in WiFi or an ethernet port for internet access.
- This enables updates & data transfer.

6. Speakers / Headphones
- Connected via audio jack for audio output.

7. Camera Module
- A Raspberry Pi camera can be connected to the CSI (Camera Serial Interface) port.
- It is used for image & video processing.

8. Touch Display
- A touchscreen can be connected to the DSI (Display Serial Interface) Port.

9. GPIO Devices (LEDs, Buttons, Sensors)

→ the 40 GPIO Pins are used to connect electric components
- like LEDs, switches, sensors, Buttons.

10. USB Devices

→ USB devices make Raspberry Pi more powerful & user-friendly.

→ they allow the Pi to behave like a mini computer

* Implementation of IOT with Raspberry Pi

IOT ⇒ It means connecting devices to the internet to collect & share data.

→ It is a technology.

→ Devices are connected to the internet
- to collect, exchange data,

Raspberry Pi ⇒ a small computer.

→ It is powerful, low-cost computer
- for IOT projects

⇒ It is used in IOT
- to connect sensors
- & send data to the internet.

→ It means using the Raspberry Pi to create smart systems that can:
- Collect data from the environment using sensors
- Send that data
  Send to the internet or cloud
- Make decisions
  - take ~~decis~~ actions automatically.

Purpose:

→ To build smart systems
- like smart homes, health monitoring

→ To automate tasks
~~(based on real-t~~

→ To monitor & control systems

Ex: In an air quality system:
- Raspberry Pi collects pollution data from a gas sensor,
- Sends it to the cloud.
- And alerts the user on their phone.

Examples

1. Air Quality Monitoring System

- Sensor: MQ135 (Gas sensor)
- what it does: checks air pollution level
- IoT Part: Upload AQI data
- use: ~~Know whe~~ We can know air quality

2. Smart Home Automation

- Devices: Light, fan
- what it does: Turn on/off appliances remotely
- IoT Part: control using Phone via internet
- Use: - Save energy
  - control home from anywhere

3. Weather Station

- Sensors: Temperature, humidity, rain
- what it does: Collects live weather data
- IoT Part: Sends data to cloud dashboard
- Use: Useful in agriculture or education.

4. Smart Irrigation System

- Sensor: Soil moisture Sensor
- what it does: Water plants when soil is dry.
- IoT Part: Sends moisture data to cloud
- use: Saves water.
  helps farmers

5. Fitness Tracker for Players

→ Measures heart rate & movement
→ Monitors player health during games.

6. Auto Scoreboard

→ Updates scores automatically
→ Controlled using Raspberry Pi

7. Weather Monitoring for outdoor Sports

→ Raspberry Pi collects temperature, wind, rain data
→ Helps schedule matches safely.

* SDN (S/w Define N/w)

→ It is a framework

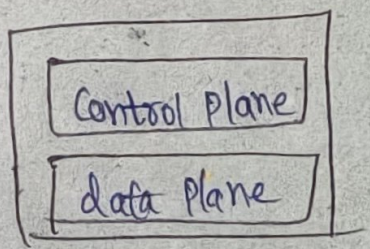
→ It allows n/w administrators

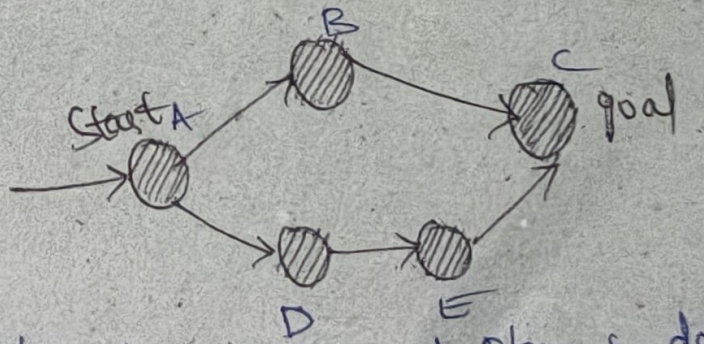
→ It is a modern to networking that seperates control pane (decision making) from the data plane (traffic forwarding) making n/w more programming & flexible.

why we need SDN

1. Virtualization : use n/w resources
2. orchestration : control & manage thousands of devices.
3. Programmable : change behaviour.
4. Dynamic Scaling : change size, quality.
5. Visibility : monitor, resource, connectivity.
6. Performance : Optimize n/w device utilization.

Traditional architecture





→ Previously routers having control plane & data plane.

→ Here data is sent to A to C

→ A router receives the data then it has to check the destination IP address & router table.

What is Raspberry Pi ?

→ Raspberry Pi is low cost, mini computer with the physical size of credit (debit card.

Difference b/w Raspberry Pi and Arduino

Raspberry Pi	Arduino
1). Raspberry Pi is microprocessor	1). Arduino is a micro controlled board
2). It needs an OS to run	2). It doesn't need any OS
3). It comes with a fully functional OS called Raspberry Pi OS	3). It doesnot have any OS.
4). Clock speed is around 1.2 GHz	4). Clock speed is around 16 MHz
5). Good for developing S/w application using python.	5). Good for interfacing sensors & controlling LEDs and motors.