Aim: Introduction to Raspberry Pi 5 Model B and its Components

Theory:

The **Raspberry Pi 5 Model B** is the latest generation of the Raspberry Pi single-board computer, offering significant performance improvements over its predecessors. It is designed for education, prototyping, automation, and IoT development.

Powered by a **quad-core Arm Cortex-A76 CPU running at 2.4 GHz**, and equipped with **VideoCore VII GPU**, it supports dual 4K displays and advanced multimedia processing. With up to **8 GB of LPDDR4X RAM**, it also includes improved I/O with PCIe 2.0 lanes, dual camera/display ports, and high-speed USB interfaces.

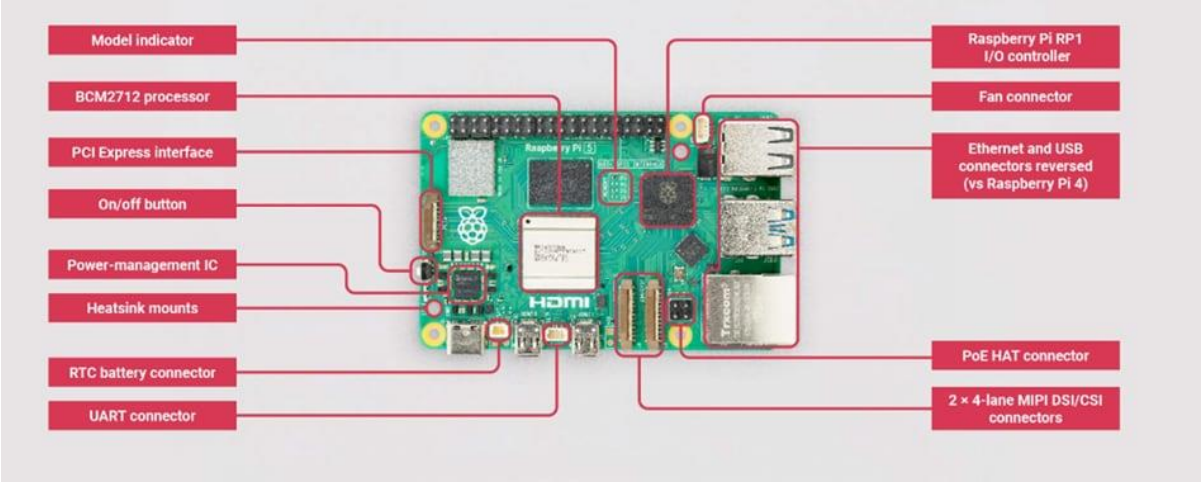
The board runs on **Linux-based Raspberry Pi OS** and supports Python, C/C++, Java, and other programming languages, making it suitable for a wide range of applications from robotics to network monitoring.

Unlike microcontrollers such as Arduino, the Raspberry Pi is a **full Linux computer**, meaning it can run a full-fledged operating system (typically **Raspberry Pi OS**, based on Debian Linux) and perform multitasking operations. It supports **HD video output**, **internet connectivity**, **storage**, and **USB peripherals**, which makes it suitable not only for embedded applications but also as a desktop replacement in certain cases.

Technical Overview:

- **Processor**:
  The CPU is a **quad-core Arm Cortex-A76** running at **2.4 GHz**. This is a major upgrade from the Cortex-A72 in Raspberry Pi 4, offering significantly better single-thread and multi-thread performance. This allows for smoother performance in tasks such as web browsing, compiling code, and video processing.
- **Graphics and Multimedia**:
  The **VideoCore VII GPU** supports dual 4K video output at 60 Hz, with **hardware-accelerated H.265 (HEVC) decoding**, making it ideal for media center applications. This enables use cases like digital signage, video editing, or even basic gaming.
- **PCIe Expansion**:
  A key new feature is the **exposed PCIe 2.0 lane**, which allows connecting high-speed peripherals like **NVMe SSDs**, AI accelerator cards, or other custom hardware

using compatible HATs or adapters. This expands the Pi's use into data-intensive applications such as edge AI and high-speed data logging.

- **Thermal Performance and Power Management**:
  Due to its higher performance, the Pi 5 generates more heat. The board includes **support for active cooling**, with dedicated fan connectors and a recommended heatsink/fan combo for stable operation. The new **RP1 Southbridge chip** manages peripheral I/O and reduces CPU load, improving thermal efficiency and system stability.
- **Real-Time Clock (RTC)**:
  Unlike previous models, Raspberry Pi 5 includes support for an RTC via a dedicated battery connector, which helps maintain timekeeping when the system is powered off — important for time-sensitive applications in automation and logging.
- **Boot and Storage Options**:
  The board supports **booting from microSD, USB, or PCIe**, allowing for fast, flexible setup.
- 

Key Concepts:

1. **Central Processing Unit (CPU):**
   a. Quad-core Arm Cortex-A76, 64-bit architecture, up to 2.4 GHz for efficient multitasking and computing.
2. **Graphics Processing Unit (GPU):**
   a. VideoCore VII with support for OpenGL ES 3.1, dual 4Kp60 HDMI output, and hardware video decoding.
3. **Memory (RAM):**

    a. Options: 4 GB or 8 GB LPDDR4X-4267 SDRAM – ideal for heavy tasks like AI and edge computing.
4. **Connectivity:**
    a. **USB Ports:** 2 × USB 3.0, 2 × USB 2.0.
    b. **Network:** Gigabit Ethernet, onboard Wi-Fi 802.11ac, Bluetooth 5.0.
    c. **PCIe 2.0 Interface:** Enables external NVMe SSDs and expansion cards.
5. **Storage:**
    a. Boot from microSD card or USB/PCIe storage.
    b. Supports UHS-I microSD for fast read/write speeds.
6. **GPIO (General Purpose Input/Output):**
    a. 40-pin GPIO header (backward-compatible), used to interface with sensors, motors, and external circuits.
7. **Display & Camera Interfaces:**
    a. 2 × MIPI connectors (1 × DSI, 1 × CSI) supporting official Raspberry Pi camera and display modules.
8. **Power Supply:**
    a. USB-C connector with 5V/5A input, providing stable power for peripherals and devices.
9. **Cooling:**
    a. Includes support for active cooling (fan headers) due to high-performance CPU and thermal management.