

IOT ASSIGNMENT

Steps of Booting a Computer

When you press the power button on a computer, a series of complex processes occur that lead to the successful startup of the system. Below is a **detailed, step-by-step explanation** of what happens

1. Power Supply Activation

- When you press the power button, it sends a signal to the **power supply unit (PSU)** to turn on.
- The PSU converts **alternating current (AC)** from the wall outlet into **direct current (DC)**, which is needed by computer components.
- The **+5V standby power** is always present in modern power supplies when the system is plugged in, which allows the power button to work.
- Once the PSU is stable, it sends a **"Power Good" signal** to the motherboard (typically after 100-500ms), allowing the boot process to continue.

2. Power-On Self-Test (POST)

- The **Basic Input/Output System (BIOS)** or **Unified Extensible Firmware Interface (UEFI)** firmware is stored on a chip on the motherboard and begins execution.
- The POST process performs hardware checks, ensuring critical components are working:
 - **CPU (Central Processing Unit)**: Ensures the processor is present and functional.

- **RAM (Random Access Memory):** Checks if memory modules are installed and functioning correctly.
 - **Keyboard & Mouse:** Verifies input devices.
 - **Storage Devices (HDD/SSD):** Detects available boot devices.
 - **Graphics Card (GPU):** Ensures a display output is available.
- If an error occurs, the system may **beep**, display an error message, or blink LED indicators (depending on the motherboard).
- If POST completes successfully, the firmware proceeds to the boot sequence.

3. BIOS/UEFI Initialization

- The BIOS/UEFI performs the following tasks:
 - Detects connected hardware (storage, USB devices, expansion cards).
 - Initializes the CPU and memory controller.
 - Checks for a bootable device based on the boot order (e.g., SSD first, then HDD, USB, or network boot).
 - If multiple operating systems are detected, a boot menu may be displayed.
- **Differences between BIOS and UEFI:**
 - **BIOS:** Uses the Master Boot Record (MBR) system, limited to 2TB boot drives.
 - **UEFI:** Uses the more advanced GUID Partition Table (GPT), allowing larger boot drives and a graphical interface.

4. Bootloader Execution

- The BIOS/UEFI locates the **bootloader** on the selected boot device.
- Common bootloaders:
 - **Windows Boot Manager (for Windows)**
 - **GRUB (for Linux-based systems)**
- The bootloader is responsible for **loading the operating system kernel** into memory.
- If multiple OSes are installed, the bootloader may present a selection menu.

5. Operating System Kernel Loading

- The **kernel** (core of the OS) is loaded into RAM.
- The OS initializes essential drivers required to interact with hardware (disk, keyboard, GPU, etc.).
- The kernel enables **multitasking**, handling multiple processes simultaneously.

6. System Initialization & Background Services

- The OS starts system processes such as:
 - **Login Manager** (e.g., Windows Login, GDM for Linux).
 - **User Interface (UI) components** such as taskbars, desktops, and icons.
 - **Background services** like network management, security services, and audio drivers.
- If there are startup programs configured, they will begin running at this stage.

7. User Login & Desktop Environment

- The system displays the **login screen**, allowing the user to enter their credentials.
- Once logged in, the OS loads:
 - User profile settings (wallpaper, icons, preferences).
 - Startup applications (e.g., antivirus, cloud storage sync).
- The computer is now fully booted and **ready for use**.

Summary of the Boot Process

Step	Description
1. Power Supply Activation	PSU turns on, stabilizes power, and sends a "Power Good" signal.
2. Power-On Self-Test (POST)	BIOS/UEFI tests CPU, RAM, and essential hardware.
3. BIOS/UEFI Initialization	Detects and configures hardware, finds bootable devices.
4. Bootloader Execution	Bootloader (Windows Boot Manager, GRUB) loads the OS kernel.
5. Kernel Loading	The OS kernel loads into RAM and starts essential system drivers.
6. System Initialization	The OS launches system services, login manager, and UI elements.
7. User Login & Desktop	The user logs in, and startup programs are executed.