

How Computer on?

Understanding How Your Computer Starts Up

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Computer Boot Process: Essential Guide

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Overview

The computer boot process transforms your computer from powered-off state to a fully operational system. This guide covers the essential steps and concepts needed to understand how computers start.

Boot Process Steps

Step 1: Firmware Initialization

When you press the power button:

- **CPU** executes the first program BIOS/UEFI
 - **BIOS** (Basic Input/Output System) - Legacy firmware (used in old computers)
 - **UEFI** (Unified Extensible Firmware Interface) - Modern firmware

Step 2: POST and Boot Device Detection

POST (Power-On Self Test):

- Tests CPU, RAM, and storage devices
- Validates hardware components

Boot Device Selection:

- Reads **Boot Order** from firmware settings
- **GPT drives**: Looks for EFI System Partition
- **MBR drives**: Checks Master Boot Record in first sector

Step 3: Bootloader Execution

Common Bootloaders:

Linux or Window bootloader, both can scan and start any OS windows or linux.

- **Linux**: GRUB2, LILO, systemd-boot - **Windows**: Windows Boot Manager

Bootloader Tasks:

- Scans partitions for installed operating systems
- Presents boot menu (if multiple OS found)
- Loads selected OS kernel into memory

Step 4: Operating System Loading

Linux OS Boot:

1. Kernel loads and initializes hardware
2. **systemd** starts (modern init system)
3. System services launch
4. User login interface appears

Windows OS Boot:

1. **NT Kernel** (`ntoskrnl.exe`) loads
2. **Hardware Abstraction Layer** initializes
3. **Registry** and system drivers load
4. **Session Manager** starts Windows subsystems
5. **Windows Logon** presents login interface

Partition Styles vs File Systems

Partition Styles

Partition styles define how a drive is divided into sections:

Feature	MBR	GPT
Max Partitions	4 primary OR 3 primary + 1 extended	128 primary
Max Storage	2 TB	18+ exabytes
Boot Support	BIOS only	BIOS + UEFI

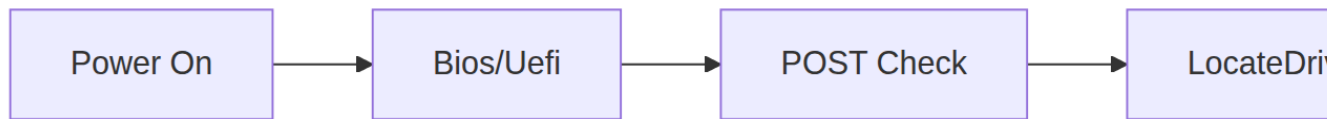
File Systems

File systems determine how data is stored within partitions:

File System	OS	Use Case
NTFS	Windows	System drives, large files
FAT32	Cross-platform	USB drives, compatibility
ext4	Linux	Linux system drives
APFS	macOS	macOS system drives

Boot Process Summary

Phase	Component	Purpose
1	Firmware (BIOS/UEFI)	Hardware initialization
2	POST	Hardware verification
3	Bootloader	OS selection and loading
4	OS Kernel	System initialization



Frequently Asked Questions

Q1: What's the difference between BIOS and UEFI?

Feature	BIOS	UEFI
Interface	Text-only	Graphical possible
Storage Support	2 TB max	No practical limit
Security	Basic	Secure Boot
Speed	Slower	Faster

Q2: What's the difference between partition style and file system?

Partition Style: Defines how the drive is divided (MBR vs GPT) **File System:** Defines how files are stored within each partition (NTFS, ext4, etc.)

Q3: Can I dual boot multiple operating systems?

Yes, by:

- Installing each OS on separate partitions
- Using a bootloader that detects all systems
- Selecting which OS to boot at startup

Resources

Video Tutorials

- [Boot Process \(English\)](#)
 - [Boot Process \(Hindi\)](#)
 - [Windows Partitions \(Hindi\)](#)
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- Boot Process (English) <https://www.youtube.com/embed/XpFsMB6FoOs>
 - Boot Process (Hindi) <https://www.youtube.com/embed/sebgrmiYdk4>
 - Windows Partitions (Hindi) <https://www.youtube.com/embed/K2NsltEIUII>

i WSL Setup

Install WSL in Windows

We will use windows powershell to install wsl.

Check WSL-2 Installed or not?

- Open PowerShell
- `wsl --version` or `wsl.exe --version`
- If any above command shows wsl version 2 , then it is already installed

If WSL 2 Not Instlled

- Search Turn Windows features on or off
- Enable Virtual Machine Platform, Windows Hypervisor Platform, Windows Subsystem for Linux
- Restart Computer (Not power on/off, click on restart)
- Install WSL [WSL-2 Setup](#)
- Switch to WSL-2 `wsl --set-default-version 2`

If already installed then Remove Previous Installed Distributions

`wsl --list --verbose`

For Each Listed distribution

- `wsl --unregister <DistributionName>`

- Open Settings → Apps → Installed apps - Find each Linux distribution, click the three-dot menu, and select Uninstall

Update WSL → Ubuntu Installation

- `wsl --update`
 - `wsl --list --online`
 - `wsl --install Ubuntu-24.04` → Install Ubuntu
 - `sudo apt update && sudo apt upgrade -y` → Update Ubuntu
- Example**

```
PS C:\Users\hrith> wsl --install Ubuntu-24.04
Downloading: Ubuntu 24.04 LTS
Installing: Ubuntu 24.04 LTS
Distribution successfully installed. It can be launched via 'wsl.exe -d Ubuntu-24.04'
Launching Ubuntu-24.04...
Provisioning the new WSL instance Ubuntu-24.04
This might take a while...
Create a default Unix user account: hrm
New password:
Retype new password:
passwd: password updated successfully
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

hrm@bitnd:/mnt/c/Users/hrith$ sudo apt update && sudo apt upgrade -y
[sudo] password for hrm:
Hit:1 http://archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://security.ubuntu.com/ubuntu noble-security InRelease [126 kB]
```

Install JavaScript Tools

- nvm install visit and run bash script <https://github.com/nvm-sh/nvm>
- node install <https://nodejs.org/en/download>
 - nvm install 22
 - nvm list nvm use 22 nvm current
 - corepack enable yarn
 - corepack enable pnpm

Check

- nvm -v
- node -v
- npm -v npx -v
- pnpm -v
- yarn -v

Install Python Tools

- 1) Python VENV
 - `python3 -m venv .venv ->` Copy error code and run `sudo apt install python3.12-venv`
- 2) PIPX
 - `sudo apt install pipx`
- 3) UV - Rust-based Python package installer
 - `pipx install uv` It will maintain isolation
- 4) LLM
 - `pipx install llm -> pipx ensurepath`
 - Configure it
 - `llm install llm-gemini` or `llm install llm-ollama`
 - `llm keys set gemini`
 - `llm -m gemini-2.0-flash 'Tell me fun facts about Mountain View'`
- 5) MiniConda
 - Download .sh <https://www.anaconda.com/download/success>
 - `bash <pathto .sh file>`
 - `conda config --set auto_activate_base false`

Install C/C++ Tools

`sudo apt install build-essential`

- `gcc ->` The C compiler
 - `g++ ->` The C++ compiler
- Check - `gcc -version`
- `g++ -version`

Install Java Tools

`sudo apt install default-jdk`

This command installs:

Java Development Kit (JDK) - Compiler, debugger, and development tools
Java Runtime Environment (JRE) - Required to run Java applications

Java Virtual Machine (JVM) - Core execution environment

- Configure JAVA_HOME Environment Variable
 - echo 'export JAVA_HOME="/usr/lib/jvm/default-java"' >> ~/.bashrc
 - ## confirm the path first using below update-alternative... command
 - restart shell
 - Install other versions of java
 - sudo apt install openjdk-17-jdk
 - Set Default Java/Javac installed version
 - sudo update-alternatives --config java
 - sudo update-alternatives --config javac
- Check
- java --version
 - javac --version
 - echo \$JAVA_HOME

Resources

Video Tutorials

- WSL-2 Setup https://www.youtube.com/embed/G4AVNkd_u0E

i Local VM Setup

In Windows

Using Type-2 Hypervisor

- Download and Install Virtual Box
 - [Link](#)
- Download .iso file of any distribution
 - e.g. [Ubuntu](#)
- Install iso file in Virtual Box
 - Click on New
 - Select Iso and fill required data...

Resources

Video Tutorials

- Virtual Box Setup (Hindi) <https://www.youtube.com/embed/4j2juiMJlhg>