

# Boot Process in Operating Systems

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# Lesson Plan

- ▶ What is Boot Process?
- ▶ Steps of Booting Process
- ▶ Why do we Need Booting?
- ▶ Linux Boot Process
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# What is Boot Process?

- ▶ Booting is the process of starting or resetting the computer when the user turns the system on. The process includes getting both the hardware and software ready and running.
- ▶ The booting process is of two types.

## 1. Cold Booting

This process happens when a computer starts up for the first time or when it is shutdown, and the power button is pressed to start the system. The operating system is automatically loaded into the system during cold booting in the computer when the machine reads all the BIOS (ROM) instructions. Compared to hot or warm booting, cold booting takes longer.

# What is Boot Process? Cont.

## 2. Warm Booting

Warm booting is the technique of restarting an already on system without completely turning it off. In this process, the user restarts the system via the operating system.

Computer systems can restart when they hang or reach a state of no response. An alternative term for it is rebooting.

The system must be restarted to apply software or hardware configuration changes, after installing new software or hardware. Otherwise, it may perform incorrectly or respond incorrectly.

# Steps of Booting Process

## ► Step 1: BIOS is Loaded

The first step involves turning on the power. It powers the essential parts, including the processor and BIOS, with electricity.

## ► Step 2: BIOS: Power on Self-Test

This is the first test run by the BIOS. Additionally, this test runs a preliminary examination of the computer's main memory, disk drives, input/output devices, etc. Moreover, the system emits a beep sound in case of any errors.

# Steps of Booting Process Cont.

## ► Step 3: Loading of OS

The bootable sequence stored in the CMOS (Common Metal Oxide Semiconductor) is read by BIOS following the successful completion of POST. Based on the bootable sequence, it will look for the Master Boot Record (MBR) on bootable devices such as USB, CD-ROM, and hard disk.

A message saying "No Boot Device Found" will be displayed, and the system will crash if MBR is not found in any of them. If MBR is discovered, the BIOS will launch a unique application software called the **Bootloader**, which will ultimately launch the operating system.

# Steps of Booting Process Cont.

## ► Step 4: System Configuration

Device drivers are put into the memory after the OS is loaded to ensure the proper operation of all devices.

## ► Step 5: Loading System Utilities

In this step, system utilities like antivirus and volume control are loaded into the memory.

# Steps of Booting Process Cont.

## ► Step 6: User Authentication

The system will prompt the user to input their credentials if any user authentication is configured. Once the system has received valid credentials, it will typically launch the GUI Shell or the CLI Shell.



# Why do we Need Booting?

- ▶ The booting prevents leaks of memory in the system.
- ▶ It checks for updates and installs them.
- ▶ RAM is flushed during the process.
- ▶ Makes small corrections to errors in the program.

# Linux Boot Process

- ▶ The process flow starts with the BIOS, which searches for active and bootable devices. The system boots Linux from the hard disk, in which the MBR contains the primary bootloader.
- ▶ The Linux Boot Process consists of three stages.
  1. The BIOS Stage
  2. The Bootloader Stage
  3. Kernel Stage

# Linux Boot Process Cont.

## The BIOS Stage

- ▶ This is the first stage of the Linux boot process.
- ▶ It initialises the system hardware during the booting process.
- ▶ The BIOS retrieves the information, stored in the CMOS chip (Complementary Metal-Oxide Semiconductor) which is a battery-operated memory chip on the motherboard that contains information about the system's hardware configuration.
- ▶ BIOS performs a Power-On Self-Test (POST) to make sure that all the hardware components of the system are working.

# Linux Boot Process Cont.

## The BIOS Stage Cont.

- ▶ Once BIOS confirms that everything is fine, it starts searching for the drive or disk which contains the operating system in a standard sequence.
- ▶ If the first listed device is not available or not working, then it checks for the next one and so on.
- ▶ A drive can be bootable only if it has the Master Boot Record in its first sector known as the boot sector. The system's hard disk acts as the primary boot disk and the optical drive works as the secondary boot disk for booting the operating system from the removable disk if in case the main hard disk fails.

# Linux Boot Process Cont.

## The Bootloader Stage

- ▶ The bootloader stage includes the task of loading the Linux kernel and optional **initial RAMdisk**. The kernel will help enable the CPU to access RAM and the disk.
- ▶ The second precursor software is an image of a temporary virtual file system called the **initrd** image or **initial RAMdisk**. Now, the system prepares to deploy the actual root file system. It then detects the device that contains the file system and loads the necessary modules.
- ▶ The last step of the bootloader stage is to load the kernel into the memory.

# Linux Boot Process Cont.

## Kernel Stage

- ▶ Once the control shifts from the bootloader stage to the Kernel stage, the virtual root file system created by the **initrd** image executes the **Linuxrc** program. This program generates the real file system for the kernel and later removes the **initrd** image.
- ▶ The kernel then searches for new hardware and loads any suitable device drivers found.
- ▶ It then mounts the actual root file system and then performs the **init** process. The **init** reads the file “**/etc/inittab**” and uses this file to load the rest of the system daemons. This prepares the system, and the user can log in and start using it.

# Linux Boot Process Cont.

## Kernel Stage Cont.

- The typical bootloaders for Linux are **LILO** (Linux Loader) and **GRUB** (Grand Unified Bootloader). These bootloaders allow the user to select which OS kernel to load during boot time.

# Dual Booting

- ▶ Dual booting of an operating system is the installation of two operating systems on a single computer.
- ▶ Numerous operating systems can be installed on such a machine. To choose which operating system to boot, a bootloader familiar with various file systems and operating systems can occupy the boot space.
- ▶ Once it has been loaded, one of the operating systems on the disk can be booted. On the disk, there may be several partitions, each of which houses a different operating system.
- ▶ When a computer system boots into the operating system, a boot manager program displays a menu so the user can choose the operating system to use.<sup>16</sup>



# Q&A

- ▶ Time for your questions and queries ...

# Thank you!