How operating system boots up ?

Step - 1 : Power ON

(ON) → Power supply

↑ electricity going to power supply & this provides power to other components of computer system

Step - 2 : CPU loads BIOS or UEFI

BIOS → Basic input output system

UEFI → Unified extensible firmware interface

↑ advance than BIOS

→ CPU initializes itself and looks for a firmware program (BIOS) stored in BIOS chip (BIOS chip is a ROM chip found on mother board, that allows to access & setup computer system at most basic level.)

- In modern PCs, CPU loads UEFI

Step-3: BIOS or UEFI run tests & initialize hardware.

3.1) Loads some settings from a memory area.

↓

Backed by CMOS (Complementary Metal Oxide Semiconductor) battery.

3.2) Program loads with settings

POST => Power ON Self Test

→ CPU runs the BIOS which tests and initializes system hardware. BIOS loads configuration settings. If something is not appropriate (like missing RAM) error is thrown and boot process is stopped.

This is called POST process.

UEFI can do a lot more than just initialize hardware, it's really a tiny OS. For example Intel CPUs have the Intel Management Engine. This provides a variety of features including powering Intel's Active Management Technology which allows for remote management of business PCs.

Step-4: BIOS or UEFI hands off to Boot device.

Boot devices → disk (HDD or SSD)
→ CD
→ USB device

Boot loader: Program execute → ON actual OS

(1) MBR → Master Boot Record
↳ stored on 0th index of disk
⇑
used in old system
(BIOS uses this)

UEFI uses EFI
↳ extensible firmware interface
⇑
partition in disk where boot loader is stored

→ BIOS will handoff responsibility for booting your PC to your OS's bootloader.

(i) BIOS looked at the MBR, a special boot sector at the beginning of a disk. The MBR contains code that loads the rest of the OS known as a bootloader.

(ii) BIOS executes the bootloader which takes it from there and begins booting the actual OS

Step-5: Boot loader loads the full OS.

Boot loader is a program that initializes actual OS.

→ The bootloader is a small program that has the large task of booting the rest of OS (boots Kernel then User space).

Windows : Windows Boot Manager (Bootmgr.exe)

Linux : GRUB

Macs : boot.efi

In short or to sum it up.

(i) Power ON

→ When you press the power button, electricity flows to the motherboard and components.

(ii) POST (Power ON self Test)

→ The BIOS or UEFI firmware performs POST.
↳ Examples of Bootstrap loader

→ It checks the basic hardware to ensure they are working properly

→ If a problem is found an error beep or message is shown.

(iii) BIOS / UEFI execution

→ The BIOS/UEFI looks for a bootable device (eg: hard disk, CD, etc.)

→ It check the boot order to find the device with the OS.
↳ Example first looks in hard disk then CD then USB device

(iv) MBR loading

→ On the selected bootable device MBR is read to find the bootloader location. {might contain bootloader in MBR or might contain it's address}

(v) Bootloader executing

→ The bootloader loads the OS's kernel into memory.

(vi) Kernel initialization

→ The OS kernel starts.

→ It sets up system drivers, memory management and starts system services.

Types of Booting

- Cold boot (Hard boot)

→ Powering on from off state.

- Warm boot (Soft boot)

→ Restarting the system without turning off the power.