

## What is a kernel?

The Linux kernel is the core component of the Linux operating system that acts as a bridge between the hardware and the software applications running on the system. It performs the following functions:

- **Process Management:** When a user requests to open a file or an application, the request is sent to the kernel. The kernel will open a new process (instance) and assigns the necessary CPU resources.
- **Memory Management:** The kernel allocates the RAM for the application to run or the space for text editor to open.
- **File System Management:** The kernel communicates with the file system and loads the file from hard disk to RAM
- **Saving the file:** The kernel ensures that the data is written to the disk properly.

## Types of Kernel

**Monolithic Kernel:** Type of OS kernel where all the core service like process management, memory management, file management, device drivers, networking, security and GUI runs in the same address space.

Advantages:

- **High Performance:** Since every component is in the same kernel space, communication between components become faster.
- **Direct Access to hardware:** All the components can access the hardware directly making execution of a task quicker

Disadvantages:

- **Less Stable:** A crash in one part of the kernel can crash the entire system
- **Harder to modify:** Changing one part may require modifying the complete kernel.

## Microkernel

It is a type of OS kernel where only the most essential functions are included in the kernel such as process management and memory management everything else such as file system, device drivers runs outside the kernel in user address space.

Key feature: A lightweight kernel that includes only the essential services

Advantages

- **Stability:** Since many components run in user address space. Fault in these components don't crash the system

- Easier Management: As the components are isolated. it is easier to add or update feature

#### Disadvantage

- The communication between the kernel and user address space involves message passing which can slow down the system.

#### **Hybrid Kernel:**

This kernel is blend of mono and micro kernel which allows both critical and non-critical tasks.

Stability: Provides better stability as the user space services are isolated and are separate. Something wrong in user space does not crash the system.

Flexibility: User Space components can be updated or replaced without effecting the main kernel.

## Finding Linux Kernel Information

Commands that can be used to find the Linux kernel information:

- `uname`
- `proc/version`
- `dmesg` (diagnostic message)

**uname:** It is used to display the system information such as operating system, kernel release, kernel version, build date.

**uname -a:** Command used to display the full information about the kernel

- Kernel name: `Linux`
- hostname: `localhost`
- kernel version: `4.15.0-00049-ga3b1e7a-dirty`
- Build Version: `#11`
- Build date and time: `Thu Nov 8 20:30:26 CET 2018`
- OS Name: `GNU/Linux`

**uname -o:** Command to display the OS name

- `GNU/Linux`

**uname -r:** Command to display the kernel release information

- `4.15.0-00049-ga3b1e7a-dirty`

**uname -v:** Command to display the kernel build version including date and time.

- `#11 Thu Nov 8 20:30:26 CET 2018`

**cat /proc/version:** The command `cat /proc/version` is used to display information about the Linux kernel and the version of the system.

**dmesg | grep Linux:** This command is used to filter and display kernel messages from the `dmesg` output that contain the word "Linux." Since `dmesg` displays various system messages, this command helps to locate specific messages related to the Linux kernel.

**Process Status (ps):** Command to list all the processes in the current shell.

- it displays the process ID (PID)
  - it displays the terminal from which the process is started (TTY)
  - it displays the amount of CPU time used (Time)
  - it displays the command that started the process (CMD)
- a. **f: Full format:** Provides details such as the user who started the process the parent process ID and command used to start the process
  - b. **e: every process:** Display all the processes running on the system
  - c. **p:** displays the details about a specific process ID

**ps -ef:** command used to display a list of all currently running process on the system with detailed information:

**ps -fp 42:** The command `ps -fp 42` in Linux operating systems is used to display information about a specific process, with 42 being the Process ID (PID)

**pgrep:** The `pgrep` command is used to search for process by their name and return their process ID

Search for process by their name and return their process ID for a specific user

**pgrep -u root sh**

**Top:** This command is used to display the real-time information about system resources usage including CPU memory and processor.

**top**

Command to display the real-time information about system resources usage including CPU memory and processor for a specific user:

**top -u root**

**renice:** This command is used to set or change the priority of a running process

**Nice Value Range:**

The nice value ranges from -20 to 19:

- -20: Highest priority (process gets the most CPU time).
- 0: Default priority (normal priority).
- 19: Lowest priority (process gets the least CPU time).

Lower nice value (-20 to 0): Higher priority (process gets more CPU time)

Higher nice value (0 to 19): Lower priority (process gets less CPU time)

Write down a command to change the nice value of a process with PID 47 to 19

**renice -n 19 -p 47**

- renice: modifies the priority (nice value) of a process
- -n 19: set the nice value to 19 which lowers the process priority
- -p 47: specifies the process ID

**kill:** This command is used to terminate a process.