

Linux

- Linux is an open-source clone of UNIX, the most secure and mature operating system.
- The major difference between Linux and UNIX is that UNIX is trademarked to The Open Group, while Linux is Open source.
- All command line tools work the same on both.
- Over 90% of the supercomputers in the world run Linux. And the 10 fastest run Linux.
- Linux is the leading operating system on Servers.

Benefits of Linux

- Low cost and very stable (some Linux servers are not rebooted for over a year, try that with Windows server!).
- Best multi-user, multitasking OS.
- Most secure OS. Hence, it's popularity as a server OS.
- Best computing power and inbuilt network support
- Fastest developing OS, with the greatest number of developers.

Linux Distributions

- A Linux distribution consists of the Linux kernel (actual OS) and a collection of applications.
 - Linux Kernel
 - X Window System
 - Graphical Desktops (GNOME, KDE...)
 - Applications
- GNU Software is at the heart of every Linux. Besides the Linux Kernel, GNU software/utilities come next.
- GNOME and KDE are the most popular graphical.

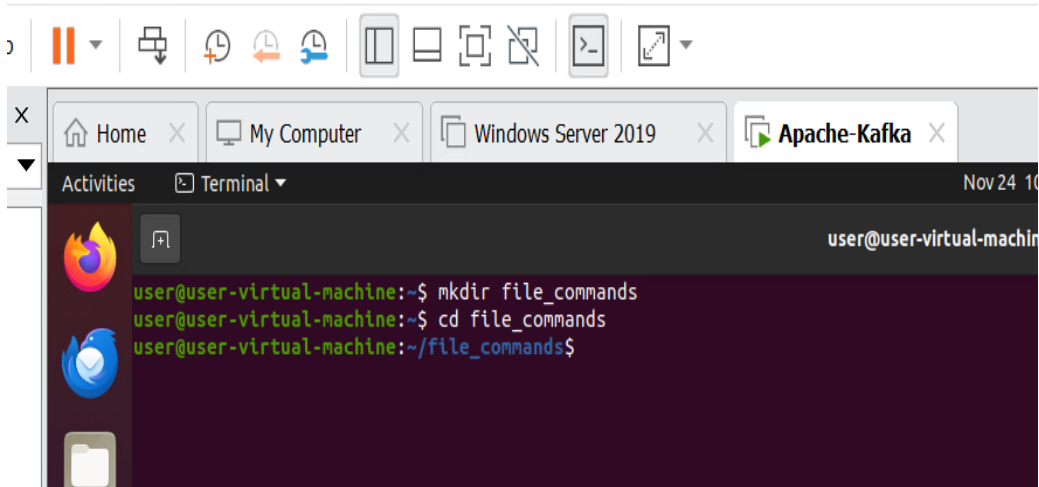
Linux Desktops

- The most common Desktops are GNOME and KDE (just cosmetic differences and default programs)
- Popular GNOME distros are Ubuntu & Fedora
- Popular KDE distros are Kubuntu & OpenSUSE
- Opening the Terminal Windows and 6 Virtual Consoles
- Navigating the Linux File System
- Linux Applications

File_commands:

- `mkdir directory_name`: to create a new directory.
- `ls`: list all files.
- `ls -l`: long list with details.
- `ls -a`: shows hidden files.
- `ls -r`: reverse order.
- `ls -h`: human readable.
- `ls -t`: sort by modification time.
- `rm -r directory_name`: remove directory.
- `rm -rf directory_name`: remove directory forcefully.

tation



```

user@user-virtual-machine:~/nithin/file_commands$ ls
basics
user@user-virtual-machine:~/nithin/file_commands$ ls -l
total 4
-rw-rw-r-- 1 user user 249 Nov  1 00:42 basics
user@user-virtual-machine:~/nithin/file_commands$ ls -a
.  ..  basics
user@user-virtual-machine:~/nithin/file_commands$ ls -r
basics
user@user-virtual-machine:~/nithin/file_commands$ ls -h
basics
user@user-virtual-machine:~/nithin/file_commands$ ls -t
basics
user@user-virtual-machine:~/nithin/file_commands$

```

```

user@user-virtual-machine:~/nithin$ ls
disk_usage  file_commands  hardware  process_realeated  systems  users
user@user-virtual-machine:~/nithin$ rm -r systems
user@user-virtual-machine:~/nithin$ ls
disk_usage  file_commands  hardware  process_realeated  users
user@user-virtual-machine:~/nithin$ rm -rf users
user@user-virtual-machine:~/nithin$ ls
disk_usage  file_commands  hardware  process_realeated
user@user-virtual-machine:~/nithin$

```

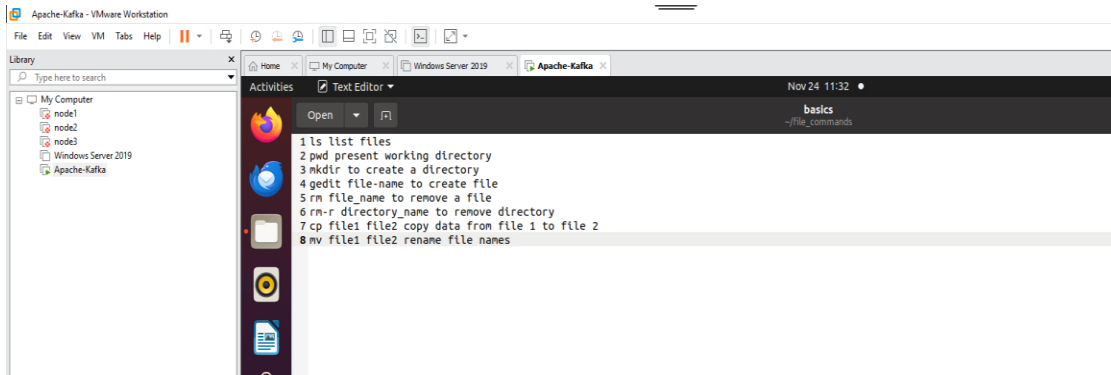
Some more basic commands in Linux:

- pwd: present working directory(displays present directory)
- gedit file_name: create a file.
- touch file_name: create a file.
- rm file_name: removes a file.
- rm -f file_name: force full removes a file.
- rm -i file_name: asks for conformation.

```

user@user-virtual-machine:~/nithin/file_commands$ pwd
/home/user/nithin/file_commands
user@user-virtual-machine:~/nithin/file_commands$ pwd
/home/user/nithin/file_commands
user@user-virtual-machine:~/nithin/file_commands$ gedit basics
user@user-virtual-machine:~/nithin/file_commands$ ls
basics
user@user-virtual-machine:~/nithin/file_commands$ touch basics2
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  basics2
user@user-virtual-machine:~/nithin/file_commands$ rm basics2
user@user-virtual-machine:~/nithin/file_commands$ ls
basics
user@user-virtual-machine:~/nithin/file_commands$

```



```

user@user-virtual-machine:~/nithin/file_commands$ touch file1
user@user-virtual-machine:~/nithin/file_commands$ touch file2
user@user-virtual-machine:~/nithin/file_commands$ touch file3
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  file1  file2  file3
user@user-virtual-machine:~/nithin/file_commands$ rm file1
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  file2  file3
user@user-virtual-machine:~/nithin/file_commands$ rm -f file2
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  file3
user@user-virtual-machine:~/nithin/file_commands$ rm -i file2
rm: cannot remove 'file2': No such file or directory
user@user-virtual-machine:~/nithin/file_commands$ rm -i file3
rm: remove regular empty file 'file3'?

```

- Cat: cat file_name: displays the content in the file
- Display: head -1 file_name: display the first line in file
- Display: head -2 file_name: display the first two lines in file
- Display: tail -1 file_name: display last line in file
- Display: tail -2 file_name: display last two lines in file

```

user@user-virtual-machine:~/nithin/file_commands$ cat basics
ls list files
pwd present working directory
mkdir to create directory
gedit file_name to create file
rm file_name to remove file
rm -r directory_name to remove directory
cp file1 file2 copy data from file1 to file2
mv file1 file2 rename file names
user@user-virtual-machine:~/nithin/file_commands$ head -1 basics
ls list files
user@user-virtual-machine:~/nithin/file_commands$ head -2 basics
ls list files
pwd present working directory
user@user-virtual-machine:~/nithin/file_commands$ tail -1 basics
mv file1 file2 rename file names
user@user-virtual-machine:~/nithin/file_commands$ tail -2 basics
cp file1 file2 copy data from file1 to file2
mv file1 file2 rename file names
user@user-virtual-machine:~/nithin/file_commands$

```

Copy and move/rename File_commands:

- `cp file1 file2`: copy content from file1 to file2.
- `cp -r file1 file2`: copy the content recursively.
- `cp -f file1 file2`: copy content forcefully.
- `cp -i`: link file instead of copying
- `mv file1 file2`: moves the file location.
- `mv -f file1 file2`: moves the file forcefully.
- `mv -i`: asks for the conformation.

```
user@user-virtual-machine:~/nithin/file_commands$ cat basics
ls list files
pwd present working directory
mkdir to create directory
gedit file_name to create file
rm file_name to remove file
rm -r directory_name to remove directory
cp file1 file2 copy data from file1 to file2
mv file1 file2 rename file names
user@user-virtual-machine:~/nithin/file_commands$ touch copied_data
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  copied_data
user@user-virtual-machine:~/nithin/file_commands$ cp basics copied_data
user@user-virtual-machine:~/nithin/file_commands$ cat copied_data
ls list files
pwd present working directory
mkdir to create directory
gedit file_name to create file
rm file_name to remove file
rm -r directory_name to remove directory
cp file1 file2 copy data from file1 to file2
mv file1 file2 rename file names
user@user-virtual-machine:~/nithin/file_commands$
```

```
user@user-virtual-machine:~/nithin/file_commands$ touch fileA
user@user-virtual-machine:~/nithin/file_commands$ touch fileB
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  fileA  fileB
user@user-virtual-machine:~/nithin/file_commands$ mv fileA fileB
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  fileB
user@user-virtual-machine:~/nithin/file_commands$ mv fileB Desktop
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  Desktop
user@user-virtual-machine:~/nithin/file_commands$ rm Desktop
user@user-virtual-machine:~/nithin/file_commands$ ls
basics
user@user-virtual-machine:~/nithin/file_commands$ touch xyz
user@user-virtual-machine:~/nithin/file_commands$ touch abc
user@user-virtual-machine:~/nithin/file_commands$ ls
abc  basics  xyz
user@user-virtual-machine:~/nithin/file_commands$ mv -i abc xyz
mv: overwrite 'xyz'? y
user@user-virtual-machine:~/nithin/file_commands$ ls
basics  xyz
user@user-virtual-machine:~/nithin/file_commands$
```

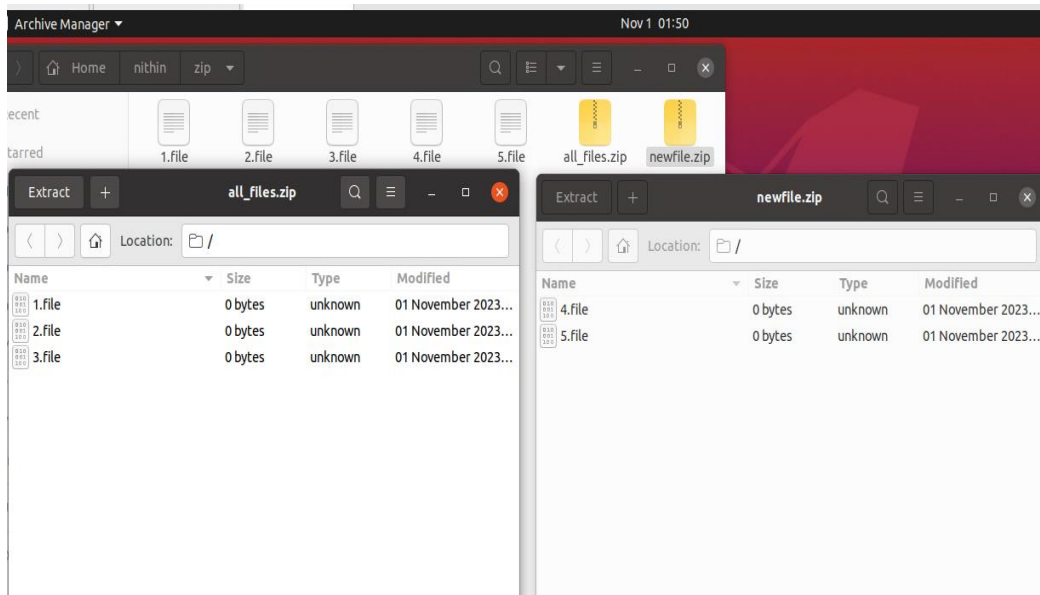
Compress files/create zip file:

cd file_name: open file/directory

cd: go back to home.

Zip file_name file1 file2 file3: compress files in zip file.

```
user@user-virtual-machine:~/nithin$ ls
disk_usage  file_commands  hardware  process_realted  zip
user@user-virtual-machine:~/nithin$ cd zip
user@user-virtual-machine:~/nithin/zip$ touch 1.file 2.file 3.file
user@user-virtual-machine:~/nithin/zip$ zip all_files.zip 1.file 2.file
  adding: 1.file (stored 0%)
  adding: 2.file (stored 0%)
  adding: 3.file (stored 0%)
user@user-virtual-machine:~/nithin/zip$ touch 4.file 5.file
user@user-virtual-machine:~/nithin/zip$ zip newfile.zip
zip error: Nothing to do! (newfile.zip)
user@user-virtual-machine:~/nithin/zip$ zip newfile.zip 4.file 5.file
  adding: 4.file (stored 0%)
  adding: 5.file (stored 0%)
user@user-virtual-machine:~/nithin/zip$
```



Linux Basic Administration

- Linux has become extremely easy to administer, compared to its early days. And can be administered using GUI applications (like Windows OS) or using the Command line Interface (CLI)
- As a professional Linux administrator, you'll have to know how to administer the OS via the CLI
- Linux supports multi-tasking, several users using the OS simultaneously.
- By default, 7 users can work simultaneously (without anyone logging out). 6 Command line users and 1 GUI user. To switch use CTRL + ALT + F1 (F2,F3,F4,F5,F6,F7) . CTRL+ALT+F7 takes you to the GUI one

Linux – User Administration

- To show the Linux distro version: `$ cat /proc/version.`
- To see Linux kernel version: `$ uname -r`
- To add new user: `#useradd michael`
- To view the default useradd options: `# useradd -D`
- The options are:
 - `-g` Group
 - `-m` home directory
 - `-f` Inactive (to set password expiry date in days)
 - `-e` Expire (to disable the user after specified number of days)
 - `-s` Shell (user's default login shell, usually `/bin/sh`)
- To delete a user: `# userdel -r michael`

Some commands in administration:

`uname`: displays Linux system information.

`uname -r`: displays kernel released information.

`uptime`: displays how long the system is running including load average.

`hostname`: shows the system host name.

`hostname -i`: displays the IP address of the system.

`last reboot`: shows system reboot information.

```
s Terminal ▾ Oct 31 16:57
user@user-virtual-machine: ~/nithin/systems

user@user-virtual-machine:~$ mkdir nithin
user@user-virtual-machine:~$ ls
Desktop  Downloads  kafka.service  Music  Pictures  spark-3.5.0-bin-hadoop3.tgz  Videos
Documents  kafka      logs           nithin  Public    Templates                    zookeeper
user@user-virtual-machine:~$ cd nithin
user@user-virtual-machine:~/nithin$ mkdir systems
user@user-virtual-machine:~/nithin$ ls
systems
user@user-virtual-machine:~/nithin$ cd systems
user@user-virtual-machine:~/nithin/systems$ uname
Linux
user@user-virtual-machine:~/nithin/systems$ uname -r
5.15.0-87-generic
user@user-virtual-machine:~/nithin/systems$ uptime
16:54:16 up 1 day, 2:05, 1 user, load average: 0.06, 0.01, 0.00
user@user-virtual-machine:~/nithin/systems$ hostname
user-virtual-machine
user@user-virtual-machine:~/nithin/systems$ hostname -i
127.0.1.1
user@user-virtual-machine:~/nithin/systems$ last reboot
reboot    system boot  5.15.0-87-generi Mon Oct 30 14:49    still running
reboot    system boot  5.15.0-86-generi Fri Oct 27 11:33    still running
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:46    still running
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:45 - 11:46 (00:01)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:36 - 11:44 (00:08)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:24 - 11:36 (00:11)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:18 - 11:24 (00:05)
reboot    system boot  5.15.0-86-generi Thu Oct 19 10:32 - 11:18 (00:46)
reboot    system boot  5.15.0-86-generi Wed Oct 18 18:50 - 10:32 (15:42)
reboot    system boot  5.15.0-86-generi Wed Oct 18 18:36 - 18:50 (00:14)
```


SYSTEM_RELATED:

date: displays current date.

cal: displays current month and date in calendar.

w: displays current logged in user in system.

whoami: displays who you are logged in as

```
s Terminal Oct 31 16:57
user@user-virtual-machine: ~/nithin/systems

reboot system boot 5.15.0-86-generi Thu Oct 19 11:36 - 11:44 (00:08)
reboot system boot 5.15.0-86-generi Thu Oct 19 11:24 - 11:36 (00:11)
reboot system boot 5.15.0-86-generi Thu Oct 19 11:18 - 11:24 (00:05)
reboot system boot 5.15.0-86-generi Thu Oct 19 10:32 - 11:18 (00:46)
reboot system boot 5.15.0-86-generi Wed Oct 18 18:50 - 10:32 (15:42)
reboot system boot 5.15.0-86-generi Wed Oct 18 18:36 - 18:50 (00:14)

wtmp begins Wed Oct 18 18:36:05 2023
user@user-virtual-machine:~/nithin/systems$ date
Tuesday 31 October 2023 04:55:04 PM IST
user@user-virtual-machine:~/nithin/systems$ cal
  October 2023
Su Mo Tu We Th Fr Sa
 1  2  3  4  5  6  7
 8  9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31

user@user-virtual-machine:~/nithin/systems$ w
 16:55:37 up 1 day, 2:06, 1 user, load average: 0.01, 0.01, 0.00
USER  TTY      FROM          LOGIN@  IDLE   JCPU   PCPU WHAT
user   :0        :0            Mon14   ?xdm?  13:37   0.01s /usr/lib/gdm3/gdm-x-session --run-script env GNOME_SHELL_SESSION_MODE=ubuntu
user@user-virtual-machine:~/nithin/systems$ whoami
user
user@user-virtual-machine:~/nithin/systems$ finger username

Command 'finger' not found, but can be installed with:

sudo apt install finger

user@user-virtual-machine:~/nithin/systems$ finger username

Command 'finger' not found, but can be installed with:

sudo apt install finger

user@user-virtual-machine:~/nithin/systems$
```

User_related:

- id: displays the details of the active user.
- last: shows last login in the system.
- who: shows who login in the system.
- groupadd "admin": adds the group admin.
- userdel: used to delete the user.
- usermod: used for modifying or change user information.

```
Nov 1 00:12
user@user-virtual-machine: ~/nithin/users

user@user-virtual-machine:~/nithin/hardware$ cd ..
user@user-virtual-machine:~/nithin$ mkdir users
user@user-virtual-machine:~/nithin$ cd users
user@user-virtual-machine:~/nithin/users$ id
uid=1000(user) gid=1000(user) groups=1000(user),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),133(lxd),134(sambashare)
user@user-virtual-machine:~/nithin/users$ last
user      :0      :0      Tue Oct 31 23:31  still logged in
reboot    system boot  5.15.0-87-generi Tue Oct 31 23:30  still running
user      :0      :0      Mon Oct 30 14:50 - crash (1+08:39)
reboot    system boot  5.15.0-87-generi Mon Oct 30 14:49  still running
user      :0      :0      Fri Oct 27 11:33 - crash (3+03:15)
reboot    system boot  5.15.0-86-generi Fri Oct 27 11:33  still running
user      :0      :0      Thu Oct 19 11:46 - crash (7+23:46)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:46  still running
user      :0      :0      Thu Oct 19 11:45 - down (00:01)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:45 - 11:46 (00:01)
user      :0      :0      Thu Oct 19 11:36 - down (00:08)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:36 - 11:44 (00:08)
user      :0      :0      Thu Oct 19 11:24 - down (00:11)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:24 - 11:36 (00:11)
user      :0      :0      Thu Oct 19 11:18 - down (00:05)
reboot    system boot  5.15.0-86-generi Thu Oct 19 11:18 - 11:24 (00:05)
user      :0      :0      Thu Oct 19 10:32 - down (00:45)
reboot    system boot  5.15.0-86-generi Thu Oct 19 10:32 - 11:18 (00:46)
user      :0      :0      Wed Oct 18 18:50 - down (15:41)
reboot    system boot  5.15.0-86-generi Wed Oct 18 18:50 - 10:32 (15:42)
user      :0      :0      Wed Oct 18 18:36 - down (00:13)
reboot    system boot  5.15.0-86-generi Wed Oct 18 18:36 - 18:50 (00:14)

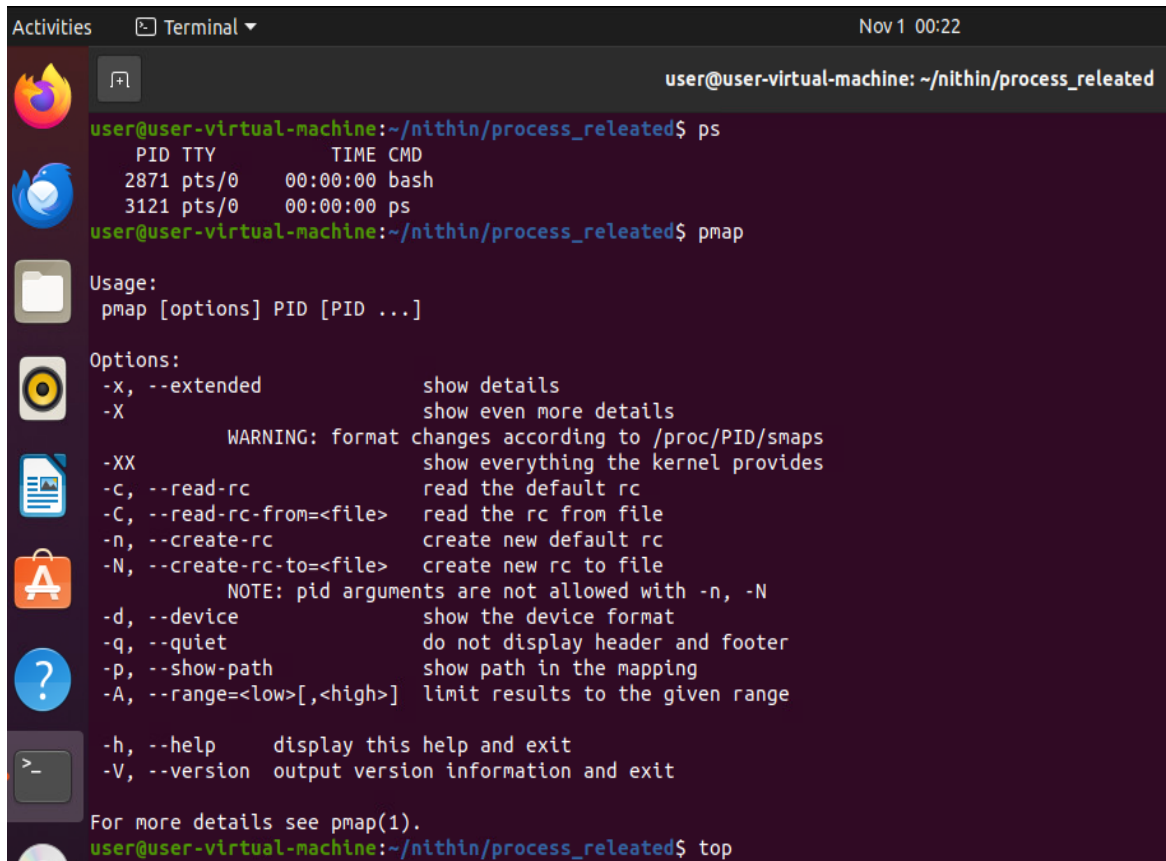
wtmp begins Wed Oct 18 18:36:05 2023
user@user-virtual-machine:~/nithin/users$ who
user      :0      2023-10-31 23:31 (:0)
user@user-virtual-machine:~/nithin/users$ adduser "nikki"
adduser: Only root may add a user or group to the system.
user@user-virtual-machine:~/nithin/users$ useradd "nik"
useradd: Permission denied.
useradd: cannot lock /etc/passwd; try again later.
user@user-virtual-machine:~/nithin/users$
```

Process_related:

ps: displays current active process.

pmap: displays memory map of process.

top: displays all running process.



```
Activities  Terminal  Nov 1 00:22
user@user-virtual-machine: ~/nithin/process_realeated

user@user-virtual-machine:~/nithin/process_realeated$ ps
  PID TTY          TIME CMD
 2871 pts/0    00:00:00 bash
 3121 pts/0    00:00:00 ps
user@user-virtual-machine:~/nithin/process_realeated$ pmap

Usage:
pmap [options] PID [PID ...]

Options:
-x, --extended          show details
-X                      show even more details
                        WARNING: format changes according to /proc/PID/smmaps
-XX                     show everything the kernel provides
-c, --read-rc           read the default rc
-C, --read-rc-from=<file> read the rc from file
-n, --create-rc         create new default rc
-N, --create-rc-to=<file> create new rc to file
                        NOTE: pid arguments are not allowed with -n, -N
-d, --device            show the device format
-q, --quiet             do not display header and footer
-p, --show-path         show path in the mapping
-A, --range=<low>[,<high>] limit results to the given range

-h, --help             display this help and exit
-V, --version           output version information and exit

For more details see pmap(1).
user@user-virtual-machine:~/nithin/process_realeated$ top
```

Disk_usage:

df -h: displays free space on mounted system.

df -i: displays free inodes on filesystem.

fdisk -l: shows disk partition, size, types.

du -sh: displays disk usage in the current directory.

```
Activities Terminal Nov 1 00:32 user@user-virtual-machine: ~/nithin/disk_usage
user@user-virtual-machine:~/nithin/disk_usage$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            1.9G   0    1.9G   0% /dev
tmpfs           392M  1.4M  390M   1% /run
/dev/sda5       98G   13G   80G  14% /
tmpfs           2.0G   0    2.0G   0% /dev/shm
tmpfs           5.0M   0    5.0M   0% /run/lock
tmpfs           2.0G   0    2.0G   0% /sys/fs/cgroup
/dev/loop0      128K  128K   0 100% /snap/bare/5
/dev/loop1      64M   64M   0 100% /snap/core20/1828
/dev/loop2      64M   64M   0 100% /snap/core20/2015
/dev/loop4      74M   74M   0 100% /snap/core22/864
/dev/loop3      350M  350M   0 100% /snap/gnome-3-38-2004/143
/dev/loop5      347M  347M   0 100% /snap/gnome-3-38-2004/119
/dev/loop6      497M  497M   0 100% /snap/gnome-42-2204/141
/dev/loop7      92M   92M   0 100% /snap/gtk-common-themes/1535
/dev/loop9      46M   46M   0 100% /snap/snap-store/638
/dev/loop8      13M   13M   0 100% /snap/snap-store/959
/dev/loop10     41M   41M   0 100% /snap/snapd/20290
/dev/loop11     50M   50M   0 100% /snap/snapd/18357
/dev/sda1       511M  4.0K  511M   1% /boot/efi
tmpfs           392M  24K  392M   1% /run/user/1000
/dev/sr0        4.1G  4.1G   0 100% /media/user/Ubuntu 20.04.6 LTS amd64
user@user-virtual-machine:~/nithin/disk_usage$ df -l
Filesystem      Inodes    IUsed   IFree IUse% Mounted on
udev            490568    436  490132    1% /dev
tmpfs           500742    826  499916    1% /run
/dev/sda5       6520832  221454 6299378    4% /
tmpfs           500742     1  500741    1% /dev/shm
tmpfs           500742     4  500738    1% /run/lock
tmpfs           500742    19  500723    1% /sys/fs/cgroup
/dev/loop0      29       29     0 100% /snap/bare/5
/dev/loop1     11906   11906   0 100% /snap/core20/1828
/dev/loop2     11991   11991   0 100% /snap/core20/2015
/dev/loop4     14329   14329   0 100% /snap/core22/864
/dev/loop3     18307   18307   0 100% /snap/gnome-3-38-2004/143
/dev/loop5     18272   18272   0 100% /snap/gnome-3-38-2004/119
/dev/loop6     20627   20627   0 100% /snap/gnome-42-2204/141
/dev/loop7     36300   36300   0 100% /snap/gtk-common-themes/1535
```

```
Activities Terminal Nov 1 00:32 user@user-virtual-machine: ~/nithin/disk_usage
user@user-virtual-machine:~/nithin/disk_usage$ fdisk -l
fdisk: cannot open /dev/loop0: Permission denied
fdisk: cannot open /dev/loop1: Permission denied
fdisk: cannot open /dev/loop2: Permission denied
fdisk: cannot open /dev/loop3: Permission denied
fdisk: cannot open /dev/loop4: Permission denied
fdisk: cannot open /dev/loop5: Permission denied
fdisk: cannot open /dev/loop6: Permission denied
fdisk: cannot open /dev/loop7: Permission denied
fdisk: cannot open /dev/sda: Permission denied
fdisk: cannot open /dev/loop9: Permission denied
fdisk: cannot open /dev/loop8: Permission denied
fdisk: cannot open /dev/loop10: Permission denied
fdisk: cannot open /dev/loop11: Permission denied
user@user-virtual-machine:~/nithin/disk_usage$ du -sh
4.0K
user@user-virtual-machine:~/nithin/disk_usage$ findmnt
TARGET          SOURCE          FSTYPE  OPTIONS
/               /dev/sda5       ext4    rw,relatime,errors=remount-ro
/sys            sysfs           sysfs   rw,nosuid,nodev,noexec,relatime
/sys/kernel/security securityfs       securityfs
/sys/fs/cgroup  tmpfs           tmpfs   ro,nosuid,nodev,noexec,mode=755,inode64
/sys/fs/cgroup/unified cgroup2         cgroup2 rw,nosuid,nodev,noexec,relatime,nsdelegate
/sys/fs/cgroup/systemd cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,xattr,name=systemd
/sys/fs/cgroup/cpusacct cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,cpu,cpuacct
/sys/fs/cgroup/cpuset cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,cpuset
/sys/fs/cgroup/devices cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,devices
/sys/fs/cgroup/net_cls,net_prio cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,net_cls,net_prio
/sys/fs/cgroup/rdma cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,rdma
/sys/fs/cgroup/memory cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,memory
/sys/fs/cgroup/perf_event cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,perf_event
/sys/fs/cgroup/blkio cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,blkio
/sys/fs/cgroup/misc cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,misc
/sys/fs/cgroup/pids cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,pids
/sys/fs/cgroup/hugetlb cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,hugetlb
/sys/fs/cgroup/freezer cgroup          cgroup  rw,nosuid,nodev,noexec,relatime,freezer
/sys/fs/pstore pstore          pstore  rw,nosuid,nodev,noexec,relatime
/sys/fs/bpf     bpf             bpf     rw,nosuid,nodev,noexec,relatime,mode=700
```

Basic security principles:

User Permissions: Assign appropriate permissions to users and groups to control access to files and directories.

Firewalls: Configure and enable firewalls (like iptables) to control incoming and outgoing network traffic.

Regular Updates: Keep the system and software up to date with the latest security patches to fix vulnerabilities.

Password Policies: Enforce strong password policies, including regular password changes and avoiding default passwords.

Limited Root Access: Minimize the use of the root account; use sudo for administrative tasks to limit the potential impact of security breaches.

Audit Logs: Enable and regularly review system logs to detect and respond to security incidents.

File System Encryption: Use encryption for sensitive data, either at the file level or for the entire file system.

Secure Shell (SSH): Configure SSH securely, including key-based authentication and disabling root login.

Network Security: Disable unnecessary services and secure network services by binding them to specific IP addresses or using secure protocols.

Application Whitelisting: Only install and run necessary applications; avoid unnecessary software that could introduce security risks.