# LINUX LAB FILE

Experiment 1:

ABOUT UNIX

Q1. STUDY OF UNIX OPERATING SYSTEM & ITS FUNDAMENTALS.

- OS (DEFINITION)
- LIST OF OS WITH THEIR UTILITY
- ABOUT UNIX OS
- FEATURE
- DISTRIBUTION
- HISTORY
- APPLICANTS
- COMPARISON OF WINDOWS AND UNIX

ANSWER:-

An operating system (OS) is a software system that manages computer hardware, software resources, and provides various services for computer programs. It acts as an intermediary between computer hardware and user-level applications, ensuring efficient utilization of hardware resources and providing a user-friendly interface.
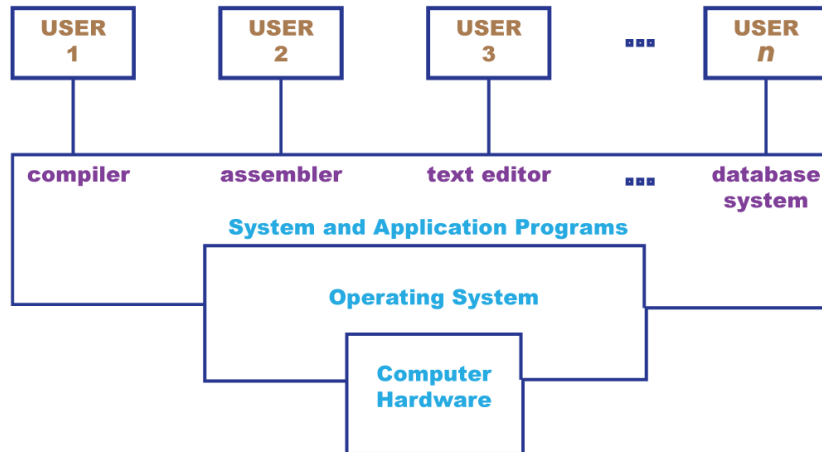
List of Operating Systems with Their Utility:

There are numerous operating systems, each designed for specific use cases. Some examples include:
1. Windows: Primarily used for personal computers, workstations, and servers. Known for its user-friendly interface.
2. macOS: Designed by Apple for their Macintosh line of computers. Known for its aesthetics and integration with Apple's ecosystem.
3. Linux: A family of open-source operating systems widely used on servers and embedded systems. Offers high customization and control.
4. Unix: The precursor to Linux, widely used in server environments for its stability and security features.

5. Android: Based on the Linux kernel, used in mobile devices and tablets.

6. iOS: Apple's mobile operating system used exclusively on iPhones and iPads.
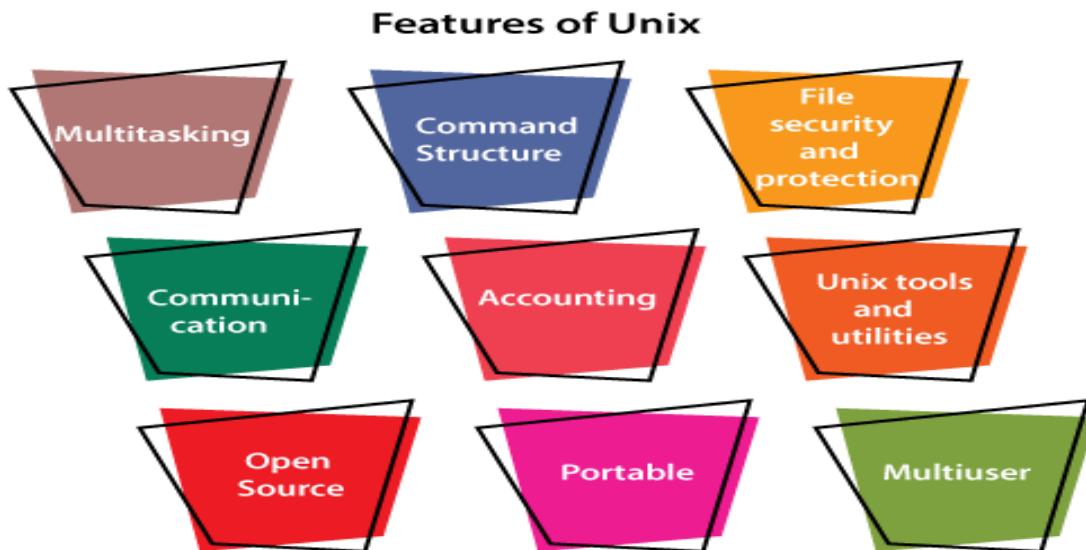
About UNIX Operating System:

Unix is a family of multitasking, multi user computer operating systems that are derived from the original AT&T Unix developed in the 1970s. It emphasizes simplicity, portability, and a strong focus on command-line interfaces. The Unix philosophy promotes the idea of building small, modular tools that can be combined to perform complex tasks.

Features of Unix:

1. Multiuser and Multitasking:Unix allows multiple users to access the system simultaneously and execute multiple processes concurrently.

2. Hierarchical File System: Files are organized in a hierarchical directory structure, allowing for easy organization and navigation.

3. Command-Line Interface: Unix provides a powerful command-line interface that allows users to interact with the system using textual commands.

4. Portability: Unix was designed to be portable across different hardware platforms, which contributed to its widespread adoption.

5. Security: Unix incorporates robust security mechanisms, including user authentication, permissions, and encryption.

6. Networking: Unix was an early adopter of networking protocols, enabling seamless communication between computers.

Features of Unix

Unix Distributions:

Unix doesn't have a single distribution like Linux. Instead, it has various versions developed by different organizations. Some well-known Unix-like operating systems include:

1. AIX (IBM)

2. HP-UX (Hewlett Packard)
3. Solaris (Oracle)
4. BSD (Berkeley Software Distribution)

History of Unix:

Unix was developed in the late 1960s and early 1970s at AT&T's Bell Labs. Its development was influenced by the Multics project. Over time, various versions and flavors of Unix emerged, including the BSD variants and the System V branch. These influenced the development of Linux.

Applications of Unix:

Unix is used in various applications, including servers, workstations, embedded
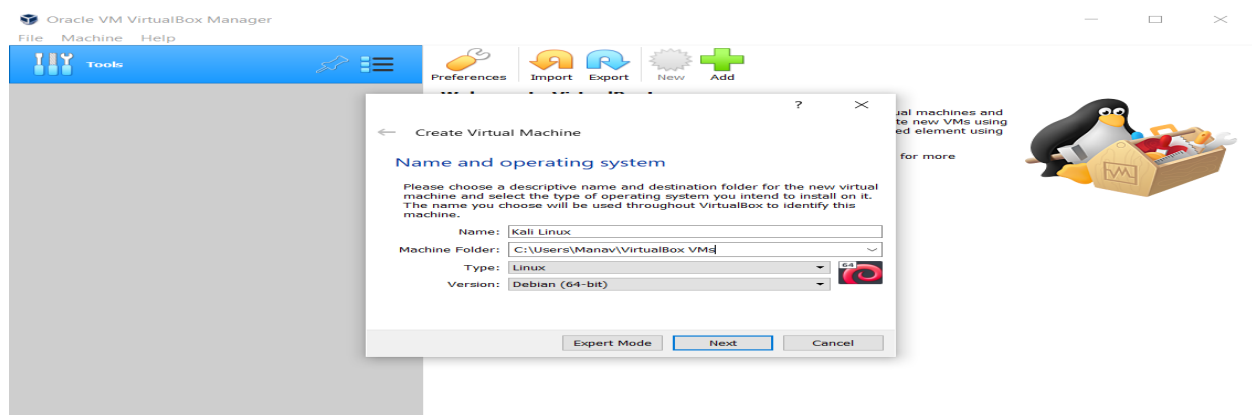
systems, supercomputers, and research environments.

Experiment 2:
Installation of kali

Procedure:

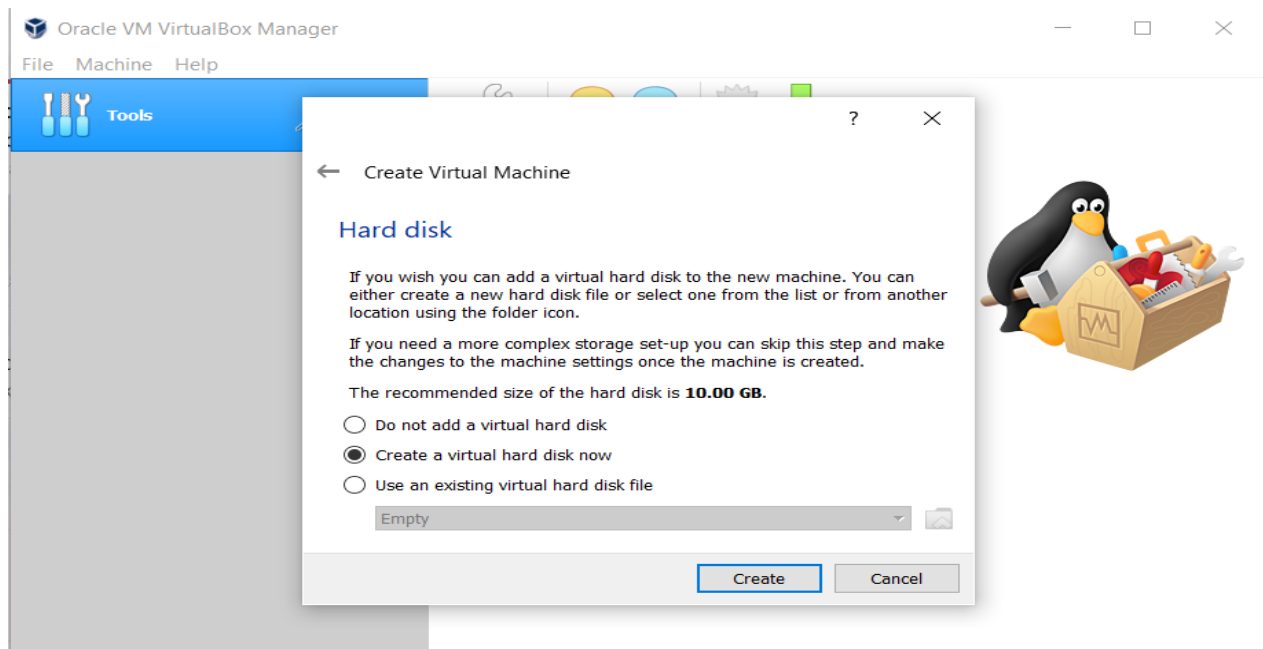**1. Open Virtual Box and then press the new button.**

2. Write the name of the virtual machine and select it to Debian based 64bit Linux architecture.
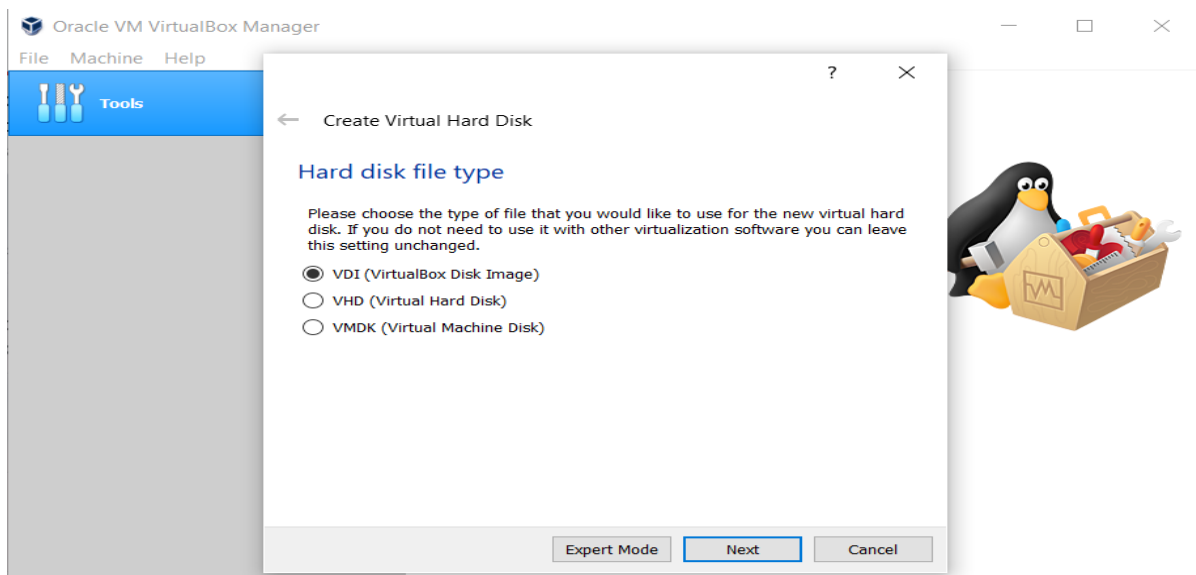

3. Allot the size of RAM memory you want to allocate to the Virtual Machine of Kali Linux. (2048 MB is recommended for normal usage)
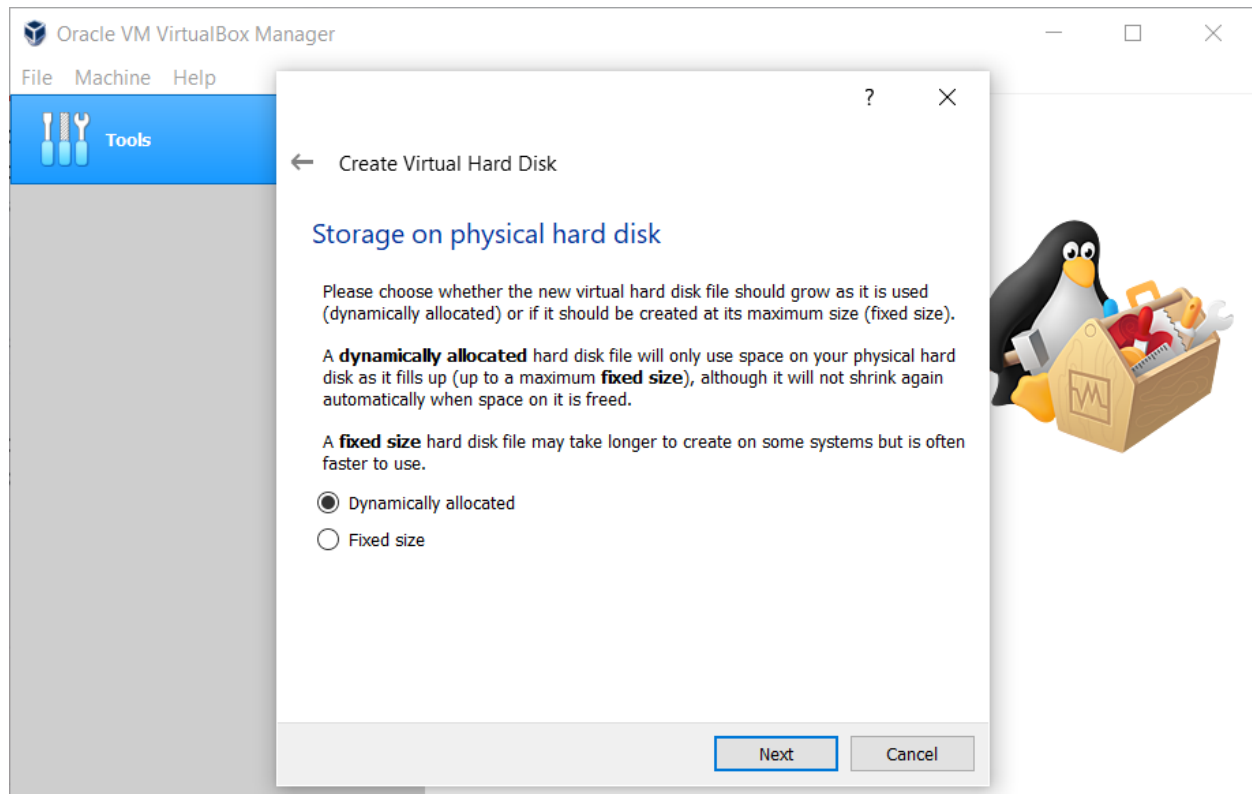
4. Select the option to create a virtual hard disk now and then click on the create button.
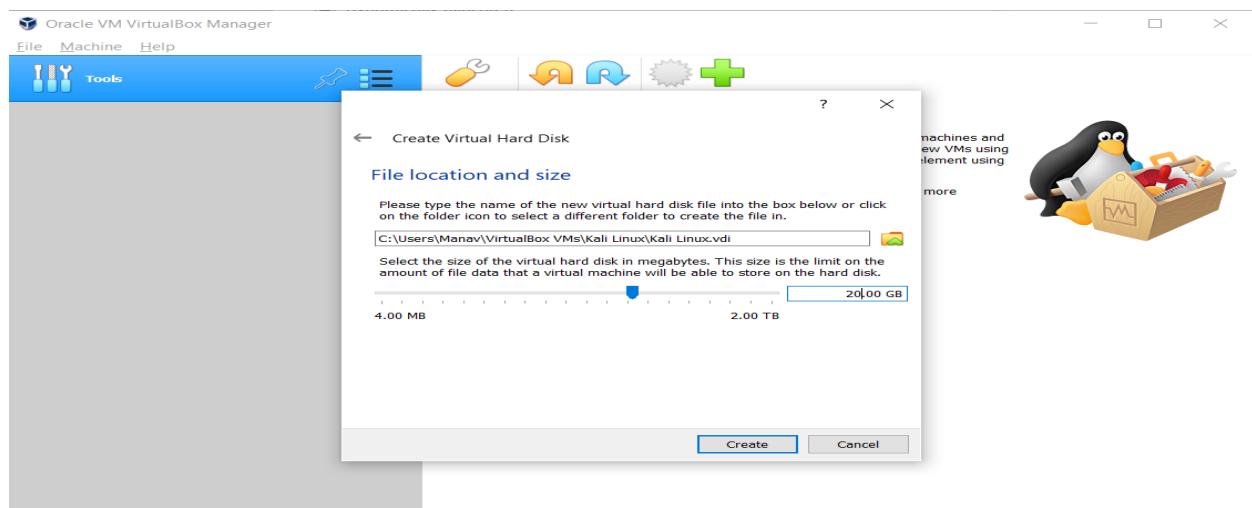

5. Now, Select the Hard Disk File type for Virtual Hard Disk. (VDI is recommended for daily purposes)
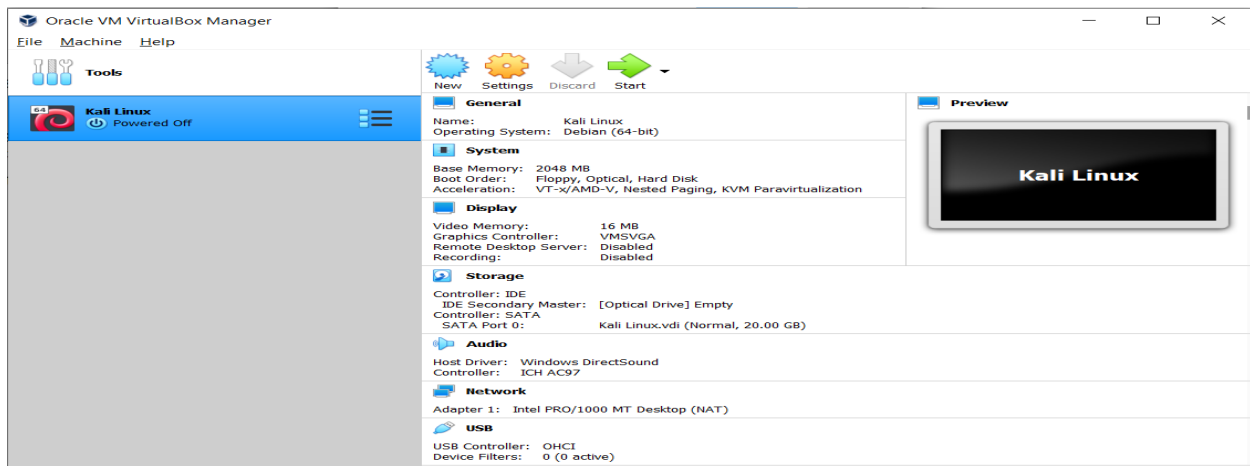
6. Now select the type of Physical Hard Disk Storage. (Dynamically Allocated is recommended for general purposes)


7. Select the size of your virtual hard disk and also the location where you want to save your machine and its files.

8. As soon as the processing is completed click on the Virtual machine name on the left panel and click on the start button from the top.
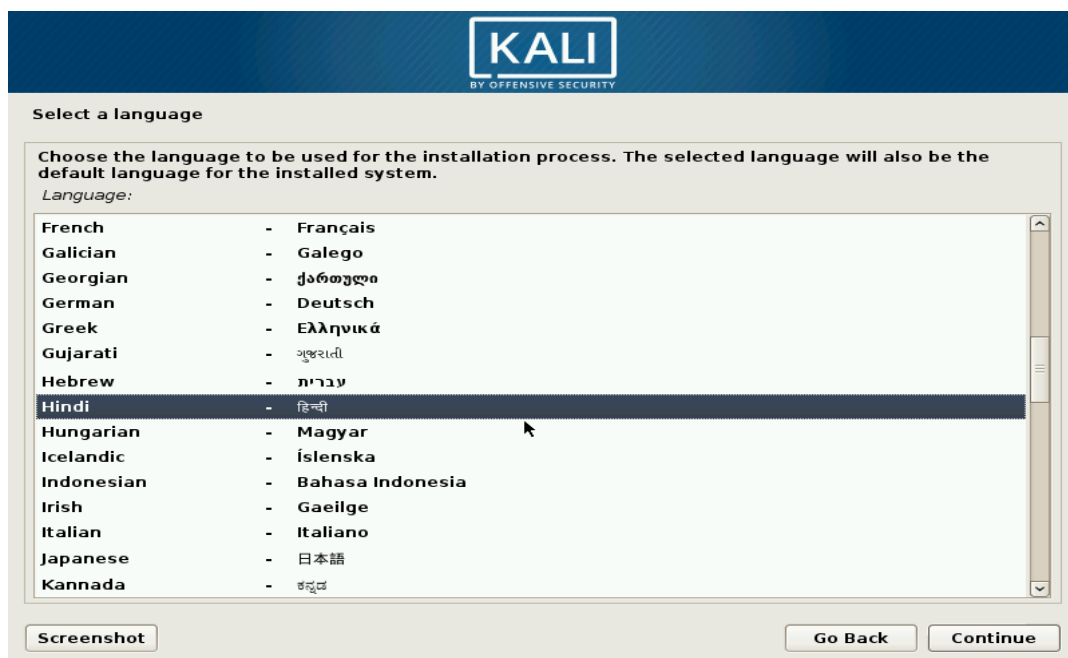

9. Now click on the Browse icon located just above the cancel button and select your downloaded Kali Linux ISO file and then click on the start button.
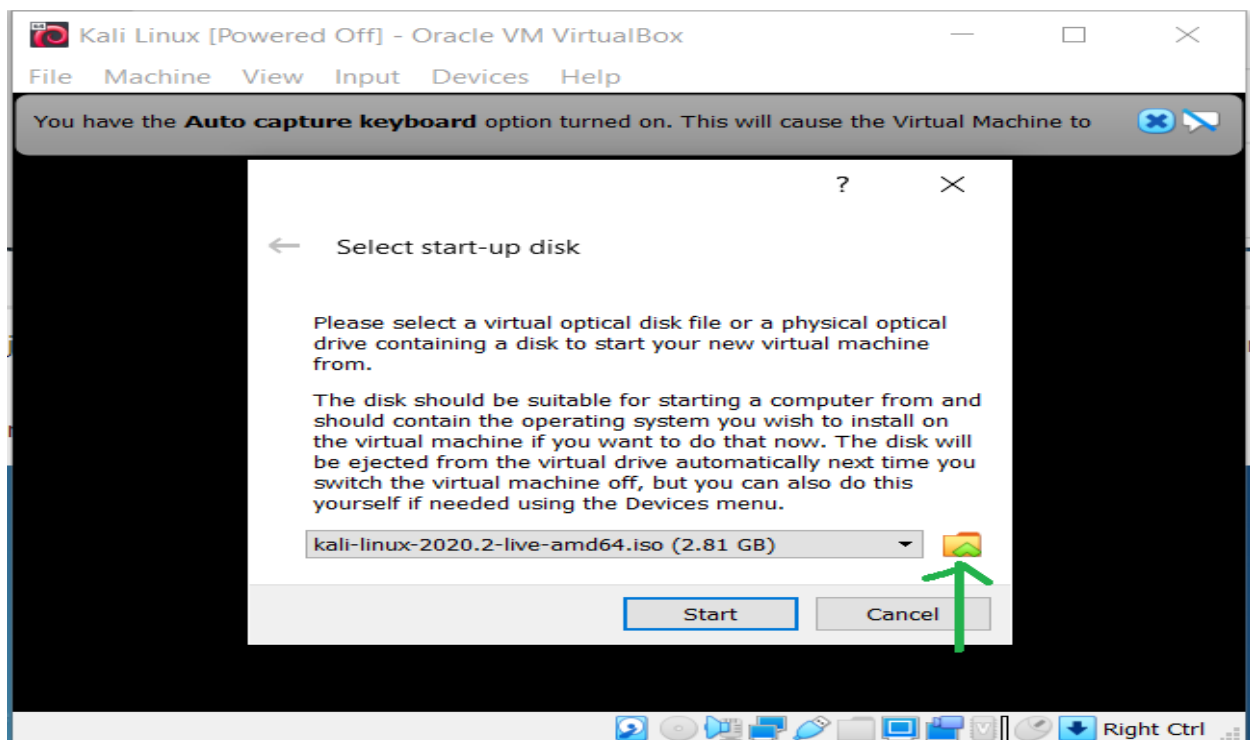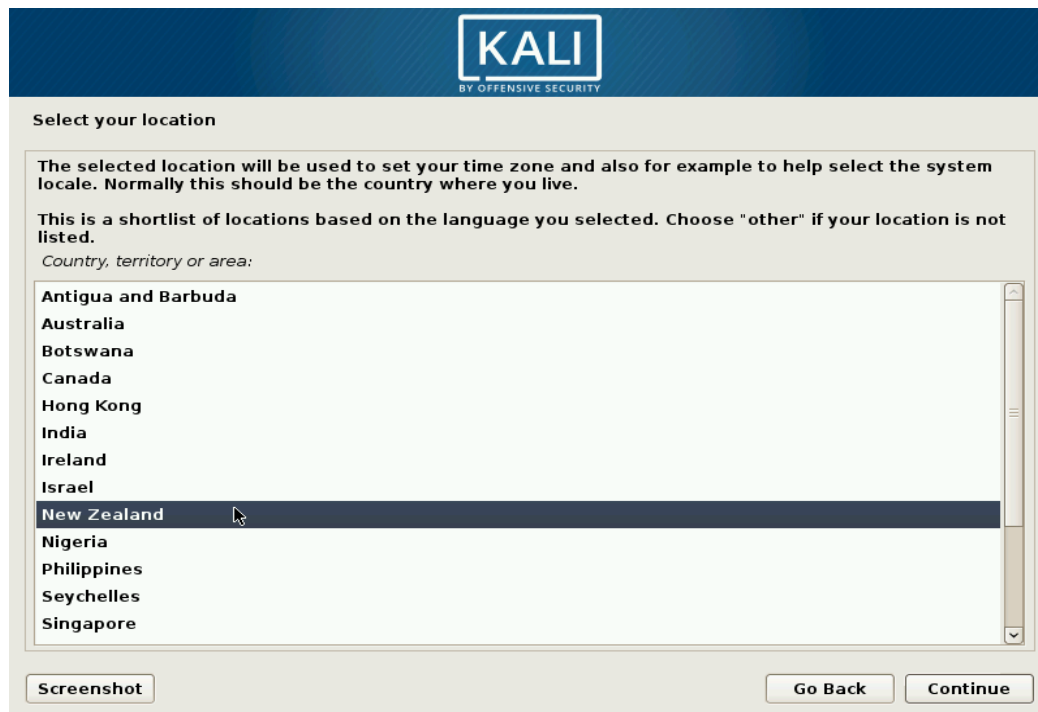
10. This will boot our virtual machine from the chosen Kali Linux ISO file. Select the Graphical Install button and hit enter.

11.The next option is to select a language, So select your desired language and hit enter.
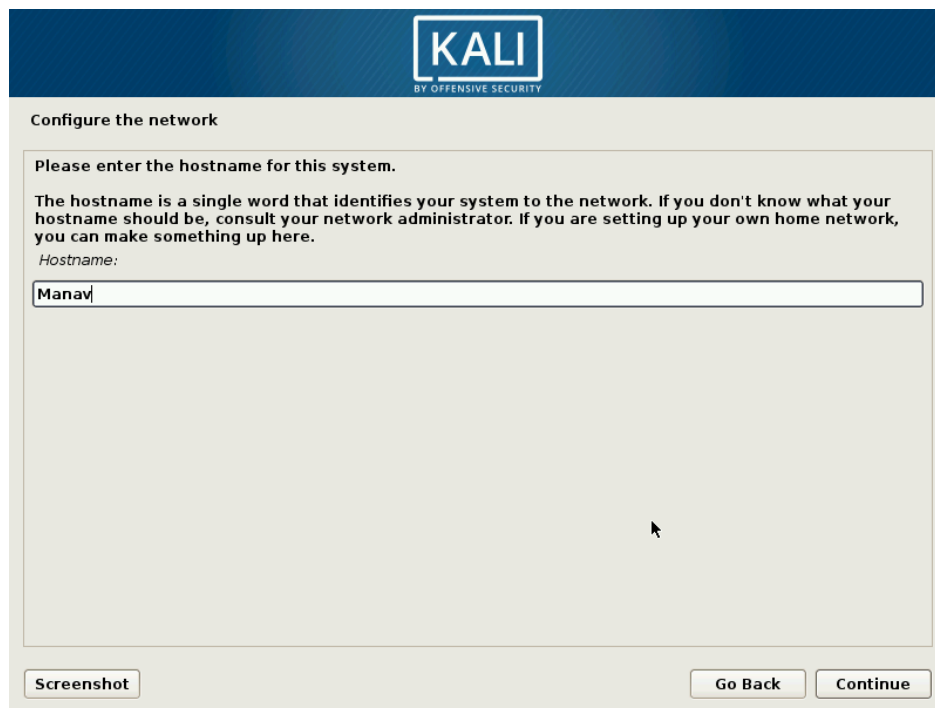
12. The next step is to select a country, territory, or area, So select your respective one.

13. The next step is to configure your keymap. Confirm the keymap you want to use and click Next.
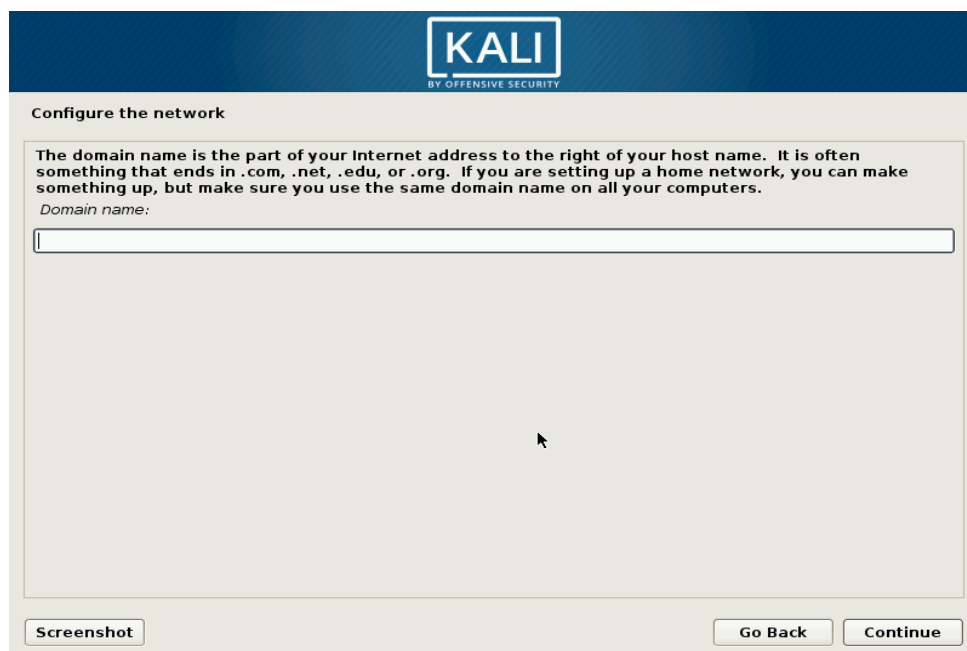
14. In the next step it is asking for a hostname, Enter the same and press the continue button.
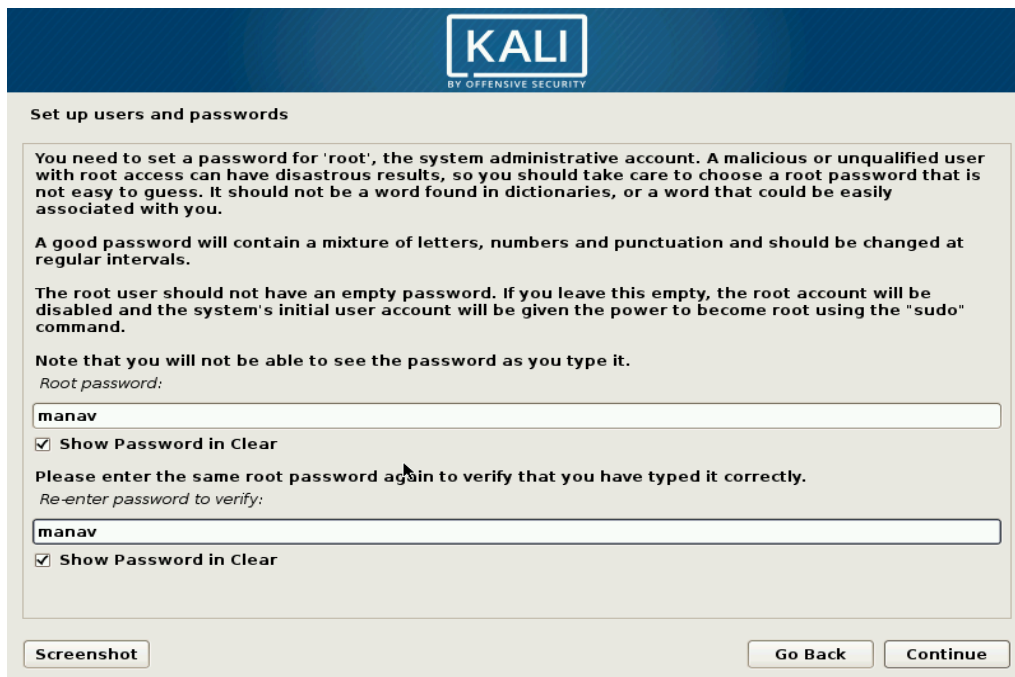

15. The next step is to enter the domain name of your choice you may leave it blank if you don't have any.

16. Enter a strong password for your Kali Linux OS and click continue.

17. The next step is to select a time zone of your choice which you want to use as a default time zone for the Kali Linux machine.

18. Now click on the "Manual" option and press continue to confirm.

19. Now select the Free Space and create a new partition with that and click continue. Also, it is recommended for new users to not use a separate partition for root, home, and swap areas.
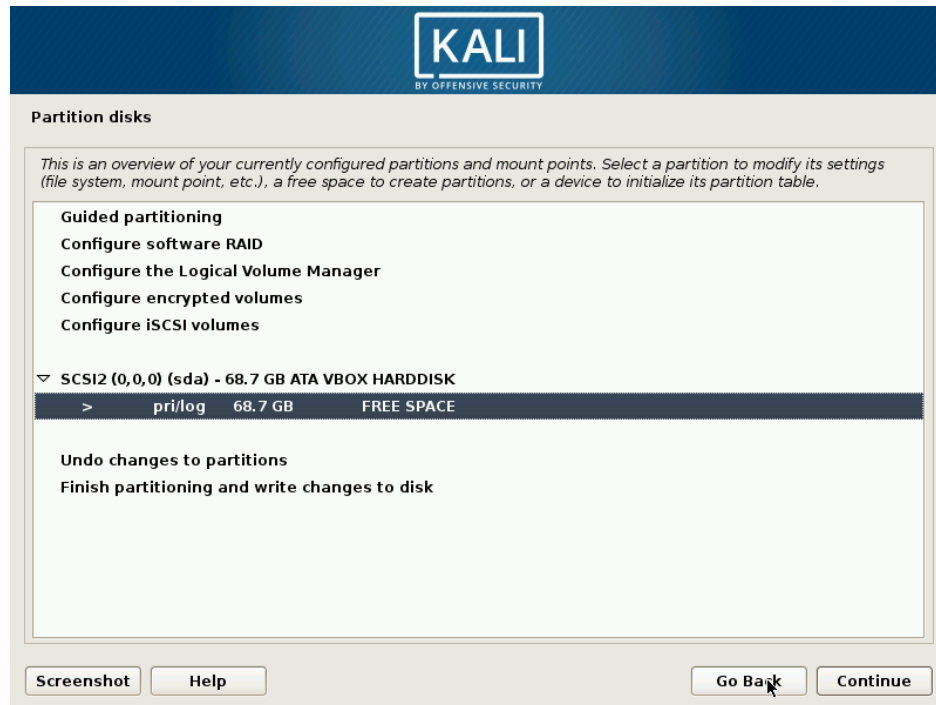
20. Now click on create a new partition.
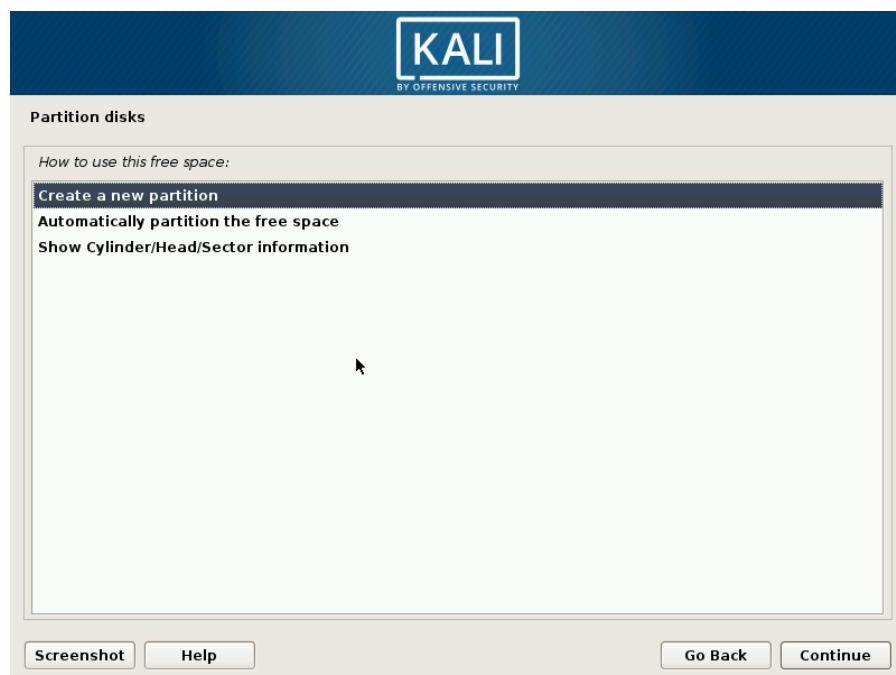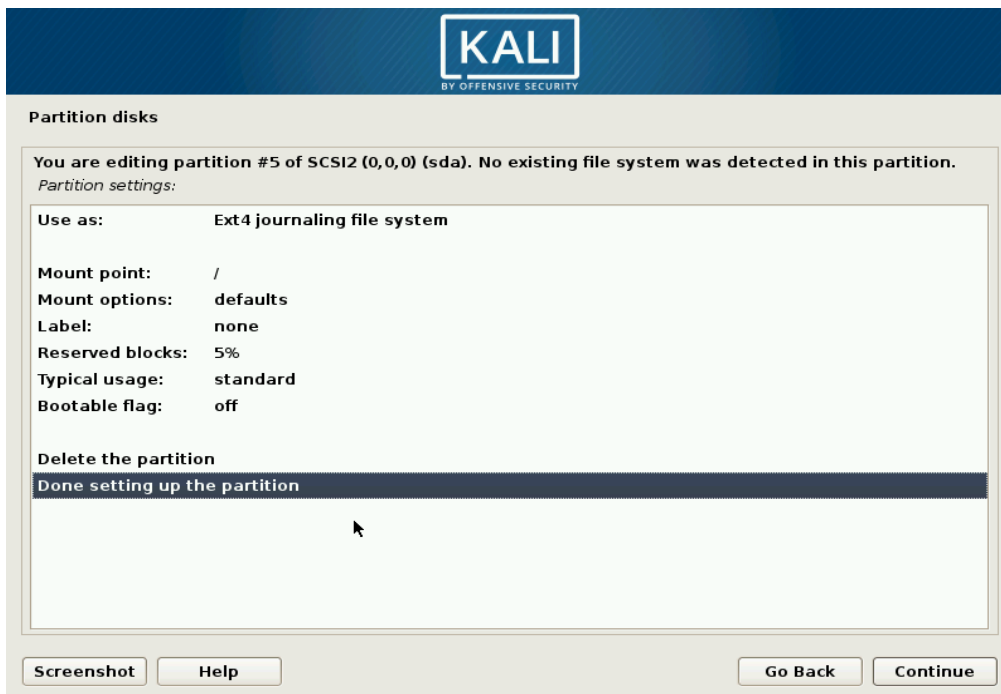
21. Now enter the partition size to be created.

22. Now select the partition type as "Logical".

23. Now if you are new to Linux then use the following settings for the partition or you may also adjust them as per your need. And then click on "Done setting up the partition"

24. Now just click on finish partitioning and write changes to disk.
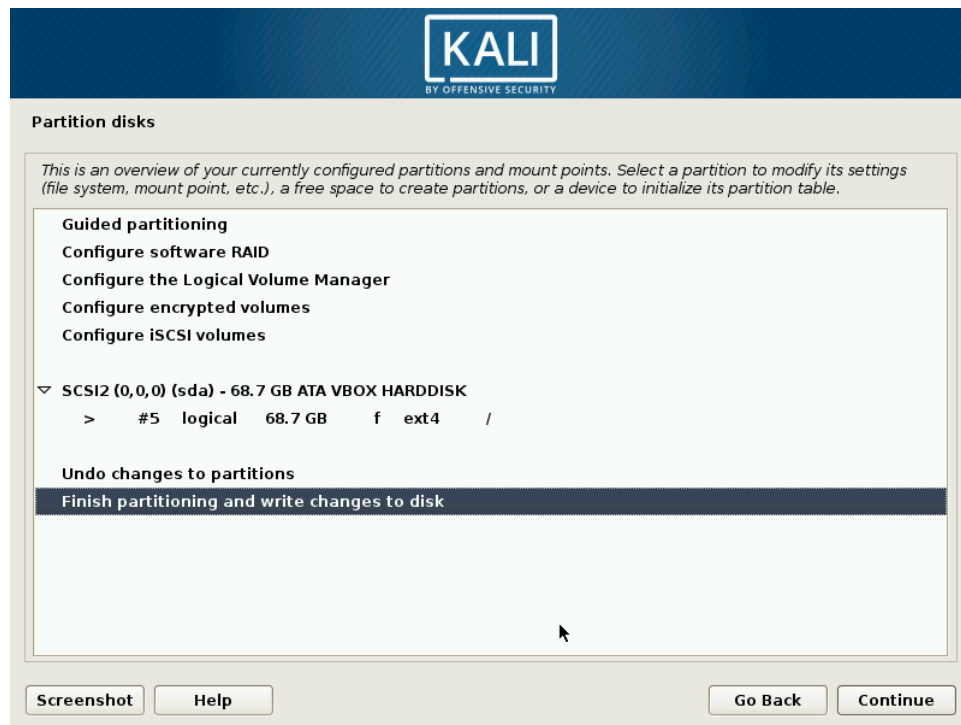
25. Now select the "no" option in order to continue.
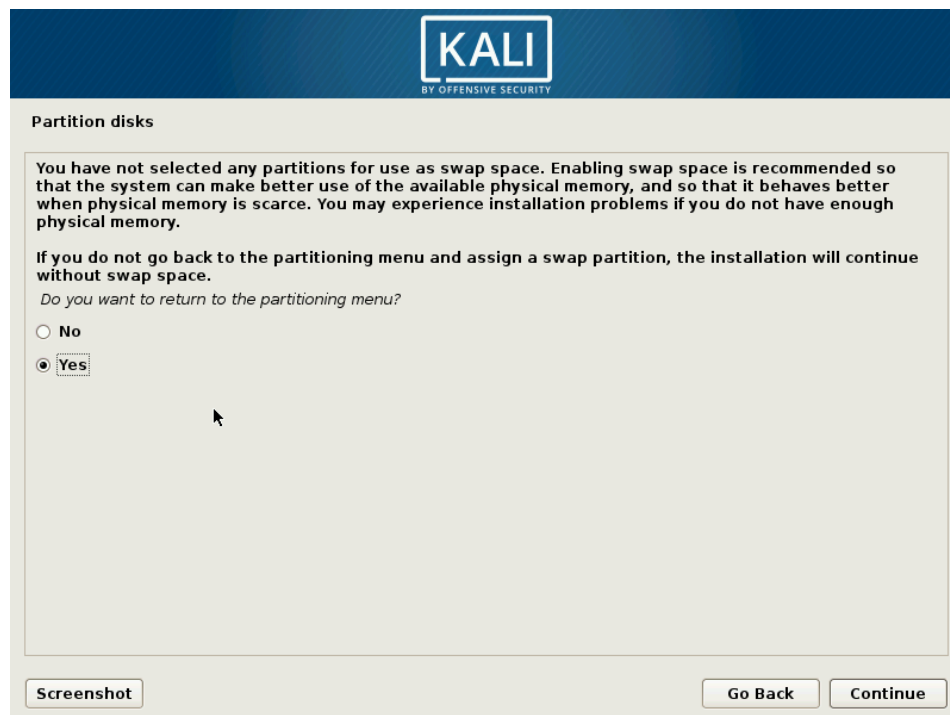
26. Now in order to write changes to the disk select the "yes" option and then click on continue.
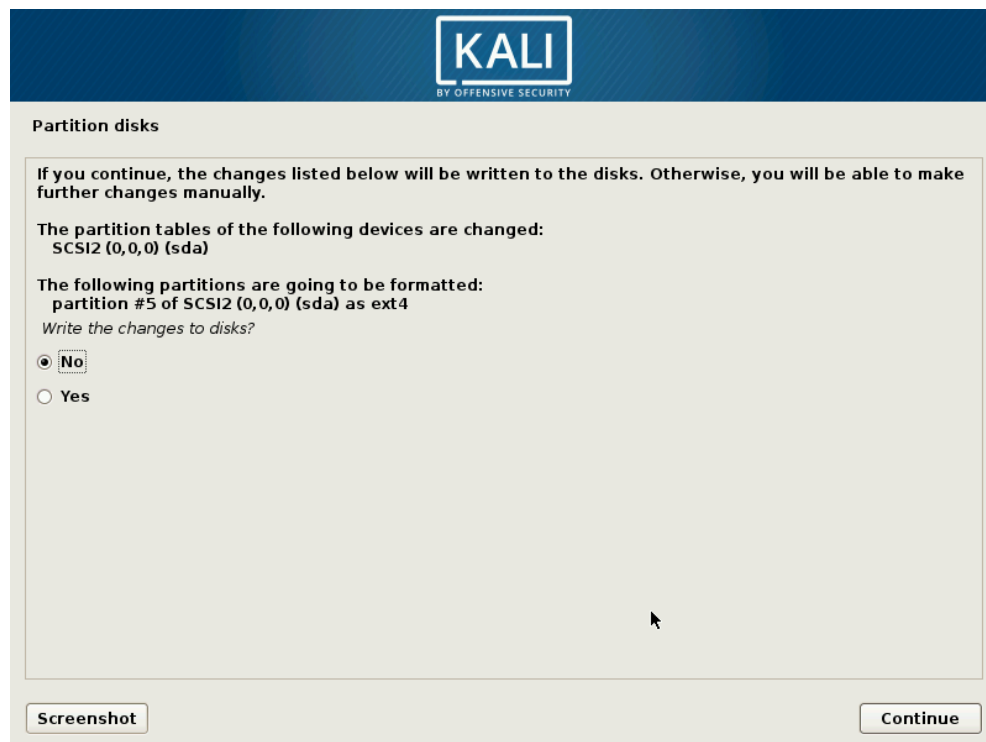
27. Now, wait for a few minutes for the Kali system to be installed into your Virtual Machine.

28. The next option is to select whether to install the GRUB boot loader to the master boot record or not. Click on yes to add the same.

29. Choose your respective hard disk to boot into, from the list of devices.

30. This will start installing the Kali Linux OS and will take a few minutes to completely install the same and will reboot after the successful completion of the installation.

31. Once the complete process is finished successfully, It will automatically restart the virtual machine and will boot the Kali Linux OS.

32. In order to close the Virtual Machine, Simply Shutdown the Kali Linux OS, this action will automatically terminate the Virtual Machine.

Experiment 4:

Study of linux architecture

Architecture of Linux system
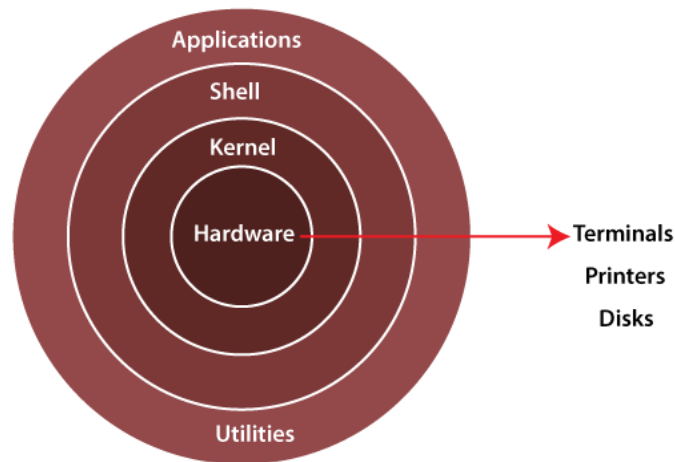
The Linux operating system's architecture mainly contains some of the components: the Kernel, System Library, Hardware layer, System, and Shell utility.

1. **Kernel:-** The kernel is one of the core section of an operating system. It is responsible for each of the major actions of the Linux OS. This operating system contains distinct types of modules and cooperates with underlying hardware directly. The kernel facilitates required abstraction for hiding details of low-level hardware or application programs to the system. There are some of the important kernel types which are mentioned below:

- ○ Monolithic Kernel
- ○ Micro kernels
- ○ Exo kernels
- ○ Hybrid kernels

2. **System Libraries**:- These libraries can be specified as some special functions. These are applied for implementing the operating system's functionality and don't need code access rights of the modules of kernel.

3. **System Utility Programs:-** It is responsible for doing specialized level and individual activities.

4. **Hardware layer:-** Linux operating system contains a hardware layer that consists of several peripheral devices like CPU, HDD, and RAM.

5. **Shell:-** It is an interface among the kernel and user. It can afford the services of kernel. It can take commands through the user and runs the functions of the kernel. The shell is available in distinct types of OSes. These operating systems are categorized into two different types, which are the graphical shells and command-line shells.

The graphical line shells facilitate the graphical user interface, while the command line shells facilitate the command line interface. Thus, both of these shells implement operations. However, the graphical user interface shells work slower as compared to the command-line interface shells.

There are a few types of these shells which are categorized as follows:

- ○ Korn shell
- ○ Bourne shell
- ○ C shell
- ○ POSIX shell

Experiment 3:

<u>Study of linux file system</u>

Linux File System

A Linux file system is a structured collection of files on a disk drive or a partition. A partition is a segment of memory and contains some specific data. In our machine, there can be various partitions of the memory. Generally, every partition contains a file system.

The general-purpose computer system needs to store data systematically so that we can easily access the files in less time. It stores the data on hard disks (HDD) or some equivalent storage type. There may be below reasons for maintaining the file system:

- Primarily the computer saves data to the RAM storage; it may lose the data if it gets turned off. However, there is non-volatile RAM (Flash RAM and SSD) that is available to maintain the data after the power interruption.

- Data storage is preferred on hard drives as compared to standard RAM as RAM costs more than disk space. The hard disks costs are dropping gradually comparatively the RAM.

The Linux file system contains the following sections:

- The root directory (/)
- A specific data storage format (EXT3, EXT4, BTRFS, XFS and so on)
- A partition or logical volume having a particular file system.

Linux File System Structure

Linux file system has a hierarchal file structure as it contains a root directory and its subdirectories. All other directories can be accessed from the root directory. A partition usually has only one file system, but it may have more than one file system.

The data structure needs to support a hierarchical directory structure; this structure is used to describe the available and used disk space for a particular block. It also has the other details about the files such as file size, date & time of creation, update, and last modified.

Also, it stores advanced information about the section of the disk, such as partitions and volumes.

The advanced data and the structures that it represents contain the information about the file system stored on the drive; it is distinct and independent of the file system metadata.

Linux file system contains two-part file system software implementation architecture. Consider the below image:
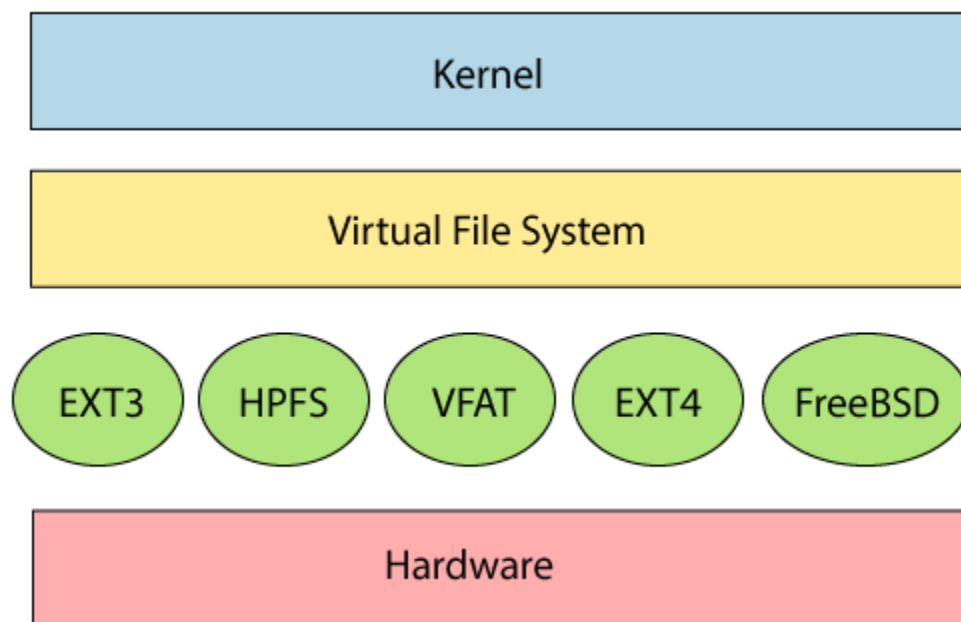
The file system requires an API (Application programming interface) to access the function calls to interact with file system components like files and directories. API facilitates tasks such as creating, deleting, and copying the files. It facilitates an algorithm that defines the arrangement of files on a file system.

The first two parts of the given file system together called a Linux virtual file system. It provides a single set of commands for the kernel and developers to access the file system. This virtual file system requires the specific system driver to give an interface to the file system.

Linux File System Features

In Linux, the file system creates a tree structure. All the files are arranged as a tree and its branches. The topmost directory called the root (/) directory. All other directories in Linux can be accessed from the root directory.

Some key features of Linux file system are as following:

○ Specifying paths: Linux does not use the backslash (\) to separate the components; it uses forward slash (/) as an alternative. For example, as in Windows, the data may be stored in C:\ My Documents\ Work, whereas, in Linux, it would be stored in /home/ My Document/ Work.

○ Partition, Directories, and Drives: Linux does not use drive letters to organize the drive as Windows does. In Linux, we cannot tell whether we are addressing a partition, a network device, or an "ordinary" directory and a Drive.

○ Case Sensitivity: Linux file system is case sensitive. It distinguishes between lowercase and uppercase file names. Such as, there is a difference between test.txt and Test.txt in Linux. This rule is also applied for directories and Linux commands.

○ File Extensions: In Linux, a file may have the extension '.txt,' but it is not necessary that a file should have a file extension. While working with Shell, it creates some problems for the beginners to differentiate between files and directories. If we use the graphical file manager, it symbolizes the files and folders.

○ Hidden files: Linux distinguishes between standard files and hidden files, mostly the configuration files are hidden in Linux OS. Usually, we don't need to access or read the hidden files. The hidden files in Linux are represented by a dot (.) before the file name (e.g., .ignore). To access the files, we need to change the view in the file manager or need to use a specific command in the shell.

Types of Linux File System

When we install the Linux operating system, Linux offers many file systems such as Ext, Ext2, Ext3, Ext4, JFS, ReiserFS, XFS, btrfs, and swap.

Types of Linux File System

Ext2 Ext JFS Ext4 Ext3 btrFS XFS Swap ReiserFS
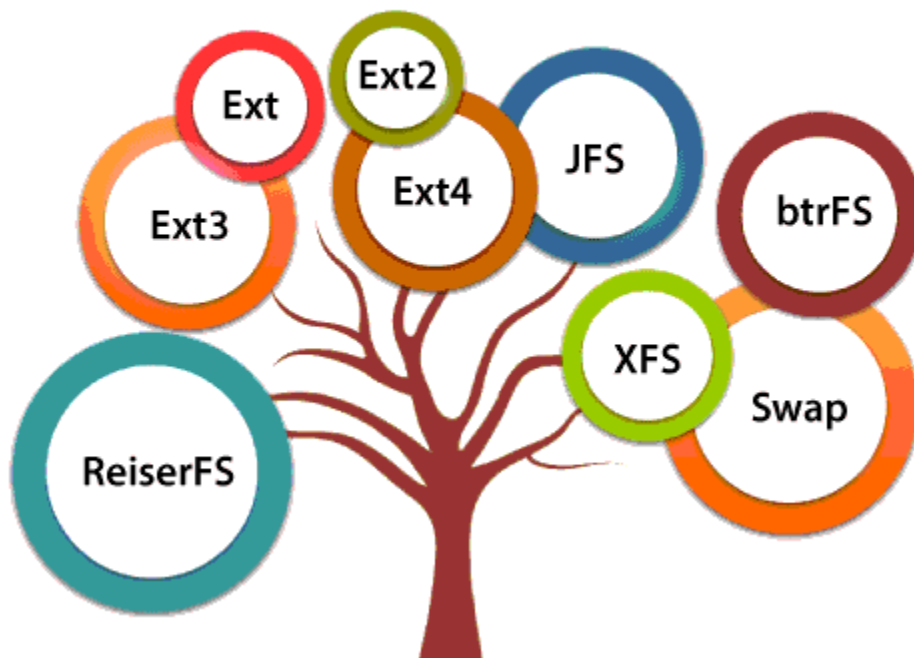
Let's understand each of these file systems in detail:

1. Ext, Ext2, Ext3 and Ext4 file system

The file system Ext stands for Extended File System. It was primarily developed for MINIX OS. The Ext file system is an older version, and is no longer used due to some limitations.

Ext2 is the first Linux file system that allows managing two terabytes of data. Ext3 is developed through Ext2; it is an upgraded version of Ext2 and contains backward compatibility. The major drawback of Ext3 is that it does not support servers because this file system does not support file recovery and disk snapshot.

Ext4 file system is the faster file system among all the Ext file systems. It is a very compatible option for the SSD (solid-state drive) disks, and it is the default file system in Linux distribution.

2. JFS File System

JFS stands for Journaled File System, and it is developed by IBM for AIX Unix. It is an alternative to the Ext file system. It can also be used in place of Ext4, where stability is needed with few resources. It is a handy file system when CPU power is limited.

3. ReiserFS File System

ReiserFS is an alternative to the Ext3 file system. It has improved performance and advanced features. In the earlier time, the ReiserFS was used as the default file system in SUSE Linux, but later it has changed some policies, so SUSE returned to Ext3. This file system dynamically supports the file extension, but it has some drawbacks in performance.

4. XFS File System

XFS file system was considered as high-speed JFS, which is developed for parallel I/O processing. NASA still using this file system with its high storage server (300+ Terabyte server).

5. Btrfs File System

Btrfs stands for the B tree file system. It is used for fault tolerance, repair system, fun administration, extensive storage configuration, and more. It is not a good suit for the production system.

6. Swap File System

The swap file system is used for memory paging in Linux operating system during the system hibernation. A system that never goes in hibernate state is required to have swap space equal to its RAM size.

Experiment 6:

<u>Commands of Linux OS</u>

1) Echo:
The echo command in Linux is a built-in command that allows users to display lines of text or strings that are passed as arguments. It is commonly used in shell scripts and batch files to output status text to the screen or a file.
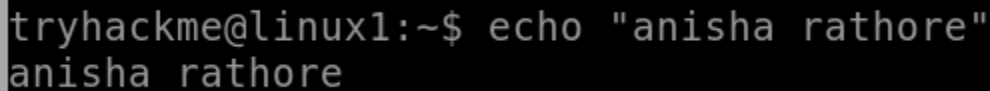
Syntax:
```
echo [option] [string]
```

Here,

[options] = The various options available for modifying the behavior of the `echo` command

[string] = It is the string that we want to display.

2) whoami:

whoami command is used both in *Unix Operating System* and as well as in *Windows Operating System*.

- It is basically the concatenation of the strings "who","am","i" as whoami.
- It displays the username of the current user when this command is invoked.
- It is similar as running the id command with the options -un.

The earliest versions were created in 2.9 BSD as a convenience form for who am i, the Berkeley Unix who command's way of printing just the logged in user's **identity. The** GNU version was written by Richard Mlynarik and is part of the GNU Core Utilities (coreutils).

Syntax:

Anisha@HP~: whoami

3) ls:

ls is a Linux shell command that lists directory contents of files and directories. It provides valuable information about files, directories, and their attributes.

Syntax:
```
ls [option] [file/directory]
```

'ls' will display the contents of the current directory. By default, 'ls' lists files and directories in alphabetical order.

4) cd:

cd command in Linux known as the change directory command. It is used to move efficiently from the current working directory to different directories in our System.

Syntax:
```
cd [directory]
```

Here, replace [directory] with the path of the destination directory you want to navigate to.

```
tryhackme@linux1:~$ cd my_anisha
tryhackme@linux1:~/my_anisha$ date
Wed Oct   4 08:12:37 UTC 2023
tryhackme@linux1:~/my_anisha$ █
```

5) cat:

Cat(concatenate) command is very frequently used in Linux. It reads data from the file and gives its content as output. It helps us to create, view, and concatenate files. So let us see some frequently used cat commands.

Syntax:

1. cat (older file name) > (newer file name)

```
tryhackme@linux1:~$ cat anisha.txt
tryhackme@linux1:~$ cat access.log█
54.36.148.184 - - [04/May/2021:06:26:27 +0000] "GET /contactme.html HTTP/1.1"
200 17512 "-" "Mozilla/5.0 (compatible; AhrefsBot/7.0; +http://ahrefs.com/robo
t/)"
176.193.62.165 - - [04/May/2021:06:28:56 +0000] "GET /category/ctf-writeup/ HT
TP/1.1" 404 3467 "https://blog.cmnatic.co.uk/" "Mozilla/5.0 (Windows NT 10.0;
WOW64) AppleWebKit/537.36 (KHTML, like Gecko) DownloaderChrome/62.0.3202.75 Sa
fari/537.36"
176.193.62.165 - - [04/May/2021:06:28:56 +0000] "GET / HTTP/1.1" 200 7704 "htt
ps://blog.cmnatic.co.uk" "Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/537
.36 (KHTML, like Gecko) DownloaderChrome/62.0.3202.75 Safari/537.36"
188.166.73.233 - - [04/May/2021:06:28:58 +0000] "GET / HTTP/1.0" 400 0 "-" "-"
34.86.35.11 - - [04/May/2021:06:34:42 +0000] "GET / HTTP/1.1" 200 18771 "-" "E
xpanse, a Palo Alto Networks company, searches across the global IPv4 space mu
ltiple times per day to identify customers&#39; presences on the Internet. If
you would like to be excluded from our scans, please send IP addresses/domains
 to: scaninfo@paloaltonetworks.com"
```

6) man:

man command in Linux is used to display the user manual of any command that we can run on the terminal. It provides a detailed view of the command which includes NAME, SYNOPSIS, DESCRIPTION, OPTIONS, EXIT STATUS, RETURN VALUES, ERRORS, FILES, VERSIONS.

Syntax :
$man [OPTION]... [COMMAND NAME]...

```
tryhackme@linux1:~/my_anisha$ man printf
PRINTF(1)                                    User Commands                                    PRINTF(1)

NAME
       printf - format and print data

SYNOPSIS
       printf FORMAT [ARGUMENT]...
       printf OPTION

DESCRIPTION
       Print ARGUMENT(s) according to FORMAT, or execute according to OPTION:

       --help display this help and exit

       --version
              output version information and exit

       FORMAT controls the output as in C printf.  Interpreted sequences are:

       \"     double quote

       \\     backslash

       \a     alert (BEL)

       \b     backspace

       \c     produce no further output

       \e     escape

       \f     form feed

       \n     new line

       \r     carriage return
```

7) whatis:

whatis command in Linux is used to get a one-line manual page description. In Linux, each manual page has some sort of description within it. So, this command search for the manual pages names and show the manual page description of the specified filename or argument.

Syntax:

whatis [option] [command_name]

[option] = replace it with the desired option of yours.

[command_name] = replace it with the desired command you want.

```
tryhackme@linux1:~/my_anisha$ whatis -h
Usage: whatis [OPTION...] KEYWORD...

  -d, --debug                 emit debugging messages
  -v, --verbose               print verbose warning messages
  -r, --regex                 interpret each keyword as a regex
  -w, --wildcard              the keyword(s) contain wildcards
  -l, --long                  do not trim output to terminal width
  -C, --config-file=FILE      use this user configuration file
  -L, --locale=LOCALE         define the locale for this search
  -m, --systems=SYSTEM        use manual pages from other systems
  -M, --manpath=PATH          set search path for manual pages to PATH
  -s, --sections=LIST, --section=LIST
                              search only these sections (colon-separated)
  -?, --help                  give this help list
      --usage                 give a short usage message
  -V, --version               print program version

Mandatory or optional arguments to long options are also mandatory or optional
for any corresponding short options.

Report bugs to cjwatson@debian.org.
tryhackme@linux1:~/my_anisha$ █
```

8) touch:

The *touch* command is a standard command used in UNIX/Linux operating system which is used to create, change and modify timestamps of a file. Basically, there are two different commands to create a file in the Linux system which is as follows:

- cat command: It is used to create the file with content.

- touch command: It is used to create a file without any content. The file created using touch command is empty. This command can be used when the user doesn't have data to store at the time of file creation.

Syntax:

touch file_name

```
tryhackme@linux1:~$ touch anisha.txt
tryhackme@linux1:~$ ls -l
total 84
-rw-rw-r-- 1 tryhackme tryhackme 65522 May 10  2021 access.log
-rw-rw-r-- 1 tryhackme tryhackme     0 Oct  4 08:03 anisha.txt
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder1
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder2
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder3
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder4
drwxrwxr-x 2 tryhackme tryhackme  4096 Oct  4 08:00 my_anisha
```

9) date:

date command is used to display the system date and time. date command is also used to set date and time of the system. By default the date command displays the date in the time zone on which unix/linux operating system is configured.You must be the super-user (root) to change the date and time.

Syntax:

date [OPTION]... [+FORMAT]

date [-u|--utc|--universal] [MMDDhhmm[[CC]YY][.ss]]

```
tryhackme@linux1:~/my_anisha$ date
Wed Oct  4 08:12:37 UTC 2023
```

10)ping:

PING (Packet Internet Groper) command is used to check the network connectivity between host and server/host. This command takes as input the IP address or the URL and sends a data packet to the specified address with the message "PING" and get a response from the server/host this time is recorded which is called latency. Fast ping low latency means faster connection. Ping uses ICMP(Internet Control Message Protocol) to send an ICMP echo message to the specified host if that host is available then it sends ICMP reply message. Ping is generally measured in millisecond every modern operating system has this ping pre-installed.

Syntax:

    ping [options] hostname or IP address

11)mkdir:

mkdir command in Linux allows the user to create directories (also referred to as folders in some operating systems). This command can create multiple directories at once as well as set the permissions for the directories. It is important to note that the user executing this command must have enough permission to create a directory in the parent directory, or he/she may receive a 'permission denied' error.

Syntax:

mkdir [options...] [directories ...]

```
tryhackme@linux1:~$ mkdir my_anisha
```

12)find:

The find command in UNIX is a command line utility for walking a file hierarchy. It can be used to find files and directories and perform subsequent operations on them. It supports searching by file, folder, name, creation date, modification date, owner and permissions. By using the '-exec' other UNIX commands can be executed on files or folders found.

Syntax:

$ find [where to start searching from]

[expression determines what to find] [-options] [what to find]

Experiment 5:

<u>LINUX FILE PERMISSIONS</u>

Linux, like other Unix-like operating systems, allows multiple users to work on the same server simultaneously without disrupting each other.

Individuals sharing access to files pose a risk exposing classified information or even data loss if other users access their files or directories. To address this, Unix added the file permission feature to specify how much power each user has over a given file or directory.

- **Check Permissions in Command-Line with Ls Command**

If you prefer using the command line, you can easily find a file's permission settings with the ls command, used to list information about files/directories. You can also add the –l option to the command to see the information in the long list format.
To check the permission configuration of a file, use the command:

```
ls -l [file_name]
```

For instance, the command for the previously mentioned file would be:

```
ls -l test.txt
```

t shows the permission settings, grouped in a string of characters (-, r, w, x) classified into four sections:

1. File type. There are three possibilities for the type. It can either be a regular file (–), a directory (d) or a link (i).

2. File permission of the user (owner)

3. File permission of the owner's group

4. File permission of other users

```
tryhackme@linux1:~$ ls
access.log  anisha.txt  folder1  folder2  folder3  folder4  my_anisha
tryhackme@linux1:~$ ls -l
total 84
-rw-rw-r-- 1 tryhackme tryhackme 65522 May 10  2021 access.log
-rw-rw-r-- 1 tryhackme tryhackme     0 Oct  4 08:03 anisha.txt
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder1
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder2
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder3
drwxr-xr-x 2 tryhackme tryhackme  4096 May 10  2021 folder4
drwxrwxr-x 2 tryhackme tryhackme  4096 Oct  4 08:00 my_anisha
```

● Using Chmod Command to Change File Permissions

As all Linux users, you will at some point need to modify the permission settings of a file/directory. The command that executes such tasks is the chmod command.

The basic syntax is:

```
chmod [permission] [file_name]
```

There are two ways to define permission:

1. using symbols (alphanumerical characters)

2. using the octal notation method

1. Define File Permission with Symbolic Mode

To specify permission settings using alphanumerical characters, you'll need to define accessibility for the user/owner (u), group (g), and others (o).

Type the initial letter for each class, followed by the equal sign (=) and the first letter of the read (r), write (w) and/or execute (x) privileges.

To set a file, so it is public for reading, writing, and executing, the command is:

```
chmod u=rwx,g=rwx,o=rwx [file_name]
```

To set permission as in the previously mentioned test.txt to be:
 • read and write for the user
 • read for the members of the group
 • read for other users

Use the following command:

```
chmod u=rw,g=r,o=r test.txt
```

2. Define File Permission in Octal/Numeric Mode

Using the octal notations table instead of 'r', 'w', and 'x'. Each digit octal notation can be used for either of the group 'u', 'g', or 'o'.

So, the following work is the same.

chmod ugo+rwx [file_name]

chmod 777 [file_name]

Both of them provide full read write and execute permission (code=7) to all the group.

●Changing User File and Group Ownership

Aside from changing file permissions, you may come across a situation that requires changing the user file ownership or even group ownership.

Performing either of these tasks requires you first need to switch to superuser privileges. Use one of the options outlined in the previous passage.

To change the file ownership use the chown command:

```
chown [user_name] [file_name]
```

Instead of `[user_name]` type in the name of the user who will be the new owner of the file.

To change the group ownership type in the following command:

```
chgrp [group_name] [file_name]
```

Instead of `[group_name]` type in the name of the group that will be the new owner of the file.

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