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File Hierarchy System

The Linux filesystem hierarchy starts with the **root** represented by a **/** character. Under the root can be found other directories containing task specific files. The hierarchy conforms to a standard called the **Linux File Hierarchy System**.

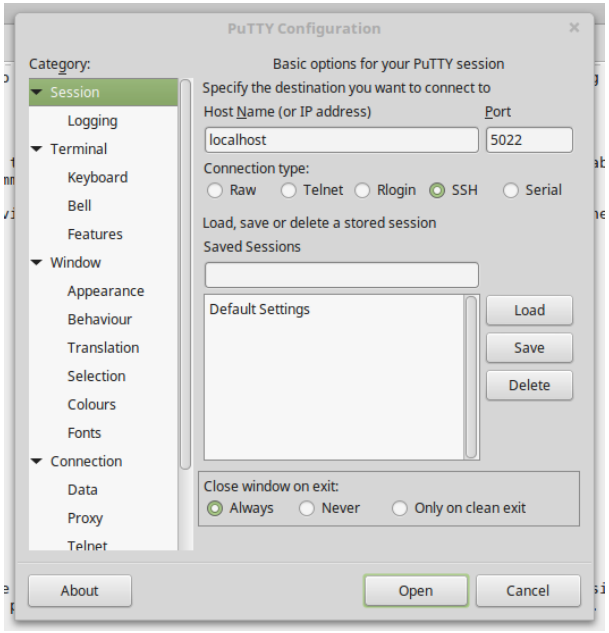
Before proceeding further, using putty or a terminal on your host system, connect to your virtual machine using the trainee account with a password of trainee via localhost and one of the following ports :

- Debian 8: 2022
- SLES 12: 3022
- Ubuntu 16.04: 4022
- CentOS 7: 5022

For example, using a terminal on a Linux host :

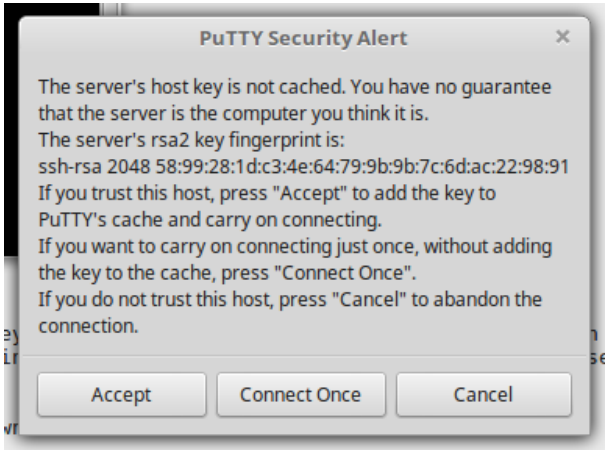
```
$ ssh -l trainee -p 5022 localhost
The authenticity of host '[localhost]:5022 ([127.0.0.1]:6022)' can't be established.
ECDSA key fingerprint is SHA256:RgOsp/XI7JHNq+oIfHKw+jkHdtTnBIh+Dd7kVmHRxtU.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '[localhost]:5022' (ECDSA) to the list of known hosts.
trainee@localhost's password: trainee
```

Using putty on a Windows™ host :



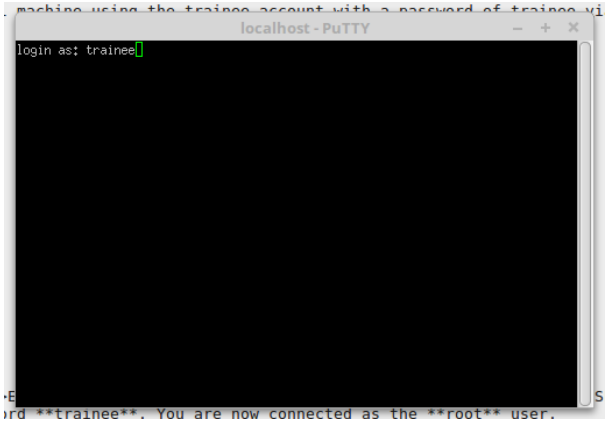
(Click on image to enlarge - note that this does not work in PDF version)

Click on the **Accept** button:



(Click on image to enlarge - note that this does not work in PDF version)

Login as trainee with password trainee :



(Click on image to enlarge - note that this does not work in PDF version)

Once connected, when using either CentOS 7, Debian 8 or SLES 12, enter the **su -** command, hit the ↵ Enter key and use the password **fenestros**. When using Ubuntu 16.04, enter the **sudo su -** command, hit the ↵ Enter key and use the password **trainee**. You are now connected as the **root** user.

Directory Contents

Directory	Contents
/bin	Contains user programs such as ls, cp e.t.c.. Note that under RHEL 7 / CentOS7, this is a soft link (shorcut) to **/usr/bin**.
/boot	Contains bootloader files, kernels and initrd (INItial Ram Disk) files.
/dev	Contains nodes for accessing all the peripherals and devices connected to the system. The *udev* binary takes care of dynamically creating and deleting the relevant nodes automatically.
/etc	Contains static configuration files.
/home	Contains a directory for each registered user of the system except for root.
/lib	Contains common 32 bit libraries for applications and modules. Note that under RHEL 7 / CentOS7, this is a soft link (shorcut) to **/usr/lib**.
/lib64	Contains common 64 bit libraries for applications and modules. Note that under RHEL 7 / CentOS7, this is a soft link (shorcut) to **/usr/lib64**.
/lost+found	Contains damaged file fragments found by the *fsck* command.
/media	Contains a folder for each of the mounted external file systems (CDRom DVDRom, USB Key e.t.c.).

Directory	Contents
/misc	**RHEL 5, 6 and CentOS 5, 6 only**. Contains mount points for local directories mounted via the automounter.
/mnt	Contains a folder for each external file system mounted temporarily by root.
/net	**RHEL 5, 6 and CentOS 5, 6 only**. Contains mount points for network directories mounted via the automounter.
/opt	Contains optional application packages.
/proc	Contains a virtual file system that documents kernel and process status information as text files.
/root	The home directory of the root user.
/run	Replaces the /var/run directory. Note that under RHEL 7 / CentOS7, Debian 7, Debian 8 and SLES 12, /var/run is a soft link (shorcut) to **/run**.
/sbin	Contains essential system administration binaires. Note that under RHEL 7 / CentOS7, this is a soft link (shorcut) to **/usr/sbin**.
/selinux	Contains a virtual file system used by SELINUX.
/snap	**Ubuntu 16.04 only**. Used in conjunction with the new **Snap** packages.
/srv	Contains site specific data **s**e**rv**ed by the system (www,ftp,databases e.t.c.).
/sys	Contains a virtual file system that describes devices for *udev*.
/tmp	Contains the temporary files created by the system and by applications.
/usr	Contains user commands in */usr/bin*, HOWTOs in */usr/share/doc*, manuals in */usr/share/man* and is the *Secondary Hierarchy* for read-only user data.
/var	Contains variable files. i.e. files that continually change such as log files and spool files.

Directory Structure

Debian

```
trainee@debian6:/$ ls -l
total 92
drwxr-xr-x   2 root root  4096  6 déc.   2014 bin
drwxr-xr-x   3 root root  4096  6 déc.   2014 boot
drwxr-xr-x  15 root root  3120 25 août  16:51 dev
drwxr-xr-x 121 root root 12288  4 juil. 15:05 etc
drwxr-xr-x   3 root root  4096 24 avril  2011 home
lrwxrwxrwx   1 root root    28 24 avril  2011 initrd.img -> boot/initrd.img-2.6.32-5-686
```

```
drwxr-xr-x  12 root root 12288  6 déc.   2014 lib
drwx------   2 root root 16384 24 avril  2011 lost+found
drwxr-xr-x   3 root root  4096 24 avril  2011 media
drwxr-xr-x   2 root root  4096 14 déc.   2010 mnt
drwxr-xr-x   4 root root  4096  4 déc.   2011 opt
dr-xr-xr-x 128 root root     0  4 juil. 14:34 proc
drwx------  11 root root  4096  7 déc.   2014 root
drwxr-xr-x   2 root root  4096  6 déc.   2014 sbin
drwxr-xr-x   2 root root  4096 21 juil.  2010 selinux
drwxr-xr-x   2 root root  4096 24 avril  2011 srv
drwxr-xr-x  12 root root     0  4 juil. 14:34 sys
drwxrwxrwt  10 root root  4096 25 août  16:34 tmp
drwxr-xr-x  10 root root  4096 24 avril  2011 usr
drwxr-xr-x  14 root root  4096 24 avril  2011 var
lrwxrwxrwx   1 root root    25 24 avril  2011 vmlinuz -> boot/vmlinuz-2.6.32-5-686
```

```
trainee@debian7:/$ ls -l
total 84
drwxr-xr-x   2 root root  4096 juin  26 16:06 bin
drwxr-xr-x   3 root root  4096 juin  26 16:09 boot
drwxr-xr-x  14 root root  3160 juil.  4 16:36 dev
drwxr-xr-x 133 root root 12288 juil.  4 16:36 etc
drwxr-xr-x   3 root root  4096 juin  26 15:42 home
lrwxrwxrwx   1 root root    32 juin  26 15:35 initrd.img -> /boot/initrd.img-3.2.0-4-686-pae
lrwxrwxrwx   1 root root    28 juin  26 15:35 initrd.img.old -> /boot/initrd.img-3.2.0-4-486
drwxr-xr-x  15 root root  4096 juin  26 16:01 lib
drwx------   2 root root 16384 juin  26 15:35 lost+found
drwxr-xr-x   3 root root  4096 juil. 15  2014 media
drwxr-xr-x   2 root root  4096 juil.  7  2014 mnt
drwxr-xr-x   2 root root  4096 juil. 15  2014 opt
dr-xr-xr-x 131 root root     0 juin  26 16:17 proc
drwx------   4 root root  4096 juil.  4 15:14 root
drwxr-xr-x  20 root root   880 juil.  4 16:36 run
drwxr-xr-x   2 root root  4096 juin  26 16:07 sbin
```

```
drwxr-xr-x   2 root root  4096 juin  10  2012 selinux
drwxr-xr-x   2 root root  4096 juil. 15  2014 srv
drwxr-xr-x  13 root root     0 juin  26 16:17 sys
drwxrwxrwt   9 root root  4096 juil.  4 16:17 tmp
drwxr-xr-x  10 root root  4096 juin  26 15:39 usr
drwxr-xr-x  12 root root  4096 juin  26 15:39 var
lrwxrwxrwx   1 root root    28 juin  26 15:39 vmlinuz -> boot/vmlinuz-3.2.0-4-686-pae
lrwxrwxrwx   1 root root    24 juin  26 15:39 vmlinuz.old -> boot/vmlinuz-3.2.0-4-486
```

```
trainee@debian8:/$ ls -l
total 84
drwxr-xr-x   2 root root  4096 juin  28 16:31 bin
drwxr-xr-x   3 root root  4096 juin  28 16:31 boot
drwxr-xr-x  17 root root  3080 juil. 23 17:04 dev
drwxr-xr-x 125 root root 12288 août  27 12:18 etc
drwxr-xr-x   3 root root  4096 juin  28 16:30 home
lrwxrwxrwx   1 root root    33 juin  28 16:26 initrd.img -> /boot/initrd.img-3.16.0-4-686-pae
lrwxrwxrwx   1 root root    29 juin  28 16:26 initrd.img.old -> /boot/initrd.img-3.16.0-4-586
drwxr-xr-x  18 root root  4096 juin  28 16:31 lib
drwxr-xr-x   2 root root  4096 juin   6 17:07 live-build
drwx------   2 root root 16384 juin  28 16:26 lost+found
drwxr-xr-x   3 root root  4096 juin   6 16:32 media
drwxr-xr-x   2 root root  4096 juin   6 16:32 mnt
drwxr-xr-x   3 root root  4096 juin  28 16:38 opt
dr-xr-xr-x 138 root root     0 juin  28 16:41 proc
drwx------   2 root root  4096 juin  28 16:35 root
drwxr-xr-x  24 root root   820 août  27 12:18 run
drwxr-xr-x   2 root root  4096 juin  28 16:39 sbin
drwxr-xr-x   2 root root  4096 juin   6 16:32 srv
dr-xr-xr-x  13 root root     0 juin  28 16:41 sys
drwxrwxrwt  12 root root  4096 juil. 23 16:17 tmp
drwxr-xr-x  10 root root  4096 juin  28 16:29 usr
drwxr-xr-x  11 root root  4096 juin  28 16:29 var
lrwxrwxrwx   1 root root    29 juin  28 16:29 vmlinuz -> boot/vmlinuz-3.16.0-4-686-pae
```

```
lrwxrwxrwx   1 root root    25 juin  28 16:29 vmlinuz.old -> boot/vmlinuz-3.16.0-4-586
```

Ubuntu

```
trainee@ubuntu1404:/$ ls -l
total 92
drwxr-xr-x   2 root root  4096 sept. 27  2014 bin
drwxr-xr-x   3 root root  4096 sept. 27  2014 boot
drwxrwxr-x   2 root root  4096 sept. 27  2014 cdrom
drwxr-xr-x  15 root root  4120 sept. 25 15:17 dev
drwxr-xr-x 131 root root 12288 sept. 25 15:17 etc
drwxr-xr-x   3 root root  4096 sept. 27  2014 home
lrwxrwxrwx   1 root root    33 sept. 27  2014 initrd.img -> boot/initrd.img-3.13.0-32-generic
drwxr-xr-x  23 root root  4096 sept. 27  2014 lib
drwx------   2 root root 16384 sept. 27  2014 lost+found
drwxr-xr-x   3 root root  4096 sept. 28  2014 media
drwxr-xr-x   2 root root  4096 avril 11  2014 mnt
drwxr-xr-x   3 root root  4096 sept. 28  2014 opt
dr-xr-xr-x 102 root root     0 sept. 25 15:17 proc
drwx------   2 root root  4096 oct.  14  2014 root
drwxr-xr-x  20 root root   700 sept. 25 15:17 run
drwxr-xr-x   2 root root 12288 sept. 28  2014 sbin
drwxr-xr-x   2 root root  4096 juil. 22  2014 srv
dr-xr-xr-x  13 root root     0 sept. 25 15:17 sys
drwxrwxrwt   4 root root  4096 sept. 25 15:17 tmp
drwxr-xr-x  10 root root  4096 juil. 22  2014 usr
drwxr-xr-x  13 root root  4096 juil. 23  2014 var
lrwxrwxrwx   1 root root    30 sept. 27  2014 vmlinuz -> boot/vmlinuz-3.13.0-32-generic
```

```
trainee@ubuntu1604:/$ ls -l
total 100
drwxr-xr-x   2 root root  4096 mai    3 07:47 bin
drwxr-xr-x   3 root root  4096 mai    3 07:49 boot
```

```
drwxrwxr-x   2 root root  4096 mai    3 07:25 cdrom
drwxr-xr-x  19 root root  4180 août  18 12:39 dev
drwxr-xr-x 129 root root 12288 sept. 25 11:12 etc
drwxr-xr-x   3 root root  4096 mai    3 07:27 home
lrwxrwxrwx   1 root root    32 mai    3 07:31 initrd.img -> boot/initrd.img-4.4.0-21-generic
drwxr-xr-x  22 root root  4096 mai    3 07:47 lib
drwxr-xr-x   2 root root  4096 avril 21 00:07 lib64
drwx------   2 root root 16384 mai    3 07:17 lost+found
drwxr-xr-x   2 root root  4096 avril 21 00:07 media
drwxr-xr-x   2 root root  4096 avril 21 00:07 mnt
drwxr-xr-x   3 root root  4096 mai    3 08:14 opt
dr-xr-xr-x 114 root root     0 août  18 12:39 proc
drwx------   4 root root  4096 mai    3 08:33 root
drwxr-xr-x  24 root root   820 sept. 25 11:40 run
drwxr-xr-x   2 root root 12288 mai    3 07:51 sbin
drwxr-xr-x   2 root root  4096 avril 19 16:31 snap
drwxr-xr-x   2 root root  4096 avril 21 00:07 srv
dr-xr-xr-x  13 root root     0 août  18 12:38 sys
drwxrwxrwt   9 root root  4096 sept. 25 11:17 tmp
drwxr-xr-x  11 root root  4096 avril 21 00:13 usr
drwxr-xr-x  14 root root  4096 avril 21 00:19 var
lrwxrwxrwx   1 root root    29 mai    3 07:31 vmlinuz -> boot/vmlinuz-4.4.0-21-generic
```

Red Hat Enterprise Linux (RHEL)/CentOS

```
[trainee@centos5 /]$ ls -l
total 138
drwxr-xr-x   2 root root  4096 août 25 13:27 bin
drwxr-xr-x   4 root root  1024 août 25 14:03 boot
drwxr-xr-x  11 root root  3800 août 25 14:06 dev
drwxr-xr-x 102 root root 12288 août 25 14:06 etc
drwxr-xr-x   3 root root  4096 août 25 13:36 home
drwxr-xr-x  14 root root  4096 août 25 13:42 lib
```

```
drwx------   2 root root 16384 août 25 13:16 lost+found
drwxr-xr-x   3 root root  4096 août 25 14:06 media
drwxr-xr-x   2 root root     0 août 25 14:06 misc
drwxr-xr-x   2 root root  4096 mai 11  2011 mnt
drwxr-xr-x   2 root root     0 août 25 14:06 net
drwxr-xr-x   4 root root  4096 août 25 13:44 opt
dr-xr-xr-x 143 root root     0 août 25 14:05 proc
drwxr-x---   4 root root  4096 août 25 14:01 root
drwxr-xr-x   2 root root 12288 août 25 14:03 sbin
drwxr-xr-x   4 root root     0 août 25 14:05 selinux
drwxr-xr-x   2 root root  4096 mai 11  2011 srv
drwxr-xr-x  11 root root     0 août 25 14:05 sys
drwxrwxrwt  14 root root  4096 août 25 14:09 tmp
drwxr-xr-x  14 root root  4096 août 25 13:23 usr
drwxr-xr-x  21 root root  4096 août 25 13:31 var
```

```
[trainee@centos6 /]$ ls -l
total 98
dr-xr-xr-x.   2 root root  4096  9 août  12:52 bin
dr-xr-xr-x.   5 root root  1024  7 déc.   2014 boot
drwxr-xr-x.  19 root root  3820 25 août  11:29 dev
drwxr-xr-x. 119 root root 12288 25 août  11:28 etc
drwxr-xr-x.   3 root root  4096  3 mai    2013 home
dr-xr-xr-x.  20 root root 12288  9 août  12:52 lib
drwx------.   2 root root 16384  3 mai    2013 lost+found
drwxr-xr-x.   2 root root  4096  7 déc.   2014 media
drwxr-xr-x.   2 root root     0 25 août  11:28 misc
drwxr-xr-x.   3 root root  4096  5 juil. 12:22 mnt
drwxr-xr-x.   2 root root     0 25 août  11:28 net
drwxr-xr-x.   6 root root  4096  7 déc.   2014 opt
dr-xr-xr-x. 154 root root     0 25 août  11:27 proc
dr-xr-x---.  10 root root  4096  9 août  12:58 root
dr-xr-xr-x.   2 root root 12288  9 août  12:52 sbin
drwxr-xr-x.   7 root root     0 25 août  11:27 selinux
```

```
drwxr-xr-x.   2 root root  4096 23 sept.  2011 srv
drwxr-xr-x.  13 root root     0 25 août  11:27 sys
drwxrwxrwt.  16 root root  4096 25 août  11:30 tmp
drwxr-xr-x.  13 root root  4096  3 mai    2013 usr
drwxr-xr-x.  22 root root  4096  9 août  12:50 var
```

```
[trainee@centos7 /]$ ls -l
total 32
lrwxrwxrwx.   1 root root    7 Mar  8 13:41 bin -> usr/bin
dr-xr-xr-x.   4 root root 4096 Jun  4 15:00 boot
drwxr-xr-x.  19 root root 3280 Jul  7 15:55 dev
drwxr-xr-x. 131 root root 8192 Jul 23 17:05 etc
drwxr-xr-x.   4 root root   47 Jul  5 14:11 home
lrwxrwxrwx.   1 root root    7 Mar  8 13:41 lib -> usr/lib
lrwxrwxrwx.   1 root root    9 Mar  8 13:41 lib64 -> usr/lib64
drwxr-xr-x.   2 root root    6 Jun 10  2014 media
drwxr-xr-x.   3 root root   18 Jul  5 13:57 mnt
drwxr-xr-x.   4 root root   47 Jun  4 09:36 opt
dr-xr-xr-x. 177 root root    0 Jul  7 15:53 proc
dr-xr-x---.   5 root root 4096 Aug 25 11:31 root
drwxr-xr-x.  35 root root 1100 Jul 23 15:40 run
lrwxrwxrwx.   1 root root    8 Mar  8 13:41 sbin -> usr/sbin
drwxr-xr-x.   2 root root    6 Jun 10  2014 srv
dr-xr-xr-x.  13 root root    0 Jul  7 15:53 sys
drwxrwxrwt.  25 root root 4096 Jul 23 15:40 tmp
drwxr-xr-x.  13 root root 4096 Mar  8 13:41 usr
drwxr-xr-x.  22 root root 4096 Jul  7 15:53 var
```

SUSE Linux Enterprise Server (SLES)

```
trainee@SLES11SP1:/> ls -l
total 101
drwxr-xr-x  2 root root  4096 25 sept. 15:48 bin
```

```
drwxr-xr-x  4 root root  1024 25 sept. 17:08 boot
drwxr-xr-x 16 root root  4020 25 sept. 17:08 dev
drwxr-xr-x 88 root root 12288 25 sept. 17:14 etc
drwxr-xr-x  3 root root  4096 25 sept. 15:55 home
drwxr-xr-x 13 root root  4096 25 sept. 15:49 lib
drwxr-xr-x  8 root root 12288 25 sept. 15:48 lib64
drwx------  2 root root 16384 25 sept. 15:43 lost+found
drwxr-xr-x  2 root root  4096  5 mai    2010 media
drwxr-xr-x  2 root root  4096  5 mai    2010 mnt
drwxr-xr-x  2 root root  4096  5 mai    2010 opt
dr-xr-xr-x 88 root root     0 25 sept. 17:07 proc
drwx------  6 root root  4096 25 sept. 17:14 root
drwxr-xr-x  3 root root 12288 25 sept. 15:50 sbin
drwxr-xr-x  2 root root  4096  5 mai    2010 selinux
drwxr-xr-x  4 root root  4096 25 sept. 15:43 srv
drwxr-xr-x 12 root root     0 25 sept. 17:07 sys
drwxrwxrwt  4 root root  4096 25 sept. 17:22 tmp
drwxr-xr-x 13 root root  4096 25 sept. 15:43 usr
drwxr-xr-x 15 root root  4096 25 sept. 15:44 var
```

```
trainee@SLES12SP1:/> ls -l
total 0
drwxr-xr-x   1 root root 1810 20 sept. 13:33 bin
drwxr-xr-x   1 root root 1096 21 sept. 04:19 boot
drwxr-xr-x  16 root root 3620 21 sept. 04:18 dev
drwxr-xr-x   1 root root 4746 21 sept. 04:18 etc
drwxr-xr-x   1 root root   14 20 sept. 13:34 home
drwxr-xr-x   1 root root 2906 20 sept. 13:32 lib
drwxr-xr-x   1 root root 4998 20 sept. 13:31 lib64
drwxr-xr-x   1 root root    0 21 sept.  2014 mnt
drwxr-xr-x   1 root root    0 21 sept.  2014 opt
dr-xr-xr-x 100 root root    0 20 sept. 13:47 proc
drwx------   1 root root  112 20 sept. 14:00 root
drwxr-xr-x  25 root root  640 21 sept. 04:18 run
```

```
drwxr-xr-x   1 root root 5044 20 sept. 13:33 sbin
drwxr-xr-x   1 root root    0 21 sept.  2014 selinux
drwxr-xr-x   1 root root   12 20 sept. 13:29 srv
dr-xr-xr-x  12 root root    0 20 sept. 13:47 sys
drwxrwxrwt   1 root root  102 21 sept. 04:18 tmp
drwxr-xr-x   1 root root  130 20 sept. 13:29 usr
drwxr-xr-x   1 root root  108 20 sept. 13:33 var
```

File Types

The three major file types under Linux are :

- Ordinary files,
- Directories,
- Special files or Devices.

Note that :

- Ordinary files can be anything from text files to binaries.
- The length of a file name is limited to 225 characters, including the file extension.
- Linux is case sensitive.
- If a file name starts with a dot (**.**), it is a hidden file.

The mount command

In order to be able to use external file systems, such as a CDRom or DVDRom, Linux needs to be informed of their availability. This is accomplished by using the **mount** command:

```
# mount /dev/<special_file> /mnt/<directory_name> [Enter]
```

where **/dev/<special_file>** is the file system to mount and **/mnt/<directory_name>** is the target directory where the mounted file system will be available to the system. The directory **/mnt/<directory_name>** must exist prior to using the **mount** command.

In the case where the **mount** command is used without options, the current mounted file systems are shown:

Debian

```
root@debian6:~# mount
/dev/sda1 on / type ext3 (rw,errors=remount-ro)
tmpfs on /lib/init/rw type tmpfs (rw,nosuid,mode=0755)
proc on /proc type proc (rw,noexec,nosuid,nodev)
sysfs on /sys type sysfs (rw,noexec,nosuid,nodev)
udev on /dev type tmpfs (rw,mode=0755)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev)
devpts on /dev/pts type devpts (rw,noexec,nosuid,gid=5,mode=620)
fusectl on /sys/fs/fuse/connections type fusectl (rw)
binfmt_misc on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,noexec,nosuid,nodev)
```

```
root@debian7:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,relatime,size=10240k,nr_inodes=127976,mode=755)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,noexec,relatime,size=103420k,mode=755)
/dev/disk/by-uuid/0f1cdb0c-8bd7-45ec-8d99-064292047bdb on / type ext4 (rw,relatime,errors=remount-
ro,user_xattr,barrier=1,data=ordered)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
tmpfs on /run/shm type tmpfs (rw,nosuid,nodev,noexec,relatime,size=597180k)
rpc_pipefs on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw,relatime)
binfmt_misc on /proc/sys/fs/binfmt_misc type binfmt_misc (rw,nosuid,nodev,noexec,relatime)
```

```
root@debian8:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
```

```
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,relatime,size=10240k,nr_inodes=126281,mode=755)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,relatime,size=206376k,mode=755)
/dev/sda1 on / type ext4 (rw,relatime,errors=remount-ro,data=ordered)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
tmpfs on /sys/fs/cgroup type tmpfs (ro,nosuid,nodev,noexec,mode=755)
cgroup on /sys/fs/cgroup/systemd type cgroup
(rw,nosuid,nodev,noexec,relatime,xattr,release_agent=/lib/systemd/systemd-cgroups-agent,name=systemd)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
cgroup on /sys/fs/cgroup/cpuset type cgroup (rw,nosuid,nodev,noexec,relatime,cpuset)
cgroup on /sys/fs/cgroup/cpu,cpuacct type cgroup (rw,nosuid,nodev,noexec,relatime,cpu,cpuacct)
cgroup on /sys/fs/cgroup/devices type cgroup (rw,nosuid,nodev,noexec,relatime,devices)
cgroup on /sys/fs/cgroup/freezer type cgroup (rw,nosuid,nodev,noexec,relatime,freezer)
cgroup on /sys/fs/cgroup/net_cls,net_prio type cgroup (rw,nosuid,nodev,noexec,relatime,net_cls,net_prio)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,blkio)
cgroup on /sys/fs/cgroup/perf_event type cgroup (rw,nosuid,nodev,noexec,relatime,perf_event)
tmpfs on /etc/machine-id type tmpfs (ro,relatime,size=206376k,mode=755)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs
(rw,relatime,fd=22,pgrp=1,timeout=300,minproto=5,maxproto=5,direct)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime)
mqueue on /dev/mqueue type mqueue (rw,relatime)
debugfs on /sys/kernel/debug type debugfs (rw,relatime)
fusectl on /sys/fs/fuse/connections type fusectl (rw,relatime)
rpc_pipefs on /run/rpc_pipefs type rpc_pipefs (rw,relatime)
tmpfs on /run/user/119 type tmpfs (rw,nosuid,nodev,relatime,size=103188k,mode=700,uid=119,gid=127)
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relatime,size=103188k,mode=700,uid=1000,gid=1000)
```

Ubuntu

```
trainee@ubuntu1404:/$ mount
```

```
/dev/sda1 on / type ext4 (rw,errors=remount-ro)
proc on /proc type proc (rw,noexec,nosuid,nodev)
sysfs on /sys type sysfs (rw,noexec,nosuid,nodev)
none on /sys/fs/cgroup type tmpfs (rw)
none on /sys/fs/fuse/connections type fusectl (rw)
none on /sys/kernel/debug type debugfs (rw)
none on /sys/kernel/security type securityfs (rw)
udev on /dev type devtmpfs (rw,mode=0755)
devpts on /dev/pts type devpts (rw,noexec,nosuid,gid=5,mode=0620)
tmpfs on /run type tmpfs (rw,noexec,nosuid,size=10%,mode=0755)
none on /run/lock type tmpfs (rw,noexec,nosuid,nodev,size=5242880)
none on /run/shm type tmpfs (rw,nosuid,nodev)
none on /run/user type tmpfs (rw,noexec,nosuid,nodev,size=104857600,mode=0755)
none on /sys/fs/pstore type pstore (rw)
systemd on /sys/fs/cgroup/systemd type cgroup (rw,noexec,nosuid,nodev,none,name=systemd)
```

```
root@ubuntu1604:~# mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
udev on /dev type devtmpfs (rw,nosuid,relatime,size=230832k,nr_inodes=57708,mode=755)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,noexec,relatime,size=50028k,mode=755)
/dev/sda1 on / type ext4 (rw,relatime,errors=remount-ro,data=ordered)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev)
tmpfs on /run/lock type tmpfs (rw,nosuid,nodev,noexec,relatime,size=5120k)
tmpfs on /sys/fs/cgroup type tmpfs (ro,nosuid,nodev,noexec,mode=755)
cgroup on /sys/fs/cgroup/systemd type cgroup
(rw,nosuid,nodev,noexec,relatime,xattr,release_agent=/lib/systemd/systemd-cgroups-agent,name=systemd,nsroot=/)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
cgroup on /sys/fs/cgroup/hugetlb type cgroup (rw,nosuid,nodev,noexec,relatime,hugetlb,nsroot=/)
cgroup on /sys/fs/cgroup/memory type cgroup (rw,nosuid,nodev,noexec,relatime,memory,nsroot=/)
cgroup on /sys/fs/cgroup/freezer type cgroup (rw,nosuid,nodev,noexec,relatime,freezer,nsroot=/)
cgroup on /sys/fs/cgroup/cpuset type cgroup (rw,nosuid,nodev,noexec,relatime,cpuset,nsroot=/)
```

```
cgroup on /sys/fs/cgroup/pids type cgroup (rw,nosuid,nodev,noexec,relatime,pids,nsroot=/)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,blkio,nsroot=/)
cgroup on /sys/fs/cgroup/net_cls,net_prio type cgroup (rw,nosuid,nodev,noexec,relatime,net_cls,net_prio,nsroot=/)
cgroup on /sys/fs/cgroup/perf_event type cgroup (rw,nosuid,nodev,noexec,relatime,perf_event,nsroot=/)
cgroup on /sys/fs/cgroup/devices type cgroup (rw,nosuid,nodev,noexec,relatime,devices,nsroot=/)
cgroup on /sys/fs/cgroup/cpu,cpuacct type cgroup (rw,nosuid,nodev,noexec,relatime,cpu,cpuacct,nsroot=/)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs
(rw,relatime,fd=22,pgrp=1,timeout=0,minproto=5,maxproto=5,direct)
mqueue on /dev/mqueue type mqueue (rw,relatime)
debugfs on /sys/kernel/debug type debugfs (rw,relatime)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime)
fusectl on /sys/fs/fuse/connections type fusectl (rw,relatime)
tmpfs on /run/user/1000 type tmpfs (rw,nosuid,nodev,relatime,size=50028k,mode=700,uid=1000,gid=1000)
```

RHEL/CentOS

```
[root@centos5 ~]# mount
/dev/sda2 on / type ext3 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/sda1 on /boot type ext3 (rw)
tmpfs on /dev/shm type tmpfs (rw)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
```

```
[root@centos6 /]# mount
/dev/sda2 on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw)
/dev/sda1 on /boot type ext3 (rw)
```

```
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw)
```

```
[root@centos7 ~]# mount
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime,seclabel)
devtmpfs on /dev type devtmpfs (rw,nosuid,seclabel,size=1449668k,nr_inodes=362417,mode=755)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev,seclabel)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,seclabel,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,seclabel,mode=755)
tmpfs on /sys/fs/cgroup type tmpfs (rw,nosuid,nodev,noexec,seclabel,mode=755)
cgroup on /sys/fs/cgroup/systemd type cgroup
(rw,nosuid,nodev,noexec,relatime,xattr,release_agent=/usr/lib/systemd/systemd-cgroups-agent,name=systemd)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
cgroup on /sys/fs/cgroup/cpuset type cgroup (rw,nosuid,nodev,noexec,relatime,cpuset)
cgroup on /sys/fs/cgroup/cpu,cpuacct type cgroup (rw,nosuid,nodev,noexec,relatime,cpuacct,cpu)
cgroup on /sys/fs/cgroup/memory type cgroup (rw,nosuid,nodev,noexec,relatime,memory)
cgroup on /sys/fs/cgroup/devices type cgroup (rw,nosuid,nodev,noexec,relatime,devices)
cgroup on /sys/fs/cgroup/freezer type cgroup (rw,nosuid,nodev,noexec,relatime,freezer)
cgroup on /sys/fs/cgroup/net_cls type cgroup (rw,nosuid,nodev,noexec,relatime,net_cls)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,blkio)
cgroup on /sys/fs/cgroup/perf_event type cgroup (rw,nosuid,nodev,noexec,relatime,perf_event)
cgroup on /sys/fs/cgroup/hugetlb type cgroup (rw,nosuid,nodev,noexec,relatime,hugetlb)
configfs on /sys/kernel/config type configfs (rw,relatime)
/dev/sda2 on / type xfs (rw,relatime,seclabel,attr2,inode64,noquota)
selinuxfs on /sys/fs/selinux type selinuxfs (rw,relatime)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs
(rw,relatime,fd=32,pgrp=1,timeout=300,minproto=5,maxproto=5,direct)
debugfs on /sys/kernel/debug type debugfs (rw,relatime)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime,seclabel)
mqueue on /dev/mqueue type mqueue (rw,relatime,seclabel)
sunrpc on /var/lib/nfs/rpc_pipefs type rpc_pipefs (rw,relatime)
nfsd on /proc/fs/nfsd type nfsd (rw,relatime)
```

```
/dev/sda1 on /boot type xfs (rw,relatime,seclabel,attr2,inode64,noquota)
fusectl on /sys/fs/fuse/connections type fusectl (rw,relatime)
gvfsd-fuse on /run/user/1000/gvfs type fuse.gvfsd-fuse (rw,nosuid,nodev,relatime,user_id=1000,group_id=1000)
```

SLES

```
SLES11SP1:~ # mount
/dev/sda2 on / type ext3 (rw,acl,user_xattr)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
debugfs on /sys/kernel/debug type debugfs (rw)
udev on /dev type tmpfs (rw,mode=0755)
tmpfs on /dev/shm type tmpfs (rw,mode=1777)
devpts on /dev/pts type devpts (rw,mode=0620,gid=5)
/dev/sda1 on /boot type ext3 (rw,acl,user_xattr)
fusectl on /sys/fs/fuse/connections type fusectl (rw)
securityfs on /sys/kernel/security type securityfs (rw)
```

```
SLES12SP1:~ # mount
sysfs on /sys type sysfs (rw,nosuid,nodev,noexec,relatime)
proc on /proc type proc (rw,nosuid,nodev,noexec,relatime)
devtmpfs on /dev type devtmpfs (rw,nosuid,size=1931968k,nr_inodes=482992,mode=755)
securityfs on /sys/kernel/security type securityfs (rw,nosuid,nodev,noexec,relatime)
tmpfs on /dev/shm type tmpfs (rw,nosuid,nodev)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,mode=755)
tmpfs on /sys/fs/cgroup type tmpfs (rw,nosuid,nodev,noexec,mode=755)
cgroup on /sys/fs/cgroup/systemd type cgroup
(rw,nosuid,nodev,noexec,relatime,xattr,release_agent=/usr/lib/systemd/systemd-cgroups-agent,name=systemd)
pstore on /sys/fs/pstore type pstore (rw,nosuid,nodev,noexec,relatime)
cgroup on /sys/fs/cgroup/cpuset type cgroup (rw,nosuid,nodev,noexec,relatime,cpuset)
cgroup on /sys/fs/cgroup/cpu,cpuacct type cgroup (rw,nosuid,nodev,noexec,relatime,cpuacct,cpu)
cgroup on /sys/fs/cgroup/memory type cgroup (rw,nosuid,nodev,noexec,relatime,memory)
```

```
cgroup on /sys/fs/cgroup/devices type cgroup (rw,nosuid,nodev,noexec,relatime,devices)
cgroup on /sys/fs/cgroup/freezer type cgroup (rw,nosuid,nodev,noexec,relatime,freezer)
cgroup on /sys/fs/cgroup/blkio type cgroup (rw,nosuid,nodev,noexec,relatime,blkio)
cgroup on /sys/fs/cgroup/perf_event type cgroup (rw,nosuid,nodev,noexec,relatime,perf_event)
cgroup on /sys/fs/cgroup/hugetlb type cgroup (rw,nosuid,nodev,noexec,relatime,hugetlb)
/dev/sda2 on / type btrfs (rw,relatime,space_cache,subvolid=259,subvol=/@/.snapshots/1/snapshot)
systemd-1 on /proc/sys/fs/binfmt_misc type autofs
(rw,relatime,fd=31,pgrp=1,timeout=300,minproto=5,maxproto=5,direct)
mqueue on /dev/mqueue type mqueue (rw,relatime)
debugfs on /sys/kernel/debug type debugfs (rw,relatime)
hugetlbfs on /dev/hugepages type hugetlbfs (rw,relatime)
/dev/sda2 on /.snapshots type btrfs (rw,relatime,space_cache,subvolid=258,subvol=/@/.snapshots)
/dev/sda2 on /var/lib/mailman type btrfs (rw,relatime,space_cache,subvolid=269,subvol=/@/var/lib/mailman)
/dev/sda2 on /var/lib/mariadb type btrfs (rw,relatime,space_cache,subvolid=270,subvol=/@/var/lib/mariadb)
/dev/sda2 on /var/log type btrfs (rw,relatime,space_cache,subvolid=274,subvol=/@/var/log)
/dev/sda2 on /tmp type btrfs (rw,relatime,space_cache,subvolid=265,subvol=/@/tmp)
/dev/sda2 on /var/spool type btrfs (rw,relatime,space_cache,subvolid=276,subvol=/@/var/spool)
/dev/sda2 on /var/lib/named type btrfs (rw,relatime,space_cache,subvolid=272,subvol=/@/var/lib/named)
/dev/sda2 on /srv type btrfs (rw,relatime,space_cache,subvolid=264,subvol=/@/srv)
/dev/sda2 on /usr/local type btrfs (rw,relatime,space_cache,subvolid=266,subvol=/@/usr/local)
/dev/sda2 on /var/opt type btrfs (rw,relatime,space_cache,subvolid=275,subvol=/@/var/opt)
/dev/sda2 on /var/lib/pgsql type btrfs (rw,relatime,space_cache,subvolid=273,subvol=/@/var/lib/pgsql)
/dev/sda2 on /opt type btrfs (rw,relatime,space_cache,subvolid=263,subvol=/@/opt)
/dev/sda2 on /var/tmp type btrfs (rw,relatime,space_cache,subvolid=277,subvol=/@/var/tmp)
/dev/sda2 on /var/lib/mysql type btrfs (rw,relatime,space_cache,subvolid=271,subvol=/@/var/lib/mysql)
/dev/sda2 on /var/lib/libvirt/images type btrfs
(rw,relatime,space_cache,subvolid=268,subvol=/@/var/lib/libvirt/images)
/dev/sda2 on /var/crash type btrfs (rw,relatime,space_cache,subvolid=267,subvol=/@/var/crash)
/dev/sda2 on /home type btrfs (rw,relatime,space_cache,subvolid=262,subvol=/@/home)
/dev/sda2 on /boot/grub2/x86_64-efi type btrfs (rw,relatime,space_cache,subvolid=261,subvol=/@/boot/grub2/x86_64-
efi)
/dev/sda2 on /boot/grub2/i386-pc type btrfs (rw,relatime,space_cache,subvolid=260,subvol=/@/boot/grub2/i386-pc)
```

Important : Note that under RHEL 5 / CentOS 5, Debian 6 and SLES 11, the default filesystem is **ext3**, under RHEL 6 / CentOS 6, Debian 7, Debian 8, Ubuntu 14.04 and Ubuntu 16.04, the default filesystem is **ext4**, under RHEL 7 / CentOS the default filesystem is **xfs** whilst under SLES 12, the default filesystem is **btrfs**. Please see the unit **Managing Disks, Swap Space and Filesystems** for further coursework concerning ext3, ext4, xfs and btrfs filesystems.

Command Line Switches

The following switches can be used with the mount command:

```
root@debian8:~# mount --help

Usage:
 mount [-lhV]
 mount -a [options]
 mount [options] [--source] <source> | [--target] <directory>
 mount [options] <source> <directory>
 mount <operation> <mountpoint> [<target>]

Options:
 -a, --all               mount all filesystems mentioned in fstab
 -c, --no-canonicalize   don't canonicalize paths
 -f, --fake              dry run; skip the mount(2) syscall
 -F, --fork              fork off for each device (use with -a)
 -T, --fstab <path>      alternative file to /etc/fstab
 -h, --help              display this help text and exit
 -i, --internal-only     don't call the mount.<type> helpers
 -l, --show-labels       lists all mounts with LABELs
 -n, --no-mtab           don't write to /etc/mtab
 -o, --options <list>    comma-separated list of mount options
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
```

```
 -r, --read-only         mount the filesystem read-only (same as -o ro)
 -t, --types <list>      limit the set of filesystem types
     --source <src>      explicitly specifies source (path, label, uuid)
     --target <target>   explicitly specifies mountpoint
 -v, --verbose           say what is being done
 -V, --version           display version information and exit
 -w, --rw, --read-write  mount the filesystem read-write (default)

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

Source:
 -L, --label <label>     synonym for LABEL=<label>
 -U, --uuid <uuid>       synonym for UUID=<uuid>
 LABEL=<label>           specifies device by filesystem label
 UUID=<uuid>             specifies device by filesystem UUID
 PARTLABEL=<label>       specifies device by partition label
 PARTUUID=<uuid>         specifies device by partition UUID
 <device>                specifies device by path
 <directory>             mountpoint for bind mounts (see --bind/rbind)
 <file>                  regular file for loopdev setup

Operations:
 -B, --bind              mount a subtree somewhere else (same as -o bind)
 -M, --move              move a subtree to some other place
 -R, --rbind             mount a subtree and all submounts somewhere else
 --make-shared           mark a subtree as shared
 --make-slave            mark a subtree as slave
 --make-private          mark a subtree as private
 --make-unbindable       mark a subtree as unbindable
 --make-rshared          recursively mark a whole subtree as shared
 --make-rslave           recursively mark a whole subtree as slave
 --make-rprivate         recursively mark a whole subtree as private
 --make-runbindable      recursively mark a whole subtree as unbindable
```

```
For more details see mount(8).
```

```
root@ubuntu1604:~# mount --help

Usage:
 mount [-lhV]
 mount -a [options]
 mount [options] [--source] <source> | [--target] <directory>
 mount [options] <source> <directory>
 mount <operation> <mountpoint> [<target>]

Mount a filesystem.

Options:
 -a, --all               mount all filesystems mentioned in fstab
 -c, --no-canonicalize   don't canonicalize paths
 -f, --fake              dry run; skip the mount(2) syscall
 -F, --fork              fork off for each device (use with -a)
 -T, --fstab <path>      alternative file to /etc/fstab
 -i, --internal-only     don't call the mount.<type> helpers
 -l, --show-labels       show also filesystem labels
 -n, --no-mtab           don't write to /etc/mtab
 -o, --options <list>    comma-separated list of mount options
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -r, --read-only         mount the filesystem read-only (same as -o ro)
 -t, --types <list>      limit the set of filesystem types
     --source <src>      explicitly specifies source (path, label, uuid)
     --target <target>   explicitly specifies mountpoint
 -v, --verbose           say what is being done
 -w, --rw, --read-write  mount the filesystem read-write (default)

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

```
Source:
 -L, --label <label>     synonym for LABEL=<label>
 -U, --uuid <uuid>       synonym for UUID=<uuid>
 LABEL=<label>           specifies device by filesystem label
 UUID=<uuid>             specifies device by filesystem UUID
 PARTLABEL=<label>       specifies device by partition label
 PARTUUID=<uuid>         specifies device by partition UUID
 <device>                specifies device by path
 <directory>             mountpoint for bind mounts (see --bind/rbind)
 <file>                  regular file for loopdev setup

Operations:
 -B, --bind              mount a subtree somewhere else (same as -o bind)
 -M, --move              move a subtree to some other place
 -R, --rbind             mount a subtree and all submounts somewhere else
 --make-shared           mark a subtree as shared
 --make-slave            mark a subtree as slave
 --make-private          mark a subtree as private
 --make-unbindable       mark a subtree as unbindable
 --make-rshared          recursively mark a whole subtree as shared
 --make-rslave           recursively mark a whole subtree as slave
 --make-rprivate         recursively mark a whole subtree as private
 --make-runbindable      recursively mark a whole subtree as unbindable

For more details see mount(8).
```

```
[root@centos7 ~]# mount --help

Usage:
 mount [-lhV]
 mount -a [options]
 mount [options] [--source] <source> | [--target] <directory>
 mount [options] <source> <directory>
 mount <operation> <mountpoint> [<target>]
```

```
Options:
 -a, --all               mount all filesystems mentioned in fstab
 -c, --no-canonicalize   don't canonicalize paths
 -f, --fake              dry run; skip the mount(2) syscall
 -F, --fork              fork off for each device (use with -a)
 -T, --fstab <path>      alternative file to /etc/fstab
 -h, --help              display this help text and exit
 -i, --internal-only     don't call the mount.<type> helpers
 -l, --show-labels       lists all mounts with LABELs
 -n, --no-mtab           don't write to /etc/mtab
 -o, --options <list>    comma-separated list of mount options
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -r, --read-only         mount the filesystem read-only (same as -o ro)
 -t, --types <list>      limit the set of filesystem types
     --source <src>      explicitly specifies source (path, label, uuid)
     --target <target>   explicitly specifies mountpoint
 -v, --verbose           say what is being done
 -V, --version           display version information and exit
 -w, --rw, --read-write  mount the filesystem read-write (default)

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

Source:
 -L, --label <label>     synonym for LABEL=<label>
 -U, --uuid <uuid>       synonym for UUID=<uuid>
 LABEL=<label>           specifies device by filesystem label
 UUID=<uuid>             specifies device by filesystem UUID
 PARTLABEL=<label>       specifies device by partition label
 PARTUUID=<uuid>         specifies device by partition UUID
 <device>                specifies device by path
 <directory>             mountpoint for bind mounts (see --bind/rbind)
 <file>                  regular file for loopdev setup
```

```
Operations:
 -B, --bind              mount a subtree somewhere else (same as -o bind)
 -M, --move              move a subtree to some other place
 -R, --rbind             mount a subtree and all submounts somewhere else
 --make-shared           mark a subtree as shared
 --make-slave            mark a subtree as slave
 --make-private          mark a subtree as private
 --make-unbindable       mark a subtree as unbindable
 --make-rshared          recursively mark a whole subtree as shared
 --make-rslave           recursively mark a whole subtree as slave
 --make-rprivate         recursively mark a whole subtree as private
 --make-runbindable      recursively mark a whole subtree as unbindable

For more details see mount(8).
```

```
SLES12SP1:~ # mount --help

Usage:
 mount [-lhV]
 mount -a [options]
 mount [options] [--source] <source> | [--target] <directory>
 mount [options] <source> <directory>
 mount <operation> <mountpoint> [<target>]

Options:
 -a, --all               mount all filesystems mentioned in fstab
 -c, --no-canonicalize   don't canonicalize paths
 -f, --fake              dry run; skip the mount(2) syscall
 -F, --fork              fork off for each device (use with -a)
 -T, --fstab <path>      alternative file to /etc/fstab
 -h, --help              display this help text and exit
 -i, --internal-only     don't call the mount.<type> helpers
 -l, --show-labels       lists all mounts with LABELs
 -n, --no-mtab           don't write to /etc/mtab
```

```
 -o, --options <list>    comma-separated list of mount options
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -r, --read-only         mount the filesystem read-only (same as -o ro)
 -t, --types <list>      limit the set of filesystem types
     --source <src>      explicitly specifies source (path, label, uuid)
     --target <target>   explicitly specifies mountpoint
 -v, --verbose           say what is being done
 -V, --version           display version information and exit
 -w, --rw, --read-write  mount the filesystem read-write (default)

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

Source:
 -L, --label <label>     synonym for LABEL=<label>
 -U, --uuid <uuid>       synonym for UUID=<uuid>
 LABEL=<label>           specifies device by filesystem label
 UUID=<uuid>             specifies device by filesystem UUID
 PARTLABEL=<label>       specifies device by partition label
 PARTUUID=<uuid>         specifies device by partition UUID
 <device>                specifies device by path
 <directory>             mountpoint for bind mounts (see --bind/rbind)
 <file>                  regular file for loopdev setup

Operations:
 -B, --bind              mount a subtree somewhere else (same as -o bind)
 -M, --move              move a subtree to some other place
 -R, --rbind             mount a subtree and all submounts somewhere else
 --make-shared           mark a subtree as shared
 --make-slave            mark a subtree as slave
 --make-private          mark a subtree as private
 --make-unbindable       mark a subtree as unbindable
 --make-rshared          recursively mark a whole subtree as shared
 --make-rslave           recursively mark a whole subtree as slave
```

```
 --make-rprivate         recursively mark a whole subtree as private
 --make-runbindable      recursively mark a whole subtree as unbindable

For more details see mount(8).
```

The /etc/fstab file

In the case where the **mount** command is used with the **-a** option, all mount points specified in the **/etc/fstab** file are mounted:

Debian

```
root@debian6:~# cat /etc/fstab
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point>   <type>  <options>       <dump>  <pass>
proc            /proc           proc    defaults        0       0
# / was on /dev/sda1 during installation
UUID=a42a1ddd-14bc-4dde-a537-e6c1b984a782 /               ext3    errors=remount-ro 0       1
# swap was on /dev/sda5 during installation
UUID=e21d8931-21ca-4ab3-9fbb-bd71657b312e none            swap    sw              0       0
```

```
root@debian7:~# cat /etc/fstab
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
```

```
#
# <file system> <mount point>   <type>  <options>       <dump>  <pass>
# / was on /dev/sda1 during installation
UUID=0f1cdb0c-8bd7-45ec-8d99-064292047bdb /               ext4    errors=remount-ro 0       1
# swap was on /dev/sda5 during installation
UUID=ae5f67d1-6fad-487e-ad41-d53992a75755 none            swap    sw              0       0
```

```
root@debian8:~# cat /etc/fstab
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point>   <type>  <options>       <dump>  <pass>
# / was on /dev/sda1 during installation
UUID=0ac29bda-b6bb-41c2-b47a-03fecb95bc87 /               ext4    errors=remount-ro 0       1
# swap was on /dev/sda5 during installation
UUID=fa3153a5-5ef4-46fe-9115-d3773a06d283 none            swap    sw              0       0
```

Ubuntu

```
root@ubuntu1404:~# cat /etc/fstab
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point>   <type>  <options>       <dump>  <pass>
# / was on /dev/sda1 during installation
UUID=70eb8bc5-1759-433d-9797-9342a7b82cb2 /               ext4    errors=remount-ro 0       1
# swap was on /dev/sda5 during installation
```

```
UUID=85017f2f-081d-464e-ad83-52c3c895a113 none            swap    sw              0       0
```

```
root@ubuntu1604:~# cat /etc/fstab
# /etc/fstab: static file system information.
#
# Use 'blkid' to print the universally unique identifier for a
# device; this may be used with UUID= as a more robust way to name devices
# that works even if disks are added and removed. See fstab(5).
#
# <file system> <mount point>   <type>  <options>       <dump>  <pass>
# / was on /dev/sda1 during installation
UUID=c27fce7f-cc8a-4c6f-b19b-d929a4d570f2 /               ext4    errors=remount-ro 0       1
# swap was on /dev/sda5 during installation
UUID=68f67549-63f1-4833-b792-3566455bbe95 none            swap    sw              0       0
```

```
[root@centos5 ~]# cat /etc/fstab
LABEL=/                 /                       ext3    defaults        1 1
LABEL=/boot             /boot                   ext3    defaults        1 2
tmpfs                   /dev/shm                tmpfs   defaults        0 0
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
sysfs                   /sys                    sysfs   defaults        0 0
proc                    /proc                   proc    defaults        0 0
LABEL=SWAP-sda3         swap                    swap    defaults        0 0
```

RHEL/CentOS

```
[root@centos6 ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Fri May  3 13:33:42 2013
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
```

```
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
UUID=b9f29672-c84e-4d3b-b132-189758a084eb /                       ext4    defaults        1 1
UUID=01baf03d-df0d-479b-b3e4-81ce63b8dec3 /boot                   ext4    defaults        1 2
UUID=2646a33a-65f3-4501-9ced-9459435fd774 swap                    swap    defaults        0 0
tmpfs                   /dev/shm                tmpfs   defaults        0 0
devpts                  /dev/pts                devpts  gid=5,mode=620  0 0
sysfs                   /sys                    sysfs   defaults        0 0
proc                    /proc                   proc    defaults        0 0
```

```
[root@centos7 ~]# cat /etc/fstab

#
# /etc/fstab
# Created by anaconda on Sun Mar  8 12:38:10 2015
#
# Accessible filesystems, by reference, are maintained under '/dev/disk'
# See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
#
UUID=b35de665-5ec8-4226-a533-58a1b567ac91 /                       xfs     defaults        1 1
UUID=e8d3bd48-1386-411c-9675-41c3f8f1a309 /boot                   xfs     defaults        1 2
UUID=11a4d11d-81e4-46a7-82e0-7796cd597dc9 swap                    swap    defaults        0 0
```

SLES

```
SLES11SP1:~ # cat /etc/fstab
/dev/disk/by-id/ata-VBOX_HARDDISK_VB62af9a29-d9a982d5-part3 swap                swap       defaults
0 0
/dev/disk/by-id/ata-VBOX_HARDDISK_VB62af9a29-d9a982d5-part2 /                   ext3       acl,user_xattr
1 1
/dev/disk/by-id/ata-VBOX_HARDDISK_VB62af9a29-d9a982d5-part1 /boot               ext3       acl,user_xattr
1 2
proc                /proc               proc       defaults              0 0
```

```
sysfs                /sys                sysfs      noauto               0 0
debugfs              /sys/kernel/debug   debugfs    noauto               0 0
usbfs                /proc/bus/usb       usbfs      noauto               0 0
devpts               /dev/pts            devpts     mode=0620,gid=5      0 0
```

```
SLES12SP1:~ # cat /etc/fstab
UUID=db743358-c2d6-47f6-97d7-e7a9c650f0c5 swap swap defaults 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b / btrfs defaults 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /boot/grub2/i386-pc btrfs subvol=@/boot/grub2/i386-pc 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /boot/grub2/x86_64-efi btrfs subvol=@/boot/grub2/x86_64-efi 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /home btrfs subvol=@/home 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /opt btrfs subvol=@/opt 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /srv btrfs subvol=@/srv 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /tmp btrfs subvol=@/tmp 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /usr/local btrfs subvol=@/usr/local 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/crash btrfs subvol=@/var/crash 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/lib/libvirt/images btrfs subvol=@/var/lib/libvirt/images 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/lib/mailman btrfs subvol=@/var/lib/mailman 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/lib/mariadb btrfs subvol=@/var/lib/mariadb 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/lib/mysql btrfs subvol=@/var/lib/mysql 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/lib/named btrfs subvol=@/var/lib/named 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/lib/pgsql btrfs subvol=@/var/lib/pgsql 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/log btrfs subvol=@/var/log 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/opt btrfs subvol=@/var/opt 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/spool btrfs subvol=@/var/spool 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /var/tmp btrfs subvol=@/var/tmp 0 0
UUID=6b7e374a-ae42-4f93-b6aa-d288dfbbb74b /.snapshots btrfs subvol=@/.snapshots 0 0
```

Understanding the /etc/fstab file

Each line in **/etc/fstab** has 6 fields :

Field 1	Field 2	Field 3	Field 4	Field 5	Field 6
Special file or UUID or Virtual File System	Mount Point	Filesystem Type	Comma separated list of options	Used by the dump command (1 = dump, 0 or empty = do not dump)	The order in which the *fsck* command checks the disks/partitions at boot time

The **UUID** (*Universally Unique Identifier*) is a randomly generated 128 bit string that is automatically generated by the system when a filesystem is created on the partition.

Mountpoint Options

The most important mount point options are as follows:

Option	Filesystem	Description	Default Value
defaults	All	Use default options: rw, suid, dev, exec, auto, nouser, and async.	N/A [1)]
auto/noauto	All	Do or do not mount when “mount -a” is given.	auto
rw/ro	All	Mount the filesystem read-write/read-only.	rw
suid/nosuid	All	Allow/disallow set-user-identifier or set-group-identifier bits to take effect.	suid
dev/nodev	All	Interpret/do not interpret character or block special devices on the filesystem.	dev
exec/noexec	All	Permit/do not permit execution of binaries.	exec
sync/async	All	All I/O to the filesystem should be done synchronously/asynchronously.	async
user/nouser	All	Allow/disallow a user to mount. The mount point is read from the /etc/fstab file. Only the user that mounted the filesystem can unmount it.	N/A
users	All	Allow every user to mount and unmount the filesystem.	N/A
owner	All	Allow device owner to mount.	N/A
atime/noatime	POSIX	Do not use noatime feature, then the inode access time is controlled by kernel defaults/Do not update inode access times on this filesystem	atime
uid=value	Non-Linux filesystems	Set the owner of the root of the filesystem.	root
gid=value	Non-Linux filesystems	Set the group of the root of the filesystem.	N/A
umask=value	Non-Linux filesystems	Set the umask. The default is the umask of the current process. The value is given in octal.	N/A

Option	Filesystem	Description	Default Value
dmask=value	Non-Linux filesystems	Set the umask applied to directories only. The value is given in octal.	Current processes' umask
fmask=value	Non-Linux filesystems	Set the umask applied to regular files only. The value is given in octal.	Current processes' umask

The umount command

To unmount a file system, you need to use the **umount** command. For example:

```
# umount /mnt/target_directory [Entrée]
```

Command Line Switches

The following switches can be used with the umount command:

```
trainee@debian8:~$ umount --help

Usage:
 umount [-hV]
 umount -a [options]
 umount [options] <source> | <directory>

Options:
 -a, --all               unmount all filesystems
 -A, --all-targets       unmount all mountpoints for the given device in the
                           current namespace
 -c, --no-canonicalize   don't canonicalize paths
 -d, --detach-loop       if mounted loop device, also free this loop device
     --fake              dry run; skip the umount(2) syscall
 -f, --force             force unmount (in case of an unreachable NFS system)
```

```
 -i, --internal-only     don't call the umount.<type> helpers
 -n, --no-mtab           don't write to /etc/mtab
 -l, --lazy              detach the filesystem now, clean up things later
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -R, --recursive         recursively unmount a target with all its children
 -r, --read-only         in case unmounting fails, try to remount read-only
 -t, --types <list>      limit the set of filesystem types
 -v, --verbose           say what is being done

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

For more details see umount(8).
```

```
root@ubuntu1604:~# umount --help

Usage:
 umount [-hV]
 umount -a [options]
 umount [options] <source> | <directory>

Unmount filesystems.

Options:
 -a, --all               unmount all filesystems
 -A, --all-targets       unmount all mountpoints for the given device in the
                           current namespace
 -c, --no-canonicalize   don't canonicalize paths
 -d, --detach-loop       if mounted loop device, also free this loop device
     --fake              dry run; skip the umount(2) syscall
 -f, --force             force unmount (in case of an unreachable NFS system)
 -i, --internal-only     don't call the umount.<type> helpers
 -n, --no-mtab           don't write to /etc/mtab
 -l, --lazy              detach the filesystem now, clean up things later
```

```
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -R, --recursive         recursively unmount a target with all its children
 -r, --read-only         in case unmounting fails, try to remount read-only
 -t, --types <list>      limit the set of filesystem types
 -v, --verbose           say what is being done

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

For more details see umount(8).
```

```
[root@centos7 ~]# umount --help

Usage:
 umount [-hV]
 umount -a [options]
 umount [options] <source> | <directory>

Options:
 -a, --all               unmount all filesystems
 -A, --all-targets       unmount all mountpoins for the given device
                         in the current namespace
 -c, --no-canonicalize   don't canonicalize paths
 -d, --detach-loop       if mounted loop device, also free this loop device
     --fake              dry run; skip the umount(2) syscall
 -f, --force             force unmount (in case of an unreachable NFS system)
 -i, --internal-only     don't call the umount.<type> helpers
 -n, --no-mtab           don't write to /etc/mtab
 -l, --lazy              detach the filesystem now, and cleanup all later
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -R, --recursive         recursively unmount a target with all its children
 -r, --read-only         In case unmounting fails, try to remount read-only
 -t, --types <list>      limit the set of filesystem types
 -v, --verbose           say what is being done
```

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

For more details see umount(8).
```

```
SLES12SP1:~ # umount --help

Usage:
 umount [-hV]
 umount -a [options]
 umount [options] <source> | <directory>

Options:
 -a, --all               unmount all filesystems
 -A, --all-targets       unmount all mountpoints for the given device in the
                           current namespace
 -c, --no-canonicalize   don't canonicalize paths
 -d, --detach-loop       if mounted loop device, also free this loop device
     --fake              dry run; skip the umount(2) syscall
 -f, --force             force unmount (in case of an unreachable NFS system)
 -i, --internal-only     don't call the umount.<type> helpers
 -n, --no-mtab           don't write to /etc/mtab
 -l, --lazy              detach the filesystem now, clean up things later
 -O, --test-opts <list>  limit the set of filesystems (use with -a)
 -R, --recursive         recursively unmount a target with all its children
 -r, --read-only         in case unmounting fails, try to remount read-only
 -t, --types <list>      limit the set of filesystem types
 -v, --verbose           say what is being done

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

For more details see umount(8).
```

Unix File Systems

Each file system contains the following :

- superblock
- inodes
- data blocks

Superblock

The superblock contains :

- the block size,
- the size of the file system,
- the number of mounts for the file system,
- a pointer to the root of the file system,
- pointers to the free inodes,
- pointers to free data blocks.

Linux maintains multiple redundant copies of the superblock in every file system.

For example, to view the primary and backup superblock locations on ext filesystems, use the following command:

```
root@debian8:~# mount | grep ext
/dev/sda1 on / type ext4 (rw,relatime,errors=remount-ro,data=ordered)
root@debian8:~# dumpe2fs /dev/sda1 | grep -i superblock
dumpe2fs 1.42.12 (29-Aug-2014)
  Primary superblock at 0, Group descriptors at 1-1
  Backup superblock at 32768, Group descriptors at 32769-32769
  Backup superblock at 98304, Group descriptors at 98305-98305
  Backup superblock at 163840, Group descriptors at 163841-163841
  Backup superblock at 229376, Group descriptors at 229377-229377
```

```
  Backup superblock at 294912, Group descriptors at 294913-294913
  Backup superblock at 819200, Group descriptors at 819201-819201
  Backup superblock at 884736, Group descriptors at 884737-884737
  Backup superblock at 1605632, Group descriptors at 1605633-1605633
```

```
root@ubuntu1604:~# mount | grep ext
/dev/sda1 on / type ext4 (rw,relatime,errors=remount-ro,data=ordered)
root@ubuntu1604:~# dumpe2fs /dev/sda1 | grep -i superblock
dumpe2fs 1.42.13 (17-May-2015)
  Primary superblock at 0, Group descriptors at 1-1
  Backup superblock at 32768, Group descriptors at 32769-32769
  Backup superblock at 98304, Group descriptors at 98305-98305
  Backup superblock at 163840, Group descriptors at 163841-163841
  Backup superblock at 229376, Group descriptors at 229377-229377
  Backup superblock at 294912, Group descriptors at 294913-294913
  Backup superblock at 819200, Group descriptors at 819201-819201
  Backup superblock at 884736, Group descriptors at 884737-884737
  Backup superblock at 1605632, Group descriptors at 1605633-1605633
```

```
SLES11SP1:~ # mount | grep ext
/dev/sda2 on / type ext3 (rw,acl,user_xattr)
/dev/sda1 on /boot type ext3 (rw,acl,user_xattr)
SLES11SP1:~ # dumpe2fs /dev/sda1 | grep -i superblock
dumpe2fs 1.41.9 (22-Aug-2009)
  Primary superblock at 1, Group descriptors at 2-2
  Backup superblock at 8193, Group descriptors at 8194-8194
  Backup superblock at 24577, Group descriptors at 24578-24578
  Backup superblock at 40961, Group descriptors at 40962-40962
  Backup superblock at 57345, Group descriptors at 57346-57346
  Backup superblock at 73729, Group descriptors at 73730-73730
```

To repair an ext file system using a backup superblock use the following command :

```
# e2fsck -f -b 32768 /dev/sda1 [Enter]
```

or

```
# e2fsck -f -b 8193 /dev/sda1 [Enter]
```

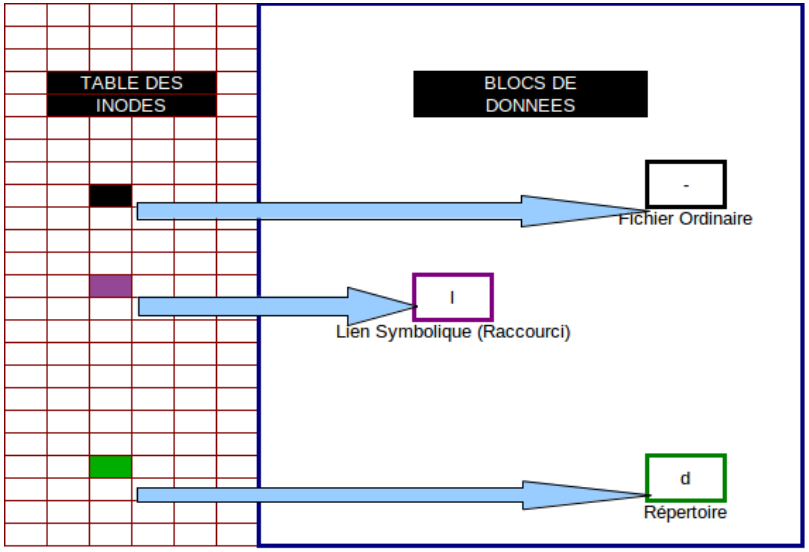
dependant upon which distribution you are using.

Inodes

Each file is represented by an **inode**. An inode contains the following information:

- the file type : **-**, **d**, **l**, **b**, **c**, **p**, **s**,
- file permissions, for example : **rwx rw- r–**,
- the number of hard links,
- the UID of the file creator or the current UID attributed by the **chown** command,
- the GID of the creating process or the current GID attributed by the **chgrp** command,
- the file size in bytes,
- the date of the last modification of the file's inode content : **ctime**,
- the date of the last modification of the file contents : **mtime**,
- the date of the last access : **atime**,
- allocation addresses that point to the data blocks used by the file.

For example:



Execute the following command:

```
root@debian8:~# ls -ld /dev/console /dev/sda1 /etc /etc/passwd
crw-------   1 root root  5, 1 Aug 18 11:29 /dev/console
brw-rw----   1 root disk  8, 1 Aug 18 11:29 /dev/sda1
drwxr-xr-x 121 root root 12288 Aug 18 11:29 /etc
-rw-r--r--   1 root root  2094 May  1 20:32 /etc/passwd
```

```
root@ubuntu1604:~# ls -ld /dev/console /dev/sda1 /etc /etc/passwd
crw-------   1 root root  5, 1 sept. 28 10:31 /dev/console
brw-rw----   1 root disk  8, 1 sept. 28 10:31 /dev/sda1
drwxr-xr-x 129 root root 12288 sept. 28 10:41 /etc
-rw-r--r--   1 root root  2296 mai    3 08:08 /etc/passwd
```

```
[root@centos7 ~]# ls -ld /dev/console /dev/sda1 /etc /etc/passwd
crw-------.   1 root root 5, 1 Sep 28 10:48 /dev/console
brw-rw----.   1 root disk 8, 1 Sep 28 10:48 /dev/sda1
drwxr-xr-x. 136 root root 8192 Sep 28 10:57 /etc
```

```
-rw-r--r--.   1 root root 2267 Sep 22 14:29 /etc/passwd
```

```
SLES12SP1:~ # ls -ld /dev/console /dev/sda1 /etc /etc/passwd
crw------- 1 root root 5, 1 Sep 28 10:37 /dev/console
brw-rw---- 1 root disk 8, 1 Sep 28 10:37 /dev/sda1
drwxr-xr-x 1 root root 4746 Sep 28 10:38 /etc
-rw-r--r-- 1 root root 1335 Sep 20 13:34 /etc/passwd
```

The first character of each line indicates the file type:

- **-** - an ordinary file,
- **d** - a directory,
- **l** - a symbolic link,
- **b** - a bloc type peripheral,
- **c** - a character type peripheral,
- **p** - a named pipe for communication between processes,
- **s** - a network socket.

To see the inode numbers, execute the previous command with, in addition, the **-i** option:

```
root@debian8:~# ls -ldi /dev/console /dev/sda1 /etc /etc/passwd
 5601 crw-------   1 root root  5, 1 Aug 18 11:29 /dev/console
 6890 brw-rw----   1 root disk  8, 1 Aug 18 11:29 /dev/sda1
38995 drwxr-xr-x 121 root root 12288 Aug 18 11:29 /etc
52831 -rw-r--r--   1 root root  2094 May  1 20:32 /etc/passwd
```

```
root@ubuntu1604:~# ls -ldi /dev/console /dev/sda1 /etc /etc/passwd
    14 crw-------   1 root root  5, 1 sept. 28 10:31 /dev/console
   376 brw-rw----   1 root disk  8, 1 sept. 28 10:31 /dev/sda1
390913 drwxr-xr-x 129 root root 12288 sept. 28 10:41 /etc
396002 -rw-r--r--   1 root root  2296 mai    3 08:08 /etc/passwd
```

```
[root@centos7 ~]# ls -ldi /dev/console /dev/sda1 /etc /etc/passwd
    4683 crw-------.   1 root root 5, 1 Sep 28 10:48 /dev/console
```

```
    8107 brw-rw----.   1 root disk 8, 1 Sep 28 10:48 /dev/sda1
33595521 drwxr-xr-x. 136 root root 8192 Sep 28 10:57 /etc
35670335 -rw-r--r--.   1 root root 2267 Sep 22 14:29 /etc/passwd
```

```
SLES12SP1:~ # ls -ldi /dev/console /dev/sda1 /etc /etc/passwd
 4306 crw------- 1 root root 5, 1 Sep 28 10:37 /dev/console
 6871 brw-rw---- 1 root disk 8, 1 Sep 28 10:37 /dev/sda1
  257 drwxr-xr-x 1 root root 4746 Sep 28 12:02 /etc
58930 -rw-r--r-- 1 root root 1335 Sep 20 13:34 /etc/passwd
```

Data Blocks

File data is stored in data blocks. In the case of a directory, the data block contains a table referencing the inodes and the names of the contents of the directory.

The name of the file is stored in the parent directory's data block and not in the inode. This means that a file can be referenced by one or more different names. To add a name to a data block, you need to create what is called a **hard link**.

Hard (Physical) Links

A hard link is created by using the **ln** command.

Debian

```
root@debian8:~# cd /tmp; mkdir inode; cd inode; touch file1; ls -ali
total 8
140612 drwxr-xr-x  2 root root 4096 Aug 18 13:28 .
130564 drwxrwxrwt 10 root root 4096 Aug 18 13:28 ..
140613 -rw-r--r--  1 root root    0 Aug 18 13:28 file1
```

file1 shows an inode number of **140613** and a single name, indicated by the number **1** in the third column:

```
140613 -rw-r--r--  1 root root    0 Aug 18 13:28 file1
```

now create the hard link and check the result:

```
root@debian8:/tmp/inode# ln file1 file2
root@debian8:/tmp/inode# ls -ali
total 8
140612 drwxr-xr-x  2 root root 4096 Aug 18 13:29 .
130564 drwxrwxrwt 10 root root 4096 Aug 18 13:28 ..
140613 -rw-r--r--  2 root root    0 Aug 18 13:28 file1
140613 -rw-r--r--  2 root root    0 Aug 18 13:28 file2
```

Now you can see two lines, one for file1 and a second for file2:

```
140613 -rw-r--r--  2 root root    0 Aug 18 13:28 file1
140613 -rw-r--r--  2 root root    0 Aug 18 13:28 file2
```

file1 and **file2** are referenced by the same inode. As a result the number of names has been increased to two in the thrid column.

Ubuntu

```
root@ubuntu1604:~# cd /tmp; mkdir inode; cd inode; touch file1; ls -ali
total 8
521308 drwxr-xr-x  2 root root 4096 sept. 29 10:26 .
390918 drwxrwxrwt 10 root root 4096 sept. 29 10:26 ..
521340 -rw-r--r--  1 root root    0 sept. 29 10:26 file1
```

file1 shows an inode number of **521340** and a single name, indicated by the number **1** in the third column:

```
521340 -rw-r--r--  1 root root    0 sept. 29 10:26 file1
```

now create the hard link and check the result:

```
root@ubuntu1604:/tmp/inode# ln file1 file2
root@ubuntu1604:/tmp/inode# ls -ali
total 8
521308 drwxr-xr-x  2 root root 4096 sept. 29 10:27 .
390918 drwxrwxrwt 10 root root 4096 sept. 29 10:26 ..
521340 -rw-r--r--  2 root root    0 sept. 29 10:26 file1
521340 -rw-r--r--  2 root root    0 sept. 29 10:26 file2
```

Now you can see two lines, one for file1 and a second for file2:

```
521340 -rw-r--r--  2 root root    0 sept. 29 10:26 file1
521340 -rw-r--r--  2 root root    0 sept. 29 10:26 file2
```

file1 and **file2** are referenced by the same inode. As a result the number of names has been increased to two in the thrid column.

RHEL/CentOS

```
[root@centos7 ~]# cd /tmp; mkdir inode; cd inode; touch file1; ls -ali
total 0
287056 drwxr-xr-x.  2 root root  60 Sep 28 12:16 .
 11071 drwxrwxrwt. 10 root root 240 Sep 28 12:16 ..
287058 -rw-r--r--.  1 root root   0 Sep 28 12:16 file1
```

file1 shows an inode number of **287058** and a single name, indicated by the number **1** in the third column:

```
287058 -rw-r--r--.  1 root root   0 Sep 28 12:16 file1
```

now create the hard link and check the result:

```
[root@centos7 inode]# ln file1 file2
```

```
[root@centos7 inode]# ls -ali
total 0
287056 drwxr-xr-x.  2 root root  80 Sep 28 12:18 .
 11071 drwxrwxrwt. 10 root root 240 Sep 28 12:16 ..
287058 -rw-r--r--.  2 root root   0 Sep 28 12:16 file1
287058 -rw-r--r--.  2 root root   0 Sep 28 12:16 file2
```

Now you can see two lines, one for file1 and a second for file2:

```
287058 -rw-r--r--.  2 root root   0 Sep 28 12:16 file1
287058 -rw-r--r--.  2 root root   0 Sep 28 12:16 file2
```

file1 and **file2** are referenced by the same inode. As a result the number of names has been increased to two in the thrid column.

SLES

```
SLES12SP1:~ # cd /tmp; mkdir inode; cd inode; touch file1; ls -ali
total 0
442 drwxr-xr-x 1 root root  10 Sep 28 12:23 .
256 drwxrwxrwt 1 root root 112 Sep 28 12:23 ..
443 -rw-r--r-- 1 root root   0 Sep 28 12:23 file1
```

file1 shows an inode number of **443** and a single name, indicated by the number **1** in the third column:

```
443 -rw-r--r-- 1 root root   0 Sep 28 12:23 file1
```

now create the hard link and check the result:

```
SLES12SP1:/tmp/inode # ln file1 file2
SLES12SP1:/tmp/inode # ls -ali
total 0
442 drwxr-xr-x 1 root root  20 Sep 28 12:24 .
```

```
256 drwxrwxrwt 1 root root 112 Sep 28 12:23 ..
443 -rw-r--r-- 2 root root   0 Sep 28 12:23 file1
443 -rw-r--r-- 2 root root   0 Sep 28 12:23 file2
```

Now you can see two lines, one for file1 and a second for file2:

```
443 -rw-r--r-- 2 root root   0 Sep 28 12:23 file1
443 -rw-r--r-- 2 root root   0 Sep 28 12:23 file2
```

file1 and **file2** are referenced by the same inode. As a result the number of names has been increased to two in the thrid column.

Important - Hard links cannot be created across file system boundaries. A hard link can only be created if the source file exists.

Soft (Symbolic) Links

A soft link is a shortcut to a file or directory. A soft link is created using the same **ln** command with the **-s** option.

Debian

```
root@debian8:/tmp/inode# ln -s file1 file3
root@debian8:/tmp/inode# ls -ali
total 8
140612 drwxr-xr-x  2 root root 4096 Aug 18 13:36 .
130564 drwxrwxrwt 10 root root 4096 Aug 18 13:28 ..
140613 -rw-r--r--  2 root root    0 Aug 18 13:28 file1
140613 -rw-r--r--  2 root root    0 Aug 18 13:28 file2
140614 lrwxrwxrwx  1 root root    5 Aug 18 13:36 file3 -> file1
```

Ubuntu

```
root@ubuntu1604:/tmp/inode# ln -s file1 file3
root@ubuntu1604:/tmp/inode# ls -ali
total 8
521308 drwxr-xr-x  2 root root 4096 sept. 29 10:32 .
390918 drwxrwxrwt 10 root root 4096 sept. 29 10:26 ..
521340 -rw-r--r--  2 root root    0 sept. 29 10:26 file1
521340 -rw-r--r--  2 root root    0 sept. 29 10:26 file2
521342 lrwxrwxrwx  1 root root    5 sept. 29 10:32 file3 -> file1
```

RHEL/CentOS

```
[root@centos7 inode]# ln -s file1 file3
[root@centos7 inode]# ls -ali
total 0
287056 drwxr-xr-x.  2 root root 100 Sep 28 12:30 .
 11071 drwxrwxrwt. 10 root root 240 Sep 28 12:16 ..
287058 -rw-r--r--.  2 root root   0 Sep 28 12:16 file1
287058 -rw-r--r--.  2 root root   0 Sep 28 12:16 file2
333487 lrwxrwxrwx.  1 root root   5 Sep 28 12:30 file3 -> file1
```

SLES

```
SLES12SP1:/tmp/inode # ln -s file1 file3
SLES12SP1:/tmp/inode # ls -ali
total 4
442 drwxr-xr-x 1 root root  30 Sep 28 12:26 .
256 drwxrwxrwt 1 root root 112 Sep 28 12:23 ..
443 -rw-r--r-- 2 root root   0 Sep 28 12:23 file1
443 -rw-r--r-- 2 root root   0 Sep 28 12:23 file2
```

```
444 lrwxrwxrwx 1 root root   5 Sep 28 12:26 file3 -> file1
```

Note here that the soft link is referenced by a separate inode.

Important - A soft link can be created across file system boundaries and can be created even when the source file does not exist.

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1)
Not Applicable