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CTEC 435

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Part 1: Exploring Linux Filesystems

Task 1: Identify Filesystem Types

1. Use the `lsblk` and `df -Th` commands to list all mounted filesystems on your system.
2. Identify the filesystem types used for each partition (e.g., ext4, xfs, etc.).
3. Document the output and briefly describe the characteristics of each filesystem type identified.

```

devin-young@devin-young-lab1:~$ lsblk
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0       7:0      0   74.3M 1 loop /snap/core22/1586
loop1       7:1      0  269.8M 1 loop /snap/firefox/4793
loop3       7:3      0  505.1M 1 loop /snap/gnome-42-2204/176
loop4       7:4      0    4K    1 loop /snap/bare/5
loop5       7:5      0  10.7M 1 loop /snap/firmware-updater/127
loop6       7:6      0  91.7M 1 loop /snap/gtk-common-themes/1535
loop7       7:7      0  10.5M 1 loop /snap/snap-store/1173
loop8       7:8      0  38.8M 1 loop /snap/snapd/21759
loop9       7:9      0   500K 1 loop /snap/snapd-desktop-integration/178
loop10      7:10     0   74.3M 1 loop /snap/core22/1612
sda         8:0      0    1.8T 0 disk 
├─sda1      8:1      0    16M 0 part 
├─sda2      8:2      0  563.1G 0 part /media/devin-young/Multiboot
├─sda3      8:3      0    1G    0 part /boot/efi
├─sda4      8:4      0   837G 0 part /media/devin-young/fb6457cf-890c-4948-9100-d0bec03967bd
└─sda5      8:5      0  461.8G 0 part /
nvme0n1     259:0    0   476.9G 0 disk 
├─nvme0n1p1 259:1    0   260M 0 part 
├─nvme0n1p2 259:2    0    16M 0 part 
├─nvme0n1p3 259:3    0   475.7G 0 part 
└─nvme0n1p4 259:4    0    1G    0 part 

devin-young@devin-young-lab1:~$ df -Th
Filesystem      Type      Size  Used Avail Use% Mounted on
tmpfs           tmpfs     1.2G  2.2M  1.2G   1% /run
/dev/sda5       ext4     454G   31G  401G   7% /
tmpfs           tmpfs     5.8G    0  5.8G   0% /dev/shm
tmpfs           tmpfs     5.0M   8.0K  5.0M   1% /run/lock
efivarfs        efivarfs  184K   147K   33K  82% /sys/firmware/efi/efivars
/dev/sda3       vfat     1.1G   6.2M   1.1G   1% /boot/efi
tmpfs           tmpfs     1.2G  128K   1.2G   1% /run/user/1000
/dev/sda4       ext4     823G   9.3G  772G   2% /media/devin-young/fb6457cf-890c-4948-9100-d0bec03967bd
/dev/sda2       ntfs3     564G   8.4G  555G   2% /media/devin-young/Multiboot

devin-young@devin-young-lab1:~$ df -Th
Filesystem      Type      Size  Used Avail Use% Mounted on
tmpfs           tmpfs     1.2G  2.2M  1.2G   1% /run
/dev/sda5       ext4     454G   31G  401G   7% /
tmpfs           tmpfs     5.8G    0  5.8G   0% /dev/shm
tmpfs           tmpfs     5.0M   8.0K  5.0M   1% /run/lock
efivarfs        efivarfs  184K   147K   33K  82% /sys/firmware/efi/efivars
/dev/sda3       vfat     1.1G   6.2M   1.1G   1% /boot/efi
tmpfs           tmpfs     1.2G  132K   1.2G   1% /run/user/1000
/dev/sda4       ext4     823G   9.3G  772G   2% /media/devin-young/fb6457cf-890c-4948-9100-d0bec03967bd
/dev/sda2       ntfs3     564G   8.4G  555G   2% /media/devin-young/Multiboot

```

Filesystem Types for Partitions

1. /dev/sda2 = ntfs3 (filesystem type)
2. /dev/sda3 = vfat (filesystem type)
3. /dev/sda4 = ext4 (filesystem type)

4. /dev/sda5 = ext4 (filesystem type)
5. tmpfs = tmpfs (filesystem type)
6. efivarfs = efivarfs (filesystem type)

Characteristics of Filesystem Types

1. ntfs3 (New Technology File System)

- Read-write driver for NTFS that works with Linux. Features include supporting all file operations (creating, altering, renaming, moving, and deleting files)
- Supports compression and system-level encryption
- Allows the alteration of access control lists and permissions
- Supports extended attributes (such as system.ntfs_security and system.ntfs_attr)
- Supports native journal replaying
- Supports NFS export of mounted NTFS volumes
- Developed from scratch in 2020 to be a part of the Linux kernel (written in C language)

2. vfat (Virtual File Allocation Table)

- Windows file system format used in storage devices
- Supports file names up to 255 characters (which includes spaces)
- Each directory entry represents a file or subdirectory
- File attributes are stored in the directory entry (file name, size, etc.)
- Available in three types (FAT12, FAT16, FAT 32)

3. ext4 (Fourth Extended Filesystem)

- Can support volumes up to 1 exbibyte and files up to 16 tebibytes

- Uses extents to allocate file blocks (improves performance for large files)
- Backward compatible with ext3 and ext2 (can mount file systems created with those versions)
- Delays block allocation until data is flushed to disk
- Uses multiblock allocation (allocate many blocks in one call)
- Allows an unlimited number of subdirectories

4. tmpfs (Temporary Filesystem)

- All files are temporary and not saved to the hard drive
- Stores data in volatile memory (such as RAM)
- Directories mounted as tmpfs can speed up access to the files within those directories
- Size parameter can be changed on remount

5. efivarfs

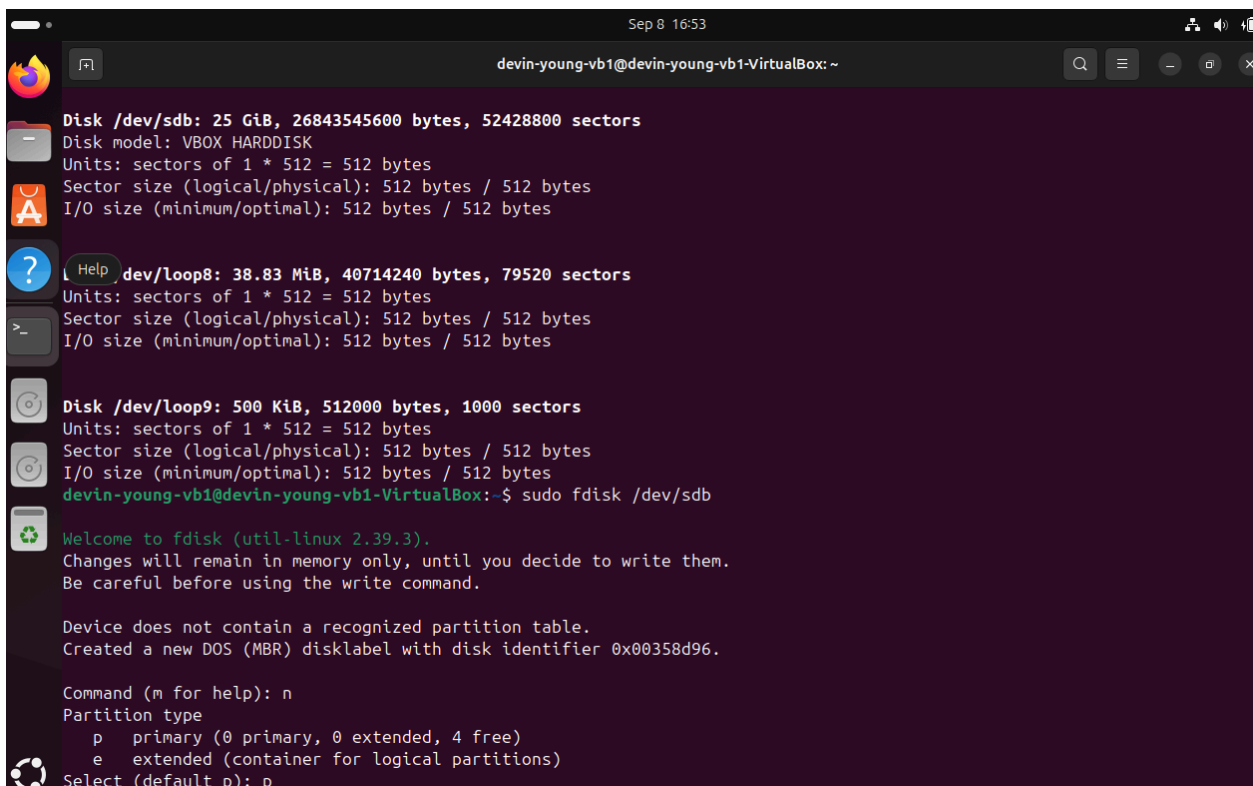
- Linux kernel filesystem that allows users to modify, create, and delete UEFI variables
- efivarfs files that are not well-known standardized variables are created as immutable files
- No size limit
- Supports UEFI secure boot
- Introduced in kernel 3.8

Task 2: Mounting and Unmounting Filesystems

1. Create a new partition using a virtual disk or an existing unpartitioned space.

2. Format the new partition with a filesystem of your choice (e.g., ext4, xfs).
 - Use `mkfs.ext4` or `mkfs.xfs` commands for formatting.
3. Mount the new partition to a directory of your choice (e.g., `/mnt/newdisk`).
 - Use the `mount` command to mount the partition.
4. Verify that the partition is mounted using the `df -h` or `mount` command.
5. Unmount the partition using the `umount` command.
6. Document each step, including the commands used and the output.

Step 1 - Created an additional virtual disk in virtual box on my already existing Ubuntu VM & Initiated the partition creation process with the `sudo fdisk /dev/sdb` command



```
devin-young-vb1@devin-young-vb1-VirtualBox: ~
Disk /dev/sdb: 25 GiB, 26843545600 bytes, 52428800 sectors
Disk model: VBOX HARDDISK
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

Help dev/loop8: 38.83 MiB, 40714240 bytes, 79520 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes

>_ Disk /dev/loop9: 500 KiB, 512000 bytes, 1000 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo fdisk /dev/sdb

Welcome to fdisk (util-linux 2.39.3).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS (MBR) disklabel with disk identifier 0x00358d96.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
```

Step 2 - Completion of the partitioning of my virtual hard disk (sdb)

```

Sep 8 16:56
devin-young-vb1@devin-young-vb1-VirtualBox: ~
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo fdisk /dev/sdb

Welcome to fdisk (util-linux 2.39.3).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS (MBR) disklabel with disk identifier 0x00358d96.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-52428799, default 2048): 2048
Last sector, +/-sectors or +/-size[K,M,G,T,P] (2048-52428799, default 52428799): +2GB

Created a new partition 1 of type 'Linux' and of size 1.9 GiB.

Command (m for help): sudo fdisk -l
Created a new partition 1 of type 'Linux native' and of size 24.9 GiB.
Created a new partition 2 of type 'Linux swap' and of size 47.1 MiB.
Created a new partition 3 of type 'Whole disk' and of size 25 GiB.
Created a new Sun disklabel.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.

```

Step 3 - Confirmation that the virtual hard disk has been partitioned

```

Sep 8 16:58
devin-young-vb1@devin-young-vb1-VirtualBox: ~

Disk /dev/sdb: 25 GiB, 26843545600 bytes, 52428800 sectors
Disk model: VBOX HARDDISK
Geometry: 255 heads, 63 sectors/track, 3263 cylinders
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: sun

Device      Start      End  Sectors  Size Id Type      Flags
/dev/sdb1    0 52323704 52323705 24.9G 83 Linux native
/dev/sdb2 52323705 52420094   96390 47.1M 82 Linux swap  u
/dev/sdb3    0 52420094 52420095   25G  5 Whole disk

```

Step 4 - Formatted the partition with an ext4 filesystem

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkfs -t ext4 /dev/sdb
[sudo] password for devin-young-vb1:
mke2fs 1.47.0 (5-Feb-2023)
Found a sun partition table in /dev/sdb
Proceed anyway? (y,N) y
Creating filesystem with 6553600 4k blocks and 1638400 inodes
Filesystem UUID: 573f1cfb-142c-4656-91b5-90089e61cc30
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
    4096000

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done

```

Step 5 - Confirmation that step 4 has been completed

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
sda
├─sda1
│   └─vfat    FAT16      89BC-1901
├─sda2
│   └─swap    1          97bc6196-4b01-417f-b912-dc63d6a03362    [SWAP]
├─sda3
│   └─ext4    1.0        630e187f-0970-4c19-9fcf-03dd81ef4c1f    13.1G    32% /
└─sda4

sdb  ext4    1.0          573f1cfb-142c-4656-91b5-90089e61cc30
sr0

```

Step 6 - Mounted the partition to a directory I created & unmounted it as directed

```

Sep 8 17:01
devin-young-vb1@devin-young-vb1-VirtualBox: ~
$ sudo
  ext4  1.0      630e187f-0970-4c19-9fcf-03dd81ef4c1f  13.1G  32% /
  sda4

sdb  ext4  1.0      573f1cfb-142c-4656-91b5-90089e61cc30
sr0

devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir /photos
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount -o defaults /dev/sdb/photos
mount: /dev/sdb/photos: can't find in /etc/fstab.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount -o defaults /dev/sdb3/photos
mount: /dev/sdb3/photos: can't find in /etc/fstab.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ mkdir /mnt/photos
mkdir: cannot create directory '/mnt/photos': Permission denied
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir /mnt/photos
devin-young-vb1@devin-young-vb1-VirtualBox:~$ mount /dev/sdb3 /mnt/photos
mount: /mnt/photos: must be superuser to use mount.
dmesg(1) may have more information after failed mount system call.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount /dev/sdb3 /mnt/photos
mount: /mnt/photos: special device /dev/sdb3 does not exist.
dmesg(1) may have more information after failed mount system call.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount /dev/sdb /mnt/photos
devin-young-vb1@devin-young-vb1-VirtualBox:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           523M  1.5M  522M   1% /run
/dev/sda3       21G   6.6G   14G  34% /
tmpfs           2.6G   0    2.6G   0% /dev/shm
tmpfs           5.0M   8.0K   5.0M   1% /run/lock
tmpfs           523M  124K  523M   1% /run/user/1000
/dev/sdb        25G   24K   24G   1% /mnt/photos
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo umount /dev/sdb /mnt/photos
sudo: umount: command not found
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo umount /dev/sdb /mnt/photos
umount: /mnt/photos: not mounted.

```

Part 2: Managing Linux Filesystems

Task 3: Disk Space Management

1. Identify the disk usage of various directories using the `du -sh` command.
2. Find the top 5 largest files and directories on the system using the `find` command combined with `sort`.
3. Clean up unnecessary files and directories (e.g., old log files, temporary files) to free up disk space.
4. Document the actions taken and the amount of space freed.

Step 1 - Identifying the disk usage of various directories using the `du -sh` command, and `du -h` command (which shows the disk usage for all directories and subdirectories)

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
devin-young-vb1@devin-young-vb1-VirtualBox:~$ du -sh
1.4G .
devin-young-vb1@devin-young-vb1-VirtualBox:~$ du -sh * | grep G
1.2G VHD.img
devin-young-vb1@devin-young-vb1-VirtualBox:~$ du -a/home/tecmint
du: invalid option -- '/'
du: invalid option -- 'o'
du: invalid option -- 'e'
du: invalid option -- '/'
du: invalid -t argument 'ecmint'
devin-young-vb1@devin-young-vb1-VirtualBox:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
tmpfs           523M  1.6M  522M   1% /run
/dev/sda3       21G   6.8G   13G  35% /
tmpfs           2.6G   0  2.6G   0% /dev/shm
tmpfs           5.0M  8.0K  5.0M   1% /run/lock
tmpfs           523M  136K  523M   1% /run/user/1000
devin-young-vb1@devin-young-vb1-VirtualBox:~$ df -ha
df: /run/user/1000/doc: Operation not permitted
Filesystem      Size  Used Avail Use% Mounted on
sysfs           0      0      0  -  /sys
proc            0      0      0  -  /proc
udev           2.6G   0  2.6G   0% /dev
devpts         0      0      0  -  /dev/pts
tmpfs          523M  1.6M  522M   1% /run
/dev/sda3       21G   6.8G   13G  35% /
securityfs     0      0      0  -  /sys/kernel/security
tmpfs          2.6G   0  2.6G   0% /dev/shm
tmpfs          5.0M  8.0K  5.0M   1% /run/lock
cgroup2        0      0      0  -  /sys/fs/cgroup
pstore         0      0      0  -  /sys/fs/pstore
bpf            0      0      0  -  /sys/fs/bpf

```

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
devin-young-vb1@devin-young-vb1-VirtualBox:~$ du -h
4.0K ./Downloads
4.0K ./Music
4.0K ./ssh
4.0K ./Documents
12K ./gnupg
4.0K ./Videos
4.0K ./Templates
4.0K ./cache/tracker3/files/errors
14M ./cache/tracker3/files
14M ./cache/tracker3
4.0K ./cache/ibus-table
196K ./cache/thumbnails/large
40K ./cache/thumbnails/normal
240K ./cache/thumbnails
16K ./cache/mesa_shader_cache/d9
8.0K ./cache/mesa_shader_cache/71
12K ./cache/mesa_shader_cache/87
20K ./cache/mesa_shader_cache/04
16K ./cache/mesa_shader_cache/7e
8.0K ./cache/mesa_shader_cache/ec
12K ./cache/mesa_shader_cache/8b
24K ./cache/mesa_shader_cache/c7
8.0K ./cache/mesa_shader_cache/83
12K ./cache/mesa_shader_cache/54
16K ./cache/mesa_shader_cache/11
8.0K ./cache/mesa_shader_cache/10
20K ./cache/mesa_shader_cache/1a
20K ./cache/mesa_shader_cache/d2
12K ./cache/mesa_shader_cache/c5
16K ./cache/mesa_shader_cache/4c
8.0K ./cache/mesa_shader_cache/66
8.0K ./cache/mesa_shader_cache/e9

```

```

Sep 8 20:10
devin-young-vb1@devin-young-vb1-VirtualBox: ~
16K  ./local/share/evolution/tasks
4.0K  ./local/share/evolution/memos/trash
8.0K  ./local/share/evolution/memos
160K  ./local/share/evolution
8.0K  ./local/share/gnome-shell
4.0K  ./local/share/nautilus/scripts
356K  ./local/share/nautilus/tags
364K  ./local/share/nautilus
76K   ./local/share/gvfs-metadata
4.0K  ./local/share/icc
1.4M  ./local/share
8.0K  ./local/state/wireplumber
12K   ./local/state
1.4M  ./local
4.0K  ./config/eog
4.0K  ./config/goa-1.0
4.0K  ./config/gtk-4.0
8.0K  ./config/gtk-3.0
4.0K  ./config/update-notifier
4.0K  ./config/gnome-session/saved-session
8.0K  ./config/gnome-session
12K   ./config/ibus/bus
16K   ./config/ibus
12K   ./config/dconf
8.0K  ./config/tiling-assistant
8.0K  ./config/evolution/sources
12K   ./config/evolution
4.0K  ./config/nautilus
8.0K  ./config/pulse
120K  ./config
1.4G  .
devin-young-vb1@devin-young-vb1-VirtualBox: ~$

```

Step 2 - Top 5 largest files or directories on the system

```

devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo du -h / | sort -rh | head -5
[sudo] password for devin-young-vb1:
du: cannot access '/run/user/1000/doc': Permission denied
du: cannot access '/run/user/1000/gvfs': Permission denied
du: cannot access '/proc/8568/task/8568/fd/4': No such file or directory
du: cannot access '/proc/8568/task/8568/fdinfo/4': No such file or directory
du: cannot access '/proc/8568/fd/3': No such file or directory
du: cannot access '/proc/8568/fdinfo/3': No such file or directory
9.7G  /
3.8G  /usr
3.0G  /snap
2.4G  /usr/lib
1.6G  /var
devin-young-vb1@devin-young-vb1-VirtualBox:~$

```

Step 3 - Removing outdated archive logs, clearing local repository of package files that are left in /var/cache (over 300k of cache was removed)

```

devin-young-vb1@devin-young-vb1-VirtualBox:~$ du -sh ~/.cache/thumbnails
340K    /home/devin-young-vb1/.cache/thumbnails
devin-young-vb1@devin-young-vb1-VirtualBox:~$ rm -rf ~/.cache/thumbnails/*
devin-young-vb1@devin-young-vb1-VirtualBox:~$ apt apt-get clean
E: Invalid operation apt-get
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo apt-get clean
[sudo] password for devin-young-vb1:
Sorry, try again.
[sudo] password for devin-young-vb1:
Sorry, try again.
[sudo] password for devin-young-vb1:
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo apt-get clean
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo apt-get autoclean
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
devin-young-vb1@devin-young-vb1-VirtualBox:~$ rm -rf /var/log/*-2023*.gz
devin-young-vb1@devin-young-vb1-VirtualBox:~$ du -sh ~/.cache/thumbnails
64K     /home/devin-young-vb1/.cache/thumbnails
devin-young-vb1@devin-young-vb1-VirtualBox:~$

```

Task 4: Resizing Filesystems

1. Create a logical volume using `LVM` (Logical Volume Manager).
2. Format the logical volume with a filesystem (e.g., ext4).
3. Mount the logical volume to a directory of your choice (e.g., `/mnt/lvtest`).
4. Add more space to the logical volume using `lvextend` and resize the filesystem using `resize2fs` or `xfs_growfs`.
5. Verify that the filesystem has been resized by checking the available space.
6. Document the entire process, including the commands used and the changes observed.

Step 1 - Preparing to create a logical volume (making sure I have what needs to be installed, and creating a partition so I can convert it to a logical volume)

```
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo apt-get install lvm2 rsync
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
lvm2 is already the newest version (2.03.16-3ubuntu3.1).
rsync is already the newest version (3.2.7-1ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 12 not upgraded.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo fdisk /dev/sdb

Welcome to fdisk (util-linux 2.39.3).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

The device contains 'LVM2_member' signature and it will be removed by a write command. See fdisk(8) man page and
d --wipe option for more details.

Device does not contain a recognized partition table.
Created a new DOS (MBR) disklabel with disk identifier 0x66243138.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-52428799, default 2048): 2048
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-52428799, default 52428799): +10G
```

```
devin-young-vb1@devin-young-vb1-VirtualBox: ~
The device contains 'LVM2_member' signature and it will be removed by a write command. See fdisk(8) man page and
d --wipe option for more details.

Device does not contain a recognized partition table.
Created a new DOS (MBR) disklabel with disk identifier 0x66243138.

Command (m for help): n
Partition type
   p   primary (0 primary, 0 extended, 4 free)
   e   extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1): 1
First sector (2048-52428799, default 2048): 2048
Last sector, +/-sectors or +/-size{K,M,G,T,P} (2048-52428799, default 52428799): +10G

Created a new partition 1 of type 'Linux' and of size 10 GiB.

Command (m for help): t
Selected partition 1
Hex code or alias (type L to list all): 8e
Changed type of partition 'Linux' to 'Linux LVM'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.
```

Step 2 - Confirming the creation of the logical volume partition

```
devin-young-vb1@devin-young-vb1-VirtualBox: ~  
  
Disk /dev/sdb: 25 GiB, 26843545600 bytes, 52428800 sectors  
Disk model: VBOX HARDISK  
Units: sectors of 1 * 512 = 512 bytes  
Sector size (logical/physical): 512 bytes / 512 bytes  
I/O size (minimum/optimal): 512 bytes / 512 bytes  
Disklabel type: dos  
Disk identifier: 0x66243138  
  
Device      Boot Start      End  Sectors  Size Id Type  
/dev/sdb1                2048 20973567 20971520   10G 8e Linux LVM
```

Step 3 - Creating the physical volume, volume group, and logical volume

```
devin-young-vb1@devin-young-vb1-VirtualBox: ~  
  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo pvcreate /dev/sdb1  
Physical volume "/dev/sdb1" successfully created.  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo vgcreate vg_ext4 /dev/sdb1  
Volume group "vg_ext4" successfully created  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo vgs  
VG      #PV #LV #SN Attr   VSize  VFree  
vg_ext4  1  0  0 wz--n- <10.00g <10.00g  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvcreate --name lv-ext4 -l 30%FREE vg-ext4  
Volume group "vg-ext4" not found  
Cannot process volume group vg-ext4  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvcreate --name lv-ext4 -l 30%FREE vg_ext4  
Logical volume "lv-ext4" created.  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvdisplay /dev/vg_ext4/lv-ext4  
--- Logical volume ---  
LV Path                /dev/vg_ext4/lv-ext4  
LV Name                 lv-ext4  
VG Name                 vg_ext4  
LV UUID                 8L3jwd-YGkd-4fzZ-TmxK-kSjM-wuPX-XskjLE  
LV Write Access         read/write  
LV Creation host, time  devin-young-vb1-VirtualBox, 2024-09-09 02:18:56 -0400  
LV Status                available  
# open                  0  
LV Size                 <3.00 GiB  
Current LE              767  
Segments                1  
Allocation              inherit  
Read ahead sectors      auto  
- currently set to      256  
Block device            252:0
```

Step 4 - Formatted the logical volume with a filesystem and created a new directory to mount the logical volume to it

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkfs.ext4 /dev/vg_ext4/lv-ext4
mke2fs 1.47.0 (5-Feb-2023)
Creating filesystem with 785408 4k blocks and 196608 inodes
Filesystem UUID: 78b7fdce-0b6f-49da-9edd-b2a4f65c953b
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912

Allocating group tables: done
Writing inode tables: done
Creating journal (16384 blocks): done
Writing superblocks and filesystem accounting information: done

devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir /data
mkdir: cannot create directory '/data': File exists
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir /ext4
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount /dev/vg_ext4/lv-ext4 /ext4
devin-young-vb1@devin-young-vb1-VirtualBox:~$ df -khT
Filesystem                Type      Size  Used Avail Use% Mounted on
tmpfs                    tmpfs     523M  1.5M  522M   1% /run
/dev/sda3                 ext4      21G   6.8G   13G  35% /
tmpfs                    tmpfs     2.6G    0    2.6G   0% /dev/shm
tmpfs                    tmpfs     5.0M   8.0K   5.0M   1% /run/lock
tmpfs                    tmpfs     523M  116K  523M   1% /run/user/1000
/dev/mapper/vg_ext4-lv--ext4 ext4       2.9G   24K   2.8G   1% /ext4
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo vgs
VG      #PV #LV #SN Attr   VSize   VFree
vg_ext4  1   1   0 wz--n- <10.00g 7.00g
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvextend -L +2G /dev/vg_ext4/ext4_db -r
Logical volume ext4_db not found in volume group vg_ext4.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvextend -L +2G /dev/vg_ext4/lv-ext4 -r
Size of logical volume vg_ext4/lv-ext4 changed from <3.00 GiB (767 extents) to <5.00 GiB (1279 extents).
Logical volume vg_ext4/lv-ext4 successfully resized.

```

Step 5 - Added more space to the logical volume by using the lvextend command (had trouble resizing the filesystem with the resize2fs command)

```

devin-young-vb1@devin-young-vb1-VirtualBox:~$ df -khT
Filesystem                Type      Size  Used Avail Use% Mounted on
tmpfs                    tmpfs     523M  1.5M  522M   1% /run
/dev/sda3                 ext4      21G   6.8G   13G  35% /
tmpfs                    tmpfs     2.6G    0    2.6G   0% /dev/shm
tmpfs                    tmpfs     5.0M   8.0K   5.0M   1% /run/lock
tmpfs                    tmpfs     523M  116K  523M   1% /run/user/1000
/dev/mapper/vg_ext4-lv--ext4 ext4       2.9G   24K   2.8G   1% /ext4
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo vgs
VG      #PV #LV #SN Attr   VSize   VFree
vg_ext4  1   1   0 wz--n- <10.00g 7.00g
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvextend -L +2G /dev/vg_ext4/ext4_db -r
Logical volume ext4_db not found in volume group vg_ext4.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo lvextend -L +2G /dev/vg_ext4/lv-ext4 -r
Size of logical volume vg_ext4/lv-ext4 changed from <3.00 GiB (767 extents) to <5.00 GiB (1279 extents).
Logical volume vg_ext4/lv-ext4 successfully resized.
resize2fs 1.47.0 (5-Feb-2023)
Filesystem at /dev/mapper/vg_ext4-lv--ext4 is mounted on /ext4; on-line resizing required
old_desc_blocks = 1, new_desc_blocks = 1
The filesystem on /dev/mapper/vg_ext4-lv--ext4 is now 1309696 (4k) blocks long.

```

```

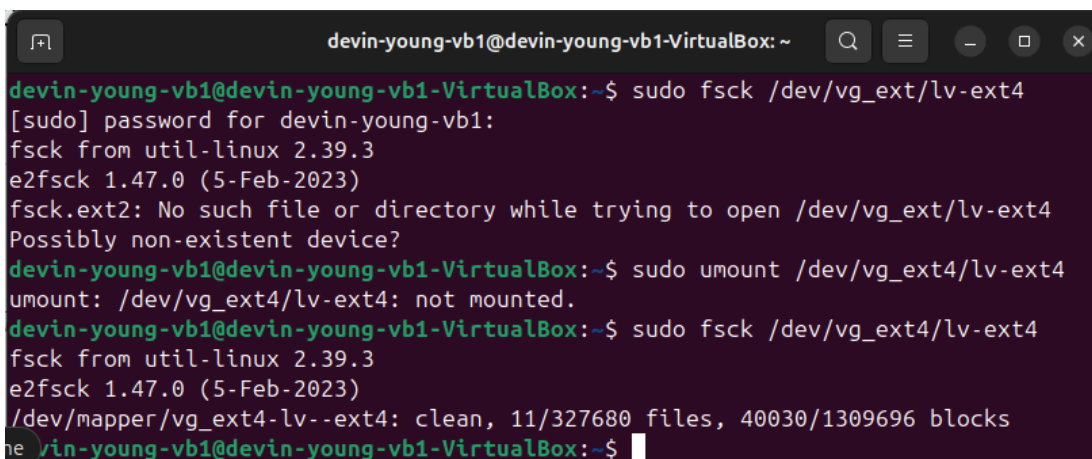
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo resize2fs /dev/sdb1
resize2fs 1.47.0 (5-Feb-2023)
resize2fs: Device or resource busy while trying to open /dev/sdb1
Couldn't find valid filesystem superblock.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo resize2fs /dev/sdb1 SIZE
resize2fs 1.47.0 (5-Feb-2023)
resize2fs: Device or resource busy while trying to open /dev/sdb1
Couldn't find valid filesystem superblock.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo resize2fs ext4 SIZE
resize2fs 1.47.0 (5-Feb-2023)
open: No such file or directory while opening ext4
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo resize2fs /dev/mapper/vg_ext4-lv-ext4 SIZE
resize2fs 1.47.0 (5-Feb-2023)
open: No such file or directory while opening /dev/mapper/vg_ext4-lv-ext4

```

Task 5: Filesystem Health Check and Repair

1. Perform a filesystem check on an unmounted filesystem using the `fsck` command.
2. Simulate a filesystem issue by creating a corrupted file and running `fsck` to repair it.
3. Document the process, including the before-and-after state of the filesystem.

Step 1 - Performing a filesystem check on an unmounted filesystem



```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo fsck /dev/vg_ext/lv-ext4
[sudo] password for devin-young-vb1:
fsck from util-linux 2.39.3
e2fsck 1.47.0 (5-Feb-2023)
fsck.ext2: No such file or directory while trying to open /dev/vg_ext/lv-ext4
Possibly non-existent device?
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo umount /dev/vg_ext4/lv-ext4
umount: /dev/vg_ext4/lv-ext4: not mounted.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo fsck /dev/vg_ext4/lv-ext4
fsck from util-linux 2.39.3
e2fsck 1.47.0 (5-Feb-2023)
/dev/mapper/vg_ext4-lv--ext4: clean, 11/327680 files, 40030/1309696 blocks
devin-young-vb1@devin-young-vb1-VirtualBox:~$

```

Step 2 & 3 - Had trouble simulating a corrupted file but I understand what the fsck command does

```
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo fsck.ext4 -f disk.img
[sudo] password for devin-young-vb1:
e2fsck 1.47.0 (5-Feb-2023)
Pass 1: Checking inodes, blocks, and sizes
Pass 2: Checking directory structure
Pass 3: Checking directory connectivity
Pass 4: Checking reference counts
Pass 5: Checking group summary information
disk.img: 11/12800 files (9.1% non-contiguous), 1837/12800 blocks
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo ls /mnt/testfs
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo cat /mnt/testfs/testfile.tx
cat: /mnt/testfs/testfile.txt: No such file or directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo dd if=/dev/zero of=disk.img
s=1M count=50
50+0 records in
50+0 records out
52428800 bytes (52 MB, 50 MiB) copied, 0.882592 s, 59.4 MB/s
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkfs.ext4 disk.img
mke2fs 1.47.0 (5-Feb-2023)
Discarding device blocks: done
Creating filesystem with 12800 4k blocks and 12800 inodes
```

```
50+0 records in
50+0 records out
52428800 bytes (52 MB, 50 MiB) copied, 0.882592 s, 59.4 MB/s
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkfs.ext4 disk.img
mke2fs 1.47.0 (5-Feb-2023)
Discarding device blocks: done
Creating filesystem with 12800 4k blocks and 12800 inodes

Allocating group tables: done
Writing inode tables: done
Creating journal (1024 blocks): done
Writing superblocks and filesystem accounting information: done

devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir /mnt/testfs
mkdir: cannot create directory '/mnt/testfs': File exists
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir /mnt/testfiles
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount -o loop disk.img /mnt/t
estfiles
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo echo "This is a test file." |
sudo tee /mnt/testfiles/testfile.txt
This is a test file.
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo dd if=/dev/urandom of=disk.im
g bs=13 seek=4 conv=notrunc
```


Part 3: Filesystem Security and Permissions

Task 6: Managing Permissions and Ownership

- 1. Create a new directory and file within your filesystem.**
- 2. Change the ownership of the directory and file to a specific user and group using ``chown``.**
- 3. Modify the permissions of the directory and file using ``chmod`` to grant specific access rights (e.g., read-only, execute).**
- 4. Verify the changes using the ``ls -l`` command.**
- 5. Document the commands used and the resulting permissions.**

Step (1-4) - In the first two screenshots I created a directory called “new directory” and a file called “new_file.txt”, changed the ownership of the directory and file to a specific user and group I created (“students” being the group, “jacob” being the user), modified the permissions so that the file owner had permission to read and write, while the group and world permission could only read (-rw-r--r or 644), and verified the changes using the `ls -l` command.

```

root@devin-young-vb1-VirtualBox: /home/devin-young-vb1
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir -p /path/to/new_directory && touch /path/to/new_directory/new_file.txt
[sudo] password for devin-young-vb1:
touch: cannot touch '/path/to/new_directory/new_file.txt': Permission denied
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mkdir -p /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo touch /path/to/new_directory/new_file.txt
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls /path/to/new_directory
new_file.txt
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chown user1:group3 /path/to/new_directory /new_file.txt
chown: invalid user: 'user1:group3'
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo groupadd students
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo useradd -m -g students jacob
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chown jacob:students /path/to/new_directory /new_file.txt
chown: cannot access '/new_file.txt': No such file or directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chown -R jacob:students /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls /path/to/new_directory
new_file.txt
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -ld /path/to/new_directory
drwxr-xr-x 2 jacob students 4096 Sep  9 12:09 /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chmod -R 644 /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -l /path/to/new_directory
ls: cannot access '/path/to/new_directory/new_file.txt': Permission denied
total 0
-???????? ? ? ? ?      ? new_file.txt
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -l /new_file.txt
ls: cannot access '/new_file.txt': No such file or directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -ld /path/to/new_directory
drw-r--r-- 2 jacob students 4096 Sep  9 12:09 /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo su
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /path/to/new_directory
total 0
-rw-r--r-- 1 jacob students 0 Sep  9 12:09 new_file.txt
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /path/to/new_file.txt

```

```

root@devin-young-vb1-VirtualBox: /home/devin-young-vb1
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo groupadd students
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo useradd -m -g students jacob
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chown jacob:students /path/to/new_directory /new_file.txt
chown: cannot access '/new_file.txt': No such file or directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chown -R jacob:students /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls /path/to/new_directory
new_file.txt
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -ld /path/to/new_directory
drwxr-xr-x 2 jacob students 4096 Sep  9 12:09 /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo chmod -R 644 /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -l /path/to/new_directory
ls: cannot access '/path/to/new_directory/new_file.txt': Permission denied
total 0
-???????? ? ? ? ?      ? new_file.txt
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -l /new_file.txt
ls: cannot access '/new_file.txt': No such file or directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls -ld /path/to/new_directory
drw-r--r-- 2 jacob students 4096 Sep  9 12:09 /path/to/new_directory
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo su
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /path/to/new_directory
total 0
-rw-r--r-- 1 jacob students 0 Sep  9 12:09 new_file.txt
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /path/to/new_file.txt
ls: cannot access '/path/to/new_file.txt': No such file or directory
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /new_file.txt
ls: cannot access '/new_file.txt': No such file or directory
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /path/to/new_directory /newfile.txt
ls: cannot access '/newfile.txt': No such file or directory
/path/to/new_directory:
total 0
-rw-r--r-- 1 jacob students 0 Sep  9 12:09 new_file.txt
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1#

```

Steps (1-4 Part II) - Lastly, I created a mount point and mounted a filesystem I have to that mount point, and then copied the directory to the mount point so the directory I created could be mounted to the file system. Afterwards, I also confirmed that the changes had been made.

```

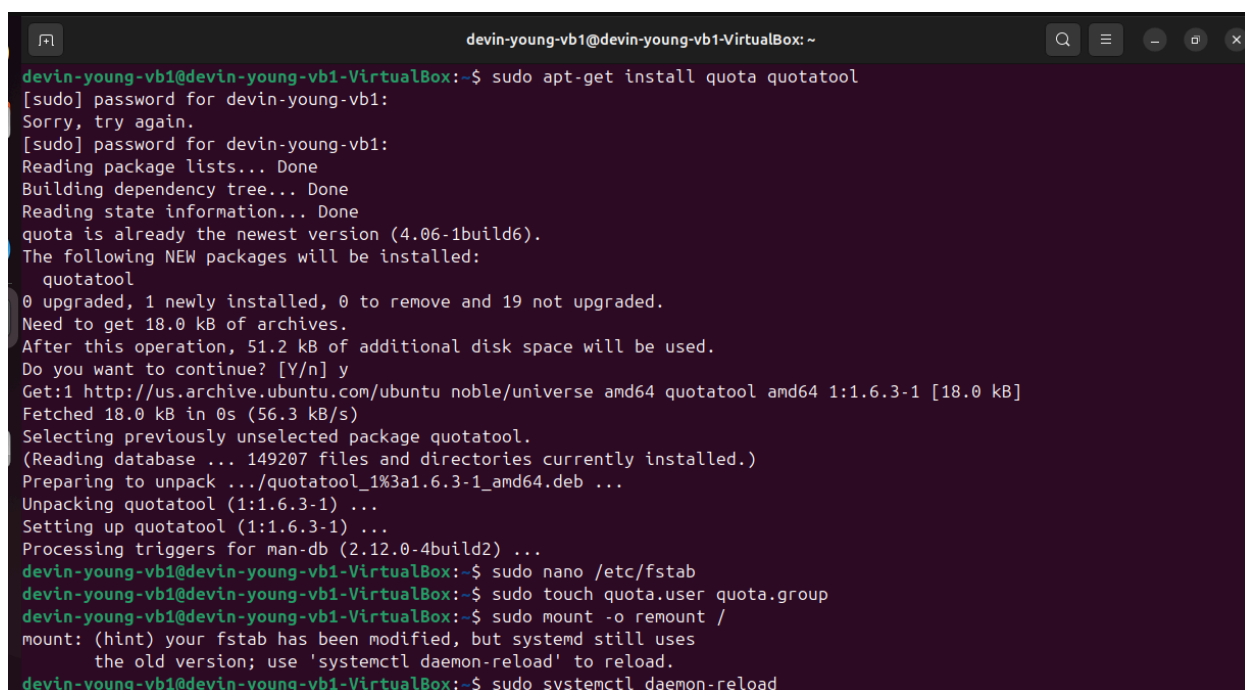
root@devin-young-vb1-VirtualBox: /home/devin-young-vb1
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# df -khT
Filesystem      Type      Size  Used Avail Use% Mounted on
tmpfs            tmpfs     523M   1.6M  522M   1% /run
/dev/sda3        ext4      21G   8.5G   12G  43% /
tmpfs            tmpfs     2.6G     0   2.6G   0% /dev/shm
tmpfs            tmpfs     5.0M   8.0K   5.0M   1% /run/lock
tmpfs            tmpfs     523M  128K   523M   1% /run/user/1000
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# mkdir -p /mnt/my_mount_point
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# mount /tmpfs /mnt/my_mount_point
mount: /mnt/my_mount_point: special device /tmpfs does not exist.
dmesg(1) may have more information after failed mount system call.
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# mount /dev/sda3 /mnt/my_mount_point
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# cp -r /path/to/new_directory /mnt/my_mount_point/
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /mnt/my_mount_point
total 124
lrwxrwxrwx  1 root root    7 Apr 22 09:08 bin -> usr/bin
drwxr-xr-x  2 root root  4096 Feb 26 2024 bin.usr-is-merged
drwxr-xr-x  3 root root  4096 Sep  8 21:57 boot
dr-xr-xr-x  2 root root  4096 Sep  1 17:02 cdrom
drwxr-xr-x  2 root root  4096 Sep  8 22:39 data
drwxr-xr-x  4 root root  4096 Aug 27 11:37 dev
drwxr-xr-x 140 root root 12288 Sep  9 12:49 etc
drwxr-xr-x  2 root root  4096 Sep  9 02:22 ext4
drwxr-xr-x  4 root root  4096 Sep  9 12:25 home
lrwxrwxrwx  1 root root    7 Apr 22 09:08 lib -> usr/lib
lrwxrwxrwx  1 root root    9 Apr 22 09:08 lib64 -> usr/lib64
drwxr-xr-x  2 root root  4096 Apr  8 10:37 lib.usr-is-merged
drwx-----  2 root root 16384 Sep  1 17:12 lost+found
drwxr-xr-x  2 root root  4096 Aug 27 11:37 media
drwxr-xr-x  6 root root  4096 Sep  9 13:00 mnt
drw-r--r--  2 root root  4096 Sep  9 13:03 new_directory
drwxr-xr-x  2 root root  4096 Aug 27 11:37 opt
drwxr-xr-x  3 root root  4096 Sep  9 12:07 path
drwxr-xr-x  2 root root  4096 Aug 27 11:37 media
drwxr-xr-x  6 root root  4096 Sep  9 13:00 mnt
drw-r--r--  2 root root  4096 Sep  9 13:03 new_directory
drwxr-xr-x  2 root root  4096 Aug 27 11:37 opt
drwxr-xr-x  3 root root  4096 Sep  9 12:07 path
drwxr-xr-x  2 root root  4096 Aug 27 11:37 media
drwxr-xr-x  6 root root  4096 Sep  9 13:00 mnt
drw-r--r--  2 root root  4096 Sep  9 13:03 new_directory
drwxr-xr-x  2 root root  4096 Aug 27 11:37 opt
drwxr-xr-x  3 root root  4096 Sep  9 12:07 path
drwxr-xr-x  2 root root  4096 Sep  8 16:34 photos
drwxr-xr-x  2 root root  4096 Apr 22 09:08 proc
drwx-----  5 root root  4096 Sep  9 00:40 root
drwxr-xr-x 19 root root  4096 Aug 27 11:42 run
lrwxrwxrwx  1 root root    8 Apr 22 09:08/sbin -> usr/sbin
drwxr-xr-x  2 root root  4096 Mar 31 05:00/sbin.usr-is-merged
drwxr-xr-x 12 root root  4096 Aug 27 11:42 snap
drwxr-xr-x  2 root root  4096 Aug 27 11:37 srv
drwxr-xr-x  2 root root  4096 Apr 22 09:08 sys
drwxrwxrwt 19 root root  4096 Sep  9 12:48 tmp
drwxr-xr-x 12 root root  4096 Aug 27 11:37 usr
drwxr-xr-x 14 root root  4096 Sep  1 17:24 var
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1# ls -l /mnt/my_mount_point/new_directory
total 0
-rw-r--r--  1 root root 0 Sep  9 13:03 new_file.txt
root@devin-young-vb1-VirtualBox:/home/devin-young-vb1#

```

Task 7: Set Up Disk Quotas

1. Enable disk quotas on a specific filesystem.
2. Set up user quotas to limit the disk space and inode usage for a specific user.
 - Use the `edquota` command to set quotas.
3. Test the quota by creating files as the user and observing when the quota is enforced.
4. Document the setup process and the results of the quota test.

Step 1 - Installing the tools to perform the task



```
devin-young-vb1@devin-young-vb1-VirtualBox: ~  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo apt-get install quota quotatool  
[sudo] password for devin-young-vb1:  
Sorry, try again.  
[sudo] password for devin-young-vb1:  
Reading package lists... Done  
Building dependency tree... Done  
Reading state information... Done  
quota is already the newest version (4.06-1build6).  
The following NEW packages will be installed:  
  quotatool  
0 upgraded, 1 newly installed, 0 to remove and 19 not upgraded.  
Need to get 18.0 kB of archives.  
After this operation, 51.2 kB of additional disk space will be used.  
Do you want to continue? [Y/n] y  
Get:1 http://us.archive.ubuntu.com/ubuntu noble/universe amd64 quotatool amd64 1:1.6.3-1 [18.0 kB]  
Fetched 18.0 kB in 0s (56.3 kB/s)  
Selecting previously unselected package quotatool.  
(Reading database ... 149207 files and directories currently installed.)  
Preparing to unpack .../quotatool_1%3a1.6.3-1_amd64.deb ...  
Unpacking quotatool (1:1.6.3-1) ...  
Setting up quotatool (1:1.6.3-1) ...  
Processing triggers for man-db (2.12.0-4build2) ...  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo nano /etc/fstab  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo touch quota.user quota.group  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount -o remount /  
mount: (hint) your fstab has been modified, but systemd still uses  
the old version; use 'systemctl daemon-reload' to reload.  
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo systemctl daemon-reload
```

Step 2 - Confirming that the user quota and group quota have been included in the etc/fstab

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo mount -o remount /
devin-young-vb1@devin-young-vb1-VirtualBox:~$ 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=2638312k,nr_inodes=659578,mode=755,inode64)
devpts on /dev/pts type devpts (rw,nosuid,noexec,relatime,gid=5,mode=620,ptmxmode=000)
tmpfs on /run type tmpfs (rw,nosuid,nodev,noexec,relatime,size=535224k,mode=755,inode64)
/dev/sda3 on / type ext4 (rw,relatime,quota,usrquota,grpquota)

```

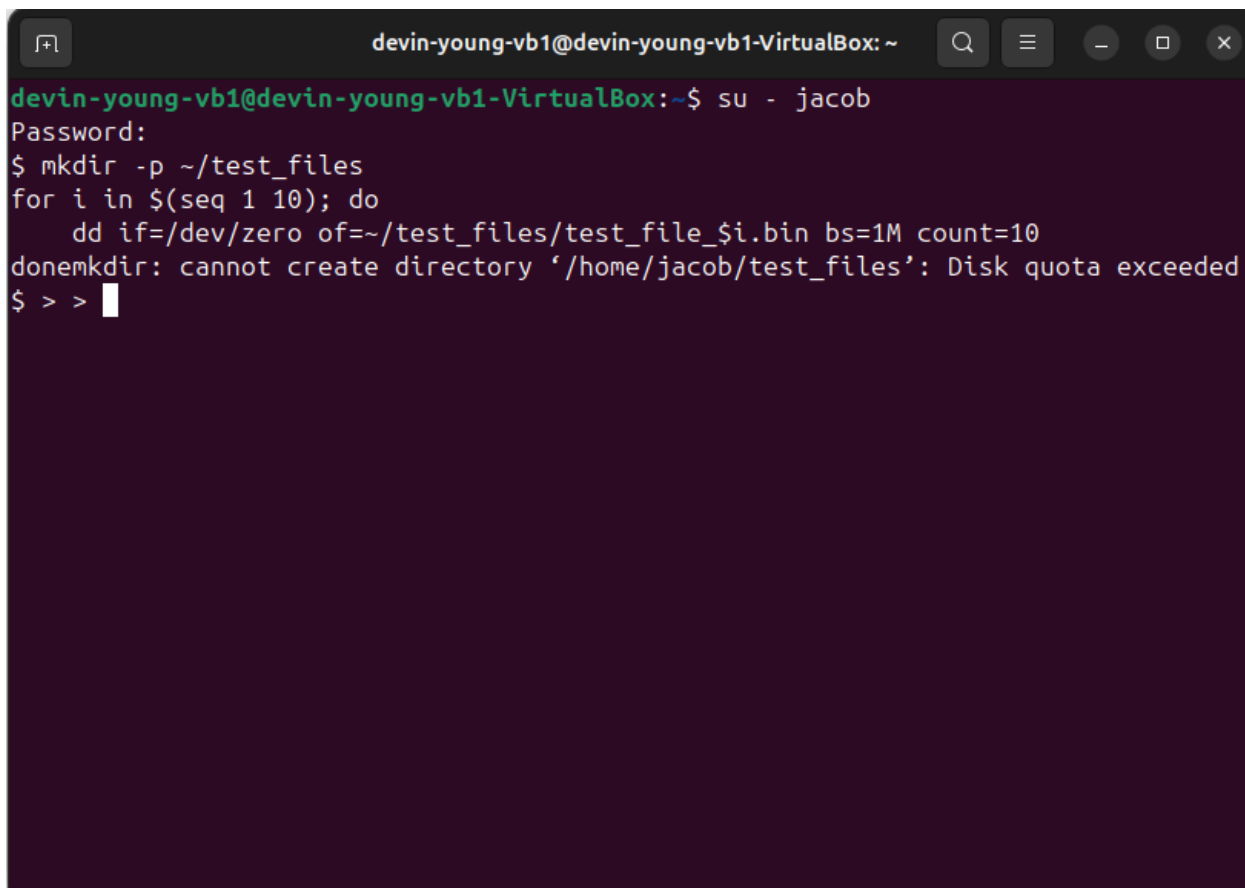
Step 3 - Set up user quotas to the disk space and inodes for a specific user

```

devin-young-vb1@devin-young-vb1-VirtualBox: ~
Bugs to jack@suse.cz
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo quotacheck -ugm /
devin-young-vb1@devin-young-vb1-VirtualBox:~$ ls /
aquota.group      boot      etc      lib64      mnt      photos    run      srv      var
aquota.user       cdrom     ext4     lib.usr-is-merged  new_directory  proc      sbin      sys
bin              data      home     lost+found  opt      quota     sbin.usr-is-merged tmp      usr
bin.usr-is-merged dev       lib      media      path      root      snap
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo modprobe quota_v1 -S 5.4.0-99-generic
modprobe: FATAL: Module quota_v1 not found in directory /lib/modules/5.4.0-99-generic
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo quotaon -v /
quotaon: Your kernel probably supports ext4 quota feature but you are using external quota files. Please switch your filesystem to use ext4 quota feature as external quota files on ext4 are deprecated.
/dev/sda3 [/]: group quotas turned on
/dev/sda3 [/]: user quotas turned on
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo edquota -u jacob
edquota: WARNING - /dev/sda3: cannot change current block allocation
edquota: WARNING - /dev/sda3: cannot change current inode allocation
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo quota -vs jacob
Disk quotas for user jacob (uid 1001):
Filesystem space quota limit grace files quota limit grace
/dev/sda3 20K 0K 0K 0 6 0 0
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo setquota -u jacob 50M 55M 0 0 /
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo quota -vs jacob
Disk quotas for user jacob (uid 1001):
Filesystem space quota limit grace files quota limit grace
/dev/sda3 20K 51200K 56320K 0 6 0 0
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo setquota -u jacob 1M 1M 2 2 /
devin-young-vb1@devin-young-vb1-VirtualBox:~$ sudo quota -vs jacob
Disk quotas for user jacob (uid 1001):
Filesystem space quota limit grace files quota limit grace
/dev/sda3 20K 1024K 1024K 0 6* 2 2 7days
devin-young-vb1@devin-young-vb1-VirtualBox:~$

```

Step 4 - Creating files as a user to test the quota (could not create 10 files because it exceeded the enforced quota, which was 6 files)

A terminal window titled 'devin-young-vb1@devin-young-vb1-VirtualBox: ~' with standard window controls. The prompt is 'devin-young-vb1@devin-young-vb1-VirtualBox:~\$'. The user enters 'su - jacob', followed by 'Password:'. Then they enter '\$ mkdir -p ~/test_files', followed by a loop 'for i in \$(seq 1 10); do' and an indented 'dd if=/dev/zero of=~/test_files/test_file_\$i.bin bs=1M count=10'. The next line shows an error: 'donemkdir: cannot create directory '/home/jacob/test_files': Disk quota exceeded'. The prompt returns to '\$ > >' with a cursor.

```
devin-young-vb1@devin-young-vb1-VirtualBox:~$ su - jacob
Password:
$ mkdir -p ~/test_files
for i in $(seq 1 10); do
    dd if=/dev/zero of=~/test_files/test_file_$i.bin bs=1M count=10
donemkdir: cannot create directory '/home/jacob/test_files': Disk quota exceeded
$ > > █
```

Reflection

I learned that there's a lot of backtracking and confirmation involved with Linux filesystem management. There were many times I had to confirm that the commands I entered were enforced, and many times where I had to trace my steps backwards to see what I missed, whether that was creating a directory, making sure I selected the correct path, checking to see if a filesystem I created is mounted or unmounted, verifying that I correctly formatted a filesystem, making sure I'm referencing the correct partition because it can be my logical or physical volume, etc. I also learned that documenting your steps as you manage a Linux filesystem is extremely important, especially since I took the route of using a Ubuntu virtual machine instead of my Ubuntu host OS. Meaning, without the real-time documentation, I would've been trying to

figure out what my previous steps were whenever I took a break and came back to working on this assignment at a later time. In addition, I learned that with many tasks, you just use different options/flags with the same commands. There were a few new commands, but most of the commands I used, I saw before. There were just different flags syntax to go along with them. Lastly, I learned that creating scripts are extremely helpful. I wouldn't have had to manually type out so many commands if I created scripts to do those commands. I don't believe that's something I could've done on this project considering how long that would take, but if I ever need to in the future that's definitely an efficient option.