

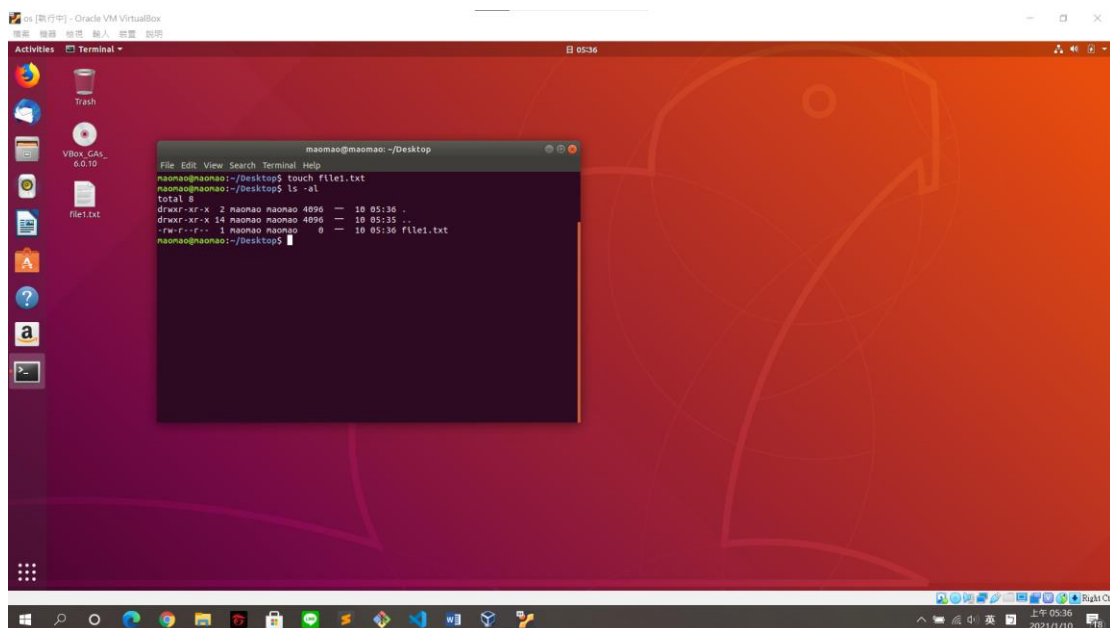
# HW3 File system

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## Task1 - Soft Link and Hard Link

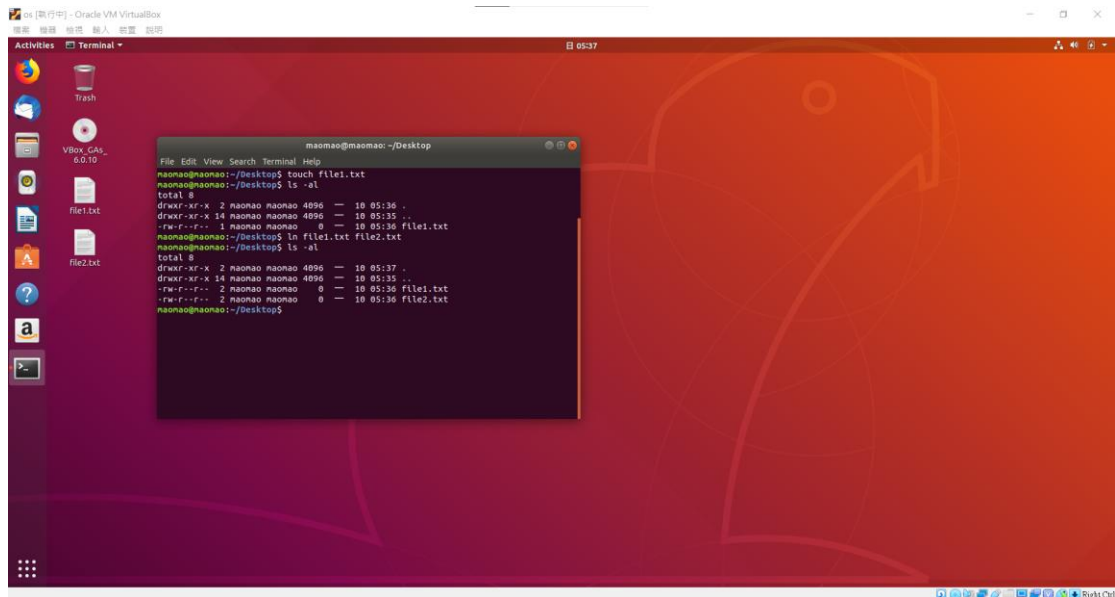
### 1. Create a text file as file1.txt

```
$ touch file1.txt
```



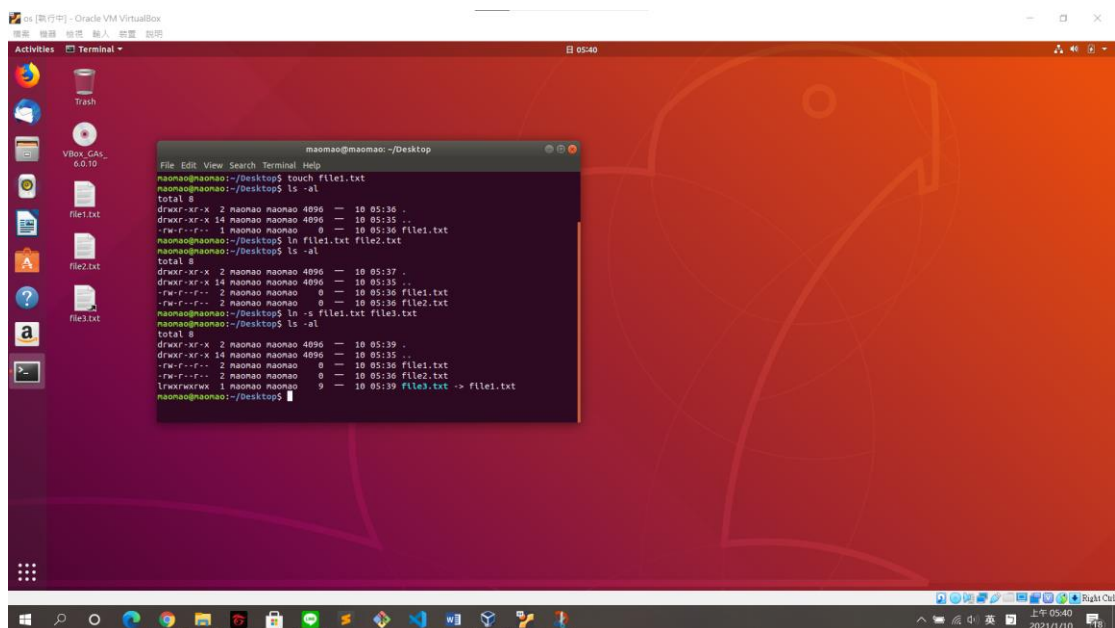
### 2. Create a hard link from file1.txt to file2.txt

```
$ ln file1.txt file2.txt
```



3. Create a soft link from file1.txt to file3.txt

`$ ln -s file1.txt file3.txt`



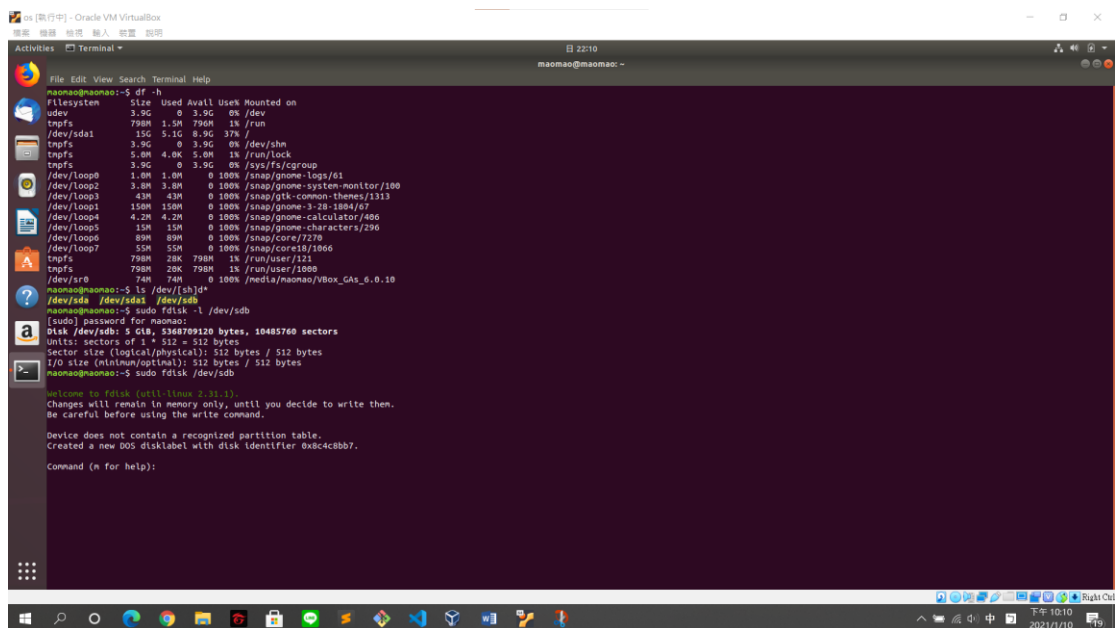
What are the inode values of each file?

`$ ls -li file1.txt file2.txt file3.txt`

# Task2 - Creating and mounting file system

1. Use the fdisk command to add a new 500MB logical partition to your hard drive.

```
$ sudo fdisk /dev/sdb
```



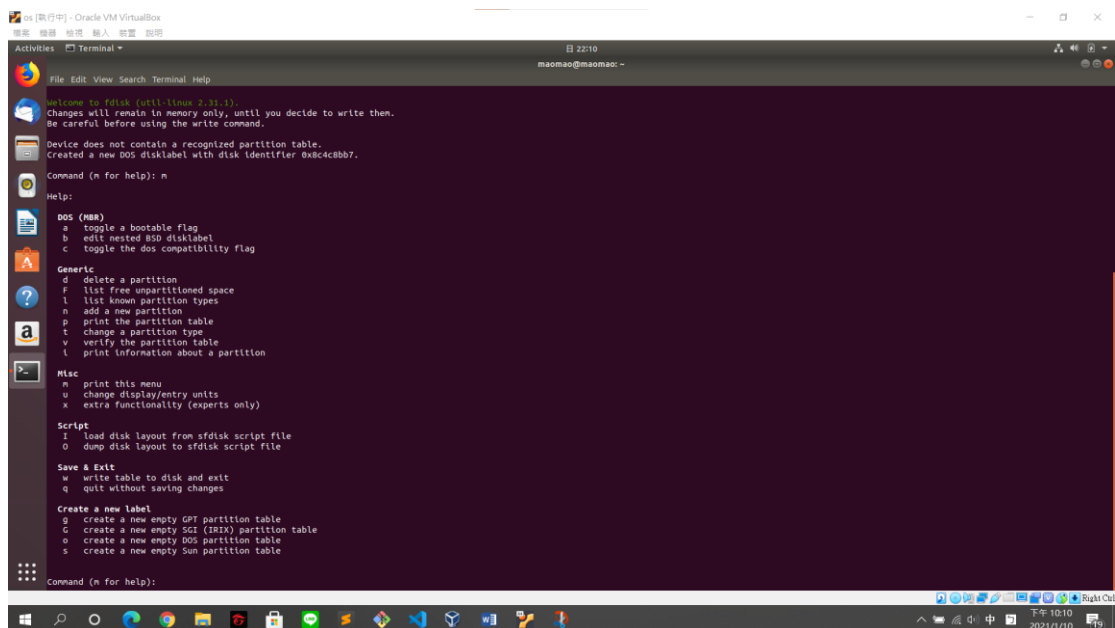
```
maomao@maomao:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            3.9G   0 3.9G   0% /dev
tmpfs           799M  2.5M 796M   1% /run
/dev/sda1       15G   5.1G 8.9G  37% /
tmpfs           3.9G   0 3.9G   0% /dev/shm
tmpfs           5.0M  4.0K 5.0M   1% /run/lock
tmpfs           3.9G   0 3.9G   0% /sys/fs/cgroup
/dev/loop0      1.0M   0 1.0M   0% /snap/gnome-logs/61
/dev/loop2      3.8M   0 3.8M   0% /snap/gnome-system-monitor/100
/dev/loop3      43M   0 43M   0% /snap/gtk-common-themes/1313
/dev/loop4     150M   0 150M   0% /snap/gnome-3-28-1004/67
/dev/loop5      4.2M   0 4.2M   0% /snap/gnome-calculator/486
/dev/loop6      15M   0 15M   0% /snap/gnome-characters/296
/dev/loop7      89M   0 89M   0% /snap/core72/20
/dev/loop8     55M   0 55M   0% /snap/core18/1066
tmpfs           799M  28K 799M   1% /run/user/121
tmpfs           799M  28K 799M   1% /run/user/1000
/dev/sr0        74M   0 74M   0% /media/maomao/VBox_GAs_6.0.10

maomao@maomao:~$ ls /dev/shd*
/dev/sda  /dev/sdas  /dev/sdb
maomao@maomao:~$ sudo fdisk -l /dev/sdb
[sudo] password for maomao:
Disk /dev/sdb: 3.9G, 348773120 bytes, 10485760 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
maomao@maomao:~$ sudo fdisk /dev/sdb

Welcome to fdisk (util-linux 2.31.1).
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 disklabel with disk identifier 0x8c4c8bb7.

Command (m for help):
```



```
Command (m for help): n

Help:
DOS (MBR)
a toggle a bootable flag
b edit nested BSD disklabel
c toggle the dos compatibility flag

Generic
d delete a partition
l list known partition types
n add a new partition
p print the partition table
t change a partition type
v verify the partition table
i print information about a partition

Misc
m print this menu
u change display/entry units
x extra functionality (experts only)

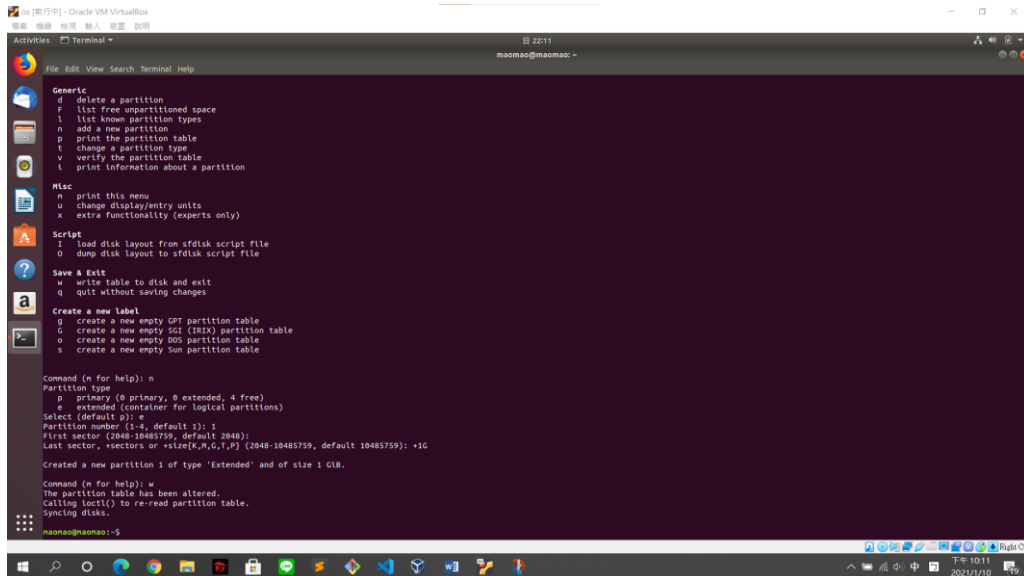
Script
i load disk layout from sfdisk script file
o dump disk layout to sfdisk script file

Save & Exit
w write table to disk and exit
q quit without saving changes

Create a new label
g create a new empty GPT partition table
G create a new empty SGI (IRIX) partition table
o create a new empty DOS partition table
s create a new empty Sun partition table

Command (m for help):
```

n -> e -> 1 -> "enter" -> +1G (must more than 500MB) -> w



```
Generic
d delete a partition
f list free unpartitioned space
l list known partition types
n add a new partition
p print the partition table
t change a partition type
v verify the partition table
l print information about a partition

Misc
m print this menu
u change display/entry units
x extra functionality (experts only)

Script
i load disk layout from sfdisk script file
o dump disk layout to sfdisk script file

Save & Exit
w write table to disk and exit
q quit without saving changes

Create a new label
o create a new empty GPT partition table
G create a new empty SGI (IBIX) partition table
o create a new empty DOS partition table
s create a new empty Sun partition table

Command (n for help): n
Partition type
  p primary (0 primary, 0 extended, 4 free)
  e extended (container for logical partitions)
Select (default p): e
Partition number (1-4, default 1): 1
First sector (2048-10485759, default 2048):
Last sector, +sectors or +size{M,G,T,P} (2048-10485759, default 10485759): +1G

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

Command (n for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.
maomao@maomao:~$
```

\$ sudo fdisk /dev/sdb

Create logical partition

Use the fdisk -l command to verify that the new partition has been created.

\$ sudo fdisk -l /dev/sdb

```
maomao@maomao:~$ sudo fdisk -l /dev/sdb
Disk /dev/sdb: 512 MiB, 524288000 bytes, 10485760 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
Disklabel type: dos
Disk identifier: 0x4c4b07

Device      Boot  Start      End  Sectors  Size Id Type
/dev/sdb1             2048  2099199  2097152    1G  5  Extended
/dev/sdb2             4096  1023999  1024000    500M  8  Linux
/dev/sdb3             4096  1023999  1024000    500M  8  Linux
/dev/sdb4             4096  1023999  1024000    500M  8  Linux
/dev/sdb5             4096  1023999  1024000    500M  8  Linux
```

2. Format this partition with an ext4 file system that contains 800 inodes and block size is 4096 bytes.

\$ sudo mkfs -t ext4 -N 800 -b 4096 /dev/sdb5

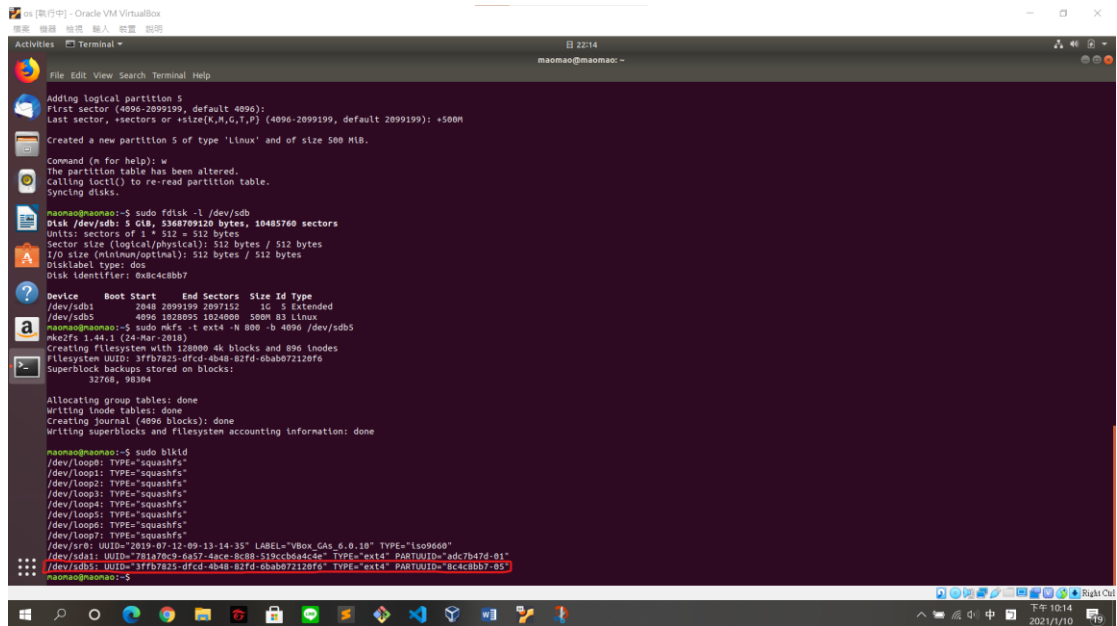
```
maomao@maomao:~$ sudo mkfs -t ext4 -N 800 -b 4096 /dev/sdb5
Creating file system with 800000 4k blocks and 800 inodes
Filesystem UUID: 3ff7823-dfcd-4b48-82fd-ebab072120f6
Superblock backups stored on blocks:
32768, 99304

Allocating group tables: done
Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

maomao@maomao:~$
```

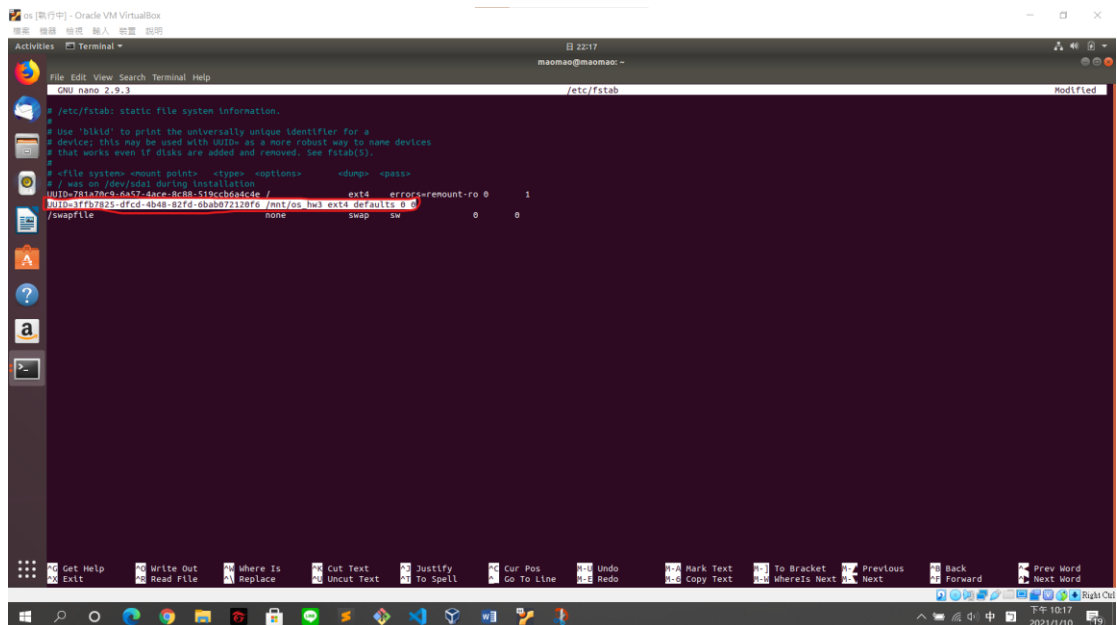
3. Edit /etc/fstab and reboot to mount file system.

\$ sudo blkid (check UUID)



```
maomao@maomao:~$ sudo blkid
/dev/loop0: TYPE="squashfs"
/dev/loop1: TYPE="squashfs"
/dev/loop2: TYPE="squashfs"
/dev/loop3: TYPE="squashfs"
/dev/loop4: TYPE="squashfs"
/dev/loop5: TYPE="squashfs"
/dev/loop6: TYPE="squashfs"
/dev/loop7: TYPE="squashfs"
/dev/sr0: UUID="2019-07-12-09-13-14-35" LABEL="VBox_GAs_6.0.10" TYPE="iso9660"
/dev/sda1: UUID="781a70c9-6a57-d4ce-8c88-51cc6b4dc4" TYPE="ext4" PARTUUID="ad7b47d-01"
/dev/sdb5: UUID="3ffb7825-dfcd-4b48-82fd-ebab072120f6" TYPE="ext4" PARTUUID="8c4c8bb7-05"
```

\$ sudo nano /etc/fstab



```
maomao@maomao:~$ sudo nano /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 points <type> <options> <dump> <pass>
# / was on /dev/sda1 during installation
UUID=781a70c9-6a57-d4ce-8c88-51cc6b4dc4 / ext4 errors=remount-ro 0 1
3ffb7825-dfcd-4b48-82fd-ebab072120f6 /mnt/os hws ext4 defaults 0 0
/swapfile none swap sw 0 0
```

check

```
os [运行中] - Oracle VM VirtualBox
maomao@maomao: ~$
Disk /dev/sdb: 5 GiB, 5368709120 bytes, 10485760 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
Disklabel type: dos
Disk identifier: 0x8c4c8bb7

Device      Boot Start      End Sectors Size Id Type
/dev/sdb1   2048 2099199 2097152 1G 5 Extended
/dev/sdb5   4096 1028095 1024000 500M 83 Linux
maomao@maomao:~$ sudo mkfs -t ext4 -N 800 -b 4096 /dev/sdb5
mke2fs 1.44.1 (24-Mar-2018)
Creating filesystem with 128000 4k blocks and 896 inodes
Filesystem UUID: 3ffb7825-dfcd-4b48-82fd-6bab072128f6
Superblock backups stored on blocks:
    32768, 98304

Allocating group tables: done
Writing inode tables: done
Creating journal (4096 blocks): done
Writing superblocks and filesystem accounting information: done

maomao@maomao:~$ sudo blkid
/dev/loop0: TYPE="squashfs"
/dev/loop1: TYPE="squashfs"
/dev/loop2: TYPE="squashfs"
/dev/loop3: TYPE="squashfs"
/dev/loop4: TYPE="squashfs"
/dev/loop5: TYPE="squashfs"
/dev/loop6: TYPE="squashfs"
/dev/loop7: TYPE="squashfs"
/dev/sr0: UUID="2019-07-12-09-13-14-35" LABEL="VBox_GAs_6.0.10" TYPE="iso9660"
/dev/sda1: UUID="781a78c9-6a57-4ace-8c88-519ccba4c4e" TYPE="ext4" PARTUUID="adc7b47d-01"
/dev/sdb1: UUID="3ffb7825-dfcd-4b48-82fd-6bab072128f6" TYPE="ext4" PARTUUID="8c4c8bb7-05"
maomao@maomao:~$ sudo nano /etc/fstab
maomao@maomao:~$ 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=781a78c9-6a57-4ace-8c88-519ccba4c4e / ext4 errors=remount-ro 0 1
# /mnt/os_hws ext4 defaults 0 0
UUID=3ffb7825-dfcd-4b48-82fd-6bab072128f6 /mnt/os_hws ext4 defaults 0 0
/swapfile none swap sw 0 0
maomao@maomao:~$
```

And then, reboot

```
os [运行中] - Oracle VM VirtualBox
maomao@maomao: ~$
Disk /dev/sdb: 5 GiB, 5368709120 bytes, 10485760 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
Disklabel type: dos
Disk identifier: 0x8c4c8bb7

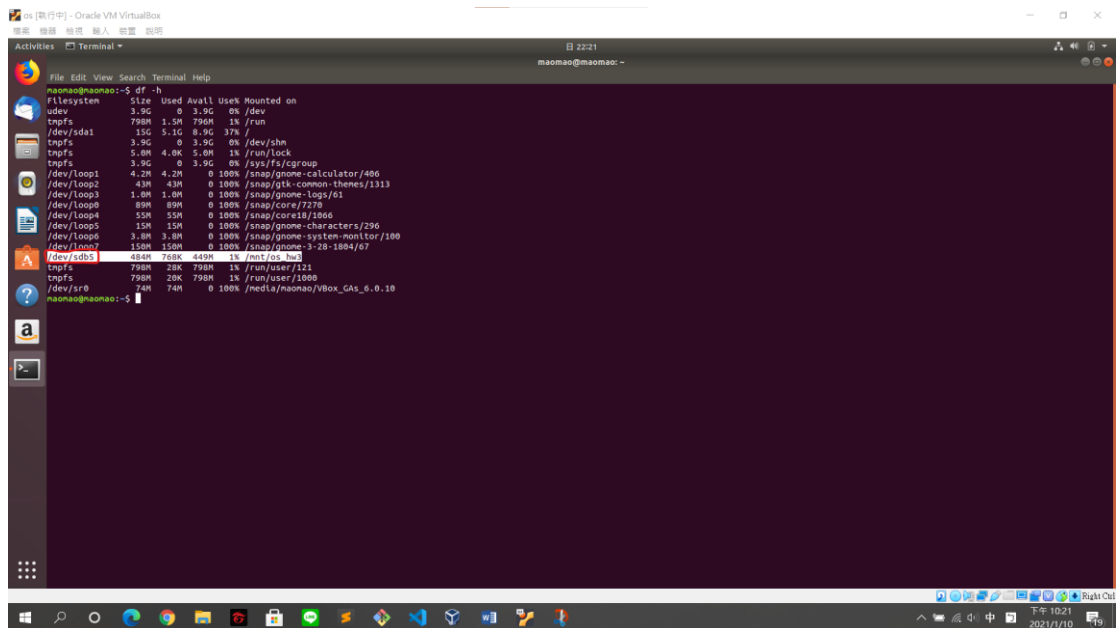
Device      Boot Start      End Sectors Size Id Type
/dev/sdb1   2048 2099199 2097152 1G 5 Extended
/dev/sdb5   4096 1028095 1024000 500M 83 Linux
maomao@maomao:~$ sudo mkfs -t ext4 -N 800 -b 4096 /dev/sdb5
mke2fs 1.44.1 (24-Mar-2018)
Creating filesystem with 128000 4k blocks and 896 inodes
Filesystem UUID: 3ffb7825-dfcd-4b48-82fd-6bab072128f6
Superblock backups stored on blocks:
    32768, 98304

Allocating group tables: done
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maomao@maomao:~$ sudo blkid
/dev/loop0: TYPE="squashfs"
/dev/loop1: TYPE="squashfs"
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/dev/loop3: TYPE="squashfs"
/dev/loop4: TYPE="squashfs"
/dev/loop5: TYPE="squashfs"
/dev/loop6: TYPE="squashfs"
/dev/loop7: TYPE="squashfs"
/dev/sr0: UUID="2019-07-12-09-13-14-35" LABEL="VBox_GAs_6.0.10" TYPE="iso9660"
/dev/sda1: UUID="781a78c9-6a57-4ace-8c88-519ccba4c4e" TYPE="ext4" PARTUUID="adc7b47d-01"
/dev/sdb1: UUID="3ffb7825-dfcd-4b48-82fd-6bab072128f6" TYPE="ext4" PARTUUID="8c4c8bb7-05"
maomao@maomao:~$ sudo nano /etc/fstab
maomao@maomao:~$ 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=781a78c9-6a57-4ace-8c88-519ccba4c4e / ext4 errors=remount-ro 0 1
# /mnt/os_hws ext4 defaults 0 0
UUID=3ffb7825-dfcd-4b48-82fd-6bab072128f6 /mnt/os_hws ext4 defaults 0 0
/swapfile none swap sw 0 0
maomao@maomao:~$ reboot
```

#### 4. Use the df command to confirm whether the mount is success

```
$ df -h
```



The screenshot shows a terminal window titled 'maomao@maomao: ~' with the command 'df -h' executed. The output is a table showing disk space usage for various filesystems. The 'run/lock' directory is highlighted in red.

Filesystem	Size	Used	Avail	Use%	Mounted on
udev	3.9G	0	3.9G	0%	/dev
tmpfs	798M	1.5M	796M	1%	/run
/dev/sda1	15G	5.1G	8.9G	37%	/
tmpfs	3.9G	0	3.9G	0%	/dev/shm
tmpfs	5.0M	4.0K	5.0M	1%	/run/lock
tmpfs	3.9G	0	3.9G	0%	/sys/fs/cgroup
/dev/loop1	4.2M	4.2M	0	100%	/snap/gnome-calculator/446
/dev/loop2	43M	43M	0	100%	/snap/gtk-common-themes/1313
/dev/loop3	1.0M	1.0M	0	100%	/snap/gnome-logs/61
/dev/loop4	89M	89M	0	100%	/snap/core/7278
/dev/loop4	55M	55M	0	100%	/snap/core18/1066
/dev/loop5	15M	15M	0	100%	/snap/gnome-characters/756
/dev/loop6	3.8M	3.8M	0	100%	/snap/gnome-system-monitor/100
/dev/loop7	150M	150M	0	100%	/snap/gnome-3-28-1004/67
run/lock	4.0K	4.0K	0	100%	/run/lock
tmpfs	798M	20K	798M	1%	/run/user/1211
tmpfs	798M	20K	798M	1%	/run/user/1000
/dev/sr0	74M	0	74M	0%	/media/maomao/vBox_GAs_6.0.10

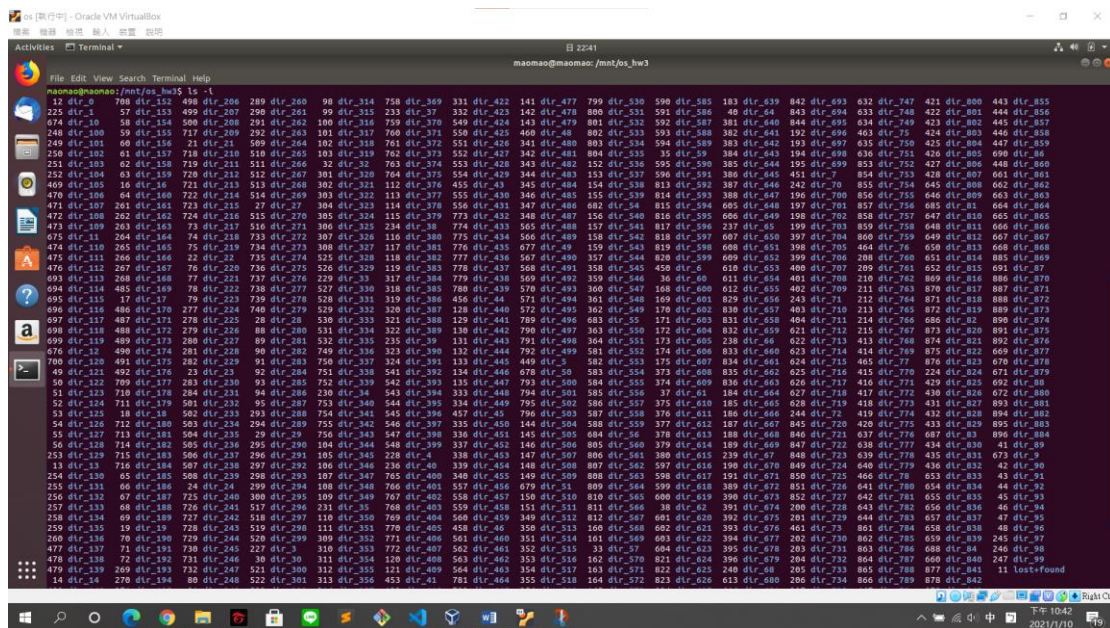


# Task3 – Inode and block

1. Try to create directories in this file system as many as you can. How many directories can be created in this file system? Why? (Hint: inode)

```
$ sudo mkdir dir
```

```
$ ls -i (show inodes)
```



2. Try to create 1-byte files in this file system as many as you can. How many 1-byte files can be created in this file system? Can it completely use

all space in this file system? (Hint: block size is 4096 bytes)

```
$ sudo truncate -s 1 file1
```

3. Try to create a file which size as large as you can.

What is the maximum file size? Can it completely use all space in this file system?

```
$ sudo fallocate -l 20M file_0.txt
```