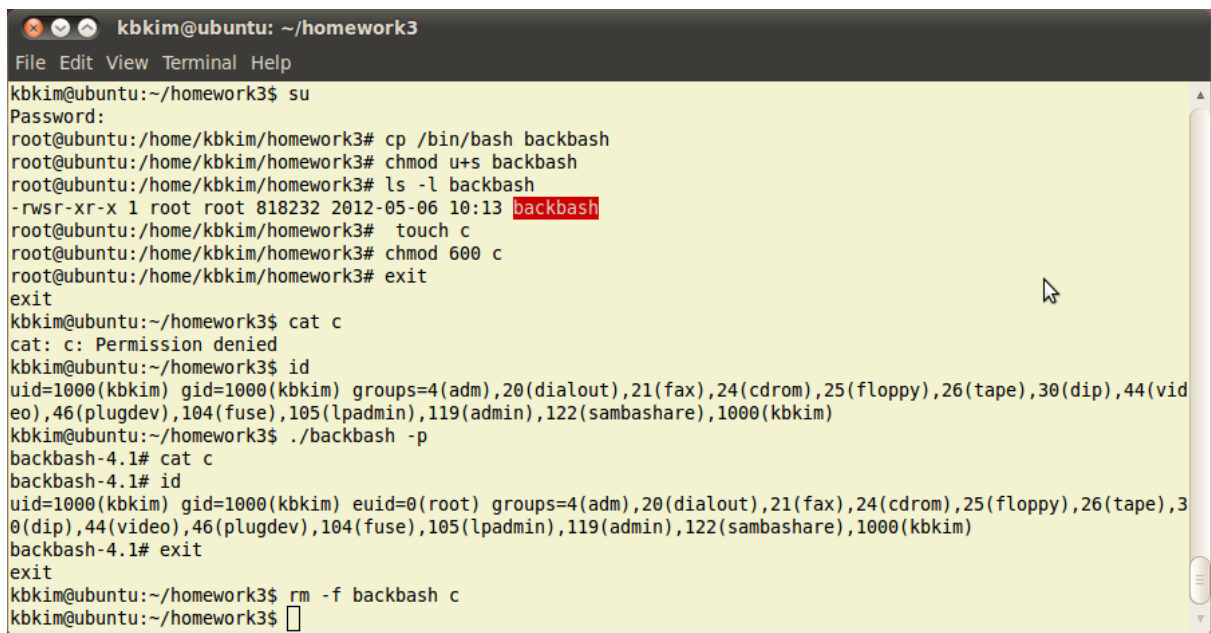


Homework #3 Solution

1. Do "mkdir ~/homework3", then do "cd ~/homework3", then do "su", then do "cp /bin/bash backbash", then do "chmod u+s backbash", then do "ls -l backbash", then do "touch c", then do "chmod 600 c", then do "exit", then do "cat c", then do "id", then do "./backbash -p", then do "cat c", then do "id", then do "exit". Then do "rm -f backbash c"

- Take a screenshot 



```
kbkim@ubuntu: ~/homework3
File Edit View Terminal Help
kbkim@ubuntu:~/homework3$ su
Password:
root@ubuntu:/home/kbkim/homework3# cp /bin/bash backbash
root@ubuntu:/home/kbkim/homework3# chmod u+s backbash
root@ubuntu:/home/kbkim/homework3# ls -l backbash
-rwsr-xr-x 1 root root 818232 2012-05-06 10:13 backbash
root@ubuntu:/home/kbkim/homework3# touch c
root@ubuntu:/home/kbkim/homework3# chmod 600 c
root@ubuntu:/home/kbkim/homework3# exit
exit
kbkim@ubuntu:~/homework3$ cat c
cat: c: Permission denied
kbkim@ubuntu:~/homework3$ id
uid=1000(kbkim) gid=1000(kbkim) groups=4(adm),20(dialout),21(fax),24(cdrom),25(floppy),26(tape),30(dip),44(video),46(plugdev),104(fuse),105(lpadmin),119(admin),122(sambashare),1000(kbkim)
kbkim@ubuntu:~/homework3$ ./backbash -p
backbash-4.1# cat c
backbash-4.1# id
uid=1000(kbkim) gid=1000(kbkim) euid=0(root) groups=4(adm),20(dialout),21(fax),24(cdrom),25(floppy),26(tape),30(dip),44(video),46(plugdev),104(fuse),105(lpadmin),119(admin),122(sambashare),1000(kbkim)
backbash-4.1# exit
exit
kbkim@ubuntu:~/homework3$ rm -f backbash c
kbkim@ubuntu:~/homework3$
```

- Explain the difference between the first "cat" result and the second "cat" result.

➔ The first "cat" is run by normal user and cannot access the file c. The second "cat" is run by root and can access the file c.

- Describe the difference between the first "id" result and the second "id" result.

➔ The second "id" shows that euid is 0.

2. Do "su – peterpan" (user peterpan should exist), then do "clear", then do "mkdir proj1", then do "mkdir proj1/sub1", then do "ls -l proj1", then do "chgrp defender proj1", then do "chmod g+s proj1", then do "mkdir proj1/sub2", then do "touch proj1/a", then do "ls -l proj1".

- Take a screenshot 📷



```
peterpan@ubuntu: ~  
File Edit View Terminal Help  
peterpan@ubuntu:~$ mkdir proj1  
peterpan@ubuntu:~$ mkdir proj1/sub1  
peterpan@ubuntu:~$ ls -l proj1  
total 4  
drwxr-xr-x 2 peterpan peterpan 4096 2012-05-06 10:18 sub1  
peterpan@ubuntu:~$ chgrp defender proj1  
peterpan@ubuntu:~$ chmod g+s proj1  
peterpan@ubuntu:~$ mkdir proj1/sub2  
peterpan@ubuntu:~$ touch proj1/a  
peterpan@ubuntu:~$ ls -l proj1  
total 8  
-rw-r--r-- 1 peterpan defender 0 2012-05-06 10:18 a  
drwxr-xr-x 2 peterpan peterpan 4096 2012-05-06 10:18 sub1  
drwxr-sr-x 2 peterpan defender 4096 2012-05-06 10:18 sub2  
peterpan@ubuntu:~$
```

- What is difference between the "sub1" directory and the "sub2" directory? Why?

➔ The ownership of sub1 is peterpan:peterpan, but the ownership of sub2 is peterpan:defender. It is because, peterpan sets setgid for the proj1 directory before creating sub2 sub-directory under proj1 directory.

- What is the ownership of the file proj1/a. Why?

➔ The ownership of the file proj1/a is peterpan:defender. The same reason of the above question.

3. Do "clear", then do "mkdir shared", then do "chmod 777 shared", then do "mkdir shared_t", then do "chmod 1777 shared_t", then do "touch shared/a", then do "touch shared_t/a", then do "su hook" (user hook should exist), then do "rm shared/a", then do "rm shared_t/a", then do "exit", then do "exit".

- Take a screenshot 📷

```
peterpan@ubuntu: ~  
File Edit View Terminal Help  
peterpan@ubuntu:~$ mkdir shared  
peterpan@ubuntu:~$ chmod 777 shared  
peterpan@ubuntu:~$ mkdir shared_t  
peterpan@ubuntu:~$ chmod 1777 shared_t  
peterpan@ubuntu:~$ touch shared/a  
peterpan@ubuntu:~$ touch shared_t/a  
peterpan@ubuntu:~$ su hook  
Password:  
hook@ubuntu:/home/peterpan$ rm shared/a  
rm: remove write-protected regular empty file `shared/a'? y  
hook@ubuntu:/home/peterpan$ rm shared_t/a  
rm: remove write-protected regular empty file `shared_t/a'? y  
rm: cannot remove `shared_t/a': Operation not permitted  
hook@ubuntu:/home/peterpan$ exit  
exit  
peterpan@ubuntu:~$
```

- Which file is removed? Why?

➔ The file, shared/a, is removed. The file, shared_t/a locates the sticky bit set directory shared_t, and it cannot be removed by other users except peterpan.

4. Do "cd ~/homework3", then do "clear", then do "mkdir lntest", then do "echo "test ln" | cat > testln", then do "ln -s lntest lntest_s", then do "ln -s testln testln_s", then do "ls -l"

- Take a screenshot 🖥️

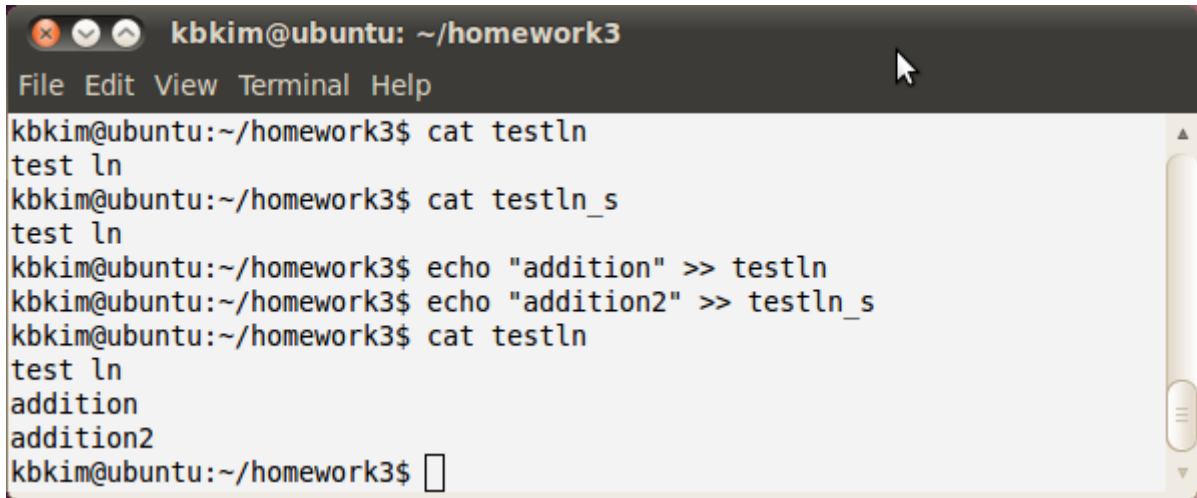
```
kdkim@ubuntu: ~/homework3  
File Edit View Terminal Help  
kdkim@ubuntu:~/homework3$ mkdir lntest  
kdkim@ubuntu:~/homework3$ echo "test ln" | cat > testln  
kdkim@ubuntu:~/homework3$ ln -s lntest lntest_s  
kdkim@ubuntu:~/homework3$ ln -s testln testln_s  
kdkim@ubuntu:~/homework3$ ls -l  
total 8  
drwxr-xr-x 2 kdkim kdkim 4096 2013-03-31 22:52 lntest  
lrwxrwxrwx 1 kdkim kdkim 6 2013-03-31 22:53 lntest_s -> lntest  
-rw-r--r-- 1 kdkim kdkim 8 2013-03-31 22:52 testln  
lrwxrwxrwx 1 kdkim kdkim 6 2013-03-31 22:53 testln_s -> testln  
kdkim@ubuntu:~/homework3$
```

- What are the files named "lntest_s" and "testln_s"?

➔ Symbolic links for the directory named as lntest and the file named as testln.

5. Do "clear", then do "cat testln", then do "cat testln_s", then do "echo "addition" >> testln", then do "echo "addition2" >> testln_s", then do "cat testln"

- Take a screenshot 



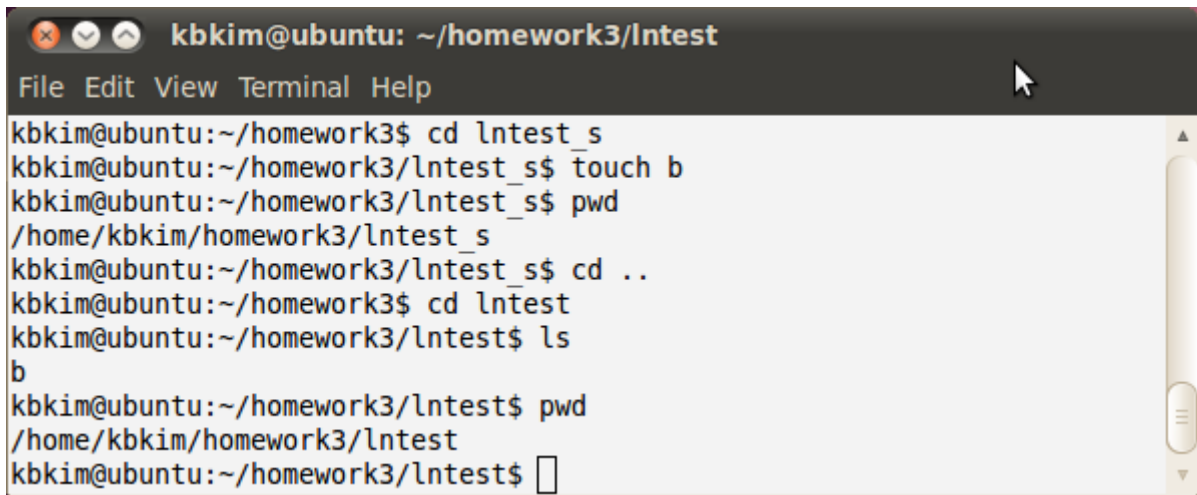
```
kbbkim@ubuntu: ~/homework3
File Edit View Terminal Help
kbbkim@ubuntu:~/homework3$ cat testln
test ln
kbbkim@ubuntu:~/homework3$ cat testln_s
test ln
kbbkim@ubuntu:~/homework3$ echo "addition" >> testln
kbbkim@ubuntu:~/homework3$ echo "addition2" >> testln_s
kbbkim@ubuntu:~/homework3$ cat testln
test ln
addition
addition2
kbbkim@ubuntu:~/homework3$
```

- What is the last result? Why?

➔ "cat testln" and "cat testln_s" returns the same result. And the addition of text using testln_s modifies the contents of the file "testln". It is because the testln_s is the symbolic link of the testln file

6. Do "clear", then do "cd lntest_s", then do "touch b", then do "pwd", then do "cd ..", then do "cd lntest", then do "ls", then do "pwd"

- Take a screenshot 



```
kbbkim@ubuntu: ~/homework3/lntest
File Edit View Terminal Help
kbbkim@ubuntu:~/homework3$ cd lntest_s
kbbkim@ubuntu:~/homework3/lntest_s$ touch b
kbbkim@ubuntu:~/homework3/lntest_s$ pwd
/home/kbbkim/homework3/lntest_s
kbbkim@ubuntu:~/homework3/lntest_s$ cd ..
kbbkim@ubuntu:~/homework3$ cd lntest
kbbkim@ubuntu:~/homework3/lntest$ ls
b
kbbkim@ubuntu:~/homework3/lntest$ pwd
/home/kbbkim/homework3/lntest
kbbkim@ubuntu:~/homework3/lntest$
```

- Compare the results between first "pwd" and second "pwd".

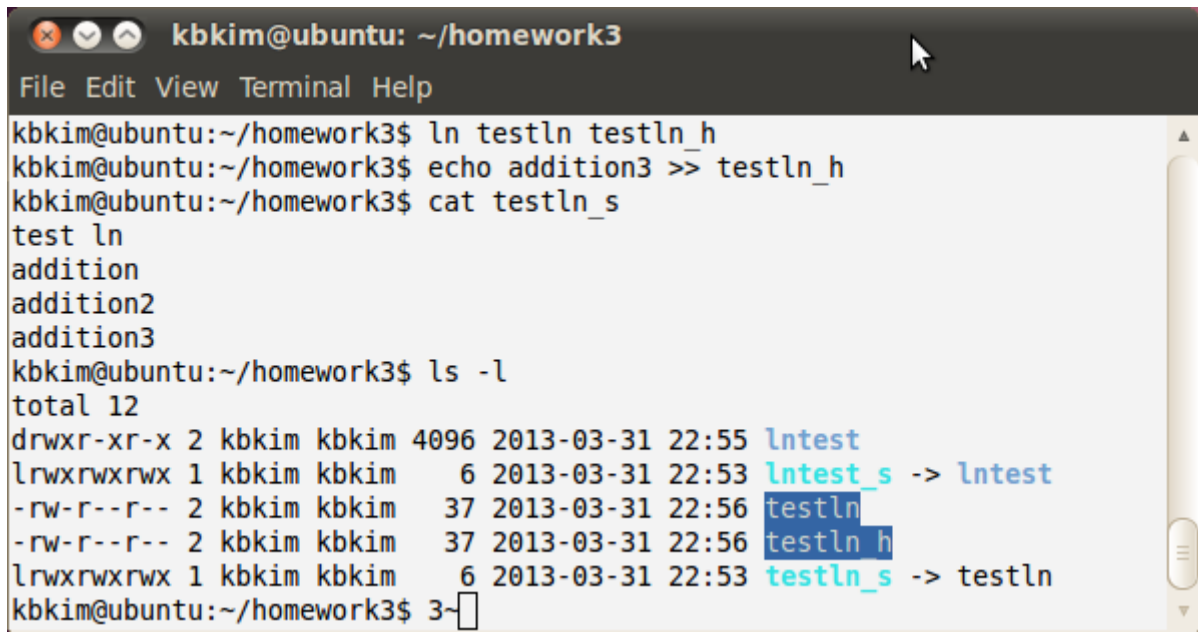
➔ First pwd shows the current directory is "/home/kbbkim/homework4/lntest_s", but the first pwd shows the current directory is "/home/kbbkim/homework4/lntest".

- What is the result of "ls"? Why?

➔ "ls" command shows the file b. It is because lntest_s is the symbolic link of the directory named as lntest.

7. Do "cd ./", then do "clear", then do "ln testln testln_h", then do "echo "addition3" >> testln_h", then do "cat testln_s", then do "ls -l"

- Take a screenshot 📷

A terminal window titled 'kbbkim@ubuntu: ~/homework3' with a menu bar (File, Edit, View, Terminal, Help). The terminal shows the following commands and output:

```
kbbkim@ubuntu:~/homework3$ ln testln testln_h
kbbkim@ubuntu:~/homework3$ echo addition3 >> testln_h
kbbkim@ubuntu:~/homework3$ cat testln_s
test ln
addition
addition2
addition3
kbbkim@ubuntu:~/homework3$ ls -l
total 12
drwxr-xr-x 2 kbbkim kbbkim 4096 2013-03-31 22:55 lntest
lrwxrwxrwx 1 kbbkim kbbkim   6 2013-03-31 22:53 lntest_s -> lntest
-rw-r--r-- 2 kbbkim kbbkim  37 2013-03-31 22:56 testln
-rw-r--r-- 2 kbbkim kbbkim  37 2013-03-31 22:56 testln_h
lrwxrwxrwx 1 kbbkim kbbkim   6 2013-03-31 22:53 testln_s -> testln
kbbkim@ubuntu:~/homework3$ 3~
```

- What is the file "testln_h"?

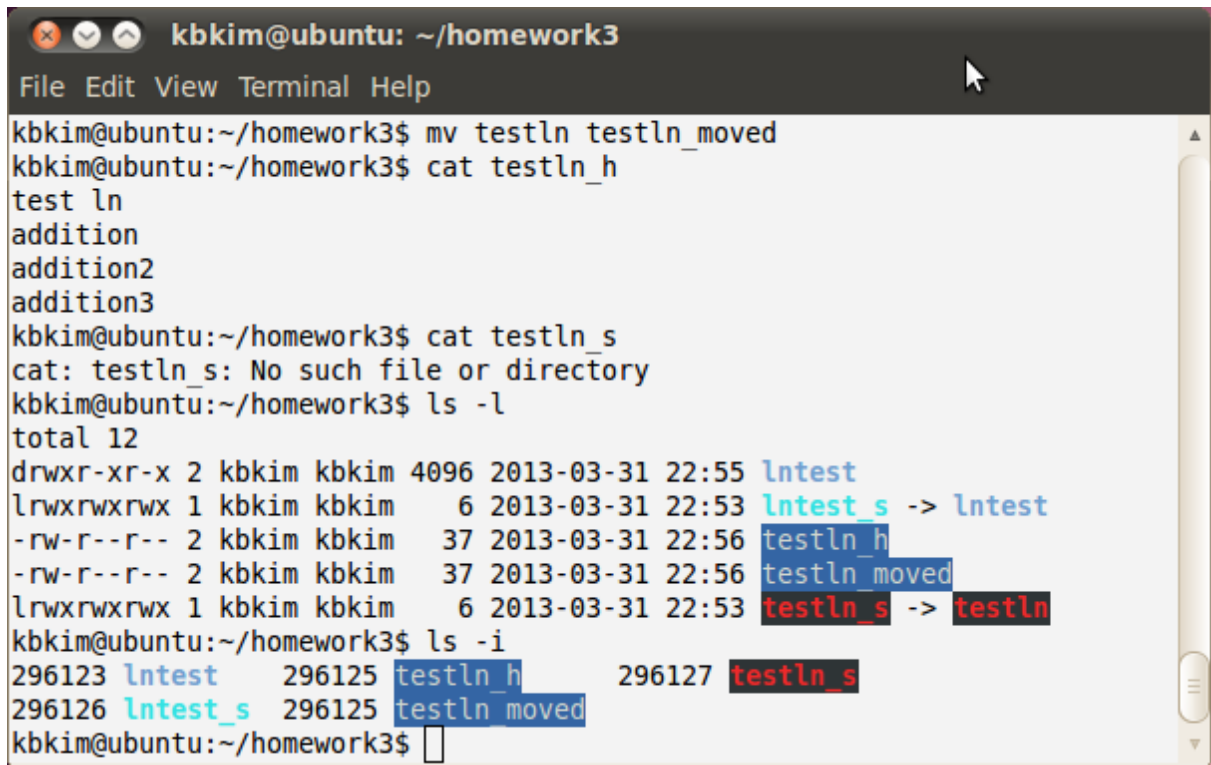
➔ **Hard link of the file named "testln".**

- What is the difference between "testln_s" and "testln_h"?

➔ **Based on the results of "ls -l", the size of "testln_s" and "testln_h" is different. The symbolic link "testln_s" points the directory entry of the file "testln", but the hard link "testln_h" points the inode of the file "testln".**

8. Do "clear", then do "mv testln testln_moved", then do "cat testln_h", then do "cat testln_s", then do "ls -l", then do "ls -i"

- Take a screenshot 📷



```
kbkim@ubuntu: ~/homework3
File Edit View Terminal Help

kbkim@ubuntu:~/homework3$ mv testln testln_moved
kbkim@ubuntu:~/homework3$ cat testln_h
test ln
addition
addition2
addition3
kbkim@ubuntu:~/homework3$ cat testln_s
cat: testln_s: No such file or directory
kbkim@ubuntu:~/homework3$ ls -l
total 12
drwxr-xr-x 2 kbkim kbkim 4096 2013-03-31 22:55 lntest
lrwxrwxrwx 1 kbkim kbkim   6 2013-03-31 22:53 lntest_s -> lntest
-rw-r--r-- 2 kbkim kbkim  37 2013-03-31 22:56 testln_h
-rw-r--r-- 2 kbkim kbkim  37 2013-03-31 22:56 testln_moved
lrwxrwxrwx 1 kbkim kbkim   6 2013-03-31 22:53 testln_s -> testln
kbkim@ubuntu:~/homework3$ ls -i
296123 lntest      296125 testln_h      296127 testln_s
296126 lntest_s    296125 testln_moved
kbkim@ubuntu:~/homework3$
```

- Compare the results between the first "cat" and the second "cat"

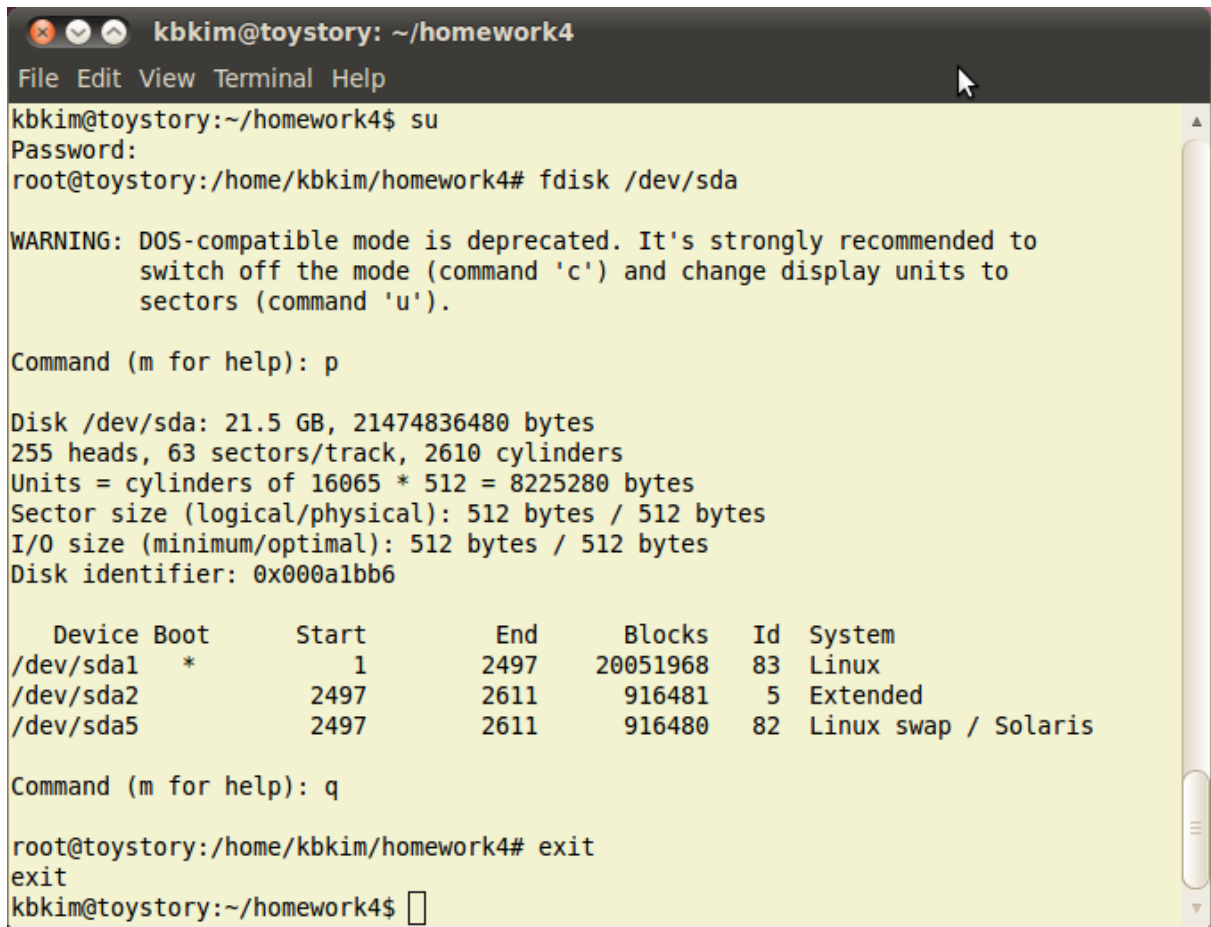
➔ The first cat shows the contents of the file "testln_moved", but the second cat occurs an error.

- What is the difference between "testln_s" and "testln_h" from the results of "ls -l" and "ls -i"?

➔ In the results of "ls -l", the entry of testln_s is shown as dark which means this symbolic link is corrupted. It is because the linked file testln is moved to testln_moved. In the results of "ls -i", the inode number of testln_h is still same to the inode number of testln_moved. This is the main reason of the difference between the results of "cat testln_h" and "cat testln_s".

9. Do "mkdir homework4", then do "cd homework4", then do "su" (password required), then do "fdisk /dev/sda", then press "p", then press "q", then do "exit"

- Take a screenshot 📷



```
kbkim@toystory: ~/homework4
File Edit View Terminal Help
kbkim@toystory:~/homework4$ su
Password:
root@toystory:/home/kbkim/homework4# fdisk /dev/sda

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
switch off the mode (command 'c') and change display units to
sectors (command 'u').

Command (m for help): p

Disk /dev/sda: 21.5 GB, 21474836480 bytes
255 heads, 63 sectors/track, 2610 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x000a1bb6

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1  *           1         2497     20051968   83   Linux
/dev/sda2                2497         2611       916481    5   Extended
/dev/sda5                2497         2611       916480   82   Linux swap / Solaris

Command (m for help): q

root@toystory:/home/kbkim/homework4# exit
exit
kbkim@toystory:~/homework4$
```

- What is the specification of the disk "sda"? (heads, sectors, cylinders, sector bytes)

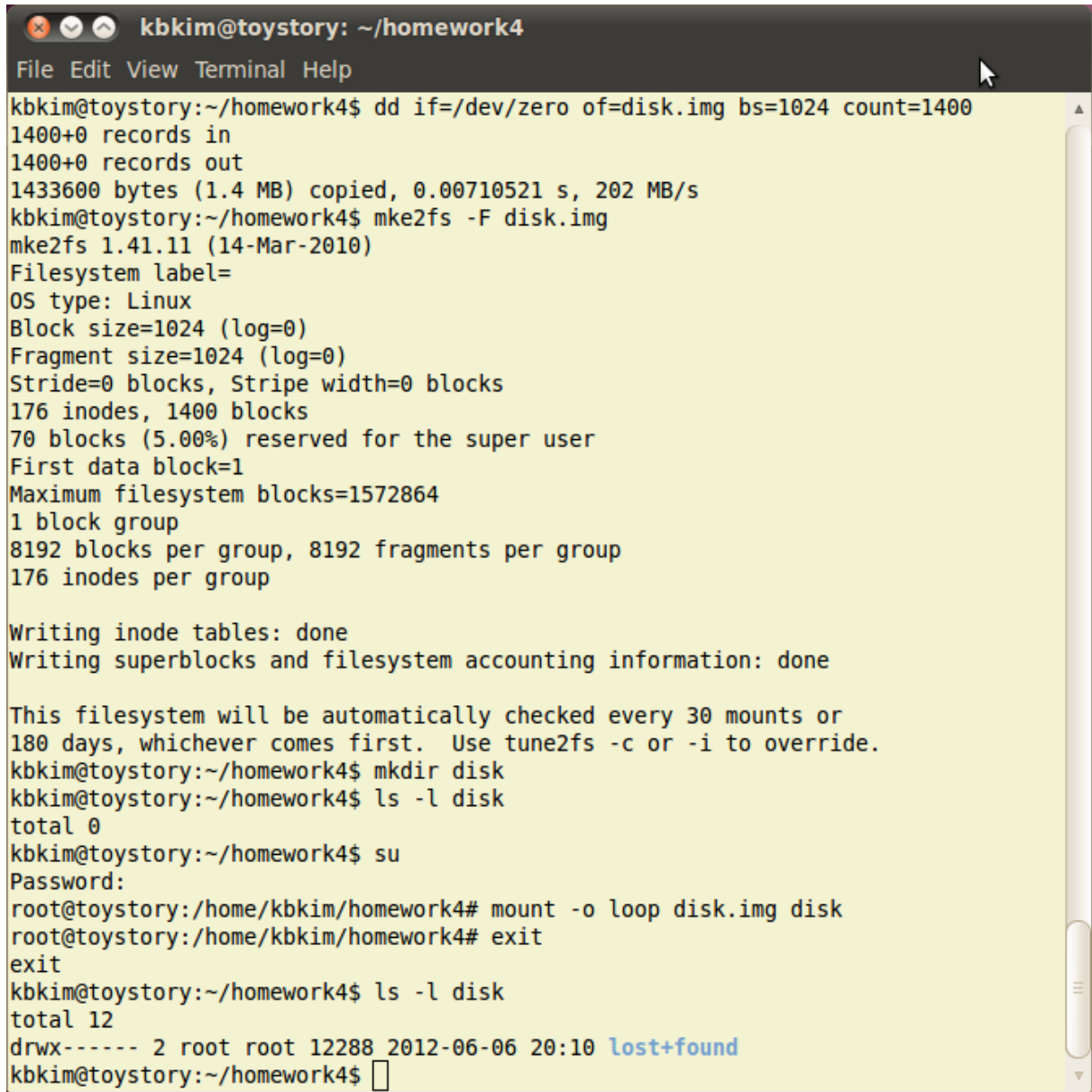
➔ **Heads : 255, Sectors : 63, Cylinders : 2610, Sector/Bytes : 512**

- How many partitions are there?

➔ **Three partitions (/dev/sda1, /dev/sda2, /dev/sda5)**

10. Do "clear", then do "dd if=/dev/zero of=disk.img bs=1024 count=1400", then do "mke2fs -F disk.img", then do "mkdir disk", then do "ls -l disk", then do "su" (password required), then do "mount -o loop disk.img disk", then do "exit", then do "ls -l disk"

- Take a screenshot 📸



```
kbkim@toystory: ~/homework4
File Edit View Terminal Help
kbkim@toystory:~/homework4$ dd if=/dev/zero of=disk.img bs=1024 count=1400
1400+0 records in
1400+0 records out
1433600 bytes (1.4 MB) copied, 0.00710521 s, 202 MB/s
kbkim@toystory:~/homework4$ mke2fs -F disk.img
mke2fs 1.41.11 (14-Mar-2010)
Filesystem label=
OS type: Linux
Block size=1024 (log=0)
Fragment size=1024 (log=0)
Stride=0 blocks, Stripe width=0 blocks
176 inodes, 1400 blocks
70 blocks (5.00%) reserved for the super user
First data block=1
Maximum filesystem blocks=1572864
1 block group
8192 blocks per group, 8192 fragments per group
176 inodes per group

Writing inode tables: done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 30 mounts or
180 days, whichever comes first. Use tune2fs -c or -i to override.
kbkim@toystory:~/homework4$ mkdir disk
kbkim@toystory:~/homework4$ ls -l disk
total 0
kbkim@toystory:~/homework4$ su
Password:
root@toystory:/home/kbkim/homework4# mount -o loop disk.img disk
root@toystory:/home/kbkim/homework4# exit
exit
kbkim@toystory:~/homework4$ ls -l disk
total 12
drwx----- 2 root root 12288 2012-06-06 20:10 lost+found
kbkim@toystory:~/homework4$
```

- What is the functionality of "dd" command?

➔ Copy blocks from a input file to output file.

- What is the functionality of "mke2fs" command?

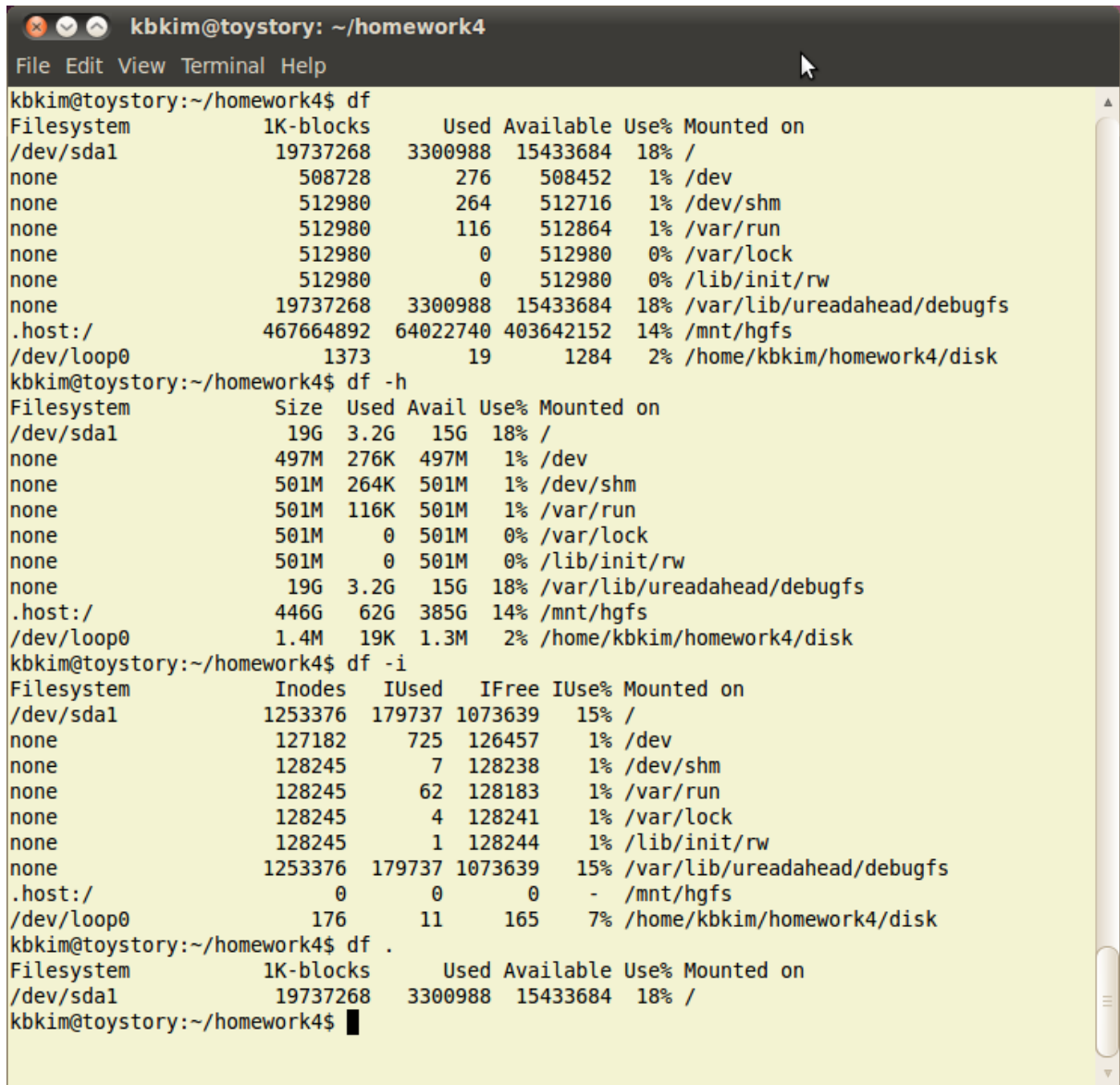
➔ Create an ext2/ext3/ext4 filesystem to a given partition. In this example, mke2fs use "-F" option to create a filesystem on a file.

- Compare the difference between the results of the first "ls" and the second "ls". Why?

➔ First "ls" shows nothing, but the second "ls" shows a directory "lost+found". It is because the disk.img file having a new filesystem is mounted to the directory ~/homework4/disk.

11. Do "clear", then do "df", then do "df -h", then "df -i", then do "df."

- Take a screenshot 📸



```
kbkim@toystory: ~/homework4
File Edit View Terminal Help
kbkim@toystory:~/homework4$ df
Filesystem      1K-blocks      Used Available Use% Mounted on
/dev/sda1      19737268    3300988   15433684   18% /
none           508728      276    508452    1% /dev
none           512980      264    512716    1% /dev/shm
none           512980      116    512864    1% /var/run
none           512980        0    512980    0% /var/lock
none           512980        0    512980    0% /lib/init/rw
none           19737268    3300988   15433684   18% /var/lib/ureadahead/debugfs
:host:/         467664892  64022740  403642152   14% /mnt/hgfs
/dev/loop0       1373        19      1284    2% /home/kbkim/homework4/disk
kbkim@toystory:~/homework4$ df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/sda1       19G   3.2G   15G   18% /
none            497M  276K  497M   1% /dev
none            501M  264K  501M   1% /dev/shm
none            501M  116K  501M   1% /var/run
none            501M    0  501M   0% /var/lock
none            501M    0  501M   0% /lib/init/rw
none            19G   3.2G   15G   18% /var/lib/ureadahead/debugfs
:host:/         446G   62G   385G   14% /mnt/hgfs
/dev/loop0      1.4M   19K   1.3M   2% /home/kbkim/homework4/disk
kbkim@toystory:~/homework4$ df -i
Filesystem      Inodes   IUsed   IFree IUse% Mounted on
/dev/sda1      1253376  179737 1073639   15% /
none           127182    725  126457    1% /dev
none           128245     7  128238    1% /dev/shm
none           128245    62  128183    1% /var/run
none           128245     4  128241    1% /var/lock
none           128245     1  128244    1% /lib/init/rw
none           1253376  179737 1073639   15% /var/lib/ureadahead/debugfs
:host:/         0         0     0     - /mnt/hgfs
/dev/loop0       176      11    165    7% /home/kbkim/homework4/disk
kbkim@toystory:~/homework4$ df .
Filesystem      1K-blocks      Used Available Use% Mounted on
/dev/sda1      19737268    3300988   15433684   18% /
kbkim@toystory:~/homework4$
```

- What are the options "-h" and "-i" for?

➔ "-h" : display results in a human-readable format. "-i" : display inode usage