Some Links are Hard, Some Links are Soft

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1 Q1

Results of ln -li file1.txt

Figure 1: ln -li file1.txt

What are the inode values of file1.txt and file2.txt? Are they the same or different? Do the two files have the same or different contents?

Inode values are both 67109127.

Figure 2: ln -li

file1.txt content is the same as file2.txt content.

Figure 3: cat file1.txt

Figure 4: cat file2.txt

2 Q2

Insert new content into file2.txt

Figure 5: echo ¿¿ file2.txt

The content of both files is still the same.

```
[camarata.sa@pc-cent Final]$ cat file1.txt
Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world.

FILE 1
teacher give this student an A!!!!!
```

Figure 6: cat file2.txt

It does not remove file2.txt as well

```
[camarata.sa@pc-cent Final]$ rm file1.txt
[camarata.sa@pc-cent Final]$ ls
file2.txt  file3.txt  writeup
```

Figure 7: rm file1.txt

Verbose removal of file2.txt. It should be noted that rm by default is using the unlink() system call.

```
[camarata.sa@pc-cent Final]$ strace rm file2.txt
execve("/usr/bin/rm", ["rm", "file2.txt"], [/* 49 vars */]) = 0
brk(NULL)                               = 0x1a06000
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f1e76287000
access("/etc/ld.so.preload", R_OK)      = -1 ENOENT (No such file or directory)
open("/etc/ld.so.cache", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=101092, ...}) = 0
mmap(NULL, 101092, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f1e7626e000
close(3)                                = 0
open("/lib64/libc.so.6", O_RDONLY|O_CLOEXEC) = 3
read(3, "\177ELF\2\1\1\3\0\0\0\0\0\0\0\0\3\0>\0\1\0\0\0P%\2\0\0\0\0\0"..., 832) = 832
fstat(3, {st_mode=S_IFREG|0755, st_size=2173512, ...}) = 0
mmap(NULL, 3981792, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_DENYWRITE, 3, 0) = 0x7f1e75c9a000
mprotect(0x7f1e75e5d000, 2093056, PROT_NONE) = 0
mmap(0x7f1e7605c000, 24576, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_DENYWRITE, 3, 0x1c2000) = 0x7f1e7605c000
mmap(0x7f1e76062000, 16864, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS, -1, 0) = 0x7f1e76062000
close(3)                                = 0
mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f1e7626d000
mmap(NULL, 8192, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) = 0x7f1e7626b000
arch_prctl(ARCH_SET_FS, 0x7f1e7626b740) = 0
mprotect(0x7f1e7605c000, 16384, PROT_READ) = 0
mprotect(0x60d000, 4096, PROT_READ)     = 0
mprotect(0x7f1e76288000, 4096, PROT_READ) = 0
munmap(0x7f1e7626e000, 101092)          = 0
brk(NULL)                               = 0x1a06000
brk(0x1a27000)                          = 0x1a27000
brk(NULL)                               = 0x1a27000
open("/usr/lib/locale/locale-archive", O_RDONLY|O_CLOEXEC) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=106070960, ...}) = 0
mmap(NULL, 106070960, PROT_READ, MAP_PRIVATE, 3, 0) = 0x7f1e6f771000
close(3)                                = 0
ioctl(0, TCGETS, {B38400 opost isig icanon echo ...}) = 0
newfstatat(AT_FDCWD, "file2.txt", {st_mode=S_IFREG|0644, st_size=148, ...}, AT_SYMLINK_NOFOLLOW) = 0
geteuid()                               = 1000
newfstatat(AT_FDCWD, "file2.txt", {st_mode=S_IFREG|0644, st_size=148, ...}, AT_SYMLINK_NOFOLLOW) = 0
faccessat(AT_FDCWD, "file2.txt", W_OK)  = 0
unlinkat(AT_FDCWD, "file2.txt", 0)      = 0
lseek(0, 0, SEEK_CUR)                   = -1 ESPIPE (Illegal seek)
close(0)                                = 0
close(1)                                = 0
close(2)                                = 0
exit_group(0)                           = ?
+++ exited with 0 +++
```

Figure 8: strace rm file2.txt

3   Q3

Create a symblolic link of file3.txt to file4.txt

```
[camarata.sa@pc-cent Final]$ ln -s file3.txt file4.txt
```

Figure 9: ln -s file3.txt file4.txt

inodes are different

```
[camarata.sa@pc-cent Final]$ ls -li
total 4
 67109115 -rw-r--r-- 1 camarata.sa wheel 144 Aug 28 21:46 file3.txt
 68558803 lrwxrwxrwx 1 camarata.sa wheel   9 Aug 28 22:30 file4.txt -> file3.txt
```

Figure 10: ls -li

Insert content into file4.txt

```
[camarata.sa@pc-cent Final]$ echo 'teacher give this student an A!!!!!' >> file4.txt
```

Figure 11: echo ¿¿ file4.txt

View the content of file3.txt. It is the same as file4.txt

```
[camarata.sa@pc-cent Final]$ cat file3.txt
Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing tha

FILE3teacher give this student an A!!!!!
```

Figure 12: cat file3.txt

remove file3.txt. file4.txt is a broken link.

```
[camarata.sa@pc-cent Final]$ rm file3.txt
[camarata.sa@pc-cent Final]$ ls -li
total 0
 68558803 lrwxrwxrwx 1 camarata.sa wheel   9 Aug 28 22:30 file4.txt -> file3.txt
```

Figure 13: rm file3.txt

Read from file4.txt

```
[camarata.sa@pc-cent Final]$ cat file4.txt
cat: file4.txt: No such file or directory
```

Figure 14: cat file4.txt

You are unable to read from file4.txt. The soft link still exists, but it is pointing to a non-existent hard link. Because the file it is referencing is gone, it throws an error.

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References

[1] Abraham Silberschatz, Peter Baer Galvin, Greg Gagne *Operating System Concepts* John Wiley & Sons Inc. 2018