

Information Technology University of the Punjab
SE301T Operating Systems – Spring 2025
Assignment 4 [CLO1]

Deadline: **Solution**

Total Marks: 60

1. Inodes and File Metadata
 - a. What is small.txt's inode number, size and link count?

```
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ ls -li small.txt
1125899907900452 -rwxrwxrwx 1 umair umair 512 Jun  2 23:03 small.txt
```

The output has the following fields from left to right:

Inode number: 1125899907900452

File permissions: -rwxrwxrwx (“-” at the start is for file as small.txt is a file, if it would have been a directory, there would have been “d” in place of “-”, rest sets of three are permissions of owner, group and others in this order)

Number of hard links: 1

Owner name: umair

Group owner: umair

File size in bytes: 512 bytes

Date of last modification: June 2

Time of last modification: 23:03

Filename: small.txt

- b. How many blocks does large.txt occupy?

```
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ stat large.txt
  File: large.txt
  Size: 102400      Blocks: 200      IO Block: 4096   regular file
Device: 0,69    Inode: 3940649675007006  Links: 1
Access: (0777/-rwxrwxrwx)  Uid: ( 1001/   umair)   Gid: ( 1001/   umair)
Access: 2025-06-02 23:17:56.687719900 +0500
Modify: 2025-06-02 23:17:56.687719900 +0500
Change: 2025-06-02 23:17:56.687719900 +0500
 Birth: -
```

As the size of large.txt is 100 KB, it has 200 512-byte blocks.

2. Key File-System System Calls

- a. What is the final content of demo.txt? Look at the output of cat demo.txt.

```
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ cat demo.txt
Hello WORLDumair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$
```

- b. What is the size of demo.txt? Use stat demo.txt to check.

```
File: demo.txt
Size: 11          Blocks: 0          IO Block: 4096   regular file
Device: 0,69     Inode: 1125899907900457  Links: 1
Access: (0777/-rwxrwxrwx)  Uid: ( 1001/   umair)   Gid: ( 1001/   umair)
Access: 2025-06-02 23:23:30.166264300 +0500
Modify: 2025-06-02 23:23:30.134772000 +0500
Change: 2025-06-02 23:23:30.134772000 +0500
Birth: -
```

Size is 11 bytes

- c. What does lseek() do in this program? Describe how it affects where data is written in the file.

Lseek lets us change the file offset. In other words, it changes the position at which read or write is being performed in a file. In the given code, although after write Hello FS\n completes, we have written to the 9th location (\n) and whatever new is to be written should start at 10th location. However, lseek (fd, 6, SEEK_SET) allows us to move the cursor position to the 6th location. And whatever is written hereafter is at 7th location onwards.

- d. What is the role of fsync()? Why is it important in ensuring that the file data is written?

Fsync() ensures that the data written using the write() system call is flushed to the disk or storage device.

Write() system call writes to an OS cache, and not the file on the disk immediately. The data is transferred from the cache to the disk by the OS after a writeback interval, usually a few seconds. Fsync makes sure that the data is written to the disk immediately, thus ensuring data integrity.

3. Directory Structure & Special Entries

- a. What are the inode numbers of dirA, dirB, f1, and f2?

```
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ ls -li .
total 116
1125899907900457 -rwxrwxrwx 1 umair umair 11 Jun 2 23:23 demo.txt
2533274791453734 drwxrwxrwx 1 umair umair 4096 Jun 2 23:37 dirA
1125899907900459 drwxrwxrwx 1 umair umair 4096 Jun 2 23:37 dirB
1125899907900456 -rwxrwxrwx 1 umair umair 16120 Jun 2 23:23 fsdemo
1688849861321767 -rwxrwxrwx 1 umair umair 249 Jun 2 23:23 fsdemo.c
3940649675007006 -rwxrwxrwx 1 umair umair 102400 Jun 2 23:17 large.txt
1125899907900452 -rwxrwxrwx 1 umair umair 512 Jun 2 23:03 small.txt
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ ls -li dirA dirB
dirA:
total 0
1125899907900460 -rwxrwxrwx 1 umair umair 2 Jun 2 23:37 f1

dirB:
total 0
1125899907900461 -rwxrwxrwx 1 umair umair 2 Jun 2 23:37 f2
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ ls -lai dirA
total 0
2533274791453734 drwxrwxrwx 1 umair umair 4096 Jun 2 23:37 .
1125899907900451 drwxrwxrwx 1 umair umair 4096 Jun 2 23:36 ..
1125899907900460 -rwxrwxrwx 1 umair umair 2 Jun 2 23:37 f1
```

- b. In the output of `ls -lai dirA`, what inodes do `.` and `..` point to?

“.” Points to the current directory inode number, which is dirA’s inode number. “..” points to the parent directory inode number, which is assign4’s inode number.

4. Hard vs Soft Links

- a. Which names still work?

Hard_demo still works but soft_demo does not.

- b. What do their inode numbers and link counts show?

```
umair@DESKTOP-7ALUV56:/mnt/d/ITU/OS_S25/assign4$ ls -li demo.txt hard_demo soft_demo
1125899907900457 -rwxrwxrwx 2 umair umair 11 Jun  2 23:23 demo.txt
1125899907900457 -rwxrwxrwx 2 umair umair 11 Jun  2 23:23 hard_demo
1688849861321770 lrwxrwxrwx 1 umair umair  8 Jun  2 23:43 soft_demo -> demo.txt
```

Before deleting the link count of both demo.txt and hard_demo is 2, whereas of soft_demo is 1.

Both demo.txt and hard_demo have the same inode number, whereas soft_demo has a different inode number.