## Wayne State University

# CSC 4421 - Winter 2025 Computer Operating Systems Labs Lab 05 - File System

Points Possible: 100

### **Tasks** \* (100 points)

For this Lab, create a single Microsoft Word .docx document or compile to .pdf. Name the file "L06 aa0000" (replacing aa000 with your access ID). **Make sure the document has a .docx or .pdf file extension.** When you are ready to submit, submit only this document to blackboard, there is no need to place it in a folder or compress it with .zip.

#### At the beginning of the document, list the following information:

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CSC 4420

Winter 2025

Lab06

#### For each of the following steps listed below:

Label the number of each step / part of the assignment in your .docx document. (e.g., 1, 2, 3, ...)

Include a screenshot of your terminal output for each execution of *df* .

Indicate what is happening at each step, what is depicted in each screen shot.

Answer any and all questions.

1. **[Screen Shot, Answer - Explanation]** *df* is a command that displays the amount of disk space available on the file system containing each file name argument. Read man page of *df* command. Run the command

df to find out how many disk blocks are available and how many are in use. Does the sum of these equals the total number of disk blocks on the disk? If not, explain why there is a difference.

```
/c/Users/rkala$ df
Filesystem
                1K-blocks
                                Used Available Use% Mounted on
                                                  0% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
                  4021848
                                   0
                                       4021848
none
                  4021848
                                   4
                                       4021844
                                                  1% /mnt/wsl
none
                976435196 848118780 128316416
                                                 87% /usr/lib/wsl/drivers
drivers
/dev/sdc
               1055762868
                             2126064 999933332
                                                  1% /
                  4021848
                                                  1% /mnt/wslg
                                       4021776
none
none
                  4021848
                                   0
                                       4021848
                                                  0% /usr/lib/wsl/lib
                  4018356
                                2372
                                       4015984
                                                  1% /init
rootfs
                                                  1% /run
none
                  4021848
                                 508
                                       4021340
                  4021848
                                       4021848
                                   0
                                                  0% /run/lock
none
                  4021848
                                   0
                                       4021848
                                                  0% /run/shm
none
                     4096
                                   0
                                          4096
                                                  0% /sys/fs/cgroup
tmpfs
                   4021848
                                       4021772
                                                  1% /mnt/wslg/versions.txt
none
                  4021848
                                       4021772
                                                  1% /mnt/wslg/doc
none
::\
                976435196 848118780 128316416
                                                 87% /mnt/c
                   804368
                                  16
                                        804352
                                                  1% /run/user/1000
tmpfs
```

Yes the sum does equals the total number of disk blocks on the disk.

2. Next run the command df -i to find out how many inodes are available and in use. [Screen Shot]

For the C:\ drive it shows that there are 999 Inodes, the IUsed is showing -999001 and for IFree is showing 1000000. From what I am observing it seems as IFree is being subtracted from Inodes (999 - 1000000 = - 999001). For the following questions I will answer while observing other Filesystems such as tmpfs or /dev/sdc.

```
ilesystem
                 Inodes
                           IUsed
                                     IFree IUse% Mounted on
                1005462
                                               1% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
none
                                   1005458
none
                1005462
                               2
                                   1005460
                                               1% /mnt/wsl
                                                  /usr/lib/wsl/drivers
drivers
                    999
                         -999001
                                  1000000
                           54514
                                              1% /
/dev/sdc
               67108864
                                 67054350
                1005462
                                  1005422
                                              1% /mnt/wslg
                              40
none
none
                1005462
                                  1005458
                                               1% /usr/lib/wsl/lib
                1004589
                              12
                                  1004577
                                              1% /init
rootfs
                1005462
                             514
                                   1004948
                                               1% /run
ione
none
                1005462
                                   1005460
                                               1% /run/lock
                1005462
                                   1005461
                                               1% /run/shm
none
                   1024
                              19
                                      1005
                                               2% /sys/fs/cgroup
tmpfs
                1005462
                              50
                                   1005412
                                               1% /mnt/wslg/versions.txt
ione
                1005462
                              50
                                   1005412
                                               1% /mnt/wslg/doc
none
                          -999001
                     999
                                   1000000
                                                  /mnt/c
                                               1% /run/user/1000
tmpfs
                 201092
                              34
                                    201058
```

3. Now create a new file with just a few characters in it, and again run *df* and *df -i* commands. [Screen Shot x2]

```
oldemort@MSI:/mnt/c/Users/rkala$ df
Filesystem
                1K-blocks
                                Used Available Use% Mounted on
                                                 0% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
                  4021848
                                   0
                                       4021848
none
none
                  4021848
                                   4
                                       4021844
                                                 1% /mnt/wsl
drivers
                976435196 847893420 128541776
                                                87% /usr/lib/wsl/drivers
               1055762868
                             2126068 999933328
                                                 1% /
/dev/sdc
                  4021848
                                  76
                                       4021772
                                                 1% /mnt/wslg
none
                  4021848
                                  0
                                       4021848
                                                 0% /usr/lib/wsl/lib
none
                  4018356
rootfs
                                2372
                                       4015984
                                                 1% /init
                  4021848
                                 508
                                       4021340
                                                 1% /run
none
                  4021848
                                   0
                                       4021848
                                                 0% /run/lock
none
                  4021848
                                   0
                                       4021848
                                                 0% /run/shm
none
                     4096
                                   0
                                          4096
tmpfs
                                                 0% /sys/fs/cgroup
                  4021848
                                       4021772
none
                                  76
                                                 1% /mnt/wslg/versions.txt
                  4021848
                                       4021772
                                                 1% /mnt/wslg/doc
none
C:\
                976435196 847893420 128541776
                                                87% /mnt/c
                                        804352
                   804368
                                  16
                                                 1% /run/user/1000
tmpfs
 oldemort@MSI:/mnt/c/Users/rkala$ df -i
                          IUsed
Filesystem
                                   IFree IUse% Mounted on
                 Inodes
none
                1005462
                                 1005458
                                             1% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
                1005462
                                 1005460
                                             1% /mnt/wsl
none
drivers
                    999 -999001 1000000
                                             - /usr/lib/wsl/drivers
                                             1% /
               67108864
                          54514 67054350
/dev/sdc
                                             1% /mnt/wslg
none
                1005462
                             40
                                 1005422
                1005462
                                 1005458
                                             1% /usr/lib/wsl/lib
none
                1004589
                                 1004577
rootfs
                             12
                                             1% /init
none
                1005462
                            516
                                1004946
                                             1% /run
                                             1% /run/lock
                1005462
                                 1005460
none
                1005462
                                 1005461
                                             1% /run/shm
none
tmpfs
                   1024
                             19
                                    1005
                                             2% /sys/fs/cgroup
                1005462
                             50
                                 1005412
                                             1% /mnt/wslg/versions.txt
none
                1005462
                             50
                                 1005412
                                             1% /mnt/wslg/doc
none
                                              - /mnt/c
                    999 -999001
                                 1000000
                 201092
                                  201058
                                             1% /run/user/1000
```

#### 4. Explain the effect of creating this new file. [Answer - Explanation]

In df command the available of 1K-blocks have increased by 10292. While in df -I command no Inodes have been used.

5. Now increase the size of this new file by entering a large number (> 5000) of characters, and again run df and df -i commands. Do you notice a difference? [Screen Shot x2, Answer - Explanation]

After adding around 5000 characters in the file, there was 34532 1k-blocks used.

Meanwhile Inodes have not been used at all.

voldemort@MS	[:/mnt/c/User	s/rkala\$ o	lf	
Filesystem	1K-blocks			Use% Mounted on
none	4021848			
none	4021848			
drivers			128507244	,,
/dev/sdc	1055762868		999942256	
none	4021848	76	4021772	·
none	4021848	6	4021848	
rootfs	4018356	2372	4015984	1% /init
none	4021848	508	4021340	1% /run
none	4021848	6	4021848	8 0% /run/lock
none	4021848	6	4021848	8 0% /run/shm
tmpfs	4096	6	4096	0% /sys/fs/cgroup
none	4021848	76	4021772	1% /mnt/wslg/versions.txt
none	4021848	76	4021772	l 1% /mnt/wslg/doc
C:\	976435196	847927952	128507244	87% /mnt/c
tmpfs	804368	16	804352	! 1% /run/user/1000
voldemort@MSI:/mnt/c/Users/rkala\$ df -i				
Filesystem	Inodes	IUsed	IFree IUs	e% Mounted on
none	1005462		005450	1% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
	1003402	4 1	005458	1% /usr/11b/mountes/3.13.16/.4-mitcrosoft-standard-wstz
none	1005462			1% /mnt/wsl
none drivers	1005462	2 1		
	1005462	2 1	005460 000000	1% /mnt/wsl
drivers	1005462 999	2 1 999001 1- 54514 67	005460 000000 054350	1% /mnt/wsl - /usr/lib/wsl/drivers
drivers /dev/sdc	1005462 999 67108864 1005462 1005462	2 1 -999001 1 54514 67 40 1 4 1	005460 000000 054350 005422 005458	1% /mnt/wsl - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg 1% /usr/lib/wsl/lib
drivers /dev/sdc none	1005462 999 - 67108864 1005462	2 1 -999001 1 54514 67 40 1 4 1	005460 000000 054350 005422 005458 004577	1% /mnt/wsl - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg
drivers /dev/sdc none none	1005462 999 67108864 1005462 1005462 1004589 1005462	2 1 -999001 1 54514 67 40 1 4 1 12 1	005460 000000 054350 005422 005458 004577	1% /mnt/wsl - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg 1% /usr/lib/wsl/lib 1% /init 1% /run
drivers /dev/sdc none none rootfs	1005462 999 67108864 1005462 1005462 1004589 1005462 1005462	2 1 -999001 1 54514 67 40 1 4 1 12 1 516 1	005460 000000 054350 005422 005458 004577 004946 005460	1% /mnt/wsl - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg 1% /usr/lib/wsl/lib 1% /init 1% /run 1% /run/lock
drivers /dev/sdc none none rootfs none	1005462 999 67108864 1005462 1005462 1005462 1005462 1005462	2 1 -999001 1 54514 67 40 1 4 1 12 1 516 1 2 1 1 1	005460 000000 054350 005422 005458 004577 004946 005460	1% /mnt/wsl - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg 1% /usr/lib/wsl/lib 1% /init 1% /run 1% /run/lock 1% /run/shm
drivers /dev/sdc none none rootfs none none	1005462 999 67108864 1005462 1005462 1005462 1005462 1005462 1005462	2 1 -999001 1 54514 67 40 1 4 1 12 1 516 1 2 1 1 19	005460 000000 054350 005422 005458 004577 004946 005460 005461 1005	<pre>1% /mnt/wsl</pre>
drivers /dev/sdc none none rootfs none none none	1005462 999 67108864 1005462 1005462 1005462 1005462 1005462 1005462 1005462	2 1 -999001 1 54514 67 40 1 4 1 12 1 516 1 2 1 1 1 19 50 1	005460 000000 054350 005422 005458 004577 004946 005460 005461 1005 005412	<pre>1% /mnt/wsl     - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg 1% /usr/lib/wsl/lib 1% /init 1% /run 1% /run/lock 1% /run/shm 2% /sys/fs/cgroup 1% /mnt/wslg/versions.txt</pre>
drivers /dev/sdc none none rootfs none none tmpfs none none	1005462 999 67108864 1005462 1005462 1004589 1005462 1005462 1005462 1005462 1005462	2 1 -999001 1 54514 67 40 1 12 1 516 1 2 1 1 19 50 1	005460 000000 054350 005422 005458 004577 004946 005460 005461 1005 005412	<pre>1% /mnt/wsl</pre>
drivers /dev/sdc none none rootfs none none tone none tmpfs none	1005462 999 67108864 1005462 1005462 1004589 1005462 1005462 1005462 1005462 1005462	2 1 -999001 1 54514 67 40 1 12 1 516 1 2 1 11 1 19 50 1 -999001 1	005460 000000 054350 005422 005458 004577 004946 005460 005461 1005 005412 005412 000000	<pre>1% /mnt/wsl     - /usr/lib/wsl/drivers 1% / 1% /mnt/wslg 1% /usr/lib/wsl/lib 1% /init 1% /run 1% /run/lock 1% /run/shm 2% /sys/fs/cgroup 1% /mnt/wslg/versions.txt</pre>

6. Repeat the last step, this time entering (> 50,000) characters. [Screen Shot x2, Answer - Explanation]

After adding 50000 characters the usage of 1K-blocks decreased by 10000 resulting in only 20664 used. No Inodes have been used or freed even after adding 50000 characters.

```
Filesystem
                1K-blocks
                               Used Available Use% Mounted on
                                                 0% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
none
                  4021848
                                  0
                                      4021848
                  4021848
                                  4
                                      4021844
                                                 1% /mnt/wsl
none
drivers
                976435196 847948616 128486580
                                                87% /usr/lib/wsl/drivers
/dev/sdc
               1055762868
                            2117144 999942252
                                                 1% /
none
                  4021848
                                 80
                                      4021768
                                                 1% /mnt/wslg
                  4021848
                                      4021848
                                                 0% /usr/lib/wsl/lib
none
                  4018356
                                      4015984
rootfs
                                                 1% /init
                                      4021340
none
                  4021848
                                                 1% /run
                  4021848
                                      4021848
none
                                  0
                                                 0% /run/lock
                  4021848
                                      4021848
none
                                  0
                                                 0% /run/shm
                     4096
                                  0
                                          4096
                                                 0% /sys/fs/cgroup
tmpfs
none
                  4021848
                                  76
                                       4021772
                                                 1% /mnt/wslg/versions.txt
                  4021848
                                      4021772
                                                 1% /mnt/wslg/doc
none
                                  76
                976435196 847948616 128486580
                                                87% /mnt/c
                   804368
                                        804352
                                 16
                                                 1% /run/user/1000
tmpfs
         @MSI:/mnt/c/Users/rkala$ df -i
Filesystem
                                   IFree IUse% Mounted on
                 Inodes
                          IUsed
                1005462
                                 1005458
                                            1% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
none
                1005462
                                 1005460
                                             1% /mnt/wsl
none
                    999 -999001
                                 1000000
                                             - /usr/lib/wsl/drivers
drivers
                                            1% /
                          54514 67054350
               67108864
/dev/sdc
                             40
                                 1005422
                                            1% /mnt/wslg
none
                1005462
                                 1005458
                                            1% /usr/lib/wsl/lib
none
                1005462
                              4
                1004589
                                 1004577
                                            1% /init
rootfs
                1005462
                            516 1004946
                                            1% /run
none
                1005462
                                 1005460
                                            1% /run/lock
none
                1005462
                                 1005461
                                             1% /run/shm
none
                             19
                                    1005
tmpfs
                   1024
                                            2% /sys/fs/cgroup
none
                1005462
                             50
                                 1005412
                                            1% /mnt/wslg/versions.txt
                                 1005412
                1005462
                             50
                                             1% /mnt/wslg/doc
none
                    999 -999001
                                 1000000
                                             - /mnt/c
tmpfs
                 201092
                                  201058
                                             1% /run/user/1000
```

7. Repeat the last step, this time entering (> 500,000) characters. [Screen Shot x2, Answer - Explanation]

After increasing the number of characters to 500000 there were 1K-blocks more that were being used. As Inodes for the it did all the drivers. usage, not change at in any of

```
ort@MSI:/mnt/c/Users/rkala$ df
Filesystem
                                Used Available Use% Mounted on
                1K-blocks
none
                  4021848
                                   0
                                       4021848
                                                  0% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
                  4021848
                                       4021844
                                                  1% /mnt/wsl
none
                                   4
drivers
                976435196 848168680 128266516
                                                 87% /usr/lib/wsl/drivers
                                                  1% /
                             2117152 999942244
/dev/sdc
               1055762868
none
                  4021848
                                  88
                                       4021760
                                                  1% /mnt/wslg
                                                  0% /usr/lib/wsl/lib
                  4021848
                                       4021848
none
                                   0
rootfs
                  4018356
                                2372
                                       4015984
                                                  1% /init
                  4021848
                                       4021340
none
                                 508
                                                  1% /run
                  4021848
                                   0
                                       4021848
                                                  0% /run/lock
none
                  4021848
                                        4021848
none
                                   0
                                                  0% /run/shm
tmpfs
                     4096
                                   0
                                           4096
                                                  0% /sys/fs/cgroup
                   4021848
                                        4021772
none
                                                  1% /mnt/wslg/versions.txt
                  4021848
                                  76
                                       4021772
                                                  1% /mnt/wslg/doc
none
                976435196 848168680 128266516
                                                 87% /mnt/c
tmpfs
                   804368
                                  16
                                         804352
                                                  1% /run/user/1000
```

```
Filesystem
                  Inodes
                            IUsed
                                     IFree IUse% Mounted on
                 1005462
                                   1005458
                                               1% /usr/lib/modules/5.15.167.4-microsoft-standard-WSL2
none
                                4
                 1005462
                                   1005460
none
                                2
                                               1% /mnt/wsl
                                                  /usr/lib/wsl/drivers
drivers
                     999
                          -999001
                                   1000000
/dev/sdc
                67108864
                            54514
                                  67054350
                                               1% /
                                               1% /mnt/wslg
                 1005462
                                   1005422
                               40
none
none
                 1005462
                                4
                                   1005458
                                               1% /usr/lib/wsl/lib
                 1004589
                               12
                                   1004577
rootfs
                                               1% /init
                 1005462
                                   1004946
none
                              516
                                               1% /run
                 1005462
                                   1005460
                                               1% /run/lock
none
                                2
none
                 1005462
                                   1005461
                                               1% /run/shm
tmpfs
                    1024
                               19
                                      1005
                                               2% /sys/fs/cgroup
                 1005462
                                   1005412
none
                               50
                                               1% /mnt/wslg/versions.txt
                                   1005412
none
                 1005462
                               50
                                               1% /mnt/wslg/doc
                     999
                         -999001
                                   1000000
C:\
                                                  /mnt/c
                  201092
                               34
                                    201058
tmpfs
                                               1% /run/user/1000
```

8. Explain the effect of increasing the size of the new file. **[Answer - Explanation]** In the beginning when the increase was not big, more 1k-blocks became available, the reason could be because those 1k-blocks shared the space with each other making more availability. But when the characters drastically increased, more 1k-blocks were being used. In conclusion the number of I nodes did not change because they track files, but 1k-blocks check the space usage of file content.

Grading:

- 1. (\*80 points) Five points for each **[Screen Shot]** and each **[Answer Explanation]**. There are 16 total, for 80 points.
- 2. (\*20 points) For a complete solution (all 16 [Screen Shot] and [Answer Explanation]), a document that is well formed, includes the specified information at the beginning of the document, and is saved with the appropriate file name and document type (.docx or .pdf).