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File System Project Write-Up

Github Link:

https://github.com/CSC415-Fall2020/group-term-assignment-file-system-Team-Mushroom.git

File System Description:

Our file system is able to make directories and change the directory to any directory in our file system using a relative or absolute path. It can also rearrange the file system by moving directories or files, removing directories and files, and copying directories to other directories. We can also see the current working directory, the files within the current working directory, and files in our exit our file system at any time. Our file system is also able to write file data to disk, as seen in the hexdump of our disk after copying a file from the Linux system to our file system. We are also able to copy the data from our file system to Linux, also seen using hexdump of the disk.

Issues:

- **b_io Issues:**
  - How to read/write all text to/from the buffer parameter to/from our data blocks. We fixed this by fixing our calculations and logic.
  - Create/overwrite file. Fixed by creating/changing permission number while the program was still running.
  - When trying to do b_open, the user passed in a flag but we didn't know how the flag was being passed in, as a decimal or as a binary number. Got help for this during office hours.
  - How to write the correct data from the data blocks to disk. Fixed by using the correct length and calculation of block count.

Didn't fix at the end

- stack smashing error still occurs.

- Larger files no longer cause a stack smashing error, but the copy from file system file to a Linux file is incorrect.

- **Directory Management Issues:**
  - We were using pointers in structs that had to be written to disk. We fixed it by putting our directory entry array in another struct that wouldn't be written to disk
  - We had a lot of trouble visualizing the structure of the file system itself, which led to a lot of uncertainty in the beginning and middle of the project. It helped knowing that we could not have pointers in any structs that we needed to write to disk.
  - Most of our other issues occurred because our indexing was wrong in several for loops. We fixed this by adding variables like highestIndex (in fdDir struct) for keeping track of the highest index that the directory goes to (instead of using the length of the record since there might be gaps in between DEs in a DE array), the last index read in a directory when doing readdir, and highest index that the allDirs array goes to.
  - deID was wrong for directories, but right for files Problem was that we were initializing the deID to self.deID rather than newDirectoryEntry.deID (the one we actually add to the allDirs array). It was hard to find and caused a lot of issues, but print statements lead us to the issue eventually.

  Didn't fix at the end
  - Extents eventually weren't implemented.
  - The mv command only works on relative paths. Not enough time to do absolute paths.

- **Free Space Issues:**
  - The flipbits function was only flipping 0 to 1, but not the other way around. Caused confusion, but was fixed with conditional statement

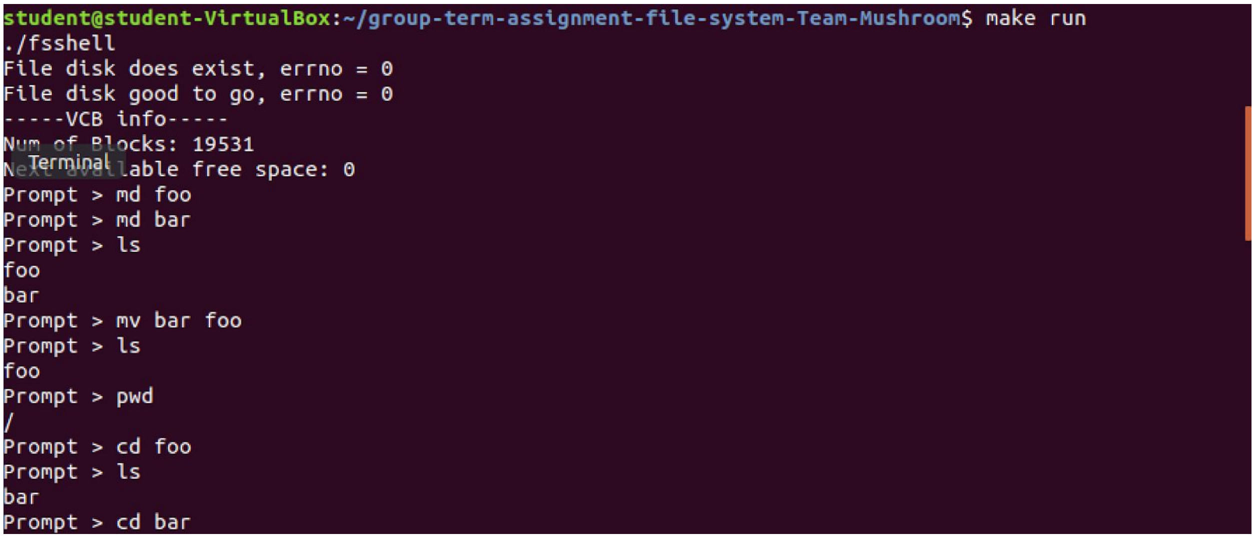
  Didn't fix at the end
  - Loading/saving bitmap from/to disk.

Driver Details:

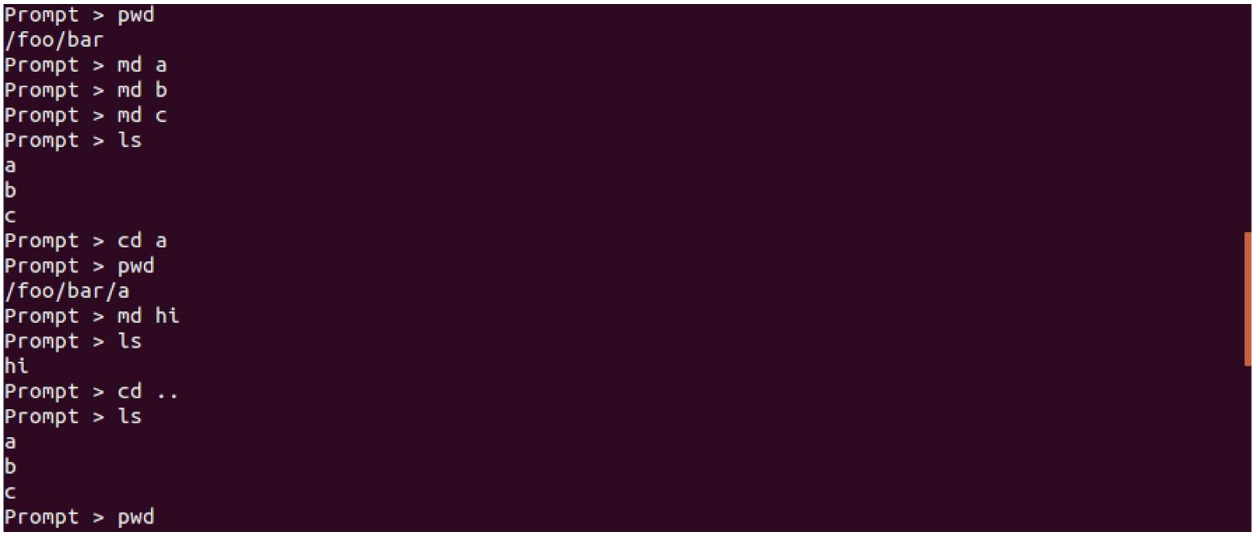
The driver program (fsshell.c) works by looking at the argument passed in after the prompt and calling the function associated with the command (argvec[0]). Once inside the command function, some logic happens and the program ends up calling associated functions in DirectoryManagement.c, where all directory and file movement and creation happens. When writing and reading, b_io.c's functions get called on. Any returns send us back to fsshell.c, and then we're ready for the next command in the prompt.

Screenshots:

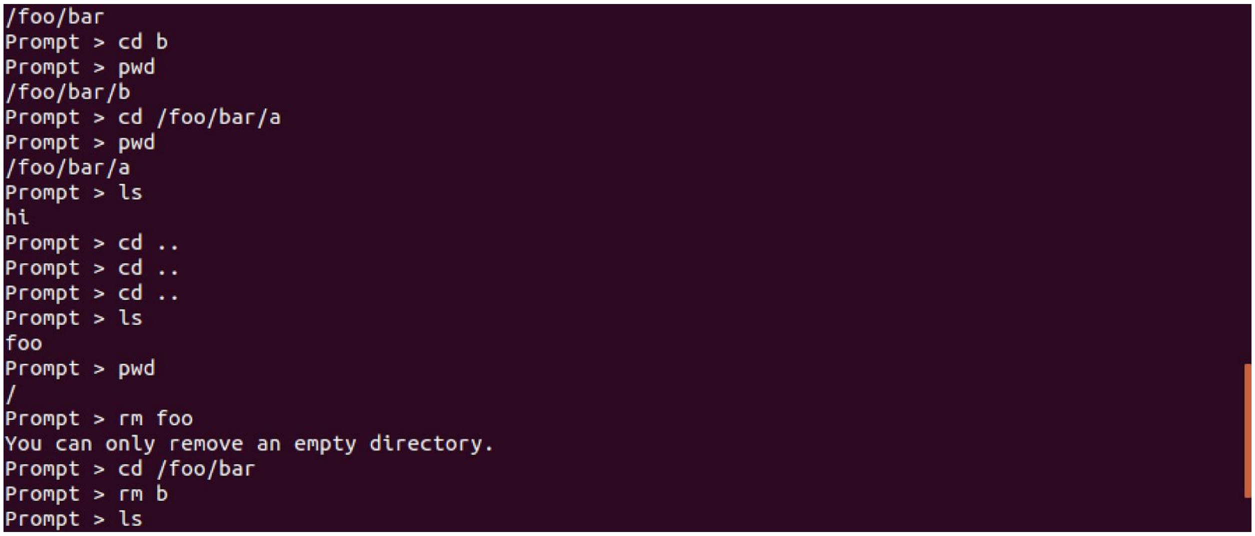
- Showcasing **ls**, **md**, **mv**, **rm**, **cd**, **pwd** (**directory testing**):



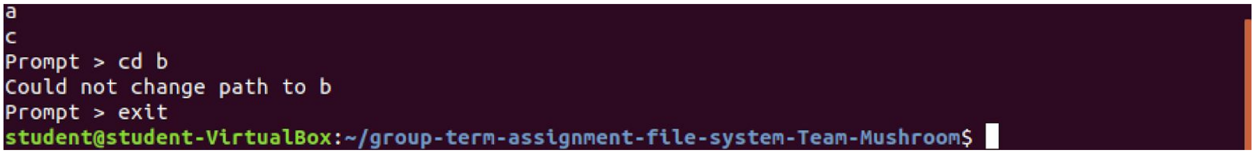
```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > md foo
Prompt > md bar
Prompt > ls
foo
bar
Prompt > mv bar foo
Prompt > ls
foo
Prompt > pwd
/
Prompt > cd foo
Prompt > ls
bar
Prompt > cd bar
```



```
Prompt > pwd
/foo/bar
Prompt > md a
Prompt > md b
Prompt > md c
Prompt > ls
a
b
c
Prompt > cd a
Prompt > pwd
/foo/bar/a
Prompt > md hi
Prompt > ls
hi
Prompt > cd ..
Prompt > ls
a
b
c
Prompt > pwd
```

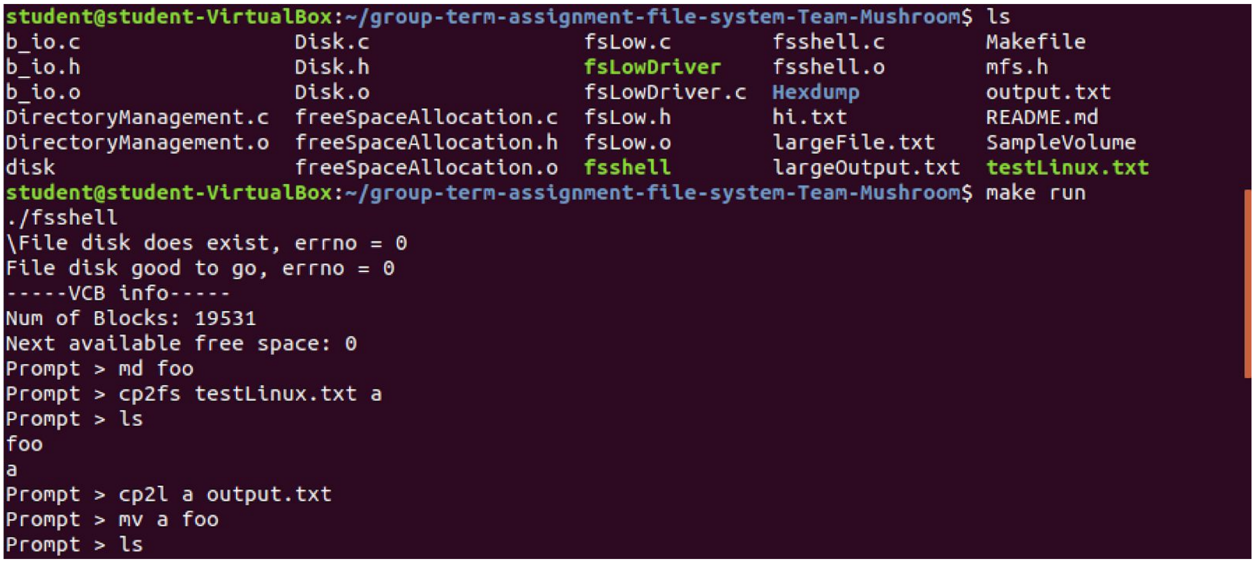


```
/foo/bar
Prompt > cd b
Prompt > pwd
/foo/bar/b
Prompt > cd /foo/bar/a
Prompt > pwd
/foo/bar/a
Prompt > ls
hi
Prompt > cd ..
Prompt > cd ..
Prompt > cd ..
Prompt > ls
foo
Prompt > pwd
/
Prompt > rm foo
You can only remove an empty directory.
Prompt > cd /foo/bar
Prompt > rm b
Prompt > ls
```

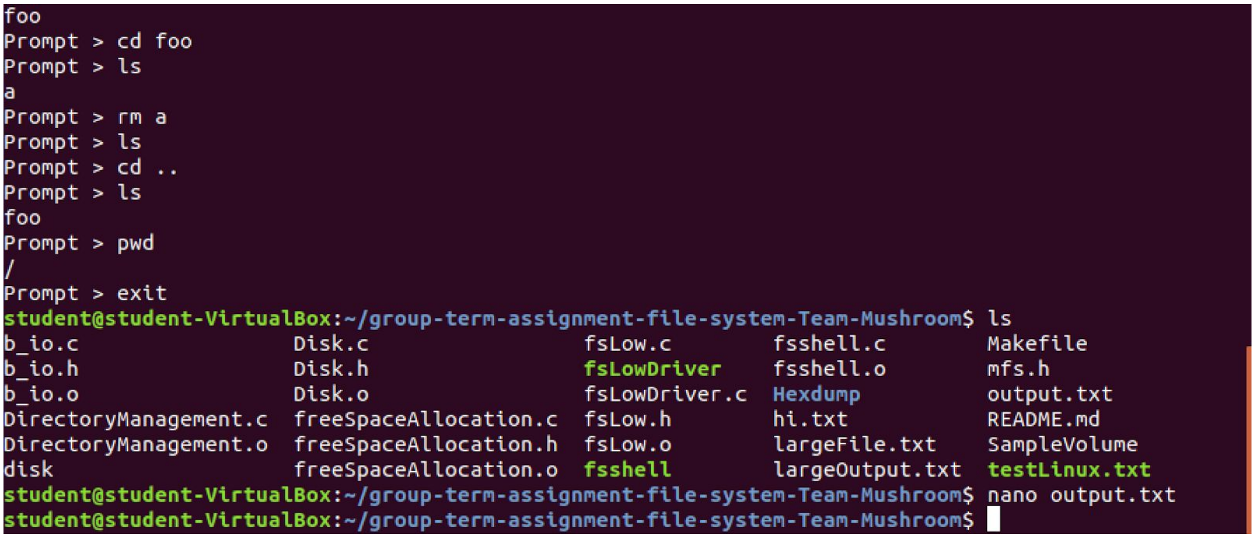


```
a
c
Prompt > cd b
Could not change path to b
Prompt > exit
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$
```

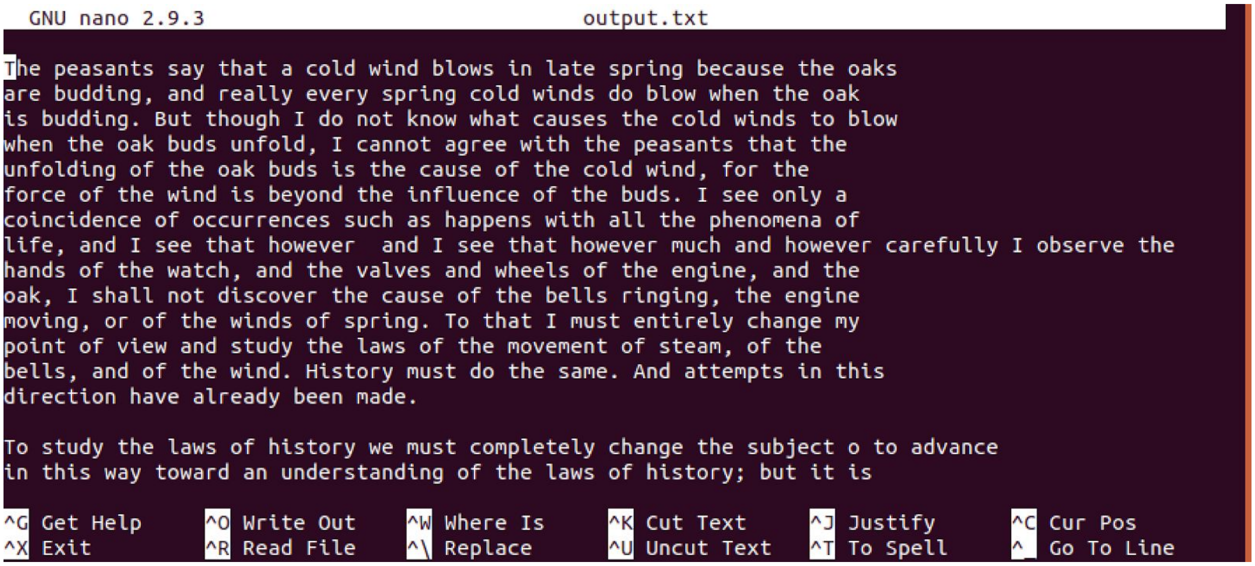
- Showcasing **ls**, **cp**, **mv**, **rm**, **cp2l**, **cp2fs** (**file testing**):



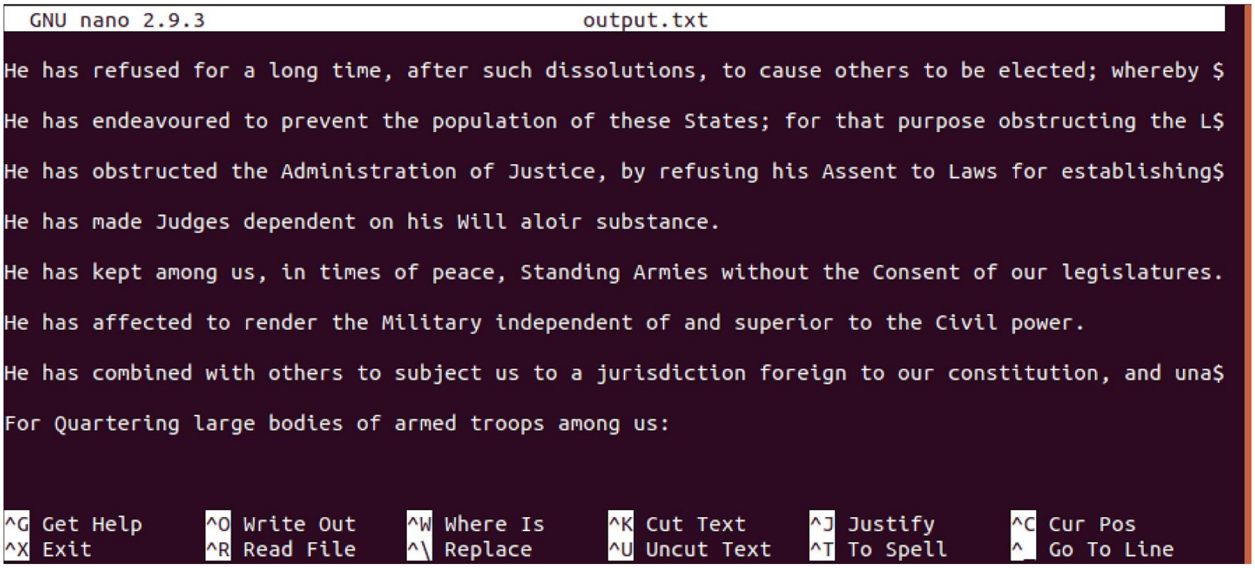
```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                  Disk.c                  fsLow.c         fsshell.c       Makefile
b_io.h                  Disk.h                  fsLowDriver     fsshell.o       mfs.h
b_io.o                  Disk.o                  fsLowDriver.c   Hexdump         output.txt
DirectoryManagement.c   freeSpaceAllocation.c   fsLow.h         hi.txt          README.md
DirectoryManagement.o   freeSpaceAllocation.h   fsLow.o         largeFile.txt   SampleVolume
disk                    freeSpaceAllocation.o   fsshell         largeOutput.txt testLinux.txt
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
\File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > md foo
Prompt > cp2fs testLinux.txt a
Prompt > ls
foo
a
Prompt > cp2l a output.txt
Prompt > mv a foo
Prompt > ls
```



```
foo
Prompt > cd foo
Prompt > ls
a
Prompt > rm a
Prompt > ls
Prompt > cd ..
Prompt > ls
foo
Prompt > pwd
/
Prompt > exit
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                  Disk.c                  fsLow.c         fsshell.c       Makefile
b_io.h                  Disk.h                  fsLowDriver     fsshell.o       mfs.h
b_io.o                  Disk.o                  fsLowDriver.c   Hexdump         output.txt
DirectoryManagement.c   freeSpaceAllocation.c   fsLow.h         hi.txt          README.md
DirectoryManagement.o   freeSpaceAllocation.h   fsLow.o         largeFile.txt   SampleVolume
disk                    freeSpaceAllocation.o   fsshell         largeOutput.txt testLinux.txt
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ nano output.txt
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$
```



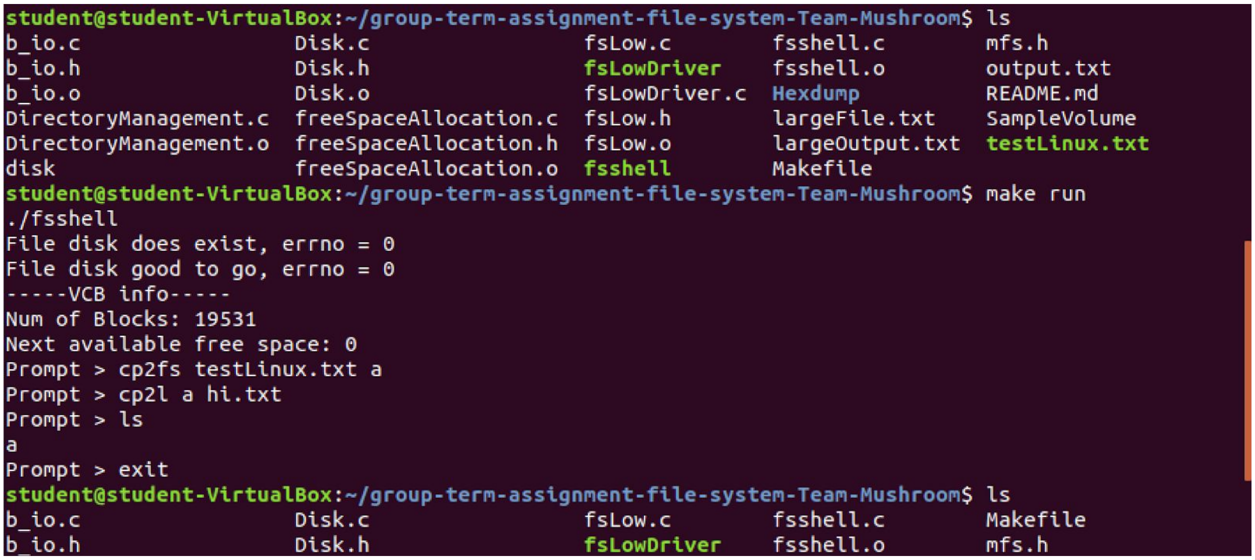
```
  GNU nano 2.9.3                              output.txt

The peasants say that a cold wind blows in late spring because the oaks
are budding, and really every spring cold winds do blow when the oak
is budding. But though I do not know what causes the cold winds to blow
when the oak buds unfold, I cannot agree with the peasants that the
unfolding of the oak buds is the cause of the cold wind, for the
force of the wind is beyond the influence of the buds. I see only a
coincidence of occurrences such as happens with all the phenomena of
life, and I see that however  and I see that however much and however carefully I observe the
hands of the watch, and the valves and wheels of the engine, and the
oak, I shall not discover the cause of the bells ringing, the engine
moving, or of the winds of spring. To that I must entirely change my
point of view and study the laws of the movement of steam, of the
bells, and of the wind. History must do the same. And attempts in this
direction have already been made.

To study the laws of history we must completely change the subject o to advance
in this way toward an understanding of the laws of history; but it is

^G Get Help     ^O Write Out    ^W Where Is     ^K Cut Text     ^J Justify      ^C Cur Pos
^X Exit         ^R Read File    ^\ Replace      ^U Uncut Text   ^T To Spell     ^_ Go To Line
```



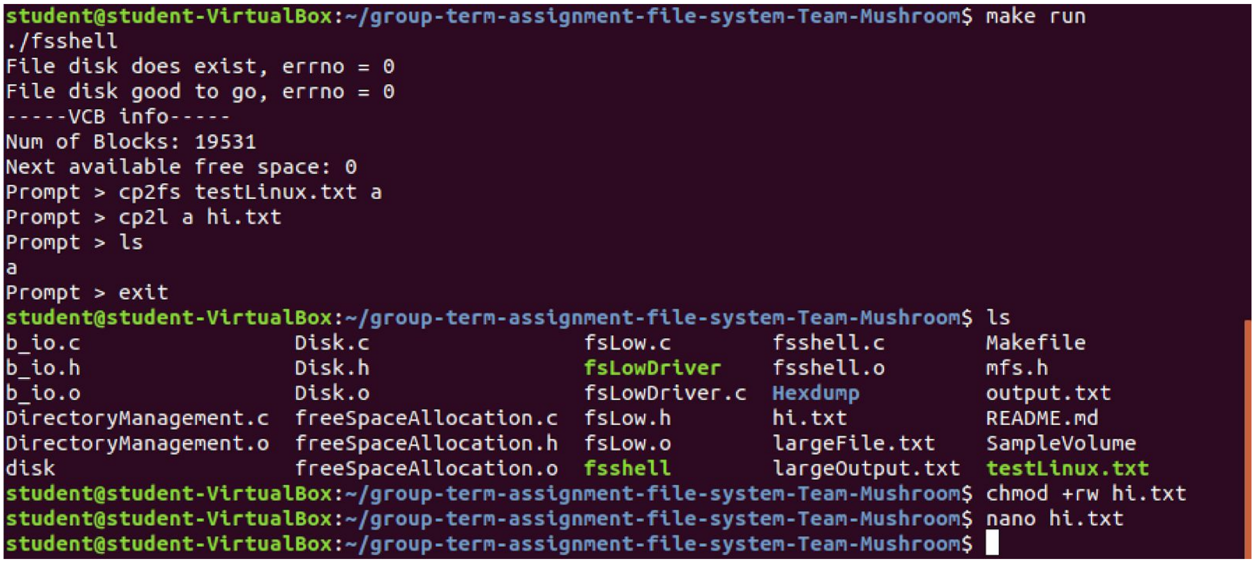
```
  GNU nano 2.9.3                                output.txt

He has refused for a long time, after such dissolutions, to cause others to be elected; whereby $

He has endeavoured to prevent the population of these States; for that purpose obstructing the L$

He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing$

He has made Judges dependent on his Will aloir substance.

He has kept among us, in times of peace, Standing Armies without the Consent of our legislatures.

He has affected to render the Military independent of and superior to the Civil power.

He has combined with others to subject us to a jurisdiction foreign to our constitution, and una$

For Quartering large bodies of armed troops among us:
```

(output.txt was created beforehand, contains all of testLinux.txt)

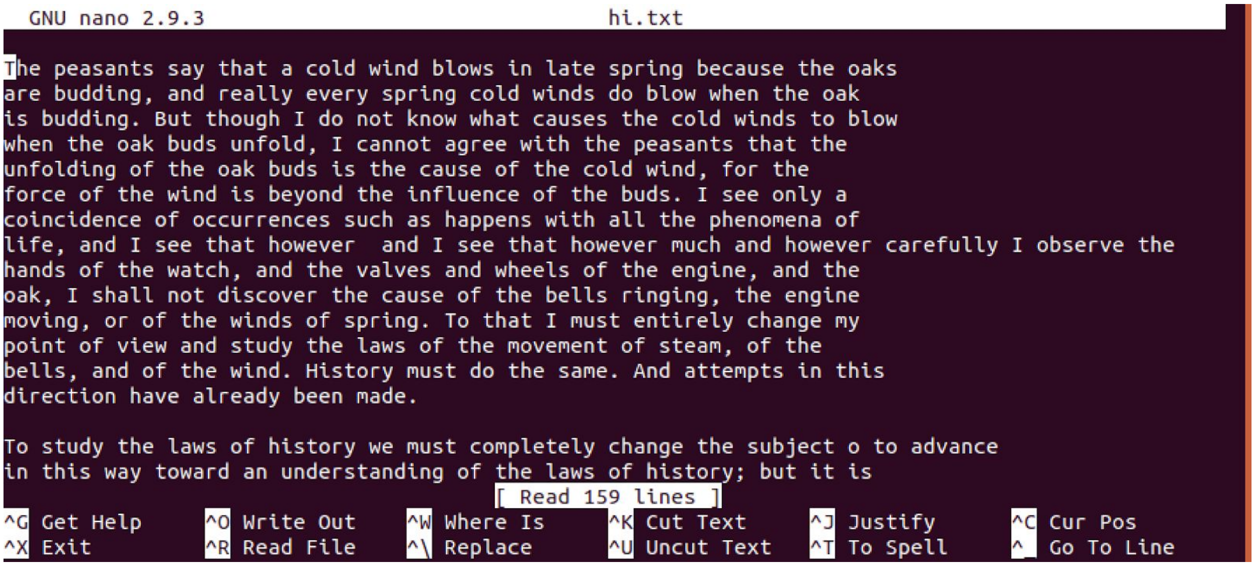
- Output 2:
  Created text file with **cp2l** and opened with permissions (creates file just fine when amount copied isn't too big):



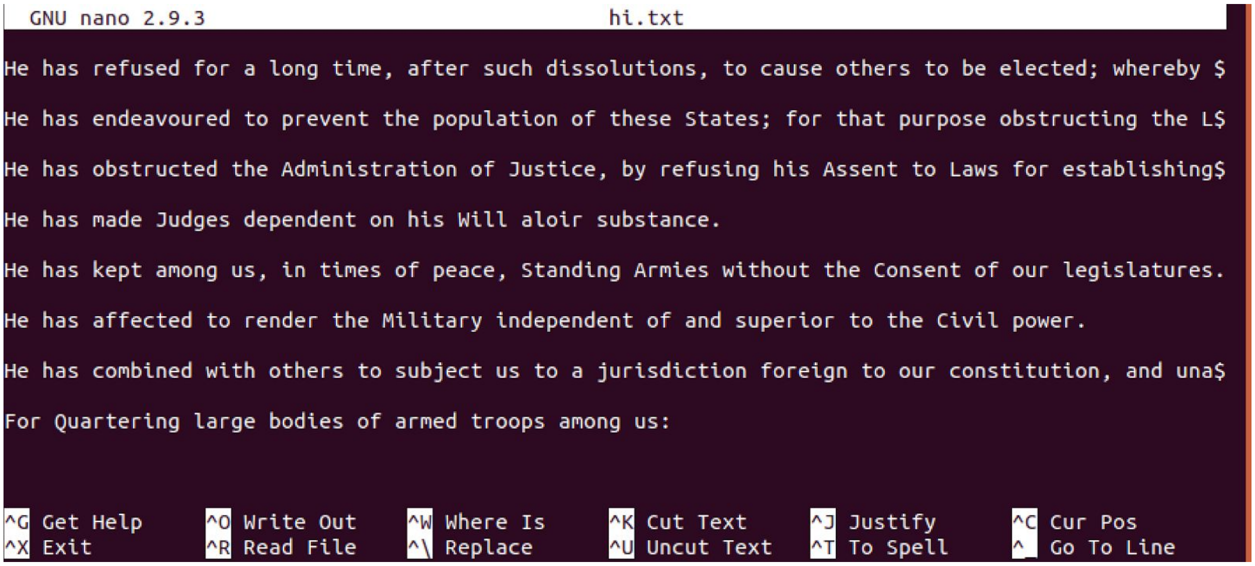
```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                   Disk.c                   fsLow.c        fsshell.c       mfs.h
b_io.h                   Disk.h                   fsLowDriver    fsshell.o       output.txt
b_io.o                   Disk.o                   fsLowDriver.c  Hexdump         README.md
DirectoryManagement.c    freeSpaceAllocation.c    fsLow.h        largeFile.txt   SampleVolume
DirectoryManagement.o    freeSpaceAllocation.h    fsLow.o        largeOutput.txt testLinux.txt
disk                     freeSpaceAllocation.o    fsshell        Makefile
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > cp2fs testLinux.txt a
Prompt > cp2l a hi.txt
Prompt > ls
a
Prompt > exit
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                   Disk.c                   fsLow.c        fsshell.c       Makefile
b_io.h                   Disk.h                   fsLowDriver    fsshell.o       mfs.h
```



```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > cp2fs testLinux.txt a
Prompt > cp2l a hi.txt
Prompt > ls
a
Prompt > exit
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                 Disk.c                 fsLow.c        fsshell.c       Makefile
b_io.h                 Disk.h                 fsLowDriver    fsshell.o       mfs.h
b_io.o                 Disk.o                 fsLowDriver.c  Hexdump         output.txt
DirectoryManagement.c  freeSpaceAllocation.c  fsLow.h        hi.txt          README.md
DirectoryManagement.o  freeSpaceAllocation.h  fsLow.o        largeFile.txt   SampleVolume
disk                   freeSpaceAllocation.o  fsshell        largeOutput.txt testLinux.txt
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ chmod +rw hi.txt
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ nano hi.txt
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ 
```



```
  GNU nano 2.9.3                                hi.txt

The peasants say that a cold wind blows in late spring because the oaks
are budding, and really every spring cold winds do blow when the oak
is budding. But though I do not know what causes the cold winds to blow
when the oak buds unfold, I cannot agree with the peasants that the
unfolding of the oak buds is the cause of the cold wind, for the
force of the wind is beyond the influence of the buds. I see only a
coincidence of occurrences such as happens with all the phenomena of
life, and I see that however  and I see that however much and however carefully I observe the
hands of the watch, and the valves and wheels of the engine, and the
oak, I shall not discover the cause of the bells ringing, the engine
moving, or of the winds of spring. To that I must entirely change my
point of view and study the laws of the movement of steam, of the
bells, and of the wind. History must do the same. And attempts in this
direction have already been made.

To study the laws of history we must completely change the subject o to advance
in this way toward an understanding of the laws of history; but it is
                                       [ Read 159 lines ]
^G Get Help     ^O Write Out    ^W Where Is     ^K Cut Text     ^J Justify      ^C Cur Pos
^X Exit         ^R Read File    ^\ Replace      ^U Uncut Text   ^T To Spell     ^_ Go To Line
```

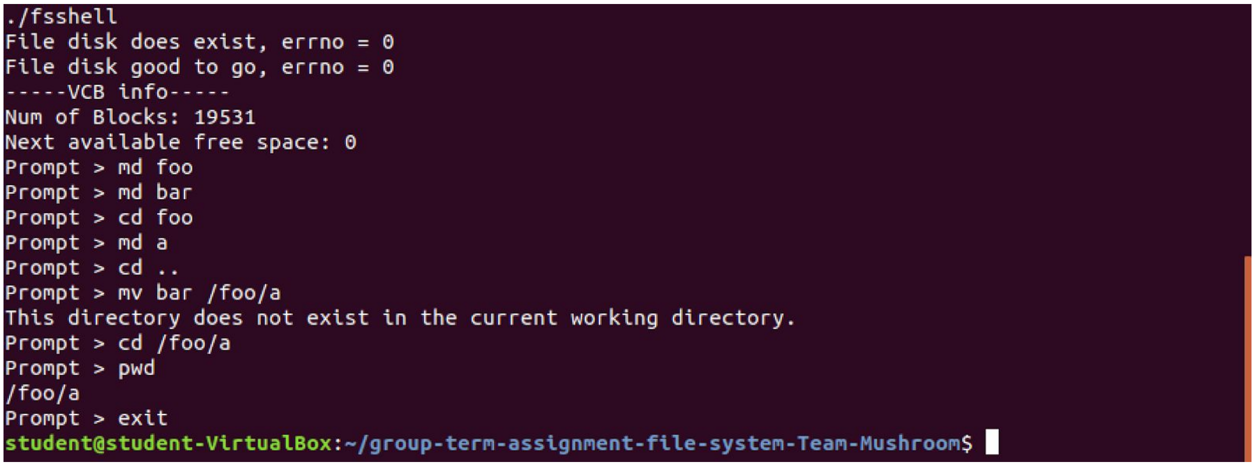


```
  GNU nano 2.9.3                                hi.txt

He has refused for a long time, after such dissolutions, to cause others to be elected; whereby $

He has endeavoured to prevent the population of these States; for that purpose obstructing the L$

He has obstructed the Administration of Justice, by refusing his Assent to Laws for establishing$

He has made Judges dependent on his Will aloir substance.

He has kept among us, in times of peace, Standing Armies without the Consent of our legislatures.

He has affected to render the Military independent of and superior to the Civil power.

He has combined with others to subject us to a jurisdiction foreign to our constitution, and una$

For Quartering large bodies of armed troops among us:



^G Get Help     ^O Write Out    ^W Where Is     ^K Cut Text     ^J Justify      ^C Cur Pos
^X Exit         ^R Read File    ^\ Replace      ^U Uncut Text   ^T To Spell     ^_ Go To Line
```

(overlap on first 2 to show they’re from the same output)

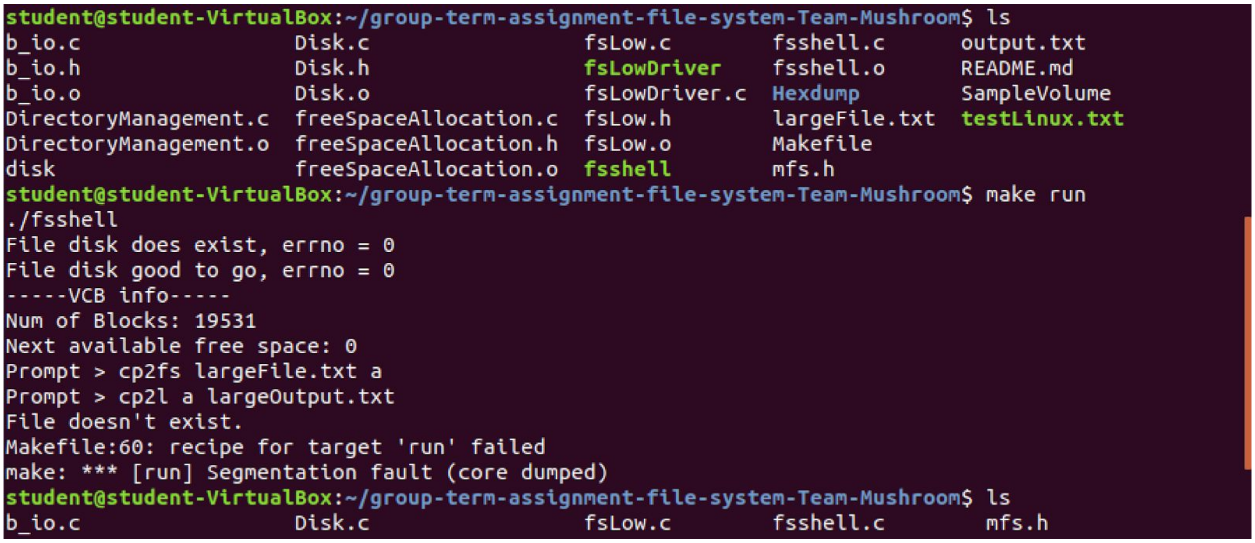
- Showcasing **issues** that occur:

  Cannot use **mv** with an absolute pathname:

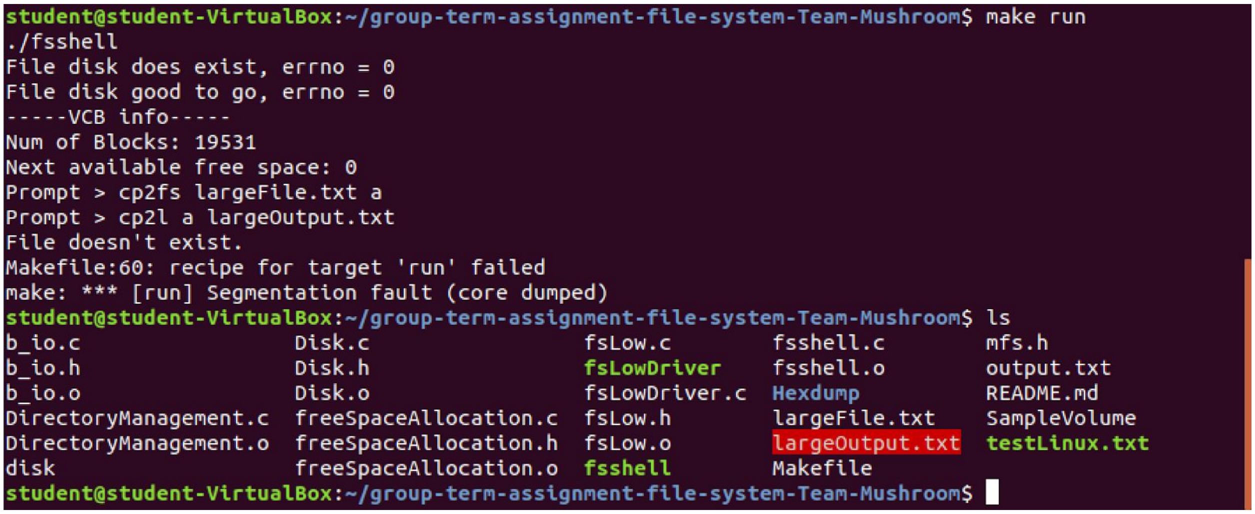


```
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > md foo
Prompt > md bar
Prompt > cd foo
Prompt > md a
Prompt > cd ..
Prompt > mv bar /foo/a
This directory does not exist in the current working directory.
Prompt > cd /foo/a
Prompt > pwd
/foo/a
Prompt > exit
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ 
```

Cannot **cp2l** a file correctly if it doesn't already exist:



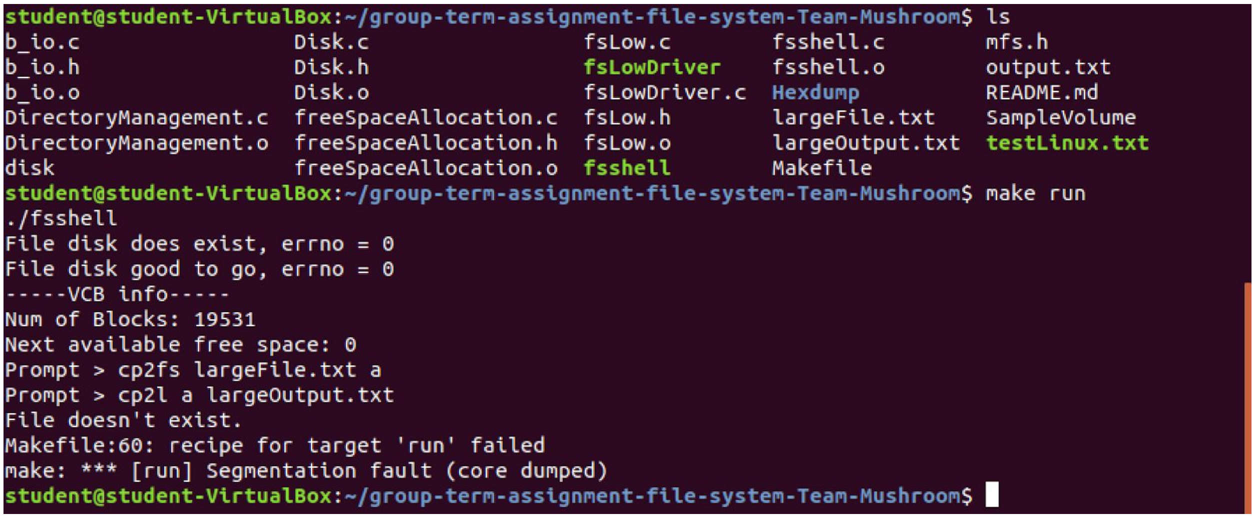
```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                 Disk.c                 fsLow.c        fsshell.c      output.txt
b_io.h                 Disk.h                 fsLowDriver    fsshell.o      README.md
b_io.o                 Disk.o                 fsLowDriver.c  Hexdump        SampleVolume
DirectoryManagement.c  freeSpaceAllocation.c  fsLow.h        largeFile.txt  testLinux.txt
DirectoryManagement.o  freeSpaceAllocation.h  fsLow.o        Makefile
disk                   freeSpaceAllocation.o  fsshell        mfs.h
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > cp2fs largeFile.txt a
Prompt > cp2l a largeOutput.txt
File doesn't exist.
Makefile:60: recipe for target 'run' failed
make: *** [run] Segmentation fault (core dumped)
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                 Disk.c                 fsLow.c        fsshell.c        mfs.h
```



```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > cp2fs largeFile.txt a
Prompt > cp2l a largeOutput.txt
File doesn't exist.
Makefile:60: recipe for target 'run' failed
make: *** [run] Segmentation fault (core dumped)
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                 Disk.c                 fsLow.c        fsshell.c        mfs.h
b_io.h                 Disk.h                 fsLowDriver    fsshell.o        output.txt
b_io.o                 Disk.o                 fsLowDriver.c  Hexdump          README.md
DirectoryManagement.c  freeSpaceAllocation.c  fsLow.h        largeFile.txt    SampleVolume
DirectoryManagement.o  freeSpaceAllocation.h  fsLow.o        largeOutput.txt  testLinux.txt
disk                   freeSpaceAllocation.o  fsshell        Makefile
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ 
```

(pictures overlap to show it's the same make run)

Cannot **cp2l** if file is too big:



```
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ ls
b_io.c                 Disk.c                 fsLow.c        fsshell.c        mfs.h
b_io.h                 Disk.h                 fsLowDriver    fsshell.o        output.txt
b_io.o                 Disk.o                 fsLowDriver.c  Hexdump          README.md
DirectoryManagement.c  freeSpaceAllocation.c  fsLow.h        largeFile.txt    SampleVolume
DirectoryManagement.o  freeSpaceAllocation.h  fsLow.o        largeOutput.txt  testLinux.txt
disk                   freeSpaceAllocation.o  fsshell        Makefile
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ make run
./fsshell
File disk does exist, errno = 0
File disk good to go, errno = 0
-----VCB info-----
Num of Blocks: 19531
Next available free space: 0
Prompt > cp2fs largeFile.txt a
Prompt > cp2l a largeOutput.txt
File doesn't exist.
Makefile:60: recipe for target 'run' failed
make: *** [run] Segmentation fault (core dumped)
student@student-VirtualBox:~/group-term-assignment-file-system-Team-Mushroom$ 
```