CMPT 300
Assignment 4
myls command
Marks: 100 marks

Notes:

1. **Failure to follow the instructions and rules may lead to failed test cases and/or a final grade of 0.**
2. You can do this assignment individually or in a team of two. If you are doing it in a group, only one submission per group is required.
3. You may submit multiple times until the deadline. Grade penalties will be imposed for late submissions (see the course outline for the details).
4. Always plan before coding.
5. For this assignment, you can use:
   - the standard C libraries
   - POSIX APIs - POSIX is a standardized operating systems interface based on UNIX. You can find a list here.
6. All the codes in this lab must be done using C language only. No other languages should be used.
7. Use function-level and inline comments throughout your code. We will not be specifically grading documentation. However, remember that you will not be able to comment on your code unless sufficiently documented. Take the time to document your code as you develop it properly.
8. We will carefully analyze the code submitted to look for plagiarism signs, so please do not do it! If you are unsure about what is allowed, please talk to an instructor or a TA.

Coding Rules

- You must follow the file name as specified in the instructions.
- There should be **no memory leaks.**
- **Makefile**: Makefile provides the following functionality:

  - **all**: compiles your program (this is the default behavior), producing an executable file named the same as the C file.
  - **clean**: deletes the executable file and any intermediate files (.o, specifically)
  - You will receive 0 if your makefile fails.
    - Check your build to ensure that there are no errors.
    - Visit TA's programming office hours to get help.

Background

The Unix/Linux ls command is used to list files and directories in the file system. For this assignment you will be implementing a version of ls which supports only a limited set of options.

Note: Mac-OS's ls is different; must develop under Linux.

By completing this assignment, you will:

1. Understand what an *inode* is and understand its role in the Unix file system.
2. Know how to use system calls to navigate the Unix file system from a user-level program.
3. Understand how files and directories are organized and stored in Unix.

Assignment requirements

In this assignment, you will be creating a program named **myls** (short for "*MY List"*).

Your program should support below mentioned functionalities.

When calling the program, it will take the form:
`./myls [options] [file list]`

- `[options]`: Optional options from the list below. May be specified in any order or grouping, such as "" (none), "`-i`", "`-i -l -R`", "`-iRl`" "`-R -li`", "`-lR`"… The options are case sensitive.
- `[file list]`: Optional space separated list of paths to files or directories to display.

Options: Implement the following options (you need *not* support any other options, and you need *not* support the long version of the option names):

`-i`: Print the index number of each file

`-l`: Use a long listing format

`-R`: List subdirectories recursively. (Make sure that recursion must not cause any infinite loop)

Sort: Sort the files and directories lexicographically. When printing directories recursively (-R option), do a depth-first traversal of the directories, entering sibling directories in lexicographical order.

Hint : Use ls -R to check your myls output. Both should have same order.

Date Format: When using the -l option you must print out date information in the following format:
mmm dd yyyy hh:mm

For example:

```
Oct  2 2021 14:52
Sep 30 2021 00:01
```

Specifically:

`mmm` Initial three characters of month name; first letter capitalized.
`dd` Two digit day of month; pad with space (‘ ‘) for single digit day.
`yyyy` Four digit year number; pad with spaces (‘ ‘) if less than 4 digits.
`hh` Two digit hour (24 hour clock); pad with zero (‘0’) if less than 2 digits.
`mm` Two digit minute; pad with zero (‘0’) if less than 2 digits.

Special Paths

You must support the following paths with special meaning (x and y are arbitrary names):

`/` Root directory (when at the front of path of the path such as /usr)

`/x/y` Absolute path to a file or directory

`/xy/` Absolute path to a directory

`x/y` Relative path to a file or directory

`x/y/` Relative path to a directory

`~` User’s home folder (can be used such as ~ or `~/test/this/out`)

`.` Current directory

`..` Up one directory (can be used such as `../` or `../../oh/my/../`really/..)

`*` Wildcard (such as *.c) (most of this work will be done by the shell!)

Simplifications vs built-in ls command

- Do not print the “`Total 123456`” line at the top of the output when using the `-l` option.
- All options (if any) must be specified before any files/directories (if any).
- You do not need to support quoted strings as arguments:

```
$ myls "thank goodness we don’t/have to support this/"
$ myls 'it is like a "gift" not to do this!.txt'
$ myls 'seemed like a good idea.c'
```

Error Handling

You must display a meaningful error and exit when:

- User specified an unsupported option such as -a. It is undefined behavior if the user specifies an argument such as “--version”. You should display a message “**Error: Unsupported Option”**
- User specified a nonexistent file/directory.
  The message should be **“Error : Nonexistent files or directories”**

Testing

- Test all permutations of the possible options, including no options at all.
- Test listing edge cases:
  - on a file; on an empty directory; on a very large directory
  - ls on different file types (normal, symbolic). Print the relevant data of what it is pointing to or the link itself. Check stat() and lstat().
- Example commands (for easy reference)

```
        $ myls
        $ myls -lR
        $ myls /
        $ myls ~
        $ myls ~/
        $ myls / /usr
        $ myls -R -il ~/cmpt300 ~/tmp /usr
        $ myls ..
        $ myls -R ../hello
```

Hints

- Initially concentrate on getting the listing for a directory correct; later worry about recursion.
- Focus on extracting the proper information and just printing it. Once you have that all done work on making the format match the ls command.
- Consult the provided file **infodemo.c** and **secret_hearder.h** to see what calls to use to get actual group and usernames.
- Don't forget to test your code on directories with symbolic links in them.

Restrictions

- You may *not* use 3rd party libraries. For example, you must write the path processing, file listing, and directory recursion code yourself. Standard c libraries are allowed.
- You may not copy other people's code. If you are copying and adapting the code from external sources, credit the source.
- Your code should make use of a modular design; try breaking your code into meaningful modules and reasonable functions!
- You must implement sorting yourself (any *$O(n^2)$* or better algorithm OK). You may not copy-and-paste sorting code from online; you may use any built-in routines in either C or Linux which will sort. You can use alphasort().

Test Cases

- Run the executable with all the combinations of iRl (-i, -l, -R, -lR, -iR, -il, -iRl) including without passing an of the options
- Run the executable by passing a file or directory along with the (iRl) options
- Place a subdirectory (with a few files) inside your original directory and test if the iRl options are working fine for the files inside the subdirectory.

Submission Instructions:

For A4, the concrete required deliverables are:

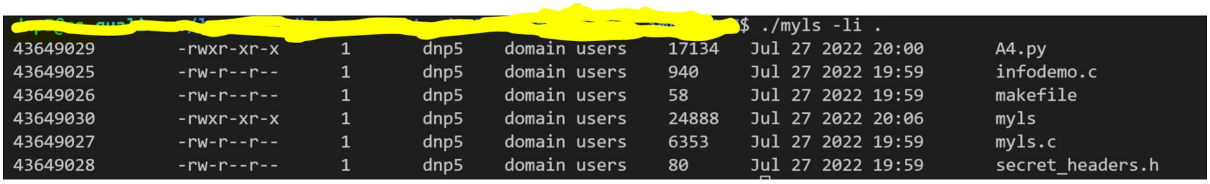
- myls.c file
- Makefile

Submit a zip file.

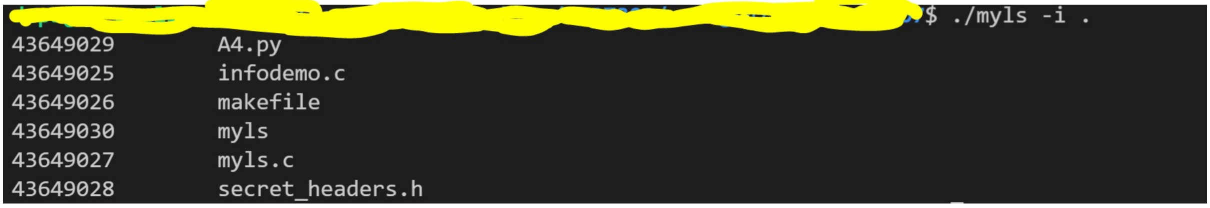
Grading Criteria

Correct make files + 10
Prints entries for a single file argument +5
Prints entries for a single directory argument +5
Prints entries for a multiple file argument +5
Prints entries for a multiple directory argument +5
Prints entries for mixed files and directories +5
Handles case when no file or directory given, and no options +5
Option -R with sort +10
Option -i +10
Option -l +10
Option combinations: -Ri, -Rl, -il, -Ril +10
Handles symbolic links properly.   +5
Wildcard +5
Special paths +5
Error handling +5
Memory leaks 50% deduction per feature

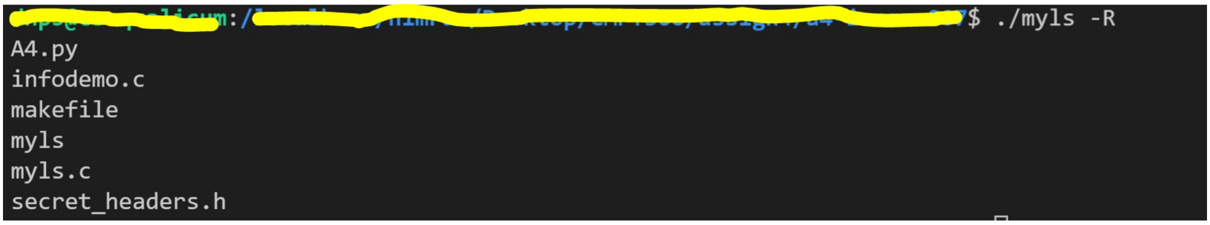
Some of the sample output screenshots for reference:



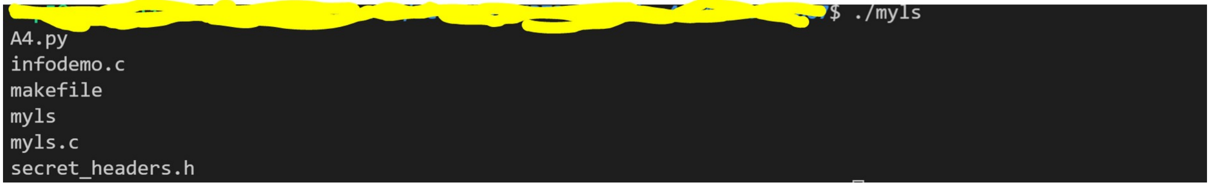
```
[redacted]$ ./myls -li .
43649029      -rwxr-xr-x     1      dnp5    domain users    17134   Jul 27 2022 20:00      A4.py
43649025      -rw-r--r--     1      dnp5    domain users    940     Jul 27 2022 19:59      infodemo.c
43649026      -rw-r--r--     1      dnp5    domain users    58      Jul 27 2022 19:59      makefile
43649030      -rwxr-xr-x     1      dnp5    domain users    24888   Jul 27 2022 20:06      myls
43649027      -rw-r--r--     1      dnp5    domain users    6353    Jul 27 2022 19:59      myls.c
43649028      -rw-r--r--     1      dnp5    domain users    80      Jul 27 2022 19:59      secret_headers.h
```



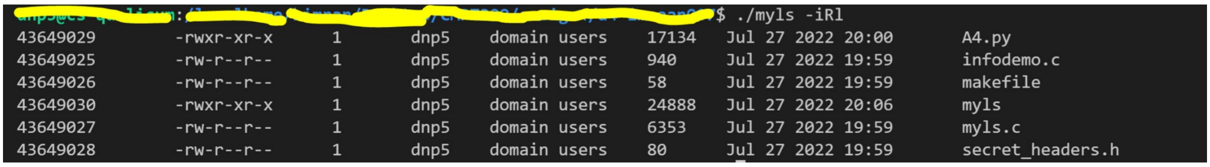
```
[redacted]$ ./myls -i .
43649029        A4.py
43649025        infodemo.c
43649026        makefile
43649030        myls
43649027        myls.c
43649028        secret_headers.h
```



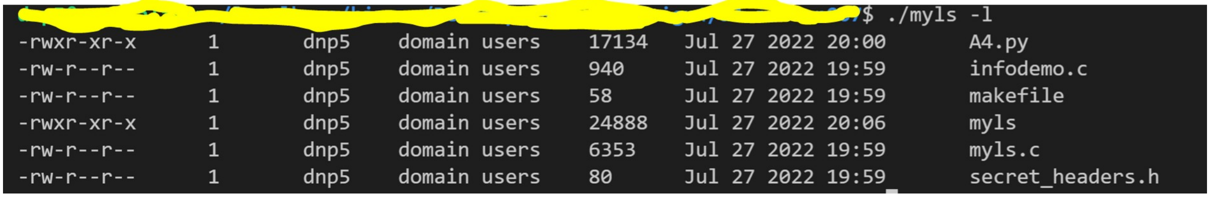
```
[redacted]$ ./myls -R
A4.py
infodemo.c
makefile
myls
myls.c
secret_headers.h
```



```
[redacted]$ ./myls
A4.py
infodemo.c
makefile
myls
myls.c
secret_headers.h
```

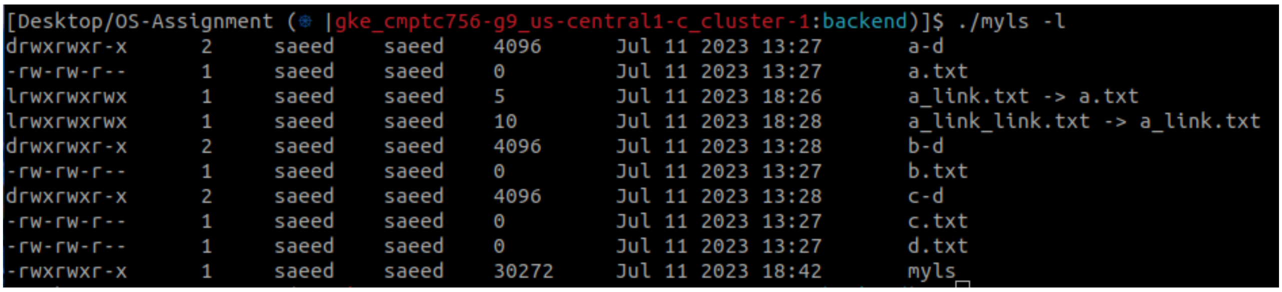


```
[redacted]$ ./myls -iRl
43649029    -rwxr-xr-x    1    dnp5    domain users    17134    Jul 27 2022 20:00    A4.py
43649025    -rw-r--r--    1    dnp5    domain users    940      Jul 27 2022 19:59    infodemo.c
43649026    -rw-r--r--    1    dnp5    domain users    58       Jul 27 2022 19:59    makefile
43649030    -rwxr-xr-x    1    dnp5    domain users    24888    Jul 27 2022 20:06    myls
43649027    -rw-r--r--    1    dnp5    domain users    6353     Jul 27 2022 19:59    myls.c
43649028    -rw-r--r--    1    dnp5    domain users    80       Jul 27 2022 19:59    secret_headers.h
```



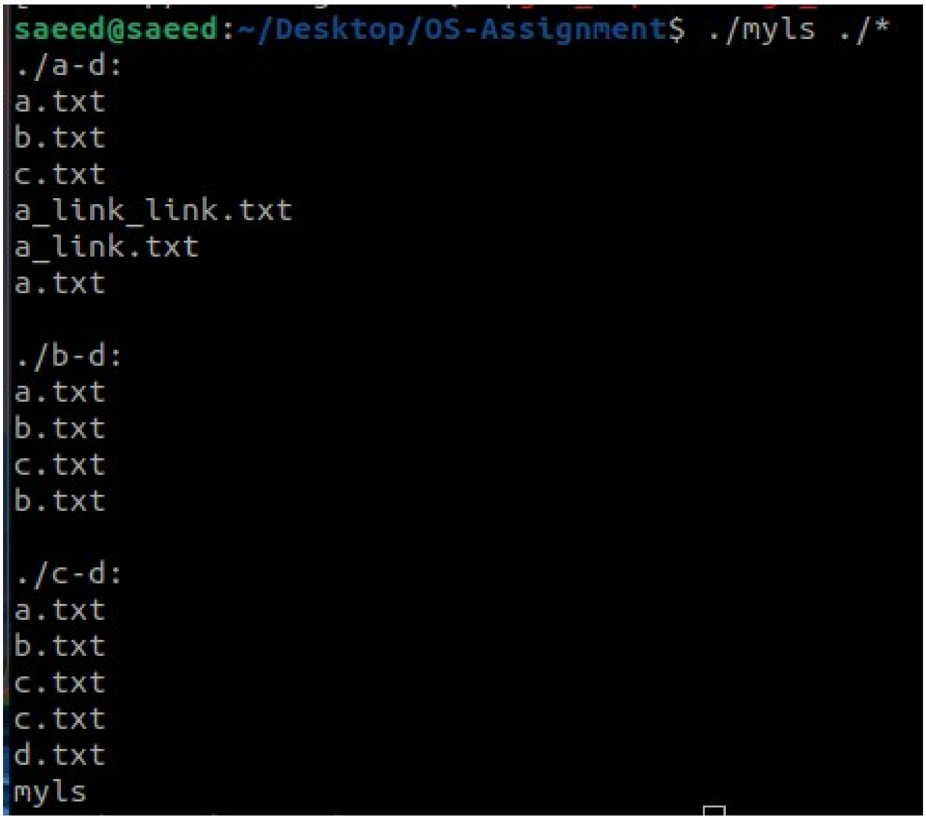
```
[redacted]$ ./myls -l
-rwxr-xr-x    1    dnp5    domain users    17134    Jul 27 2022 20:00    A4.py
-rw-r--r--    1    dnp5    domain users    940      Jul 27 2022 19:59    infodemo.c
-rw-r--r--    1    dnp5    domain users    58       Jul 27 2022 19:59    makefile
-rwxr-xr-x    1    dnp5    domain users    24888    Jul 27 2022 20:06    myls
-rw-r--r--    1    dnp5    domain users    6353     Jul 27 2022 19:59    myls.c
-rw-r--r--    1    dnp5    domain users    80       Jul 27 2022 19:59    secret_headers.h
```

For symbolic link files use the format in the below screenshot



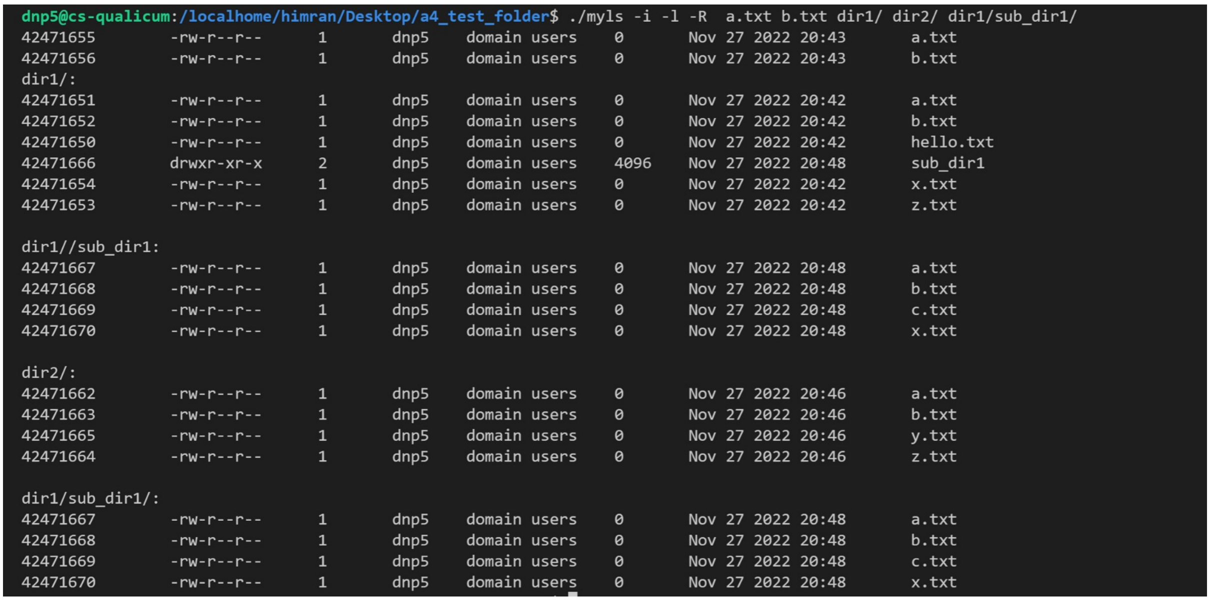
```
[Desktop/OS-Assignment (⎈ |gke_cmptc756-g9_us-central1-c_cluster-1:backend)]$ ./myls -l
drwxrwxr-x    2    saeed    saeed    4096     Jul 11 2023 13:27    a-d
-rw-rw-r--    1    saeed    saeed    0        Jul 11 2023 13:27    a.txt
lrwxrwxrwx    1    saeed    saeed    5        Jul 11 2023 18:26    a_link.txt -> a.txt
lrwxrwxrwx    1    saeed    saeed    10       Jul 11 2023 18:28    a_link_link.txt -> a_link.txt
drwxrwxr-x    2    saeed    saeed    4096     Jul 11 2023 13:28    b-d
-rw-rw-r--    1    saeed    saeed    0        Jul 11 2023 13:27    b.txt
drwxrwxr-x    2    saeed    saeed    4096     Jul 11 2023 13:28    c-d
-rw-rw-r--    1    saeed    saeed    0        Jul 11 2023 13:27    c.txt
-rw-rw-r--    1    saeed    saeed    0        Jul 11 2023 13:27    d.txt
-rwxrwxr-x    1    saeed    saeed    30272    Jul 11 2023 18:42    myls
```

For wildcard example:

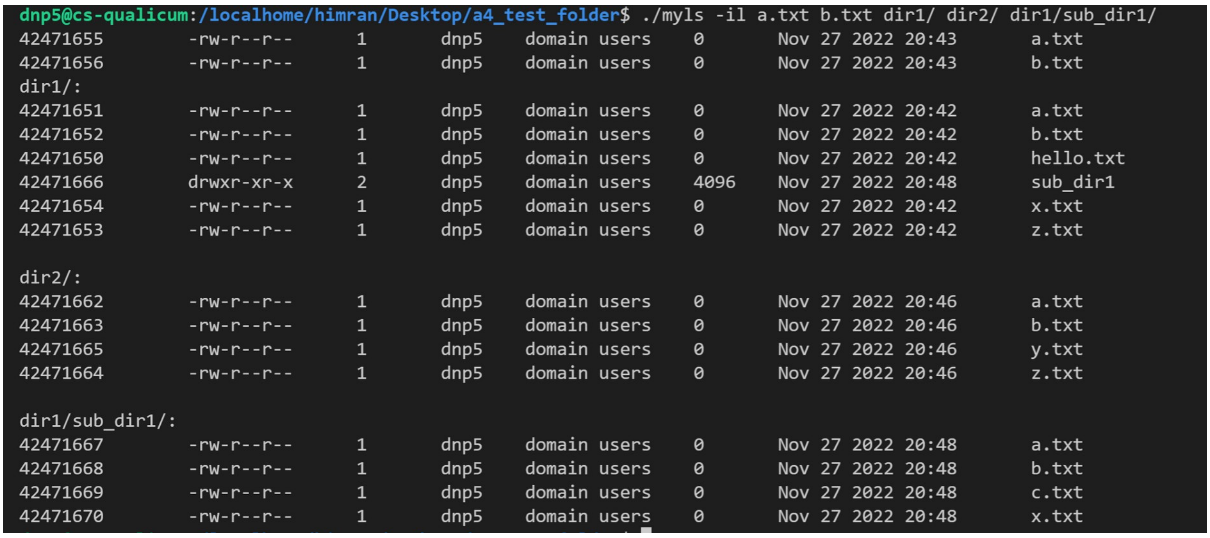


```
saeed@saeed:~/Desktop/OS-Assignment$ ./myls ./*
./a-d:
a.txt
b.txt
c.txt
a_link_link.txt
a_link.txt
a.txt

./b-d:
a.txt
b.txt
c.txt
b.txt

./c-d:
a.txt
b.txt
c.txt
c.txt
d.txt
myls
```

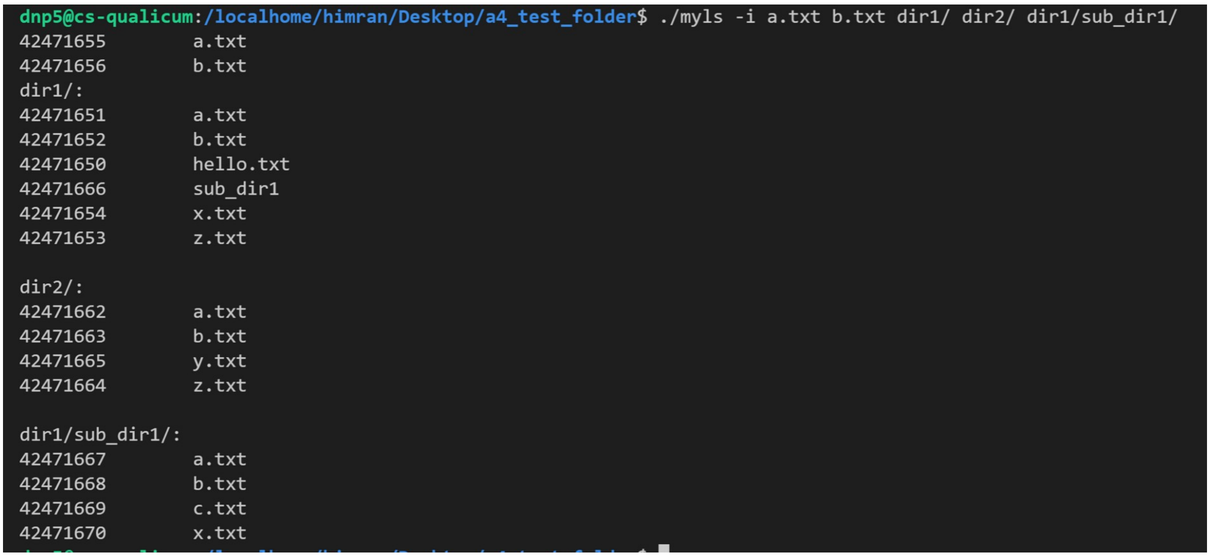
Screenshots which includes combinations of **files, directory and sub-directory**



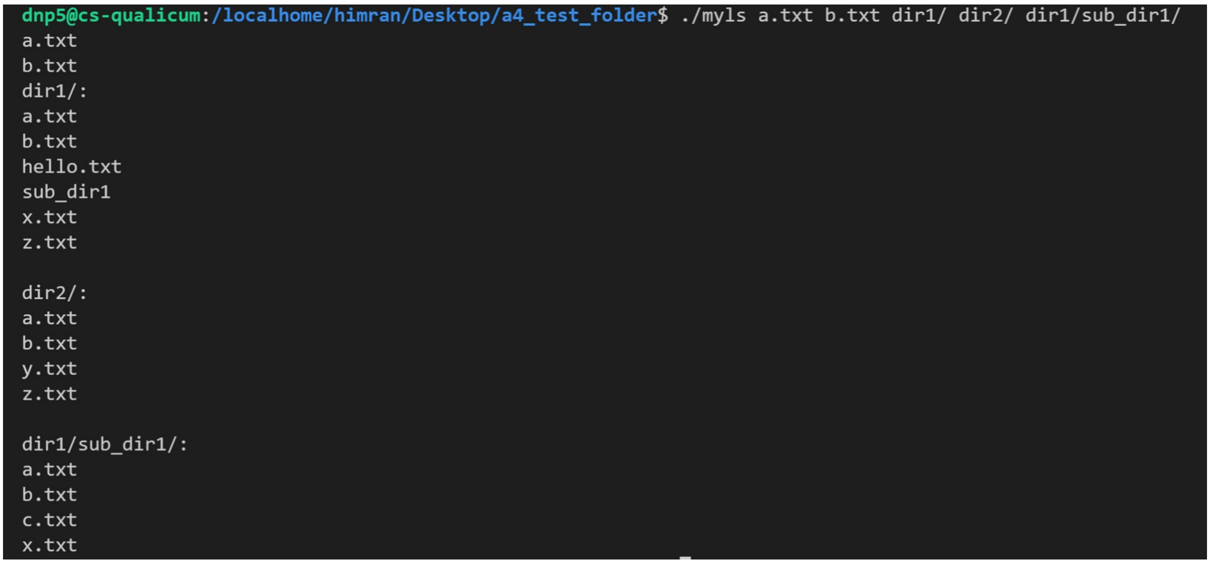
```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -i -l -R  a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
42471655        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       a.txt
42471656        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       b.txt
dir1/:
42471651        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       a.txt
42471652        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       b.txt
42471650        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       hello.txt
42471666        drwxr-xr-x      2       dnp5    domain users    4096    Nov 27 2022 20:48       sub_dir1
42471654        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       x.txt
42471653        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       z.txt

dir1//sub_dir1:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt

dir2/:
42471662        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       a.txt
42471663        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       b.txt
42471665        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       y.txt
42471664        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       z.txt

dir1/sub_dir1/:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt
```



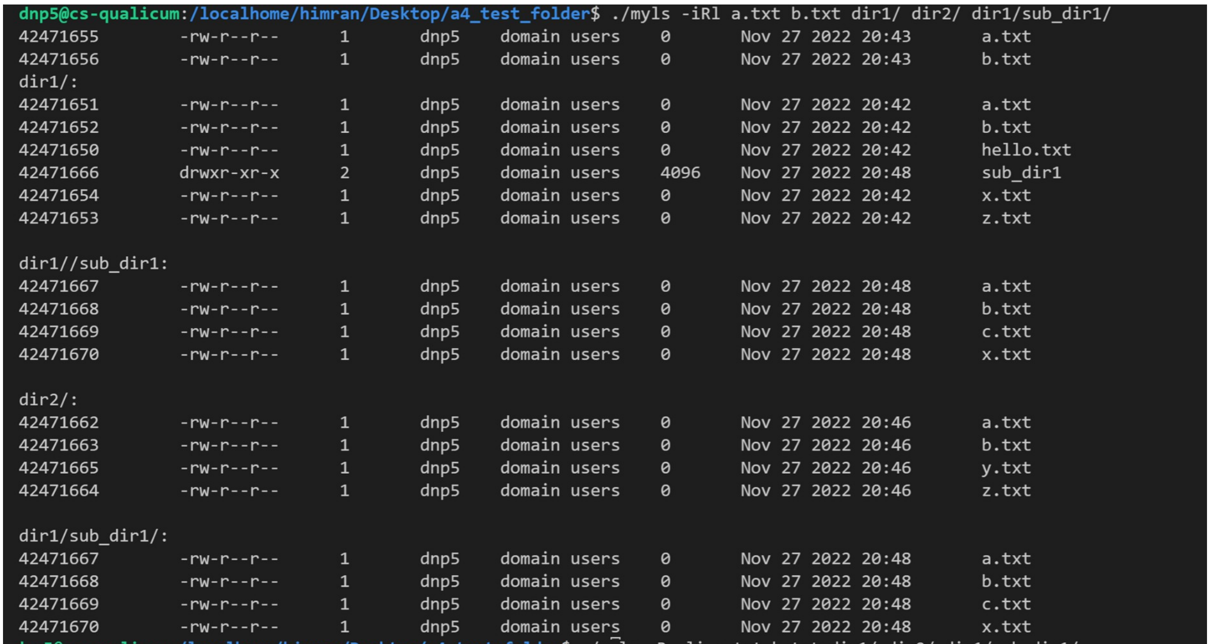
```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -il a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
42471655        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       a.txt
42471656        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       b.txt
dir1/:
42471651        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       a.txt
42471652        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       b.txt
42471650        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       hello.txt
42471666        drwxr-xr-x      2       dnp5    domain users    4096    Nov 27 2022 20:48       sub_dir1
42471654        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       x.txt
42471653        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       z.txt

dir2/:
42471662        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       a.txt
42471663        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       b.txt
42471665        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       y.txt
42471664        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       z.txt

dir1/sub_dir1/:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt
```



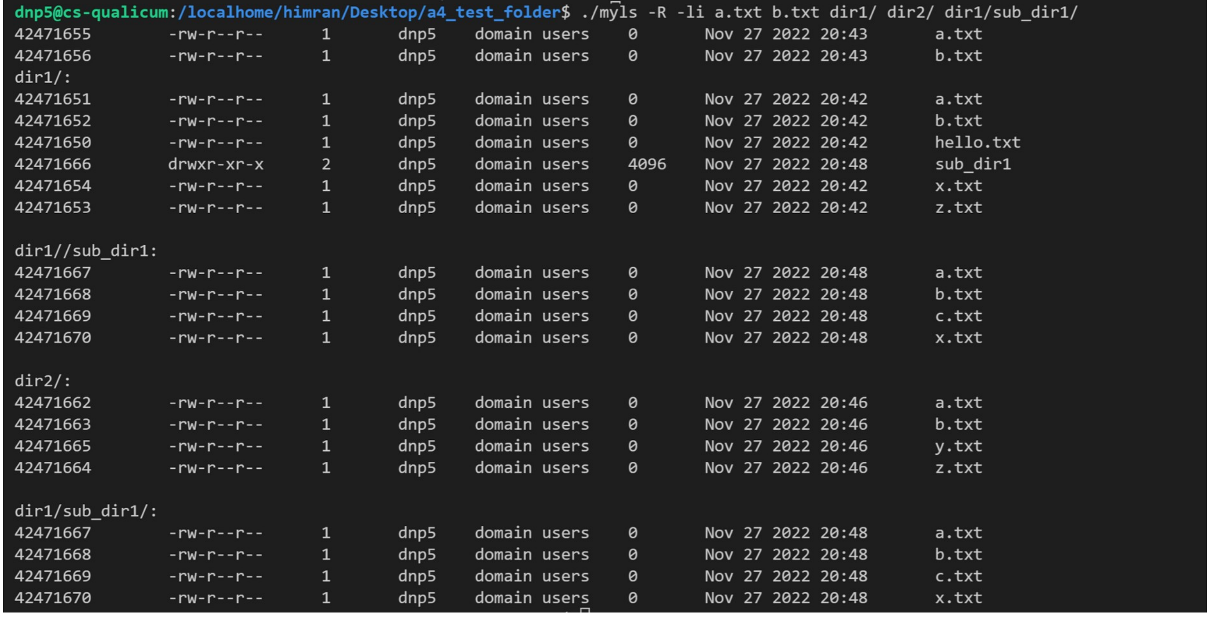
```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -i a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
42471655        a.txt
42471656        b.txt
dir1/:
42471651        a.txt
42471652        b.txt
42471650        hello.txt
42471666        sub_dir1
42471654        x.txt
42471653        z.txt

dir2/:
42471662        a.txt
42471663        b.txt
42471665        y.txt
42471664        z.txt

dir1/sub_dir1/:
42471667        a.txt
42471668        b.txt
42471669        c.txt
42471670        x.txt
```



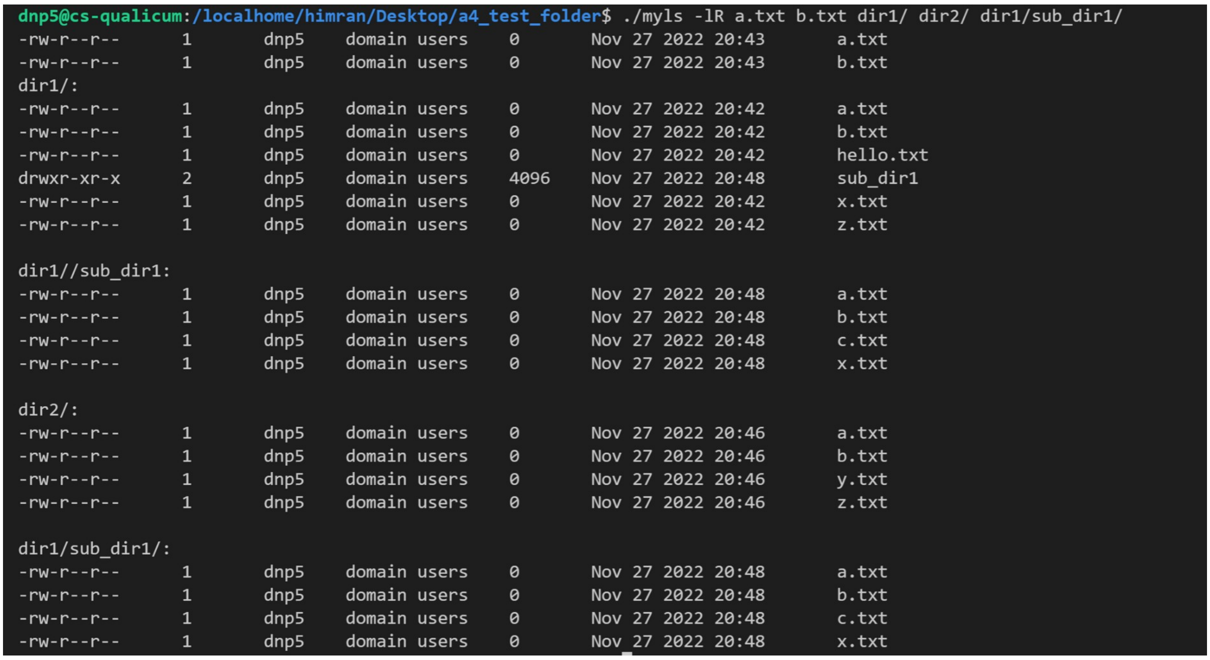
```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
a.txt
b.txt
dir1/:
a.txt
b.txt
hello.txt
sub_dir1
x.txt
z.txt

dir2/:
a.txt
b.txt
y.txt
z.txt

dir1/sub_dir1/:
a.txt
b.txt
c.txt
x.txt
```



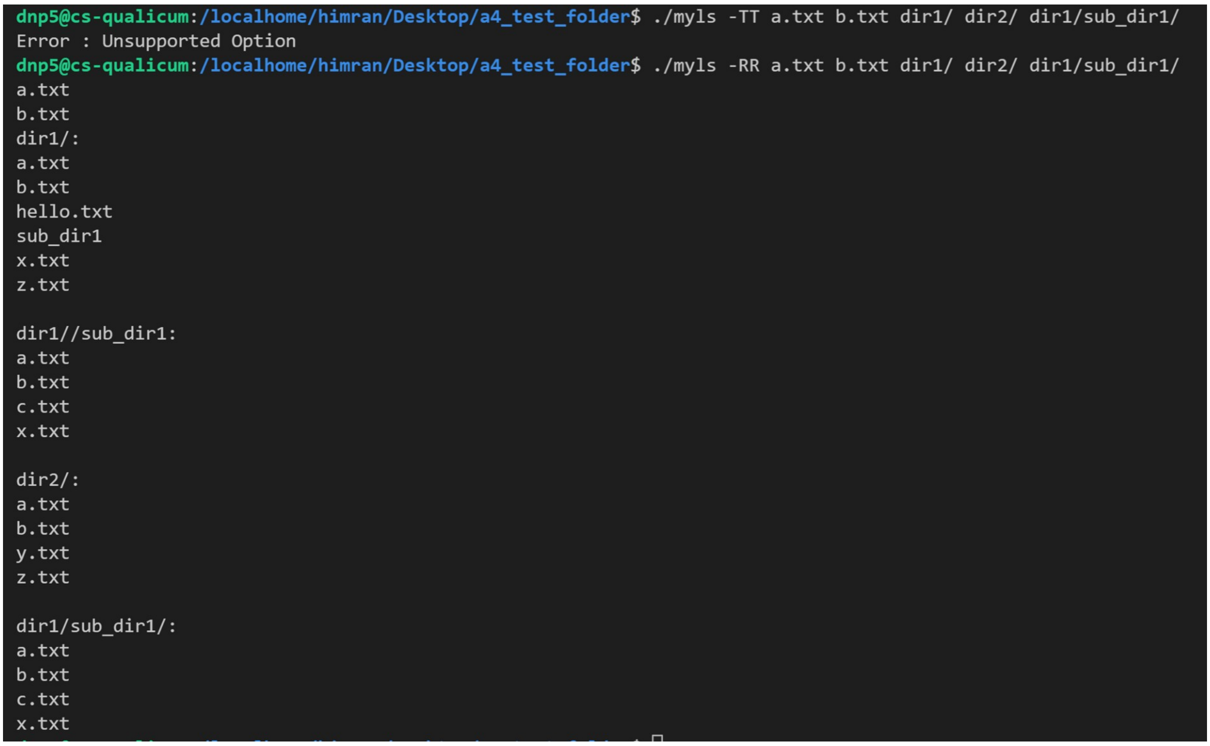
```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -iRl a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
42471655        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       a.txt
42471656        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       b.txt
dir1/:
42471651        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       a.txt
42471652        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       b.txt
42471650        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       hello.txt
42471666        drwxr-xr-x      2       dnp5    domain users    4096    Nov 27 2022 20:48       sub_dir1
42471654        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       x.txt
42471653        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       z.txt

dir1//sub_dir1:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt

dir2/:
42471662        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       a.txt
42471663        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       b.txt
42471665        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       y.txt
42471664        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       z.txt

dir1/sub_dir1/:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt
```



```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -R -li a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
42471655        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       a.txt
42471656        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       b.txt
dir1/:
42471651        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       a.txt
42471652        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       b.txt
42471650        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       hello.txt
42471666        drwxr-xr-x      2       dnp5    domain users    4096    Nov 27 2022 20:48       sub_dir1
42471654        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       x.txt
42471653        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       z.txt

dir1//sub_dir1:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt

dir2/:
42471662        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       a.txt
42471663        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       b.txt
42471665        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       y.txt
42471664        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       z.txt

dir1/sub_dir1/:
42471667        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
42471668        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
42471669        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
42471670        -rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt
```



```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -lR a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       a.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:43       b.txt
dir1/:
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       a.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       b.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       hello.txt
drwxr-xr-x      2       dnp5    domain users    4096    Nov 27 2022 20:48       sub_dir1
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       x.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:42       z.txt

dir1//sub_dir1:
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt

dir2/:
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       a.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       b.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       y.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:46       z.txt

dir1/sub_dir1/:
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       a.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       b.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       c.txt
-rw-r--r--      1       dnp5    domain users    0       Nov 27 2022 20:48       x.txt
```



```
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -TT a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
Error : Unsupported Option
dnp5@cs-qualicum:/localhome/himran/Desktop/a4_test_folder$ ./myls -RR a.txt b.txt dir1/ dir2/ dir1/sub_dir1/
a.txt
b.txt
dir1/:
a.txt
b.txt
hello.txt
sub_dir1
x.txt
z.txt

dir1//sub_dir1:
a.txt
b.txt
c.txt
x.txt

dir2/:
a.txt
b.txt
y.txt
z.txt

dir1/sub_dir1/:
a.txt
b.txt
c.txt
x.txt
```

****Note: 0 after "domain users" is the size of file. Since most if the sample file is empty, file size is 0.**

FAQ

1. Can i simply run execve with a path to the program ls with the input arguments?
   No

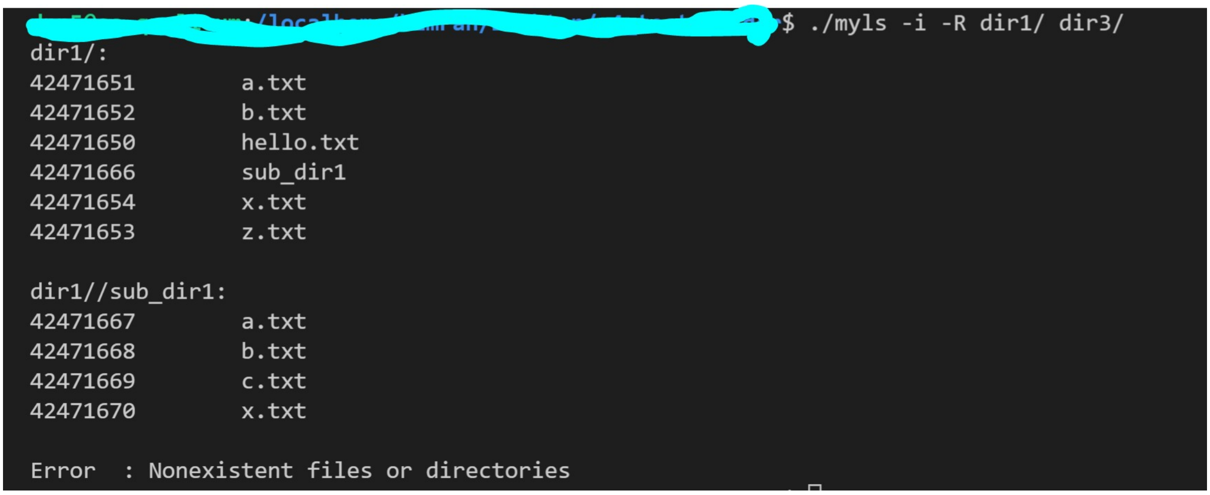
2. Can I use dirent.h for assignment 4?
   Yes

3. Can we use alphasort for -R?

   Yes

4. Are the following cmd valid inputs for myls?
   a. ./myls -i -i -i -i [Valid]
   b. ./myls -i -l   [Valid]
   c. ./myls -i -R   [Valid]
   d. ./myls -i existing_directory non_existing_directory [Not valid]

Answer: All the above cmds are valid except last cmd. If directory doesn't exist, you may display below error message. In the below sample dir3 doesn't exist.



```
[redacted]$ ./myls -i -R dir1/ dir3/
dir1/:
42471651        a.txt
42471652        b.txt
42471650        hello.txt
42471666        sub_dir1
42471654        x.txt
42471653        z.txt

dir1//sub_dir1:
42471667        a.txt
42471668        b.txt
42471669        c.txt
42471670        x.txt

Error  : Nonexistent files or directories
```