OPERATING SYSTEMS LAB

LAB MANUAL # 05

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Contents

CL220 - OPERATING SYSTEM LAB

1. NANO Editor

There are many text editors available for Linux. At the moment you will have access to the nano editor. Nano is an advanced text editor provided by GNU. Simply typing *nano* on the shell will give you the editor. You may also start your nano by explicitly mentioning the file you want to work on. This file may be already existing or you may be creating a new one.

nano <myFile>

Near the end of your screen you will see a list of shortcuts. The ones which you should get yourself familiar with are as such:

CTRL+X for exit

CTRL+O for saving

CTRL+W for searching

CTRL+K for cutting

CTRL+U for pasting

CTRL+C for displaying cursor position

Other commands are listed at the bottom of the text-editor window.

2. Links

Links are the equivalent of Shortcuts in Windows. The syntax of creating a link to a file or directory.

A link in UNIX/linux is a pointer to a file. Like pointers in any programming languages, links in UNIX are pointers pointing to a file or a directory. Creating links is a kind of shortcuts to access a file. Links allow more than one file name to refer to the same file, elsewhere.

There are two types of links:

1. Soft Link or Symbolic links
2. Hard Links

These links behave differently when the source of the link (what is being linked to) is moved or removed. Symbolic links are not updated (they merely contain a string which is the path name of its target); hard links always refer to the source, even if moved or removed.

For example, if we have a file **a.txt**. If we create a hard link to the file and then delete the file, we can still access the file using hard link. But if we create a soft link of the file and then delete the file, we can't access the file through soft link and soft link becomes dangling. Basically, hard link increases reference count of a location while soft links work as a shortcut (like in Windows).

1. Hard Links

- Each hard-linked file is assigned the **same Inode value** as the original, therefore they reference the same physical file location. Hard links more flexible and remain linked even if the original or linked files are moved throughout the file system, although hard links are unable to cross different file systems.
- ls -l command shows all the links with the link column shows number of links.
- Links have actual file contents
- Removing any link, just reduces the link count, but doesn't affect other links.
- Even if we change the filename of the original file then also the hard links properly work.
- We cannot create a hard link for a directory to avoid recursive loops.
- If original file is removed then the link will still show the content of the file.
- The size of any of the hard link file is same as the original file and if we change the content in any of the hard links then size of all hard link files are updated.
- The disadvantage of hard links is that it cannot be created for files on different file systems and it cannot be created for special files or directories.
- Command to create a hard link is:

```
$ ln  [original filename] [link name]
```

2. Soft Links

- A soft link is similar to the file shortcut feature which is used in Windows Operating systems. Each soft linked file contains a **separate Inode value** that points to the original file. As similar to hard links, any changes to the data in either file is reflected in the other. Soft links can be linked across different file systems, although if the original file is deleted or moved, the soft linked file will not work correctly (called hanging link).
- ls -l command shows all links with first column value l? and the link points to original file.
- Soft Link contains the path for original file and not the contents.
- Removing soft link doesn't affect anything but removing original file, the link becomes "dangling" link which points to nonexistent file.
- A soft link can link to a directory.

- Size of a soft link is equal to the name of the file for which the soft link is created. E.g If name of file is file1 then size of it's soft link will be 5 bytes which is equal to size of name of original file.
- If we change the name of the original file then all the soft links for that file become dangling i.e. they are worthless now.
- Link across file systems: If you want to link files across the file systems, you can only use symlinks/soft links.
- Command to create a Soft link is:

```
$ ln  -s [original filename] [link name]
```

To practice, try out the following commands:

ln existingfile linkname

ls

touch blankfile

mkdir blankdir

ls

ln blankdir dirpointer

ln -s blankdir dirpointer

ln blankfile filepointer

cat < blankfile

cat < filepointer

echo "Hello dear" > filepointer

cat < blankfile

cat < filepointer

ls

ls –lh

Look carefully at the contents of both filepointer and dirpointer.Changing one will automatically change the other. Also look at how the directory pointers appear using ls -lh.

3. More | Less

Sometimes a user may give a command which generates so much output that it scrolls very fast. As a result, the top information simply flows out of the screen whereas only the low-end information is visible. For example, use the following command

ls /etc -lh

We can view the lost information using the more or less commands. Try both of them first.

ls /etc -lh | more

To quit, press q.

ls /etc -lh | less

The syntax of both above commands are such that we are specifying two commands in one go. The first command starts with ls, the second command starts with more or less. Both these commands are joined by the pipe symbol **|**.

With more, you are able to browse down the display 1-page at a time using spacebar. With less, you are able to browse up and down the display 1-line at a time using up and down arrow keys. An alternative is using output redirection that you have covered in last lab. Usage would be as such:

ls /etc -lh > temp.txt

nano temp.txt

1. more command

The more command is quite similar to the cat command, as it is used to display the file content in the same way that the cat command does. The only difference between both commands is that, in case of larger files, the more command displays screenful output at a time.

In more command, the following keys are used to scroll the page:

ENTER key: To scroll down page by line.

Space bar: To move to the next page.

b key: To move to the previous page.

Syntax:

more **<file** name**>**

e.g. more temp.txt

man printf |more

man scanf |more

2. less Command

The less command is similar to the more command. It also includes some extra features such as 'adjustment in width and height of the terminal.' Comparatively, the more command cuts the output in the width of the terminal.

Syntax:

less **<file** name**>**

e.g. less temp.txt

man printf |less

man scanf |less

4. Searching

By default, searching for files or directories is performed using the find command.

1. find command

Find command is used to locate a specific by name or extension.

The syntax of find command is as such:

find <*where*> *-name* <*what*>

The following symbols are used after the find command:

(.) : For current directory name

(/) : For root

So, if I want to find all pdf files in / directory, I will give:

find / -name ".pdf"*

sudo find / -name "*.pdf"

To find file name use the following command (In Root Directory)

sudo find / -name prog

sudo find / -name prog.c

finding file in current directory

sudo find . -name prog.c

sudo find . -name prog

finding directory by name

sudo find . -name blankdir

Searching with file Extention

sudo find / -name "*.pdf"

sudo find . -name "*.c"

sudo find . -name "*.cpp"

sudo find . -name "*.txt"

find Desktop -name "*.txt" will find all txt files in Desktop directory.

2. locate Command

The locate command is used to search a file by file name. It is quite similar to find command; the difference is that it is a background process. It searches the file in the database, whereas the find command searches in the file system. It is faster than the find command. To find the file with the locates command, keep your database updated.

Syntax: locate **<file** name**>**

e.g. locate "*.pdf" , locate test4 (test4 is directory name)

(Explore **locate** command by yourself)

5. File Permissions

All files and directories in Linux have an associated set of owner permissions that are used by the operating system to determine access. These permissions are grouped into ***three sets of three bits***. The **sets** represent {owner, group, everyone else} whereas the **bits** represent {read, write, execute}. So overall, we have 9 permissions, as shown in the following table:

	Read	**Write**	**Execute**
Owner	1	1	1
Group	1	1	0
Others	0	0	1
	2^2	2^1	2^0

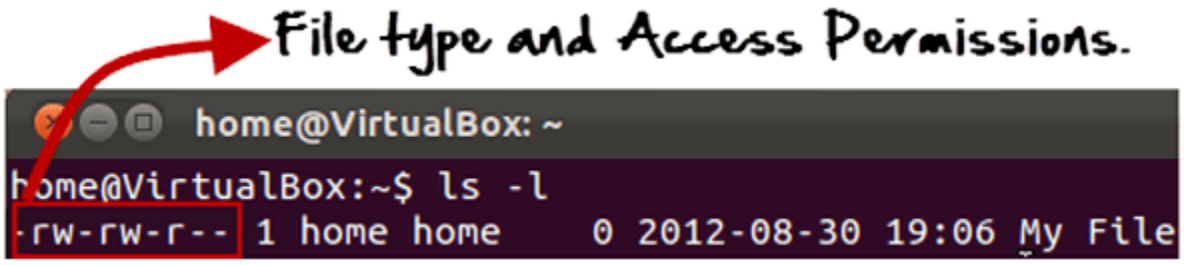
If we look at the first row for Owner, we see three 1's. Which specify that the Owner has read, write, and execute permissions on a file or directory. Since all of the bits are in allow mode, we can add them up together to get $2^2 + 2^1 + 2^0 = 4 + 2 + 1 = 7$. Similarly, the second row for Group, i.e., users within the same group as that of the file owner, have read and write, but no execute permissions. This will be translated only as $2^2 + 2^1 = 4 + 2 = 6$. And lastly, every other user can only execute files and have no permission to read or write to them. This will be translated as $2^0 = 1$. So, the file permissions would be 761. To give the permission of 761 to a file, we would use the command:

chmod 761 <filename>

chmod 777 <filename>

You can view the file permissions using the command:

ls –lh



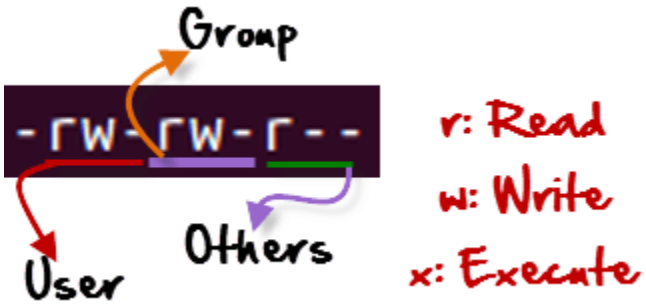
```
muhammad@muhammad-VirtualBox:~/Desktop$ ls -l
total 8
-rw-rw-r-- 1 muhammad muhammad   33 09:50 14   مارچ file2.txt
-rw-rw-r-- 1 muhammad muhammad    0 16:13 22   مارچ hello.sh
drwxrwxr-x 2 muhammad muhammad 4096 19:22 4    اپریل test
muhammad@muhammad-VirtualBox:~/Desktop$
```

The characters are pretty easy to remember.

r = read permission
w = write permission
x = execute permission
- = no permission

The first part of the code is **'rw-'**. This suggests that the owner 'Home' can:

- Read the file
- Write or edit the file
- He cannot execute the file since the execute bit is set to '-'.



-rw-rw-r-- (-) show normal file.

drw-rw-r (d) show directory.

crw-rw-r (c) show character special file.

brw-rw-r (b) show binary special file.

Changing file permissions with 'chmod' command

We can use the '**chmod'** command which stands for **'change mode'**. Using the command, we can set permissions (read, write, execute) on a file/directory for the owner, group and the world.

Syntax: *chmod permissions filename*

There are 2 ways to use the command -

1. **Absolute mode**
2. **Symbolic mode**

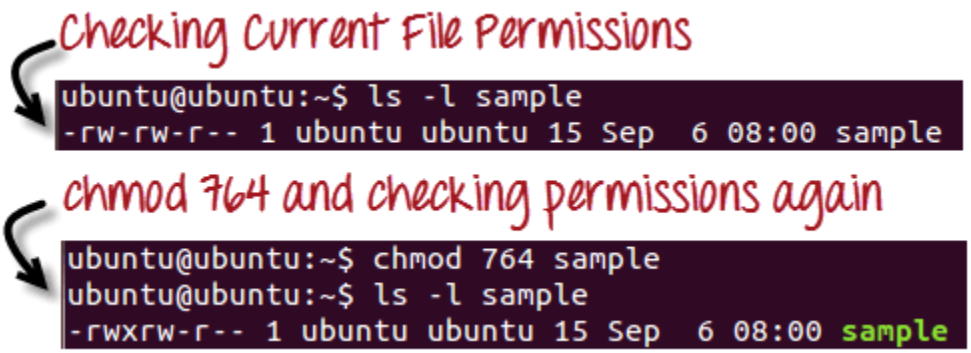
1. Absolute (Numeric) Mode

In this mode, file **permissions are not represented as characters but a three-digit octal number**.

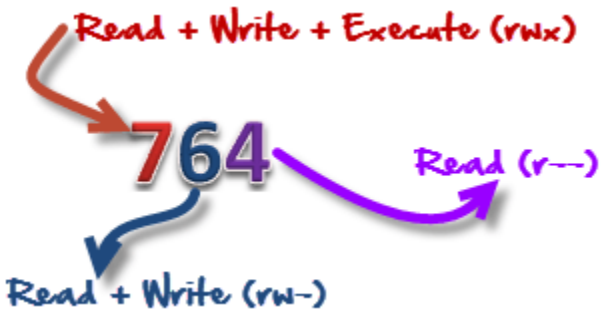
The table below gives numbers for all for permissions types.

Number	Permission Type	Symbol
0	No Permission	---
1	Execute	--x
2	Write	-w-
3	Execute + Write	-wx
4	Read	r--
5	Read + Execute	r-x
6	Read +Write	rw-
7	Read + Write +Execute	rwx

Let's see the chmod permissions command in action.



In the above-given terminal window, we have changed the permissions of the file 'sample to '764'.



'764' absolute code says the following:

- Owner can read, write and execute
- Usergroup can read and write
- World can only read

This is shown as '-rwxrw-r--

This is how you can change user permissions in Linux on file by assigning an absolute number.

2. Symbolic Mode

In the Absolute mode, you change permissions for all 3 owners. In the symbolic mode, you can modify permissions of a specific owner. It makes use of mathematical symbols to modify the Unix file permissions.

Operator	Description
+	Adds a permission to a file or directory
-	Removes the permission
=	Sets the permission and overrides the permissions set earlier.

The various owners are represented as –

User Denotations	
u	user/owner
g	Group
o	Other
a	All

We will not be using permissions in numbers like 755 but characters like rwx.

1. Permission to Others

1) To allow others to execute file

chmod o+x filename

where **o** stands for other, **x** means executable permissions and **+** is used for adding permissions.

e.g. chmod o+x testfile.txt

ls -l

2) To give permission to others to write file

chmod o+w filename

e.g. chmod o+w testfile.txt

ls -l

where w stands for write permissions.

chmod o+wx testfile.txt --------> Give both permissions to others

ls -l

chmod o+rwx testfile.txt --------> Give all permissions to users

ls -l

2) Take permission from others

chmod o-w testfile.txt ----------> Take write permission from others

ls -l
chmod o-wx testfile.txt ----------->Take write and executable permission from others

ls -l

chmod o-rwx testfile.txt ------------------->Take all permissions from users

2. Permission to Group

chmod o+w filename

e.g. chmod g+w testfile.txt

ls -l

chmod g-wx testfile.txt

ls -l

chmod o+w testfile.txt

3. Permission to User

chmod u+r testfile.txt

ls -l

chmod u+w testfile.txt

ls -l

chmod u+x testfile.txt

ls -l

chmod u+rwx testfile.txt

ls -l

chmod u-rwx testfile.txt

ls -l

To give permission to everybody or take permission from every body

chmod ug=rwx testfile.txt ----------->To give all permissions to user and group

ls -l

chmod ugo=rwx testfile.txt ----->To give all permissions to user and group and others

ls -l

OR

chmod ugo+rwx testfile.txt-------->To give all permissions to user and group and others

chmod ugo-rwx testfile.txt ----> To take all permissions to user and group and others

chmod a+rwx testfile.txt --------> a stand for all (Give all permissions to all)

chmod a-rwx testfile.txt --------> (take all permissions from all)

chmod u+rw,g+rw,o+r testfile.txt

ls -l

This how you can change the permissions of a file using symbolic notations. , w, x are called symbolic notations.

6. Directory Permissions

1. Permission to User

ls -l

chmod u-w test ----------->Take write permission from user

ls-l

chmod u+wrx test ----------->Give all permission to user

ls-l

chmod u=wrx test ----------->Give all permission to user

ls-l

chmod u-wrx test ----------->Take all permissions from user

ls -l

cd test

bash: cd: test: Permission denied

chmod u+x test executable permission given to user

now

cd test

mkdir test4

mkdir: cannot create directory ‘test4’: Permission denied

cd ..

chmod u+w test

cd test

mkdir test4

ls -l

ls: cannot open directory '.': Permission denied

cd ..

chmod u+r test

chmod u+r test

cd test

2. Permission to Group

chmod g+wrx test ---------->Give all permission to group

ls -l

chmod g-wrx test ---------->Take all permissions from group

ls -l

3. Permission to Others

chmod o+wrx test ---------->Give all permission to other

ls -l

chmod o-wrx test ---------->Take all permissions from other

ls -l

7. File or Directory Ownership

A file's owner can be changed using the command:

chown <username> <filename>

Where, <username> would be the username of any user on your system, and <filename> is the target to which this setting is going to apply to. **chown** stands for **change owner.**

ch--------> change

own--------->owner

Examples:

sudo chown usman test4 Change the directory current owner to **usman**

ls-l

sudo chown usman file.txt Change the file current owner to **usman**

ls-l

In case you want to change the user as well as group for a file or directory use the command.

```
chown user:group filename
```

sudo chown usman:usman file.txt

ls-l

cat > test.txt --------> use this command you will get the following message.

"bash: test.txt: Permission denied". This is because that currently working user is muhammad in my case and owner of the file is usman.

sudo chown usman:usman test4

ls-l

In case you want to change group-owner only, use the command

```
chgrp group_name filename
```

'**chgrp'** stands for change group.

sudo chgrp muhammad file.txt

8. GNU Compiler Collection

Programs written in C on Linux are compiled using the gcc compiler. Programs written in C++ are compiled using the g++ compiler. Both these compilers are provided by GNU under the label GCC.

Any C program written for linux should have the extension of .c (e.g., hello.c), whereas a C++ program should have an extension of .cpp (e.g., hello.cpp). When compiling, the general syntax of command is as follows:

gcc first.c [-o first]

g++ first.cpp [-o first]

A breakdown is as such:

- gcc|g++ is the compiler itself
- first.c|first.cpp will be the filename with extension of your source code.
- [ ] Anything inside this square brackets is an optional arguments. Do not write the square brackets themselves in your command.
- -o is the output filename. It is the argument for making an executable file with the name you specify. Without this, the source code will be compiled into an executable file named a.out first is the name of executable file which you pass to -o argument.

So, considering that we have a source code with the name first.c, and compile it with the above command, we can execute it using:

./first

Where ***./*** specifies the current directory, and first is the name of executable file which you passed as an argument to the compiler.

How To Write C Program In Ubuntu

- Open a text editor (gedit, VI). Command: gedit prog.c
- Write a C program. Example: #include<stdio.h> int main(){ printf(“Hello”); return 0;}
- Save C program with .c extension. Example: prog.c
- *Compile C program*. Command: gcc prog.c -o prog
- Run/ Execute. Command: ./prog

1. Enter the command given below in a terminal window to open a text editor.

```
gedit prog.c
```

Here prog.c is the name of the program. After entering the above code, it will ask for the password.

2. Now write your program, for your convenience, I have given a sample program below, you can copy and paste it into the gedit text editor.

```
#include<stdio.h>

int main()

{

printf("\nThis is C Programming in Ubuntu\n\n");

return 0;

}
```

3. Now save and close the editor.
4. ***Compile the C program in Ubuntu*** *as below.* GCC compiler will compile our code.

```
gcc prog.c -o prog
```

5. If there will be no error in the program, then nothing will be shown. And if an error occurs, it will be shown. In case you get an error you have to open the text editor again by repeating steps 1 and remove it and again save and close the editor.
6. Enter the command given below to run the C program.

```
./prog
```

How To Write C++ Program In Ubuntu

- Open any text editor (gedit, vi). Command: gedit progcpp.cpp
- Write a C++ program. Example: #include int main(){ cout<<“Hello world”; return 0;}
- Save C++ program with .cpp extension. Example: progcpp.cpp
- Compile C++ program. Command: g++ progcpp.cpp -o progcpp
- Run/ Execute. Command: ./progcpp

We will follow same steps as C program we did.

1. Enter the command given below in the terminal window to open a text editor.

```
gedit progcpp.cpp
```

Now you can write your program, I have given an example below.

```
#include<iostream>

using namespace std;

int main()

{

cout<<"\nThis is C++ Programming in Ubuntu\n\n";

return 0;

}
```

2. Now save and close the editor.
3. To compile the C++ program in Linux. Enter the command given below in the terminal window.

```
g++ progcpp.cpp -o progcpp
```

4. Enter the command given below to run the C++ program.

```
./progcpp
```

9. How to execute any command in Linux (ubuntu) through C Program

system() function is used to execute command of linux through c program. This system function is defined in **stdlib.h** header file. So, you are required to include this header file in your program.

The system() function is a part of the C/C++ standard library. It is used to pass the commands that can be executed in the command processor or the terminal of the operating system, and finally returns the command after it has been completed.

<stdlib.h> or <cstdlib> should be included to call this function.

Steps:

1. Write a program namely command and save it with .c extention. i.e. command.c
2. Write this command in terminal **gedit command.c** geditor will be opened, write your C program in this editor.

```
#include<stdio.h>
#include<stdlib.h>
void main()
{
printf("\nThis is C Programming in Ubuntu\n\n");
printf("\nHere in this program we will run linux commands\n\n");
system("ls -l");     // this command will print  all the contents of current directory in long format.
}
```

3. Compile your c program using gcc compiler i.e. **gcc command.c -o command**.
4. After successful compilation execute you program from terminal and check the result.

10. References

https://www.guru99.com/file-permissions.html

Good Luck :)