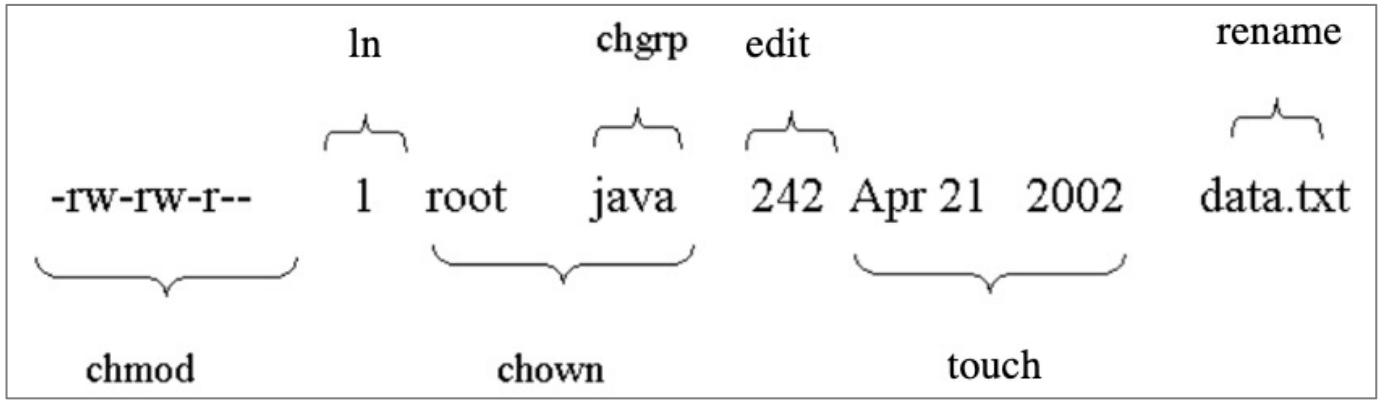
Operating Systems

Lab Work 07. Linux Permissions. SUID/SGID/Sticky Bits.

Changing a File's Parameters

- inodes contain a lot of information about a file
  - mode and type of file
  - number of links to the file
  - owner's UID
  - owners GID
  - number of bytes in file
  - last accessed, modified, inode changed times
  - physical disk addresses (direct and indirect blocks)
  - number of blocks
  - shadow inode with extend access information (ACL)
- Test all inode change commands: ls –al , ln, rename, editor, chown, chgrp, chmod, touch, chattr, lsattr



File's & Directory Permissions

File type
- : plain file
d : directory
c : character device (tty, printer)
b : block device (disk, CD-ROM)
l : symbolic link
s : socket
=, p : pipe (FIFO)

How to read a –rwxrw-r– permission
r : read / w : write / x : execute

user	group	other
rwx	rw-	r--
4+2+1	4+2+0	4+0+0
7	6	4

Access granted to owner

Access granted to others

Access granted to group member

chmod: Changing a File's Permissions

- When you create a file, its initial permissions depend on your umask value (discussed later).
- You can change a file's permissions with the chmod command or the chmod( ) system call.
- If you are logged in as the superuser, you can change the permissions of any file.
- You can change a file's permissions only if you are the file's owner.
- The symbolic form of the chmod command:

`chmod [-R] [agou][+-=][rwxst]` *`filelist`*

- This command changes the permissions of filelist (a single file or a group of files).
- The letters agou specify whose privileges are being modified. You may provide one or more.
- The symbols +-= specify what is to be done with the privilege. You must type only 1 symbol
- The last letters rwxst specify which privilege will be modified: read, write, execute bits and suid, sgid, sticky bits.
- The -R option causes the chmod command to run recursively. If you specify a directory in filelist, that directory's permissions change, as do all of the files contained in that directory. If the directory contains any subdirectories, the process is repeated.

chmod: Changing a File's Permissions

Letter	Meaning
a	Modifies privileges for all users
g	Modifies group privileges
o	Modifies others' privileges
u	Modifies the owner's privileges

Symbol	Meaning
+	Adds to the current privilege
-	Removes from the current privilege
=	Replaces the current privilege

Letter	Meaning
r	Read access
w	Write access
x	Execute access
s	SUID or SGID
t	Sticky bit[9]

Examples:

```
$ chmod a+rwx file
$ chmod u=rw file
$ chmod ag-r,o+wx f1 f2
$ chmod u=s file
$ chmod ug+wxs,o-t file
$ chmod a+rwx,go-wx f1
$ chmod a-rwx,u=rwxs f1
```

```
% ls -l notes
-rw-r--r-- 1 sian     biochem    4320 Feb  9 13:20 notes
% chmod g+w notes
% ls -l notes
-rw-rw-r-- 1 sian     biochem    4320 Feb  9 13:20 notes
%
```

chmod: Changing a File's Permissions

- This format is called the absolute (or numeric, or octal) form of the chmod command:

`chmod [-R] mode filelist`

- The mode to which you wish to set the file, expressed as an octal value with 3 octal numerals. Every octal numeral is interpreted as 3 binary bits (rwx)

Task 1. Find binary and symbolic permissions:

```
$ chmod 000  file      000 000 000     ----------
$ chmod 640  file      110 100 000     -rw-r-----
$ chmod 123  file      001 010 011     ---x-w--wx
$ chmod 777  file      111 111 111     -rwxrwxrwx
$ chmod 752  file              ?               ?
$ chmod 246  file              ?               ?
$ chmod 412  file              ?               ?
$ chmod 206  file              ?               ?
$ chmod 213  file              ?               ?
$ chmod 357  file              ?               ?
$ chmod 234  file              ?               ?
$ chmod 325  file              ?               ?
$ chmod 567  file              ?               ?
$ chmod -R 341 dir f1 a*.txt   ?               ?
```

umask

- The umask (Unix shorthand for "user file-creation mode mask") is a 3 or 4 octal number that Unix uses to determine the file permission for newly created files and directory.

$ umask NNN

- Every process has its own umask, inherited from its parent process.
- By default, Linux/Unix specify an octal standard mode of 666 (any user can read or write the file) when they create new files.
- By default, Linux/Unix specify an octal standard mode of 777 (any user can read, write, or look the directory) when they create new directory.
- For Result Permissions using bitwise AND with the default permissions and the complement of the umask value (the bits that are not set in the umask).
- Normally, you or your system administrator set the umask in your .login, .cshrc, or .profile files, or in the system /etc/profile or /etc/cshrc file. For example, you may have a line that looks like this in one of your startup files:

```
# Set the user's umask
umask 033
```

- The most common umask values are 022, 027, and 077. A umask value of 022 lets the owner both read and write all newly created files, but everybody else can only read them.

umask

Rules.

File Result Permissions Bits = NOT(umask Bits) AND (File Standard Permissions Bits)
Directory Result Permissions Bits = NOT(umask Bits) AND (Directory Standard Permissions Bits)

Example.

After umask 174

```
  174  (001 111 100)   Umask
- 603  (110 000 011)   NOT(Umask)
* 666  (110 110 110)   Default file-creation mode
  602  (110 000 010)   Result mode for new file

  174  (001 111 100)   Umask
- 603  (110 000 011)   NOT(Umask)
* 777  (111 111 111)   Default directory-creation mode
  603  (110 000 011)   Result mode for new directory
```

Set and test umask value.

```
$ umask                 # current umask
0002
$ umask 174             # new umask
$ mkdir dir1            # create new directory
$ touch file1           # create new file
$ ls -l                 # list permissions
drw-----wx 2 std std 512 Sep 1 20:59 dir1
-rw-----w- 1 dave dave 0 Sep 1 20:59 file1
```

Task 2.

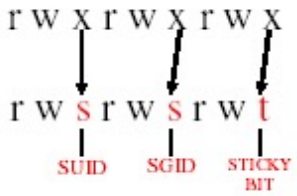
Find result permissions for new files and directory after command:

Command	Directory	File
$ umask 022	755	644
$ umask 077	700	600
$ umask 123	?	?
$ umask 325	?	?
$ umask 547	?	?
$ umask 406	?	?
$ umask 737	?	?
$ umask 100	?	?
$ umask 372	?	?
$ umask 077	?	?
$ umask 345	?	?
$ umask 704	?	?

SUID/SGID/sticky bits

- SUID (set uid)
  - Processes are granted access to system resources based on user who owns the file.
- SGID (set gid)
  - (For file) Same with SUID except group is affected.
  - (For directory) Files created in that directory will have their group set to the directory's group.
- sticky bit
  - If set on a directory, then a user may only delete files that he owns or for which he has explicit write permission granted, even when he has write access to the directory. (e.g. /tmp)

- The access permission status that is displayed using the "ls –l" command does not have a section for special permissions
- However, since special permissions required "execute", they mask the execute permission when displayed using the "ls –l" command.



SUID/SGID/sticky bits

Use the chmod command with 4 numerals octal mode

suid	sgid	stb	r	w	x	r	w	x	r	w	x
4	2	1	4	2	1	4	2	1	4	2	1
7			7			7			7		
Special			user			group			others		

Task 3. Find all of the SUID and SGID files for Your UbuntuMini.

```
# find / \( -perm -004000 -o -perm -002000 \) -type f -print
```

SUID/SGID/sticky bits

Task 4. Find binary and symbolic permissions value after command:

```
$ chmod 7000  file              111 000 000 000        ---S--S--T
$ chmod 5740  file              101 111 100 000        -rwsr----T
$ chmod 1123  file              001 001 010 011        ---s-w--wx
$ chmod 0777  file              000 111 111 111        -rwxrwxrwx
$ chmod 2752  file              ?                      ?
$ chmod 3246  file              ?                      ?
$ chmod 4357  file              ?                      ?
$ chmod 4457  file              ?                      ?
$ chmod 2143  file              ?                      ?
$ chmod 5475  file              ?                      ?
$ chmod 5234  file              ?                      ?
$ chmod 6567  file              ?                      ?
$ chmod 3210  file              ?                      ?
$ chmod -R 5640 dir f1 a*.txt ?                        ?
```

SUID/SGID/sticky bits

Task 5. Find binary and absolute permissions value:

---S--S--T	111 000 000 000	7000
-rwsr----T	101 111 100 000	5740
---s-w--wx	001 001 010 011	1123
-rwxrwxrwx	000 111 111 111	0777
-r-xrwS-wt	?	?
-rw---sr-T	?	?
----rwx-wx	?	?
--wS-wx-wx	?	?
-r-x-w-r-t	?	?
--w-r-S-w-	?	?
----r-s--x	?	?
-rwsr-x--T	?	?
-r-S-ws-wx	?	?
drw-rwsr-t	?	?

The End