Privileges: who can control what

Introduction to Unix

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Hervey Allen

Goal

Understand the following:

- The Unix security model
- How a program is allowed to run
- Where user and group information is stored
- Details of file permissions

Users and Groups

- Unix understands Users and Groups
- A user can belong to several groups
- A file can belong to only one user and one group at a time
- A particular user, the superuser *“root”* has extra privileges (uid = “0” in /etc/passwd)
- Only root can change the ownership of a file

Users and Groups cont.

- User information in `/etc/passwd`
- User info in db-format in `/etc/pwd.db`
- User password hashes in db-format in `/etc/spwd.db`
- Group information is in `/etc/group`
- `/etc/passwd` and `/etc/group` divide data fields using ":"

A program runs...

1. A program may be run by a user, when the system starts or by another process.
2. Before the program can execute the kernel inspects several things:
   a) Looks up the numeric ID values for uid and gid of the user in the file /etc/passwd.
   b) Is the execute bit set on the program file?
   c) Does whoever ran the program, or the program itself have the required privileges to do what is requested?
   d) In most cases, while executing, a program inherits the privileges of the user/process who started it.

A program in detail

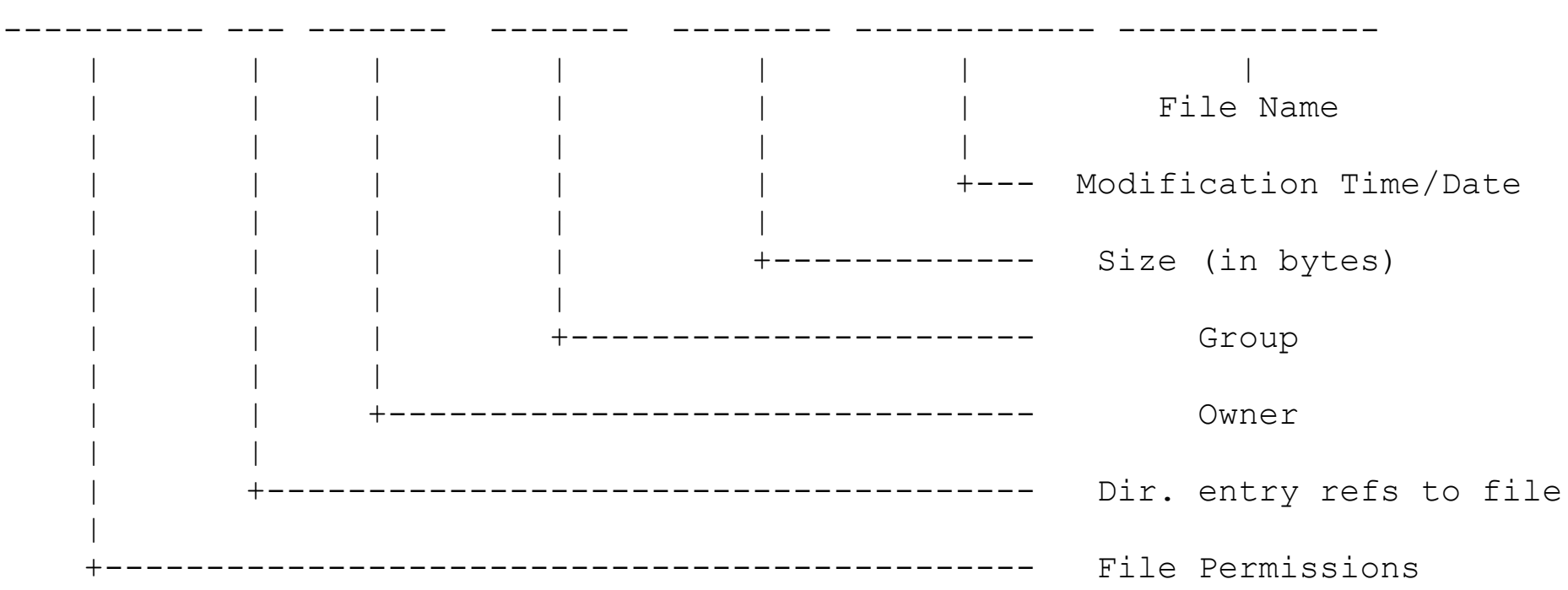
When we type:

```
ls -l /usr/bin/top
```

We'll see:

```
-r-xr-xr-x  1 root  wheel  46112 Apr 28 10:52 /usr/bin/top
```

What does all this mean?



Group
The name of the group that has file permissions in addition to the file's owner.

Owner
The name of the user who owns the file.

File Permissions
A representation of the file's access permissions. The first character is the type of file. A "-" indicates a regular (ordinary) file. A "d" would indicate a directory. The second set of three characters represent the read, write, and execution rights of the file's owner. The next three represent the rights of the file's group, and the final three represent the rights granted to everybody else.

(Example modified from **http://www.linuxcommand.org/lts0030.php**)

Access rights

- Files are owned by a *user* and a *group* (ownership)
- Files have permissions for the user, the group, and *other*
- "*other*" permission is often referred to as "world"
- The permissions are *Read, Write* and *Execute* (R, W, X)
- The same applies to all files

Some special cases

When looking at the output from "`ls -l`" in the first column you might see:

```
d = directory
- = regular file
l = symbolic link
s = Unix domain socket
p = named pipe
c = character device file
b = block device file
```

Some special cases cont

In the Owner, Group and other columns you might see:

`s = setuid`	[when in Owner column]
`s = setgid`	[when in Group column]
`t = sticky bit`	[when at end]

Some References

http://www.tuxfiles.org/linuxhelp/filepermissions.html

http://www.cs.uregina.ca/Links/class-info/330/Linux/linux.html

http://www.onlamp.com/pub/a/bsd/2000/09/06/FreeBSD_Basics.html

File permissions

There are two ways to set permissions when using the `chmod` command:

Symbolic mode:

testfile has permissions of `-r--r--r--`

```
                                    U   G   O*
$ chmod g+x testfile      ==>   -r--r-xr--
$ chmod u+wx testfile     ==>   -rwxr-xr--
$ chmod ug-x testfile     ==>   -rw--r--r--
U=user, G=group, O=other (world)
```

File permissions cont.

Absolute mode:

We use octal (base eight) values represented like this:

Letter	Permission	Value
R	read	4
W	write	2
X	execute	1
-	none	0

For each column, User, Group or Other you can set values from 0 to 7. Here is what each means:

0= **---** 1= **--x** 2= **-w-** 3= **-wx**

4= **r--** 5= **r-x** 6= **rw-** 7= **rwx**

File permissions cont.

Numeric mode cont:

Example index.html file with typical permission values:

```
$ chmod 755 index.html
$ ls -l index.html
-rwxr-xr-x  1 root  wheel  0 May 24 06:20 index.html

$ chmod 644 index.html
$ ls -l index.html
-rw-r--r--  1 root  wheel  0 May 24 06:20 index.html
```

Inherited permissions

Two critical points:

1. The permissions of the directory in which a file resides determines what a user can do to the file.
2. The permissions of the file determine what a user can do to the data in the file.

Example:

If a directory is owned by another user, then you cannot delete a file in the directory, even if you have write (w) access to the file, but you can update the data in the file.

Conclusion

To reinforce these concepts let's do some exercises.

In addition, a very nice reference on using the `chmod` command is:

An Introduction to Unix Permissions -- Part Two

By Dru Lavigne

http://www.onlamp.com/pub/a/bsd/2000/09/13/FreeBSD_Basics.html