File Security and Permissions

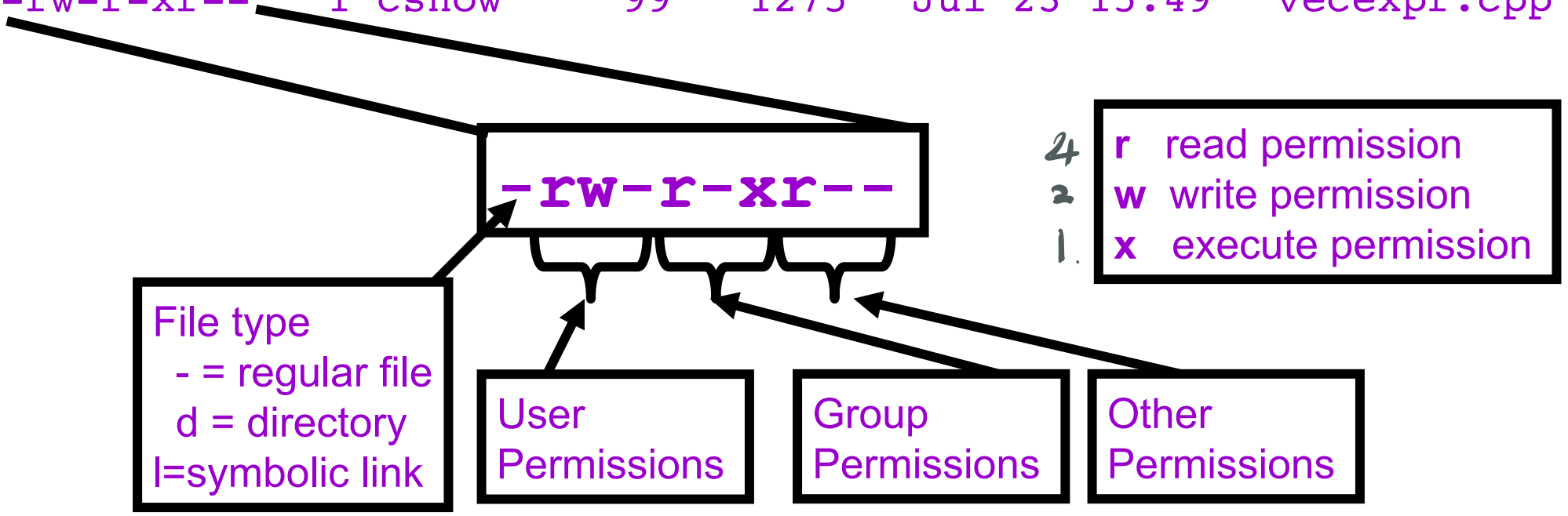
File Permissions (1)

- With respect to a particular file, Unix divides the set of all users on a system into three categories:
  - user
    - The owner of the file.
  - group users
    - Your group may be 2ndyr, or same as your user name.
    - Used for easier administration of access control.
    - Normally only the superuser can set up groups.
    - Users can be in more than one group.
  - others
    - Everyone else.

File Permissions (2)

- Permissions can be viewed with the ls -l command

```
compute[1] > ls -l
total 1247
-rw-------   1 csnow      99    1117   Jul 23 15:49   bad.cpp
drwx--x--x   2 csnow      99       8   Jul 17 10:13   bibd/
drwxr-xr-x   2 csnow  csnow      32   Aug 27 23:18   cache/
-rw-------   1 csnow      99    2081   Jul 23 15:49   tst2.s
-rw-r-xr--   1 csnow      99    1275   Jul 23 15:49   vecexpr.cpp
```



File Permissions (3)

- Permissions are changed with the chmod command.

- There are two syntaxes you can use:

  chmod DDD file [file ...]

  – DDD are 3 octal digits representing bits of protection

  – rwx rwx rwx can be thought of as 111 111 111 in binary

```
rw-r--r--
110100100
 6   4   4        chmod 644 file
```

File Permissions (4)

- chmod [ugoa][+-=][rwx] file [...]
  - This is the “symbolic” method.
  - chmod u+rwx file gives the User Read, Write, and eXecute
  - chmod g+rx file gives the Group Read and eXecute
  - chmod o-rwx file removes R, W, and X from Others
  - chmod a+x file gives All eXecute permission
  - chmod g=r file gives Group Read permission and makes sure it has nothing else

- Symbolic modes can be appended with commas
  - chmod u=rwx,g-w,o-rwx file for instance

File Permissions (5)

- The -R option to chmod is useful when working with directories.
  - All files and directories would receive those permissions.
  - It recursively changes the mode for each chmod operand that is a directory.

  - chmod -R a+rw dir gives everyone read and write permission to each file under dir (not execute though!!!)
  - chmod -R a+rwx dir gives the executable access to allow people to actually access the files under dir
    - Makes all files executable though ...
  - chmod -R a+rwX dir gives the executable access only to those files already executable (programs, directories, …)

The umask command

- umask sets the default permissions for any file you will create

- Format is **backwards** to the chmod command
  - tells you which permissions will **NOT** be given
    - umask 077 means don't let anyone but the User do anything with my files by default

- Generally set umask once in your .bash_profile file and never set it again

Files and inode (1)

- Each file is associated with an inode (index node) in the inode table of a file system
- The inode is accessed by the inode number and contains the following attributes of the file
  - File type (regular, directory, device, link, etc.)
  - File permission (the nine permissions and three more)
  - Number of links (number of aliases of the file)
  - The UID of the owner
  - The GID of the group owner
  - File size in byte
  - Date and time of last modification
  - Date and time of last access
  - Date and time of last change of the inode
  - An array of pointers for all disk blocks used by the file

Files and inode (2)

- Use stat file_name to check inode contents of file_name
- An inode does not store the name of the file
- An inode does not store the inode number of the file
- File name and its inode number are stored in the directory containing the file
- A directory is a file containing file name and its associated inode number of each file in the directory
- A directory is a special file because you can not directly read or write its file content
- Each file system has its inode table stored in a separate area of the disk
- The inode number of a file is unique within a single file system

Regular File Permissions

- The meaning of regular file permissions are simple
  - Requires execute permission to run the file as a command or a program
  - Requires read permission to read the file content
    - example: can use more, vi (read only), or open file for read
  - Requires write permission to write the file or modify the file
    - example: can cp to it or open file for write

Directory Permissions (1)

- The meaning of directory permissions are different from the regular file permissions

ls -a / ls -l => excute

  - Requires execute permission to access the directory itself and files and subdirectories in the directory
    - example: cd into the directory
  - Requires read permission to list the contents of the directory
    - example: ls the directory
  - Requires write permission to create files, delete files, and rename files in the directory
    - example: rm a file or mv with a new name

Directory Permissions (2)

```
compute[1] > ls -l
drwx--x--- 2 csnow 99    8 Jul 17 10:13  bibd/
compute[2] > ls -l bibd
-r--r--rwx 1 csnow 99 173 Jul 17 10:13  readme
```

- Files in bibd/ are accessible to user
- Files in bibd/ are accessible by name (if you know the name) for group users
- Files in bibd/ and subdirectories are not accessible to others.

Exercise – File permission

- Create a directory dir1 in your home directory
- Edit a file test.txt in dir1
- Remove your own read permission of test.txt
- *Try* to display the content of test.txt by cat
- Add you own read permission back for test.txt
- Remove your own write permission of test.txt
- Make some changes to test.txt with an editor and *try* to save.
- *Try* to delete the file test.txt

Exercise – Directory Permission

- Create a directory dir2.
  - What is the permission of dir2?
  - What argument is provided to umask in your .bash_profile or .bashrc file?
- Copy test.txt to dir2/test2.txt
- Remove your own ‘r’ permission of dir2.
  - *Try* to ls dir2.
  - cat dir2/test2.txt
  - cd dir2
  - ls
  - cd ..
- Set your own permission of dir2 to be r-x
  - cp test.txt dir2/test3.txt
  - rm dir2/test2.txt
  - edit the file dir2/test2.txt using an editor and save the changes
- Set your own permission of dir2 to be rw-
  - cd dir2
  - cat dir2/test2.txt
  - cp test.txt dir2/test3.txt
  - ls dir2