UNIX

UNIX File System

Lesson Objectives

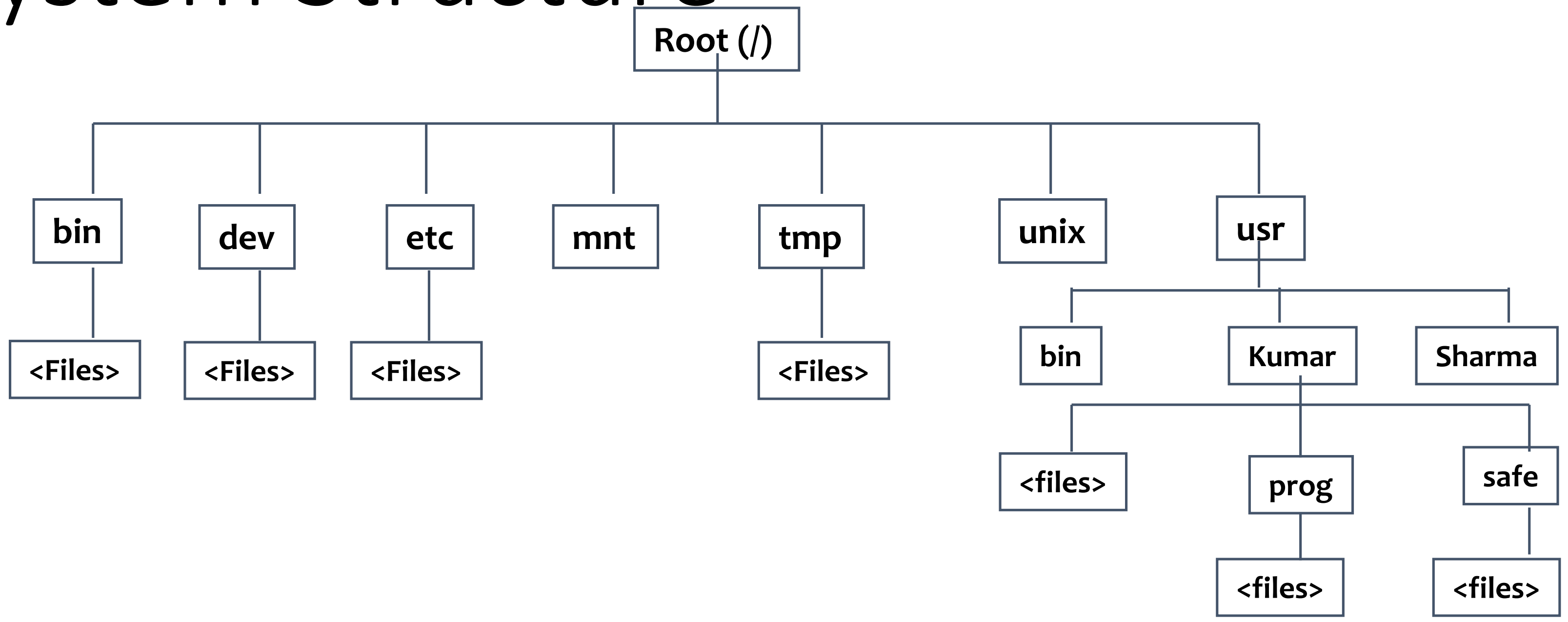
- In this lesson, you will learn:
  - UNIX File system
  - File types
  - File permissions
  - Commands related to file permission
    - mkdir, cd, cat etc…

2.1: File System

Overview

- Let us discuss a File System with respect to the following:
  - Hierarchical Structure
  - Consistent Treatment of Data: Lack of file format
  - The Treatment of Peripheral Devices as Files
  - Protection of File Data

File System Structure



File System Structure

- / bin : commonly used UNIX Commands like who, ls
- /usr/bin : cat, wc etc. are stored here
- /dev : contains device files of all hardware devices
- /etc : contains those utilities mostly used by system administrator
  - Example: passwd, chmod, chown

File System

- /tmp : used by some UNIX utilities especially vi and by user to store temporary files
- /usr : contains all the files created by user, including login directory
- /unix : kernel
- Release V:
  - It does not contain / bin.
  - It contains / home instead of /usr.

File Types in UNIX

- We have the following file types in UNIX:
  - Regular File
  - Directory File
  - Device File

File Permissions in UNIX

- File Access Permissions

$$\underbrace{r\ w\ x}_{\text{user}}\quad\underbrace{r\ w\ x}_{\text{group}}\quad\underbrace{r\ w\ x}_{\text{others}}$$

File Permissions in UNIX

- Permissions are associated with every file, and are useful for security.
- There are three categories of users:
  - Owner (u)
  - Group (g)
  - Others (o)
- There are three types of “access permissions”:
  - Read (r)
  - Write (w)
  - Execute (e)

pwd Command

- The pwd command checks current directory.

```
$ pwd
```

- **Output:** /usr/Kumar

cd Command

- The cd command changes directories to specified directory
- The directory name can be specified by using absolute path (Full Path) or relative path

```
$ pwd
```

- **Output:** /usr/kumar

```
$ cd Prog
$ pwd
```

- **Output:** /usr/kumar/Prog

cd Command

- Moving one level up:

```
$ cd ..
```

Switching to home directory:

```
$ cd
```

```
$ cd /usr/Sharma
```

- Switching to /usr/sharma:

```
$ cd /
```

- Switching to root directory:

logname Command

- The logname command checks the login directory.

```
$ logname
```

Output: Kumar

ls Command

- The ls command lists the directory contents.
- Example:

```
$ ls
```

Output:

```
a.out
chap1
chap2
test
test.c
```

ls Command

- Options available in ls command:

Option	Description
-x	**Displays multi columnar output (prior to Release 4)**
-F	**Marks executables with *and directories with /**
-r	**Sorts files in reverse order (ASCII collating sequence by default)**
-l	**The long listing showing seven attributes of a file**
-d	**Forces listing of a directory**
-a	**Shows all files including ., .. And those beginning with a dot**

ls Command

- Options available in ls command:

Option	Description
-t	**Sorts files by modification time**
-R	**Recursive listing of all files in sub-directories**
-u	**Sorts files by access time (when used with the –t option)**
-i	**Shows i-node number of a file**
-s	**Displays number of blocks used by a file**

ls Command

- Example:

```
$ ls – l
```

- It displays output as follows which includes 7 columns

  total 8:

```
-rw-rw-rw-        1 Kumar group 44   May 9 09:08 dept.h
-rw-rw-rw-        1 Kumar group 212 May 9 09:08 dept.q
-rw-rw-rw-        1 Kumar group 154 May 9 09:08 emp.h
```

ls Command

- Consider the first column:

  Field1 --> mode

  -   r w x   r w x   r w x

  ✶ ✸ ✹

  ✶ --> user permissions

  ✸ --> group permissions

  ✹ --> others permissions

ls Command

- File type
  - 1 st character represents file type:

    -   r w x   r w x   r w x

    - -   --> regular file
    - d --> directory file
    - c --> character - read
    - b --> block read

ls Command

• Field2	: indicates number of links
• Field3	: File owner id
• Field4	: Group id
• Field5	: File size in bytes
• Field6	: Date/time last altered
• Field7	: Filename

cat Command

- The cat command is used for displaying and creating files.
  - To display file:

```
$ cat dept.lst
```

```
01|accounts|6213
02|admin|5423
:
06|training|1006
```

  - To create a file:

```
$cat > myfile
```

    - This is a new file
    - Press ctrl-d to save the contents in file myfile

cat Command

- The cat command can be used to display contents of more than one file.

```
$ cat chap1 chap2
```

  - It displays contents of chap2 immediately after displaying chap1.

Input and Output Redirection

- Standard Input : Keyboard
- Standard Output: Monitor
- Standard Error : Monitor
- Redirection operators:
    - < : Input Redirection
    - > : Output Redirection
    - 2> : Error Redirection
    - >> : Append Redirection

Redirection

- Input redirection: Instead of accepting i/p from standard i/p(keyboard) we can change it to file.
  - **Example:** $cat < myfile will work same as $cat myfile
  - < indicates, take i/p form myfile and display o/p on standard o/p device.
- Output redirection: To redirect o/p to some file use >
  - **Example:** $cat < myfile > newfile
  - The above command will take i/p from myfile and redirect o/p to new file instead of standard o/p (monitor).

Redirection

- $ cat < file1.txt > result is same as $cat file1.txt > result.

```
$ cat result
```

Output: 2   12   60

- >> is append redirection
- The given command will append the contents of file1.lst in result file.

```
$ cat  < file1.lst >> result
$ cat result
```

Output: 2   12   60
            4   4   8

cat file exist/not exist

- Consider an example of cat –(file exist/not exist):

```
$ cat abc.txt > pqr.txt 2> errfile.txt
```

- If file abc.txt exists:
  - Then contents of the file will be sent to pqr.txt. Since no error has occurred nothing will be transferred to errfile.txt.
- If abc.txt file does not exist:
  - Then the error message will be transferred to errfile.txt and pqr.txt will remain empty.

cp Command (copy file)

- The cp (copy file) command copies a file or group of files.
- The following example copies file chap1 as chap2 in test directory.
  - Example:

```
$ cp chap1 temp/chap2
Option - i (interactive)
        $cp  - i  chap1    chap2
        cp: overwrite chap2   ? y
Option -r (recursive) to copy entire directory
$cp  -  r   temp   newtemp
```

rm Command (delete file)

- The rm (remove file) command is used to delete files:

```
$ rm chap1        chap2        chap3
        $ rm   *
          Are you sure? y
Option - i (interactive delete)
        $ rm  -  i     chap1        chap2
        chap1 : ? Y
        chap2  :?  Y
Option   -   r (recursive delete)    (Avoid using this option)
```

mv Command

- The mv command is used to rename file or group of files as well as directories.

```
$ mv   chap1  man1
```

- The destination file, if existing, gets overwritten:
  - Example: $ mv temp doc
  - Example: $ mv chap1 chap2 chap3 man1
    - It will move chap1, chap2 & chap3 to man1 directory

wc Command

- The wc command counts lines, words, and character depending on option.
- It takes one or more filename as arguments.
- no filename is given or - will accept data from standard i/p.

```
$ wc infile
3  20  103 infile
$wc       or   $wc  -
This is standard input
press ctrl-d to stop
```

- **Output:** 2   8   44

wc Command

```
$ wc  infile test
```

```
Output:   3      20      103     infile

          10     100     180     test

          13     120     283     total
```

```
$ wc  -  l  infile
```

```
Output:          3 infile
```

```
$ wc  -  wl  infile
```

```
Output:          20    3   infile
```

The following command will take i/p from infile and send o/p to result file

```
$ wc < infile > result
$ cat result
```

```
Output:          2    12    60
```

cmp Command

- cmp Com

```
$ cmp file1.txt file2.txt
file1.txt file2.txt differ: char 41, line 2
$ cmp file1.txt file1.txt
```

comm Command

- comm Command:
  - The comm command compares two sorted files. It gives a 3 columnar output:
    - First column contains lines unique to the first file.
    - Second column contains lines unique to the second file.
    - Third column displays the common lines.

comm Command

```
$ cat cfile1.lst
A
G
K
X
```

```
$ cat cfile2.lst
A
F
K
W
X
Z
```

```
$ comm cfile1.lst cfile2.lst
                A
        F
G
                K
        W
                X
        Z
```

```
$ comm -12 cfile1.lst cfile2.lst
A
K
X
```

diff Command

- The diff command is used to display the file differences. It tells the lines of one file that need to be changed to make the two files identical.

```
$ diff cfile1.lst cfile2.lst
2c2
< G
> F
3a4
> W
4a6
> Z
```

tr Command

- The tr command accepts i/p from standard input.
- This command takes two arguments which specify two character sets.
- The first character set is replaced by the equivalent member in the second character set.
- The –s option is used to squeeze several occurrences of a character to one character.

tr Command

- Example 1: To squeeze number of spaces by single s

```
$ tr –s “ ”  < file1.txt
```

- E

```
$ tr “[a-z]” “[A-Z]” < file1.txt
ONE
TWO
THREE
FOUR
```

more Command

- The more command, from the University of California, Berkeley, is a paging tool.
- The more command is used to view one page at a time. It is particularly useful for viewing large files.
- Syntax for more command is as follows:

```
more <options> <+linenumber> <+/pattern> <filename(s)>
```

```
$ more file1.txt
```

- Example: To display file1.txt one screenful at a time

chmod Command (Alter File Permissions)

- The chmod command is used to alter file permissions:
- Syntax:

```
chmod <category> <operation> <permission> <filenames>
```

Category	Operations	Attribute
u-user	+assigns permission	r-read
g-group	-remove permission	w-write
o-others	=assigns absolute permission	x-execute
a-all		

chmod Command (Alter File Permissions)

- Example 1:

```
$ chmod u+x note
$ ls - l note
     -rwx r-- r --1 ……      note
```

- Example 2:

```
$ chmod ugo+x           note
$ ls - l note
  -rwxr-xr-x ……           note
```

- When we use + symbol, the previous permissions will be retained and new permissions will be added.
- When we use = symbol, previous permissions will be overwritten.

chmod Command (Alter File Permissions)

- Example 3:

```
$ chmod u-x, go+r       note
      $ chmod u+x       note      note1     note2
      $ chmod o+wx      note
      $ chmod ugo=r     note
```

chmod Command (Alter File Permissions)

- Octal notation:
  - It describes both category and permission.
  - It is similar to = operator (absolute assignment).
    - read permission: assigned value is 4
    - wr
    - execute permission: assigned value is 1
  - Example 1:

```
$ chmod   666 note
```

    - It will assign read and write permission to all.

chmod Command (Alter File Permissions)

- Example 2:

```
$ chmod 777 note
```

  - It will assign all permissions to all.

```
$ chmod 753 note
```

mkdir Command

- The mkdir command creates a directory.
  - Example: 1:

```
$ mkdir doc
```

```
$ mkdir doc     doc/example          doc/data
```

```
$ mkdir           doc/example          doc
```

  - Example 3:
    - It will give error - Order important.

rmdir Command

- The rmdir command is used to remove directory.
- Only empty dir can be deleted.
- More than one dir can be deleted in a single command.
- Command should be executed from at least one level above in the hierarchy.

rmdir Command

- Example 1:

```
$ rmdir doc
```

- Example 2:

```
$ rmdir doc/example doc
```

- Example 3:

```
$ rmdir doc  doc/example
```

  - It will give error.

Internal and External Commands:

- External commands
  - A new process will be set up
  - The file for external command should be available in BIN directory
  - E.g – cat, ls , Shell scripts
- Internal commands
  - shell’s own built in statements, and commands
  - No process is set up for such commands.
  - E.g cd , echo

Summary

- In this lesson, you have learnt:
  - UNIX organizes files in hierarchical manner.
  - File access can be secured using different file permissions.
  - < - Input Redirection
  - > - Output Redirection
  - 2> - Error Redirection
  - chmod command is used to change file permissions.

Review Questions

- Question 1: To copy all files with extension txt to mydir directory ___ command is used, if mydir is parent directory of current directory.
  - Option 1: cp *.txt ..
  - Option 2: cp *.txt ../mydir
  - Option 3: cp mydir *.txt
- Question 2: 2> symbol is used as error redirection
  - True / False
- Question 3: cd . changes the directory to ___.
- Question 4: Which of the following command will give only read permission to all for file file1.txt?
  - Option 1: chmod a=r file1.txt
  - Option 2: chmod a+r file1.txt
  - Option 3: Chmod 666 file1.txt

Review – Match the Following

1. To change directory to home directory
2. To remove all files with extension *.dat
3. To display contents of file abc.txt
4. To create abc.txt file

a. rm *.dat
b. cat <abc.txt
c. cat > abc.txt
d. cd
e. cd \
f. mkdir mydir