SIRE511 : LINUX AND BIOINFORMATICS DATA SKILLS

Fundamental Linux III :

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Course Outlines

- Search Operations in Linux
  - “find” command
- Compressing and Sorting in Linux
- User management and permissions in Linux
- Network in linux
  - Prepare docker container ‘alpine’ for running IP Utilities

Search Operations in Linux

Introduction to the find command

- The 'find' command is used to search for files and directories in a directory hierarchy.

```
$ find [path..] [options] [expression]
```

  - Path : The starting directory where the 'find' command searches for files or directories.
  - Options : command options
  - Expression : File name, directory, or search pattern

https://linuxize.com/post/how-to-find-files-in-linux-using-the-command-line/#google_vignette

Useful options of ‘find’ command

Options	Options pattern	Description
`-exec`	`-exec CMD {} \;`	The 'find' command's results will be used as input for the command in the '-exec' option.
`-type`	`-type d/f/l`	This option is used to specify the type of file for searching with the 'find' command.
`-name`	`-name filename/pattern`	Search for a filename or pattern within directories and their subdirectories in the specified location.
`-iname`	`-iname filename/pattern`	This option functions similarly to the '-name' option, but it is case-insensitive.
`-newer`	`-newer filename`	Search for files or folders created or updated after the specified input filename.
`-perm`	`-perm octal`	Search for files with permissions matching the provided octal value."
`-empty`	`find [path..] -empty`	Search for empty files and directories
`-user`	`-user username`	Search for files owned by the inputted username.

https://www.geeksforgeeks.org/find-command-in-linux-with-examples/

The example of using the “find” command

- Search for a file with a specific name.
  - `$ find . -name gene.txt` ## Search for filename “gene.txt”
- Search for a file with pattern.
  - `$ find . -name “*.txt”` ## Search all txt file
- Search for a file and delete with the confirmation
  - `$ find . -name test.txt -exec rm –i {} \;` ## Search for “test.txt” file and delete it
- Search for empty file and directories
  - `$ find . -empty`
- Search for file with the entered permissions
  - `$ find . -perm 666`
- Search text within multiple files
  - `$ find . -name “*.txt” -exec grep “ns2” {} \;`

https://www.geeksforgeeks.org/find-command-in-linux-with-examples/

“Xargs” command

- The ‘xargs’ command (stand for ”extended arguments”) used to build and execute pipeline from standard input. This command will convert input from standard input into command arguments.

```
$ xargs [options] [command]
```

Try running the following command

```
$ ls *.txt | cat
```

THEN;

```
$ ls *.txt | xargs cat
```

The example of ‘xargs’ command

- Create folders from a list of names.
    - Change to the 'consensus' directory and run the following command.

```
$ ls | cut -d "." -f 2 | sort | uniq | xargs mkdir
```

- Move consensus file of dv1 to folder “dv1” using “find” and “xargs”
    - `find . -type f -name "*dv1*" | xargs mv -t dv1`

Piping results of the “find” command to the other command using “Xargs”

- Use find and “-exec”

```
$ find / -name kernel -type d -exec ls -l --color {} \;
```

- Use find and “xargs”

```
$ find / -name kernel -type d | xargs ls -l --color
```

Compressing and sorting in Linux

Overview of the tar and gzip utilities

- Create archive file using tar utility. The command will create a new 'archive.tar.gz' file while the original file or folder still exists.

```
$ tar -czvf archive.tar.gz /path/to/directory/
```

c : create a new archive file

v : show the progress of the compression

z : compress the archive file using gzip

f : specify the name of archive file

- To extract the content of “archive. This command will extract the contents of the 'archive.tar.gz' and create new uncompressed files while the compressed file still exist.

```
$ tar -xzvf archive.tar.gz
```

x : extract the archive file

https://stackdiary.com/tutorials/linux-compress-a-file/

Overview of the tar and gzip utilities

- Create archive file using gzip . This command is commonly used in Linux.

```
$ gzip [options] filename
```

  - The command will compress 'filename' and create a new archive file 'filename.gz' instead.
  - Options:
    - -d : To decompress the archived file. The command will extract the “filename.gz” file, and create new “filename”
      - `gzip -d filename.gz`
    - -f : Force to compress file
    - -k : Tell command to create new archived file without remove the original file
    - -r : The option can compress every file in a folder and its subfolders.

https://stackdiary.com/tutorials/linux-compress-a-file/ https://www.geeksforgeeks.org/gzip-command-linux/

The power of Z commands: working with compressed file

- zcat
  - View compressed file
- zless / zmore
  - Paging the compressed file
- zgrep
  - Searching inside the compressed file
- zdiff / zcmp
  - Comparison of the compressed file

https://www.thegeekstuff.com/2009/05/zcat-zless-zgrep-zdiff-zcmp-zmore-gzip-file-operations-on-the-compressed-files/

Sorting file using “ls” command

- Using the 'ls' command and its options to sort the displayed files.
  - Some useful sorting options of ‘ls’
    - `$ ls -lS`   ## Option ‘-S’ used for sorting the files by file size.
    - `$ ls -lt`   ## Option ‘-t’ used for sorting the files by modification time.
    - `$ ls -l --sort=WORD`   ## Sort by WORD instead of name: none (-U), size (-S), time (-t), version (-v), extension (-X)
      - Ex. `$ ls -l --sort=extension`   ## Sort file by file extension

Sorting contents of files using “sort” utilities

- The 'sort' command is used to sort the contents of a file.

```
$ sort [option] [File]
```

  - Some useful options:
    - -r Reverse the sort result
    - -n   Sort by numeric
    - -t   Field separation
    - -k   Sort via a specify key.
    - Example: `$ sort –t “delimiter” –k “field number” [file]`

https://saixiii.com/sort-linux-command/

Practice: Sorting contents of files using “sort” utilities

- Let create a file for testing ‘sort’ command.

```
$ nano animal.txt
```

- Type 'cat‘, 'dog’, 'elephant’, 'monkey’, and 'bear‘, one word per line in the 'animal.txt' file.
  - `$ sort animal.txt   ## Sort by alphabet`
  - `$ sort -o sorted.txt animal.txt`

```
## keep sort result in “sorted.txt” file
```

Practice: Sorting contents of files using “sort” utilities

- Let create a file for testing ‘sort’ command.

```
$ nano numbers.txt
```

- Type four random numbers and save the file.
  - `$ sort numbers.txt`
  - `$ sort -n numbers.txt`
  - `S sort -n numbers.txt > sorted_num.txt`
  - Add some redundant number in “numbers.txt” file.
  - `$ sort -n numbers.txt`
  - `$ sort -nu numbers.txt`

User management and permissions in Linux

Introduction to the user management in Linux

- If you want to create new user, you need to have root access to the system.
- If you are a regular user, you need to use 'sudo' as a prefix for superuser commands.
- There are two commands, 'useradd' and 'adduser,' that perform the same task.
  - The 'useradd' command is used to create a new user in a more manual manner than 'adduser’.
  - ‘adduser’ command is more user friendly and interactive than ‘useradd’

Creating Users using the “useradd” command

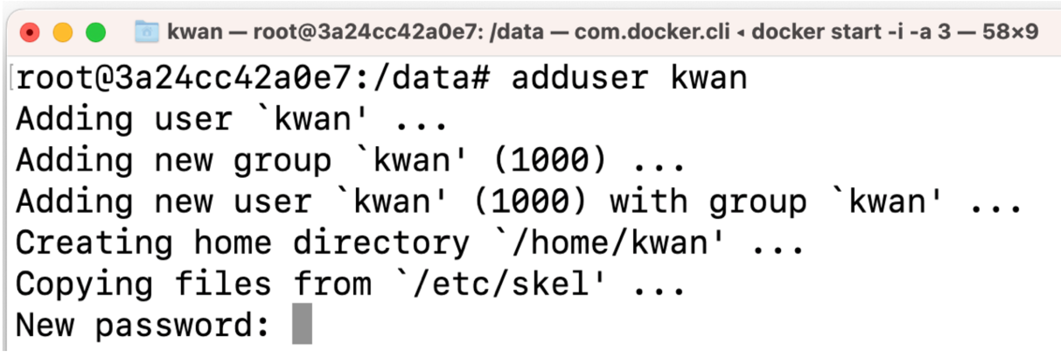
- Let start create user by using ‘useradd’ command:
  - `$ useradd kwan`
  - Try login as ‘kwan’ user
    - `$ su kwan` ## ‘su’ command is used for “change user”
    - `$ ls /home/` ## The result show that there has no home directory was create for user “kwan”
    - `$ exit` ## Exit for logout and back to root user
  - Set password for user ‘kwan’
    - `$ passwd kwan` ## Command ‘passwd’ follow by username for setting password
  - Remove user
    - `$userdel kwan` ## Command ‘userdel’ follow by username

Creating Users using the “useradd -m” command

- Let start create user by using ‘useradd -m’ command:
  - `$ useradd -m kwan` ## Option ‘-m’ is used for creating home directory for the new user
  - `$ ls /home/` ## The directory ‘kwan’ should be created in /home
  - `$ ls -la /home/kwan`
    - There are three hidden files, .bash_logout, .bashrc, .profile, are created automaticlly default in ’/home/user/ ‘.
- How linux system decide which shell should be used by default for new added user?
  - `$ cat /etc/default/useradd`
    - You will found this line “SHELL=/bin/sh” The default shell set by ‘useradd’ is sh.
  - `$ nano /etc/default/useradd` ## Edit this line from “/bin/sh” to “/bin/bash”. New ‘useradd’ will be set to use “bash” as default
  - `$ useradd -m test`
- Remove user using ‘userdel’ and ‘userdel -r’
  - `$ userdel test`
  - `$ userdel -r kwan`
  - `$ ls /home/`

Creating a New User using the “adduser” command

- Creating a new user with the 'adduser' command is more user-friendly than using the 'useradd' command.
- Create user ‘kwan’ using ‘adduser’ command
  - $ adduser kwan
    - User and group are automatically added.
      - User ID: 1000, Group ID: 1000
    - The home directory is automatically created.
    - $ ls /home ## Checking the home directory
    - $ ls -la /home/kwan
      - The owner and group of three hidden files is ‘kwan’
    - $ cat /etc/passwd ## The last line is information of newly created user. The default shell is bash
    - $ cat /etc/adduser.conf
      - DSHELL=/bin/bash/
  - $ su - kwan ## Login to user ‘kwan’ at the home directory



kwan — root@3a24cc42a0e7: /data — com.docker.cli ◂ docker start -i -a 3 — 58×9

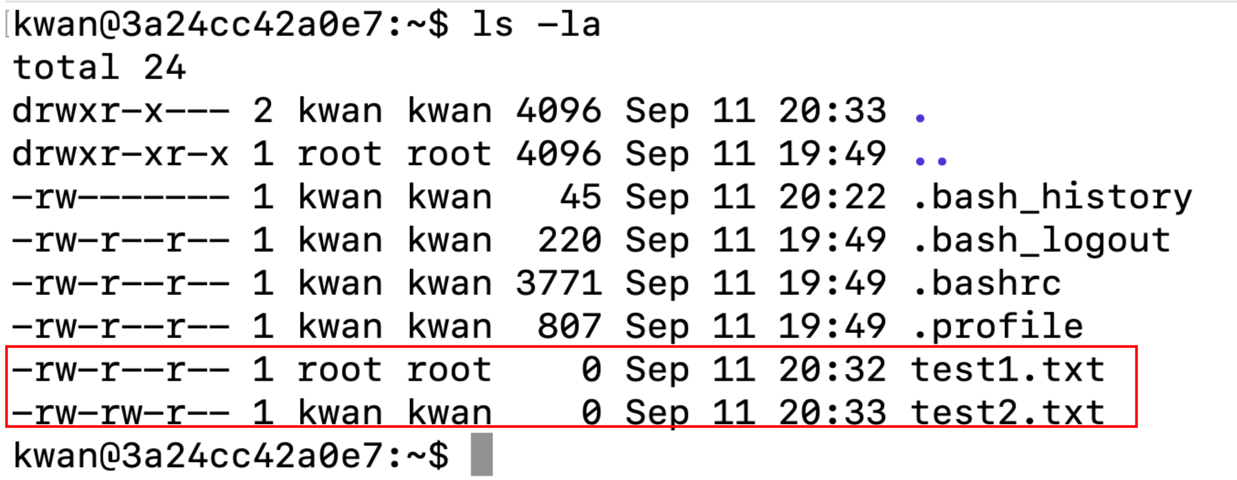
```
root@3a24cc42a0e7:/data# adduser kwan
Adding user `kwan' ...
Adding new group `kwan' (1000) ...
Adding new user `kwan' (1000) with group `kwan' ...
Creating home directory `/home/kwan' ...
Copying files from `/etc/skel' ...
New password: 
```

Changing ownership of the file

- The owner of a file determines who may read, write (modify), or execute the file. Ownership can be changed with the chown command.
- Let’s create file “test1.txt’ at ’/home/kwan’ using root user.
  - `$ touch /home/kwan/test1.txt`
- Login to ‘kwan’ account and create file ‘test2.txt’ in /home/kwan/ directory
  - `$ su - kwan`
  - `$ touch test2.txt`
- Check the ownership of all files in ‘/home/kwan’ directory
  - `$ ls -la`

Changing ownership of the file (cont.)

- Check the ownership of all files in ‘/home/kwan’ directory
  - `$ ls -la`



```
kwan@3a24cc42a0e7:~$ ls -la
total 24
drwxr-x--- 2 kwan kwan 4096 Sep 11 20:33 .
drwxr-xr-x 1 root root 4096 Sep 11 19:49 ..
-rw------- 1 kwan kwan   45 Sep 11 20:22 .bash_history
-rw-r--r-- 1 kwan kwan  220 Sep 11 19:49 .bash_logout
-rw-r--r-- 1 kwan kwan 3771 Sep 11 19:49 .bashrc
-rw-r--r-- 1 kwan kwan  807 Sep 11 19:49 .profile
-rw-r--r-- 1 root root    0 Sep 11 20:32 test1.txt
-rw-rw-r-- 1 kwan kwan    0 Sep 11 20:33 test2.txt
kwan@3a24cc42a0e7:~$ 
```

- Try editting test1.txt file from user ‘kwan’
  - `$ kwan@3a24cc42a0e7:~$ nano test1.txt`
- Try editting test2.txt file from root
  - `$ exit   ## Logout from user ‘kwan`
  - `$ nano test2.txt`

Changing ownership of the file (cont.)

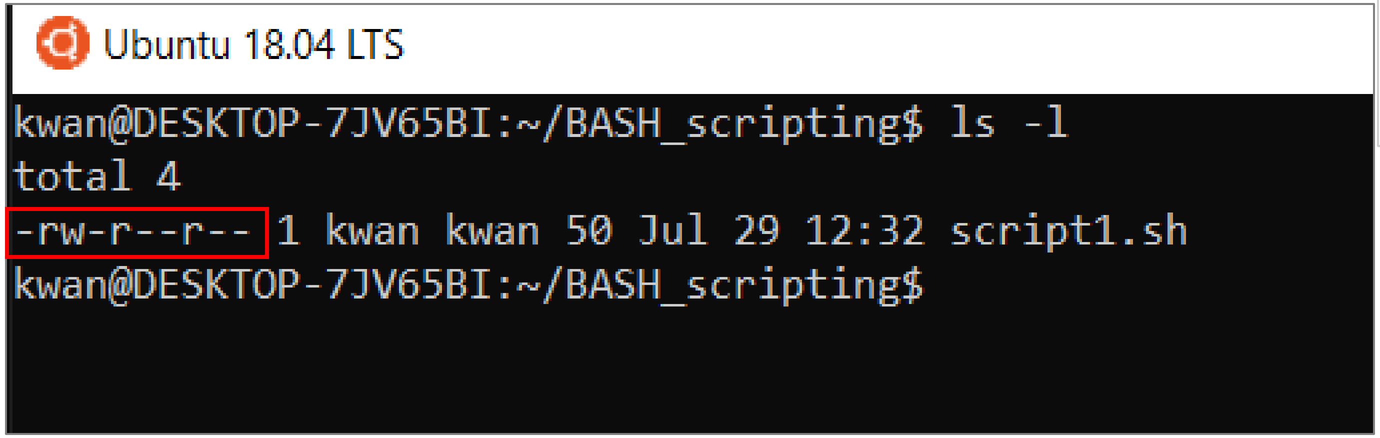
- Change owner of the file using ‘chown’ command
  - `$ chown [option] [owner] [filename]`
- Let’s change owner of ‘test1.txt’ file
  - Try under ‘kwan’ account:
    - `kwan@3a24cc42a0e7:~$ chown kwan test1.txt`
      - `“Operation not permitted”`
  - Try under ‘root’ account
    - `kwan@3a24cc42a0e7:~$ exit` ## To logout from ‘kwan’ account
    - `$ chown kwan /home/kwan/test1.txt` ## Already in root
    - `$ ls -la`
    - Now the owner is changed to ‘kwan’, group still be ‘root’. To change the group name, using the following command:
      - `$ chown kwan:kwan /home/kwan/test1.txt` ## owner:group
- Let’s try modify ‘test1.txt’ under ‘kwan’ account, again.
  - `$ su - kwan`
  - `kwan@3a24cc42a0e7:~$ nano test1.txt`

Changing ownership of the file (cont.)

- The command for changing the owner and group of folder and its entire files is:
  - `chown -r owner:group /path/to/directory`
- Example:
  - `chown -r kwan:kwan /home/kwan/folder`

File permission

You can check file permissions by using the 'ls -l' command.



```
kwan@DESKTOP-7JV65BI:~/BASH_scripting$ ls -l
total 4
-rw-r--r-- 1 kwan kwan 50 Jul 29 12:32 script1.sh
kwan@DESKTOP-7JV65BI:~/BASH_scripting$
```

Read, write, execute permission for the owner of file

Read, write, execute permission for all other users

```
-   rwx   r--   r--
```

File type
"-" indicate file
"d" indicate directory
"l" indicated link

Read, write, execute permission for the group which own the file

r = Readable
w = Writeable

x = Executable
- = Denied

The octal values for setting file permission

Octal value	File permission set	Permission Description
0	`---`	No permission
1	`--x`	Execute permission only
2	`-w-`	Write permission only
3	`-wx`	Write and execute permissions
4	`r--`	Read permission only
5	`r-x`	Read and execute permissions
6	`rw-`	Read and write permissions
7	`rwx`	Read, write, and execute permissions

https://docs.oracle.com/cd/E19504-01/802-5750/6i9g464pv/index.html

Changing permission

- The ‘chmod’ command is used to change the file permission

```
$ chmod [option] MODE File
```

  - Mode is set of octal value
- Example:
  - Change test.txt to be denied for all user
    - `$ chmod 000 test.txt`
  - Change test.txt to be full permission for all user
    - `$ chmod 777 test.txt`
  - What is “chmod +x file” ?

Practice: Changing file permission

- Create ‘newfile.txt’ under root account.
- Modify permissions for the ‘newfile.txt’ as the following:
  - Make it readable, writable, and executable by the owner.
  - Make it readable and executable by the users in the group and by the users in other group.

Networking in Linux

Prepare docker container for exploring network in Linux

- The example of commom command for checking IP address are:
  - ifconfig
  - ping
  - hostname
  - hostname -i
  - ip address
  - ip route
- The Docker container that we are using does not have IP utilities. It is easier to use another container named 'alpine’.
  - Exit the current docker container.
  - Create new docker container:
    - `docker run -it alpine`

Exploring IP address setting

- Running the following command in alpine
    - ifconfig
    - ping
    - hostname
    - hostname -i
    - ip address
    - ip route

Quiz

- The quiz for this session will be conducted at the beginning of the next class.