CST 8102
Operating System Fundamentals - Linux

Winter 2016

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1

Introduction

1.1 Review Questions

Multiple Choice

1. A kernel

   A. gets loaded into system memory and runs code in kernel space

   B. gets loaded into system memory and runs code in user space

   C. gets loaded in ROM BIOS and runs from the BIOS

   D. gets loaded from flash memory then gets loaded in BIOS

2. A user edits a document using `vim`. Identify the memory area where it runs.

   A. kernel space

   B. user space

   C. device driver routines

3. Kernel space is protected because

   A. user data is confidential and should not be viewed by other users

   B. an error in an application program is isolated and does not bring down the entire system or make it unstable

   C. user data can be large and will not fit in kernel space

4. Identify the software that interacts with and processes requests from peripherals such as keyboard, mouse, camera, microphone, hard disk, CD ROM, Flash Drive.

   A. Kernel

   B. application program

   C. device driver

   D. BIOS

   E. flash memory

5. A task is currently running using the CPU. It is interrupted by the kernel with the intention of resuming later. What term fits this description.

A. multi user operating system

B. single user operating system

C. pre-emption

D. multi processor system

6. Identify the term that matches this description. *Programs usually started at boot-up time, provides service(s) to other programs that are run by a user or by the system.*

A. background process

B. foreground process

C. daemon

D. kernel

7. Which command will restart the system immediately.

A. `shutdown -r now`

B. `shutdown -h now`

C. `shutdown -P now`

D. `shutdown -k`

E. `shutdown -c`

8. Which command will give the name of the operating system that is currently running.

A. `passwd`

B. `uname`

C. `hostname`

D. `whoami`

E. `su`

9. Which one of the two pathnames will work regardless of the current directory the user is in.

A. absolute path

B. relative path

Answer True/False

1. `rsyslogd`, `ftpd`, `httpd` are examples of daemons

2. Multiuser is the same as multitasking. These two terms can be used interchangeably

Written Answer

1. Differentiate between multiuser and multi-tasking operating system.

2

Basic Commands

2.1 Review Questions

1. Identify the root users home directory in Linux.

   A. `/`

   B. `/root/home`

   C. `/home/root`

   D. `/root`

2. The Linux command that allows for deleting a directory, but only if it is empty:

   A. `mv -u`

   B. `rm`

   C. `rmdir`

3. The Linux command that will print the current working directory

   A. `pwd`

   B. `cd`

   C. `mkdir`

   D. `ls`

4. Which one of the following will delete directory `/test1` and files stored in it?

   A. `rmdir ~/test1`

   B. `rm ~/test1`

   C. `rmdir -p ~/test1`

   D. `rm -r ~/test1`

   E. `rm -r /test1`

5. The command that is used to change directory to `test1`, a sub-directory of `user1`'s home directory, `/home/user1`, given the command prompt listed below: `user1@localhost: /etc$`

   A. `cd /test1`

   B. `cd ./test1`

C. `cd ../home/user1/test1`

D. `cd home/user1/test1`

6. Identify the redirecton operator, that will not overwrite an existing file but will append it.

   A. `>`

   B. `>>`

   C. `|`

7. Identify the operator that will stream the output of the first command and send it as input to the second command.

   A. `>`

   B. `>>`

   C. `|`

   D. `;`

8. What will the command `echo $SHELL` do?

   A. it will run the default shell

   B. it will show the default shell as specified in the environment variable `SHELL`

   C. it will show all shells currently in the system

9. What does the command `cat` ***file1 file2*** do?

   A. redirects output of *file1* to *file2*

   B. concatenates files *file1* and *file2* and prints to standard output, (i.e. default - screen)

   C. takes each line from *file1* and appends it to corresponding line in *file2*.

10. What does the command `touch` *file1* do?

    A. creates *file1* with zero bytes, gives an error if *file1* exists.

    B. creates *file1* with zero bytes if it does not exist, if *file1* exists `touch` will update the time stamp of the file.

    C. creates *file1* with zero bytes, if *file1* exists `touch` overwrites and creates a file with zero bytes.

11. Identify the command to rename a file in LINUX

    A. `ren`

    B. `rename`

    C. `cp`

    D. `mv`

3

File Permission

3.1 Review Questions

3.1.1 Multiple Choice Questions

1. The root account has access to all resources on a computer

   A. True

   B. False

2. To run a shell script a user must have a *minumum* of

   A. `execute` permission

   B. `read` and `execute` permission

   C. `write` and `execute` permission

3. To run a binary file a user must have a *minumum* of

   A. `execute` permission

   B. `read` and `execute` permission

   C. `write` and `execute` permission

4. What *minimum* permission, is required for a directory, to delete a file?

   A. read

   B. read and write

   C. read, write and execute

   D. read and execute

   E. write and execute

5. User `PrjMgr` copies the file `Plan.Q01` to directory

   `\archive\Mgt\Q01`

   using the following command:

   `cp␣\home\PrjMgr\Plan.Q01␣\archive\Mgt\Q01\`

What are the *minimum* permissions required for the directories `PrjMgr` and `Mgt`

A. for source directory `r`, `w` and `x`, for target directory `r` and `w`

B. for source directory `r` and `w`, for target directory `r` and `w`

C. for source directory `x`, for target directory `r` and `x`

D. for source directory `x`, for target directory `w` and `x`

E. for source directory `w`, for target directory `w` and `x`

6. To delete a file a user must have write and execute permission in the directory, but does not need any permission for the file itself.

A. True

B. False

7. To move a file a user must have appropriate permission in the source and target directories, but does not need any permission for the file itself.

A. True

B. False

8. `user1` moves the file `budget.2015` using the following command.
`mv /home/user1/budget.2015 /home/accounts/`
The *minimum* file permission required for source and target directories are

A. `read` permission for `/home/user1` directory and `/home/accounts` directory

B. `write` permission for `/home/user1` directory and `/home/accounts` directory

C. `read` and `write` permission for `/home/user1` directory and `/home/accounts` directory

D. `read` permission for `/home/user1` directory and `write` permission for `/home/accounts` directory

E. `write` and `execute` permission for both `/home/user1` and `/home/accounts` directory

9. What is the *minimum* permission required for the file to copy it?

A. `read` and `write`

B. `read` and `execute`

C. `write` and `execute`

D. `read`

E. `write`

10. What is the permission, in octal mode, of the file `MySQL.log`, given the file listing:
`-rwxrw--w- 2 maotse students 15 Jan 25 12:37 MySQL.log`

A. `652`

B. `651`

C. `762`

D. `732`

11. Given the file permission `rw-rw-r--` for a file `report.draft` in current directory, identify the `chmod` command that adds execute permissions for owner and removes read permission from others. Permission for group should remain unchanged.

A. `chmod 740 report.draft`

B. `chmod 750 report.draft`

C. `chmod 760 report.draft`

D. `chmod 770 report.draft`

12. Identify the Linux command used by `root` to give everyone full access permission to directory `/public`. [Select all that apply]

A. `chmod 777 /public`

B. `chmod ugo=rwx /public` 

C. `chmod a+rwx /public`

D. `chmod ugo+rwx /public`

The user has set the `umask` to `022`. Answer the next two questions based on this value of `umask`.

13. A file is created, what will be the file permission

A. `----rw-rw-`

B. `-rw-r--r--`

C. `-rw-rw-rw-`

D. `----r--r--`

E. `-rwxr-xr-x`

14. A directory is created, what will be the file permission

A. `----rw-rw-`

B. `-rw-r--r--`

C. `-rw-rw-rw-`

D. `-rwxr-xr-x`

E. `-----w--w-`

15. What `umask` should be set so the resultant file permission is `-r--r--r--`

A. `044`

B. `033`

C. `022`

D. `011`

E. `333`

16. The `root` user wants to change the owner to `cfo` and group to `ExecCmt` for file `Strategy.Q03`. Identify the command that will achieve the result.

A. `chown cfo root Strategy.Q03`

B. `chown Strategy.Q03 cfo root`

C. `chgrp Strategy.Q03 cfo ExecCmt`

D. `chgrp cfo.ExecCmt Strategy.Q03`

E. `chown cfo.ExecCmt Strategy.Q03`

4

File System

4.1 Reading Assignment

Reference: A Practical Guide to Ubuntu Linux, 4e, Mark G Sobell, Prentice Hall,
ISBN: 978-0-13-392731-3
Chapter 6 - The Linux Filesystem

1. Page 204-205, SetUID and SetGID Permissions
2. Page 1276, Sticky bit in glossary
3. Page 598-599, (bottom of page) Setuid file

4.2 Review Questions

Multiple Choice Questions

1. Which directory stores device files, i.e. files that interface with hardware and filesystem

   A. `/etc`
   B. `/dev`
   C. `/root`
   D. `/var`
   E. `/bin`

2. Which directory stores log files and administrative files

   A. `/etc`
   B. `/dev`
   C. `/lib`
   D. `/var`
   E. `/bin`

3. Which directory stores libraries and executables needed to run programs that usually reside in `/bin` and `/sbin`

   A. `/etc`
   B. `/dev`
   C. `/lib`
   D. `/var`
   E. `/bin`

4. Information about a file, a directory, the directory's parent and each of its children is stored in a data structure called

   A. `inode`
   B. `metadata`
   C. `timestamp`
   D. `linkcount`
   E. hardlink

5. `ln -s oldfilename slinkname` creates a

   A. symbolic link (soft link) to a file
   B. hard link to a file
   C. lists the directory structure in short form
   D. removes the link from oldfile and places it in slinkname

Answer the following five questions based on the output of /dev/sdc

```
Disk /dev/sdc: 2147 MB, 2147483648 bytes
255 heads, 63 sectors/track, 261 cylinders, total 4194304 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x97e8fc8b

Device Boot      Start         End      Blocks   Id  System
/dev/sdc1            2048      206847      102400   83  Linux
/dev/sdc2          206848      309247       51200   82  Linux swap / Solaris
/dev/sdc3          309248      514047      102400    5  Extended
/dev/sdc5          311296      362495       25600   83  Linux
/dev/sdc6          364544      415743       25600   83  Linux
```

6. How many logical drives are created?

   A. 1
   B. 2
   C. 3
   D. 4

7. How many primary partitions have been created?

   A. 0
   B. 2
   C. 3
   D. 4
   E. 5

8. How may additional primary partitions can be created?

   A. 0
   B. 1
   C. 2
   D. 4
   E. 5

9. Identify the extended partition

   A. `/dev/sdc1`
   B. `/dev/sdc2`
   C. `/dev/sdc3`
   D. `/dev/sdc5`
   E. `/dev/sdc6`

10. How many maximum primary partitions are allowed in a drive?

    A. 0

B. 1
C. 2
D. 3
E. 4

11. How many maximum extended partitions are allowed in a drive?

A. 1
B. 2
C. 3
D. 4
E. 5

12. Logical drives can reside only on

A. a primary partition
B. a swap partition
C. an extended partition

13. Which of the following command will display all active swap partitions?

A. `swapoff`
B. `mkfs`
C. `swapon -s`
D. `fdisk -l`

5

User Management

5.1 Review Questions

Multiple Choice Questions

1. Identify the file that stores encrypted passwords

   A. `/etc/fstab`

   B. `/etc/passwd`

   C. `/etc/group`

   D. `/etc/shadow`

   E. `/etc/gshadow`

2. `user1` is logged in. What is the command to change the default shell for `user1` to `/bin/sh` the next time `user1` logs in?

   A. `useradd s /bin/sh user1`

   B. `chsh s /bin/sh`

   C. `usermod -s /bin/sh user1`

   D. `sudo usermod -s /bin/sh user1`

   E. `$SHELL=/bin/sh`

3. `user1` is logged in. What is the command to change the default shell for `user1` to `/bin/dash` the next time `user1` logs in?

   A. `useradd s /bin/dash user1`

   B. `chsh s /bin/dash`

   C. `usermod -s /bin/dash user1`

   D. none of the above

4. Identify the command that will allow the superuser to delete account and home directory of `user2`

   A. `userdel user2`

   B. `userdel -r user2`

   C. `usermod -r user2`

D. `usermod -d user2`

5. How will you verify that `user2` has been deleted from the system?

   A. `ls /home/user2`

   B. `ls /root`

   C. `cat /etc/fstab | grep user2`

   D. `cat /etc/passwd | grep user2`

6. Identify the command that is used to delete a group in Linux.

   A. `gpasswd`

   B. `groupmod`

   C. `groupdel`

   D. `newgrp`

Short Answer

The `root` user runs the following commands. Based on the outcome answer the following 5 questions.

```
groupadd account
groupadd finance
groupadd audit
useradd -g account woqag
useradd -g account gavop
useradd -g finance turoz
useradd -g finance nibeg
gpasswd -a turoz finance
gpasswd -d nibeg finance
usermod -G account,finance,audit woqag
groups woqag
```

7. Who are the members of `account`

8. Who are the members of `finance`

9. What is the output of the command `groups woqag`

10. What is the outcome of the command
    `usermod -G audit woqag`? Which groups will user `woqag` belong to after this command is run?

11. The command `useradd user1` will

    A. add a user called `user1` to the group `root`

    B. add a user called `user1` to the first group on the list

    C. create a group called `user1` and add a user called `user1` in the newly created group

    D. give an error

12. The command `useradd -G account,audit user2` will

A. add `user2` to groups `account` and `audit`

B. give an error

13. The command `useradd -g audit user3` will

A. add `user3` to group `audit`

B. will make `user3` an administrator to `group audit`

C. give an error

14. The command `gpasswd -a user1 audit` will

A. add `user1` to group `audit`

B. make `user1` the administrator to group `audit`

C. delete `user1` from group `audit`

D. give an error

15. The command `gpasswd -d user1 audit` will

A. will give an error

B. add `user1` to group `audit`

C. will make `user1` the administrator to group `audit`

D. will delete `user1` from group `audit`

6

Shell Script

6.1 Review Questions

Multiple Choice Questions

1. Which of the following uses the bash shell as the command interpreter in a script?

   A. `/bin/bash`

   B. `#/bin/bash`

   C. `!/bin/bash`

   D. `#!/bin/bash`

2. What special variable will indicate the exit status of the last command?

   A. `$#`

   B. `$0`

   C. `$?`

   D. `$9`

3. What special variable will indicate the number of positional parameters?

   A. `$#`

   B. `$0`

   C. `$?`

   D. `$9`

4. Which symbol is used to indicate the beginning of a comment in a shell script.

   A. `#`

   B. `$`

   C. `!`

   D. `>`

   E. `<`

5. Which operator is used when you want the second command to execute only when the preceeding command succeeds?

A. ;

B. &&

C. ||

D. >>

6. What is the output of the command
`echo "$(pwd)"`

A. The command will give a syntax error

B. The current working directory will be displayed

C. `$(pwd)`

D. `pwd`

7. `ls -l log.03052015` gives the following output.
`-rw-r--r-- 1 user2 faculty 0 Mar 5 19:59 log.03052015`
What is the output of the following command
`echo "$(ls -l log.03052015 | cut -d" " -f4)"`

A. `user2`

B. `faculty`

C. `0`

D. `Mar`

E. The command will give a syntax error

8. What is the output of the command
`echo 'We pay $32 per month for Internet'`

A. `'We pay $32 per month for Internet '`

B. `We pay $32 per month for Internet`

C. `We pay 32 per month for Internet`

Answer the following three questions based on the following declaration in `bash`
`groups=(audit:2001 finance:2002 account:2003 sales:2004 purchase:2005)`

9. What is the output of the following command
`echo ${groups[1+2]}`

A. `account:2003`

B. `finance:2001`

C. `sales:2004`

10. What is the output of the command
`echo ${#groups[*]}`

A. 0

B. *

C. 4

D. 5

11. What is the output of the command
```
echo ${groups[*]}
```

    A. `audit:2001`

    B. There is no output from the command

    C. `audit:2001 finance:2002 account:2003 sales:2004 purchase:2005`

12. What is the output after the following statements are executed
```
x=20;y=30
{ x=300;y=400; }
(x=30;y=40)
echo $x $y
```

    A. `20 30`

    B. `300 400` 

    C. `30 40`

13. How many times will the echo statement execute when the following script is run?
```
for num in {1..10..2}
do
echo $num
done
```

    A. 0

    B. 2

    C. 3

    D. 4

    E. 5

14. How may times will the `echo` statement execute
```
((a=3))
while [ $a -ge 3 ] || [ $a -le 5 ]
do
echo "Everest"
((a++))
done
```

    A. 0

    B. 3

    C. 4

    D. infinite

6.1.1 Exercise

1. Study the following script to understand its task. How can you enhance the script

    (a) to recognize a directory

(b) to check if a file has execute permission

```
#!/bin/bash
# filename: is_file.sh
# adopted from page 957, Sobell, 4e
if test $# -eq 0
   then
   echo "Need at least one argument"
   exit 1
fi

if test -f "$1"
   then
   echo "$1 is an regular file"
else
   echo "$1 is not an regular file"
fi
#eof: is_file.sh
```

Based on the following shell script answer the three questions that follow

```
#!/bin/bash
# adapted from pg 1021, Sobell, 4e
# filename: inc_dec.sh
n=10
echo $n
echo $((--n+3))
echo $n
echo $((n++ -3))
echo $n

#eof: inc_dec.sh
```

2. Write the output of each of the five echo statements

3. Explain the behavior of preoperator `--n`

4. How is it different from postoperator `n++`

5. What is the output of `echo s{o,u,i}n`

6. What is the function of `$( )`

7. In bash shell, what is the operation done by braces { }?

   A. arithmetic evaluation
   B. parameter expansion
   C. logical evaluation
   D. command substitution
   E. arithmetic expansion

8. In bash shell, what is the operation done by double brackets (( ))?

   A. arithmetic evaluation
   B. parameter expansion
   C. logical evaluation
   D. command substitution
   E. arithmetic expansion

9. In bash shell, what is the operation done by a dollar sign and double brackets $(( ))?

   A. arithmetic evaluation
   B. parameter expansion
   C. logical evaluation
   D. command substitution
   E. arithmetic expansion

10. In bash shell, what is the operation done by a dollar sign and brackets $( )?

    A. arithmetic evaluation
    B. parameter expansion
    C. logical evaluation
    D. command substitution
    E. arithmetic expansion

7

Selection & Iteration

7.1 Review Questions

Multiple Choice Questions

8

Regular Expression

8.1 Review Questions

Multiple Choice Questions

1. Given the following at command line:
   `user@localhost: /lab6$ touch aaa cbd bbc bda cdd ab ad`
   `user@localhost: /lab6$ ls [a-d]?[!ac]`
   What is the output of the above command?

   A. `bbc`

   B. `aaa cdd`

   C. `cbd cdd`

   D. `bda`

2. Which command will remove all files that begin with `a`, `b` or `c` in the current directory?

   A. `rm [abc]*`

   B. `rm [abc]?`

   C. `rm [a][b][c]*`

   D. `rm [a][b][c]?`

9

vim

9.1 Review Questions

Short Answer Questions

1. You have made changes to a file in `vim`, you decide not to save the changes and quit. What command will you use?

2. Write the command to save changes and quit.

3. Write the command you will use to copy one line in the buffer.

4. Write the command you will use to copy 4 line in the buffer.

5. Write the command you will use to paste data from the buffer before cursors location.

6. Write the command you will use to paste data from the buffer after cursors location.

7. To run an external program in `vim` you should be in command mode. Write the command you will use to run the program.

8. Write the command to search for a string of characters in the forward direction, i.e. from the cursors position until the end of the file.

9. Write the command to search for a string of characters in the reverse direction, i.e. from the cursors position until the beginning of the file.

10. Write the command replace a character at the cursors location.

11. Write the command to delete the contents from the cursors position until the end of the line.

12. Write the command to delete the contents from the cursors position until the beginning of the line.

13. Write the command to delete the entire line at the cursor.

14. Write the command to undo all changes on a line.

15. Write the command to undo the last action.

16. How will you insert text before the cursor.