Comp311- Lab Linux

Lab 7
Job and Process Management

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Objectives

After completing this lab, the student should be able to:

- **Manage several jobs** running in the background.
- Understand how processes are created using the **fork and exec steps**.
- Control the **priority** of newly created processes using the **nice** command.
- Identify and use signals for manipulating processes.

Job Control:

- We can execute more than one job on **the same terminal**, but we are forced to wait until one command is done executing and **getting the shell prompt back before wecan execute the next command.**
- This is especially a problem if the one of the jobs we are executing takes **a long time such as a backup job**.
- To get around this, Linux allows us to run several jobs at the same time in the background.
- **This is called job control**.To be able to understand job control, we need to create and use a command that will take

a long time. To do this, we do the following steps:

Job Control:

Use sleep command
sleep 100
ctrl+z
jobs
sleep 200 ctrl+z
sleep 300 ctrl+z
sleep 400 ctr+z
jobs %2 %4
jobs
fg %3
bg %4
jobs

1- Create a new file called forever using vi as follows:
vi forever
while true
do
echo running > myfile
done
:wq
This is basically a script file with an infinite loop.

What is the difference ?
sleep
sleep&

forever
forever&

Cont..:

2- Now we have to make sure that our **PATH variable includes the current directory** (.). This step is important for the shell to locate our newly created command forever. This is done as follows:
PATH=$PATH:. ??

3- The third step is adding the execute (x) permission to the command to make it executable. This is done by adding x to all parts of the mode as follows:

Cont..

Now we have a command called ***forever*** that runs for a long time and that can be used to understand job control.
To run a job **in the background**, we follow the command with an ampersand (**&**). In our
case we are going to run three forever jobs in the background as follows:
forever&
[1][2000]

forever&
[2][2500]
forever&
[3][2503]

Each time we run a job in the background the system displays two numbers. The first is the job id number and the second is the job process number. These numbers are important to be able to reference the job later on for manipulation

Cont..

We can display our background job by using the command:
jobs This will display an output similar to the following:

[1] **[2] -** **[3] +**	**Running** **Running** **Running**	**forever** **forever** **forever**

The number is the job id number. **The plus and minus signs reference the last and the one before last stopped jobs.** The status of all jobs is running. The last column is the name of the command used to create the job.

We can manipulate the jobs in several ways, as follows:
To get a job back to the foreground we use the **fg** (foreground) command followed by the job id number. E.g. to get job 2 to the foreground, we run the command:
fg %2

Continue

This brings the job to the foreground. To send the job to the **background**, we press **ctrl-z**.
The job is moved back to the background.
Run the following command:
jobs
What do you notice different about job # 2?
_____.
To resume a stopped or suspended job, we use the **bg** (background) command followed
by the job id number. To resume job 2 (change its status to running) we use the command:
bg %2

Run the command:
jobs
What is the status of job # 2 now? _____.
To terminate a job we use the ***kill*** command followed by the job id number. E.g. to kill job 3 we issue the following command:
kill %3
If we type the command: **jobs** quickly enough we will see the status of job 3 changing to Terminated and if we check again it will disappear.

Practice

Do the following:

kill all remaining jobs such that none are in the background. Write the sequence of commands needed to have the following output displayed when the command "jobs" is issued:

```
[1]+  Stopped                 forever
[2]   Terminated              forever
[3]-  running                 forever&
```

_____
_____
_____

Practice 2

Do the following:

kill all remaining jobs such that none are in the background. Write the sequence of commands needed to have the following output displayed when the command "jobs" is issued:

```
[1]   Running                 forever
[2]-  Stopped                 forever
[3]   Terminated              forever
[4]+  Stopped                 forever
[5]   Terminated              forever
[6]   Terminated              forever
```

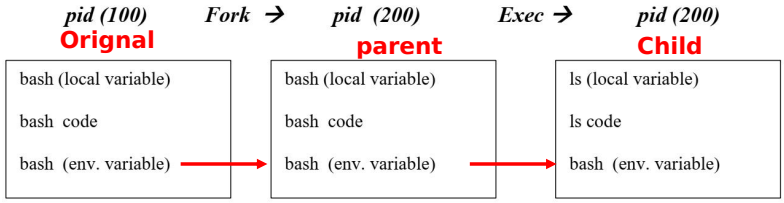
_____

_____

Process Control

A process is simply a program in execution. Each command we run, results in one or more processes. There are several processes running in the background that allow us to use the system and provide us with different services. Interacting and manipulating processes is called **process control**.
When a command is run, a **duplicate copy** of the parent process is created using the **fork function**. This copy is similar to the original except for **its process id number (pid).** After that the system executes the command using the **exec step** which basically loads the new command on top of the copy created as follows:

When we run the command **ls** **under the bash shell**, a copy of bash is



Continue..

Notice that the environment variables are passed from the parent process (**bash**) to the child process (**ls**).
Let us now run through to see the some details on what happens above.
To view process information, we can use the **ps** (process status) command. To see our running processes we use ps with the –f option as follows:
ps –f (do full format)
Describe the output?

_____.
Let us create two variables called var1 and var2 respectively.
var1=first
var2=second

When new variables are created they are defined as **local variables**. To change a variable **from local to environment**, we export it (use the export command). Let us make var2 an environment variable as follows:
export var2

Cont..

The ***set*** command is used to display both local and environment variables. The command
env is used to check the environment variables only. Let us check for **var1** and **var2** in
our main process (bash shell):
Run the command:
set | grep var
Which of the two variables (var1 and var2) do you see in the output? Why?
_____.
Now run the command:
env | grep var
Which do you see now? Why?
_____

```
:~$ env|grep var2
:~$ set|grep var2

:~$ var1=first
:~$ var2=second

:~$ set|grep var2
var2=second

:~$ set|grep var1
var1=first
:~$ env|grep var1
:~$ env|grep var2

:~$ export var2

:~$ env|grep var2
var2=second
```

Cont:

Notice the numbers **pid** (process id) and **ppid** (parent process id). Those should tell you that bash is the parent process and **ksh** is the child process.
You are now in the child process. Let us check for the variables **var1** and **var2** in the child process **(ksh).**

Run the command:
set | grep var
Which of the two variables (var1 and var2) do you see in the output? Why?

_____.

Now run the command:
env | grep var

Which do you see now? Why?
_____.

This shows that only environment variables are passed from parent processes to child processes.

Now run a child processes (ksh) as follows:
ksh
Run the command:
ps -f
What is the output now?

_____.

```
mnjoum@ubuntu:~$ ksh
$ ps -f
UID          PID  PPID  C STIME TTY          TIME CMD
mnjoum      1902  1838  0 23:04 pts/1    00:00:00 -bash
mnjoum      1930  1902  0 23:05 pts/1    00:00:00 ksh
mnjoum      1932  1930  0 23:05 pts/1    00:00:00 ps –f
```

Continue:

As shown above any created process goes through the **fork** and **exec** steps explained above. We can use the **exec** command to skip the **fork** step and just do the exec step and
see what happens, as follows:
Run the command:

ps –f
You should have three processes (bash, ksh, and ps –f). ps –f does not exist anymore.
Now register the pid number for the **ksh process**. Now instead of running the "ps –f"

command as before, run is as follows:
exec ps –f
What processes do you see now? What happened to ksh (hint: note the pid number for the ps –f process)

exec ps –f

UID	PID	PPID	C	STIME	TTY	TIME	CMD
mnjoum	2354	2267	0	12:26	pts/0	00:00:00	-bash
mnjoum	2373	2354	0	12:32	pts/0	00:00:00	ksh
mnjoum	2377	2373	0	12:33	pts/0	00:00:00	-sh
mnjoum	2378	2377	0	12:33	pts/0	00:00:00	ps -f

mnjoum	2354	2267	0	12:26	pts/0	00:00:00	-bash
mnjoum	2373	2354	0	12:32	pts/0	00:00:00	ksh
mnjoum	2377	2373	0	12:33	pts/0	00:00:00	ps -f

What happen with ksh shell (parent of ps –f) process?

More ..

What would you expect to happen if you run the command "exec ps –f" again?

_____.

Try it. What happened?

_____.

This shows that processes do go through **both the fork and the exec steps**, otherwise a new child process will take over its parent process and **destroy it**.

Nice command

Users may decrease the priority of their processes (especially those that take a long time and are not of high priority such as backups) to allow other users to run their processes at a higher priority. When they do that, they are nice and to do that they use the nice command. **The only user that can both decrease and increase the priority of his/her processes is the root** (system administrator). Let us see how the nice command is used.
Run the command:
ps -l
PRI (which refers to the priority of the process)
NI (which refers to the nice value of the process)
Now run the above command as follows:

nice -6 ps –l or nice -n 10 ps –l (renice with -p (useful with process id) renice +1 -p 123 -p 200 , also see, top,htop)

Notice what happened to the **PRI** and **NI** values for process "**ps -l**". They increased.
Increasing the priority number actually makes the **priority for that process less**.
Now try to run the command:
nice --8 ps –l (--8 = two dashes then 8)
What happened? Why?

_____.

Niceness values range from
-20 (most favorable to the process) to 19 (least favorable to the process).

Signals :

Users can control their processes through sending signals using the “kill” command.
There are many signals that may be sent to a process. To get a list you may use the following command:

man 7 signal
There are three interesting signals that stand out. Those are namely **TERM** (also called SIGTERM) which has the number 15,

HUP (also called SIGHUP) which has the number 1,

and **KILL** (also called SIGKILL) which has the number 9.
The **default** signal is the TERM signal.

Signals :

The **TERM** signal tries to terminate signals **cleanly** and may be **blocked** by processes such as shells. **this signal can be blocked, handled, and ignored. It is the normal way to politely ask a program to terminate.**
The **HUP** signal is used to **restart** a process to have it upload any changes in its configuration files.

The **KILL** signal is used to kill a process **uncleanly** and **cannot be blocked**.
Let us try the **TERM** and **KILL** signals:

- Run the command we created in the beginning of this lab (**forever**) in the **background** and note the process id number given (let us assume it is **1234**). Check to see that the process is running in the background (use the **jobs** command).

Signals :

Try the following command:
kill 1234 (use the number shown for your process)
Now recheck if the process is running with the **jobs** command. What did you find?

Now repeat the same steps (i.e. create the **forever** job in the background and check its PID (we are assuming its 1234, but it could be anything)).

For **each time** you create the **forever** job try killing it with one of the following
commands:

kill -15 1234 (specify the correct PID, we are assuming it
kill -TERM 1234
kill -SIGTERM 1234
What did you notice about each of the three commands above?
_____.

EXAMPLES

kill -9 -1
Kill all processes you can kill.

kill -l
List the available signal choices

kill 123 543 2341 3453
Send the default signal, SIGTERM, to all those processes.

```
$ Kill -L
1) SIGHUP       2) SIGINT       3) SIGQUIT      4) SIGILL       5) SIGTRAP
 6) SIGABRT      7) SIGBUS       8) SIGFPE       9) SIGKILL     10) SIGUSR1
11) SIGSEGV     12) SIGUSR2     13) SIGPIPE     14) SIGALRM     15)
SIGTERM
16) SIGSTKFLT   17) SIGCHLD     18) SIGCONT     19) SIGSTOP     20)
SIGTSTP
21) SIGTTIN     22) SIGTTOU     23) SIGURG      24) SIGXCPU     25) SIGXFSZ
26) SIGVTALRM   27) SIGPROF     28) SIGWINCH    29) SIGIO       30)
SIGPWR
31) SIGSYS      34) SIGRTMIN    35) SIGRTMIN+1  36) SIGRTMIN+2  37)
SIGRTMIN+3
38) SIGRTMIN+4  39) SIGRTMIN+5  40) SIGRTMIN+6  41) SIGRTMIN+7  42)
SIGRTMIN+8
43) SIGRTMIN+9  44) SIGRTMIN+10 45) SIGRTMIN+11 46) SIGRTMIN+12
47) SIGRTMIN+13
48) SIGRTMIN+14 49) SIGRTMIN+15 50) SIGRTMAX-14 51) SIGRTMAX-13
52) SIGRTMAX-12
53) SIGRTMAX-11 54) SIGRTMAX-10 55) SIGRTMAX-9  56) SIGRTMAX-8  57)
SIGRTMAX-7
58) SIGRTMAX-6  59) SIGRTMAX-5  60) SIGRTMAX-4  61) SIGRTMAX-3  62)
SIGRTMAX-2
63) SIGRTMAX-1  64) SIGRTMAX
```


Signals :

Open two terminals (if you are using telnet then open two telnet connections)
Use the ***ps*** command to determine the process id number of the terminal you are not using, as follows:

ps –f
What is the pid number for the bash process running on the pts number different from the pts number that your ps –f process is running. That is the pid you need. Now try running the following command:
kill pidbash (or kill -15 pidbash) (i.e kill -15 2890)
What happened? Why?

_____
_____.
Now try the following kill command:

Kill -9 pidofbash (-9 is equivalent to –KILL or -SIGKILL)
Now what happened?

_____.

Thank You for attention !

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