

Simple Shell (Multiprocessing)

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Problem Statement:

Implement a Unix shell program with the following commands:

1. exit
2. Commands with no arguments: ls, cp, rm, ..etc
3. Commands with arguments: ls -a -l -h
4. Background commands
5. Shell builtin commands: cd, echo
6. Expression evaluation: export

Code Organization & Main Functions:

1. set_up_environment(): open log file and initialize signal connection to be called on child exit and prevent zombie processes.
2. parse_input() : takes user input and splits it at the space to the command and arguments.
3. shell(): forks a child process using fork(), executes the command using execvp() and directs the parent process to wait on the child

process using `waitpid()` till it executes successfully if it's a foreground process.

Sample Runs:

1. Basic commands:

```
yara@yara:~ ls
logFile.txt  shell  shell.c  tempCodeRunnerFile.c  test  test2  test3

yara@yara:~ mkdir yara

yara@yara:~ ls
logFile.txt  shell  shell.c  tempCodeRunnerFile.c  test  test2  test3  yara
```

2. Evaluating expressions:

```
yara@yara:~ export x=-l

yara@yara:~ ls $x
total 48
-rw-rw-r-- 1 yara yara  520 Mar 24 05:16 logFile.txt
-rwxrwxr-x 1 yara yara 13824 Mar 24 05:15 shell
-rw-rw-r-- 1 yara yara  4297 Mar 24 05:14 shell.c
-rw-rw-r-- 1 yara yara    6 Mar 24 04:12 tempCodeRunnerFile.c
drwxrwxr-x 2 yara yara  4096 Mar 24 01:13 test
drwxrwxr-x 2 yara yara  4096 Mar 24 01:14 test2
drwxrwxr-x 2 yara yara  4096 Mar 24 01:15 test3
drwxrwxr-x 2 yara yara  4096 Mar 24 05:15 yara
```

3.

```
yara@yara:~ export y="Hello World"

yara@yara:~ echo $y

Hello World
yara@yara:~ hello

Execution failed.
yara@yara:~
```

4.

```
yara@yara:~ export q="-a -l -h"

yara@yara:~ ls $q
total 56K
drwxrwxr-x 6 yara yara 4.0K Mar 24 05:15 .
drwxrwxr-x 3 yara yara 4.0K Mar 24 00:33 ..
-rw-rw-r-- 1 yara yara 572 Mar 24 05:19 logFile.txt
-rwxrwxr-x 1 yara yara 14K Mar 24 05:15 shell
-rw-rw-r-- 1 yara yara 4.2K Mar 24 05:14 shell.c
-rw-rw-r-- 1 yara yara 6 Mar 24 04:12 tempCodeRunnerFile.c
drwxrwxr-x 2 yara yara 4.0K Mar 24 01:13 test
drwxrwxr-x 2 yara yara 4.0K Mar 24 01:14 test2
drwxrwxr-x 2 yara yara 4.0K Mar 24 01:15 test3
drwxrwxr-x 2 yara yara 4.0K Mar 24 05:15 yara

yara@yara:~
```

5. Basic command to make a copy of a file then remove it:

```
yara@yara:~ cp logFile.txt a.txt

yara@yara:~ ls
a.txt logFile.txt shell shell.c tempCodeRunnerFile.c test test2 test3 yara

yara@yara:~ rm a.txt

yara@yara:~ ls
logFile.txt shell shell.c tempCodeRunnerFile.c test test2 test3 yara

yara@yara:~ exit
yara@yara:~/Desktop/boo/Shell$
```

6. Opening firefox in the foreground:

```
yara@yara:~ firefox
ls
mkdir os
█
```

7. Closing firefox and the commands get executed by then:

```
yara@yara:~ firefox
ls
mkdir os

yara@yara:~ logFile.txt shell shell.c tempCodeRunnerFile.c test test2 test3 yar

yara@yara:~
yara@yara:~ ls
logFile.txt os shell shell.c tempCodeRunnerFile.c test test2 test3 yara

yara@yara:~ █
```

8. Opening firefox in the background with the commands executing normally:

```
cd "/home/yara/Desktop/boo/Shell/" && gcc shell.c -o shell &&
yara@yara:~/Desktop/boo$ cd "/home/yara/Desktop/boo/Shell/" &
yara@yara:~$ firefox &
yara@yara:~$ ls
logFile.txt  os  shell  shell.c  tempCodeRunnerFile.c  test
yara@yara:~$ ls -a -l -h
total 60K
drwxrwxr-x 7 yara yara 4.0K Mar 24 05:37 .
drwxrwxr-x 3 yara yara 4.0K Mar 24 00:33 ..
-rw-rw-r-- 1 yara yara 988 Mar 24 05:37 logFile.txt
drwxrwxr-x 2 yara yara 4.0K Mar 24 05:34 os
-rwxrwxr-x 1 yara yara 14K Mar 24 05:37 shell
-rw-rw-r-- 1 yara yara 4.2K Mar 24 05:22 shell.c
-rw-rw-r-- 1 yara yara 6 Mar 24 04:12 tempCodeRunnerFile.c
drwxrwxr-x 2 yara yara 4.0K Mar 24 01:13 test
drwxrwxr-x 2 yara yara 4.0K Mar 24 01:14 test2
drwxrwxr-x 2 yara yara 4.0K Mar 24 01:15 test3
drwxrwxr-x 2 yara yara 4.0K Mar 24 05:15 yara
yara@yara:~$
```

Screenshots of the System Monitor during execution:

Open firefox in the foreground:

The screenshot shows the System Monitor application with the 'Processes' tab selected. A search bar at the top contains the text 'firefox'. The process list shows a hierarchy starting with 'code --no-sandbox --force-use', which includes a 'code' process, which in turn includes a 'bash' process, which includes a 'shell' process, which finally includes the 'firefox' process. The 'firefox' process is highlighted, showing its details: User: yara, % CPU: 0.00, ID: 10896, Memory: 114.6 MB, and Disk read to: N/A. Below the 'firefox' process, several sub-processes are listed, including 'MainThread', 'Privileged Cont', 'Socket Process', 'Web Content', and 'WebExtensions'.

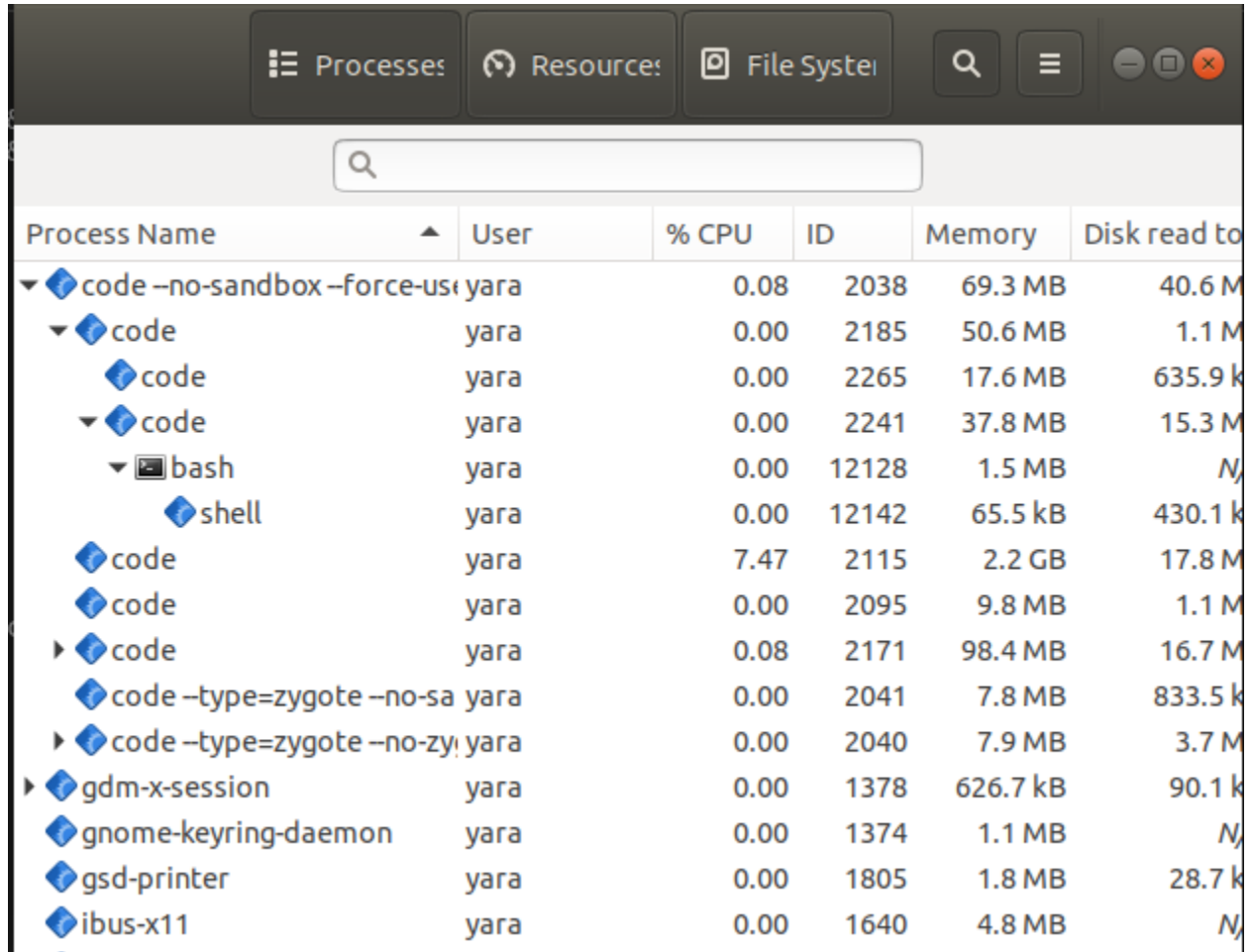
Process Name	User	% CPU	ID	Memory	Disk read to
code --no-sandbox --force-use	yara	0.25	2038	68.6 MB	40.6 M
code	yara	0.00	2185	50.3 MB	1.1 M
code	yara	0.00	2241	37.9 MB	15.3 M
bash	yara	0.00	10865	1.5 MB	N/A
shell	yara	0.00	10879	65.5 kB	N/A
firefox	yara	0.00	10896	114.6 MB	N/A
MainThread	yara	0.00	11129	10.7 MB	N/A
Privileged Cont	yara	0.00	10983	26.9 MB	N/A
Socket Process	yara	0.00	10956	7.5 MB	N/A
Web Content	yara	0.00	11114	10.8 MB	N/A
Web Content	yara	0.00	11105	10.7 MB	N/A
WebExtensions	yara	0.00	11025	19.2 MB	N/A

Open firefox in the background:

The screenshot shows the System Monitor application with the 'Processes' tab selected. A search bar at the top is empty. The process list shows a hierarchy starting with 'code --no-sandbox --force-use', which includes a 'code' process, which includes a 'bash' process, which includes a 'shell' process, which finally includes the 'firefox' process. The 'firefox' process is highlighted, showing its details: User: yara, % CPU: 0.08, ID: 12160, Memory: 115.3 MB, and Disk read to: N/A. Below the 'firefox' process, several sub-processes are listed, including 'Privileged Cont', 'Socket Process', 'Web Content', and 'WebExtensions'. Additionally, there are other 'code' processes listed at the bottom of the list.

Process Name	User	% CPU	ID	Memory	Disk read to
code --no-sandbox --force-use	yara	0.08	2038	69.3 MB	40.6 M
code	yara	0.17	2185	50.4 MB	1.1 M
code	yara	0.00	2265	17.6 MB	635.9 k
code	yara	0.00	2241	37.8 MB	15.3 M
bash	yara	0.00	12128	1.5 MB	N/A
shell	yara	0.00	12142	65.5 kB	N/A
firefox	yara	0.08	12160	115.3 MB	N/A
Privileged Cont	yara	0.00	12251	27.5 MB	N/A
Socket Process	yara	0.00	12217	7.5 MB	N/A
Web Content	yara	0.00	12381	10.5 MB	N/A
Web Content	yara	0.00	12384	10.5 MB	N/A
Web Content	yara	0.00	12390	10.5 MB	N/A
WebExtensions	yara	0.00	12297	20.2 MB	N/A
code	yara	4.36	2115	2.2 GB	17.8 M
code	yara	0.00	2095	9.8 MB	1.1 M

When exiting firefox:



Process Name	User	% CPU	ID	Memory	Disk read to
code --no-sandbox --force-use	yara	0.08	2038	69.3 MB	40.6 M
code	yara	0.00	2185	50.6 MB	1.1 M
code	yara	0.00	2265	17.6 MB	635.9 k
code	yara	0.00	2241	37.8 MB	15.3 M
bash	yara	0.00	12128	1.5 MB	N/
shell	yara	0.00	12142	65.5 kB	430.1 k
code	yara	7.47	2115	2.2 GB	17.8 M
code	yara	0.00	2095	9.8 MB	1.1 M
code	yara	0.08	2171	98.4 MB	16.7 M
code --type=zygote --no-sa	yara	0.00	2041	7.8 MB	833.5 k
code --type=zygote --no-zy	yara	0.00	2040	7.9 MB	3.7 M
gdm-x-session	yara	0.00	1378	626.7 kB	90.1 k
gnome-keyring-daemon	yara	0.00	1374	1.1 MB	N/
gsd-printer	yara	0.00	1805	1.8 MB	28.7 k
ibus-x11	yara	0.00	1640	4.8 MB	N/