

Programming Assignment #1 – A Simple Shell

Introduction to Operating Systems

Prof. Li-Pin Chang

A Simple Shell

- Control flow of your simple shell:
 - Display the prompt sign “>” and take a string from user
 - Parse the string into a program name and arguments
 - Fork a child process
 - Have the child process execute the program
 - Wait until the child terminates
 - Go to the first step

Example Output

```
justin@justin-virtual-machine:~/Desktop/SimpleShell$ ls
a.out shell.c shell.o simpleshell.c simpleshell.o trace
justin@justin-virtual-machine:~/Desktop/SimpleShell$ ./a.out
>ls
a.out shell.c shell.o simpleshell.c simpleshell.o trace
>/bin/ls
a.out shell.c shell.o simpleshell.c simpleshell.o trace
>which ls
/bin/ls
>rm shell.o
>ls
a.out shell.c simpleshell.c simpleshell.o trace
>
```

Important System Calls

- `fork()`
 - Create a child process
 - <http://man7.org/linux/man-pages/man2/fork.2.html>
- `exec()` family
 - Have the current process execute the program specified in the pathname
 - <http://man7.org/linux/man-pages/man3/exec.3.html>
- `wait()` family
 - `wait()` wait the termination of anyone of the child processes
 - `waitpid()` waits the termination of the specified child process
 - <http://man7.org/linux/man-pages/man2/waitpid.2.html>

Waiting on child processes

- If a command is ended with “&”, then the shell will not be blocked on a child process
- For example:
 - sleep 10s
 - The prompt re-appears after 10 seconds
 - sleep 10s &
 - The prompt re-appears immediately
- A child process becomes a zombie if it is not waited by its parent process
 - How to deal with this problem?

Test Cases

- Your shell must correctly handle test cases of the following format
 - `<program> <arg1> <arg2> <...>`
- Test cases are like the following, but not limited to:
 - `clear`
 - `ls -l`
 - `cp a.txt b.txt`
 - `cat c.txt &`
- Do not leave zombie processes in the system!
 - Before or after your shell terminate
- You got zero point if you use `system()` !

Bonus!

- I/O redirection (+10 pts)
 - `ls -l > a.txt`
- Pipe (+10 pts)
 - `ls | more`
- **No** multiple or combined redirections
 - `a | b | c`
 - `a < b > c`
 - `a | b > c`
 - ...

Facebook Group

- Ask question and discuss here
- 『2018F 交大資工作業系統概論』

Testing OS Environment

- Ubuntu 16.04, Ubuntu 14.04 or CS linux work station
 - Your code should compile successfully in one of the above environments