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# Assignment 3 – SimpleShell

**Description**:
This assignment is to implement a simple shell that runs on top of the regular command-line interpreter for Linux. The simple shell should read lines of user input, then parse and execute the commands by forking/creating new processes. If the simple shell encounters an error while reading a line of input it should report the error and exit.
Also, the simple shell must support piping. The pipe character | separates different commands and the output (stdout) of the program on the left becomes the input (stdin) for the program on the right.

**Approach**:
Step1) User input (just one command per line not pipelining)

1. In infinite while loop, print the shell prompt
2. By using fgets, get a line that size is smaller than BUFFER_SIZE(177)
    a. If meeting End of File, print “End of input” and turn off the simple shell and go back to the bash shell.
    b. If failing to fgets, print “Error: fgets” and exit program.
    c. If the line is empty, print error and reprint prompt(“Prompt>” )
    d. if the line is “exit”, turn off the simple shell and go back to the bash shell.
3. Parse input
    a. By using strtok, parsing line based on “ “ or “\t” or \n” or “\t”
    b. If the first parsed token is empty, print Empty error and turn off the simple shell and go back to the bash shell.
    c. If the parsed token is NULL, stop parsing. (last token)
    d. Add Null as the last token.
4. Fork and Execute command
    a. If p_id is -1, print fork error.
    b. If p_id is 0, it means the process is a child process, so by using execvp, execute the command.
    c. If not, it means the process is a parent process, so by using waitpid, wait the end of their child process and print child’s pid and return status.

Step2) Pipelining

1. Parse input based on “|”.
    a. By using strtok, seperate commands and store them in an array of files.
    b. And then, by looping files array, parse commands to arguments like Step1.
2. Create pipes
    a. Create pipes array that size is pipes[number of file][2].
    b. If failing to create a pipe, return error and exit the program.
3. Fork and Execute pipe
    a. If p_id is -1, print fork error.
    b. If p_id is 0, it means the process is child process

i. If the first command line, just duplicate STDOUT_FILEEND in pipes[0][WRITEEND] and close pipes.
ii. If the last command line, just duplicate STDIN_FILEEND in pipes[i-1][READEND] and close pipes.
iii. If middle command line
    1. duplicate STDIN_FILEEND in pipes[i-1][READEND]
    2. duplicate STDOUT_FILEEND in pipes[i][WRITEEND]
    3. and close pipes.
iv. Then, execute command
    1. If fail to execute, print error and exit program.

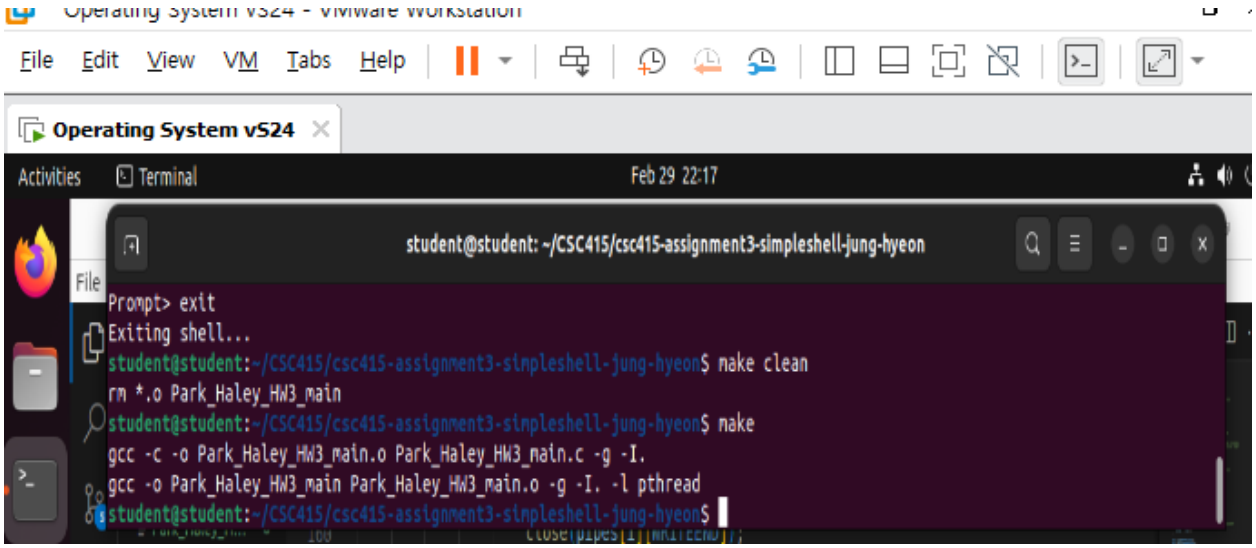
c. Close all pipes in parent process
    i. Close all pipes.
    ii. Wait at the end of the child process and print their pid and status.

**Issues and Resolutions:**

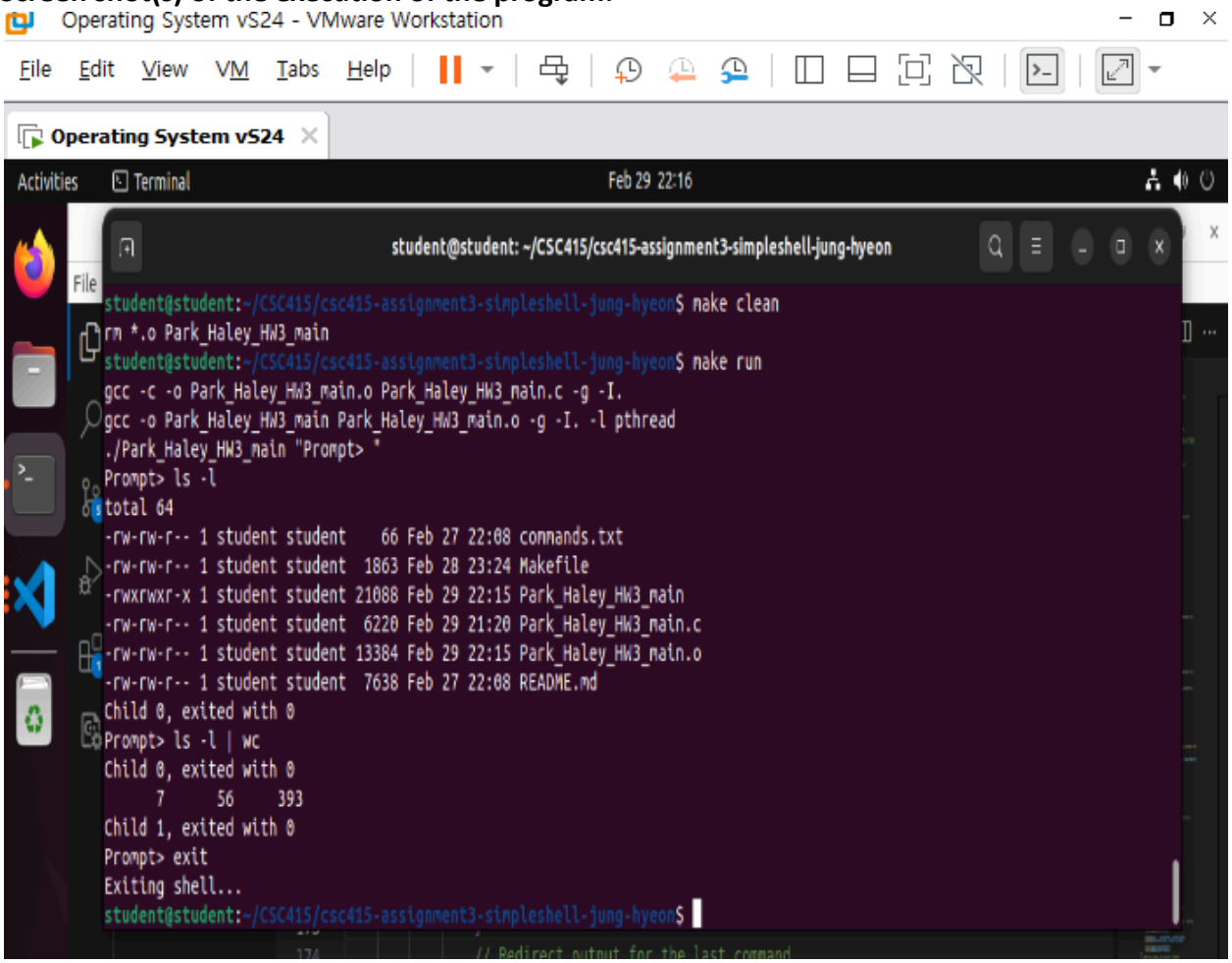
1. Parsing Issue (using strtok)
    a. When I parsed pipe command lines, I used double for loop.
    b. But After I parse arguments in one command line, I cannot find/approach the next command line.
    c. Because, After using strtok(files[count], " \t\n"); like that, I cannot find strtok(NULL, "|"); .
    d. So, I made another array to store command lines.
        i. First, I parsed command lines based on “|”.
        ii. Secont, I parsed arguments based on " \t\n" per one command line.
2. Connecting pipes issue
    a. At first, I just connected STDIN_FILENO to the pipe's READEND and STDOUT_FILENO to the pipe's WRITEEND.
    b. But, It didn’t work.
    c. So, I separate the case (1. first command 2. middle command 3. last command).
3. Pipe closing issue
    a. At first, I didn’t close the pipe. My shell didn’t notice the End of Input.
    b. So, I closed all of the pipes that are not being used.

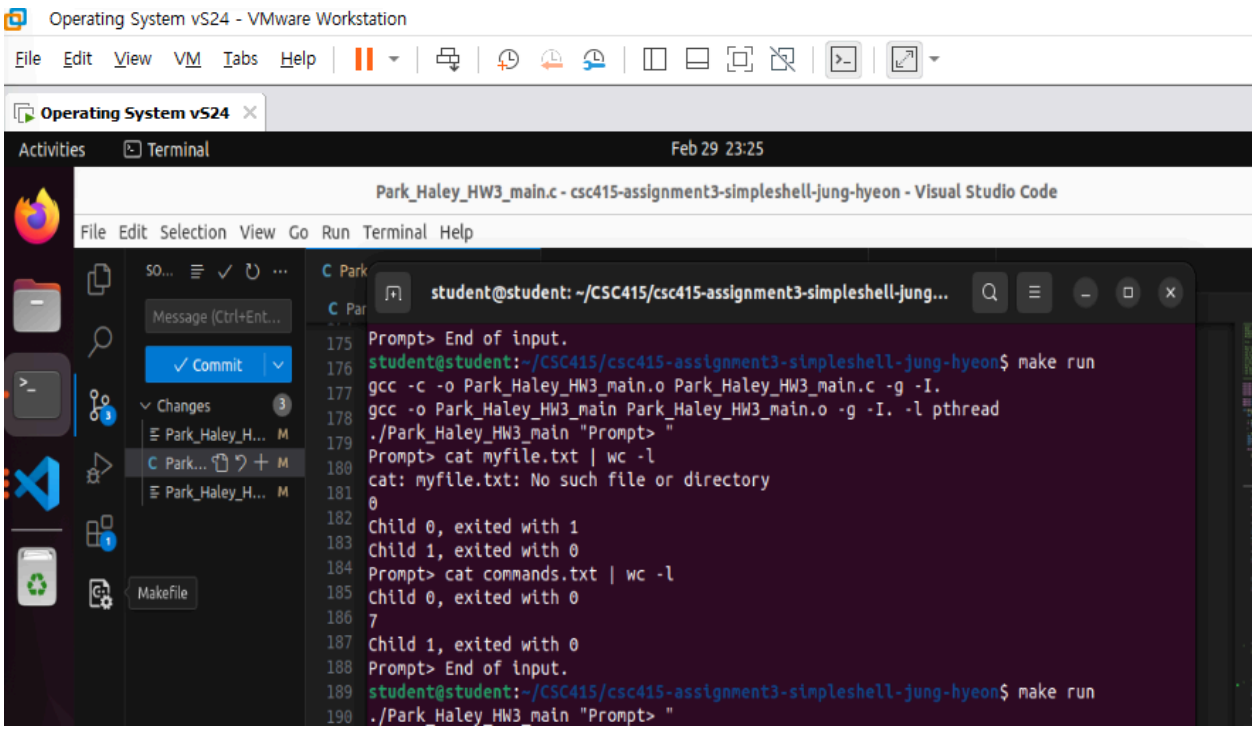
**Analysis**: (If required for the assignment)

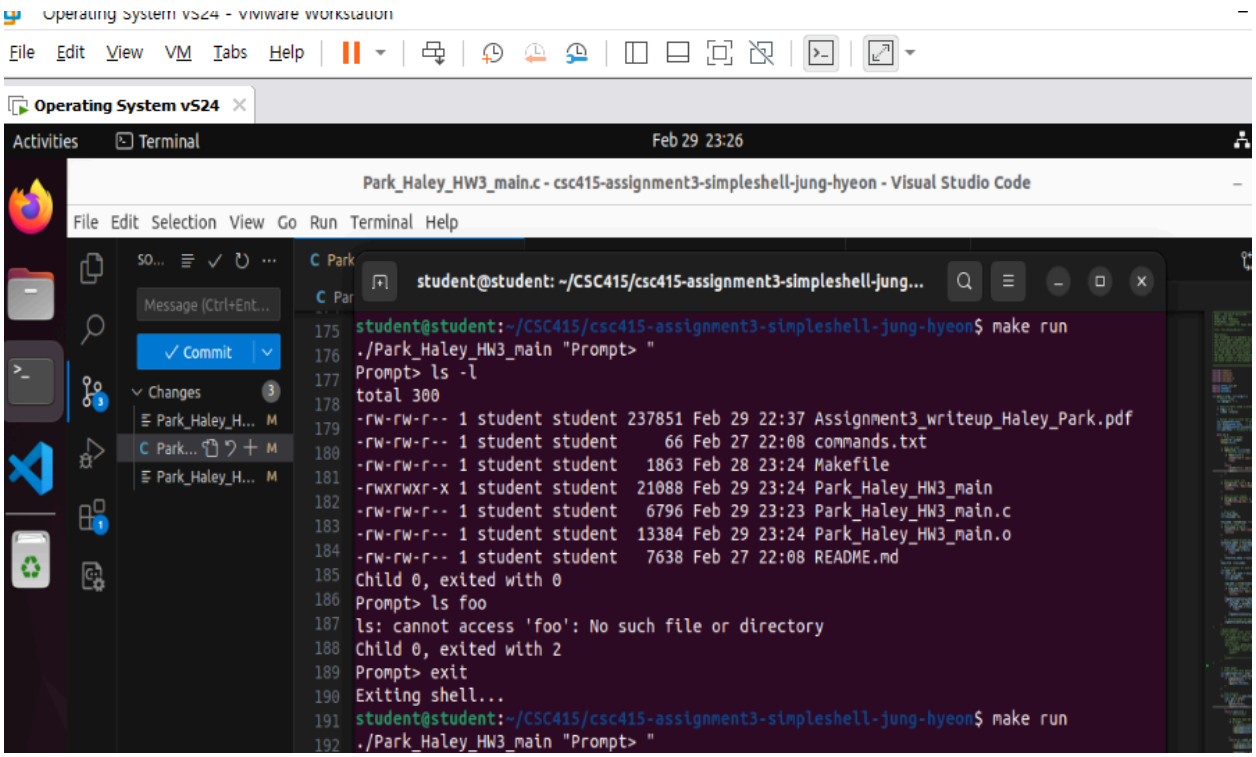
**Screen shot of compilation:**

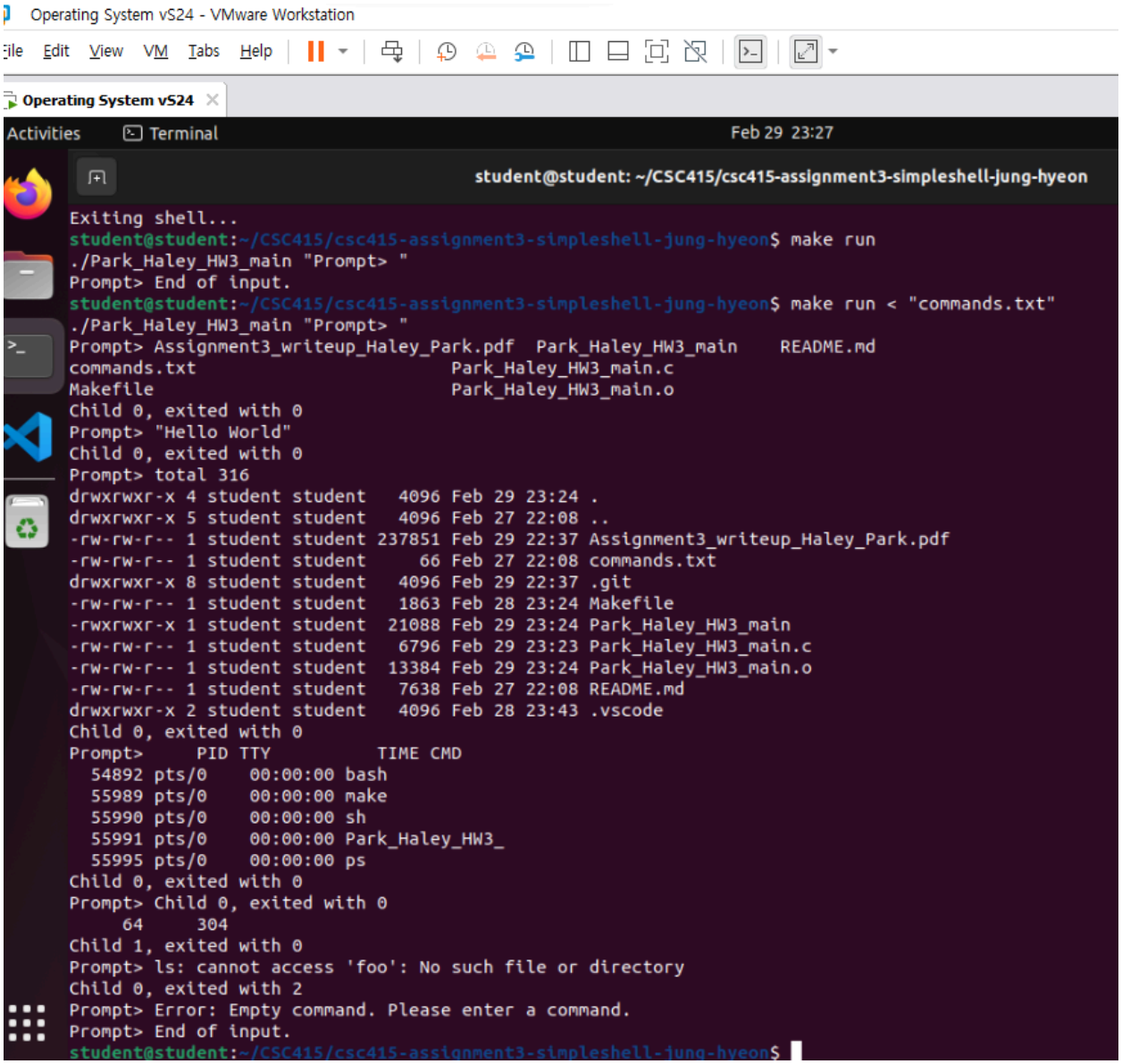



**Screen shot(s) of the execution of the program:**




Operating System vS24 - VMware Workstation
File Edit View VM Tabs Help
Operating System vS24
Activities
Terminal
Feb 29 23:25
Park_Haley_HW3_main.c - csc415-assignment3-simpleshell-jung-hyeon - Visual Studio Code
File Edit Selection View Go Run Terminal Help
student@student: ~/CSC415/csc415-assignment3-simpleshell-jung...
Prompt> End of input.
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$ make run
gcc -c -o Park_Haley_HW3_main.o Park_Haley_HW3_main.c -g -I.
gcc -o Park_Haley_HW3_main Park_Haley_HW3_main.o -g -I. -l pthread
./Park_Haley_HW3_main "Prompt> "
Prompt> cat myfile.txt | wc -l
cat: myfile.txt: No such file or directory
0
Child 0, exited with 1
Child 1, exited with 0
Prompt> cat commands.txt | wc -l
Child 0, exited with 0
7
Child 1, exited with 0
Prompt> End of input.
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$ make run
./Park_Haley_HW3_main "Prompt> "
Commit
Changes
Park_Haley_H... M
Park... M
Park_Haley_H... M
Makefile


File Edit View VM Tabs Help
Operating System vS24
Activities
Terminal
Feb 29 23:26
Park_Haley_HW3_main.c - csc415-assignment3-simpleshell-jung-hyeon - Visual Studio Code
File Edit Selection View Go Run Terminal Help
student@student: ~/CSC415/csc415-assignment3-simpleshell-jung...
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$ make run
./Park_Haley_HW3_main "Prompt> "
Prompt> ls -l
total 300
-rw-rw-r-- 1 student student 237851 Feb 29 22:37 Assignment3_writeup_Haley_Park.pdf
-rw-rw-r-- 1 student student     66 Feb 27 22:08 commands.txt
-rw-rw-r-- 1 student student   1863 Feb 28 23:24 Makefile
-rwxrwxr-x 1 student student  21088 Feb 29 23:24 Park_Haley_HW3_main
-rw-rw-r-- 1 student student   6796 Feb 29 23:23 Park_Haley_HW3_main.c
-rw-rw-r-- 1 student student  13384 Feb 29 23:24 Park_Haley_HW3_main.o
-rw-rw-r-- 1 student student   7638 Feb 27 22:08 README.md
Child 0, exited with 0
Prompt> ls foo
ls: cannot access 'foo': No such file or directory
Child 0, exited with 2
Prompt> exit
Exiting shell...
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$ make run
./Park_Haley_HW3_main "Prompt> "
Commit
Changes
Park_Haley_H... M
Park... M
Park_Haley_H... M


Operating System vS24 - VMware Workstation
File Edit View VM Tabs Help
Operating System vS24
Activities
Terminal
Feb 29 23:27
student@student: ~/CSC415/csc415-assignment3-simpleshell-jung-hyeon
Exiting shell...
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$ make run
./Park_Haley_HW3_main "Prompt> "
Prompt> End of input.
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$ make run < "commands.txt"
./Park_Haley_HW3_main "Prompt> "
Prompt> Assignment3_writeup_Haley_Park.pdf Park_Haley_HW3_main README.md
commands.txt Park_Haley_HW3_main.c
Makefile Park_Haley_HW3_main.o
Child 0, exited with 0
Prompt> "Hello World"
Child 0, exited with 0
Prompt> total 316
drwxrwxr-x 4 student student 4096 Feb 29 23:24 .
drwxrwxr-x 5 student student 4096 Feb 27 22:08 ..
-rw-rw-r-- 1 student student 237851 Feb 29 22:37 Assignment3_writeup_Haley_Park.pdf
-rw-rw-r-- 1 student student 66 Feb 27 22:08 commands.txt
drwxrwxr-x 8 student student 4096 Feb 29 22:37 .git
-rw-rw-r-- 1 student student 1863 Feb 28 23:24 Makefile
-rwxrwxr-x 1 student student 21088 Feb 29 23:24 Park_Haley_HW3_main
-rw-rw-r-- 1 student student 6796 Feb 29 23:23 Park_Haley_HW3_main.c
-rw-rw-r-- 1 student student 13384 Feb 29 23:24 Park_Haley_HW3_main.o
-rw-rw-r-- 1 student student 7638 Feb 27 22:08 README.md
drwxrwxr-x 2 student student 4096 Feb 28 23:43 .vscode
Child 0, exited with 0
Prompt> PID TTY TIME CMD
54892 pts/0 00:00:00 bash
55989 pts/0 00:00:00 make
55990 pts/0 00:00:00 sh
55991 pts/0 00:00:00 Park_Haley_HW3_
55995 pts/0 00:00:00 ps
Child 0, exited with 0
Prompt> Child 0, exited with 0
64 304
Child 1, exited with 0
Prompt> ls: cannot access 'foo': No such file or directory
Child 0, exited with 2
Prompt> Error: Empty command. Please enter a command.
Prompt> End of input.
student@student:~/CSC415/csc415-assignment3-simpleshell-jung-hyeon$