FACULTY OF ENGINEERING
COMPUTER ENGINEERING
DEPARTMENT

CSE3033
OPERATING SYSTEMS
Report of Programming Assignment #2

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The objective of this assignment is to develop a simple shell program that can execute commands, handle foreground and background processes, support internal commands, and manage I/O redirection.
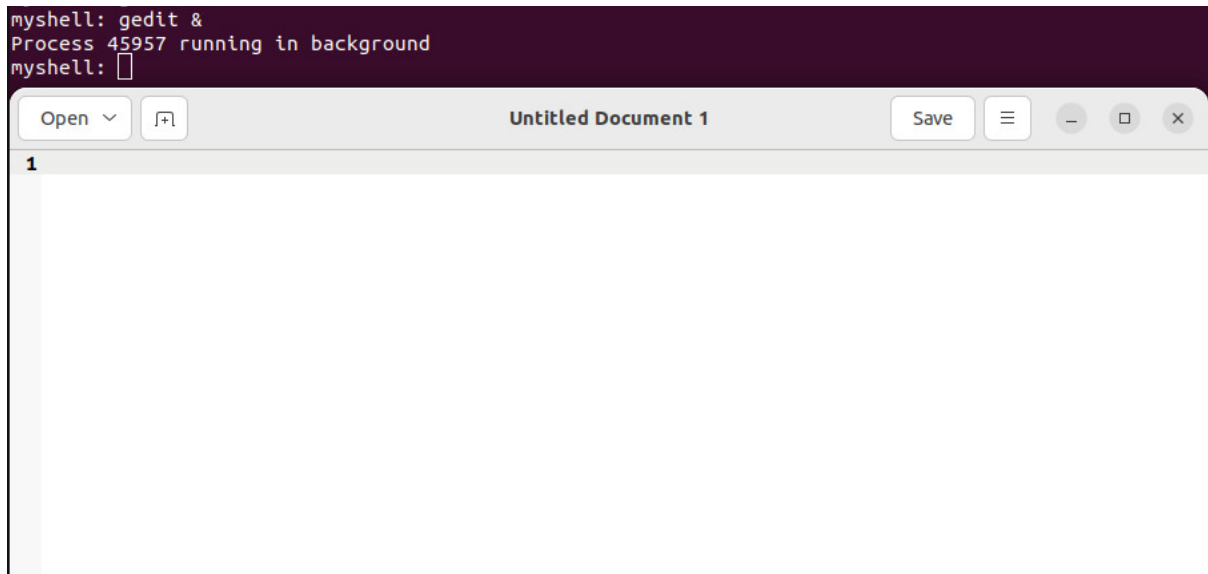
A) New Process

Shell implementation support both background and foreground process executions. Down below, there is some screenshots of part A test cases.

Foreground Application:
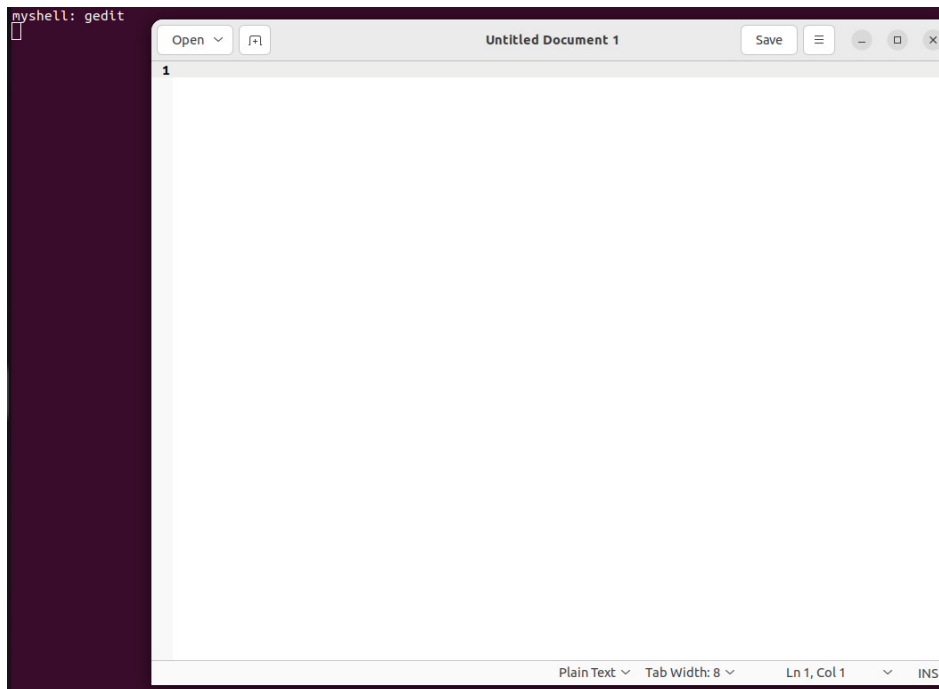
Background Application:

B)Built-in Functions

Our Shell implementation also support internal (built-in) commands. Down below you can see explanations and some screenshots to explain how these functions work.

history: Displays the last 10 commands executed.

history -i num: Executes the command at the specified index in the history.

^Z: Terminates the currently running foreground process and its descendants.

fg %num: Moves the background process with the specified process ID to the foreground.

exit: Terminates the shell. If there are background processes running, the shell notifies the user and does not terminate until all background processes are terminated.

History Display and Execute from History :

```
myshell: history
0. ls /bin
1. ps
2. ls
3. ls -l
4. who
5. ps -a
6. chmod 777 a.txt
7. ls | wc
8. ps -ef
9. ps
myshell: history -i 9
    PID TTY          TIME CMD
  45833 pts/3    00:00:00 bash
  46989 pts/3    00:00:00 a.out
  47309 pts/3    00:00:00 ps
myshell: history
0. ls /bin
1. ps
2. ls
3. ls -l
4. who
5. ps -a
6. chmod 777 a.txt
7. ls | wc
8. ps -ef
9. ps
myshell: 
```

Control Z:

```
myshell: sleep 20
^Z
Caught SIGTSTP (Ctrl+Z). Terminating foreground process 64987 and its descendants.
```

fg %num (Move Foreground):

```
myshell: sleep 25 &
Process 48575 running in background
myshell: fg %48575
myshell: 
```

Exit:

```
myshell: sleep 5 &
Process 48708 running in background
myshell: exit
There are still background process that are still running!
myshell: exit
yegezici@yegezici-OMEN-by-HP-Laptop-16-b0xxx:~/Desktop/OSProject2$ 
```

C)I/O Redirection

Our Shell support I/O Redirection standart input, standart output and both standart input and output. Down below some screenshots to explain how these redirections work.

Standard Output Redirection (> and >>):

```
myshell: ls -l > file.out
myshell: cat file.out
total 112
-rwxrwxr-x 1 yegezici yegezici 25912 Dec 16 11:40 a.out
-rwxrwxrwx 1 yegezici yegezici    54 Dec 15 16:57 a.txt
-rw-r--r-- 1 yegezici yegezici     6 Dec 15 19:18 b.txt
-rw-r--r-- 1 yegezici yegezici     0 Dec 16 11:41 file.out
-rw-rw-r-- 1 yegezici yegezici  8209 Dec 14 19:07 io.c
-rw-rw-r-- 1 yegezici yegezici   583 Dec 15 22:07 lsOutput.txt
-rw-rw-r-- 1 yegezici yegezici  3485 Dec 15 21:24 main.c
-rwxrwxr-x 1 yegezici yegezici 34616 Dec 15 21:58 mainSetup
-rw-rw-r-- 1 yegezici yegezici 19805 Dec 15 21:57 mainSetup.c
myshell: ls >> file.out
myshell: cat file.out
total 112
-rwxrwxr-x 1 yegezici yegezici 25912 Dec 16 11:40 a.out
-rwxrwxrwx 1 yegezici yegezici    54 Dec 15 16:57 a.txt
-rw-r--r-- 1 yegezici yegezici     6 Dec 15 19:18 b.txt
-rw-r--r-- 1 yegezici yegezici     0 Dec 16 11:41 file.out
-rw-rw-r-- 1 yegezici yegezici  8209 Dec 14 19:07 io.c
-rw-rw-r-- 1 yegezici yegezici   583 Dec 15 22:07 lsOutput.txt
-rw-rw-r-- 1 yegezici yegezici  3485 Dec 15 21:24 main.c
-rwxrwxr-x 1 yegezici yegezici 34616 Dec 15 21:58 mainSetup
-rw-rw-r-- 1 yegezici yegezici 19805 Dec 15 21:57 mainSetup.c
a.out
a.txt
b.txt
file.out
io.c
lsOutput.txt
main.c
mainSetup
mainSetup.c
myshell:
```

Standard Input Redirection (<):

```
myshell: sort < file.out
a.out
a.txt
b.txt
file.out
io.c
lsOutput.txt
main.c
mainSetup
mainSetup.c
-rw-r--r-- 1 yegezici yegezici     0 Dec 16 11:41 file.out
-rw-r--r-- 1 yegezici yegezici     6 Dec 15 19:18 b.txt
-rw-rw-r-- 1 yegezici yegezici 19805 Dec 15 21:57 mainSetup.c
-rw-rw-r-- 1 yegezici yegezici  3485 Dec 15 21:24 main.c
-rw-rw-r-- 1 yegezici yegezici   583 Dec 15 22:07 lsOutput.txt
-rw-rw-r-- 1 yegezici yegezici  8209 Dec 14 19:07 io.c
-rwxrwxrwx 1 yegezici yegezici    54 Dec 15 16:57 a.txt
-rwxrwxr-x 1 yegezici yegezici 25912 Dec 16 11:40 a.out
-rwxrwxr-x 1 yegezici yegezici 34616 Dec 15 21:58 mainSetup
total 112
myshell:
```

Standard Error Redirection (2>):

```
myshell: ls x 2> errorMessage.txt
myshell: cat errorMessage.txt
ls: cannot access 'x': No such file or directory
myshell:
```

Combined Standart Input and Standart Output Redirection:

```
myshell: ps -l > input.txt
myshell: cat input.txt
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN   TTY           TIME CMD
0 S   1000   65395   65377 0  80   0 -   3585 do_wai pts/2      00:00:00 bash
0 S   1000   65417   65395 0  80   0 -    696 do_wai pts/2      00:00:00 yyk
4 R   1000   65466   65417 0  80   0 -   3935 -      pts/2      00:00:00 ps
myshell: sort < input.txt > output.txt
myshell: cat output.txt
0 S   1000   65395   65377 0  80   0 -   3585 do_wai pts/2      00:00:00 bash
0 S   1000   65417   65395 0  80   0 -    696 do_wai pts/2      00:00:00 yyk
4 R   1000   65466   65417 0  80   0 -   3935 -      pts/2      00:00:00 ps
F S   UID     PID    PPID  C PRI  NI ADDR SZ WCHAN   TTY           TIME CMD
myshell:
```