



## Computer & Systems Engineering Department

Operating Systems

### Lab 1 : Simple Shell

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#### Description and organization of the code:

- In the **main function** where our program starts execution from I set a signal handler (`on_child_exit`) for the “SIGCHLD” signal as when the child terminates it sends a signal to its parent and if the parent didn't handle this signal the child process will be zombie and will remain in the process table (which is a bad use of our resources) so when the parent receives the signal the “`on_child_exit`” function is called which reap the zombie process and clear process table from it.

```
1 int main()
2 {
3     signal(SIGCHLD, on_child_exit); // register child signal
4     setup_environment();
5     shell();
6     return 0;
7 }
```

- **on\_child\_exit** function: which is used to reap zombie processes and log to the file that the child process's been terminated.

```

1 void on_child_exit()
2 {
3     int wstat;
4     pid_t pid;
5
6     // function to reap zombie to clear process table from zombies
7     while (1)
8     {
9         pid = wait3(&wstat, WNOHANG, (struct rusage *)NULL);
10        if (pid == 0 || pid == -1)
11            break;
12    }
13    // log here
14    logfile = fopen("logfile.txt", "a");
15    fprintf(logfile, "Child process was terminated\n");
16    fclose(logfile);
17 }

```

this function works by calling wait3 system call with “WNOHAND” flag which tells it to terminate immediately if there are no child process to reap and if there is a child process to reap it returns the process ID of the child and fills the wstat with info about the child exit status. if wait3 returns 0 this means that there is no other processes to reap so the we break the loop and log to the file.

- after setting a the signal handler I called the **setup\_environment** function which sets the current user directory when opening my simple shell program in the first time to a default path and I chose the home path as the default path.

```

1 void setup_environment()
2 {
3     // setup my default directory to home
4     char *default_directory = getenv("HOME");
5     chdir(default_directory);
6 }

```

- then I called the **shell** function which contains the execution of the user shell commands:

```

1 void shell()
2 {
3     char input[max_command_length];
4     char *arguments[max_arguments];
5     while (1)
6     {
7         char cwd[1024]; // buffer to hold the current working directory
8         if (getcwd(cwd, sizeof(cwd)) != NULL)
9         {
10             printf("\033[1;31m%s:~$ \033[0m", cwd);
11         }
12         else
13         {
14             printf("\033[1;31m:~$ \033[0m");
15         }
16         fgets(input, max_command_length, stdin);
17         // check background or foreground
18         int backGround = 0, num_arguments = 0;
19         if (input[strlen(input) - 2] == '&')
20         {
21             backGround = 1;
22             input[strlen(input) - 2] = '\0';
23         }
24         // parse input and prepare input
25         arguments[num_arguments] = parse_input(strtok(input, " \n"));
26         if (strcmp(arguments[num_arguments], "echo") == 0 || strcmp(arguments[num_arguments], "export") == 0)
27         {
28             char *temp = remove_quotes(strtok(NULL, "\0\n"));
29             temp[strlen(temp) - 1] = '\0';
30             arguments[++num_arguments] = parse_input(temp);
31             num_arguments++;
32         }

```

```

1
2     else
3     {
4         while (arguments[num_arguments] != NULL && num_arguments < max_arguments - 1)
5         {
6             num_arguments++;
7             arguments[num_arguments] = parse_input(strtok(NULL, " \n"));
8         }
9         if (arguments[1] != NULL)
10        {
11            char *ch = strchr(arguments[1], ' ');
12            if (ch != NULL)
13                *ch = '\0';
14        }
15    }
16    // to identify the end of the array
17    arguments[num_arguments] = NULL;
18    if (num_arguments == 0)
19    {
20        continue;
21    }
22    if (strcmp(arguments[0], "exit") == 0)
23    {
24        exit(EXIT_SUCCESS);
25    }
26    else if (strcmp(arguments[0], "cd") == 0 || strcmp(arguments[0], "echo") == 0 || strcmp(arguments[0], "export") == 0)
27    {
28        execute_shell_builtin(arguments[0], arguments);
29    }
30
31    else
32    {
33        execute_command(arguments[0], arguments, backGround);
34    }
35 }
36 }

```

Inside the shell function there is a while(true) loop which represents the continuous execution of the shell program and doesn't break until the user enters the command exit.

Inside the loop I took user input and check his desire to run the command in background or not then split the input string to command and parameters using the "strtok" function and used the parse input function to evaluate the variables the has "\$" before them using the "getenv" system call then check the command if it was exit to terminate the program or it was built in command to call **execute\_shell\_builtin** function or a non built in command to call **execute\_command** function.

- ❖ **execute\_shell\_builtin** function: this function is used to handle “cd” commands by using **execute\_cd** function, “echo” command, and export command using **execute\_export** function.

```
1 void execute_shell_builtin(char *command, char *arguments[])
2 {
3     if (!strcmp(command, "cd"))
4     {
5         execute_cd(arguments[1]);
6     }
7     else if (!strcmp(command, "echo"))
8     {
9         printf("%s\n", remove_quotes(arguments[1]));
10    }
11    else if (!strcmp(command, "export"))
12    {
13        execute_export(arguments[1]);
14    }
15 }
```

- **execute\_cd** function: used to handle cd command using “chdir” system call.

```
1 void execute_cd(char *path)
2 {
3     if (path == NULL)
4     {
5         // cd
6         path = getenv("HOME");
7         chdir(path);
8     }
9     else if (path[0] == '~')
10    {
11        // cd
12        char *home_dir = getenv("HOME");
13        path++;
14        strcat(home_dir, path);
15        chdir(home_dir);
16    }
17    else
18    {
19        chdir(path);
20    }
21 }
```

- **execute\_export function:** used to export a variable with a value using setenv system call.

```
1 void execute_export(char *arg)
2 {
3     // separate the argument to variable and value
4     char *var = strtok(arg, "=");
5     char *val = remove_quotes(strtok(NULL, "="));
6     setenv(var, val, 1);
7 }
```

- ★ **execute\_command function:** this function is used to execute non built in commands by using fork system call to fork a child process and if the pid was 0 execute the child process by using execvp system call and if the pid was greater than 0 so it's the parent process so the parent process waits for the child termination signal either in the background or in the foreground according to the backGround parameter.

```

1 void execute_command(char *command, char *arguments[], int backGround)
2 {
3     pid_t pid = fork();
4
5     if (pid < 0)
6     {
7         perror("fork failed");
8         exit(EXIT_FAILURE);
9     }
10    else if (pid == 0)
11    {
12        // child processe executes the command
13        if (execvp(command, arguments) < 0)
14        {
15            perror("execvp failed");
16            exit(EXIT_FAILURE);
17        }
18    }
19    else
20    {
21        // parent process waits the child either from background or foreground
22        int status;
23        if (backGround)
24        {
25            waitpid(pid, &status, WNOHANG);
26        }
27        else if (waitpid(pid, &status, 0) < 0)
28        {
29            perror("waitpid failed");
30            exit(EXIT_FAILURE);
31        }
32    }
33 }

```

- the following three functions I used in the shell function to parse, evaluate and prepare the user input as illustrated before:
  - **remove quotes function:** which is used to remove quotes from the str parameter

```

1 char *remove_quotes(char str[])
2 {
3     if (str != NULL)
4     {
5         int i, j = 0;
6         int len = strlen(str);
7         for (i = 0; i < len; i++)
8         {
9             if (str[i] != '"')
10            {
11                str[j++] = str[i];
12            }
13        }
14        str[j] = '\0'; // null-terminate the new string
15    }
16    return str;
17 }

```

- **replace subString function:** which is used to replace the substring parameter from the string parameter by the replacement parameter.

```

1 // function to replace the substring in the string by the replacement
2 void replaceSubstring(char *string, char *substring, char *replacement)
3 {
4     char buffer[100];
5     char *ptr;
6
7     if ((ptr = strstr(string, substring)) != NULL)
8     {
9         strcpy(buffer, string);
10        buffer[ptr - string] = '\0';
11        strcat(buffer, replacement);
12        strcat(buffer, ptr + strlen(substring));
13        strcpy(string, buffer);
14    }
15 }

```

- **parse\_input function:** which is used to get the value of the environment variable passed after the "\$" char in the str parameter using getenv system call and replaceSubstring function.



```

1 char *parse_input(char str[])
2 {
3     if (str != NULL)
4     {
5         str = remove_quotes(str);
6         for (int i = 0; i < strlen(str); i++)
7         {
8             char *ptr = strchr(str, '$');
9             if (ptr != NULL)
10            {
11                // use temp to determine the end of the substring
12                char temp[255];
13                strcpy(temp, ptr);
14                char *p1, *p2, *p;
15                p1 = strchr(temp + 1, '$');
16                p2 = strchr(temp + 1, ' ');
17                if ((p1 == NULL) || (p2 != NULL && (p2 < p1)))
18                    p = p2;
19                else if (p2 == NULL || (p1 != NULL && (p1 < p2)))
20                    p = p1;
21                // end of the substring
22                if (p != NULL)
23                    *p = '\0';
24                // get the value of the variable from environment
25                char *r = getenv(temp + 1);
26                if (r == NULL)
27                    replaceSubstring(str, temp, "");
28                else
29                    replaceSubstring(str, temp, r);
30            }
31        }
32    }
33    return str;
34 }
35

```

---

## sample runs:

- Note: my shell is colored red.

```
Terminal
mahmoud@mahmoud-IdeaPad-5-15ITL05:~$ cd vsCode
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode$ cd OS-Lab1
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$ gcc lab1.c -o lab1
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$ ./lab1
/home/mahmoud:~$ ls
Desktop  Downloads  Music      Public  Templates  vsCode
Documents  GNUstep  Pictures  snap    Videos
/home/mahmoud:~$ mkdir test
/home/mahmoud:~$ ls
Desktop  Downloads  logFile.txt  Pictures  snap    test  vsCode
Documents  GNUstep  Music      Public    Templates  Videos
/home/mahmoud:~$ ls -a -l -h
total 112K
drwxr-x--- 22 mahmoud mahmoud 4.0K 21:24 8 مار .
drwxr-xr-x  4 root    root    4.0K 02:51 2 مار ..
-rw-----  1 mahmoud mahmoud 4.0K 20:44 8 مار .bash_history
-rw-r--r--  1 mahmoud mahmoud 220 02:51 2 مار .bash_logout
-rw-r--r--  1 mahmoud mahmoud 3.7K 02:51 2 مار .bashrc
drwx----- 19 mahmoud mahmoud 4.0K 03:02 8 مار .cache
drwx----- 22 mahmoud mahmoud 4.0K 03:10 8 مار .config
drwxr-xr-x  2 mahmoud mahmoud 4.0K 04:56 2 مار Desktop
drwxr-xr-x  2 mahmoud mahmoud 4.0K 20:53 6 مار Documents
drwxrwxr-x  3 mahmoud mahmoud 4.0K 03:47 2 مار .dotnet
drwxr-xr-x  3 mahmoud mahmoud 4.0K 17:25 5 مار Downloads
drwx-----  2 mahmoud mahmoud 4.0K 03:14 7 مار .gnupg
drwxrwxr-x  4 mahmoud mahmoud 4.0K 20:46 8 مار GNUstep
drwx-----  3 mahmoud mahmoud 4.0K 04:56 2 مار .local
-rw-rw-r--  1 mahmoud mahmoud   87 21:24 8 مار logFile.txt
drwxr-xr-x  2 mahmoud mahmoud 4.0K 04:56 2 مار Music
drwxr-xr-x  3 mahmoud mahmoud 4.0K 03:10 8 مار Pictures
drwx-----  3 mahmoud mahmoud 4.0K 03:45 2 مار .pki
-rw-r--r--  1 mahmoud mahmoud   807 02:51 2 مار .profile
drwxr-xr-x  2 mahmoud mahmoud 4.0K 04:56 2 مار Public
drwx-----  9 mahmoud mahmoud 4.0K 00:40 8 مار snap
drwx-----  2 mahmoud mahmoud 4.0K 03:08 2 مار .ssh
-rw-r--r--  1 mahmoud mahmoud    0 03:38 2 مار .sudo_as_admin_successful
drwxr-xr-x  2 mahmoud mahmoud 4.0K 04:56 2 مار Templates
drwxrwxr-x  2 mahmoud mahmoud 4.0K 21:24 8 مار test
drwxr-xr-x  3 mahmoud mahmoud 4.0K 00:47 8 مار Videos
drwxrwxr-x  3 mahmoud mahmoud 4.0K 03:45 2 مار .vscode
drwxrwxr-x  3 mahmoud mahmoud 4.0K 23:47 4 مار vsCode
-rw-rw-r--  1 mahmoud mahmoud 177 01:55 3 مار .wget-hsts
```

```

Terminal
mahmoud@mahmoud-

-rw-rw-r-- 1 mahmoud mahmoud 177 01:55 3 مار wget-hsts
/home/mahmoud:~$ export x="-a -l -h"
/home/mahmoud:~$ ls $x
total 112K
drwxr-x--- 22 mahmoud mahmoud 4.0K 21:24 8 مار .
drwxr-xr-x 4 root root 4.0K 02:51 2 مار ..
-rw----- 1 mahmoud mahmoud 4.0K 20:44 8 مار .bash_history
-rw-r--r-- 1 mahmoud mahmoud 220 02:51 2 مار .bash_logout
-rw-r--r-- 1 mahmoud mahmoud 3.7K 02:51 2 مار .bashrc
drwx----- 19 mahmoud mahmoud 4.0K 03:02 8 مار .cache
drwx----- 22 mahmoud mahmoud 4.0K 03:10 8 مار .config
drwxr-xr-x 2 mahmoud mahmoud 4.0K 04:56 2 مار Desktop
drwxr-xr-x 2 mahmoud mahmoud 4.0K 20:53 6 مار Documents
drwxrwxr-x 3 mahmoud mahmoud 4.0K 03:47 2 مار .dotnet
drwxr-xr-x 3 mahmoud mahmoud 4.0K 17:25 5 مار Downloads
drwx----- 2 mahmoud mahmoud 4.0K 03:14 7 مار .gnupg
drwxrwxr-x 4 mahmoud mahmoud 4.0K 20:46 8 مار GNUstep
drwx----- 3 mahmoud mahmoud 4.0K 04:56 2 مار .local
-rw-rw-r-- 1 mahmoud mahmoud 116 21:24 8 مار logFile.txt
drwxr-xr-x 2 mahmoud mahmoud 4.0K 04:56 2 مار Music
drwxr-xr-x 3 mahmoud mahmoud 4.0K 03:10 8 مار Pictures
drwx----- 3 mahmoud mahmoud 4.0K 03:45 2 مار .pki
-rw-r--r-- 1 mahmoud mahmoud 807 02:51 2 مار .profile
drwxr-xr-x 2 mahmoud mahmoud 4.0K 04:56 2 مار Public
drwx----- 9 mahmoud mahmoud 4.0K 00:40 8 مار snap
drwx----- 2 mahmoud mahmoud 4.0K 03:08 2 مار .ssh
-rw-r--r-- 1 mahmoud mahmoud 0 03:38 2 مار .sudo_as_admin_successful
drwxr-xr-x 2 mahmoud mahmoud 4.0K 04:56 2 مار Templates
drwxrwxr-x 2 mahmoud mahmoud 4.0K 21:24 8 مار test
drwxr-xr-x 3 mahmoud mahmoud 4.0K 00:47 8 مار Videos
drwxrwxr-x 3 mahmoud mahmoud 4.0K 03:45 2 مار .vscode
drwxrwxr-x 3 mahmoud mahmoud 4.0K 23:47 4 مار vsCode
-rw-rw-r-- 1 mahmoud mahmoud 177 01:55 3 مار wget-hsts
/home/mahmoud:~$ export y="hello world"
/home/mahmoud:~$ echo $y
hello world
/home/mahmoud:~$ export x=-l
/home/mahmoud:~$ ls $x
total 52
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Desktop
drwxr-xr-x 2 mahmoud mahmoud 4096 20:53 6 مار Documents
drwxr-xr-x 3 mahmoud mahmoud 4096 17:25 5 مار Downloads
drwxrwxr-x 4 mahmoud mahmoud 4096 20:46 8 مار GNUstep
-rw-rw-r-- 1 mahmoud mahmoud 145 21:24 8 مار logFile.txt
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Music
drwxr-xr-x 3 mahmoud mahmoud 4096 03:10 8 مار Pictures
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Public
drwx----- 9 mahmoud mahmoud 4096 00:40 8 مار snap
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Templates
drwxrwxr-x 2 mahmoud mahmoud 4096 21:24 8 مار test
drwxr-xr-x 3 mahmoud mahmoud 4096 00:47 8 مار Videos
drwxrwxr-x 3 mahmoud mahmoud 4096 23:47 4 مار vsCode

```

```

welcome to my shell program
/home/mahmoud:~$ export ab="welcome"
/home/mahmoud:~$ export t="to"
/home/mahmoud:~$ export m="my shell program"
/home/mahmoud:~$ export x=9
/home/mahmoud:~$ echo "$ab $t $m"
welcome to my shell program
/home/mahmoud:~$ echo "$t$x $x$t"
execvp failed: No such file or directory
/home/mahmoud:~$ echo "$t$x $x$t"
to9 9to
/home/mahmoud:~$ pwd
/home/mahmoud
/home/mahmoud:~$ cd vsCode
/home/mahmoud/vsCode:~$ cd OS-Lab1
/home/mahmoud/vsCode/OS-Lab1:~$ cd ..
/home/mahmoud/vsCode:~$ cd ~
/home/mahmoud:~$ cd vsCode/OS-Lab1
/home/mahmoud/vsCode/OS-Lab1:~$ cd ~/vsCode
/home/mahmoud/vsCode:~$ pwd
/home/mahmoud/vsCode
/home/mahmoud/vsCode:~$ exit
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$

```

```

/home/mahmoud/vsCode:~$ exit
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$ ./lab1
/home/mahmoud:~$ pwd
/home/mahmoud
/home/mahmoud:~$ echo "AHLAN RAMADAN"
AHLAN RAMADAN
/home/mahmoud:~$ export x="full mark"
/home/mahmoud:~$ echo "$x"
full mark
/home/mahmoud:~$ ls
Desktop Documents Downloads GNUstep logFile.txt Music Pictures Public snap Templates test Videos vsCode
/home/mahmoud:~$ touch sample.txt
/home/mahmoud:~$ ls
Desktop Documents Downloads GNUstep logFile.txt Music Pictures Public sample.txt snap Templates test Videos vsCode
/home/mahmoud:~$ rm sample.txt
/home/mahmoud:~$ ls
Desktop Documents Downloads GNUstep logFile.txt Music Pictures Public snap Templates test Videos vsCode
/home/mahmoud:~$ ls
Desktop Documents Downloads GNUstep logFile.txt Music Pictures Public snap Templates test Videos vsCode
/home/mahmoud:~$ ls -l
total 52
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Desktop
drwxr-xr-x 2 mahmoud mahmoud 4096 20:53 6 مار Documents
drwxr-xr-x 3 mahmoud mahmoud 4096 17:25 5 مار Downloads
drwxrwxr-x 4 mahmoud mahmoud 4096 20:46 8 مار GNUstep
-rw-rw-r-- 1 mahmoud mahmoud 435 21:40 8 مار logFile.txt
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Music
drwxr-xr-x 3 mahmoud mahmoud 4096 03:10 8 مار Pictures
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Public
drwx----- 9 mahmoud mahmoud 4096 00:40 8 مار snap
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Templates
drwxrwxr-x 2 mahmoud mahmoud 4096 21:24 8 مار test
drwxr-xr-x 3 mahmoud mahmoud 4096 00:47 8 مار Videos
drwxrwxr-x 3 mahmoud mahmoud 4096 21:34 8 مار vsCode
/home/mahmoud:~$ heyy
execvp failed: No such file or directory
/home/mahmoud:~$ jk
execvp failed: No such file or directory
/home/mahmoud:~$ exit
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$

```

## screenshots for processes hierarchy during execution:

- first run the lab.c program and view system monitor:

```
mahmoud@mahmoud-IdeaPad-5-15ITL05:~$ cd vsCode
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode$ cd OS-Lab1
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$ ./lab1
/home/mahmoud:~$
```

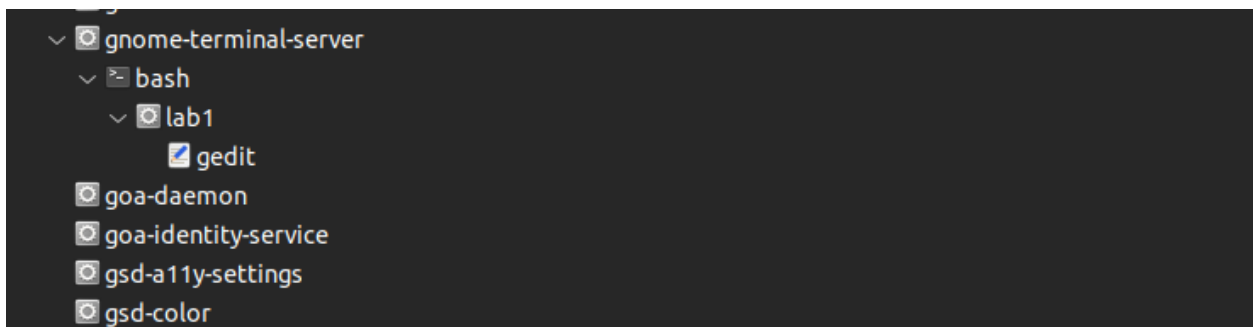


- then run some programs in the background and view system monitor to see processes hierarchy:

➤ run **gedit &**:

```
mahmoud@mahmoud-IdeaPad-5-15ITL05:~$ cd vsCode
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode$ cd OS-Lab1
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$ ./lab1
/home/mahmoud:~$ gedit &
/home/mahmoud:~$ pwd
/home/mahmoud
/home/mahmoud:~$
```

➤ system monitor show us that gedit was added to the lab1 process:



➤ run **libreoffice &** :

```

/home/mahmoud:~$ gedit &
/home/mahmoud:~$ pwd
/home/mahmoud
/home/mahmoud:~$ libreoffice &
/home/mahmoud:~$ Warning: failed to launch javaldx - java may not function corre
ctly
pwd
/home/mahmoud
/home/mahmoud:~$

```

➤ system monitor show us that libreoffice was added to the lab1 process:



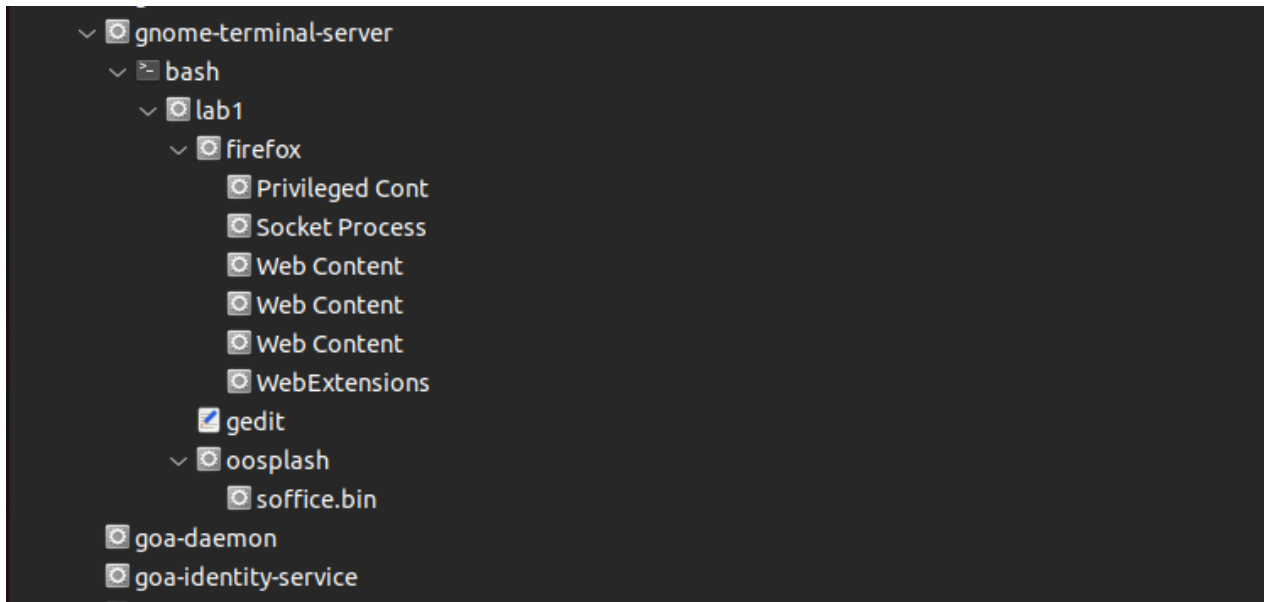
➤ run **firefox &** :

```

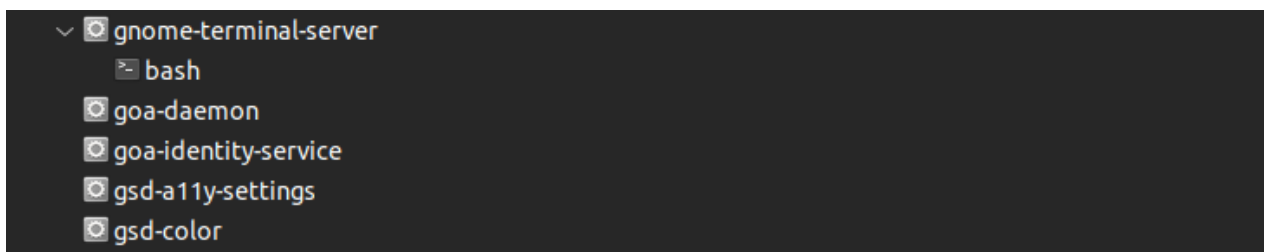
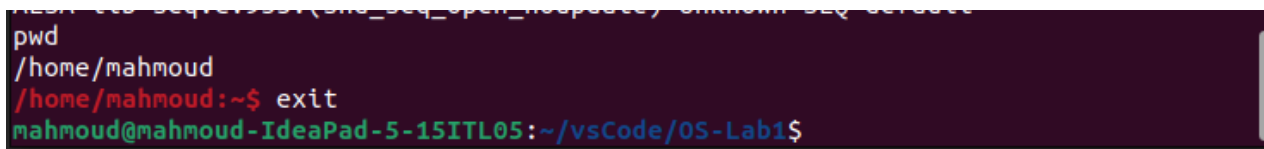
/home/mahmoud:~$ gedit &
/home/mahmoud:~$ pwd
/home/mahmoud
/home/mahmoud:~$ libreoffice &
/home/mahmoud:~$ Warning: failed to launch javaldx - java may not function corre
ctly
pwd
/home/mahmoud
/home/mahmoud:~$ firefox &
/home/mahmoud:~$ Gtk-Message: 22:07:19.827: Not loading module "atk-bridge": The
functionality is provided by GTK natively. Please try to not load it.
ATTENTION: default value of option mesa_glxthread overridden by environment.
ATTENTION: default value of option mesa_glxthread overridden by environment.
ATTENTION: default value of option mesa_glxthread overridden by environment.
pwd
/home/mahmoud

```

➤ system monitor show us that firfox was added to the lab1 process:



➤ run **exit** :




---

## running some commands against the log file:

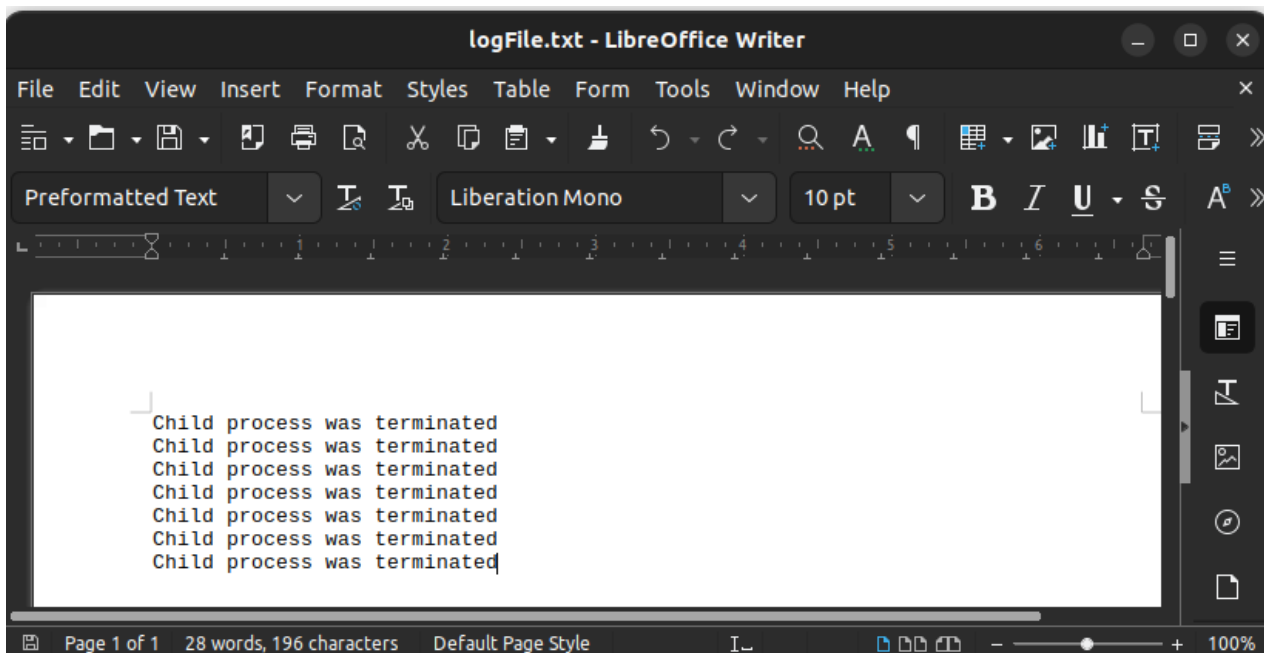
- I will run 6 random commands:

```

mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$ ./lab1
/home/mahmoud:~$ pwd
/home/mahmoud
/home/mahmoud:~$ ls
Desktop  Downloads  logFile.txt  Pictures  snap      Videos
Documents  GNUstep    Music        Public    Templates  vsCode
/home/mahmoud:~$ touch hii.txt
/home/mahmoud:~$ rm hii.txt
/home/mahmoud:~$ ls -l
total 48
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Desktop
drwxr-xr-x 2 mahmoud mahmoud 4096 20:53 6 مار Documents
drwxr-xr-x 3 mahmoud mahmoud 4096 17:25 5 مار Downloads
drwxrwxr-x 4 mahmoud mahmoud 4096 20:46 8 مار GNUstep
-rw-rw-r-- 1 mahmoud mahmoud 116 22:19 8 مار logFile.txt
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Music
drwxr-xr-x 3 mahmoud mahmoud 4096 03:10 8 مار Pictures
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Public
drwx----- 9 mahmoud mahmoud 4096 00:40 8 مار snap
drwxr-xr-x 2 mahmoud mahmoud 4096 04:56 2 مار Templates
drwxr-xr-x 3 mahmoud mahmoud 4096 00:47 8 مار Videos
drwxrwxr-x 3 mahmoud mahmoud 4096 21:34 8 مار vsCode
/home/mahmoud:~$ mkdir test
/home/mahmoud:~$ ls
Desktop  Downloads  logFile.txt  Pictures  snap      test  vsCode
Documents  GNUstep    Music        Public    Templates  Videos
/home/mahmoud:~$ exit
mahmoud@mahmoud-IdeaPad-5-15ITL05:~/vsCode/OS-Lab1$

```

- then explore the logFile.txt :



we have found 6 child processes terminated as expected.



**video link:**

**video link-click here**