



TUBA TOPRAK

161044116 -Hw2

SYSTEM PROGRAMMING

The program is a Unix shell implemented in C programming language. It provides a command-line interface where the user can execute commands and programs, and also supports pipes to connect multiple commands.

The main function of the program is responsible for reading the user input, parsing it into separate commands, creating child processes to execute each command, and managing the communication between these child processes using pipes.

The program starts by declaring a char array "input" to store the user input, and enters into a while loop with a flag . Inside the loop, the program displays a prompt "myshell> " and reads the user input from stdin using the "fgets" function. If the input is NULL, indicating an error in stdin, the program exits with an error message. If the input is ":q", the program exits gracefully.

The user input is then parsed into separate commands using the "parse_input" function, which takes the input string and an array of command strings as input, and returns the number of commands found. The parsing is done by splitting the input string at the "|" character, and trimming the leading and trailing whitespaces of each command.

The program then creates pipes using the "pipe" function, with the number of pipes equal to the number of commands minus one, to enable communication between the child processes. It then creates child processes using the "fork" function, with each child process executing one command.

In each child process, the input/output streams are redirected using the "dup2" function to connect the child process to the appropriate pipe, depending on whether it is the first, middle, or last command. The child process then executes the command using the "execl" function with "/bin/sh" as the path, and "sh -c" followed by the command string as the arguments. If the "execl" function fails, the child process exits with an error message.

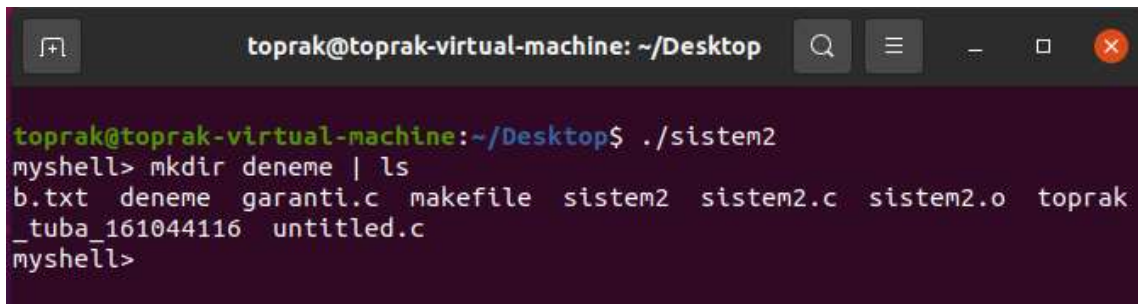
In the parent process, the program waits for all child processes to finish using the "wait" function, and then logs the PID and command string of each child process into a log file using the "log_commands" function. The log file name is created based on the current date and time. After logging the commands, the program frees the memory allocated for the command strings, and goes back to the beginning of the while loop to wait for the next user input.

The program also defines two signal handlers for SIGINT and SIGTERM, which simply print a message indicating that the signal has been received and ignored, and sets the signal to be ignored using the "signal" function.

The libraries used in this program are used for the following purposes:

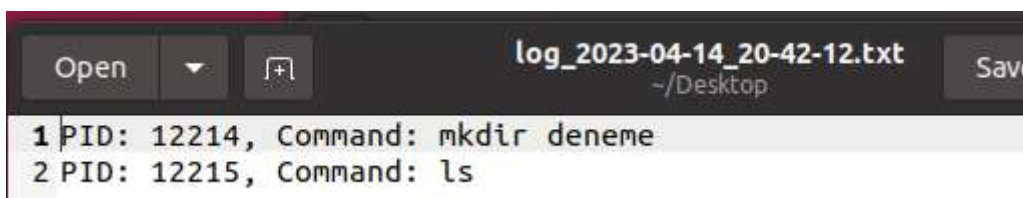
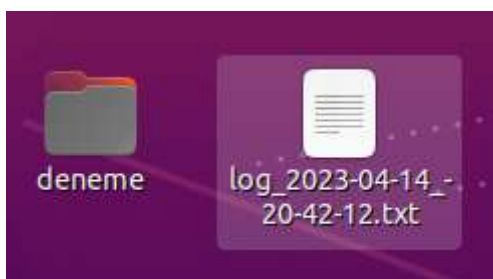
- `stdio.h`: Used for standard input/output functions. For example, `printf` and `fgets` functions are defined in this library.
- `stdlib.h`: Used for program termination and memory management. For example, `exit` and `malloc` functions are defined in this library.
- `string.h`: Used to handle strings. For example, `strtok`, `strcmp` and `strlen` functions are defined in this library.
- `unistd.h`: Used to make system calls on POSIX-compliant operating systems. For example, `pipe`, `dup2` and `close` functions are defined in this library.
- `fcntl.h`: Used for file opening, closing and management.
- `sys/types.h`: Used for system types. In this program, the `pid_t` type is defined specifically.
- `sys/wait.h`: Used to wait for child processes to complete. In this program, the child processes are expected to be completed with the `wait` function.
- `time.h`: Used for time functions. In this program, especially `time` and `localtime` functions are used.

Tests:



```
toprak@toprak-virtual-machine: ~/Desktop
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> mkdir deneme | ls
b.txt  deneme  garanti.c  makefile  sistem2  sistem2.c  sistem2.o  toprak
_tuba_161044116  untitled.c
myshell>
```

files created with this command:



```
Open  ▼  log_2023-04-14_20-42-12.txt  Save
~/Desktop
1 PID: 12214, Command: mkdir deneme
2 PID: 12215, Command: ls
```

```
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> mkdir deneme | ls
b.txt deneme garanti.c makefile sistem2 sistem2.c sistem2.o toprak
_tuba_161044116 untitled.c
myshell> ls -l | grep sistem2
-rwxrwxr-x 1 toprak toprak 17920 Nis 14 20:38 sistem2
-rw-rw-r-- 1 toprak toprak 4333 Nis 14 17:31 sistem2.c
-rw-rw-r-- 1 toprak toprak 6888 Nis 14 20:38 sistem2.o
myshell> 
```

log_2023-04-14_20-47-38.txt
~/Desktop

log_2023-04-14_20-42-12.txt

1 PID: 12292, Command: ls -l
2 PID: 12293, Command: grep sistem2

b.txt
~/Desktop

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toprak@toprak-virtual-machine: ~/Desktop

```
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> cat b.txt > a.txt
myshell> 
```

a.txt
~/Desktop

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toprak@toprak-virtual-machine: ~/Desktop

```
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> ls > out.txt
myshell> ls -l | grep sistem > grepp.txt
```

grepp.txt
~/Desktop

```
1 -rwxrwxr-x 1 toprak toprak 17920 Nis 14 20:38 sistem2
2 -rw-rw-r-- 1 toprak toprak 4333 Nis 14 17:31 sistem2.c
3 -rw-rw-r-- 1 toprak toprak 6888 Nis 14 20:38 sistem2.o
```

log_2023-04-14_21-23-53.
~/Desktop

1 PID: 13621, Command: ls -l
2 PID: 13622, Command: grep sistem > grepp.txt

```
toprak@toprak-virtual-machine: ~/Desktop
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> ls -l | cat > z.txt
myshell> 
```

z.txt

	a.txt	z.txt
1	total 88	
2	-rw-rw-r-- 1 toprak toprak 27 Nis 14 20:55 a.txt	
3	-rw-rw-r-- 1 toprak toprak 27 Nis 14 20:53 b.txt	
4	drwxrwxr-x 2 toprak toprak 4096 Nis 14 20:42 deneme	
5	-rw-rw-r-- 1 toprak toprak 0 Nis 14 20:51 ex1.txt	
6	-rw-rw-r-- 1 toprak toprak 3799 Nis 13 23:22 garanti.c	
7	-rw-rw-r-- 1 toprak toprak 58 Nis 14 20:42 log_2023-04-14_20-42-12.txt	
8	-rw-rw-r-- 1 toprak toprak 61 Nis 14 20:47 log_2023-04-14_20-47-38.txt	
9	-rw-rw-r-- 1 toprak toprak 64 Nis 14 20:51 log_2023-04-14_20-51-46.txt	
10	-rw-rw-r-- 1 toprak toprak 39 Nis 14 20:53 log_2023-04-14_20-53-26.txt	
11	-rw-rw-r-- 1 toprak toprak 63 Nis 14 20:54 log_2023-04-14_20-54-19.txt	
12	-rw-rw-r-- 1 toprak toprak 66 Nis 14 20:55 log_2023-04-14_20-55-02.txt	
13	-rw-rw-r-- 1 toprak toprak 133 Nis 14 18:43 makefile	
14	-rwxrwxr-x 1 toprak toprak 17920 Nis 14 20:38 sistem2	
15	-rw-rw-r-- 1 toprak toprak 4333 Nis 14 17:31 sistem2.c	
16	-rw-rw-r-- 1 toprak toprak 6888 Nis 14 20:38 sistem2.o	
17	drwxrwxr-x 2 toprak toprak 4096 Mar 26 23:40 toprak_tuba_161044116	
18	-rw-rw-r-- 1 toprak toprak 2825 Nis 13 14:50 untitled.c	
19	-rw-rw-r-- 1 toprak toprak 0 Nis 14 21:00 z.txt	

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```
toprak@toprak-virtual-machine: ~/Desktop
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> ls -l | cat > z.txt
myshell> 
```

log_2023-04-14_21-00-50.txt

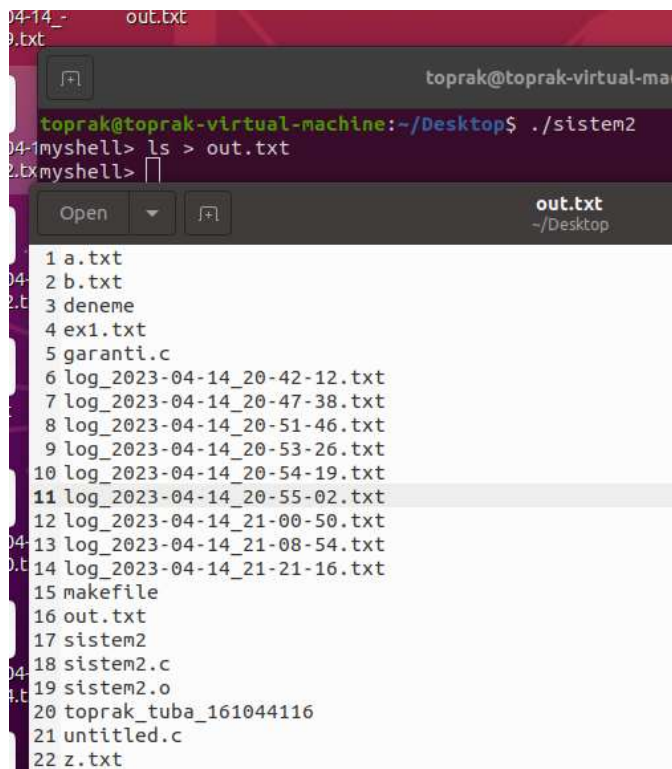
	a.txt	z.txt	log_2023-04-14_21-00-50.txt
1			PID: 12928, Command: ls -l
2			PID: 12929, Command: cat > z.txt

Running processes were checked. It is seen that there is only one running process terminal.

```
==20306== For lists of detected and suppressed errors, rerun with: -s
==20306== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
toprak@toprak-virtual-machine:~/Desktop$ ps -aux | grep "Z"
toprak 20547 0.0 0.0 11776 656 pts/0 S+ 22:23 0:00 grep --color=auto "Z"
toprak@toprak-virtual-machine:~/Desktop$ 
```


No memory leaks were found when running the code with Valgrind.

```
toprak@toprak-virtual-machine:~/Desktop$ valgrind --leak-check=full --track-origins=yes ./sistem2
==20306== Memcheck, a memory error detector
==20306== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==20306== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==20306== Command: ./sistem2
==20306==
mysHELL> ls
==20314== Syscall param close(fd) contains uninitialised byte(s)
==20314==   at 0x4870437: close (close.c:27)
==20314==   by 0x1096BA: main (in /home/toprak/Desktop/sistem2)
==20314==   Uninitialised value was created by a stack allocation
==20314==   at 0x109457: main (in /home/toprak/Desktop/sistem2)
==20314==
==20314== Warning: invalid file descriptor 67110272 in syscall close()
a.txt garanti.c sistem2      sistem2.o      untitled.c
b.txt makefile  sistem2.c  toprak_tuba_161044116
mysHELL> :q
==20306==
==20306== HEAP SUMMARY:
==20306==   in use at exit: 0 bytes in 0 blocks
==20306==   total heap usage: 3 allocs, 3 frees, 2,051 bytes allocated
==20306==
==20306== All heap blocks were freed -- no leaks are possible
==20306==
==20306== For lists of detected and suppressed errors, rerun with: -s
==20306== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
toprak@toprak-virtual-machine:~/Desktop$
```



```
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
mysHELL> ls > out.txt
mysHELL>
```

out.txt
~/Desktop

- 1 a.txt
- 2 b.txt
- 3 deneme
- 4 ex1.txt
- 5 garanti.c
- 6 log_2023-04-14_20-42-12.txt
- 7 log_2023-04-14_20-47-38.txt
- 8 log_2023-04-14_20-51-46.txt
- 9 log_2023-04-14_20-53-26.txt
- 10 log_2023-04-14_20-54-19.txt
- 11 log_2023-04-14_20-55-02.txt
- 12 log_2023-04-14_21-00-50.txt
- 13 log_2023-04-14_21-08-54.txt
- 14 log_2023-04-14_21-21-16.txt
- 15 makefile
- 16 out.txt
- 17 sistem2
- 18 sistem2.c
- 19 sistem2.o
- 20 toprak_tuba_161044116
- 21 untitled.c
- 22 z.txt

```
toprak@toprak-virtual-machine:~/Desktop$ ./s
myshell> ls > out.txt
myshell> ls -l | grep sistem > grepp.txt
myshell> cat out.txt | grep log
log_2023-04-14_20-42-12.txt
log_2023-04-14_20-47-38.txt
log_2023-04-14_20-51-46.txt
log_2023-04-14_20-53-26.txt
log_2023-04-14_20-54-19.txt
log_2023-04-14_20-55-02.txt
log_2023-04-14_21-00-50.txt
log_2023-04-14_21-08-54.txt
log_2023-04-14_21-21-16.txt
myshell> █
```

```
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> cat out.txt | sort | wc -l
```

Open ▼ log_2023-04-14_21-49-58.txt
~/Desktop

- 1 PID: 14135, Command: cat out.txt
- 2 PID: 14136, Command: sort
- 3 PID: 14137, Command: wc -l

```
toprak@toprak-virtual-machine: ~/Desktop
toprak@toprak-virtual-machine:~/Desktop$ ./sistem2
myshell> ls
b.txt          log_2023-04-14_21-32-17.txt  out.txt
deneme        log_2023-04-14_21-47-00.txt  sistem2
garanti.c     log_2023-04-14_21-47-17.txt  sistem2.c
log_2023-04-14_21-28-08.txt log_2023-04-14_21-47-33.txt  sistem2.o
log_2023-04-14_21-31-42.txt log_2023-04-14_21-49-58.txt  toprak_tuba_161044116
log_2023-04-14_21-32-07.txt makefile                     untitled.c
myshell> ^C Received SIGINT signal, ignored...
myshell> █
```