Spring,2020

Gebze Tecnical University

Department of Computer Engineering

CSE 312 /CSE 504 Operating Systems

Homework #03

REPORT

STUDENT: Nevra Gürses

NO:161044071

Before the explain kernels and other sections,I will explain assembly programs and I will show their results:

BinarySearch.s : This program finds the target number by implementing the binary search algorithm for in given integer list.

Output of BinarySearch.s program:

- If target is in list:

```
~~~~~~~~IN BINARY SEARCH FILE~~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.
```

- If target is not in list:

```
~~~~~~~~IN BINARY SEARCH FILE~~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 2
Element was not found in list.
So output: -1

END OF BINARY SEARCH FILE.
```

LinearSearch.s : This program finds the target number by implementing the linear search algorithm for in given integer list.

Output of LinearSearch.s program:

- If target is in list:

```
~~~~~~~~IN LINEAR SEARCH FILE~~~~~~~~
 Given integer list is: 10 5 1 12 9 8 7
Searching element is: 1
Element was found  at index : 2

END OF LINEAR SEARCH FILE.
```

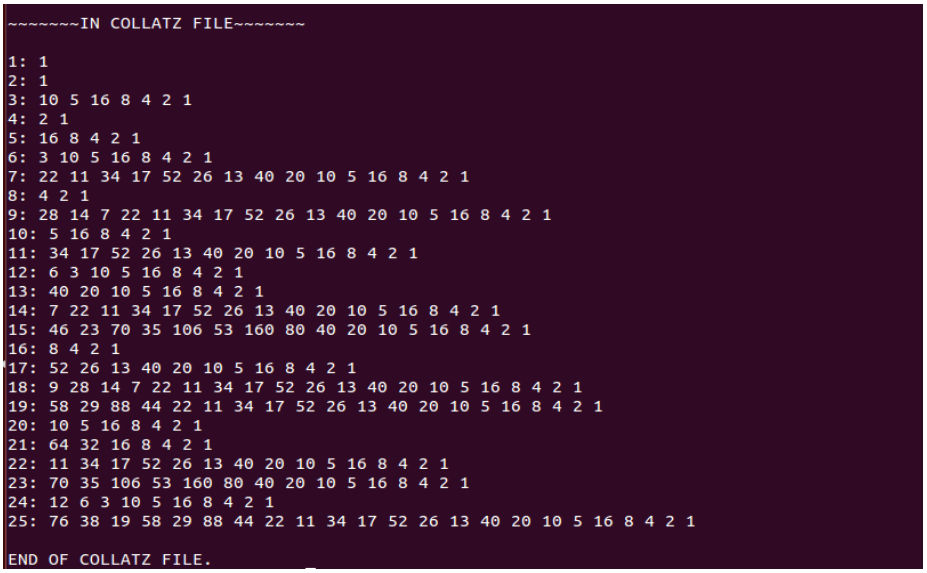
- If target is not in list:

```
~~~~~~~~IN LINEAR SEARCH FILE~~~~~~~~
 Given integer list is: 10 5 1 12 9 8 7
Searching element is: 11
Element was not found in  list.
So output: -1

END OF LINEAR SEARCH FILE.
```

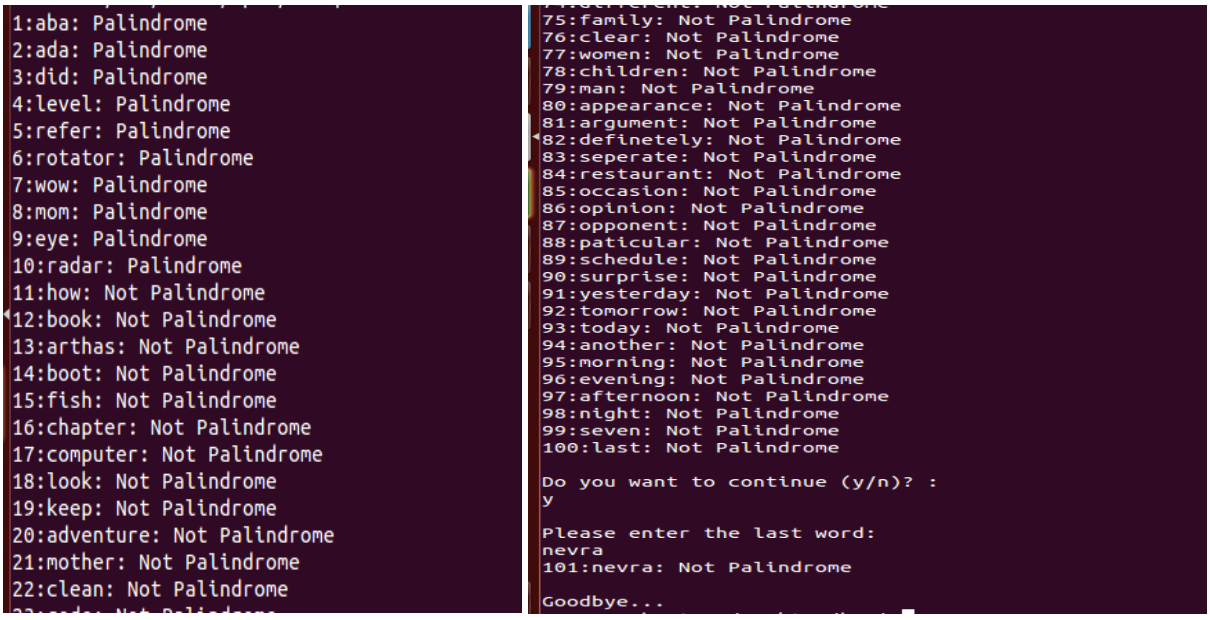
Collatz.s : This program finds collatz sequence for each number less than 25.

Output of Collatz.s program:



Palindrome.s : This program creates a dictionary that contains 100 words, where 90 of the words are not palindrome, 10 of them are palindrome.Then,prints out each word and whether they are palindrome or not respectively. When all the words are assigned in the dictionary whether palindrome or not, asks for the user continue or not, if yes, takes an input word and shows whether a string given from keyboard is a palindrome by printing the “string” semicolon: “Palindrome” or “Not Palindrome”. Otherwise terminates the program.

Some parts of output of Palindrome.s program:



Now,I will explain actual parts of homework:

Process Table in Kernels:

For process table in kernels that are assembly files, I allocate a special space for every kernel.For 1 process,I keep several informations for process table of that process.This informations are; program counter,process id,parent process id,process name,text segment address,data segment address,stack segment address,register array that's size 32,hi register,lo register,and process state.For total of this informations,I allocate 264 byte for 1 process.In SPIMOS_GTU_1.s kernel,there are total 5 process 1 of them is init process and 4 of them are child process,so I allocate 1320 byte for first kernel. In SPIMOS_GTU_2.s kernel,there are total 6 process 1 of them is init process and 5 of them are child process,so I allocate 1584 byte for second kernel. In SPIMOS_GTU_3.s kernel,there are total 10 process 1 of them is init process and 9 of them are child process,so I allocate 2640 byte for third kernel.

If I show this process table space in kernels:

In fist kernel:

```
#Process table that includes 1 init process and 4 child processes.Each of them 264 byte.
ProcessTable:.align 2
            .space 1320
```

In second kernel:

```
#Process table that includes 1 init process and 1 child process in 5 times.Each of them 264 byte.
ProcessTable:.align 2
            .space 1584
```

In third kernel:

```
#Process table that includes 1 init process and 9 child  process.Each of them 264 byte.
ProcessTable:.align 2
            .space 2640
```

In init,fork ,execve, and other syscalls,I update process table of process by communicating syscall.cpp and assembly kernels.I will explain this communicating as more detailed while I'm explaining syscalls in system.cpp.

I keep also some global variables in kernels for processess.That are;

```
.data
    #Global variables that are actually integers.
    processCount :.word 4 #total process count.
    currentRunning:.word 4 #current running process id.
    waitpidReturn :.word 4 #for waitpid return value.
    waitpidControl :.word 4  #for waitpid control.
    flag : .word 4 #for context switch.
```

This globals are used when some controls and some informations for process table for process and also in syscalls.

system.cpp file:

In system.cpp file I make global functions and system calls for processes.For make communication between the sytem.cpp file and kernels,I keep process table address and global variables address in system.cpp file as define.That is:

```
#define ProcessTableAddr 268501012 //Process Table Address in kernels that are assembly files.
#define ProcessTableSize 264 //1 Process size in process table.
#define GlobVariablesStartAddr 268500992 //Global variables start address in kernels that are assembly files.
#define contextSwitchAddr 4194352 //Context switch address in kernels that are assembly files.
using namespace std;
```

System Calls in syscall.cpp file:

INITIALIZE_SYSCALL: This system call creates a init process and initializes process table in kernels that are assembly files.For initialize process table,system.cpp file communicates with kernels with addresses of first process in process table.I use set_mem_word function to initialize process table informations for init process.And also with set_mem_word function,I initialize globals for example I increment process count and I make current running process as init process.

FORK_SYSCALL: This system call creates a new process that is copy of parent process.Writes informations of created process in process table by using set_mem_word function.And also updates globals in kernels.For example after fork,process count is increased.

EXECVE_SYSCALL: This sytem call replaces process's image core by given process.Writes informations of new process in process table of old process.Updates process table of old process by using set_mem_word function.

WAITPID_SYSCALL: This system call provides to wait until end of given process.It updates waitpid section of globals in kernels.

RANDOM_GENERATOR_SYSCALL: This sytem call creates random number that has interval of 1-4.

CONTEXT_SWITCH_SYSCALL: This sytem call provides context switch between processess.When timer interrupt occurs and there is no waitpid for process,context switch is made.In this sytem call,current state of machine for example pc,registers etc is saved and then printing process table informations of new process that is selected by Round Robin scheduling.

END_OF_PROCESS_SYSCALL: This system call is using end of a file.That deletes process from process table by changing data segment address of process as 0.

PROCESS_EXIT_SYSCALL: This sytem call gives acknowledge of termination.

Global Functions in syscall.cpp:

save_beforeSwitch(): Saves current informations of computer(registers,pc etc) in Process Table in kernels that are assembly files.s before context switch.

printProcessInformations(int currentRunningProc): Prints process table informations of current process on screen.

NEVRA GÜRSES
161044071

Working of Program Briefly:

First kernel: In first kernel, all 4 assembly programs is working.Firstly,init process is creating.After, 4 times fork+execve syscalls for each of assembly files are making so all 4 process is creating.When timer interrupt comes,a context switch is making if there is no waitpid.According to my code,I use waitpid for Collatz.s file and Palindrome.s file,so while this processes is working,there is no context switch.After waitpid ends,context switch occurs.I make context switch part in kernel.I update flag when this part is working.And I use context switch syscall in this part.And also,I use Round Robin scheduling for context switch.

Second kernel: In second kernel,one random number is taken by using random number generator syscall and according to that number,selected process works 5 times.5 times fork+ecexve syscall is calling for process.If process is Collatz.s or Palindrome.s , waitpid is used,so other processess wait until one collatz or palindrome file ends. And also,I use Round Robin scheduling for context switch.

Third kernel: In third kernel,3 random numbers are taken by using random number generator syscall.After,according to selected process,each selected process works 3 times. If process is Collatz.s or Palindrome.s , waitpid is used,so other processess wait until one collatz or palindrome file ends.And also,I use Round Robin scheduling for context switch.

NOTE: In my code,I use waitpid for Collatz.s and Palindrome.s files.So,there is no context switch before 1 collatz or palindrome file ends.After waitpid ends,then context switch occurs according to Round Robin scheduling.

RUNNING RESULTS:

SOME PART OF OUTPUT OF SPIMOS_GTU_1.s

```
cse312@ubuntu:~/Desktop/hw3$ spim read SPIMOS_GTU_1.s
Loaded: /usr/share/spim/exceptions.s

END OF  SPIMOS_GTU_1.s FILE


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:LinearSearch.s
Program Counter:4194524
Process Id:1
Parent Process Id:0
Data Pointer Address:268502647
Stack Pointer Address:2147479912
End of Text Pointer Address:4194796
Process State: READY


~~~~~~~IN LINEAR SEARCH FILE~~~~~~~
 Given integer list is: 10 5 1 12 9 8 7
Searching element is: 1
Element was found  at index : 2

END OF LINEAR SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4194796
Process Id:2
Parent Process Id:1
Data Pointer Address:268502879
Stack Pointer Address:2147479912
End of Text Pointer Address:4195164
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.
```

NEVRA GÜRSES
161044071

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195164
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: READY


~~~~~~~IN COLLATZ FILE~~~~~~~

1: 1
2: 1
3: 10 5 16 8 4 2 1
4: 2 1
5: 16

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195312
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING

8 4 2 1
6: 3 10 5 16 8 4 2 1
7: 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
8: 4 2 1
9: 28 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
10: 5 16 8 4 2 1
11: 34 17 52 26 13 40 20 10

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195328
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING
```

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195328
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING

5 16 8 4 2 1
12: 6 3 10 5 16 8 4 2 1
13: 40 20 10 5 16 8 4 2 1
14: 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
15: 46 23 70 35

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195264
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING

106 53 160 80 40 20 10 5 16 8 4 2 1
16: 8 4 2 1
17: 52 26 13 40 20 10 5 16 8 4 2 1
18: 9 28 14 7 22

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195312
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING

11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
19: 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
20: 10 5 16 8 4 2 1
21: 64 32 16 8 4 2
```

NEVRA GÜRSES
161044071

```
21: 64 32 16 8 4 2

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195332
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING

1
22: 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
23: 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
24: 12 6 3 10 5 16 8 4 2

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195352
Process Id:3
Parent Process Id:2
Data Pointer Address:268502943
Stack Pointer Address:2147479912
End of Text Pointer Address:4195400
Process State: RUNNING

1
25: 76 38 19 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1

END OF COLLATZ FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Palindrome.s
Program Counter:4195400
Process Id:4
Parent Process Id:3
Data Pointer Address:268504319
Stack Pointer Address:2147479912
End of Text Pointer Address:4195932
Process State: READY

1:aba: Palindrome
2:ada: Palindrome
```

```
Program Counter:4195400
Process Id:4
Parent Process Id:3
Data Pointer Address:268504319
Stack Pointer Address:2147479912
End of Text Pointer Address:4195932
Process State: READY

1:aba: Palindrome
2:ada: Palindrome
3:did: Palindrome
4:level: Palindrome
5:refer: Palindrome
6:rotator: Palindrome
7:wow: Palindrome
8:mom: Palindrome
9:ey

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Palindrome.s
Program Counter:4195728
Process Id:4
Parent Process Id:3
Data Pointer Address:268504319
Stack Pointer Address:2147479912
End of Text Pointer Address:4195932
Process State: RUNNING

e: Palindrome
10:radar: Palindrome
11:how: Not Palindrome
12:book: Not Palindrome
13:arthas: Not Palindrome
14:boot: Not Palindrome
15:fish: Not Palindrome
16:chapter: Not Palindrome
17:computer: Not Palindrome
18:look: Not Palindrome
19:keep: Not Palindrome
20:adventure: Not Palindrome
21:mother: Not Palindrome
22:clean: Not Palindrome
23:code: Not Palindrome
24:good: Not Palindrome
25:love: Not Palindrome


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------
```

NEVRA GÜRSES
161044071

```
: Not Palindrome
98:night: Not Palindrome
99:seven: Not Palindrome
100:last: Not Palindrome

Do you want to continue (y/n)? :
y


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Palindrome.s
Program Counter:4195788
Process Id:4
Parent Process Id:3
Data Pointer Address:268504319
Stack Pointer Address:2147479912
End of Text Pointer Address:4195932
Process State: RUNNING


Please enter the last word:
nevra


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Palindrome.s
Program Counter:4195840
Process Id:4
Parent Process Id:3
Data Pointer Address:268504319
Stack Pointer Address:2147479912
End of Text Pointer Address:4195932
Process State: RUNNING

101:nevra: Not Palindrome

Goodbye...

ALL PROCESSES FINISHED SUCCESFULLY.

cse312@ubuntu:~/Desktop/hw3$
```

SOME PART OF OUTPUT OF SPIMOS_GTU_2.s

```
cse312@ubuntu:~/Desktop/hw3$ spim read SPIMOS_GTU_2.s
Loaded: /usr/share/spim/exceptions.s

END OF  SPIMOS_GTU_2.s FILE


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4194672
Process Id:1
Parent Process Id:0
Data Pointer Address:268502915
Stack Pointer Address:2147479912
End of Text Pointer Address:4195040
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4195040
Process Id:2
Parent Process Id:1
Data Pointer Address:268503147
Stack Pointer Address:2147479912
End of Text Pointer Address:4195408
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.
```

NEVRA GÜRSES
161044071

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4195408
Process Id:3
Parent Process Id:2
Data Pointer Address:268503379
Stack Pointer Address:2147479912
End of Text Pointer Address:4195776
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4195776
Process Id:4
Parent Process Id:3
Data Pointer Address:268503611
Stack Pointer Address:2147479912
End of Text Pointer Address:4196144
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.
```

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4196144
Process Id:5
Parent Process Id:4
Data Pointer Address:268503843
Stack Pointer Address:2147479912
End of Text Pointer Address:4196512
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.

ALL PROCESSES FINISHED SUCCESFULLY.

cse312@ubuntu:~/Desktop/hw3$
```

NEVRA GÜRSES
161044071

SOME PART OF OUTPUT SPIMOS_GTU_3.s

```
cse312@ubuntu:~/Desktop/hw3$ spim read SPIMOS_GTU_3.s
Loaded: /usr/share/spim/exceptions.s

END OF  SPIMOS_GTU_3.s FILE


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195104
Process Id:1
Parent Process Id:0
Data Pointer Address:268503802
Stack Pointer Address:2147479912
End of Text Pointer Address:4195340
Process State: READY

~~~~~~~IN COLLATZ FILE~~~~~~~

1: 1
2: 1
3: 10 5 16 8 4 2 1
4: 2 1
5: 16 8 4 2 1
6: 3 10 5 16 8 4 2 1
7: 22 11

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195276
Process Id:1
Parent Process Id:0
Data Pointer Address:268503802
Stack Pointer Address:2147479912
End of Text Pointer Address:4195340
Process State: RUNNING

 34 17 52 26 13 40 20 10 5 16 8 4 2 1
8: 4 2 1
9: 28 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
10: 5 16 8 4 2 1
11: 34 17 52 26
```

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195268
Process Id:1
Parent Process Id:0
Data Pointer Address:268503802
Stack Pointer Address:2147479912
End of Text Pointer Address:4195340
Process State: RUNNING

13 40 20 10 5 16 8 4 2 1
12: 6 3 10 5 16 8 4 2 1
13: 40 20 10 5 16 8 4 2 1
14: 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195292
Process Id:1
Parent Process Id:0
Data Pointer Address:268503802
Stack Pointer Address:2147479912
End of Text Pointer Address:4195340
Process State: RUNNING

2 1
15: 46 23 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
16: 8 4 2 1
17: 52 26 13 40 20 10 5 16 8 4 2 1
18: 9 28 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
19: 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
20: 10 5 16 8

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195292
Process Id:1
Parent Process Id:0
Data Pointer Address:268503802
Stack Pointer Address:2147479912
End of Text Pointer Address:4195340
Process State: RUNNING
```

NEVRA GÜRSES
161044071

```
4 2 1
21: 64 32 16 8 4 2 1
22: 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
23: 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
24: 12 6 3 10 5 16 8 4 2 1
25: 76 38 19 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1

END OF COLLATZ FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:LinearSearch.s
Program Counter:4195340
Process Id:2
Parent Process Id:1
Data Pointer Address:268504031
Stack Pointer Address:2147479904
End of Text Pointer Address:4195612
Process State: READY


~~~~~~~IN LINEAR SEARCH FILE~~~~~~~
 Given integer list is: 10 5 1 12 9 8 7
Searching element is: 1
Element was found  at index : 2

END OF LINEAR SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4195612
Process Id:3
Parent Process Id:2
Data Pointer Address:268504263
Stack Pointer Address:2147479904
End of Text Pointer Address:4195980
Process State: READY
```

```
~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4195980
Process Id:4
Parent Process Id:3
Data Pointer Address:268504327
Stack Pointer Address:2147479912
End of Text Pointer Address:4196216
Process State: READY
```

NEVRA GÜRSES
161044071

```
~~~~~~~IN COLLATZ FILE~~~~~~~

1: 1
2: 1
3: 10 5 16 8 4 2 1
4: 2 1
5: 16 8 4 2 1
6: 3 10 5 16 8 4 2 1
7: 22 11 34 17 52 26 13 40 20

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4196152
Process Id:4
Parent Process Id:3
Data Pointer Address:268504327
Stack Pointer Address:2147479912
End of Text Pointer Address:4196216
Process State: RUNNING

 10 5 16 8 4 2 1
8: 4 2 1
9: 28 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
10: 5 16 8 4 2 1
11: 34 17 52 26 13 40 20 10 5 16 8 4 2 1
12: 6 3 10 5 16 8 4 2 1
13: 40 20 10 5 16 8 4 2 1
14: 7 22 11 34 17 52 26 13 40

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4196132
Process Id:4
Parent Process Id:3
Data Pointer Address:268504327
Stack Pointer Address:2147479912
End of Text Pointer Address:4196216
Process State: RUNNING
```

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4196132
Process Id:4
Parent Process Id:3
Data Pointer Address:268504327
Stack Pointer Address:2147479912
End of Text Pointer Address:4196216
Process State: RUNNING

20 10 5 16 8 4 2 1
15: 46 23 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
16: 8 4 2 1
17: 52 26 13 40 20 10 5 16 8 4 2 1
18: 9 28 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
19: 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
20: 10 5 16 8 4 2 1
21: 64 32 16 8 4 2 1
22: 11 34 17 52 26 13 40

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4196132
Process Id:4
Parent Process Id:3
Data Pointer Address:268504327
Stack Pointer Address:2147479912
End of Text Pointer Address:4196216
Process State: RUNNING

20 10 5 16 8 4 2 1
23: 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
24: 12 6 3 10 5 16 8 4 2 1
25: 76 38 19 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1

END OF COLLATZ FILE.
```

NEVRA GÜRSES
161044071

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:LinearSearch.s
Program Counter:4196216
Process Id:5
Parent Process Id:4
Data Pointer Address:268504555
Stack Pointer Address:2147479904
End of Text Pointer Address:4196488
Process State: READY


~~~~~~~IN LINEAR SEARCH FILE~~~~~~~
 Given integer list is: 10 5 1 12 9 8 7
Searching element is: 1
Element was found  at index : 2

END OF LINEAR SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4196488
Process Id:6
Parent Process Id:5
Data Pointer Address:268504787
Stack Pointer Address:2147479904
End of Text Pointer Address:4196856
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.
```

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4196856
Process Id:7
Parent Process Id:6
Data Pointer Address:268504851
Stack Pointer Address:2147479912
End of Text Pointer Address:4197092
Process State: READY


~~~~~~~IN COLLATZ FILE~~~~~~~

1: 1
2: 1
3: 10 5 16

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4197004
Process Id:7
Parent Process Id:6
Data Pointer Address:268504851
Stack Pointer Address:2147479912
End of Text Pointer Address:4197092
Process State: RUNNING

8 4 2 1
4: 2 1
5: 16 8 4 2 1
6: 3 10 5 16 8 4 2 1
7: 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
8: 4 2 1
9: 28
```

NEVRA GÜRSES
161044071

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4196988
Process Id:7
Parent Process Id:6
Data Pointer Address:268504851
Stack Pointer Address:2147479912
End of Text Pointer Address:4197092
Process State: RUNNING

 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
10: 5 16 8 4 2 1
11: 34 17 52 26 13 40 20 10 5 16 8 4 2 1
12: 6 3 10 5 16 8 4 2 1
13: 40 20 10 5 16 8 4 2 1
14: 7 22 11 34 17 52 26 13 40 20

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4197028
Process Id:7
Parent Process Id:6
Data Pointer Address:268504851
Stack Pointer Address:2147479912
End of Text Pointer Address:4197092
Process State: RUNNING

 10 5 16 8 4 2 1
15: 46 23 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
16: 8 4 2 1
17: 52 26 13 40 20 10 5 16 8 4 2 1
18: 9 28 14 7 22 11 34 17 52 26 13 40 20
```

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4197044
Process Id:7
Parent Process Id:6
Data Pointer Address:268504851
Stack Pointer Address:2147479912
End of Text Pointer Address:4197092
Process State: RUNNING

10 5 16 8 4 2 1
19: 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
20: 10 5 16 8 4 2 1
21: 64 32 16 8 4 2 1
22: 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
23: 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
24: 12

-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:Collatz.s
Program Counter:4197044
Process Id:7
Parent Process Id:6
Data Pointer Address:268504851
Stack Pointer Address:2147479912
End of Text Pointer Address:4197092
Process State: RUNNING

6 3 10 5 16 8 4 2 1
25: 76 38 19 58 29 88 44 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1

END OF COLLATZ FILE.
```

NEVRA GÜRSES
161044071

```
-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:LinearSearch.s
Program Counter:4197092
Process Id:8
Parent Process Id:7
Data Pointer Address:268505079
Stack Pointer Address:2147479904
End of Text Pointer Address:4197364
Process State: READY


~~~~~~~IN LINEAR SEARCH FILE~~~~~~~
 Given integer list is: 10 5 1 12 9 8 7
Searching element is: 1
Element was found  at index : 2

END OF LINEAR SEARCH FILE.


-------INFORMATIONS OF PROCESS WHEN TIMER INTERRUPT COME----------

Process Name:BinarySearch.s
Program Counter:4197364
Process Id:9
Parent Process Id:8
Data Pointer Address:268505311
Stack Pointer Address:2147479904
End of Text Pointer Address:4197732
Process State: READY



~~~~~~~IN BINARY SEARCH FILE~~~~~~~
Given integer list is: 1 4 5 7 9 10 11
Searching element is: 11
Element was found at index :  6

END OF BINARY SEARCH FILE.

ALL PROCESSES FINISHED SUCCESFULLY.

cse312@ubuntu:~/Desktop/hw3$
```