

CS-220 Operating Systems

THREADS & RACE CONDITIONS

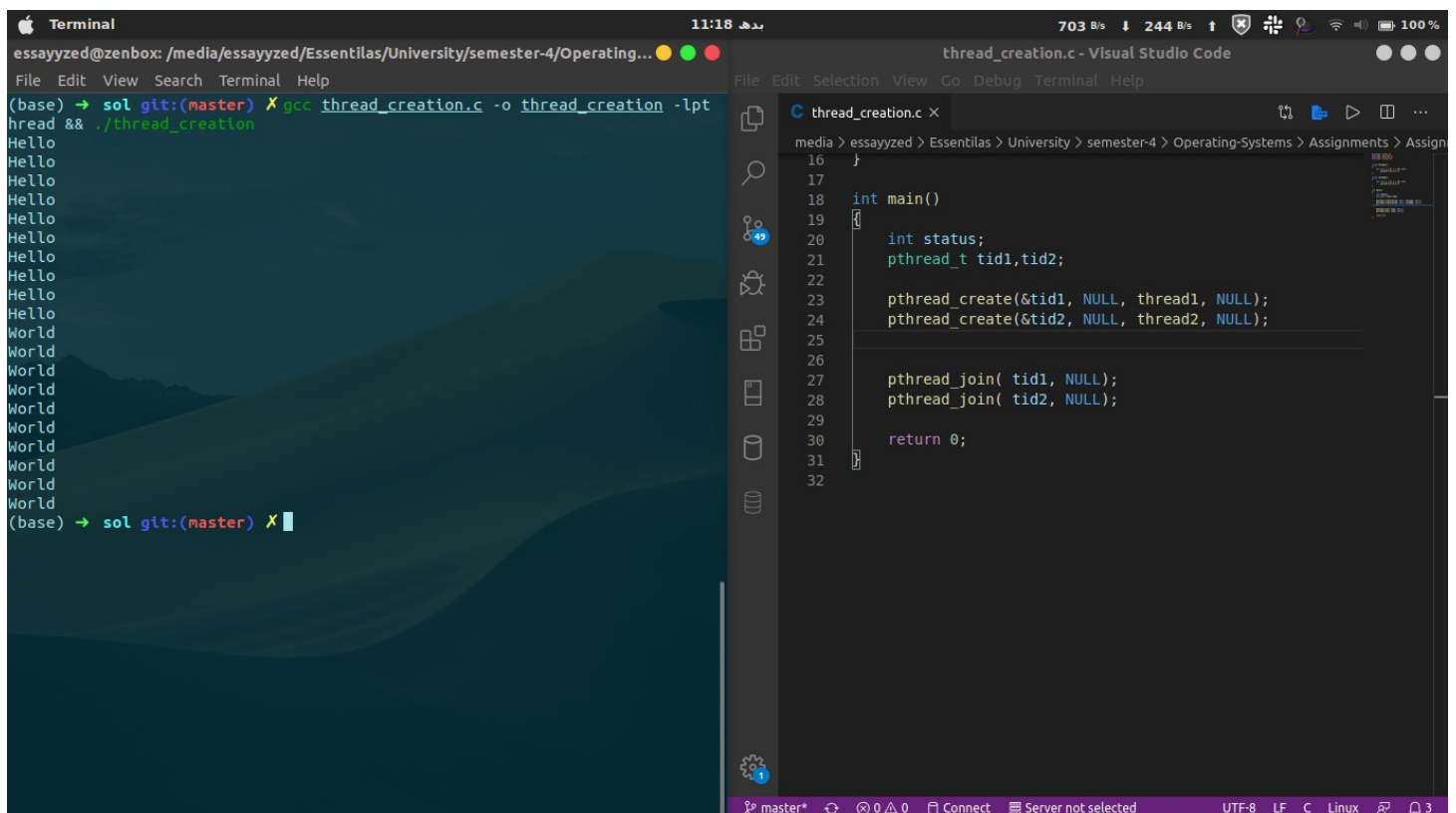
SYED ASAD ZAMAN

p18-0034

(B)

1.

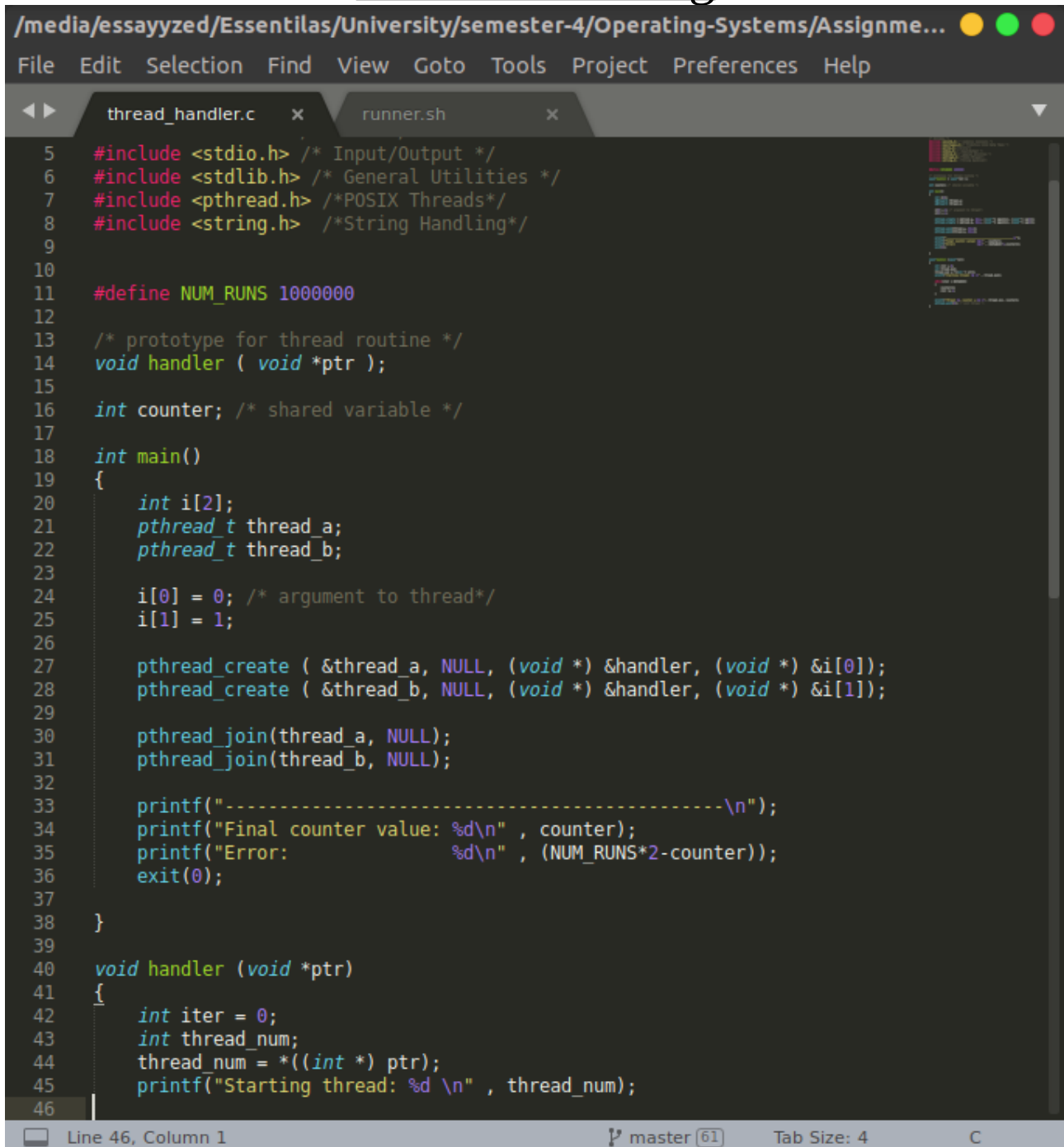
THREAD CREATION(2 Threads)



Thread Creation(4 Threads)

[illegible]

2. Thread Handling



The screenshot shows a code editor window with the title bar "/media/essayzed/Essentilas/University/semester-4/Operating-Systems/Assignme...". The editor has two tabs: "thread_handler.c" and "runner.sh". The "thread_handler.c" tab is active, displaying the following C code:

```
5  #include <stdio.h> /* Input/Output */
6  #include <stdlib.h> /* General Utilities */
7  #include <pthread.h> /*POSIX Threads*/
8  #include <string.h> /*String Handling*/
9
10
11  #define NUM_RUNS 1000000
12
13  /* prototype for thread routine */
14  void handler ( void *ptr );
15
16  int counter; /* shared variable */
17
18  int main()
19  {
20      int i[2];
21      pthread_t thread_a;
22      pthread_t thread_b;
23
24      i[0] = 0; /* argument to thread*/
25      i[1] = 1;
26
27      pthread_create ( &thread_a, NULL, (void *) &handler, (void *) &i[0]);
28      pthread_create ( &thread_b, NULL, (void *) &handler, (void *) &i[1]);
29
30      pthread_join(thread_a, NULL);
31      pthread_join(thread_b, NULL);
32
33      printf("-----\n");
34      printf("Final counter value: %d\n", counter);
35      printf("Error: %d\n", (NUM_RUNS*2-counter));
36      exit(0);
37  }
38
39
40  void handler (void *ptr)
41  {
42      int iter = 0;
43      int thread_num;
44      thread_num = *((int *) ptr);
45      printf("Starting thread: %d \n", thread_num);
46
```

The status bar at the bottom indicates "Line 46, Column 1", "master 61", "Tab Size: 4", and "C".

thread_handler.c x

```
39
40 void handler (void *ptr)
41 {
42     int iter = 0;
43     int thread_num;
44     thread_num = *((int *) ptr);
45     printf("Starting thread: %d \n" , thread_num);
46
47     while(iter < NUM_RUNS)
48     {
49         counter++;
50         iter += 1;
51     }
52
53     printf("Thread %d, counter = %d \n", thread_num, counter);
54     pthread_exit(0); /* exit thread */
55 }
56
57
```

```

essayyzed@zenbox: /media/essayyzed/Essentilas/University/semester-4/Op...
File Edit View Search Terminal Help
(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 1, counter = 823378
Thread 0, counter = 1112820
-----
Final counter value: 1112820
Error: 887180
(base) → sol git:(master) X subl thread_handler.c
(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 0, counter = 983763
Thread 1, counter = 1168160
-----
Final counter value: 1168160
Error: 831840
(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 1, counter = 1248641
Thread 0, counter = 1311240
-----
Final counter value: 1311240
Error: 688760
(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 1, counter = 924590
Thread 0, counter = 1159640
-----
Final counter value: 1159640
Error: 840360
(base) → sol git:(master) X

```

ANSWERS

1.

*The Value of **Container** variable should be the sum of **Thread0** & **Thread1**. But it's only the value of **Thread0** i.e. value is overridden.*

2.

*The value I m getting is of **Thread0**.*

3.

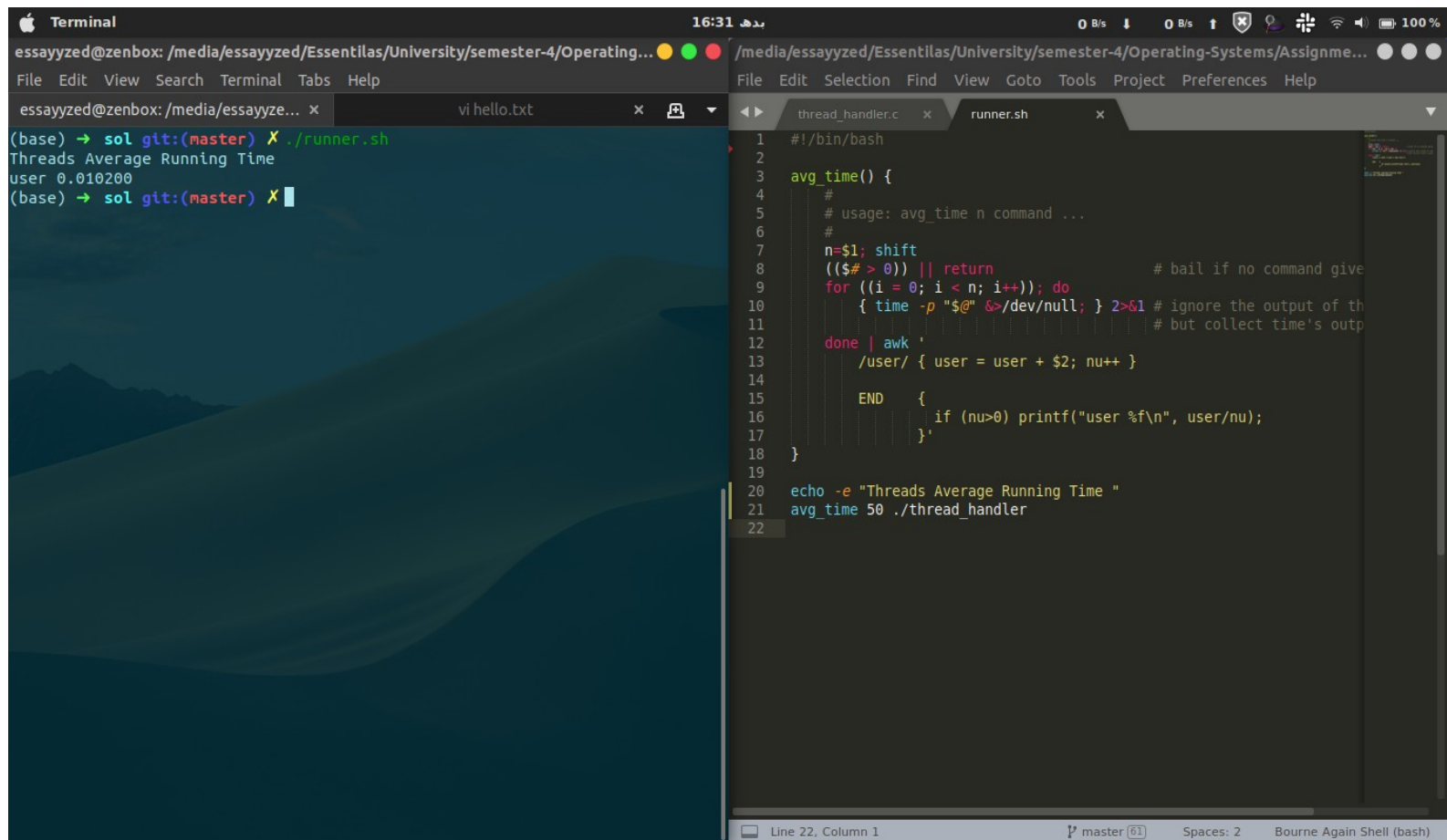
*The value of error is different when it is running multiple time.
Roughly its about 60% - 70%.*

As Follows:

```
essayyzed@zenbox: /media/essayyzed/Essentilas/University/semester-4/Op...
File Edit View Search Terminal Help
(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 1, counter = 823378
Thread 0, counter = 1112820
-----
Final counter value: 1112820
Error: 887180
(base) → sol git:(master) X subl thread_handler.c
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Starting thread: 0
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Thread 0, counter = 983763
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Final counter value: 1168160
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(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 1, counter = 1248641
Thread 0, counter = 1311240
-----
Final counter value: 1311240
Error: 688760
(base) → sol git:(master) X gcc thread_handler.c -o thread_handler -
lpthread && ./thread_handler
Starting thread: 0
Starting thread: 1
Thread 1, counter = 924590
Thread 0, counter = 1159640
-----
Final counter value: 1159640
Error: 840360
(base) → sol git:(master) X
```

4.

*User Time I get is Roughly 0.010200ms
on average.*



The image shows a screenshot of a macOS desktop with two windows open. The left window is a Terminal application, and the right window is a code editor (likely Visual Studio Code) showing a shell script named `runner.sh`.

Terminal Window:

```
essayzyzed@zenbox: /media/essayzyzed/Essentilas/University/semester-4/Operating...
File Edit View Search Terminal Tabs Help

essayzyzed@zenbox: /media/essayzyzed... x vi hello.txt x
(base) → sol git:(master) X ./runner.sh
Threads Average Running Time
user 0.010200
(base) → sol git:(master) X
```

Code Editor Window:

```
thread_handler.c x runner.sh x
1 #!/bin/bash
2
3 avg_time() {
4     #
5     # usage: avg_time n command ...
6     #
7     n=$1; shift
8     (($# > 0)) || return # bail if no command give
9     for ((i = 0; i < n; i++)); do
10        { time -p "$@" &>/dev/null; } 2>&1 # ignore the output of th
11        # but collect time's outp
12    done | awk '
13        /user/ { user = user + $2; nu++ }
14
15        END {
16            if (nu>0) printf("user %f\n", user/nu);
17        }'
18 }
19
20 echo -e "Threads Average Running Time "
21 avg_time 50 ./thread_handler
22
```

The status bar at the bottom of the code editor shows: Line 22, Column 1, master (61), Spaces: 2, Bourne Again Shell (bash).