**Operating System**

**Report**

**Stimulation Based Assignment**

**Que16. Barrier Based Question**

**(Multithreading Programming)**

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**Question:**

A barrier is a tool for synchronizing the activity of a number of threads. When a thread reaches

a barrier point, it cannot proceed until all other threads have reached this point as well. When the

last thread reaches the barrier point, all threads are released and can resume concurrent execution.

Assume that the barrier is initialized to N —the number of threads that must wait at the barrier

point:

init(N);

Each thread then performs some work until it reaches the barrier point:

/\* do some work for awhile \*/

barrier point();

/\* do some work for awhile \*/

Using synchronization tools described in this chapter, construct a barrier

that implements the following API :

• int init(int n) —Initializes the barrier to the specified size.

• int barrier point(void) —Identifies the barrier point. All

threads are released from the barrier when the last thread reaches this point.

The return value of each function is used to identify error conditions. Each function will return 0

under normal operation and will return −1 if an error occurs. A testing harness is provided in the

source code download to test your implementation of the barrier.

**Code:-**

#include<stdio.h>

#include<pthread.h>

#include<stdlib.h>

#include <unistd.h>

pthread\_mutex\_t lock = PTHREAD\_MUTEX\_INITIALIZER;

pthread\_cond\_t finish\_cond = PTHREAD\_COND\_INITIALIZER;

int barrier = 0;

int thread\_count;

int barrier\_size;

int counter=0;

int invoke\_barrier = 0;

void barrier\_init(int n\_threads)

{

if ( thread\_count < barrier\_size ) { barrier = thread\_count; return; }

barrier = n\_threads;

}

int decrement()

{

if (barrier == 0) {

return 0;

}

if(pthread\_mutex\_lock(&lock) != 0)

{

perror("Failed to take lock.");

return -1;

}

barrier--;

if(pthread\_mutex\_unlock(&lock) != 0)

{

perror("Failed to unlock.");

return -1;

}

return 0;

}

int wait\_barrier()

{

if(decrement() < 0)

{

return -1;

}

while (barrier)

{

if(pthread\_mutex\_lock(&lock) != 0)

{

perror("\n Error in locking mutex");

return -1;

}

if(pthread\_cond\_wait(&finish\_cond, &lock) != 0)

{

perror("\n Error in cond wait.");

return -1;

}

}

if(0 == barrier)

{

if(pthread\_mutex\_unlock(&lock) != 0)

{

perror("\n Error in locking mutex");

return -1;

}

if(pthread\_cond\_signal(&finish\_cond) != 0)

{

perror("\n Error while signaling.");

return -1;

}

}

return 0;

}

void \* barrier\_point(void \*numthreads)

{

int r = rand() % 5;

printf("\nThread %d \nPerforming init task of length %d sec\n",++counter,r);

sleep(r);

wait\_barrier();

if (barrier\_size!=0) {

if ((thread\_count - (invoke\_barrier++) ) % barrier\_size == 0) {

printf("\nBarrier is Released\n");

}

printf("\nI am task after barrier\n");

}

//printf("Thread completed job.\n");

return NULL;

}

int main()

{

printf("Enter Barrier Size\n");

scanf("%d", &barrier\_size);

printf("Enter no. of thread\n");

scanf("%d", &thread\_count);

if (barrier\_size>=0 && thread\_count>=0) {

pthread\_t tid[thread\_count];

barrier\_init(barrier\_size);

for(int i =0; i < thread\_count; i++)

{

pthread\_create(&(tid[i]), NULL, &barrier\_point, &thread\_count);

}

for(int j = 0; j < thread\_count; j++)

{

pthread\_join(tid[j], NULL);

}

}

else{

printf("You are entering wrong data.\n");

main();

}

return 0;

}

**Description:-**

* A barrier is a type of synchronization method. A barrier for a group of threads or processes in the source code means any thread/process must stop at this point and cannot proceed until all other threads/processes reach this barrier.
* A barrier is a method to implement synchronization. Synchronization ensures that concurrently executing threads or processes do not execute specific portions of the program at the same time.
* When a barrier is inserted at a specific point in a program for a group of threads [processes], any thread [process] must stop at this point and cannot proceed until all other threads [processes] reach this barrier.
* The basic barrier has mainly two variables, one of which records the pass/stop state of the barrier, the other of which keeps the total number of threads that have entered in the barrier.

**Algorithm:-**

1. initialize barrier\_size and thread\_count;

2. create threads

3. threads doing some work

4. threads waiting at the barrier.

5. barrier is released when last thread comes at the thread.

6. all threads complete thier task and exit.

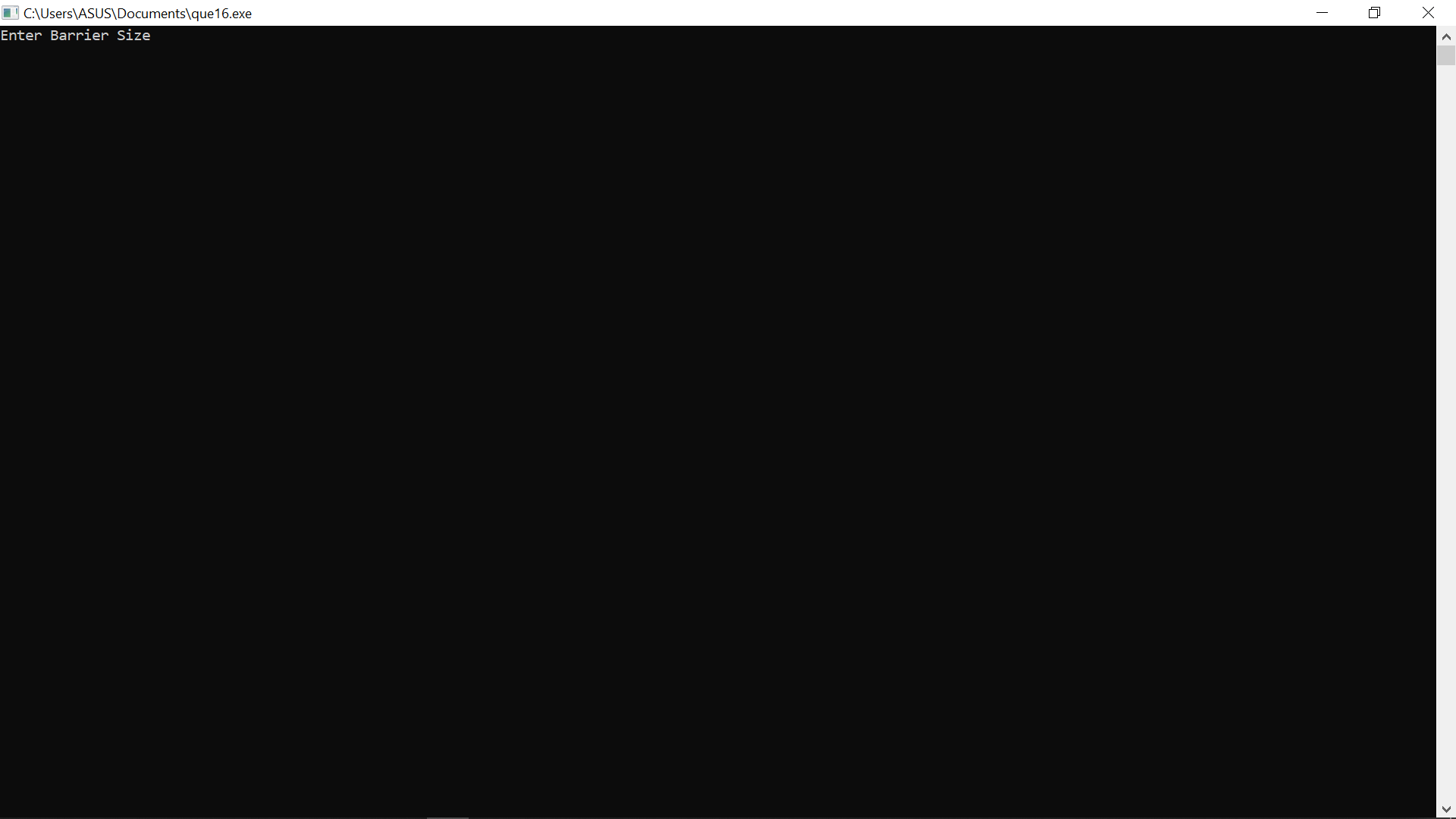
7. exit.

**Complexity:-**

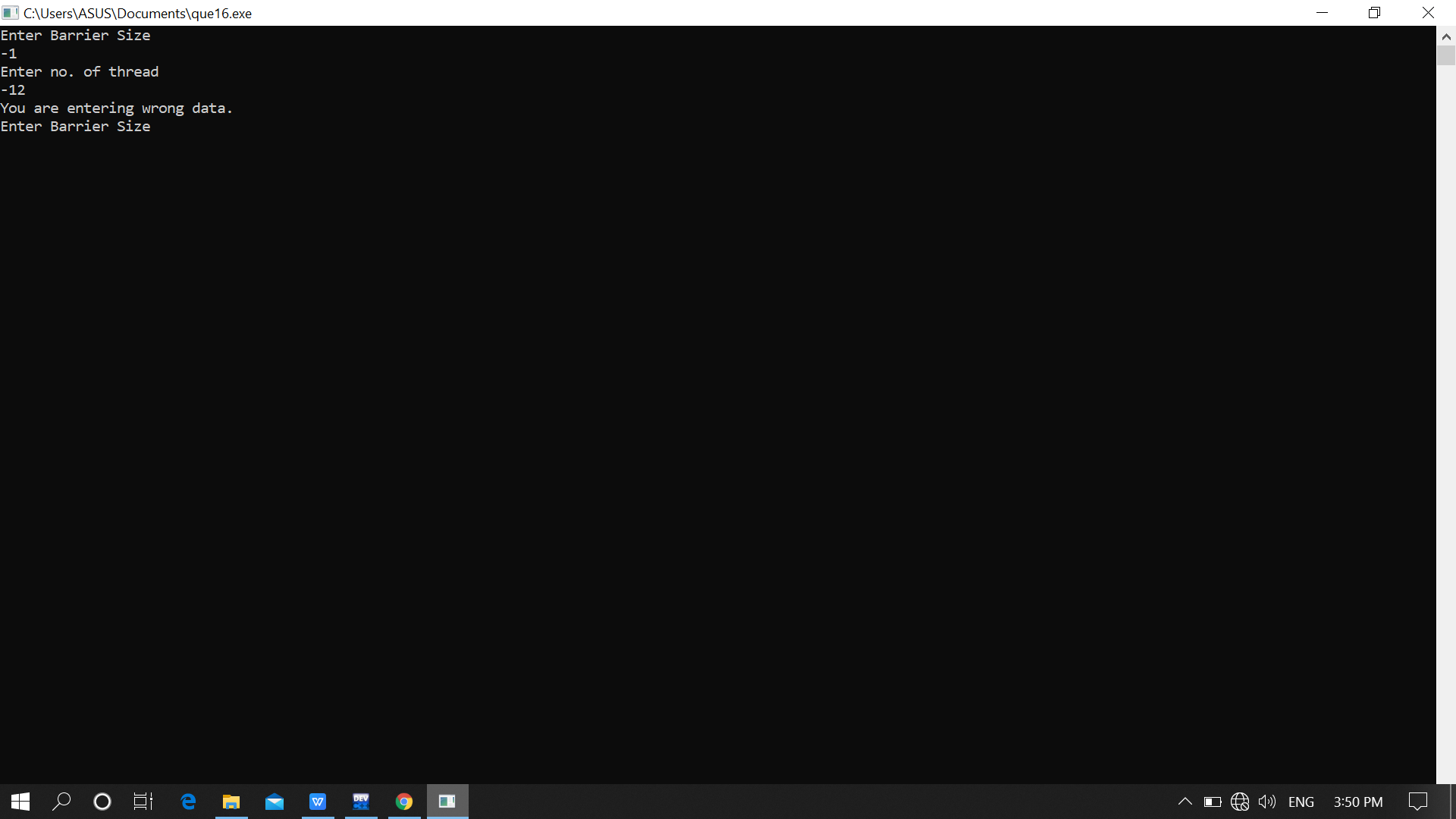
O (n) complexity. “n” is no of thread\_count.

**Compilation And Test Cases:-**

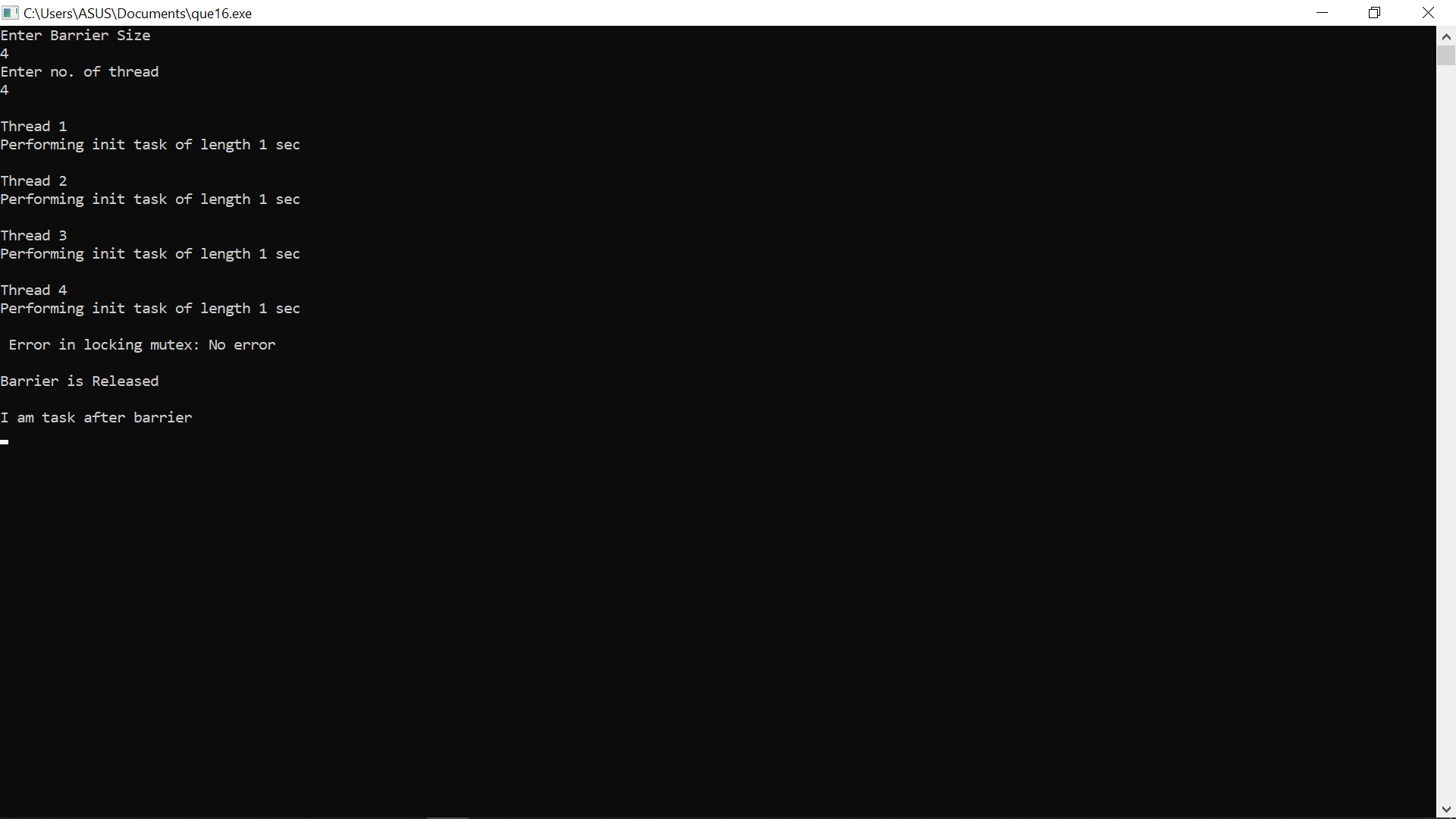
Compilation window:



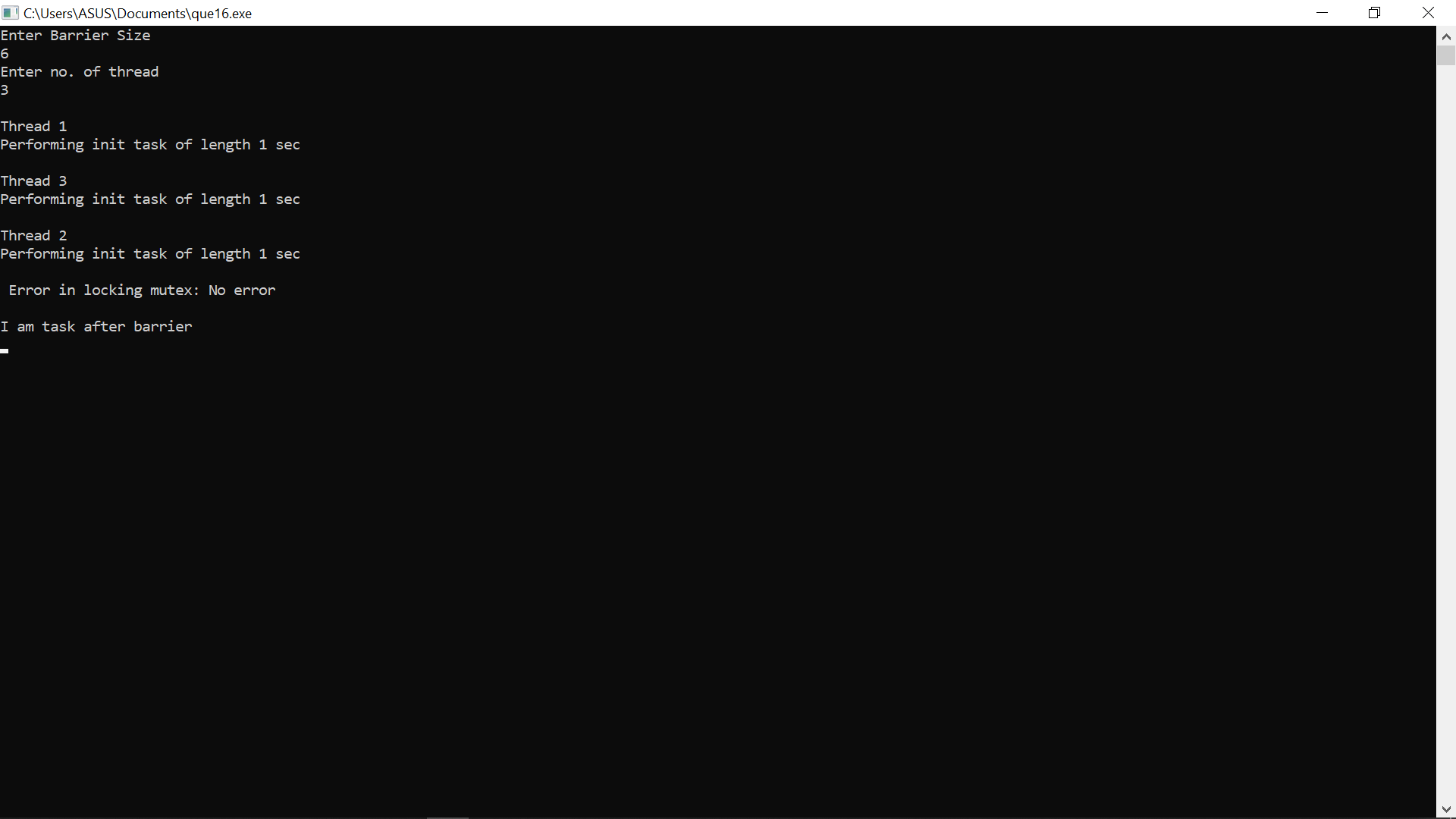
Case 1: when user enter invalid input like – string, double, float, negative no. etc.



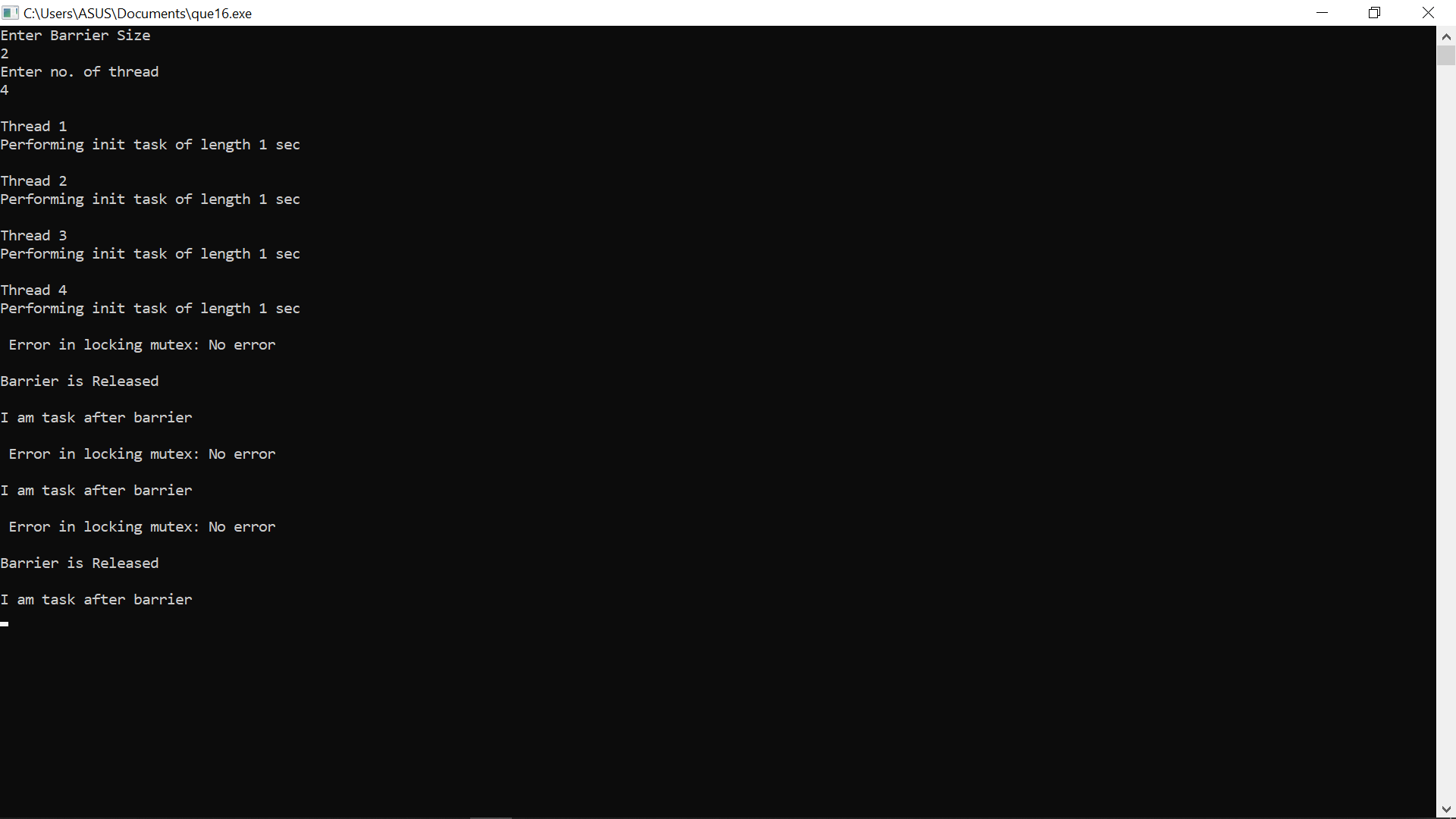
Case 2: when no. of thread equal to size of barrier.



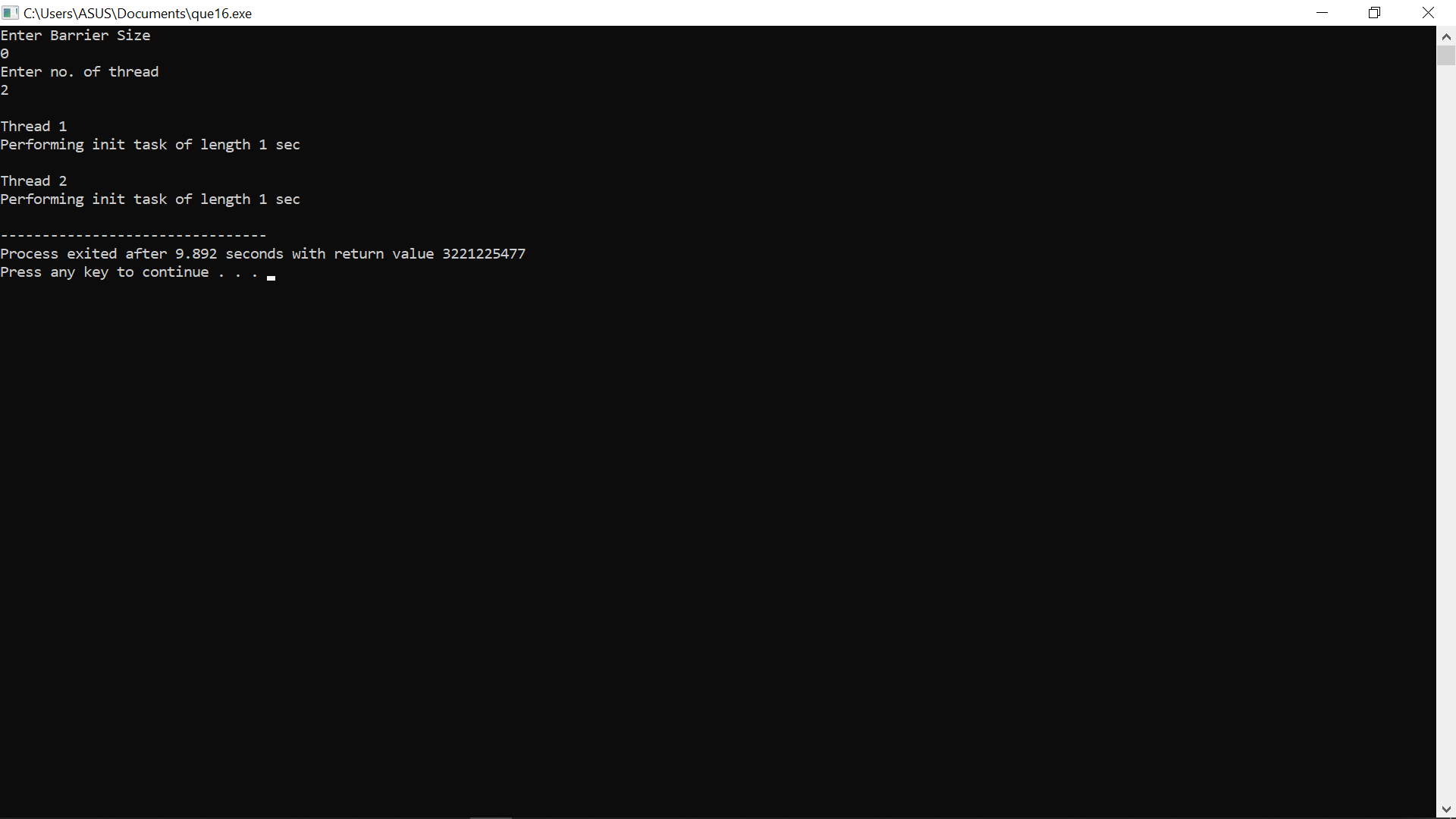
Case 3: when no. of thread is less than size of barrier .



Case 4: when no. of thread is greater than size of Barrier.



Case 5: when size of Barrier equal to ‘0’.



Case 6: when thread equal to ‘0’.

