**A close up of a sign

Description automatically generated**

**Operating System**

**Report**

**Assignment Simulation**

**Based**

**16th Question**

**16.** 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.

**Student Name:**  Aditya Kumar

**Student ID:** 11703629

**Section No:** EE029

**Roll No.:** B37

**Email Address:** er.aksingh110@gmail.com

**GitHub Link:** https://github.com/adityasingh110/OS\_Assignment\_Q16.git

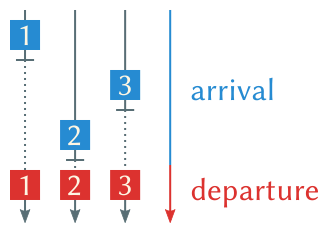
Table of Contents

1. Introduction to Barriers
2. Algorithm Involved
3. Complexity
4. Solution Code
5. Compile and Run
6. Test Cases

# Barriers

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.



**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.

**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;

/\*

\* params : number of threads a process is creating.

\* returns : none.

\*

\* Initialize barrier with total number of threads.

\*/

void barrier\_init(int n\_threads)

{

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

barrier = n\_threads;

}

/\*

\* params: none.

\* returns: -1 on failure, 0 on success.

\* decrement the count by 1.

\*

\*/

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;

}

/\*

\* params: none.

\* returns: int : 0 on sucess, -1 on failure.

\*

\*

\* wait for other threads to complete.

\*/

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;

}

}

/\*

\* last thread will execute this.

\*/

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);

//Checking valid input

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

pthread\_t tid[thread\_count];

barrier\_init(barrier\_size);

int i;

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

{

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

}

int j;

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

{

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

}

}

//when user give wrong input then this section will execute.

else{

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

main();

}

return 0;

}

**Compile and Run:**

Use following command to compile program -

gcc Barrier.c -o Barrier -pthread

**A screenshot of a video game

Description automatically generated**

use following command to run program-

./Barrier

**A screenshot of a computer screen

Description automatically generated**

**Test Cases:-**

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

A screenshot of a cell phone

Description automatically generated

**Case 2:** When no. of thread equal to size of barrier.

A screenshot of a computer screen

Description automatically generated

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

**A screenshot of a computer screen

Description automatically generated**

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

**A screenshot of a computer screen

Description automatically generated**

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

**A screenshot of a cell phone

Description automatically generated**

**Case 6:** When thread equal to ‘0’.

**A screenshot of a cell phone

Description automatically generated**

**GitHub Link:** **https://github.com/adityasingh110/OS\_Assignment\_Q16.git**