SHANTHAN REDDY
CB.EN.U4CSE19459

THREAD SYNCHRONIZATION :-

It is concurrent execution of two (or) more threads that share critical resources. Synchronisation of threads help in avoiding conflicts regarding critical resources. otherwise, conflicts may arise, when parallel running threads attempts to modify a common variable at the same time.

* Critical section :- The region of a program that try to access shared resources and cause race condition.

* Race condition :- It typically occurs when two (or) more threads try to read, write and possibly make the decisions based on the memory they are accessing concurrently.

Pseudocode :-

```
do
  {
  //entry section → wait ( ) ; here request are processed for entry into
                              critical section.
      *critical section*
  //exit section → signal ( ) ; here removes locks on critical section.

      - remaining section

  }
  while (True)
```

Solution for critical section:-

solution for a critical section problem must satisfy following cond:-

i) Mutual exclusion:- out of group of threads, only one thread can be in its critical section at a given point of time.

ii) Progress:- If no thread is in the critical section, and if one or more thread wants to execute their critical section then only one of these threads must be allowed to get in.

iii) Bounded wait:- After a thread makes requests for getting into critical section, there is limit for how many process may get into the critical section, before threads request is granted.

widely used methods for critical section problem:-

* Petersons solution.
* Mutex lock.
* semaphores.

SEMAPHORE:- It is a signaling mechanism, and a thread that is waiting on semaphore, can be signaled by another thread. There are two types of semaphores.

i) counting semaphore.

ii) Binary semaphore.

All the semaphores make use of two atomic operations i) wait and (ii) signal.

System calls in windows :-

```
(i) create semaphore (
            LPsecurity - attribute ,
            lInitial count,
            lMaxium count ,
            lPName
    );
```

LPsecurity attribute :- it is a security attribute, if NULL handle can't be inherited by its child.

lInitial count :- must be greater than zero and less than or equal to Max count. Signaled state → greater than zero , Non - signaled state = 0.

lMaxium count :- max count of semaphore object.

lPName :- name of semaphore object.

```
(ii) Wait for single object (
            hHandle ;
            dwMilliseconds
    );
```

hHandle :- A handle to object.

dwMilliseconds :- time - out interval in milliseconds

```
(iii) WaitforMultipleObjects (
          ncount,
          lpHandle,
          bwaitAll
          dwmilliseconds,
    );
```

ncount :- max Numbers of objects handles in array pointed to lpthreads

lpthread :- array of object handles.

bwait All :- If TRUE, returns when all objects are signaled, If FALSE, returns when any one objects is signaled.

dwmillisecond :- time-out interval in millisecond.

```
(iv) Release semaphore (
          hsemaphore,
          lRelease count,
          lP Previous count.
    );
```

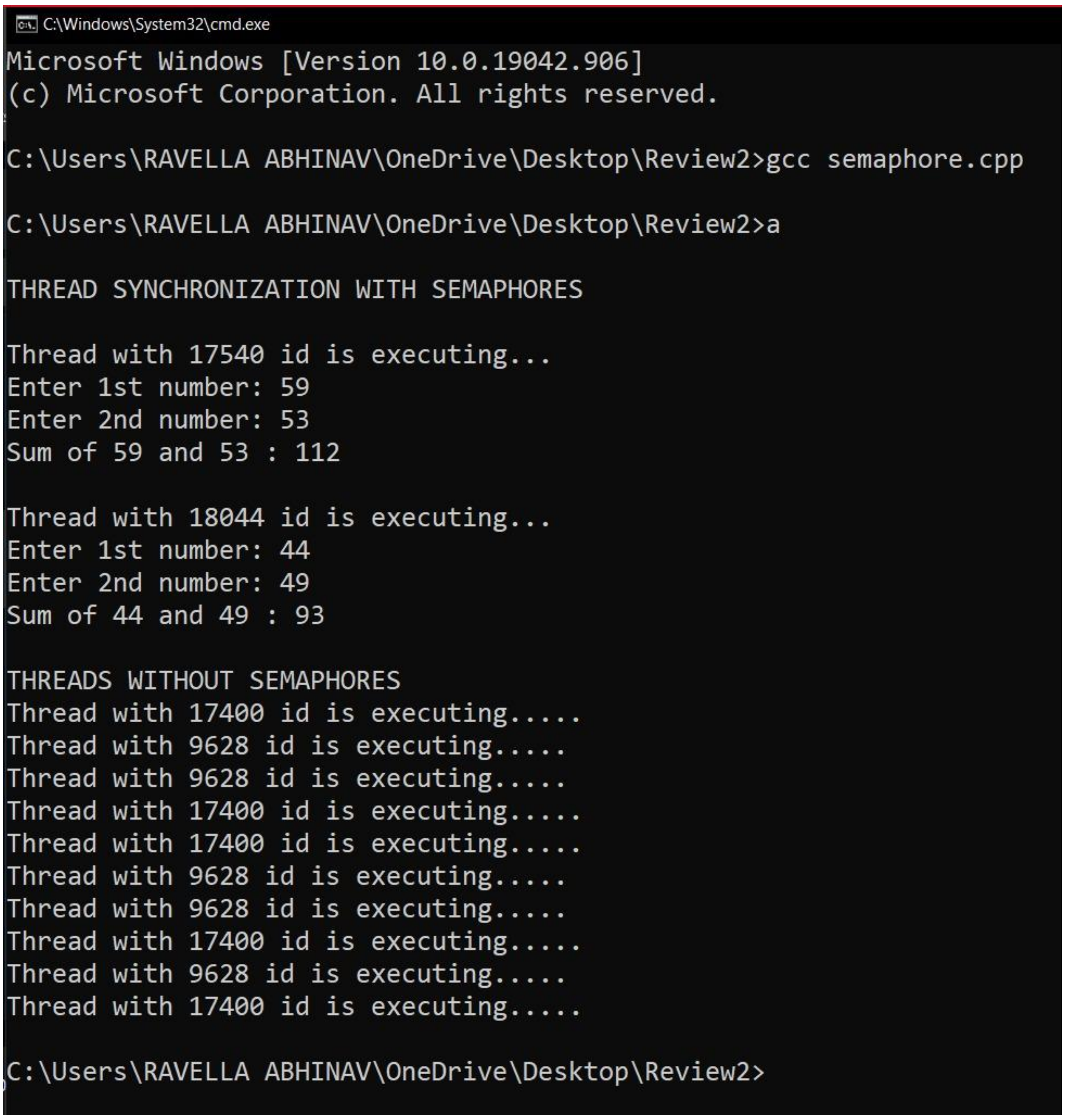
SYNCHRONIZATION

NAME	S.SHANTHAN REDDY
ROLL No.	CB.EN.U4CSE19459

```
#include <windows.h>
#include <stdio.h>

#define MAX_SEM_COUNT 4
#define THREADCOUNT 4

HANDLE ghSemaphore;
int num1, num2, sum;

DWORD WINAPI ThreadProcSemaphore( LPVOID lpParam )
{

    // lpParam not used in this example
    UNREFERENCED_PARAMETER(lpParam);

    DWORD dwWaitResult;
    BOOL bContinue=TRUE;

    while(bContinue)
    {
        // Try to enter the semaphore gate.

        dwWaitResult = WaitForSingleObject(
            ghSemaphore,   // handle to semaphore
            INFINITE);           // zero-second time-out interval

        switch (dwWaitResult)
        {
            // The semaphore object was signaled.
            case WAIT_OBJECT_0:
                // TODO: Perform
            printf("\nThread with %d id is executing...",
GetCurrentThreadId());
            printf("\nEnter 1st number: ");
            scanf("%d", &num1);

            printf("Enter 2nd number: ");
            scanf("%d", &num2);

            sum = num1 + num2;
            printf("Sum of %d and %d : %d\n", num1, num2, sum);


            bContinue=FALSE;

                // Release the semaphore when task is finished
```

```c
                if (!ReleaseSemaphore(
                        ghSemaphore,  // handle to semaphore
                        1,            // increase count by one
                        NULL) )       // not interested in previous count
                {
                    printf("ReleaseSemaphore error: %d\n", GetLastError());
                }
                break;

            // The semaphore was nonsignaled, so a time-out occurred.
            case WAIT_TIMEOUT:
                printf("Thread %d: wait timed out\n",
GetCurrentThreadId());
                break;
        }
    }
    return TRUE;
}

DWORD WINAPI ThreadProc( LPVOID lpParam )
{

    // lpParam not used in this example
    UNREFERENCED_PARAMETER(lpParam);
   int i;

   for( i=0; i < 5; i++)
   {
      Sleep(2);
      printf("Thread with %d id is executing..... \n",
GetCurrentThreadId());
   }

    /*printf("\nEnter 1st number: ");
    scanf("%d", &num1);

   printf("\nEnter 2nd number: ");
    scanf("%d", &num2);

    sum = num1 + num2;

    printf("Sum : %d", sum);*/

    return 0;
}

int main( void )
{
    HANDLE aThread[THREADCOUNT];
    DWORD ThreadID;
    int i;

    // Create a semaphore with initial and max counts of MAX_SEM_COUNT

    ghSemaphore = CreateSemaphore(
        NULL,           // default security attributes
        1,           // initial value
        1,          // no.of resources
        NULL);       // unnamed semaphore
    if (ghSemaphore == NULL)
    {
        printf("CreateSemaphore error: %d\n", GetLastError());
        return 1;
    }

    // Create worker threads

   printf("\nTHREAD SYNCHRONIZATION WITH SEMAPHORES\n");
    for( i=0; i < 2; i++ )
    {
        aThread[i] = CreateThread(
                     NULL,       // default security attributes
                     0,       // default stack size
                     &ThreadProcSemaphore,        //starting address of the
thread
                     NULL,       // no thread function arguments
                     0,          // default creation flags
                     &ThreadID); // receive thread identifier

        if( aThread[i] == NULL )
        {
            printf("CreateThread error: %d\n", GetLastError());
            return 1;
        }
    }

    // Wait for all threads to terminate

    WaitForMultipleObjects(
      2,         // number of object handles in the array
      aThread,          // array of object handles
      TRUE,           // function returns when the state of all objects in
the handles array is signaled
      INFINITE);      // time-out interval, in milliseconds

    // Close thread and semaphore handles

    for( i=0; i < 2; i++ )
        CloseHandle(aThread[i]);

    CloseHandle(ghSemaphore);


   printf("\nTHREADS WITHOUT SEMAPHORES\n");
   for( i=2; i < 4; i++ )
    {
        aThread[i] = CreateThread(
                     NULL,       // default security attributes
                     0,       // default stack size
                     (LPTHREAD_START_ROUTINE) ThreadProc,     //starting
address of the thread
                     NULL,       // no thread function arguments
                     0,          // default creation flags
                     &ThreadID); // receive thread identifier

        if( aThread[i] == NULL )
        {
            printf("CreateThread error: %d\n", GetLastError());
            return 1;
        }
    }

   WaitForSingleObject(
      aThread[2],    // handle to semaphore
        INFINITE);            // zero-second time-out interval

   WaitForSingleObject(
        aThread[3],    // handle to semaphore
        INFINITE);            // zero-second time-out interval


    return 0;
}
```

Output :



C:\Windows\System32\cmd.exe

```
Microsoft Windows [Version 10.0.19042.906]
(c) Microsoft Corporation. All rights reserved.

C:\Users\RAVELLA ABHINAV\OneDrive\Desktop\Review2>gcc semaphore.cpp

C:\Users\RAVELLA ABHINAV\OneDrive\Desktop\Review2>a

THREAD SYNCHRONIZATION WITH SEMAPHORES

Thread with 17540 id is executing...
Enter 1st number: 59
Enter 2nd number: 53
Sum of 59 and 53 : 112

Thread with 18044 id is executing...
Enter 1st number: 44
Enter 2nd number: 49
Sum of 44 and 49 : 93

THREADS WITHOUT SEMAPHORES
Thread with 17400 id is executing.....
Thread with 9628 id is executing.....
Thread with 9628 id is executing.....
Thread with 17400 id is executing.....
Thread with 17400 id is executing.....
Thread with 9628 id is executing.....
Thread with 9628 id is executing.....
Thread with 17400 id is executing.....
Thread with 9628 id is executing.....
Thread with 17400 id is executing.....

C:\Users\RAVELLA ABHINAV\OneDrive\Desktop\Review2>
```