National Textile University

Department of Computer Science

Subject: Operating System

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Reg. number: 23-NTU-CS-1170

Lab 6 (class task)

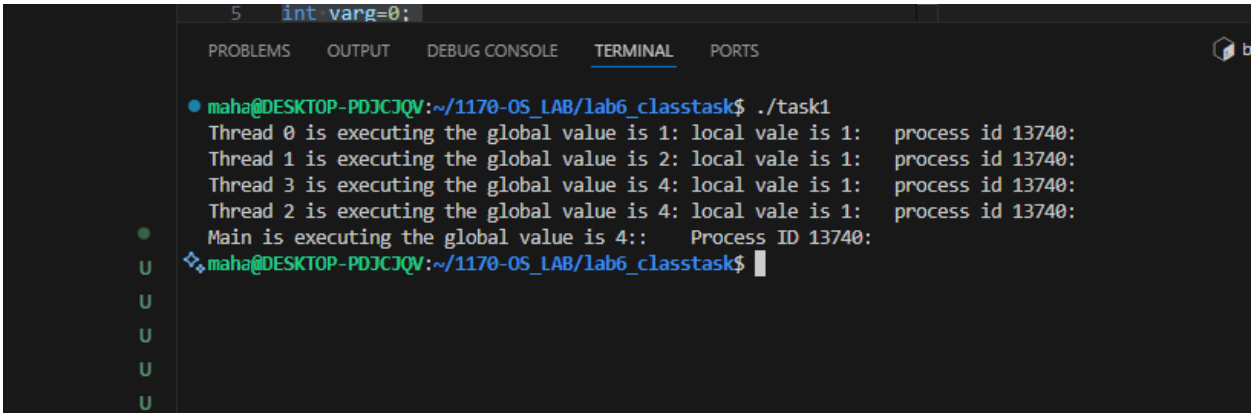
Semester:5th

Task 1:

Code:

```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
#define NUM_ITERATIONS 1000000

int count=10;

 pthread_mutex_t mutex; // mutex object

// Critical section function
void critical_section(int process) {
    //printf("Process %d is in the critical section\n", process);
    //sleep(1); // Simulate some work in the critical section
    if(process==0){

        for (int i = 0; i < NUM_ITERATIONS; i++)
        count--;
    }
    else
    {
        for (int i = 0; i < NUM_ITERATIONS; i++)
        count++;
    }
    //printf("Process %d has updated count to %d\n", process, count);
    //printf("Process %d is leaving the critical section\n", process);
}

// Peterson's Algorithm function for process 0
void *process0(void *arg) {

        pthread_mutex_lock(&mutex); // lock

        // Critical section
        critical_section(0);
        // Exit section

        pthread_mutex_unlock(&mutex); // unlock

    return NULL;
}

// Peterson's Algorithm function for process 1
void *process1(void *arg) {


        pthread_mutex_lock(&mutex); // lock

        // Critical section
        critical_section(1);
        // Exit section

        pthread_mutex_unlock(&mutex); // unlock


    return NULL;
}

int main() {
    pthread_t thread0, thread1, thread2, thread3;

    pthread_mutex_init(&mutex,NULL); // initialize mutex

    // Create threads
    pthread_create(&thread0, NULL, process0, NULL);
    pthread_create(&thread1, NULL, process1, NULL);
    pthread_create(&thread2, NULL, process0, NULL);
    pthread_create(&thread3, NULL, process1, NULL);

    // Wait for threads to finish
    pthread_join(thread0, NULL);
    pthread_join(thread1, NULL);
    pthread_join(thread2, NULL);
    pthread_join(thread3, NULL);

    pthread_mutex_destroy(&mutex); // destroy mutex

    printf("Final count: %d\n", count);

    return 0;
}
```

Terminal:

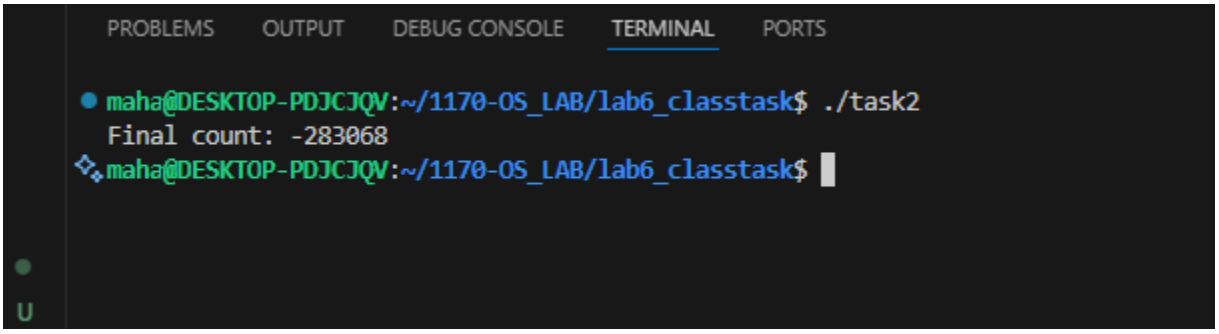


Question 2:

Code:

```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>

#define NUM_ITERATIONS 1000000
int count=10;
// Critical section function
void critical_section(int process) {
    //printf("Process %d is in the critical section\n", process);
    //sleep(1); // Simulate some work in the critical section
    if(process==0){
        for (int i = 0; i < NUM_ITERATIONS; i++)
        count--;
    }
    else
    {
        for (int i = 0; i < NUM_ITERATIONS; i++)
        count++;
    }

}
void *process0(void *arg) {
        // Critical section
        critical_section(0);
        // Exit section
    return NULL;
}
void *process1(void *arg) {
        // Critical section
        critical_section(1);
        // Exit section
    return NULL;
}
int main() {
    pthread_t thread0, thread1, thread2, thread3;
    // Create threads
    pthread_create(&thread0, NULL, process0, NULL);
    pthread_create(&thread1, NULL, process1, NULL);
    pthread_create(&thread2, NULL, process0, NULL);
    pthread_create(&thread3, NULL, process1, NULL);
    // Wait for threads to finish
    pthread_join(thread0, NULL);
    pthread_join(thread1, NULL);
    pthread_join(thread2, NULL);
    pthread_join(thread3, NULL);
    printf("Final count: %d\n", count);
    return 0;
}
```

Terminal:



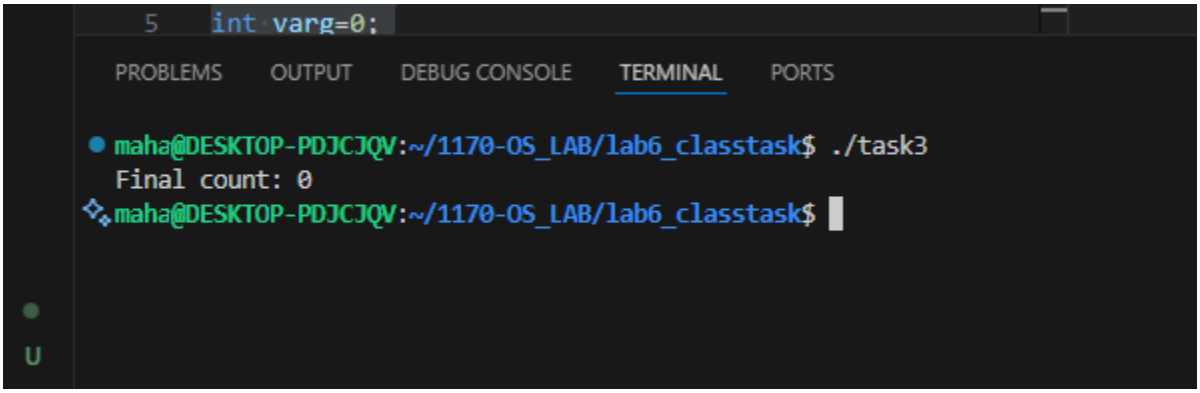
Question 3:

Peterson algorithm:

Code:

```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
#define NUM_ITERATIONS 100000
// Shared variables
int turn;
int flag[2];
int count=0;
// Critical section function
void critical_section(int process) {
    //printf("Process %d is in the critical section\n", process);
    //sleep(1); // Simulate some work in the critical section
    if(process==0){

        for (int i = 0; i < NUM_ITERATIONS; i++)
            count--;
    }
    else
    {
        for (int i = 0; i < NUM_ITERATIONS; i++)
            count++;

    }
   // printf("Process %d has updated count to %d\n", process, count);
    //printf("Process %d is leaving the critical section\n", process);
}

// Peterson's Algorithm function for process 0
void *process0(void *arg) {
         flag[0] = 1;
         turn = 1;
         while (flag[1]==1 && turn == 1) {
             // Busy wait
         }
         // Critical section
         critical_section(0);
         // Exit section
         flag[0] = 0;
         //sleep(1);
    pthread_exit(NULL);
}
// Peterson's Algorithm function for process 1
void *process1(void *arg) {

         flag[1] = 1;
         turn = 0;
         while (flag[0] ==1 && turn == 0) {
             // Busy wait
         }
         // Critical section
         critical_section(1);
         // Exit section
         flag[1] = 0;
         //sleep(1);
    pthread_exit(NULL);
}
int main() {
    pthread_t thread0, thread1;
    // Initialize shared variables
    flag[0] = 0;
    flag[1] = 0;
    turn = 0;
    // Create threads
    pthread_create(&thread0, NULL, process0, NULL);
    pthread_create(&thread1, NULL, process1, NULL);
    // Wait for threads to finish
    pthread_join(thread0, NULL);
    pthread_join(thread1, NULL);
    printf("Final count: %d\n", count);
    return 0;
}
```

Terminal:



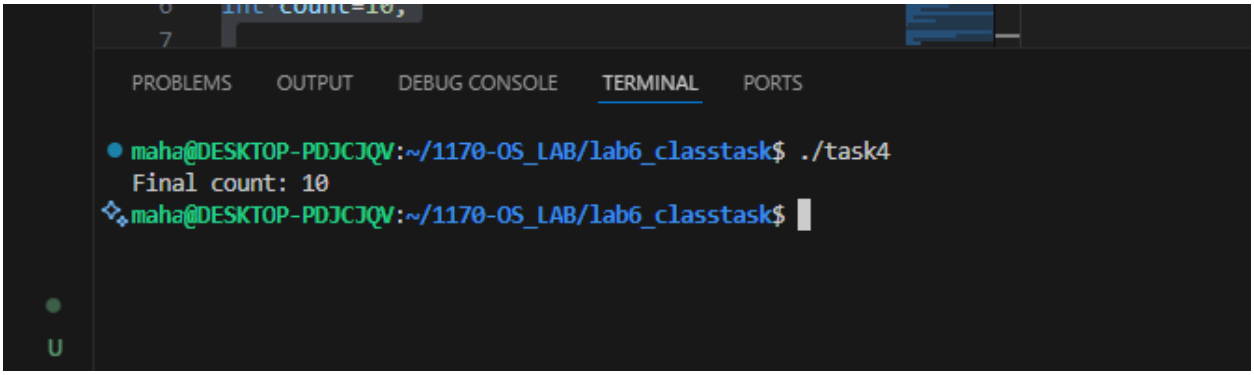
Question 4:

mutex locks

Code:

```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
#define NUM_ITERATIONS 100000
// Shared variables
int turn;
int flag[2];
int count=0;
// Critical section function
void critical_section(int process) {
    //printf("Process %d is in the critical section\n", process);
    //sleep(1); // Simulate some work in the critical section
    if(process==0){

        for (int i = 0; i < NUM_ITERATIONS; i++)
            count--;
    }
    else
    {
        for (int i = 0; i < NUM_ITERATIONS; i++)
            count++;

    }
   // printf("Process %d has updated count to %d\n", process, count);
    //printf("Process %d is leaving the critical section\n", process);
}

// Peterson's Algorithm function for process 0
void *process0(void *arg) {
        flag[0] = 1;
        turn = 1;
        while (flag[1]==1 && turn == 1) {
            // Busy wait
        }
        // Critical section
        critical_section(0);
        // Exit section
        flag[0] = 0;
        //sleep(1);
    pthread_exit(NULL);
}
// Peterson's Algorithm function for process 1
void *process1(void *arg) {

        flag[1] = 1;
        turn = 0;
        while (flag[0] ==1 && turn == 0) {
            // Busy wait
        }
        // Critical section
        critical_section(1);
        // Exit section
        flag[1] = 0;
        //sleep(1);
    pthread_exit(NULL);
}
int main() {
    pthread_t thread0, thread1;
    // Initialize shared variables
    flag[0] = 0;
    flag[1] = 0;
    turn = 0;
    // Create threads
    pthread_create(&thread0, NULL, process0, NULL);
    pthread_create(&thread1, NULL, process1, NULL);
    // Wait for threads to finish
    pthread_join(thread0, NULL);
    pthread_join(thread1, NULL);
    printf("Final count: %d\n", count);
    return 0;
}
```

Terminal:



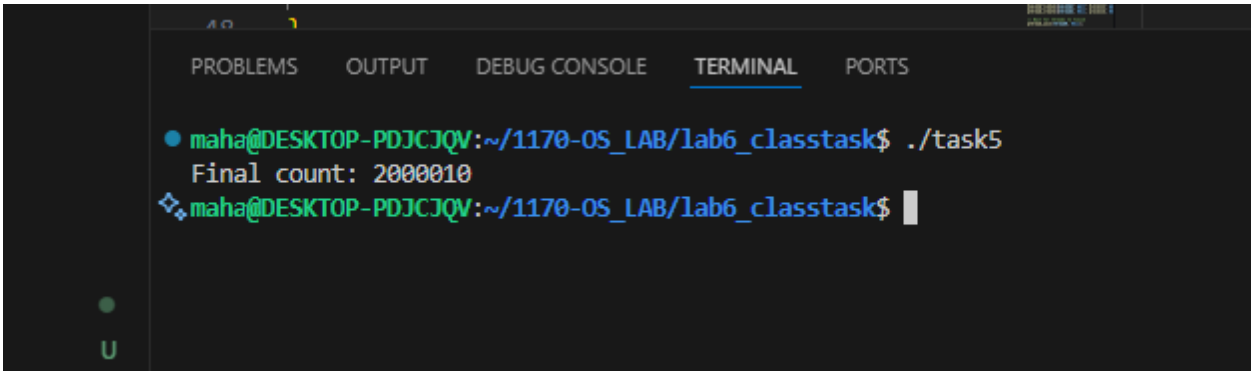
Question 5:

Do task4 with three process

Code:

```c
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
#define NUM_ITERATIONS 100000
// Shared variables
int turn;
int flag[2];
int count=0;
// Critical section function
void critical_section(int process) {
    //printf("Process %d is in the critical section\n", process);
    //sleep(1); // Simulate some work in the critical section
    if(process==0){

        for (int i = 0; i < NUM_ITERATIONS; i++)
            count--;
    }
    else
    {
        for (int i = 0; i < NUM_ITERATIONS; i++)
            count++;

    }
   // printf("Process %d has updated count to %d\n", process, count);
    //printf("Process %d is leaving the critical section\n", process);
}

// Peterson's Algorithm function for process 0
void *process0(void *arg) {
        flag[0] = 1;
        turn = 1;
        while (flag[1]==1 && turn == 1) {
            // Busy wait
        }
        // Critical section
        critical_section(0);
        // Exit section
        flag[0] = 0;
        //sleep(1);
    pthread_exit(NULL);
}
// Peterson's Algorithm function for process 1
void *process1(void *arg) {

        flag[1] = 1;
        turn = 0;
        while (flag[0] ==1 && turn == 0) {
            // Busy wait
        }
        // Critical section
        critical_section(1);
        // Exit section
        flag[1] = 0;
        //sleep(1);
    pthread_exit(NULL);
}
int main() {
    pthread_t thread0, thread1;
    // Initialize shared variables
    flag[0] = 0;
    flag[1] = 0;
    turn = 0;
    // Create threads
    pthread_create(&thread0, NULL, process0, NULL);
    pthread_create(&thread1, NULL, process1, NULL);
    // Wait for threads to finish
    pthread_join(thread0, NULL);
    pthread_join(thread1, NULL);
    printf("Final count: %d\n", count);
    return 0;
}
```

Terminal:



Compare Peterson and mutex locks:

Feature	Peterson's Algorithm	Mutex Lock
Type	Software-based	Hardware/library-based
Processes Supported	Only 2	Multiple
Implementation	Manual (flags & turn)	Simple API (`lock`, `unlock`)
Performance	Slow (busy waiting)	Fast (no busy waiting)
Use	Theoretical / Educational	Practical / Real-world
Fairness	Ensured	Depends on system
Deadlock Risk	No (if correct)	Yes (if misused)