National Textile University

Department of Computer Science

Subject:

Operating system

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Registration No:

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Lab No:

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Semester:

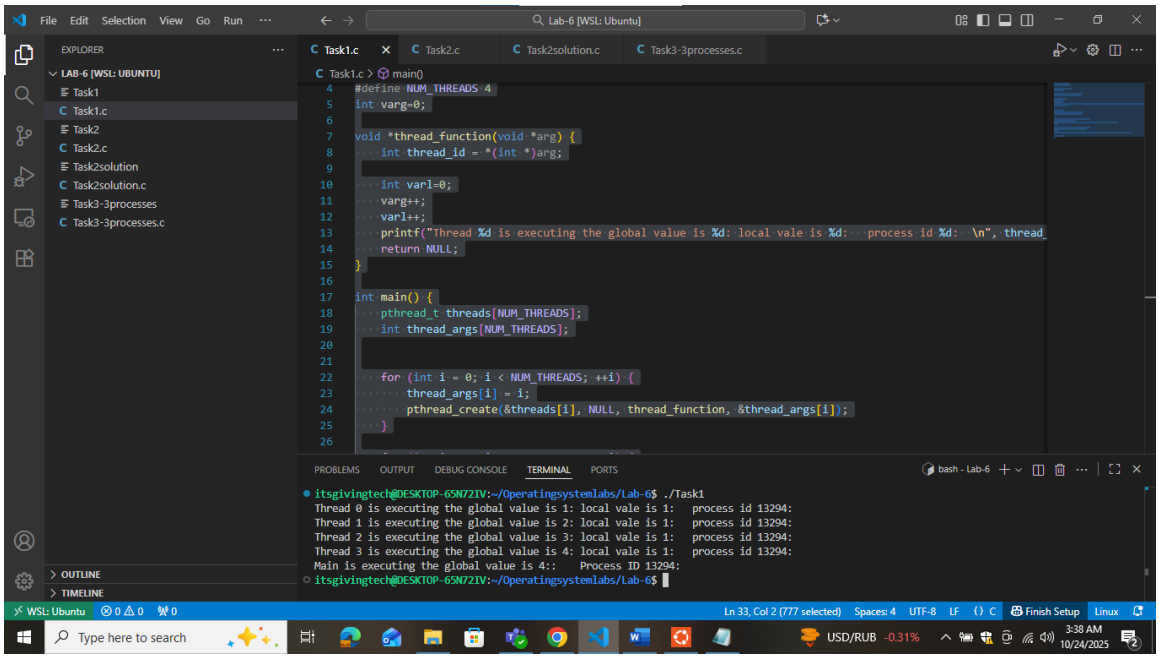
5th

Task1:

Code:

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

#define NUM_THREADS 4
int varg=0;

void *thread_function(void *arg) {
    int thread_id = *(int *)arg;

    int varl=0;
    varg++;
    varl++;
    printf("Thread %d is executing the global value is %d: local vale is
%d:   process id %d:  \n", thread_id,varg,varl,getpid());
    return NULL;
}

int main() {
    pthread_t threads[NUM_THREADS];
    int thread_args[NUM_THREADS];


    for (int i = 0; i < NUM_THREADS; ++i) {
        thread_args[i] = i;
        pthread_create(&threads[i], NULL, thread_function,
&thread_args[i]);
    }

    for (int i = 0; i < NUM_THREADS; ++i) {
        pthread_join(threads[i], NULL);
    }
    printf("Main is executing the global value is %d::    Process ID
%d:  \n",varg,getpid());

    return 0;
}
```

Output:



Task 2:

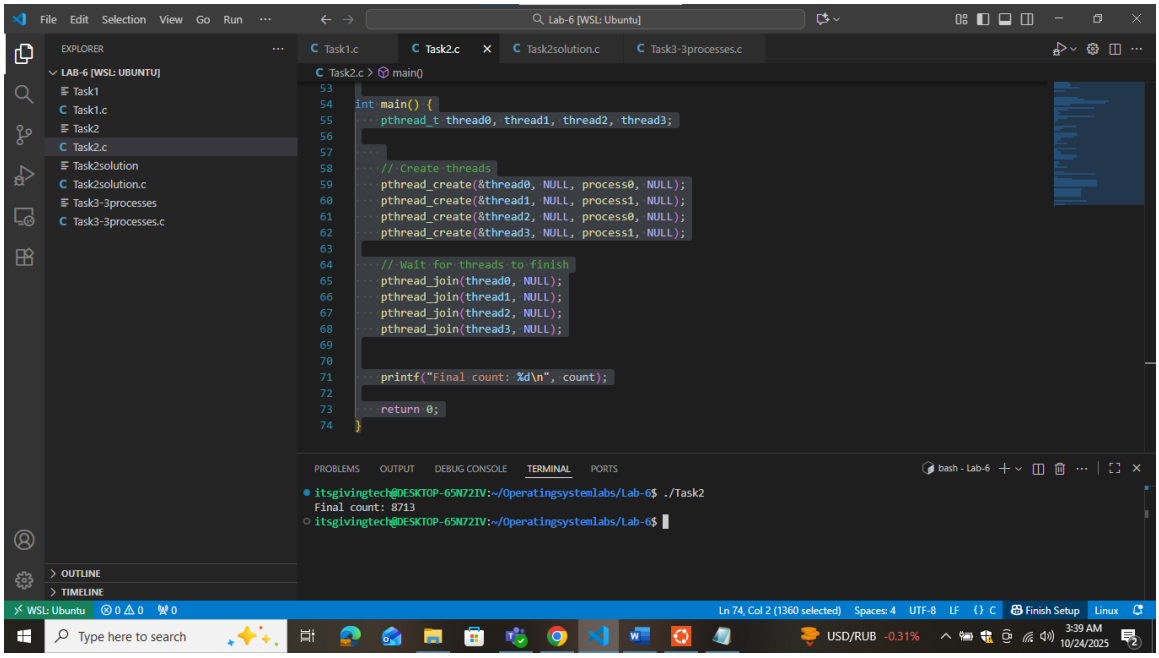
Code:

```
#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;
}
```

Output:



Task 3:

With peterson's algorithm

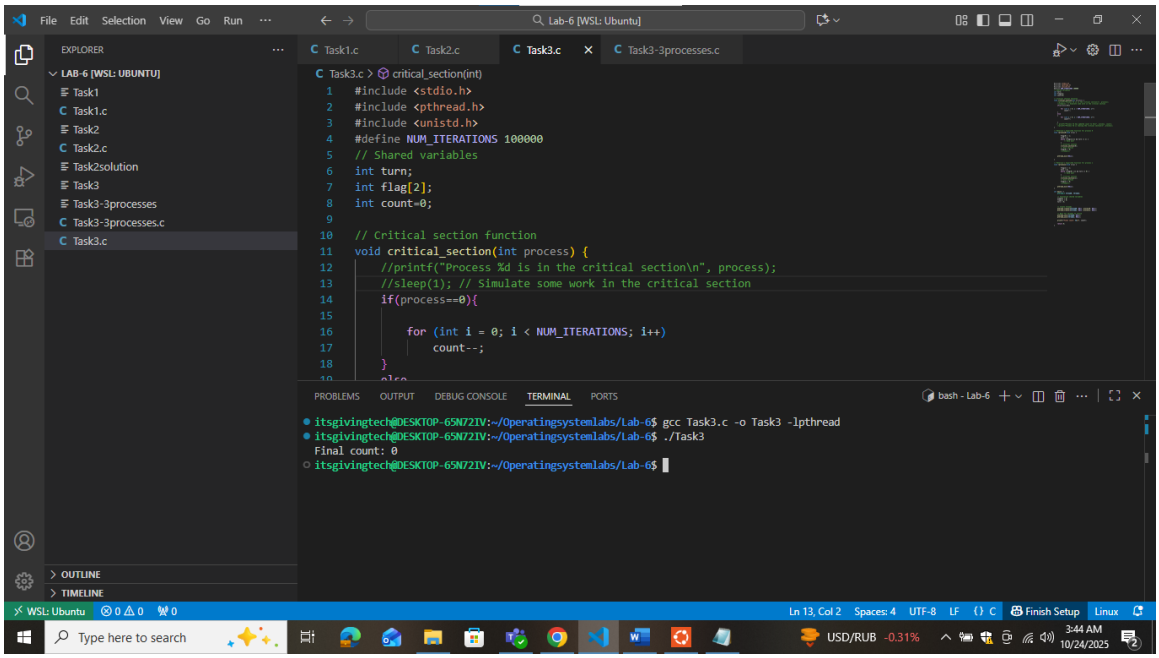
Code:

```
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
#define NUM_ITERATIONS 100000
// Shared variables
int turn;
int flag[2];
int count=0;
```

```c
// 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;
}
```

Output:



Task 4:

3 processes:

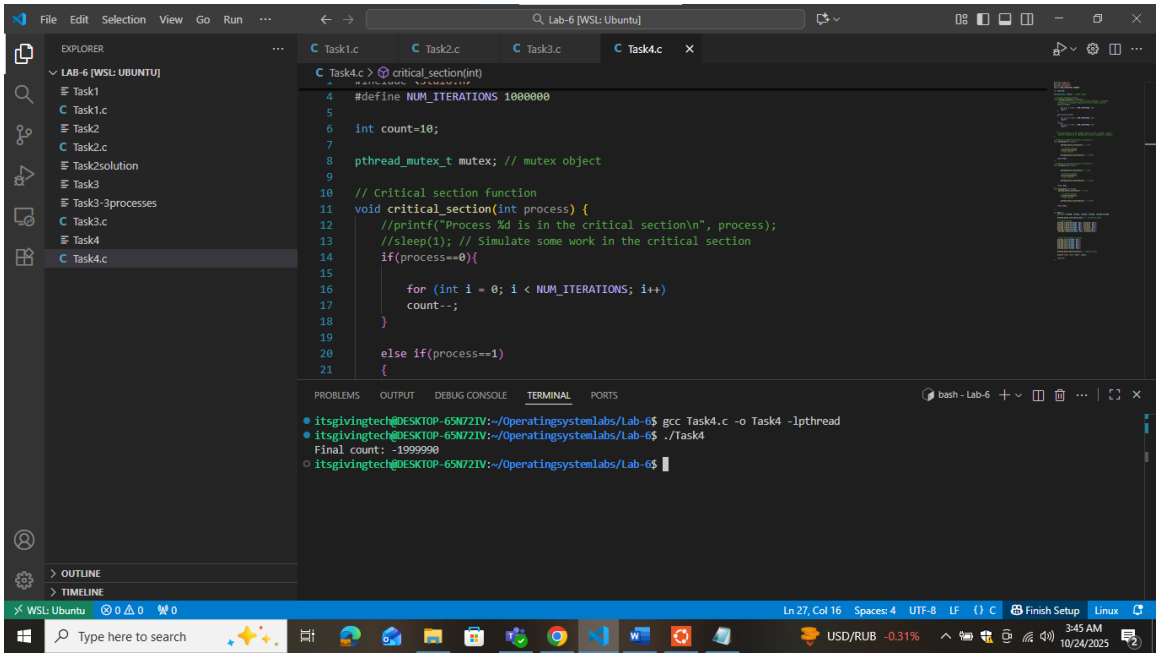
Code:

```
#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 if(process==1)
    {
        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;
}
void *process2(void *arg){
```

```
     pthread_mutex_lock(&mutex); // lock

        // Critical section
        critical_section(2);
        // Exit section

        pthread_mutex_unlock(&mutex); // unlock


    return NULL;

}

int main() {
    pthread_t thread0, thread1, thread2, thread3, thread4,thread5;

    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, process2, NULL);
    pthread_create(&thread3, NULL, process0, NULL);
    pthread_create(&thread4, NULL, process1,NULL);
     pthread_create(&thread5, NULL, process2,NULL);



    // Wait for threads to finish
    pthread_join(thread0, NULL);
    pthread_join(thread1, NULL);
    pthread_join(thread2, NULL);
    pthread_join(thread3, NULL);
    pthread_join(thread4, NULL);
    pthread_join(thread5, NULL);

    pthread_mutex_destroy(&mutex); // destroy mutex

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

    return 0;
}
```

output:



Remarks:

Difference between Mutex and Peterson algorithm:

Peterson's Algorithm	Mutex
A software-only method for handling mutual exclusion between two processes.	A built-in synchronization tool provided by the operating system.
Works only for **two processes** at a time.	Can easily handle **many processes or threads**.
Uses two shared variables (`flag` and `turn`) to decide which process enters the critical section.	Uses **lock** and **unlock** functions to control access automatically.
Wastes CPU time because processes keep checking (busy waiting) until they get access.	Doesn't waste CPU — threads simply wait until the lock is available.
Purely a **software solution** — doesn't rely on OS or hardware support.	Depends on the **operating system** and hardware for thread management.
Not very efficient; mainly used for understanding how synchronization works.	Much faster and efficient for real-world programs.
Harder to write and more error-prone.	Simple and easy to use with built-in thread libraries.
Mostly used for **learning and theory** in computer science.	Commonly used in **real applications and operating systems**.

Peterson's Algorithm	Mutex
Makes sure both processes take turns using the `turn` variable.	Fairness is managed by the OS; some systems add features like **priority control**.