



National Textile University

Department of Computer Science

Subject:
Operating system

Submitted to:

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Reg number:

23-NTU-CS-1139

Lab no:
6th

Semester:

5th

Task 1

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

```

C thread1.c
lab6 > C thread1.c
1 #include <stdio.h>
2 #include <pthread.h>
3
4 #define NUM_THREADS 4
5 int var=0;
6
7 void *thread_function(void *arg) {
8     int thread_id = *(int *)arg;
9
10    int var1=0;
11    var++;
12    var1++;
13    printf("Thread %d is executing the global value is %d: local vale is %d: process id %d: \n", thread_id,var,var1,getpid());
14    return NULL;
15 }
16
17 int main() {
18     pthread_t threads[NUM_THREADS];
19     int thread_args[NUM_THREADS];
20
21     for (int i = 0; i < NUM_THREADS; ++i) {
22         thread_args[i] = i;
23     }
24 }

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```

• arbaari@reeba:~/OSLABS$ cd lab6
• arbaari@reeba:~/OSLABS/lab6$ gcc thread1.c -o thread1
thread1.c: In function ‘thread_function’:
thread1.c:13:12: warning: implicit declaration of function ‘getpid’ [-Wimplicit-function-declaration]
   13 |     printf("Thread %d is executing the global value is %d: local vale is %d: process id %d: \n", thread_id,var,var1,^~~~~~
Main is executing the global value is 4: Process ID 24868:

```

arbaari@reeba:~/OSLABS/lab6\$./thread1
Thread 0 is executing the global value is 1: local vale is 1: process id 24868:
Thread 2 is executing the global value is 3: local vale is 1: process id 24868:
Thread 1 is executing the global value is 2: local vale is 1: process id 24868:
Thread 3 is executing the global value is 4: local vale is 1: process id 24868:

Remarks

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

The screenshot shows the Visual Studio Code interface with the following details:

- File Explorer:** Shows a tree view of files under "OSLABS [WSL: UBUNTU-24.04]". Visible files include lab4, lab5, lab6, and several thread-related files (thread1.c, thread2.c, thread3.c, thread4.c, thread5.c).
- Code Editor:** Two tabs are open: "thread.c" and "thread2.c".
- Terminal:** The terminal window at the bottom shows the following output:

```
arebari@Areba:~/OSLABS$ cd lab6
arebari@Areba:~/OSLABS/lab6$ gcc thread2.c -o thread2
arebari@Areba:~/OSLABS/lab6$ ./thread2
Final count: 22051
arebari@Areba:~/OSLABS/lab6$
```

Remarks

Task 3

Code

```
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
#define NUM_ITERATIONS 10000000
```

```
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++;
```

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1

1

}

“P” stands for A1 with $s_1 = s_2 = \dots = s_n = 0$.

```
// Peterson's Algorithm function for process 0
```

V

```
// Peterson's Algorithm function for process 0
```

```
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;
}

```

Output

The screenshot shows a terminal window with the following output:

```
arebaariq@Reeba:~/OSLABS$ cd lab6
arebaariq@Reeba:~/OSLABS/lab6$ gcc thread2.c -o thread2
arebaariq@Reeba:~/OSLABS/lab6$ ./thread2
Final count: 22051
arebaariq@Reeba:~/OSLABS/lab6$ gcc thread3.c -o thread3
arebaariq@Reeba:~/OSLABS/lab6$ ./thread3
Final count: 10
arebaariq@Reeba:~/OSLABS/lab6$
```

Remarks

Task 4

Code

```

#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;
}

```

Output

The screenshot shows the Visual Studio Code interface with the following details:

- EXPLORER:** Shows files in the OSLABS [WSL: UBUNTU-24.04] workspace, including lab4, lab5, and lab6, each containing multiple C files (thread1.c, thread2.c, etc.).
- CODE EDITOR:** Displays the content of thread4.c. The code implements Peterson's algorithm with two threads (thread0 and thread1) and shared variables (flag[0], flag[1], turn). It includes critical section locks and a sleep operation.
- TERMINAL:** Shows the terminal output of the program execution. The user runs `cd lab6` and `gcc thread2.c -o thread2` for thread2, resulting in a final count of 22951. Then, they run `gcc thread3.c -o thread3` and `gcc thread4.c -o thread4` for threads 3 and 4, respectively, both resulting in a final count of 18.
- STATUS BAR:** Shows the current file is main.c, the line number is 85, the column is 2, there are 1808 selected characters, and the encoding is UTF-8.

Remarks

This program uses **Peterson's Algorithm** to safely control access to a shared variable count between two threads. It ensures **mutual exclusion** using flags and a turn variable so both threads update count without race conditions. The final value of count confirms correct synchronization.

Task 6

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) {

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

// Process 0 (Decrement)
void *process0(void *arg) {

    pthread_mutex_lock(&mutex);

    critical_section(0);
```

```

pthread_mutex_unlock(&mutex);

return NULL;
}

// Process 1 (Increment)
void *process1(void *arg) {

    pthread_mutex_lock(&mutex);

    critical_section(1);

    pthread_mutex_unlock(&mutex);

    return NULL;
}

// ✅ New Process 2 (Increment)
void *process2(void *arg) {

    pthread_mutex_lock(&mutex);

    critical_section(2);

    pthread_mutex_unlock(&mutex);

    return NULL;
}

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

    pthread_mutex_init(&mutex, NULL);

    // Create threads (same pattern + 1 more)
    pthread_create(&thread0, NULL, process0, NULL);
    pthread_create(&thread1, NULL, process1, NULL);
    pthread_create(&thread2, NULL, process0, NULL);
    pthread_create(&thread3, NULL, process1, NULL);
    pthread_create(&thread4, NULL, process2, NULL); // 👉 new thread

    // 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_mutex_destroy(&mutex);

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

    return 0;
}

```

}

Output:



The screenshot shows a terminal window with several processes running. The processes are as follows:

- Process 0: ./thread2
- Process 1: ./thread3
- Process 2: ./thread3
- Process 3: ./thread4
- Process 4: ./thread4
- Process 5: ./thread5

Each process has a final count value displayed at the end of its output.

Remarks

This program uses **mutex locking** to protect a shared variable count during updates by multiple threads. Three different thread functions modify count by incrementing or decrementing it, while `pthread_mutex` prevents race conditions and ensures correct final output.