



# National Textile University

*Department of Computer Science*

**Subject:**

Operating Systems

**Submitted To:**

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**Registration No:**

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**Lab No:**

5

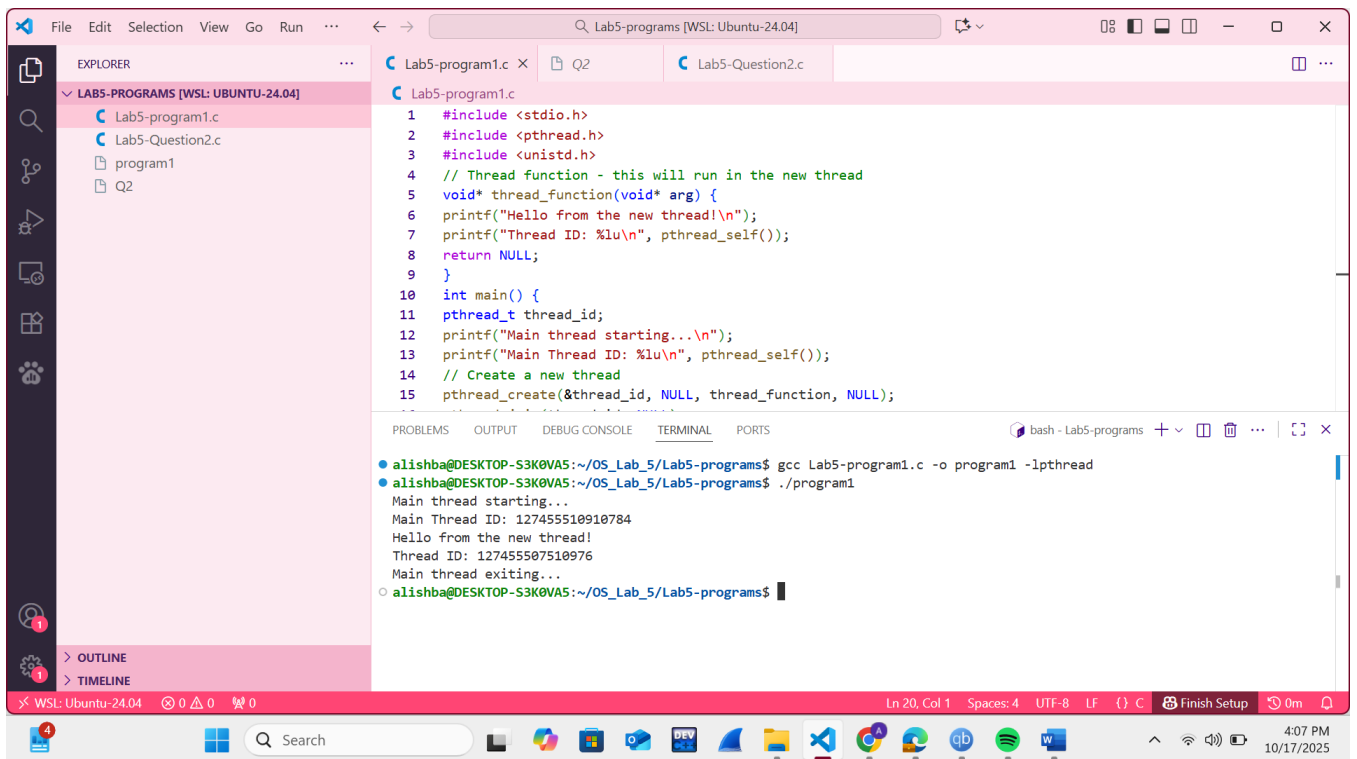
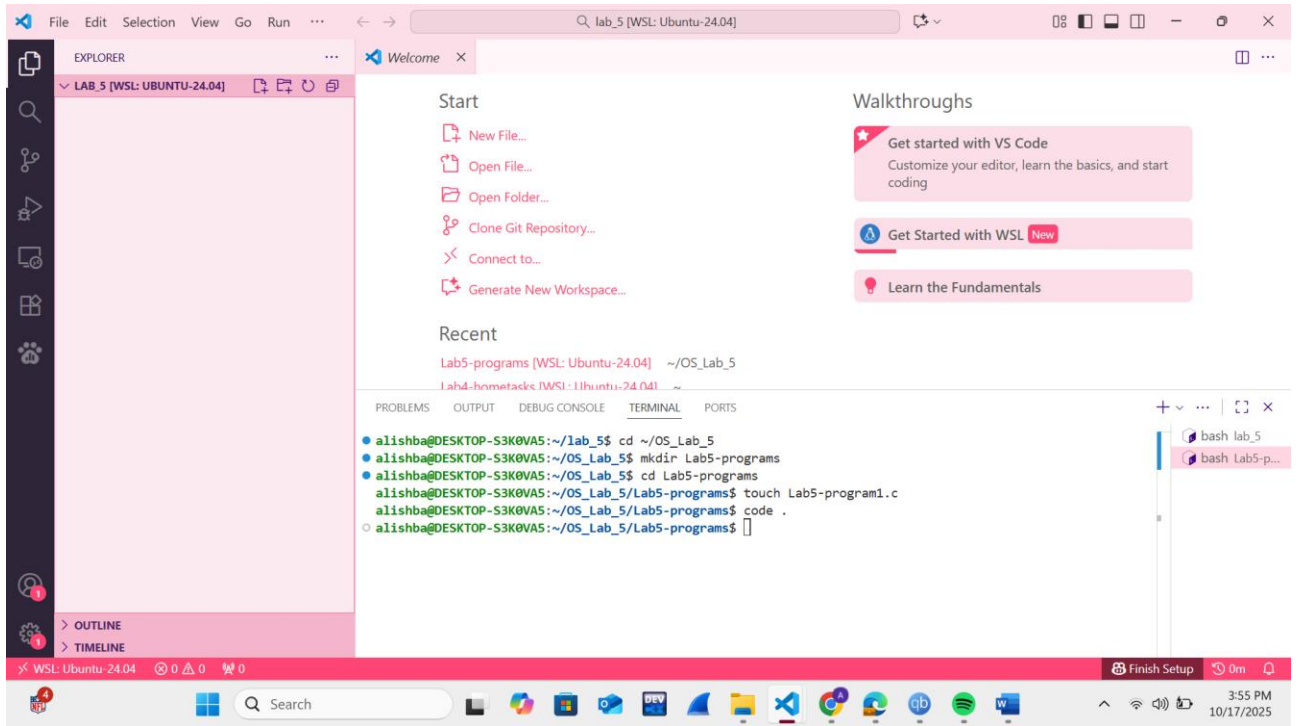
**Semester:**

5th

### 3. C Programs with Threads

#### Program 1:

```
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
// Thread function - this will run in the new thread
void* thread_function(void* arg) {
    printf("Hello from the new thread!\n");
    printf("Thread ID: %lu\n", pthread_self());
    return NULL;
}
int main() {
    pthread_t thread_id;
    printf("Main thread starting...\n");
    printf("Main Thread ID: %lu\n", pthread_self());
    // Create a new thread
    pthread_create(&thread_id, NULL, thread_function, NULL);
    pthread_join(thread_id, NULL);
    printf("Main thread exiting...\n");
    return 0;
}
```

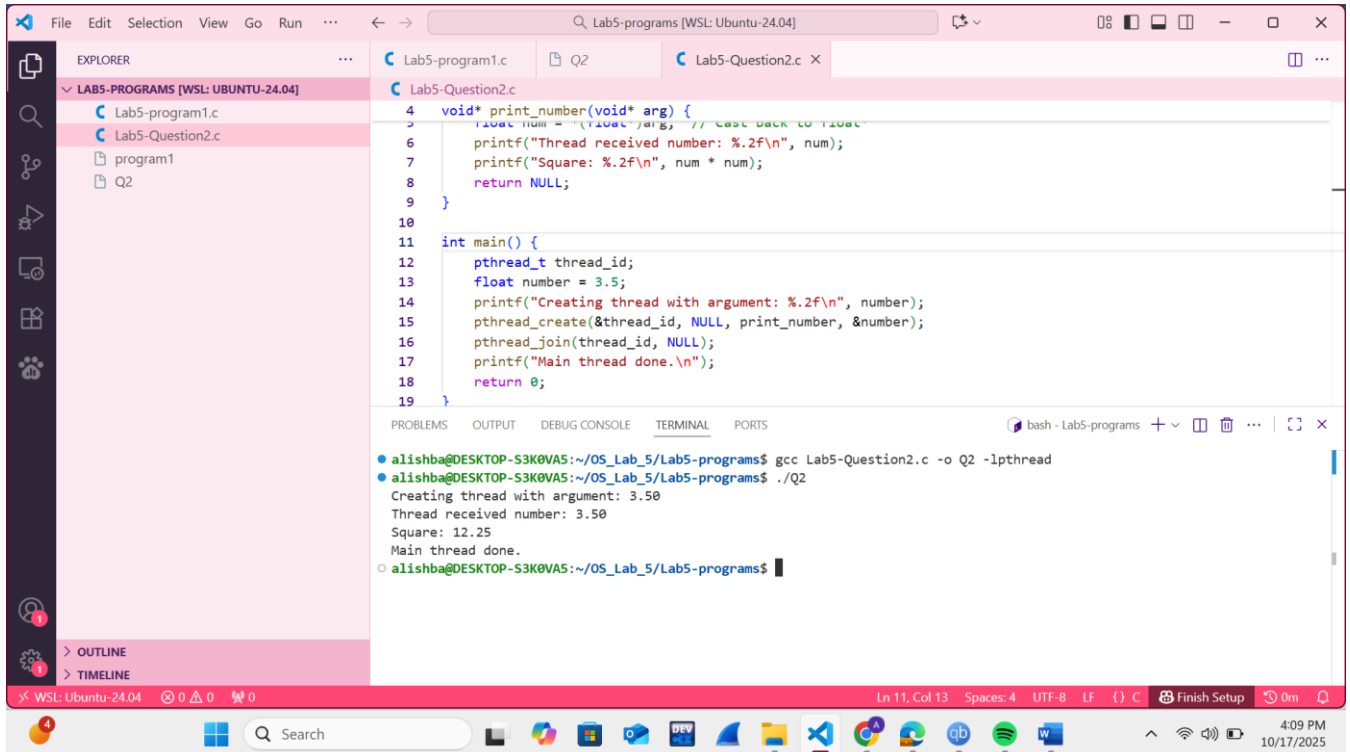


## Question No.2:

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

void* print_number(void* arg) {
    float num = *(float*)arg; // Cast back to float*
    printf("Thread received number: %.2f\n", num);
    printf("Square: %.2f\n", num * num);
    return NULL;
}

int main() {
    pthread_t thread_id;
    float number = 3.5;
    printf("Creating thread with argument: %.2f\n", number);
    pthread_create(&thread_id, NULL, print_number, &number);
    pthread_join(thread_id, NULL);
    printf("Main thread done.\n");
    return 0;
}
```



The screenshot displays the Visual Studio Code interface with the following components:

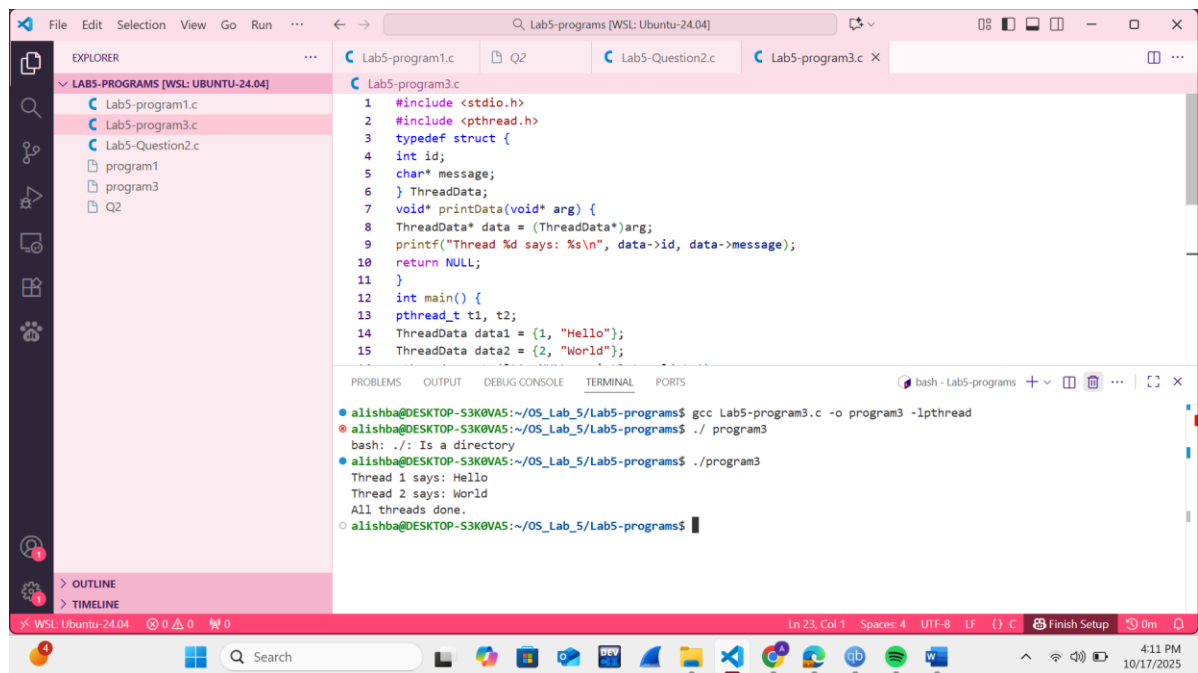
- EXPLORER:** Shows the file structure for 'LABS-PROGRAMS [WSL: UBUNTU-24.04]', including 'Lab5-program1.c', 'Lab5-Question2.c', 'program1', and 'Q2'.
- EDITOR:** Displays the source code for 'Lab5-Question2.c', which matches the code provided in the previous block.
- TERMINAL:** Shows the execution output:
  - Command: `gcc Lab5-Question2.c -o Q2 -lpthread`
  - Output:

```
Creating thread with argument: 3.50
Thread received number: 3.50
Square: 12.25
Main thread done.
```

The status bar at the bottom indicates the file is at 'Ln 11, Col 13' with 'Spaces: 4' and 'UTF-8' encoding. The system clock shows '4:09 PM 10/17/2025'.

## Program 3:

```
#include <stdio.h>
#include <pthread.h>
typedef struct {
    int id;
    char* message;
} ThreadData;
void* printData(void* arg) {
    ThreadData* data = (ThreadData*)arg;
    printf("Thread %d says: %s\n", data->id, data->message);
    return NULL;
}
int main() {
    pthread_t t1, t2;
    ThreadData data1 = {1, "Hello"};
    ThreadData data2 = {2, "World"};
    pthread_create(&t1, NULL, printData, &data1);
    pthread_create(&t2, NULL, printData, &data2);
    pthread_join(t1, NULL);
    pthread_join(t2, NULL);
    printf("All threads done.\n");
    return 0;
}
```



The screenshot shows the Visual Studio Code interface with the file explorer on the left displaying the project structure. The main editor window shows the source code for Lab5-program3.c, which is identical to the code provided above. The terminal at the bottom shows the compilation and execution of the program:

```
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$ gcc Lab5-program3.c -o program3 -lpthread
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$ ./program3
bash: ./: Is a directory
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$ ./program3
Thread 1 says: Hello
Thread 2 says: World
All threads done.
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$
```

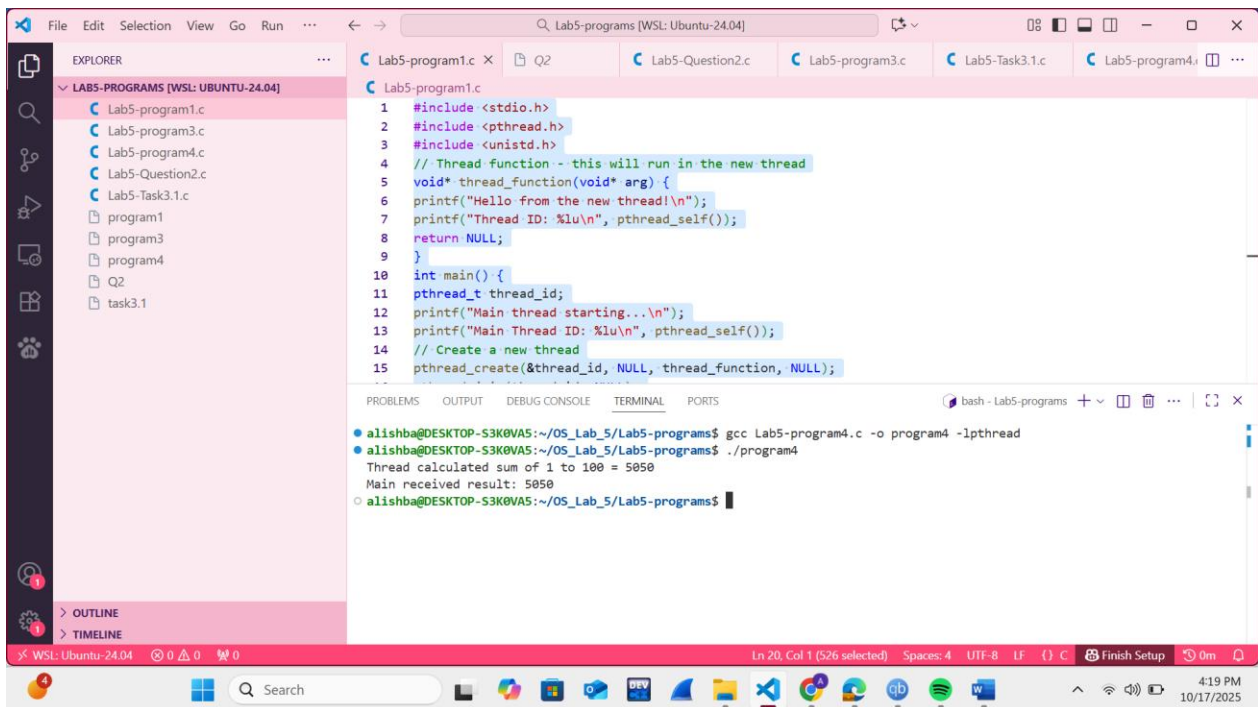
## Task 3.1 (Name & Cgpa)

```
#include <stdio.h>
#include <pthread.h>
typedef struct {
float id;
char* message;
} ThreadData;
void* printData(void* arg) {
ThreadData* data = (ThreadData*)arg;
printf("Thread %f says: %s\n", data->id, data->message);
return NULL;
}
int main() {
pthread_t t1;
ThreadData data1 = {1, "Alishba Riasat \n My CGPA is 3.5"};
pthread_create(&t1, NULL, printData, &data1);
pthread_join(t1, NULL);
printf("All threads done.\n");
return 0;
}
```

```
File Edit Selection View Go Run ... Lab5-programs [WSL: Ubuntu-24.04]
EXPLORER
LAB5-PROGRAMS [WSL: UBUNTU-24.04]
  Lab5-program1.c
  Lab5-program3.c
  Lab5-Question2.c
  Lab5-Task3.1.c
  program1
  program3
  Q2
  task3.1
Lab5-Task3.1.c
10 return NULL;
11 }
12 int main() {
13 pthread_t t1;
14 ThreadData data1 = {1, "Alishba Riasat \n My CGPA is 3.5"};
15 pthread_create(&t1, NULL, printData, &data1);
16 pthread_join(t1, NULL);
17 printf("All threads done.\n");
18 return 0;
19 }
20
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
bash - Lab5-programs
aishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$ gcc Lab5-Task3.1.c -o task3.1 -lpthread
aishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$ ./task3.1
Thread 1.000000 says: Alishba Riasat
My CGPA is 3.5
All threads done.
aishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$
Ln 19, Col 2 Spaces: 4 UTF-8 LF C Finish Setup 0m
```

## Program 4:

```
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
// Thread function - this will run in the new thread
void* thread_function(void* arg) {
    printf("Hello from the new thread!\n");
    printf("Thread ID: %lu\n", pthread_self());
    return NULL;
}
int main() {
    pthread_t thread_id;
    printf("Main thread starting...\n");
    printf("Main Thread ID: %lu\n", pthread_self());
    // Create a new thread
    pthread_create(&thread_id, NULL, thread_function, NULL);
    pthread_join(thread_id, NULL);
    printf("Main thread exiting...\n");
    return 0;
}
```



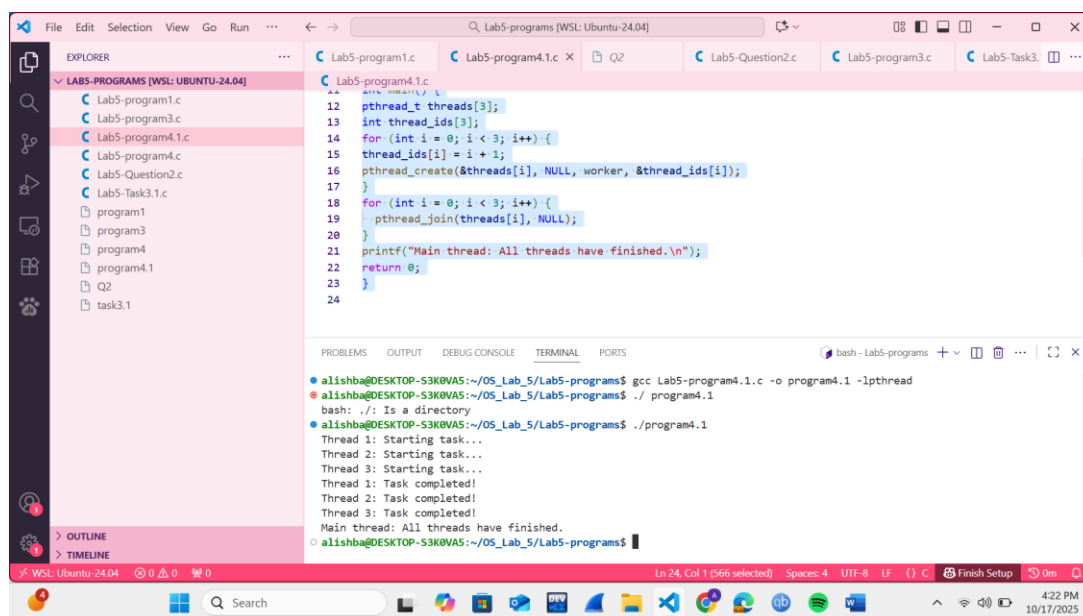
The screenshot shows the Visual Studio Code editor interface. The Explorer pane on the left displays the file structure for 'LAB5-PROGRAMS [WSL: UBUNTU-24.04]', including files like 'Lab5-program1.c', 'Lab5-program3.c', 'Lab5-program4.c', 'Lab5-Question2.c', 'Lab5-Task3.1.c', 'program1', 'program3', 'program4', 'Q2', and 'task3.1'. The main editor window shows the code for 'Lab5-program4.c', which is identical to the code provided in the previous block. The Output pane at the bottom shows the execution results of the program, including the compilation command, the execution of the program, and the printed output from both the main thread and the new thread.

```
bash - Lab5-programs
alishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$ gcc Lab5-program4.c -o program4 -lpthread
alishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$ ./program4
Main thread starting...
Main Thread ID: 5050
Hello from the new thread!
Thread ID: 5050
Main thread exiting...
alishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$
```

## 4. Basic Multithreading

### Program1:

```
#include <stdio.h>
#include <pthread.h>
#include <unistd.h>
void* worker(void* arg) {
    int thread_num = *(int*)arg;
    printf("Thread %d: Starting task...\n", thread_num);
    sleep(1); // Simulate some work
    printf("Thread %d: Task completed!\n", thread_num);
    return NULL;
}
int main() {
    pthread_t threads[3];
    int thread_ids[3];
    for (int i = 0; i < 3; i++) {
        thread_ids[i] = i + 1;
        pthread_create(&threads[i], NULL, worker, &thread_ids[i]);
    }
    for (int i = 0; i < 3; i++) {
        pthread_join(threads[i], NULL);
    }
    printf("Main thread: All threads have finished.\n");
    return 0;
}
```



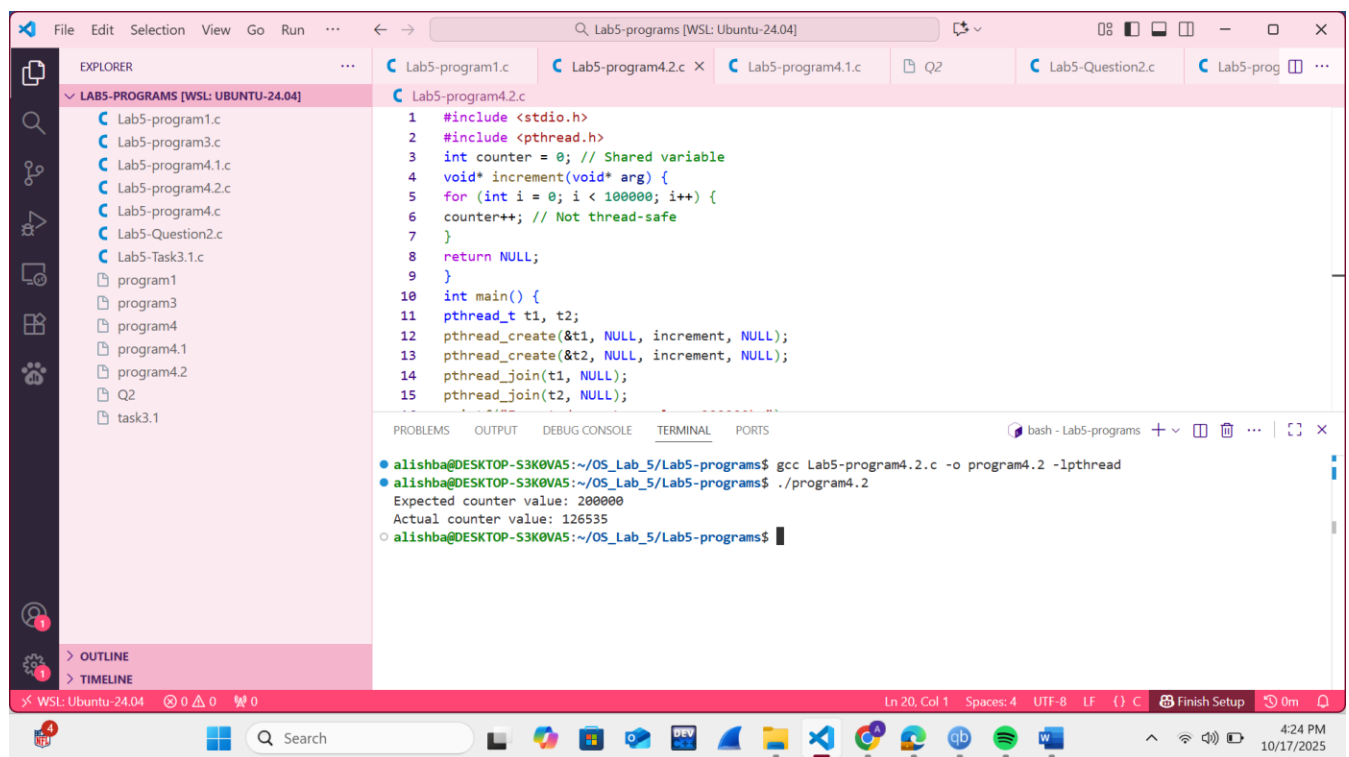
The screenshot shows the Visual Studio Code interface with the C program code in the editor and its execution output in the terminal. The code is the same as provided above. The terminal output shows the program being compiled and executed, with the following output:

```
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$ gcc Lab5-program4.1.c -o program4.1 -lpthread
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$ ./program4.1
bash: ./: Is a directory
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$ ./program4.1
Thread 1: Starting task...
Thread 2: Starting task...
Thread 3: Starting task...
Thread 1: Task completed!
Thread 2: Task completed!
Thread 3: Task completed!
Main thread: All threads have finished.
alishba@DESKTOP-S3K0VAS:~/OS_Lab_5/Lab5-programs$
```



## Program 2:

```
#include <stdio.h>
#include <pthread.h>
int counter = 0; // Shared variable
void* increment(void* arg) {
    for (int i = 0; i < 100000; i++) {
        counter++; // Not thread-safe
    }
    return NULL;
}
int main() {
    pthread_t t1, t2;
    pthread_create(&t1, NULL, increment, NULL);
    pthread_create(&t2, NULL, increment, NULL);
    pthread_join(t1, NULL);
    pthread_join(t2, NULL);
    printf("Expected counter value: 200000\n");
    printf("Actual counter value: %d\n", counter);
    return 0;
}
```



The screenshot shows the Visual Studio Code interface with a file explorer on the left and a code editor on the right. The file explorer displays a list of files under the 'LABS-PROGRAMS [WSL: UBUNTU-24.04]' directory, including 'Lab5-program1.c', 'Lab5-program3.c', 'Lab5-program4.1.c', 'Lab5-program4.2.c', 'Lab5-program4.c', 'Lab5-Question2.c', 'Lab5-Task3.1.c', 'program1', 'program3', 'program4', 'program4.1', 'program4.2', 'Q2', and 'task3.1'. The code editor displays the source code for 'Lab5-program4.2.c', which is identical to the code provided in the 'Program 2' section. Below the code editor, the 'TERMINAL' panel shows the execution of the program. The terminal output indicates that the program was compiled and executed successfully, resulting in an 'Actual counter value' of 126535, which is significantly lower than the 'Expected counter value' of 200000. The terminal also shows the user's prompt and the command used to run the program: 'aishba@DESKTOP-S3K0VA5:~/OS\_Lab\_5/Lab5-programs\$ ./program4.2'.

```
1 #include <stdio.h>
2 #include <pthread.h>
3 int counter = 0; // Shared variable
4 void* increment(void* arg) {
5     for (int i = 0; i < 100000; i++) {
6         counter++; // Not thread-safe
7     }
8     return NULL;
9 }
10 int main() {
11     pthread_t t1, t2;
12     pthread_create(&t1, NULL, increment, NULL);
13     pthread_create(&t2, NULL, increment, NULL);
14     pthread_join(t1, NULL);
15     pthread_join(t2, NULL);
16     printf("Expected counter value: 200000\n");
17     printf("Actual counter value: %d\n", counter);
18     return 0;
19 }
```

```
aishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$ gcc Lab5-program4.2.c -o program4.2 -lpthread
aishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$ ./program4.2
Expected counter value: 200000
Actual counter value: 126535
aishba@DESKTOP-S3K0VA5:~/OS_Lab_5/Lab5-programs$
```