

Operating Systems

LAB#08 (In-LAB Tasks)



23K-2001

BCS-4J

Q1:

Ubuntu 24.04.1 [Running] - Oracle VirtualBox

File Machine View Input Devices Help

Mar 26 15:04

serial_k232001.c
~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001

serial_k232001.c

```
1 #include<stdio.h>
2 #include<stdlib.h>
3
4 int main(){
5     long int n = 10000000;
6     float *A = (float *)malloc(n * sizeof(float));
7     float *B = (float *)malloc(n * sizeof(float));
8     float *C = (float *)malloc(n * sizeof(float));
9
10    for(long int i = 0; i < n; i++){
11        A[i] = 1.5;
12        B[i] = 1.5;
13        C[i] = A[i] + B[i];
14    }
15
16    printf("\nDone!");
17
18    free(A);
19    free(B);
20    free(C);
21    return 0;
22 }
```

muzammil@muzammil: ~/Desktop/Lab08_k232001/In-L... gedit concurrent_k232001.c

```
muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001$
gedit concurrent_k232001.c

muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001$
gcc serial_k232001.c -o serial
muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001$
./serial
muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001$
./serial

Done!muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001$
```

a) Serial Code:

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

int main(){
    long int n = 100000000;
    float *A = (float *)malloc(n * sizeof(float));
    float *B = (float *)malloc(n * sizeof(float));
    float *C = (float *)malloc(n * sizeof(float));

    for(long int i = 0; i < n; i++){
        A[i] = 1.5;
        B[i] = 1.5;
        C[i] = A[i] + B[i];
    }

    printf("\nDone!");

    free(A);
    free(B);
    free(C);
    return 0;
}
```

Ubuntu 24.04.1 [Running] - Oracle VirtualBox

File Machine View Input Devices Help

Mar 26 15:17

concurrent_k232001.c

~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001

concurrent_k232001.c

```
6 float *B;
7 float *C;
8
9 void *runner(void *param){
10     long int n = (long)(param);
11     for(int i=0;i<1000000;i++)
12         C[i+n] = A[i+n] + B[i+n];
13     pthread_exit(0);
14 }
15
16 int main(){
17     long int n = 10000000;
18     A = (float *)malloc(n * sizeof(float));
19     B = (float *)malloc(n * sizeof(float));
20     C = (float *)malloc(n * sizeof(float));
21
22     pthread_t worker[10];
23
24     for(int i = 0; i<10; i++){
25         long int range = i * 1000000;
26         pthread_create(&worker[i], NULL, runner, (void *)range);
27     }
28
29     for(int i = 0; i<10; i++)
30         pthread_join(worker[i], NULL);
31
32     printf("\nDone!");
33     free(A);
34     free(B);
35     free(C);
36     return 0;
37 }
```

muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001

muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$ gedit concurrent_k232001.c

muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$ gcc serial_k232001.c -o serial

muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$./serial

muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$./serial

Done!muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$ gcc concurrent_k232001.c -o concurrent

muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$./concurrent

Done!muzammil@muzammil:~/Desktop/Lab08_k232001/In-Lab Tasks/Q1_k232001\$

b) Concurrent code:

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

float *A;
float *B;
float *C;

void *runner(void *param){
    long int n = (long)(param);
    for(int i=0;i<10000000;i++)
        C[i+n] = A[i+n] + B[i+n];
    pthread_exit(0);
}

int main(){
    long int n = 10000000;
    A = (float *)malloc(n * sizeof(float));
    B = (float *)malloc(n * sizeof(float));
    C = (float *)malloc(n * sizeof(float));

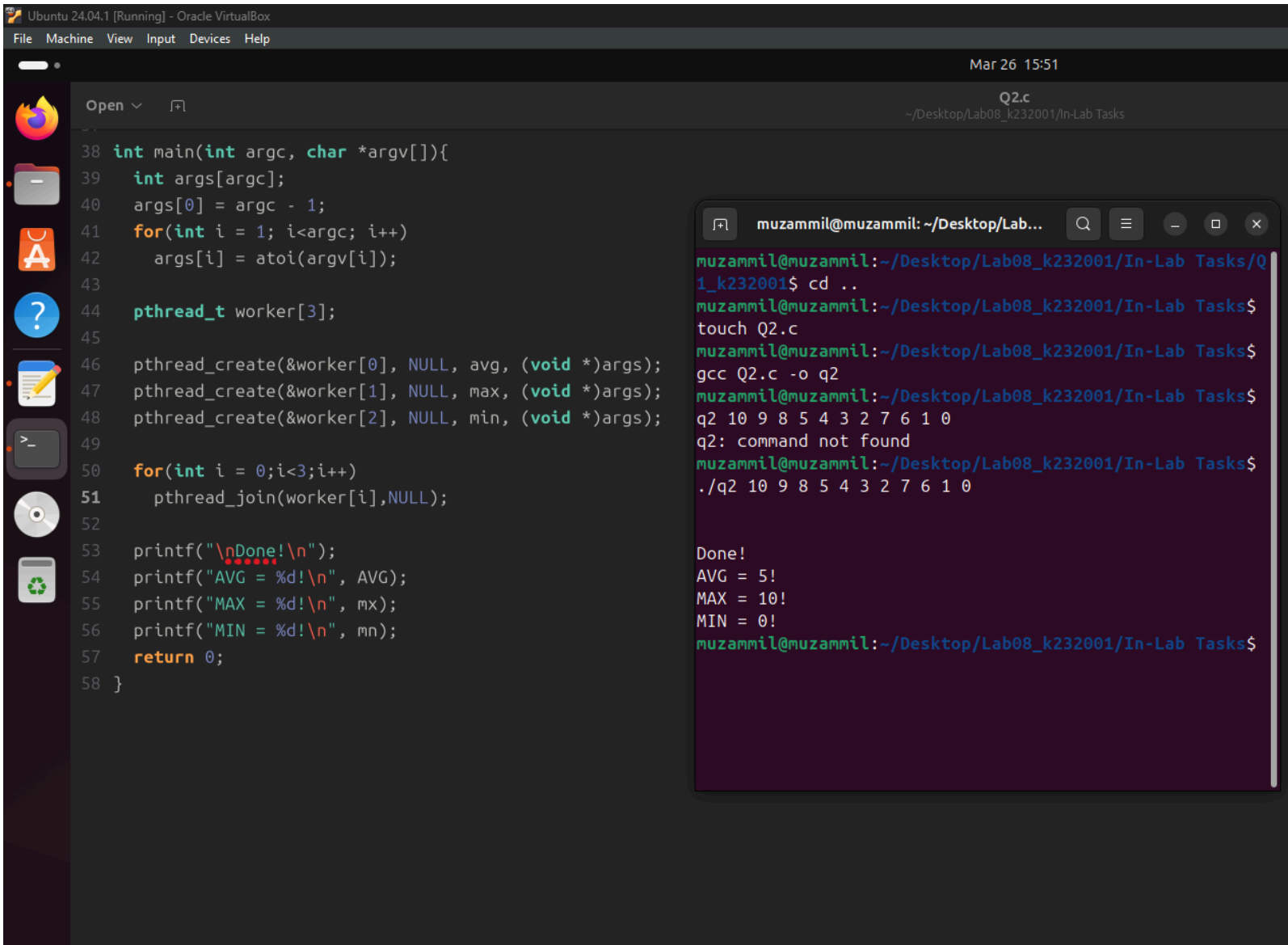
    pthread_t worker[10];

    for(int i = 0; i<10; i++){
        long int range = i * 1000000;
        pthread_create(&worker[i], NULL, runner, (void *)range);
    }

    for(int i = 0;i<10;i++)
        pthread_join(worker[i],NULL);

    printf("\nDone!");
    free(A);
    free(B);
    free(C);
    return 0;
}
```

Q2:



The image shows a code editor window in a virtual machine (Ubuntu 24.04.1) displaying a C program. The program uses pthreads to calculate the average, maximum, and minimum of an array of numbers. The code is as follows:

```
38 int main(int argc, char *argv[]){
39     int args[argc];
40     args[0] = argc - 1;
41     for(int i = 1; i<argc; i++){
42         args[i] = atoi(argv[i]);
43     }
44     pthread_t worker[3];
45
46     pthread_create(&worker[0], NULL, avg, (void *)args);
47     pthread_create(&worker[1], NULL, max, (void *)args);
48     pthread_create(&worker[2], NULL, min, (void *)args);
49
50     for(int i = 0; i<3; i++){
51         pthread_join(worker[i], NULL);
52     }
53     printf("\nDone!\n");
54     printf("AVG = %d!\n", AVG);
55     printf("MAX = %d!\n", mx);
56     printf("MIN = %d!\n", mn);
57     return 0;
58 }
```

On the right, a terminal window shows the execution of the program. The user navigates to the directory, compiles the program, and runs it, resulting in the following output:

```
muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks/Q
1_k232001$ cd ..
muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks$
touch Q2.c
muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks$
gcc Q2.c -o q2
muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks$
q2 10 9 8 5 4 3 2 7 6 1 0
q2: command not found
muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks$
./q2 10 9 8 5 4 3 2 7 6 1 0

Done!
AVG = 5!
MAX = 10!
MIN = 0!
muzammil@muzammil: ~/Desktop/Lab08_k232001/In-Lab Tasks$
```

```

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

int AVG, mx, mn;

void *avg(void *param){
    int *arr = (int *)param;
    int n = arr[0];
    int sum = 0;
    for(int i = 1; i<=n; i++){
        sum += arr[i];
    }
    AVG = sum/n;
    pthread_exit(0);
}

void *max(void *param){
    int *arr = (int *)param;
    int n = arr[0];
    mx = arr[1];
    for(int i = 2; i<=n; i++){
        if (arr[i] > mx)
            mx= arr[i];
    }
    pthread_exit(0);
}

void *min(void *param){
    int *arr = (int *)param;
    int n = arr[0];
    mn = arr[1];
    for(int i = 2; i<=n; i++){
        if (arr[i] < mn)
            mn = arr[i];
    }
    pthread_exit(0);
}

int main(int argc, char *argv[]){
    int args[argc];
    args[0] = argc - 1;
    for(int i = 1; i<argc; i++)
        args[i] = atoi(argv[i]);

    pthread_t worker[3];

```

```
pthread_create(&worker[0], NULL, avg, (void *)args);
pthread_create(&worker[1], NULL, max, (void *)args);
pthread_create(&worker[2], NULL, min, (void *)args);

for(int i = 0;i<3;i++)
    pthread_join(worker[i],NULL);

printf("\nDone!\n");
printf("AVG = %d!\n", AVG);
printf("MAX = %d!\n", mx);
printf("MIN = %d!\n", mn);
return 0;
}
```