

National University of Computer and Emerging Sciences, Lahore Campus



Course:	Operating Systems	Course Code:	CS 2006
Program:	BS(CS)	Semester:	Spring 2024
Section:	F,G,H	Total Marks:	50
Assignment:	2	Pages	(3)
Due Date:	24 March,2024		

Important Instructions:

1. Submit each question file named as your roll number along with the question number., i.e., 22L-1111_Q1.c. DO NOT ZIP YOUR FILES.
2. You are not allowed to copy solutions from other students. We will check your code for plagiarism using plagiarism checkers. If any sort of cheating is found, heavy penalties will be given to all students involved.
3. Late submission of your solution is not allowed.

Question 1: [15 marks]

Write a multithreaded program that calculates various statistical values for a list of numbers. This program will be passed a series of numbers on the command line and will then create three separate worker threads. One thread will determine the average of the numbers, the second will determine the maximum value, and the third will determine the minimum value. The array of numbers must be passed as parameter to threads, and the thread must return the calculated value to the main thread. The main thread will then print these values

Question 2: [25 marks]

Create a program that acts like a basic web server. This program should be able to receive requests from web browsers (client program in this case), figure out what files the browsers are asking for, read the data from those files and then send that data back to the browsers. The browsers (ie., client program) should be able to display the data after receiving it. Each request from a browser should be handled by a different part of the program (to be done through threads) to make sure things happen at the same time. Communication between client and server should be done through named pipes.

(You can make use of the sleep function for synchronization)

Sample Output

Client (Brower)

```
Got filename 'file.txt' from command line  
Sending filename to server  
Waiting for server to respond...  
Contents of file from pipe: 'abcdef'
```

Server

```
Waiting for client...  
Received filename:'file.txt'  
Thread created with ID: 1234  
Contents read from file: 'abcdef'  
Sending file contents to client  
Waiting for client...
```

Please note that the server will not terminate and will be waiting for other clients to send requests.

Question 3: [10 marks]

Write a program that will create a number N of threads specified in the command line, each of which prints out a hello message and its own thread ID. To see how the execution of the threads interleaves, make the main thread sleep for 1 second for every 4 or 5 threads it creates. The output of your code should be similar to:

```
I am thread 1. Created new thread (4) in iteration 0...  
Hello from thread 4 - I was created in iteration 0  
I am thread 1. Created new thread (6) in iteration 1...  
I am thread 1. Created new thread (7) in iteration 2...  
I am thread 1. Created new thread (8) in iteration 3...  
I am thread 1. Created new thread (9) in iteration 4...
```

I am thread 1. Created new thread (10) in iteration 5...

Hello from thread 6 - I was created in iteration 1

Hello from thread 7 - I was created in iteration 2

Hello from thread 8 - I was created in iteration 3

Hello from thread 9 - I was created in iteration 4

Hello from thread 10 - I was created in iteration 5

I am thread 1. Created new thread (11) in iteration 6...

I am thread 1. Created new thread (12) in iteration 7...

Hello from thread 11 - I was created in iteration 6

Hello from thread 12 - I was created in iteration 7

(hint: pthread_self() function to get thread id and pthread_exit() to exit the thread execution).

Please note the file manipulation is to be done through system calls only(open,read,write etc). There will be no credit if any other file manipulation method is used such as ofstream/ ifstream/ fscanf/ fgets/ fprintf/fputs etc.