CSE 321 Operating Systems
Lab Assignment 2
Total Marks: 20

Problem 1: Multithreaded Fibonacci Computation and Search [10 Marks]

Problem Statement:

You are tasked with implementing a multithreaded C program that performs the following two tasks using threads:

1. **Fibonacci Sequence Generation**
   The first thread should compute the Fibonacci sequence up to the n-th term (inclusive), where n is an integer input from the user. The result should be returned to the main thread using dynamic memory allocation.

2. **Fibonacci Value Search**
   The second thread should take the computed Fibonacci sequence and search for multiple terms specified by the user. For each search index, it should return the corresponding Fibonacci value if the index is valid, or -1 if the index is invalid.

Sample Input	Sample Output
Enter the term of fibonacci sequence: 8 How many numbers you are willing to search?: 3 Enter search 1: 0 Enter search 2: 4 Enter search 3: 10	a[0] = 0 a[1] = 1 a[2] = 1 a[3] = 2 a[4] = 3 a[5] = 5 a[6] = 8 a[7] = 13 a[8] = 21 result of search #1 = 0 result of search #2 = 3 result of search #3 = -1

Constraints:

- $0 \leq n \leq 40$

- The number of searches s must be greater than 0

- The search indices must be integers

Problem 2: The Sleeping ST Problem [10 Marks]

Problem Statement:

A **Student Tutor Consultation System** is being simulated using **POSIX threads (`pthread`)**, **semaphores**, and **mutexes**. In this system:

- **One ST is available** to provide consultation.

- **A total of 10 students** arrive at random intervals seeking consultation.

- **Only 3 waiting chairs** are available in the lobby for students waiting for consultation.

- If a student arrives and all chairs are occupied, they **leave** without receiving consultation.

- The ST **goes to sleep** when no students are waiting.

- If a student arrives while the ST is asleep, they **wake the ST up** and wait for consultation.

Your task is to **implement this synchronization system** ensuring that:

1. The ST serves one student at a time.

2. No race conditions occur when students enter the waiting area.

3. Proper synchronization is maintained using **semaphores** and **mutex locks**.

Sample Output 1
Student 0 started waiting for consultation A waiting student started getting consultation Number of students now waiting: 0 ST giving consultation Student 0 is getting consultation Student 1 started waiting for consultation Student 0 finished getting consultation and left Number of served students: 0 Student 2 started waiting for consultation

A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 1 is getting consultation
Student 3 started waiting for consultation
Student 4 started waiting for consultation
Student 1 finished getting consultation and left
Number of served students: 1
No chairs remaining in lobby. Student 5 Leaving.....
Student 5 finished getting consultation and left
Number of served students: 2
A waiting student started getting consultation
Number of students now waiting: 2
ST giving consultation
Student 2 is getting consultation
Student 6 started waiting for consultation
No chairs remaining in lobby. Student 7 Leaving.....
Student 7 finished getting consultation and left
Number of served students: 4
Student 2 finished getting consultation and left
Number of served students: 4
A waiting student started getting consultation
Number of students now waiting: 2
ST giving consultation
Student 3 is getting consultation
A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 4 is getting consultation
Student 8 started waiting for consultation
Student 3 finished getting consultation and left
Number of served students: 6
Student 9 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 2
ST giving consultation
Student 6 is getting consultation
A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 8 is getting consultation
Student 4 finished getting consultation and left
Number of served students: 8
A waiting student started getting consultation
Number of students now waiting: 0
ST giving consultation
Student 9 is getting consultation

Student 9 finished getting consultation and left
Number of served students: 9
Student 8 finished getting consultation and left
Number of served students: 9
Student 6 finished getting consultation and left
Number of served students: 10

Sample Output 2

Student 0 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 0
ST giving consultation
Student 0 is getting consultation
Student 1 started waiting for consultation
Student 0 finished getting consultation and left
Number of served students: 1
Student 2 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 1 is getting consultation
Student 1 finished getting consultation and left
Number of served students: 2
Student 3 started waiting for consultation
Student 4 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 2
ST giving consultation
Student 2 is getting consultation
Student 5 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 2
ST giving consultation
Student 3 is getting consultation
Student 6 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 2
ST giving consultation
Student 4 is getting consultation
Student 7 started waiting for consultation
Student 4 finished getting consultation and left
Number of served students: 5
A waiting student started getting consultation

Number of students now waiting: 2
ST giving consultation
Student 5 is getting consultation
Student 2 finished getting consultation and left
Number of served students: 6
Student 5 finished getting consultation and left
Number of served students: 6
A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 6 is getting consultation
Student 3 finished getting consultation and left
Number of served students: 7
Student 8 started waiting for consultation
A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 7 is getting consultation
Student 9 started waiting for consultation
Student 6 finished getting consultation and left
Number of served students: 8
Student 7 finished getting consultation and left
Number of served students: 8
A waiting student started getting consultation
Number of students now waiting: 1
ST giving consultation
Student 8 is getting consultation
A waiting student started getting consultation
Number of students now waiting: 0
ST giving consultation
Student 9 is getting consultation
Student 8 finished getting consultation and left
Number of served students: 10
Student 9 finished getting consultation and left
Number of served students: 10