National University

of Computer & Emerging Sciences-Lahore

CS3006– Parallel and Distributed Computing

Assignment 2

Deadline: Friday 15th, March 2024

Question No. 1:

Suppose an array of size N is to be mapped on P processes numbered as [p0, p1,....., p_{P-1}] using array-block-distribution scheme, then answer the following questions:

a) How many tasks/blocks will be there?
b) What will be the size of each block?
c) If block number starts from zero then, to which process number the i(th) block will be assigned?
d) Suppose array indexing starts from zero, what will be the starting index of the block assigned to i(th) process?
e) Suppose array indexing starts from zero, what will be the end index of the block assigned to i(th) process?

Question No. 2

Write a multithreaded program using **'Posix threads'** to perform matrix operations as instructed below. You will perform task decomposition as well as data decomposition. Your program should provide the following functionality. You must submit your code file on google classroom. Your assignment will be evaluated against it.

1. Take two matrices of size (m1 x n1) where 'm1' and 'n1' values are taken as input from the user through command line. Initialize the matrix by some random values or user input.
2. Then perform multiplication as described below
   - **i.** These tasks should be performed using data decomposition by assigning each row to a new thread.
   - **ii.** Mutual exclusion should be used to modify shared variables

Question No. 3

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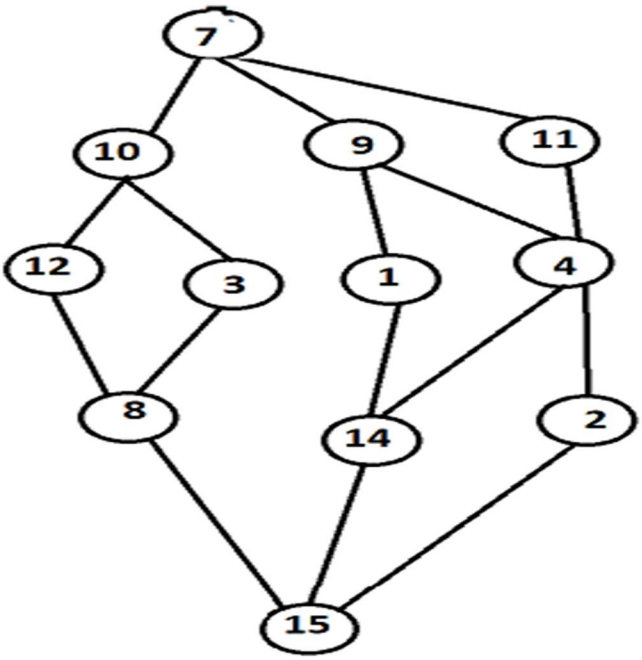

For the task graph given above, determine:

- Critical path
- Critical path length
- Maximum possible speedup assuming large number of processes are available
- Minimum number of processes needed to obtain the maximum possible speedup
- Maximum speed up if number of processes are limited to 4

Question No. 4: RECURSIVE DECOMPOSITION

Write a multithreaded program using **'Posix threads'** to perform matrix operations as instructed below.

You will perform task decomposition. Your program should provide the following functionality. You can paste your code in this document. Teaching assistant can ask any student/group to run the code, or he can conduct a viva to check the authenticity.

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1. Take a matrix of size (m x n) where 'm' and 'n' values are taken as input from the user. Initialize the matrix by some random values or user input.

2. Then take your student ID for the following.

- if the last digit of selected student ID is (0, 1 or 2) then create number of threads equal to number of columns 'n' and each thread will sort a column using Quick Sort in Ascending order.

- if the last digit of student ID is (3, 4 or 5) then create number of threads equal to number of columns 'n' and each thread will sort a column using Quick Sort in Descending order.

- if the last digit of student ID is (6 or 7) then create number of threads equal to number of rows m' and each thread will sort a row using Quick Sort in Ascending order.

- if the last digit of student ID is (8 or 9) then create number of threads equal to number of rows 'm and each thread will sort a row using Quick Sort In Descending order.

3. While the above can be easily completed using serial processing the requirement of this the assignment is to implement **Quick Sort** using Recursive decomposition. Each subtask will need to be done by a new thread.

4. At the end each thread should add all values of the column/row that is being sorted and the resultant number will be added to Matrix addition which is the sum of all values of the matrix.

Let's take the scenario of **(4x4)** matrix for first batch of students.

3	5	32	80
23	11	9	15
20	7	14	26
4	17	2	7

(Input Matrix)

3	5	2	7
4	7	9	15
20	11	14	26
23	17	32	80

(Output Matrix)

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Matrix Addition = 275

NOTE: Kindly submit your assignment on Google Classroom. Each file contains your roll number. Submit your assignment in Zip form with proper naming/roll no.