

Assignment-1

Parallel and Distributed Computing

Last Date of Submission: 01/04/2023

~~01/04/2022~~

1. What is meant by Bernstein conditions ? Find out Bernstein Condition in the following example :

P1: $A=B \times C$

P2: $C=D+E$

P3: $C=A+B$

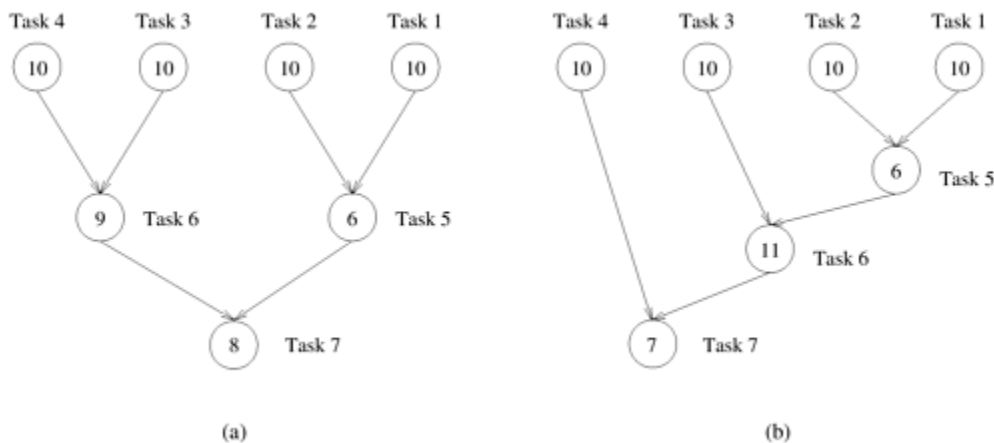
P4: $E=F-D$

P5: $H=I+J$

2. With the help of a diagram, illustrate the concept of sorting using comparators for the unsorted list having the following elements:

4, 5, 9, 11, 95, 7, 23, 46, 39, 12, 6, and 18

3. Calculate the max number of concurrency in a given dependency graph



4. Imagine that we want to evaluate the following expression for seven sets of values: $A_i \times B_i + C_i$, for $i = 1, 2, 3, \dots, 7$ • Each sub operation can be implemented by a different segment within the pipeline.

5. Extending this further, consider the problem of multiplying two dense matrices of dimension $4K \times 4K$. What is the peak achievable performance using a three-loop dotproduct based formulation? (Assume that matrices are laid out in a row-major fashion.)

```
/* matrix-matrix product loop */  
for (i = 0; i < dim; i++)  
    for (j = 0; j < dim; j++)  
        for (k = 0; k < dim; k++)  
            c[i][j] += a[i][k] * b[k][j];
```

6. The four PRAM models (EREW, CREW, ERCW, and CRCW), which model is the most powerful? Why?
7. The labels in a d -dimensional hypercube use d bits. Fixing any k of these bits, show that the nodes whose labels differ in the remaining $d - k$ bit positions form a $(d - k)$ -dimensional subcube composed of $2^{(d-k)}$ nodes.
8. Define 8×8 Benes networks of 4 stages in detail.
9. Assume $n=2^k$ processors are connected by an Omega network. Design an algorithm to route a message from processor I to processor J (Hint: Represent the destination address j as a binary number).
10. Determine the number of clock cycles that it takes to process 200 tasks in a six-segment pipeline.

*****All the Best*****