EE/CSCI 451
Fall 2020
Homework 8

Assigned: October 16, 2020
Due: October 22, 2020, AOE
Total Points: 100

YOU DO NOT NEED TO SUBMIT THIS HOMEWORK.

1 [10 points]

Explain the following terms:

- Task dependency graph
- Block distribution
- Master-slave model
- Owner-computes rule
- Critical path length

2 [10 points]

Perform a level-by-level ordering of the task dependency graph given in Figure 1 and show the level that each node (i.e., task) belongs to.

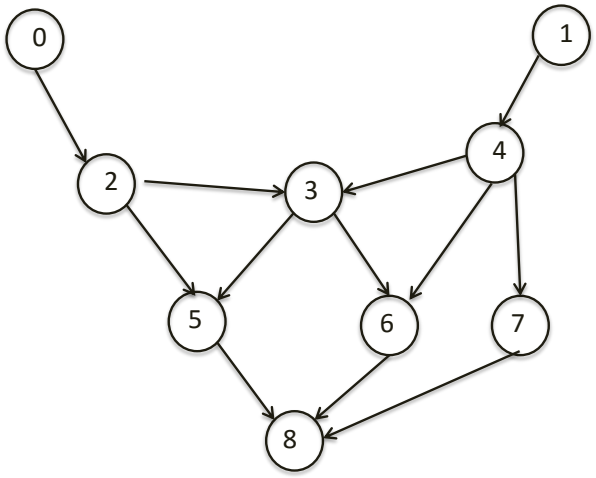

Figure 1: Problem 2

3 [12 points]

For the task dependency graphs shown in Figure 2, determine the following:

- Maximum degree of concurrency
- Critical path length
- Maximum achievable speedup over one process assuming that an arbitrarily large number of processes is available

Assume each task is of unit size.

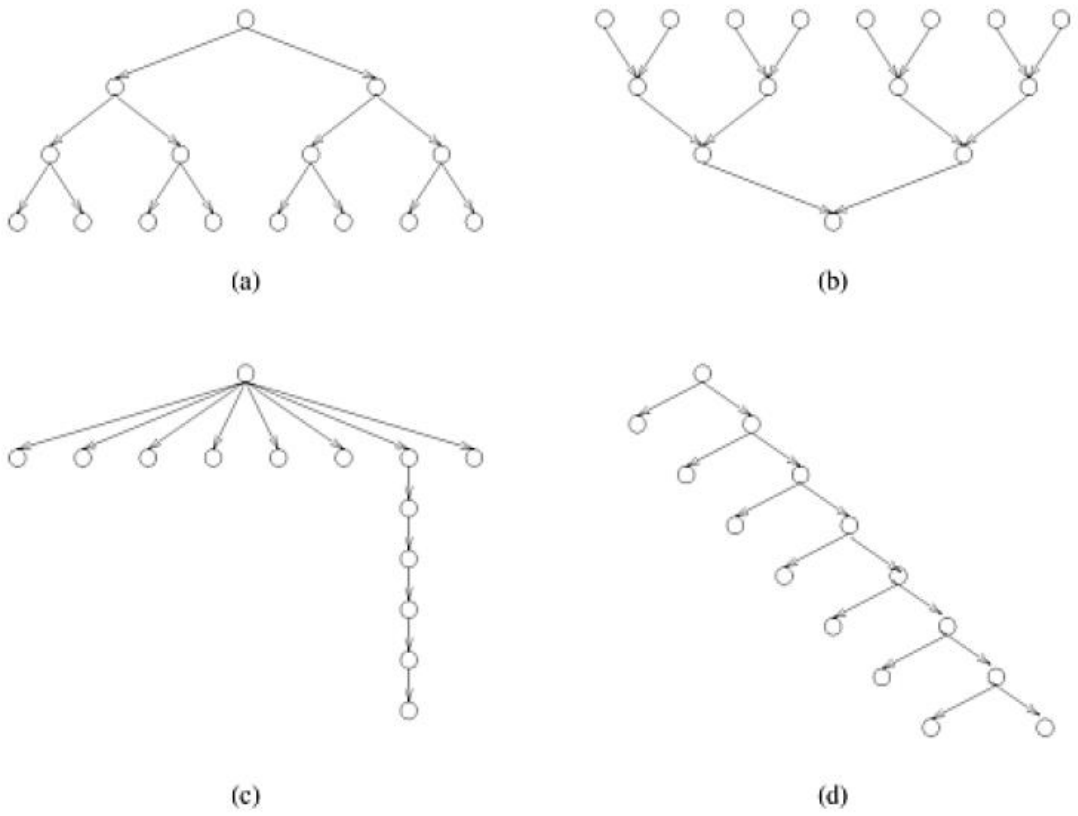

Figure 2: Problem 3

4 [18 points]

Suppose there are 4 processes and suppose that $\mathbf{x}$ is a vector with $n = 24$ elements.

- How would the elements of $\mathbf{x}$ be distributed among the processes in a program that uses the block distribution?
- How would the elements of $\mathbf{x}$ be distributed among the processes in a program that uses the cyclic distribution?
- How would the elements of $\mathbf{x}$ be distributed among the processes in a program that uses a block-cyclic distribution with block size of 2?

5 [20 points]

Consider an array of n elements which is distributed among p processes using (i) block distribution and (ii) cyclic distribution. Assume n and p are powers of 2 and the amount of work performed on the i^{th} element, $0 \leq i \leq n-1$, of the array is $i+1$ units.

- For $n = 16$ and $p = 4$, calculate the total units of work done by each process using (i) block distribution and (ii) cyclic distribution.

	Block distribution	Cyclic distribution
Process 0		
Process 1		
Process 2		
Process 3		

- Derive exact expressions for the total work done by the j^{th} process ($0 \leq j \leq p-1$) where the n elements are distributed using (i) block distribution and (ii) cyclic distribution (n and p are powers of 2).

6 [10 points]

Consider seven tasks with running times of 1, 2, 3, 4, 5, 5, and 10 units, respectively. Assuming that it does not take any time to assign work to a process, compute the best-case and worst-case speedup for a centralized scheme using dynamic mapping with two processes.