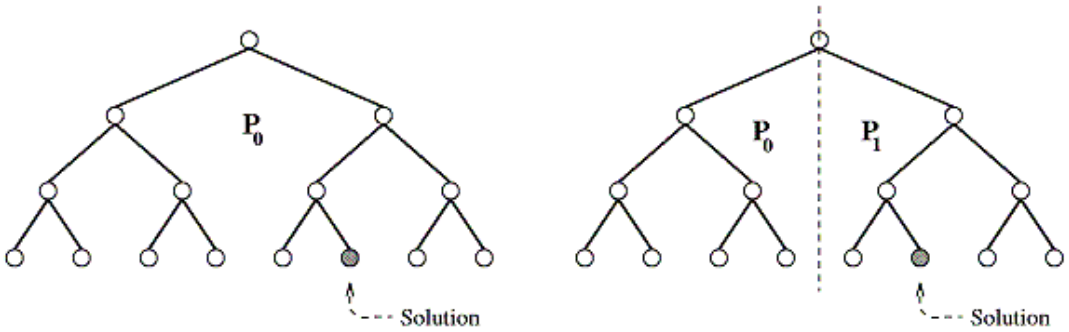
CS546 "Parallel and Distributed Processing"
Homework 1

Submission:
Due by 03:30pm of 09/23/2021

Late penalty: 10% penalty for each day late
Please upload your assignment on Blackboard with the following name:
CS546_SectionNumber_LastName_FirstName_HW1.
Please do NOT email your assignment to the instructor and/or TA!

1. What are the two main styles of parallelism? Explain.
2. What are the two main types of locality? Explain.
3. What are the three basic programming paradigms for parallel processing? Explain.
4. Discuss the difference between shared address space machines and distributed address space machines. Discuss the advantages and disadvantages of both architectures.
5. What is parallel I/O? Why do need parallel I/O?
6. Give two examples of anti-dependence and give the corresponding solutions to remove the dependence.
7. Consider the search tree shown in the following figure, in which the dark node represents the solution.



(a) DFS with one processor (b) DFS with two processors

   a) If a sequential search of the tree is performed using the standard depth-first search (DFS) algorithm, how much time does it take to find the solution if traversing each arc of the tree takes one unit of time? Note: check this on how DFS works.
   b) Assume that the tree is partitioned between two processing elements that are assigned to do the search job, as shown in figure b. If both processing elements perform a DFS on their respective halves of the tree, how much time does it take for the solution to be found? What is the speedup? Is there a speedup anomaly? If so, can you explain the anomaly?
8. Derive the formula for calculating the average access time for a word in a system with three levels of cache. Assume the following values for a theoretical system containing an L1, L2, and L3 cache.

Location	Latency
L1	5 ns
L2	10ns
L3	35ns
Main Memory (RAM)	100 ns

If an application has following hit rates, what is the average memory access time for a memory word?

Location	Hit Rate
L1	90%
L2	75%
L3	60%
Main Memory (RAM)	100%

9. Why is it difficult to construct a true shared-memory computer? What is the minimum number of switches for connecting p processors to a shared memory with b words (where each word can be accessed independently)?

10. A cycle in a graph is defined as a path originating and terminating at the same node. The length of a cycle is the number of edges in the cycle. Show that there are no odd-length cycles in a d-dimensional hypercube.

Note: We encourage collaboration between you and your classmates. Discuss various approaches and techniques to better understand the questions. However, we do NOT allow copying solutions or code. This is considered as cheating and falls under IIT code of honor. Penalties will be enforced. Please make sure you write your own solutions.
GOOD LUCK!