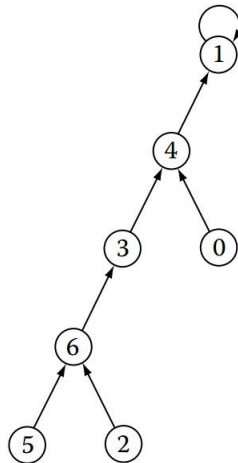


CS121 Parallel Computing
Problem Set 10

- 1) We have seen a method for computing reduction using n processors in $O(\log n)$ time. However, the total work done by this method is $O(n \log n)$, so it is not work efficient. Describe a work efficient method for computing reduction in $O(\log n)$ time.
- 2) In the Common CRCW PRAM model, different processors are allowed to concurrently write to the same register, but only if they write the same value. All processors can also concurrently read a register. Suppose that n processors each have a integer input value between 0 and $n-1$, and the processors have access to one shared Common CRCW register. Describe an algorithm for computing the maximum input value running in $O(\log n)$ time.
- 3) Suppose we have a rooted, directed tree with n nodes. Initially, every node other than the root node points to another node, while the root points to itself. Thus, initially only the root node knows the root of the tree. An example of such a tree is shown below.



- a) Let the height of the tree be h . Describe an algorithm with n processors in the CREW model for every node to determine the root node in $O(\log h)$ time.
 - b) Show that in the EREW model, any algorithm using any number of processors takes $\Omega(\log n)$ time for all the processors to find the root.
- 4) In class we discussed a deterministic algorithm to compute the convex hull of n 2D points in $O(\log^2 n)$ time. Following the randomized, divide and conquer spirit of QuickSort, describe a randomized parallel algorithm for computing the convex hull of n points using n processors in expected $O(\log^2 n)$ time.