

Principles of Distributed Computing

Exercise 7

1 Concurrent Ivy

Consider the tree for the Ivy shared variable protocol in Figure 1. There are three concurrent requests placed by the nodes v_1, v_2 and v_3 . The token is initially held by the circled node labeled r . We assume synchronous execution.

- a) Give the order of serviced requests.
- b) Draw the tree after the last request has been served.
- c*) Show that in an asynchronous setting, Ivy incurs at most an $O(\log n)$ overhead in amortized message complexity.

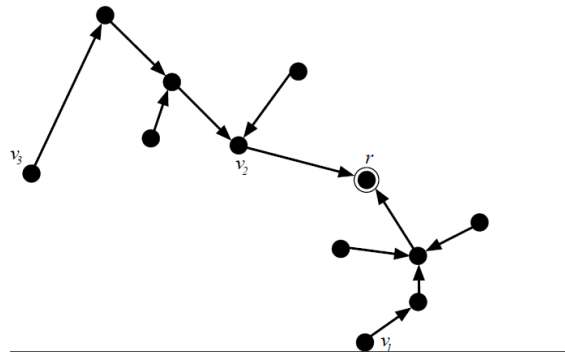


Figure 1: Tree for Question 1.

2 Tight Ivy

In Theorem ?? it was shown that, on average, acquiring a lock requires at most $\log n$ steps, where n is the number of processors.

- a) Show that this bound on the number of steps is tight by constructing a tree consisting of n nodes in which each request requires $\log n$ steps if all requests are performed sequentially by suitable nodes in the tree.¹
- b) Show that this worst case is even possible for the specific case where each node requests the object once.

¹Hints: Assume that n is a power of 2. Construct a tree whose topology remains the same with respect to the token holder after each request.