

## Network Algorithms, Summer Term 2012 Problem Set 4

### Exercise 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 a synchronous execution.

1. Give the order of serviced requests.
2. Draw the tree after the last request has been served.

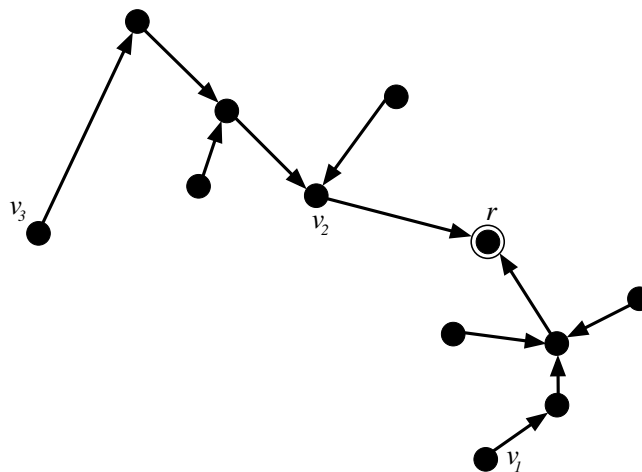


Figure 1: Tree for Exercise 1.

### Exercise 2: Tight Ivy

In Theorem 5.5 in the lecture notes, it was shown that, on average, acquiring a lock requires at most  $\log n$  steps, where  $n$  is the number of processors.

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.<sup>1</sup>

---

<sup>1</sup>Hints: 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.