Principles of Distributed Computing
Exercise 6

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.

2 Tight Ivy
In Theorem 10.5 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.¹

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.