Assignment 2
Sketch of Solutions with Marking Scheme

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1 QUESTION 1

Algorithm Alternate *alternates an electoral stage to the right and one to the left. The sequence of...*

1.1 Answer

At each step, we add a node to separate a pair of nodes (n_1, n_2) where $n_1 < n_2$ and where n_2 lies in the current direction of the messages from n_1. This yields to: $x_1 = 1, x_2 = 2, x_3 = 3, x_4 = 4, x_5 = 7, x_6 = 10$.

To compute the number of nodes at stage i, we distinguish whether i is odd or even.

$$x_i = \begin{cases} x_{i-1} + x_{i-2}, & \text{if } i \text{ is odd} \\ x_{i-1} + x_{i-3}, & \text{if } i \text{ is even} \end{cases}$$

where $x_1 = 1$, $x_2 = 2$, and $x_3 = 3$.

This is worst than *Alternate*, for which the number of nodes in the worst case follows the *Fibonacci* sequence, which grows faster than previous formula (due to now $x_i = x_{i-1} + x_{i-3}$ for i even). This results implies that *Alternate* has a lower number of steps (nodes are defeated faster), and thus less messages in total (there is always n messages per stage) in the worst case.

1.2 Marking

- 25 points allocated as follows:

1. Filling the 5 empty rings in the figure - 10 pts.
2. Rule to generate number of nodes - 10 pts.
3. Better or Worst than *Alternate* (explain) - 5 pts.

2 QUESTION 2

Consider a tree network T where each entity has locally available a clock. Furthermore, the clocks...

2.1 Answer

We can use saturation to find a node (or two nodes) that will send a timer to all nodes, after which all nodes will simultaneously start. Such timer is the maximum distance from the saturated nodes to a any other node.

We perform wake-up and saturation finding at the same time the *eccentricities* of the saturated nodes. In the resolution phase, the saturated nodes send v to every node except the saturated link, where v is the highest among the eccentricities of the saturated nodes, and waits $v+1$ units of times. (Note that the saturated nodes can know what is the maximum value they both received.) A node receiving a value v, will send $v-1$ to its children, and wait v units of times. After waiting its corresponding time, every node will start.

The message cost is the cost from *Activation* + *Saturation* + *Resolution*. This is $M = (n + k_* - 2) + (n) + (n-2) = 3n + k_* - 4$, where k_* is the number of initiators.

2.2 Marking

- 25 points allocated as follows:

- Describe *Simultaneous Start-up* protocol (correct): 10 pts.
- Efficient: 5 pts. (If M $> O(n)$: 0 pts. If using Saturation twice: 2 pts.)
- Compute complexity: 10 pts.