Question 1 (10+10 points)
(a) Label the ports and the nodes of the following graph for the purpose of interval routing:

(b) Propose an optimal interval routing scheme for the following 3-cube. You may have to do some trial and error to generate the correct answer.

Question 2 (15 points) Devise a distributed algorithm for computing a spanning tree of a connected undirected graph in which no root is designated. You can assume that the nodes have unique names. You must explain the steps, and reason about why it will work.

Question 3 (15 points) Consider a unidirectional ring of \( n \) processes \( 0, 1, 2, \ldots, n-1, 0 \). Process 0 wants to detect termination, so after the local computation at 0 has terminated, it sends a token to process 1. Process 1 forwards that token to process 2 after process 1's computation has terminated, and the token is passed around the ring in this manner. When
process 0 gets back the token, it concludes that the computation over the entire ring has terminated. You can assume that all channels are FIFO.

Bob feels that the algorithm will correctly detect termination, but Alice does not agree. Whom would you support? Explain your answer.

**Question 4.** (10 points) Design a probe-echo algorithm to count the number of processes in an anonymous network whose topology is a strongly connected graph. The algorithm starts when an initiator node sends out a probe to each of its neighbors, and ends when the initiator receives an echo from each neighbor. When the algorithm terminates, the initiator of the algorithm should figure out the count. Briefly argue why your solution will work.