National University

of Computer & Emerging Sciences-Lahore

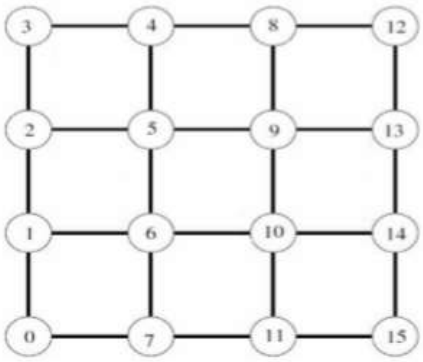
CS-3006– Parallel and Distributed Computing

Assignment 4

Deadline: Tuesday, 30th April 2024 (11 PM)

Instructions: Write the assignment in your own handwriting (except question#4—that can be submitted as a code file as well), scan with your mobile camera, create a single pdf file, and upload back to Google's classroom. Each page of the assignment should have your roll number and the page number written on it.

Question 1.(1): Draw step-by-step procedure for one-to-all broadcast on following 16-node mesh with **node 3** as source of the broadcast. **[10 points]**

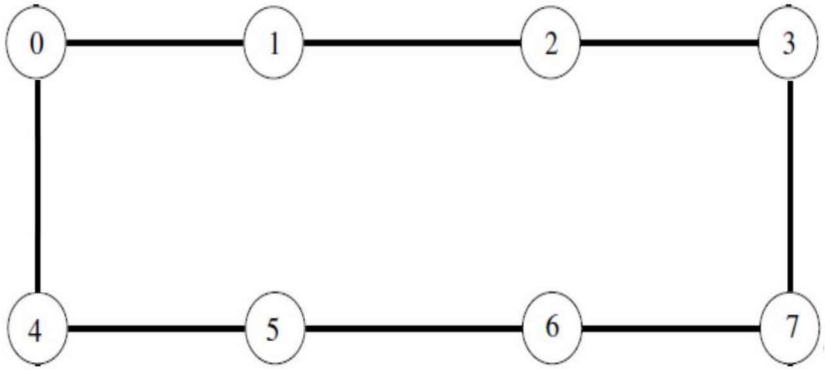


Question 1.(2): Perform all-to-one reduction on the 16-node mesh above with **node 12** as the destination of the reduction. **(5 points)**

Question 1.(3): Assume that the startup time (ts) is 2 seconds, per-word transfer time (tw) is 0.5 seconds, and the message of a communication between two nodes has 16 words. Calculate the total time taken by the message passing in Q1_part(1) and the total time taken by the message passing in Q1_part(2). **(5 points)**

Question 2.(1): The figure below is a one-to-all broadcast on an eight-node ring. Note that **node 3** is the source of the broadcast. Add message transfer steps on the figure, each of which is shown by a numbered, dotted arrow from the source of the message to its

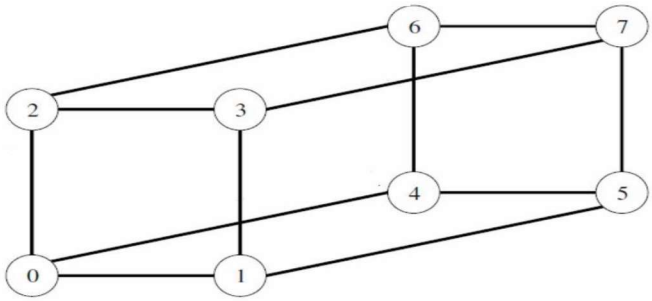
destination. The number on the arrow indicates the time step during which the message is transferred. (8 points)



Question 2.(2): Perform all-to-one reduction on the eight-node ring above with node 4 as the destination of the reduction. (8 points)

Question 2.(3): Assume that the startup time (ts) is 2 seconds, per-word transfer time (tw) is 0.4 seconds, and the message of a communication between two nodes has 8 words. Calculate the total time taken by the message passing in Q2_(1), and the total time taken by the message passing in Q2_(2). (4 points)

Question 3.(1): The figure below is a one-to-all broadcast on a 3d hypercube. Note that node 5 is the source of the broadcast. Add message transfer steps on the figure, each of which is shown by a numbered, dotted arrow from the source of the message to its destination. The number on the arrow indicates the time step during which the message is transferred. (8 points)



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Question 3.(2): Perform all-to-one reduction on the 3d hypercube above with **node 4** as the destination of the reduction. **(8 points)**

Question 3.(3): Assume that the startup time (ts) is 2 seconds, per-word transfer time (tw) is 200 milli-seconds, and the message of a communication between two nodes has 3 words. Calculate the total time taken by the message passing in the Q3, part (1), and the total time taken by the message passing in Q3, part (2). **(4 points)**

Question 4.(1): Write a program [preferably in c/c++] that simulates the one-to-all Broadcast on a hypercube with process zero as a source node. **(10 points)**

Question 4.(2): Write a program [preferably in c/c++] that simulates the one-to-all Broadcast on Linear Ring without any restriction on the source node. **(10 points)**