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Theory of Network Communication

Fall 2004

Assignment 3

Problem 5 (2 points)**:**
Show that when using the $x - y$ routing strategy in a 2-dimensional mesh, any permutation routing problem in which the distance between any source-destination pair is at most d can be routed with congestion at most $2d$ and dilation at most d.

Problem 6 (3 points)**:**
Consider the d-dimensional hypercube. Suppose that we use the bit adjustment strategy presented in the lecture to get from any source to any destination (i.e. every source-destination pair only has a single path). Construct a permutation routing problem for this case that causes $\Omega(\sqrt{2^d})$ paths to cross a single node. (Hint: compute for a given node, how many nodes can reach it in i hops and how many nodes can be reached from it in $d - i$ hops when using the bit adjustment strategy, and use this to construct a bad permutation.)

Problem 7 (2 points)**:**
Consider the (binary) d-dimensional deBruijn graph. Suppose we use the bit adjustment strategy to get from any source to any destination. Show that when using this as the basis for Valiant's trick, any permutation routing problem can be routed in the deBruijn graph with congestion and dilation at most $O(d)$. (Hint: adapt the arguments in the proof for the hypercube in the lecture notes to the deBruijn graph.)

Problem 8 (3 points)**:**
On the course web page, a simple "hello world" example can be downloaded in which a client invokes a method in a server causing it to print out "hello world". Extend this program so that a client plays ping-pong with a server for 10 rounds. I.e. the client starts with initiating a ping method in the server upon which the server invokes a pong method in the client, upon which the client invokes the ping method in the server, and so on until the client has invoked the ping method in the server 10 times. Please submit a printout of your program together with the other solutions, and send the code to "scheideler@cs.jhu.edu".