

Homework 2: CS621, Fall 2009

Due Date: 3:15PM, October 22, 2009

1. (10 points) A cycle in a graph is defined as a path originating and terminating at the same node. The length of a cycle is the number of edges in the cycle. Show that there are no odd-length cycles in a d -dimensional hypercube, i.e., all cycle will have an even-length.
2. (10 points) Why is it difficult to construct a true shared-memory computer for a large number of processors? What is the minimum number of switches for connecting p processors to a shared memory with b words (where each word can be accessed independently)? If blocking is allowed, what other less expensive networks may be used to reduce the cost of such a non-blocking network?
3. (10 points) A d -dimensional hypercube can be formed by connecting the corresponding nodes of two $(d - 1)$ -dimensional hypercubes. The corresponding nodes in each of these subcubes have a direct communication link, and there are 2^{d-1} links across the partition. However, it is possible to partition a hypercube into two parts such that neither of the partitions is a hypercube. Show that any such partitions will have more than 2^{d-1} direct links between them.
4. (10 points) The labels in a d -dimensional hypercube use d bits. Fixing any k of these bits, show that the nodes whose labels differ in the remaining $d - k$ bit positions form a $(d - k)$ -dimensional subcube composed of $2^{(d-k)}$ nodes.
5. (10 points) What are the major differences between message-passing and shared-address-space computers? What are their relative advantages and disadvantages?