

# MIDTERM: CS685-004, Fall 2001

October 23, 2001, 9:30–10:45AM

## Your Name Please:

Answer all problems in as detail as you can, within the given amount of time. For the multiple choice problems, only one answer should be chosen for each problem. Use the other side of the paper if needed. **(8 problems for 100 points in total.)**

1. (10 points) In MPI programming, what is the correct procedure to invoke an One-to-All broadcast subroutine in a network, assuming processor 0 is the source processor?
  - A. Processor 0 should call a send subroutine, the rest of the processors should call a receive subroutine at the same code segment;
  - B. All processors in the network should call the same subroutine with the same arguments;
  - C. Processor 0 should call a send subroutine first, the rest of the processors should call a receive subroutine later to avoid deadlock;
  - D. None of the above is correct.
2. (10 points) To send a message of size  $m$  from one processor to another processor directly linked in a network, which of the following statement is correct?
  - A. Cut-through routing is faster if  $m$  is large;
  - B. Store-and-forward routing is faster if  $m$  is large;
  - C. Cut-through routing and store-forward-routing have similar performance;
  - D. Cut-through routing may be faster if the link is bidirectional.
3. (10 points) Concerning the nonuniform memory access (NUMA) architecture, which of the following statement is correct?
  - A. A nonuniform memory access machine must be a message passing machine;
  - B. A nonuniform memory access machine has a shared address space, but its memory location may be physically distributed;
  - C. A nonuniform memory access machine cannot have its load balanced due to its nonuniform memory access mode;

- D. A nonuniform memory access machine cannot have more processors than a uniform memory access machine does.
4. (10 points) A cost optimal parallel system is what kind of the following systems?
- A. A cost optimal parallel system is always faster than the fastest sequential algorithm;
  - B. A cost optimal parallel system is not scalable unless the problem size is large enough;
  - C. The parallel cost of a cost optimal parallel system is proportional to the cost of the fastest sequential algorithm;
  - D. A cost optimal parallel system can only be a distributed memory system.
5. (15 points) What are the major advantages and disadvantages of the crossbar switching networks and the bus-based networks?

6. (20 points) Figure 1 is a 4 dimensional hypercube architecture. (a) Label the processors using binary representation and calculate the Hamming distance between the processors 4 and 11. (b) Describe a noncongestion optimal procedure (show it on the picture) and compute the corresponding communication time for processors 4 and 11 to exchange an  $m$ -word message using store-and-forward routing with the *E-cube routing scheme*.

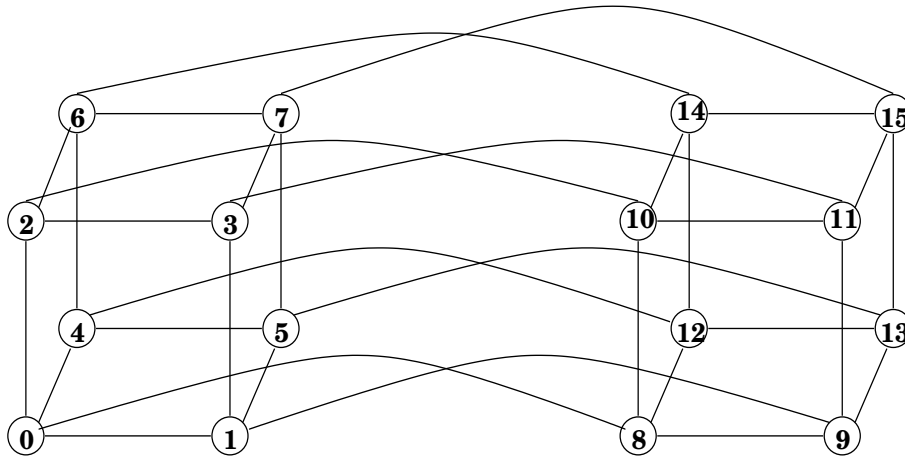


Figure 1: A 4 dimensional hypercube architecture for Problem 6.

7. (20 points) A problem of size  $n$  can be solved in  $n^2$  time on one processor using the best sequential algorithm. If a parallel system with  $p$  processors has a parallel run time as

$$T_P = \frac{n^2}{p} + t_s p^2 \sqrt{n} + t_w p^{3/2} \sqrt{n}.$$

What is the overall asymptotic isoefficiency function for this parallel system? Is this parallel system cost-optimal? why?

8. (5 points) Sign your name below to receive 5 points. Thank you for being here!