Homework 01, due on 03/08.

Problem 1 (Problems 2.3 & 2.4 of Intro. to Parallel Comput.**).** Assume a computer system with a memory system with a level 1 (L1) cache of 32KB and DRAM of 512 MB and a processor operating at 1GHz. The latency to L1 cache is one cycle and the latency to DRAM is 100 cycles. In each memory cycle, the processor fetches four words (assume length of a word is 4 bytes).

(a) Consider the problem of multiplying a dense matrix with a vector using a two-loop dot-product formulation. The matrix is of dimension $4K \times 4K$ (each row of the matrix takes 16KB of storage.)

(b) Consider the problem of multiplying two dense matrices of dimension $4K \times 4K$. What is the peak achievable performance using a three-loop dot-product based formulation?

Problem 2 (Problem 2.7 of Intro. to Parallel Comput.**).** What are the major differences between message-passing and shared-address space computers. Outline the advantage and disadvantage of the two.

Problem 3. Problem 3.2 of Intro. to Parallel Comput.

Problem 4. Problem 3.14 of Intro. to Parallel Comput.

Problem 5. If a problem of size W has a serial component W_s**,** show that W/W_s is an upper bound on speedup, no matter how many processes are used.

Problem 6. A parallel program executes in 242 seconds on 16 processors. Analysis shows that 9 seconds are spent executing initialization and cleanup on one processor, and all 16 processors are active during the remaining 233 seconds. What is the scaled speedup?

Problem 7. Assume that a hypercube interconnection network is used (Table 4.1 in "Introduction to Parallel Computing" lists all communication times). Analyze the parallel run time for the matrix-vector multiplication algorithm using 1D column-wise decomposition. Also perform the scalability analysis and find the isoefficiency of the algorithm.

Problem 8. Assume a person can rank-order a single deck of standard "poker" cards (52 cards) in 107 seconds. (Lowest denomination to highest denomination, the suits being ordered from Clubs (lowest), through Hearts, Spades, to Diamonds (highest)). Two more persons join the game. The same task is now partitioned between three persons: One person divides the deck into three deals of approx. equal height (3s), each person takes a deal (1s) and rank-orders his deal (36s), one person takes the three sorted deals (2s) and sorts them into one deal (40s).

a) Calculate parallel cost, speed-up, efficiency, and communication overhead of this procedure.

b) What are parallel cost, speed-up, efficiency, and overhead for rank-ordering three separate decks of cards with three persons?