Problem Set 3 (Due December 13, 2000)

Problem 1. (30 points)

The performance of the two matrix multiplication algorithms MultA and MultB is shown on pages 12 and 13 of the notes (Subject 8).

(1) What are the value of π and μ (use the formulae of pages 12 and 13) for the following cases.

(a) A BSP machine with $L = 2000$, $p = 256$ and $g = 0.30$ and $n = 256$.

(b) A BSP machine with $L = 2000$, $p = 256$ and $g = 0.30$ and $n = 4096$.

What if

(c) A BSP machine with $L = 300$, $p = 64$ and $g = 0.40$ and $n = 256$.

(d) A BSP machine with $L = 300$, $p = 64$ and $g = 0.40$ and $n = 4096$.

(2) Which algorithm do you expect to be more efficient? Explain.

The remaining problems deal with matrix-vector multiplication. The matrix-vector product $y = Ax$ is to be computed, where A is an $n \times n$ matrix and x, y are $n \times 1$ vectors. You may assume that n is a multiple of p and $\sqrt{p}$, where p is the number of processors of a BSP computer used in the problems.

Problem 2. (20 points)

Suppose A is row-block distributed and vector x is evenly distributed among the processors as well (n/p elements per processor). You are otherwise free to allocate each block of A or x to any processor of the machine. Design a BSP algorithm for matrix vector multiplication that is memory efficient (i.e. no more than $O(n^2/p + n/p)$ memory is used per processor at any step of the computation).

What are the BSP parameters π and μ of your design?

For what values of p, L and g is your algorithm one-optimal?

Explain.

Problem 3. (25 points)

Suppose A is column-block distributed and vector x is evenly distributed among the processors as well (n/p elements per processor). You are otherwise free to allocate each block of A or x to any processor of the machine. Design a BSP algorithm for matrix vector multiplication that is memory efficient (i.e. no more than $O(n^2/p + n/p)$ memory is used per processor at any step of the computation).

What are the BSP parameters π and μ of your design?

For what values of p, L and g is your algorithm one-optimal?

Explain.

Problem 4. (25 points)

Suppose A is block distributed (i.e. matrix multiplication) and vector x is evenly distributed among the processors as well (n/p elements per processor). You are otherwise free to allocate each block of A or x to any processor of the machine. Design a BSP algorithm for matrix vector multiplication that is memory efficient (i.e. no more than $O(n^2/p+n/p)$ memory is used per processor at any step of the computation).

What are the BSP parameters π and μ of your design?

For what values of p, L and g is your algorithm one-optimal?

Explain.