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In 2006/2007, the course WISM459 was given by Rob H. Bisseling.

Parallel Algorithms (WISM459)
November 22, 2006

Each of the five questions is worth 10 points. Total time 45 minutes.

Question 1

Define the term h-relation.

Question 2

A vector of length 150 has been distributed over 12 processors of a parallel computer by a block distribution with varying block length. $P(0)$ has the first 42 vector components; $P(1)$ has the next 39; processors $P(2)$ to $P(11)$ have 23, 20, 9, 5, 4, 2, 2, 2, 1, 1 components, respectively. The data are redistributed into the cyclic distribution. What is the exact BSP cost of this redistribution?

Question 3

The *1-norm* of a vector $\mathbf{x}$ is given by $\|\mathbf{x}\| = \|\mathbf{x}\|_1 = \sum_{i=0}^{n-1} |x_i|$. Give an efficient BSP algorithm for processor $P(s)$ (in the notation we learned) for the computation of the norm. Analyse its BSP cost. You are free to choose the input distribution. The output must become available on all processors.

Question 4

Let $k \geq 1$ be an odd integer. Assume the number of processors is $p \geq 2$. What is the exact communication cost of swapping all pairs $(x_i, x_{(i+k) \bmod n})$ with i even for a cyclically distributed vector $\mathbf{x}$ of length n, where n is even?

Question 5

Give a BSP algorithm for processor $P(s)$ (in the notation we learned) for the computation of the output vector $\mathbf{y}$ defined by $y_j = \sum_{i=0}^{j} (-1)^i x_i$, for $0 \leq j < n$, starting from a given input vector $\mathbf{x}$. The length of the vectors is n. Assume both vectors are block distributed and that $n \bmod p = 0$.