Department of Mathematics, Faculty of Science, UU.
Made available in electronic form by the $\mathcal{TBC}$ of A−Eskwadraat
In 2005/2006, the course WISM459 was given by Rob H. Bisseling.

Parallel Algorithms, repeated examination (WISM459) November 23, 2005

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

Question 1

Explain the structure of a BSP algorithm.

Question 2

Give an example of a 49-relation that is not a full h-relation.

Question 3

The *Euclidean norm* of a vector $\mathbf{x}$ is given by $\|\mathbf{x}\| = \|\mathbf{x}\|_2 = (\sum_{i=0}^{n-1} x_i^2)^{1/2}$. 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 p, n be powers of two, with $2 \leq p \leq n$. Define a permutation σ by

$$\sigma(i) = \begin{cases} i/2 & \text{if } i \text{ even} \\ n/2 + (i-1)/2 & \text{if } i \text{ odd} \end{cases} \quad \text{for } 0 \leq i < n.$$

What is the exact communication cost of permuting a block distributed vector $\mathbf{x}$ by σ, i.e., assigning $y_{\sigma(i)} = x_i$? The length of the input and output vectors is n.

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 $y_i = x_{i-1} + x_i + x_{i+1}$, for $0 \leq i < n$, starting from a given input vector $\mathbf{x}$. Here, we define for convenience $x_{-1} = x_n = 0$. Analyse the BSP cost. The length of the vectors is n. Assume both vectors are block distributed and that $n \bmod p = 0$.