Exercises (Dec. 16th)
Parallel Computing, DM818 (Fall 2015)

Department of Mathematics and Computer Science
University of Southern Denmark
Daniel Merkle

Exercise 1

Bitonic Sort

Consider the sequence $s = (a_0, a_1, \ldots, a_{n-1})$, where n is a power of 2. In the following cases, prove that the sequences s_2 and s_2 obtained by performing the bitonic split operation described in Section 9.2.1, on the sequence s, satisfy the properties that (1) s_1 and s_2 are bitonic sequences, and (2) the elements of s_1 are smaller than the elements of s_2 for the three following cases

a) s is a bitonic sequence such that $a_0 \leq a_1 \leq \ldots \leq a_{n/2-1}$and $a_{n/2} \geq a_{n/2+1} \geq \ldots \geq a_{n-1}$

b) s is a bitonic sequence such that $a_0 \leq a_1 \leq \ldots \leq a_i$and $a_{i+1} \geq a_{i+1} \geq \ldots \geq a_{n-1}$ for some $0 \leq i \leq n-1$

c) s is a bitonic sequence that becomes increasing-decreasing after shifting its elements.

Exercise 2

Scalability

Assume the following hypothetical overhead function for an algorithm (as usual W denotes the problem size).

$$T_O = p^2 \cdot \sqrt{W} + p \cdot \sqrt{W}$$

Assume that maximal degree of concurrency of the algorithm is $2^{\sqrt{W}}$.

a) Determine the parallel computation time T_P (as a function in W and p).

b) Determine the isoefficiency function due to the overheads T_O.

c) Determine the isoefficiency function due to the maximal concurrency.

d1) Determine the number of processes p', for which the parallel runtime is minimal.

d2) Determine the runtime when using p' processes (cmp. d1).

d3) Determine the asymptotic efficiency (as a function in W) when using p' processes. What is the efficiency for arbitrary large problem sizes W when using p' processes?