Exercises for Week 45 / 46

Parallel Computing, DM818 (Fall 2009)

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Course book exercises:

Chapter 4: 4.5, 4.8, 4.11, 4.10, 4,20, 4.24

Chapter 5: 5.2, 5.3, 5.4, (5.5-5.8), 5.13

In addition:

Exercise 1

Amdahl's law

If a problem of size W has a serial component W_S (i.e. the part of a program that can to be parallelized), prove that W/W_S is an upper bound on its speedup, no matter how many processing elements are used.

Read up on Gustafson's law (check for example the corresponding wikipedia entry), that addresses shortcomings of Amdahls's law, and explain the law.

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?