Prof. G. Zachmann
A. Srinivas

University of Bremen
School of Computer Science
CGVR Group
April 28, 2014

Summer Semester 2014

Assignment on Massively Parallel Algorithms - Sheet 1

Due Date 30. 04. 2014

Exercise 1 (Moore's Law and Power consumption, *3 Credits*)

a) Consider two approaches of doubling the number of transistors: halving the size of a single transistor while maintaining constant die area (Moore's Law) versus maintaining the size of a single transistor while doubling the die area. List some reasons why the first approach is superior to the second approach?

b) The idealized formula for energy consumption by a processor core is

$$E = ctfV^2$$

where c is a CPU-dependent constant, t is total execution time, f is the processor's clock frequency, and V is the supply voltage. The frequency and voltage are correlated as follows

$$f = \alpha V$$

with $\alpha = 0.2 \cdot 10^9$ $\texttt{HzV}^{-1}$. Suppose our algorithm must complete in $t = 10$ seconds and needs a total of 10^{10} clock cycles to execute. What is the CPU energy consumption E for one task that completes in $t = 10$ seconds? What is the energy saving ratio when we run this perfectly parallelizable algorithm in two tasks on two CPU cores in parallel, assuming each task takes $t = 10$ seconds to complete?

Exercise 2 (Amdahl's law, *2 Credits*)

Given a single core processor A and a multi-core processor B with N cores. Additionally, assume that all cores of A and B are identical.

a) Given a program that runs 1.7 times faster on processor B than on processor A. Compute the parallel portion of the program i.e. $f = P/(P + S)$ with P = execution time of parallizable part on single processor and S = execution time of inherently serial part on single processor (see Slide on Amdahl's Law (the "Pessimist") in the Introduction Chapter)

b) Suppose parallel portion f is 0.5, how many processor cores are needed to achieve an overall speed up of 1.6?