Design of Parallel and High Performance Computing
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Homework 9
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Amdahl's Law

Exercise 1

Assume 1% of the runtime of a program is not parallelizable. This program is run on 61 cores of a Intel Xeon Phi. Under the assumption that the program runs at the same speed on all of those cores, and there are no additional overheads, what is the parallel speedup?

Exercise 2

Assume that the program invokes a broadcast operation. This broadcast adds overhead, depending on the number of cores involved. There are two broadcst implementations available. One adds a parallel overhead of $0.0001 \times n$, the other one $0.0005 \times log(n)$. For which number of cores do you get the highest speedup for both implementations?

Exercise 3

By Amdahl's law, it does not make much sense to run a programm on millions of cores, if there is only a small fraction of sequential code (which is often inevitable, i.e., reading input data). Why do people build such systems anyway?

PRAM Model

Exercise 1

We can find the minimum from an unordered collection of n natural numbers by performing a reduction along a binary tree: In each round, each processor compares two elements, and the smaller element gets to the next round, the bigger one is discarded. What is the work and depth of this algorithm?

Exercise 2

Develop an Algorithm which can find the minimum in an unordered collection of n natural numbers in $O(1)$ time on a PRAM machine.