Introduction to HPC: Übung #6

Abgabe am Montag, 01. Dezember 2014

Günther Schindler, Christoph Klein, Klaus Naumann

Inhaltsverzeichnis

Heat Relaxation II - Experiments

Following table shows the average time for different grid-sizes. The measured results base on 100 to 10.000 iterations, depending on the used grid-size.

Time / Iteration	NP	NP	NP	NP	NP	NP
Grid Size	2	4	6	8	10	12
128x128	0.000196	0.000217	0.000079	0.000065	0.000094	0.000100
512x512	0.003130	0.001246	0.001260	0.003804	0.001596	0.001323
1024x1024	0.013285	0.004686	0.005300	0.005174	0.006413	0.006468
2kx2k	0.052558	0.018573	0.021031	0.016017	0.025776	0.026442
4kx4k	0.227757	0.093330	0.066810	0.056120	0.046239	0.044635

In order to calculate the Speedup we divided the execution time of the sequential implementation by the execution time of the parallel implementation for each grid-size and number of processes:

$$Speedup = \frac{T_s}{T_p}$$

Speedup	NP	NP	NP	NP	NP	NP	Sequential execution time
Grid Size	2	4	6	8	10	12	
128x128	0.311	0.281	0.772	0.938	0.649	0.610	0.000061
512x512	0.411	1.033	1.021	0.338	0.806	0.973	0.001287
1024x1024	0.549	1.555	1.375	1.408	1.136	1.127	0.007287
2kx2k	0.563	1.592	1.406	1.846	1.147	1.118	0.029565
4kx4k	0.501	1.224	1.71	2.035	2.470	2.559	0.114212

Here you can see that the maximum speedup is reached for a grid-size of *4k x 4k* with 12 processes. At a grid-size of *2k x 2k* we reached the maximum Speedup with 8 processes. With every additional processes the speedup for this grid-size decreases. The reason for this is the overhead of the parallel implementation.
This effect can be seen for the other grid-sizes as well which means that an additional amount of processes does not lead to an increasing speedup.
In order to calculate the efficiency we used the following formula

$$Efficiency = \frac{Speedup}{p}$$

in which p is the number of involved processes.

Efficiency	NP	NP	NP	NP	NP	NP
Grid Size	2	4	6	8	10	12
128x128	0.156	0.070	0.129	0.117	0.0645	0.051
512x512	0.206	0.258	0.170	0.042	0.081	0.081
1024x1024	0.275	0.389	0.229	0.176	0.114	0.094
2kx2k	0.282	0.398	0.234	0.231	0.115	0.093
4kx4k	0.251	0.306	0.285	0.254	0.247	0.213

This table represents the efficiency of our parallel implementation of the heat relaxation depending on grid-size and involved processes. For a grid-size of *4k x 4k* with 12 involved processes - where we reached the highest speedup - we couldn't achieve the highest efficiency. For the given grid-size the maximum efficiency

was reached with 4 involved processes.
For smaller grid-sizes the highest speedup and efficiency can be reached with the same amount of processes. The bottom line is that the speedup and efficiency heavily depends on the problem size and the involved processes, whereas a higher amount of processes does not result in a faster and efficient computation.