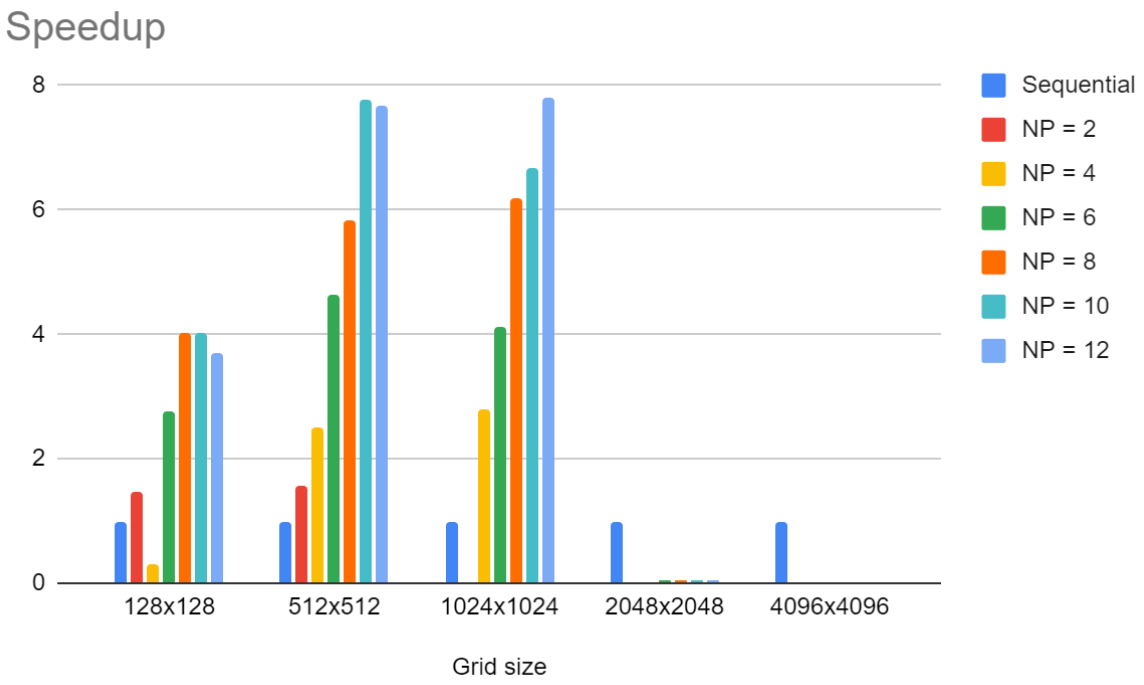
HPC03ex05 - Florian Schrittwieser, Davit Melkonyan, Simon Pavicic

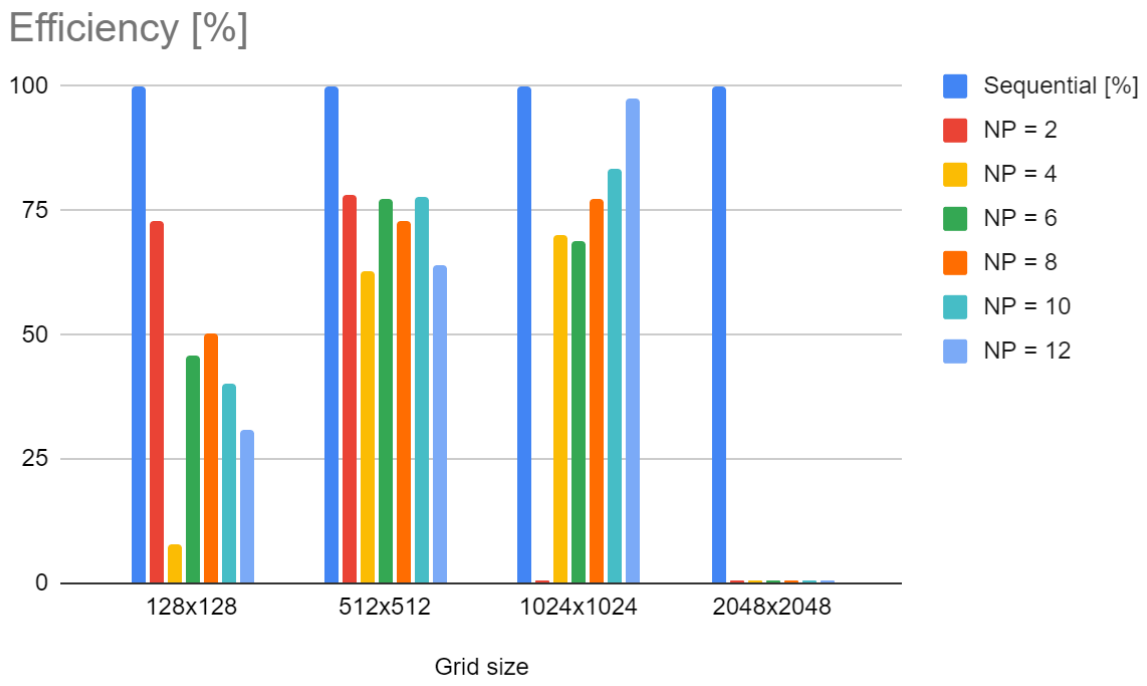
5.1 Heat Relaxation II - Parallel implementation based on 1D-row partitioning:

5.2 Heat Relaxation II - Experiments:

Time / iteration							
Grid size	Sequential	NP = 2	NP = 4	NP = 6	NP = 8	NP = 10	NP = 12
128x128	0.00027	0.000185	0.00087	0.000098	0.000067	0.000067	0.000073
512x512	0.003814	0.002443	0.001522	0.000824	0.000654	0.000491	0.000497
1024x1024	0.013497	0.999432	0.004829	0.003269	0.002187	0.00202	0.001728
2048x2048	0.051446	3.996949	2.000642	1.004163	1.000012	0.997804	0.998925
4096x4096	0.206253						
Speedup (compared to sequential execution time)							
Grid size	Sequential	NP = 2	NP = 4	NP = 6	NP = 8	NP = 10	NP = 12
128x128	1	1.459459459	0.310344827	2.755102041	4.029850746	4.029850746	3.698630137
512x512	1	1.561195252	2.505913272	4.628640777	5.831804281	7.767820774	7.674044266
1024x1024	1	0.013504670	2.794988661	4.128785561	6.171467764	6.681683168	7.810763889
2048x2048	1	0.012871317	0.025714745	0.051232718	0.051445382	0.051559224	0.051501363
4096x4096	1						

Efficiency (compared to sequential execution time)							
Grid size	Sequential [%]	NP = 2	NP = 4	NP = 6	NP = 8	NP = 10	NP = 12
128x128	100	72.97297297	7.75862069	45.91836735	50.37313433	40.29850746	30.82191781
512x512	100	78.05976259	62.647831 8	77.14401294	72.89755352	77.67820774	63.95036888
1024x1024	100	0.6752335326	69.87471526	68.81309269	77.14334705	83.521039 6	97.63454861
2048x2048	100	0.6435658799	0.6435658799	0.6435658799	0.6435658799	0.6435658799	0.6435658799
4096x4096	100						





As shown in the diagrams above, a significant speed-up of the runtime can be achieved by parallelizing the task and using a higher number of processes. The difference is especially significant for larger grid sizes. It is however hard to achieve high efficiency for the parallelized solution.

5.3 Heat Relaxation II - Tracing:

1. The stencil is a memory and computation-heavy task, therefore we would expect most time to be spent on stencil computations. However, we would also assume that the communication of the ranks (processes) will use a considerable amount of computation performance.
2. The performed experiments meet our expectations since smaller workloads take longer with a rising number of tasks since the communication overhead starts to increase. For larger workloads, we reach speedups approximately proportional to the number of tasks.
3. -
4. Yes, Score-P helped us better understand our program.

5.4 Willingness to Present:

Willing to present 5.1, 5.2, and 5.3.