Supercomputing Praktikum

Exercise 1

Compiled at **April 23, 2023**

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Task 1

The lecture stated that the theoretical peak floating-point performance of a modern CPU is:

$$\text{PCPU [Flop/s]} = n_{\text{cores}} \cdot f_{\text{core}}[\text{GHz}] \cdot n_{\text{ILP}}[\text{instr./cy}] \cdot n_{\text{SIMD}}[\text{FP ops/instr.}] \cdot n_{\text{FMA}}$$

For node one has to multiply it by the number of CPUs in this node. In our case we consider one node, one core ($n_{\text{cores}} = 1$), and $f_{\text{core}} = 2,2\text{GHz}$, $n_{\text{ILP}} = 2$, $n_{\text{FMA}} = 2$, $n_{\text{SIMD}} = \frac{256}{64} = 4$.

We therefore get:

$$\text{PCPU [Flop/s]} = 35,2$$

Task 2

As stated in the documentation:

$$\text{Memory-Usage} \cdot \text{available Memory} = \frac{N^2}{PQ} \cdot 8$$

In our case we get:

$$N = \sqrt{\text{Memory-Usage} \cdot 2^{32}}$$

Therefore we get for N in terms of memory-usage M the values:

M	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
N	14654	20724	25381	29308	32768	35895	38771	41448	43962	46340
M	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	1
N	48602	50763	52836	54831	56755	58617	60421	62172	63876	65536

Making these divisible by the blocking factor yields:

M	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
N	14592	20736	25344	29376	32832	35904	38784	41472	43968	46272
M	0.55	0.6	0.65	0.7	0.75	0.8	0.85	0.9	0.95	1
N	48576	50688	52800	54912	56832	58560	60480	62208	63936	65472

Task 3 and 4

The results can be found in fig. 1

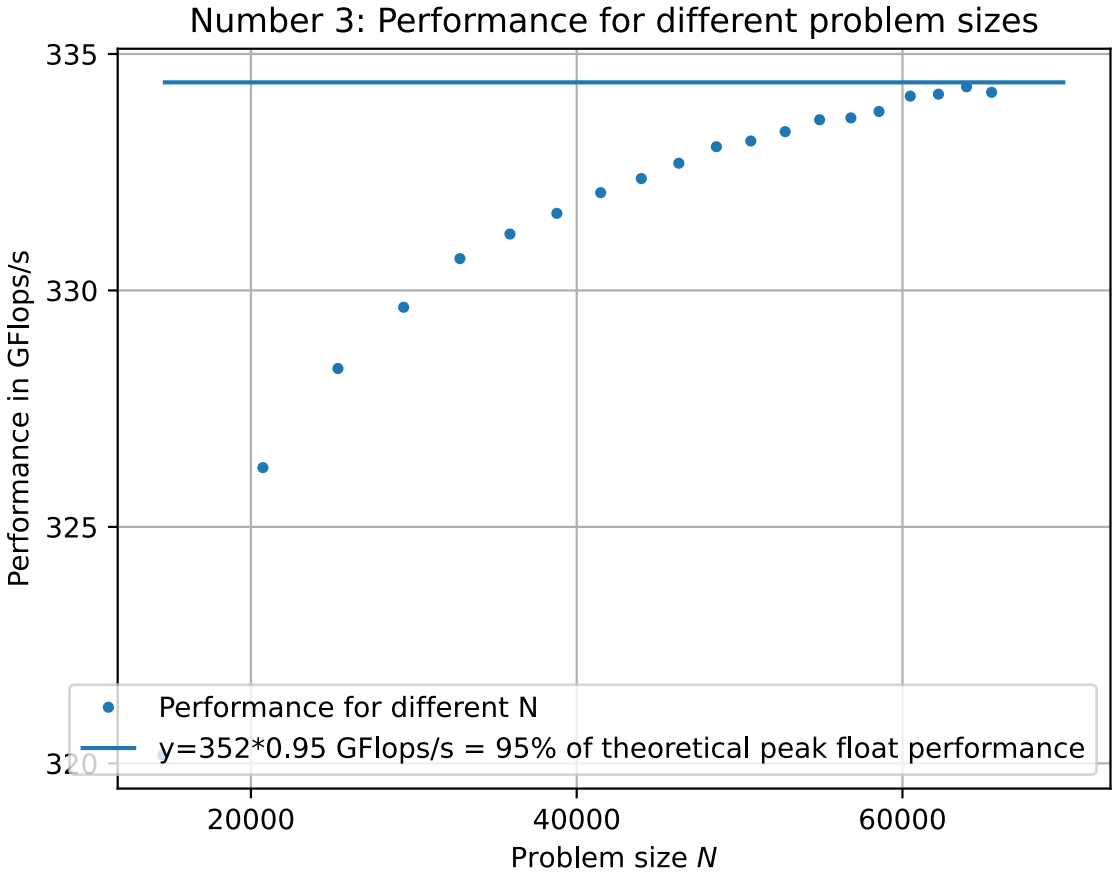

Figure 1: The performance of one Meggie socket for different problem sizes N

As we can see, 95% of the theoretical peak floating-point performance is archieved by a memory usage of 0.95, thus 95% of total memory per NUMA node which in our case is approximately 30,4 GB.

Task 5

The results can be found in fig. 2.

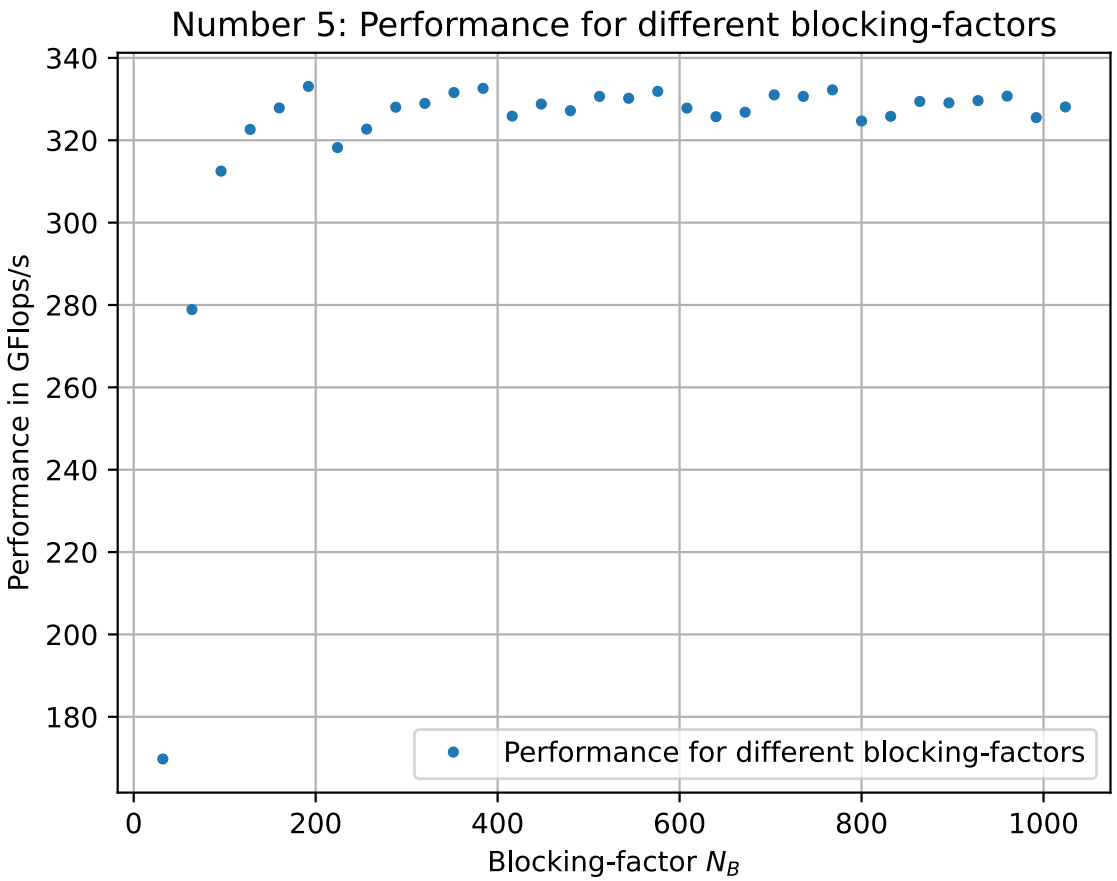

Figure 2: The performance of one Meggie socket for different blocking factors N_B

As expected, the given blocking factor of 192 has the best performance.

Task 6

For 2 cores I tried to use 95% of the total memory. Somehow this did not work, and Jakob told me to use $N = 14400$ arbitrarily. So I used this for 1 and 2 cores. The result is shown in fig. 3.

As expected the performance in terms of the number of nodes is approximately linear. The stronger deviations for one and two cores can be explained by the diferent problem size N.

The Code

The code, which I used to solve the exercise can be found at: https://github.com/Sinthoras7/supercomputing-praktikum-uebungsaufgaben.

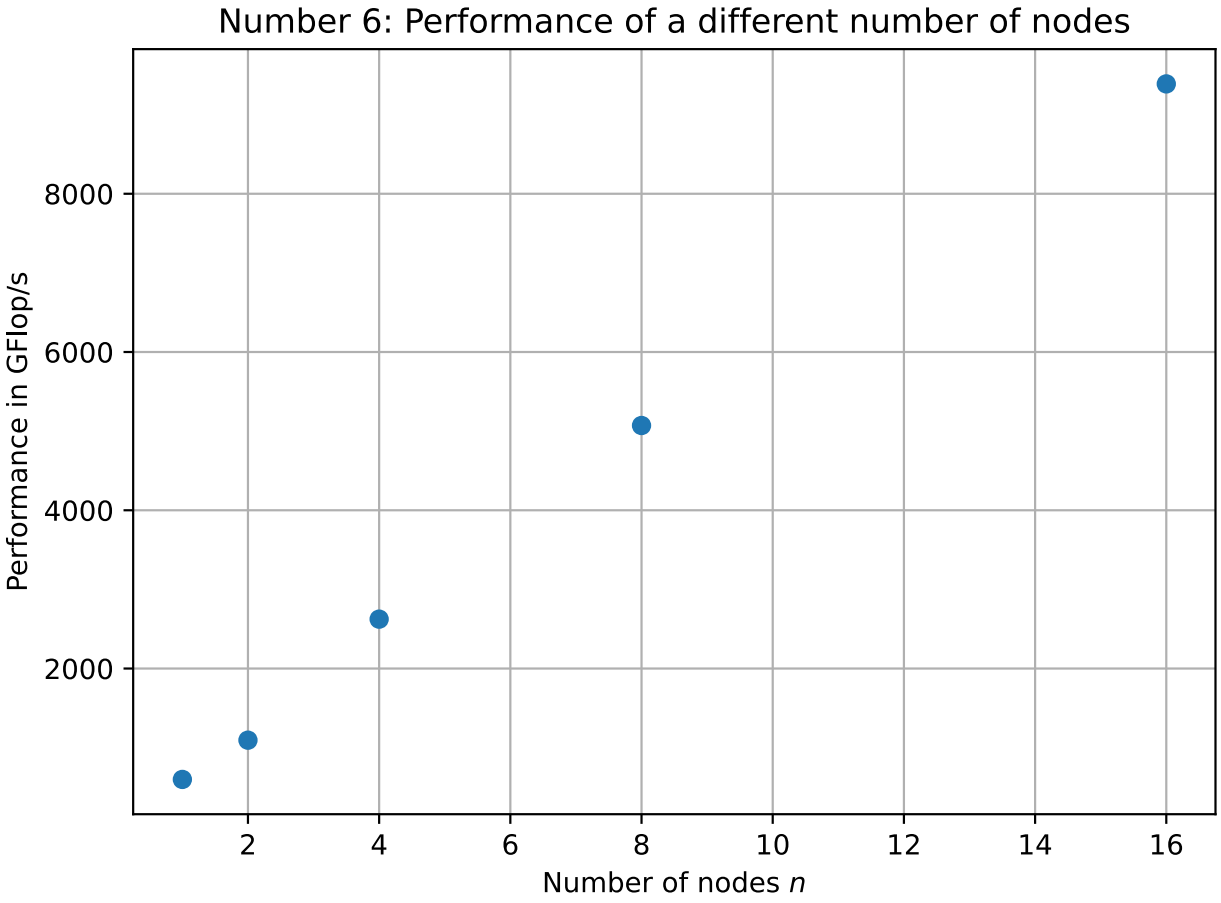

Figure 3: The performance for different numbers of cores