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Algorithms of Scientific Computing II

Exercise 4 - Hardware-aware implementations and Barnes-Hut-Method

1) Today's Systems - Compute Power

Today's supercomputer are highly parallel systems. Please read LRZ's web page and identify the different levels of parallelism in SuperMUC!

Which levels of parallelism are not documented there, but can be found in Intel Architecture Manual?

2) Today's Systems - Memory Subsystem

Please sketch the memory subsystem/ network structure of SuperMUC. Is there a different network topology available on another supercomputer?

What is the peak performance of the system if a memory bound application is executed?

Which hardware feature may help to improve this performance?

3) Vectorization of Linked-Cells particle simulations

Recently C++ has established itself as one of the standard language for new development of HPC codes apart from FORTRAN and C. Please sketch the software layout of a linked-cells C++ implementation.

Which problems do you face when it comes to low level kernels and data layout?

Can you use vectorization in order to speed-up calculations?

additional: 4) Complexity of the Barnes-Hut-Method

In the lecture the costs for the d-dimensional Barnes-Hut-Method were given as $O(\theta^{-d} N log N)$. First derive the costs for the twodimensional Barnes-Hut-Method. Then explain descriptively (without proof), why the formula is also correct for 3d.