

Lab-Course: Scientific Computing

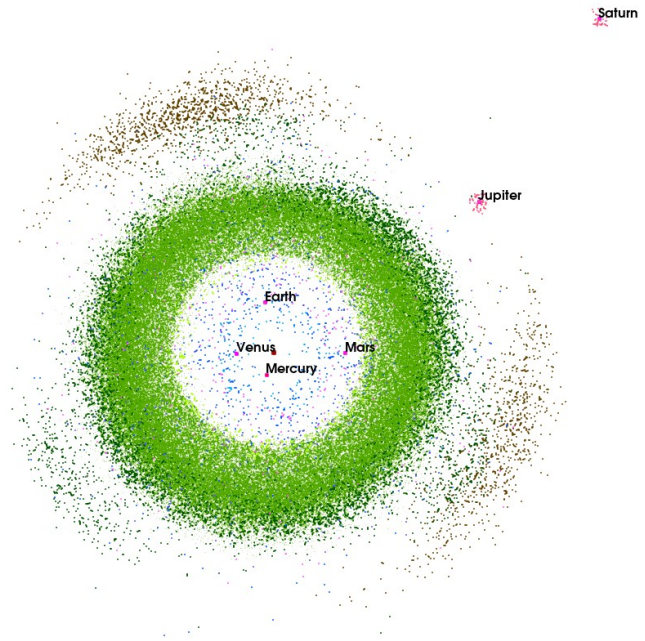
Goals

This Lab-Course is meant as an introduction to the world of parallel computing and simulations. The main project is the parallel implementation of an n-body algorithm simulating our solar system including planets, dwarf planets, moons, and asteroids.

The primary goal of this Lab-Course is to get familiar with parallelization strategies and frameworks established in the High-Performance Computing (HPC) community.

Other goals include:

- Gaining experience with versioning software like Git as well as continuous integration
- A practical and efficient application of tree data structures
- Working with remote systems
- Learning to translate mathematical equations or pseudo-code to actual source code
- Usage of established programs in the world of simulations (e.g., ParaView)
- Practicing writing short scientific texts as well as giving short presentations



Procedure

This Lab-Course can be divided into four parts:

- Get familiar with the problem and implement the first n-body simulation using the tree-based Barnes-Hut algorithm.
- Parallelize the n-body simulation on multiple cores and multiple compute nodes using the established HPC frameworks OpenMP and MPI. This also includes a small performance evaluation.
- Implement a custom project based on the previous parallelization. This can include (but is not limited to): Speeding up the simulation using GPUs, implementing new physics, or creating new simulation scenarios.
- Summarize your results and findings in a short text and presentation.

Note that the first two parts will be realized in groups of 3 students while in the custom project and final presentation, everyone will work on its own. In-person meetings, e.g., for an introduction to the topic or to discuss the progress of the groups are mandatory to attend.

Prerequisites

Students should be familiar with an object-oriented programming language, preferably C++ (used in this Lab-Course). Students should have at least attended the “Datenstrukturen und Algorithmen” (BA) lecture. Lectures like “Numerische Grundlagen” (BA) and “High-Performance Computing” (MA) are also helpful for this Lab-Course.

Contact

If you have any questions feel free to contact us at sc@ipvs.uni-stuttgart.de.