

# Lab-Course: Scientific Computing

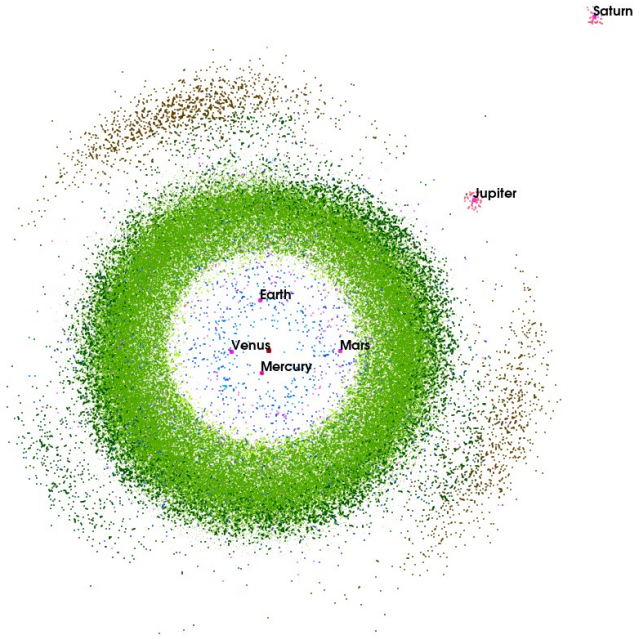
## Goals

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 report and presentation.

Note that the first two parts will be realized in groups of two 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](mailto:sc@ipvs.uni-stuttgart.de).