Tárgytematika / Course Description
High performance computing

GKNM_MSTA039

Tárgyfelelős neve / Teacher's name: dr. Környei László
Félév / Semester: 2023/24/2
Beszámolási forma / Assesment: Vizsga
Tárgy heti óraszáma / Teaching hours(week): 2/2/0
Tárgy féléves óraszáma / Teaching hours(sem.): 0/0/0

OKTATÁS CÉLJA / AIM OF THE COURSE

The aim of the course is to get hands on experience on advanced high performance computing tools, environment and development. The focus is on programming a small cluster system.

TANTÁRGY TARTALMA / DESCRIPTION

Programming with MPI. The MPI standard. Program structure, compiling, execution. Setting number of processes and threads. Measuring runtime. Categorizing MPI functions. Point-to-point communication. Buffered and unbuffered calls. Blocking and non-blocking communication. Collective MPI calls. Defining and using deduced data types. Communication groups and communicator. Calculating speedup and parallel efficiency. Amdahl's and Gustafson's law. Planning and measuring weak and strong scaling.
Advanced topics in MPI: Communication groups and virtual topologies. 1D and 2D cartesian topologies. Solving the 2D heat equation. Visualizing results. Analysing 2D and 3D data sets. Automating postprocessing.
MPI-aware numerical linear algebra packages: Installing, implementing numerical solvers, running on cluster.
Advanced topics in MPI: Derived datatypes. Domain decomposition: computation and communication focus. Input and output handling. Parallel I/O
Advanced topics in OpenMP: Task directive. Work sharing with taskloops. Parallel traversing of a tree.
Using SIMD. Pitfalls and Optimization problems in OpenMP
Hybrid programming: MPI+OpenMP. Compiling, running, job submission. Benchmarking, process pinning, profiling

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

The final note consist of some smaller tasks to work on at home as homework. A home project is to be created at home and to be presented at the end of the semester. An oral exam is required to present the learned topics. Attendance is not compulsory, but recommended. Students attending get extra credit at the final evaluation.

These parts weigh as follows:

30% Homework
30% Home project

30% Oral exam
10% Attendance

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

the lecture notes of the classes, that will be available online in electronic format

AJÁNLOTT IRODALOM / RECOMMENDED MATERIAL

[1] Andrew S. Tanenbaum, Maarten van Steen: Distributed Systems 3rd. ed. (2017)
[2] Blaise Barney, Lawrence Livermore National Laboratory, Introduction to OpenMP.
https://hpc-tutorials.llnl.gov/mpi/
[3] Rolf Rabenseifner, Georg Hager, Claudia Blaas-Scheenner: Introduction to Hybrid Programming in HPC