Tárgytematika / Course Description
Introduction to HPC

GKNM_MSTA088

Tárgyfelelős neve / Teacher's name: dr. Környei László
Félév / Semester: 2025/26/1
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 acquire the basic skills necessary to develop programs in a high performance computing environment and learn some basic parallelization techniques, including OpenMP

TANTÁRGY TARTALMA / DESCRIPTION

Scalable solutions for IT problems. Accessing supercomputing systems at the university.
Computer and HPC hardware and architectures. Basic LINUX commands.
The LINUX system environment. LINUX command line tools: editors, cut, grep, sed, awk, etc.
Programming in BASH: data types, execution control, environment variables. Running script in the LINUX CLI.
Programming in C: Basic program layout and I/O. Compiling and running in command line interface.
Programming in C: basic data types and execution control.
Programming in C: Advanced data structures. Debugging, profiling, instrumentation. Implementing simple algorithms.
Numeriocal linear algebra packages. Installing and configuring external libraries. Using lineal algebra tools for solving linear equations.
Simulating physical systems. Physical, mathematical and numerical modelling. Implementing numerical models for solving differential equations.
Measuring, modelling and estimating runtime. Visualizing results and plotting of simple graphs efficiently.
Job and resource management in SLURM. Basic job management commands and tools. Setting up and running serial jobs on a computer cluster.
Parallel programming with OpenMP: programming modell, basic directives and clauses. Running an OpenMP job with SLURM. Measuring runtime.
Parallel programming with OpenMP: data types and controlling number of threads.
Parallel programming with OpenMP: loop parallelization, scheduling and reduction.

SZÁMONKÉRÉSI ÉS ÉRTÉKELÉSI RENDSZERE / ASSESMENT'S METHOD

During the semester, students are required to do homeworks, write a mid term exam, do a home project and/or take part in an oral exam. Attendance is also encouraged. Students may choose oral exam or home project,

which must be decided until the date of the mid term exam.

1. Homework
- every week, students receive 5 homeworks for 5+5+10+10+20 points
- a weekly average of 10 points (one homework) must be completed
- maximum points for one week's homework is 30 points.
- if any 5-point homework is considered, 20 points are max.
- homeworks are checked every week at class
- students must mark before class which homeworks they completed
- the student who cannot present his or her homework orally, will lose the corresponding points

2. Mid term exam
- generally on week 10, exact date in szelearning.
- 10 random questions with 4-choice answers, 1 is correct
- Good answer: 3 points, bad answer: -1 point, no answer: 0 point
- All questions will be provided beforehand (but not the answers)

To get a signature, 33% of the homeworks, so an average of 10 points per week, must be completed. Additionally, at the mid term exam, 50% must be reached. Extra homework can be presented and the mid term can be retaken on the last week of the lecture period.

3. Home project
- Must use OpenMP parallelization, except if you never learned C-like (C++, C#, Java)
- Topics must be clarified until mid term exam.

4. Oral exam
- Random chosen topic from a list provided here.
- Cannot use any material.
- Can have a 10 minute preparation with pen and paper
- Must use proper english and whole sentences.
- Prepare 5-7 minutes per topic.

5. Attendance
- not required, but students attending get points, which counts toward the final note.

Final note:
Homework (30% - min 10%)
Mid term exam (30% - min 15%)
Oral exam OR Home project (30%)
Attendance (10%)

The exam is successful at 50%.

KÖTELEZŐ IRODALOM / OBLIGATORY MATERIAL

[1] William Shotts: The Linux Command Line. https://linuxcommand.org/

[2] Suzanne J. Mathews, Tia Newhall, Kevin C. Webb: Dive into Systems. https://diveintosystems.org/book/

[3] Blaise Barney, Lawrence Livermore National Laboratory, Introduction to OpenMP.

https://hpc.llnl.gov/tuts/openMP/

AJÁNLOTT IRODALOM / RECOMMENDED MATERIAL