CS-E4690 – Programming parallel supercomputers D

1 - Course management

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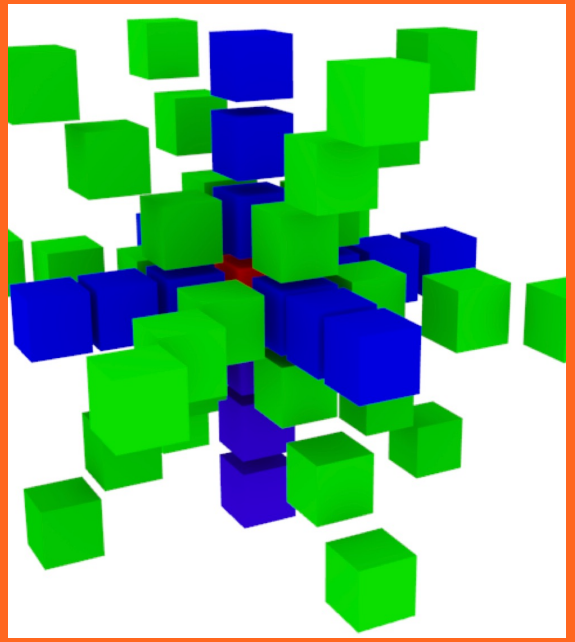
Aalto University
School of Science



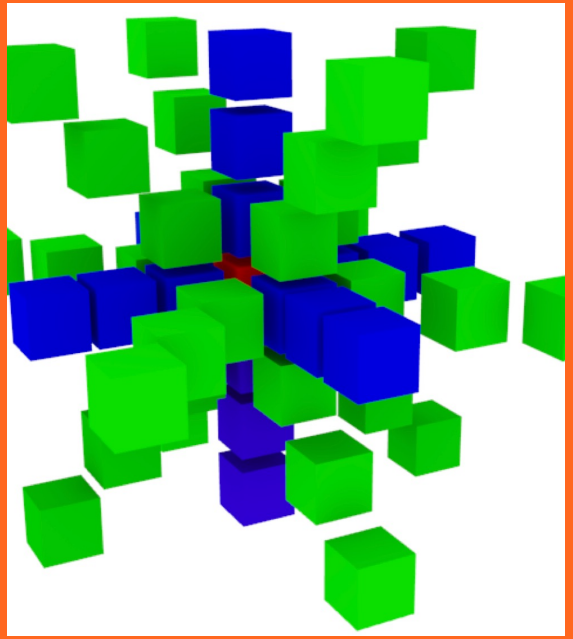
Other teaching staff

Johannes Pekkilä: johannes.pekkila@aalto.fi

Matthias Rheinhardt: matthias.rheinhardt@aalto.fi

- Responsible for some of the exercises
- Provide technical assistance on MPI, CUDA, …, that are required for some of the exercises.
- One-three people from the teaching staff will be available in the exercise sessions.

Learning outcomes



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Our learning objectives are

- **Get yourself familiarized with the current HPC landscape** to be able to choose the correct framework for your large-scale problem.
- **Learn basic concepts on how to build efficient applications** for clusters or supercomputers with thousand(s) to million(s) of cores
- **Master distributed memory and hybrid** (distributed + shared memory) programming models
- **Learn essentials of message-passing interface**
- **Learn essentials of HPC in hybrid architectures with graphics processing units (GPUs).**

Our learning objectives are not

- To become fluent in using Triton and CSC supercomputing environments; we get you started in Triton; SciComp and CSC trainings will support you further

- To solve any practical large-scale problem; the next course in the series, **CS-E4002 Large-scale computing and data analysis**, will deal with practical applications in the CSC environment.

- The knowledge presented in this course will be useful for your practical applications, even if it is theoretical.

Break-down of learning objectives

Lecture1

Introduction to the current HPC landscape

Understanding how this course fits into that

Establishing understanding of the learning outcomes

Lecture2

Learning basic definitions and taxonomies

Understanding the importance of the "network"

Learning basic performance models

Lecture3

Becoming knowledgeable of the modern landscape of distributed memory programming

Understanding why in this course we will concentrate on low-level programming models

Getting acquainted with MPI: basics and synchronous and asynchronous point-to-point communication

Break-down of learning objectives

Lecture4

Learning more about MPI:

One-sided point-to-point communications

Collective communications

Lecture5

Programming MP hybrid architectures

Becoming knowledgeable of the spectrum of options

Understanding efficiency issues

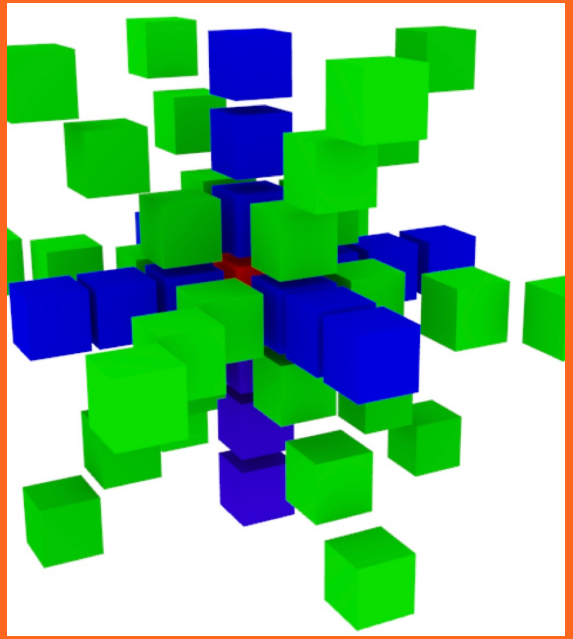
Lecture6

Programming hybrid architectures with accelerators

Acquiring knowledge of CUDA-MPI programming model

Some background from “Programming parallel computers” is essential

Practicalities



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Sessions

- Six 90 min “lectures” Tuesdays 14:15, in T5.
- Pre-recorded **videos & slides** + extra reading
  - MyCo will give you a compilation of materials belonging to each lecture
  - Minimally watch/read through the **core material** (excl. extra reading) before Tuesday session; made available one week before the session. Extra reading is for the curious/passionate.
  - The lecture times are intended to be **discussions**, where we make a **synthesis** out of the materials. Discussion points by the lecturer, Q&A from students.
  - You can also post questions or comments in the Zulip chat, and these will be discussed/answered on Tuesdays.

Exercises

- There is **one exercise sheet per lecture**, available from A+.
- Course grading is solely based on the exercise points.
- 2 first ones involve no coding (some reading, thinking and maths; avail from the 1st lecture onwards), 4 last ones (avail after the third lecture) involve coding exercises.
- All exercises can be iteratively improved (more than one submission allowed), and the **final submissions will be graded**.
- Exercise session on **Fridays 12:15-13:45 (**Y342a**)** to ask more questions about any of the exercises and why not about the lecture materials.
- Technical assistance on Triton environment and coding exercises will be provided during this session; location, Linux class.
- DL for final submissions is in the end of the evaluation week (11.12.2022).

Basic exercises (2 first weeks)

- Reading, understanding
- Little bit of maths
- **Additionally, you should get prepared to the four last exercises by familiarizing yourself with the computing environment that is going to be used (next slide).**

Coding exercises (4 last weeks)

- **HPC environment** to be used is Tier-2 semi-local **Triton cluster**; a temporary user account have been set up for those who did not already have one.
- Submission of a **pre-assignment** is required for obtaining Triton account (final closing date 2.11.2022).
- Example codes and scripts are available through **GitLab**.
- Everybody is encouraged to create repositories in Aalto GitLab, as the user accounts are temporary (31.12.2022; for those who did not have one before)
- Submissions of **short reports** through A+, the code will be **evaluated** in Triton directly (dedicated submission directory set up per each participant). DL 11.12.2022. **Well-commented code exceeds the value of long reports!**
- Model solutions will be made available in GitLab to those who submitted **all sheets** (link avail. soon after 11.12.2022).

Communications

- Pre-recorded videos, slides, and reading materials are posted in MyCourses
- Exercise sheets in A+
- Example scripts and codes GitLab repo.
- Zulip chat for the course

pps.zulip.cs.aalto.fi

Invite link