Master Course
High Performance Computing
MCS, MSI, MAI, MFT, MSDE

Prof. Olaf Schenk (CI, INF)

Organization

- Prof. Olaf Schenk, olaf.schenk@usi.ch
  Dr. Juraj Kardos, juraj.kardos@usi.ch
  Institute of Computing, INF Faculty
  USI, Lugano
- TA PhD Students:
  Tim Holt, timothy.holt@usi.ch
  Malik Lechekhab, malik.lechekhab@usi.ch
- TA Master Students:
  Panthakkalakath Zenin Easa, zenin.easa.panthakkalakath@usi.ch

- Software Atelier - High Performance Computing
  Tuesday, 2:30pm - 4:15pm, room C1.03
  Wednesday, 10:30am - 12:15pm, MS Teams, room D1.14
- Registration:
  - Please enroll within one week until September 23 on teaching.inf.usi.ch, and
  - On ICORSI, https://www.icorsi.ch/course/view.php?id=14652

Your Background?

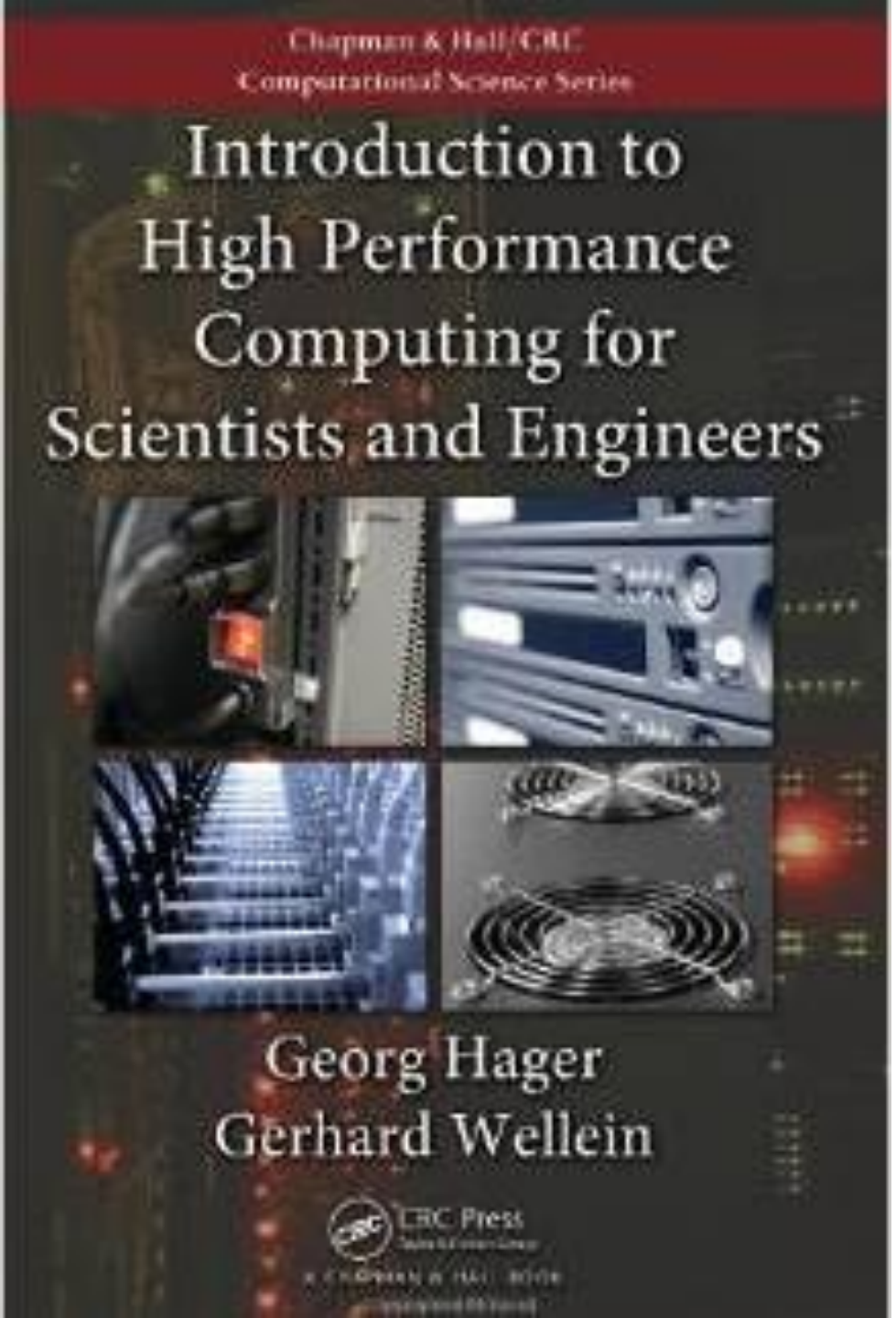
- MSc CS? MSc FinTEC? MSc AI? MSc INF? Other?
- Programming experience & languages?
- Parallel programming languages?
- Operating systems?
- Working at the command line in Unix-like shells (e.g., Linux or a Mac OSX terminal)?
- Scientific libraries or mathematical libraries?
- Latex?
- Version control systems, particularly git, and the use of Github repositories?
- Piz Daint at CSCS?
- Please fill-in the questionnaire form: https://tinyurl.com/mr3jj2ha

About this course (or better this lab)

- In depth understanding of:
- When is parallel computing useful?
- Understanding of parallel computing hardware options.
- Overview of programming models (software) and tools, and experience using some of them
- Some important parallel applications and the algorithms
- Performance analysis and tuning
- Ability to implement parallel numerical algorithms efficiently in C/C++ using mathematical libraries on a cluster
- C/C++, MPI, OpenMP, Matlab

Course Organization

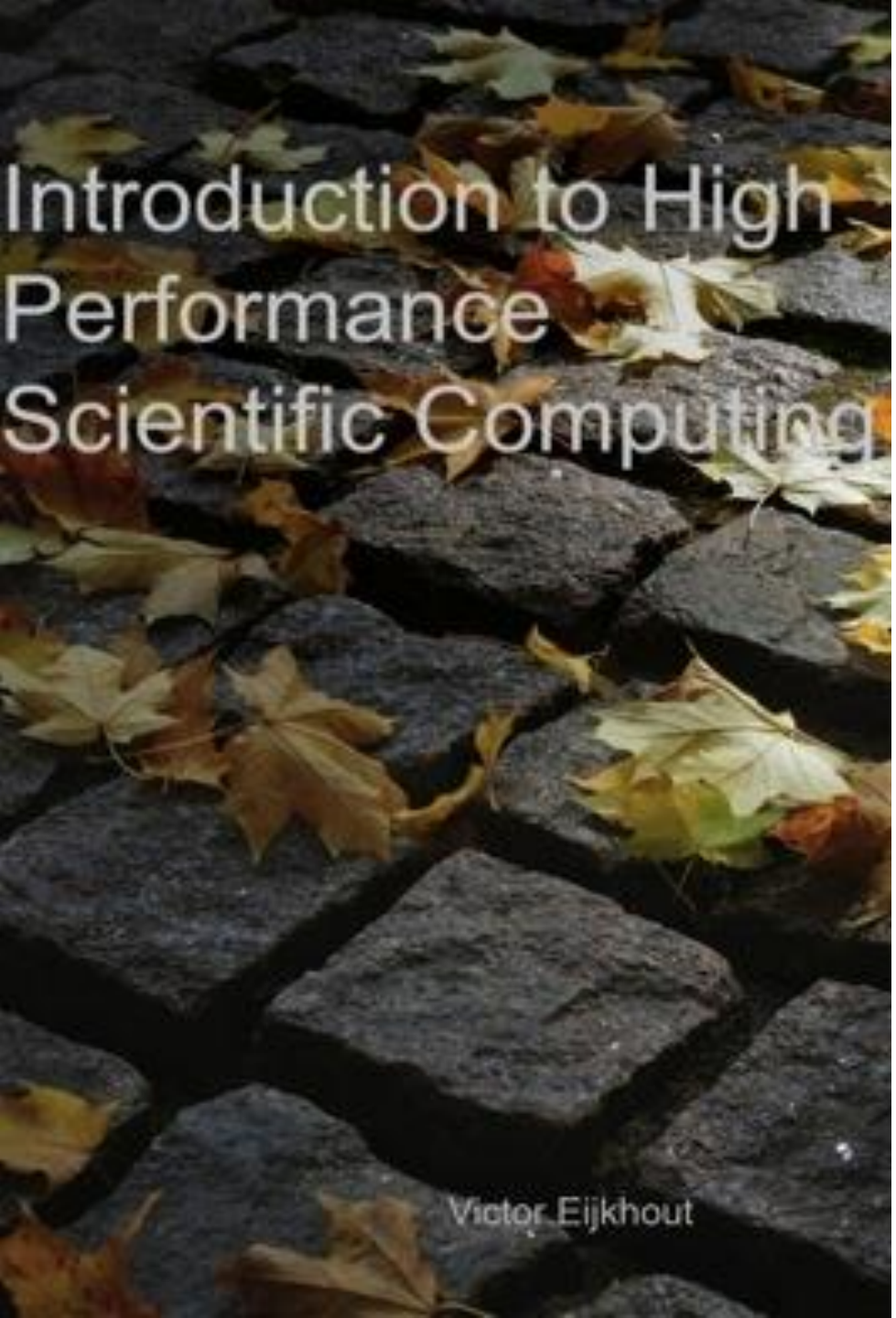
- The course is a **HPC software atelier**
- In-class HPC projects on USI HPC cluster (please always bring your laptop to the class).
- 7 to 8 projects & reading assignments (support and discussion in class)
- Course grading
  - All projects (40% of the grade)
  - no midterm (but much more emphasis on scientific programming)
  - Final oral exam (60% of the grade)
- Late day policy: All assignments are due in class on the assigned due date. ONE free assignment that we will not count for the final grading of the projects.
- Date for the exam (during the official exam period, mid/end of January)



Books

- *Introduction to High Performance Computing for Scientists and Engineers*

  by G. Wellein and G. Hager



Books

- *Introduction to High-Performance Scientific Computing* and
- *Parallel Computing Book*

  by Victor Eijkout

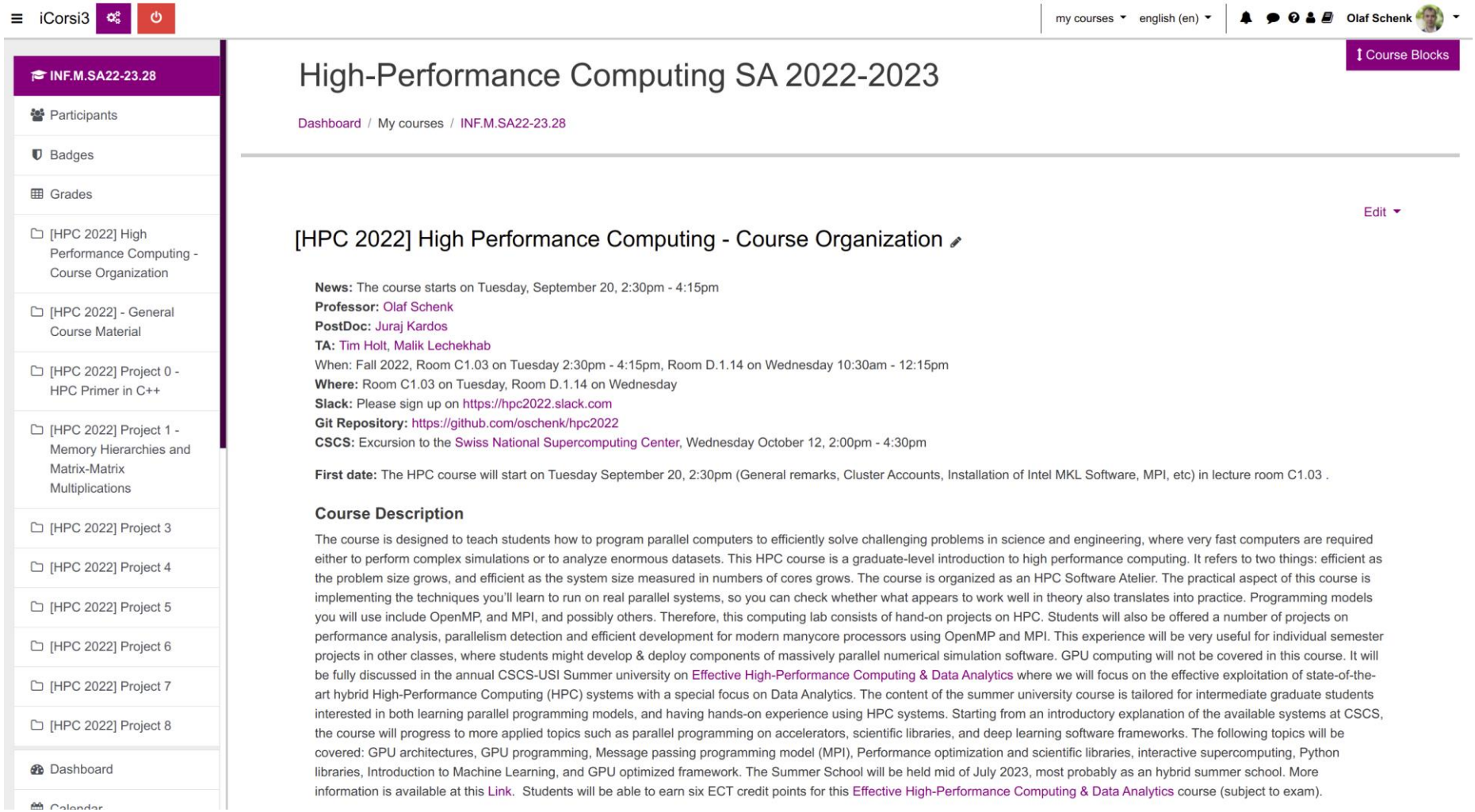
- Both books are available on https://bitbucket.org/VictorEijkhout/

Applications of Parallel Computers

- Applications of Parallel Computers
  - U.C. Berkeley CS267 Home Page, **Applications of Parallel Computers,** Spring 2018
  - https://sites.google.com/lbl.gov/cs267-spr2018/

Repositories: iCorsi (for Upload & Download)

We will use iCorsi for this https://www.icorsi.ch/course/view.php?id=14652



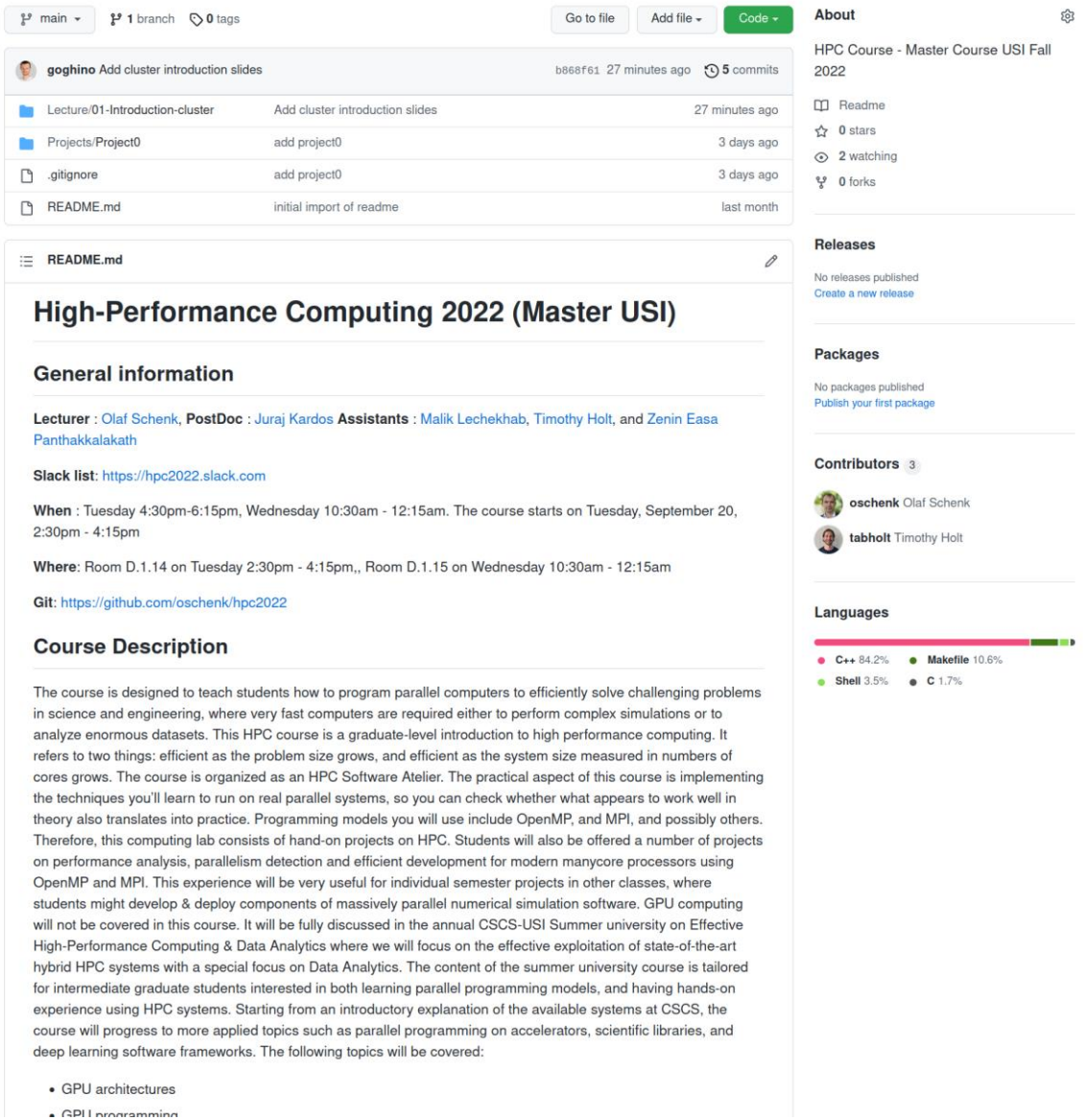
Projects & Icorsi

Icorsi

- The mini-projects sheets will be uploaded on the iCorsi webpage
- The exercise should be solved until the deadline with is given on the project summary
- Please upload your code and a clear summary solution in electronic form on the iCorsi page
- We only accept submissions using our Latex template including Julia and C/C++ code.

Repositories: Github (for Download)

We will use Github for this course https://github.com/oschenk/hpc2022



main 1 branch 0 tags — Go to file — Add file — Code

goghino Add cluster introduction slides — b868f61 27 minutes ago — 5 commits

Lecture/01-Introduction-cluster	Add cluster introduction slides	27 minutes ago
Projects/Project0	add project0	3 days ago
.gitignore	add project0	3 days ago
README.md	initial import of readme	last month

README.md

High-Performance Computing 2022 (Master USI)

General information

Lecturer : Olaf Schenk, **PostDoc** : Juraj Kardos **Assistants** : Malik Lechekhab, Timothy Holt, and Zenin Easa Panthakkalakath

Slack list: https://hpc2022.slack.com

When : Tuesday 4:30pm-6:15pm, Wednesday 10:30am - 12:15am. The course starts on Tuesday, September 20, 2:30pm - 4:15pm

Where: Room D.1.14 on Tuesday 2:30pm - 4:15pm,, Room D.1.15 on Wednesday 10:30am - 12:15am

Git: https://github.com/oschenk/hpc2022

Course Description

The course is designed to teach students how to program parallel computers to efficiently solve challenging problems in science and engineering, where very fast computers are required either to perform complex simulations or to analyze enormous datasets. This HPC course is a graduate-level introduction to high performance computing. It refers to two things: efficient as the problem size grows, and efficient as the system size measured in numbers of cores grows. The course is organized as an HPC Software Atelier. The practical aspect of this course is implementing the techniques you'll learn to run on real parallel systems, so you can check whether what appears to work well in theory also translates into practice. Programming models you will use include OpenMP, and MPI, and possibly others. Therefore, this computing lab consists of hand-on projects on HPC. Students will also be offered a number of projects on performance analysis, parallelism detection and efficient development for modern manycore processors using OpenMP and MPI. This experience will be very useful for individual semester projects in other classes, where students might develop & deploy components of massively parallel numerical simulation software. GPU computing will not be covered in this course. It will be fully discussed in the annual CSCS-USI Summer university on Effective High-Performance Computing & Data Analytics where we will focus on the effective exploitation of state-of-the-art hybrid HPC systems with a special focus on Data Analytics. The content of the summer university course is tailored for intermediate graduate students interested in both learning parallel programming models, and having hands-on experience using HPC systems. Starting from an introductory explanation of the available systems at CSCS, the course will progress to more applied topics such as parallel programming on accelerators, scientific libraries, and deep learning software frameworks. The following topics will be covered:

- GPU architectures
- GPU programming

About

HPC Course - Master Course USI Fall 2022

Readme
0 stars
2 watching
0 forks

Releases

No releases published
Create a new release

Packages

No packages published
Publish your first package

Contributors 3

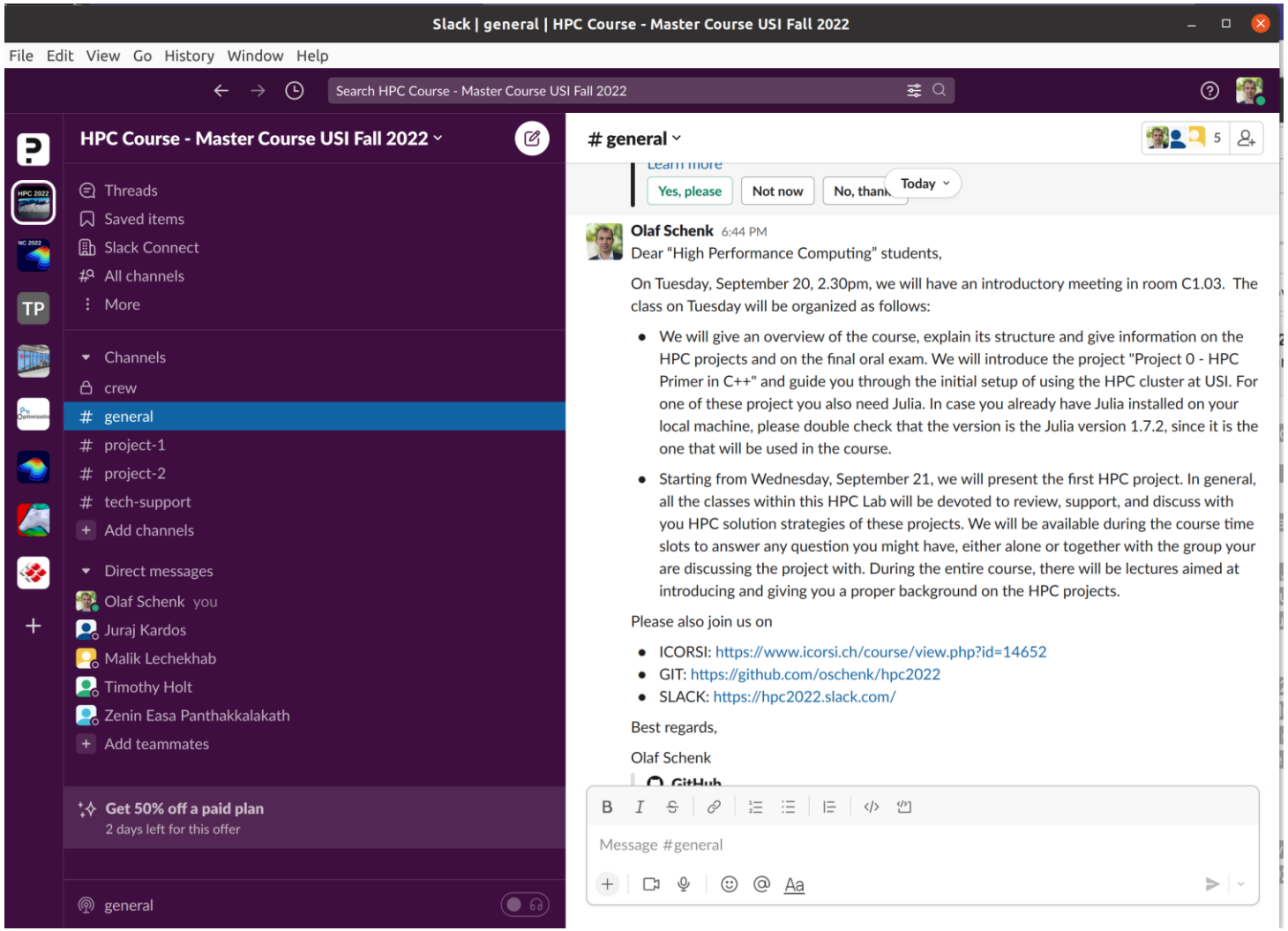
oschenk Olaf Schenk
tabholt Timothy Holt

Languages

C++ 84.2% Makefile 10.6%
Shell 3.5% C 1.7%

Slack (for General Support and Discussion)

SLACK - https://hpc2022.slack.com



Assignments collaboration policy

- You are allowed to discuss such questions with anyone you like; however:
- Your submission **must list anyone** you discussed problems with.
- You must write up your submission **independently**.
- Late day policy: All assignments are due in class on the assigned due date, but you/we have ONE free mini-project that we will not count for the final grade.

- We only accept submissions using our Latex template and C/C++ code. Each project will have 100 points (out of 15 point will be given to the general written quality of the report).

Where do we meet in this Software Atelier (Lab) on High Performance Computing?

Room C1.03
Tuesday
2:30pm - 4:15pm

Room D.1.14
Wednesday
10:30am - 12:15pm

CSCS - Swiss National Supercomputing Centre

- CSCS
  Swiss National Supercomputing Centre
  Via Trevano 131
  6900 Lugano
- CSCS Visit:
  Wednesday
  October 12, 2:00pm - 4:30pm
  (Please attend in person)
- The agenda will be

  Overview CSCS (30 min)
  Research Talk (30 min)
  Guided Tour CSCS Server Room (60 min)

This summer school will focus on the effective exploitation of state-of-the-art hybrid High-Performance Computing (HPC) systems with a special focus on Data Analytics.

First week

- GPU architectures
- GPU programming (CUDA and OpenACC)
- Message passing programming model (MPI
- Performance optimization and scientific libraries
- Interactive Supercomputing with JupyterLab

Second week

- Interactive supercomputing Python HPC libraries
- Introduction to Machine Learning frameworks (Rapids)
- Deep Learning on HPC platforms (TensorFlow)

6 ECTS for MSC students in AI, CS, FINTECH

Next Schedule

- Questions?

- Release of HPC project 0: September 20.
- Release of HPC project 1: September 21.

- Deadline for HPC project 0: Wednesday, 5 October 2022, 11:59 PM
- Deadline for HPC project 1: Wednesday, 12 October 2022, 11:59 PM

Today

- Support with Cluster installation/accounts – Dr. Juraj Kardos
- Presentation of project P0 - Tim Holt