

# Welcome to Thematic CERN School of Computing



**thematic**  
CERN  
School of Computing

14-18 June 2021  
Online

**Scientific Software for  
Heterogeneous Architectures**

<http://cern.ch/csc>

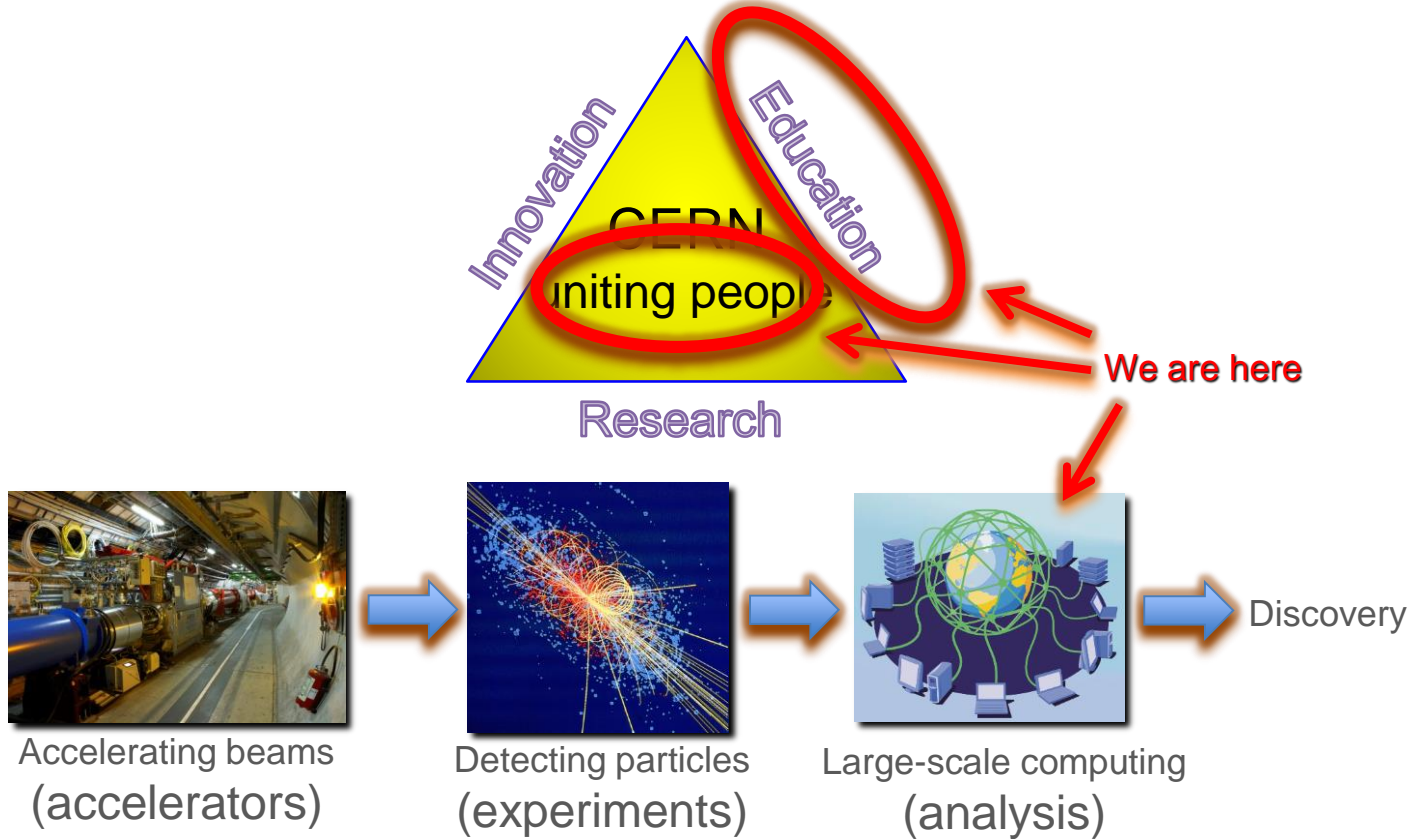
CERN

<http://indico.cern.ch/e/tCSC-spring-2021>

*Sebastian Lopienski*  
*CERN School of Computing director*

# Introduction to CERN School of Computing

# CERN's mission



# A school with a long history

- The school was created in **1970**
  - 42<sup>nd</sup> edition in 2019
- **2800** students of ~80 different nationalities have followed the school
  - usually 60-80 per year
  - alumni web site: <https://cern.ch/CSC/history/alumni/>
- The school has visited 22 countries
  - <https://cern.ch/CSC/history/past-schools/>
  - recent: Romania, Croatia, Israel, Spain, Belgium, Greece, Portugal, Cyprus



# Bridging science and computing

- Technological evolution in computing empowers science
  - especially in data-intensive domains such as High Energy Physics
  - **computing is the main strategy** for many scientific fields to do research efficiently on a large scale
- It is nowadays essential that:
  - **scientists master computing technologies** as a main tool for their research
  - **computer engineers understand the scientific needs** in order to deliver computing services to research projects

# Academic dimension

## CERN School of Computing...

- is **not a conference**
  - lecturers do not present their work or promote their projects
- is **not a training session**
  - not a replication of training courses available at home institutes or online
  - focus on persistent knowledge, less on know-how



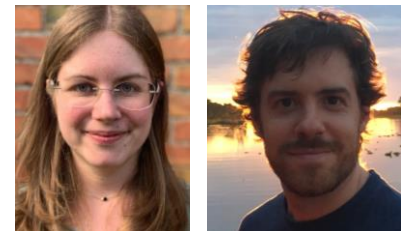
# Thematic CSC spring 2021

# Academic programme

<https://indico.cern.ch/event/1017080/program>

## Theme: *“Scientific Software for Heterogeneous Architectures”*

- Introduction lecture *“Preparing for the HL-LHC computational challenge”* by **Danilo Piparo** (CERN)
- Track 1: *Technologies and Platforms* by **Andrzej Nowak**
- Track 2: *Parallel and Optimised Scientific Software* by **Danilo Piparo** (CERN) and **Sebastien Ponce** (CERN) exercises assisted by **Arthur Hennequin** (CNRS)
- Track 3: *Programming for Heterogeneous Architectures* by **Dorothea vom Bruch** (CPPM/CNRS) and **Daniel Campora** (University of Maastricht)





# CSC Organizers



**Joelma Tolomeo**  
Administrative Manager



**Jarek Polok**  
Technical Manager



**Sebastian Lopienski**  
Director

# Participants (**you!**)

 Applications **159**





**42 students invited**

<https://indico.cern.ch/event/1017080/page/21983-participants>

# School organization and logistics

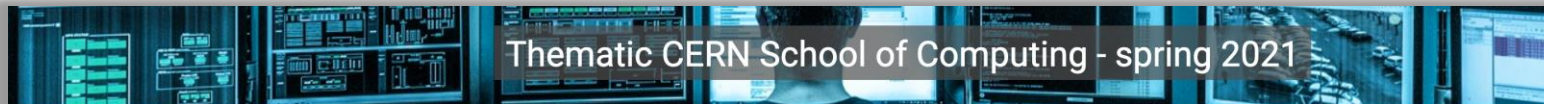
# Online school

<https://indico.cern.ch/event/1017080/page/22013-school-guide>  
<https://indico.cern.ch/event/1017080/page/22182-online-platforms>

- **Active participation** throughout the whole week 
  - attend all **classes**, taking **lecture quizzes**
  - contribute to **group assignments**, completing **exercises**
  - use **Mattermost chat** for discussions, questions, interactions with others
  - **don't plan to work in parallel during this week**
  - **block social media?**
- **Zoom etiquette** 
  - connect on time (or before!)
  - stay muted, video disabled (*except for group assignments*)
  - to ask a question, Raise Hand 🖐️ or write on the chat

# Indico is your friend

<https://indico.cern.ch/e/tCSC-spring-2021>



## Thematic CERN School of Computing - spring 2021

### Overview

Academic programme

Classes per lecturer

Lecture quizzes

Timetable (weekly)

Timetable (daily)

Practical information

└ School guide

└ Terms & Conditions

Online platforms

└ Access details

└ Mattermost chat

└ Desktop/laptop system configuration

Lecturers

Participants

Organisers

CSC portal website

Privacy notice

The 8th **Thematic** CERN School of Computing (tCSC spring 2021) will take place on **June 14-18, 2021** in an online format.

The theme of the School is "**Scientific Software for Heterogeneous Architectures**" - see the [academic programme](#) for more details.

The School is targeted at postgraduate (i.e. minimum of Bachelor degree or equivalent) students, engineers and scientists with a few years' experience in particle physics, in computing, or in related fields. We welcome applications from all countries and nationalities.



Due to the ongoing Covid-19 pandemic, this School is organised in an online format. Nevertheless, we aim at creating the usual rich, interactive learning experience, for which CERN School of Computing (CSC) is known since years.



14 to 18 June 2021 - Online School

Scientific Software for Heterogeneous Architectures  
Technologies and platforms  
Parallel and optimised scientific software  
Programming for heterogeneous architectures

<https://indico.cern.ch/e/tCSC-spring-2021>

## School booklet

- Electronic version only
- Linked from [school main page](#) on Indico (at the bottom)
- Contains **pictures and short biographies of all participants**



# Mattermost is your friend, too

<https://mattermost.web.cern.ch/csc>

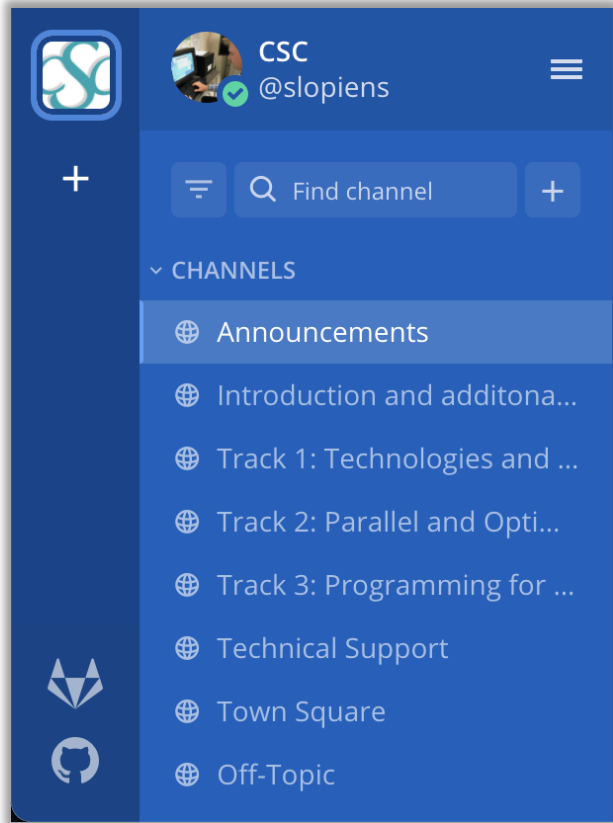
<https://indico.cern.ch/event/1017080/page/22182-online-platforms#mattermost>

The screenshot displays the Mattermost web interface for the CSC channel. On the left is a dark blue sidebar with the CSC logo at the top, a search bar labeled "Find channel", and a list of channels including "Announcements", "Introduction and additona...", "Track 1: Technologies and ...", "Track 2: Parallel and Opti...", "Track 3: Programming for ...", "Technical Support", "Town Square", and "Off-Topic". The main content area shows the "Announcements" channel header with 39 members and a description "Channel for official communication...". A message from Sebastian Lopienski, posted at 5:08 PM, reads: "Hello everyone - welcome to the Thematic CERN School of Computing spring 2021!". Below the message is a text input field with the placeholder "Write to Announcements" and icons for attachments and emojis. A "Help" link is located in the bottom right corner of the interface.

# Mattermost is your friend, too

<https://mattermost.web.cern.ch/csc>

<https://indico.cern.ch/event/1017080/page/22182-online-platforms#mattermost>

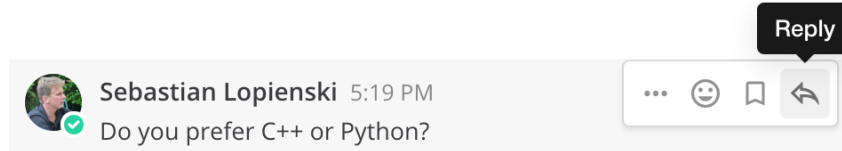


## Channels:

- A channel for each *Track*
  - to discuss with the speakers and other students
- [Announcements](#) – official communications
- [Technical support](#)

(You can create more channels, public or private, or chat directly with other participants)

**Reminder:** please use “*Reply*” button





# Timetable

<https://indico.cern.ch/event/1017080/timetable/>

Monday, 14 June 2021	Tuesday, 15 June 2021	Wednesday, 16 June 2021	Thursday, 17 June 2021	Friday, 18 June 2021
09:00 <b>Opening Session</b>	09:00 <b>Writing parallel software</b> - Danilo Piparo (CERN)	09:00 <b>Hardware evolution and heterogeneity</b> - Andrzej Nowak	09:00 <b>Data-oriented design</b> - Andrzej Nowak	09:00 <b>Group assignment for Track 3: Programming for heterogeneous architectures</b>
09:30 <b>Preparing for the HL-LHC computational challenge</b> - Danilo Piparo (CERN)	10:00 <b>Modern programming languages for HEP</b> - Sebastien Ponce (CERN)	10:00 <b>Practical vectorization</b> - Sebastien Ponce (CERN)	10:00 <b>Programming for GPUs</b> - Dorothea vom Bruch (CPPM/CNRS)	10:30 <b>Coffee break</b>
10:30 <b>Coffee break</b>	11:00 <b>Coffee break</b>	11:00 <b>Coffee break</b>	11:00 <b>Coffee break</b>	10:50 <b>Design patterns and best practices</b> - Daniel Campora (University of Maastricht)
10:50 <b>Introduction to efficient computing</b> - Andrzej Nowak	11:20 <b>Optimizing existing large codebase</b> - Sebastien Ponce (CERN)	11:20 <b>Scientific computing on heterogeneous architectures</b> - Dorothea vom Bruch (CPPM/CNRS)	11:20 <b>Performant programming for GPUs</b> - Daniel Campora (University of Maastricht)	11:50 <b>Programming for heterogeneous architectures</b>
11:50 <b>Self-presentation: 1 minute per p...</b>				
14:00 <b>Self-presentation: 1 minute per p...</b>	14:00 <b>School photo</b>	14:00 <b>Group assignment for Track 2: Parallel and Optimised Scientific Software</b>	14:00 <b>Programming for heterogeneous architectures</b>	14:00 <b>Summary and future technologies overview</b> - Andrzej Nowak
14:30 <b>Coffee break</b>	14:05 <b>Parallel and optimised scientific ...</b>	15:30 <b>Coffee break</b>	14:20 <b>Programming for heterogeneous architectures - exercise</b> - Dorothea vom Bruch (CPPM/CNRS) Daniel Campora (University of Maastricht)	15:00 <b>Coffee break</b>
14:50 <b>Group assignment for Track 1: Technologies and Platforms</b>	14:25 <b>Parallel and optimised scientific software - exercise</b> - Sebastien Ponce (CERN) Arthur Hennequin (CNRS)	15:50 <b>Student lightning talks</b>		15:30 <b>Exam</b>
		16:30 <b>Parallel and optimised scientific s...</b>		
				16:40 <b>Closing Session</b>

## Lecture quizzes (mandatory)

- After each lecture, go to [lecture quizzes](#) page and complete a simple test (2-3 questions)
- **The goal is to confirm what you've learned** – it's for you only
- Once you select an answer, it will be highlighted in **red** or **green**, and additional explanations may appear

How much storage space do the LHC experiments need today to operate and securely save the raw data? \*

- A few hundred Terabytes**
- A few hundred Petabytes
- More than one Exabyte
- A few hundred Gigabytes

Submit

# Group assignments

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# Group assignments

(one session for each Track)

## Part one (45 minutes)

- You will be split into 7 groups of 6 persons each (Zoom breakout rooms)
- You will be given a topic to discuss
  - everyone is expected to participate in the discussion, with cameras enabled
  - please use a shared document (e.g. on [Codimd](#))
- Elect a **chairperson** (ensures that everyone can and does contribute, keeps track of time)
- ... and a **secretary** (takes notes, and reports afterwards the outcome of the discussion)

## Part two (45 minutes)

- Everyone gets back to the main Zoom room
- Each group reports briefly (5 minutes) on their discussion and conclusions

# Hands-on exercises

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# Hands-on exercises

(for Track 2 and Track 3)

**14:00 Exercise introduction: Parallel ...**

**14:20 Exercise: Parallel and optimised scientific software**

**16:30 Exercise debriefing: Parallel and ...**

Exercise introduction

Hands-on part

- split into two Zoom breakout rooms
- a lecturer or a mentor in each room

Exercise debriefing (the next day)

Exercise instructions and materials published in Indico ([Track 2](#) and [Track 3](#))

Access to exercise environment – see [prerequisites](#) and [access details](#) pages

- use your CERN account

# Student lightning talks (Wednesday at 15:50)

<https://indico.cern.ch/event/1017080/contributions/4268654/>

- A short talk (7-10 minutes) on a **scientific or technical topic**
- An **informal opportunity** for you to share your interest or passion
  - a technology, tool or service that you are using
  - your PhD research
  - experiment or project you're working on
- Still a few slots available → if interested, [submit your proposal](#)
  - talk to me on Mattermost ([@slopiens](#)) or by email ([Sebastian.Lopienski@cern.ch](mailto:Sebastian.Lopienski@cern.ch)) if you're hesitating or not sure if your topic fits

# Special evening lecture (Tuesday 19:00 - *optional*)

<https://indico.cern.ch/event/1017080/contributions/4268656/>

by Ivica Puljak (University of Split)





# Exam (Friday at 15:30)

<https://indico.cern.ch/event/1017080/contributions/4268646/>

- Covering all lectures, except the [Introduction](#) and the [Summary](#) lectures
- Two questions per lecture → **22 questions**
- Duration: **40 minutes**
- Multiple choice questions: **4 answers possible – only one is correct**
  
- The passing threshold is 50% of correct answers
- **Rules:**
  - you **may** consult materials (slides etc.)
  - you **must not** use external help, or communicate with other people
- Results will be sent by e-mail as soon as possible after the exam

# Enjoy and profit from the school!



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CERN  
School of Computing

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<http://cern.ch/csc>



## CSC Rule #3

# Wear your badge

