

CERN School of Computing 2022



Sunday, 4 September 2022 - Saturday, 17 September 2022

AGH University of Science and Technology

Academic programme

The complete programme will offer over 50 hours of lectures and hands-on exercises. The programme is organized over three distinct tracks: Physics Computing, Software Engineering, and Data Technologies. In addition, guest lectures, student presentations and special evening talks will be organised. Finally, AGH (the hosting university) plans to offer an optional, half-day CUDA training.

(Please note that this programme may be subject to minor changes.)

Physics Computing

Introduction to Physics Computing

by Arnulf Quadt (University of Göttingen)

2h lectures

foundations of particle physics

introduction to the Standard Model

event filtering

calibration and alignment

event reconstruction

event simulation

physics analysis

data flow and computing resources

Data Science and Interactive Data Exploration

by Bob Jacobsen (UC Berkeley)

2h lectures + 2h exercises

introduction, data science tools

using data from different sources

non-numeric data

Data Analysis

by Toni Šćulac (University of Split)

4h lectures + 3h exercises

introduction to data analysis

probability density functions and Monte Carlo methods

parameter estimation and confidence intervals

hypothesis testing and p-value

Introduction to Machine Learning

by Tomasz Szumlak (AGH) and Kamila Kalecinska (AGH)

3h lectures + 3h exercises

what is machine learning

learning algorithm, loss function, optimisation

overfitting and underfitting

machine learning in HEP

Software Engineering

Tools and Techniques

by Bob Jacobsen (UC Berkeley)

2h lectures + 3h exercises
introduction to software engineering
test frameworks, memory checkers
collaborating on complex software

Software Design in the Many-Cores Era

by Andrei Gheata (CERN) and Stephan Hageboeck (CERN)

4h lectures + 3h exercises

Amdahl's and Gustafson's laws, data and task parallelism
parallel programming in C++, concurrency and synchronisation
performance and correctness - profiling and debugging multithreaded applications
patterns for parallel software development

Creating Secure Software

by Sebastian Lopienski (CERN)

3h lectures + 3h exercises

introduction to computer security
security in different phases of software development
web application security

Data Technologies

Data Management

by Alberto Pace (CERN)

5h lectures

data workflow, storage models and technologies
reliability and error correction
practical cryptography: hash functions, symmetric and asymmetric encryption, digital signatures
authentication, authorization and accounting: PKI, certificates, Kerberos, OpenID, OAuth etc.
distributed hash tables, block storage, data replication, caching

Data and Storage Technologies

by Andreas J. Peters (CERN)

1h lecture + 3h exercises

storage technologies: present and future
data formats and access patterns
optimizations in IO systems
redundancy, cloud storage

Data Visualization

by Eamonn Maguire (Proton, Switzerland)

2h lectures + 2h exercises

data visualization: theory and practical applications
multi-dimensional data visualization

Additional lectures

Student lightning talks session

Guest lecture

Heterogeneous computing

by Tomasz Szumlak (AGH)

Special Evening talk

When Internet history meets philosophy

by Francois Fluckiger (CERN)

(Optional) CUDA training

Fundamentals of Accelerated Computing with CUDA C/C++

This optional half-day course will allow you to learn how to accelerate and optimise existing C/C++ CPU-only applications to leverage the power of GPUs using innovative and modern CUDA techniques. It is also an excellent way to start working with highly optimised professional tools like Nsight integrated development environment with a graphical profiler. To start your journey with the massively parallel world, you are going to need a basic C/C++ competency, including familiarity with variable types, loops, functions, arrays, etc.

This course, kindly organized by AGH University of Science and Technology (the hosting university), is offered to the participants of CSC 2022 for free (the usual fee is approximately 100 USD per person with a non-profit academic background). The promotion code which unlocks the materials and computation time in NVIDIA cloud will be given to you at the beginning of the course. The materials can be accessed and run in the cloud for approximately six months after the course. **It is possible to get an official Certificate of Competency (CoC)** issued by the NVIDIA after completing the exam session (at the end of the course day, or at any convenient time up to six months after the CSC 2022).