

# Comprehensive General LUMI Course (Oct 3-6 2023)

Location: Hybrid (Warsaw/Online)

Announcement web page:

<https://www.lumi-supercomputer.eu/events/general-lumi-course-oct2023/>

## **Agenda**

The main topics day by day. Each day 9:00 til 17:30 CEST / 10:00 til 18:30 EEST.

**Day 1** – Connecting to the system, building and executing applications, simple use of GPUs via libraries, programming GPUs via OpenACC and OpenMP.

**Day 2** – Optimizations techniques, debugging, additional software on LUMI, AMD ROCm ecosystem.

**Day 3** – Profiling, MPI optimizations, ROCm tools.

**Day 4** – Note optimizations, I/O, Advanced ROCm tools, LUMI support.

## Day 1: Tuesday 03/10 (times in CEST)

Start	Duration	Item
09:00	15	<b>Welcome, introduction to the course</b> <i>Course organisation.</i> <i>Demonstration of how to use HedgeDoc.</i>
09:15	60	<b>Introduction to the HPE Cray Hardware</b> <i>Focus on the HPE Cray EX hardware architecture.</i>
10:15	30	<b>Introduction to the HPE Cray Programming Environment</b> <i>Focus on the HPE Cray EX software stack.</i> <i>Tutorial on the Cray module environment and compiler wrapper scripts.</i>
10:45	15	<b>Break</b>
11:00	20	<b>First steps for running on Cray EX Hardware</b> <i>Examples of using the Slurm Batch system, launching jobs on the front end and basic controls for job placement.</i>
11:20	40	<b>Exercises (session #1)</b>
12:00	90	<b>Lunch break</b>
13:30	60	<b>Overview of compilers and Parallel Programming Models</b> <i>An introduction to the compiler suites available, including examples of how to get additional information about the compilation process. Special attention is given the Cray Compilation Environment (CCE) noting options relevant to porting and performance.</i> <i>Description of the Parallel Programming models.</i>
14:30	30	<b>Exercises (session #2)</b>
15:00	15	<b>Break</b>
15:15	30	<b>Scientific Libraries</b> <i>Presentation of the Cray Scientific Libraries for CPU and GPU execution.</i>
15:45	30	<b>Exercises (session #3)</b>
16:15	45	<b>OpenACC and OpenMP offload with Cray Compilation Environment</b> <i>Directive-based approach for GPU offloading execution with the Cray Compilation Environment.</i>
17:00	30	<b>Open Questions &amp; Answers</b> Participants are encouraged to continue with exercises in case there should be no questions.
17:30		<b>End of the course day</b>

## Day 2: Wednesday 04/10 (times in CEST)

Start	Duration	Item
09:00	60	<b>Advanced Application Placement</b> <i>More detailed treatment of Slurm binding technology and OpenMP controls.</i>
10:00	30	<b>Exercises (session #4)</b>
10:30	15	<b>Break</b>
10:45	45	<b>Debugging at Scale</b> <i>gd4hpc, valgrind4hpc, sanitizer4hpc, ATP, STAT.</i>
11:30	30	<b>Exercises (session #5)</b>
12:00	90	<b>Lunch break</b>
13:30	90	<b>Additional software on LUMI</b> <i>Software policy.</i> <i>Software environment on LUMI.</i> <i>Installing software with EasyBuild (concepts, contributed recipes).</i> <i>Containers for Python, R, VNC (container wrappers).</i>
15:00	30	<b>Break</b>
15:30	60	<b>Introduction to AMD ROCm ecosystem and HIP</b>
16:30	30	<b>Exercises (session #6)</b>
17:00	30	<b>Open Questions &amp; Answers</b> Participants are encouraged to continue with exercises in case there should be no questions.
17:30		<b>End of the course day</b>

## Day 3: Thursday 05/10 (times in CEST)

Start	Duration	Item
09:00	40	<b>Introduction to Perftools - Perftools-lite modules</b> <i>Overview of the Cray Performance and Analysis toolkit for profiling applications.</i> <i>Demo: Visualization of performance data with Apprentice2.</i>
09:40	30	<b>Exercises (session #7)</b>
10:10	20	<b>Break</b>
10:30	60	<b>Advanced performance analysis</b> <i>Automatic performance analysis and loop work estimated with perftools.</i> <i>Communication Imbalance, Hardware Counters, Perftools API, OpenMP.</i> <i>Compiler feedback and variable scoping with Reveal.</i>
11:30	30	<b>Exercises (session #8)</b>
12:00	75	<b>Lunch break</b>
13:15	60	<b>Understanding Cray MPI on Slingshot, rank reordering and MPMD launch</b> <i>High level overview of Cray MPI on Slingshot, useful environment variable controls.</i> <i>Rank reordering and MPMD application launch.</i>
14:15	30	<b>Exercises (session #9)</b>
14:45	15	<b>Break</b>
15:00	30	<b>AMD Debugging</b>
15:30	30	<b>Exercises (session #10)</b>
16:00	30	<b>Introduction to AMD Rocprof</b>
16:30	30	<b>Exercises (session #11)</b>
17:00	30	<b>Open Questions &amp; Answers</b> Participants are encouraged to continue with exercises in case there should be no questions.
17:30		<b>End of the course day</b>

## Day 4: Friday 06/10 (times in CEST)

Start	Duration	Item
09:00	15	<b>Python on HPE Cray EX Supercomputer</b>
09:15	45	<b>Performance Optimization: Improving single-core efficiency</b>
10:00	15	<b>Exercises (session #12)</b>
10:15	15	<b>Break</b>
10:30	60	<b>I/O Optimisation - Parallel I/O</b> <i>Introduction into the structure of the Lustre Parallel file system.</i> <i>Tips for optimising parallel bandwidth for a variety of parallel I/O schemes. Examples of using MPI-IO to improve overall application performance.</i> <b>Advanced Parallel I/O considerations</b> <i>Further considerations of parallel I/O and other APIs.</i> <b>Being nice to Lustre</b> <i>Consideration of how to avoid certain situations in I/O usage that don't specifically relate to data movement.</i>
11:30	30	<b>Exercises (session #13)</b>
12:00	75	<b>Lunch break</b>
13:15	25	<b>AMD Omnitrace</b>
13:40	20	<b>Exercises (session #14)</b>
14:00	25	<b>AMD Omnipperf</b>
14:25	20	<b>Exercises (session #15)</b>
14:45	15	<b>Break</b>
15:00	90	<b>Best practices: GPU Optimization, tips &amp; tricks / demo</b>
16:30	30	<b>LUMI support and LUMI documentation</b> <ul style="list-style-type: none"> <li>• <i>What can we help you with and what not? How to get help, how to write good support requests.</i></li> <li>• <i>Some typical/frequent support questions of users on LUMI?</i></li> </ul>
17:00	30	<b>Open Questions &amp; Answers</b> Participants are encouraged to continue with exercises in case there should be no questions.
17:30		<b>End of the course day</b>