

From Printed Manuals to Modular Online Training: Teaching Introduction to High-Performance Computing at the Juelich Supercomputing Centre

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Abstract

Over the years, the Jülich Supercomputing Centre (JSC) has developed a comprehensive ‘Introduction to Supercomputing at JSC - Theory & Practice’ training course to bridge the gap between university education and practical high-performance computing (HPC) science. Since its inception in 1992, the course has evolved from face-to-face lectures to an online format, integrating a modular lecture structure and practical hands-on exercises. Divided into six modules, it covers fundamental HPC concepts, advanced techniques such as GPU programming and AI, JSC-specific tooling, and vendor-specific hardware insights. Hands-on sessions emphasize practical application, allowing participants to test workflows in their own work environments while receiving live support from tutors. The modular structure addresses challenges in HPC education stemming from vastly different levels of user competence, and helps ensure efficient HPC resource usage. The course prioritizes accessibility through asynchronous learning material, including slides, recordings, and self-study resources, ensuring continuous availability for users. Engagement and thereby higher learning outcome is achieved through interactive quizzes, moderated discussions, and a

multi-channel support system. The course design provides a replicable concept that can be adopted by other HPC centers seeking to support their users through custom-fit HPC training.

CCS Concepts

• **Social and professional topics** → **Computational science and engineering education**; • **Software and its engineering** → **Massively parallel systems**.

Keywords

high-performance computing, education and training, modular course structure, online training

ACM Reference Format:

Jolanta Zjupa, Ilya Zhukov, Junxian Chew, Sabine Hoefler-Thierfeldt, Tom Ridley, Benedikt Steinbusch, and Alexandre Strube. 2026. From Printed Manuals to Modular Online Training: Teaching Introduction to High-Performance Computing at the Juelich Supercomputing Centre. In *Practice and Experience in Advanced Research Computing (PEARC '26)*, July 26–30, 2026, Minneapolis, MN, USA. ACM, New York, NY, USA, 9 pages. <https://doi.org/10.1145/3785462.3815791>

1 Introduction

Over the course of the last two decades, Tier-0 German High-Performance Computing (HPC) centers rose to fill the educational gap between STEM MSc-level university education (including computer science and computer engineering) and HPC science. There are three Tier-0 HPC centers in Germany: the High-Performance Computing Center Stuttgart (HLRS), the Jülich Supercomputing Centre (JSC) at Forschungszentrum (‘Research Centre’) Jülich, and the Leibniz Supercomputing Centre (LRZ) in Garching near Munich, which together form the ‘Gauss Centre for Supercomputing’ (GCS)

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†In alphabetic order.



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ACM ISBN 979-8-4007-2377-3/26/07

<https://doi.org/10.1145/3785462.3815791>

alliance¹. Each of the three GCS centers has developed its own independent teaching and training curriculum, similar in scope to an HPC MSc program offered by the HPC centers to complement university education. The curriculum encompasses a variety of courses covering basic and advanced topics, as well as topics of particular relevance to specific scientific communities. Courses are offered in online, in-person, and hybrid formats. Basic courses, such as 'Parallel programming with MPI and OpenMP', are offered at all three centers, while more advanced courses are offered by the center specializing in given expertise, fostering exchange and closer collaboration between the three centers. An exhaustive list of currently offered training courses by the three centers can be found on the GCS website² as well as for each center individually on the HLRS training website³, JSC training website⁴, and LRZ training website⁵. Training courses are open to all (potential) users of the HPC systems hosted at the GCS centers, both from academic institutions and industry. The JSC training courses are free of charge for the participants.

The 'Introduction to Supercomputing at JSC - Theory & Practice' training course (hereafter 'introductory course'), held online twice a year, is the main pillar of JSC's HPC curriculum. This course is the oldest and largest training course at JSC, repeatedly receiving over 100 registrations. The main motivation for this course is to provide a comprehensive onboarding to new users of JSC's HPC systems, teach core HPC usage skills, and establish best practices early on. More experienced users should also be able to close knowledge gaps or expand existing knowledge on specific HPC topics. Through this approach, the HPC center aims to reduce the load on HPC user support and to ensure efficient usage of the HPC resources. In this paper, we present the content of the 'Introduction to Supercomputing at JSC - Theory & Practice' training course and detail the structure implemented to achieve those goals. We elaborate on the logistics of the course, providing a reference for other HPC centers interested in establishing similar courses at their sites.

2 Evolution of the course and participation statistics

The first 'Introduction to Supercomputing at JSC - Theory & Practice' training course was held in 1992 under the name 'Einführung in die Benutzung der CRAY-Rechner' ('Introduction to the Usage of CRAY Computers') targeted at the CRAY Y-MP M94 computer hosted in ZAM ('Zentralinstitut für Angewandte Mathematik'), the predecessor institute of JSC. The course was held in German with a duration of 1.5 days. It was comprised of in-person lectures without hands-on sessions. Attendance was limited by the classroom size to roughly two dozen participants, which fully satisfied demand at that time. The main motivation for the course was to provide users with a comprehensive overview of the then state-of-the-art technology at ZAM and to accelerate users' ability to take advantage of the HPC resources for their scientific work. The introductory course was therefore scheduled at the beginning of every compute

time allocation period⁶ on the ZAM/JSC HPC systems. It provided easy access and a compact overview of the most important know-hows needed to efficiently use the HPC systems, at a time when the sole other source of information was lengthy system manuals that were handed out to users in printed form. The first online documentation for JSC's HPC systems was made available on the world wide web in 1996⁷ and has been continuously brought up to date to reflect the current state of JSC's various HPC systems⁸. The course has been held in English since 2009. Registration to the course was done initially by email to 'dispatch', now 'Office for User Services'. Since 2016, registration has been done through a course management platform. The platform of choice since 2021 is Indico⁹. In the beginning of 2020, the introductory course, similar to most other JSC training courses, was ported to an online format to meet the restrictions imposed by the Covid-19 pandemic. Registration numbers skyrocketed from 20 - 30 registrations per course in 2018 and 2019 to over 100 registrations in 2020, and actual participation numbers approximately tripled. No upper limit on the number of participants had yet been put in place, as the first online course in 2020 offered lectures only. Since then, JSC continues to offer the introductory course in the online format to ensure the widest reach (see section 3.2).

In order to maximize participants' knowledge retention, as well as to increase motivation and engagement, practical hands-on exercises were developed based on existing documentation to complement the lecture curriculum. The hands-on exercises were first offered in 2021 as a stand-alone half day unit with separate registration immediately after the course. This test-run received very positive feedback and prompted the hands-on to be fully integrated into the introductory course. The hands-on are continuously extended, currently spanning 1.5 days (see section 3.4).

Fig. 2 shows the evolution of course registrations (*dark blue circles*) and participation numbers (*light blue circles*) since the inclusion of the hands-on component. The upper limit on registrations (*red down-pointing triangles*) is dictated by the capacity (availability of tutors) for the hands-on sessions. Fig. 2 shows that there is substantially higher demand for courses offered in November compared to May due to the beginning of the academic year (many PhD programs and postdoctoral positions starting in autumn). Despite progressively increasing capacity, the course was repeatedly over-subscribed. In order to accommodate more participants during the November courses in 2022 and 2023, additional tutors were scouted on short notice to raise the upper limit on registrations (initial upper limit shown as *red down-pointing triangles with dashed line*). At the same time, hands-on participation which determines the course capacity was observed to be consistently lower than overall participation. Therefore, separate (modular) registrations were introduced for the lectures and hands-on (*yellow circles*) in 2024. This allowed, for the first time, to admit all (eligible) registered individuals to

¹<https://www.gauss-centre.eu/>

²<https://www.gauss-centre.eu/trainingsworkshops/>

³<https://www.hlr.de/training/hpc-training>

⁴<https://www.fz-juelich.de/en/jsc/news/events/training-courses>

⁵<https://app1.edoobox.com/en/LRZ>

⁶The **allocation period** of an HPC project is the time span (typically one year) during which the project is granted access to compute and/or data resources on an HPC system. Prior to 2009, JSC had one allocation period per year beginning in July. Since 2009, there have been two allocation periods per year starting May and November.

⁷Wayback archive from 24.6.1997: <https://web.archive.org/web/19970710123745/http://www.kfa-juelich.de/zam/docs/bhb/bhb-cray.html>

⁸JSC user documentation: <https://www.fz-juelich.de/en/jsc/systems/supercomputers/>

⁹Indico - an open-source tool for event organization, archival and collaboration, available at <https://getindico.io>

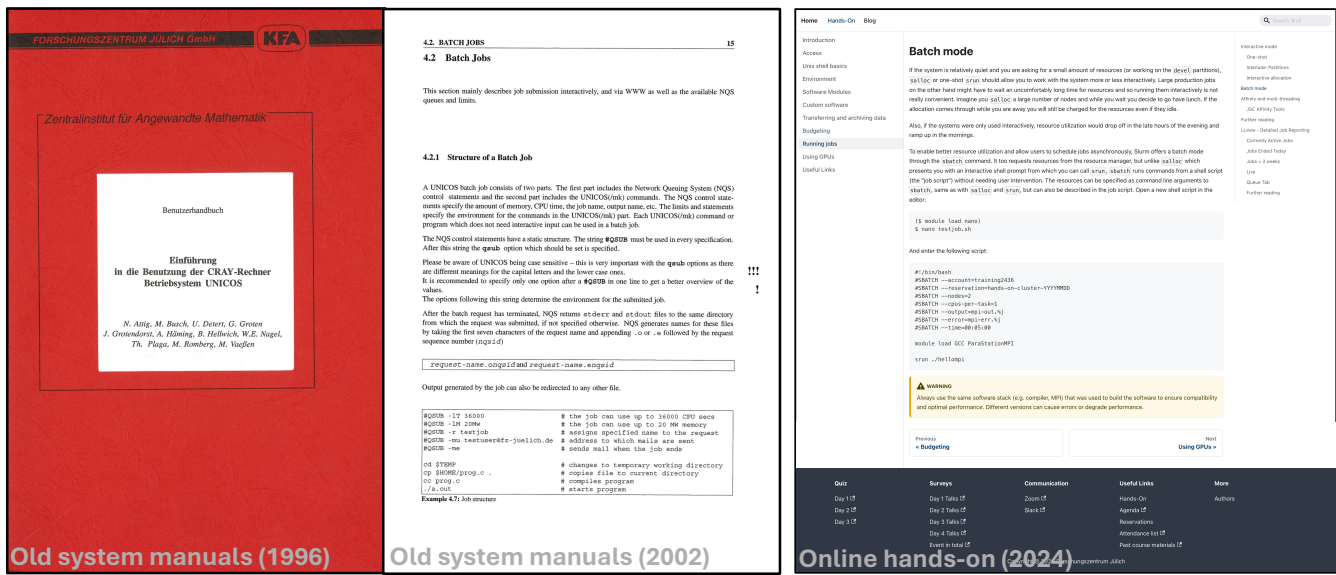


Figure 1: From printed manuals to online hands-on material. Left panel: Old 1996 and 2002 system manuals used in the introductory course. **Right panel:** Most up-to-date hands-on webpage. Both excerpts show instructions for batch job submission on JSC’s HPC systems.

the November instance. The number of hands-on participants is estimated through the number of self-entries in the participant list (*green up-pointing triangle*) and since November 2024 better estimated by the number of proactive joins to the hands-on chat channel (*green down-pointing triangle*). The number of participants receiving a certificate (*purple circles*) indicates a lower bound on hands-on participation. Participation certificates are handed out to participants who have completed the hands-on and explicitly request a certificate (by flagging themselves in the participant list). This is mostly relevant for students who can count the hours spent in the course towards their university degree programs, or professionals who want to strengthen their portfolio. Starting in 2026, it is further intended to introduce a multiple-choice pass-or-fail online exam at the end of the course as prerequisite to obtain a course certificate. The course’s popularity reaffirms the demand for this type of introductory course to HPC and the course’s quality.

3 Course structure

In its established form, the ‘Introduction to Supercomputing at JSC - Theory & Practice’ training course has a duration of 3.5 days. It consists of lectures in the afternoons that are arranged in modules (see section 3.3) and hands-on exercises in the mornings (see section 3.4). The course is held twice per year in an online format (see section 3.2), always at the beginning of an allocation period for national (regular and large-scale) compute projects at JSC (starting May and November each year with a duration of 1 year). The course is a combined effort from a large number of staff members from various divisions within JSC, complemented by selected industry partners, who are domain-specific experts and contribute in various roles during the course (see section 3.1).

3.1 Course organization

The course is conducted via a video conferencing tool and a separate chat-based communication platform. The current video conferencing tool of choice is Zoom due to its simplicity, widespread familiarity, and stability across multiple operating systems. It supports cloud recording that allows saving to local storage, simplifies the scheduling of recurring events, and has a readily available PRO license at JSC. A downside of Zoom is its chat structure, which becomes difficult to navigate for a large number of messages, and a lack of retention of chat history. Therefore, we complement Zoom with the Slack chat platform. Slack is chosen due to its comprehensive structure and widespread use. It facilitates maintaining a clean overview while treating individual issues in separate, sometimes long threads. The introductory course’s Slack chat is organized in 4 channels:

1. **General** for announcements, communication with the participants, and questions concerning lecture content.
2. **Hands-on** for questions concerning the hands-on material.
3. **Misc/social** for communications and/or questions going beyond the scope of the general and hands-on channels.
4. **Staff** for organizational aspects among (and restricted to) organizers, moderators, speakers, and tutors.

During the online lectures, attention is focused on Zoom, and questions about the lecture’s content can be asked either in the Zoom chat, the Slack general channel, or by speaking up at the end of each lecture during the dedicated questions slot. During the hands-on, attention is focused on the Slack hands-on channel while Zoom is running in the background. We provide a detailed description of how the hands-on are conducted in section 3.4.

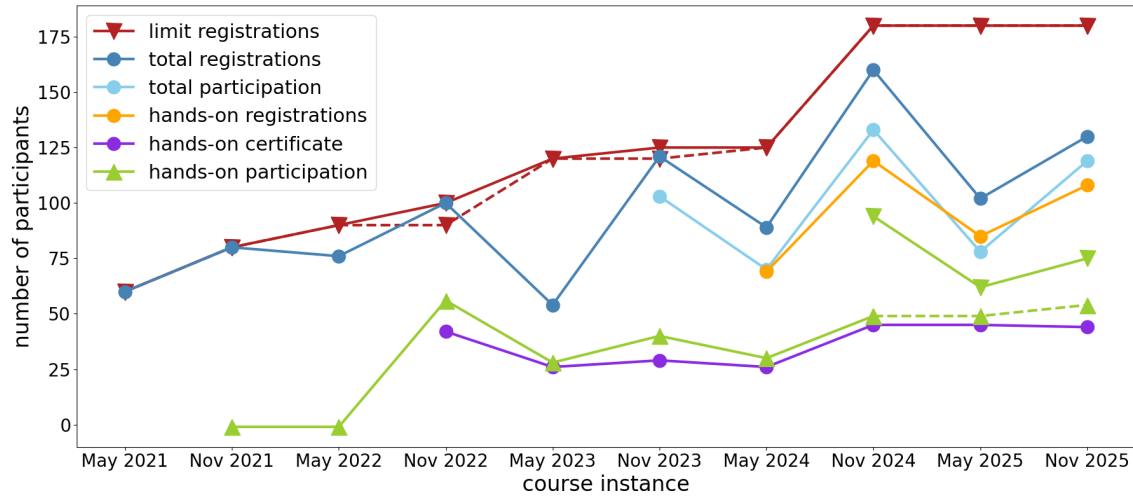


Figure 2: Introductory course registration and participation statistics since the inclusion of the hands-on component (for a detailed description see section 2).

Two *organizers* handle the overall organization and logistics of the course, as detailed in section 4. *Moderators* (hosts, typically the organizers plus an additional person) guide the participants through the course. In the afternoons, moderators chair the lecture sessions, collect questions and conduct the Q&A sessions, address participant queries, and make announcements. They also play a crucial coordinating role during the hands-on sessions, ensuring that all questions are addressed, managing breakout room assignments for participants and tutors, performing administrative tasks such as communicating with HPC system administrators and speakers if needed, as well as making quizzes and important announcements to all participants. *Tutors* serve as the primary point of contact during the hands-on, actively responding to participants' questions and providing technical guidance. *Speakers* give the topic lectures listed in Tab. 1. Individuals can (and do) have multiple roles over the course of one training event.

3.2 Course format

The course is offered in an online format to lower the barrier for participation and reach as many potential participants who would benefit from the course's content as possible. The online format allows for a large (effectively unlimited) number of participants, removing restrictions originating from size of the available rooms or the availability of work stations [11]. Most importantly, this format is particularly beneficial as it allows participation regardless of geographical location or availability of travel funds. Furthermore, the online format paired with the modular structure of the course (see section 3.3) increases the willingness to set time aside for training in the otherwise busy schedules of professionals, and to commit to the course. It allows participants to test out the taught content directly in their personal work environments that are also used for the core scientific work, removing hurdles of integrating and adopting newly learned content into the daily workflow.

For JSC it is of high priority to reach as many (mostly new) users of the HPC systems at the beginning of every allocation period for new compute projects in order to reduce the load on HPC user support and the ticket system. This is achieved by solving recurring and common issues for new HPC users directly during the course, and by establishing best practices for smooth workflows and an efficient use of the provided HPC resources early on.

3.3 Lecture content and modular structure

In contrast to university education where students are expected to be mostly synchronized regarding their current knowledge baseline as they progress from lecture to lecture through the semesters, participants who join courses offered at HPC centers have very diverse knowledge backgrounds, vastly different expertise level, and often fragmented knowledge as HPC skills are often acquired through learning-by-doing when confronted with specific problems instead of in a systematic way. Educators at HPC centers are therefore faced with the challenge of filling in different knowledge gaps for different participants and at the same time bring across a structural understanding of the topic to participants at different expertise levels. In order to address those challenges, several JSC courses, including the introductory course, have been designed with a modular structure.

Clearly defined modules provide participants with a first-level structural understanding already before the start of the training event, making it easier to navigate the offered content. Well-structured training ultimately leads to higher learning outcome [6] and participant satisfaction [4]. Participants who seek to close only specific knowledge gaps or those who have little time can participate selectively in individual modules or lectures. We stress that partial participation based on the participants' needs & availability is possible, while full participation is recommended for a structurally complete overview. In Tab. 1 we list the lectures that form the 'Introduction to Supercomputing at JSC - Theory

& Practice’ course. Lectures are held on 4 days, always in the afternoon, from 1 PM to 5 PM, with two 20 min coffee breaks in between. The length of the lectures varies between 30 min and 90 min based on the scope of content. In the second column of Tab. 1 we provide a brief classification of each lecture’s core content, and in the last column show to which module each lecture belongs. The third column indicates whether the content of that lecture mostly covers aspects of supercomputing (SC) in general, is specific to JSC’s HPC systems, or both. Broadly speaking, the introductory course organizes its lectures in 6 modules, sorted by increasing difficulty level and increasing specialization:

- **Module 0:** General overview.
- **Module 1:** Overview of the HPC resources, services, and tools at JSC. Teaches best practices for smooth workflows and efficient HPC resource usage.
- **Module 2:** Basic tooling. Overview of essential HPC building blocks: libraries, pre-installed software, scheduler (Slurm), Jupyter notebooks. Familiarizes users with the modes of operation of those tools.
- **Module 3:** Advanced tooling. Overview of advanced HPC building blocks: debuggers, profilers, correctness checkers, pinning, visualization. Familiarizes users with the modes of operation of those tools.
- **Module 4:** Latest compute paradigms: GPU programming, Machine- and Deep-Learning, AI.
- **Module 5:** Vendor hardware (HW) specific information from industry partners.

In order to cover the broad spectrum of topics and depth of the content, speakers are comprised of experts from various divisions at JSC, including general support, tool development, software team, storage team, performance optimization, system administration, GPU programming, and AI team. Selected speakers are also available for questions and in-depth discussions during the hands-on sessions. We stress that the quality of the course is defined by the composition of the team and the willingness of the team members to engage with the participants.

3.4 Hands-on exercises

Putting recently learned content into practice helps knowledge retention and immediate feedback improves learner motivation [1]. The hands-on format provides an ideal environment for participants to familiarize themselves with complex HPC concepts at their own pace, ensuring a smooth onboarding experience. While participants can access and work through the materials at any time, attending the dedicated sessions offers the advantage of live support and immediate assistance. The hands-on take place over the course of three morning sessions, from 9 AM to 12 PM, and are designed to build on the previous day’s lectures, helping participants put theory into practice. The morning hands-on sessions start on the second day of the course, with the first day being a half day of afternoon lectures only, as such ensuring a lecture-then-practice course structure, with a total course duration of 3.5 days. While the lecture-then-practice sequence is recommended, participants have the flexibility to work through the material in any order, or selectively based on their needs.

The hands-on sessions operate with a well-organized support structure and clear roles. Live support is provided via the Slack hands-on channel and Zoom breakout rooms. In Slack, tutors respond to questions in separate threads to keep the main chat organized. Breakout rooms in Zoom are used for longer discussions or in-depth explanations whenever a need is identified or expressed in a thread topic on Slack. The main Zoom channel is reserved for announcements, scheduled events, and coordination among participants, tutors, and moderators. This structured, multi-channel support system ensures that participants receive prompt assistance according to their needs, minimizing participant frustration. The availability of knowledgeable tutors with a supportive attitude who actively engage in discussions is a key factor in increasing the learning gain [8]. At JSC, tutors are recruited from staff working in a user-facing capacity, either through having regular duties assisting JSC users with general issues through the ticket system, or work with users on their projects in their role as members of cross-sectional teams. Tutors receive instructions on the mode of operation of the hands-on sessions in form of a written guideline that is disseminated by the organizers together with the final assignment of tutor duties. New tutors receive in addition a short personal briefing.

The effectiveness of this approach is reflected in the feedback received from the course evaluation surveys (see section 5). In order to further boost engagement (see section 3.6) and recapitulate crucial take-aways from the day before, every hands-on session starts with a short quiz of 15-30 minutes duration. Anonymized participant responses are displayed and the moderator in charge discusses all questions and answers in a timely manner to rectify any misconceptions in the participants’ understanding.

The hands-on material is delivered via a structured webpage that guides participants step-by-step, following the natural workflow of typical HPC system usage. It includes the following sections:

- **Access:** this section explains the steps to access the HPC systems at JSC, including account creation, project membership, secure authentication, and login methods.
- **Unix shell basics:** this section introduces the basics of the Unix shell, explaining how to navigate and interact with the system using commands. It covers paths and directory navigation, file manipulation, environment variables, and command execution.
- **Environment:** this section explains JSC’s computing environment, including project resource management, file system organization, and key directories for storage.
- **Software modules:** this section explains the software ecosystem at JSC, describing the hierarchical structure of software dependencies, the role of toolchains, and how to load, find, and manage software modules.
- **Custom software:** this section explains how to run custom software at JSC, either by compiling source code (for languages such as C, C++, and Fortran) or by using scripting languages such as Python.
- **Transferring and archiving data:** this section describes various methods for transferring and archiving data on HPC systems, focusing on tools such as *scp*, *rsync* for file transfers, and *tar* for archiving files.

Day	Lecture name	Content classification	Type	Module
1	Introduction to JSC	Introduction to JSC	JSC specific	0
	HPC in a nutshell	Introduction to HPC	General	0
	User portal and job monitoring	JSC webportals and tools	JSC specific	1
	JSC Systems — JUWELS, JURECA & JUSUF	JSC HPC systems	JSC specific	1
	JUST: Juelich Storage Cluster	JSC filesystem	JSC specific	1
2	HPC Software — Modules, Libraries & Software	Software usage	Both	2
	Batch usage on JSC	Slurm usage	General	2
	JupyterLab — Supercomputing in your Browser	Jupyter notebook usage	Both	2
	Proper Pinning Prevents Pretty Poor Performance	Tools: Pinning	General	3
	Uniform Resource Access, Data Access and Cloud Resources at JSC	JSC data management & cloud	JSC specific	1
3	GPU accelerators at JSC	GPU programming	General	4
	Deep Learning on Supercomputers	AI/ML/DL usage	General	4
	HPC Software - Debuggers and performance analysis	Tools: debuggers & performance analysis	General	3
4	Intel tuning for JUWELS and JURECA	tuning for vendor HW/SW	Both	5
	JUWELS & JURECA Tuning for the platform	tuning for vendor HW/SW	Both	5

Table 1: Complete list of lectures offered during the 2025 ‘Introduction to Supercomputing at JSC - Theory & Practice’ training course at JSC. All lectures are organized in 6 modules (for a detailed description see section 3.3).

- **Budgeting:** this section covers accounting of used compute time (*core-h*) and data quotas at JSC, emphasizing efficient resource usage tracking.
- **Running jobs:** this section provides detailed guidance on how to run jobs on JSC’s HPC systems, with a particular focus on how to submit and manage compute jobs using the Slurm workload manager.
- **Using GPUs:** this section provides an overview of using NVIDIA GPUs on JSC’s HPC systems, focusing on compiling, running, and monitoring GPU-accelerated applications with CUDA and MPI.
- **Useful Links:** this section gathers a collection of links related to various topics, e.g. JSC’s system documentation, job reporting services, computing and data project applications, course programs, etc.

Thereby, participants have freedom of choice on how they interact with the HPC systems (e.g. through a *terminal*, an *editor* of their choice with integrated functionality, or a *JupyterLab notebook* in the browser, etc.). All these options are supported, and instructions on their usage are provided as part of the hands-on material. This approach is crucial for smooth onboarding of new users, because participants can work through all potentially arising issues in the same environment they will be using for their project work.

The footer of the hands-on webpage contains all relevant links for the current course, including quizzes, surveys, Zoom and Slack access points, and attendance lists (see Fig. 1) providing participants a centralized location for all course-relevant materials. The hands-on webpage is created and hosted online using Docusaurus and GitLab Pages to maintain and share course materials. Docusaurus is an open-source tool that simplifies the creation of documentation websites. It uses Markdown files for content, making it easy to write, update and maintain documents. Once the content is written in Markdown, it is converted into a structured, navigable website.

GitLab Pages is used to deploy the website online, making it publicly accessible and easy to update with a simple push to the GitLab repository. This combination of Docusaurus and GitLab Pages provides an easy-to-manage, scalable, and accessible learning platform, while ensuring that course materials are always up-to-date and well organized. More details about the hands-on and their technical implementation can be found in the published paper [12].

3.5 Asynchronous learning and self-study material

The introductory course takes on a leading role at JSC pioneering sharing course material open-source and allowing learning on-demand. Providing relevant information freely and at all times serves the broader educational mandate to provide access to anybody actively seeking out knowledge, independent of time and geographical location, allowing for asynchronous learning [5]. Open-source course material furthermore allows participants to revise and refine their knowledge on specific topics when needed, while new users of the HPC systems are provided the most immediate access to relevant knowledge independent of when they get first access to the HPC systems. The latter is of particular relevance for the AI community, which has recently been making increasing use of HPC, and has dedicated access pathways to HPC systems that are not (yet) synchronized with the HPC centers’ annual cycle and the academic year¹⁰.

All lecture slides as well as additional hands-on material (e.g. demos, discussion session notes) are uploaded both on the JSC course website¹¹ as well as on the registration platform. The course website

¹⁰Due to the increased relevance of AI, JSC also offers a separate 1-day introductory course specifically on AI in HPC environments ‘Running and Scaling Performant Deep Learning Models on JSC Supercomputers’ four times per year since its inception in 2023 (back then under the name ‘Getting started with AI on supercomputers’).

¹¹Latest instance from November 2025: <https://www.fz-juelich.de/en/ias/jsc/news/events/training-courses/2025/supercomputing-2>

furthermore hosts recordings of all talks. Slides and recordings are available for one year, such that the course material from the last two course instances is publicly available at any time. The described practices have been implemented in 2020 when the course moved to the online format. Since its introduction in 2021, the hands-on were provided to registered participants through a webpage for half a year after the course. Since 2024, a PDF version of the hands-on is additionally uploaded on both the course website and the registration platform, making the hands-on material publicly available open-source. Anybody working through the course material in self-study is encouraged to reach out to the lecturers, the course organizers, or HPC user support at JSC by email in case of questions or for clarifications on specific topics. Such inquiries reach JSC staff over the course of the year and are mostly solved over email exchange, while few cases are addressed by scheduling video calls, allowing for screen sharing or a more in-depth discussion.

3.6 Engagement

Keeping participants engaged during the course is crucial, as engagement is correlated with higher retention of newly learned content and higher student satisfaction [9]. High engagement can be successfully achieved in face-to-face HPC training events [3], [2]. Online training courses face greater challenges in achieving levels of engagement comparable to in-person training events [7]. During the hands-on sessions, the introductory course manages to achieve high perceived participant engagement, which is reflected in the feedback gathered from the evaluation process (see section 5).

Experience with the introductory course shows that the most crucial element of creating a welcoming environment, and through that higher engagement and higher learning outcome, is through the continuous presence of the moderators during the course, as also found in [10] and [4]. Moderators have their cameras switched on during all interactions, as well as during periods with no interaction simply showing them working or interacting with the participants over chat on the other side of the screen. Through such efforts the moderators create the atmosphere of a common working space and lower the barrier for participants to strike up a conversation through written chat or by speaking up. Moderators, and tutors during the hands-on, also strike up conversations with each other which significantly lowers the barrier for participants to join in instead of having to initiate a new conversation. A high level of sensitivity and situational awareness is required from the moderators to create an accommodating yet focused space for learning, which is a demanding and energy consuming task. Engagement during the hands-on is further built up through quickly addressing participant questions in the Slack hands-on channel (typically within a few minutes) from where topic discussions often naturally develop and continue as group discussions in Zoom breakout rooms. The main driver of engagement is attributed to the collective efforts in addressing participant issues, with multiple tutors providing comprehensive perspectives during problem-solving, in a structured & friendly chat environment. Moderators and tutors can be identified easily in the chat by the institute label (JSC) following their name and a profile picture, which can be representative for the tutor's

domain of expertise or something funny & approachable to lower the barrier for participants to initiate conversation.

4 Course logistics

In this section we detail the sequence of steps needed to organize the 'Introduction to Supercomputing at JSC - Theory & Practice' training course. Necessary actions can be divided into three categories: 1) technical and infrastructural setup and post-processing; 2) communication with speakers, moderators, and tutors; 3) communication with (potential) participants. A timeline of the individual steps is depicted in Fig. 3 with the individual activities detailed below:

1. **Infrastructural setup:** prepare agenda, course website, and registration platform, open registration.
2. **Initial communication with speakers:** send email with the agenda, request feedback confirming availability, assigned time slot and length of lectures.
3. **Technical setup:** create training project which grants participants access to HPC systems, create reservations on the HPC systems so that participants do not have to wait for compute resources during the hands-on.
4. **Material preparation:** finalize the hands-on material and create a new website instance, allocate a PRO Zoom license (allows for 300 attendees, up to 24 hours of meeting, and video recording and storage in the Zoom Cloud), create a recurring Zoom event for the entire duration of the course.
5. **Team recruitment:** recruit tutors for the hands-on sessions and moderators for the lectures.
6. **Quality check:** assign a tutor (preferably someone different from the one who did the same job last time) to go through the latest version of the hands-on exercises to check for outdated links, typos, or technical problems.
7. **Agenda finalization:** incorporate speakers' availability changes, confirm Zoom test session times, and distribute the finalized agenda to the speakers.
8. **Contacting potential participants:** send email with course invitation to all JSC users in active compute and data projects. This event occurs after the start of the new allocation period for computing time project. Typically, organizers wait a few days to allow new users to join the project.
9. **Communication infrastructure:** create Slack workspace for real-time support during the course.
10. **Pre-event preparations:** provide a Zoom test session for speakers, instruct moderators and hands-on tutors on procedures, share a document with guidelines and the latest version of the hands-on exercises.
11. **Registration closure:** close registrations and send email to all participants with logistics details.
12. **Participant list:** generate list of participants to mark attendance.
13. **Post-event coordination:** collect presentation slides and send recordings for post-processing.
14. **Certification:** lock the participant list, update the participant certificate template for the current instance and forward the list of attendees eligible for certificate issuance to HR.

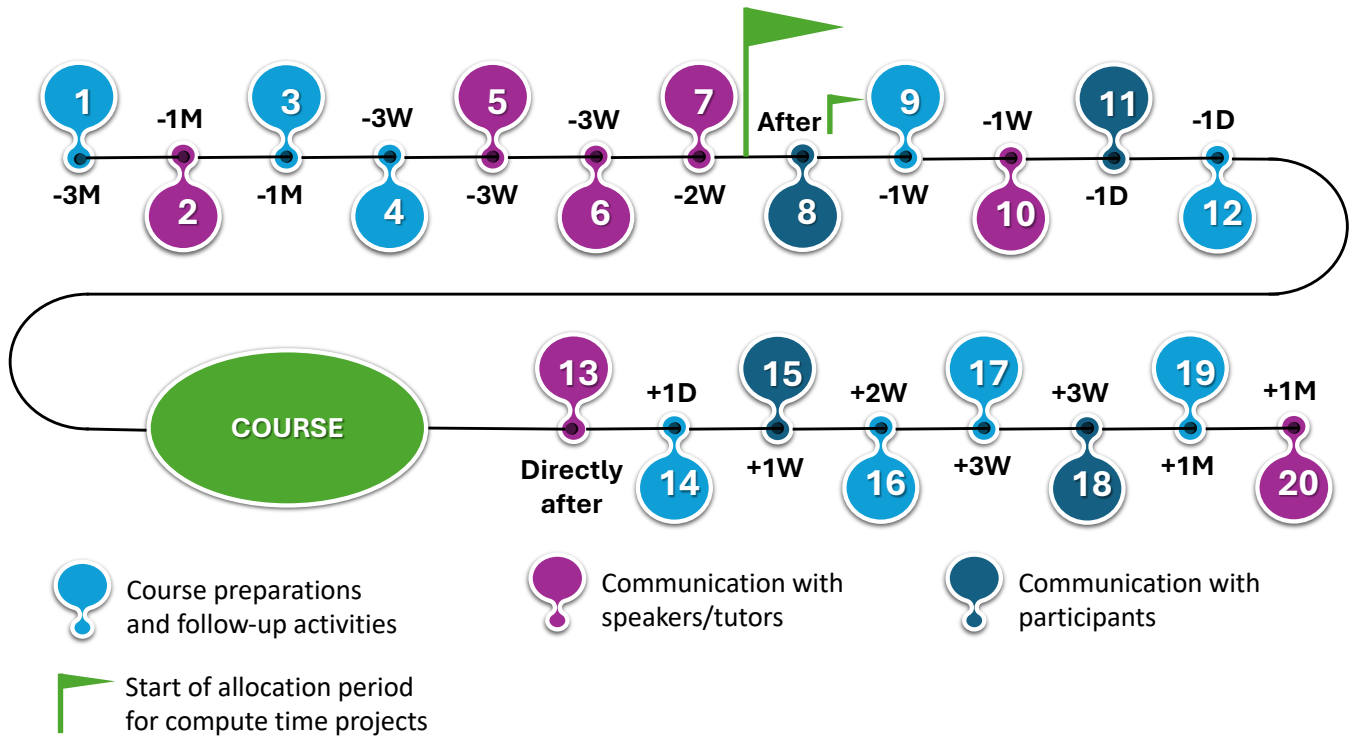


Figure 3: Timeline of steps needed for course organization. Various events are marked with circles of different colors representing different event types (see legend). Near each circle there is a number indicating when the event occurred relative to the course. Negative numbers (-) mean the event happened before the course, whereas positive numbers (+) mean it happened after the course. The time units used are "M" for month(s), "W" for week(s), and "D" for day(s). For a detailed description of the events see section 4.

15. **Participant follow-up:** send email to all participants with a reminder about the final survey, emphasizing the impact on future events.
16. **Close final survey.**
17. **Material publication:** upload slides and post-processed recordings to the course website.
18. **Post-event communication with participants:** send an email notifying all participants that the materials are now available on the website, that the certificates have been sent, and that the Slack chat has been discontinued.
19. **Evaluation analysis:** assess and summarize the surveys. Incorporate changes into planning for the next instance.
20. **Post-event communication with speakers:** send results to the speakers with suggested improvements.

Besides preparatory and follow-up activities, organizers need to perform a number of actions during the course for a smooth operation. The day before the course, all moderators and tutors receive a reminder email with access information and guidelines with a summary of their role and instructions. All speakers receive a reminder email with access information and reference to the agenda (including the time and length of their lectures) the day before their lectures. Each afternoon, the lecture sessions conclude with the daily survey being posted in both the Zoom chat and the Slack

general channel. At the end of the course a global survey is sent to all registered participants by email (see section 5). Every hands-on session starts with a daily quiz (see section 3.4) shared with the participants in the Slack hands-on channel. Lastly, the organizers need to start and stop recording of the individual lectures, as well as demos and special discussion sessions during the hands-on.

5 Evaluation process

Each instance of the course undergoes several levels of evaluation. The first level includes daily surveys conducted after each afternoon lecture. These surveys provide an anonymous channel for participants to share immediate feedback on how the course can be improved, as well as any other comments they wish to communicate to the organizers. This near real-time feedback allows the organizers to respond quickly and, where necessary, make adjustments during the course. Participants are encouraged to be direct and upfront in their feedback, as the survey results are used exclusively to help the organizers better meet participants' needs and support continuous improvement over time.

At the end of the course, a global survey is sent to all participants via email through the registration platform. This survey is (almost) identical for all training courses offered by any of the GCS centers (see section 1). It assesses overall quality, content, and organization.

It is used for general quality assurance as well as to position the course in the context of HPC training offered by JSC and across GCS. Results from the global survey are available two weeks after the end of the course and are used for improvements of the next course instance. Based on evaluations from 2024 and 2025, 80–90% of respondents rated the introductory course as excellent or very good, with an average score of 8–10 out of 10.

The third level consists of an annual survey of all JSC users conducted by HPC user support in cooperation with the training division. The survey aims to examine how different parts of JSC's infrastructure work together to support the users, and how users benefit from training in both short and long term. Whereas the first two survey levels target only course participants, this survey reaches every user with access to the HPC systems at JSC, providing a broader insight into the impact of training across the entire user community. The annual 'all JSC user survey' has been conducted since 2024 and has highlighted the importance of the introductory course as a key element of JSC's HPC user support.

6 Conclusion

The 'Introduction to Supercomputing at JSC - Theory & Practice' training course is a key building block in the HPC curriculum offered by JSC, serving to close the gap between university education and practical HPC science. The course evolved from face-to-face lectures to an online format with modular structure and interactive hands-on exercises, significantly increasing accessibility and engagement. The rising number of registrations highlights the continued demand for this introductory course and affirms the quality of the training. Selected feedback from participants reads: 'In my opinion, the structure of the course was very well planned', 'The format was just right. [...] I was flexible and was able to get specific information I needed.', and 'I just felt I learnt a lot personally'. At the same time, JSC user support observed a gradual reduction of common beginner issues reported through the ticket system as the course was expanding its practical hands-on material and admitting more participants. In the last two years, the ticket load from common beginner issues at the beginning of the allocation periods has become statistically indistinguishable from the rest of the year.

Going forward, the course will be further offered in online format to have the widest reach. Lecture content is continuously updated to reflect the state-of-the-art in the field. Equally, the hands-on are continuously updated and will be expanded to include more advanced application examples, such as example workflows for advanced Slurm usage, advanced GPU usage, performance analysis and debugging, and analysis of resource usage efficiency of applications based on example workflows. As potential further development of the course, the introduction of automated checks for quizzes and questionnaires is envisioned to streamline assessment and feedback, as well as the introduction of a virtual badge displayed next to participants' names on the JSC internal user portal for those who will have successfully passed a multiple-choice exam. The course will expand the material provided open-source on the course website to also include a series of short demos, aiming to gradually build a public library of HPC training material. Experience gained in the introductory course provides valuable input for structuring other HPC training courses at JSC, and can be drawn

upon by educators in the HPC community when designing their own (introductory) courses at other HPC centers.

Acknowledgments

This research was supported by the Jülich Supercomputing Centre at Forschungszentrum Jülich and the BMBF project 01-1H1-6013 AP6-NRW Anwenderunterstützung SiVeGCS. We thank all speakers, tutors, and moderators for their valuable contributions to this course. We also gratefully acknowledge past organizers and all those who helped make this course possible. Special thanks go to Daniel Rohe, Andreas Klasen, Stefanie Janetzko, Florian Janetzko, and Anna Lührs for providing valuable input.

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