

# Exercise: Design a Learning Pathway

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## ABSTRACT

Despite the quantity of existing training materials, acquisition and development of the specialist skills required for High Performance Computing (HPC) is not straightforward enough to address the needs of the growing, diversifying and constantly evolving HPC community. The HPC education and training community is exploring different approaches that could facilitate the uptake and progression of technical skills - one of those new approaches is focused on defining and formalising learning pathways. In this lightning talk we will briefly present an exercise designed as a starting point for capturing and outlining learning pathways for the HPC community. This exercise was run for the first time during the ISC'24 BoF on "Developing a Sustainable Future for HPC and RSE Skills: Training Pathways and Structures" and was accompanied by a Mentimeter survey to evaluate its effectiveness. The summary of the survey results is also included.

## KEYWORDS

Learning Pathways, HPC Training, Research Software Skills

## 1 INTRODUCTION

To address the educational needs of the growing HPC community we need new approaches that will not only ensure multiple entry points to training for new HPC users but also enable continuous professional development for all members of the HPC community, regardless of their role. These 'learning pathways' are not meant to replace any of the existing training efforts but rather complement them. The learning pathways provide two major benefits, first they encourage a shift from teaching topics in a linear manner toward concept based learning pathways that better align with adult learning models. Secondly, learning pathways are an important component that is needed to make training content more FAIR - findable, accessible, interoperable and reusable. Developing interoperable, citable and persistent training materials is key to creating personalised learning pathways that directly correspond to the training needs and job requirements of HPC community members, especially in the exascale era.

Data that was collected during the community driven BoF sessions at ISC'23 and SC'23 presented a snapshot of the educational HPC landscape and illustrated some of the challenges associated with creation of learning pathways [1, 2]. The learning pathways need to be personalised enough to be useful, but it's impossible for

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training providers to outline and support every possible learning journey. Therefore, the goal of the ISC'24 BoF was to capture example learning pathways and explore general trends that could be used to guide the design of other pathways, which was done through the exercise described below. The exercise and survey results are available at: <https://zenodo.org/records/11395712>.

## 2 EXERCISE DESIGN

The exercise sheet (A3) designed for the session consists of two fields at opposite ends that need to be filled in - starting point and learning objective - and a set of bubbles containing skills from 6 different categories that should be connected to create a path. The skill categorisation is based on the skill tree developed by the HPC Certification Forum (HPC-CF) [3] and includes these categories:

- Use of HPC Environment
- HPC Knowledge
- Software Development
- Performance Engineering
- System Administration
- Big Data Analytics

Due to the space limitation on paper, not all of the skills defined by HPC-CF (v. CS-1.0) have been used. Nonetheless, we felt that running this as a paper-based exercise would help participants to engage more with the topic than trying to use online tooling. The participants were asked to define a starting point and learning objective and then to create a learning pathway connecting the two using the listed skills. The learning path could be outlined in any way that worked for the participants - they could annotate the existing content, add skills, specify order or co-dependencies between skills etc. The example pathway, developed by one of the authors, is shown in Figure 1. The goal of the exercise was to collect as many different learning pathways as possible and to test if a similar template could be developed further to facilitate design of new pathways for specific skill sets or roles. This meant some of the pathways were focused on specific skill sets while others covered 20+ years of work experience. Some were linear and others had multiple loops, branches and merging points between skills.

Many of the participants expressed their interest in repeating this exercise within their institutions or even with their user base. Depending on the intended scope and audience of the exercise, it is recommended to clearly define the desired granularity of starting points, learning objectives and the pathways. This will help to narrow the scope and design something useful for the participants.

## 3 SURVEY RESULTS

The second part of the ISC'24 BoF session was used to understand how participants felt the exercise went, using an online Mentimeter survey. The survey was designed to be fully anonymous and consisted of 10 questions, including multiple choice, Likert scale and

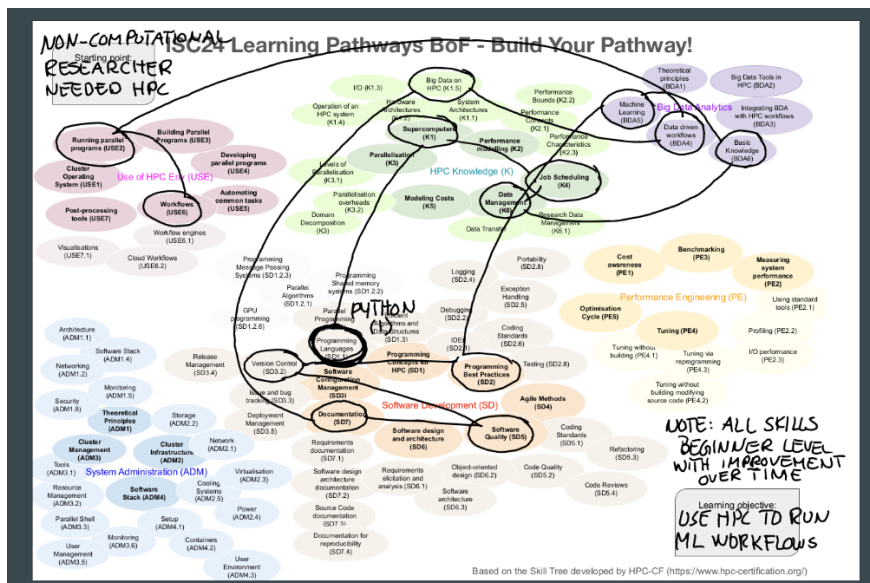


Figure 1: An example learning pathway created by Samantha Wittke to test the design of the exercise.

open questions. Out of about 70 people in the room at the ISC’24 session up to 39 provided responses to at least one question.

The first question asked the participants to describe their role in the educational context, from a set of options, and allowed multiple answers - 23 declared themselves as educators/trainers, 18 as training content providers, 8 as training managers, 19 as learners and 12 as having another role. Out of 39 respondents 25 indicated this was their first time attempting to design a learning pathway. The participants strongly agreed that the exercise illustrated the challenges of learning pathway design and that designing learning pathways is hard - both statements got the average score of 4.1 out of 5. They also generally agreed that the listed skills provided enough scaffolding to build useful paths and that the skill granularity was sufficient - both scored 3.3. Most also wished for more example pathways to exist - score 3.9.

Most people started their design process at the ‘starting point’ (17), some started with the learning objective (9) and the rest started somewhere in the middle i.e. with a specific skill (11). Most people also stated that the path they designed includes branching and merging points, or circular relations. Only 3 said their path was linear. Some of the design challenges included: determining the appropriate starting and ending point, deciding on the skill order, grasping the scope of possibilities, keeping the path relevant and meaningful, thinking about inter-dependencies and skill levels, and identifying missing skills. Many participants also believed their pathway was personal, task driven and could be hard to follow in different contexts e.g. working environment, role. It was also noted that learning takes time and there are always competing priorities.

Finally, when asked what could be done to make learning pathways easier to discover and navigate, some of the answers included: providing problem to skill maps, a catalogue of pathways that is searchable/browsable by starting/ending points or roles, better alignment with career options, more higher level examples that

can be customised to fit the individual’s needs, and collecting all relevant resources in a single location. Most of the answers aligned well with many on-going efforts within the HPC community, clearly demonstrating how important they are.

#### 4 NEXT STEPS

Subsequently, the exercise was also run at another BoF session at PEARC’24. Across both sessions, the authors collected over 60 example pathways that need to be analysed. Additionally, the exercise is going to be refined and hopefully used in different contexts to further the community understanding of how the learning pathways should be designed and used. Anyone interested in reusing this exercise or adapting it to their own needs is free to do so under the CC-BY v. 4.0 license.

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#### REFERENCES

- [1] Weronika Filingier, Julia Mullen, and Jeremy Cohen. 2024. Developing HPC Learning Pathways: Challenges and Recommendations. In *Practice and Experience in Advanced Research Computing* (Providence, RI, USA) (PEARC ’24). Association for Computing Machinery, New York, NY, USA. <https://doi.org/10.1145/3626203.3670575>
- [2] Weronika Filingier, Julia Mullen, Jeremy Cohen, Ann Backhaus, and Samantha Wittke. 2024. Building HPC Learning Pathways: Understanding our Community. In *Practice and Experience in Advanced Research Computing* (Providence, RI, USA) (PEARC ’24). Association for Computing Machinery, New York, NY, USA. <https://doi.org/10.1145/3626203.3670513>
- [3] Julian Kunkel, Weronika Filingier, Christian Meesters, and Anja Gerbes. 2020. The HPC Certification Forum: Toward a Globally Acknowledged HPC Certification. *Computing in Science and Engineering* 22, 4 (2020), 110–114. <https://doi.org/10.1109/MCSE.2020.2996073>