GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

Institute for Computer Science / GWDG

HPC CF

https://hpc-certification.org

Julian Kunkel

Workshop HPC Certification for the German HPC Community

2021-12-14

About the Workshop

- Goal: to explore the potential of HPC Certification with the German community
- This workshop is organized by
  - Julian Kunkel (University of Göttingen/GWDG, NHR@Göttingen)
  - Anja Gerbes (ZIH, Technische Universität Dresden)
- This workshop is supported by NHR@GÖTTINGEN

NHR Nationales Hochleistungsrechnen

GWDG Gesellschaft für wissenschaftliche Datenverarbeitung mbH Göttingen

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Agenda

- 14:00 - **Introduction to the HPC Certification Forum** – (Julian Kunkel)
- 14:30 - **Potential synergies between offering NHR trainings and the HPC CF competence standard** – (Anja Gerbes)
- 15:00 - **Certification strategy and contributions** – (Christian Meesters)
- Virtual coffee break
- 16:00 - **Applying the skill tree — Early experiences with course classification and design** – (Marc-Andre Hermanns)
- 16:30 - **Discussion**

Interactivity

- This should be an interactive workshop
- Please ask questions any time using the chat (or orally at the end)
- Feel free to be critical, step forward with your thoughts and ideas

Outline

Challenges for HPC (and Open Source) Training

- Not all users possess the right level of training
  - Inefficient usage of systems, frustration, lost potential
  - Good training saves compute time and costs!
- Diverse user background and goals
  - Science is the goal, HPC is the vehicle
  - Need to run an application to complete the PhD
- Learning is not easy
  - Users need to understand beneficial knowledge for tasks
  - There exist various different training material
  - Teaching of different data centers is hard to compare
- Data center have difficulties to verify the skills of users

The HPC Certification Forum

Goals

- Fine-grained standardizing HPC knowledge representation
  - What competences exist, how are they defined?
  - Puzzle of competences for everyone (practitioners, students, admins)
  - Supporting navigation and role-specific knowledge maps
- Establishing international certificates attesting knowledge
- Supporting an ecosystem around the HPC competences

Scope of the forum

- Central authority for competence representation, certification, and support
- Purposeful limitations of the forum:
  - We do not compete with content providers
  - We do not create a curriculum (university/centers responsibility)

The HPC Certification Forum

Organization Details

- An independent international body
- Organized into
  - Steering board (elected)
  - Full members (with voting rights)
    - Contributors to the project (e.g., 1-2 hours per month)
  - Associate members (anyone and any institution)
  - Collaboration with e.g., SIGHPC Education Chapter

Responsibilities

- Curating and maintaining the **Competence Standard**
- Providing tools and ecosystem around the competences

Governance

Various processes are documented here.

Steering Board

- General chair: Julian Kunkel (University of Göttingen / GWDG)
- Skill-tree curator: Kai Himstedt (University of Hamburg)
- Topic curators:
  - HPC Knowledge: Lev Lafayette (University of Melbourne)
  - Performance Engineering: Anja Gerbes (University of Dresden)
  - Administration: Sudeep Narayan Banerjee (Indian Institute of Technology Gandhinagar)
- Examination curator: Christian Meesters (University of Mainz)
- Publicity chair: Weronika Filinger, Sudeep Banerjee
- Other topics are jointly managed by the board

Organization

Organization of the members

- Webpage is the central hub (`https://www.hpc-certification.org`)
- Mailinglists (news, members, board)
- Monthly public meetings on our Slack channel
- Annual general assembly (form of a BoF at ISC or workshop)

Data handling

- Everything* is developed/available in the open GitHub (`https://github.com/HPC-certification-forum`)
- Exception are examination questions

Outline

Classification of Competences == Skills

- A **skill** defines background, objectives, learning outcomes
- The **skill tree** organizes the competences as hierarchical skills
- Certificates bundle several skills into attestable unit

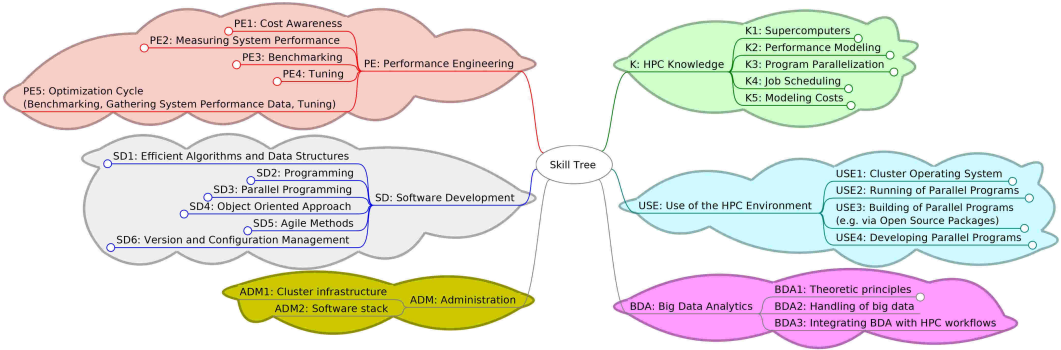


Figure: Top-levels of the skill tree (Initial ADM and BDA branches)

Example High-Level Skill (Excerpt)

- Name: Command Line Interface
- Id: USE1.1-B
- Background: HPC systems are usually accessed via a Linux-based Command Line Interface (CLI) that is provided by a shell. At its core, a shell is ...
- Aim:
  - describe the key principles of a shell
  - execute basic programs to query system information and manipulate...

Learning outcomes (these must be examinable)

- Utilize the bash shell to execute individual programs with arguments
- Describe the meaning of the exit code of a program
- Run multiple programs after another depending on the exit code ;, &&, ||
- List the set of basic programs and their tasks:
  - pwd

Classification of HPC Competences

- Granularity of skill descriptions
  - Too fine $\Rightarrow$ content of a skill is predefined at leaf level
  - Too coarse $\Rightarrow$ no help for structuring the material
  - Guiding principle: leaf node should be coverable in 1-4 hour lecture/workshop
- Organization of HPC skills
  - Skills are typically depending on sub-skills $\Rightarrow$ tree structure
  - References to skills are possible; still skills are building blocks for various tasks
  - One skill can have multiple instances for different skill levels (basic, ..., expert)
- Verification of skill tree and certification approach
  - Feedback by the HPC community/practitioners justify the approaches

Further Considerations

- Certificate definition
  - Bundles a set of useful skills together
  - A users' HPC qualification is certified by successful exams
  - Testing a single (fine-grained) skill may be too easy with a cheat sheet
- Separation of **skill**, **certificates** and **content provider**
  - Similar to the concept of a high school graduation exam
  - Learning material can be provided by different institutions
  - Teachers can put badges on material: this "trains skills X, Y, Z"
- External information can be linked to the skills providing different **views**
  - Suitability for a user role (Tester, Builder, Developer)
  - Suitability for a scientific domain (Chemistry, Physics, ...)
  - View: purpose-specific representation / coloring / content
    - Groups/institutions can derive a new skill tree with their own emphasis
    - What should people know to effectively work in your environment?

Status / Previous Activities

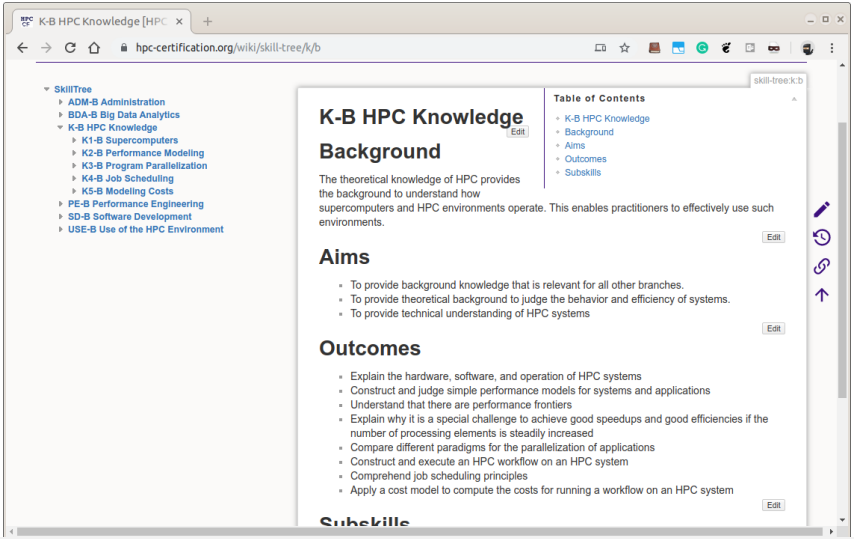
- Development version of the Competence Standard is online
  - Git managed Markdown files
  - Files are also available in a Wiki (for interaction)
- Developed various processes

2021 News

- Experts Adopting Skills
  - Enable experts to curate skills that are in their field of expertise
  - Similar to code maintainer
- Working on sponsoring
- Developed first (but limited exam!)

All our developments are under open licenses (except the exam questions)

Wiki for Skills



Contribution to the Skill-Tree High-Level Editing

How can members contribute?

- Webpage with Markdown version controlled in Git
  - https://www.hpc-certification.org/wiki/skill-tree/b
  - GitHub: https://github.com/HPC-certification-forum/skill-tree
    - Pull requests, reviews, comments, ...
- Editing a MindMap, the structure of Skills
  - Synchronized with the skill tree in Git
  - Uses the OpenSource tool Freemind
- Discussion on our Slack
- Documented in our processes section
- See our videos on YouTube

Outline

Certification: Assessment

1. User registers to test, receives email
2. User takes test online (any time!), consists of
   - Scenario
   - Multiple choice exam
     - System selects number of questions (and responses) randomly from a pool
3. Results are submitted to the web server
4. Automatic approval of response
5. Automatic creation of certificate and returned by email
   - Permanent computer-verifiable proof that skill is created
     - Return a text version with GPG signature
     - Return a link that can be verified on hpc-certification.org

- Privacy: minimize information stored on servers, keep some for statistics
- Includes some measure to prevent cheating and brute forcing (e.g., delay)

Certification: Certificate

Text representation

```
-----BEGIN PGP SIGNED MESSAGE-----
Hash: SHA512
HPC Certification Forum Certificate
This text confirms that "Jane Doe" has
successfully obtained the certificate
"HPC driving license" (id: 1) at 02/2019.
Verification URL: https://hpc-certification.org/[...]
-----BEGIN PGP SIGNATURE-----
[...]
-----END PGP SIGNATURE-----
```

Certificate

Outline

Outlook and Expected Benefits

HPC practitioners

- Increase motivation to participate as the certificates are recognized in a CV
- Validate knowledge via tests
- Browse relevant competences
- Identify recommended and required skills related to certain tasks
- Understand and compare teaching offers across sites

Data centers

- Increase sharing of teaching materials
- Simplifies documentation of taught skills
- Identify missing teaching activities
- Tailor skill-representation specifically to users
- Correlate lack of skills with efficient use

Summary

HPC Certification Program

- Effort to standardize representation/certification of relevant HPC skills
  - Hierarchical definition of skills for practitioners
  - Building blocks that can be cherry-picked for different tasks
  - It's goal is **NOT** to provide content or a linear curriculum
- Perspective for data centers
  - Use statistics and machine learning to direct users to right skills
  - Make certain skills a mandatory requirement?
- Customizable representation and navigation for data centers/domains
  - Interactive viewer to browse skills and related content
  - We will use the viewer to link good content to the skills, too!
- Visit us and join our Slack/mailing lists: `https://hpc-certification.org`