The HPC Certification Program

J. Kunkel on behalf of the HPC Certification Forum

BoF: HPC Certification Program; Supercomputing 2018

https://hpc-certification.org

2018-11-15

The Program
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The HPC Certification Forum
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Presentations from Representatives
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Conclusions & Roadmap
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Outline

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HPC Certification Program

Motivation

■ Not all users possess the right level of training
  ▶ Inefficient usage of systems, frustration, lost potential
  ▶ Good training saves compute time and costs!

■ 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

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The HPC Certification Program

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Goals

■ Standardizing HPC knowledge representation
  ▶ What competences exist, how are they defined?
  ▶ Supporting navigation and role-specific knowledge maps
■ Establishing international certificates attesting knowledge

The work was bootstraped and is supported by the PeCoH project

Important!

■ We do not compete with content providers
■ We do not intent to create a curriculum

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Contributions by the PeCoH Project[1]

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Past contributions

1. Initial classification of competences
2. Initial development of a certification program

The program will be curated by the **HPC Certification Forum**

Pending contributions

- Creation of workshop material for basic certificates
- Providing an online tutorial for basic certificates
- Enabling an online examination

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Content of the Certification Program

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- ■ Skill is characterized by unique key, background, knowledge covered
- ■ Skill tree defining the organization of the competences
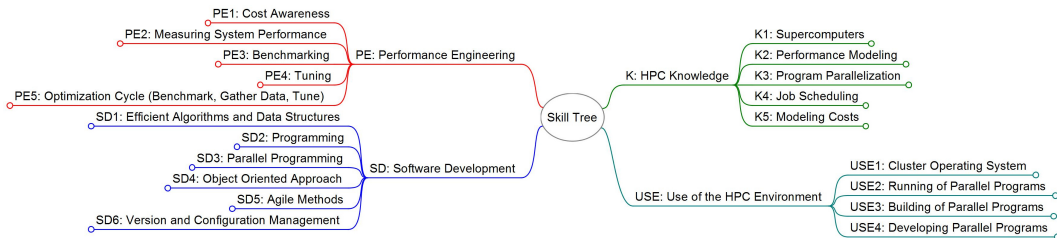- ■ Certificates bundle several skills into attestable unit

Figure: Top-levels of the skill tree

- ■ Content is **NOT** covered and subject to content providers
  - ▶ We may link good content on our page

Example High-Level Skill (Version 0.5)

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- Name: Hardware Architectures
- Id: K1.2-B
- Level: Basic
- Category: HPC Knowledge

Description of knowledge, i.e., what will the user learn

The skill delivers a high-level overview of:

- Elementary processing elements like CPUs, GPUs, many core architectures
- Vector systems, and FPGAs
- The NUMA architecture used for symmetric multiprocessing
- Network demands for HPC systems (e.g. high bandwidth and low latency)
- Typical network architectures like fast Ethernet (1 or 10 Gbit) or InfiniBand

Classification of HPC Competences

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- HPC skills are generally built upon one another
  - ▶ Skills are typically depending on sub-skills ⇒ tree structure
  - ▶ References to skills are possible; still skills are building blocks for various tasks
- Additional attributes are used to describe:
  - ▶ Level of a skill (Basic, Intermediate, Expert)
  - ▶ Suitability for a user role (Tester, Builder, Developer)
  - ▶ Suitability for a scientific domain (Chemistry, Physics, ...)
- Skill tree supports different "views" on the content
  - ▶ View: purpose-specific representation / coloring / content

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Considerations

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- Granularity of skill descriptions
  - Too fine ⇒ content of a skill is predefined at leaf level
  - Too coarse ⇒ no help for structuring the material
  - Actual skill tree contains 76 skills
- Certificate definition
  - Bundles a set of skills
  - A users' HPC qualification is certified by successful exams
- 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 XYZ"
- Support flexible usage (views on skill tree) and skills is key
  - Institutions can derive new skill tree with own groups
    e.g. users in weather/climate, single program, testers

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Status

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■ A first version of the skill tree is released (35 basic skills)

■ Idea been discussed to DKRZ user group; they want it yesterday

■ Technical representation of the HPC skills

  ▶ Database for the HPC certification program
  ▶ Implementation is based on XML
  ▶ Corresponding XML Schema (XSD) assures consistency
  ▶ Contribution is available on GitHub
    https://github.com/HPC-certification-forum/curriculum

■ JavaScript for visualization of skill tree

  ▶ Can be embedded in your webpage and adapted
    • Role/software-specific knowledge
    • What should people know to effectively work in your environment?

■ Live Demo

Outline

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The **HPC** Certification Forum

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The HPC-CF the central authority for the development of the program

Organization Details

- An independent international body
- Organized into
  - ▶ Steering board
  - ▶ Full members with voting rights
  - ▶ Associate members

Responsibilities

- Curating and maintaining the skill tree and certificates
- Providing tools and ecosystem around the competences

Governance – 2018

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Governance Rules

■ We have an initial set of governance rules

■ Splitting responsibility across different roles

Current Chairs

■ Program chair: Julian Kunkel (University of Reading)

■ Curriculum chair: Kai Himstedt (University of Hamburg)

■ Topic chairs:

▶ HPC Knowledge: Lev Lafayette (University of Melbourne)
▶ Performance Engineering: Anja Gerbes (University of Frankfurt)
▶ Use of the HPC Environment: Jean-Thomas Acquaviva (DDN)
▶ Software Development: Waseem Kamleh (University of Adelaide)
▶ Administration (to be confirmed by the board): Sharan Kalwani (DataSwing)

■ Examination chair: not seated this year

■ Publicity chair: Weronika Filinger

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Outline

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Outlook and Expected Benefits

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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

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HPC Certification Program

■ Effort to standardize representation 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
- ▶ Mandatory requirements

■ Customizable navigation for compute centers
- ▶ Interactive viewer to browse skills and related content

■ Visit us and join our mailing lists: https://hpc-certification.org

Roadmap: ISC-2019

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- Finalizing the first version of the skill-tree (V1)
- Finalizing documentation how to create views with the JavaScript
  - ▶ This will allow to outsource roles (e.g., tester) but also link to material
- Finalizing the seal that can be added to training material
  - ▶ We are looking forward to work with together with anyone
- Adding a "Big Data for HPC" skill subtree
- Creating a markdown version of the skill-tree (with converters)
- Embed a version that can be edited in an online Wiki (by members)
- Creation of workshop material (of some base courses)
- Creating an online certification (of some base courses)

Certification

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Approach

- User takes online multiple-choice test
    - Likely to use a combination of JavaScript and a web service
    - System selects number of questions randomly from a pool
    - System draws 4-5 responses from 10 possible responses
        - Some responses may be parameterized (random)
- Choices are submitted to the web server
- Manual approval of scores
- Automatic creation of certificate + permanent record
- Permanent record proofs that a certain user has a skill

Open Questions

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- Affiliation program for companies?
- Examination
  - Cheating has been a discussion, but we won't focus on this right now
  - How to ensure that a person does not brute force the exam?
    - Delay between retry?
- Determine legal constraints for exams (help welcome)
- Create a unique proof that a user has a skill
  - Hash instead of person name?