Anja Gerbes

Potential synergies between offering NHR trainings and the HPCCF competence standard

Dresden, 14.12.2021

Outline

Introduction

NHR Training-Portfolio 2021 @ ZIH

HPC Certfication Forum (HPC-CF) Skill Tree

Comparison: NHR Course Website vs. HPC-CF Skill Tree Entry

NHR Certification of Participation

Summary

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Introduction

TU Dresden

- is a member of the National High Performance Computing (NHR) since January 2021. (`https://tu-dresden.de/zih/hochleistungsrechnen/nhr-center`)
- defined several competences in their NHR application.
- started their NHR Training Sessions in September 2021. (`https://tu-dresden.de/zih/hochleistungsrechnen/nhr-training`)
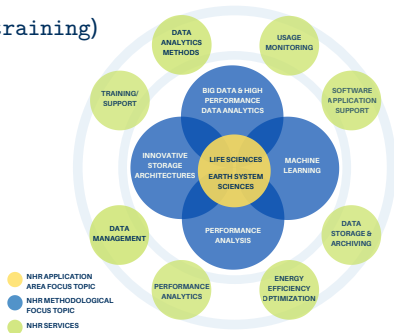
NHR Training-Portfolio 2021 @ ZIH

Target Group
- HPC Beginner
- HPC User
- HPC Dev
- HPC Admin
- HPC Expert

Keyword | **NHR Competencies**
- PE — Performance Engineering
- ISA — Innovative Storage Architecture
- BD & HPDA — Big Data & High Performance Data Analytics
- ML — Machine Learning
- S — NHR Services
- A — Administration
- AS — Application Science

Course Type
- NHR-Tutorial → Course with Hands-On
- NHR-Lecture → Course without Hands-On
- NHR-Workshop → Workshop

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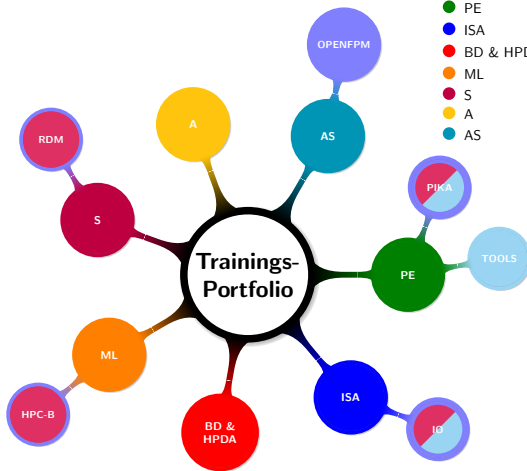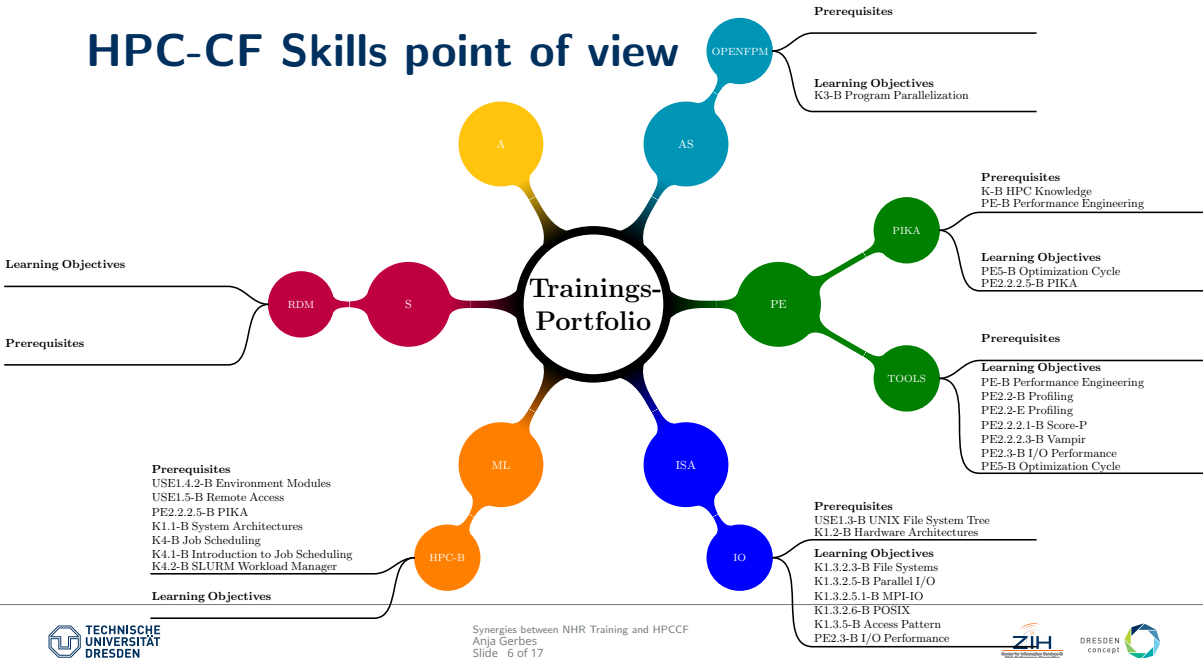
NHR Training-Portfolio 2021 @ ZIH

Speaker:

- Define Course Type
- Define Target Group
- Define Course Title
- Write Summary
- Define Agenda
- Create Reference Guide (optional)
- Define Questions for Survey
- Define Prerequisites ⟶ ⟶ ⟶
- Define Learning Objectives ⟶ ↓
  mapping ↓ ↓
- Search/Define HPC-CF Skill Tree Entry
  – Background
  – Aim
  – Outcomes

NHR Coordinator:

- Define Questions for Survey
- Create Course Website Link
- Create Registration Link
- Create Survey Link
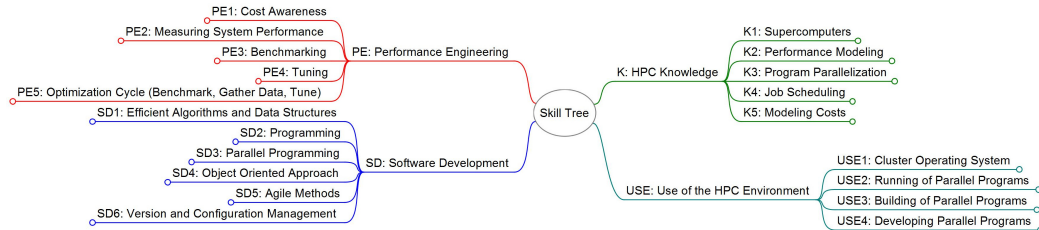- Create Certficate of Participation

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ZIH · Center for Information Services · High Performance Computing

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HPC-CF Skills point of view

OPENFPM

Prerequisites

Learning Objectives
K3-B Program Parallelization

AS

A

PIKA

Prerequisites
K-B HPC Knowledge
PE-B Performance Engineering

Learning Objectives
PE5-B Optimization Cycle
PE2.2.5-B PIKA

PE

TOOLS

Prerequisites

Learning Objectives
PE-B Performance Engineering
PE2.2-B Profiling
PE2.2-E Profiling
PE2.2.2.1-B Score-P
PE2.2.2.3-B Vampir
PE2.3-B I/O Performance
PE5-B Optimization Cycle

RDM

S

Learning Objectives

Prerequisites

Trainings-Portfolio

ML

ISA

Prerequisites
USE1.4.2-B Environment Modules
USE1.5-B Remote Access
PE2.2.2.5-B PIKA
K1.1-B System Architectures
K4-B Job Scheduling
K4.1-B Introduction to Job Scheduling
K4.2-B SLURM Workload Manager

HPC-B

Learning Objectives

IO

Prerequisites
USE1.3-B UNIX File System Tree
K1.2-B Hardware Architectures

Learning Objectives
K1.3.2.3-B File Systems
K1.3.2.5-B Parallel I/O
K1.3.2.5.1-B MPI-IO
K1.3.2.6-B POSIX
K1.3.5-B Access Pattern
PE2.3-B I/O Performance

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HPC-CF Skill Tree

Keyword **HPC-CF Competencies**
- ADM — Administration
- BDA — Data Analytics
- PE — Performance Engineering
- K — HPC Knowledge
- SD — Software Development
- USE — Use of the HPC Environment

HPC-CF ID
- PE2.2.2.5-B → position in the skill tree

Target Group
- B → Beginner
- I → Intermediate
- E → Expert

PE1: Cost Awareness
PE2: Measuring System Performance
PE3: Benchmarking
PE4: Tuning
PE5: Optimization Cycle (Benchmark, Gather Data, Tune)

PE: Performance Engineering

SD1: Efficient Algorithms and Data Structures
SD2: Programming
SD3: Parallel Programming
SD4: Object Oriented Approach
SD5: Agile Methods
SD6: Version and Configuration Management

SD: Software Development

Skill Tree

K: HPC Knowledge
K1: Supercomputers
K2: Performance Modeling
K3: Program Parallelization
K4: Job Scheduling
K5: Modeling Costs

USE: Use of the HPC Environment
USE1: Cluster Operating System
USE2: Running of Parallel Programs
USE3: Building of Parallel Programs
USE4: Developing Parallel Programs

PIKA NHR Tutorial

Course Website

HPC-CF Skill Tree

Prerequisites

- basic HPC knowledge
  (K-B HPC Knowledge)

- optional:
  PE-B Performance Engineering

Learning Objectives

- PIKA - first stage of the optimization cycle
  (PE5-B Optimization Cycle)

- Basic understanding of resource utilization using the hardware counter & interactive use of the PIKA web interface
  (PE2.2.2.5-B PIKA)

PE2.2.2.5-B PIKA

Maintainer: Frank Winkler, ZIH Team @ TU Dresden

Background Analyzing application performance in HPC can be a very challenging task. It depends on both the performance analysis tools and the build system of your application.

Aim Students should learn how to determine the efficiency of their HPC jobs using the PIKA web interface.

Outcomes ● Able to detect pathological performance behavior
● Able to understand the resource utilization based on the application algorithm
● Able to determine possible limitations by resources
● Able to find performance bottlenecks by correlating various performance metrics

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IO NHR Lecture
Course Website

Maintainer: Sebastian Oeste, ZIH Team @ TU Dresden

Prerequisites
- Safe handling of the Unix command line (bash) (USE1.3-B UNIX File System Tree)
- Good to know: Architecture of computers/clusters (K1.2-B Hardware Architectures)

Learning Objectives
- Introduction to local file systems (K1.3.2.3-B File Systems)
- Best practices for parallel I/O (K1.3.2.5-B Parallel I/O)
- Working with parallel file systems (K1.3.2.5.1-B MPI-IO)
- Introduction to POSIX I/O semantic (K1.3.2.6-B POSIX)
- Overview of parallel I/O access patterns (K1.3.5-B Access Pattern)
- Introduction in I/O (PE2.3-B I/O Performance)
- (PE2.3-B I/O Performance)
- Overview of I/O performance analysis techniques (PE2.3-I I/O Performance)

TOOLS NHR Workshop
Course Website

Prerequisites

- compiling and running parallel applications on command line
- modifying source code on the command line

Learning Objectives

- applying a performance engineering cycle to a parallel program
- reducing overhead caused by instrumentation
- finding typical performance bottlenecks via visual analysis
- determine parallel I/O behavior

HPC-Certification Forum Links

- PE-B Performance Engineering
- PE2.2-B Profiling
- PE2.3-B I/O Performance
- PE2.2-E Profiling
- PE5-B Optimization Cycle
- PE2.2.2.1-B Score-P
- PE2.2.2.3-B Vampir

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TOOLS NHR Workshop
HPC-CF Skill Tree

Maintainer: Bert Wesarg, William (Bill) Williams, ZIH Tools Team @ TUD

PE2.2.2.3-B Vampir

Background Vampir is a tool that focuses on providing quality visualization to support manual trace analysis.

Aim Students should be able to use Vampir on trace files that they have collected, and on sample trace files provided by the instructors.

Outcomes ● Able to launch Vampir both stand-alone and connected to a VampirServer instance if available
● Able to use the function summary to determine at a high level what parts of the code may not perform well

PE2.2.2.1-B Score-P

Background Score-P presents a generally uniform approach to collecting profiling and tracing data that can be applied to a broad range of HPC applications.

Aim Students should learn how to use Score-P to produce profiling and tracing data for their HPC applications.

Outcomes ● Able to instrument applications including one or more parallel paradigms
● Able to instrument applications including at least one specialized form of measurement

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Certification of Participation
PIKA NHR TUTORIAL

Content:

- PIKA hardware performance monitoring stack
  (HPC-CF Skill-Tree: PE2.2.2.5-B PIKA)
- Basics of resource utilization by using a hardware counter and the interactive PIKA web interface
- Efficiency analysis by using an interactive web interface
- Job-specific monitoring on the HPC systems of ZIH
- Evaluation of the performance and the resource utilization with the help of PIKA

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Certification of Participation
TOOLS NHR WORKSHOP

Content:

- Introduction to performance engineering
- Presentation of the framework Score-P for instrumentation and performance analysis (HPC-CF Skill-Tree: PE2.2.2.1-B Score-P)
- Presentation of the framework Vampir for visual performance analysis (HPC-CF Skill-Tree: PE2.2.2.3-B Vampir)
- Application of a performance engineering cycle to a parallel program
- Reduction of the overhead caused by the instrumentation
- Detecting typical performance bottlenecks with visual analysis
- Insights into the parallel I/O behavior of HPC applications
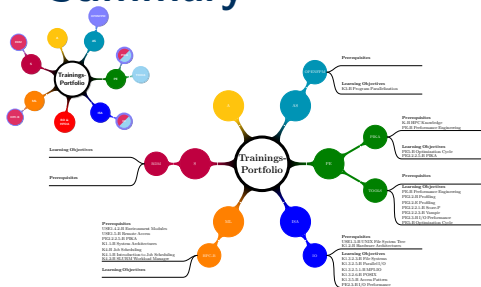- Determining the parallel I/O behavior

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IO NHR LECTURE
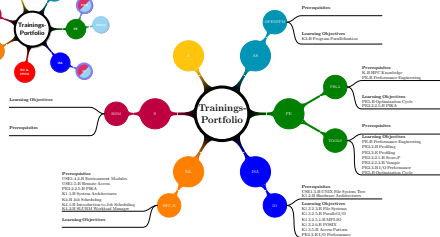
Content:
- Introduction in I/O (HPC-CF Skill-Tree: PE2.3-B I/O Performance)
- Introduction to POSIX I/O semantic (HPC-CF Skill-Tree: K1.3.2.6-B POSIX)
- Introduction to local file systems (HPC-CF Skill-Tree: K1.3.2.3-B File Systems)
- Overview of Linux file system caches
- Introduction of parallel file systems (HPC-CF Skill-Tree: K1.3.2.3-B File Systems)
- Overview of parallel I/O access patterns
  (HPC-CF Skill-Tree: K1.3.5-B Access Pattern)
- Introduction to collective IO and optimization strategies
  (HPC-CF Skill-Tree: K1.3.2.5.1-B MPI-IO)
- Overview of I/O performance analysis techniques
  (Skill-Tree: PE2.3-I I/O Performance)
- Best practices for parallel I/O (HPC-CF Skill-Tree: K1.3.2.5-B Parallel I/O)

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Summary

NHR Training 2021 @ ZIH + HPC-CF Skill Trees

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NHR Training 2021 @ ZIH + HPC-CF Skill Trees

Comparison: NHR Course Website vs. HPC-CF Skill Tree Entry

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Summary

NHR Training 2021 @ ZIH + HPC-CF Skill Trees

- ⬤ **Description**
- 🟠 Skill updated in HPC-CF
- 🔴 Skill didn't exist in HPC-CF
- 🟢 Skill already exist in HPC-CF

Mapping of Learning Outcomes into HPC-CF Skill Tree

Comparison: NHR Course Website vs. HPC-CF Skill Tree Entry

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Summary

NHR Training 2021 @ ZIH + HPC-CF Skill Trees

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Mapping of Learning Outcomes into HPC-CF Skill Tree

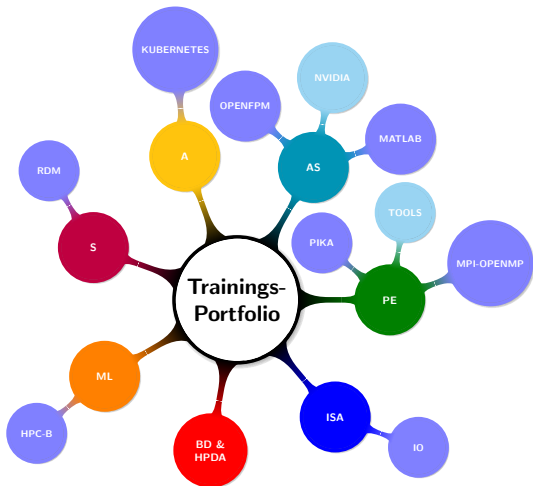Comparison: NHR Course Website vs. HPC-CF Skill Tree Entry

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Zentrum für Informationsdienste und Hochleistungsrechnen (ZIH)

CERTIFICATE OF PARTICIPATION

Certification of Participation

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Thank You!

Anja Gerbes

NHR-Course Coordination @ ZIH

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Reach out to us

More info: `https://www.hpc-certification.org/`

Contact us: board@hpc-certification.org

Participate/Contribute: Join our Slack channel

NHR Training-Portfolio @ ZIH 2022

More info about the NHR Center - ZIH:
`https://tu-dresden.de/zih/hochleistungsrechnen/nhr-center`

Participate: Join our NHR Training @ ZIH
`https://tu-dresden.de/zih/hochleistungsrechnen/nhr-training`

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Merry Christmas and a Happy New Year 2022!