Extreme Scale Computing Competence Profiles: Education and Training RTP Pathways

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https://www.hartree.stfc.ac.uk/

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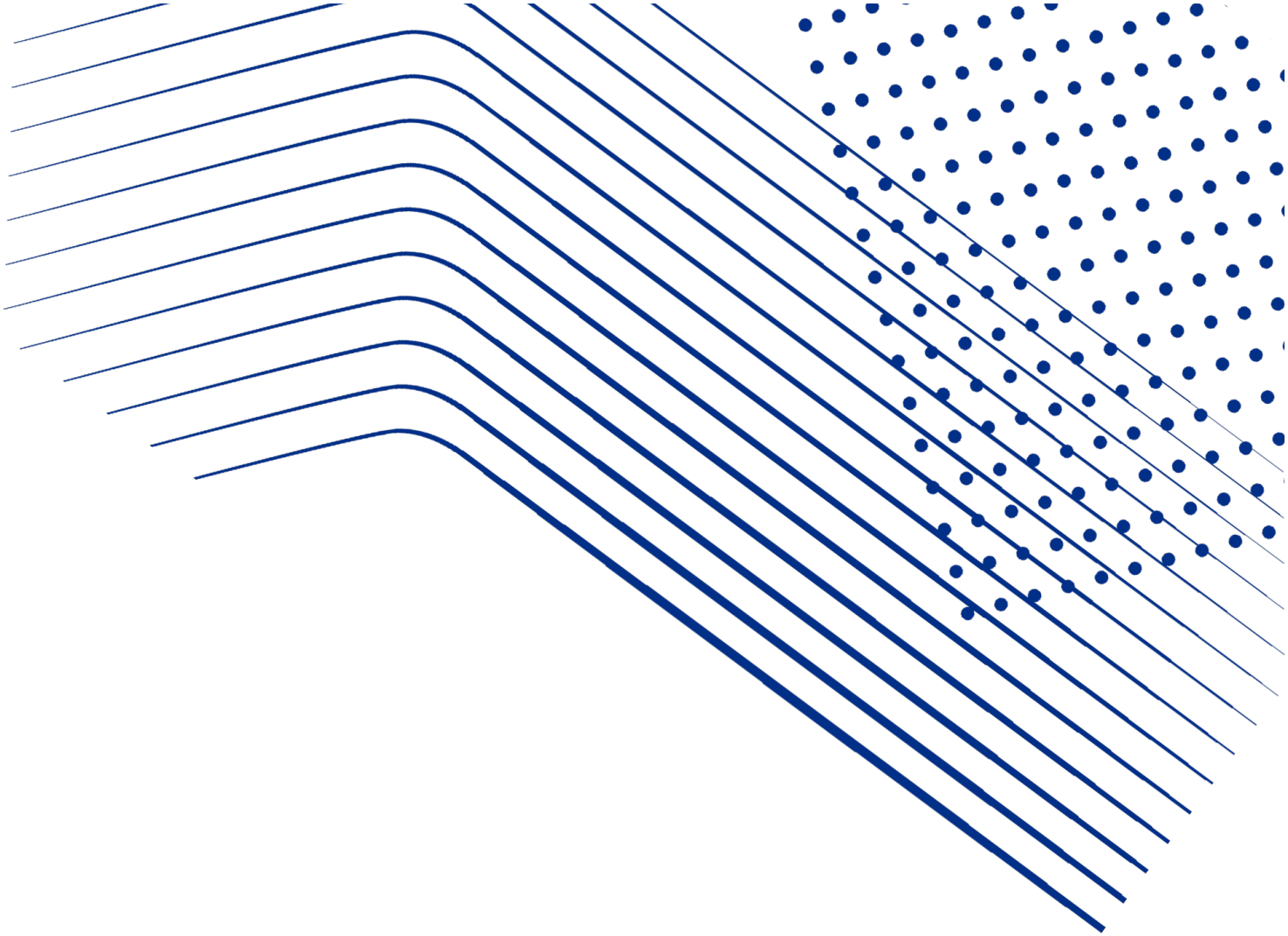
Context



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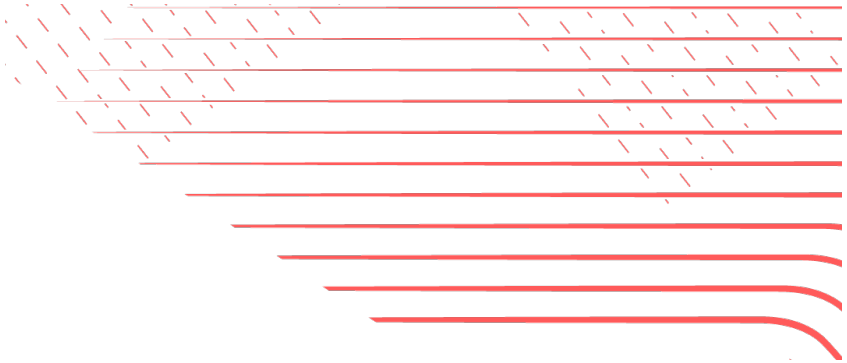
Tackling Extreme Scale Computing complexity



Talent

Widening the talent pool
HPC developers & administrators
AI researchers
Data Science and Analytics
Computational Scientists
Engineers
Non-STEM users
Business sector RTPs

Platforms

Scalability
Heterogeneity
Interoperability
Integration of Emerging paradigms
Resilience
Programming environments

Applications

Data intensive
Compute intensive
Data and compute intensive

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RTP Competence Profiles

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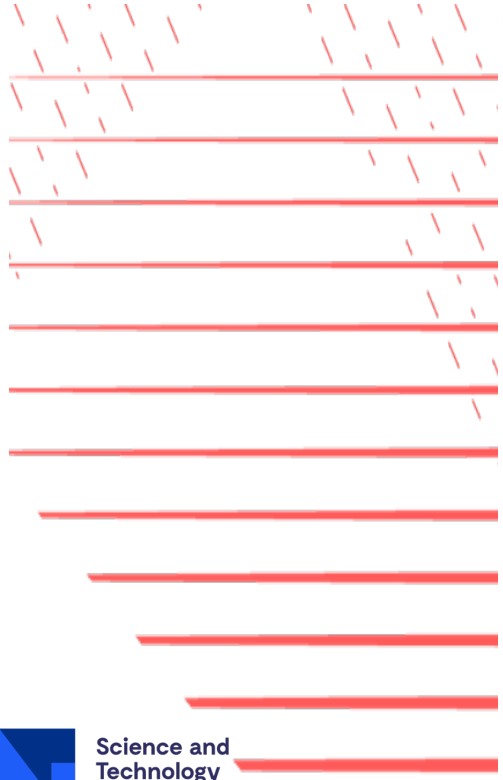
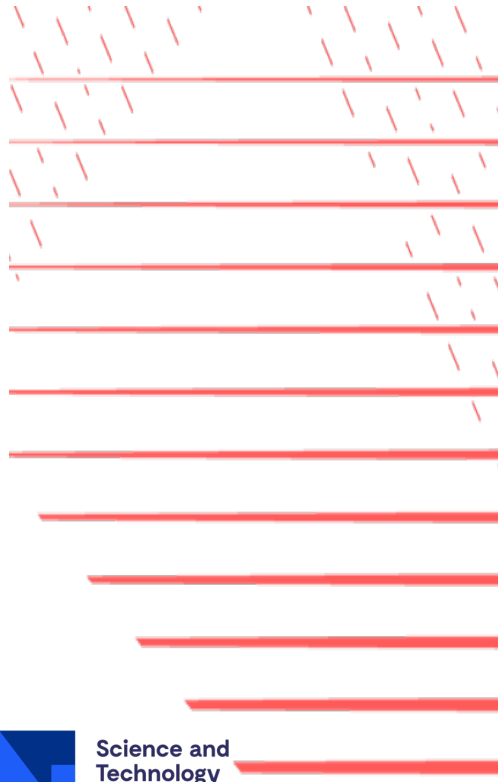
An incomplete list of existing Competency Frameworks



- The Global skills and competency framework for the digital world
  https://sfia-online.org/en
- HPC-Europe Competence Map
  https://hpc-portal.eu/support/competence-map
- SIAM: The future of Computational Science
  https://www.siam.org/media/ofaijdru/siam-report-on-the-future-of-computational-science.pdf
- Innovate UK BridgeAI: AI Skills for Business Competency Framework
  https://zenodo.org/records/11092677
- National Competency Framework for Data Professionals in Health and Care
  https://transform.england.nhs.uk/media/documents/NCF_Framework_Booklet.pdf
- The Vitae Researcher Development Framework
  https://vitae.ac.uk/

Competency Frameworks - Research



- **Professional Research & Investment Strategy Manager**

  PRISM network - PRISM network

  How PRISMs Support and Enhance ARC's Mission

  https://rdr.ucl.ac.uk/articles/model/ARC_Professional_Research_Investment_Strategy_Managers_Job_Description_Framework/25196612

- **Research Community & Impact Managers**

  Community Managers: Overview - The Turing Way

  Woodley, L., Pratt, K., Sandström, M., Wood-Charlson, E., Davison, J., & Leidolf, A. (2021). *The CSCCE Skills Wheel – Five core competencies and 45 skills to describe the role of the community engagement manager in STEM*. Zenodo. 10.5281/ZENODO.4437294

  Center for Scientific Collaboration and Community Engagement - CSCCE

  Research Application Managers: Overview - The Turing Way

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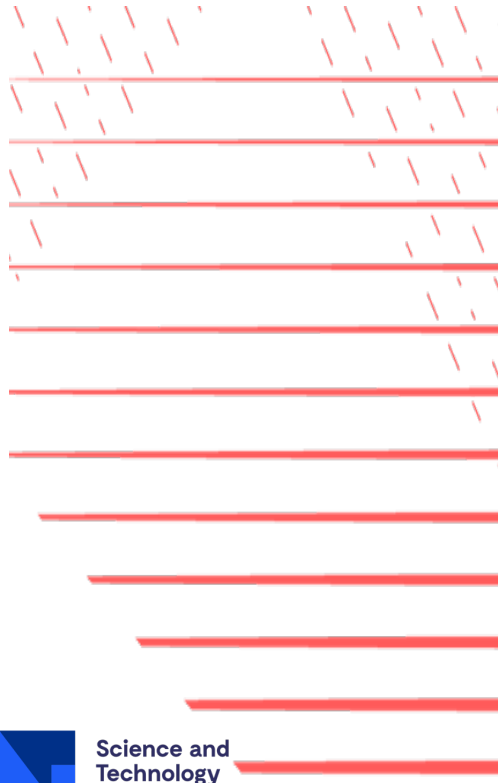
provided by Louise Chisholm, UCL

Competency Frameworks- Research



- **Research Managers / Research Infrastructure Managers**

  RM ROADMAP Project Home

  Managers of research infrastructures

  Driving Excellence for Research Infrastructures and Core Facilities - RITRAIN PLUS Workshop (Report) - Driving Excellence for Research Infrastructures and Core Facilities

- What do you need to run a Research Infrastructure? Here are three skills managers need the most - Driving Excellence for Research Infrastructures and Core Facilities ritrainplus
- Other

  Professionalising traditional and infrastructure research roles in data science

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RTP today – painting by numbers profile

- HPC specific
  - Advanced computer architectures
  - Operating systems
  - Heterogeneity and novel software environments
  - Parallel programming
  - Performance analysis and tools
  - Parallel Algorithms
  - GPU and accelerator programming
  - Resilience and fault-tolerance
  - Scalable solutions
  - Exascale mathematics
- Data specific
  - Big Data analysis
  - Stochastic modelling
  - Data visualisation
- AI specific
  - Generative AI
  - Foundation Models
  - DL Algorithms
  - Stochastic ML
- QC & Emerging computing paradigms specific
  - Quantum – Classical computing
  - Integrating QC & emerging computing paradigms
  - Hosting heterogeneous hardware
- RSE specific
  - Trusted research environments
  - Cyber security
  - Production run times(cloud, edge, IoT)
- Working in collaborative multidisciplinary environments:
  - Collaborative programming
  - Digital twins
  - Project management

I have more questions than answers

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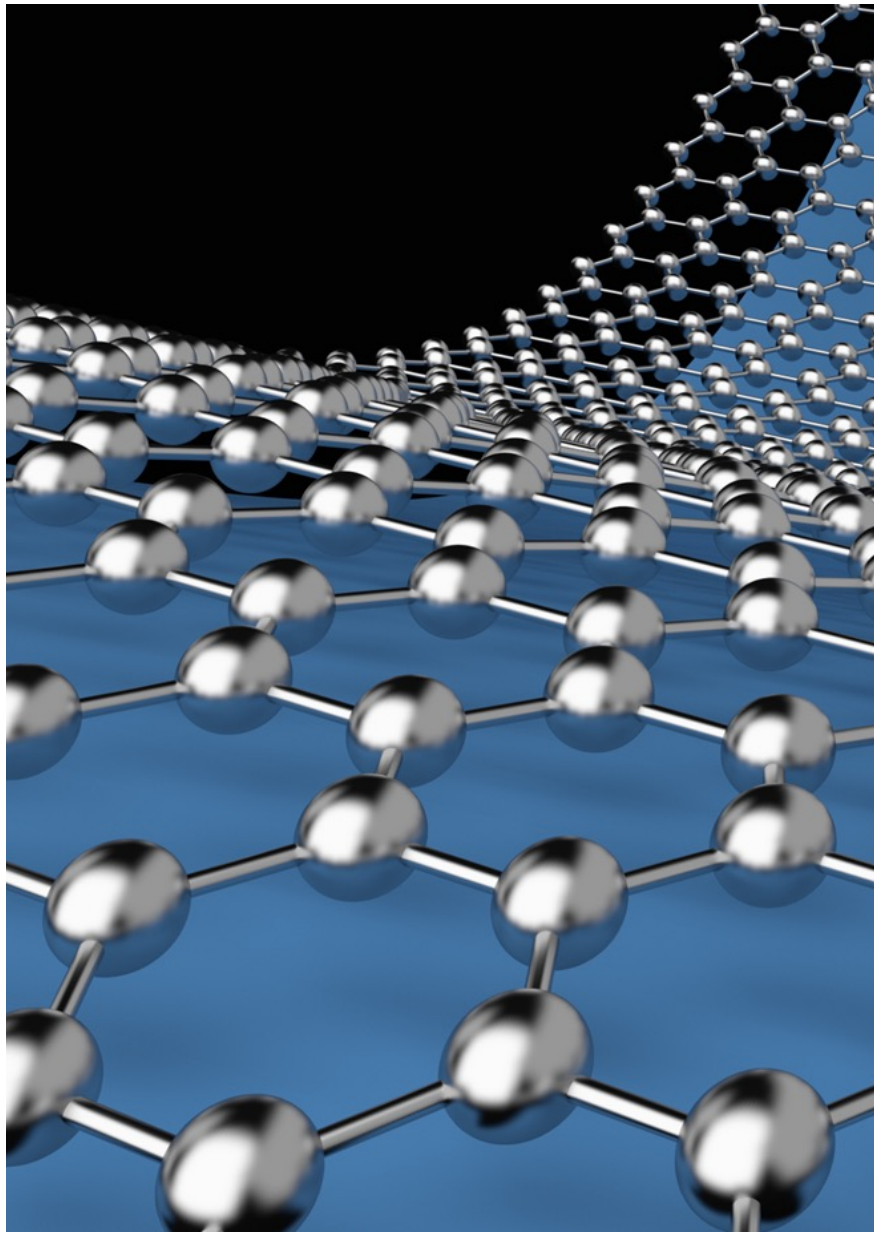
Where to start - content

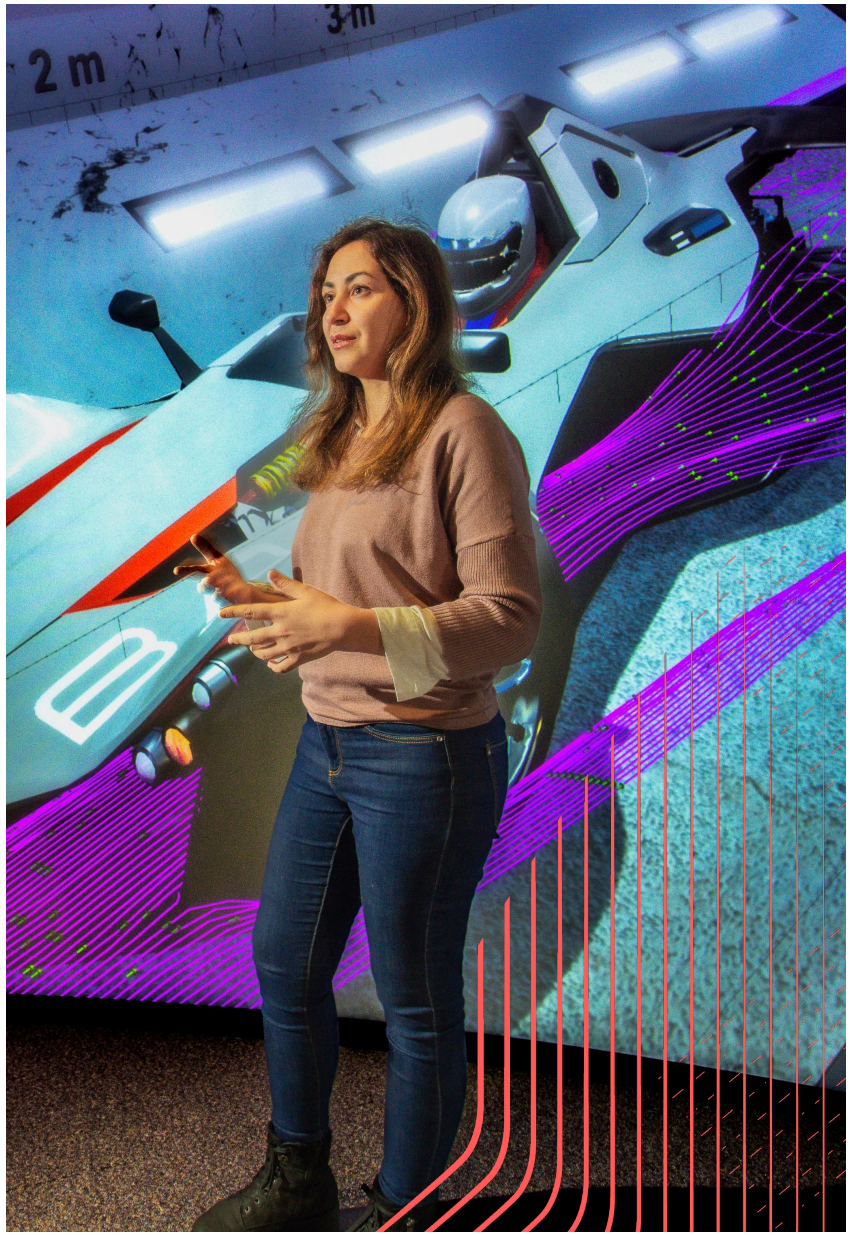
- Multidisciplinary demands & Cognitive overload
  - Do we have to teach it all to everyone? When? On what level of depth?
  - Are all subject areas with the same impact to everyone?
  - Should we let ourselves join the vendors' chorus that AI is the ultimate solution?
  - How much we should leave on self-driven learning by non-specialists?

- Back to basics on building curricula for the FE/HE
- Visibility to all available opportunities for training



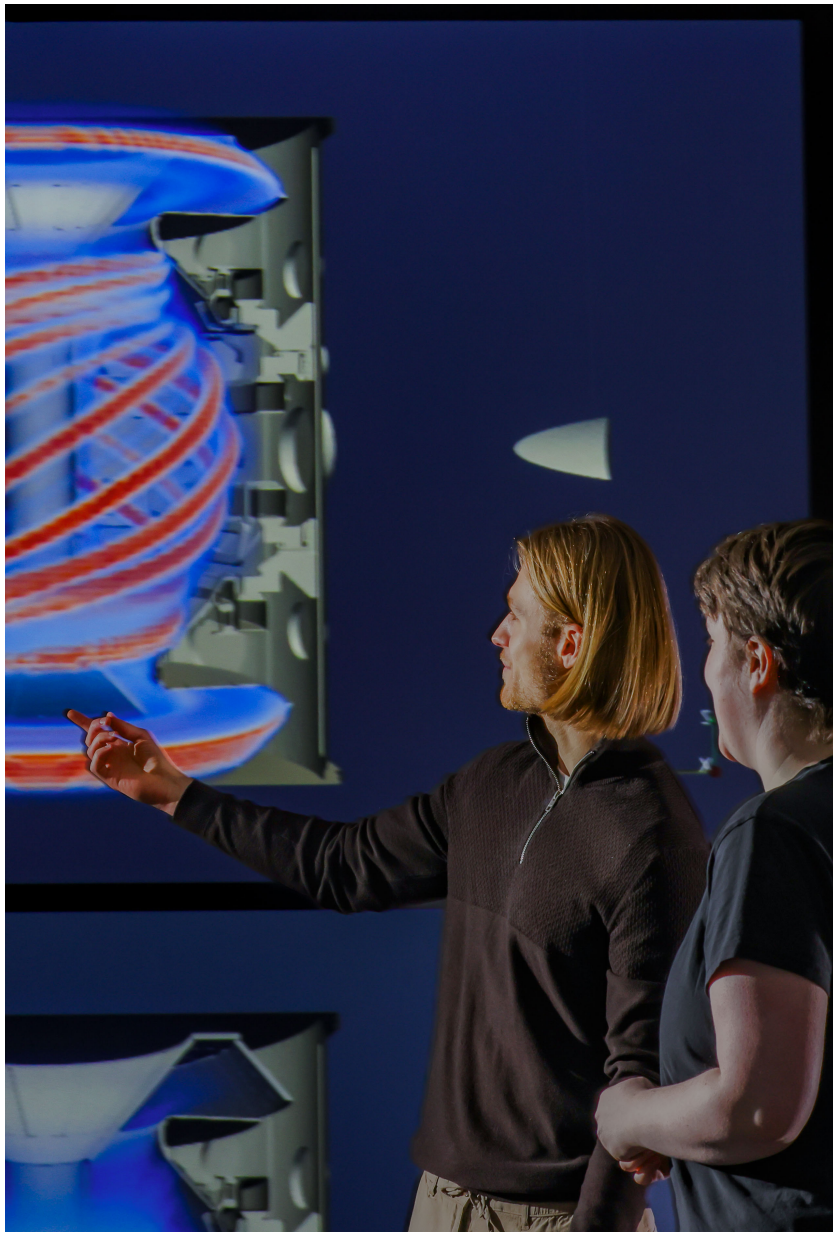
Where to start - delivery

- FAIR principles:
  - Findability - Do we have clear educational landscape picture of UK?
  - Accessibility – How assessable is the training (language and methods)
  - Interoperability – Many of the same options vs complementarity of provision
  - Reusability - How effectively we can react on changes in context and demand
- Managing Expectations: Education vs Training
  - Can someone learn in 5 days something requiring 9 years?



Removing the barriers to adoption through awareness

- Plain language messaging from the HPC community
- Pushing out the required minimal understanding in the research community
- Creating awareness of the available access and adoption of scalable solutions:
  - UK Government investment should be pared with DSIT communication of existing opportunities
  - In HE: Providing an environment to explore the latest technologies, develop proofs-of-concept and apply them to real life challenges
  - De-risking investment into new technologies for organisations needs to carry clear message about the need to upskill and foster talent.



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How to engage

- Determine the high-priority areas for upskilling through this project
- 25 years ago, there was EU career-space in IT with a clear advice on effective building of curricula and check list of pre-requisites for successful adoption.

Should we repeat this exercise through NFCSNetwork+?

- ➢ Not telling what to teach but how to structure and where to find support and technology access

- A gateway for to available training focussed on resolving users' problems not listing academic materials

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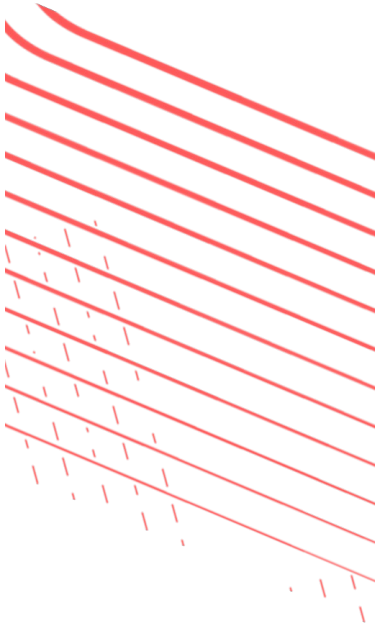
Training Priorities



- For Training Providers:
  - Create clear education landscape for UK
  - Understand the minimal required know-how for the independent users
  - Reuse already proven to work tools and environments
  - Emphasise collaborative knowledge creation skills through technical training
- For users:
  - Develop solid HPC core skills: architectures, OS, programming
  - Ensure functioning multidisciplinarity – how much understanding is enough for technical areas that are not core to the individual
  - Foster positive interdependence through appropriate programming practices in multidisciplinary teams
  - Develop maths skills: scalable math methods and algorithms

Credit where credit is due

- UK has longstanding training programs in HPC run by EPCC, DiRAC, Hartree Centre, Turing Institute, Digital Catapult to mention but a few
- UKRI funded multidisciplinary Centres for Doctoral Training
- UKRI and DSIT funded projects for upskilling the workforce for digital transformation and innovation
  - ➢ Ensuring that we create a clear picture of all available opportunities by networking with all existing initiatives will benefit both the community and facilitate collaborative delivery for a federated environment

Hartree Centre Training Portfolio

Free unrestricted access to the Hartree Centre Training Portal

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Streams and Courses

Software Engineering: These courses cover the increasingly wide range of software engineering topics such as cloud, data engineering, data analysis workflows and data visualisation (10 courses)

Data Science: These courses explore methods that can help your organisation to make the most out your business data. Covering data collection, engineering and data visualisation, we'll provide the tools and cover practical examples of how data analytics can help optimise your business processes and make data-informed decisions (5 courses)

Emerging Technologies: Our courses will help you to explore emerging digital technologies like quantum computing, IoT and Edge computing. They will guide you through current and future trends, show the latest tools and help you de-mystify jargon to understand how the latest technologies can benefit your organisation (4 courses)

High Performance and Exascale Computing: Access to more powerful computing resources can increase productivity and speed up your calculations. Using a combination of theory and practical exercises, our courses will show you how to speed up your calculations and work at scale. Join us if you're looking for a practical guide to help you use HPC more effectively and want to decide on the resources you need to maximise efficiency and value for your business. (6 courses)

Artificial Intelligence and Modelling: Topics that inform the generation of real-time decision-making insights from data helping you to innovate, speed up processes and boost efficiency. From predictive maintenance to intelligent automation and the optimisation of tools and processes, our courses will walk you through how to embed AI into your organisation (7 courses)

Entrance levels

- **Introductory:** For trainees from non-related background and very little knowledge on the topic.
- **Learner:** For trainees with some theoretical or practical knowledge.
- **Independent User**: For trainees who are able to work independently but would require guidance for solving complex problems.
- **Practitioner:** For trainees working in the specific field, to be presented with the state-of-the-art developments and collaborative multidisciplinary applications with higher levels of complexity.

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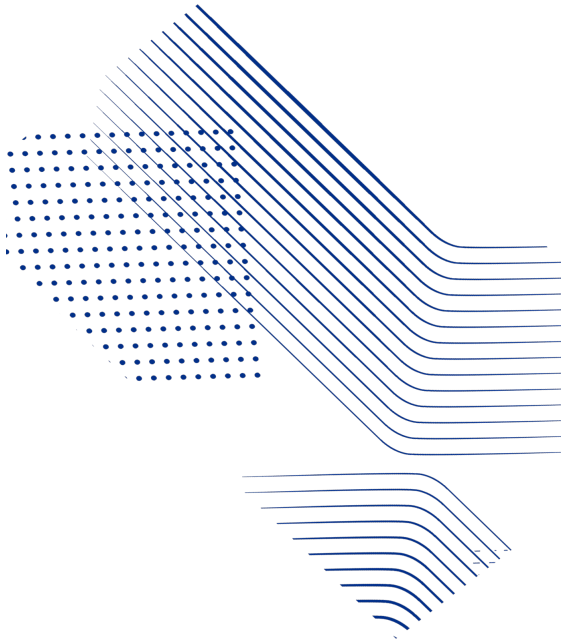
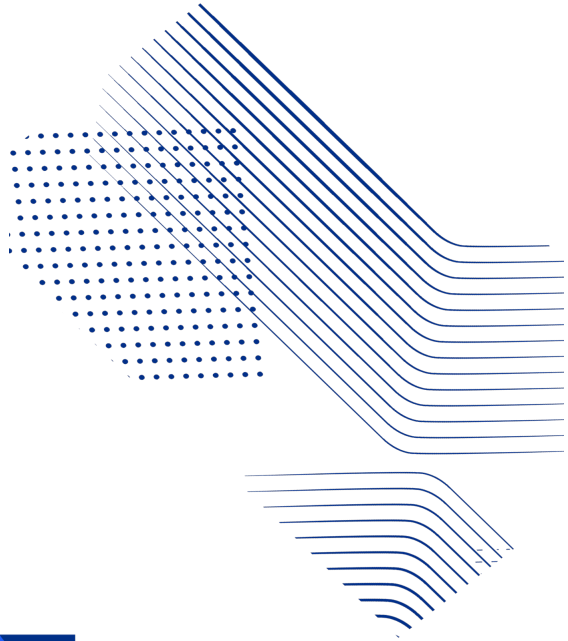
Example RTP pathways



- In HPC
  - Beginner's Guide to HPC
  - Practical Guide to High Performance Computing: Hartree Centre Driving License
  - Fundamentals of Parallel Computing: Parallel Programming with MPI and OpenMP
  - Fundamentals of Performance Analysis
- In Exascale
  - Beginner's Guide to Exascale Computing
  - Fundamentals of Exascale Computing: Parallel Programming with SYCL and Kokkos

Example RTP pathways



- For Physics & Engineering RSEs
  - Research Software Engineering Best Practice
  - Practical Guide to Collaborative Development
  - Advice for Research Scientists Using LLM’s
  - Career Pathways, Skills Development, and making Data AI friendly

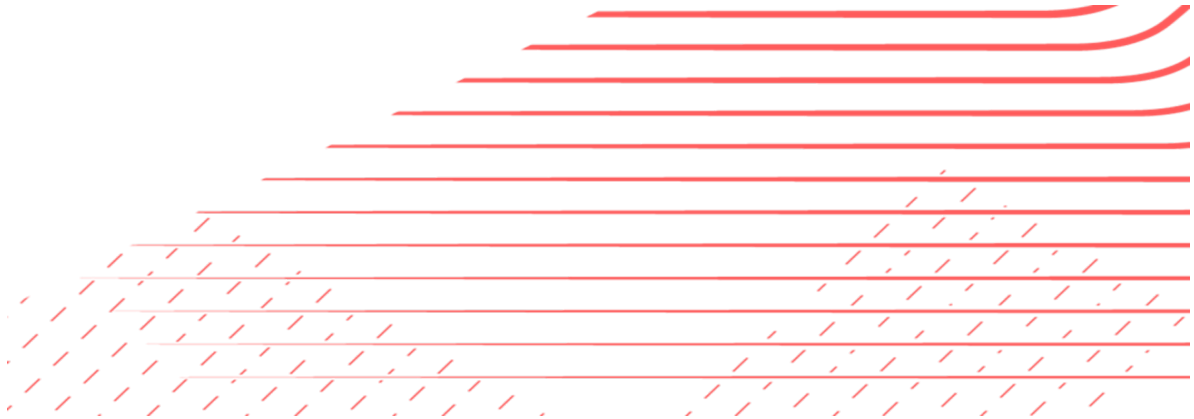
Schools on-demand and Workshops

Schools:

- Algorithms and GPU Programming Schools
- HPC, Multi GPU Programming and Exascale School
- Train-the-Trainer: Design and Delivery of Technical Courses for Digital Innovation

Workshops 2025 – registration opens soon

- On the Trail to Exascale and Scalable AI Workshop 16-18/06/25
- Quantum Computing for Material Science – late spring 2025



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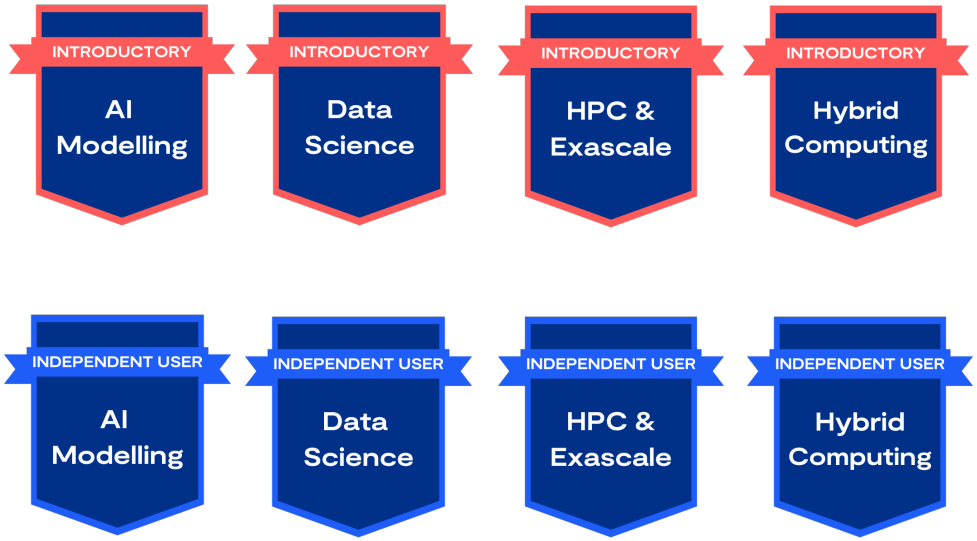
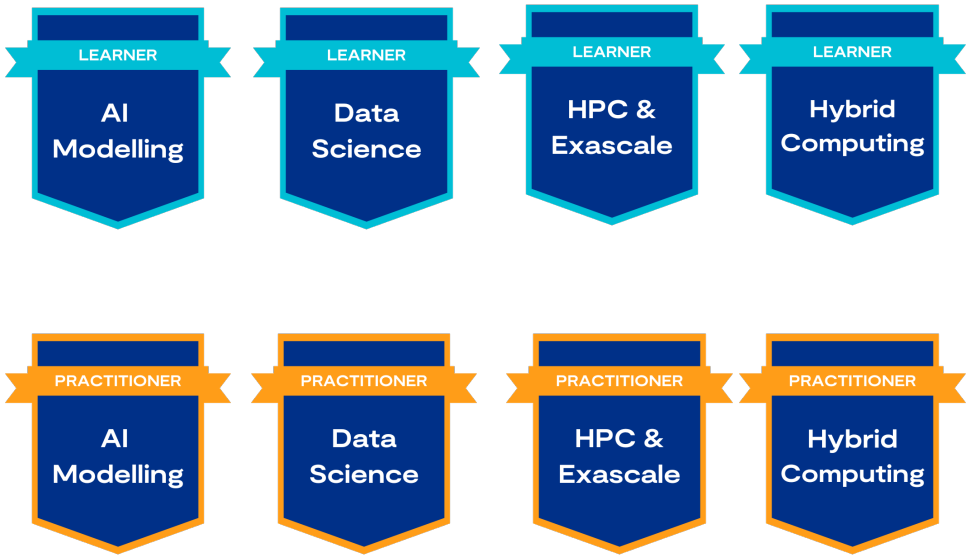
Badges

- Badges are awarded for the different streams and on levels 1 to 3
- Awarded after the course and based on criteria completion
- These can be added to social media as customised existing option from Totara





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Thank You

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