

Work Package: AI/ML and Emerging Technologies

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Introduction

- Added a new work package in SWIFT-HEP Phase 2.0 vision document

WP7 AI/ML tools and emerging technologies. Artificial intelligence is transformative in several disciplines and is driving the development of new hardware. To continue to benefit from AI developments, we need to develop the tools to optimise and deploy the ML algorithms used in HEP to AI-optimised architectures, including the latest HPC being deployed by UKRI. It's essential that our computing workflows evolve to efficiently utilise these emerging resources, following the FAIR principle.

Another emerging technology is quantum computing. Given the quantum mechanical nature of many problems in HEP, such as scattering matrix element calculations, quantum computing and quantum machine learning offer exciting new technological frontiers.

- This talk is aimed to start the process of gathering feedback from the community on what such a package should look like
 - Will help shape the text we put in the Sol

Focus in Vision Document

- Tools to optimise and deploy to AI-optimised architectures
 - Development of HEP specific tools
 - Both for training and inference, adhering to the FAIR principle
 - Effectively use range of HPCs/hardware e.g.
 - Especially those available in the UKRI
 - A lot of training happens on institute specific resources
 - Deployment to FPGAs (Edge-AI)
 - Trigger (e.g. NextGen Trigger Project)
- Emerging Technologies/Quantum Computing (QC)
 - Potential for QC to have large impact in HEP
 - Explore the potential of this new technology for HEP
 - Vital to build UK skills in these areas
 - UK-based studies exploring potential areas of application already published
 - e.g. [tracking](#), [parton-shower](#)
 - Many problems will very likely be similar across experiments
 - Potential for cross-experimental development work
 - Essential to explore significant potential of new technologies
 - Government priority area and large-scale funding being deployed

Common Model Development

- The vision document focussed on hardware for AI and quantum computing
 - Consider other areas?
- Development of cross-cutting ML/AI tools, could include
 - Simulation/Generation
 - Data quality/Anomaly detection
 - Triggering and reconstruction
 - Event classification
 - Resource management or automation of simple coding tasks
 - Documentation
 - ML training packages and architectures (e.g. image, graph-like [SALT](#))
- This could also provide a forum for spreading applied ML/AI expertise
 - PPTAP process identified knowledge-exchange of ML expertise essential
 - STFC's DIS CDT's have been successfully doing this
 - Significant benefits to STFC's physics programme
 - Sharing/Developing common tools would be ideal way to foster this
 - Very much feeds into skills/training agenda
 - Act as a focal point for interaction with CDTs/UKHEP ML community

Points to Consider

➤ AI/ML

- Focus on hardware deployment and better exploitation of HPC facilities?
- Add development of cross-cutting AI/ML tools?
- Act as a focal point for the UK-HEP ML community?
- Key deliverables?
- UK's strengths?

➤ Emerging technologies:

- Focus on QC and on a limited set of applications?
- Other emerging technologies we should mention?
- Keep a 'blue-skies' aspect to enable new developments to be explored?
- Act as a focal point for UK-HEP next generation technologies
- Key deliverables?
- UK's strengths?

• gDoc here to add any thoughts:

- <https://docs.google.com/document/d/1WTa8JrjK5E2EeRzpTSy34iTVQzWU-NtyuJmv5-NnSFQ/edit?usp=sharing>

Backup