Exascale Panel – Introductory Slides

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About me

- Born in Debrecen, Hungary
- Moved to Aberdeen, Scotland at age 12
- University education at Edinburgh University
  - B. Sc. (Hons) Physics & Computer Science (1996)
  - EPCC Summer Scholarship Programme (1996)
  - Ph. D. Theoretical Physics (2000)
- Post Docs at
  - University of Kentucky (2000)
  - University of Edinburgh at Columbia Univ. (2000-2002) working on QCDOC
  - University of Edinburgh (back in Edinburgh) (2002-2005)
- Staff Scientist at Jefferson Lab (2005-2020)
  - Working on Lattice QCD software and algorithms
- Oak Ridge National Laboratory (2020-present)
  - Group Leader for Advanced Computing in Nuclear Particle and Astrophysics in the Science Engagement Section
  - Exascale Computing Project (HI - Application Integration at the Facilities)
  - Preparing Lattice QCD Code for Frontier
  - and now: taking an interest in other areas: medical imaging & HemeLB

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Oak Ridge Leadership Computing Facility Mission

from the OLCF web pages

• “The Oak Ridge Leadership Computing Facility (OLCF) was established at Oak Ridge National Laboratory to accelerate scientific discovery and engineering progress by providing world-leading computational performance and advanced data infrastructure.”

• “The Oak Ridge Leadership Computing Facility is charged with helping researchers solve some of the world’s most challenging scientific problems with a combination of world-class high-performance computing (HPC) resources and world-class expertise in scientific computing.”
Our Systems

• Frontier – Exascale System (1.194 EF/s in HPL)
  – HPE/Cray EX system, 9408 nodes
  – 1 HPC Optimized 3rd Gen EPYC CPU (Trento)/node
  – 4 AMD MI250X Instinct GPUs (8 GCDs)/node
  – Cray Slingshot 11 Interconnect
  – 21 MW of power, liquid cooled (~6000 gal/min)
  – #1 on June 2023 Top 500 List
  – Now in EARLY production for INCITE, ECP

• Summit (148.6 PF/s in HPL)
  – IBM AC922 system, 4600 Compute nodes
  – 2xPower 9 CPUs/node
  – 6 NVIDIA Volta V100/node
  – Infiniband Interconnect
  – 13 MW of power, liquid cooled
  – #5 on June 2023 Top 500 list (#1 in 2018)
Come and Compute with Us!!!

• Did you know that ~60% of our cycles are available via the DOE INCITE program?
  – Anyone can apply, worldwide!
  – Successive applicants get liaisons like me to help them reach their science goals.
  – The deadline for INCITE proposals for 2023 has passed... but there is always next year
  – visit: https://www.doeleadershipcomputing.org/

• Up to ~25% of our cycles go to the ASCR Leadership Computing Challenge (ALCC):
  – visit: https://science.osti.gov/ascr/Facilities/Accessing-ASCR-Facilities/ALCC
(My own) ponderings about the future (but not my ideas)

• Moore’s law is slowing
  – longer lifetimes for systems before they cease to be cost effective?
  – potential rise of custom accelerators for various tasks (implemented via chiplet tech?)
  – what if your application can’t use them? -> will you be sent off to use the cloud?

• Deteriorating balance between FLOPS/network/memory -> more communication avoidance (Peter’s and Evans’ talks at this conference)

• High performance infrastructure for instruments & data processing?
  – less focus on a single “big machine” more on data & data flow? (IRI initiative)

• Improved ISO C++ support for accelerators
  – support by other accelerator vendors than just NVIDIA
  – ISO C++ evolution:
    • parallelism & concurrency (sender/receiver model)?
    • linear algebra (already being discussed)
  – Standard evolution is steady but can be slow moving... CUDA/HIP/SYCL/OpenMP as well as Kokkos/Raja etc will not go away anytime soon.

• Increased hardware complexity => increased likelihood of failures.
  – defensive coding, defensive running w. checkpointing

NB: I saw this discussed at the ECP AM in the panel: “What’s coming next for HPC architectures?” J. Shalf, D. Reed, K. Yellick, N. Thompson. I think it came from D. Reed
Acknowledgement

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• And a gentle reminder in case it is needed:
  – Users should acknowledge the OLCF in all publications and presentations that speak to work performed on OLCF resources... (see above)
  – When discussing your research efforts that have been supported by ECP resources, we respectfully ask you to use the following acknowledgment text in your slide presentations ... (see above)