Long-term Vision and R&D Efforts

James Amundson

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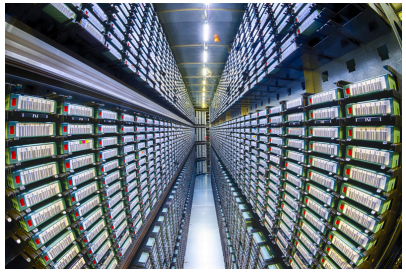
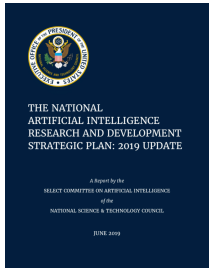
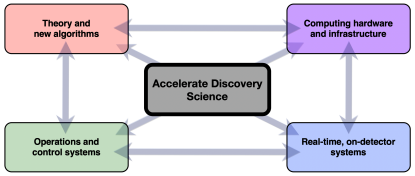
Operations Computing for the DUNE + HL LHC Era

- Facility Strategy
  - Exascale
    - Leverage Exascale resources to avoid having to dramatically expand Fermilab CPU capacity
    - Part of Fermilab CPU capacity aimed at bridging to Exascale
      - Requires GPU resources at Fermilab
  - Mass Storage
    - Fermilab will serve as the data repository for DUNE, Mu2e and the rest of the Intensity Frontier
  - AI
    - Provide computing support for AI effort
    - Assist AI applications' use of Exascale resources







Evolving Storage for the DUNE + HL LHC Era

- Long-term research and plan for storage facility
  - Mass storage technology is evolving
    - Industry support for tape is declining
      - Cost advantage is declining
    - Tape management software is at a crucial juncture
    - Wider variety of disk types becoming available
  - Interest in mass storage growing across DOE facilities
    - We are engaged, but the effort has not converged
  - Working on research projects
    - Long-term replacement for current Enstore + dCache
      - Just getting started
      - Exploring community collaborations
    - Rucio & Data Management
      - Data lakes – Multi-tiered storage/Quality of service
      - Object stores – particularly for DUNE

Evolving Computing for the DUNE + HL LHC Era

- Exascale and even post-Exascale facilities will be relevant for DUNE Era
  - Actively working on integrating HPC facilities into HEP workflows
  - Primary tool is HEPCloud
    - HEPCloud effort transferred from CompHEP to Operations
      - “Uncanny Valley”
        - HEPCloud now in production use
        - Much development work left to be done
  - Science workflow interface to HPC facilities ongoing
    - Much more work to be done for Exascale, but funded as research

Evolving Software for the DUNE + HL LHC Era

- High Energy Physics Center for Computational Excellence (CCE)
  - Existing effort
  - Newly focused and expanded ($500-$800K)
    - Collaboration with LBL, BNL, ANL
    - Portable parallelization strategies (PPS) for HPC systems
    - Fine-grained I/O and storage (IOS) on HPC platforms, including data models and structures
    - Event generators (EG) on HPC systems
    - Complex workflows (CW) on HPC systems
- Celeritas
  - Research project to complement GeantIV by providing efficient simulation of Geant physics on GPUs
- SciDAC Projects
  - HEP Data Analytics
  - HEP Reco

Additional Directions for the DUNE + HL LHC Era

- Analysis Cluster
  - Research projects including CPU and storage optimized for analysis
  - Ultimately will be the carrot that draws experiments away from more expensive and less efficient solutions, e.g., NAS
- Support for AI-centric computing
  - Will require more GPU resources

- See a growing need for GPU resources at Fermilab on many fronts
  - AI and Exascale are the primary drivers
  - We have experienced a chicken/egg problem in this area
  - Expect new (old) GPU portion of Wilson Cluster to break the cycle