subMIT Overview/Status

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Basic Computing Services (subMIT) Users Meeting

Oct. 22, 2024

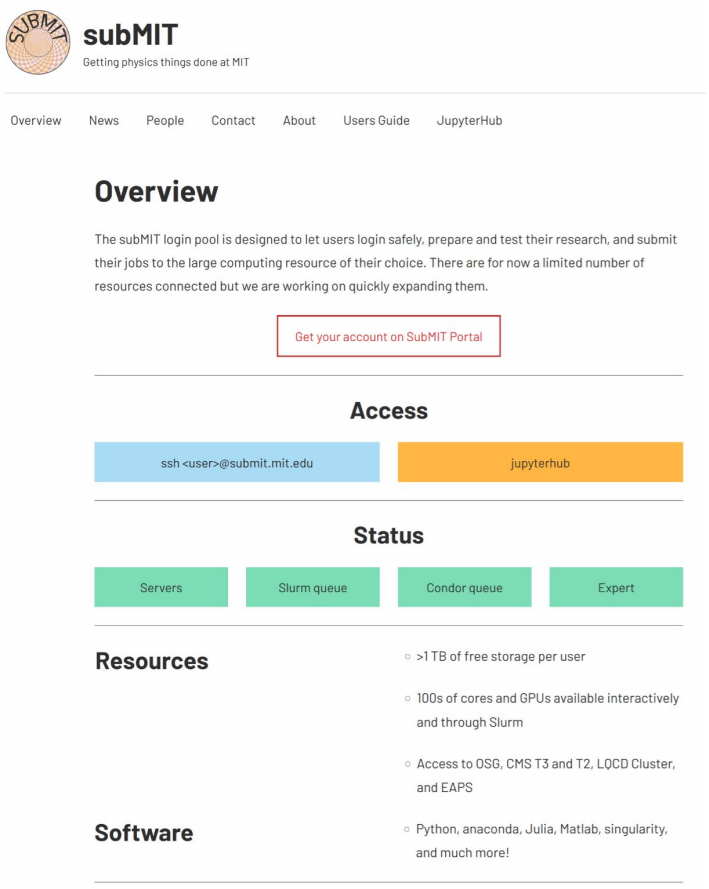
Introduction

- subMIT system provides an interactive login pool + scale-out to batch resources
  - Home directories
  - Convenient software environment (Alma Linux 9 native, docker/singularity images, conda)
  - SSH or Jupyterhub access
  - Local batch system with O(1000) cores, >50 GPU's
  - Additional storage for software installation/development, large datasets
  - Convenient access to larger external resources (OSG, CMS Tier-2 and Tier-3, LQCD Cluster, EAPS)
- User support is a key feature of the system
  - Beyond basic troubleshooting
    - Help users make optimal use of the available resources
    - Expert advice on designing/improving workflows
    - Customize and evolve system configuration to accommodate user needs as appropriate

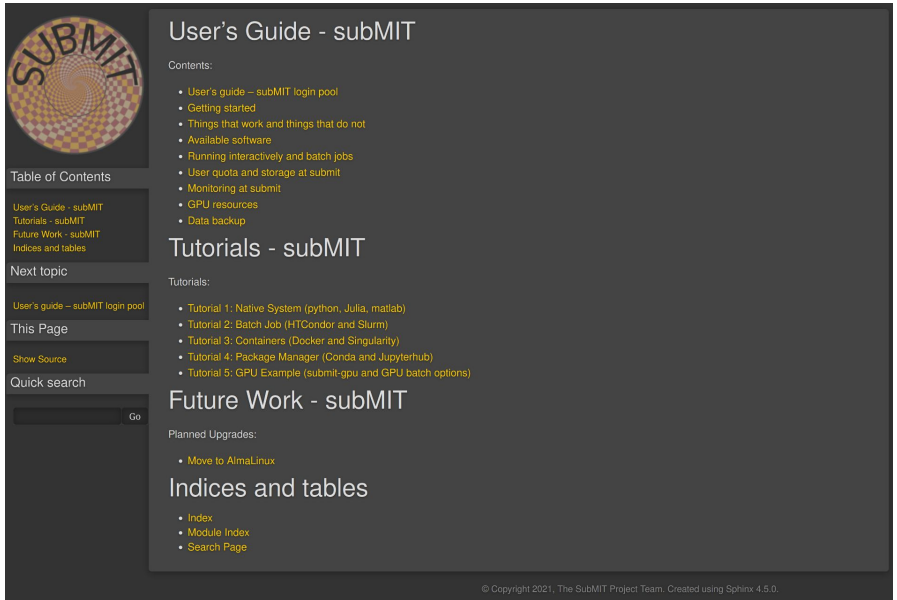
Introduction

- Storage and networking
  - 800TB of spinning disks
  - Local storage (1TB/user), 10’s of TB for larger group datasets
  - 40TB of ultra-fast NVME storage with room for future expansion
  - Fast networking: 100 Gbps ethernet
    - RoCE (RDMA over Converged Ethernet) has been partially tested/commissioned, should be possible for MPI applications
- System is located in B24 basement, with 100gbps uplink

Introduction: subMIT Website



- Website (with User's Guide/Instructions): https://submit.mit.edu/
  - Overview and general information
  - Direct JupyterHub access
  - User's Guide: https://submit.mit.edu/submit-users-guide/



Introduction: Project Organization

- Formally the project is organized as ***Basic Computing Services*** in the Physics Department
  - **Project Team:** Implementation/Operations/Maintenance of the system
  - **Users Group:** Contact point between the user community and the project team, forum for user feedback, requests, information flow to and from users
  - **Steering Committee:** Faculty oversight, funding, etc
  - See https://submit.mit.edu/?page_id=6

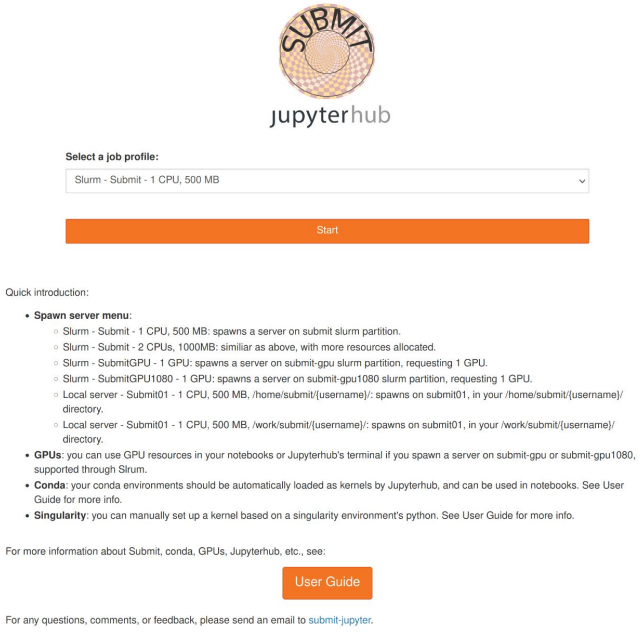
Users Group In Practice

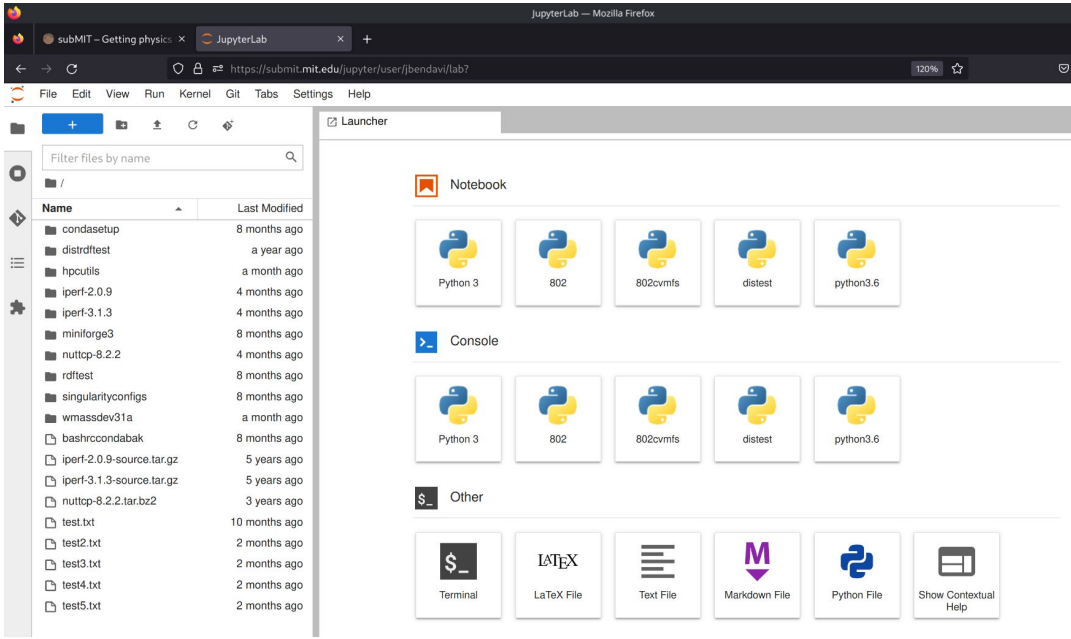
- Regular meetings (every few months)
  - Advertised and open to the broader community
  - Topical presentations from project team, Users Group representatives, or other users or community members
  - Forum for feedback and information flow between the user community and the project team
  - Regular timeslot: Tuesday 10:00-11:00 EST
- Users Group representatives
  - Identified representatives from research groups across the department
  - Attend the monthly meetings
  - Provide feedback from your groups/community
  - Distribute information/news from the project team

Storage breakdown

- Several different storage areas are available covering different use cases
  - /home/submit/<username>
    - Home directories (nfs server), redundant disk array with backups
    - 5GB quota
    - Use for software development and (small) critical data
  - /work/submit/<username>
    - Work directory (nfs server), no backups (but redundant disk array)
    - 50GB quota
    - Use for software installation (conda or docker/singularity images)
  - /ceph/submit/data/user/<username>
    - Large distributed disk system, no backups, but redundancy against disk failure (“erasure coding”)
    - 1TB user quota, larger quotas available in dedicated group directories
    - Store large datasets here
  - /scratch/submit/<username>
    - Fast NVMe SSD array
    - Commissioned by several groups for high performance data analysis
  - /cvmfs/
    - Read-only distributed storage for distributing software, singularity images, etc
    - Several CERN-related repositories are available
    - Local repository /cvmfs/cvmfs.cmsaf.mit.edu where additional software or data can be added if needed
- Flexible tiered storage system, can accommodate a wide range of user needs
- Larger datasets encouraged to use shared group space, but quotas can be increased when needed
  - Group space in /ceph/submit/data/group/<groupname>

Interactive Use: Terminal or JupyterHub





- Interactive Jupyter session available directly from website with touchstone authentication (subMIT account still required)
- SLURM is used to efficiently share resources between interactive and batch use
- Primary usage is research, but also being used for classroom exercises

Communication Channels

- User support mailing list: submit-help@mit.edu
- Experimental large language model application under development for interactive user support and to augment support ticket handling
- Slack workspace: https://mit-submit.slack.com
  - “help-desk” channel
- Monthly Users Meetings
  - Open for discussion
  - Open for user contributions: full set of Users Group representatives can be contacted at submit-usersgroup@mit.edu
- Annual subMIT workshop
  - February 2024 workshop: https://indico.mit.edu/event/956/
- In addition to direct interaction with the subMIT project team, users are encouraged to discuss with Users Group representative from their own group or “nearby” group

Linux Distribution Upgrade

- Previous CentOS 7 distribution reached EOL for maintenance updates in June 2024
- Decision by Red Hat to reorganize CentOS project and releases disrupted the logical upgrade path from CentOS 7->8
- Decision was taken to upgrade from CentOS 7 to Alma Linux 9, considering:
  - Ease of transition
  - Support lifetime
  - Functionality
  - Direction being taken at other universities and labs (CERN, Fermilab, etc)
- Discussion included Users Group and broader community
- System has been fully upgraded, with user facing services (ssh, Jupyter, batch queues) switched to Alma 9 by default in April
- Dedicated documentation to ease user transition
  - https://submit.mit.edu/submit-users-guide/future/alma.html
- Well-supported and documented use of containers to keep older software environments available where needed

Mass Storage Upgrade

- Previous mass storage system (/data/submit) was 500TB of spinning disks in a Gluster distributed filesystem
- **Users experienced throughput bottlenecks for high performance analysis**
  - unable to effectively leverage the throughput of a large number of disks in parallel
- **Some other performance and operational issues related to user access patterns (system responsiveness/reliability problems for users)**
  - Large number of small files, large number of files in a single directory
- A number of limitations in maintenance and flexibility, plus suboptimal failure modes (files appear to have vanished when they are only temporarily offline)
- These issues also drive extra demand for scarce/expensive NvME storage (/scratch area)
- **Mass storage has been migrated to higher performance and more robust CephFS**
  - Migration completed in September
  - Additional disks added and more efficient erasure coding -> 800TB of usable space

Mass Storage Upgrade

- Mass storage fully migrated to CephFS
  - More space
  - More robust
  - More responsive
  - Better monitoring for project team