Overview of CHPC

Anita Orendt
Assistant Director
Research Consulting & Faculty Engagement
anita.orendt@utah.edu
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CHPC Mission

In addition to deploying and operating high performance computational resources and providing advanced user support and training, CHPC serves as an expert team to broadly support the increasingly diverse research computing needs on campus. These needs include support for big data, big data movement, data analytics, security, virtual machines, Windows science application servers, protected environments for data mining and analysis of protected health information, and advanced networking.
Downtown Data Center

- Came online spring 2012
- Shared with enterprise (academic/hospital) groups (wall between rooms)
- 92 racks and 1.2MW of power with upgrade path to add capacity for research computing
- Metro optical ring connecting campus, data center, & internet2
- 24/7/365 facility
Overview

• What’s new
• HPC Clusters
• Storage
• Protected Environment
• Software
• Other Services
• Accounts & Allocation
• Getting Started
• Getting Help
New at CHPC

• Redesigned website – www.chpc.utah.edu
• Tangent cluster
• Use of modules for maintaining user environment
• New batch scheduler – SLURM
• Moving to single executable that is optimized for multiple CPU architectures and running over multiple networks.
CHPC Clusters - Condominium Model

• General resources – No charge for usage
  – Allocation process for cycles on kingspeak and ember
  – Out of allocation – freecycle allowed (with preemption)

• Owner nodes
  – 24 core Intel Haswell (2.5GHz cpu speed), 128GB RAM, 1TB local hard drive, 5 year warranty, IB connectivity @ ~$6800/node
  – Others allowed on as owner-guest when not in use (preemption)

• Lonepeak – no allocation and no preemption on general nodes

• Tangent - dynamically provisioned cluster resource

• Owner cluster – ash
CHPC Provides Core Infrastructure

- Physical needs (racks, power, cooling)
- Core ethernet and IB fabric
- IB to ethernet bridging
- Login/head/management nodes
- Scheduling, batch and allocation systems
- HPC scratch space
- Some application and licensing costs
- High speed data transfer nodes
- Emerging “science DMZ” network
Ember
141 nodes/1728 cores
Infiniband and GigE
General 70 nodes/852 cores
11 general GPU nodes

Ash (417 nodes/6312 cores)

Tangent (new, dynamically provisioned resource)

Apexarch

Lonepeak
141 nodes/1376 cores
Large memory, GigE (owner IB)
General 16 nodes/256 cores

Kingspeak
245 nodes/4444 cores
Infiniband and GigE
General 48 nodes/832 cores

Administrative Nodes

NFS
Home Directories & Group Directories

NFS
/scratch/lonepeak/serial

NFS
/scratch/ibrix/chpc_gen

NFS
/scratch/kingspeak/serial

NFS
homerfs
Sources of Useful Information

• Getting Started Guide
  – https://www.chpc.utah.edu/documentation/gettingstarted.php

• CHPC policies

• Cluster Usage Guides

• Application Documentation

• Programming Guide
  – https://www.chpc.utah.edu/documentation/ProgrammingGuide.php
Storage

- CHPC home directory space NFS mounted on all HPC platforms
  - `/uuufs/chpc.utah.edu/common/home/<uNID>`
  - Home directories not backed up (some exceptions)
- Groups can purchase home and/or group space
  - 1TB max home directory/group @$500/TB – 5 year warranty; tape backup (nightly incremental/weekly full)
  - Group space @$210/TB; can get quarterly archives with purchase of tapes
Scratch File Systems

- Ember, Kingspeak, Tangent and Ash
  /scratch/ibrix/chpc_gen (56 TB)
  /scratch/kingspeak/serial (175 TB)
- Lonepeak
  /scratch/lonepeak/serial (33 TB)
- NFS mounted on all interactive nodes
- Scrubbed of files older than 60 days
- All nodes also have a local scratch space which varies in size
File Systems

- Access speed based on connectivity
- Local disk fastest – local to each node; varies in size
  - /scratch/local
- NFS
  - /scratch/kingspeak/serial
  - /scratch/ibrix/chpc_gen
  - home directories and group spaces (*don’t use for large i/o*)

*Remember NFS mounted spaces – including file systems of group spaces -- are a shared resource!*

To check the **current** status of the file systems (and clusters) --

https://www.chpc.utah.edu/chpc/systems/graphs.php
Protected Environment

- Dedicated protected resources for handling of data/projects with protected information or other form of access restrictions
- Currently HIPAA, looking at FISMA & FERPA
- Have both general, owner and VM resources
- HPC – apexarch with associated homerfs file system
- Significant area of growth for CHPC
- Described in recent paper (Bradford et al.)
  [link](http://www.ncbi.nlm.nih.gov/pubmed/23911553)
Software

• CHPC supports a wide array of software – some have documentation pages – see

• Coming soon – searchable database of all software

• For ALL clusters
  /uufs/chpc.utah.edu/sys/pkg/packagename OR
  /uuufs/chpc.utah.edu/sys/installdir/packagename

• Specific build for EACH cluster (usually due to Infiniband/MPI needs): /uuufs/cluster/sys/pkg/packagename

• Moving toward single unified build that will run on multiple CPU architectures and network fabrics
Other Services

• Windows Statistics Servers
  – Two servers each with 48 core and 512 GB RAM, one for general (kachina) and the other for use in protected environment (swasey)
  – SAS 9.3 with text miner, SPSS, R, STATA, Mathematica, Matlab

• Virtual Machine (VM) Farms
  – For applications that do not fit in our normal HPC environment
  – Allows for maximum use of infrastructure and minimizes physical servers to be managed
  – Two farms – one for general needs and the second for needs in the protected environment
  – Setting up MOU/SLA with VM owners prior to provisioning of VM
Accounts

• Account Policies
  – https://www.chpc.utah.edu/documentation/policies/1.2AccountPolicies.php

• CHPC uses campus uNID and password

• Account Application Procedure – Online process
  – Complete CHPC account form
    http://www.chpc.utah.edu/apps/profile/account_request.php
  – PIs must have account and also approve accounts for any members of their research group (can delegate)
  – For collaborators outside of University of Utah must first complete online affiliate form with HR to get uNID
    https://www.hr.utah.edu/forms/affiliate.php
Security Policies

- No clear text passwords, use ssh and scp
- You may not share your account under any circumstances
- Don’t leave your terminal unattended while logged into your account
- Do not introduce classified or sensitive work onto CHPC systems unless on Protected Environment
- Do not try to break passwords, tamper with files etc.
- Do not distribute or copy privileged data or software
- Report suspicions to CHPC (security@chpc.utah.edu)
- For more details, see https://www.chpc.utah.edu/documentation/policies/1.6SecurityPolicy.php
Allocation

• General Allocation Process Information
  – https://www.chpc.utah.edu/documentation/policies/1.4AllocationPolicies.php

• Regular allocation form
  – https://www.chpc.utah.edu/apps/profile/allocation_form.php
  – Requests due Sept 1, Dec 1, Mar 1, and Jun 1
  – Allocation in SU
    • 1 core-hour = 1SU on both kingspeak and ember

• Quick allocation
  – https://www.chpc.utah.edu/apps/profile/allocation_quick_form.php

• Check usage -- http://www.chpc.utah.edu/docs/allocations/
Accessing Clusters

• Login or interactive nodes with each cluster
  – ssh –Y kingspeak.chpc.utah.edu
  – ssh –Y ember.chpc.utah.edu
  – ssh –Y lonepeak.chpc.utah.edu
  – ssh –Y tangent.chpc.utah.edu
  – ssh –Y ash-guest.chpc.utah.edu

• Interactive nodes only used for short compiles, editing and very short test runs

• *No more than 15 minutes and no jobs of any length that make heavy use of cpu or memory!*
SSH clients for windows

- PuTTY
  - [http://www.chiark.greenend.org.uk/~sgtatham/putty/](http://www.chiark.greenend.org.uk/~sgtatham/putty/)
- Xshell
- Xming – used in conjunction with one of the above for displaying X windows back to desktop
  - Use Mesa version
FastX – Tool for Remote X

- [https://www.starnet.com/fastx](https://www.starnet.com/fastx) and [https://www.chpc.utah.edu/documentation/software/fastx2.php](https://www.chpc.utah.edu/documentation/software/fastx2.php)
- Used to interact with remote Linux systems graphically in much more efficient and effective way than simple X forwarding.
- Graphical sessions can be detached from without being closing, allowing users to reattach to the session from the same or different systems.
- Server on all interactive nodes as well as several dedicated FastX servers (frisco nodes).
- Clients for Windows, Mac, and Linux; can be installed on both university and personal desktops.
Login scripts

- CHPC provides login scripts ("dot" files) when creating account for both tcsh and bash shells
- These files set the environment so that applications are found, batch commands work – *Do not remove!*
- Choose shell at account creation – can change at [www.chpc.utah.edu](http://www.chpc.utah.edu) (sign in, select edit profile)
- Four files: .bashrc, .tcshrc, .custom.sh, .custom.csh
  - The first two should not be edited!
  - The second two is where to add custom module loads!
- Will automatically execute a .aliases file if it exists
- Watch for a session on using modules and slurm next week

9/1/2015 http://www.chpc.utah.edu Slide 22
Batch System -- SLURM

- Used to access compute nodes
  - [https://www.chpc.utah.edu/documentation/software/slurm.php](https://www.chpc.utah.edu/documentation/software/slurm.php)

- This site has example scripts, basic commands, information on SLURM environmental variables, table with correspondence between SLURM and PBS commands and variables
Some Basic Batch commands

• sbatch <script> -- submit job
• squeue -- lists all jobs in queue
• scancel jobid -- deletes job
• sinfo -- lists all nodes in cluster
• srun – to submit a job for execution or initiate job steps in real time (interactive job or step in a batch job)
• sview – GUI of resource and state of nodes
Batch Policies

- [Link to Policies](https://www.chpc.utah.edu/documentation/policies/2.1GeneralHPCClusterPolicies.php#Pol2.1.2)

- Walltime limit generally – 72 hours; owners can set their own

- Partition
  - `cluster` --- with allocation on general
  - `cluster-freecycle` --- without allocation on general
  - `cluster-guest` --- to run as guest on owner nodes
  - `piname-{kp,em,lp}` --- to run on nodes owned by your group

- Account
  - `piname` for general allocation
  - `piname-{kp,em,lp}` for owner nodes on kingspeak, ember, or lonepeak
  - `owner-guest` for guest jobs on owner nodes; `smithp-guest` for guest jobs on ash
Sample Batch Script

#!/bin/csh
#SBATCH --time=1:00:00 # walltime, abbreviated by -t
#SBATCH --nodes=2 # number of cluster nodes, abbreviated by –N
#SBATCH -o slurm-%j.out-%N # name of the stdout, using the job number (%j) and the first node (%N)
#SBATCH --ntasks=16 # number of MPI tasks, abbreviated by -n # additional information for allocated clusters
#SBATCH --account=baggins # account - abbreviated by -A
#SBATCH --partition=lonepeak # partition, abbreviated by -p

#set data and working directories

# load appropriate modules, in this case Intel compilers, MPICH2

# run the program

#move any data if needed
Coming Soon

- More applications built as single executable
- Application Database
- New scratch file system
- Short (5-10 minutes) “How to” training videos on a number of topics
- Change from RHEL to Centos (should be transparent to users)
Getting Help

• CHPC website and wiki
  – www.chpc.utah.edu
    • Getting started guide, cluster usage guides, software manual pages, CHPC policies

• Jira Ticketing System
  – Email: issues@chpc.utah.edu

• Help Desk: 405 INSCC, 581-6440 (9-5 M-F)

• We use chpc-hpc-users@lists.utah.edu for sending messages to users; also have Twitter accounts for announcements -- @CHPCOutages & @CHPCUpdates
CHPC Fall Presentation Series

Notes all in INSCC Auditorium at 1-2pm unless otherwise noted

*1-3pm; **In INSCC 345 ***details on time and location TBA

Sept 1 – Overview of CHPC – Anita Orendt
Sept 3 – Hands-on Introduction to Linux, part 1* – Anita Orendt and Albert Lund
Sept 8 – Hands-on Introduction to Linux, part 2* – Albert Lund and Anita Orendt
Sept 10 – Hands-on Introduction to Modules and Slurm Batch Scripts* – Albert Lund and Anita Orendt
Sept 15 – Hands-on Introduction to Python, Part 1* – Wim Cardoen and Walter Scott
Sept 17 – Hands-on Introduction to Python, Part 2* – Wim Cardoen and Walter Scott
Sept 22 – Hands-on Introduction to Numpy/Scipy* – Wim Cardoen and Walter Scott
Sept 24 – Introduction to Parallel Computing – Martin Cuma
Sept 29/30 – NVDIA Training @ SCI***
Oct 1 – Introduction to Programming with OpenMP** – Martin Cuma
Oct 6 – XSEDE Monthly Workshop: OpenMP***
Thurs Oct 8 – Introduction to Programming with MPI – Martin Cuma
FALL BREAK OCT 11-18
Oct 20 – Hybrid MPI-OpenMP Programming – Martin Cuma
Oct 22 – Introduction to I/O – Martin Cuma
Nov 3 – XSEDE Monthly Workshop: Big Data***
Nov 5 – Protected Environment at CHPC – Anita Orendt and Wayne Bradford
Nov 10 – Chemistry Packages at CHPC/Gaussian – Anita Orendt
Nov 12 – XSEDE Resource Support at CHPC – Anita Orendt
Nov 17 – Introduction to Debugging – Martin Cuma
Nov 19 – Introduction to Profiling – Martin Cuma
Nov 24 - Introduction to GPU Programming – Wim Cardoen
Dec 1 – Visualization* – Aaron Knoll
Dec 3 – XSEDE Monthly Workshop: OpenACC***

https://www.chpc.utah.edu/presentations/Fall2015CHPCPresentationSchedule.php
If you would like training for yourself or your group, CHPC staff would be happy to accommodate your request. Please contact anita.orendt@utah.edu