



Introduction to the MSU HPCC

High Performance Computing Center

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Thanks to Dr. Mahmoud Parvizi for the slides

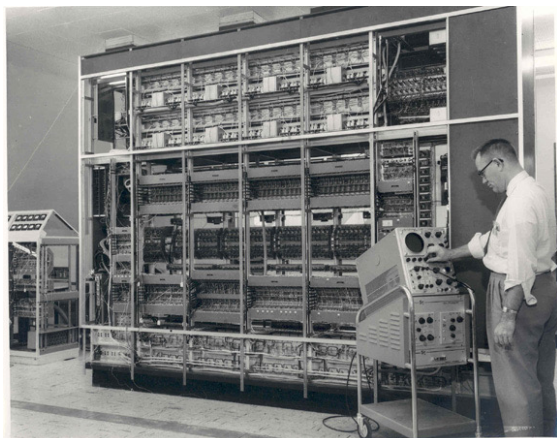


Agenda

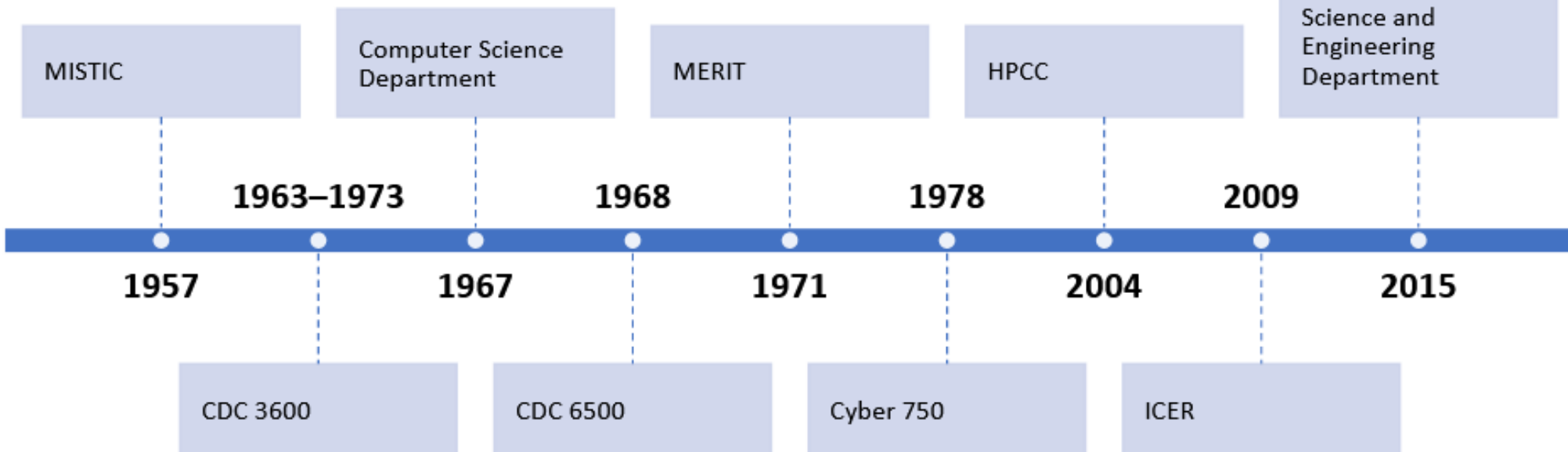
- *Overview of the HPCC*
- Logging on to the HPCC
- Simple example
 - Navigating Files
 - Module System
 - Submitting a job
- Where to get help



Computing at MSU



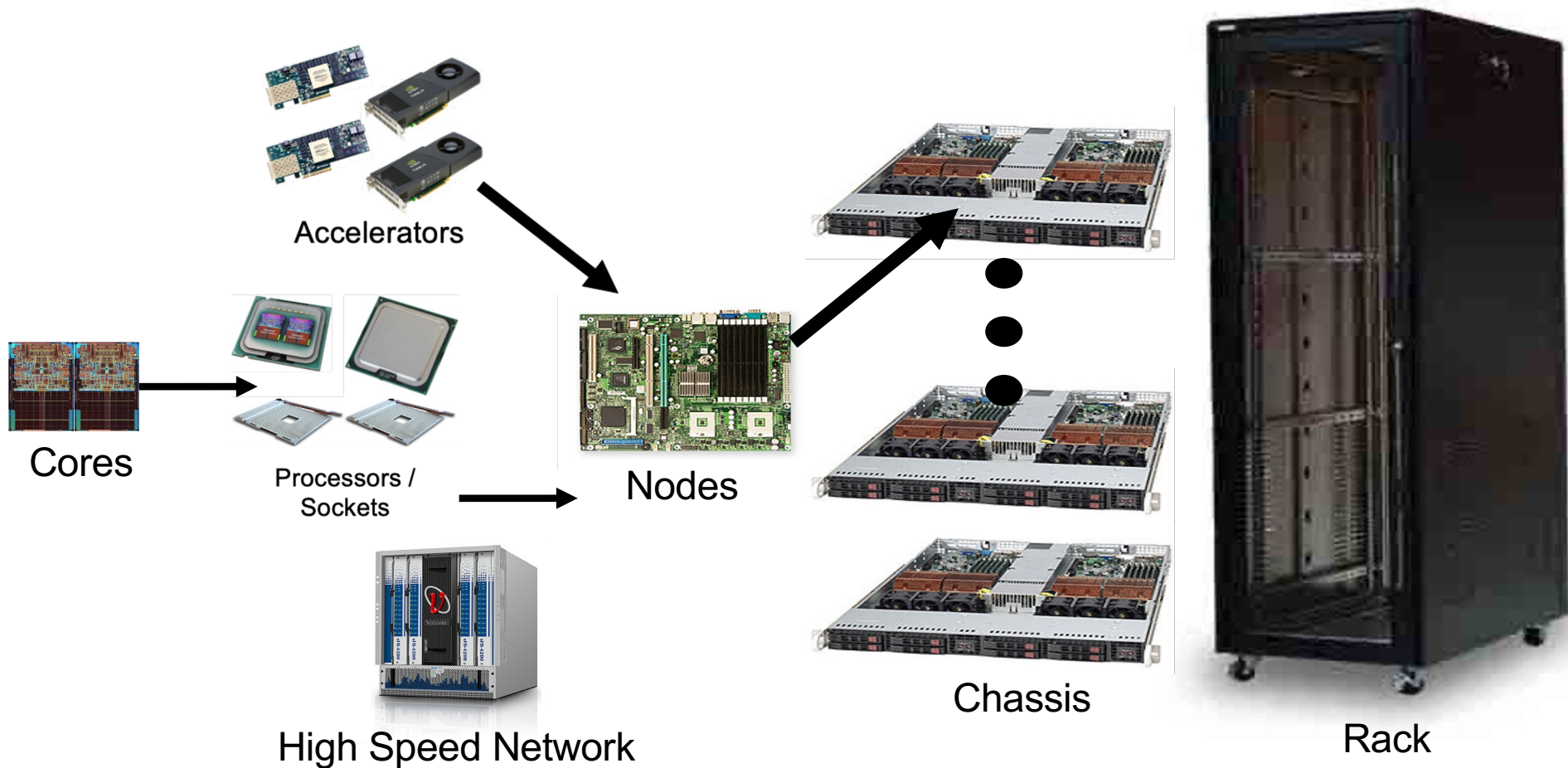
Computational
Mathematics
Science and
Engineering
Department



INSTITUTE FOR CYBER-ENABLED RESEARCH

Creating a Cluster

aka Supercomputer

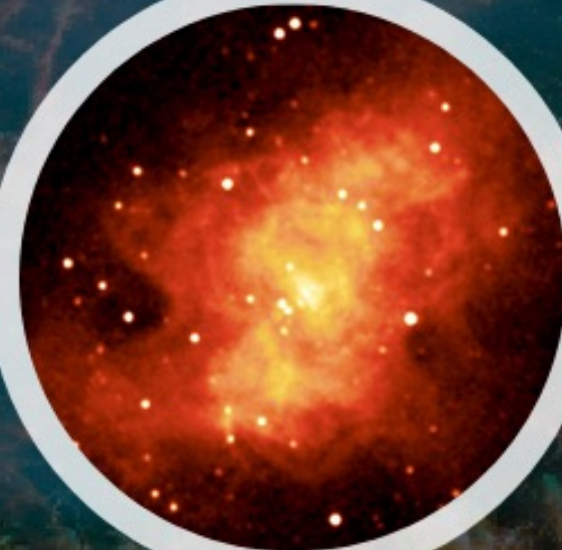
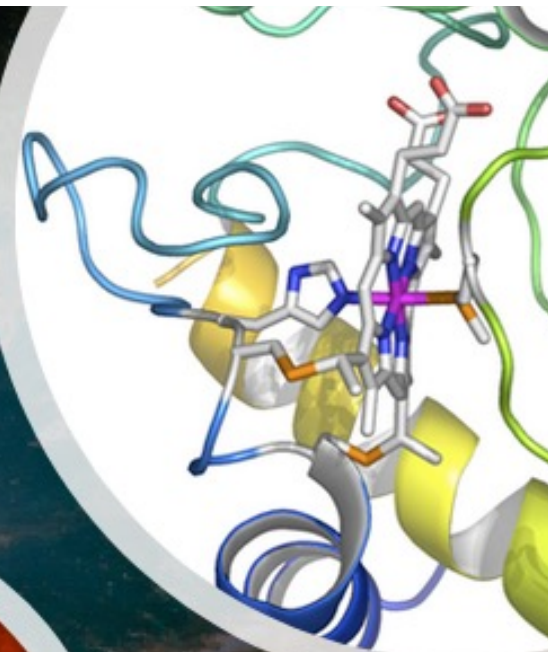
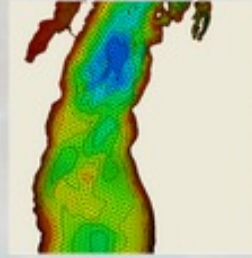


Data Center



What Problems are we Solving?

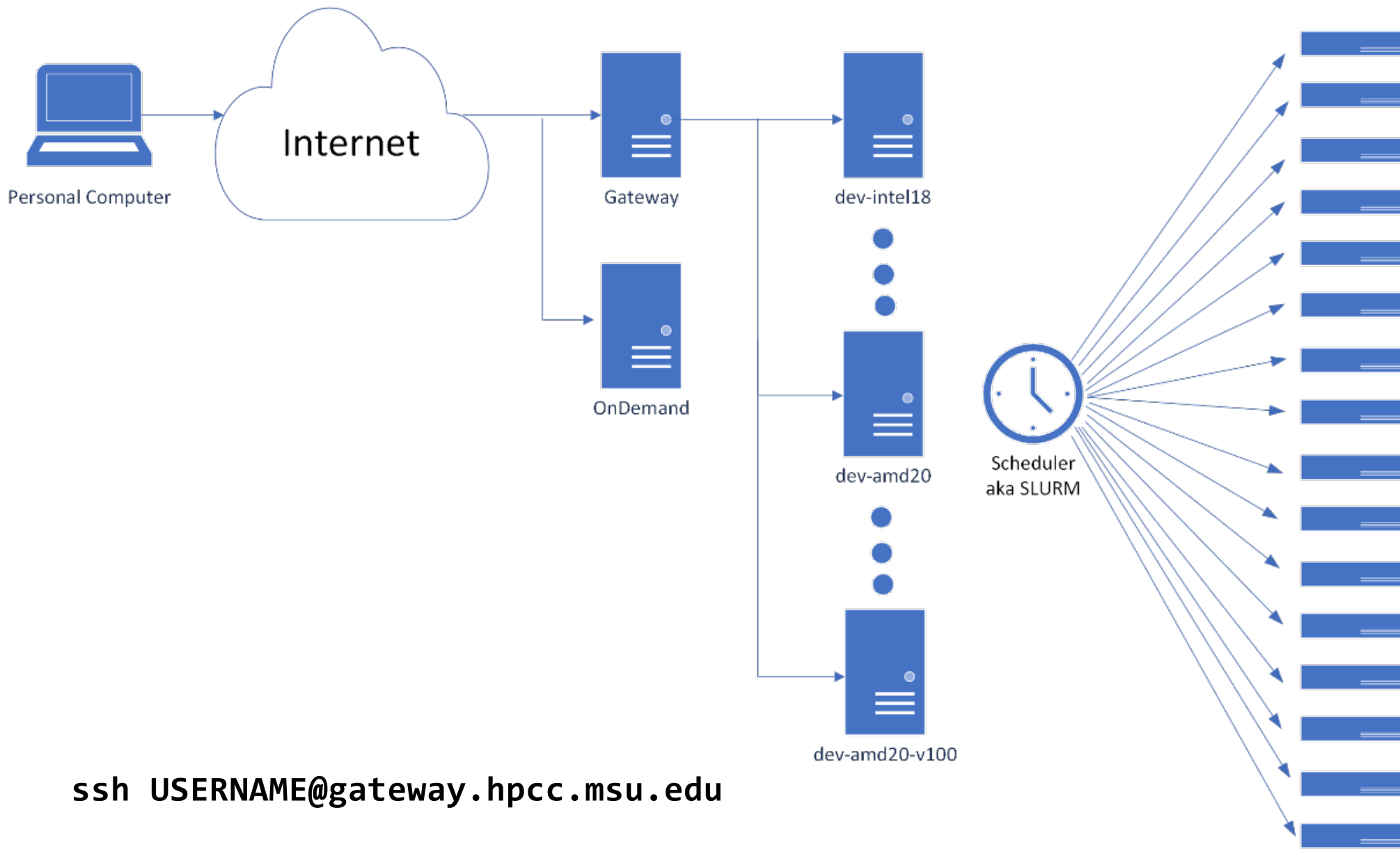
- Boundary Simulations
- Data Analysis
- Search (aka Optimization)



Agenda

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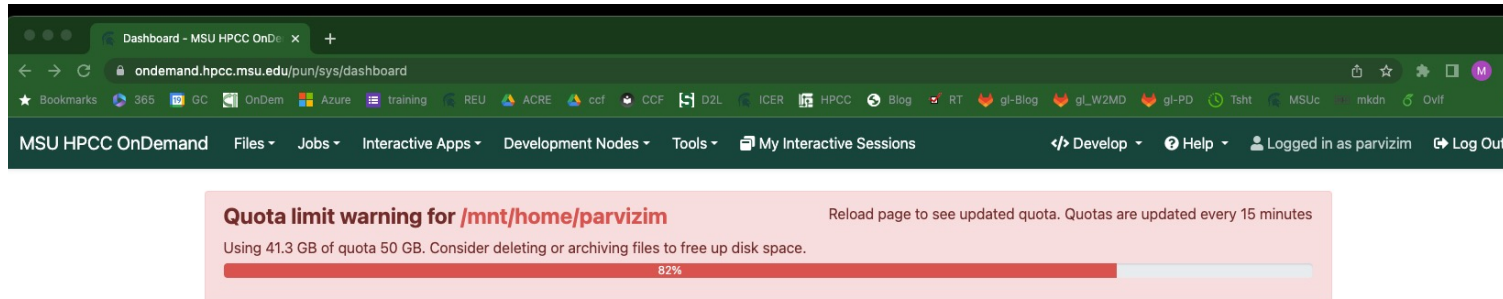
`ssh USERNAME@gateway.hpcc.msu.edu`



HPCC OnDemand

HPCC OnDemand

ondemand.hpcc.msu.edu



The screenshot shows a web browser window with the URL `ondemand.hpcc.msu.edu/pun/sys/dashboard`. The dashboard header includes navigation links for Files, Jobs, Interactive Apps, Development Nodes, Tools, and My Interactive Sessions. A red warning banner is displayed, stating: "Quota limit warning for /mnt/home/parvizim. Reload page to see updated quota. Quotas are updated every 15 minutes. Using 41.3 GB of quota 50 GB. Consider deleting or archiving files to free up disk space." A progress bar below the warning indicates that 82% of the quota is used.

MICHIGAN STATE
UNIVERSITY

Institute for Cyber-Enabled Research

OnDemand is an integrated access point for the MSU High Performance Computing Center's resources.

Please [Contact Us](#) if you have any questions, feedback, or suggestions.

Message of the Day

ICER's OnDemand Resources

In 30 minutes or less, this non-credit, self-paced training course introduces OnDemand Resources available to utilize the High Performance Computing Center (HPCC) provided by the Institute for Cyber-Enabled Research (ICER) at Michigan State University. No prior knowledge is required for this course.



INSTITUTE FOR CYBER-ENABLED RESEARCH

Agenda

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Getting a simple example

1. Open a “terminal” on the HPCC
2. Load the powertools module

```
module load powertools
```

3. See all of the examples

```
getexample
```

4. Run the “get example” command

```
getexample helloHPCC
```

5. Change to the “helloworld” directory

```
cd helloHPCC
```

6. Run the example

```
cat README
```



Compiling and Running the Example

1. Compile the code (follow the README)

```
cc -o example -O example_calc_e.c
```

2. Test the example on the dev node

```
./example
```

3. Review the submission script

```
cat example.sb
```

4. Run the the example on the “cluster”

```
sbatch example.sb
```

5. Review the output

```
cat slurm*
```



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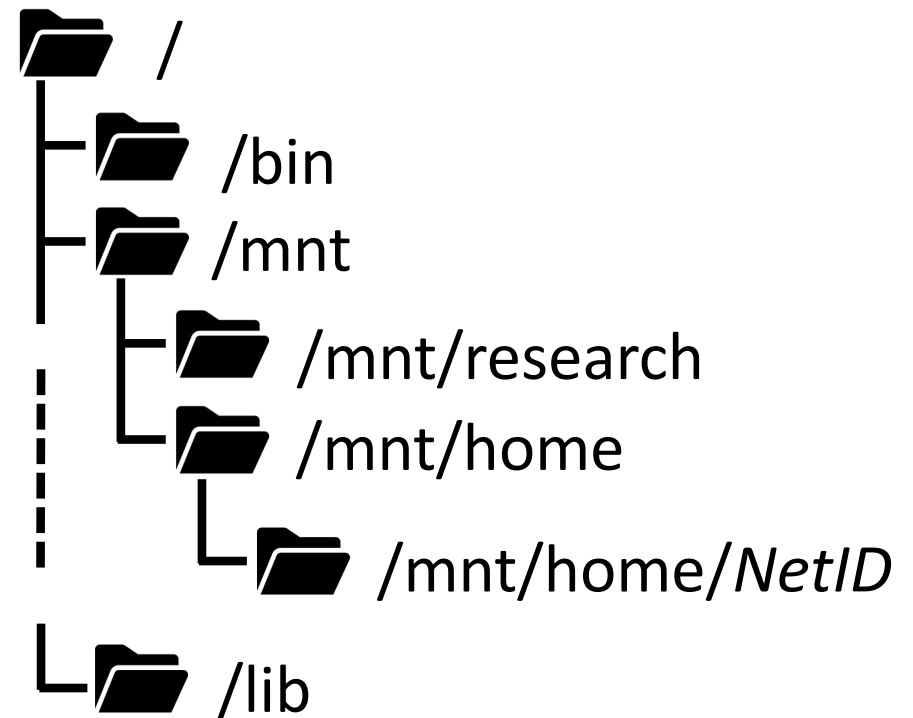


Linux

Linux on the HPC

A **clustered filesystem** is a hierarchical collection of files accessible to all compute nodes of a cluster

- **File:** A formatted collection of bytes referenced by the OS
- **Directory:** Any file containing another file
- **Filesystem:** Method use by OS to store and retrieve files

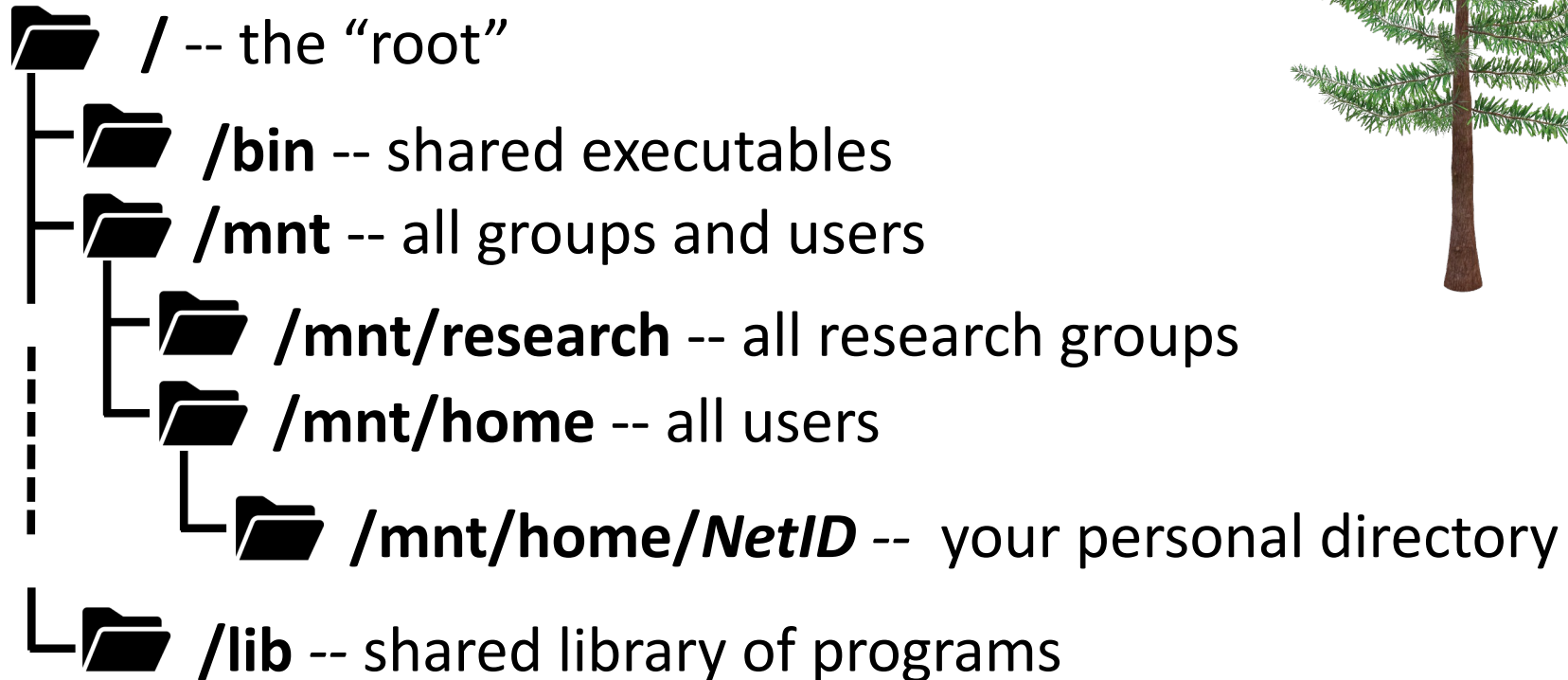


Linux

Linux on the HPCC

Directories have a **tree-like** structure

- **Examples:**

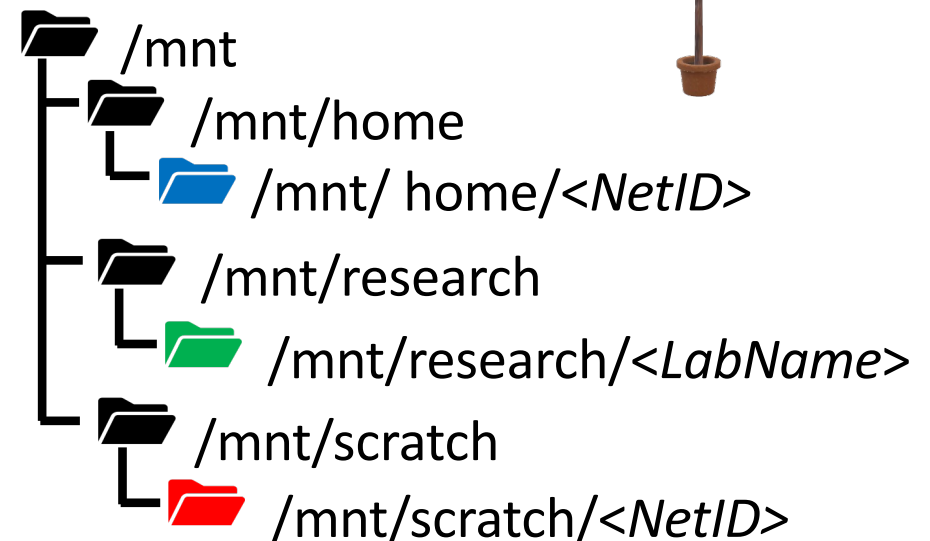


Linux

Linux on the HPCC

User Spaces are directories users can write files to using any nodes in a cluster

- **Home:** Personal files and default login directory (50Gb storage)
- **Research:** Group research files (50Gb - 1Tb storage)
- **Scratch:** Temporary working files (~800 Tb total storage)



Linux

Linux on the HPCC

Exercise: use the **quota** command to display the details of your user spaces



Type in Your Terminal:

[user@computer] \$ quota

```
parvizim@dev-intel18:~$ ssh parvizim@hpc.msui.edu - 123x49
Development nodes are a shared system; for information about performance
considerations please see: https://wiki.hpc.msui.edu/x/W4JnAg
-----
[parvizim@dev-intel18 ~]$ quota
Home Directory:
Files      Space      Space      Space      Space      Files      Files      Files
% Used    Quota     Used       Available  % Used    Quota     Used       Available
-----
/mnt/home/parvizim
8%        50G       7G        43G       14%      1048576   87299     961277

Research Groups:
Files      Space      Space      Space      Space      Files      Files      Files
% Used    Quota     Used       Available  % Used    Quota     Used       Available
-----
TOPMED    4096G     3733G     363G      91%      4194304   1558      4192746
0%
UKBB      9216G     8242G     974G      89%      9437184   6897      9430287
0%
helpdesk  12288G    9888G     2400G     80%      52428800  44415439  8013361
85%

Temporary Filesystems:
-----
/mnt/scratch (/mnt/gsl8)
Files % Used    Space Quota  Space Used  Space Free  Space % Used  Files Quota  Files Used  Files Free
0%          51200G  1G        51199G    0%          1048576    2          1048574

/mnt/lsl15 (legacy scratch)
Inodes Used  Quota  Free
1           1000000  999999

[parvizim@dev-intel18 ~]$
```

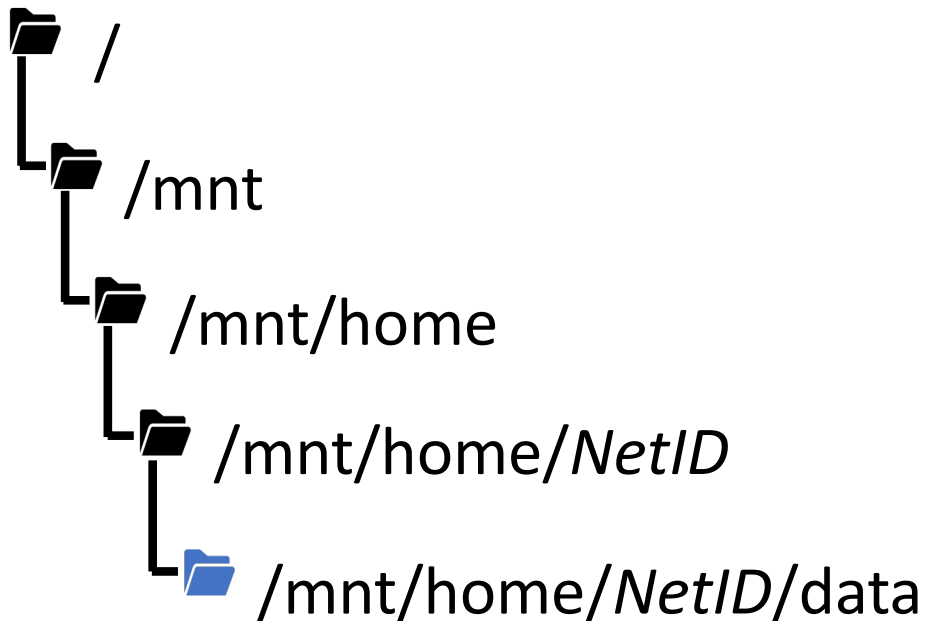


Linux

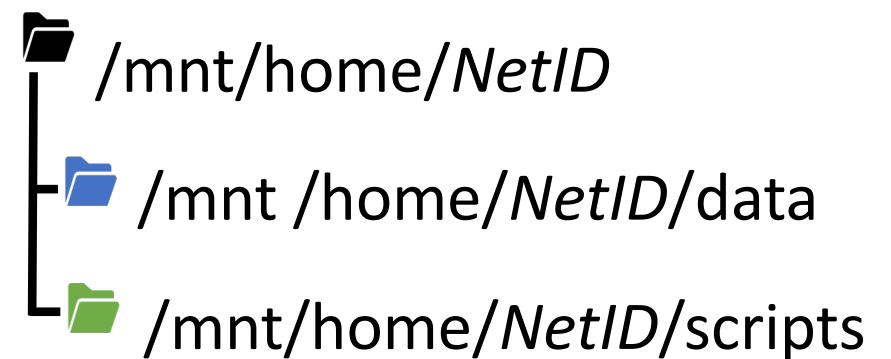
Linux on the HPC

A **path to a file** is a list of the files containing the file of interest

Absolute `/mnt/home/NetID/data`



Relative `../scripts`



Path Shortcuts

Shortcut	Description	Example
.	Current folder (single dot)	./command
..	Parent folder (two dots)	cat ../.bashrc
~	Home Directory (tilde)	cd ~/Documents/
-	Previous Directory (dash)	cd -

Note: If you want a file to be “hidden” have its name start with a dot
ex: .bashrc

If you want to see hidden files use the command “ls -a” (List all)



Linux

Linux on the HPC

Exercise: Find path with **pwd**, or print working directory, command



```
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$ pwd  
/mnt/home/parvizim  
[parvizim@dev-intel18 ~]$
```

Type in Your Terminal:

[user@computer] \$ pwd



Linux

Linux on the HPCC

Exercise: List files with `ls`, or list information, command



```
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$ ls |  
Documents  
[parvizim@dev-intel18 ~]$
```

Type in Your Terminal:

[user@computer] \$ ls



Linux

Linux on the HPCC

Exercise: Enter 'Documents' with **cd**, or change directory, command and list the contents



```
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$ cd Documents; ls  
MATLAB  RT  Workshops  
[parvizim@dev-intel18 Documents]$
```

Type in Your Terminal:

```
[user@computer] $ cd Documents; ls
```



Transferring files to/from HPCC

	Small Files < 10MB	Med Files < 2 GB	Lots of Big Files	Interface	Upload To HPCC	Download To PC
OnDemand	Yes	No	No	Web	Yes	Yes
wget / curl	Yes	Maybe	No	Command Line	Yes	No
git	Yes	Maybe	No	Command Line	Yes	Maybe*
scp/rsync*	Yes	Yes	Maybe	Command Line	Yes	Yes
MobaXTerm	Yes	Yes	Maybe	Windows App	Yes	Yes
Globus*	Yes	Yes	Yes	Web	Yes	Yes

* Requires Software Install on your PC

```
scp FILENAME USERNAME@rsync.hpcc.msu.edu:~
```

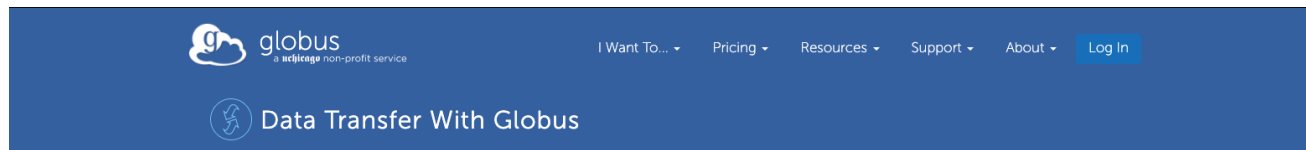


Linux

Linux on the HPCC

File transfer GUI **Globus** provided by MSU

<https://www.globus.org/data-transfer>



Globus provides a secure, unified interface to your research data. Use Globus to 'fire and forget' high-performance data transfers between systems within and across organizations.



Research often requires sophisticated data management capabilities across systems and institutions. Globus was built to provide these capabilities. Laptops, supercomputers, tape archives, cloud storage, HPC clusters, and scientific instruments are some of the systems that can be connected to Globus, as well as cloud storage like [Google Drive](#) and [Amazon S3](#).

Globus lets you use a web browser or command line interface to submit transfer and synchronization requests, optionally choosing encryption. Globus takes it from there. With this 'fire and forget' model you can concentrate on your research while Globus handles the mundane (but important) details of successful large-scale data transfers, even for [protected data](#) like HIPAA-regulated data.

Your data is transferred directly between the source and destination systems while Globus tunes performance parameters, maintains security, monitors progress, and validates

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What's New

Globus Connect Server v5.4 released: Check out the new features

State of the Craft in Research Data Management: Read our latest article in Science Node

Globus at Argonne: Researchers use Theta for real-time analysis of COVID-19 proteins

"The system is reliable and secure – and also amazingly easy to use. It just



INSTITUTE FOR CYBER-ENABLED RESEARCH

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Linux

Linux on the HPCC

The HPCC **module system** helps manage the software environment you need to run your computations

- **Environment:** User specified software applications and their dependencies
- **Dependency:** Any file needed by an executable software application
- **Module:** User loaded software that comprise an environment



Linux

Linux on the HPC

Examples of HPC modules include **compilers** and **libraries**

- **Compiler:** Software that translates code e.g., source to machine (GCC, intel, CUDA)
- **Library:** Collection of software resources used by the compiler and other executables; e.g., Math (BLAS, LaPACK)



Linux

Linux on the HPC

Exercise: List default HPC modules with the **module list** command



```
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$ module list  
  
Currently Loaded Modules:  
1) GCCcore/6.4.0      7) OpenBLAS/0.2.20      13) CMake/3.11.1      19) libffi/3.2.1  
2) binutils/2.28     8) FFTW/3.3.7          14) ncurses/6.0       20) Python/3.6.4  
3) GNU/6.4.0-2.28   9) ScaLAPACK/2.0.2-OpenBLAS-0.2.20  15) libreadline/7.0  21) Java/1.8.0_152  
4) OpenMPI/2.1.2    10) bzip2/1.0.6        16) Tcl/8.6.8         22) MATLAB/2018a  
5) tbb/2018_U3      11) zlib/1.2.11       17) SQLite/3.21.0  
6) imkl/2018.1.163  12) Boost/1.67.0      18) GMP/6.1.2
```

Type in Your Terminal:

[user@computer] \$ module list



Linux

Linux on the HPC

Exercise: Find all HPC modules with the **module avail** command



Type in Your Terminal:

[user@computer] \$ module avail

```
parvizi@dev-intel8:~$ ssh parvizi@hpc.msu.edu -- 12349
----- /opt/modules/NP1/GCC/6.4.0-2.28/OperMPI/2.1.2 -----
Pango/1.41.1
Abyss/2.1.1
Abyss/2.1.5
ANTS/2.3.2
ATK/2.24.1
ArmaLite/3.480.0
BBMap/37.81
BCFtools/1.9
BLAST+/2.7.1
BUSCO/3.1.0-Python-3.6.4
BWA/0.7.17
BamTools/2.5.1
BioPerl/1.7.2-Perl-5.26.1
Boost.Python/1.66.0-Python-3.6.4
Boost/1.66.0
Boost/1.67.0-Python-2.7.14
Boost/1.67.0
Bracken/2.2
CGAL/4.11.1-Python-2.7.14
CLASS/2.1.7
CONVERGE/2.4.21
CONVERGE/2.4.27
CP2K/7.1
DMTCP/2.5.2
LDPA/2018.05.001
EvoM/3.0.21
FFTW/3.3.7
FFmpeg/3.4.2
FLTK/1.3.4
FOP/4.1.2
FrIBio/1.0.1
GATK/4.0.5.1-Python-3.6.4
GATK/4.1.3.0-Python-3.6.4
GATK/4.1.4.1-Python-3.6.4
GDAL/2.2.3-Python-3.6.4
GDOS/3.6.2-Python-3.6.4
GLP/5.1.4.0
GMAP-GSNAP/2018-05-11
GObject-Introspection/1.54.1-Python-2.7.14
GROMACS/2019
GROMACS/2018B3
GStreamer/1.8.3
GTK+/2.24.32
Gdk-Pixbuf/2.36.11
GraphicMagick/1.3.28
Hadoop/2.7.1
ParMETIS/4.0.3
Perl/5.26.1
PyTAM/3.12-Python-2.7.14
PyTAM/3.12-Python-3.6.4
Python/2.7.14
Python/3.6.4
Qt5/5.10.1
QuantumESPRESSO/5.4.0-hybrid
QuantumESPRESSO/6.2
R/3.5.0-x86_64-suse20181131
R/3.5.1-x86_64-suse20181131
SAMtools/0.11.9
SAMtools/1.7
SAMtools/1.9
SCOTDR/6.0.6
SCONS/3.0.1-Python-3.6.4
SDL2/2.0.9
SLIM/2019dev
SLIM/2021dev
SMP/demon2/2241
SPAdes/3.11.1
SPAdes/3.13.0
STAR/2.6.0c
SWIG/3.0.12-Python-3.6.4
SnpSites/4.8
ScalAPACK/2.0.2-OpenBLAS-0.2.20
Stacks/2.0beta10a
Stacks/2.4
Subread/1.6.2
SuiteSparse/5.1.2-METIS-5.1.0
Tk/8.6.8
Tkinter/2.7.14-Python-2.7.14
Tkinter/3.6.4-Python-3.6.4
Trilinos/12.12.1-Python-3.6.4
VCFtools/0.1.15-Perl-5.26.0
VCFtools/0.1.15-Perl-5.26.1
VTK/7.1.1-Python-3.6.4
VTK/8.1.0-Python-3.6.4
Volgrid/3.13.0
VxWorks/2.10-net-lmer_101
Vim/8.2.0226-Python-3.6.4
ZeroMQ/4.2.5
zpack-ng/3.5.0
zpack-ng/3.6.3
awscli/1.16.109-Python-3.6.4
```



Linux

Linux on the HPC

Exercise: Load HPC modules with the **module load** command



```
[parvizim@dev-intel18 ~]$ module load R/4.0.2
Lmod has detected the following error: These module(s) or extension(s) exist but cannot be loaded as requested:
"R/4.0.2"
  Try: "module spider R/4.0.2" to see how to load the module(s).

[parvizim@dev-intel18 ~]$
```

Type in Your Terminal:

[user@computer] \$ module load R/4.0.2



Linux

Linux on the HPC

Exercise: Find specific modules with the **module spider** command



Type in Your Terminal:

[user@computer] \$ module spider R

```
[parvizim@dev-intel18 ~]$
[parvizim@dev-intel18 ~]$ module spider R
R:
-----
Description:
R is a free software environment for statistical computing and graphics.

Versions:
R/3.5.1
R/3.4.3-X11-20160819
R/3.4.3-X11-20171023
R/3.4.3df
R/3.4.3df
R/3.4.4-X11-20180131
R/3.5.0-X11-20180131
R/3.5.1-X11-20180131
R/3.5.1-X11-20180604-UR
R/3.5.1-X11-20180604
R/3.6.0-X11-20180604
R/3.6.2-X11-20180604
R/3.6.2
R/3.6.2
R/4.0.0-X11-20180604
R/4.0.0
R/4.0.2-bak
R/4.0.2-test
R/4.0.2-X11-20180604
R/4.0.2
R/4.0.3
R/4.1.0
R/4.1.2
R/4.2.2

Other possible modules matches:
ADMIXTURE AMDUProf APR APR-util Abaqus_parallel AdapterRemoval Advisor Amber AmrPlusPlus Armadillo ...

To find other possible module matches execute:

$ module -r spider '*R*'

For detailed information about a specific "R" package (including how to load the modules) use the module's full name.
```



Linux

Linux on the HPC

Exercise: Load HPC modules with the **module load** command



```
[parvizim@dev-intel18 ~]$ module load GCC/8.3.0 OpenMPI/3.1.4 R/4.0.2
Lmod is automatically replacing "GNU/6.4.0-2.28" with "GCC/8.3.0".

Lmod is automatically replacing "GNU/6.4.0-2.28" with "GCC/8.3.0".

-----
The following dependent module(s) are not currently loaded: OpenBLAS/0.2.20 (required by: ScaLAPACK/2.0.2-OpenBLAS-0.2.20, Boost/1.67.0, Python/3.6.4, ScaLAPACK/2.0.2-OpenBLAS-0.2.20, Boost/1.67.0, Python/3.6.4)
-----

Inactive Modules:
 1) Clake/3.11.1      2) imkl/2018.1.163    3) tbb/2018_U3

Due to MODULEPATH changes, the following have been reloaded:
 1) Boost/1.67.0     2) GMP/6.1.2         3) libffi/3.2.1      4) zlib/1.2.11

The following have been reloaded with a version change:
 1) FFTW/3.3.7 => FFTW/3.3.8           8) ScaLAPACK/2.0.2-OpenBLAS-0.2.20 => ScaLAPACK/2.0.2
 2) GCCcore/6.4.0 => GCCcore/8.3.0     9) Tcl/8.6.8 => Tcl/8.6.9
 3) Java/1.8.0_152 => Java/11.0.2      10) binutils/2.28 => binutils/2.32
 4) OpenBLAS/0.2.20 => OpenBLAS/0.3.7  11) bzip2/1.0.6 => bzip2/1.0.8
 5) OpenMPI/2.1.2 => OpenMPI/3.1.4    12) libreadline/7.0 => libreadline/8.0
 6) Python/3.6.4 => Python/3.7.4      13) ncurses/6.0 => ncurses/6.1
 7) SQLite/3.21.0 => SQLite/3.29.0

[parvizim@dev-intel18 ~]$
```

Type in Your Terminal:

[user@computer] \$ module load GCC/8.3.0 OpenMPI/3.1.4 R/4.0.2



Linux

Linux on the HPCC

Exercise: Unload HPCC modules with the **module unload** command



```
parvizim -- parvizim@dev-intel18:~ -- ssh -XY parvizim@hpcc.msu.edu -- 102x27
Currently Loaded Modules:
 1) GCCcore/6.4.0      9) ScaLAPACK/2.0.2-OpenBLAS-0.2.20  17) SQLite/3.21.0
 2) binutils/2.28     10) bzip2/1.0.6                    18) GMP/6.1.2
 3) GNU/6.4.0-2.28   11) zlib/1.2.11                   19) libffi/3.2.1
 4) OpenMPI/2.1.2    12) Boost/1.67.0                  20) Python/3.6.4
 5) tbb/2018_U3      13) CMake/3.11.1                  21) Java/1.8.0_152
 6) imkl/2018.1.163  14) ncurses/6.0                   22) MATLAB/2018a
 7) OpenBLAS/0.2.20  15) libreadline/7.0               23) powertools/1.2
 8) FFTW/3.3.7       16) Tcl/8.6.8

[parvizim@dev-intel18 ~]$ module unload powertools/1.2; module list

Currently Loaded Modules:
 1) GCCcore/6.4.0      9) ScaLAPACK/2.0.2-OpenBLAS-0.2.20  17) SQLite/3.21.0
 2) binutils/2.28     10) bzip2/1.0.6                    18) GMP/6.1.2
 3) GNU/6.4.0-2.28   11) zlib/1.2.11                   19) libffi/3.2.1
 4) OpenMPI/2.1.2    12) Boost/1.67.0                  20) Python/3.6.4
 5) tbb/2018_U3      13) CMake/3.11.1                  21) Java/1.8.0_152
 6) imkl/2018.1.163  14) ncurses/6.0                   22) MATLAB/2018a
 7) OpenBLAS/0.2.20  15) libreadline/7.0
 8) FFTW/3.3.7       16) Tcl/8.6.8

[parvizim@dev-intel18 ~]$ █
```

Type in Your Terminal:

[user@computer] \$ module unload powertools; module list



Linux

Linux on the HPCC

Exercise: Unload all HPCC modules with **module purge** command



```
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$ module list  
  
Currently Loaded Modules:  
 1) GCCcore/6.4.0      7) OpenBLAS/0.2.20      13) CMake/3.11.1      19) libffi/3.2.1  
 2) binutils/2.28     8) FFTW/3.3.7          14) ncurses/6.0       20) Python/3.6.4  
 3) GNU/6.4.0-2.28   9) ScaLAPACK/2.0.2-OpenBLAS-0.2.20 15) libreadline/7.0   21) Java/1.8.0_152  
 4) OpenMPI/2.1.2    10) bzip2/1.0.6        16) Tcl/8.6.8         22) MATLAB/2018a  
 5) tbb/2018_U3      11) zlib/1.2.11       17) SQLite/3.21.0  
 6) imkl/2018.1.163 12) Boost/1.67.0      18) GMP/6.1.2  
  
[parvizim@dev-intel18 ~]$ module purge; module list  
No modules loaded  
[parvizim@dev-intel18 ~]$
```

Type in Your Terminal:

[user@computer] \$ module purge; module list



Linux

Linux on the HPC

Exercise: Reload default HPC modules with the **logout** command



Type in Your Terminal:

[user@computer] \$ logout

```
[parvizim@dev-intel18 ~]$
[parvizim@dev-intel18 ~]$ module purge; module list
No modules loaded
[parvizim@dev-intel18 ~]$ logout
Connection to dev-intel18 closed.

Currently Loaded Modules:
 1) gateway/1.0

[parvizim@gateway-03 ~]$ ssh dev-intel18
Last login: Mon Jan 23 21:39:23 2023 from gateway-03.dmz

===
Please note that processes on development nodes are limited to two hours of
CPU time; for longer-running jobs, please submit to the queue.

Development nodes are a shared system; for information about performance
considerations please see: https://docs.icer.msu.edu/development\_nodes/
===

[parvizim@dev-intel18 ~]$ module list

Currently Loaded Modules:
 1) GCCcore/6.4.0      7) OpenBLAS/0.2.20      13) CMake/3.11.1      19) libffi/3.2.1
 2) binutils/2.28     8) FFTW/3.3.7          14) ncurses/6.0       20) Python/3.6.4
 3) GNU/6.4.0-2.28   9) ScaLAPACK/2.0.2-OpenBLAS-0.2.20 15) libreadline/7.0  21) Java/1.8.0_152
 4) OpenMPI/2.1.2    10) bzip2/1.0.6        16) Tcl/8.6.8         22) MATLAB/2018a
 5) tbb/2018_U3      11) zlib/1.2.11        17) SQLite/3.21.0    23) power tools/1.2
 6) imkl/2018.1.163 12) Boost/1.67.0       18) GMP/6.1.2
```



Linux

Linux on the HPCC

Exercise: See what the module is doing with the **module show** command



Type in Your Terminal:

[user@computer] \$ module show matlab

```
[parvizim@dev-intel18 ~]$  
[parvizim@dev-intel18 ~]$ module purge; module list  
No modules loaded  
[parvizim@dev-intel18 ~]$ logout  
Connection to dev-intel18 closed.  
  
Currently Loaded Modules:  
  1) gateway/1.0  
  
[parvizim@gateway-03 ~]$ ssh dev-intel18  
Last login: Mon Jan 23 21:39:23 2023 from gateway-03.dmz  
===  
Please note that processes on development nodes are limited to two hours of  
CPU time; for longer-running jobs, please submit to the queue.  
  
Development nodes are a shared system; for information about performance  
considerations please see: https://docs.icer.msu.edu/development\_nodes/  
===  
  
[parvizim@dev-intel18 ~]$ module list  
  
Currently Loaded Modules:  
  1) GCCcore/6.4.0      7) OpenBLAS/0.2.20      13) CMake/3.11.1      19) libffi/3.2.1  
  2) binutils/2.28     8) FFTW/3.3.7          14) ncurses/6.0       20) Python/3.6.4  
  3) GNU/6.4.0-2.28   9) ScaLAPACK/2.0.2-OpenBLAS-0.2.20 15) libreadline/7.0  21) Java/1.8.0_152  
  4) OpenMPI/2.1.2    10) bzip2/1.0.6        16) Tcl/8.6.8         22) MATLAB/2018a  
  5) tbb/2018_U3      11) zlib/1.2.11       17) SQLite/3.21.0    23) power tools/1.2  
  6) imkl/2018.1.163  12) Boost/1.67.0      18) GMP/6.1.2
```



Agenda

- Overview of the HPCC
- Logging on to the HPCC
- Simple example
 - Navigating Files
 - Module System
 - *Submitting a job*
- Where to get help



Two Components of a Submission Script

- Resource Requests
 - Commands to communicate to the Scheduler
 - Resources you will need (time, memory, etc.)
 - Other settings (mail, names, etc.)
- List of Commands
 - What you would typically type on a command line



```
#!/bin/bash
#SBATCH --nodes=1
#SBATCH --ntasks-per-node=1
#SBATCH --time=00:06:00
#SBATCH --mem=1gb

# output information about how this job is running
using bash commands

echo "This job is running on $HOSTNAME on `date`"

# run the "hello" program in this directory

time ./example
```



Linux

Linux on the HPCC

Exercise: Write a bash script 'my_job.sb' to schedule a SLURM job that runs your 'hello.c' script

```
#!/bin/bash                                #Tell the shell to interpret bash

##### SLURM Resource Requests #####

#SBATCH --time=0-00:10                      #How long the job will run (days-hours:minutes)
#SBATCH --nodes=1                          #How many compute nodes the job needs
#SBATCH --ntasks=1                         #How many concurrent tasks the job needs
#SBATCH --cpus-per-task=1                  #How many CPUs each task needs
#SBATCH --mem-per-cpu=1G                   #How much memory each CPU needs

##### SLURM Administrative Settings #####

#SBATCH --job-name HelloWorld              #Name the job for convenience
#SBATCH --output=%x-%j.SLURMout           #Name the output file (JobName-JobNumber.SLURMout)
#SBATCH --mail-type=ALL                   #Tell SLURM to email you when job starts, stops, error
#SBATCH --mail-user=                      #Provide SLURM your email address

##### bash Commands to Run #####

module purge                               #unload all modules
module load GNU/8.2.0-2.31.1              #load the GNU compiler
cd /mnt/home/                             #Navigate to the directory containing hello.c
gcc hello.c -o hello                       #Run the command to compile hello.c
./hello                                    #Run the compiled executable hello
```



Linux

Linux on the HPCC

Exercise: Submit 'my_job.sb' to SLURM with the **sbatch** command



```
[parvizim@dev-intel18 ~]$ sbatch my_job.sb  
Submitted batch job 3479290  
[parvizim@dev-intel18 ~]$
```

Type in Your Terminal:

```
[user@computer] $ sbatch my_job.sb
```



Other Useful Commands

- `sq` – Show the contents of your queue
- `qs` – Show the status of your queue
- `scancel #####` - Cancel a job with number #
- `js -j #####` - Show job stats



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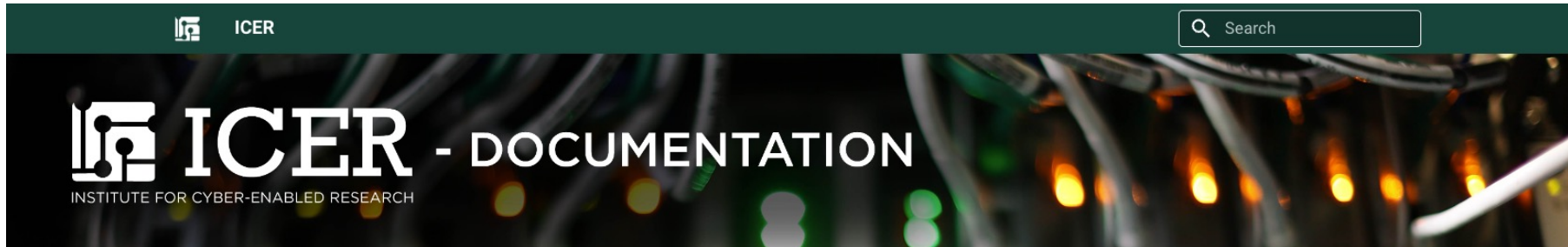


Linux

Linux on the HPCC

HPCC Documentation

docs.icer.msu.edu



MSU HPCC User Documentation

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Getting Access to the HPCC

For potential users with an MSU NetID, accounts must be requested by a MSU tenure-track faculty member. Researchers at partner institutions should use the mechanism specified by their institution's agreement with MSU. For more information, see: [Obtain an HPCC Account](#) and on the [ICER website](#).

CPU and GPU Time Limits

Non-buyin users are limited to 500,000 CPU hours (30,000,000 minutes) and 10,000 GPU hours (600,000 minutes) every year (from January 1st to December 31st). More information is available at [Job Policies](#).

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Office Hours

- Mondays and Thursdays 1-2pm
- Microsoft Teams
 - https://docs.icer.msu.edu/virtual_help_desk/



Another Example

Use the rest of the time (if any) to explore other curated examples. Ask Questions...

1. See all of the examples

```
getexample
```

2. Copy an example

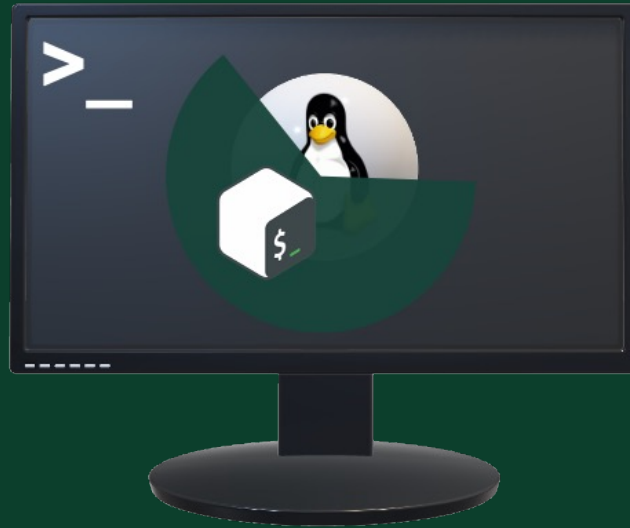
```
getexample helloMPI
```

3. Review the example

```
cd helloMPI
```

```
cat README
```





Contact ICER

icer.msu.edu/contact



INSTITUTE FOR CYBER-ENABLED RESEARCH

Thanks

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