

Introduction to Modules at CHPC

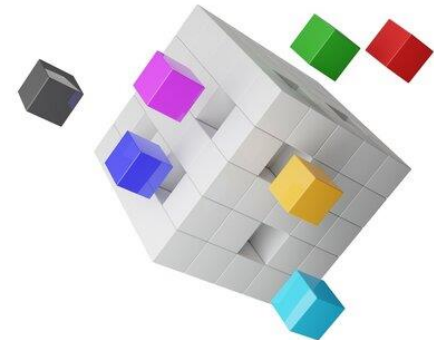
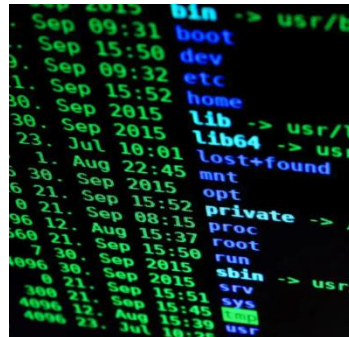
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Overview of Talk

- Why Modules
- Where to find more information
- How to setup to use modules
- Module basics
- Demonstration

What modules do

- Modules are a way of managing the user's shell environment in an interactive session or a batch job



Why Modules

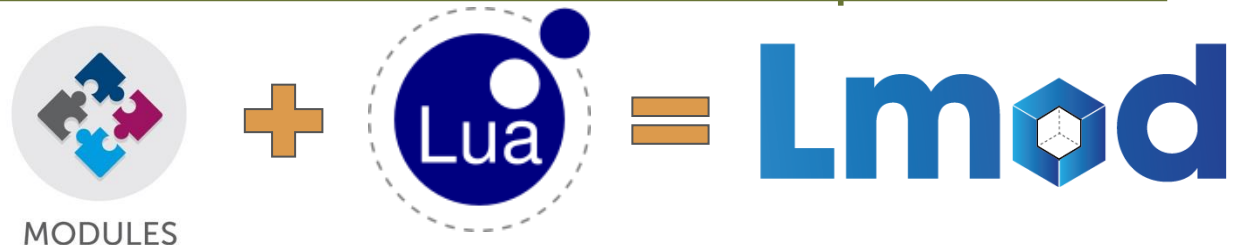
- Modules lets users dynamically change the Shell Environment – including easily adding and removing directories needed for a given task from system **Environment Variables**, eg **\$PATH**, without needing to log out and back in
- Easy to switch between version of a package or application – again without having to start a new session
- Useful when packages have conflicts in their environment settings

Module Documentation at CHPC

- <https://www.chpc.utah.edu/documentation/software/modules.php>
- <https://www.chpc.utah.edu/documentation/software/modules-advanced.php>
- Video -- <https://youtu.be/Cu6C5INLDAY>

We make use of TACC's LMOD

- <https://www.tacc.utexas.edu/research-development/tacc-projects/lmod>
- LUA based



All accounts automatically use modules –

- This is done via the login scripts (dot files) CHPC provides in home directories, even if you have older versions
- **DO NOT** make changes in the **.tcshrc** and **.bashrc**
- Use the **.custom.csh/.custom.sh** to customize environment variables and/or pre-load modules for programs regularly used in ssh sessions
- Use **.aliases** file to create aliases (but not environment variables); if this file exists it will be sourced during login
 - `alias c='clear'`
- You may reset login scripts (dot files) if necessary
 - CHPC official version: `/uufs/chpc.utah.edu/sys/modulefiles/templates`

Basic Module commands

- **module** - shows the list of module commands
- **module load <name>** - loads module name (shortcut: **ml <name>**)
- **module unload <name>** - unloads module name (**ml -<name>**)
- **module avail** - shows a list of "available" modules (**ml av**)
- **module list** - shows a list of loaded modules (**ml**)
- **module help** - prints help for the module command
- **module help <name>** - prints help for module
- **module show <name>** - prints the module file (lua)
- **module purge** - unload all modules
- **module reset system** – resets to system default
- **module swap <name1> <name2>** - swaps between two modules
- **module spider <string>** - shows all modules that have string in name

Explore CHPC Modules

- **module list (ml)** – see what are currently loaded

```
[class99@linuxclass:~]$ module list

Currently Loaded Modules:
  1) chpc/1.0 (S)

Where:
  S:  Module is Sticky, requires --force to unload or purge
```

- **Naming Convention** <ModuleName>/<ModuleVersion>
- **module load <name>/<version>** -- load a module
 - **module load <module1> <module2> ...<moduleN>**

```
[class99@linuxclass:~]$ module load matlab/R2022a
[class99@linuxclass:~]$ module list

Currently Loaded Modules:
  1) chpc/1.0 (S)   2) matlab/R2022a

Where:
  S:  Module is Sticky, requires --force to unload or purge

[class99@linuxclass:~]$ which matlab
/uufs/chpc.utah.edu/sys/installdir/matlab/R2022a/bin/matlab
```


Explore CHPC Modules (cont.)

- **module purge** – unload all modules

```
[class99@linuxclass:~]$ module purge
```

```
[class99@linuxclass:~]$ module list
```

Currently Loaded Modules:

1) chpc/1.0 (S)

```
[class99@linuxclass:~]$ which matlab
```

```
/usr/bin/which: no matlab in (/uufs/chpc.utah.edu/sys/bin:/usr/sbin:/usr/sbin)
```

- **Load a default module** (not specify the version)

```
[class99@linuxclass:~]$ module load matlab
```

```
[class99@linuxclass:~]$ module list
```

Currently Loaded Modules:

1) chpc/1.0 (S) 2) matlab/R2023b

Where:

S: Module is Sticky, requires --force to unload or purge

```
[class99@linuxclass:~]$ which matlab
```

```
/uufs/chpc.utah.edu/sys/installdir/matlab/R2023b/bin/matlab
```

Module Avail command

- **module avail (ml av)** – what modules are currently loadable
 - Not a full list of modules at CHPC
 - Show Loadable modules at the moment
 - Standalone module (independent of other modules)
 - Non-standalone module whose dependencies are already loaded
 - List may change when other modules get loaded or unloaded
 - Marks default (D), already loaded (L), gpu specific (g) and aliases
 - Filter/Search: **module avail <string>**
 - Eg: **module avail mat**
 - Pagination: **module --redirect avail | more**
 - Counting:
 - **module --terse --redirect avail | wc -l**

```
masurca/3.3.1
mathematica/12.3.1
mathematica/13.3.1
mathematica/14.0.0 (D)
matlab/R2021b
matlab/R2022a
matlab/R2022b
matlab/R2023a
matlab/R2023b (L,D)
maven/3.3.3
maxquant/1.6.10.43
medaka/1.5.0 (g)
medaka/1.6.1 (g)
medaka/1.7.2 (g,D)
medea/3.7.2
mega2/6.0.0
megadetector/4.1
megadolon/2.3.3
mercurial/3.6
merlin/1.1.2
mesa/r15.14.0
```

CHPC Module Hierarchy

- Core
 - Contains modules for applications independent of both Compiler and MPI modules installed by CHPC (eg self-contained software)
- Compiler
 - Contains modules for applications dependent on a Compiler (& version) module but not on a MPI module
- MPI
 - Contains modules for applications dependent on both a compiler module and a MPI module

Modules themselves are named by application name/version

Module Avail command (cont.)

- module purge
- module av (or module --redirect av | more)

```
----- Global Aliases -----
python3 -> python/3.10.3

---- /uufs/chpc.utah.edu/sys/modulefiles/spack/linux-rocky8-x86_64/Core/linux-rocky
nehalem ----
aocc/3.1.0
armadillo/1.13.6
bazel/6.1.1
bear/2.2.0
boost/1.76.0
boost/1.72.0
boost/1.83.0
boost/1.77.0
boost/1.85.0
boost/1.82.0
bpp-core/2.10.0
bpp-phyl-om/2.10.0
bpp-phyl/2.10.0
bpp-seq-omi/2.10.0
bpp-seq/2.4.0
binutils/2.40
(D) proj/8.2.1
py-archspec/0.2.4

----- /uufs/chpc.utah.edu/sys/modulefiles/CHPC-r8/Core -----
3DSlicer/5.8.1 (g)
ABCtoolbox/2009.06
CMG/2023.119.GU
CNVnator/0.4.1
CRABS/0.1.5
CameraTraps/20230713.f39289a
ChemEM/0.0.3 (D)
ChemEM/01052024
ChemEM/04022024
```

```
[class99@linuxclass:~]$ module --terse --redirect av | wc -l
2259
```

Module Avail command (cont.)

- module load gcc/8.5.0 → module av

```
---- /uufs/chpc.utah.edu/sys/modulefiles/spack/linux-rocky8-x86_64/Compiler/linux-rocky8-nehalem/gcc/8.5.0 ----
boost/1.77.0                               mpich/4.1.2
cantera-pokitt/develop                     mvapich2/2.3.6 (D)
cdo/2.0.5 (D)                             mvapich2/2.3.7
fftw/2.1.5                                netcdf-c/4.8.1
fftw/3.3.10 (D)                          netcdf-cxx/4.2
gdal/3.3.2                                netcdf-fortran/4.5.3
geant4/10.7.3                             openblas/0.3.18
geant4/11.0.3 (D)                        openkim-models/2021-01-28
gsl/2.7 (D)                              openmpi/4.1.1
hdf4/4.2.15 (D)                          openmpi/4.1.3-gpu (g)
hdf5/1.10.7 (D)                          openmpi/4.1.3
hoomd-blue/2.5.0-gpu-mkl (g)             openmpi/4.1.4
hoomd-blue/2.5.0-gpu-obl (g,D)          openmpi/4.1.5-gpu (g)
hysplit/5.2.3                            openmpi/4.1.5
```

```
[class99@linuxclass:~]$ module --terse --redirect av | wc -l
2383
```

Module Avail command (cont.)

- module load openmpi/4.1.1 → module av

```

---- /uufs/chpc.utah.edu/sys/modulefiles/CHPC-r8/MPI/gcc/8.5.0/openmpi/4.1.1 ----
charmm/46b2      orca/4.2.0      orca/5.0.3 (D)      rosetta/3.13

---- /uufs/chpc.utah.edu/sys/modulefiles/spack/linux-rocky8-x86_64/MPI/linux-rocky8-nehalem
/gcc/8.5.0/openmpi/4.1.1 ----
  hdf5/1.8.22      hypre/2.23.0      parallel-netcdf/1.12.2
  hdf5/1.10.7      lammps/20220107   petsc/3.16.4
  hyphy/2.5.41     netcdf-c/4.8.1    wi4mpi/3.5.0

---- /uufs/chpc.utah.edu/sys/modulefiles/spack/linux-rocky8-x86_64/Compiler/linux-rocky8-nehalem/gcc/8.5.0 ----
  boost/1.77.0      mpich/4.1.2
  cantera-pokitt/develop  mvapich2/2.3.6      (D)
  cdo/2.0.5          (D)      mvapich2/2.3.7
  fftw/2.1.5          netcdf-c/4.8.1
  fftw/3.3.10        (D)      netcdf-cxx/4.2
  gdal/3.3.2          netcdf-fortran/4.5.3
  hdf5/1.10.7        libnetcdf/4.3.10
  hdf5/1.8.22        libnetcdf/4.3.10
  hypre/2.23.0       libnetcdf/4.3.10
  lammps/20220107    libnetcdf/4.3.10
  netcdf-c/4.8.1     libnetcdf/4.3.10
  netcdf-cxx/4.2     libnetcdf/4.3.10
  netcdf-fortran/4.5.3  libnetcdf/4.3.10
  parallel-netcdf/1.12.2  libnetcdf/4.3.10
  petsc/3.16.4       libnetcdf/4.3.10
  rosetta/3.13       libnetcdf/4.3.10
  wi4mpi/3.5.0       libnetcdf/4.3.10

```

```

[class99@linuxclass:~]$ module --terse --redirect av | wc -l
2409

```

Module Avail command (cont.)

- module load hdf5/1.10.7 → which h5diff

```
[class99@linuxclass:~]$ module load hdf5/1.10.7  
[class99@linuxclass:~]$ module list
```

Currently Loaded Modules:

1) chpc/1.0 (S) 2) gcc/8.5.0 3) openmpi/4.1.1 4) hdf5/1.10.7

Where:

S: Module is Sticky, requires --force to unload or purge

```
[class99@linuxclass:~]$ which h5diff  
/uufs/chpc.utah.edu/sys/spack/linux-rocky8-nehalem/gcc-8.5.0/hdf5-1.10.7-fc  
pb7a7hytf7lwlba7sgwx6hkenyv/bin/h5diff
```

- Note: For a specific application (<name>/<version>), there might be multiple module instances, each was installed with different compilers and/or mpi implementations --- **For reproducibility, take notes on the target module as well as the dependent modules (“path”).**

Module Spider command

- Most of the time, we want to do direct searches
 - Is a module installed on CHPC?
 - What versions do you have?
 - How do I load it? (what dependencies needed?)

- **module spider <string>**
 - show all versions

```
[class99@linuxclass:~]$ module spider hdf5
-----
hdf5:
-----
Versions:
  hdf5/1.8.19
  hdf5/1.8.22
  hdf5/1.10.7
  hdf5/1.12.2
  hdf5/1.14.1-2
Other possible modules matches:
  phdf5
```

- **module spider <name>/<version>**
 - show how to load a specific module

```
[class99@linuxclass:~]$ module spider hdf5/1.10.7
-----
hdf5: hdf5/1.10.7
-----

You will need to load all module(s) on any one of the lines b
he "hdf5/1.10.7" module is available to load.

gcc/11.2.0  openmpi/4.1.6
gcc/11.2.0-cpu  openmpi/4.1.6
gcc/11.2.0-gpu  openmpi/4.1.6
gcc/8.5.0
gcc/8.5.0  intel-oneapi-mpi/2021.4.0
gcc/8.5.0  openmpi/4.1.1
intel-oneapi-compilers/2021.4.0
intel-oneapi-compilers/2021.4.0  intel-oneapi-mpi/2021.4.0
intel-oneapi-compilers/2021.4.0  openmpi/4.1.1
intel/2018.5.274
nvhpc/21.5
nvhpc/21.5-nompi
nvhpc/21.7
```


Multiple Instances

```
[class99@linuxclass:~]$ ml
```

```
Currently Loaded Modules:
```

```
1) chpc/1.0 (S) 2) gcc/8.5.0 3) openmpi/4.1.1 4) hdf5/1.10.7
```

```
Where:
```

```
S: Module is Sticky, requires --force to unload or purge
```

```
[class99@linuxclass:~]$ which h5diff
```

```
/uufs/chpc.utah.edu/sys/spack/linux-rocky8-nehalem/gcc-8.5.0/hdf5-1.10.7-fcupypb7a7hytf7lwlba7s  
gwx6hkenyv/bin/h5diff
```

```
[class99@linuxclass:~]$ module list
```

```
Currently Loaded Modules:
```

```
1) chpc/1.0 (S) 3) openmpi/4.1.6 5) hdf5/1.10.7  
2) gcc/11.2.0 4) zlib/1.2.13
```

```
Where:
```

```
S: Module is Sticky, requires --force to unload or purge
```

```
[class99@linuxclass:~]$ which h5diff
```

```
/uufs/chpc.utah.edu/sys/spack/v019/linux-rocky8-nehalem/gcc-11.2.0/hdf5-1.10.7-dgyqdgf7r5e4edun  
4azuvhomxgfotxuk/bin/h5diff
```

Module Show command

- Format `module show <module-name>/<version>`
- Shows you the content of the module file (lua)
- This is useful if there is information on running the program included in the module
- Only works if module is available, i.e., you have modules that it depends on loaded

```
[class99@linuxclass:~]$ module show matlab/R2023b
-----
/uufs/chpc.utah.edu/sys/modulefiles/CHPC-r8/Core/matlab/R2023b.lua:
-----
help([[This module sets the variables for Matlab R2023b
]])
setenv("MATLAB_ROOT", "/uufs/chpc.utah.edu/sys/installdir/matlab/R2023b")
setenv("MLM_LICENSE_FILE", "27000@ls1.chpc.utah.edu,27000@ls2.chpc.utah.edu,27000@ls3.chpc.utah.edu")
prepend_path("PATH", "/uufs/chpc.utah.edu/sys/installdir/matlab/R2023b/bin")
whatis("MATLAB R2023b")
whatis("http://www.mathworks.com")
whatis("Installed on 09/21/2023")
family("matlab")
```

Under the hood

- **Module changes Environment Variables (system & application)**

```
[class99@linuxclass:~]$ module list

Currently Loaded Modules:
  1) chpc/1.0 (S)

Where:
  S:  Module is Sticky, requires --force to unload or purge

[class99@linuxclass:~]$ which matlab
/usr/bin/which: no matlab in (/uufs/chpc.utah.edu/sys/bin:/usr/local/bin:/usr/local/sbin:/usr/sbin)
[class99@linuxclass:~]$ echo $PATH
/uufs/chpc.utah.edu/sys/bin:/usr/local/bin:/usr/bin:/usr/local/sbin
[class99@linuxclass:~]$ module load matlab
[class99@linuxclass:~]$ echo $PATH
/uufs/chpc.utah.edu/sys/installdir/matlab/R2023b/bin:/uufs/chpc.utah.edu/sys/installdir/matlab/R2023b/bin:/usr/local/bin:/usr/bin:/usr/local/sbin:/usr/sbin
[class99@linuxclass:~]$ which matlab
/uufs/chpc.utah.edu/sys/installdir/matlab/R2023b/bin/matlab
[class99@linuxclass:~]$
```

One Name Rule and Module “Family”

- The One Name Rule:
 - Any named software with multiple versions, only one version loaded at a time
- We also define module “families”; can only have one module in a family loaded at a time
 - Used for compilers, mpi, python-based (eg conda), R-based, and etc
 - For example, if you have intel loaded, and load any gcc it will unload intel

Default, aliases, and hidden modules

- For some applications have a default module – one that is installed if you do not provide a specific version
 - Typically, but not always, the latest version is specified to be the default
- We may have depreciated older installations and their modules so some modules have been hidden
 - Many depreciated modules were from old OS, so some may not work on current OS
 - **module --show_hidden avail**

Create your own module(s)

- Create a Conda environment (miniforge recommended) in your Home
- Install all libraries you would need (eg jupyter)
- Make it a Module
- Load module in Shell or OpenOnDemand
- For each project, create a dedicated conda env (and module)

<https://www.chpc.utah.edu/documentation/software/python-anaconda.php>

Getting Help

- CHPC website
 - www.chpc.utah.edu
 - Getting started guide, cluster usage guides, software manual pages, CHPC policies
- Service-Now issue/incident tracking system
 - Help Desk: helpdesk@chpc.utah.edu
- We use chpc-hpc-users@lists.utah.edu for sending messages to users