Modules on LUMI

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Module environments

- Modules are used on HPC systems to enable users to create custom environments and select between multiple versions of applications
  - Applications on HPC systems are installed in non-standard places
  - Can set environment variables for the application also
- 3 systems in use
  - Original module tool written in C with modules in Tcl, development halted
  - New implementation in Tcl with many new features, developed at INRIA
    - Not supported by HPE Cray
  - Lmod, an implementation in Lua with native module files in Lua but support for most Tcl module files
- We chose Lmod for LUMI

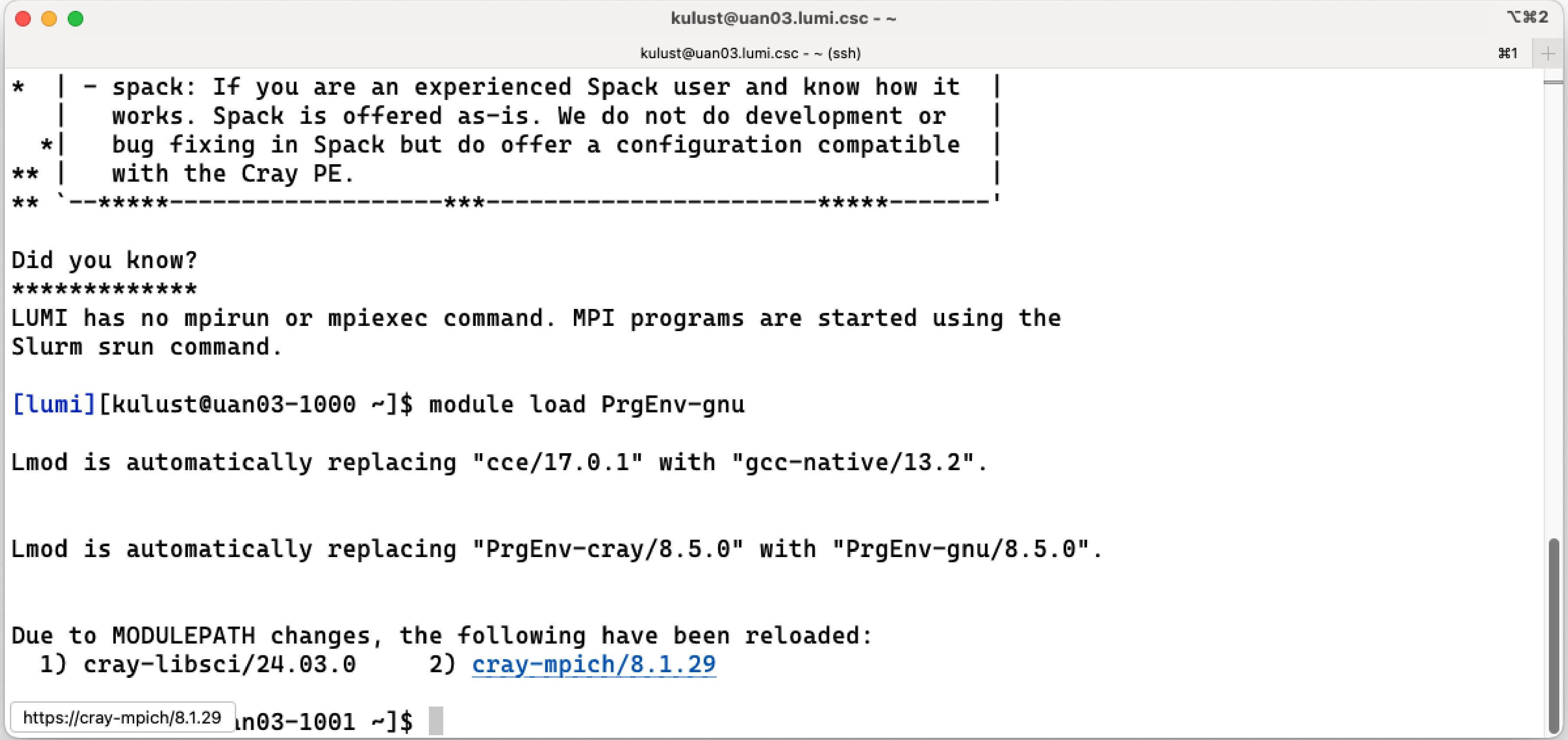
Exploring modules with Lmod

- Contrary to some other module systems, not all modules are immediately available for loading
  - Installed modules: All modules on the system that can be loaded one way or another
  - Available modules: Can be loaded without first loading another module
- Examples in the HPE Cray PE:
  - `cray-mpich` requires a compiler module and network target module first
  - Many of the performance monitoring tools require `perftools-base` first
  - `cray-fftw` only becomes available when a processor target module is loaded
- Tools
  - `module avail` searches in the available modules
  - `module spider` and `module keyword` search in the installed modules
    - But with some restrictions on LUMI

Benefits of a hierarchy

- When well designed, you get some protection from loading modules that do not work together well
  - Only partially implemented on LUMI
- When “swapping” a module that makes other modules available with a different one, Lmod will try to look for equivalent modules in the new hierarchy
  - Example: Try `module load PrgEnv-gnu` in the default login environment and see what happens

module load PrgEnv-gnu


kulust@uan03.lumi.csc - ~
⌥⌘2
kulust@uan03.lumi.csc - ~ (ssh)
⌘1
https://cray-mpich/8.1.29

```
*  | - spack: If you are an experienced Spack user and know how it  |
   |   works. Spack is offered as-is. We do not do development or   |
  *|   bug fixing in Spack but do offer a configuration compatible  |
** |   with the Cray PE.                                            |
** `--*****-------------------***-----------------------*****-------'

Did you know?
*************
LUMI has no mpirun or mpiexec command. MPI programs are started using the
Slurm srun command.

[lumi][kulust@uan03-1000 ~]$ module load PrgEnv-gnu

Lmod is automatically replacing "cce/17.0.1" with "gcc-native/13.2".


Lmod is automatically replacing "PrgEnv-cray/8.5.0" with "PrgEnv-gnu/8.5.0".


Due to MODULEPATH changes, the following have been reloaded:
  1) cray-libsci/24.03.0     2) cray-mpich/8.1.29

n03-1001 ~]$
```

Module names and families

- In Lmod you cannot have two modules with the same name loaded together
  - On LUMI, when loading a new module the other one with the same name will be automatically unloaded
  - Automatic protection from conflicts
- Extension: family concept: No two modules of the same family can be loaded together
  - E.g., make compilers member of the family "compiler"
  - On LUMI, the conflicting module of the same family will be unloaded automatically

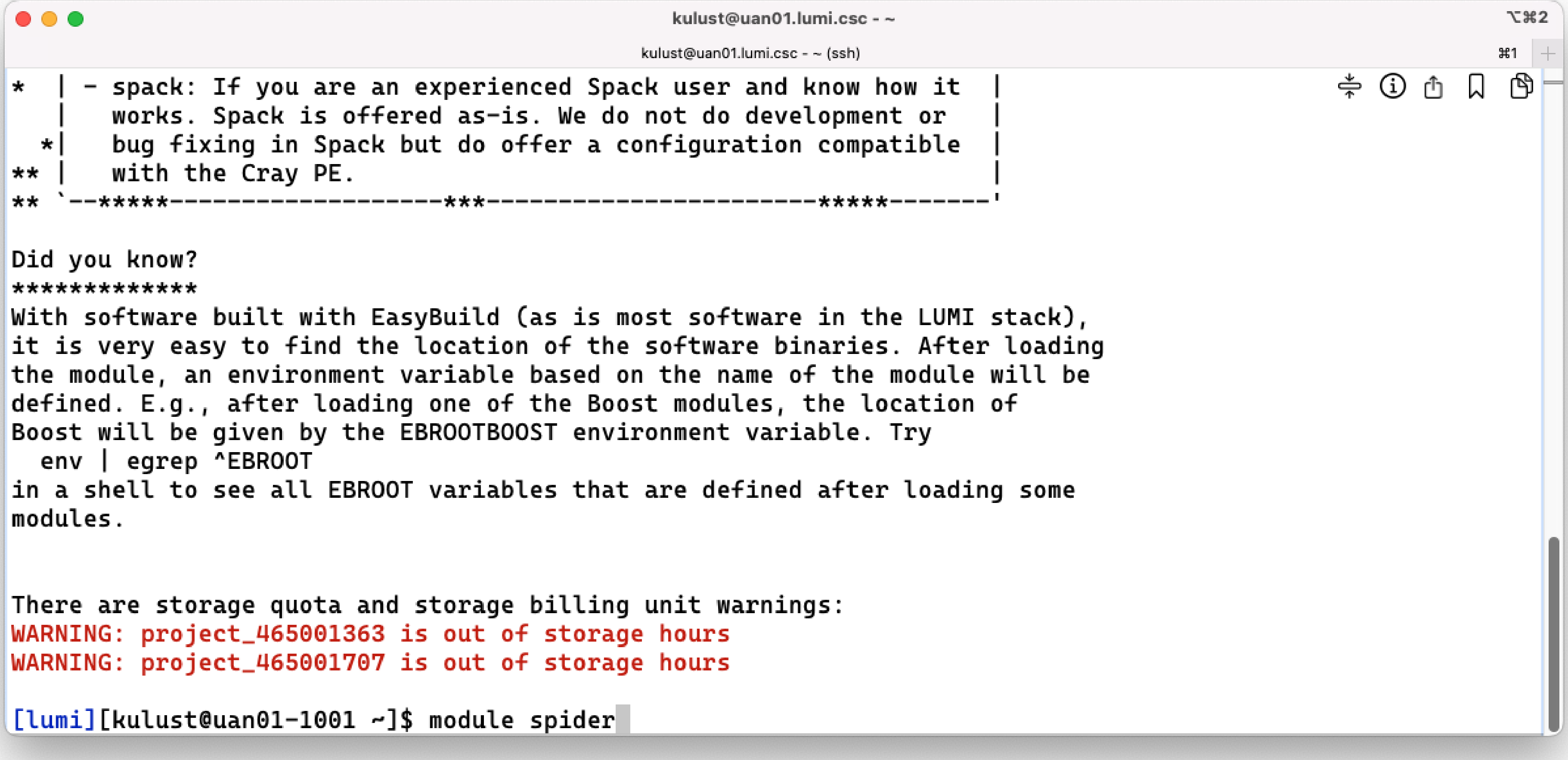
Extensions

- It would not make sense to have a separate module for each of the hundreds of R packages or tens of Python packages a software stack may contain.
  - Would actually also create a performance problem due to excess metadata access and long PATH variables
  - Bundle related packages in a single module
- Lmod solution: A module can define a list of extensions, basically other packages provided by the module.
  - And the regular commands can be used to search for these
  - Unfortunately not used in the HPE Cray PE cray-python and cray-R modules

module spider

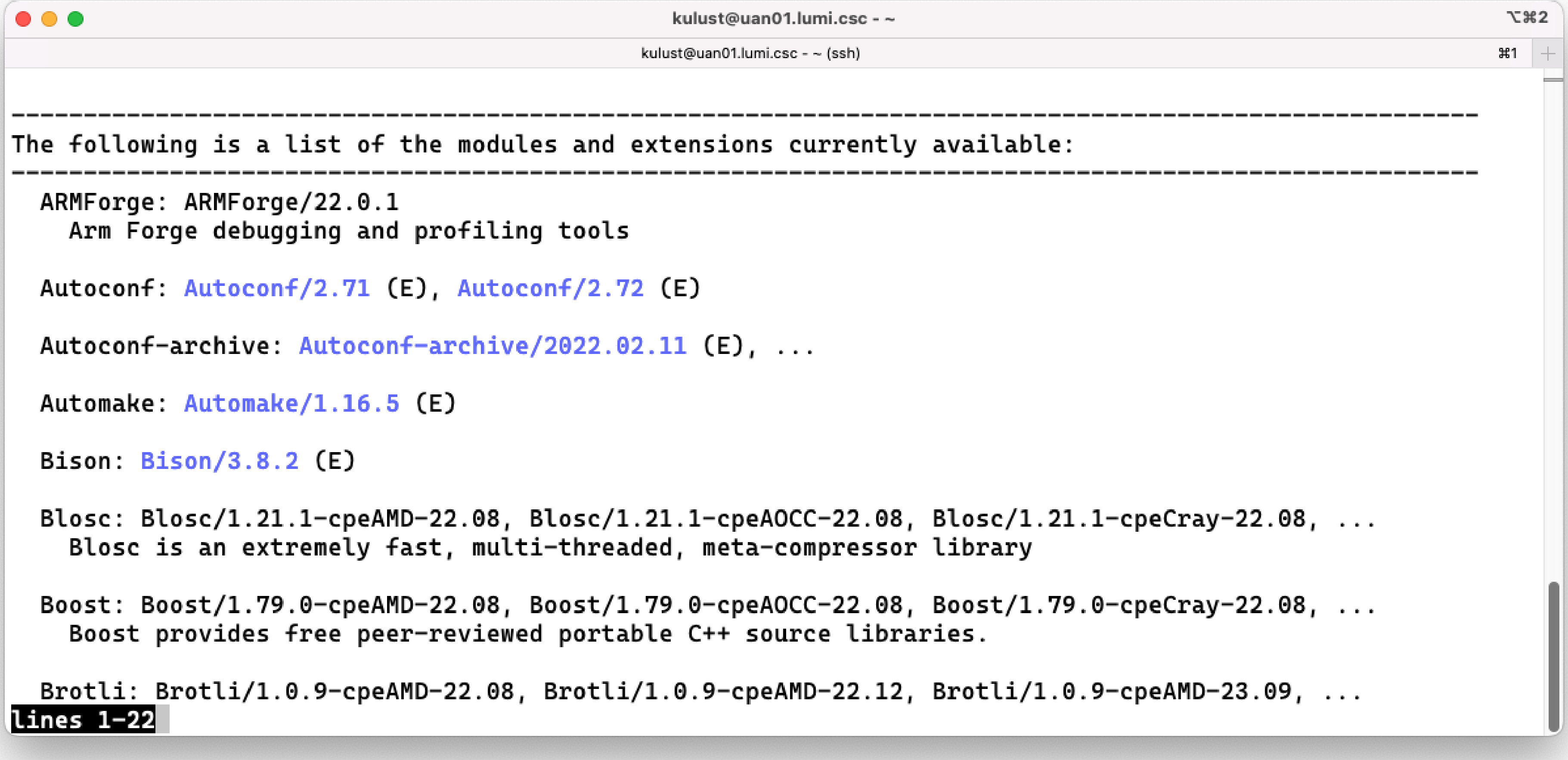
- `module spider` : Long list of all installed software with short description
  - Will also look into modules for “extensions” and show those also, marked with an “E”
  - By default only in the main software stacks on LUMI

module spider (command) (1)



```
*   | - spack: If you are an experienced Spack user and know how it  |
    |   works. Spack is offered as-is. We do not do development or   |
   *|   bug fixing in Spack but do offer a configuration compatible  |
**  |   with the Cray PE.                                             |
**  `--*****-------------------***-----------------------*****-------'

Did you know?
*************
With software built with EasyBuild (as is most software in the LUMI stack),
it is very easy to find the location of the software binaries. After loading
the module, an environment variable based on the name of the module will be
defined. E.g., after loading one of the Boost modules, the location of
Boost will be given by the EBROOTBOOST environment variable. Try
  env | egrep ^EBROOT
in a shell to see all EBROOT variables that are defined after loading some
modules.


There are storage quota and storage billing unit warnings:
WARNING: project_465001363 is out of storage hours
WARNING: project_465001707 is out of storage hours

[lumi][kulust@uan01-1001 ~]$ module spider
```

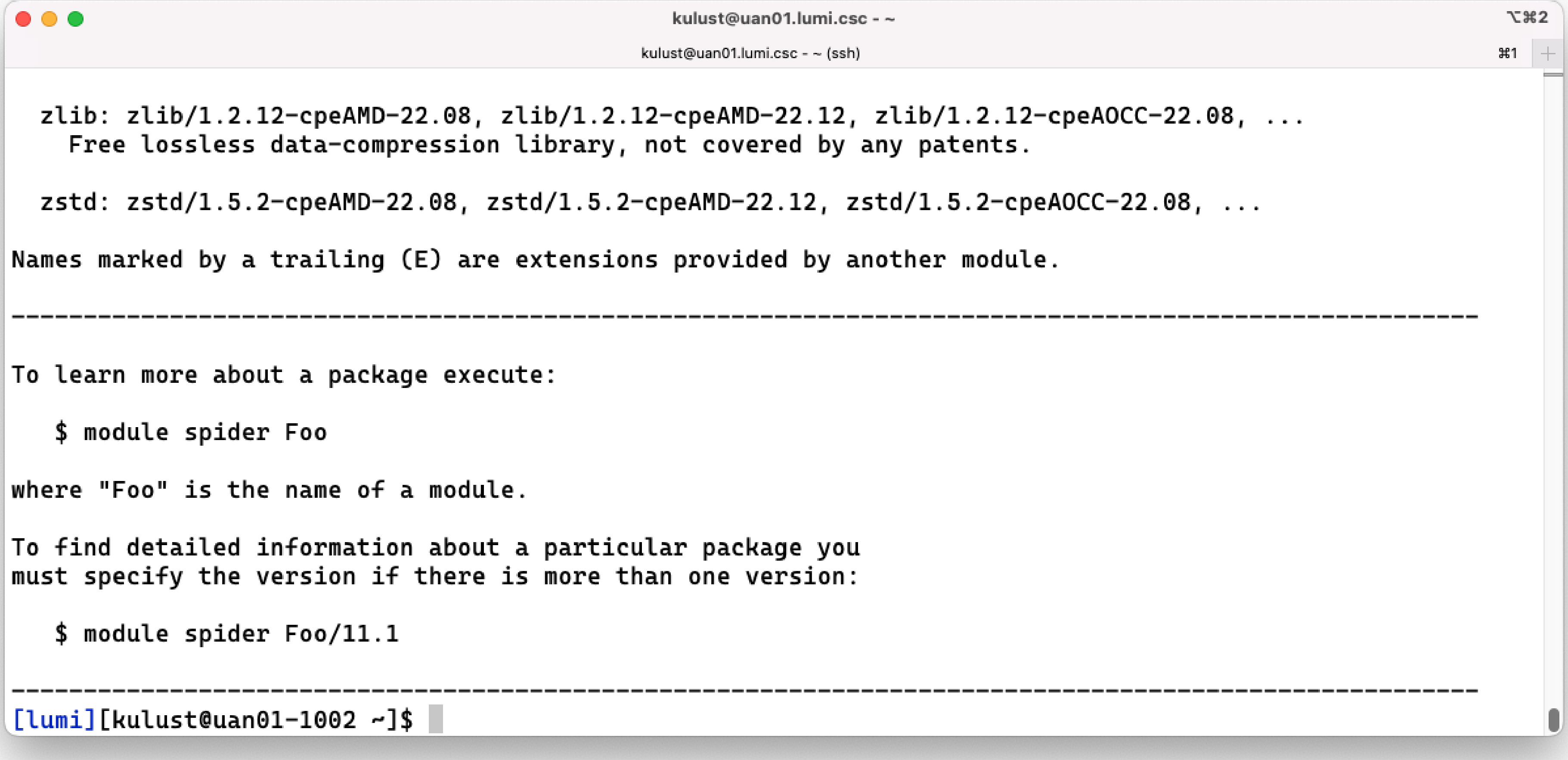
module spider (command) (2)



```

------------------------------------------------------------------------------------------------------
The following is a list of the modules and extensions currently available:
------------------------------------------------------------------------------------------------------
  ARMForge: ARMForge/22.0.1
    Arm Forge debugging and profiling tools

  Autoconf: Autoconf/2.71 (E), Autoconf/2.72 (E)

  Autoconf-archive: Autoconf-archive/2022.02.11 (E), ...

  Automake: Automake/1.16.5 (E)

  Bison: Bison/3.8.2 (E)

  Blosc: Blosc/1.21.1-cpeAMD-22.08, Blosc/1.21.1-cpeAOCC-22.08, Blosc/1.21.1-cpeCray-22.08, ...
    Blosc is an extremely fast, multi-threaded, meta-compressor library

  Boost: Boost/1.79.0-cpeAMD-22.08, Boost/1.79.0-cpeAOCC-22.08, Boost/1.79.0-cpeCray-22.08, ...
    Boost provides free peer-reviewed portable C++ source libraries.

  Brotli: Brotli/1.0.9-cpeAMD-22.08, Brotli/1.0.9-cpeAMD-22.12, Brotli/1.0.9-cpeAMD-23.09, ...
lines 1-22
```

module spider (command) (3)

LUMI

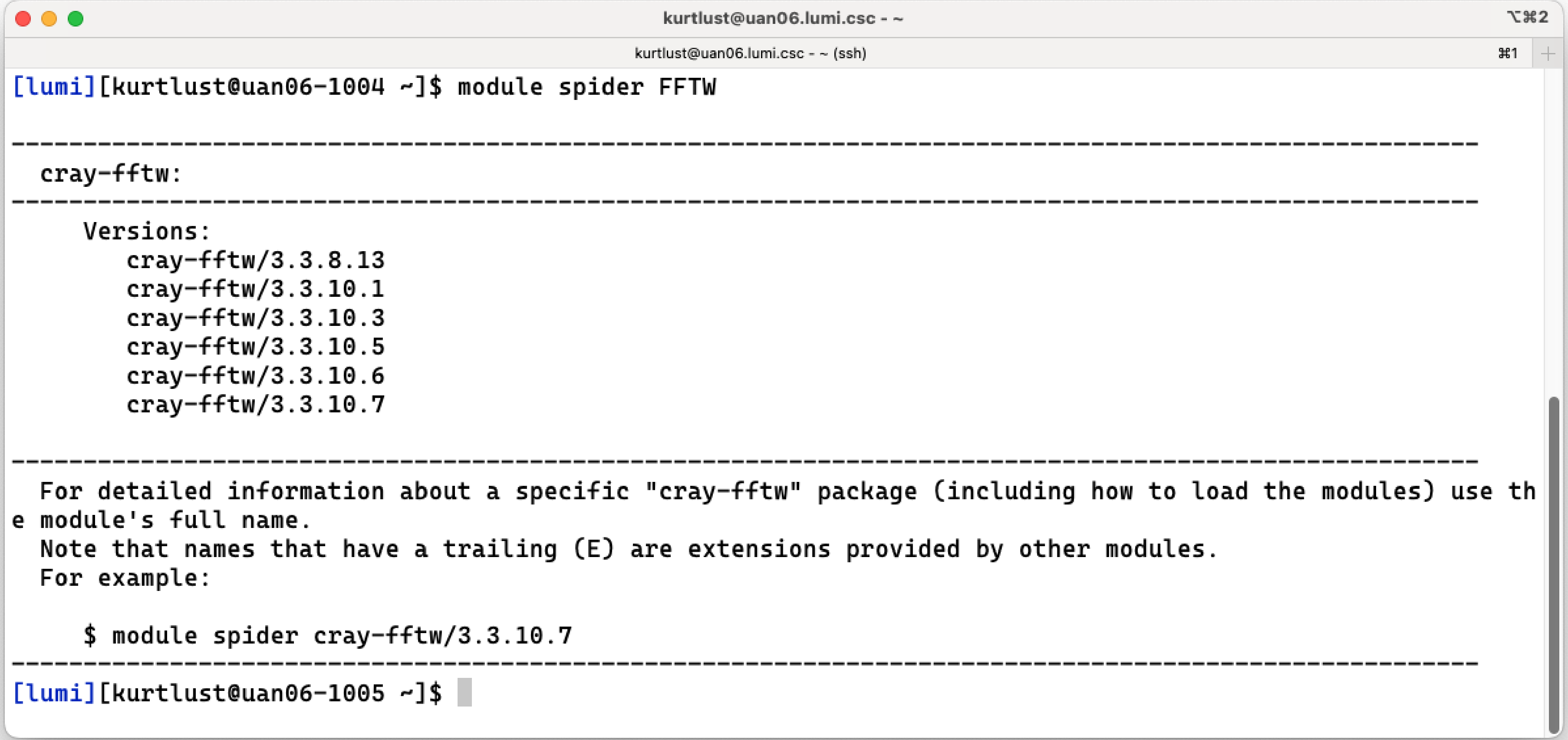


```
  zlib: zlib/1.2.12-cpeAMD-22.08, zlib/1.2.12-cpeAMD-22.12, zlib/1.2.12-cpeAOCC-22.08, ...
    Free lossless data-compression library, not covered by any patents.

  zstd: zstd/1.5.2-cpeAMD-22.08, zstd/1.5.2-cpeAMD-22.12, zstd/1.5.2-cpeAOCC-22.08, ...

Names marked by a trailing (E) are extensions provided by another module.

--------------------------------------------------------------------------------------------------------


To learn more about a package execute:

   $ module spider Foo

where "Foo" is the name of a module.

To find detailed information about a particular package you
must specify the version if there is more than one version:

   $ module spider Foo/11.1

--------------------------------------------------------------------------------------------------------
[lumi][kulust@uan01-1002 ~]$
```

module spider

- `module spider` : Long list of all installed software with short description
  - Will also look into modules for “extensions” and show those also, marked with an “E”
  - By default only in the main software stacks on LUMI
- `module spider FFTW` : Look for the FFTW libraries on the system

module spider FFTW



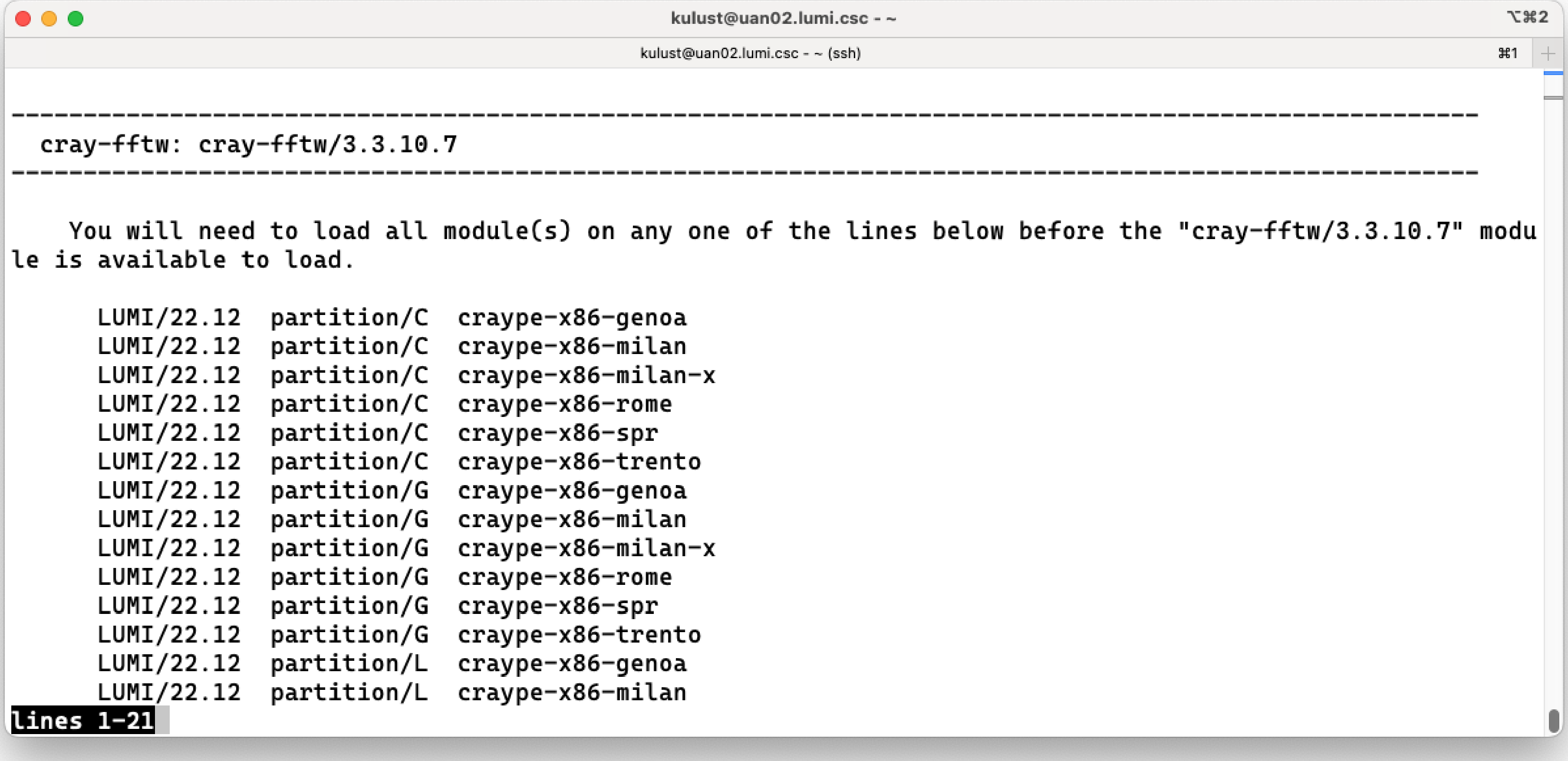
kurtlust@uan06.lumi.csc - ~
⌥⌘2
kurtlust@uan06.lumi.csc - ~ (ssh)
⌘1

```
[lumi][kurtlust@uan06-1004 ~]$ module spider FFTW

----------------------------------------------------------------------------------------------------
  cray-fftw:
----------------------------------------------------------------------------------------------------
     Versions:
        cray-fftw/3.3.8.13
        cray-fftw/3.3.10.1
        cray-fftw/3.3.10.3
        cray-fftw/3.3.10.5
        cray-fftw/3.3.10.6
        cray-fftw/3.3.10.7

----------------------------------------------------------------------------------------------------
  For detailed information about a specific "cray-fftw" package (including how to load the modules) use th
e module's full name.
  Note that names that have a trailing (E) are extensions provided by other modules.
  For example:

     $ module spider cray-fftw/3.3.10.7
----------------------------------------------------------------------------------------------------
[lumi][kurtlust@uan06-1005 ~]$
```

module spider

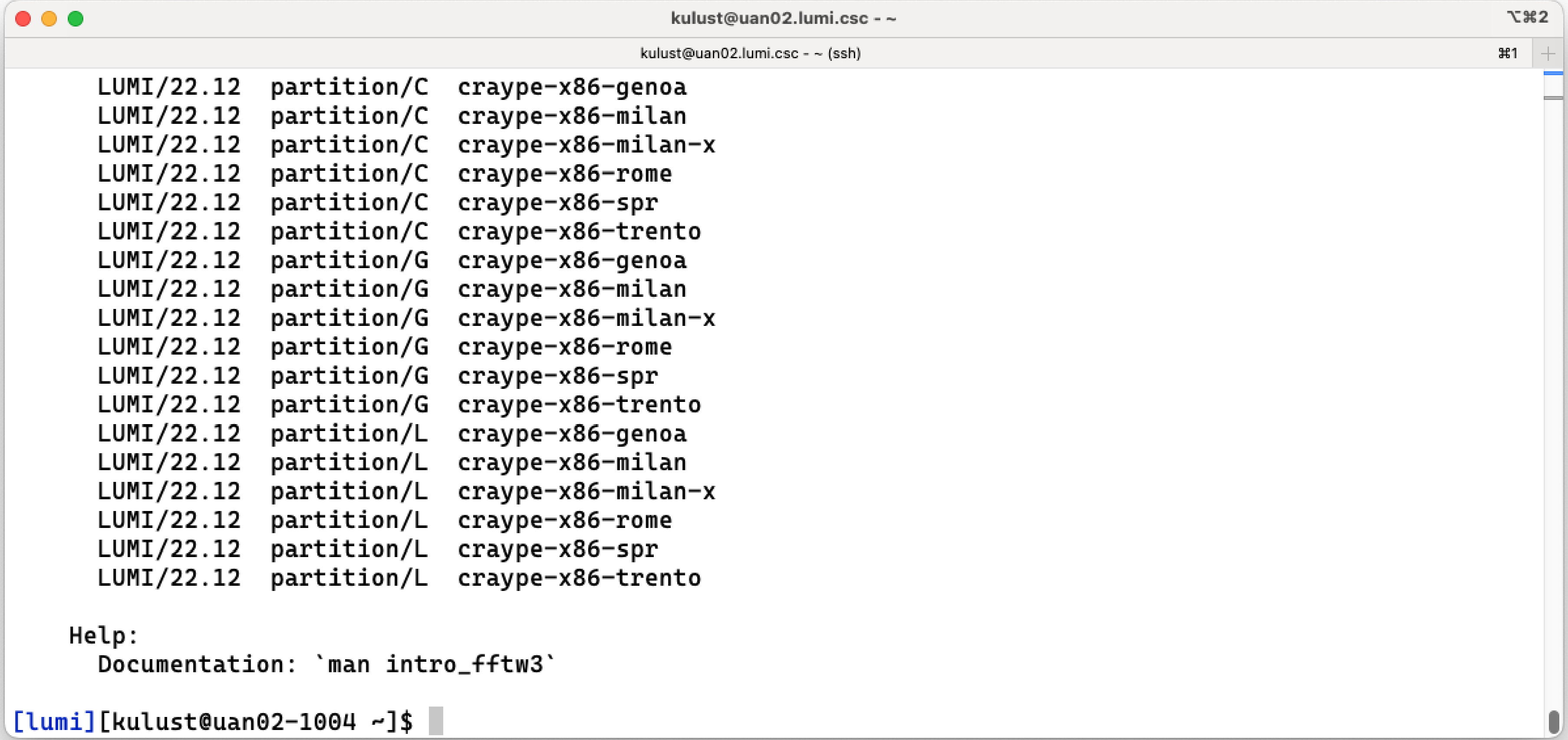
- `module spider` : Long list of all installed software with short description
  - Will also look into modules for “extensions” and show those also, marked with an “E”
  - By default only in the main software stacks on LUMI
- `module spider FFTW` : Look for the FFTW libraries on the system
- `module spider cray-fftw/3.3.10.7`: Look for this specific version
  - But this immediately shows the problems with the HPE Cray PE
    - Some of the lines don’t make much sense (see later)
    - Some options are missing also

module spider cray-fftw/3.3.10.7



```
----------------------------------------------------------------------------------------------------
  cray-fftw: cray-fftw/3.3.10.7
----------------------------------------------------------------------------------------------------


    You will need to load all module(s) on any one of the lines below before the "cray-fftw/3.3.10.7" modu
le is available to load.

      LUMI/22.12  partition/C  craype-x86-genoa
      LUMI/22.12  partition/C  craype-x86-milan
      LUMI/22.12  partition/C  craype-x86-milan-x
      LUMI/22.12  partition/C  craype-x86-rome
      LUMI/22.12  partition/C  craype-x86-spr
      LUMI/22.12  partition/C  craype-x86-trento
      LUMI/22.12  partition/G  craype-x86-genoa
      LUMI/22.12  partition/G  craype-x86-milan
      LUMI/22.12  partition/G  craype-x86-milan-x
      LUMI/22.12  partition/G  craype-x86-rome
      LUMI/22.12  partition/G  craype-x86-spr
      LUMI/22.12  partition/G  craype-x86-trento
      LUMI/22.12  partition/L  craype-x86-genoa
      LUMI/22.12  partition/L  craype-x86-milan
lines 1-21
```

module spider cray-fftw/3.3.10.7 (2)

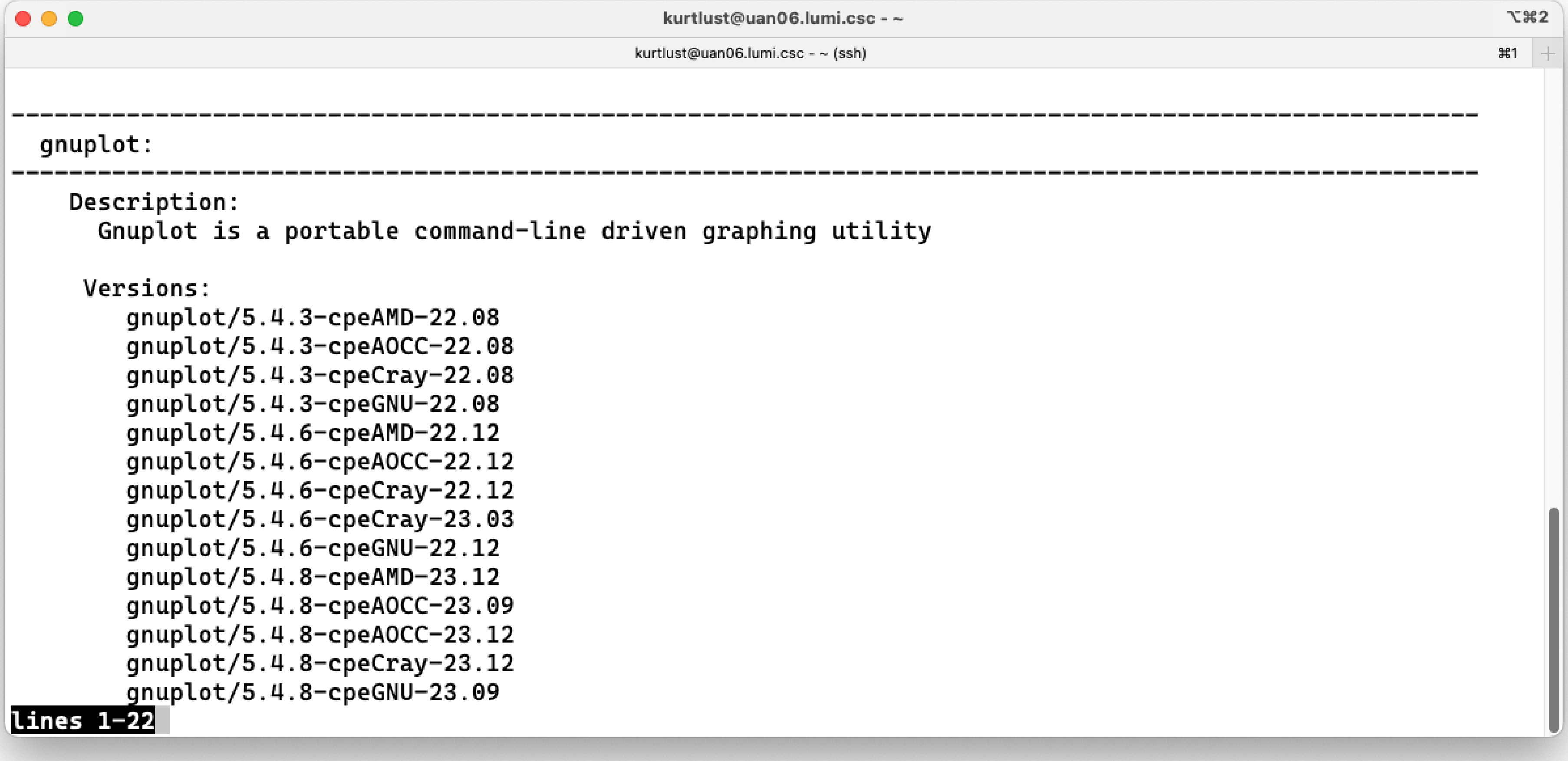


```
     LUMI/22.12  partition/C  craype-x86-genoa
     LUMI/22.12  partition/C  craype-x86-milan
     LUMI/22.12  partition/C  craype-x86-milan-x
     LUMI/22.12  partition/C  craype-x86-rome
     LUMI/22.12  partition/C  craype-x86-spr
     LUMI/22.12  partition/C  craype-x86-trento
     LUMI/22.12  partition/G  craype-x86-genoa
     LUMI/22.12  partition/G  craype-x86-milan
     LUMI/22.12  partition/G  craype-x86-milan-x
     LUMI/22.12  partition/G  craype-x86-rome
     LUMI/22.12  partition/G  craype-x86-spr
     LUMI/22.12  partition/G  craype-x86-trento
     LUMI/22.12  partition/L  craype-x86-genoa
     LUMI/22.12  partition/L  craype-x86-milan
     LUMI/22.12  partition/L  craype-x86-milan-x
     LUMI/22.12  partition/L  craype-x86-rome
     LUMI/22.12  partition/L  craype-x86-spr
     LUMI/22.12  partition/L  craype-x86-trento

   Help:
     Documentation: `man intro_fftw3`

[lumi][kulust@uan02-1004 ~]$ 
```

module spider for a regular package

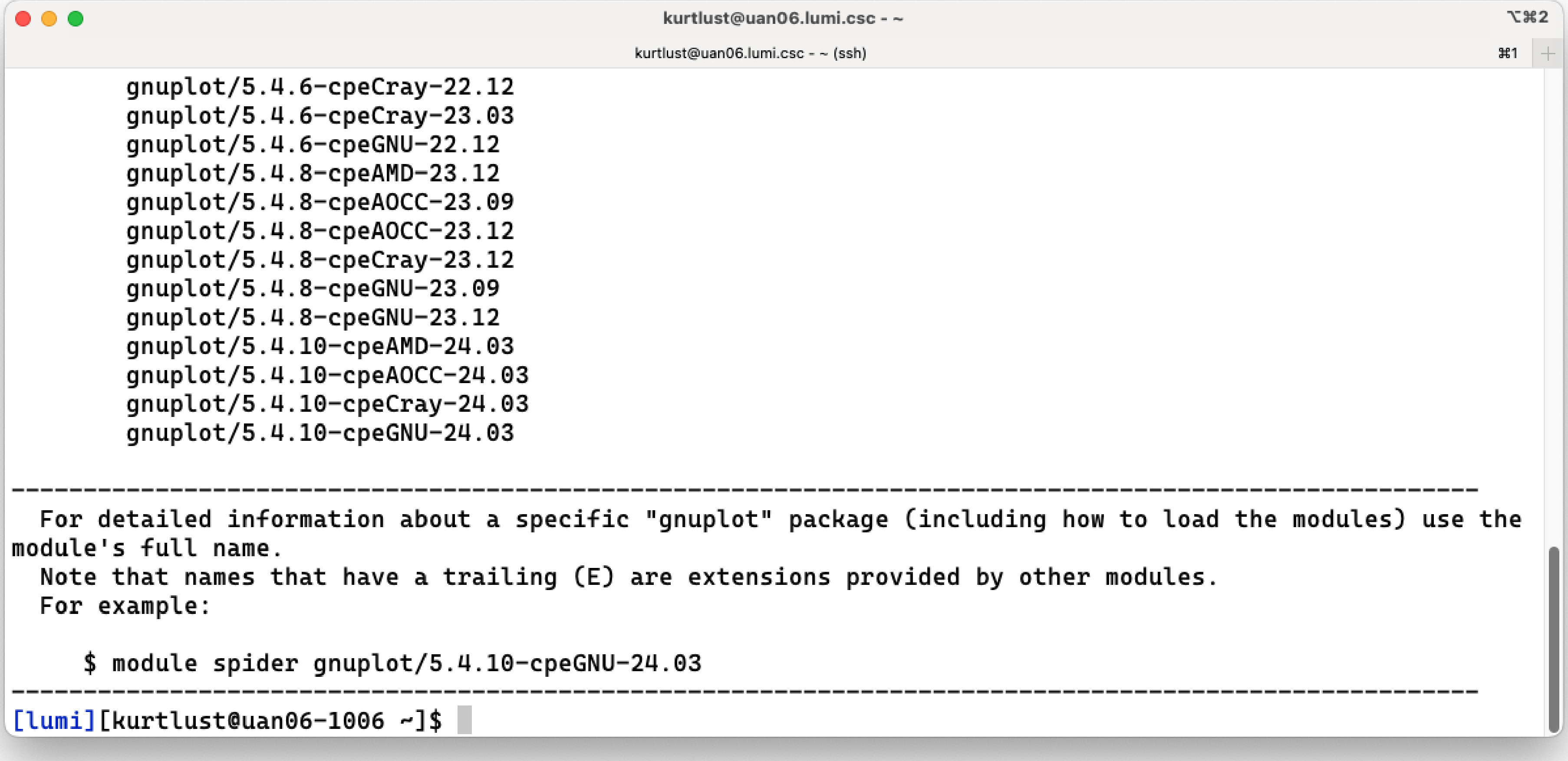
- `module spider gnuplot` : Shows all versions of gnuplot on the system
- `module spider gnuplot/5.4.10-cpeGNU-24.03` : Shows help information for the specific module, including what should be done to make the module available

module spider gnuplot


kurtlust@uan06.lumi.csc - ~
⌥⌘2
kurtlust@uan06.lumi.csc - ~ (ssh)
⌘1

```
-----------------------------------------------------------------------------------------------------
  gnuplot:
-----------------------------------------------------------------------------------------------------
    Description:
      Gnuplot is a portable command-line driven graphing utility

     Versions:
        gnuplot/5.4.3-cpeAMD-22.08
        gnuplot/5.4.3-cpeAOCC-22.08
        gnuplot/5.4.3-cpeCray-22.08
        gnuplot/5.4.3-cpeGNU-22.08
        gnuplot/5.4.6-cpeAMD-22.12
        gnuplot/5.4.6-cpeAOCC-22.12
        gnuplot/5.4.6-cpeCray-22.12
        gnuplot/5.4.6-cpeCray-23.03
        gnuplot/5.4.6-cpeGNU-22.12
        gnuplot/5.4.8-cpeAMD-23.12
        gnuplot/5.4.8-cpeAOCC-23.09
        gnuplot/5.4.8-cpeAOCC-23.12
        gnuplot/5.4.8-cpeCray-23.12
        gnuplot/5.4.8-cpeGNU-23.09
lines 1-22
```

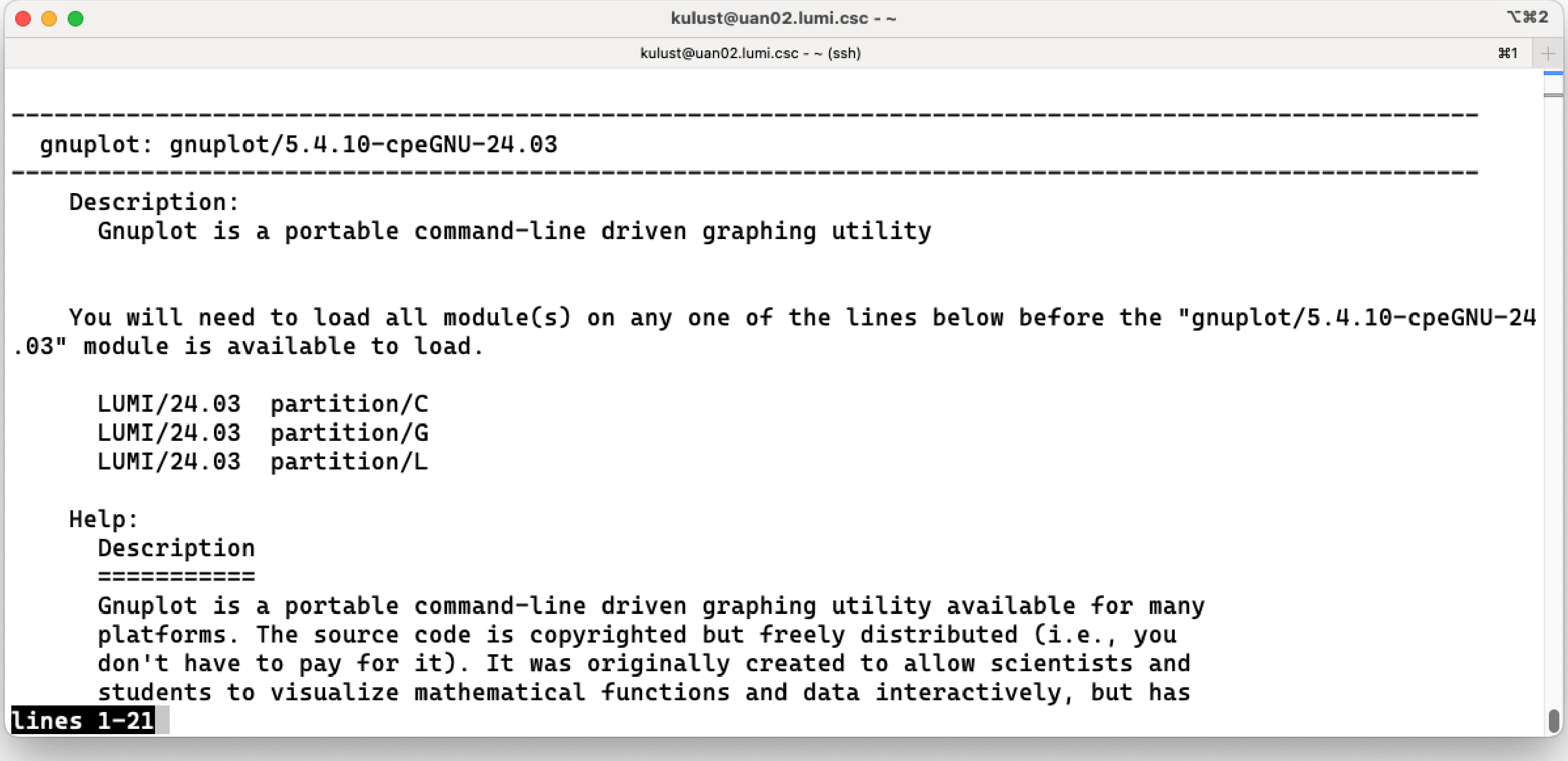
module spider gnuplot (2)



kurtlust@uan06.lumi.csc - ~
⌥⌘2
kurtlust@uan06.lumi.csc - ~ (ssh)
⌘1

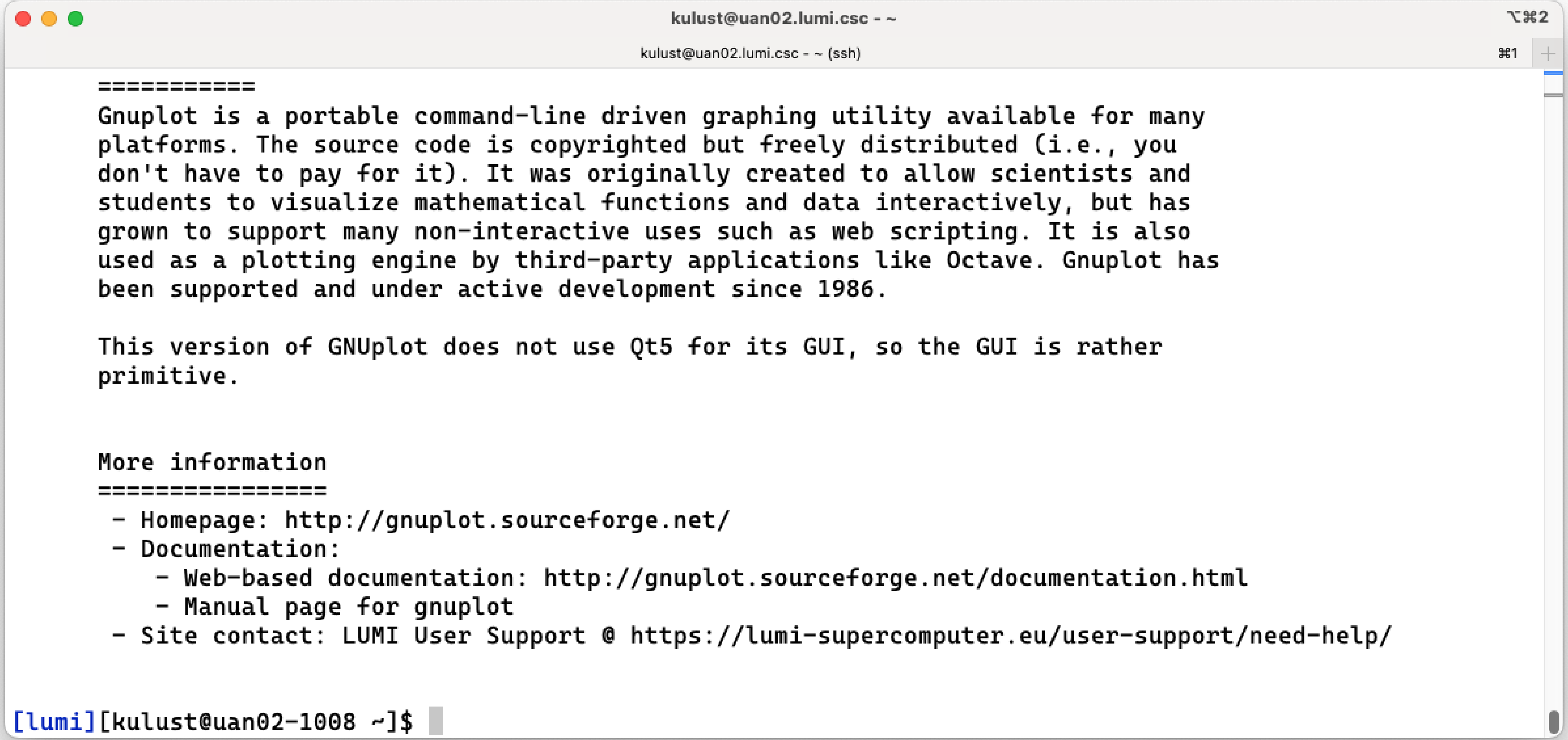
```
        gnuplot/5.4.6-cpeCray-22.12
        gnuplot/5.4.6-cpeCray-23.03
        gnuplot/5.4.6-cpeGNU-22.12
        gnuplot/5.4.8-cpeAMD-23.12
        gnuplot/5.4.8-cpeAOCC-23.09
        gnuplot/5.4.8-cpeAOCC-23.12
        gnuplot/5.4.8-cpeCray-23.12
        gnuplot/5.4.8-cpeGNU-23.09
        gnuplot/5.4.8-cpeGNU-23.12
        gnuplot/5.4.10-cpeAMD-24.03
        gnuplot/5.4.10-cpeAOCC-24.03
        gnuplot/5.4.10-cpeCray-24.03
        gnuplot/5.4.10-cpeGNU-24.03


------------------------------------------------------------------------------------------------------
  For detailed information about a specific "gnuplot" package (including how to load the modules) use the
module's full name.
  Note that names that have a trailing (E) are extensions provided by other modules.
  For example:

     $ module spider gnuplot/5.4.10-cpeGNU-24.03
------------------------------------------------------------------------------------------------------
[lumi][kurtlust@uan06-1006 ~]$
```

module spider gnuplot/5.4.10-cpeGNU-24.03



```

-----------------------------------------------------------------------------------------------------
  gnuplot: gnuplot/5.4.10-cpeGNU-24.03
-----------------------------------------------------------------------------------------------------
    Description:
      Gnuplot is a portable command-line driven graphing utility


    You will need to load all module(s) on any one of the lines below before the "gnuplot/5.4.10-cpeGNU-24
.03" module is available to load.

      LUMI/24.03  partition/C
      LUMI/24.03  partition/G
      LUMI/24.03  partition/L

    Help:
      Description
      ===========
      Gnuplot is a portable command-line driven graphing utility available for many
      platforms. The source code is copyrighted but freely distributed (i.e., you
      don't have to pay for it). It was originally created to allow scientists and
      students to visualize mathematical functions and data interactively, but has
lines 1-21
```

module spider gnuplot/5.4.10-cpeGNU-24.03 (2)

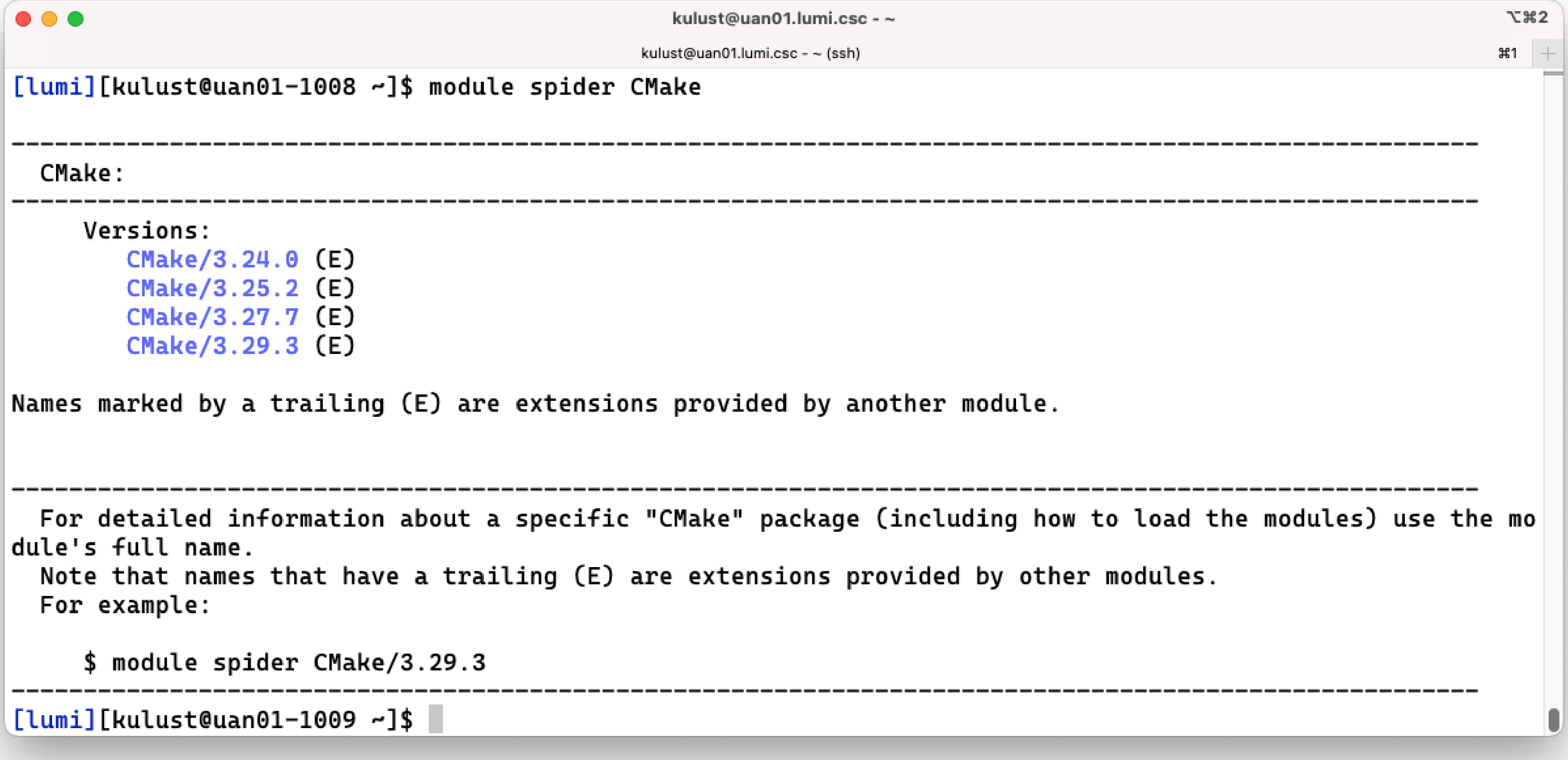


```
      ===========
      Gnuplot is a portable command-line driven graphing utility available for many
      platforms. The source code is copyrighted but freely distributed (i.e., you
      don't have to pay for it). It was originally created to allow scientists and
      students to visualize mathematical functions and data interactively, but has
      grown to support many non-interactive uses such as web scripting. It is also
      used as a plotting engine by third-party applications like Octave. Gnuplot has
      been supported and under active development since 1986.

      This version of GNUplot does not use Qt5 for its GUI, so the GUI is rather
      primitive.


      More information
      ================
       - Homepage: http://gnuplot.sourceforge.net/
       - Documentation:
          - Web-based documentation: http://gnuplot.sourceforge.net/documentation.html
          - Manual page for gnuplot
       - Site contact: LUMI User Support @ https://lumi-supercomputer.eu/user-support/need-help/


[lumi][kulust@uan02-1008 ~]$
```

module spider for extensions

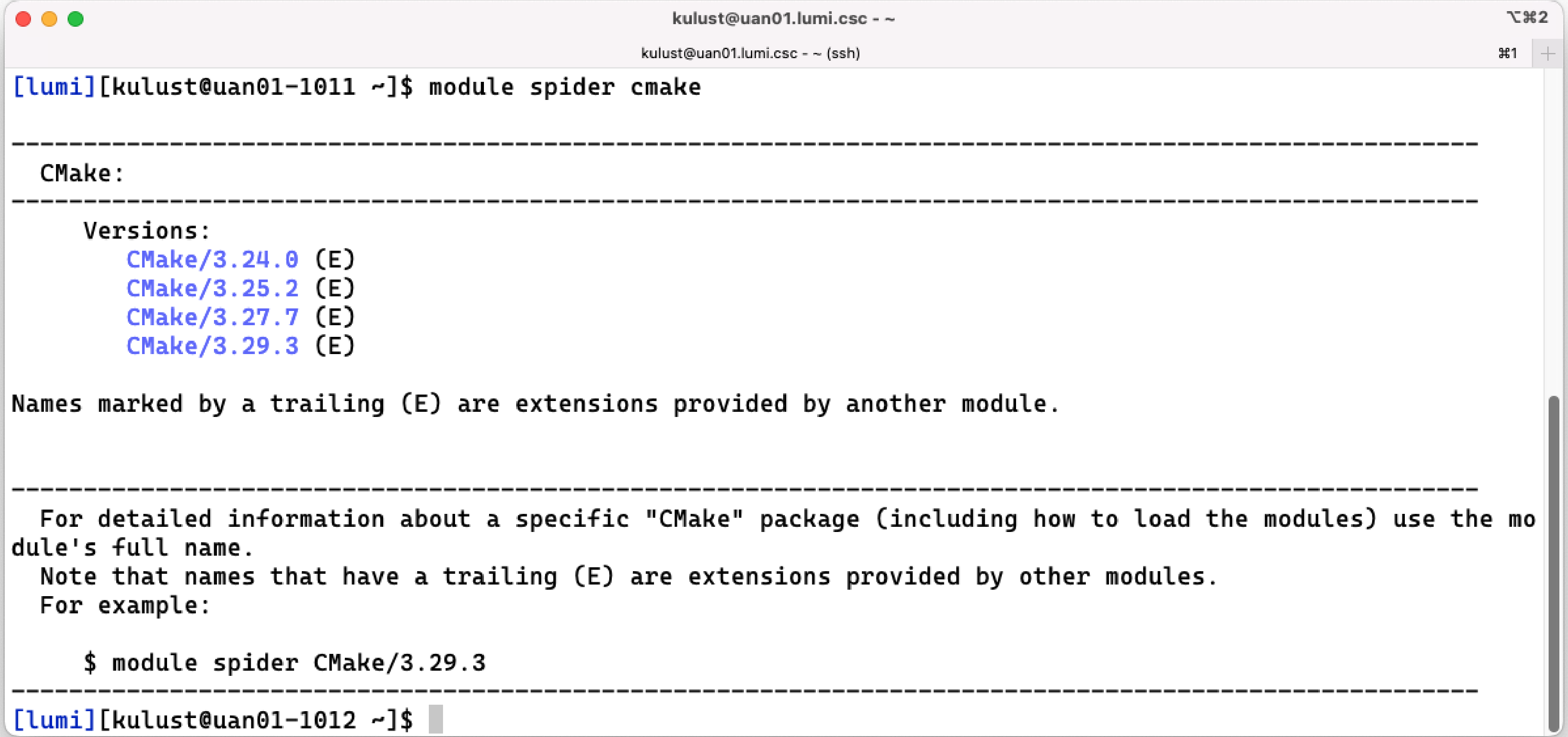
- No example in the default Cray modules, so examples come from the LUMI software stacks
- `module spider CMake`
- `module spider CMake/3.29.3` : Will tell you which module contains this version of CMake and how to load it

module spider CMake



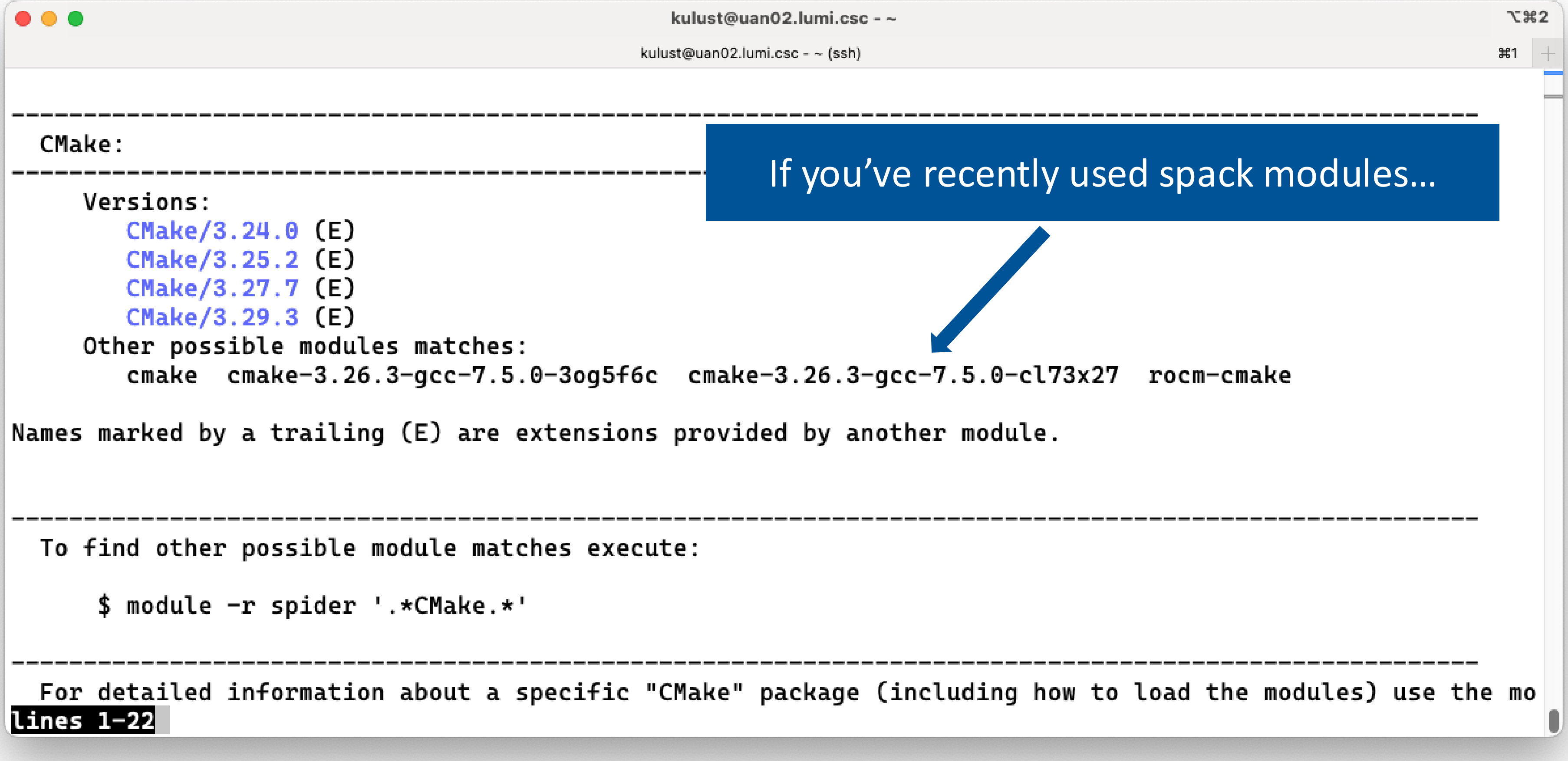
```
[lumi][kulust@uan01-1008 ~]$ module spider CMake

----------------------------------------------------------------------------
  CMake:
----------------------------------------------------------------------------
     Versions:
        CMake/3.24.0 (E)
        CMake/3.25.2 (E)
        CMake/3.27.7 (E)
        CMake/3.29.3 (E)

Names marked by a trailing (E) are extensions provided by another module.



----------------------------------------------------------------------------
  For detailed information about a specific "CMake" package (including how to load the modules) use the mo
dule's full name.
  Note that names that have a trailing (E) are extensions provided by other modules.
  For example:

     $ module spider CMake/3.29.3
----------------------------------------------------------------------------
[lumi][kulust@uan01-1009 ~]$
```

module spider cmake



```
[lumi][kulust@uan01-1011 ~]$ module spider cmake

----------------------------------------------------------------------------
  CMake:
----------------------------------------------------------------------------
     Versions:
        CMake/3.24.0 (E)
        CMake/3.25.2 (E)
        CMake/3.27.7 (E)
        CMake/3.29.3 (E)

Names marked by a trailing (E) are extensions provided by another module.


----------------------------------------------------------------------------
  For detailed information about a specific "CMake" package (including how to load the modules) use the mo
dule's full name.
  Note that names that have a trailing (E) are extensions provided by other modules.
  For example:

     $ module spider CMake/3.29.3
----------------------------------------------------------------------------
[lumi][kulust@uan01-1012 ~]$
```

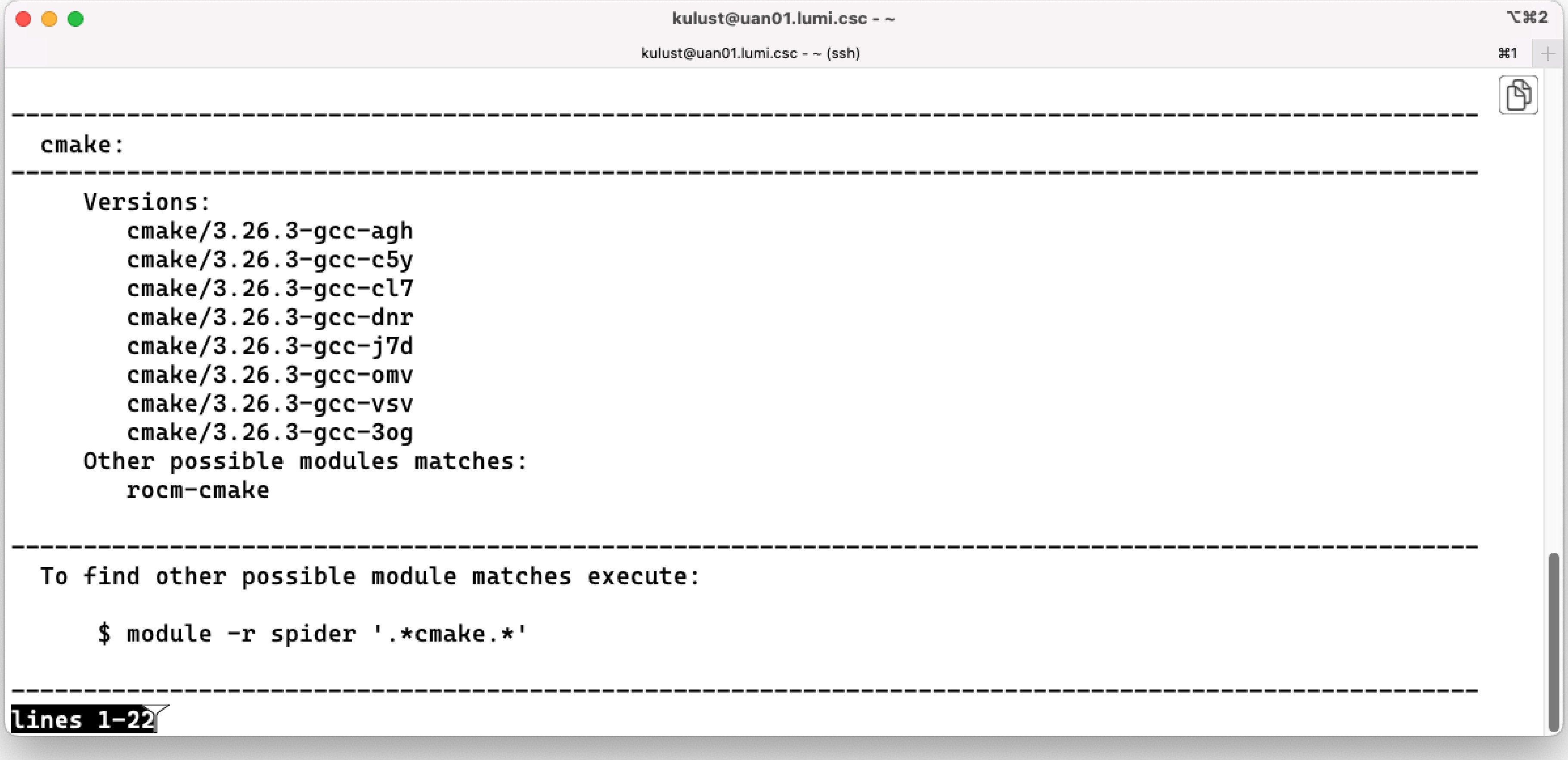
module spider CMake



```
----------------------------------------------------------------------------------------------------
  CMake:
------------------------------------------------
     Versions:
        CMake/3.24.0 (E)
        CMake/3.25.2 (E)
        CMake/3.27.7 (E)
        CMake/3.29.3 (E)
     Other possible modules matches:
        cmake  cmake-3.26.3-gcc-7.5.0-3og5f6c  cmake-3.26.3-gcc-7.5.0-cl73x27  rocm-cmake

Names marked by a trailing (E) are extensions provided by another module.


----------------------------------------------------------------------------------------------------
  To find other possible module matches execute:

      $ module -r spider '.*CMake.*'

----------------------------------------------------------------------------------------------------
  For detailed information about a specific "CMake" package (including how to load the modules) use the mo
lines 1-22
```

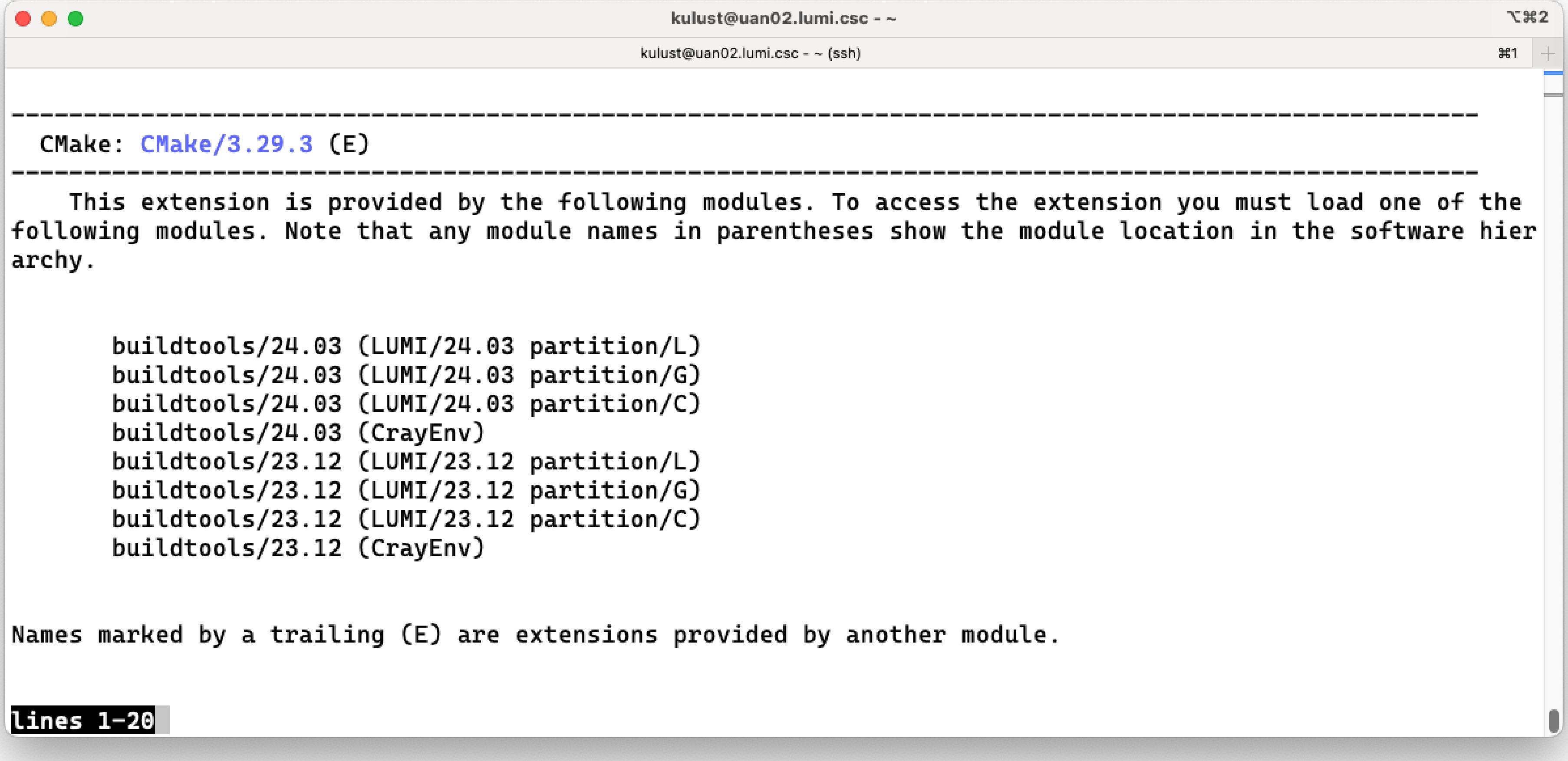
If you’ve recently used spack modules…

module spider cmake (with spack module loaded)



```
----------------------------------------------------------------------------------------------------
  cmake:
----------------------------------------------------------------------------------------------------
     Versions:
        cmake/3.26.3-gcc-agh
        cmake/3.26.3-gcc-c5y
        cmake/3.26.3-gcc-cl7
        cmake/3.26.3-gcc-dnr
        cmake/3.26.3-gcc-j7d
        cmake/3.26.3-gcc-omv
        cmake/3.26.3-gcc-vsv
        cmake/3.26.3-gcc-3og
     Other possible modules matches:
        rocm-cmake

----------------------------------------------------------------------------------------------------
  To find other possible module matches execute:

      $ module -r spider '.*cmake.*'

----------------------------------------------------------------------------------------------------
lines 1-22
```

module spider CMake/3.29.3

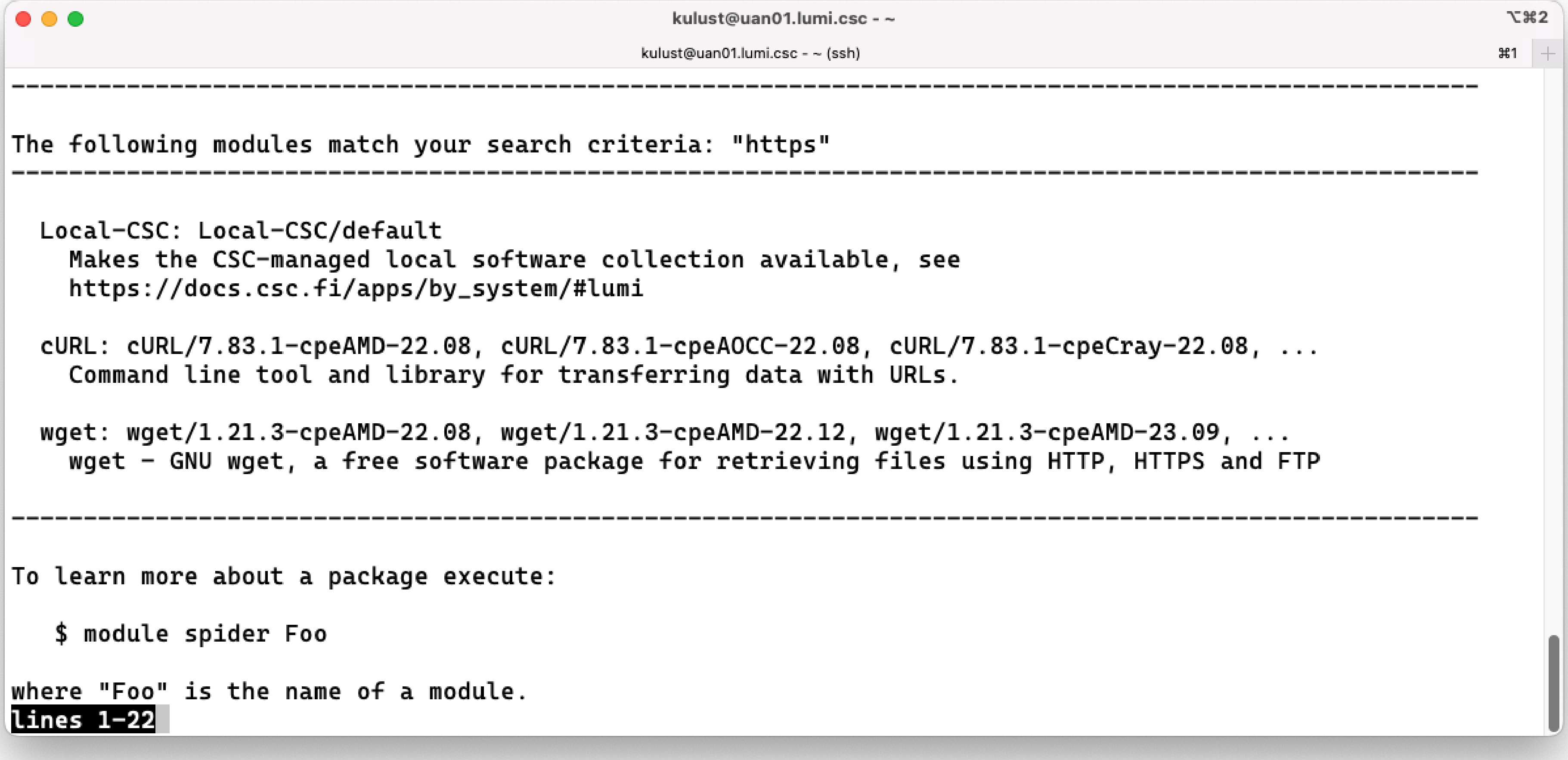


```
-----------------------------------------------------------------------------------------------------
  CMake: CMake/3.29.3 (E)
-----------------------------------------------------------------------------------------------------
    This extension is provided by the following modules. To access the extension you must load one of the
following modules. Note that any module names in parentheses show the module location in the software hier
archy.


       buildtools/24.03 (LUMI/24.03 partition/L)
       buildtools/24.03 (LUMI/24.03 partition/G)
       buildtools/24.03 (LUMI/24.03 partition/C)
       buildtools/24.03 (CrayEnv)
       buildtools/23.12 (LUMI/23.12 partition/L)
       buildtools/23.12 (LUMI/23.12 partition/G)
       buildtools/23.12 (LUMI/23.12 partition/C)
       buildtools/23.12 (CrayEnv)


Names marked by a trailing (E) are extensions provided by another module.


lines 1-20
```

module keyword

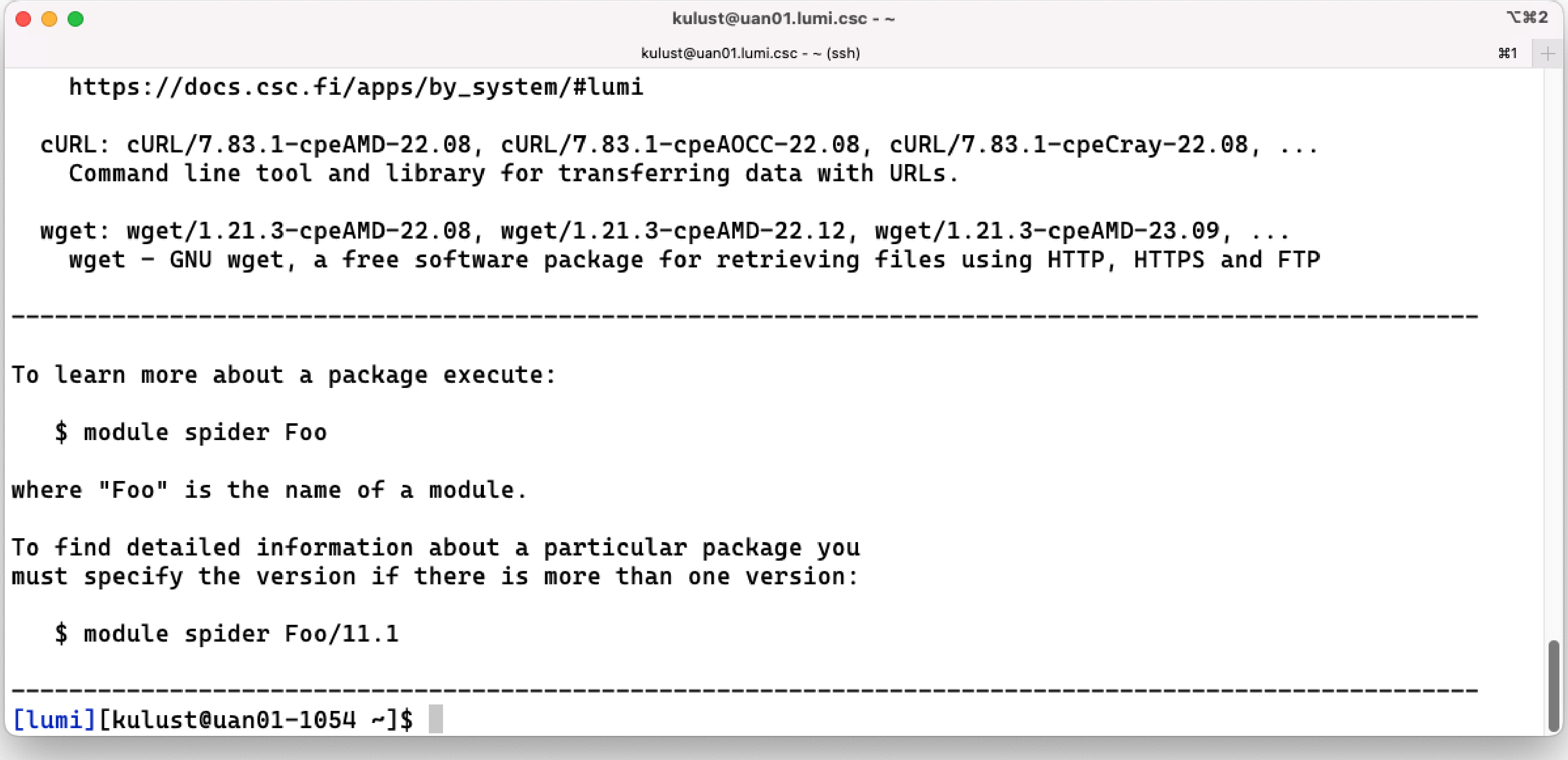
- Searches in the module short description and help message for the keyword.
  - E.g., try
    `module keyword https`
- We do try to put enough information in the modules to make this a suitable additional way to discover software that is already installed on the system

module keyword https



```
----------------------------------------------------------------------------------------------------

The following modules match your search criteria: "https"
----------------------------------------------------------------------------------------------------


  Local-CSC: Local-CSC/default
    Makes the CSC-managed local software collection available, see
    https://docs.csc.fi/apps/by_system/#lumi

  cURL: cURL/7.83.1-cpeAMD-22.08, cURL/7.83.1-cpeAOCC-22.08, cURL/7.83.1-cpeCray-22.08, ...
    Command line tool and library for transferring data with URLs.

  wget: wget/1.21.3-cpeAMD-22.08, wget/1.21.3-cpeAMD-22.12, wget/1.21.3-cpeAMD-23.09, ...
    wget - GNU wget, a free software package for retrieving files using HTTP, HTTPS and FTP

----------------------------------------------------------------------------------------------------

To learn more about a package execute:

   $ module spider Foo

where "Foo" is the name of a module.
lines 1-22
```

module keyword https (2)

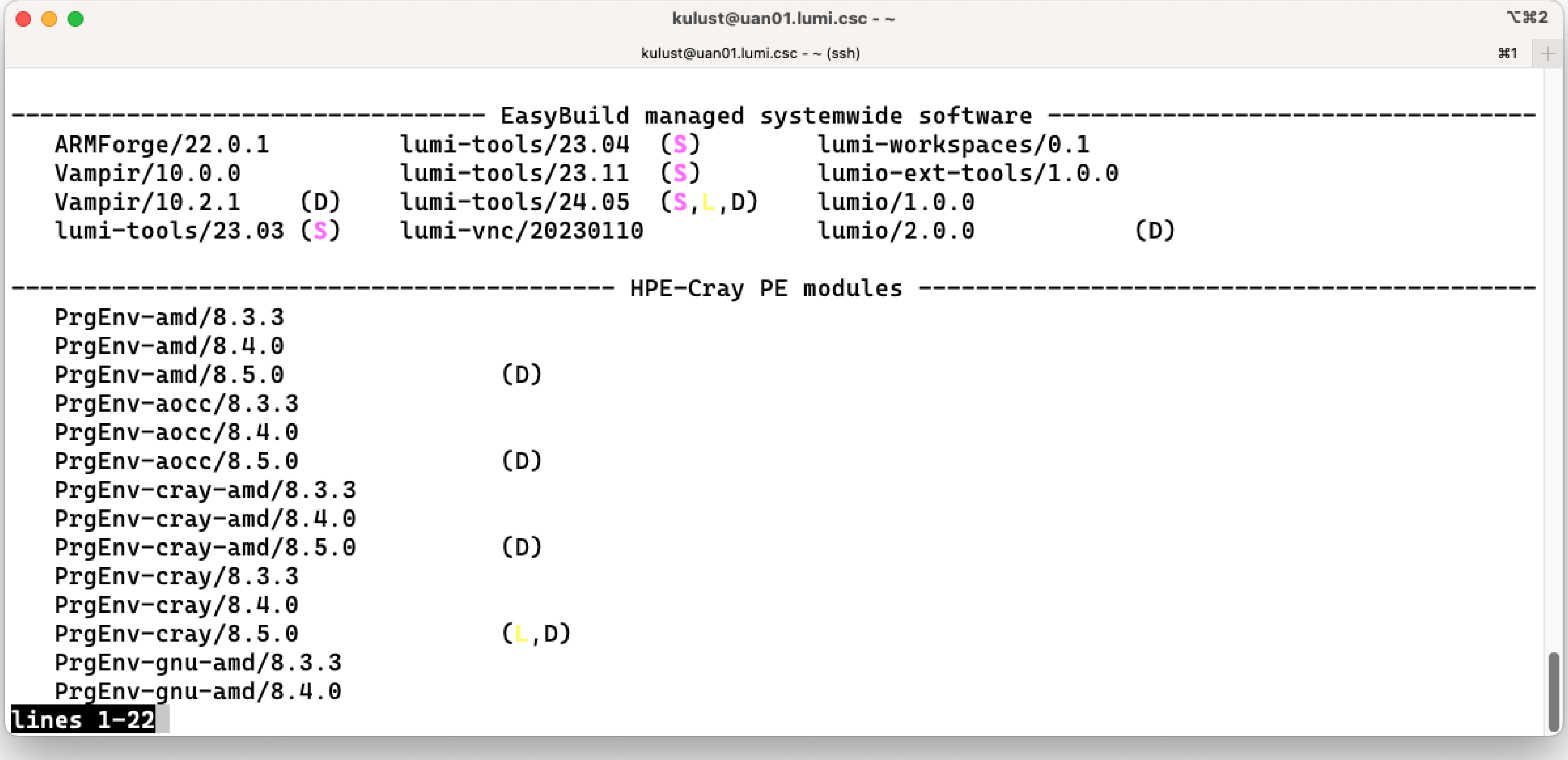


```
    https://docs.csc.fi/apps/by_system/#lumi

  cURL: cURL/7.83.1-cpeAMD-22.08, cURL/7.83.1-cpeAOCC-22.08, cURL/7.83.1-cpeCray-22.08, ...
    Command line tool and library for transferring data with URLs.

  wget: wget/1.21.3-cpeAMD-22.08, wget/1.21.3-cpeAMD-22.12, wget/1.21.3-cpeAMD-23.09, ...
    wget - GNU wget, a free software package for retrieving files using HTTP, HTTPS and FTP

------------------------------------------------------------------------------------------------------


To learn more about a package execute:

   $ module spider Foo

where "Foo" is the name of a module.

To find detailed information about a particular package you
must specify the version if there is more than one version:

   $ module spider Foo/11.1

------------------------------------------------------------------------------------------------------
[lumi][kulust@uan01-1054 ~]$
```

Sticky modules and module purge

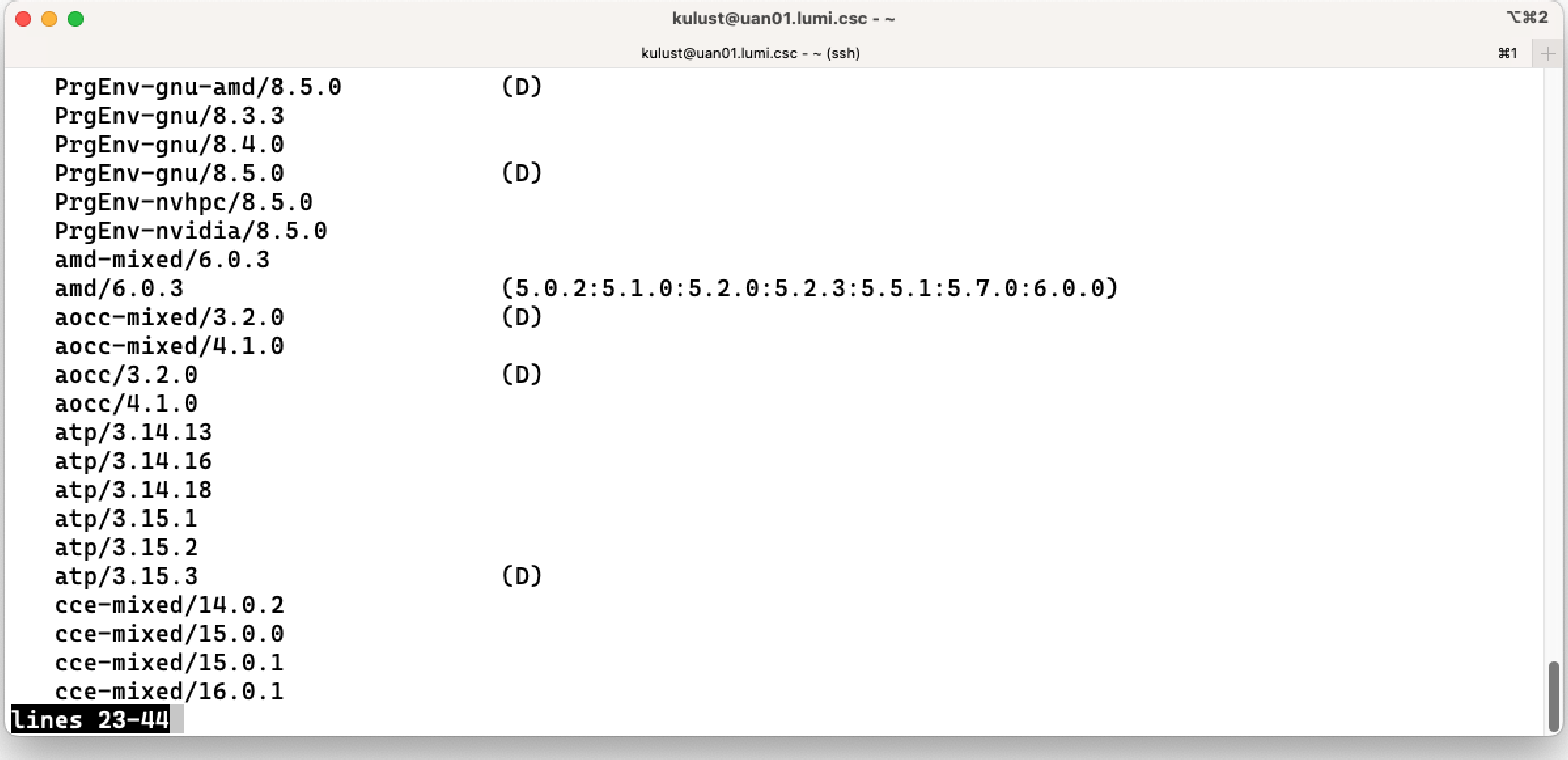
- On some systems, you will be taught to avoid `module purge` (which unloads all modules)
- Sticky modules are modules that are not unloaded by `module purge`, but reloaded.
  - They can be force-unloaded with `module --force purge` and `module --force unload` but use at your own risk!
- Used on LUMI for the software stacks and modules that set the display style of the modules
  - But keep in mind that the modules are reloaded which can have side effects

module av



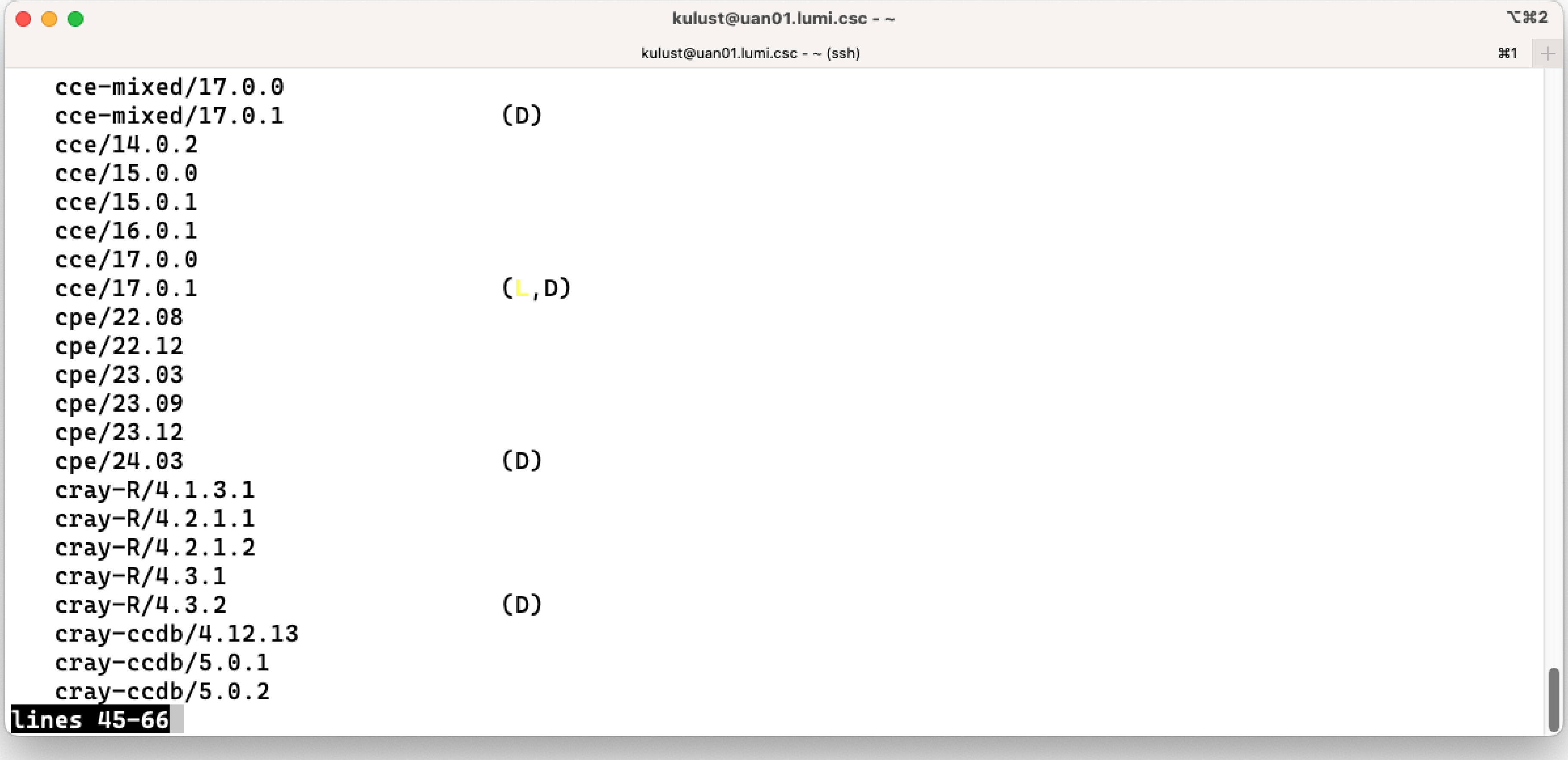
```
-------------------------------- EasyBuild managed systemwide software ------------------------------------
   ARMForge/22.0.1          lumi-tools/23.04  (S)       lumi-workspaces/0.1
   Vampir/10.0.0            lumi-tools/23.11  (S)       lumio-ext-tools/1.0.0
   Vampir/10.2.1    (D)     lumi-tools/24.05  (S,L,D)   lumio/1.0.0
   lumi-tools/23.03 (S)     lumi-vnc/20230110           lumio/2.0.0           (D)

------------------------------------------ HPE-Cray PE modules --------------------------------------------
   PrgEnv-amd/8.3.3
   PrgEnv-amd/8.4.0
   PrgEnv-amd/8.5.0                (D)
   PrgEnv-aocc/8.3.3
   PrgEnv-aocc/8.4.0
   PrgEnv-aocc/8.5.0               (D)
   PrgEnv-cray-amd/8.3.3
   PrgEnv-cray-amd/8.4.0
   PrgEnv-cray-amd/8.5.0           (D)
   PrgEnv-cray/8.3.3
   PrgEnv-cray/8.4.0
   PrgEnv-cray/8.5.0               (L,D)
   PrgEnv-gnu-amd/8.3.3
   PrgEnv-gnu-amd/8.4.0
lines 1-22
```

module av (2)



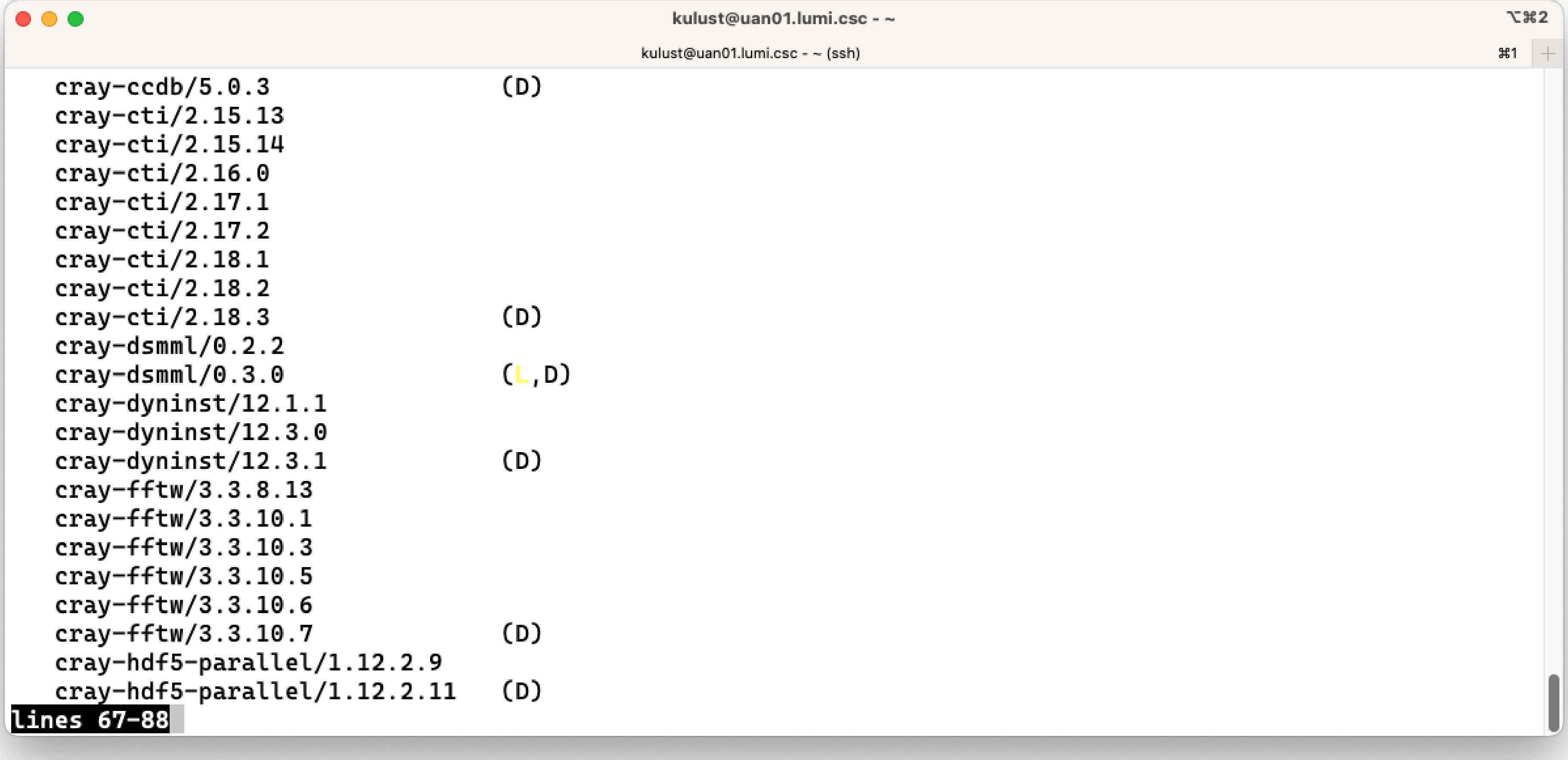
```
   PrgEnv-gnu-amd/8.5.0             (D)
   PrgEnv-gnu/8.3.3
   PrgEnv-gnu/8.4.0
   PrgEnv-gnu/8.5.0                 (D)
   PrgEnv-nvhpc/8.5.0
   PrgEnv-nvidia/8.5.0
   amd-mixed/6.0.3
   amd/6.0.3                        (5.0.2:5.1.0:5.2.0:5.2.3:5.5.1:5.7.0:6.0.0)
   aocc-mixed/3.2.0                 (D)
   aocc-mixed/4.1.0
   aocc/3.2.0                       (D)
   aocc/4.1.0
   atp/3.14.13
   atp/3.14.16
   atp/3.14.18
   atp/3.15.1
   atp/3.15.2
   atp/3.15.3                       (D)
   cce-mixed/14.0.2
   cce-mixed/15.0.0
   cce-mixed/15.0.1
   cce-mixed/16.0.1
lines 23-44
```

module av (3)



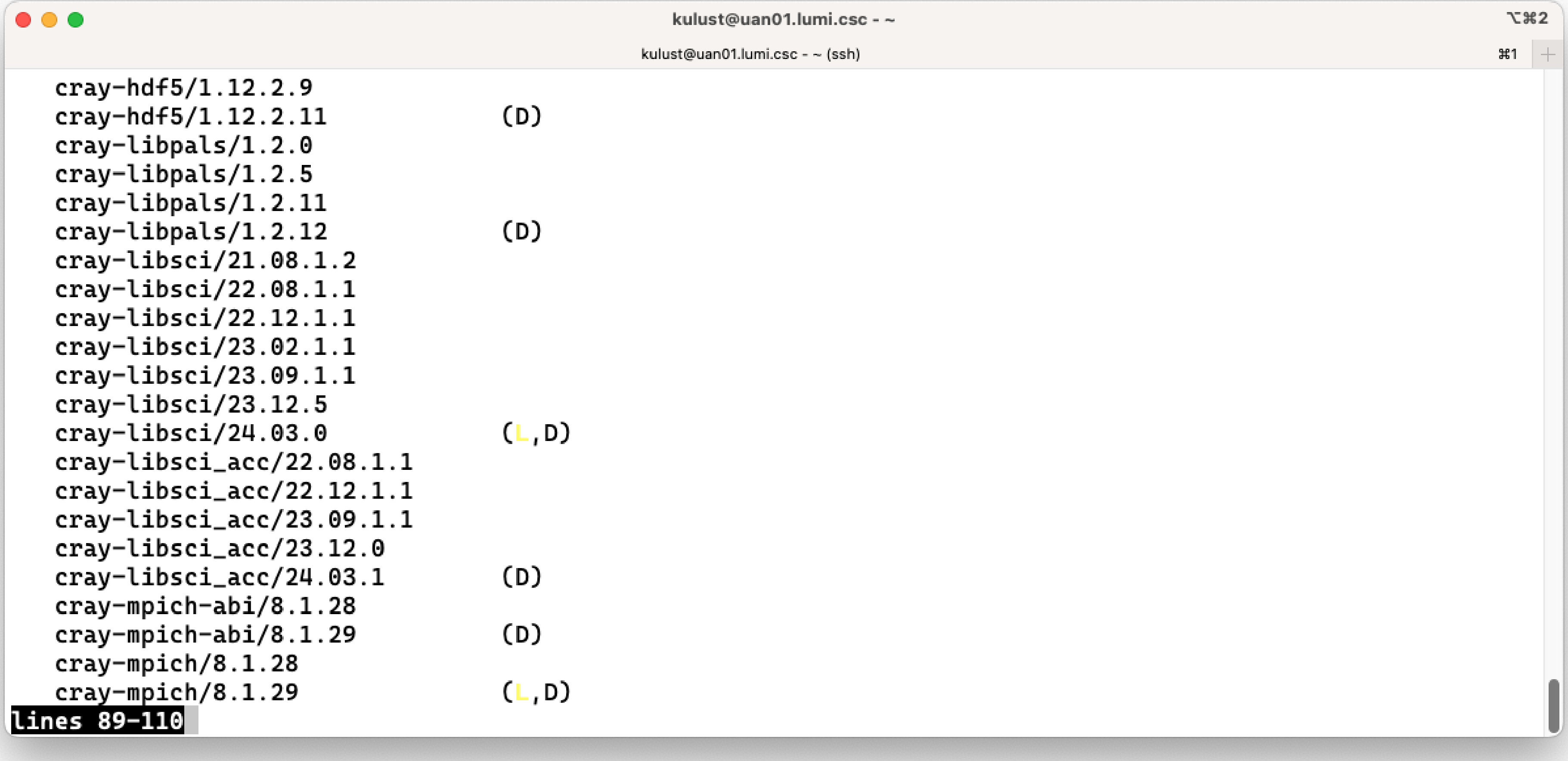
```
   cce-mixed/17.0.0
   cce-mixed/17.0.1                   (D)
   cce/14.0.2
   cce/15.0.0
   cce/15.0.1
   cce/16.0.1
   cce/17.0.0
   cce/17.0.1                         (L,D)
   cpe/22.08
   cpe/22.12
   cpe/23.03
   cpe/23.09
   cpe/23.12
   cpe/24.03                          (D)
   cray-R/4.1.3.1
   cray-R/4.2.1.1
   cray-R/4.2.1.2
   cray-R/4.3.1
   cray-R/4.3.2                       (D)
   cray-ccdb/4.12.13
   cray-ccdb/5.0.1
   cray-ccdb/5.0.2
lines 45-66
```

module av (4)



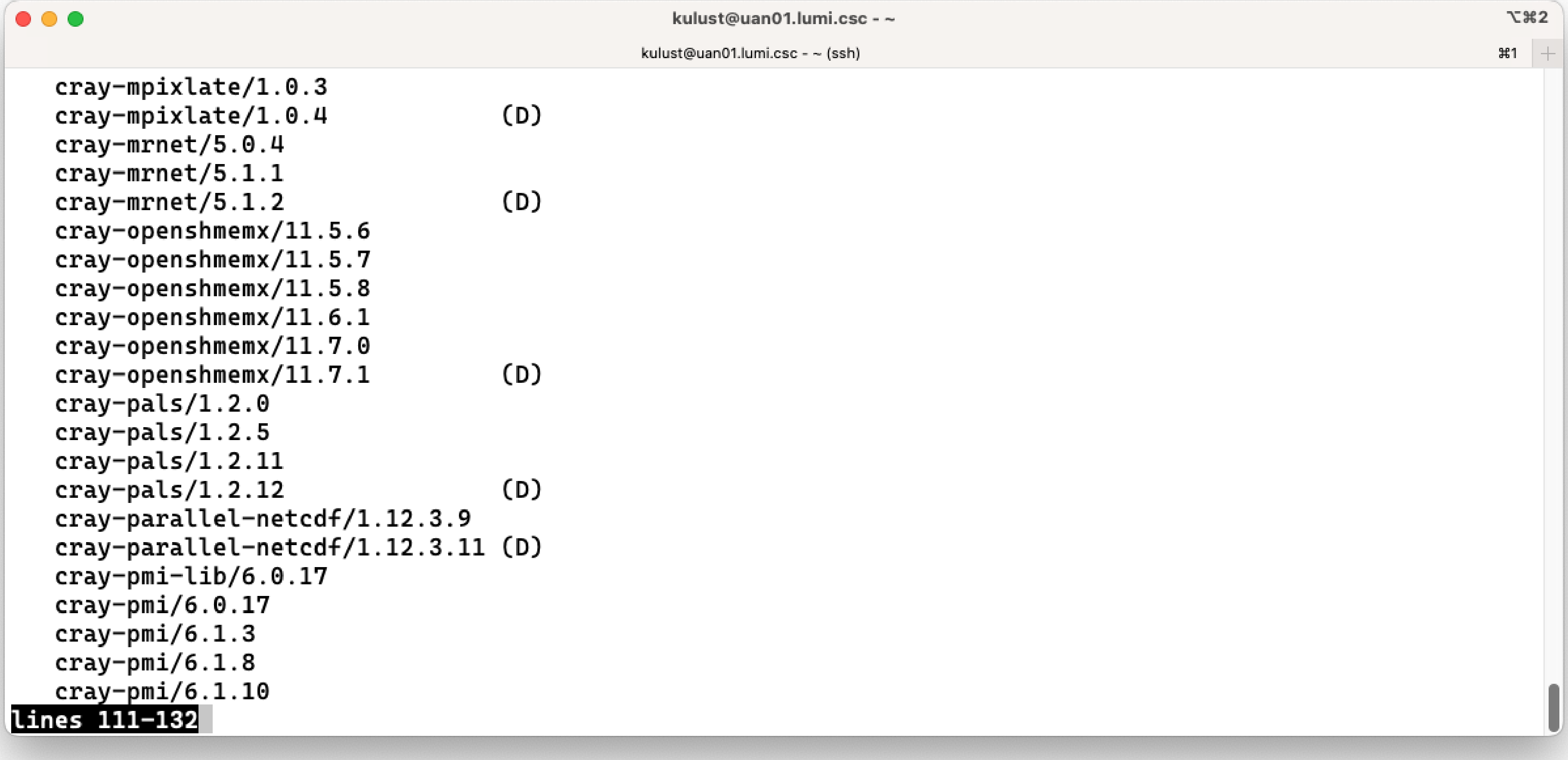
```
   cray-ccdb/5.0.3                (D)
   cray-cti/2.15.13
   cray-cti/2.15.14
   cray-cti/2.16.0
   cray-cti/2.17.1
   cray-cti/2.17.2
   cray-cti/2.18.1
   cray-cti/2.18.2
   cray-cti/2.18.3                (D)
   cray-dsmml/0.2.2
   cray-dsmml/0.3.0               (L,D)
   cray-dyninst/12.1.1
   cray-dyninst/12.3.0
   cray-dyninst/12.3.1            (D)
   cray-fftw/3.3.8.13
   cray-fftw/3.3.10.1
   cray-fftw/3.3.10.3
   cray-fftw/3.3.10.5
   cray-fftw/3.3.10.6
   cray-fftw/3.3.10.7             (D)
   cray-hdf5-parallel/1.12.2.9
   cray-hdf5-parallel/1.12.2.11   (D)
lines 67-88
```

module av (5)



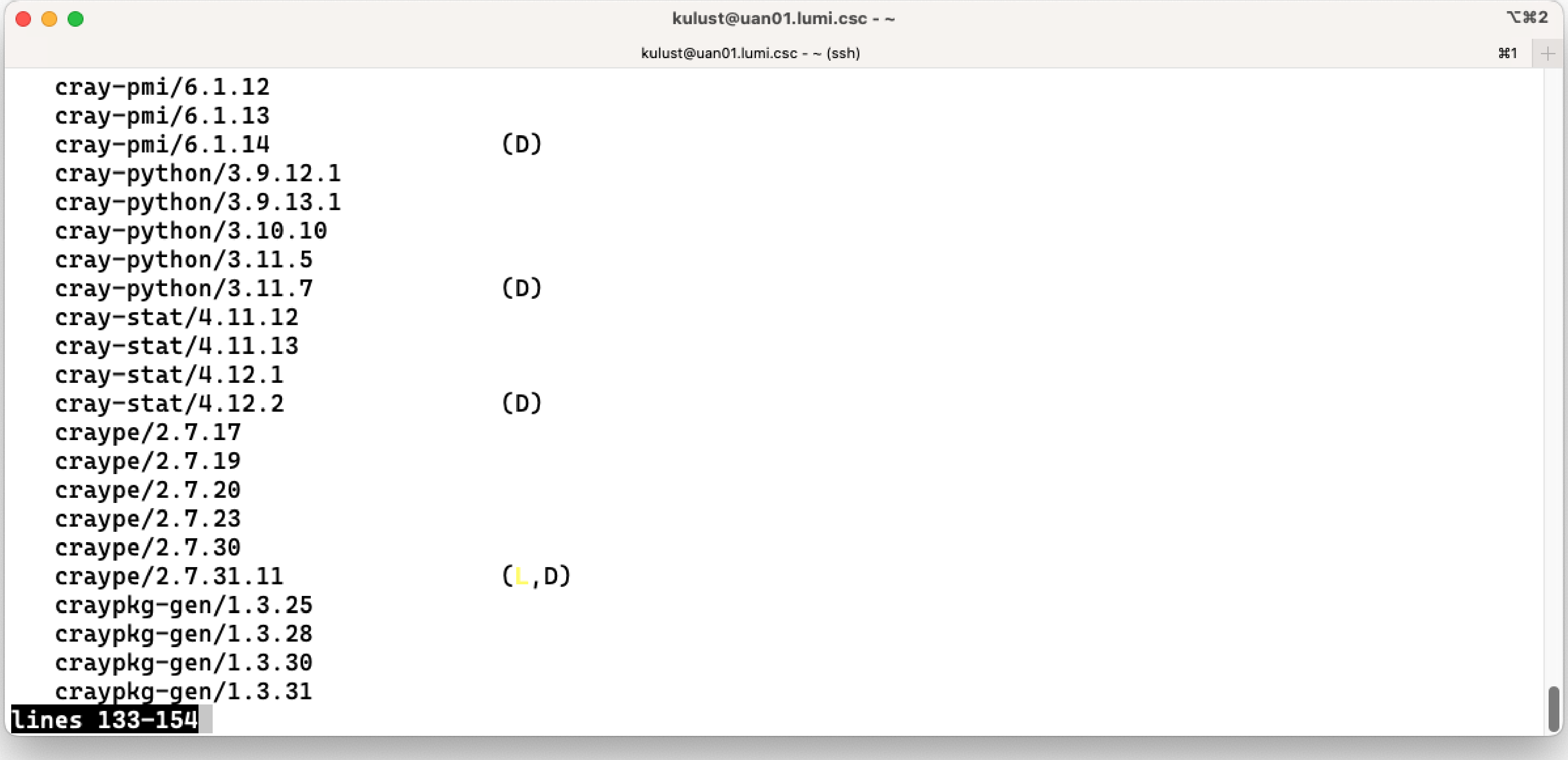
```
   cray-hdf5/1.12.2.9
   cray-hdf5/1.12.2.11             (D)
   cray-libpals/1.2.0
   cray-libpals/1.2.5
   cray-libpals/1.2.11
   cray-libpals/1.2.12             (D)
   cray-libsci/21.08.1.2
   cray-libsci/22.08.1.1
   cray-libsci/22.12.1.1
   cray-libsci/23.02.1.1
   cray-libsci/23.09.1.1
   cray-libsci/23.12.5
   cray-libsci/24.03.0             (L,D)
   cray-libsci_acc/22.08.1.1
   cray-libsci_acc/22.12.1.1
   cray-libsci_acc/23.09.1.1
   cray-libsci_acc/23.12.0
   cray-libsci_acc/24.03.1         (D)
   cray-mpich-abi/8.1.28
   cray-mpich-abi/8.1.29           (D)
   cray-mpich/8.1.28
   cray-mpich/8.1.29               (L,D)
lines 89-110
```

module av (6)



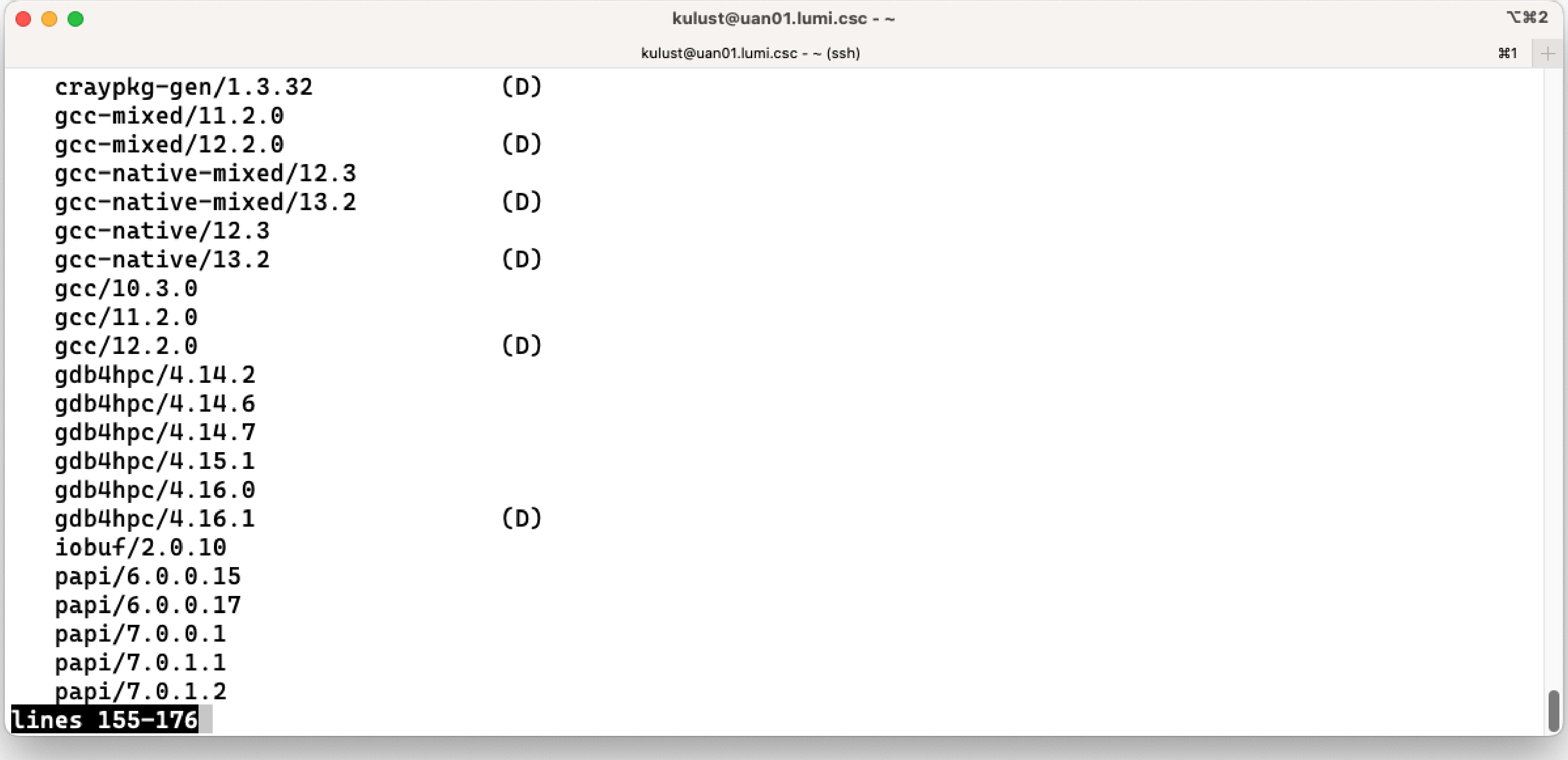
```
   cray-mpixlate/1.0.3
   cray-mpixlate/1.0.4            (D)
   cray-mrnet/5.0.4
   cray-mrnet/5.1.1
   cray-mrnet/5.1.2               (D)
   cray-openshmemx/11.5.6
   cray-openshmemx/11.5.7
   cray-openshmemx/11.5.8
   cray-openshmemx/11.6.1
   cray-openshmemx/11.7.0
   cray-openshmemx/11.7.1         (D)
   cray-pals/1.2.0
   cray-pals/1.2.5
   cray-pals/1.2.11
   cray-pals/1.2.12               (D)
   cray-parallel-netcdf/1.12.3.9
   cray-parallel-netcdf/1.12.3.11 (D)
   cray-pmi-lib/6.0.17
   cray-pmi/6.0.17
   cray-pmi/6.1.3
   cray-pmi/6.1.8
   cray-pmi/6.1.10
lines 111-132
```

module av (7)



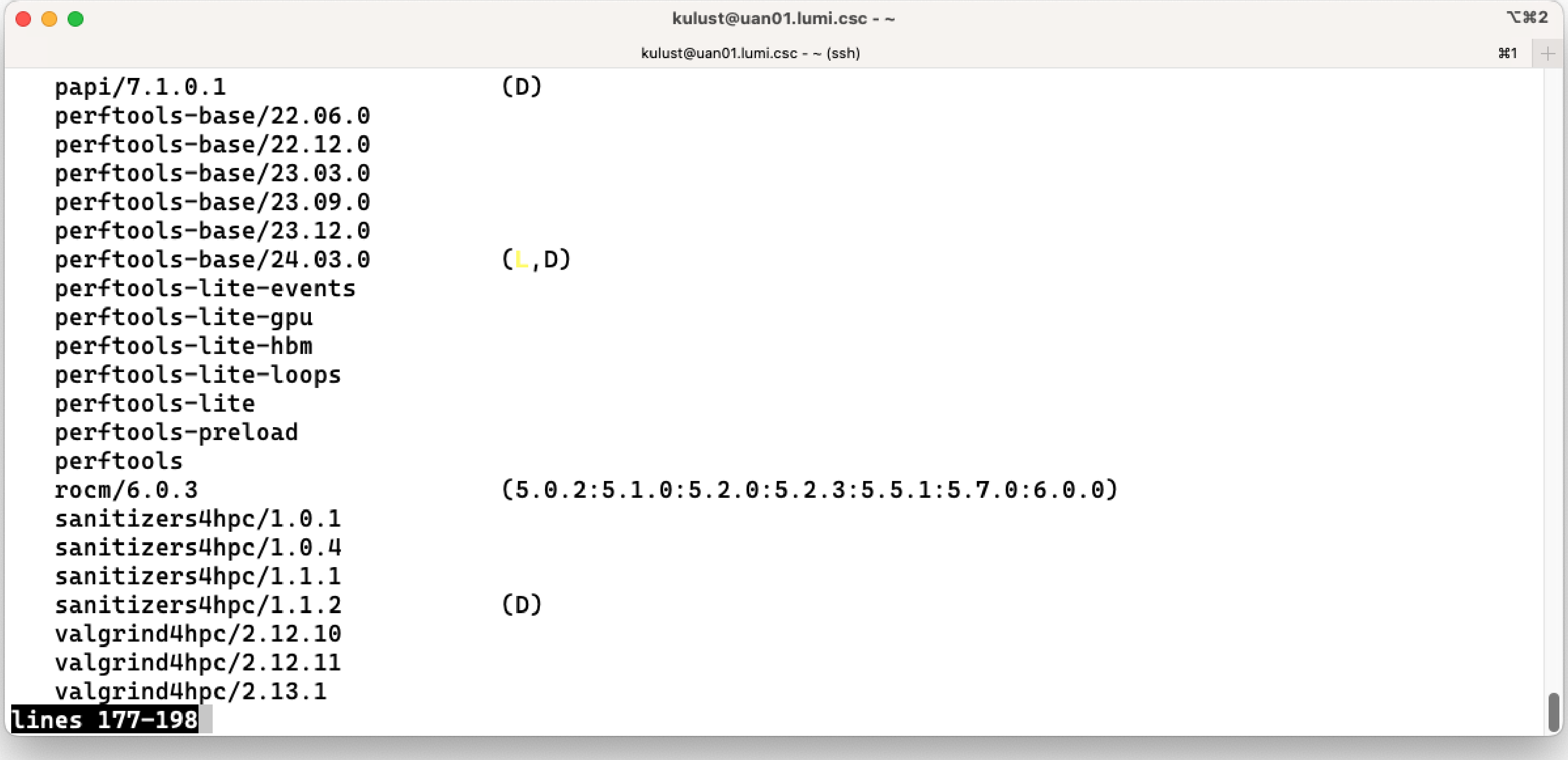
```
   cray-pmi/6.1.12
   cray-pmi/6.1.13
   cray-pmi/6.1.14                    (D)
   cray-python/3.9.12.1
   cray-python/3.9.13.1
   cray-python/3.10.10
   cray-python/3.11.5
   cray-python/3.11.7                 (D)
   cray-stat/4.11.12
   cray-stat/4.11.13
   cray-stat/4.12.1
   cray-stat/4.12.2                   (D)
   craype/2.7.17
   craype/2.7.19
   craype/2.7.20
   craype/2.7.23
   craype/2.7.30
   craype/2.7.31.11                   (L,D)
   craypkg-gen/1.3.25
   craypkg-gen/1.3.28
   craypkg-gen/1.3.30
   craypkg-gen/1.3.31
lines 133-154
```

module av (8)



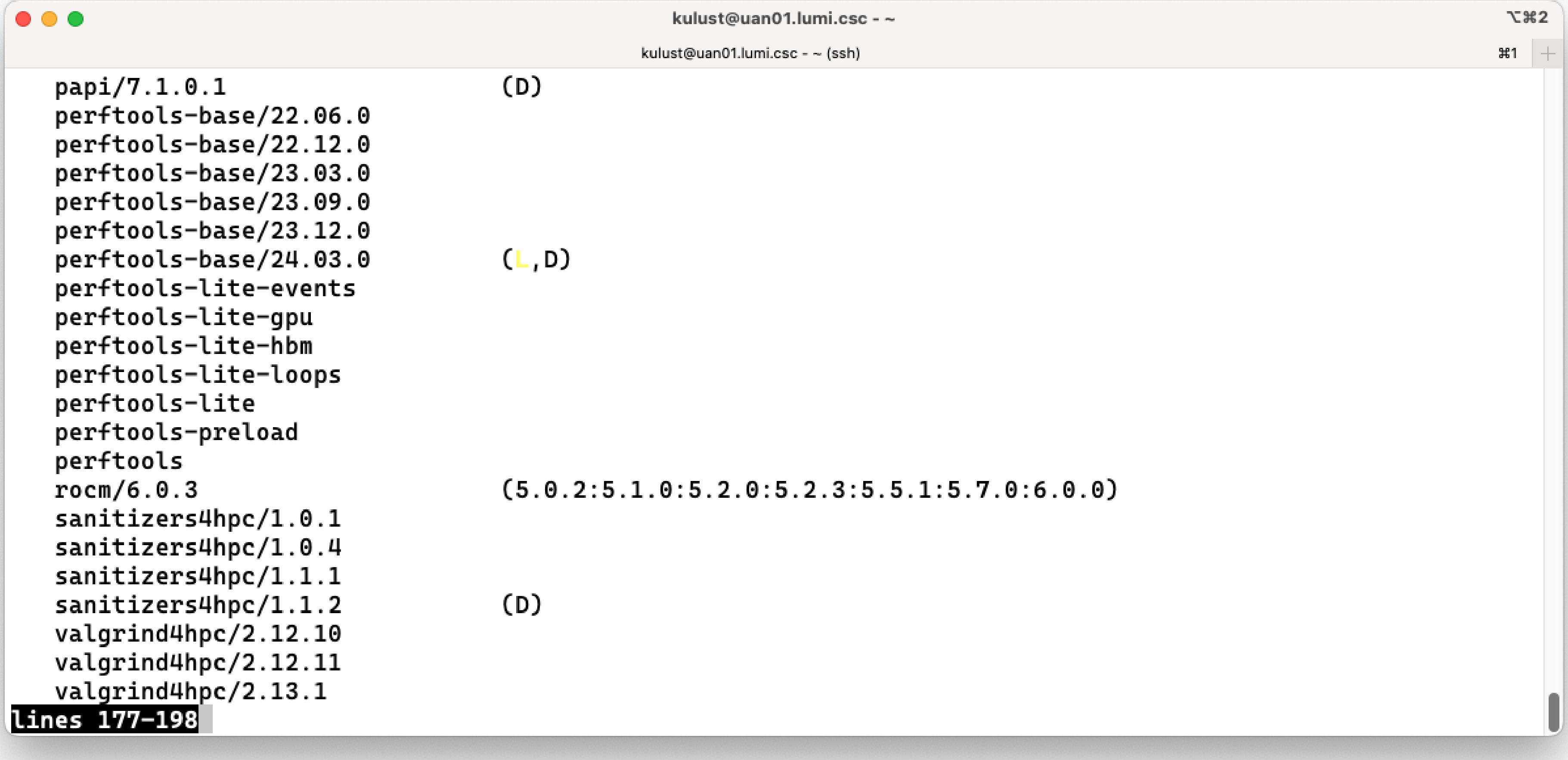
```
   craypkg-gen/1.3.32             (D)
   gcc-mixed/11.2.0
   gcc-mixed/12.2.0               (D)
   gcc-native-mixed/12.3
   gcc-native-mixed/13.2          (D)
   gcc-native/12.3
   gcc-native/13.2                (D)
   gcc/10.3.0
   gcc/11.2.0
   gcc/12.2.0                     (D)
   gdb4hpc/4.14.2
   gdb4hpc/4.14.6
   gdb4hpc/4.14.7
   gdb4hpc/4.15.1
   gdb4hpc/4.16.0
   gdb4hpc/4.16.1                 (D)
   iobuf/2.0.10
   papi/6.0.0.15
   papi/6.0.0.17
   papi/7.0.0.1
   papi/7.0.1.1
   papi/7.0.1.2
lines 155-176
```

module av (9)



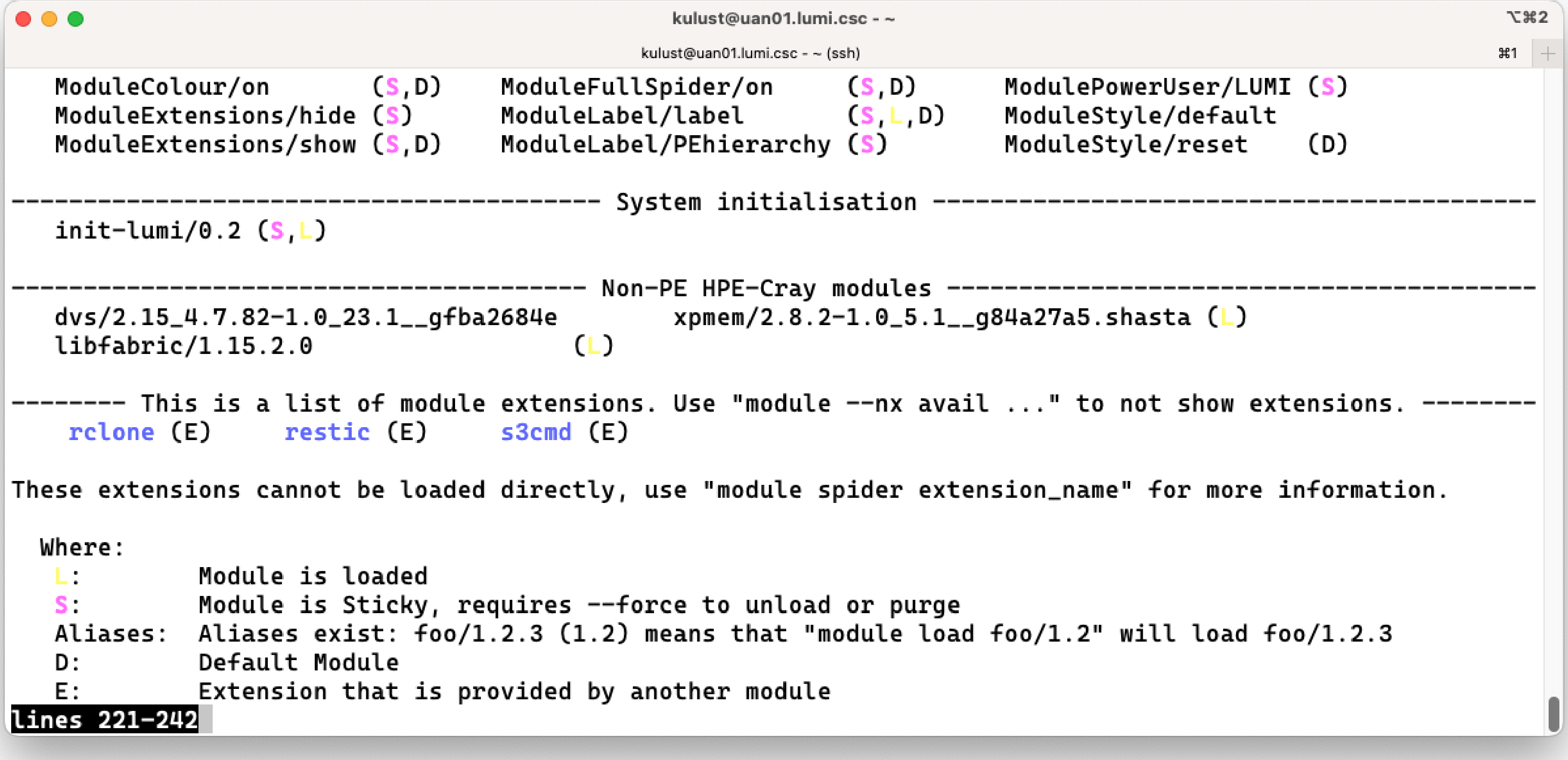
```
   papi/7.1.0.1                        (D)
   perftools-base/22.06.0
   perftools-base/22.12.0
   perftools-base/23.03.0
   perftools-base/23.09.0
   perftools-base/23.12.0
   perftools-base/24.03.0              (L,D)
   perftools-lite-events
   perftools-lite-gpu
   perftools-lite-hbm
   perftools-lite-loops
   perftools-lite
   perftools-preload
   perftools
   rocm/6.0.3                          (5.0.2:5.1.0:5.2.0:5.2.3:5.5.1:5.7.0:6.0.0)
   sanitizers4hpc/1.0.1
   sanitizers4hpc/1.0.4
   sanitizers4hpc/1.1.1
   sanitizers4hpc/1.1.2                (D)
   valgrind4hpc/2.12.10
   valgrind4hpc/2.12.11
   valgrind4hpc/2.13.1
lines 177-198
```

module av (10)



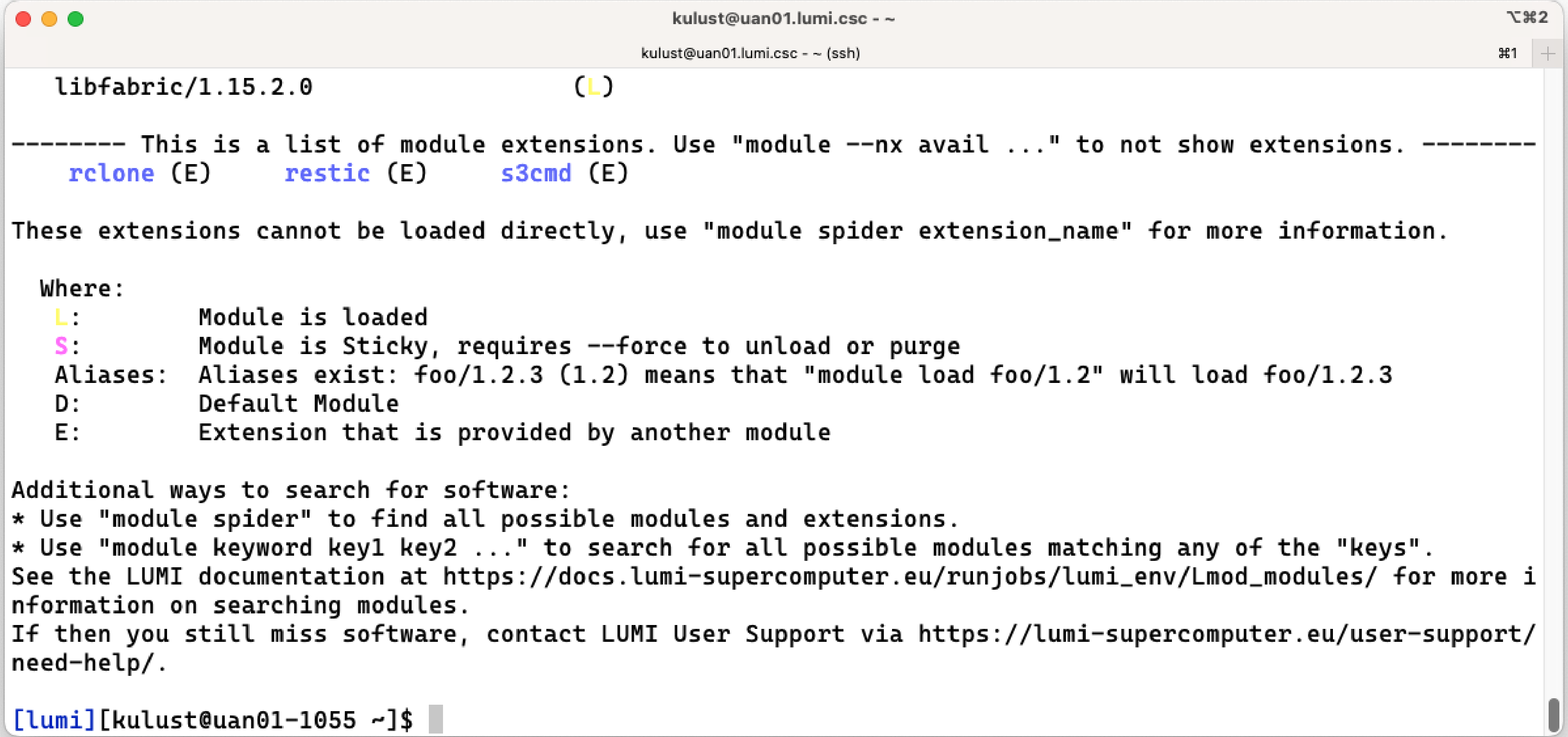
```
   papi/7.1.0.1                        (D)
   perftools-base/22.06.0
   perftools-base/22.12.0
   perftools-base/23.03.0
   perftools-base/23.09.0
   perftools-base/23.12.0
   perftools-base/24.03.0              (L,D)
   perftools-lite-events
   perftools-lite-gpu
   perftools-lite-hbm
   perftools-lite-loops
   perftools-lite
   perftools-preload
   perftools
   rocm/6.0.3                          (5.0.2:5.1.0:5.2.0:5.2.3:5.5.1:5.7.0:6.0.0)
   sanitizers4hpc/1.0.1
   sanitizers4hpc/1.0.4
   sanitizers4hpc/1.1.1
   sanitizers4hpc/1.1.2                (D)
   valgrind4hpc/2.12.10
   valgrind4hpc/2.12.11
   valgrind4hpc/2.13.1
lines 177-198
```

module av (11)



```
   ModuleColour/on        (S,D)    ModuleFullSpider/on     (S,D)      ModulePowerUser/LUMI (S)
   ModuleExtensions/hide (S)       ModuleLabel/label       (S,L,D)    ModuleStyle/default
   ModuleExtensions/show (S,D)    ModuleLabel/PEhierarchy (S)         ModuleStyle/reset    (D)

-------------------------------------- System initialisation --------------------------------------
   init-lumi/0.2 (S,L)

------------------------------------- Non-PE HPE-Cray modules -------------------------------------
   dvs/2.15_4.7.82-1.0_23.1__gfba2684e        xpmem/2.8.2-1.0_5.1__g84a27a5.shasta (L)
   libfabric/1.15.2.0                  (L)

-------- This is a list of module extensions. Use "module --nx avail ..." to not show extensions. --------
    rclone (E)     restic (E)     s3cmd (E)

These extensions cannot be loaded directly, use "module spider extension_name" for more information.

  Where:
   L:         Module is loaded
   S:         Module is Sticky, requires --force to unload or purge
   Aliases:   Aliases exist: foo/1.2.3 (1.2) means that "module load foo/1.2" will load foo/1.2.3
   D:         Default Module
   E:         Extension that is provided by another module
lines 221-242
```

module av (12)



```
   libfabric/1.15.2.0                  (L)

-------- This is a list of module extensions. Use "module --nx avail ..." to not show extensions. --------
    rclone (E)     restic (E)     s3cmd (E)

These extensions cannot be loaded directly, use "module spider extension_name" for more information.

  Where:
   L:        Module is loaded
   S:        Module is Sticky, requires --force to unload or purge
   Aliases:  Aliases exist: foo/1.2.3 (1.2) means that "module load foo/1.2" will load foo/1.2.3
   D:        Default Module
   E:        Extension that is provided by another module

Additional ways to search for software:
* Use "module spider" to find all possible modules and extensions.
* Use "module keyword key1 key2 ..." to search for all possible modules matching any of the "keys".
See the LUMI documentation at https://docs.lumi-supercomputer.eu/runjobs/lumi_env/Lmod_modules/ for more i
nformation on searching modules.
If then you still miss software, contact LUMI User Support via https://lumi-supercomputer.eu/user-support/
need-help/.

[lumi][kulust@uan01-1055 ~]$
```

Changing how the module list is displayed

- You may have noticed that you see descriptive texts in the module, not directories
- This can be changed by loading a module
  - `ModuleLabel/label` : The default view
  - `ModuleLabel/PEhierarchy` : Descriptive texts and unfolded PE hierarchy
  - `ModuleLabel/system` : Module directories
- Turn colour on or off using `ModuleColour/on` or `ModuleColour/off`
- Show or hide the module extensions with `ModuleExtensions/show` or `ModuleExtensions/hide`
- Index all modules with the spider command using `ModuleFullSpider/on`
- Show some hidden modules with `ModulePowerUser/LUMI`
  - This will also show undocumented/unsupported modules!
  - Can use `module --show_hidden avail` instead
- More customisation possible via LMOD environment variables

Getting help

- `module help` is the command to get help information for available modules
  - Without further arguments: help about the module command
  - We do try to add a bit more help information about what a module provides to the modules than default EasyBuild or Spack installations tend to do.
- Examples (require loading `CrayEnv`):

  ```
  module help cray-mpich
  module help cray-python/3.11.7
  module help buildtools/24.03
  ```

- `module whatis` can produce a short description

  ```
  module whatis Subversion
  module whatis Subversion/1.14.3
  ```

A note on caching

- Large module system = lots of small module files = Lustre not very happy
  - But Lmod does use caches by default
  - Currently no system cache, only a user cache in `$HOME/.cache/lmod`
- Cache refreshed automatically every 24 hours
  - You'll notice when the `spider` or `available` commands are slow
  - But you may need to clean the cache after creating a new module as on LUMI Lmod does not always detect the change
- Also clear the cache if you notice very strange answers from `module spider`.
  - Looks like the HPE Cray PE sometimes causes cache problems

A note on other commands

- `module load`, `module unload`, `module list` are fairly standard commands and the basic operation is the same in all module systems
  - Note that `module list` may also show inactive modules: Modules that were loaded at some point but got unloaded when a module closer to the root of the hierarchy got unloaded
- `module swap`:
  - Equivalent to an unload followed by a load
  - For two modules of the same family `module swap` is more efficient as Lmod does not first have to discover the family conflict
  - But it is not essential as LUMI has autoswap enabled

Questions?