Connecting with SSH

CÉCI HPC Training
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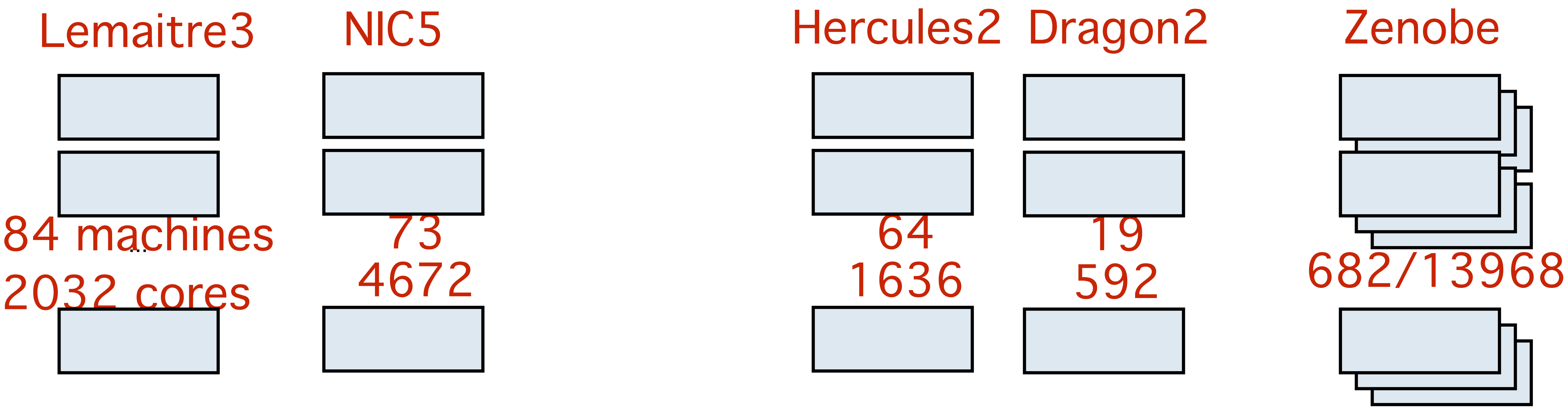
Plan of the talk

- Cluster presentation
  - ➡ On which machine you can connect and from where
- SSH theory
  - ➡ What is a public/private key
- SSH Tools
  - ➡ To connect
  - ➡ To edit file
  - ➡ To transfer file from/to the cluster



Lemaitre3 NIC5 Hercules2 Dragon2 Zenobe

84 machines
2032 cores

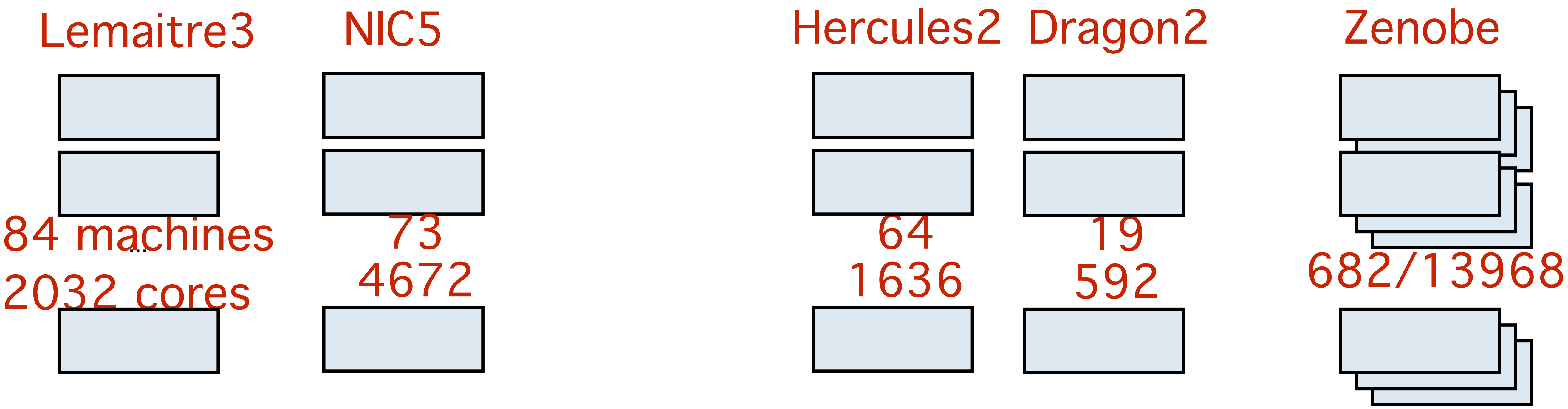
73
4672

64
1636

19
592

682/13968

- Close to 10,000 cores available trough your login
  - ➡ 14k more with zenobe (require approval but same login)
  - ➡ More available at European level (Prace program)
    - ✦ European competition to receive cpu time



Lemaitre3

84 machines

...

2032 cores

NIC5

73

4672

Hercules2

64

1636

Dragon2

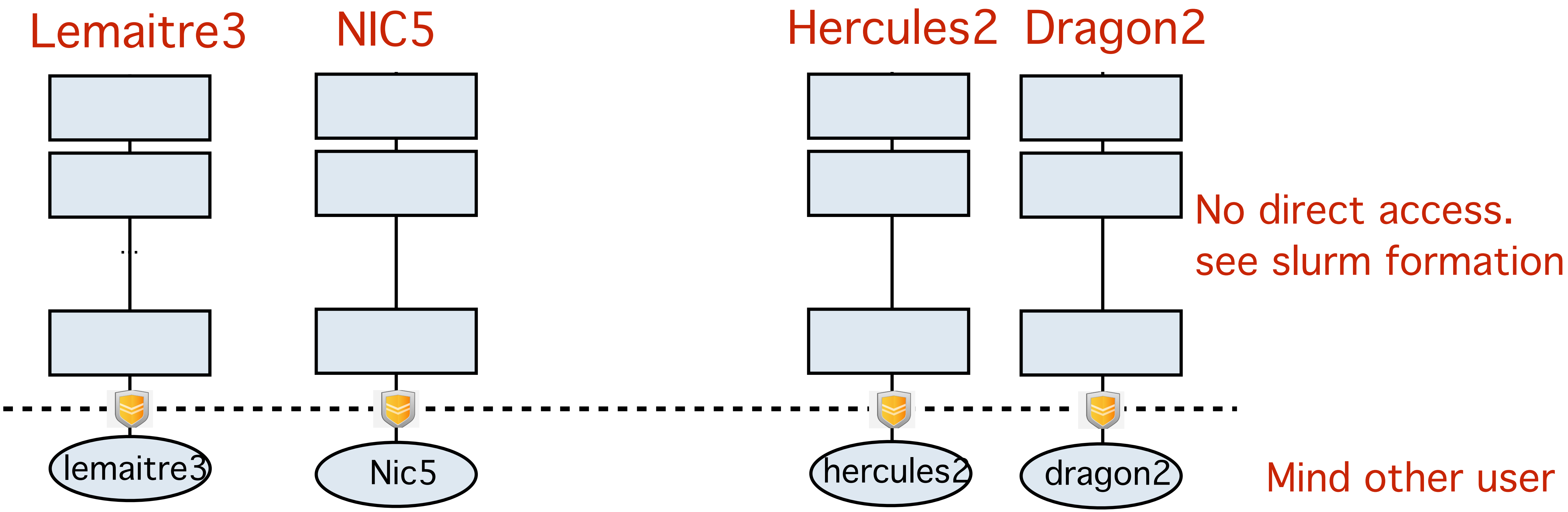
19

592

Zenobe

682/13968

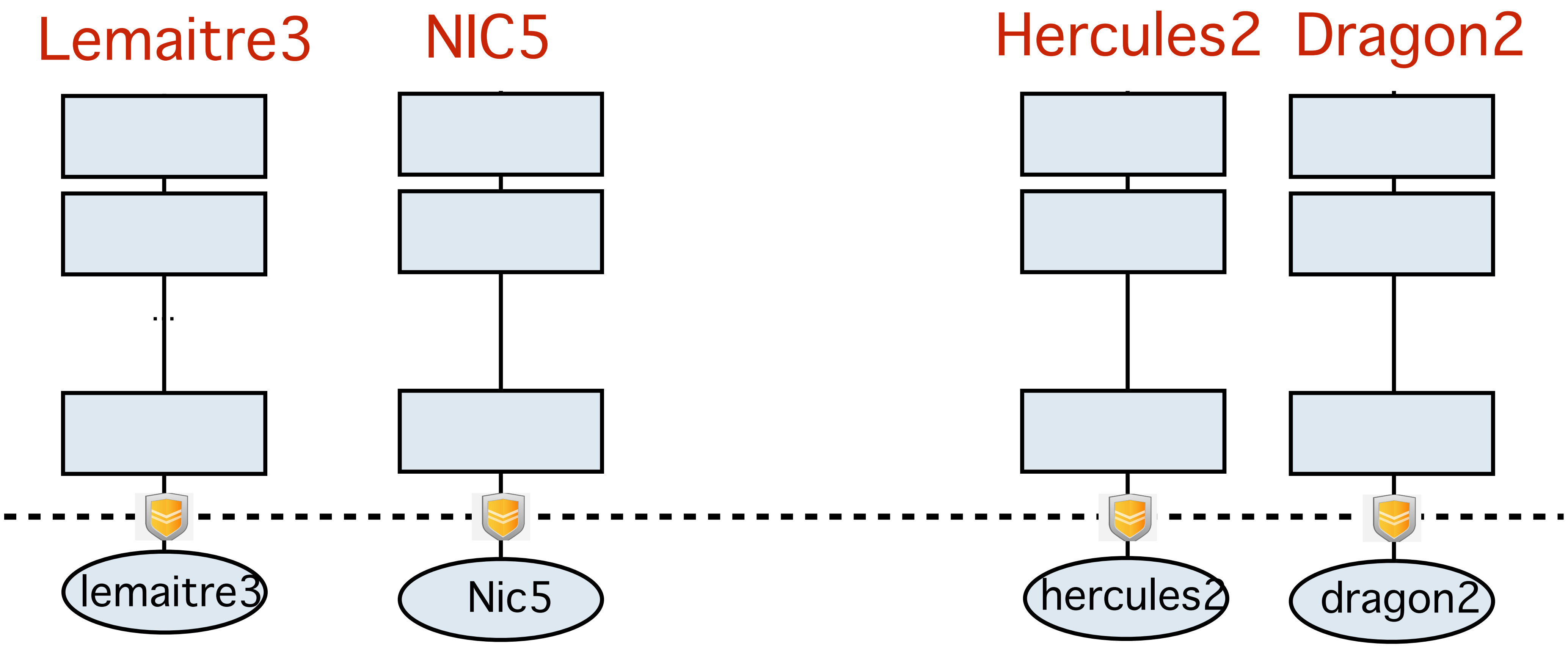
- You do not need/want to physically connect to all those machines to run script
  - ➡ Difficult to control fair share of the machines
  - ➡ Using a job scheduler -> SLURM
    - ✦ Session on SLURM on Thursday



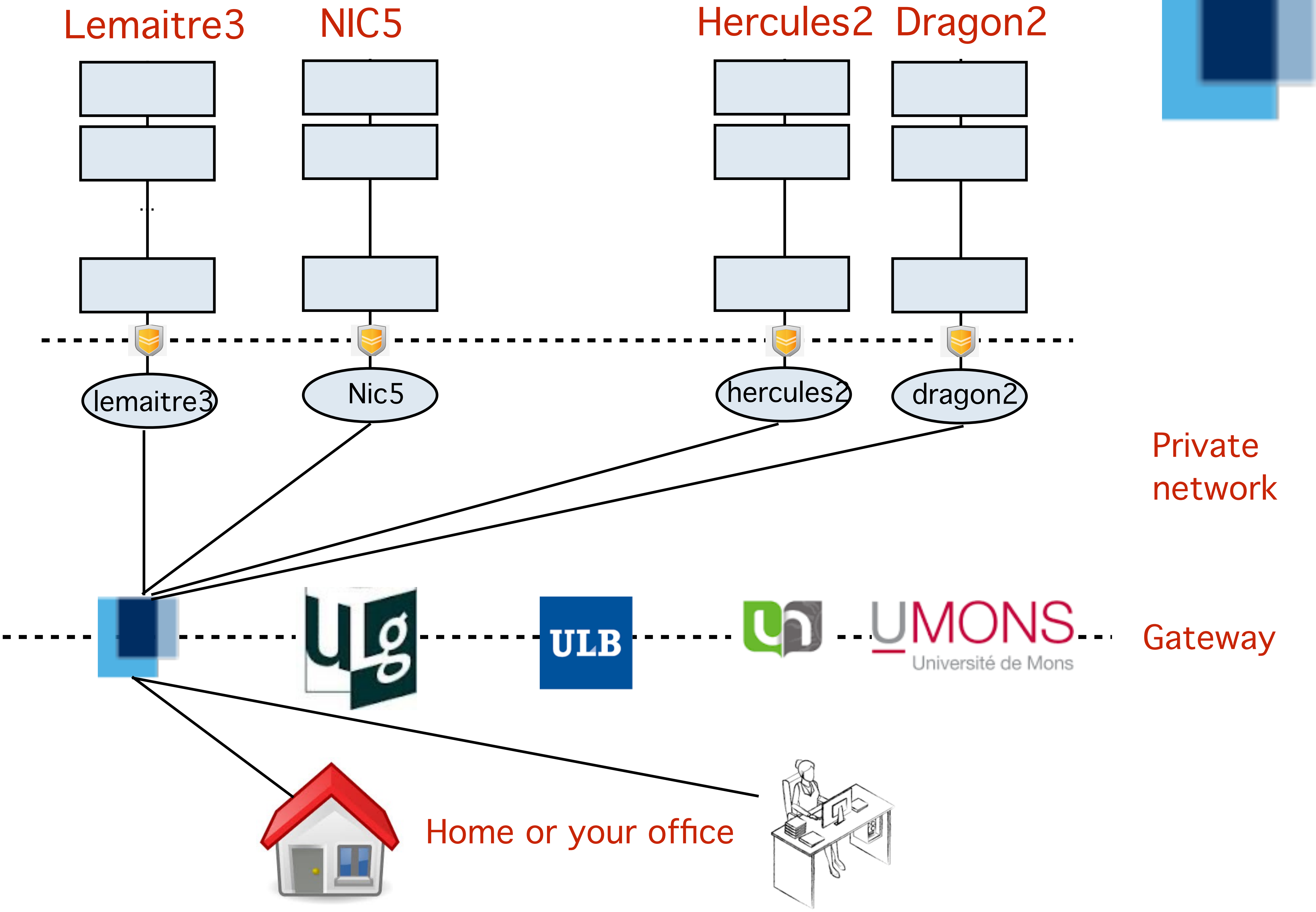
No direct access.
see slurm formation

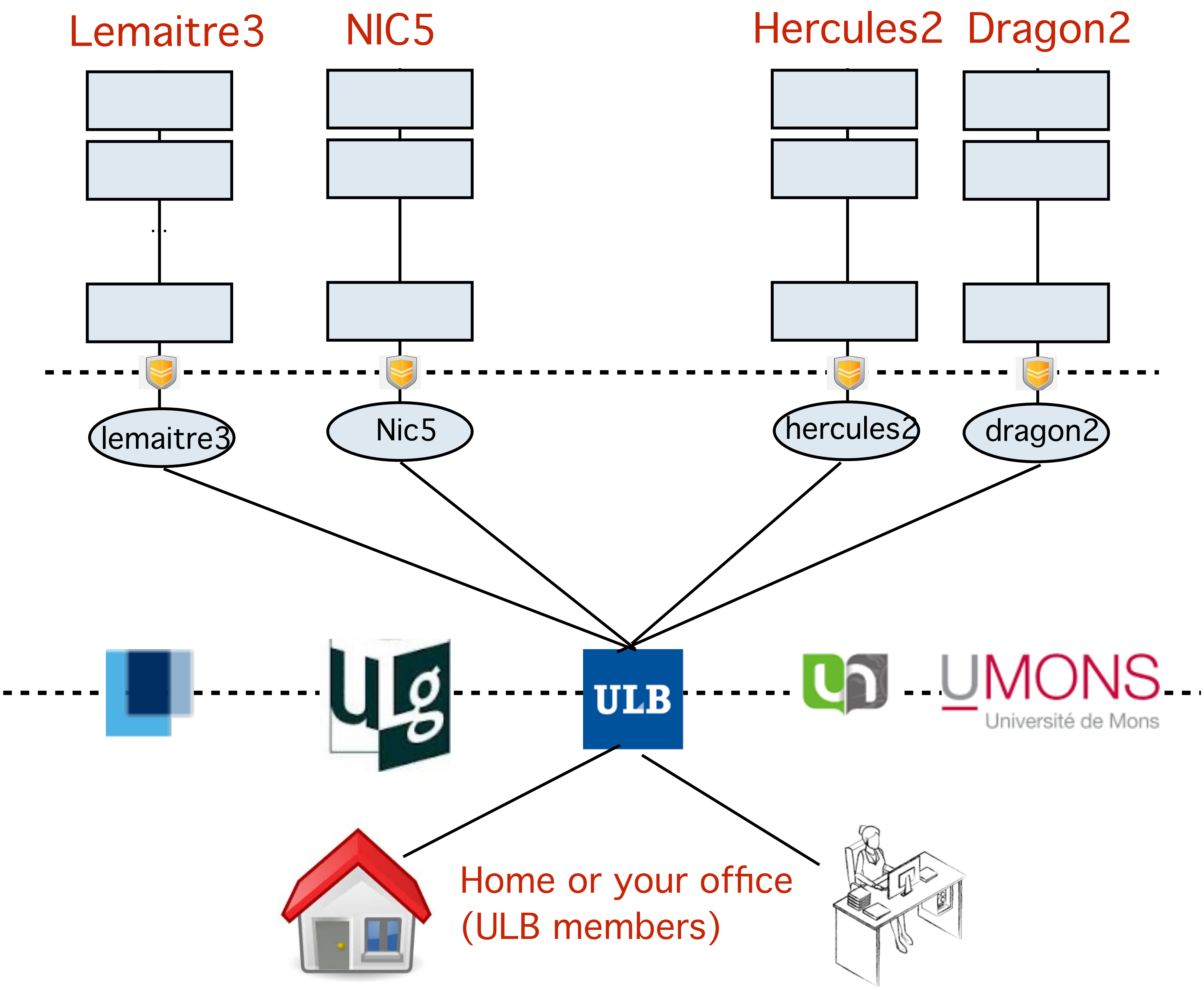
Mind other user

- To request machine, you connect to the FRONTNODE (also called user interface)
  - ✦ You can not connect to the other cpu!
  - ✦ You have to submit a job
- ➡ No heavy jobs on that machine
  - ✦ You will impact everyone
  - ✦ rather use debug/fast partition



- Cluster adress:
  - ➡ lemaitre3.cism.ucl.ac.be
  - ➡ nic5.uliege.be
  - ➡ hercules.ptci.unamur.be
  - ➡ dragon2.umons.ac.be

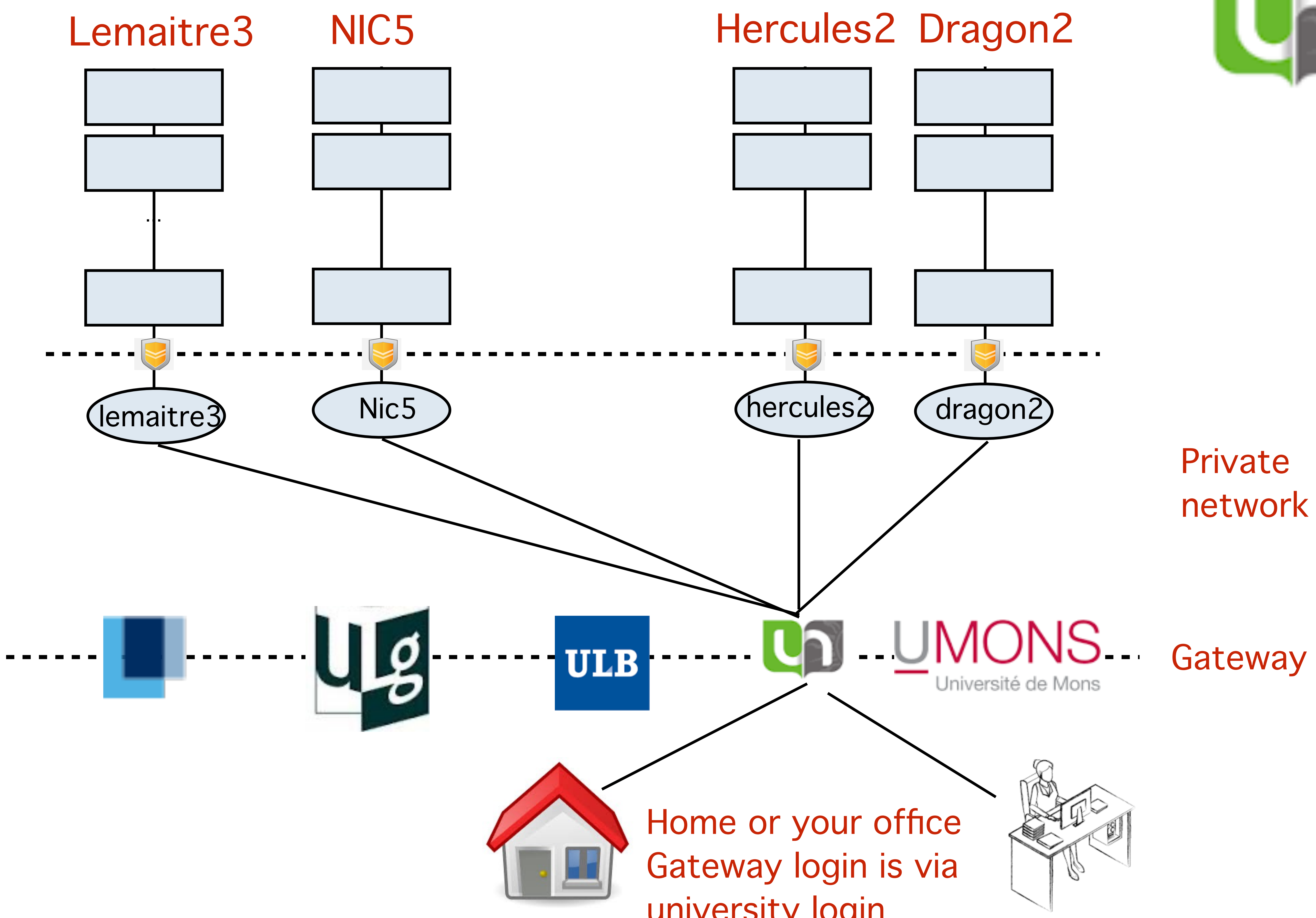

Lemaitre3
NIC5
Hercules2
Dragon2
...
lemaitre3
Nic5
hercules2
dragon2
Private network
ULB
UMONS
Université de Mons
Gateway
Home or your office



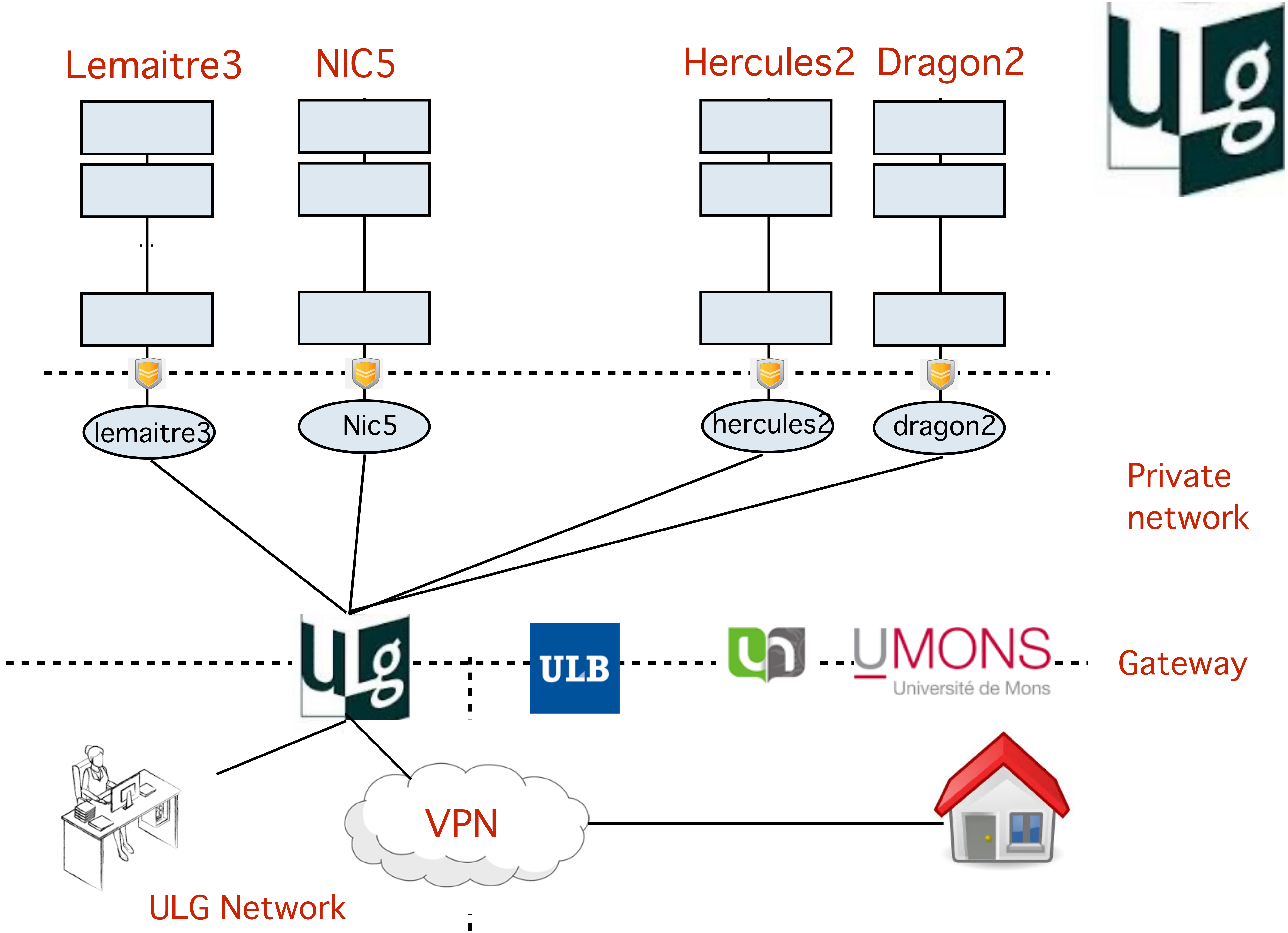
Private network

Gateway

Home or your office (ULB members)



Home or your office
Gateway login is via
university login


Lemaitre3
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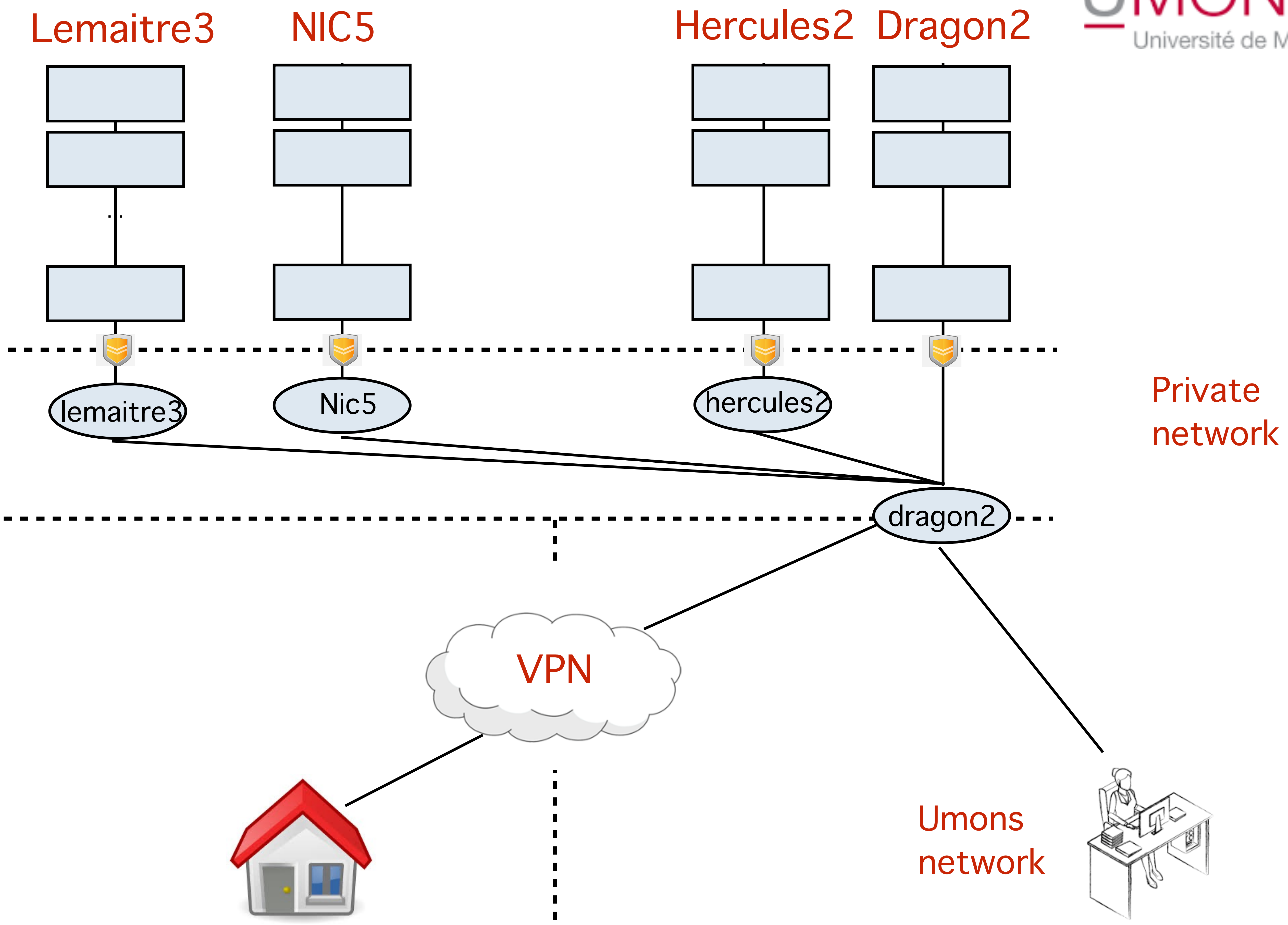
Nic5
hercules2
dragon2
Private network
ULB
UMONS
Université de Mons
Gateway
VPN
ULG Network


Lemaitre3
NIC5
Hercules2
Dragon2
...
lemaitre3
Nic5
hercules2
dragon2
Private network
VPN
Umons network

Gateway

- Machine where you can not do anything
  - ➡ But gives you access to the frontend
  - ➡ Some of those gateway you are not even allowed to open a terminal (ulb, ucl, ulg)
- Gateway address

➡ gwceci.cism.ucl.ac.be

➡ gwceci.ulb.ac.be

➡ gwceci.uliege.be

➡ gwceci.unamur.be (unamur id)

➡ dragon2.umons.ac.be

SSH concept

Each user can enter the computer via a dedicated door protected via a key hole

Key hole
=
Public key

The user has the associate key

Physical key
=
Private key

To protect the key it is store in a safe with digicode

Digi-code
=
Pass-phrase

SSH concept

Key hole
=
Public key

Physical key
=
Private key

Digi-code
=
Passphrase

- When you create/renew your CECI account
  - ➡ We generate the public key (key hole)
    - ✦ Set it up on all cluster
  - ➡ We generate the private key (crypted by your passphrase)
  - ➡ Send it to YOU by email (we do not have any copy)

- Public key
  - ➡ Used to encrypt data
  - ➡ Use to verify digital signature

- Private key
  - ➡ Used to decrypt data
  - ➡ Create digital signature

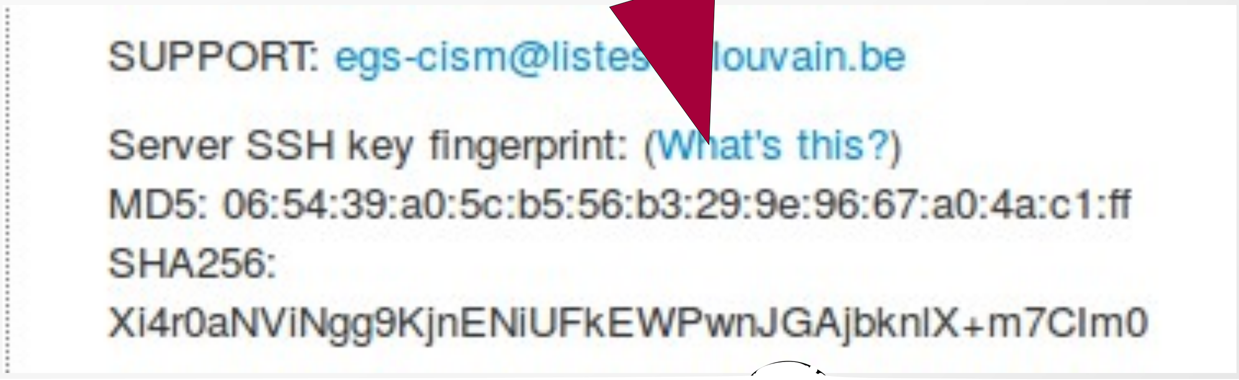
steps of a ssh connection

1. Establishing communication and Negotiate algorithm of encryption
2. Host Identification
   - ➡ Host send his public key + message sign with Host private key

Example

```
$ ssh -i ~/.ssh/id_rsa.ceci jcabrera@hmem.cism.ucl.ac.be
The authenticity of host 'hmem.cism.ucl.ac.be (130.104.1.220)' can't be established.
RSA key fingerprint is 06:54:39:a0:5c:b5:56:b3:29:9e:96:67:a0:4a:c1:ff.
Are you sure you want to continue connecting (yes/no)?
```

FIRST TIME you connect to a frontend host from a client,
you will be asked to accept the Public Key
Check the key fingerprint from CÉCI web site
http://www.ceci-hpc.be/clusters.html#hmem



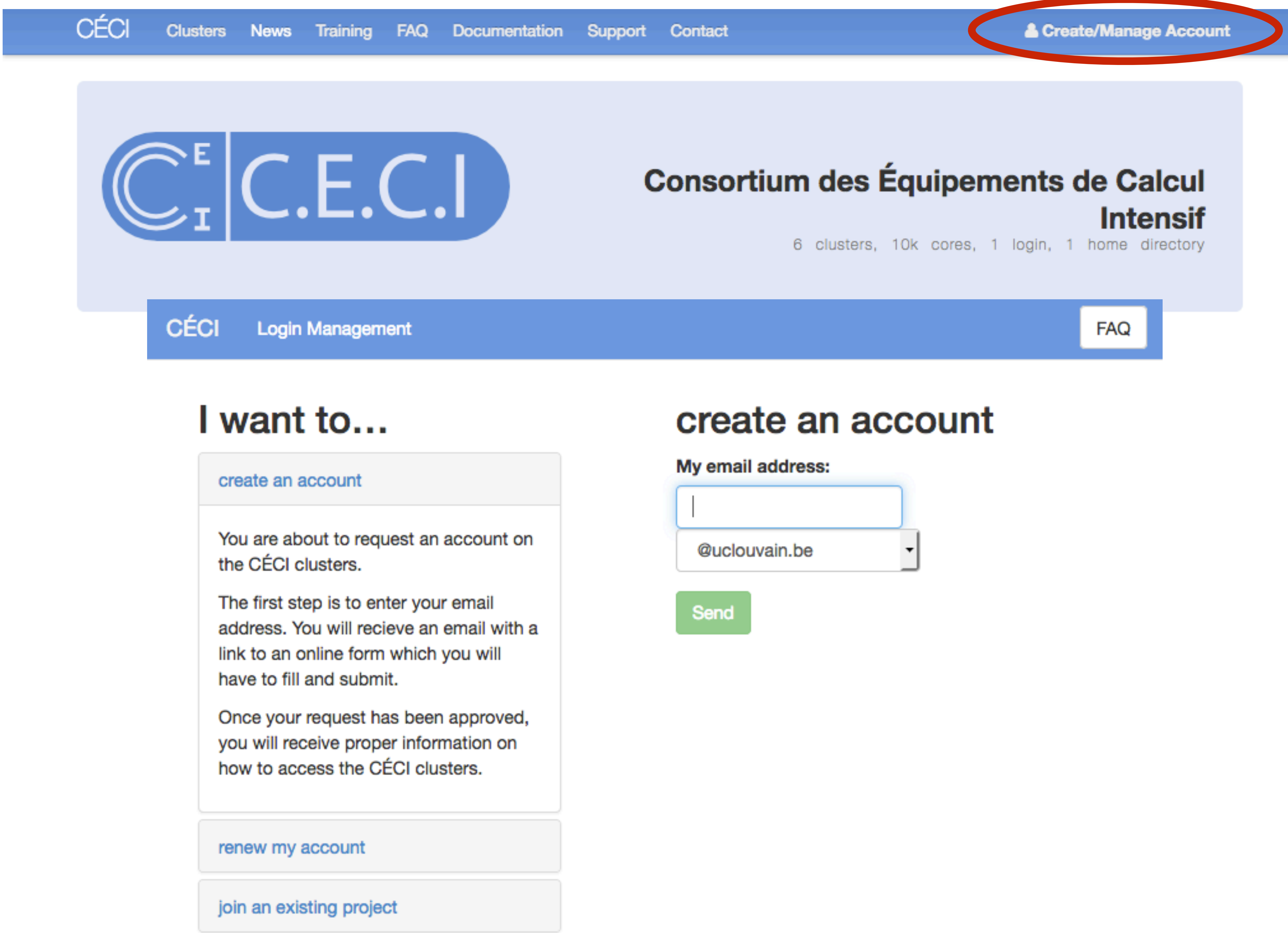
SUPPORT: egs-cism@listes.uclouvain.be

Server SSH key fingerprint: (What's this?)
MD5: 06:54:39:a0:5c:b5:56:b3:29:9e:96:67:a0:4a:c1:ff
SHA256:
Xi4r0aNViNgg9KjnENiUFkEWPwnJGAjbknlX+m7CIm0

steps of a ssh connection

1. Establishing communication and Negotiate algorithm of encryption
2. Host Identification
   - ➡ Host send his public key + message sign with Host private key
3. Generation of symmetric key based on a common integer
   - ➡ from now all data are crypted with that method
4. User identification

Enough of “theory”
Let’s get practical and connect to the machines !!



Consortium des Équipements de Calcul Intensif

6 clusters, 10k cores, 1 login, 1 home directory

I want to...

create an account

You are about to request an account on the CÉCI clusters.

The first step is to enter your email address. You will recieve an email with a link to an online form which you will have to fill and submit.

Once your request has been approved, you will receive proper information on how to access the CÉCI clusters.

renew my account

join an existing project

create an account

My email address:

Getting your private key (I)

- Users with email account access can ask for an account at: https://login.ceci-hpc.be/init/
  - ➡ Click 'Create Account’
  - ➡ Type in your email address
  - ➡ Click on the link sent to you by email.
  - ➡ Fill-in the form and hit the “Submit” button.
  - ➡ Wait ... (A sysadmin is reviewing your information). receive your private key by email.

Getting your private key

1) Open a terminal
2) Create the .ssh directory if it does not exist and set permissions

```
$ mkdir ~/.ssh
$ chmod 700 ~/.ssh
```

3) Move your key to this directory

```
$ mv id_rsa.ceci  ~/.ssh/.
```

4) Change the permissions of the file so that only you can read it

```
$ chmod 600 ~/.ssh/id_rsa.ceci
```

5) Check the permissions. Use the follow commands :

```
$ ls -l ~/.ssh/id_rsa.ceci
-rw------- 1 user user 1743 oct 18 06:48 .ssh/id_rsa.ceci
$ ls -ld .ssh
drwx------ 2 user user 4096 oct 18 06:45 .ssh
```

Must output -rw------ and drwx------ permissions

6) Create the public key

```
$ ssh-keygen -y -f ~/.ssh/id_rsa.ceci > ~/.ssh/id_rsa.ceci.pub
```

Connecting cluster for Windows

SSH tools for windows

- Putty
  - ➡ Only ssh connection
  - ➡ No file transfer, bad support of key
- MobaXterm
  - ➡ Very easy
  - ➡ Both connection and file transfer
- VSCode
  - ➡ Based on openssh, connection, file transfer and text edition, no graphical server
- OpenSSH on Windows (since 2018)
  - ➡ Linux like experience
  - ➡ Configure for free if using VSCode

SSH tools for windows

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  - Configure for free if using VSCode

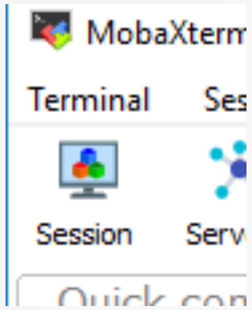
MobaXterm

- Live demo
- Demo also available on YouTube:
  - ➡ https://youtu.be/o41r0mFaURU
- Screen-shot available here

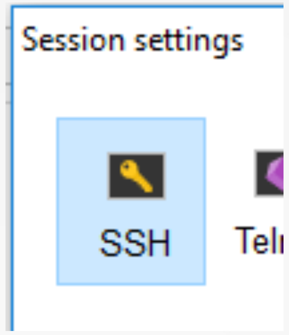
Configure mobaxterm

1) Save your id_rsa.ceci key file from your e-mail in a safe location

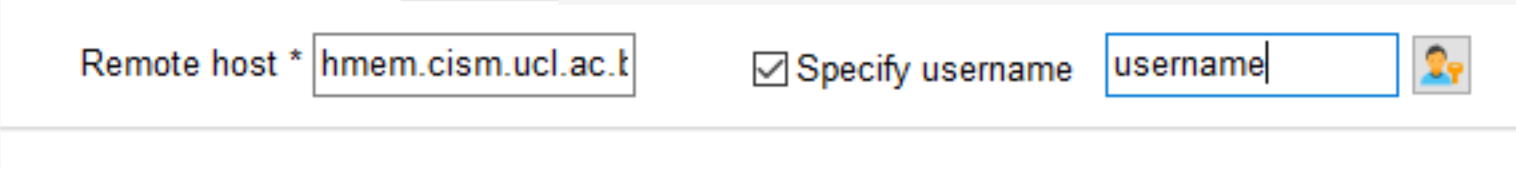
2) Click on Session



and SSH

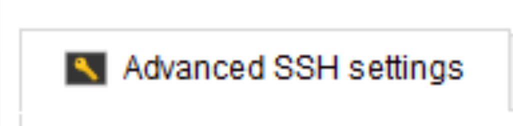


3) Add the Remote host

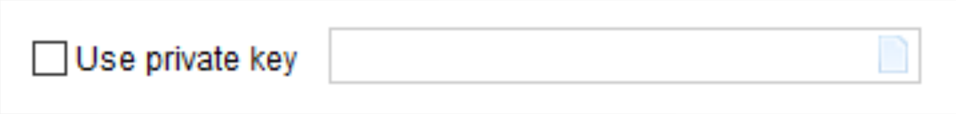


Remote host * hmem.cism.ucl.ac.b ☑ Specify username username

4) Select Advanced SSH Setting tab



5) Select use private key and browse for your id_rsa.ceci file



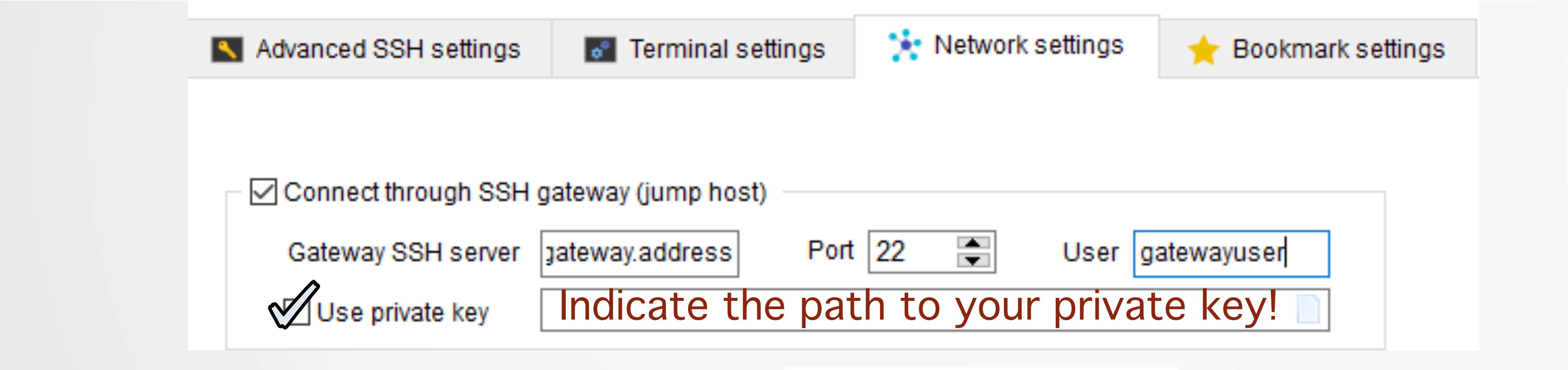
□ Use private key

Depending of your version of mobaxterm/configuration it might ask you the passphrase already now

- Remote host options:
  - lemaitre3.cism.ucl.ac.be nic5.uliege.be hercules.ptci.unamur.be dragon2.umons.ac.be vega.ulb.ac.be

Gateway configuration

- Need to go trough a gateway!
  - ➡ Network settings



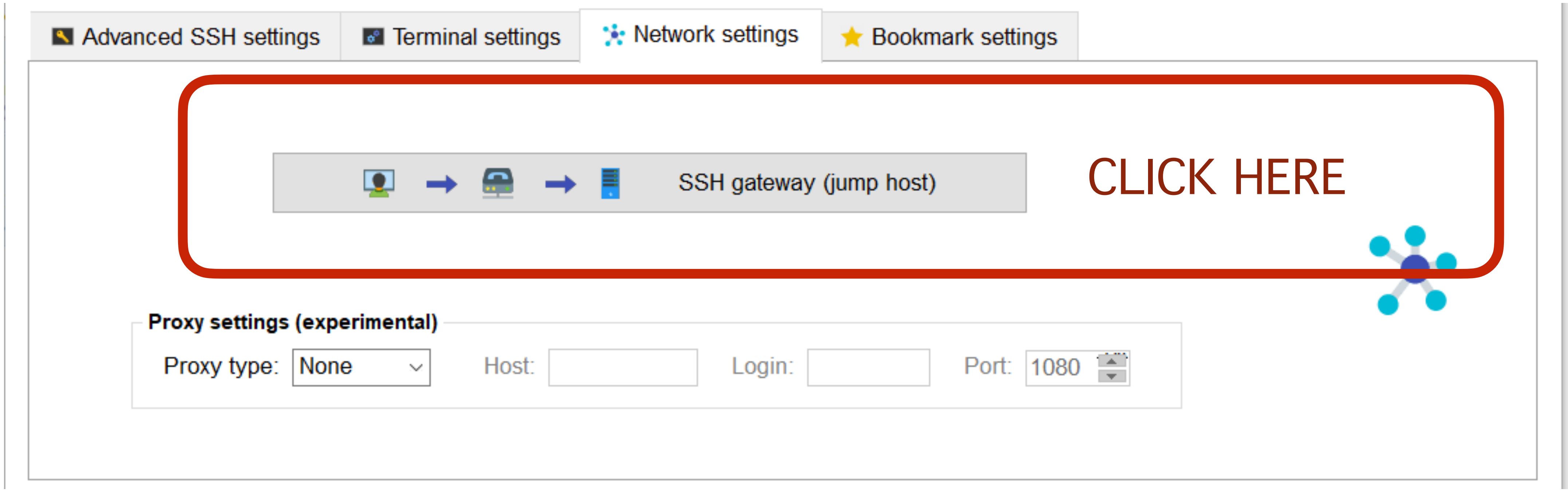
Advanced SSH settings | Terminal settings | Network settings | Bookmark settings

☑ Connect through SSH gateway (jump host)

Gateway SSH server gateway.address Port 22 User gatewayuser

☑ Use private key Indicate the path to your private key!

- Newer version looks like this:



Advanced SSH settings | Terminal settings | Network settings | Bookmark settings

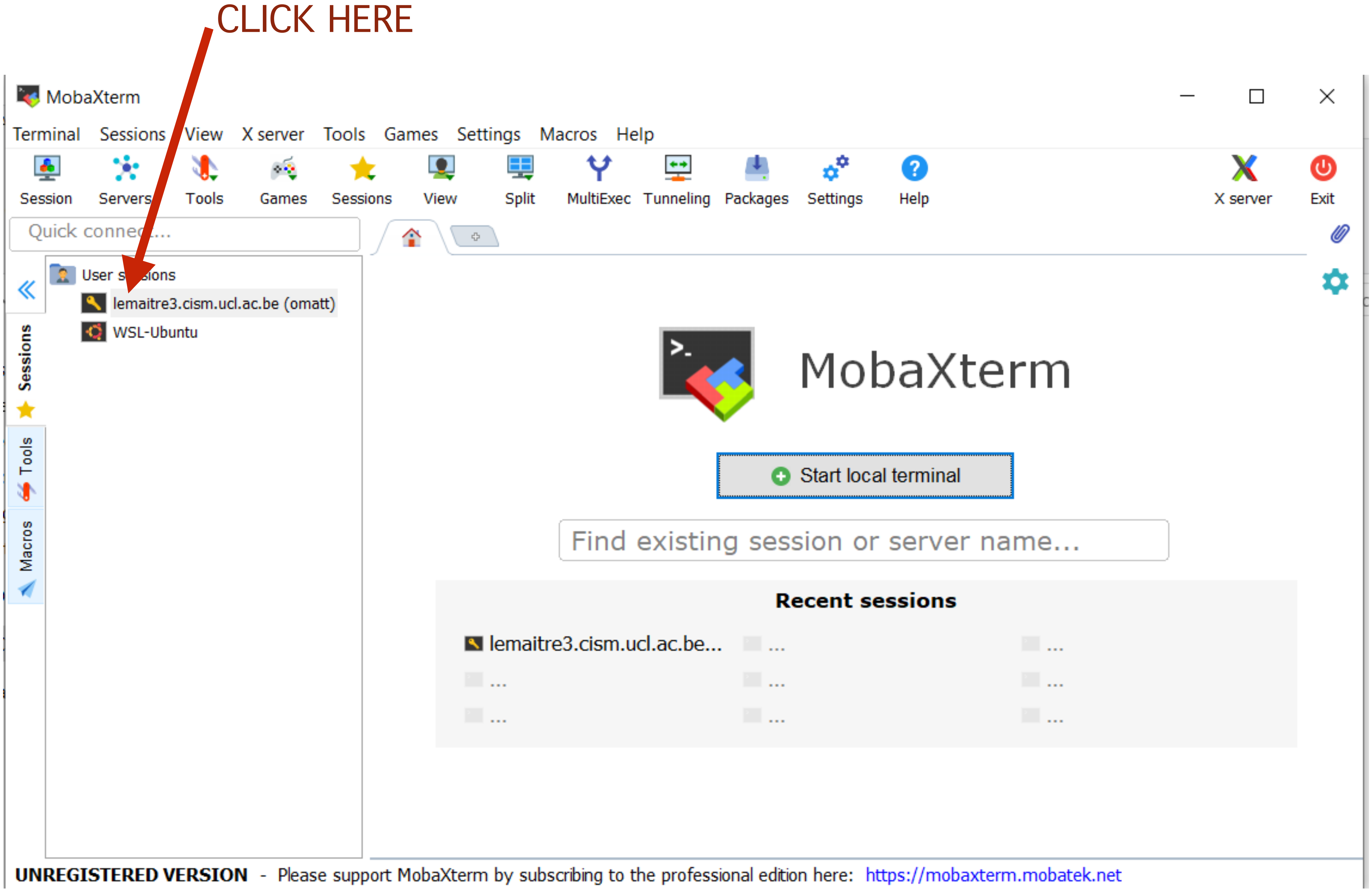
SSH gateway (jump host)

CLICK HERE

Proxy settings (experimental)

Proxy type: None Host: Login: Port: 1080

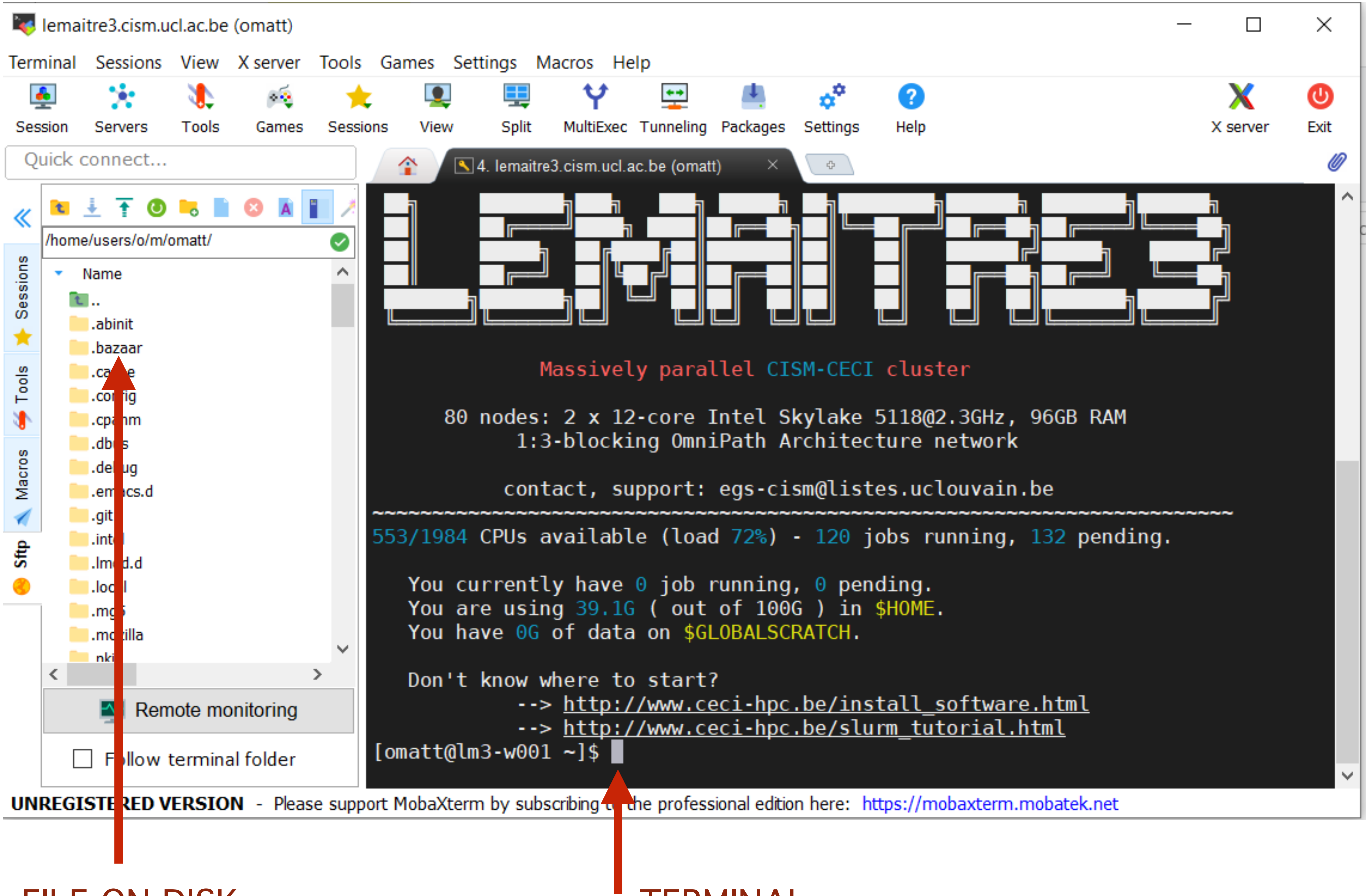
You can now connect to the cluster



CLICK HERE
MobaXterm
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help X server Exit
Quick connect...
User sessions
lemaitre3.cism.ucl.ac.be (omatt)
WSL-Ubuntu
Sessions
Tools
Macros
MobaXterm
Start local terminal
Find existing session or server name...
Recent sessions
lemaitre3.cism.ucl.ac.be...

UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net

You are now connected


lemaitre3.cism.ucl.ac.be (omatt)
Terminal Sessions View X server Tools Games Settings Macros Help
Session Servers Tools Games Sessions View Split MultiExec Tunneling Packages Settings Help X server Exit
Quick connect...
4. lemaitre3.cism.ucl.ac.be (omatt)
/home/users/o/m/omatt/
Sessions
Tools
Macros
Sftp
Name
..
.abinit
.bazaar
.cache
.config
.cpanm
.dbus
.debug
.emacs.d
.git
.int
.lmod.d
.local
.mgs
.mozilla
.nki
Remote monitoring
□ Follow terminal folder
UNREGISTERED VERSION - Please support MobaXterm by subscribing to the professional edition here: https://mobaxterm.mobatek.net

```
             Massively parallel CISM-CECI cluster

   80 nodes: 2 x 12-core Intel Skylake 5118@2.3GHz, 96GB RAM
          1:3-blocking OmniPath Architecture network

         contact, support: egs-cism@listes.uclouvain.be
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
553/1984 CPUs available (load 72%) - 120 jobs running, 132 pending.

   You currently have 0 job running, 0 pending.
   You are using 39.1G ( out of 100G ) in $HOME.
   You have 0G of data on $GLOBALSCRATCH.

   Don't know where to start?
            --> http://www.ceci-hpc.be/install_software.html
            --> http://www.ceci-hpc.be/slurm_tutorial.html
[omatt@lm3-w001 ~]$
```

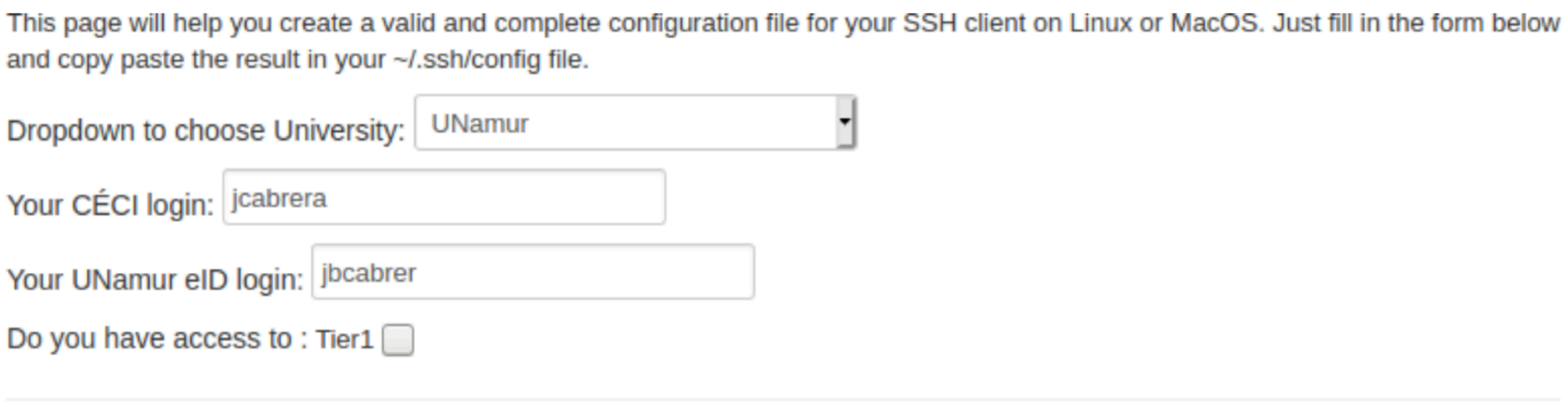
FILE ON DISK

TERMINAL

Connecting cluster With OpenSSH (Unix/Mac/Windows)

Creating your configuration file

- Go to the CÉCI wizard http://www.ceci-hpc.be/sshconfig.html
- Chose your university.
- Set your CÉCI and gateway login name.
- Depending on your university, the number of inputs fields will change.
- Tick the field "tier 1" if you have access to zenobe.
  If you are not sure, leave it unchecked.



This page will help you create a valid and complete configuration file for your SSH client on Linux or MacOS. Just fill in the form below and copy paste the result in your ~/.ssh/config file.

Dropdown to choose University: UNamur

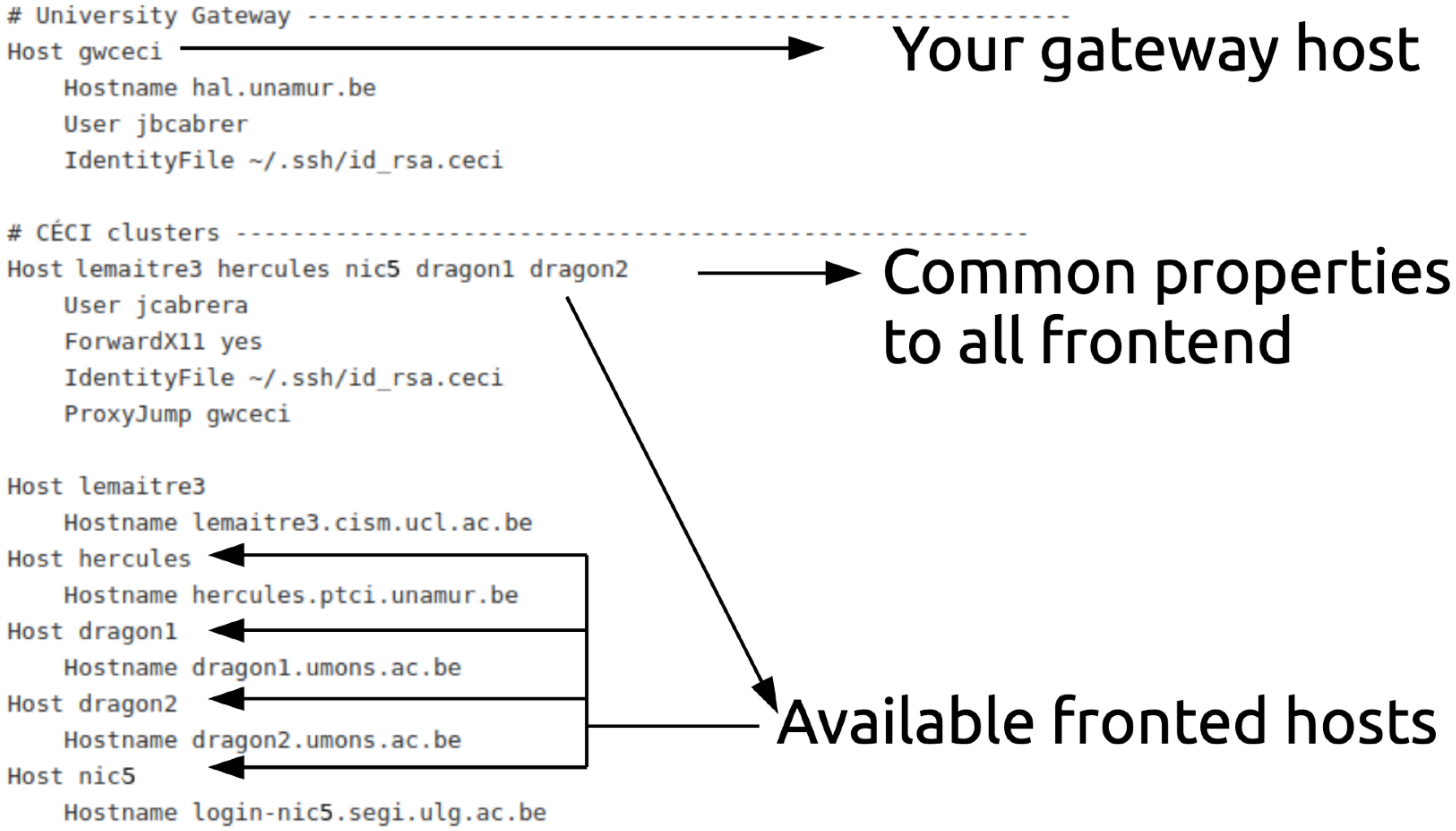
Your CÉCI login: jcabrera

Your UNamur eID login: jbcabrer

Do you have access to : Tier1 □

Creating your configuration file

Copy and paste the result in the .ssh/config file



```
# University Gateway -----------------------------------------------------
Host gwceci
    Hostname hal.unamur.be
    User jbcabrer
    IdentityFile ~/.ssh/id_rsa.ceci

# CÉCI clusters -------------------------------------------------------
Host lemaitre3 hercules nic5 dragon1 dragon2
    User jcabrera
    ForwardX11 yes
    IdentityFile ~/.ssh/id_rsa.ceci
    ProxyJump gwceci

Host lemaitre3
    Hostname lemaitre3.cism.ucl.ac.be
Host hercules
    Hostname hercules.ptci.unamur.be
Host dragon1
    Hostname dragon1.umons.ac.be
Host dragon2
    Hostname dragon2.umons.ac.be
Host nic5
    Hostname login-nic5.segi.ulg.ac.be
```

Your gateway host

Common properties
to all frontend

Available fronted hosts

First connexion

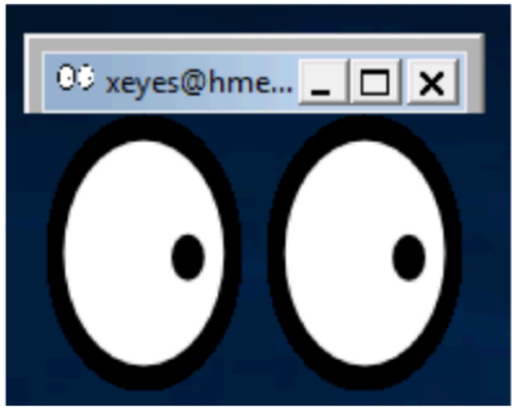
Connect to a cluster with the command

```
$ ssh host
```

where **host** is one of the frontend names defined in the configuration file.

The option **ForwarX11** in your configuration file allows you to open a remote window. For this, on **MacOs > 10.7** users need to install xquartz (needs reboot)

Try in **lemaitre3** the command xeyes



The permissions on your key file are not correct

- **Error**: bad permissions

```
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@         WARNING: UNPROTECTED PRIVATE KEY FILE!          @
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
Permissions 0644 for '/home/user/.ssh/id_rsa.ceci' are too open.
It is recommended that your private key files are NOT accessible by others.
This private key will be ignored.
bad permissions: ignore key: /home/user/.ssh/id_rsa.ceci
user@host's password:
it means that Permissions 0644 for '/home/user/.ssh/id_rsa.ceci' are too open.
Change them to 600 as explained in the first section of this document.
```

- **Problem:** Permissions 0644 for '/home/user/.ssh/id_rsa.ceci' are too open.
- **Solution**: Change them to 600 as explained previously

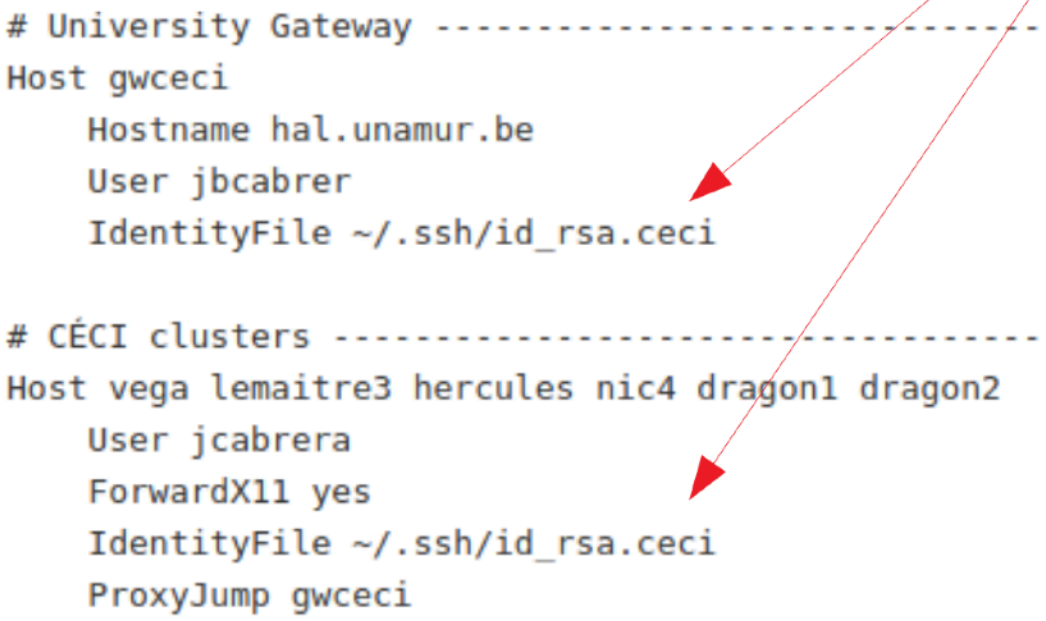
```
$ chmod 600 ~/.ssh/id_rsa.ceci
```

You did not specify the correct path to your SSH key

- **Error**: you are being asked for a password directly

```
$ ssh frontend
user@frontend's password:
```

- **Problem**: your SSH client did not use the SSH key.
- **Solution**: Make sure that your .ssh/config is properly configured and the key is present.



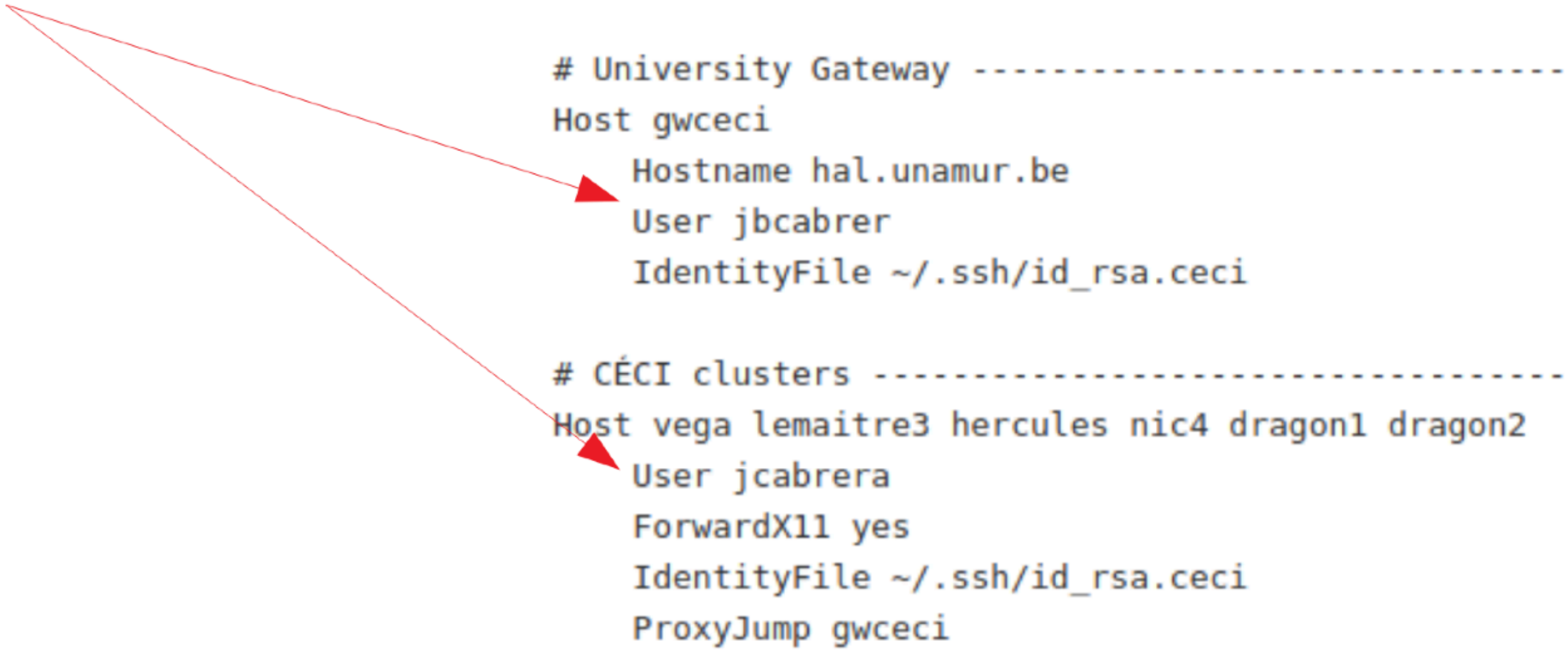
```
# University Gateway ------------------------------
Host gwceci
    Hostname hal.unamur.be
    User jbcabrer
    IdentityFile ~/.ssh/id_rsa.ceci

# CÉCI clusters -----------------------------------
Host vega lemaitre3 hercules nic4 dragon1 dragon2
    User jcabrera
    ForwardX11 yes
    IdentityFile ~/.ssh/id_rsa.ceci
    ProxyJump gwceci
```

You used a wrong username or tried to connect before your keys are synchronized

- **Error**: you are being asked for a passphrase, then a password

```
$ ssh frontend
Enter passphrase for key '/home/user/.ssh/id_rsa.ceci':
user@frontend's password:
```

- **Problem**: the user name you are using is not the correct one or you are trying to connect with the new private key while it has not been synchronized to the cluster yet.
- **Solution**: Verify your user name or wait ~30 min



```
# University Gateway -------------------------------
Host gwceci
    Hostname hal.unamur.be
    User jbcabrer
    IdentityFile ~/.ssh/id_rsa.ceci

# CÉCI clusters -------------------------------------
Host vega lemaitre3 hercules nic4 dragon1 dragon2
    User jcabrera
    ForwardX11 yes
    IdentityFile ~/.ssh/id_rsa.ceci
    ProxyJump gwceci
```

You can use -v, -vv or -vvv to troubleshooting a session

```
$ ssh frontend -v
OpenSSH_7.6p1 Ubuntu-4ubuntu0.5, OpenSSL 1.0.2n  7 Dec 2017
debug1: Reading configuration data /home/user/.ssh/config
debug1: /home/user/.ssh/config line 4: Applying options for *
debug1: /home/user/.ssh/config line 126: Applying options for hercules
...
debug1: SSH2_MSG_KEXINIT sent
debug1: SSH2_MSG_KEXINIT received
...
debug1: Server host key: ssh-rsa SHA256:GfUSNZEFZg28WRCaxJvDNSCClhrX1IujNIky29ui7IY
debug1: Host 'gwceci' is known and matches the RSA host key.
debug1: Found key in /home/user/.ssh/known_hosts:33
...
debug1: Offering public key: RSA SHA256:IMDnFOL/9DI4otUnSUJBMxLc0v3jXSHkGUsM4ogi5Us
/home/user/.ssh/id_rsa.ceci
debug1: Server accepts key: pkalg rsa-sha2-512 blen 277
debug1: Authentication succeeded (publickey).
Authenticated to gwceci ([YYY.YYY.YYY.YYY]:22).
...
debug1: Server host key: ecdsa-sha2-nistp256 SHA256:SyLaaBe7CuO7Dpa6vJa0vbAUxnYSpl30xaJo5yBF//c
debug1: Host 'frontend' is known and matches the ECDSA host key.
debug1: Found key in /home/user/.ssh/known_hosts:217
...
debug1: Offering public key: RSA SHA256:IMDnFOL/9DI4otUnSUJBMxLc0v3jXSHkGUsM4ogi5Us
/home/user/.ssh/id_rsa.ceci
debug1: Server accepts key: pkalg rsa-sha2-512 blen 277
debug1: Authentication succeeded (publickey).
Authenticated to frontend (via proxy).
...
```

Exercise: Connect to the cluster

- Cluster adress:
  - ➡ lemaitre3.cism.ucl.ac.be
  - ➡ nic5.uliege.be
  - ➡ hercules.ptci.unamur.be
  - ➡ dragon2.umons.ac.be

- Gateway address

- ➡ gwceci.cism.ucl.ac.be
- ➡ gwceci.ulb.ac.be
- ➡ gwceci.uliege.be
- ➡ gwceci.unamur.be (unamur id)
- ➡ dragon2.umons.ac.be

Getting your private key

1) Open a terminal
2) Create the .ssh directory if it does not exist and set permissions

```
$ mkdir ~/.ssh
$ chmod 700 ~/.ssh
```

3) Move your key to this directory

```
$ mv id_rsa.ceci  ~/.ssh/.
```

4) Change the permissions of the file so that only you can read it

```
$ chmod 600 ~/.ssh/id_rsa.ceci
```

5) Check the permissions. Use the follow commands :

```
$ ls -l ~/.ssh/id_rsa.ceci
-rw------- 1 user user 1743 oct 18 06:48 .ssh/id_rsa.ceci
$ ls -ld .ssh
drwx------ 2 user user 4096 oct 18 06:45 .ssh
```

Must output -rw------ and drwx------ permissions

6) Create the public key

```
$ ssh-keygen -y -f ~/.ssh/id_rsa.ceci > ~/.ssh/id_rsa.ceci.pub
```

Agent

Agent and Passphrase managers

Use an SSH agent which will remember the passphrase so
you do not have to type it in each time you issue the SSH command.

Most of the time an ssh-agent starts automatically at login if a
password managing software is installed :

Mac OS Keychain, KDE KWallet, Gnome Keyring (Seahorse), etc.

Gnome Keyring loads all private keys in ~/.ssh **which have the corresponding public key**.

In MacOS add in ~/.ssh/config

```
Host *
   UseKeychain yes
   AddKeysToAgent yes
```

Agent and Passphrase managers

Make sure you have an agent running

```
$ ssh-add -l
Could not open a connection to your authentication agent.
```

```
$ ssh-add -l
The agent has no identities.
```

If you get "Could not open a connection to your authentication agent." start an agent with

```
$ eval $(ssh-agent)
```

If you get "The agent has no identities." The agent is already running. Add your key. Your key is decrypted and stored in memory

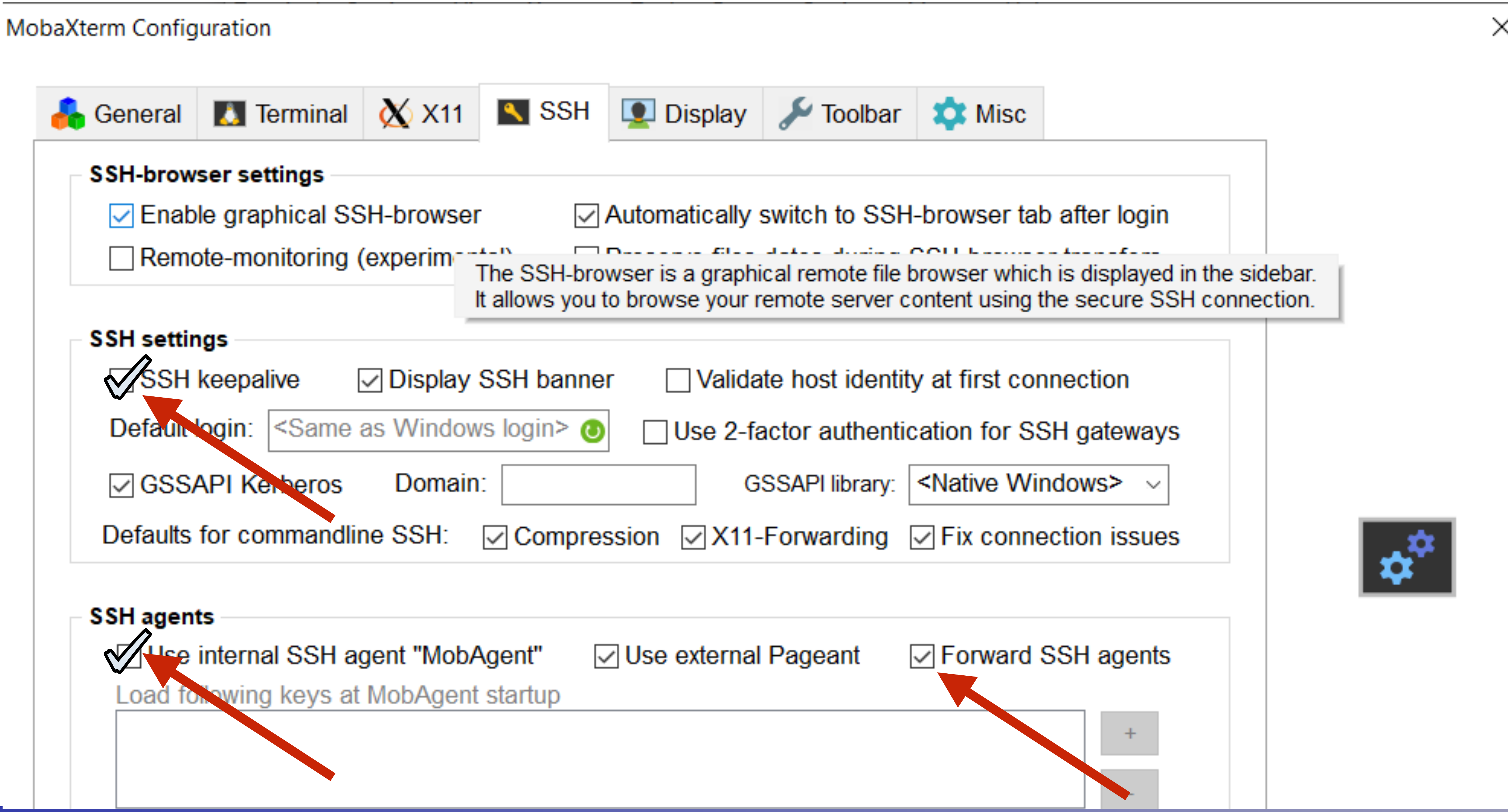
```
$ ssh-add ~/.ssh/id_rsa.ceci
Enter passphrase for /home/user/.ssh/id_rsa.ceci:
Identity added: /home/user/.ssh/id_rsa.ceci (/home/user/.ssh/id_rsa.ceci)
```

check the loaded key

```
$ ssh-add -l
2048 20:6c:8c:cd:e8:e6:9b:4f:8c:9c:d6:8a:eb:37:6d:17 /home/user/.ssh/id_rsa.ceci (RSA)
```

SSH AGENT for MobaXterm

- Save your passphrase locally and let MobaXterm fill it for you!



MobaXterm Configuration

SSH-browser settings

☑ Enable graphical SSH-browser ☑ Automatically switch to SSH-browser tab after login

☐ Remote-monitoring (experim ☐ Preserve files dates during SSH-browser transfers

The SSH-browser is a graphical remote file browser which is displayed in the sidebar.
It allows you to browse your remote server content using the secure SSH connection.

SSH settings

☑ SSH keepalive ☑ Display SSH banner ☐ Validate host identity at first connection

Default login: <Same as Windows login> ☐ Use 2-factor authentication for SSH gateways

☑ GSSAPI Kerberos Domain: GSSAPI library: <Native Windows>

Defaults for commandline SSH: ☑ Compression ☑ X11-Forwarding ☑ Fix connection issues

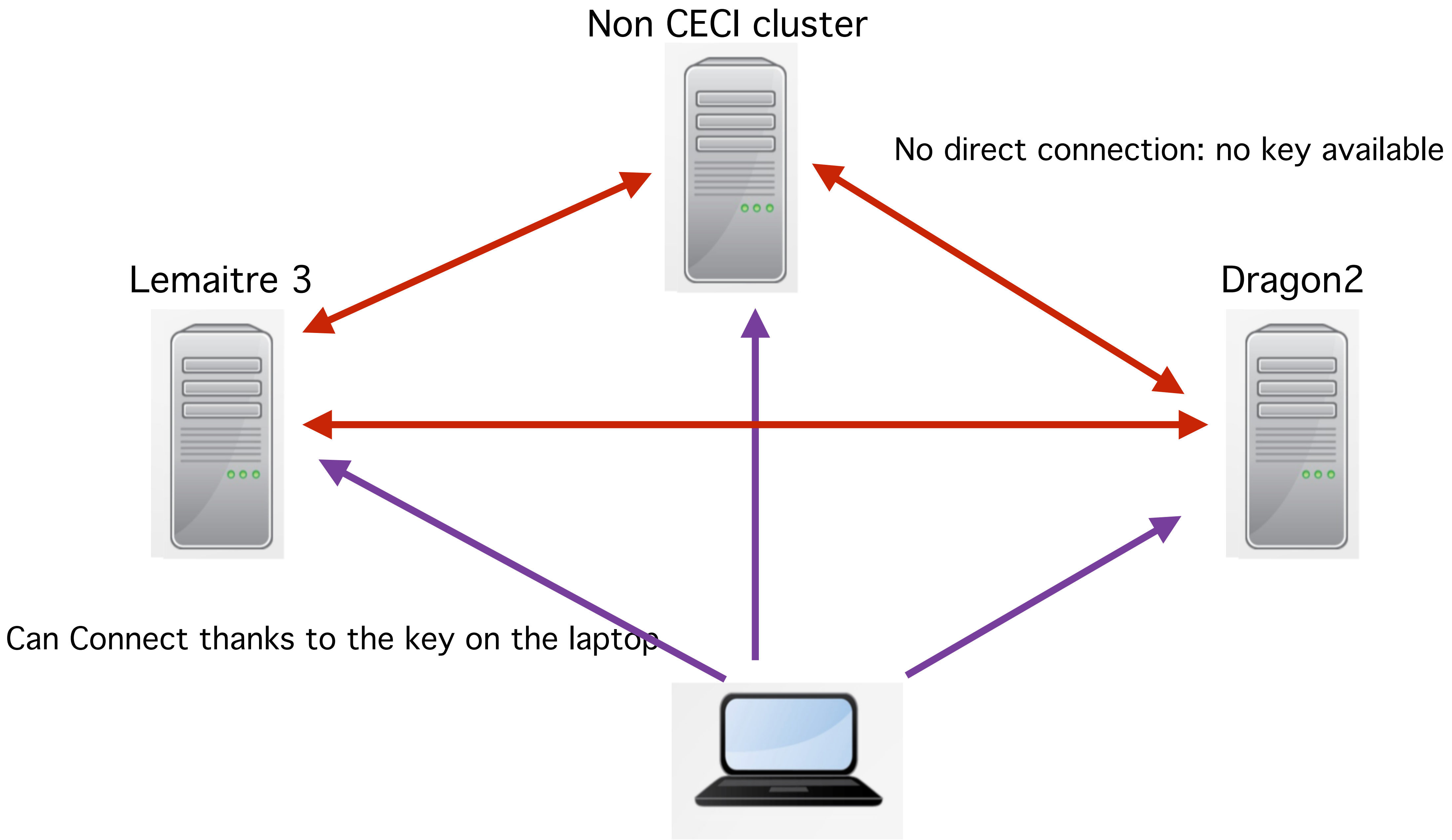
SSH agents

☑ Use internal SSH agent "MobAgent" ☑ Use external Pageant ☑ Forward SSH agents

Load following keys at MobAgent startup

Avoid to propagate your private keys

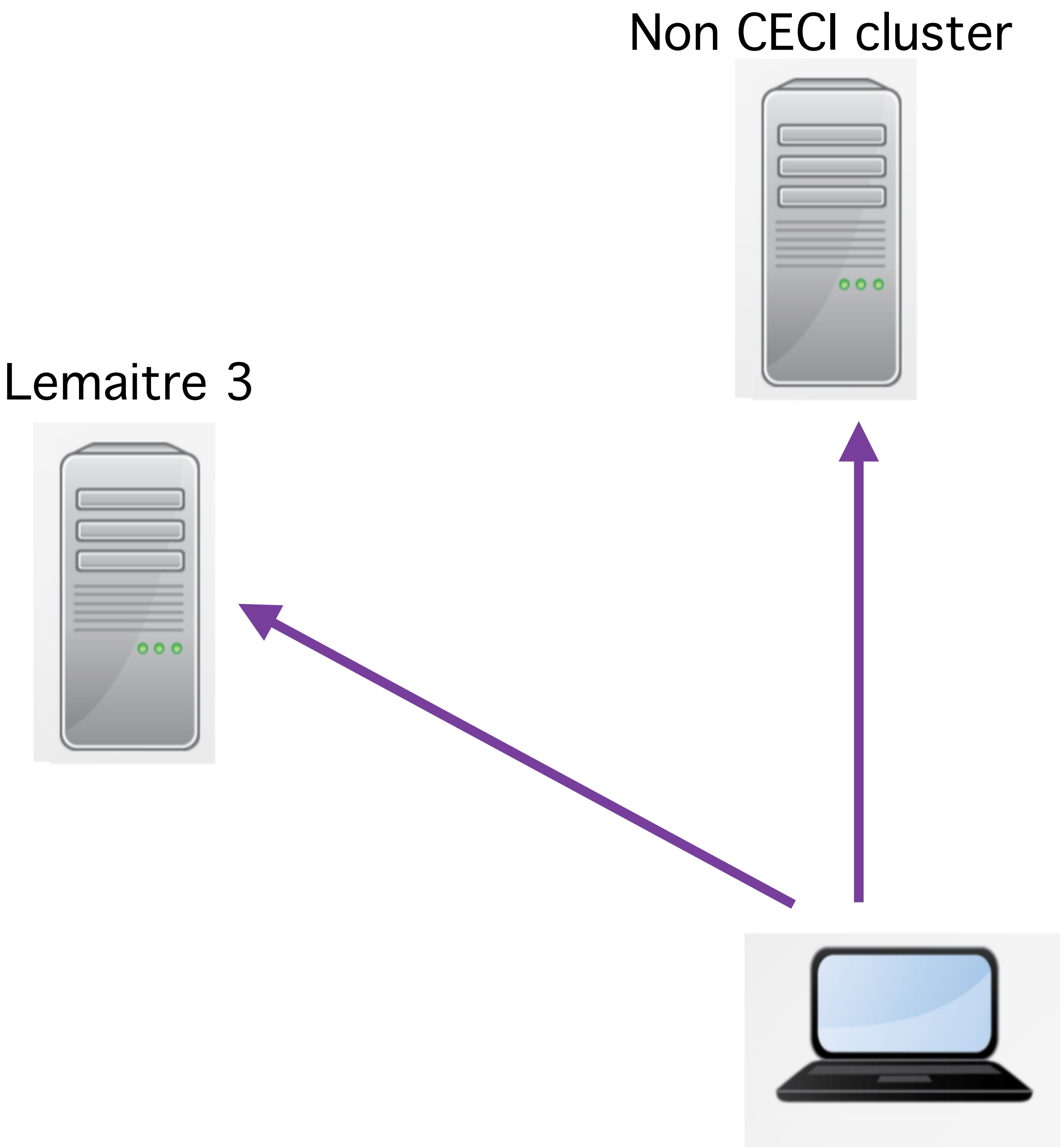
- Less keys means more security



Non CECI cluster
No direct connection: no key available
Lemaitre 3
Dragon2
Can Connect thanks to the key on the laptop

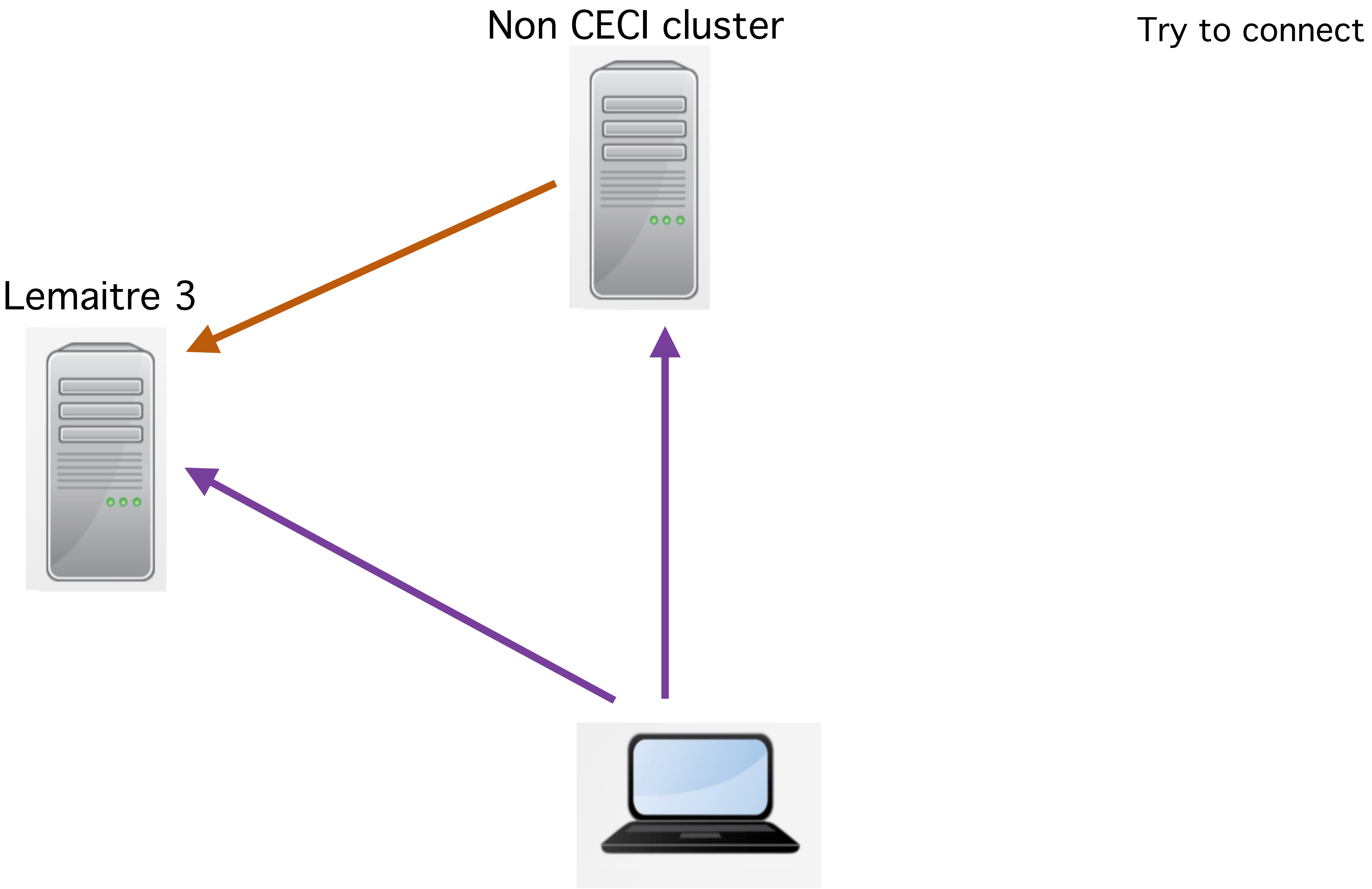
Avoid to propagate your private keys

- Forward agent send back the ssh request for a key to your laptop



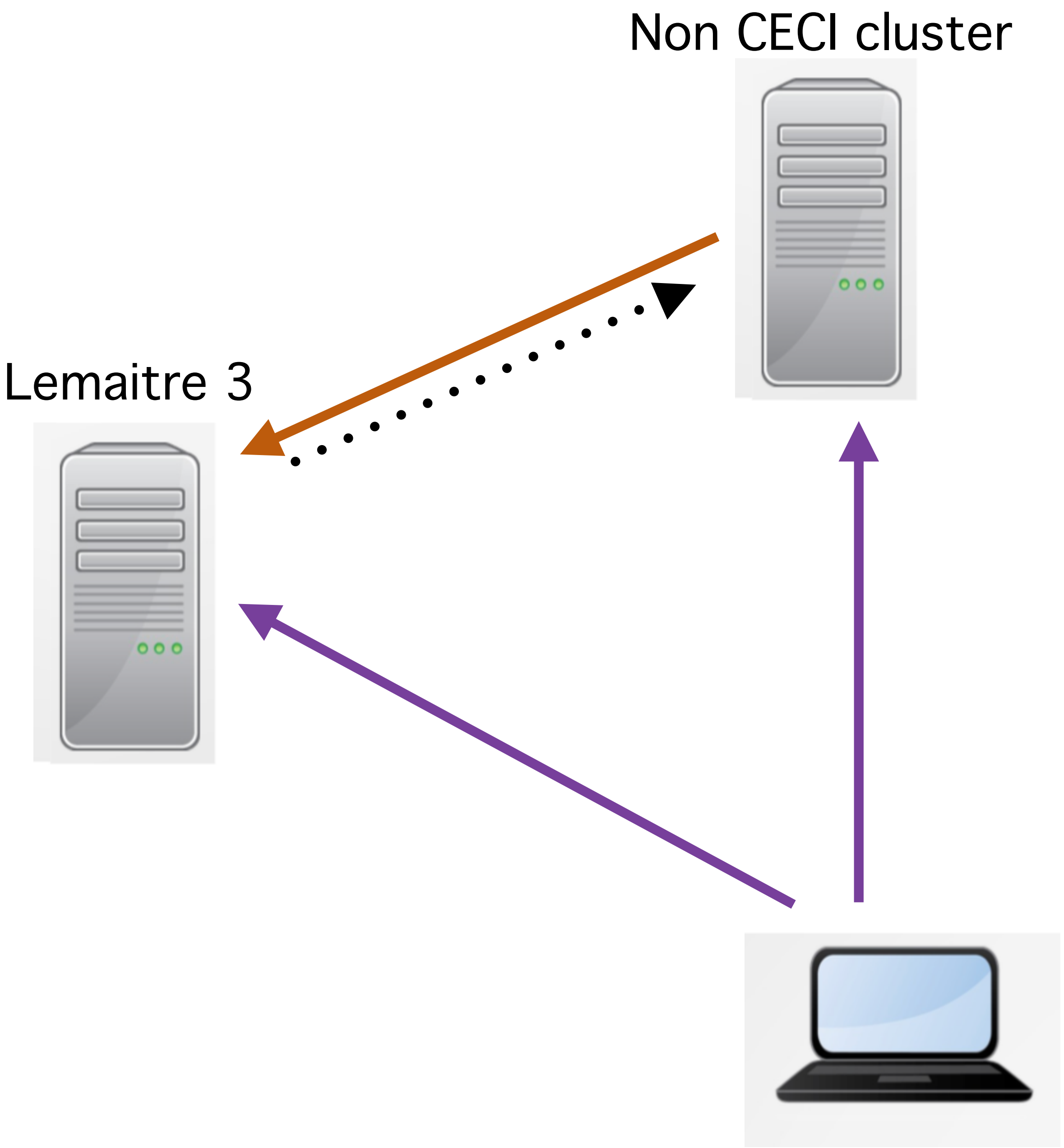
Avoid to propagate your private keys

- Forward agent send back the ssh request for a key to your laptop



Avoid to propagate your private keys

- Forward agent send back the ssh request for a key to your laptop

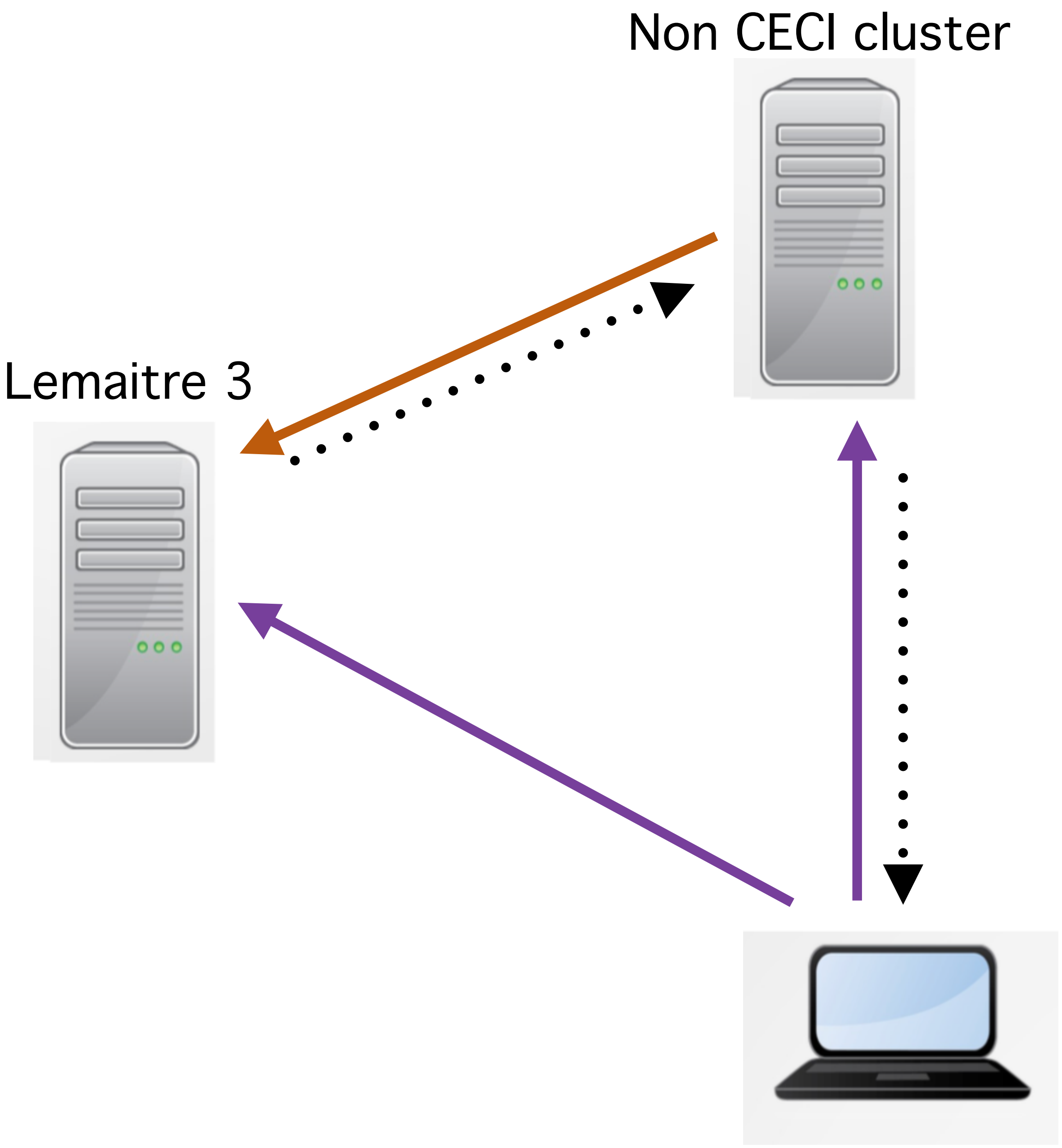


Try to connect

Host ask for a key

Avoid to propagate your private keys

- Forward agent send back the ssh request for a key to your laptop



Non CECI cluster

Lemaitre 3

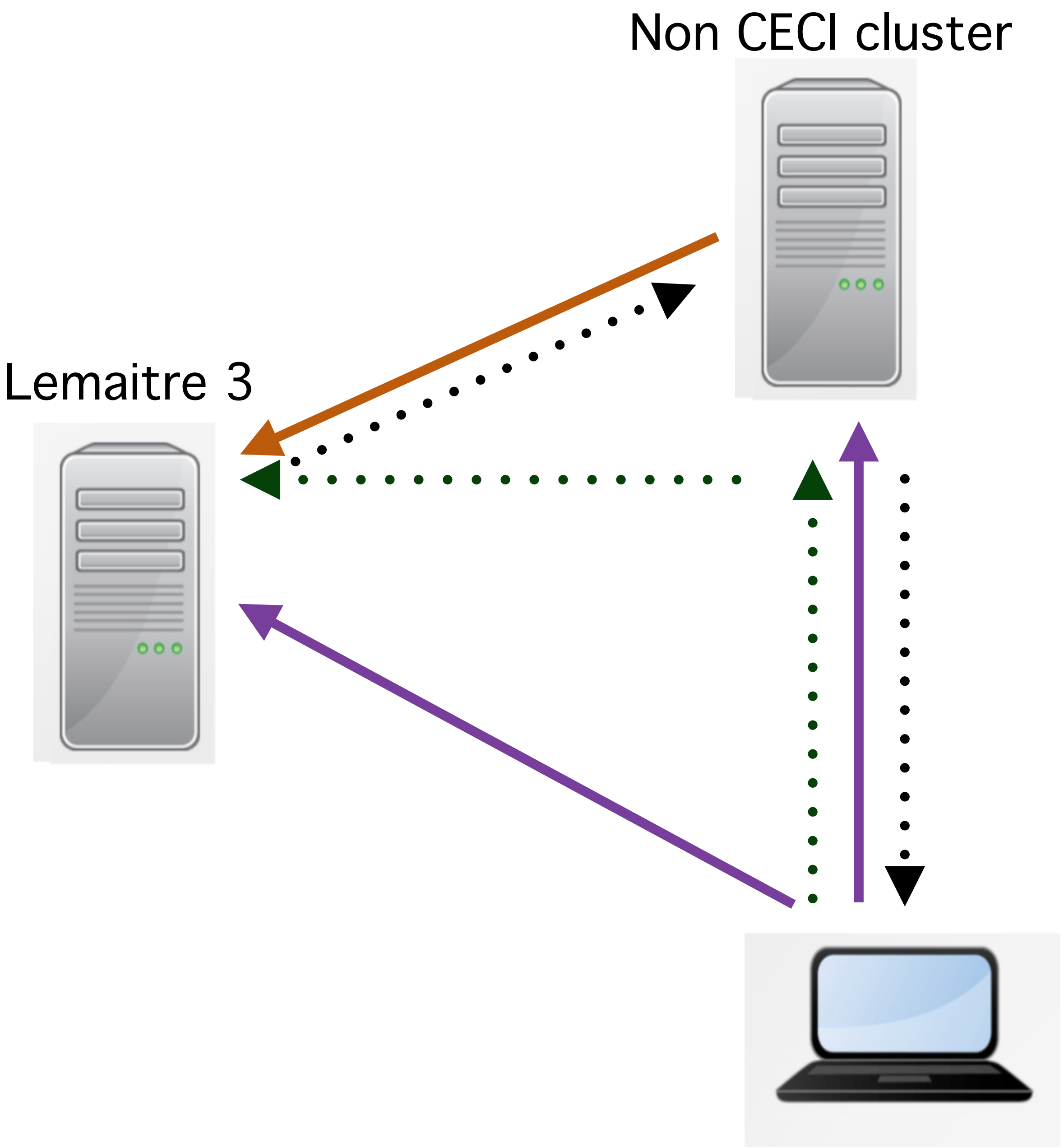
Try to connect

Host ask for a key

Message forward to laptop

Avoid to propagate your private keys

- Forward agent send back the ssh request for a key to your laptop



Try to connect

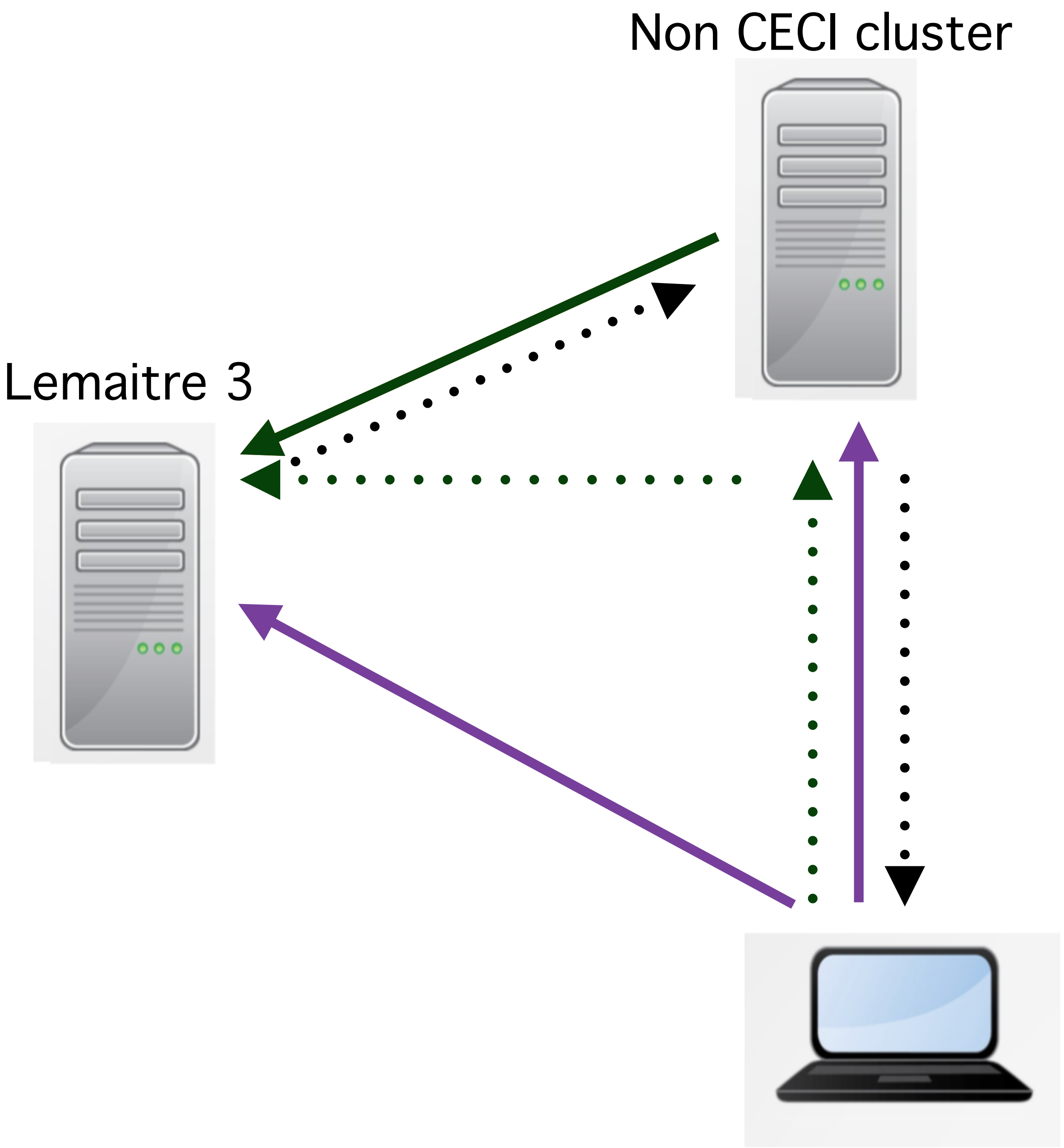
Host ask for a key

Message forward to laptop

Key provided

Avoid to propagate your private keys

- Forward agent send back the ssh request for a key to your laptop



Try to connect

Host ask for a key

Message forward to laptop

Key provided

Connection granted

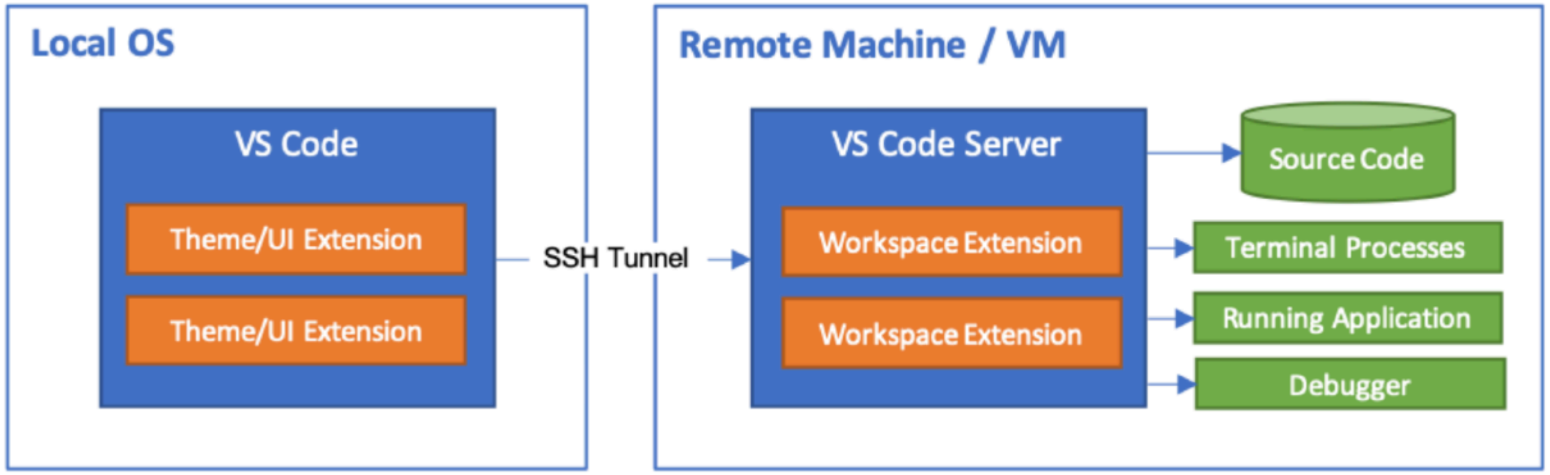
Text Editor

Text Editor Option

- Text editor on the cluster
  - Non graphical: Emacs, vi
    - Tutorial on vi on Thursday
  - Graphical one: gedit, nano, …
    - Slow
- Graphical interface running on your laptop
  - Visual Studio Code
  - Mount the file-system

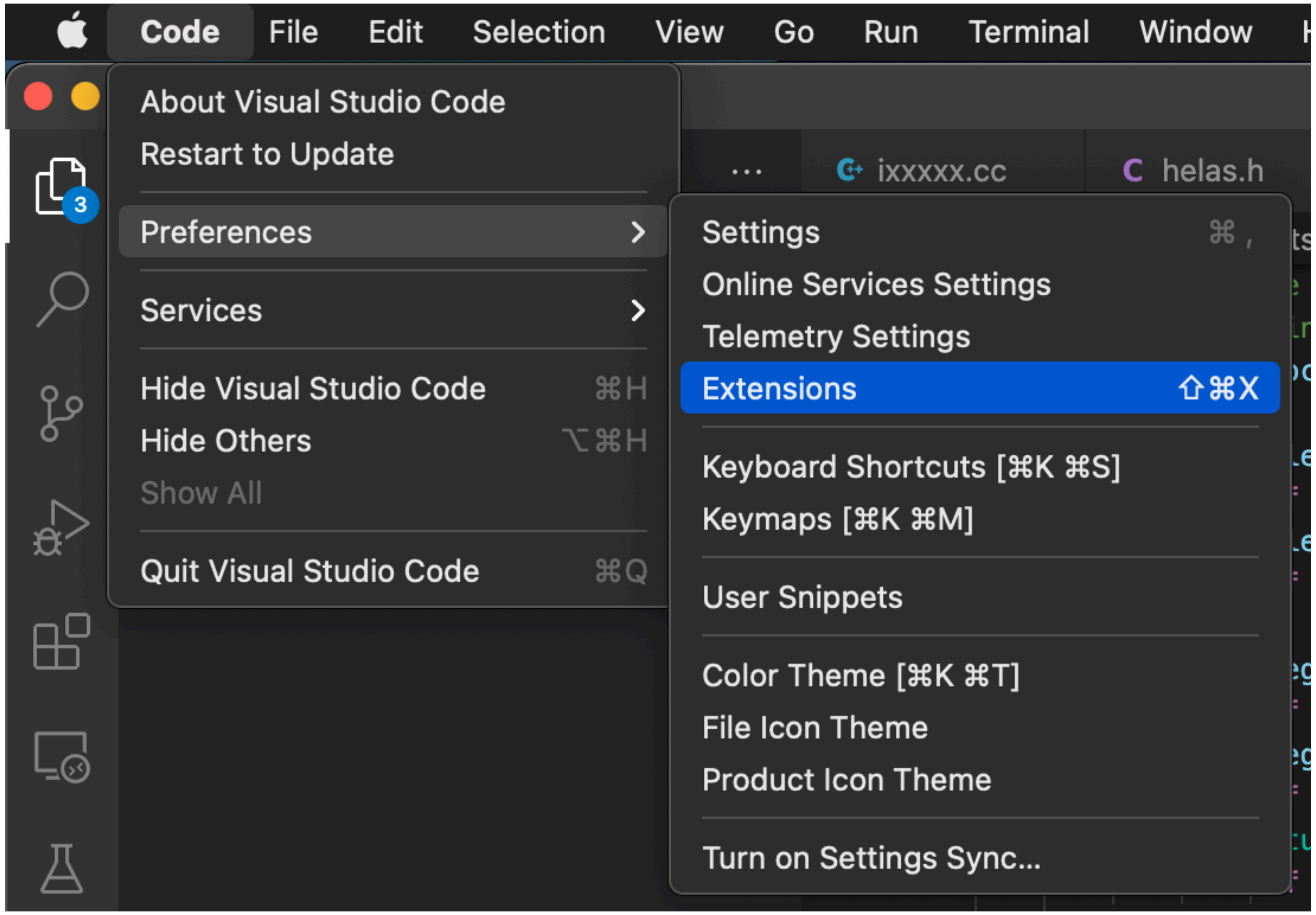
Visual Studio Code

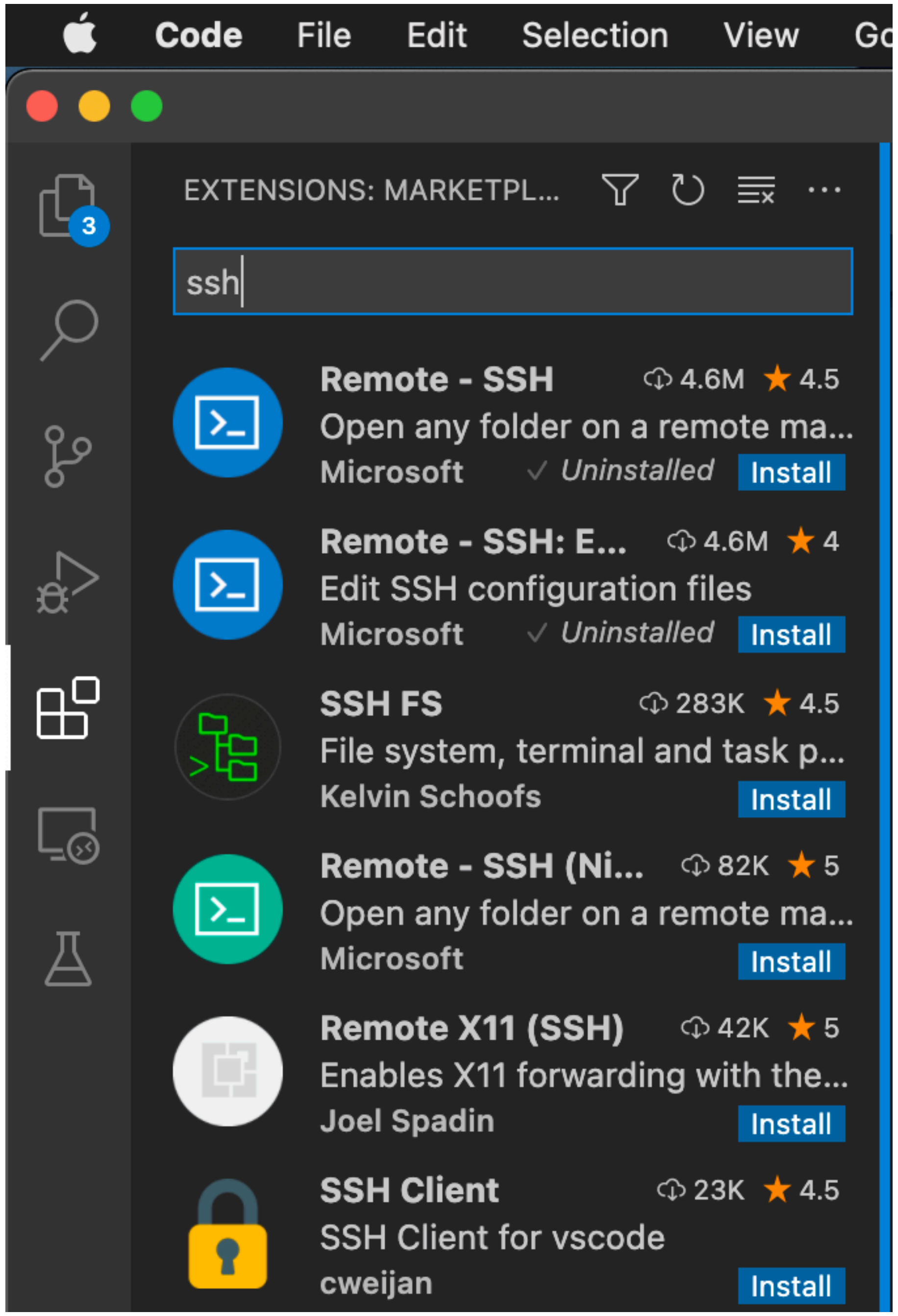
- Install VSC
  - ➡ https://code.visualstudio.com/download
- add ssh extension:
  - ➡ https://code.visualstudio.com/docs/remote/ssh



Install the ssh extension

- Install Visual Studio Code
  - ➡ https://code.visualstudio.com/download
- Go to the preference menu/ extensions





ssh

Remote - SSH 4.6M ★ 4.5
Open any folder on a remote ma...
Microsoft ✓ Uninstalled Install

Remote - SSH: E... 4.6M ★ 4
Edit SSH configuration files
Microsoft ✓ Uninstalled Install

SSH FS 283K ★ 4.5
File system, terminal and task p...
Kelvin Schoofs Install

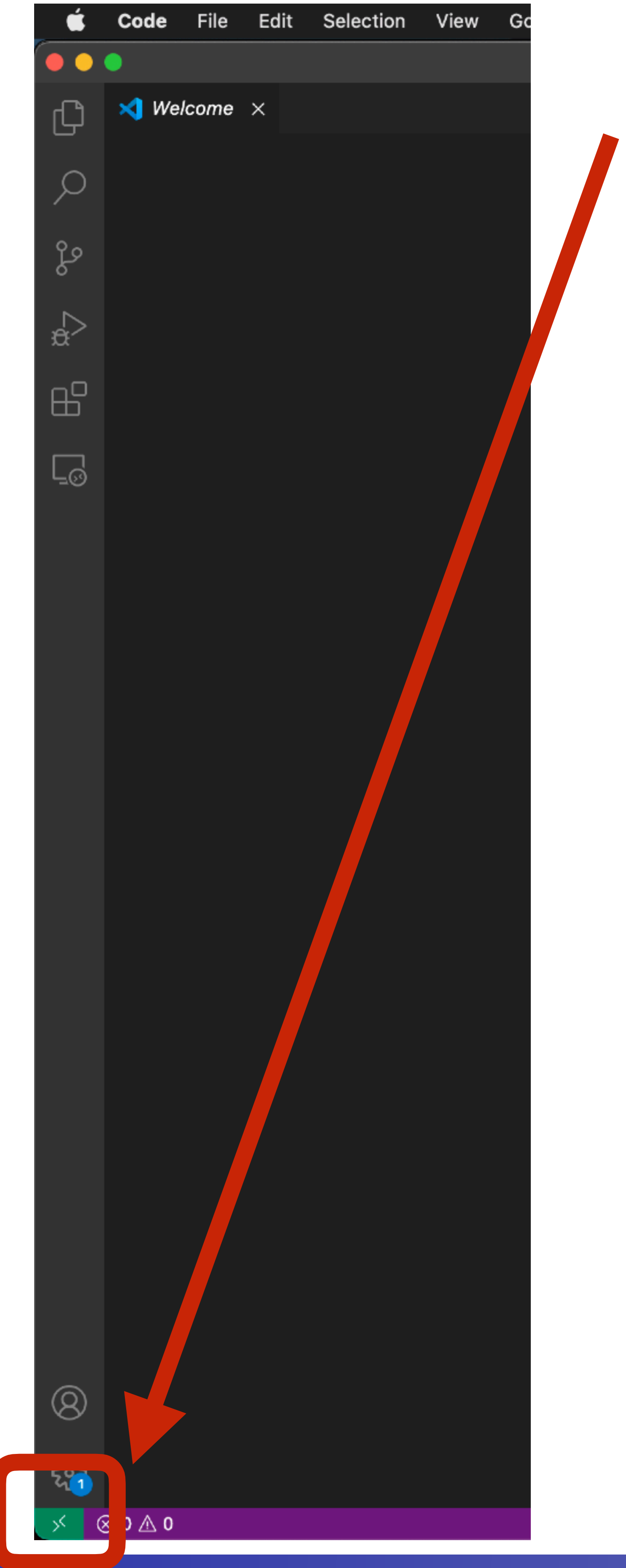
Remote - SSH (Ni... 82K ★ 5
Open any folder on a remote ma...
Microsoft Install

Remote X11 (SSH) 42K ★ 5
Enables X11 forwarding with the...
Joel Spadin Install

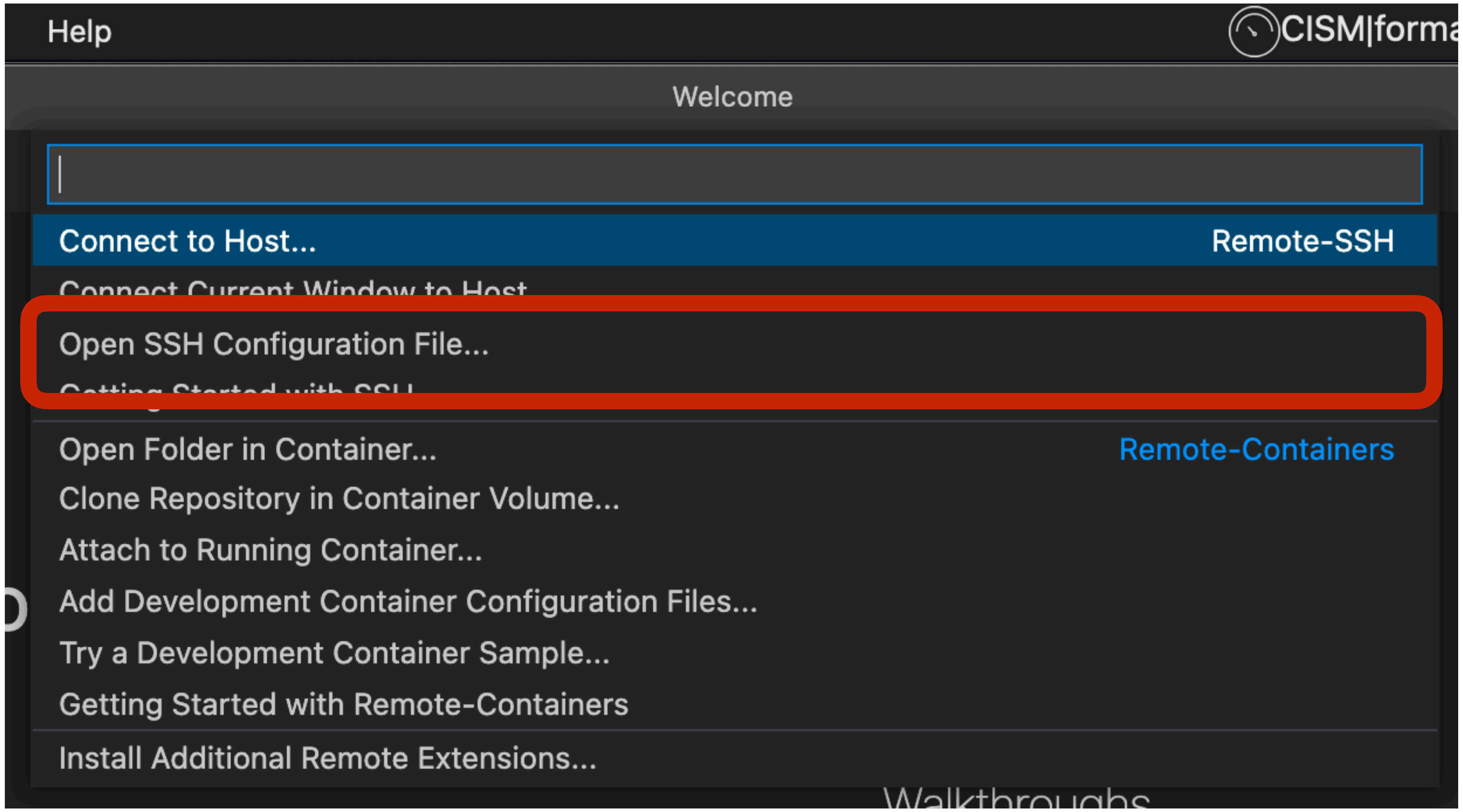
SSH Client 23K ★ 4.5
SSH Client for vscode
cweijan Install

- Search for “ssh”
- Click on “install” of the Remote - SSH

Setup connection



- Click on the green square
  - ➡ Bottom left
- Menu open (see below)
  - ➡ Select “open ssh configuration file”


Help

CISM|forma

Welcome

Connect to Host... Remote-SSH

Connect Current Window to Host

Open SSH Configuration File...

Getting Started with SSH

Open Folder in Container... Remote-Containers

Clone Repository in Container Volume...

Attach to Running Container...

Add Development Container Configuration Files...

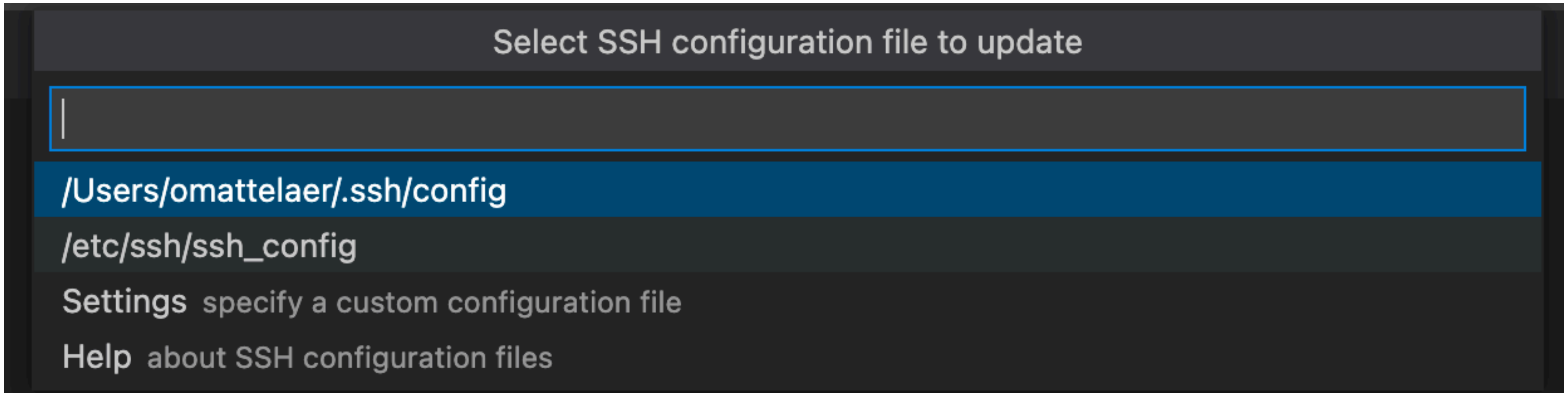
Try a Development Container Sample...

Getting Started with Remote-Containers

Install Additional Remote Extensions...

Walkthroughs

Setup connection



Select SSH configuration file to update

/Users/omattelaer/.ssh/config

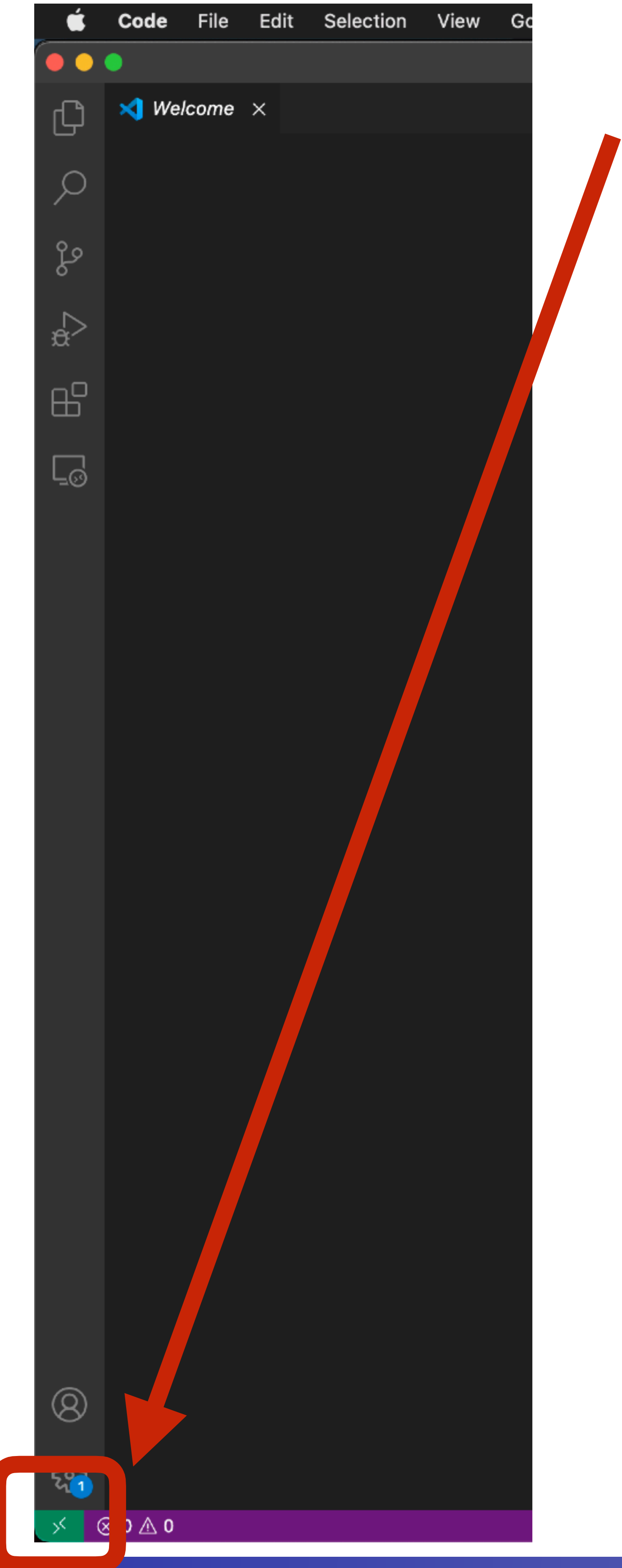
/etc/ssh/ssh_config

Settings specify a custom configuration file

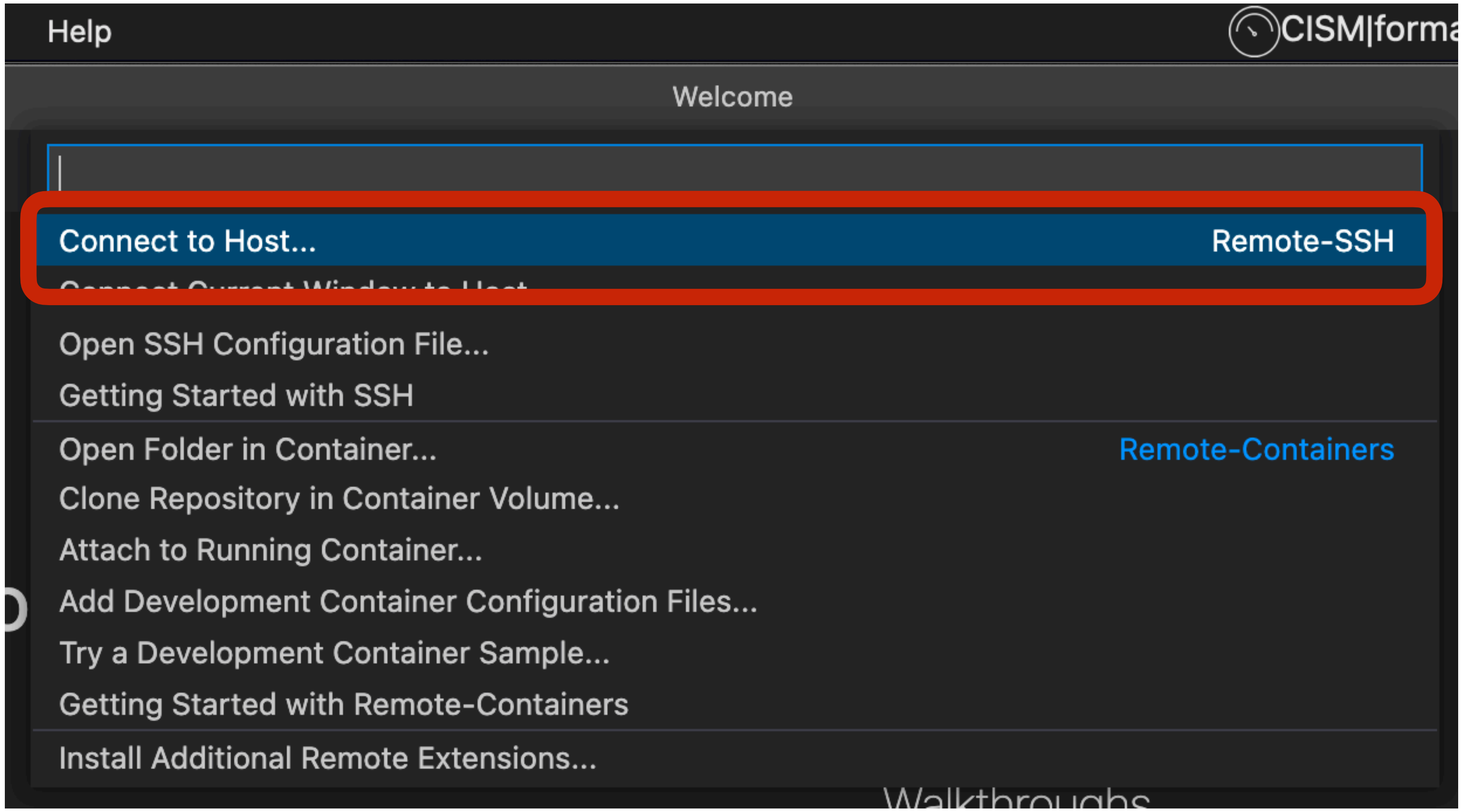
Help about SSH configuration files

- First one is likely the best here (it is for me)
- Copy/paste in that file the content of
  - ➡ http://www.ceci-hpc.be/sshconfig.html
  - ➡ Edit the path to your private key
- Save the file and exit

connection to cluster



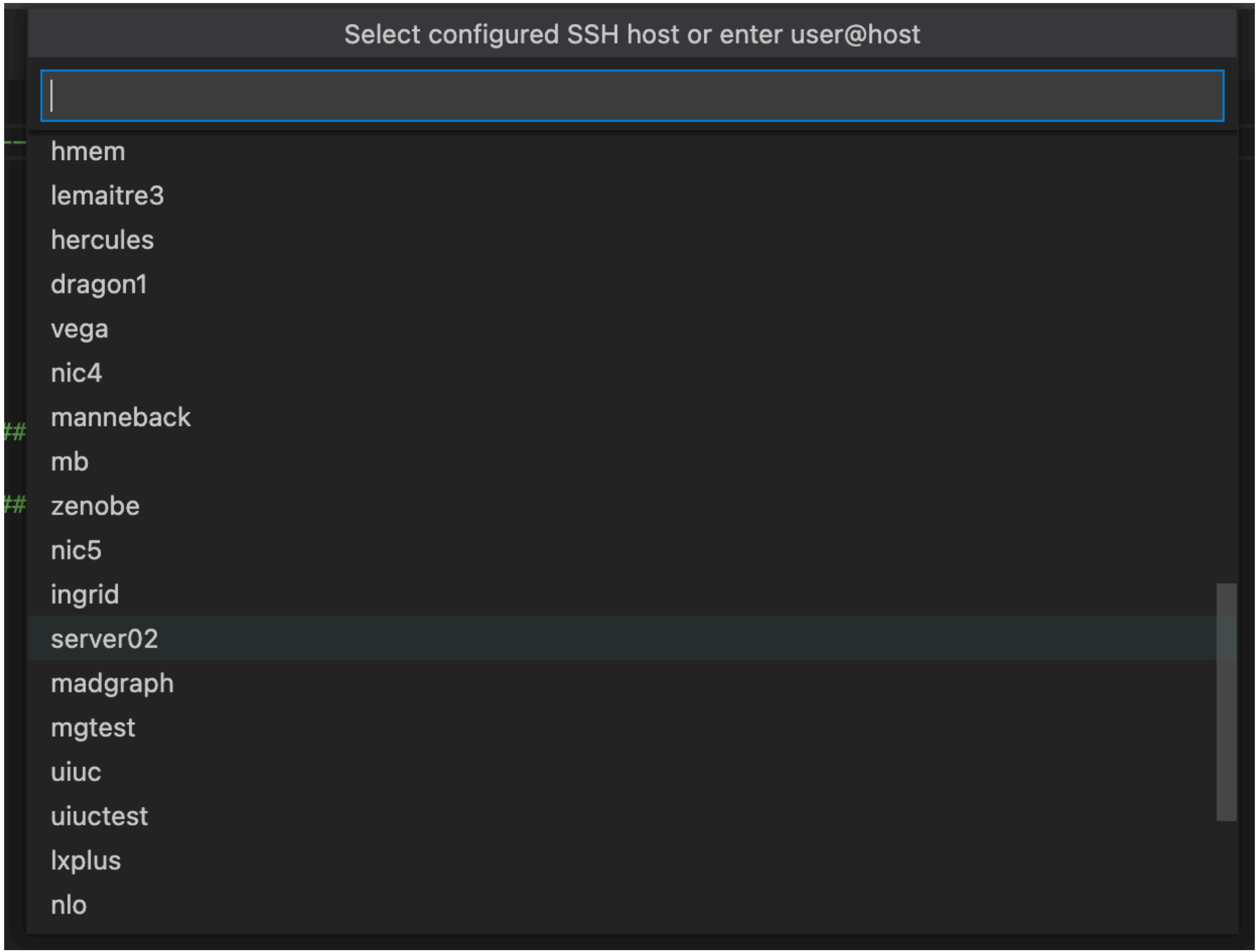
- Click on the green square
  - ➡ Bottom left
- Menu open (see below)
  - ➡ Select “connect to Host”



Connect to Host... Remote-SSH
Connect Current Window to Host
Open SSH Configuration File...
Getting Started with SSH
Open Folder in Container... Remote-Containers
Clone Repository in Container Volume...
Attach to Running Container...
Add Development Container Configuration Files...
Try a Development Container Sample...
Getting Started with Remote-Containers
Install Additional Remote Extensions...

Ssh connection

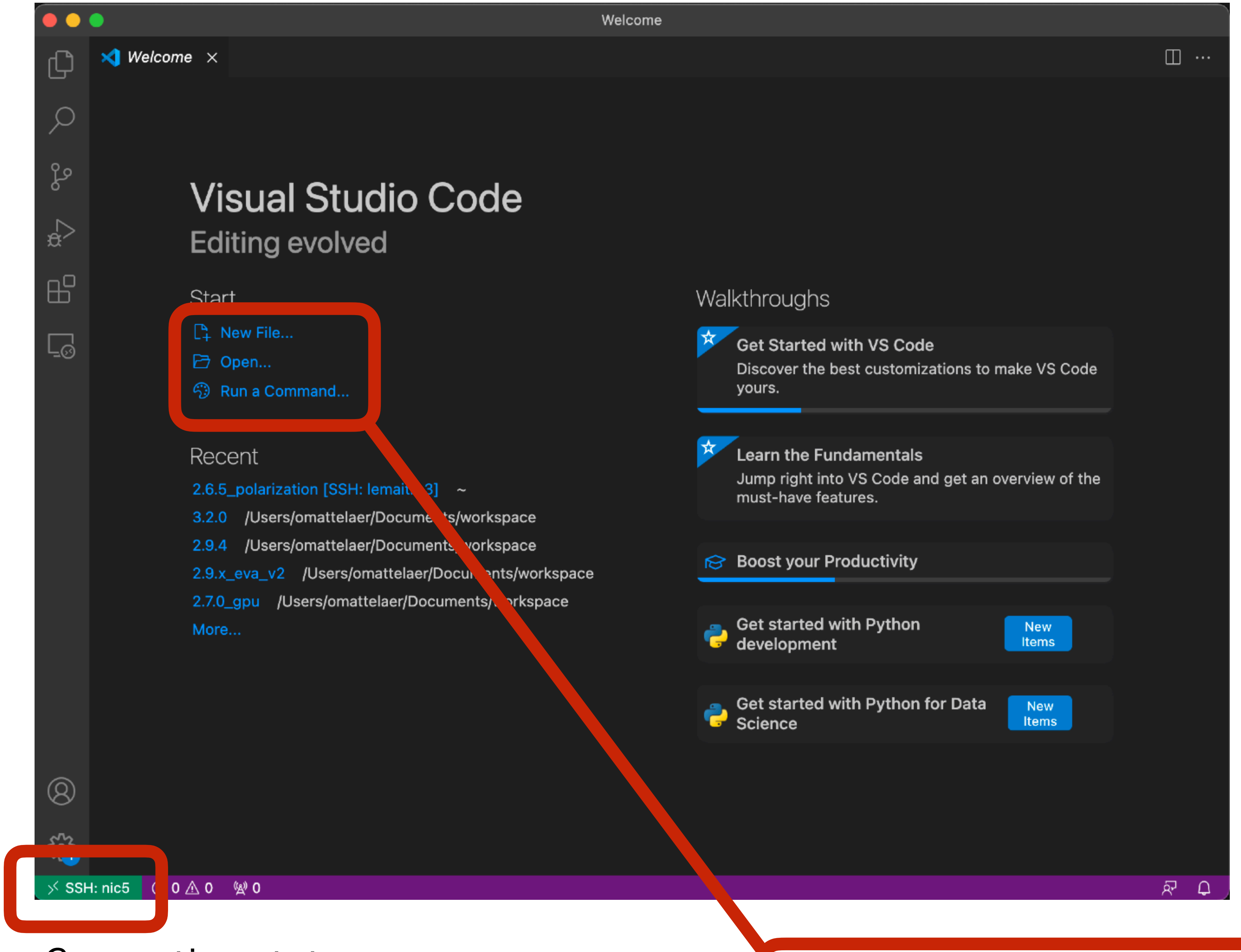
- Select the cluster that you want to connect/edit files



Select configured SSH host or enter user@host

```
hmem
lemaitre3
hercules
dragon1
vega
nic4
manneback
mb
zenobe
nic5
ingrid
server02
madgraph
mgtest
uiuc
uiuctest
lxplus
nlo
```

Start editing file



Visual Studio Code

Editing evolved

Start

Recent

2.6.5_polarization [SSH: lemait 3] ~

3.2.0 /Users/omattelaer/Docume ts/workspace

2.9.4 /Users/omattelaer/Documents workspace

2.9.x_eva_v2 /Users/omattelaer/Docu ents/workspace

2.7.0_gpu /Users/omattelaer/Documents/ rkspace

Walkthroughs

Get Started with VS Code

Discover the best customizations to make VS Code yours.

Learn the Fundamentals

Jump right into VS Code and get an overview of the must-have features.

Boost your Productivity

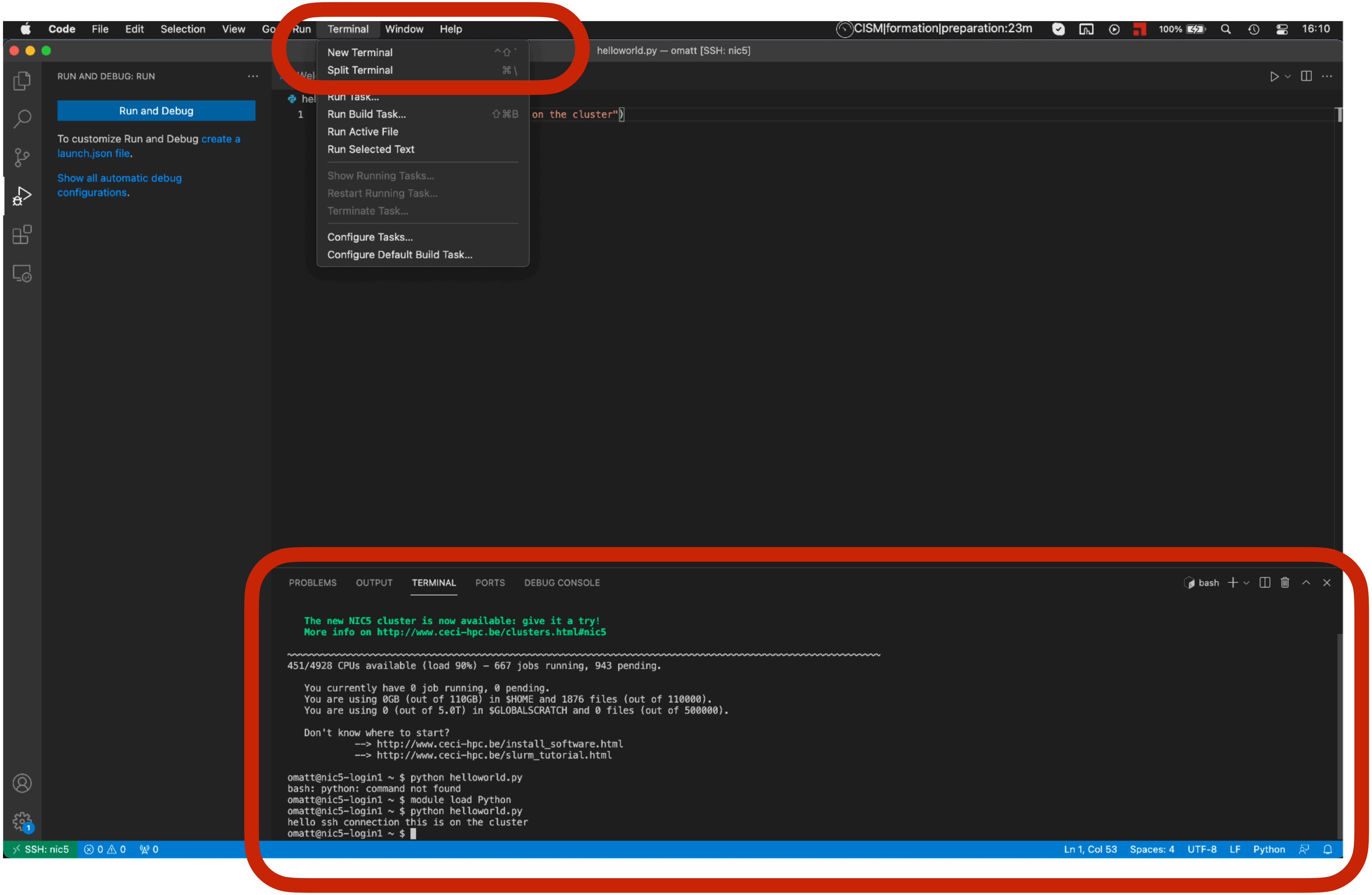
Get started with Python development

Get started with Python for Data Science

Connection status

Open file/directory (on the cluster)

Terminal from VScode



Code File Edit Selection View Go Run Terminal Window Help
CISM|formation|preparation:23m
100%
16:10
helloworld.py — omatt [SSH: nic5]
RUN AND DEBUG: RUN
Run and Debug
To customize Run and Debug create a launch.json file.
Show all automatic debug configurations.
New Terminal
Split Terminal
Run Task...
Run Build Task...
Run Active File
Run Selected Text
Show Running Tasks...
Restart Running Task...
Terminate Task...
Configure Tasks...
Configure Default Build Task...
on the cluster")
PROBLEMS OUTPUT TERMINAL PORTS DEBUG CONSOLE
bash
SSH: nic5
Ln 1, Col 53 Spaces: 4 UTF-8 LF Python

```
   The new NIC5 cluster is now available: give it a try!
   More info on http://www.ceci-hpc.be/clusters.html#nic5

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
451/4928 CPUs available (load 90%) - 667 jobs running, 943 pending.

   You currently have 0 job running, 0 pending.
   You are using 0GB (out of 110GB) in $HOME and 1876 files (out of 110000).
   You are using 0 (out of 5.0T) in $GLOBALSCRATCH and 0 files (out of 500000).

   Don't know where to start?
            --> http://www.ceci-hpc.be/install_software.html
            --> http://www.ceci-hpc.be/slurm_tutorial.html

omatt@nic5-login1 ~ $ python helloworld.py
bash: python: command not found
omatt@nic5-login1 ~ $ module load Python
omatt@nic5-login1 ~ $ python helloworld.py
hello ssh connection this is on the cluster
omatt@nic5-login1 ~ $
```

Note: You do have openssh configured now, you can do “ssh nic5” from your windows terminal

File Transfer

SCP

You can copy files/directories back and forth between computers

- Verify your agent is running and you have the ssh config file
- Create a temporary directory with dummy files on your computer

```
$ mkdir -p cours_ssh/scp_test; touch cours_ssh/scp_test/file{1..4}.txt
$ ssh frontend 'mkdir cours_ssh'
```

- Copy the directory to your home directory in one of the frontends and check

```
$ scp -r cours_ssh/scp_test host:cours_ssh/.
$ ssh frontend 'ls cours_ssh/scp_test/'
```

- Copy it back

```
$ scp -r frontend:cours_ssh/scp_test cours_ssh/scp_test2
```

- Copy between frontends is not permitted. Use $CECITRSF partition

- For a copy throw your computer use -3 option

```
$ scp -r -3 frontend1:cours_ssh/scp_test frontend2:cours_ssh/.
```

rsync

rsync is widely used for backups and mirroring and as an improved copy command for everyday use

Most common usage is to synchronize files with archive option ‘a’, and compress option ‘z’. If you want to get a copy of your hard work you did in the frontend to your laptop:

```
$ ssh frontend 'mkdir cours_ssh/rsync_test; touch cours_ssh/rsync_test/file{1..4}.txt'
$ rsync -avz --progress frontend:cours_ssh/rsync_test cours_ssh/.
```

Modify a file at the frontend and synchronize

```
$ ssh frontend 'echo "Adding hello1 word in $(hostname)" >> coursssh/rsynctest/file4.txt'
$ rsync -avz --progress frontend:coursssh/rsynctest coursssh/.
```

Modify a file in your computer and prevent Overwrite when synchronize -u

```
$ echo 'Adding hello in client' > cours_ssh/rsync_test/file3.txt
$ rsync -avzu --progress frontend:cours_ssh/rsync_test cours_ssh/.
```

Delete a file at the frontend and force delete it in your computer.

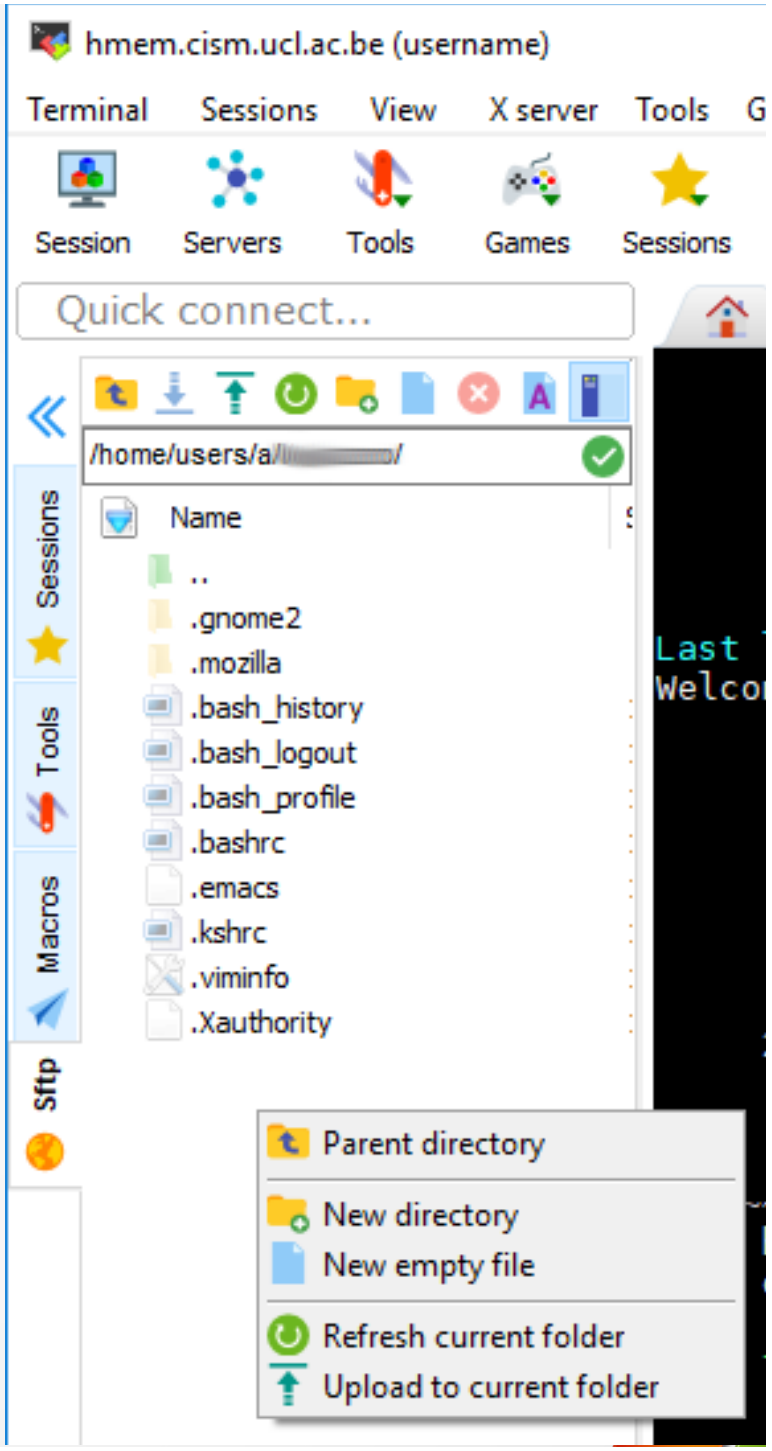
```
$ ssh host rm cours_ssh/rsync_test/file1.txt
$ rsync -avz --del --progress frontend:cours_ssh/rsync_test cours_ssh/.
```

SCP/SFTP

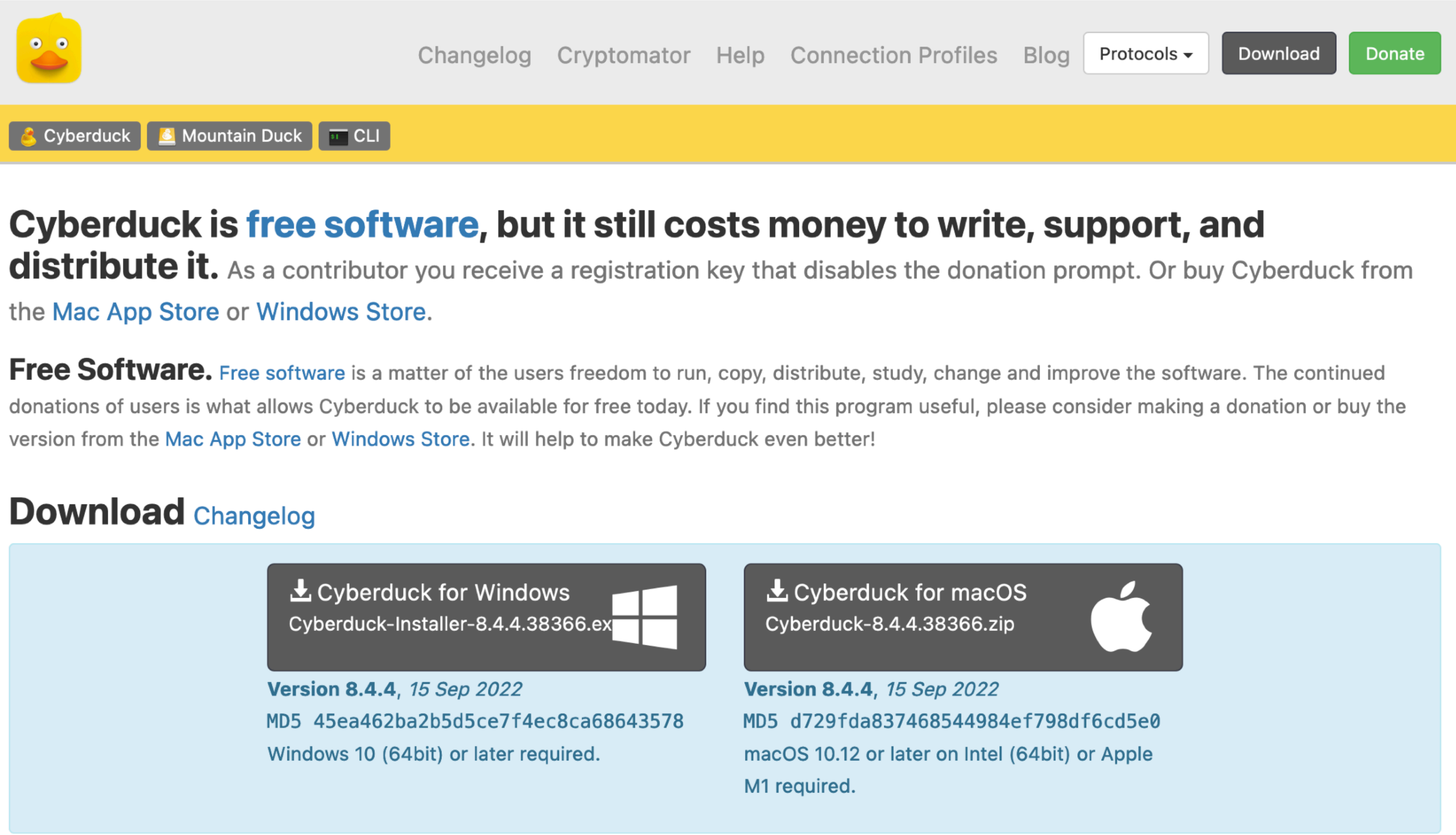
1) Select Sftp tab on the left sidebar you get
   a file browser on the cluster you are connected to

2) Drag and drop files from/to your computer
   to/from that panel and they will be copied
   to/from the cluster

3) Right click on the panel and press the
   Refresh current folder button after you copied
   something or a new file or folder is created
   on the cluster



Cyberduck (graphical filesystem)



Cyberduck is free software, but it still costs money to write, support, and distribute it. As a contributor you receive a registration key that disables the donation prompt. Or buy Cyberduck from the Mac App Store or Windows Store.

Free Software. Free software is a matter of the users freedom to run, copy, distribute, study, change and improve the software. The continued donations of users is what allows Cyberduck to be available for free today. If you find this program useful, please consider making a donation or buy the version from the Mac App Store or Windows Store. It will help to make Cyberduck even better!

Download Changelog

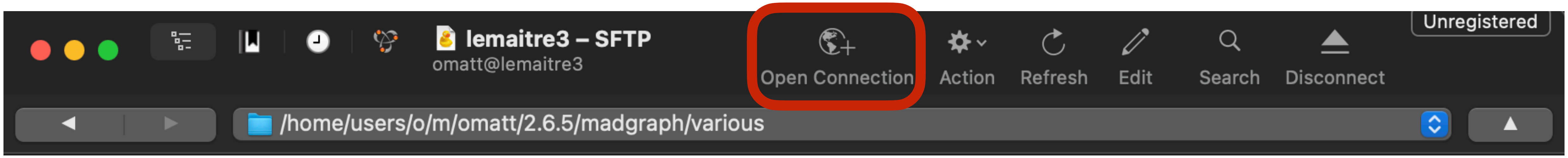
Cyberduck for Windows
Cyberduck-Installer-8.4.4.38366.ex

Version 8.4.4, *15 Sep 2022*
MD5 45ea462ba2b5d5ce7f4ec8ca68643578
Windows 10 (64bit) or later required.

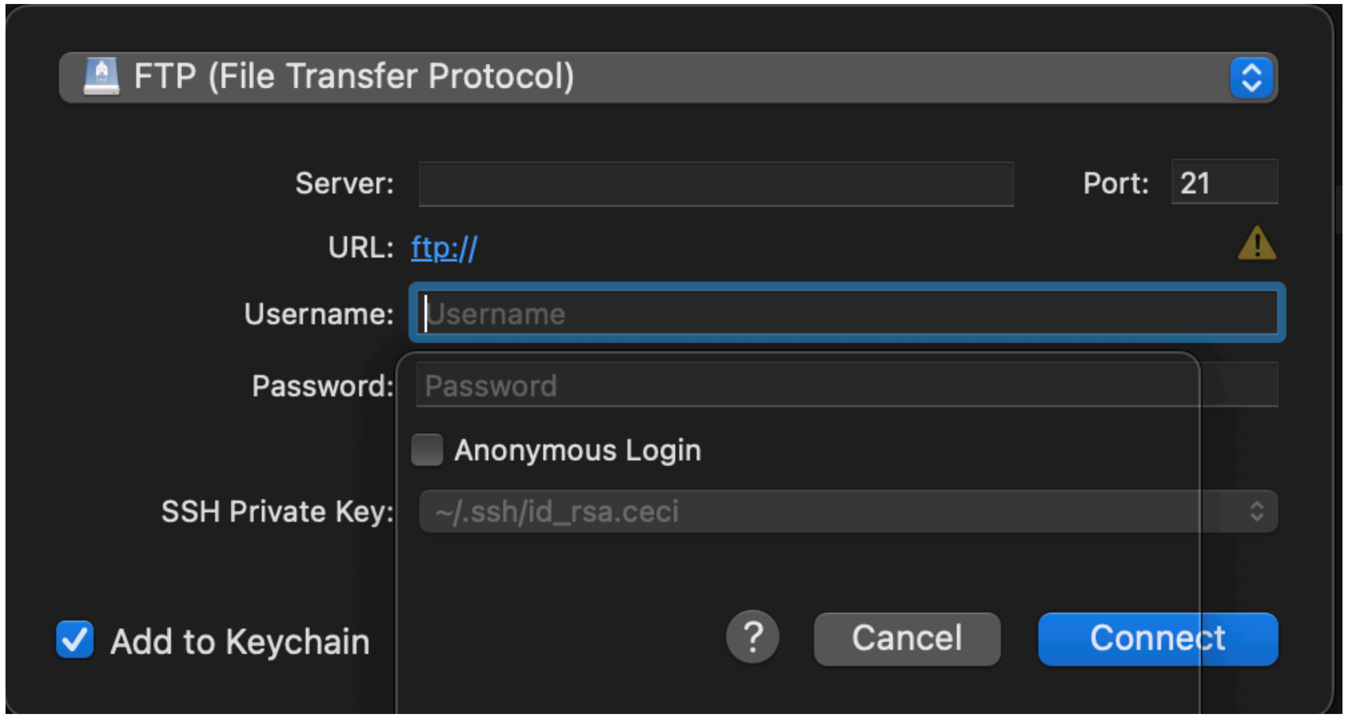
Cyberduck for macOS
Cyberduck-8.4.4.38366.zip

Version 8.4.4, *15 Sep 2022*
MD5 d729fda837468544984ef798df6cd5e0
macOS 10.12 or later on Intel (64bit) or Apple M1 required.

Cyberduck


lemaitre3 – SFTP
omatt@lemaitre3

/home/users/o/m/omatt/2.6.5/madgraph/various


FTP (File Transfer Protocol)

Server: Port: 21

URL: ftp://

Username: Username

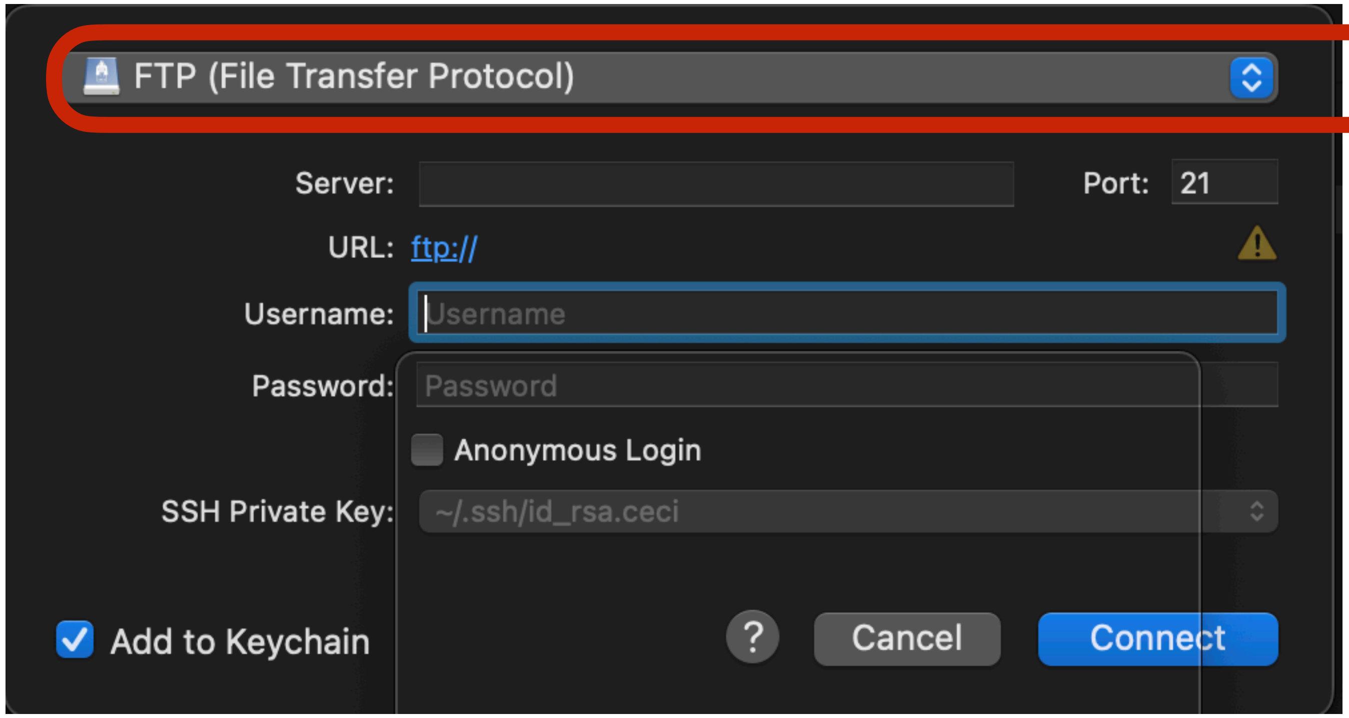
Password: Password

☐ Anonymous Login

SSH Private Key: ~/.ssh/id_rsa.ceci

☑ Add to Keychain

Cyberduck



FTP (File Transfer Protocol)

Server:

Port: 21

URL: ftp://

Username: Username

Password: Password

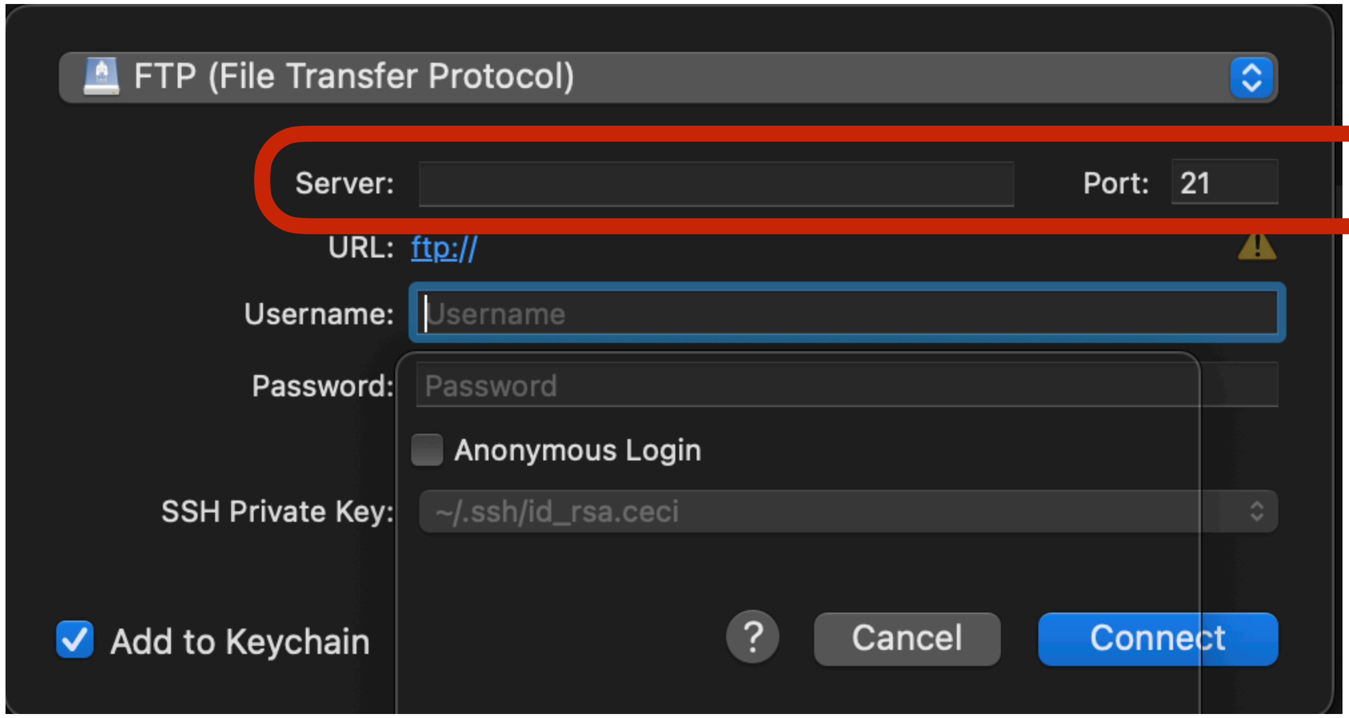
□ Anonymous Login

SSH Private Key: ~/.ssh/id_rsa.ceci

☑ Add to Keychain

Select SFTP

Cyberduck



FTP (File Transfer Protocol)

Server:

Port: 21

URL: ftp://

Username: Username

Password: Password

☐ Anonymous Login

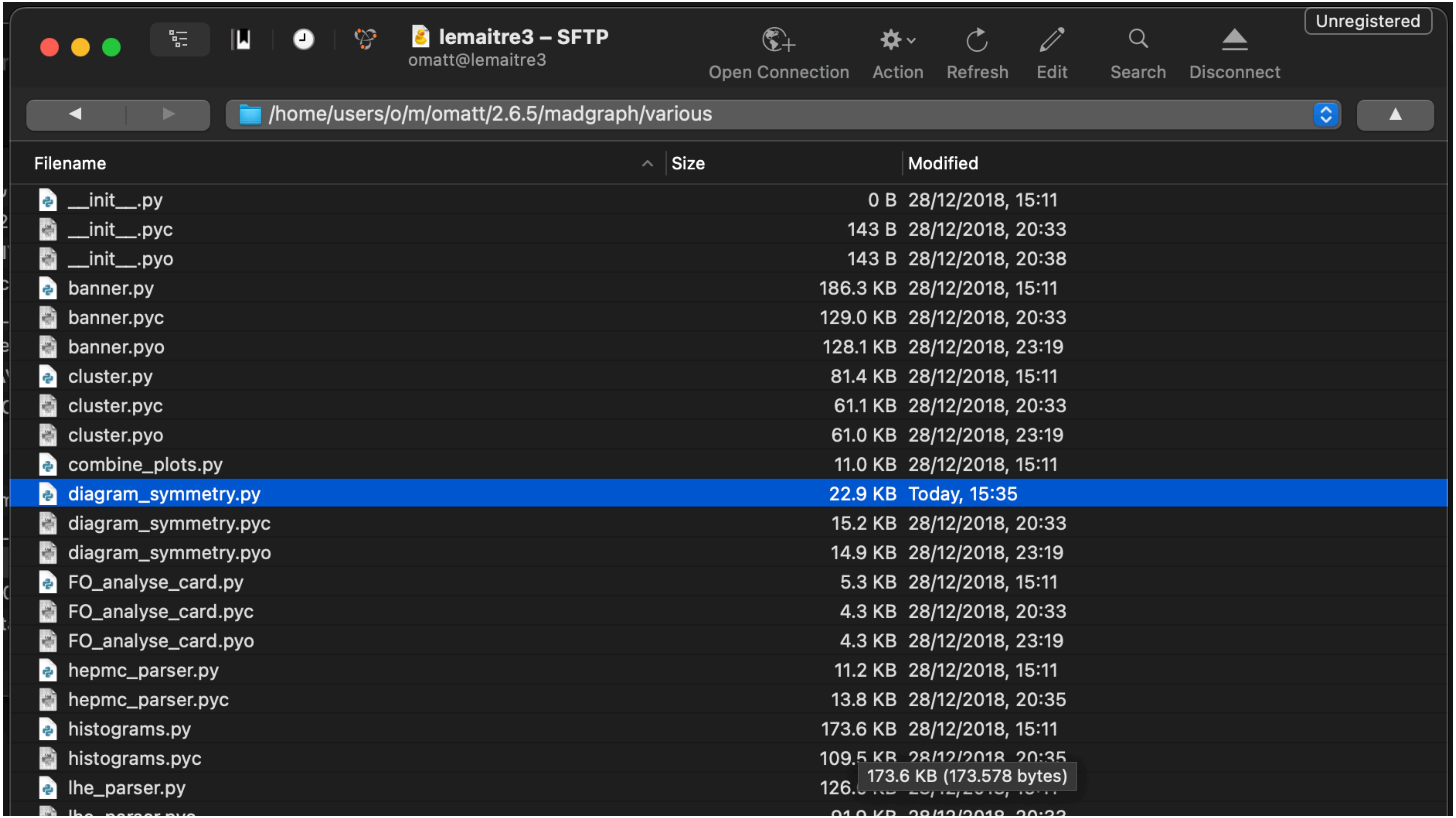
SSH Private Key: ~/.ssh/id_rsa.ceci

☑ Add to Keychain

Set the name of the cluster

If your openssh is configured that is it (i.e. if your ~/.ssh/config file is setup according to the wizard

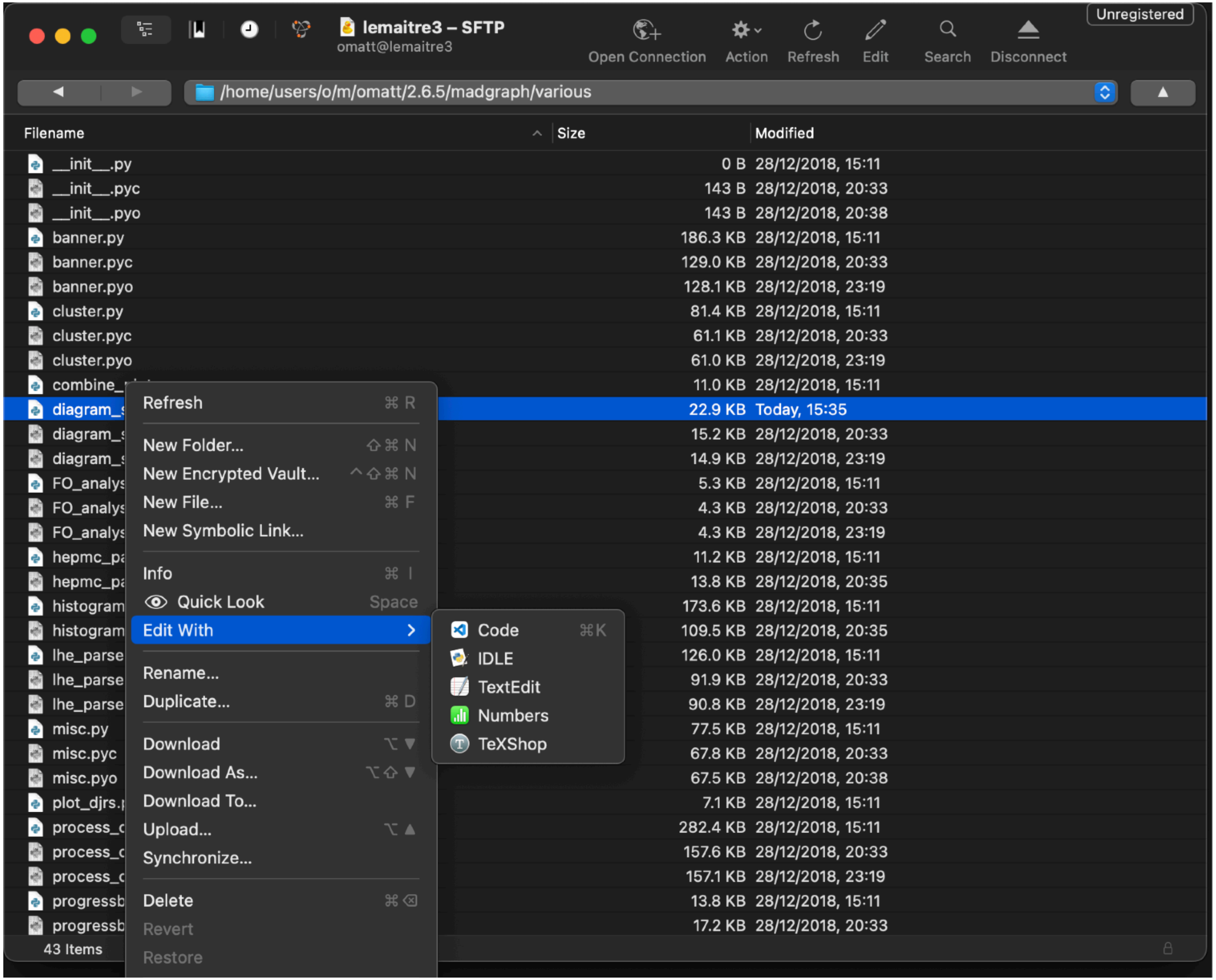
Graphical file system



Filename	Size	Modified
__init__.py	0 B	28/12/2018, 15:11
__init__.pyc	143 B	28/12/2018, 20:33
__init__.pyo	143 B	28/12/2018, 20:38
banner.py	186.3 KB	28/12/2018, 15:11
banner.pyc	129.0 KB	28/12/2018, 20:33
banner.pyo	128.1 KB	28/12/2018, 23:19
cluster.py	81.4 KB	28/12/2018, 15:11
cluster.pyc	61.1 KB	28/12/2018, 20:33
cluster.pyo	61.0 KB	28/12/2018, 23:19
combine_plots.py	11.0 KB	28/12/2018, 15:11
diagram_symmetry.py	22.9 KB	Today, 15:35
diagram_symmetry.pyc	15.2 KB	28/12/2018, 20:33
diagram_symmetry.pyo	14.9 KB	28/12/2018, 23:19
FO_analyse_card.py	5.3 KB	28/12/2018, 15:11
FO_analyse_card.pyc	4.3 KB	28/12/2018, 20:33
FO_analyse_card.pyo	4.3 KB	28/12/2018, 23:19
hepmc_parser.py	11.2 KB	28/12/2018, 15:11
hepmc_parser.pyc	13.8 KB	28/12/2018, 20:35
histograms.py	173.6 KB	28/12/2018, 15:11
histograms.pyc	109.5 KB	28/12/2018, 20:35
lhe_parser.py	126.[illegible]	[illegible]
lhe_parser.pyc	91.0 KB	28/12/2018, 20:33

Drag and Drop are working
Rename/remove/... as well

Text Editor option



/home/users/o/m/omatt/2.6.5/madgraph/various

Filename	Size	Modified
__init__.py	0 B	28/12/2018, 15:11
__init__.pyc	143 B	28/12/2018, 20:33
__init__.pyo	143 B	28/12/2018, 20:38
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banner.pyo	128.1 KB	28/12/2018, 23:19
cluster.py	81.4 KB	28/12/2018, 15:11
cluster.pyc	61.1 KB	28/12/2018, 20:33
cluster.pyo	61.0 KB	28/12/2018, 23:19
combine_	11.0 KB	28/12/2018, 15:11
diagram_	22.9 KB	Today, 15:35
diagram_	15.2 KB	28/12/2018, 20:33
diagram_	14.9 KB	28/12/2018, 23:19
FO_analys	5.3 KB	28/12/2018, 15:11
FO_analys	4.3 KB	28/12/2018, 20:33
FO_analys	4.3 KB	28/12/2018, 23:19
hepmc_pa	11.2 KB	28/12/2018, 15:11
hepmc_pa	13.8 KB	28/12/2018, 20:35
histogram	173.6 KB	28/12/2018, 15:11
histogram	109.5 KB	28/12/2018, 20:35
lhe_parse	126.0 KB	28/12/2018, 15:11
lhe_parse	91.9 KB	28/12/2018, 20:33
lhe_parse	90.8 KB	28/12/2018, 23:19
misc.py	77.5 KB	28/12/2018, 15:11
misc.pyc	67.8 KB	28/12/2018, 20:33
misc.pyo	67.5 KB	28/12/2018, 20:38
plot_djrs.	7.1 KB	28/12/2018, 15:11
process_	282.4 KB	28/12/2018, 15:11
process_	157.6 KB	28/12/2018, 20:33
process_	157.1 KB	28/12/2018, 23:19
progressb	13.8 KB	28/12/2018, 15:11
progressb	17.2 KB	28/12/2018, 20:33

SSHFS

Use SSHFS to mount a remote file system - accessible via SSH

Linux install:

Debian, Ubuntu

```
$ sudo apt-get install sshfs
```

Fedora/CentOs

```
$ yum install sshfs
```

MacOS Install:

Install FUSE and SSHFS from https://osxfuse.github.io/

SSHFS

Example: Mount your CECIHOME

Create on your computer a repository to mount the CÉCI home

```
$ mkdir frontend_home
```

Mount the remote CÉCI Home on your computer

```
$ cluster=frontend;
$ sshfs -o uid=`id -u` -o gid=`id -g` $cluster:$(ssh $cluster 'echo $CECIHOME')/ host_home
```

Create a file in the mounted directory

```
$ echo 'file content' > frontend_home/file_fuse.txt
```

Check the file content in the frontend

```
$ ssh frontend 'cat $CECIHOME/file_fuse.txt'
```

disconnect

```
$ fusermount -u frontend_home
```

Conclusion

- Now you should have access to our clusters
  - ➡ Mobaxterm / VSCode / openssh
  - ➡ Do not forget gateway
- A lot of core are available
  - ➡ Great power = great responsibility
  - ➡ Remember to not overload the front node
    - ✦ Use SLURM (-> Thursday)
- Security is important
  - ➡ Do not share your private key
  - ➡ Invalidate your key if your laptop is stolen/...