

Connecting with SSH from Windows

CÉCI HPC Training
olivier.mattelaer@uclouvain.be



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 receive 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:

Send

Plan of the talk

- Cluster presentation

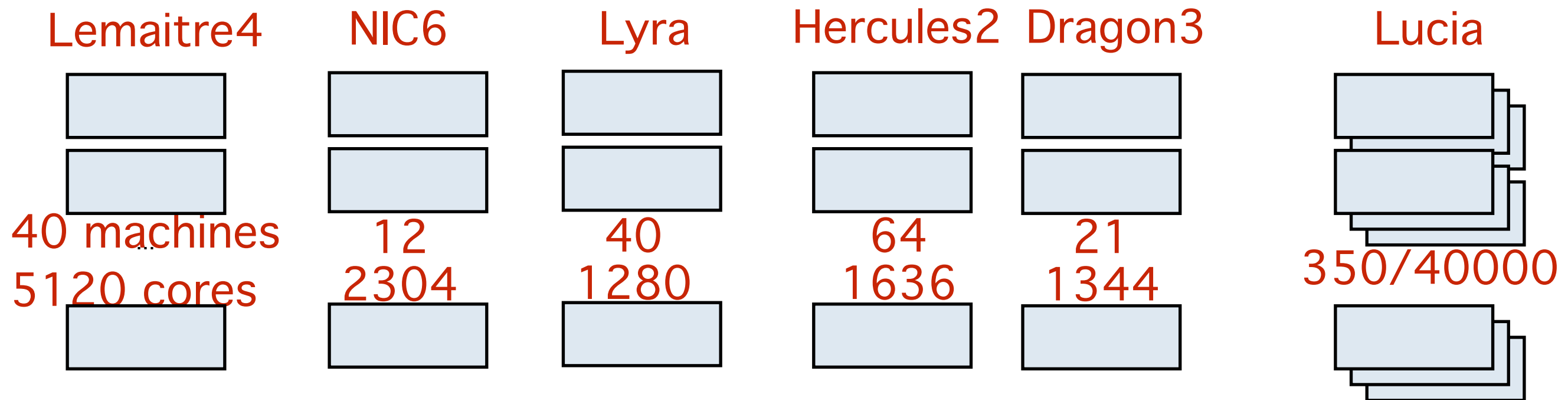
- ➔ On which machine you can connect and from where

- SSH theory

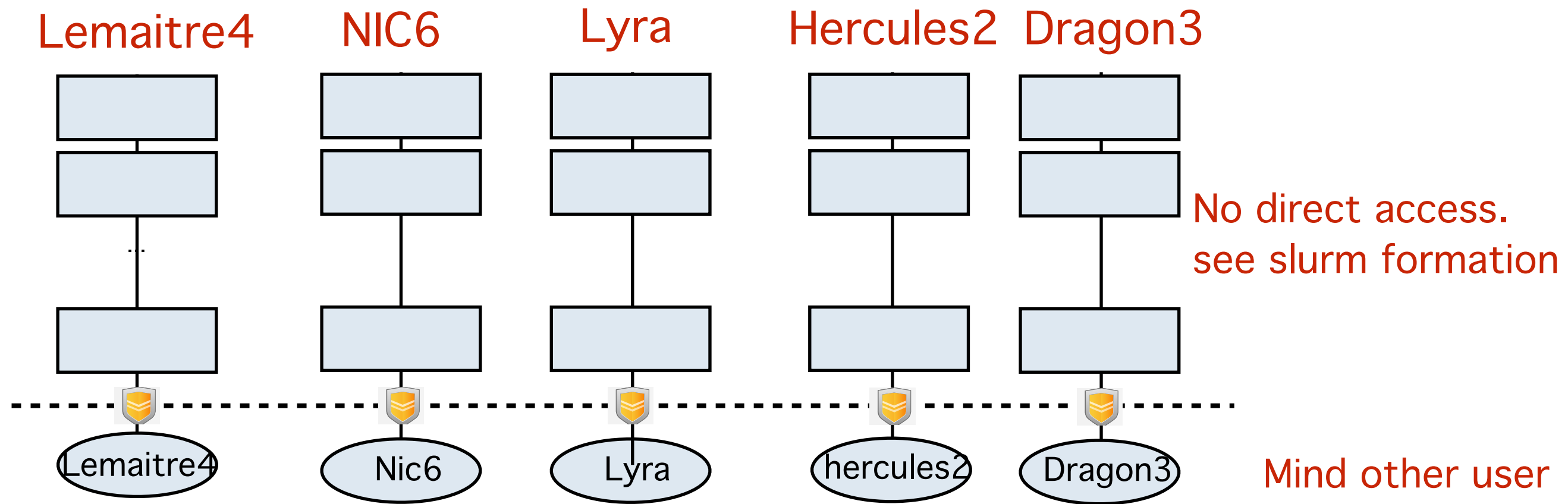
- ➔ What is a public/private key

- SSH Tools

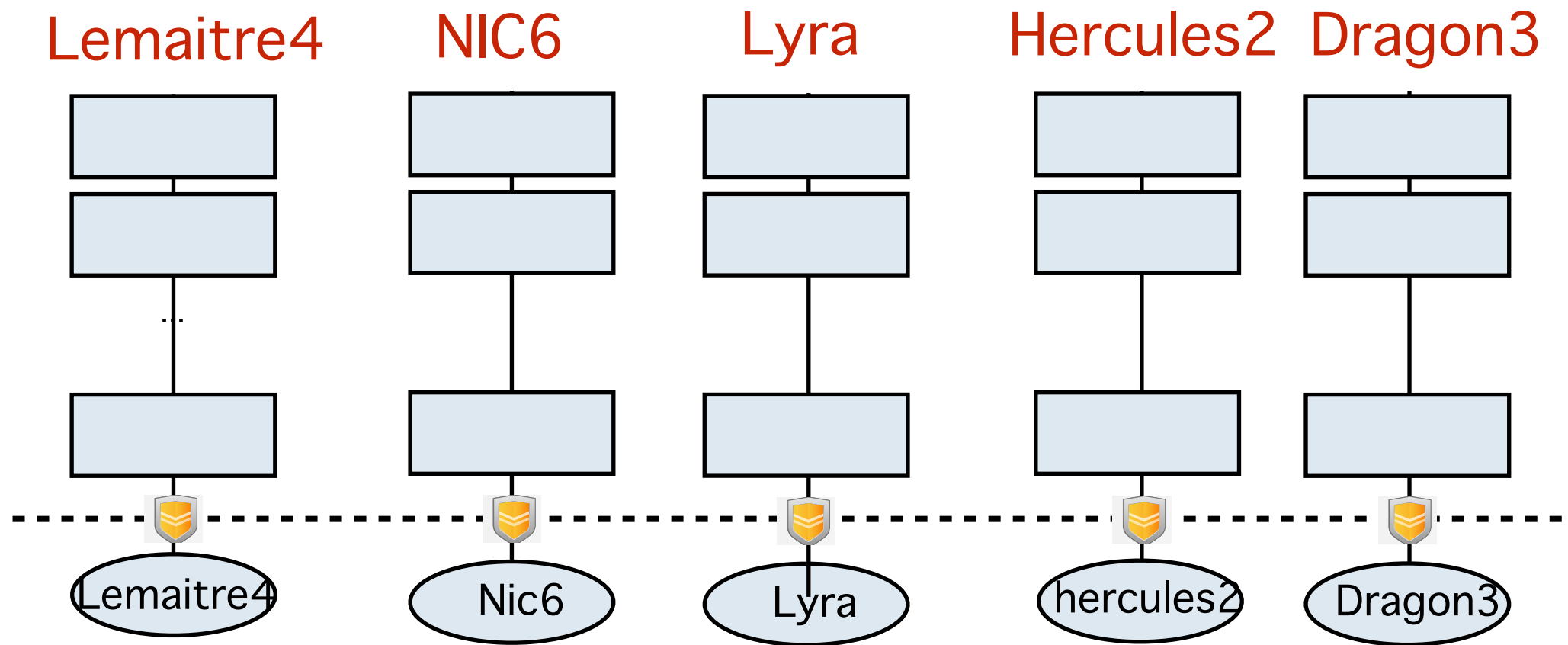
- ➔ To connect
- ➔ To edit file
- ➔ To transfer file from/to the cluster



- 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 November 12



- 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:

- ➔ lemaitre4.cism.ucl.ac.be
- ➔ nic5.uliege.be nic6.uliege.be
- ➔ hercules.ptci.unamur.be
- ➔ dragon2.umons.ac.be dragon3.umons.ac.be
- ➔ lyra.ulb.be

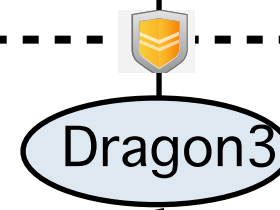
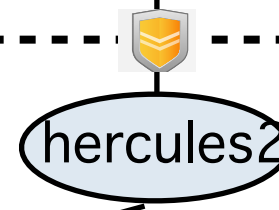
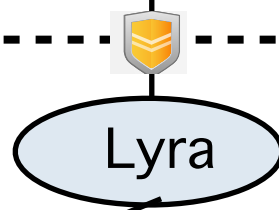
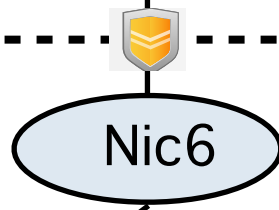
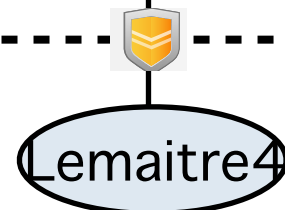
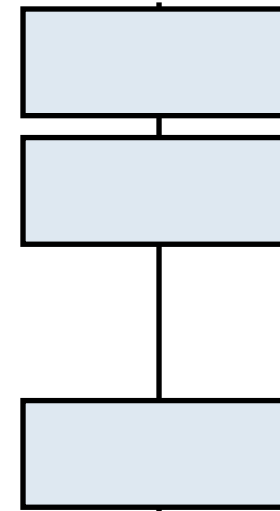
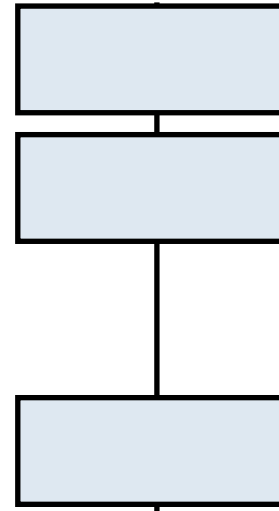
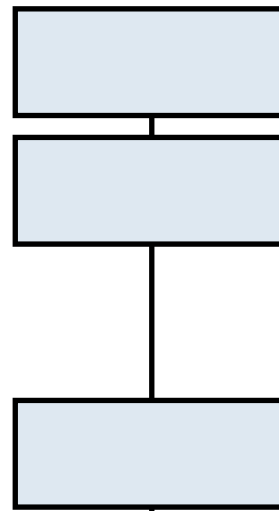
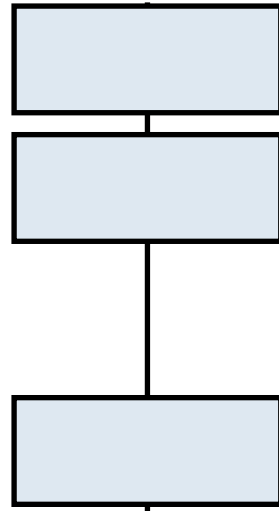
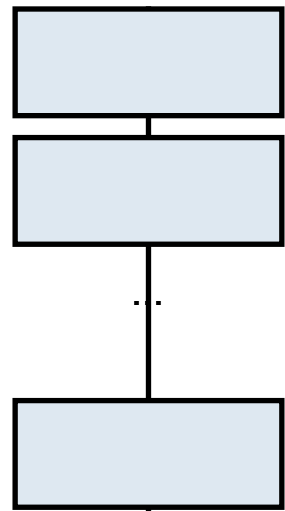
Lemaitre4

NIC6

Lyra

Hercules2

Dragon3



Private
network



Gateway



Home or your office





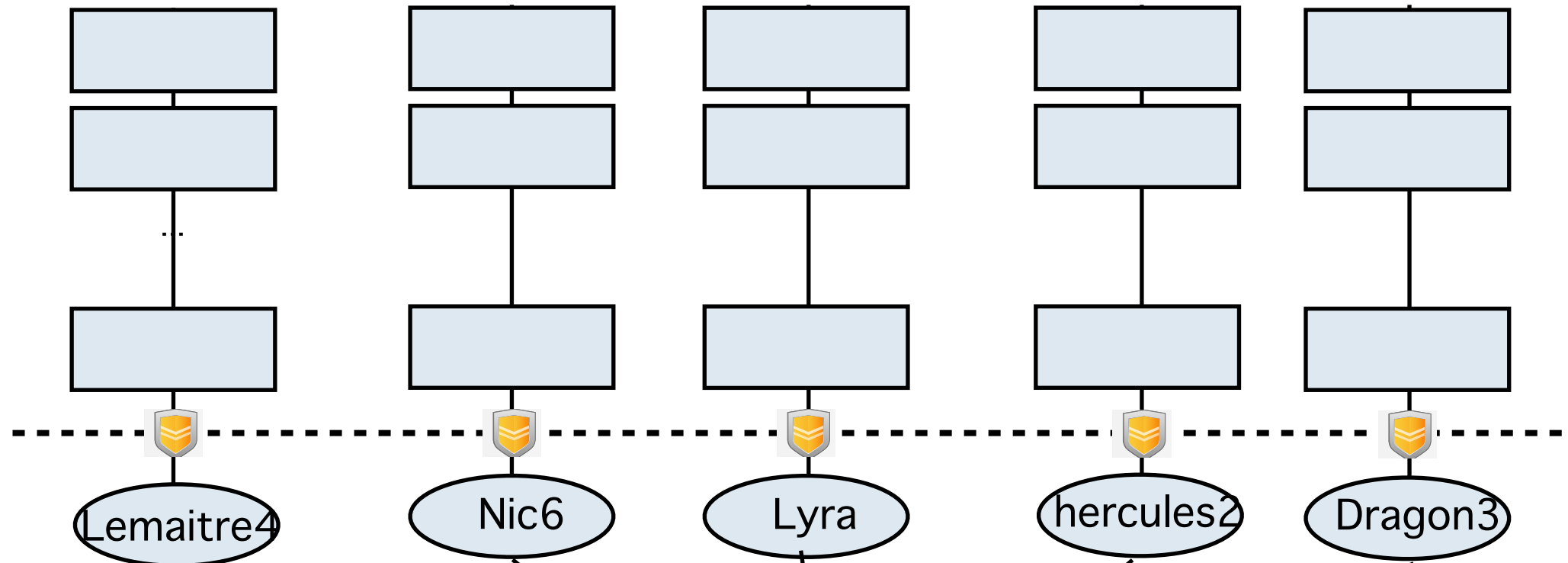
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Gateway



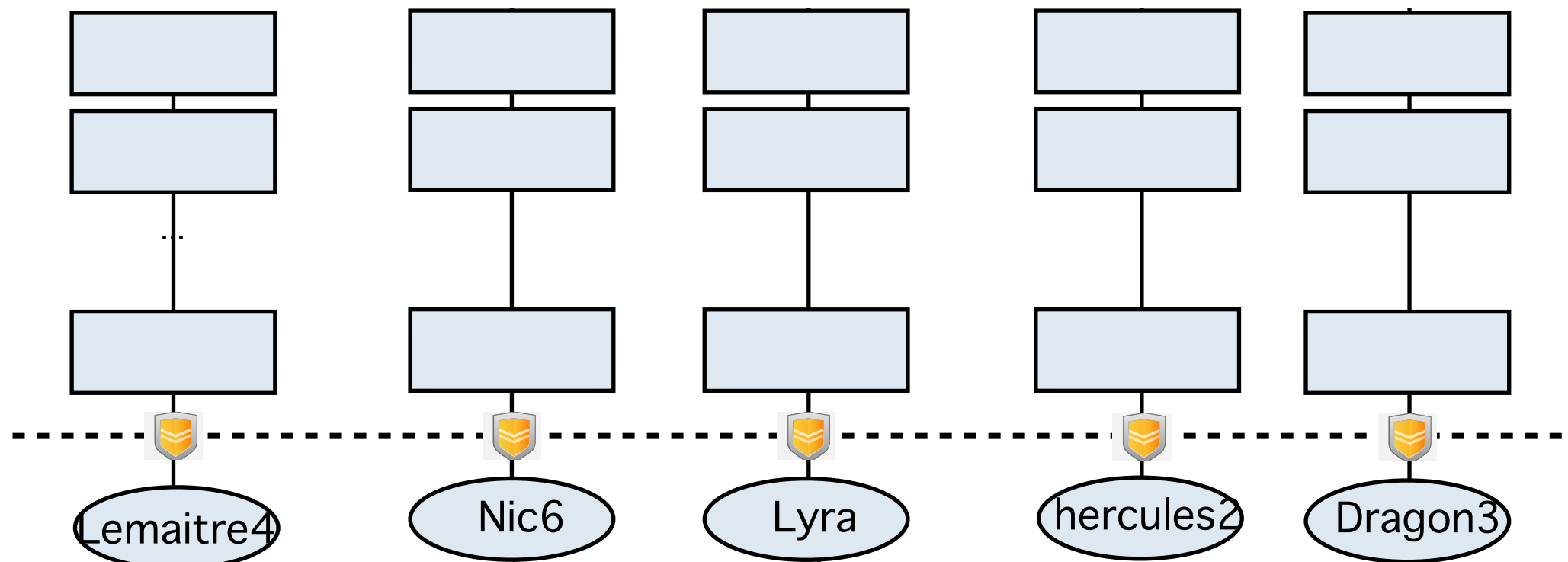
Lemaitre4

NIC6

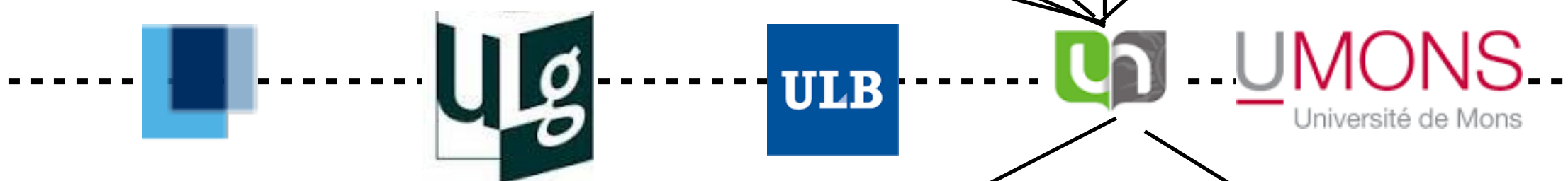
Lyra

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Private
network



Gateway



Home or your office
Gateway login is via
university login





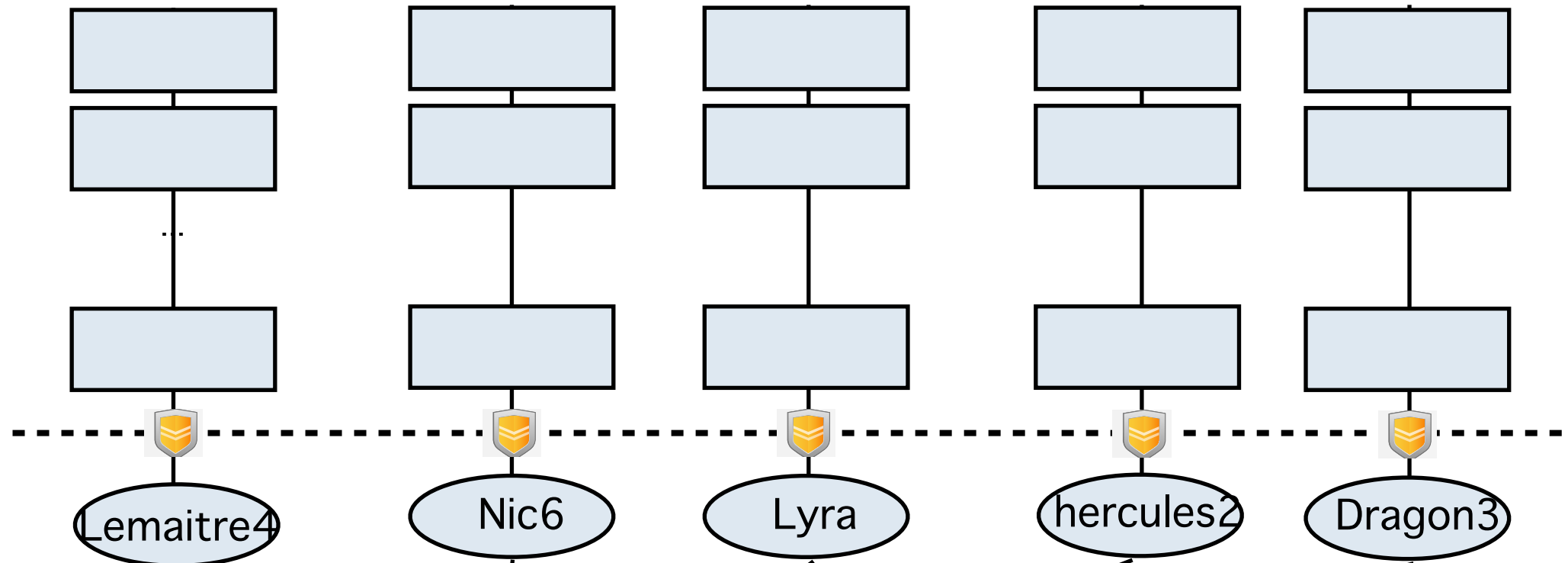
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Private
network



UMONS
Université de Mons

Gateway



ULG Network

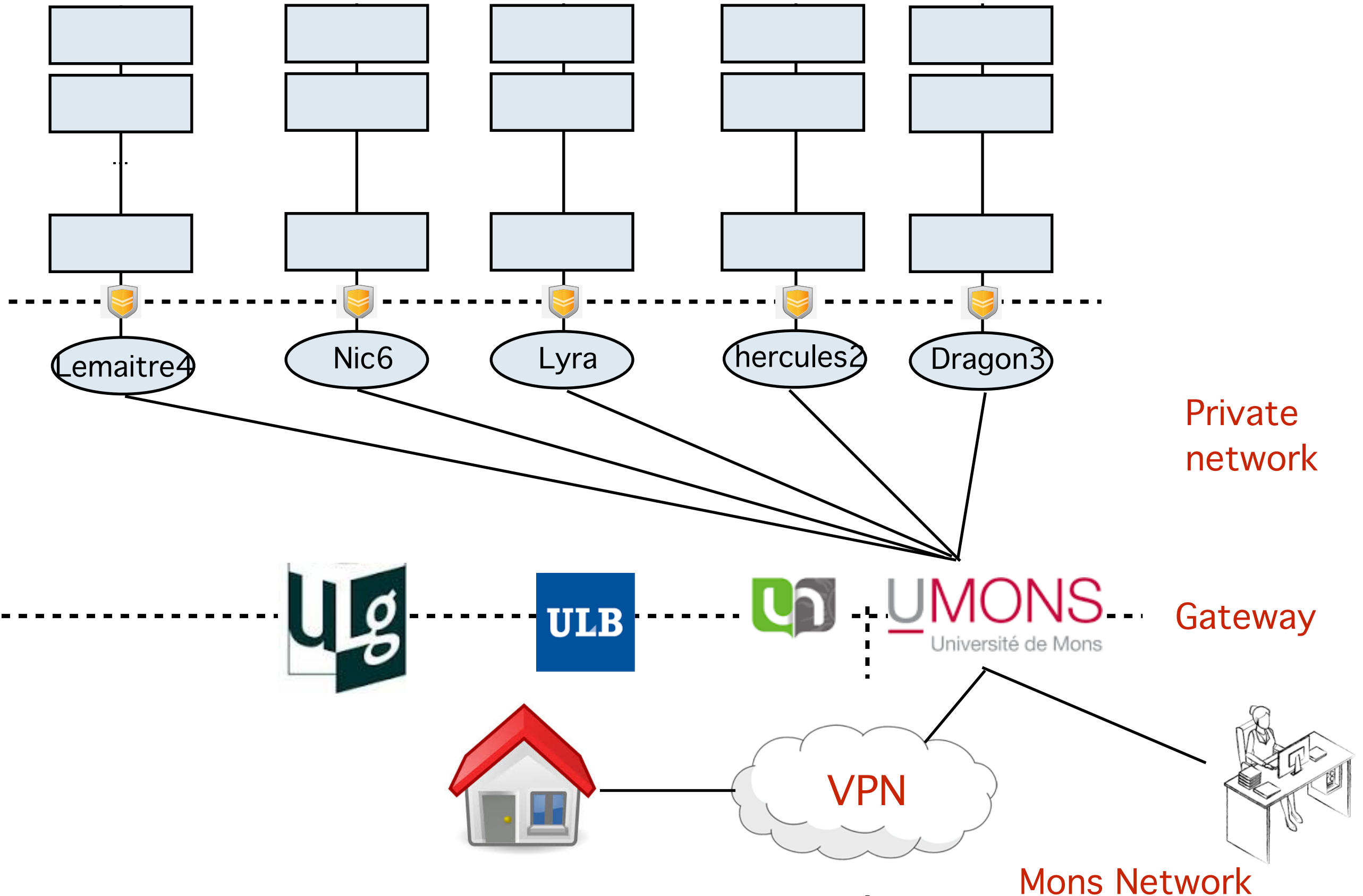


Lemaitre4

NIC6

Lyra

Hercules2 Dragon3



- 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)
- ➔ gwceci.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
=
Pass-phrase

- 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 (encrypted 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

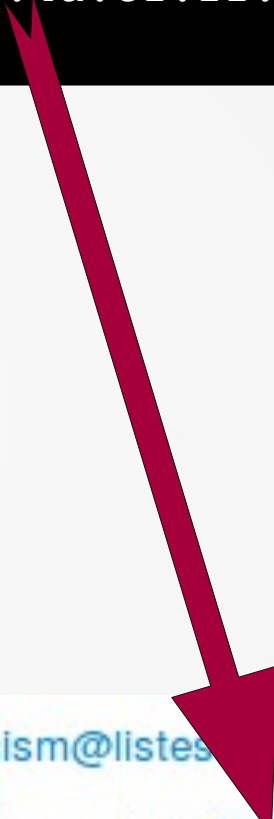
2. Host Identification

- ➔ 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>



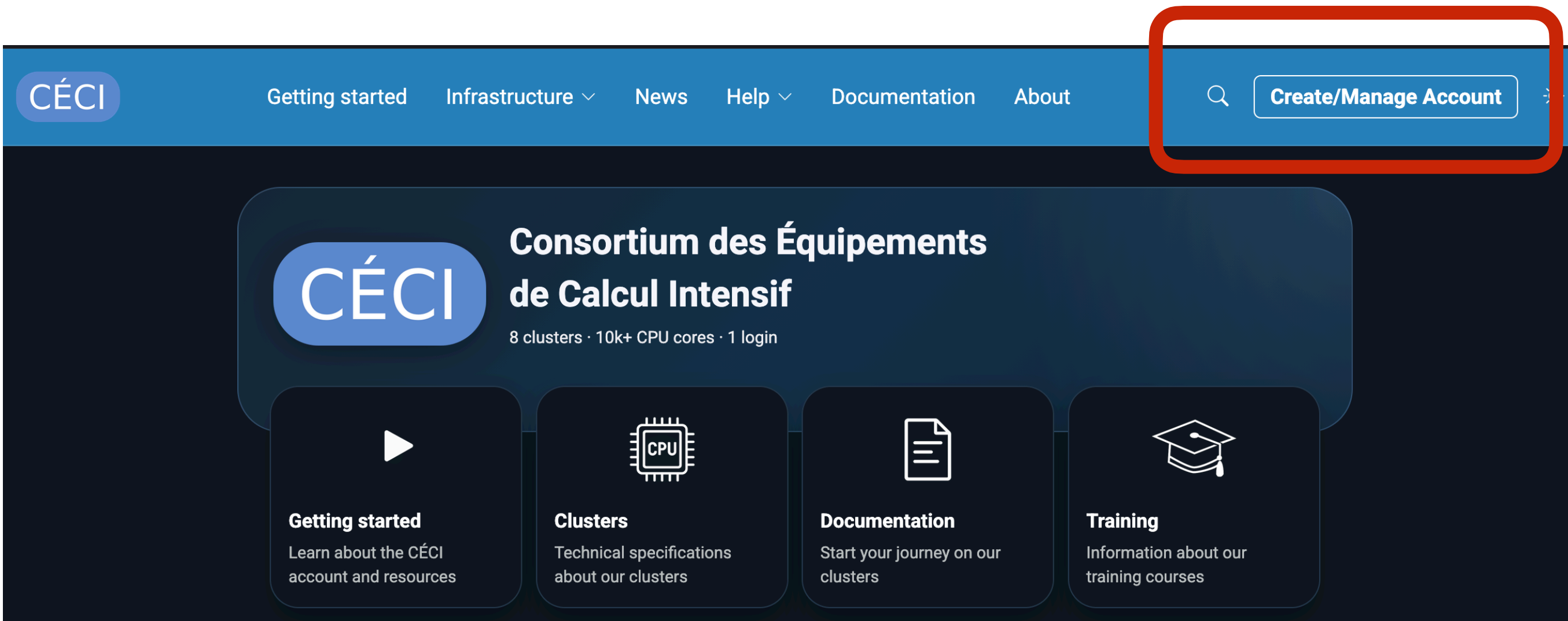
SUPPORT: egs-cism@listes.louvain.be
Server SSH key fingerprint: (What's this?)
MD5: 06:54:39:a0:5c:b5:56:b3:29:9e:96:67:a0:4a:c1:ff
SHA256:
Xi4r0aNViNgg9KjnENiUFkEWPwnJGAjbknIX+m7CI m0

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 !!

https://www.cec-hpc.be/



The screenshot shows the homepage of the CÉCI website. The top navigation bar is blue and contains the CÉCI logo on the left, followed by links for 'Getting started', 'Infrastructure' (with a dropdown arrow), 'News', 'Help' (with a dropdown arrow), 'Documentation', and 'About'. On the right side of the navigation bar, there is a search icon and a button labeled 'Create/Manage Account', which is highlighted with a red rectangular border. Below the navigation bar, the main content area has a dark blue background. It features a large header section with the CÉCI logo on the left and the text 'Consortium des Équipements de Calcul Intensif' on the right, followed by the tagline '8 clusters · 10k+ CPU cores · 1 login'. Below this header, there are four rounded rectangular buttons arranged horizontally. Each button contains an icon, a title, and a description: 1. A play button icon, titled 'Getting started', with the description 'Learn about the CÉCI account and resources'. 2. A CPU chip icon, titled 'Clusters', with the description 'Technical specifications about our clusters'. 3. A document icon, titled 'Documentation', with the description 'Start your journey on our clusters'. 4. A graduation cap icon, titled 'Training', with the description 'Information about our training courses'.

CÉCI

Getting started Infrastructure ▾ News Help ▾ Documentation About

🔍 Create/Manage Account

CÉCI

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8 clusters · 10k+ CPU cores · 1 login

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Please provide name-based email address, not numerical-based email address.

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

reset my passphrase

retrieve my private key

change my email address

invite a guest or renew a guest account

look at my account details

create an account

My email address:

@uclouvain.be



Send

Getting your private key (I)

- Users with email account access can ask for an account at: <https://login.cecihpc.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.

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

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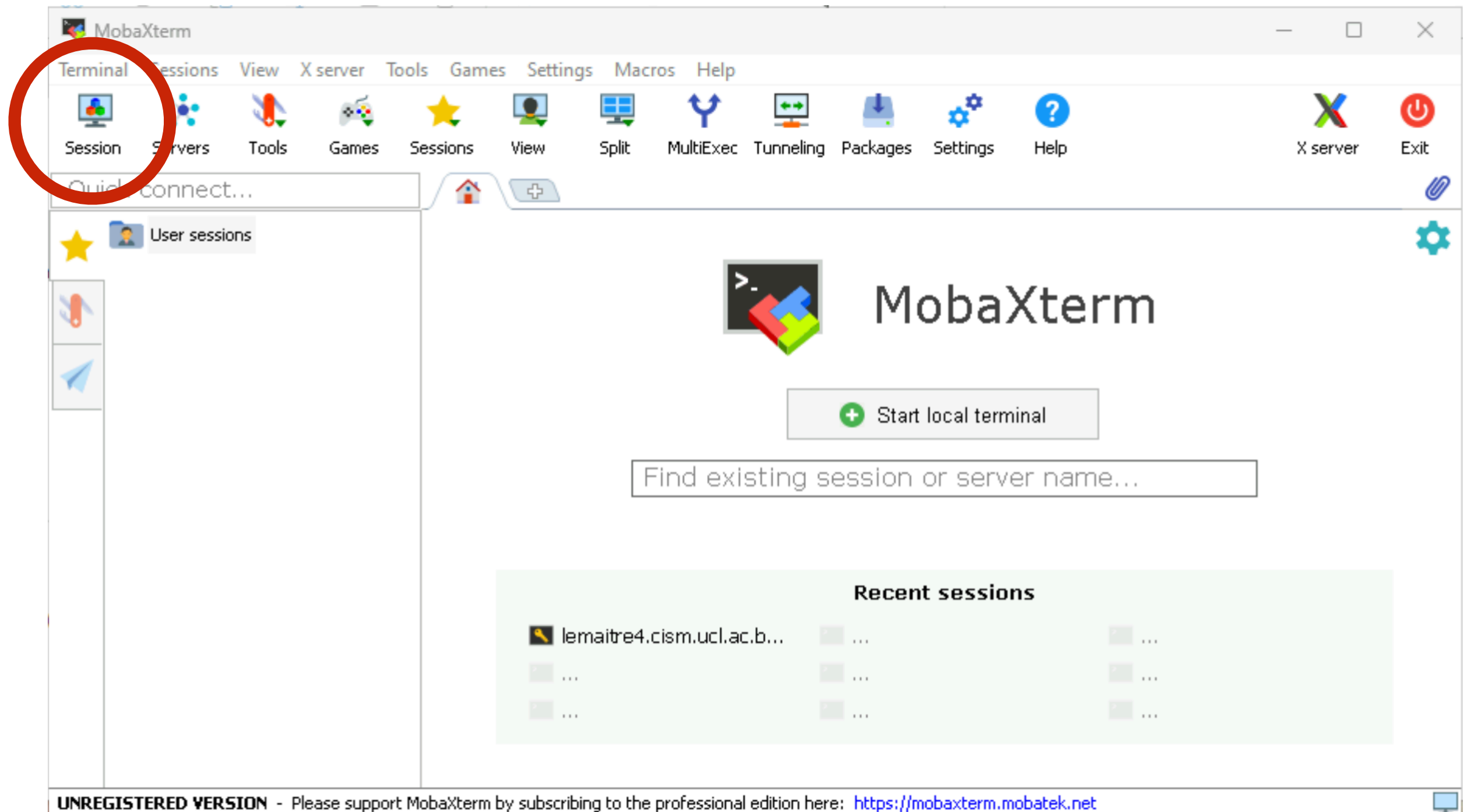
● OpenSSH on Windows (since 2018)

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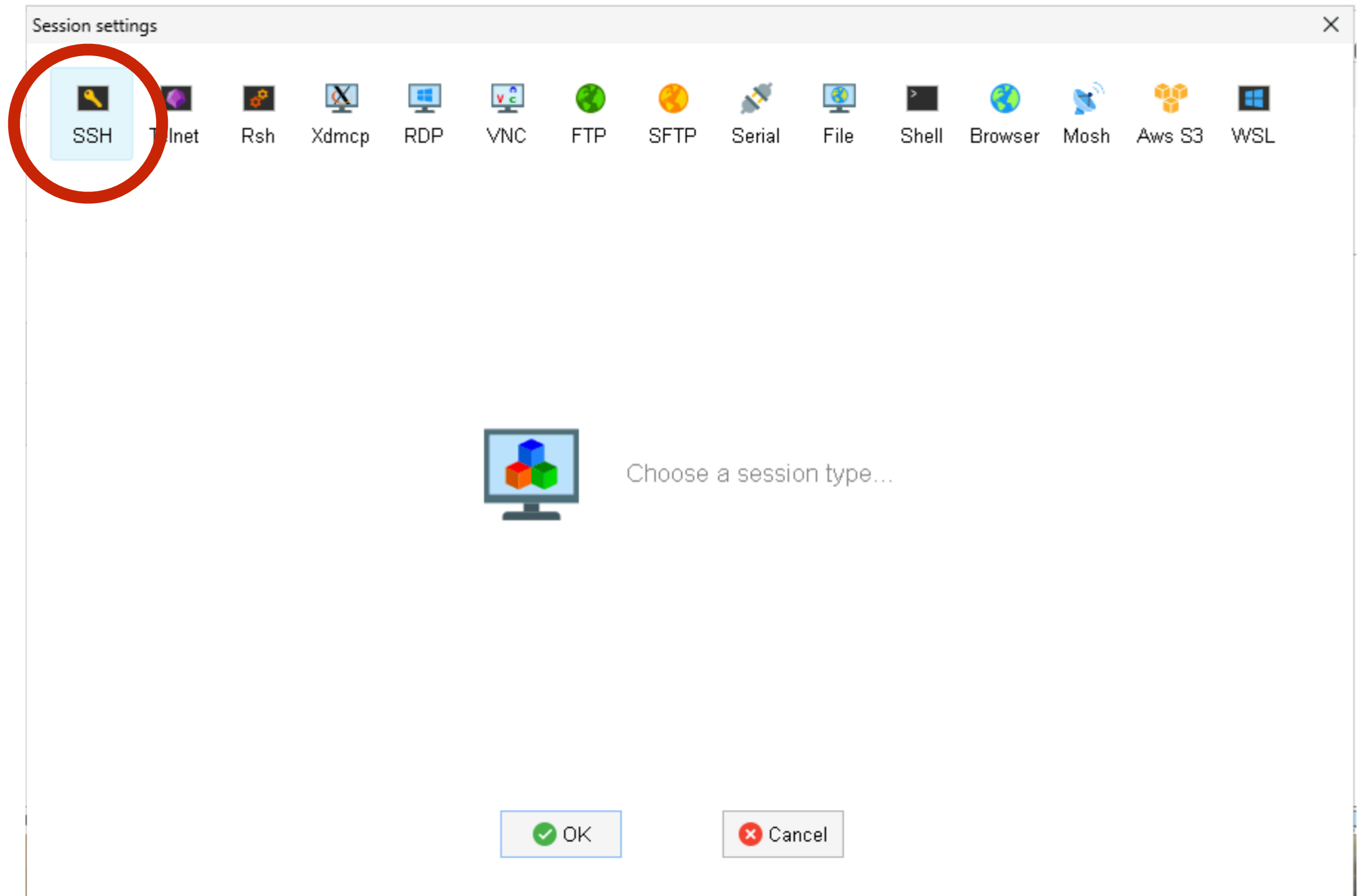
MobaXterm

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

Click Here



Click Here



Fill the cluster name and the user name

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * ☒ Specify username  Port 22

Advanced SSH settings Terminal settings Network settings Bookmark settings

Secure Shell (SSH) session 

OK Cancel

Click Here

Session settings

SSH

Telnet

Rsh

Xdmcp

RDP

VNC

FTP

SFTP

Serial

File

Shell

Browser

Mosh

Aws S3

WSL

Basic SSH settings

Remote host *

lemaitre4.cism.ucl.ac.be

Specify username

omatt

Port

22

Advanced SSH settings

Terminal settings

Network settings

Bookmark settings

Secure Shell (SSH) session

OK

Cancel

ssh

30

2026

Click on "use private key"

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * lemaitre4.cism.ucl.ac.be ☒ Specify username omatt Port 22

Advanced SSH settings Terminal settings Network settings Bookmark settings

☒ X11-Forwarding ☒ Compression Remote environment: Interactive shell

Execute command:

SSH-browser type: SFTP protocol ☐ Do not exit after command ends

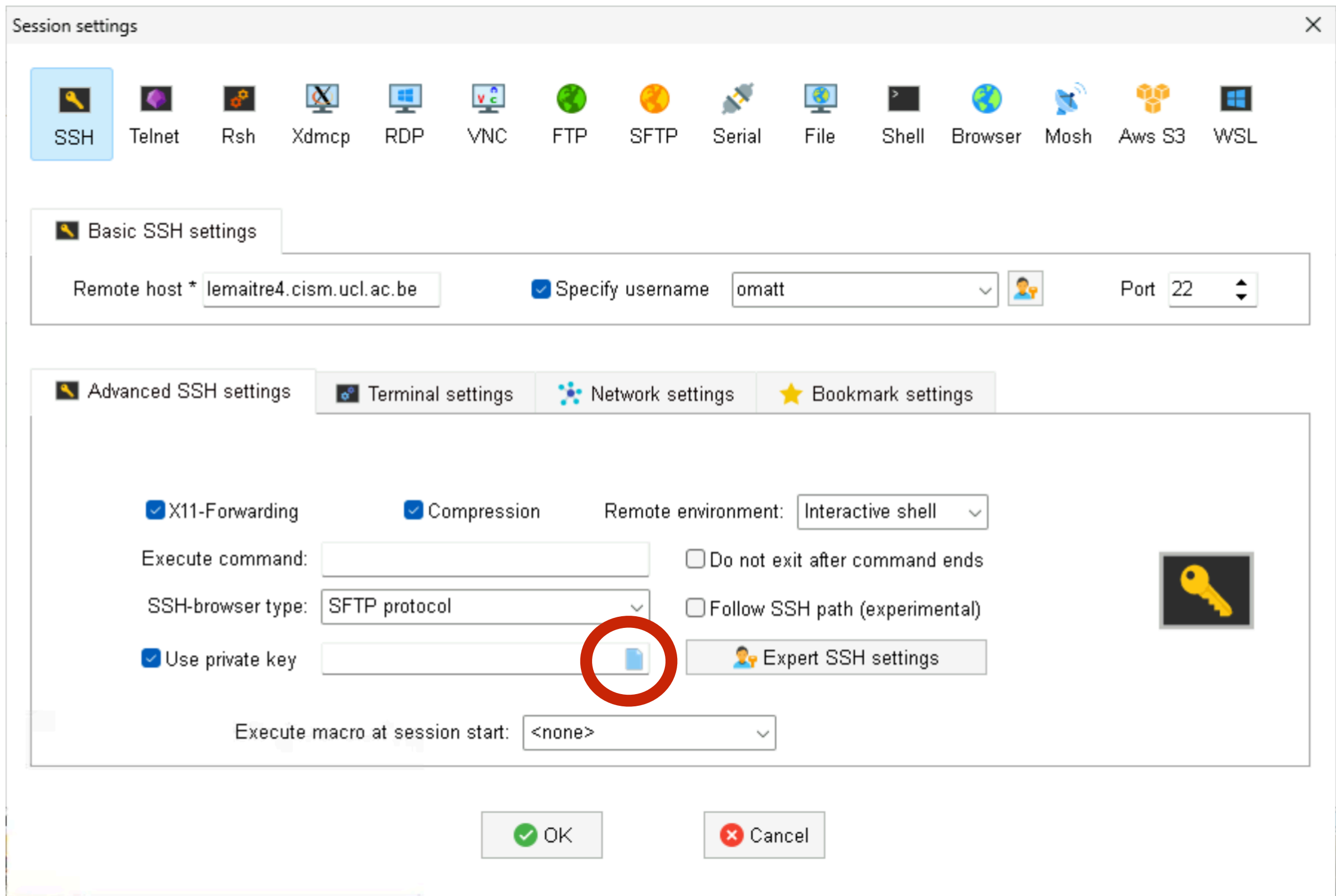
☐ Use private key ☐ Follow SSH path (experimental)

Execute macro at session start: <none>

Expert SSH settings

OK Cancel

Click on the blue icon and then select the private key on your system



Click Here

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * lemaitre4.cism.ucl.ac.be ☒ Specify username omatt Port 22

Advanced SSH settings Terminal settings Network settings Bookmark settings

☒ X11-Forwarding ☒ Compression Remote environment: Interactive shell

Execute command:

SSH-browser type: SFTP protocol ☐ Do not exit after command ends

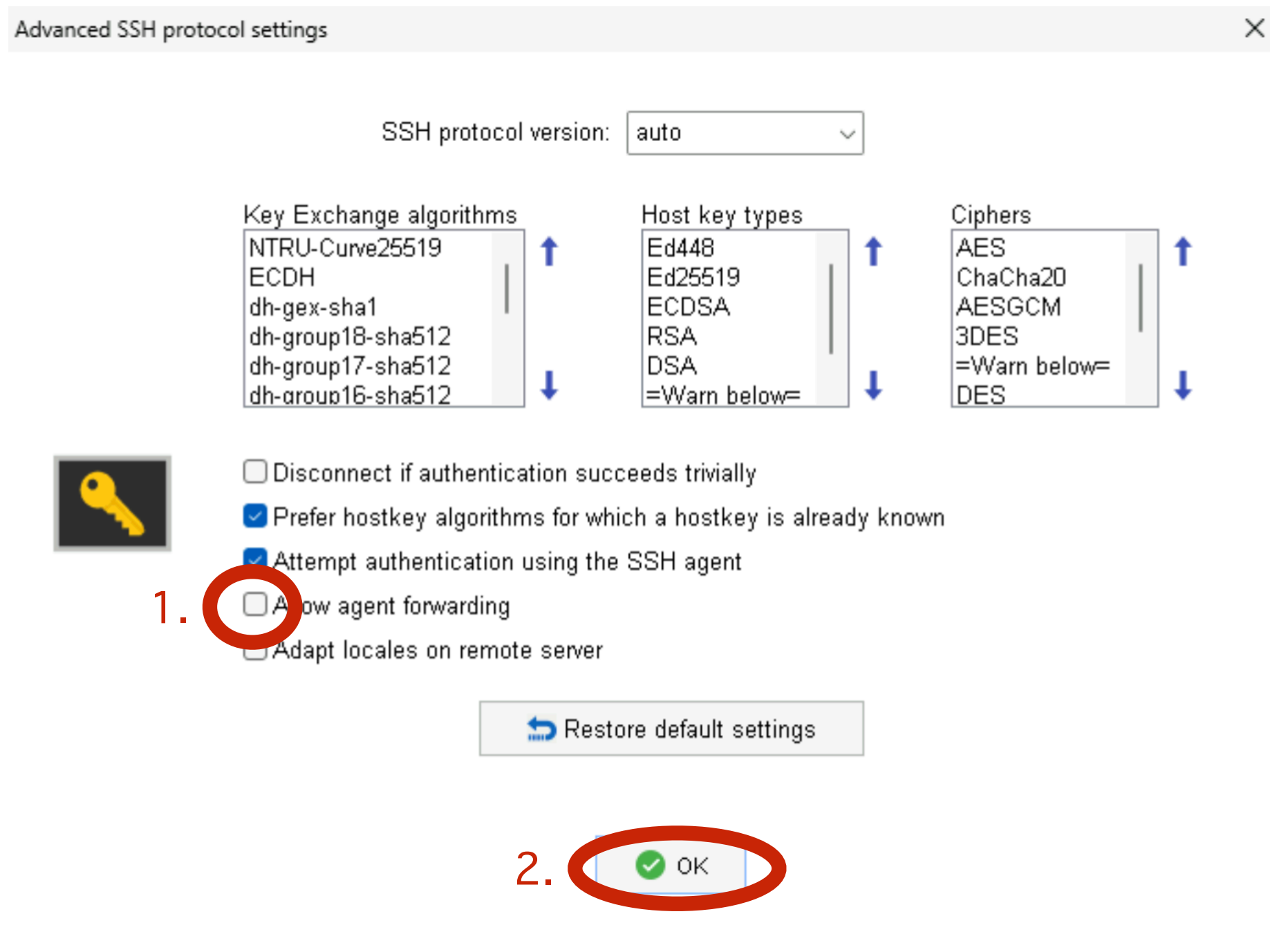
☒ Use private key C:\Users\omattelaer\Downloads\id ☐ Follow SSH path (experimental)

☒ Expert SSH settings

Execute macro at session start: <none>

OK Cancel

Click Here then click OK



Click Here

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * lemaitre4.cism.ucl.ac.be ☒ Specify username omatt Port 22

Advanced SSH settings Terminal settings **Network settings** Bookmark settings

☒ X11-Forwarding ☒ Compression Remote environment: Interactive shell

Execute command: ☐ Do not exit after command ends

SSH-browser type: SFTP protocol ☐ Follow SSH path (experimental)

☒ Use private key C:\Users\omattelaer\Downloads\id.

Execute macro at session start: <none>

OK Cancel

Click Here

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * lemaitre4.cism.ucl.ac.be ☒ Specify username omatt Port 22

Advanced SSH settings Terminal settings Network settings Bookmark settings

SSH gateway (jump host)

Proxy settings (experimental)

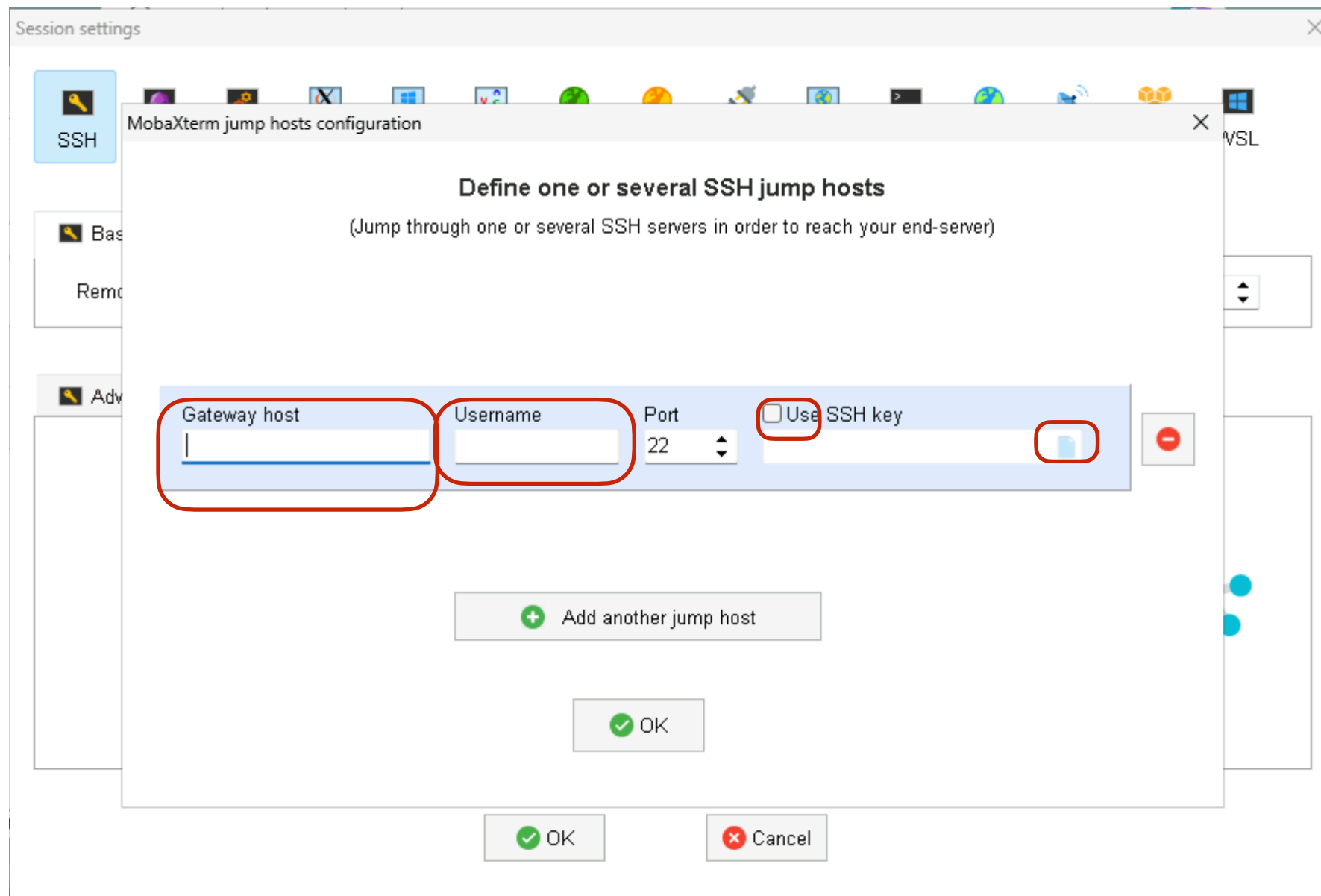
Proxy type: None Host: Login: Port: 1080

OK Cancel

Fill the information
Gateway address depend
Of YOUR university
(Same private key)

- gwceci.cism.ucl.ac.be
- gwceci.ulb.ac.be
- gwceci.uliege.be

- gwceci.unamur.be
(unamur id)
- dragon2.umons.ac.be



Click Here

Session settings

SSH

MobaXterm jump hosts configuration

Define one or several SSH jump hosts
(Jump through one or several SSH servers in order to reach your end-server)

Gateway host	Username	Port	☒ Use SSH key
gwceci.cism.ucl.ac.be	omatt	22	C:\Users\omattelaer\Downloads\ir

+ Add another jump host

OK

OK Cancel

Click Here

Session settings

SSH

Telnet

Rsh

Xdmcp

RDP

VNC

FTP

SFTP

Serial

File

Shell

Browser

Mosh

Aws S3

WSL

Basic SSH settings

Remote host *

☒ Specify username

Port

Advanced SSH settings

Terminal settings

Network settings

Bookmark settings

→ →

SSH gateway (jump host)

Proxy settings (experimental)

Proxy type:

Host:

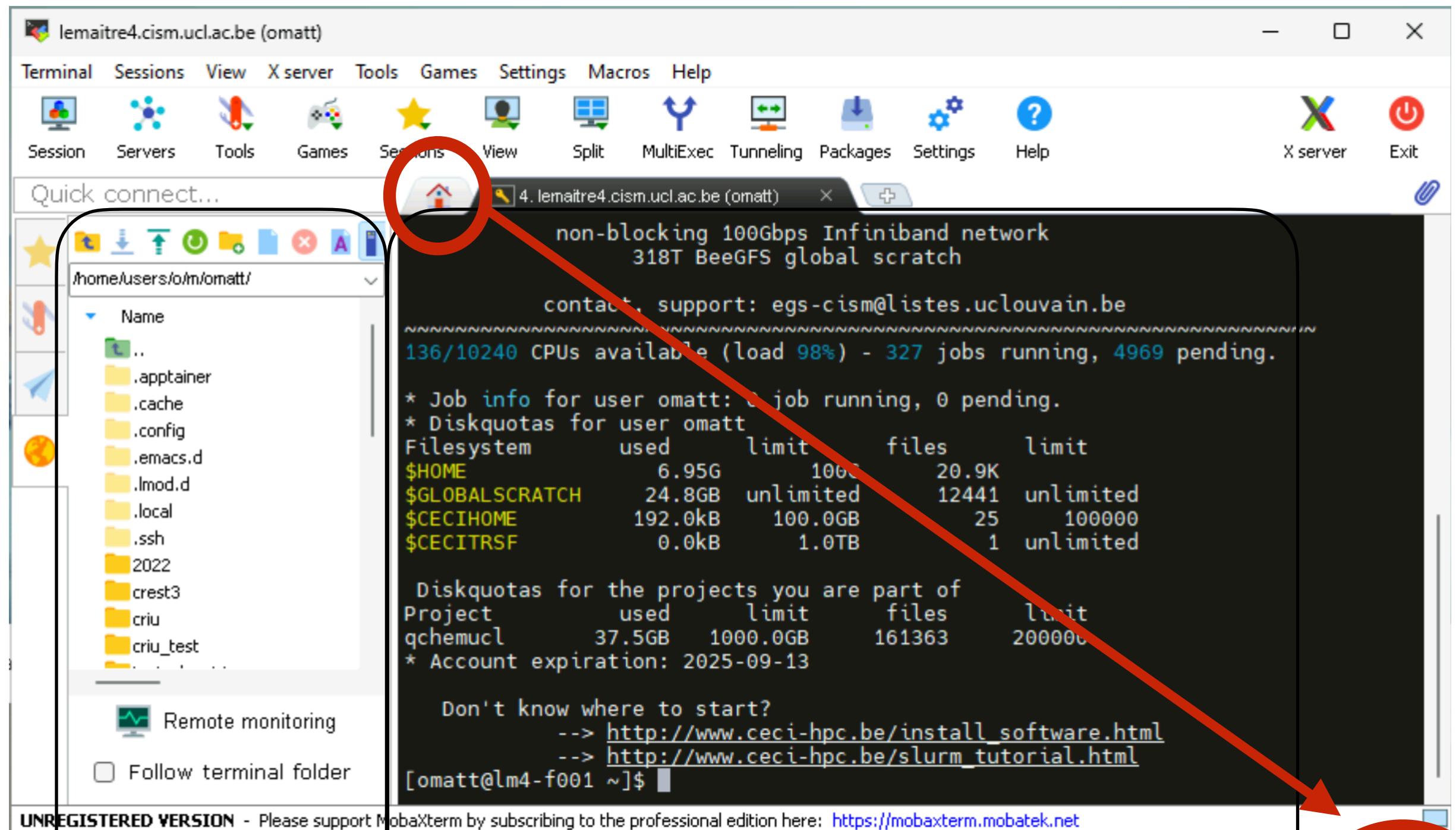
Login:

Port:

OK

Cancel

You are connected !!!

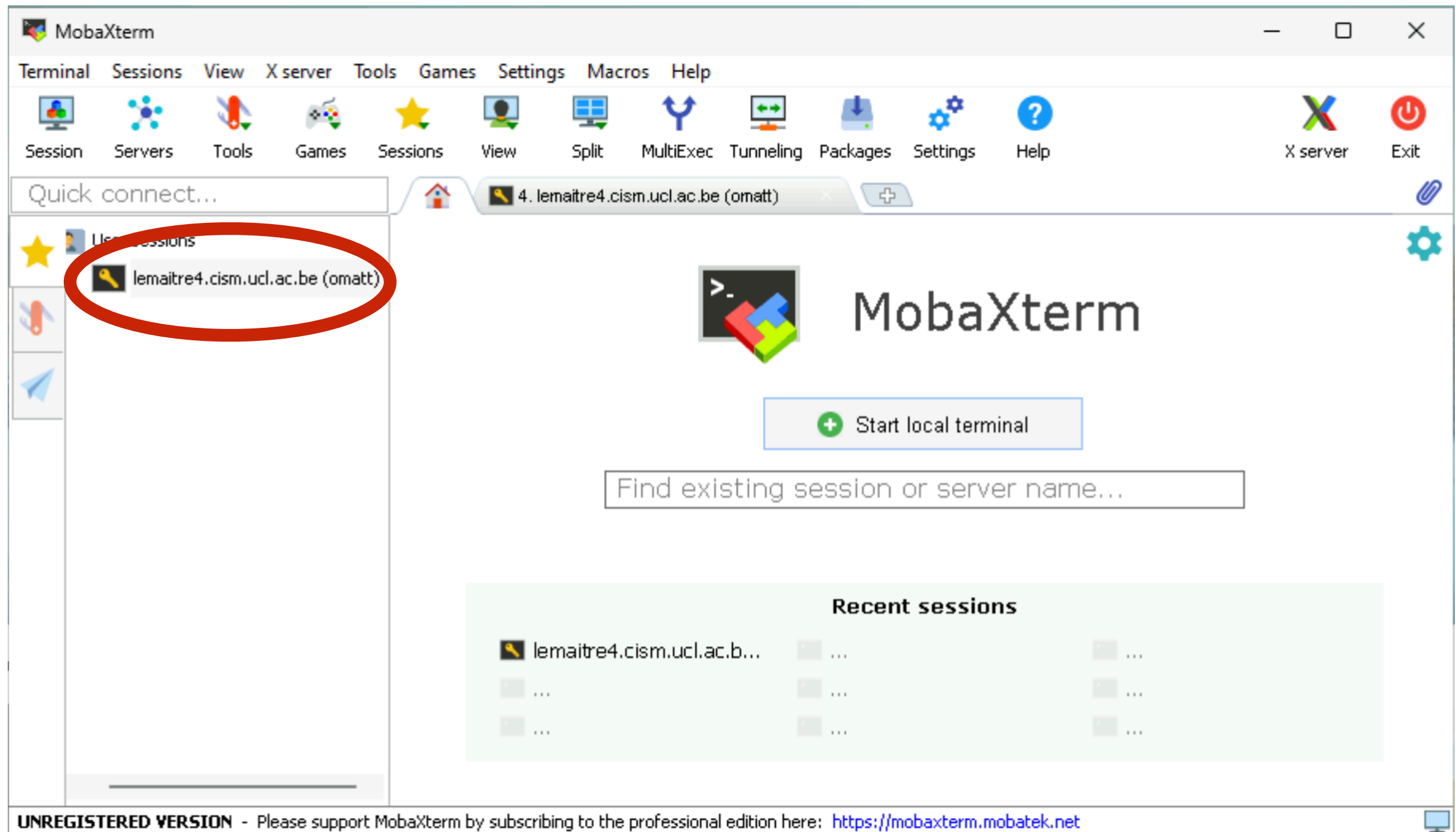


Drag and drop
file from/to the
cluster

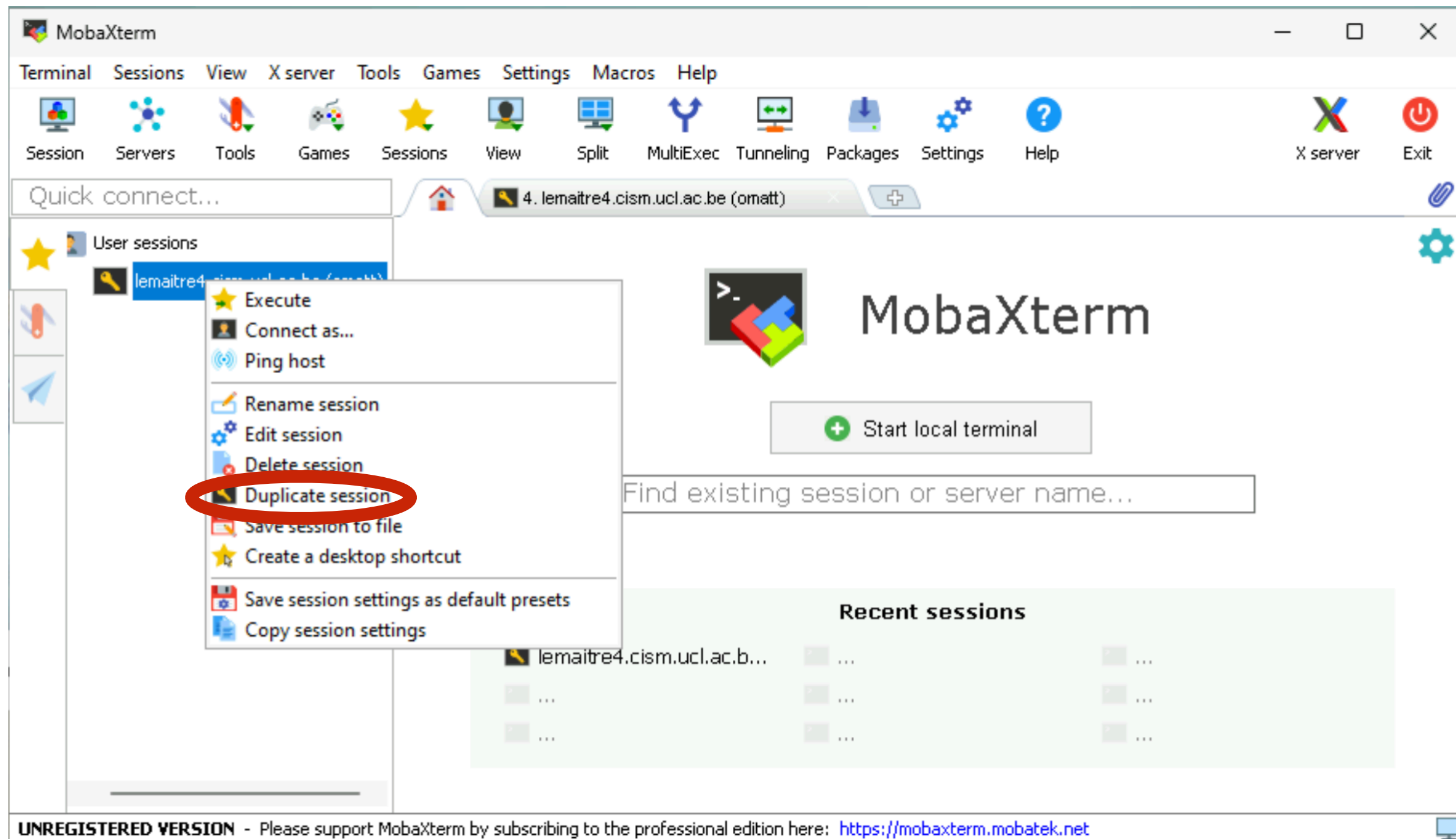
Unix terminal
running on the
cluster

New
connection
(See next
slide)

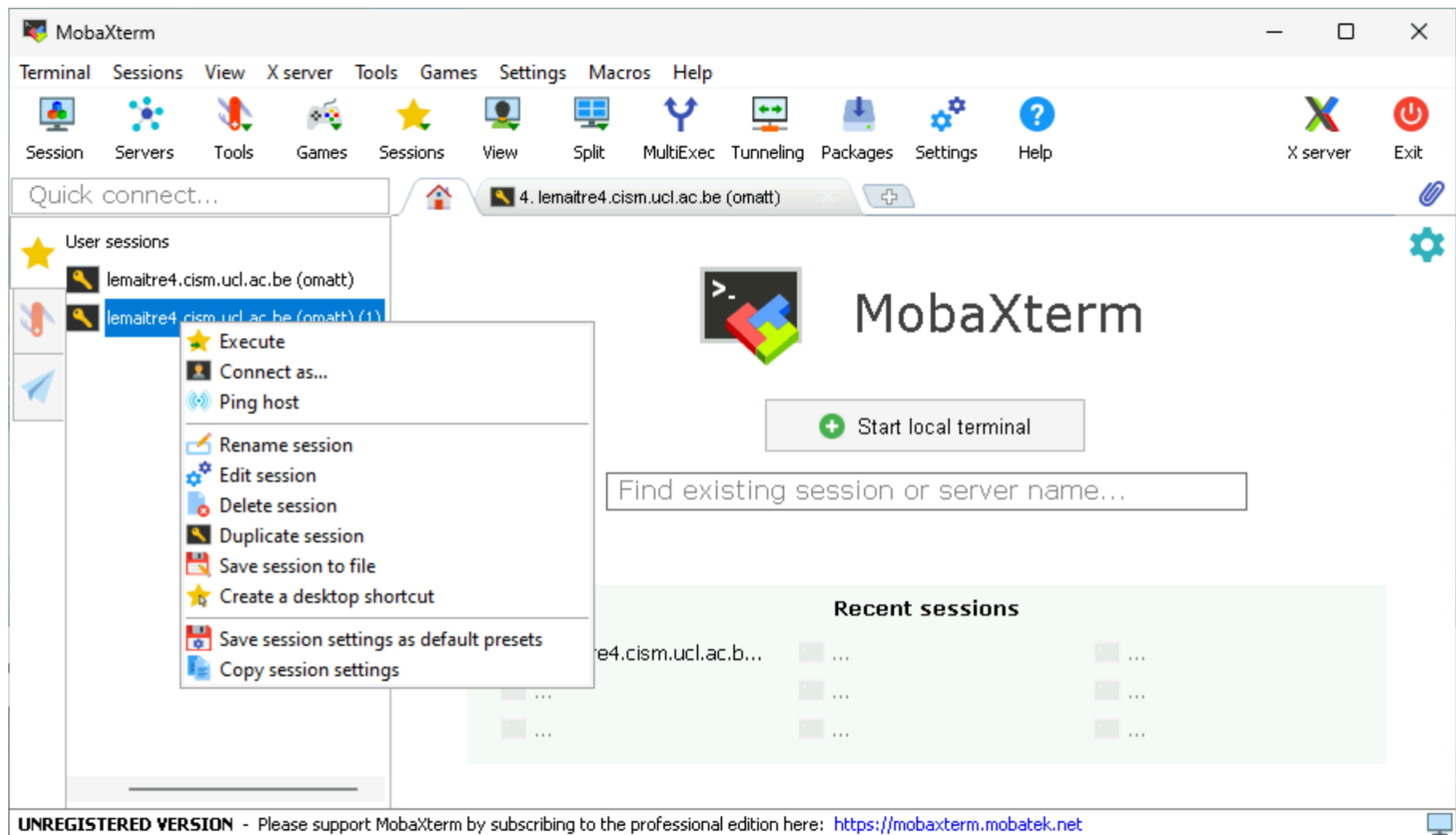
Click Here to start a second terminal on the same cluster



Or right click on it and duplicate it to copy the configuration for another cluster



Right click on the duplicate and choose edit session:



Change the address of the cluster

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * lemaitre4.cism.ucl.ac.be ☒ Specify username omatt  Port 22

Advanced SSH settings Terminal settings Network settings Bookmark settings

Secure Shell (SSH) session 

OK Cancel

Click Here

Session settings

SSH

Telnet

Rsh

Xdmcp

RDP

VNC

FTP

SFTP

Serial

File

Shell

Browser

Mosh

Aws S3

WSL

Basic SSH settings

Remote host *

☒ Specify username

Advanced SSH settings

Terminal settings

Network settings

★ Bookmark settings

Font settings

Color settings

Expert settings

☒ Backspace sends ^H

☒ Use Windows PATH

Terminal type:

☐ Log terminal output to:

Paste delay:

Syntax highlighting:

Check this option if you want to copy all terminal activity to a text file for further analysis

OK

Cancel

Change the name of the cluster (this will be the name displayed on the left column)
Then click OK

Session settings

SSH Telnet Rsh Xdmcp RDP VNC FTP SFTP Serial File Shell Browser Mosh Aws S3 WSL

Basic SSH settings

Remote host * nic5.uliege.be ☒ Specify username omatt Port 22

Advanced SSH settings Terminal settings Network settings Bookmark settings

Session name: lemaitre4.cism.ucl ☒ Lock terminal title Session Icon

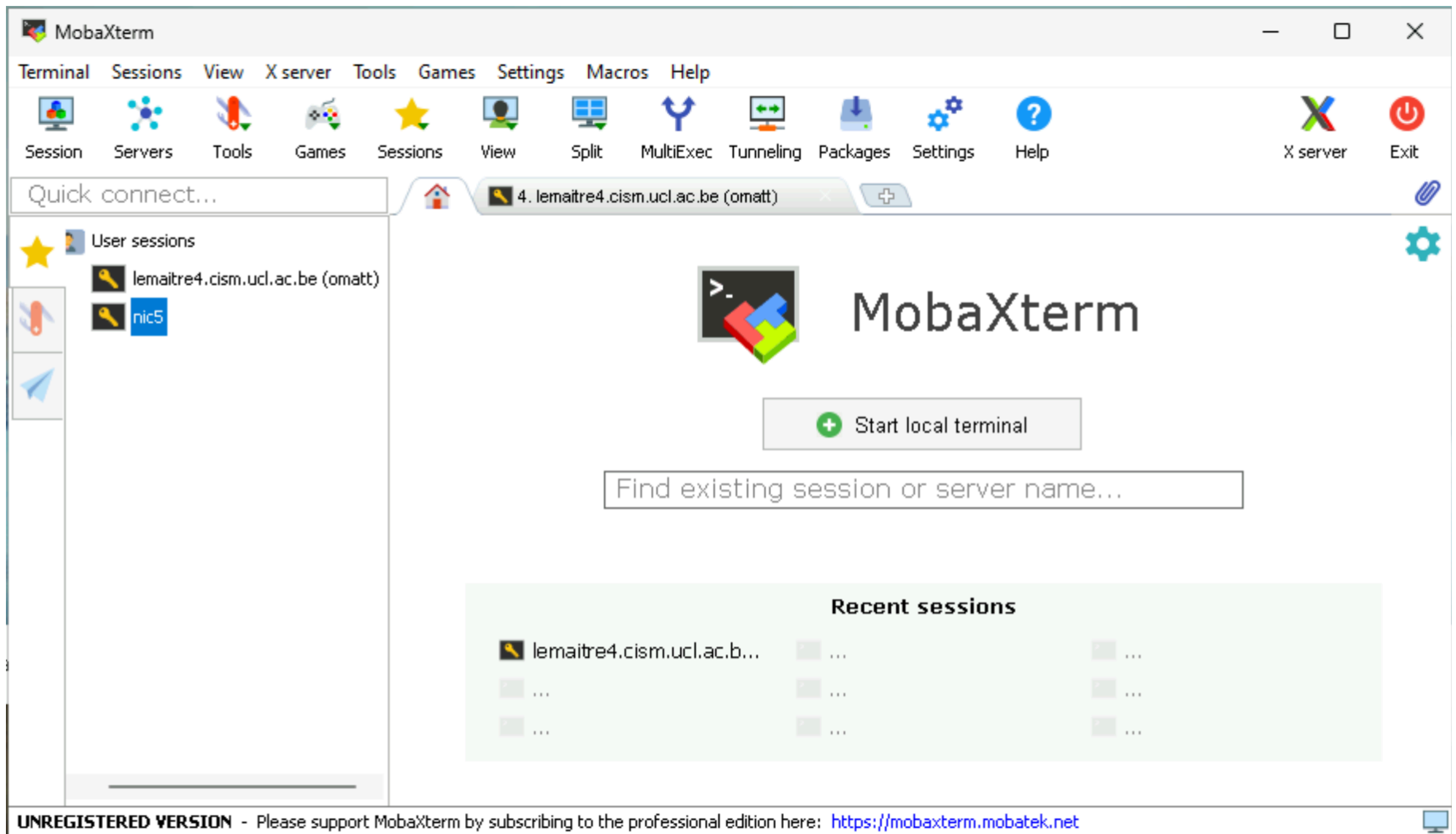
Start session in Normal tab ☒ Display reconnection message at session end

☐ Customize tab color Comments:

Create a desktop shortcut to this session

2.

Now you can start a session on the second cluster by double clicking on it!



Exercise: Connect to the cluster

- Cluster address:

- ➔ [lemaitre3.cism.ucl.ac.be](#)
- ➔ [nic5.uliege.be](#)
- ➔ [hercules.ptci.unamur.be](#)
- ➔ [dragon2.umons.ac.be](#)
- ➔ [lyra.ulb.be](#)

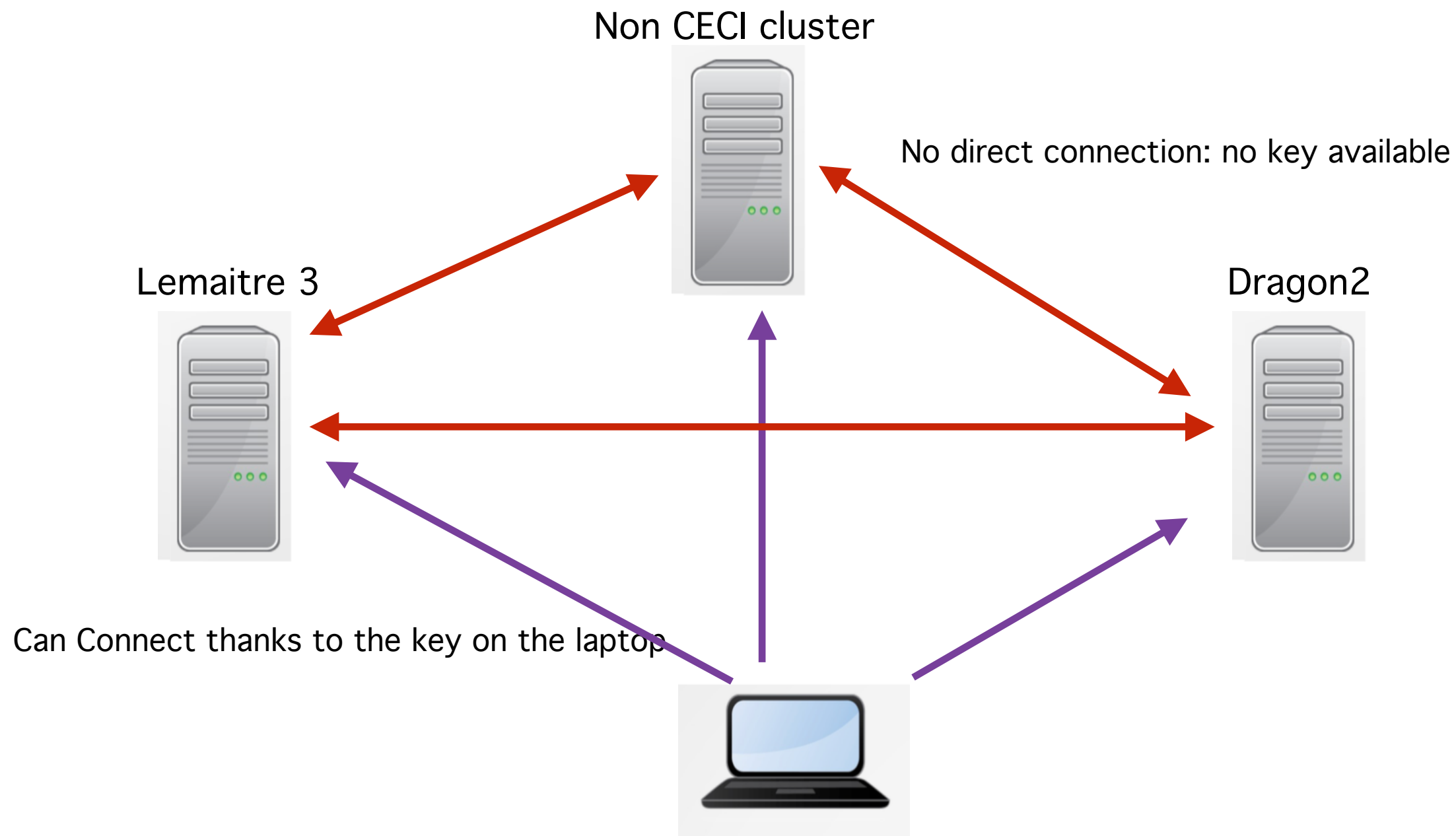
- Gateway address

- ➔ [gwceci.cism.ucl.ac.be](#)
- ➔ [gwceci.ulb.ac.be](#)
- ➔ [gwceci.uliege.be](#)
- ➔ [gwceci.unamur.be](#) (unamur id)
- ➔ [dragon2.umons.ac.be](#)

More features:

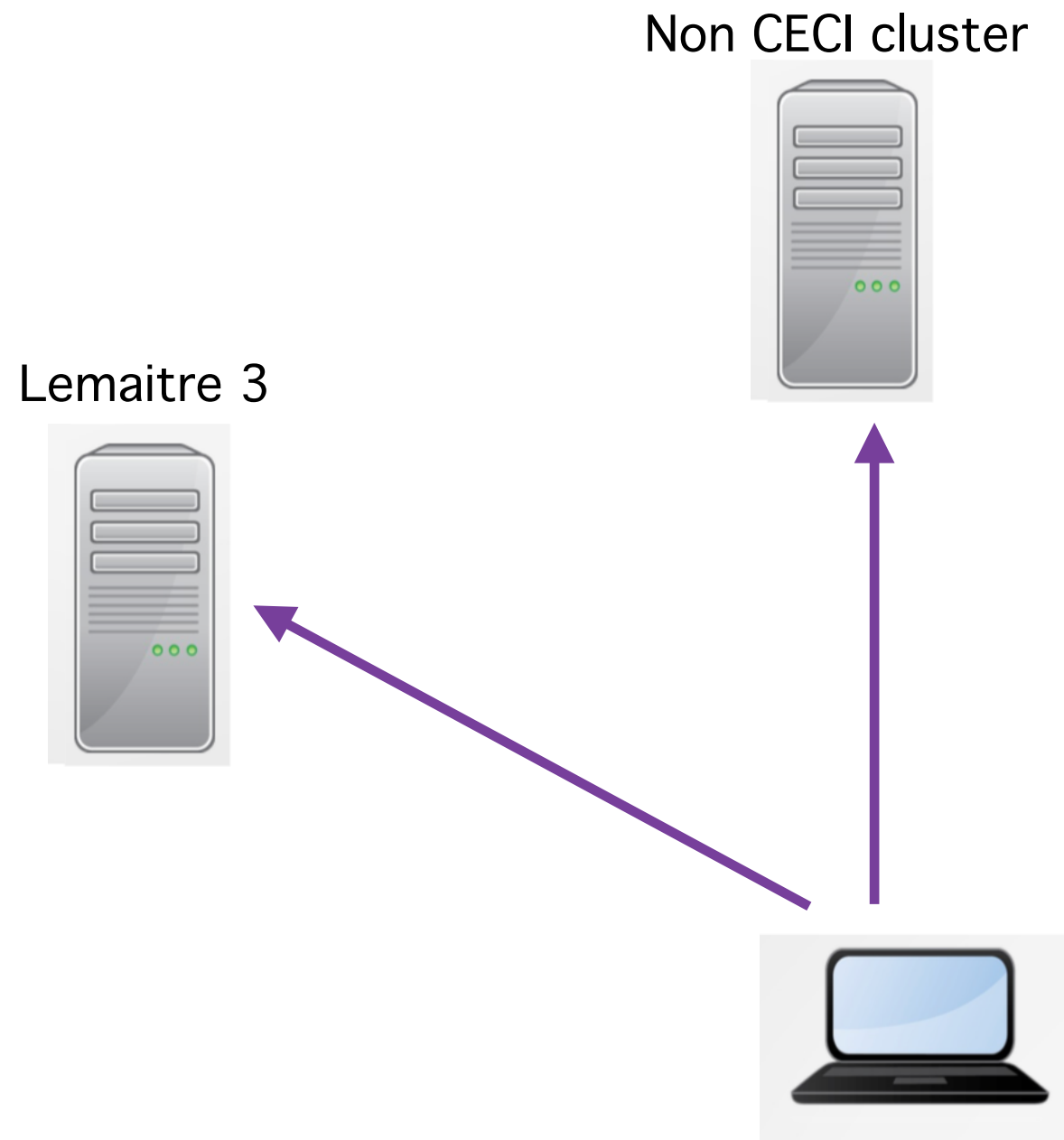
Avoid to propagate your private keys

- Less keys means more security



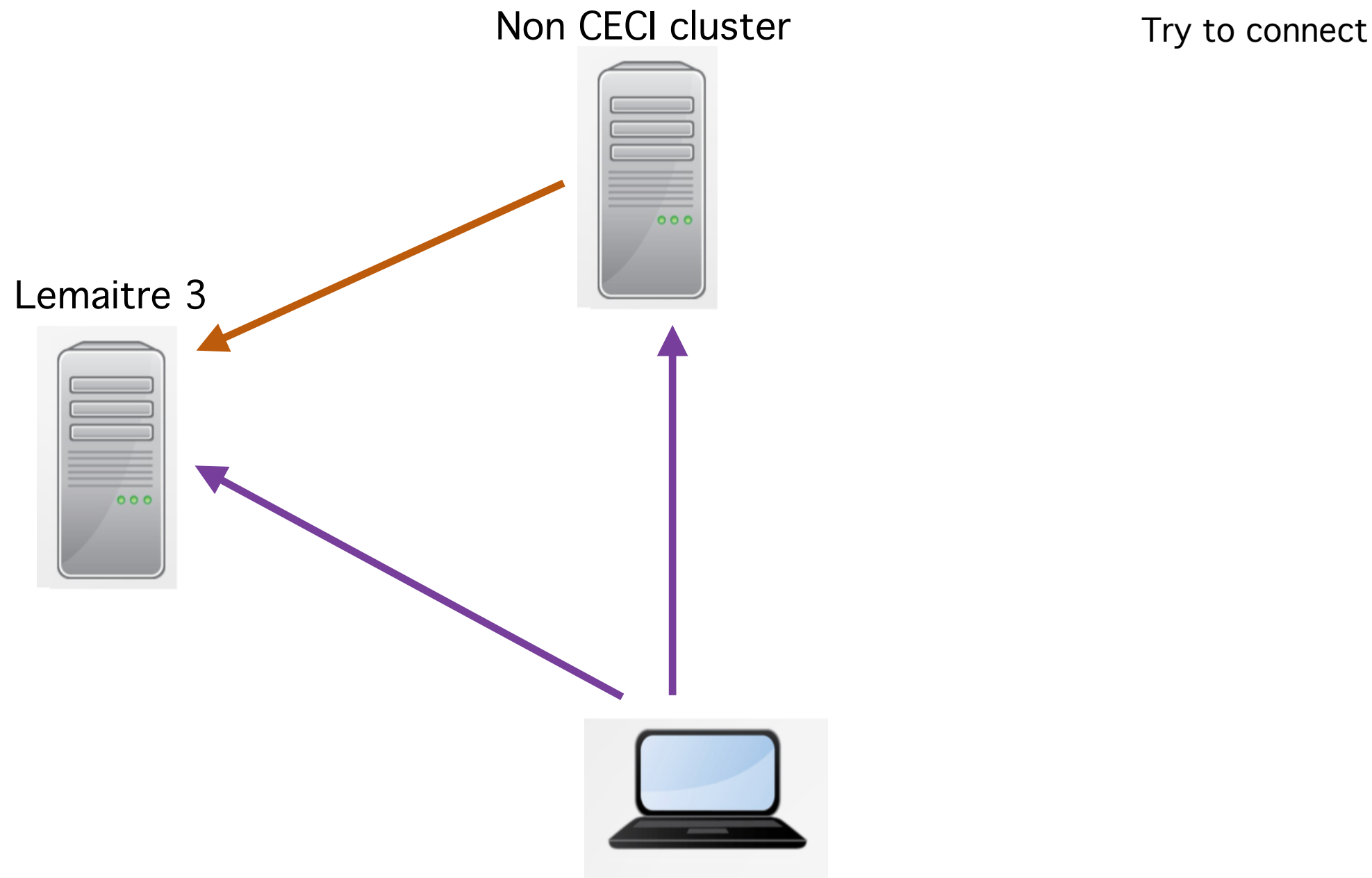
Avoid to propagate your private keys

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



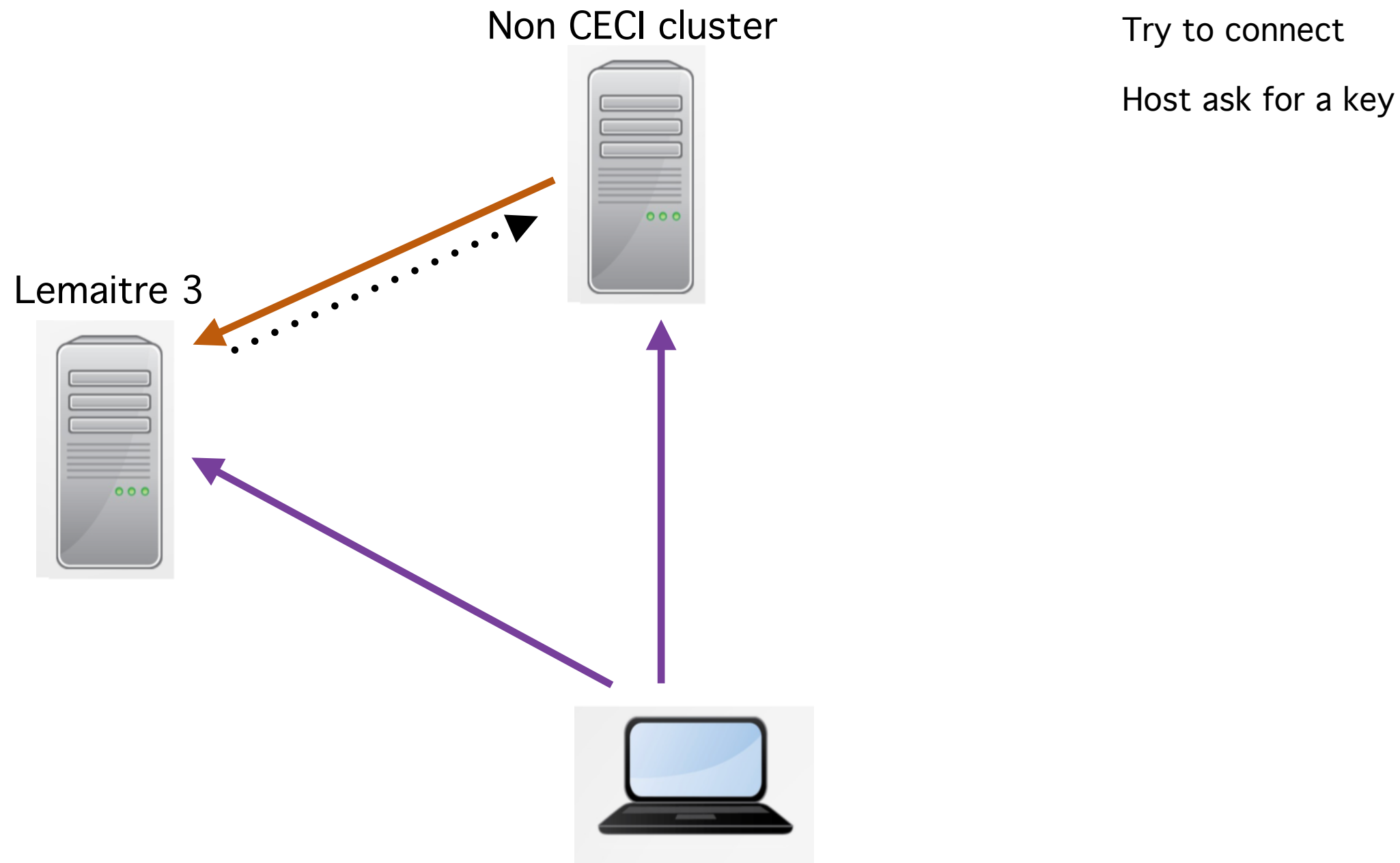
Avoid to propagate your private keys

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



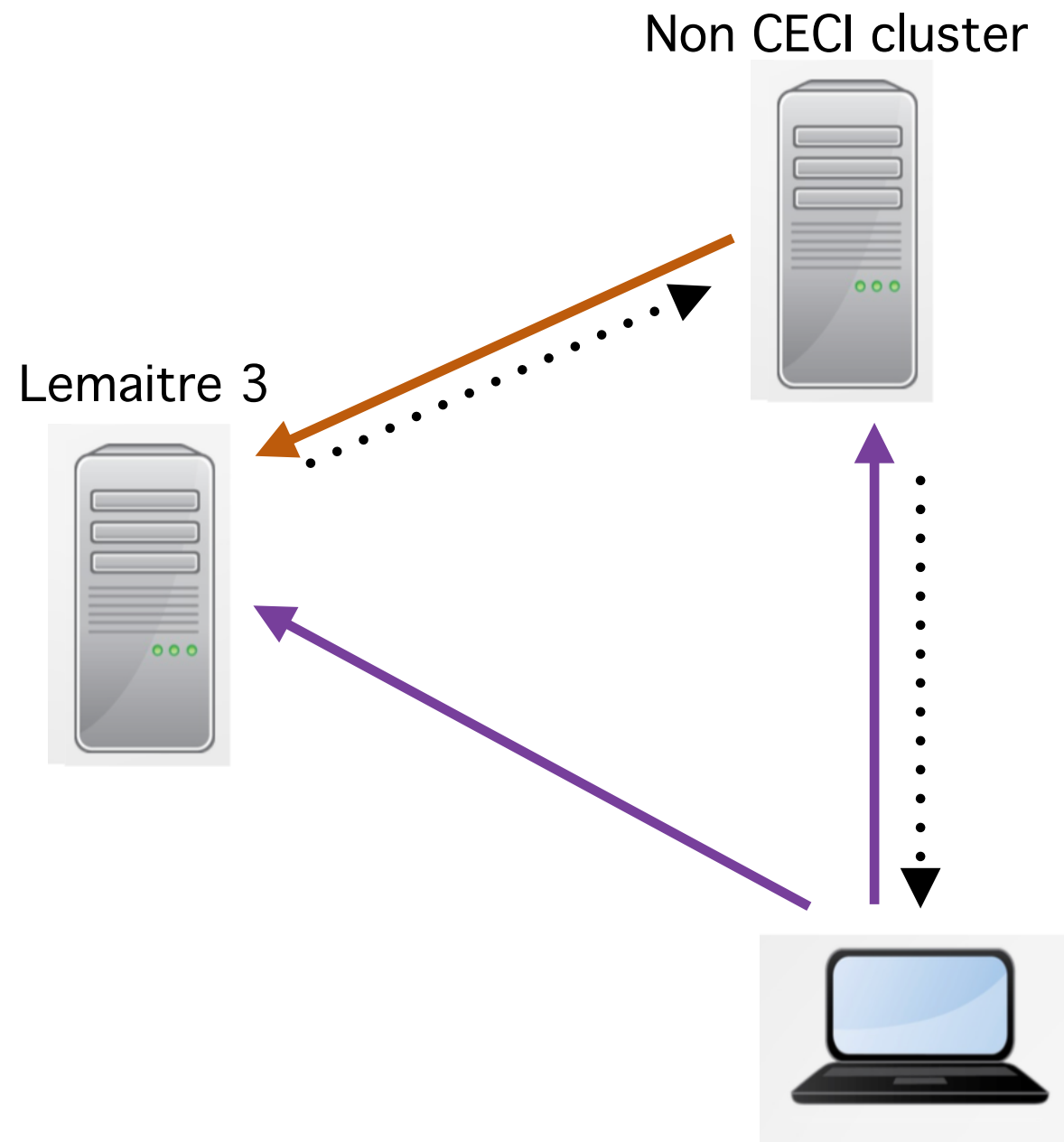
Avoid to propagate your private keys

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



Avoid to propagate your private keys

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



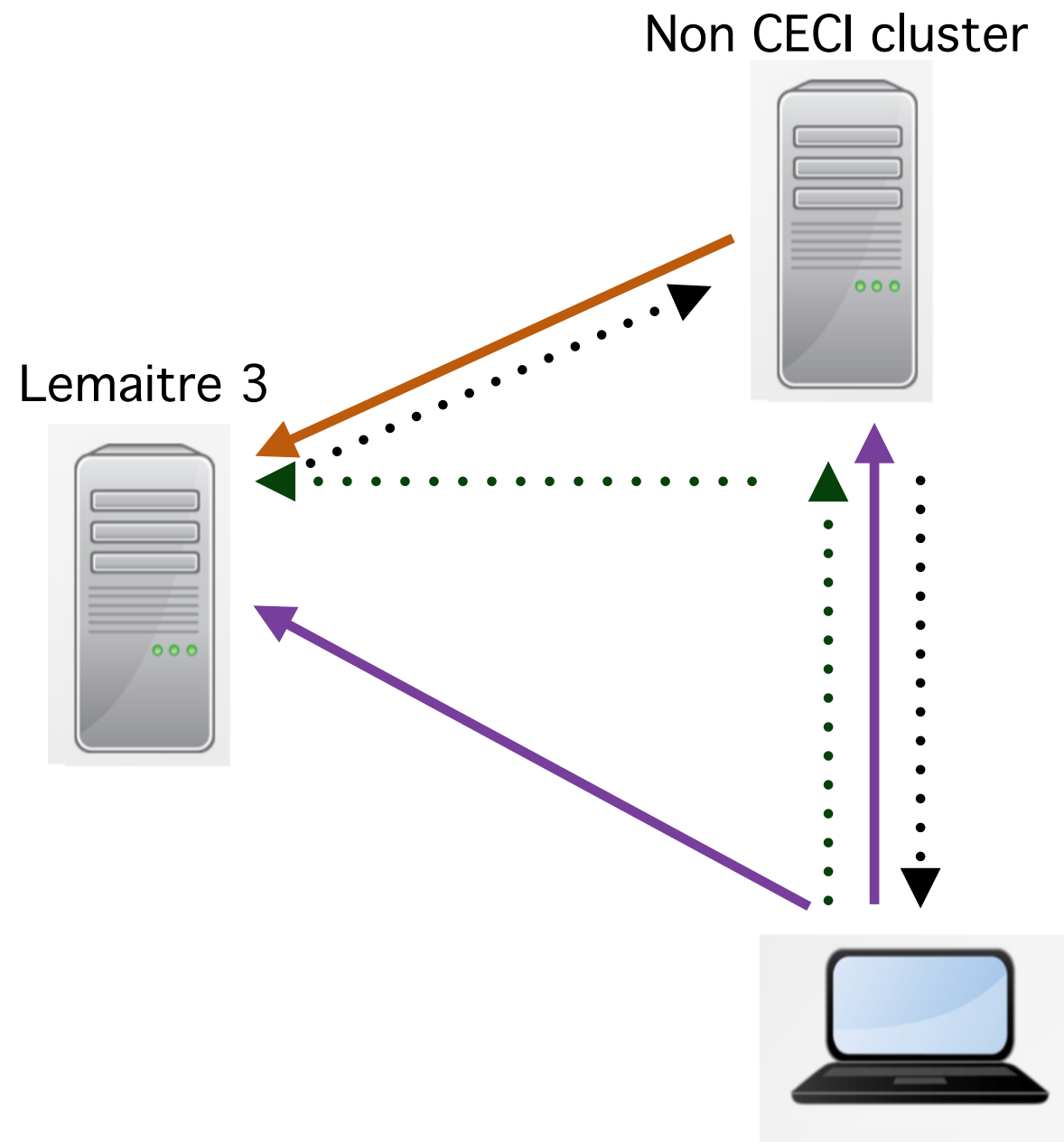
Try to connect

Host ask for a key

Message forward to laptop

Avoid to propagate your private keys

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



Try to connect

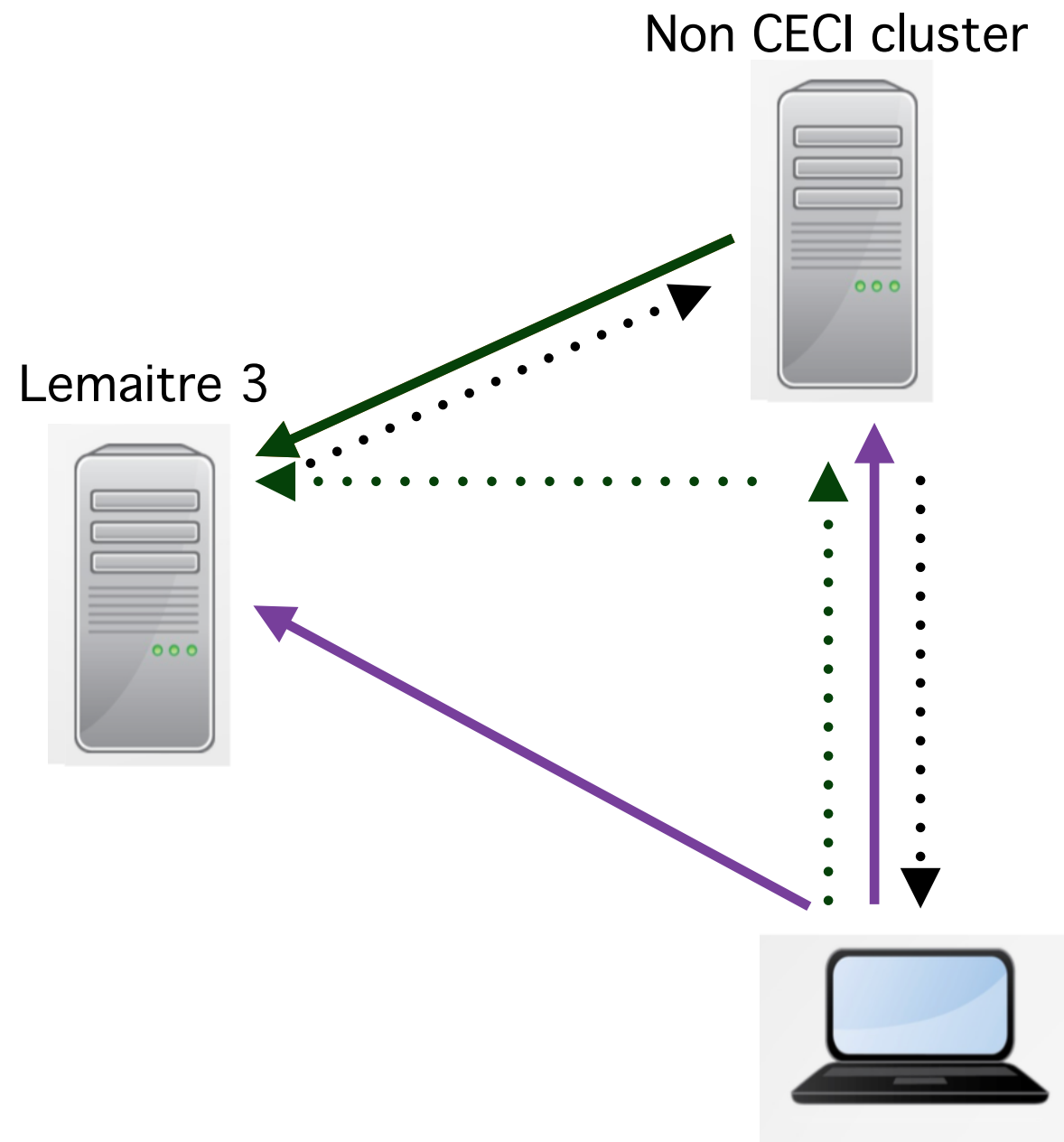
Host ask for a key

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

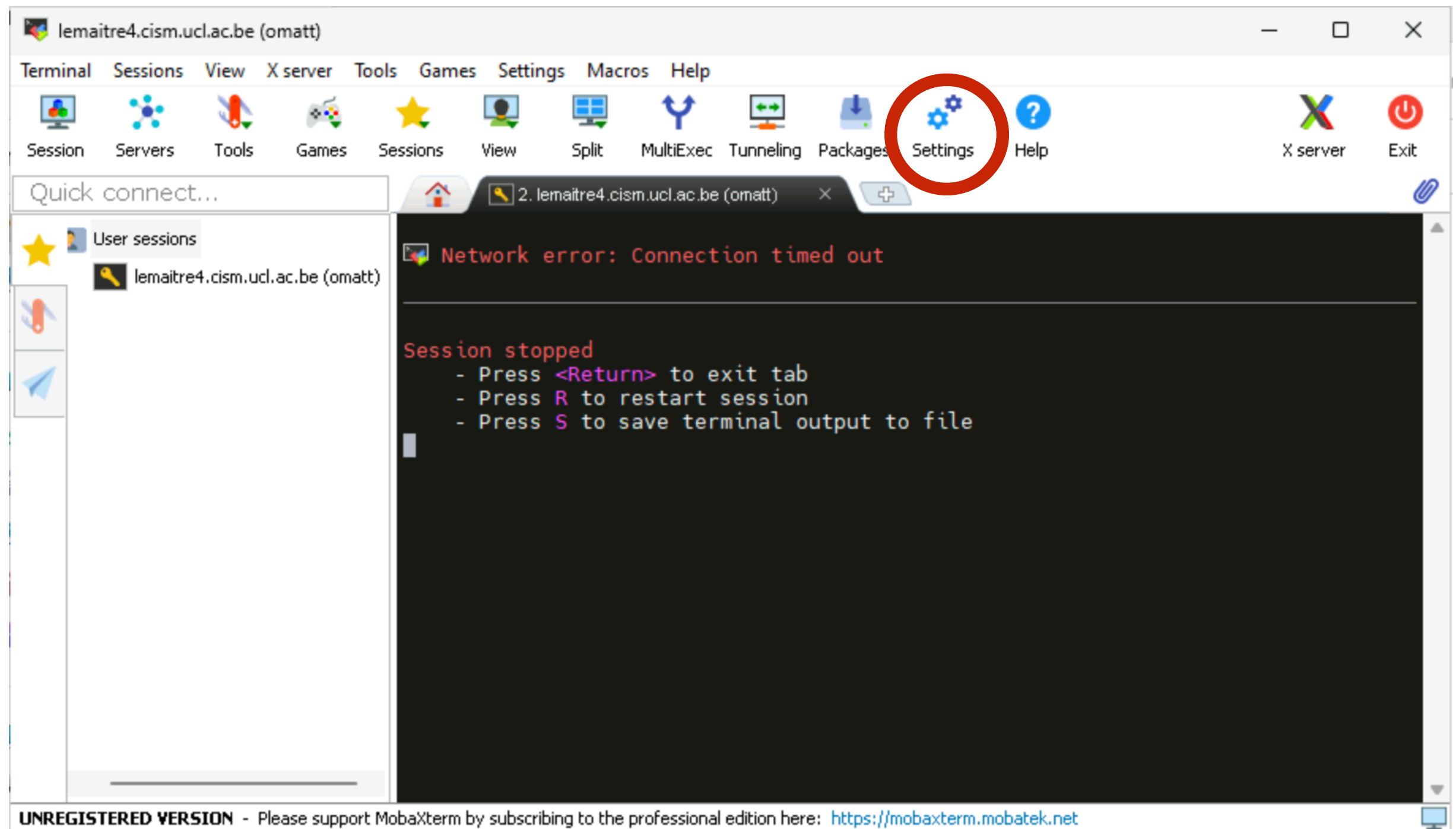
Host ask for a key

Message forward to laptop

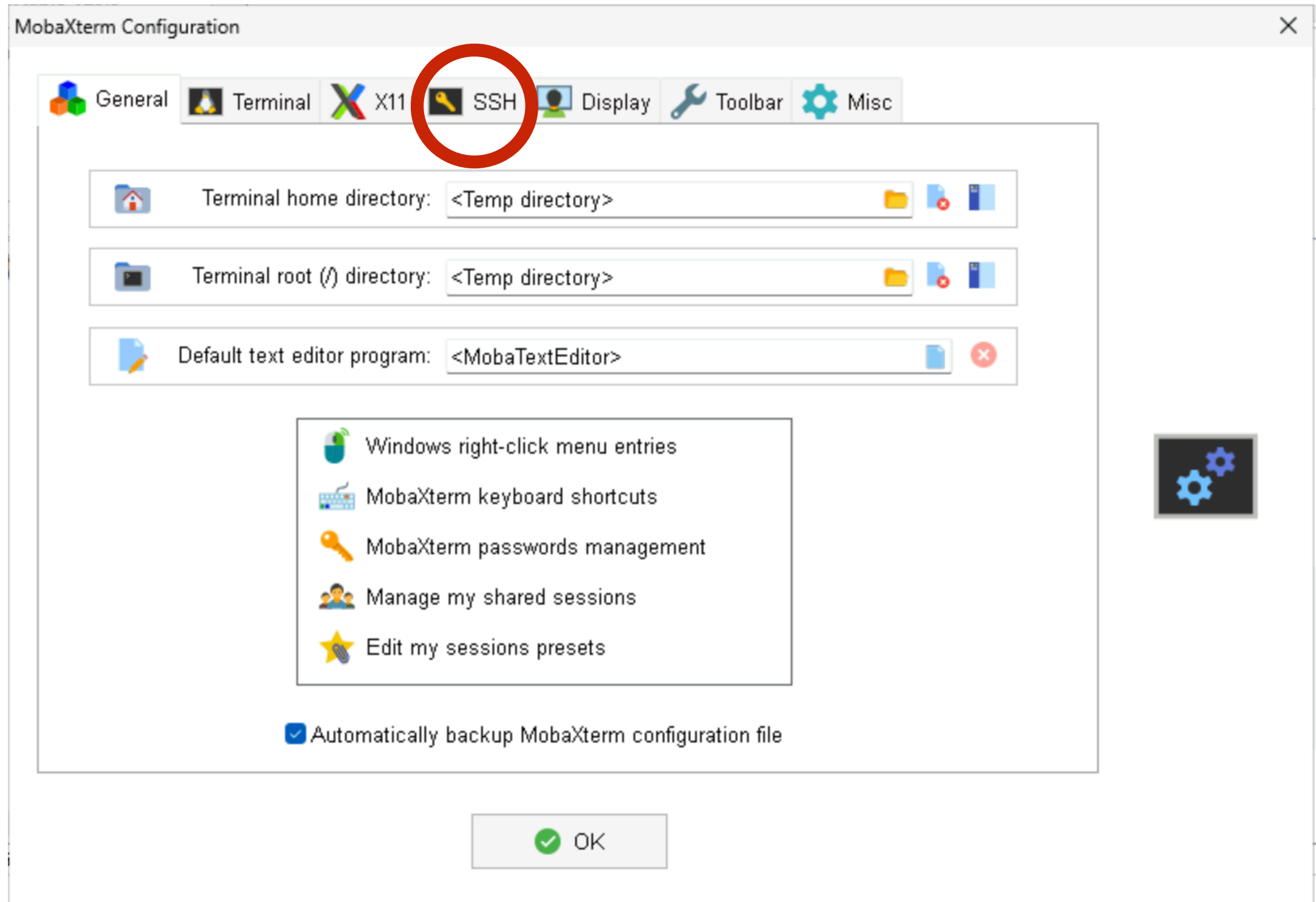
Key provided

Connection granted

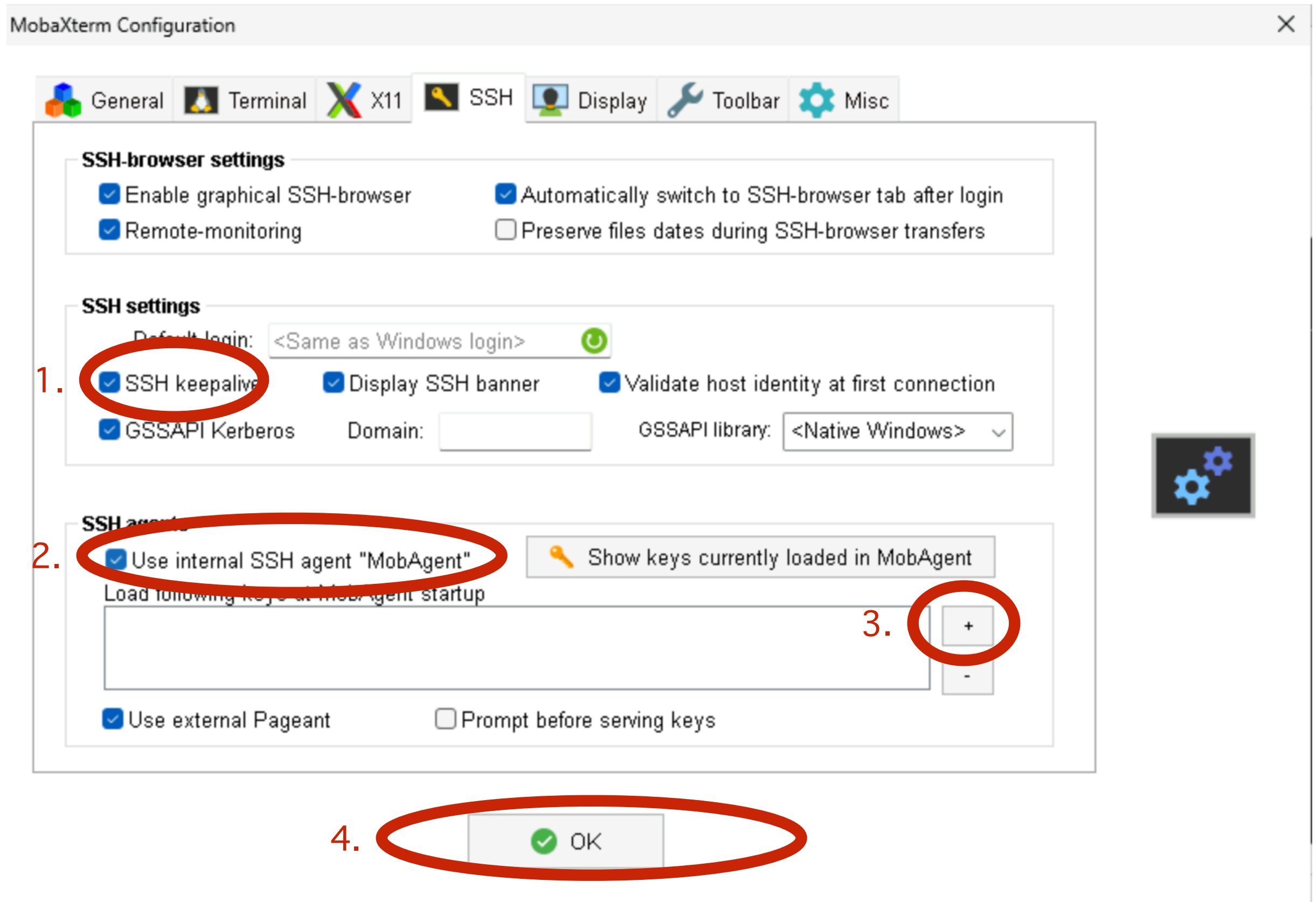
Additional Configuration



Additional Configuration



Additional Configuration



Basic Intro to SLURM

- What is available on the cluster

- ➔ sinfo

```
[omattadm@lm3-w001 ~]$ sinfo
Partitions:
batch* (2days)  debug (6hours)
Nodes:
#Nodes  Partition  CPU                               Cores/Slots  Memory  GPUs
78      batch*     intel,skylake5000,5118          24           93G     (null)
4       debug     intel,haswell,e5-2690v4         28           63G     (null)
```

- ask to have access to one core for interactive session

- ➔ srun --pty bash

```
▶[omatt@lm3-w001 ~]$ srun --pty bash
srun: job 70196378 queued and waiting for resources
srun: job 70196378 has been allocated resources
[omatt@lm3-w076 ~]$ █
```

Note that you are now in one node of the cluster, you can run heavy jobs here (note that you are restricted to one core but the above command can be updated to ask for more core)

Basic Intro to SLURM

- Check what is your current usage of the clusters: `squeue`

```
[omatt@lm3-w076 ~]$ squeue --user=omatt
CLUSTER: lemaître3
      JOBID PARTITION    NAME    USER  ST       TIME  NODES NODELIST(REASON)
      70196378      batch    bash    omatt   R         3:45       1 lm3-w076
```

- ➔ Plenty of options to customise your resource allocation (max-time, how many core, how many memory,....)
- ➔ <http://www.ceci-hpc.be/scriptgen.html>
- ➔ Use the `sbatch` command for that
 - ➔ `sbatch mycmd.sh`

Text Editor

Text Editor Option

- Text editor on the cluster
 - ➔ Non graphical: Emacs, vi
 - ◆ Tutorial on vi, next week
 - ◆ Graphical one: gedit , ...
 - ◆ Nano (next week)
- Graphical interface running on your laptop
 - ➔ Visual Studio Code
 - ➔ Mount the file-system

Visual Studio Code

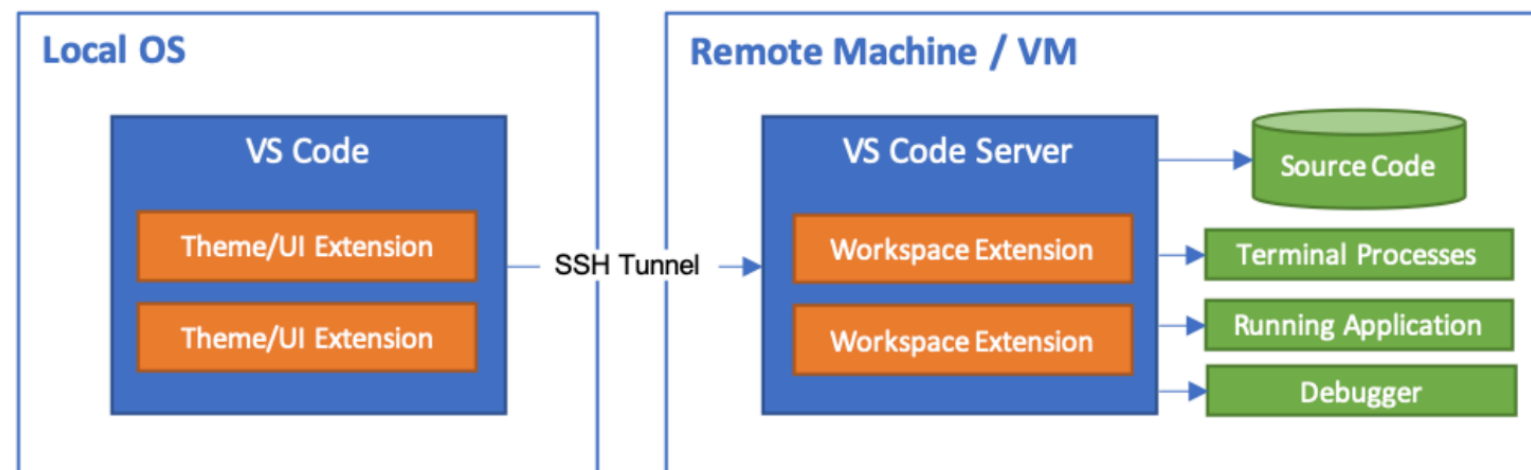
- Install VSC

- ➔ <https://code.visualstudio.com/download>

- add ssh extension:

- ➔ <https://code.visualstudio.com/docs/remote/ssh>

- See step by step pdf on indico page

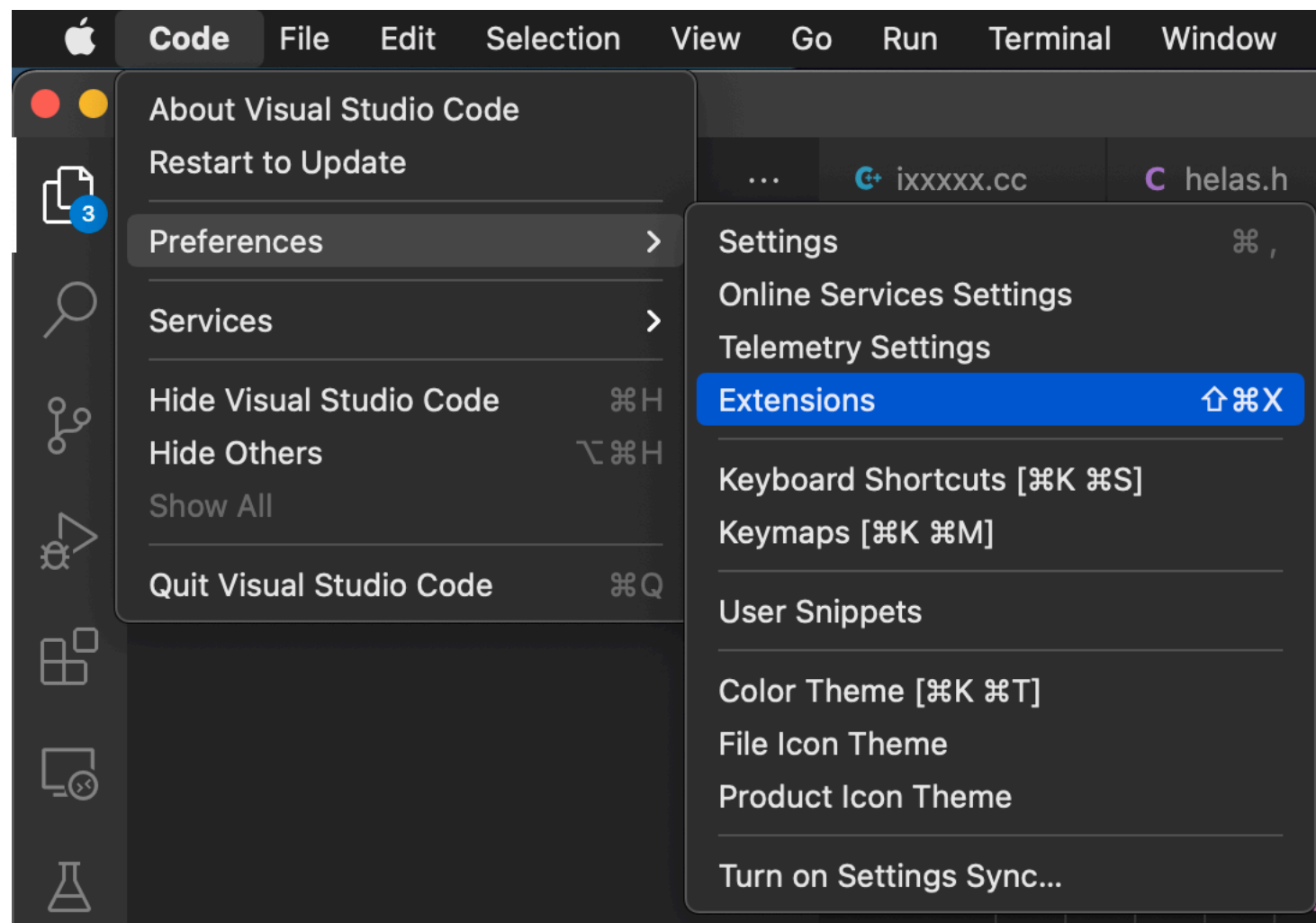


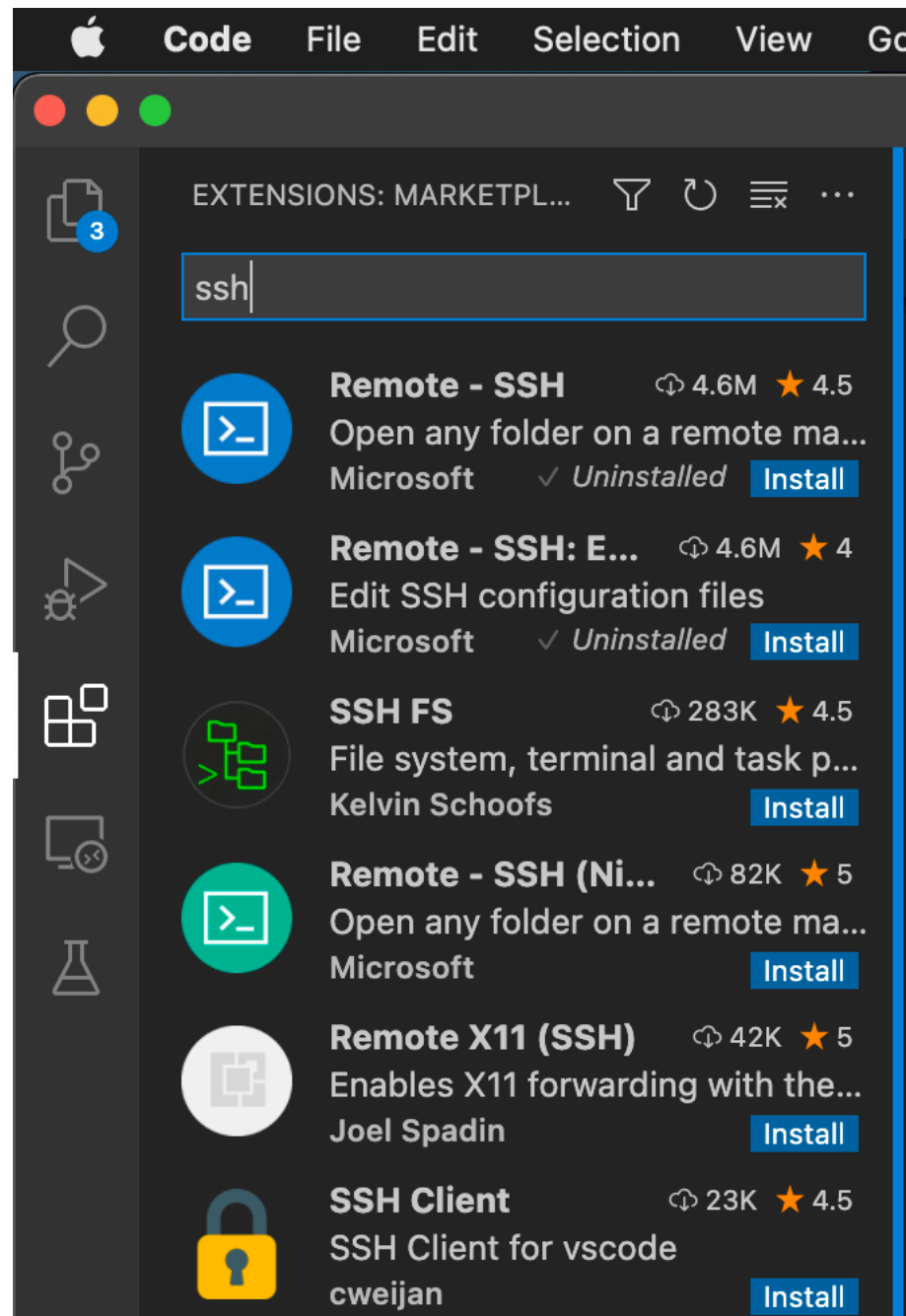
Install the ssh extension

- Install Visual Studio Code

- ➔ <https://code.visualstudio.com/download>

- Go to the preference menu/ extensions

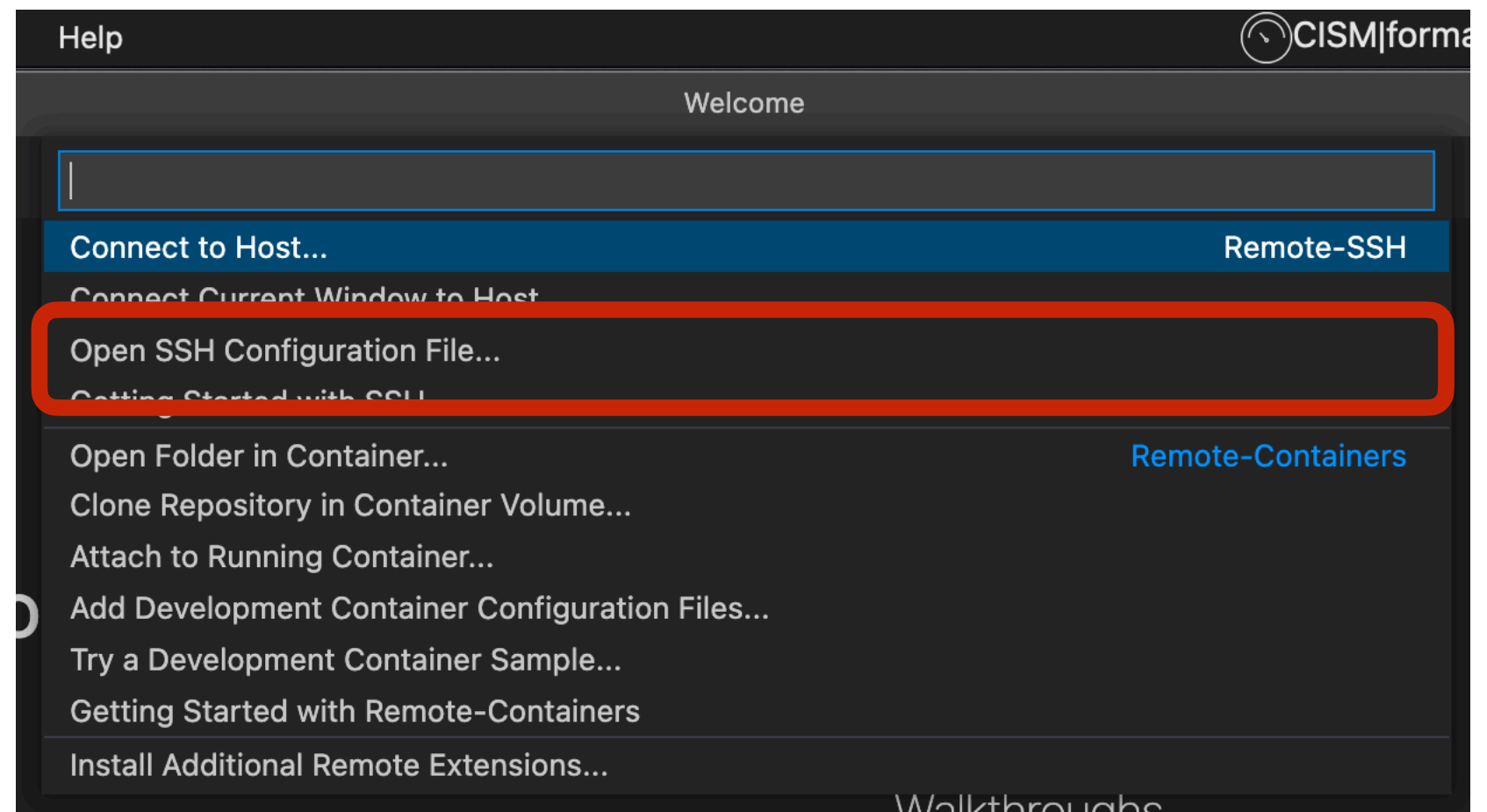




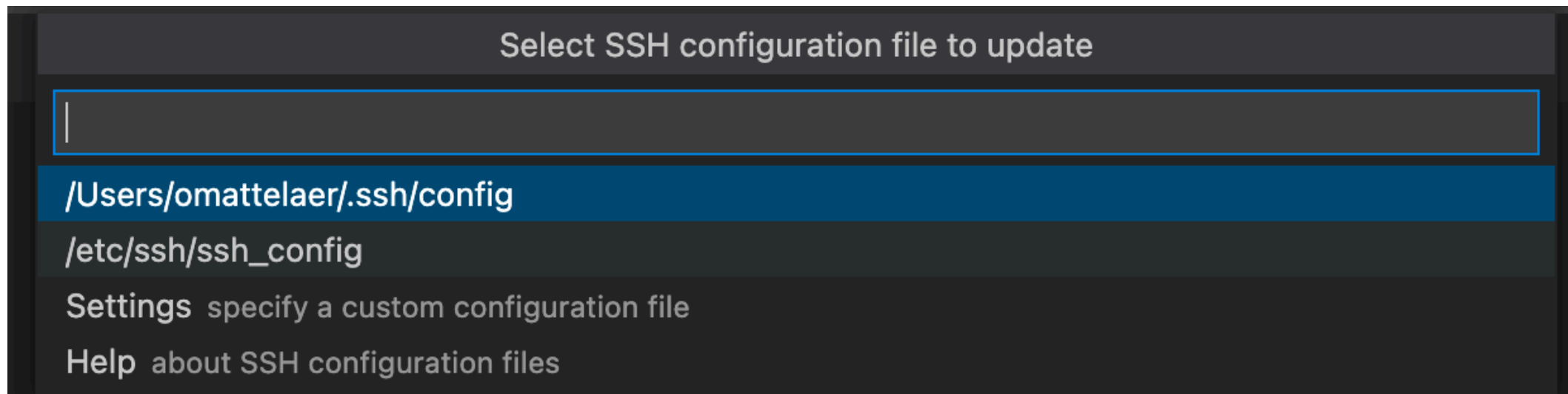
- Search for “ssh”
- Click on “install” of the Remote - SSH

Setup connection

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



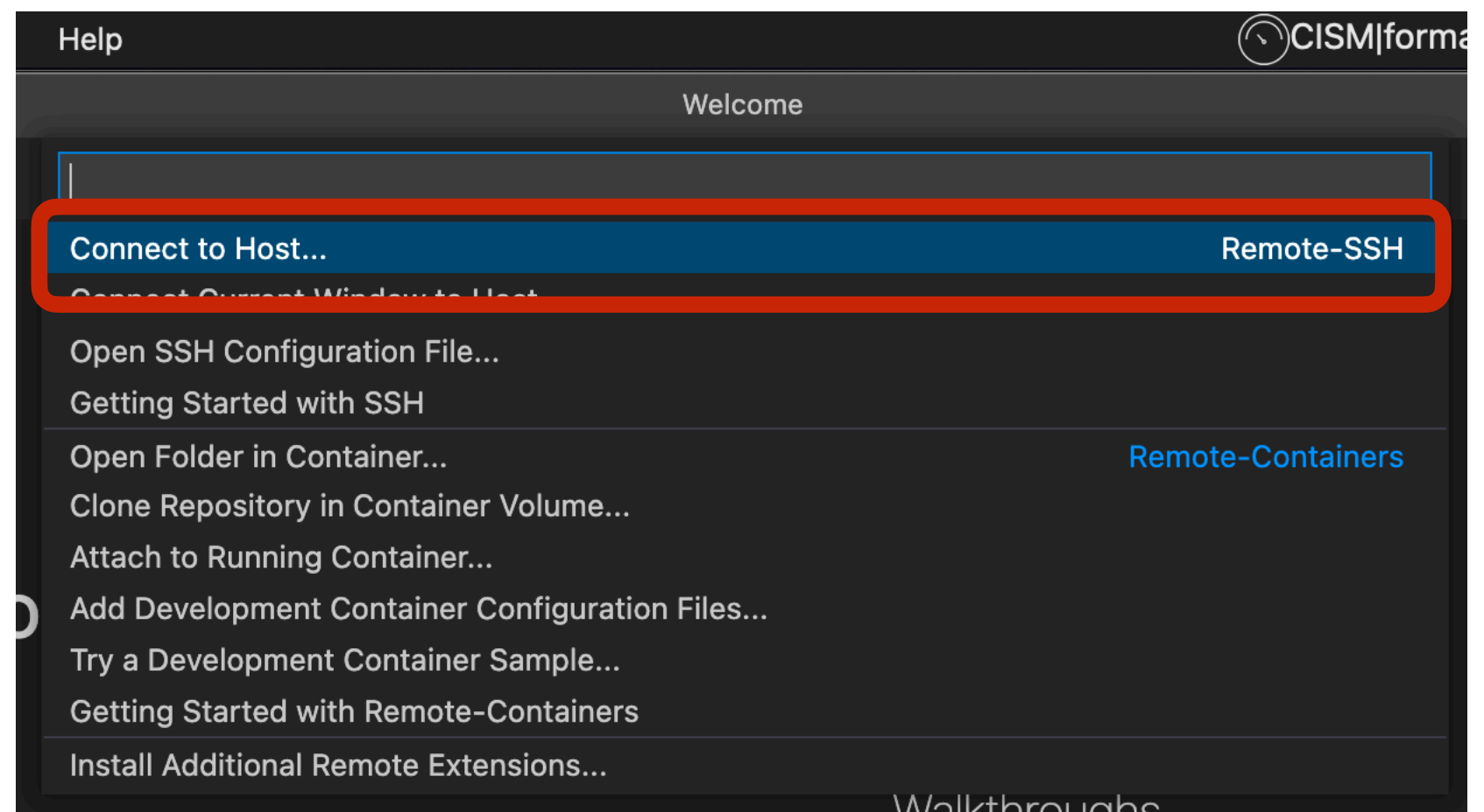
Setup connection



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

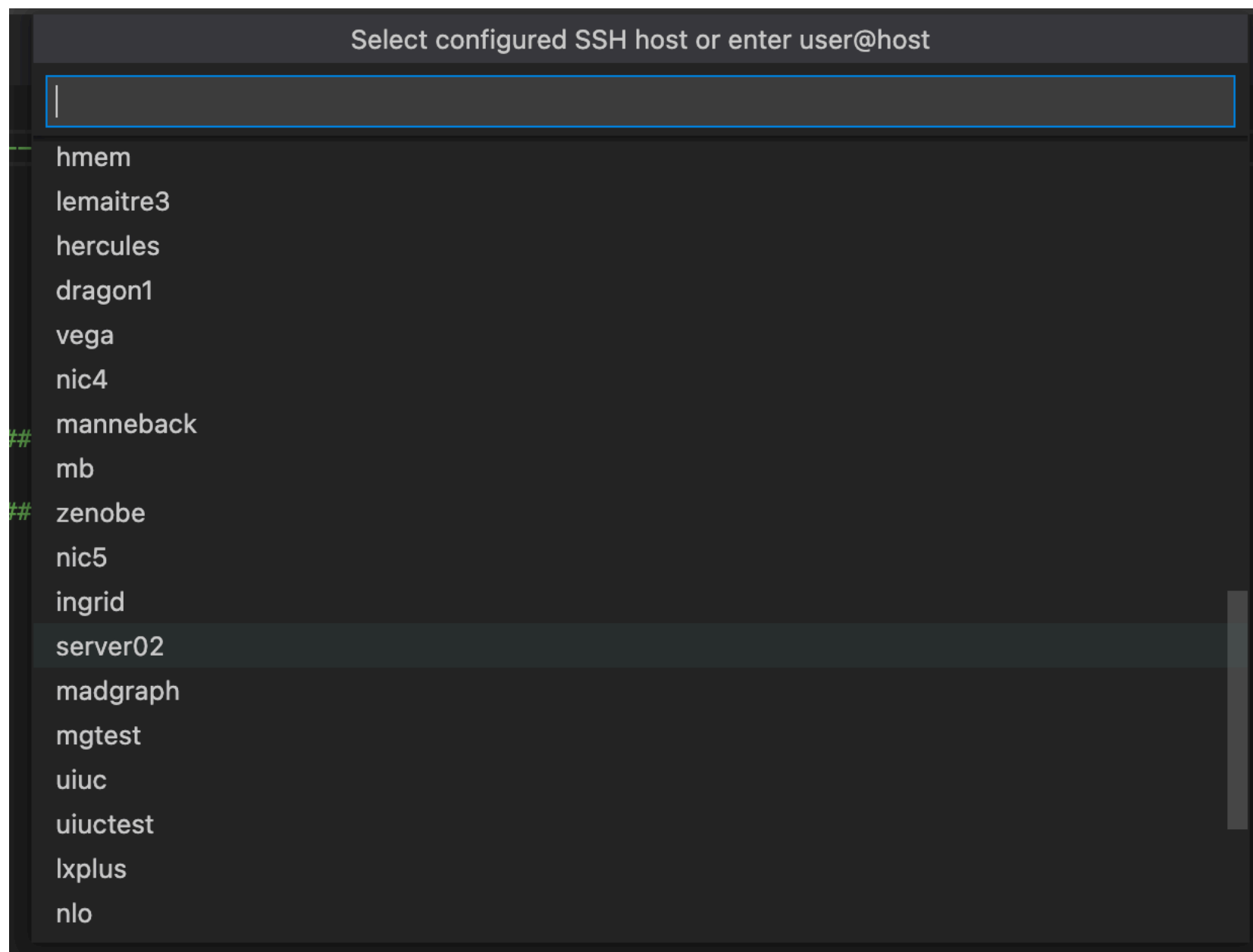
connection to cluster

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

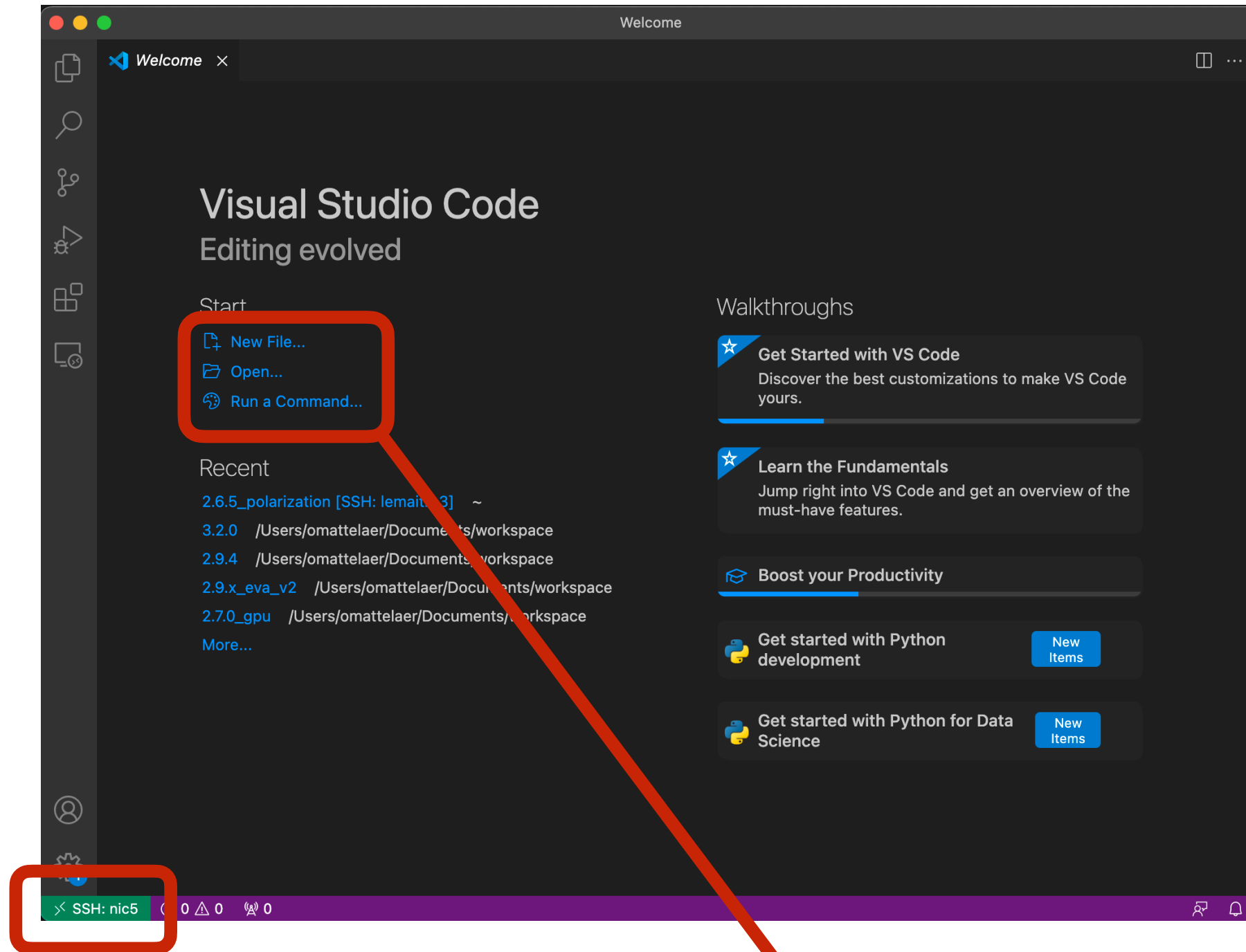


Ssh connection

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



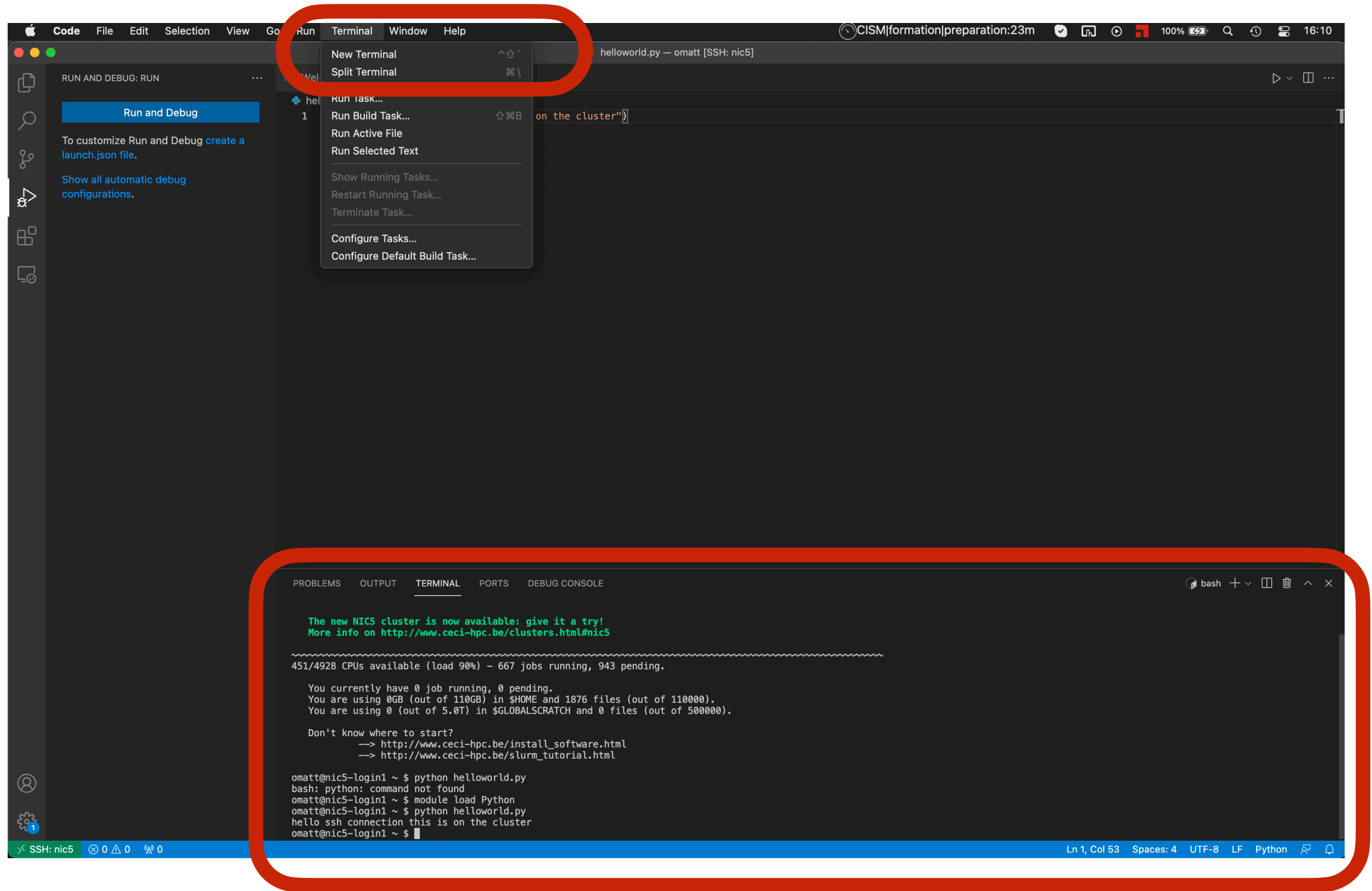
Start editing file



Connection status

Open file/directory (on the cluster)

Terminal from VScode



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

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 (-> Next Week)
- Security is important
 - ➔ Do not share your private key
 - ➔ Invalidate your key if your laptop is stolen/...