

Formation cluster

Louis Carillo

Séminaire des jeunes du Cermics
17 Avril 2025

Objectifs

- Comprendre ce qu'est le cluster et son utilité
- Se connecter avec [SSH](#) au cluster (TP)
- Les [bonnes pratiques](#) pour le cluster du CERMICS
- Se connecter avec [VS-Code](#)
- Les autres clusters (Léo et Amaury)

Tout est sur le github du CERMICS: [Demander les accès à Léo](#)

- Plus ou moins 17 “ordinateurs” liés
- Moins puissants que les vôtres mais l’union fait la force
- Presque toujours allumé
- Pas de GPU

Idéal pour:

Faire de la parallélisation

Laisser tourner vos codes toute la nuit et le weekend



Photo du cluster

Connection SSH (secure shell)



```
~ $ ssh louis.carillo@enpc.fr@passerelle.enpc.fr
Linux henry 5.10.0-14-amd64 #1 SMP Debian 5.10.113-1 (2022-04-29) x86_64
#####
#                               #
#   Bienvenue sur le serveur passerelle !   #
#                               #
#   Merci de respecter les bonnes pratiques :   #
#                               #
#   - Avant de vous déconnecter, veuillez vérifier #
#     et nettoyer votre répertoire personnel      #
#     (/home/votre_utilisateur) afin d'éviter    #
#     l'encombrement et d'optimiser l'espace disque.#
#                               #
#   Merci et bonne session SSH :) !   #
#                               #
#####
louis.carillo@enpc.fr@henry:~$
```

```
louis.carillo@enpc.fr@henry:~$ ssh carillol@clustern15
carillol@clustern15's password:
```

ssh carillol@clustern...

Yes

Mot de passe titan

Numeros de clusters valide:
01 puis de 08 à 25
(sauf 11,17,24 qui sont cassés)

ssh surname.name@enpc.fr@passerele.enpc.fr
Yes
Mot de passe enpc

Bienvenue dans le cluster

Comment aller plus vite: le proxy jump!

A screenshot of a text editor window titled 'config ~/.ssh'. The window contains an SSH configuration file with the following content:

```
1 HostkeyAlgorithms +ssh-rsa
2
3 Host passerelle
4     PubkeyAcceptedKeytypes +ssh-rsa
5     HostName passerelle.enpc.fr
6     User louis.carillo@enpc.fr
7
8 Host clustern01
9     PubkeyAcceptedKeytypes +ssh-rsa
10    HostName clustern01
11    User carillol
12    ProxyJump passerelle
13
14 Host clustern15
15    HostName clustern15
16    User carillol
17    ProxyJump passerelle
```

Then this is the same as the two previous commands:

A terminal window showing the execution of an SSH command. The prompt is '~ \$' and the command is 'ssh clustern15'. The output is 'Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.0.0-37-generic x86_64)'.

```
~ $ ssh clustern15
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.0.0-37-generic x86_64)
```

Comment ne pas taper son mot de passe à chaque fois

Step 1: Check for an Existing SSH Key Pair

On your **local machine** (the one you're connecting from):

```
bash
```

[Copy](#)[Edit](#)

```
ls ~/.ssh
```

Look for `id_rsa` (private key) and `id_rsa.pub` (public key).

If you don't have them:

Step 2: Generate a New SSH Key Pair

Run:

```
bash
```

[Copy](#)[Edit](#)

```
ssh-keygen
```

- Accept the default file location by pressing Enter.
- Optionally set a passphrase (or leave it blank for no passphrase).

Step 3:

Les commandes précédentes
avec `ssh-copy-id` au lieu de
`ssh`

Comment savoir si un cluster est libre?

Cluster du CERMICS = pas de jobs ni de scheduler, c'est le Far West.

htop

Le cluster 15
est non-utilisé

```
carillol@clustern15: /home

1 [ 0.0%] 9 [ 0.0%] 17 [ 0.0%] 25 [ 0.0%]
2 [ 0.0%] 10 [ 0.0%] 18 [ 0.0%] 26 [ 0.0%]
3 [ 0.0%] 11 [ 0.0%] 19 [ 0.0%] 27 [ 0.0%]
4 [ 0.0%] 12 [ 1.3%] 20 [ 0.0%] 28 [ 0.0%]
5 [ 0.0%] 13 [ 0.0%] 21 [ 0.0%] 29 [ 0.0%]
6 [ 0.0%] 14 [ 0.0%] 22 [ 0.0%] 30 [ 0.0%]
7 [ 0.0%] 15 [ 0.0%] 23 [ 0.0%] 31 [ 0.0%]
8 [ 0.0%] 16 [ 0.0%] 24 [ 0.0%] 32 [ 0.0%]
Mem[|||||] 22.7G/189G Tasks: 128, 267 thr; 1 running
Swp[ ] 0K/29.8G Load average: 0.00 0.00 0.00
Uptime: 250 days(!), 02:36:17

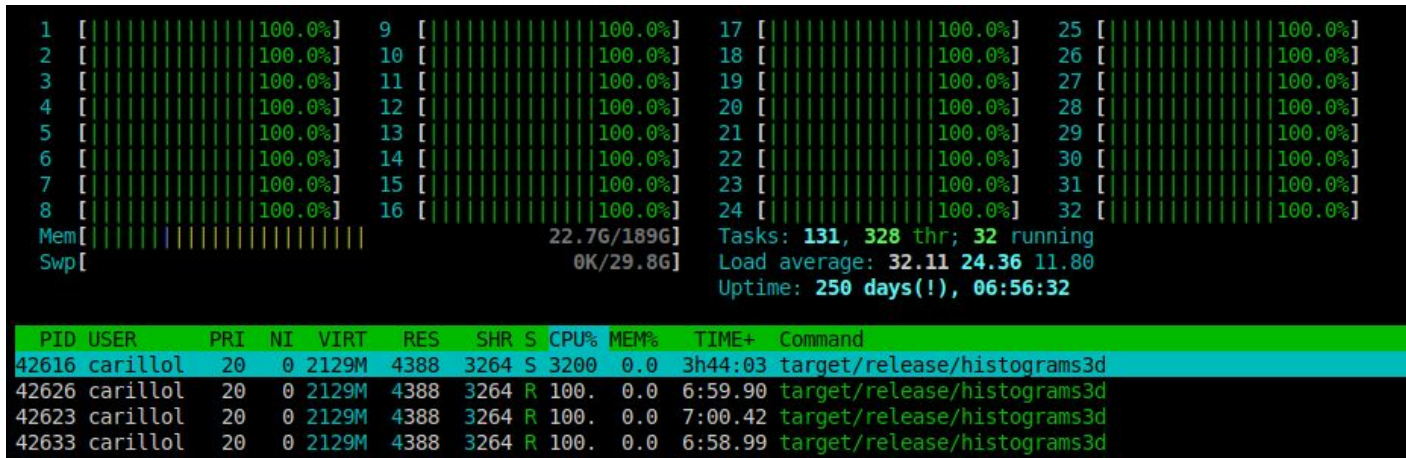
PID USER PRI NI VIRT RES SHR S CPU% MEM% TIME+ Command
1374 carillol 20 0 28580 4820 3728 R 0.7 0.0 0:00.14 htop
10169 carillol 20 0 11.5G 71712 44460 S 0.0 0.0 0:16.26 /home/carillol/.vscode-server/cli/servers/Stabl
634 root 19 -1 466M 246M 234M S 0.0 0.1 7h57:49 /lib/systemd/systemd-journald
1787 root 20 0 302M 24600 10324 S 0.0 0.0 1h07:06 /usr/bin/python3 /usr/bin/fail2ban-server -xf s
1336 Debian-sn 20 0 67344 12296 7072 S 0.0 0.0 12h18:48 /usr/sbin/snmpd -Lsd -Lf /dev/null -u Debian-sn
12426 carillol 20 0 31.3G 112M 49904 S 0.0 0.1 0:00.96 /home/carillol/.vscode-server/cli/servers/Stabl
```

Comment savoir si un cluster est libre?

Cluster du CERMICS = pas de jobs ni de scheduler, c'est le Far West.

htop

Le cluster 15
est utilisé



The screenshot shows the htop interface. The top section displays system statistics: 16 CPUs at 100.0% usage, 22.7G/189G memory, and 0K/29.8G swap. System tasks are 131, with 328 threads and 32 running. Load averages are 32.11, 24.36, and 11.80. Uptime is 250 days(!), 06:56:32.

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
42616	carillol	20	0	2129M	4388	3264	S	3200	0.0	3h44:03	target/release/histograms3d
42626	carillol	20	0	2129M	4388	3264	R	100.	0.0	6:59.90	target/release/histograms3d
42623	carillol	20	0	2129M	4388	3264	R	100.	0.0	7:00.42	target/release/histograms3d
42633	carillol	20	0	2129M	4388	3264	R	100.	0.0	6:58.99	target/release/histograms3d

Comment savoir si un cluster est libre? Version malin

multitop.py se connecte sur chaque cluster, fait top, et fait un résumé:

```
~ $ python3 Documents/multitop.py
```

host	%CPU	PID	User	time	command
-----+-----+-----+-----+-----+-----					
clustern09					
clustern10					
clustern12					
clustern12	106,2	47825	marmey	7:56.80	julia
clustern12	106,2	47828	marmey	7:57.01	julia
clustern12	106,2	47831	marmey	7:56.93	julia
clustern12	106,2	47838	marmey	7:56.85	julia
clustern13					
clustern14					
clustern15					
clustern15	3153	22309	carillol	406:03.52	histograms+
clustern16					
clustern16	5,9	18378	root	0:00.12	kworker/25+
clustern20					
clustern20	11,8	40965	polacke	5788:04	julia
clustern21					
clustern23					
clustern25					

host	Load
-----+-----	
clustern09	0.0
clustern10	0.0
clustern12	12.5
clustern13	0.0
clustern14	0.0
clustern15	100.0
clustern16	0.0
clustern20	3.12
clustern21	0.0
clustern23	0.0
clustern25	0.0

On est dans le cluster, que faire?

- Le home partagé: ~/yourname

Seulement 2 Tera de données stockées sur clustern01 partagés avec tout le monde. **A NE PAS REMPLIR!!!!**

Bien pour:

- Stocker les languages (Julia, Python, Rust....) voir les libraries
- Passer du code rapidement entre les clusters
- **NE JAMAIS ÉCRIRE DE DONNÉES DEDANS**

On est dans le cluster, que faire?

- Les disques non-partagés: /libre et /libre2

Non partagés entre les clusters

Pas de limite de taille de stockage

Vous pouvez vous créer un dossier /libre2/votre nom

```
carillol@clustern15:/home$ mkdir /libre2/carillo
```

Bien pour:

- Stocker tout

Comment passer votre code de votre ordinateur au cluster

- Github -> git clone

1. **Generate a new SSH key** on the remote machine:

```
bash
```

Copy

Edit

```
ssh-keygen
```

2. Then **add the public key to your GitHub account** under **Settings → SSH and GPG keys**.

3. Now the remote machine can do:

```
bash
```

Copy

Edit

```
git clone git@github.com:yourusername/your-private-repo.git
```

Comment passer votre code de votre ordinateur au cluster

- Mauvaise methode: supercopy:

scp -r origine destination

exemple:

```
~ $ scp -r ./Mon_Code_Multigroup/ clustern09:./FreeFem/Mon_Code_Multigroup/
```

Comment passer votre code de votre ordinateur au cluster

- Idéal: Vs-Code (ou monter un disque en local (Urbain))

Installer Julia

1. Install Julia (and Juliaup) in your home folder

1. Open a terminal.
2. Connect to a cluster. For instance, `ssh clustern20`
3. You are in your home folder. (Otherwise type `cd`)
4. Run the following command (see <https://julialang.org/downloads/>):

```
curl -fsSL https://install.julialang.org | sh
```



This will install juliaup, a tool to install Julia and manage Julia versions. You can run `juliaup --help` if you want more information about this tool.

5. juliaup should automatically have added some lines to your `.bashrc` file.
6. Disconnect and reconnect to the cluster.
7. Verify the installation (and the version) of Julia by running `julia` in your terminal.

Les commandes utiles: screen (tmux)

Un terminal qui ne se ferme pas quand on se déconnecte du cluster

Créer/rattacher un screen

```
carillol@clustern15:~$ screen -R rust  
[detached from 27323.rust]
```

Quitter un screen Ctrl + A, Ctrl+D

Voir la liste des screens:

```
carillol@clustern15:~$ screen -ls  
There are screens on:  
    36749.julia      (24/01/2025 11:09:55)  (Detached)  
    27323.rust       (26/09/2024 10:42:14)  (Detached)  
    40281.cpp        (11/09/2024 17:48:24)  (Detached)  
3 Sockets in /run/screen/S-carillol.
```

Comment profiter des performances du cluster

- Utiliser les 32 coeurs: parallélisation
 - Faire 32x en même temps la même tâche indépendante

You have an experiment, you do it `num_experiments` time, and then you collect the results into a vector

```
let results: Vec<(usize, usize, usize, Vector2<f64>)> = (0..self.num_experiments).into_par_iter().map(|_| {  
    let mut experiment: Experiment = Experiment::new(self.params.clone());  
    experiment.run()  
}).collect();
```

```
using Distributed
using CSV
using DataFrames
n_proc = 32
if nprocs() < n_proc + 1
    addprocs(n_proc - nprocs() + 1)
end

@everywhere begin
    #all the modules, structs and functions that
    #each worker will need to run the code
end

result = @distributed (vcat) for _ in 1:samples
    param = Params( $\Delta t$ , J, d, n_step,  $\phi$ ,  $\nabla\phi$ , DYN, MEANFIELD)
    experience(param)
end

#data treatment
treated_results = result#
#save in csv
CSV.write("data/test.csv", DataFrame(treated_results, :auto), delim=',', header=false)
```

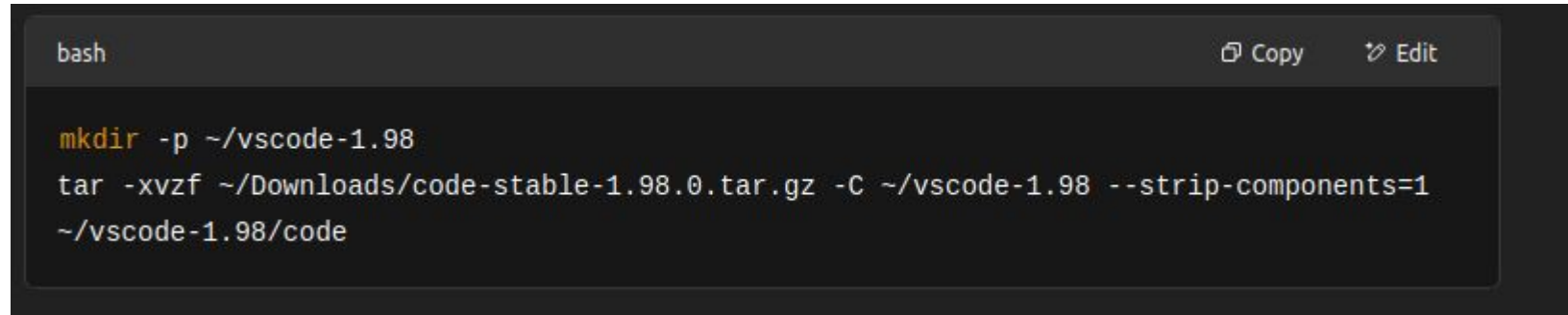
VS-Code

- I **STRONGLY** recommend it on ANY cluster
- With the previous set-up normally there is nothing else to do, you can connect with vs-code
- However the Cluster is incompatible with versions > 1.98

Double version of VS-Code

Download Vs-code 1.98 in .tar.gz format

https://code.visualstudio.com/updates/v1_98

A terminal window with a dark background. The title bar shows 'bash' on the left and 'Copy' and 'Edit' icons on the right. The terminal contains three lines of text: 'mkdir -p ~/vscode-1.98', 'tar -xvzf ~/Downloads/code-stable-1.98.0.tar.gz -C ~/vscode-1.98 --strip-components=1', and '~/vscode-1.98/code'.

```
bash                                                                    Copy  Edit

mkdir -p ~/vscode-1.98
tar -xvzf ~/Downloads/code-stable-1.98.0.tar.gz -C ~/vscode-1.98 --strip-components=1
~/vscode-1.98/code
```

Then you good!