# Spark Environment Configuration in SoC Compute Cluster

## SoC Compute Cluster and Slurm

### What are the SoC Compute Cluster and Slurm?

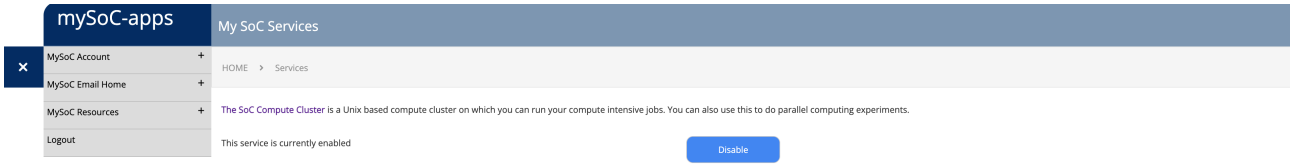
SoC Compute Cluster is a high-performance Linux server cluster designed to support high-performance and/or distributed computing applications. This is available to all SoC users and users from other faculties that are taking modules in SoC. You can check Compute Cluster Guide for more information.

Slurm, the Slurm Workload Manger is the system to manage all jobs in this cluster. You can check Slurm Cluster Information for more information.

Here we will focus on how to log in Compute Cluster, configure an environment for Spark and use Slurm to submit your jobs.

## Log in

First of all, you must have an SoC account and enable "SoC Compute Cluster" in MySoC to use service. When you visit MySoC, go to Home -> Service, you can see a page like this




After that, we can try to log in.

The cluster nodes only accepts SSH connections from within SoC. If you are not connecting from inside SOC, then you must use SoC VPN first before logging in to the cluster.

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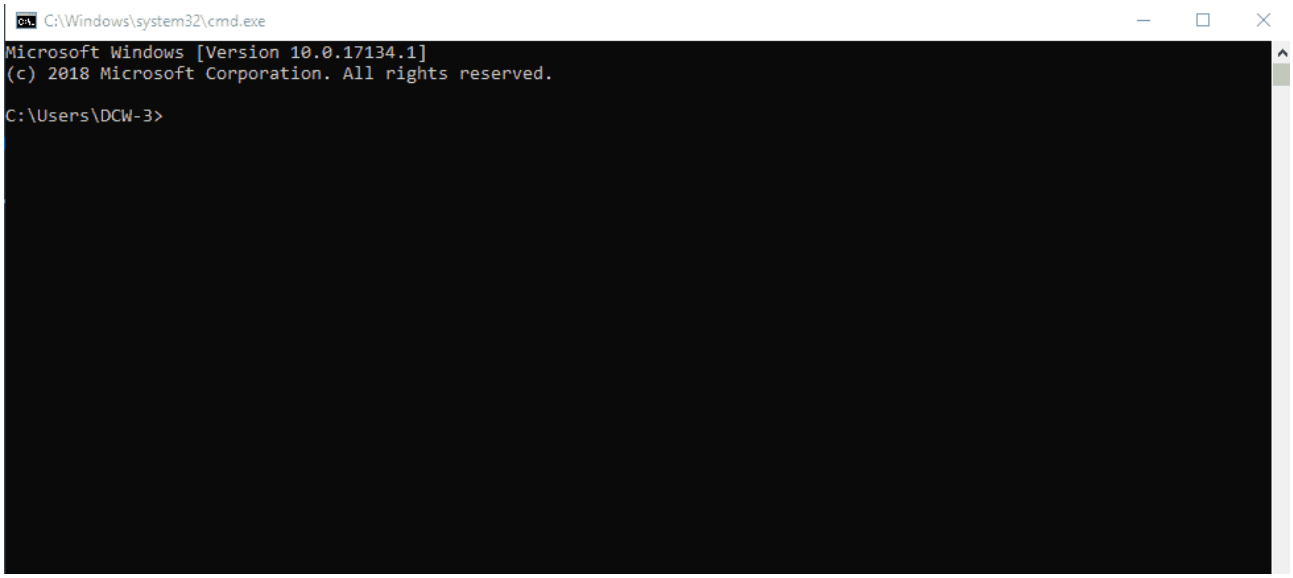
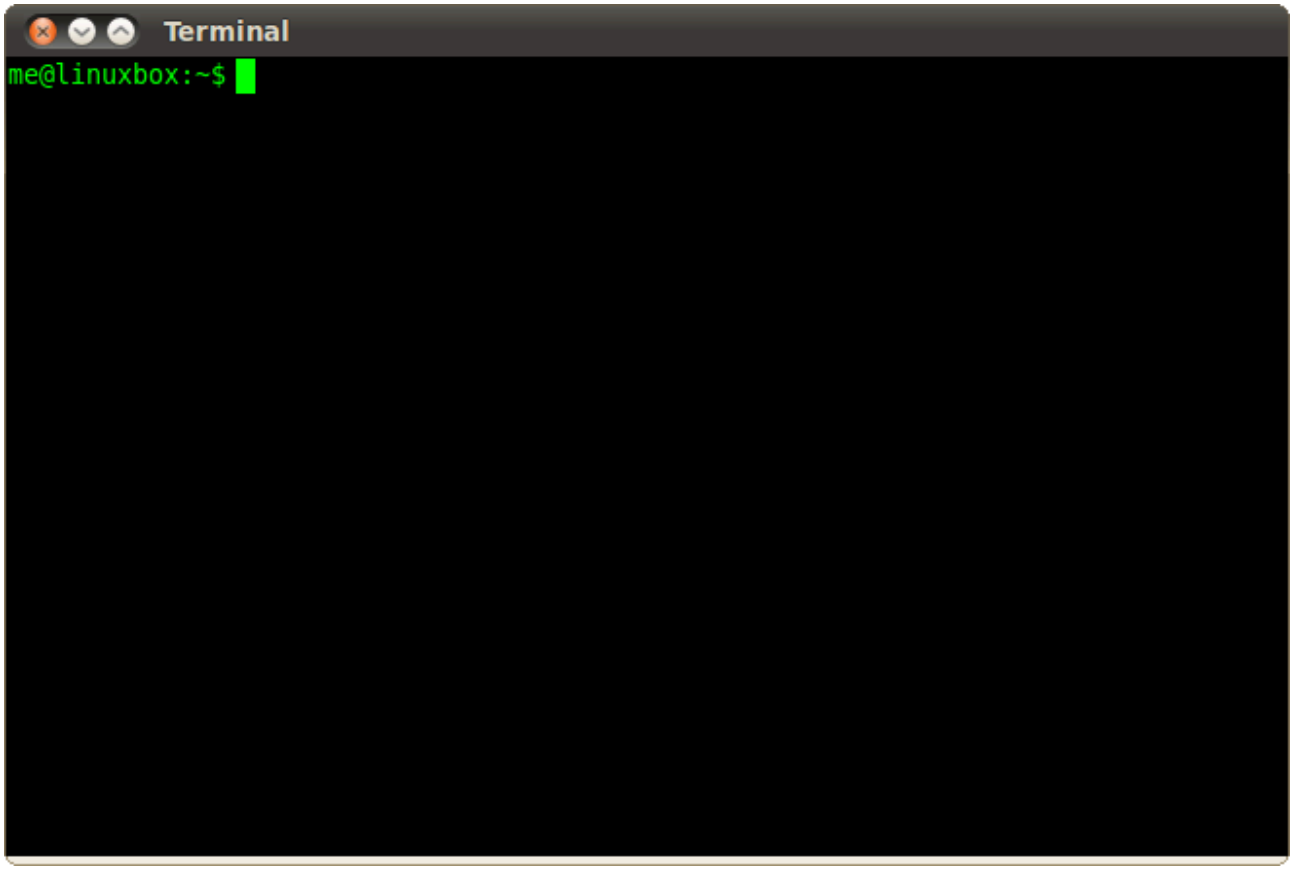
### Open your Command Line (CLI)

Command line is a text interface to your computer. It is also called the shell, terminal, console, prompt or some other names.
When you opened the command line, you will see something like this




if you are using a Unix like system e.g., macOS or Unbutu,



Anyway, you basically get yourself a blank window where you can input some commands.

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## Log in with SSH

You can check the SSH Guide for more about SSH. But right now, let's log in.
Input this command into the command line

**ssh user1234@xlog0**

Please replace **user1234** with your own account. If you are not sure about your account, please check this SoC account, or simply try every account you have that is given NUS.
After log in, you will see a prompt like this:

**user1234@xlog0:~$**

This means you, the **user1234**, are logged into the node **xlog0** and is currently in your home directory (denoted by ~). You can log into the node **xlog0**, **xlog1**, **xlog2** or **xlog3**. These nodes are just for log in, not computation. Then we will configure the environment for Spark here and finally submit our jobs to Slurm here.

Since Soc Compute Cluster uses a Network File System, all files under your home directory are shared among different servers, which means you only need to configure the environment on one server and it is available in all servers. But it also means that the I/O operation could be very slow if you are dealing with some very large files.

# Environment Configuration for Spark

## Install Anaconda

Download Anaconda individual edition at https://anaconda.com/, and install. Here is the official instruction about how to do that, installing on Linux.

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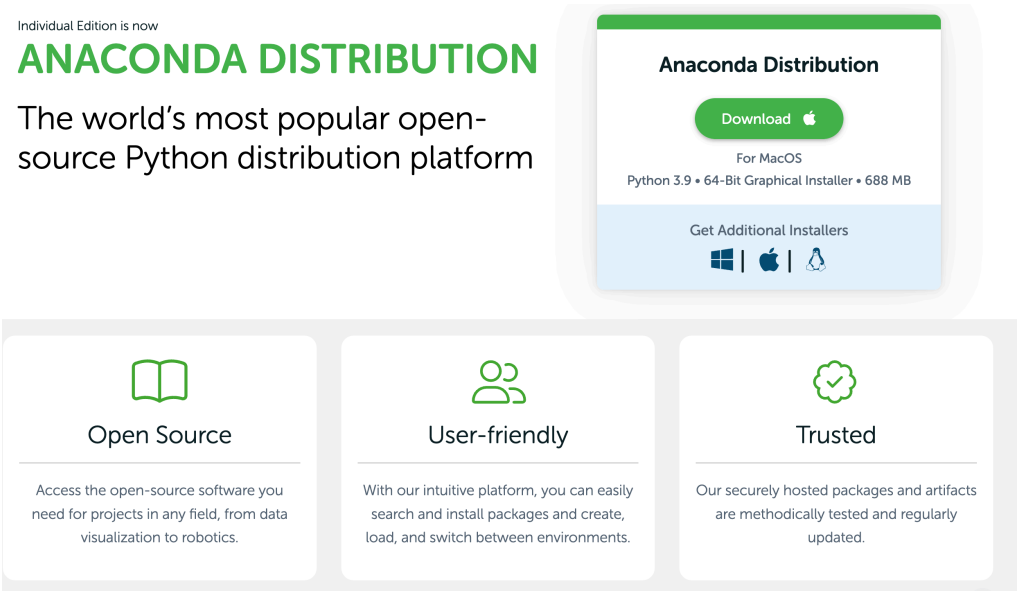
### 1. Visit the Anaconda downloads page

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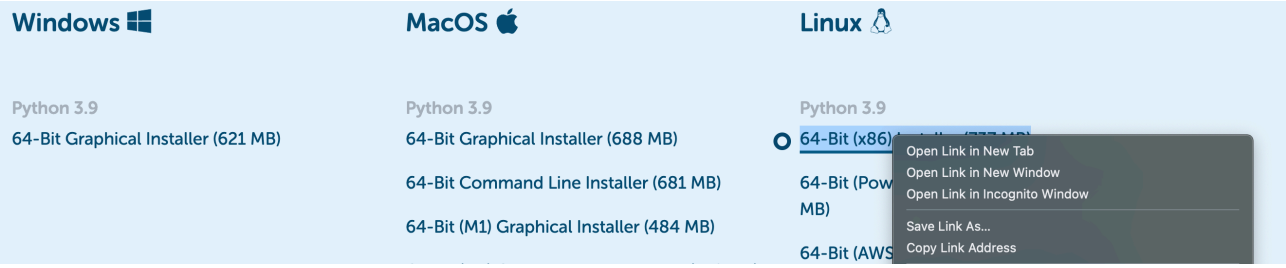
### 2. Select Linux


3. Copy the download link




4. Use wget to download

**wegt https://repo.anaconda.com/archive/Anaconda3-2022.10-Linux-x86_64.sh**

5. Run the script to install

**bash Anaconda3-2022.10-Linux-x86_64.sh**

6. source the .bash-rc file to add Anaconda to your PATH. Note that .bashrc file is in your home directory

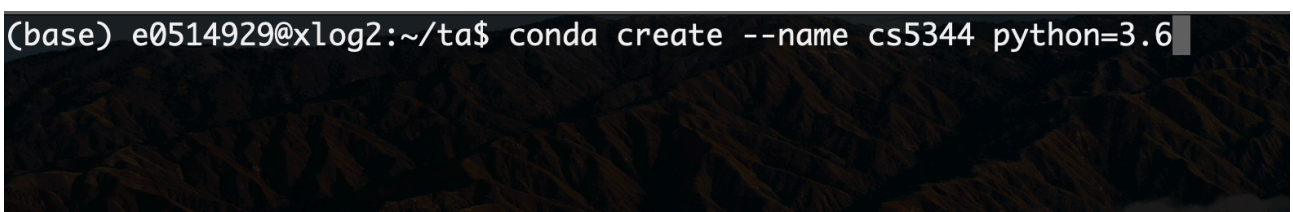
**cd ~**
**source .bashrc**

# Install Java

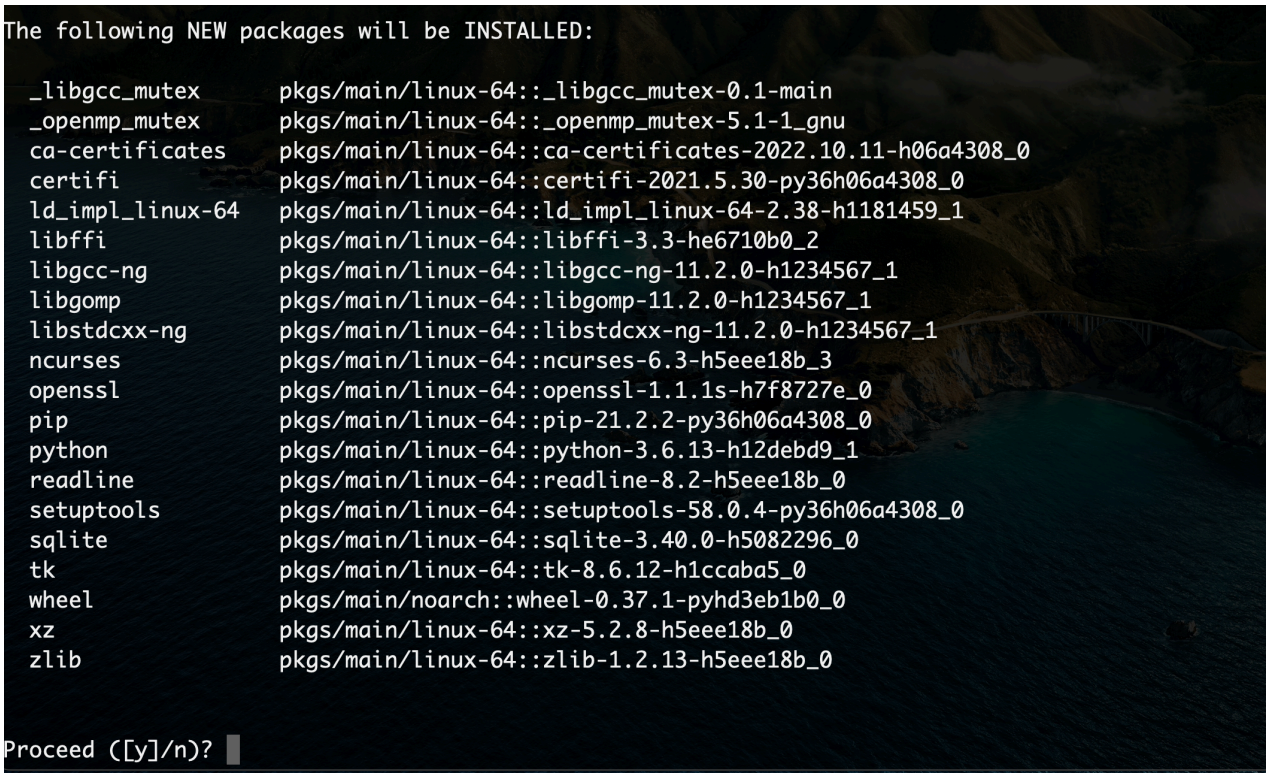
1. Create an environment.

**conda create --name myenv python=<version>**

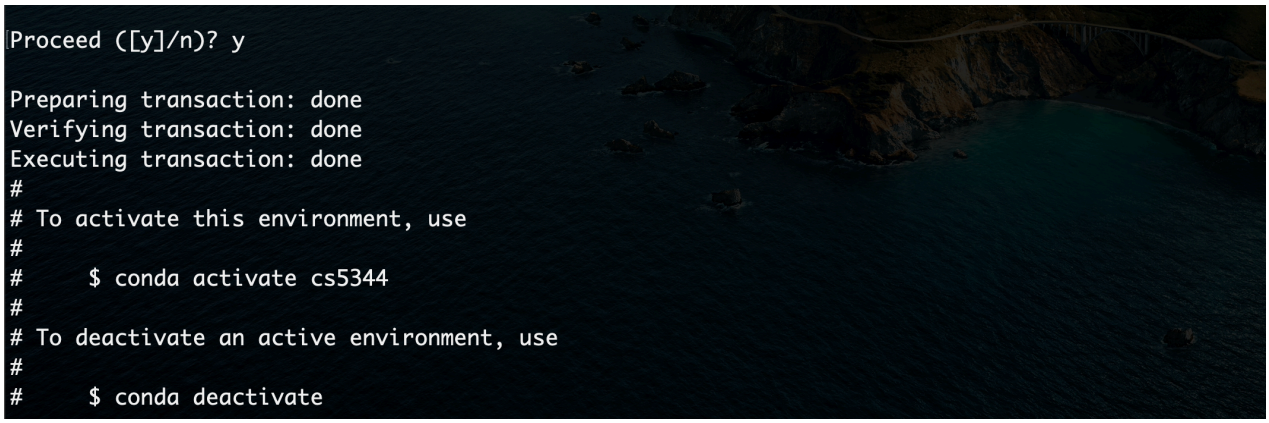
You can specify the python version here. Replace <version> with the version number you want, i.e., 3.6



For example, the environment name is cs5344 here.
Then it will show a list of new packages need to be installed, just type ‘y’ and wait for it to finish.

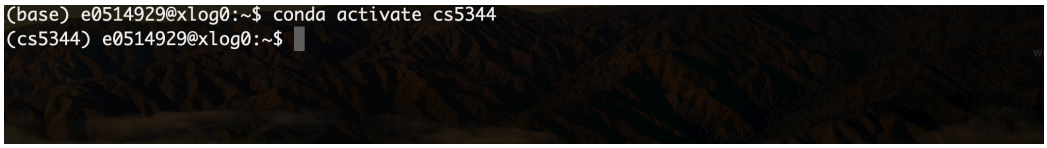



When finished




## 2. Activate Conda Environment

After log in one of xlog nodes, activate the environment you just created. For example,




(check the command to do that in Conda Cheat Sheet based on your operating system). Now you are in the cs5344 conda environment.

## 3. Install OpenJDK

To install OpenJDK (a version of Java), use the following command,

**conda install openjdk=<version>**

Again, replace <version> with the version number you want, e.g., 11. Like this,
Just input 'y' and wait it to finish.

```
==> WARNING: A newer version of conda exists. <==
  current version: 4.10.3
  latest version: 22.11.1

Please update conda by running

    $ conda update -n base -c defaults conda



## Package Plan ##

  environment location: /home/e/e0514929/anaconda3/envs/cs5344

  added / updated specs:
    - openjdk


The following NEW packages will be INSTALLED:

  dbus               pkgs/main/linux-64::dbus-1.13.18-hb2f20db_0
  expat              pkgs/main/linux-64::expat-2.4.9-h6a678d5_0
  freetype           pkgs/main/linux-64::freetype-2.12.1-h4a9f257_0
  glib               pkgs/main/linux-64::glib-2.69.1-h4ff587b_1
  libpng             pkgs/main/linux-64::libpng-1.6.37-hbc83047_0
  libxcb             pkgs/main/linux-64::libxcb-1.15-h7f8727e_0
  openjdk            pkgs/main/linux-64::openjdk-11.0.13-h87a67e3_0
  pcre               pkgs/main/linux-64::pcre-8.45-h295c915_0


Proceed ([y]/n)?

Preparing transaction: done
Verifying transaction: done
Executing transaction: done
(cs5344) e0514929@xlog0:~$
```

# Install PySpark

The last thing we need to install is pyspark. You do not need to worry about Python, Spark or Scala. Conda will take care of them for you. The command is

**conda install pyspark**

Like this,
Again, input 'y' and wait. This could take some time.

When it is finished, you have a conda environment for spark named cs5344.

```
long         up 3-00:00:00      1   down amdgpu2
test         up      10:00      2  down* xgpf[2,11]
test         up      10:00     28   idle xcne[0-7],xgpf[0-1,3-10],xgpg[0-9]
(base) e0514929@xlog0:~$ squeue
             JOBID PARTITION     NAME     USER ST       TIME  NODES NODELIST(REASON)
(base) e0514929@xlog0:~$
```

```
Solving environment: done


==> WARNING: A newer version of conda exists. <==
  current version: 4.10.3
  latest version: 22.11.1

Please update conda by running

    $ conda update -n base -c defaults conda



## Package Plan ##

  environment location: /home/e/e0514929/anaconda3/envs/cs5344

  added / updated specs:
    - pyspark


The following NEW packages will be INSTALLED:

  abseil-cpp         pkgs/main/linux-64::abseil-cpp-20210324.2-h2531618_0
  arrow-cpp          pkgs/main/linux-64::arrow-cpp-3.0.0-py36h6b21186_4
  aws-c-common       pkgs/main/linux-64::aws-c-common-0.4.57-he6710b0_1
  aws-c-event-stream pkgs/main/linux-64::aws-c-event-stream-0.1.6-h2531618_5
  aws-checksums      pkgs/main/linux-64::aws-checksums-0.1.9-he6710b0_0
  aws-sdk-cpp        pkgs/main/linux-64::aws-sdk-cpp-1.8.185-hce553d0_0
  blas               pkgs/main/linux-64::blas-1.0-mkl
  boost-cpp          pkgs/main/linux-64::boost-cpp-1.73.0-h27cfd23_11
  brotli             pkgs/main/linux-64::brotli-1.0.9-h5eee18b_7
  brotli-bin         pkgs/main/linux-64::brotli-bin-1.0.9-h5eee18b_7
  bzip2              pkgs/main/linux-64::bzip2-1.0.8-h7b6447c_0
  c-ares             pkgs/main/linux-64::c-ares-1.18.1-h7f8727e_0
```

# Submit your job to Slurm

Let's say you have done some Spark coding and you want to run your script in Slurm. Since we do not use xlog0~2 to do computation. We need to ask Slurm to allocate us some resources to do the computation.

There are some common helpful Slurm commands.
**sinfo**: Show status of nodes and partitions in the Slurm cluster.

```
(base) e0514929@xlog0:~$ sinfo
PARTITION AVAIL  TIMELIMIT  NODES  STATE NODELIST
standard*    up      10:00      1  down* xgpd0
standard*    up      10:00     15    mix xcnd[19-25],xgpc2,xgpd[3-4],xgph[5-9]
standard*    up      10:00      5  alloc xcnc24,xcnd[15-18]
standard*    up      10:00     72   idle amdgpu[0-1],xcna[0-6],xcnb[0-9],xcnc[0-15,17-23],xcnd[0-8,10,12-14,26-29],xgpc[0-1],xgpd2,xgpe[0-4],xgph[0-4]
medium       up    3:00:00     35    mix xcnc[28-32,34-35],xcnd[19-25],xgpc[2-4],xgpd[3-6],xgpe[6-9],xgph[5-14]
medium       up    3:00:00      9  alloc xcnc[24-27],xcnd[15-18],xgpd7
medium       up    3:00:00     49   idle amdgpu1,xcna[4-6,8-11],xcnb[5-14],xcnc[13-15,17-23,36-37],xcnd[26-44]
medium       up    3:00:00      1   down amdgpu2
long         up 3-00:00:00     25    mix xcnc[28-32,34-35],xgpc[3-4],xgpd[5-6,8-9],xgpe[10-11],xgph[10-19]
long         up 3-00:00:00      4  alloc xcnc[25-27],xgpd7
long         up 3-00:00:00     61   idle xcna[8-15],xcnb[10-14,16-19],xcnc[36-49],xcnd[30-59]
long         up 3-00:00:00      1   down amdgpu2
test         up      10:00      2  down* xgpf[2,11]
test         up      10:00     28   idle xcne[0-7],xgpf[0-1,3-10],xgpg[0-9]
```

**squeue**: Show the Slurm job queue.
This is the first semester that all nodes are managed by Slurm. IT service guys are also trying to find the best way to set the system. So, sometimes Slurm commands may not behave like it should. To find out more, please check Slurm Guide.

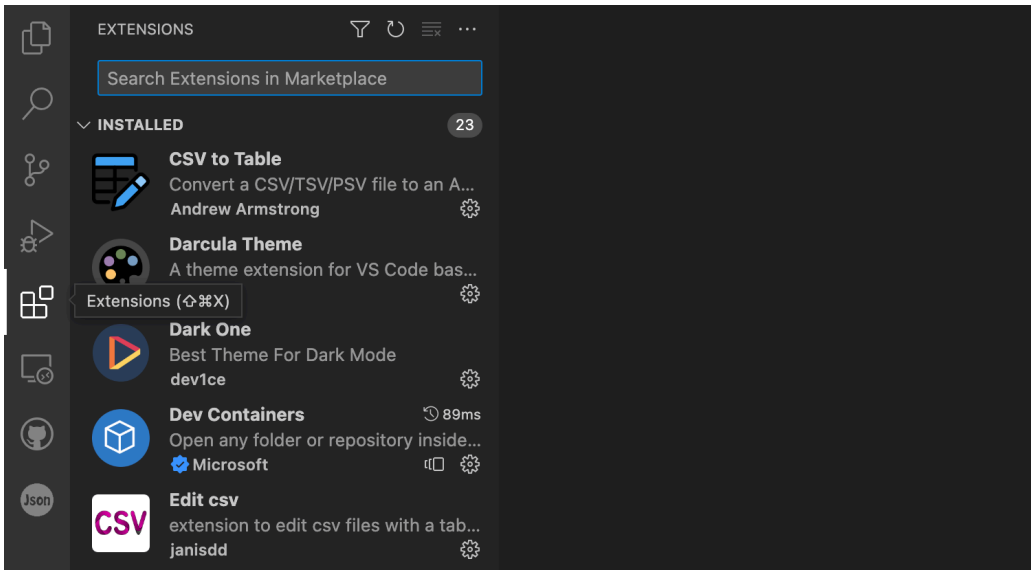
To submit a job to Slurm, **srun**. This command will automatically get you a job allocation and submit your job. Remember to activate your environment. Like this,

```
(base) e0514929@xlog0:~/ta/CS5344/Lab1$ conda activate cs5344
(cs5344) e0514929@xlog0:~/ta/CS5344/Lab1$ srun spark-submit wordcount.py in.txt outfile
```

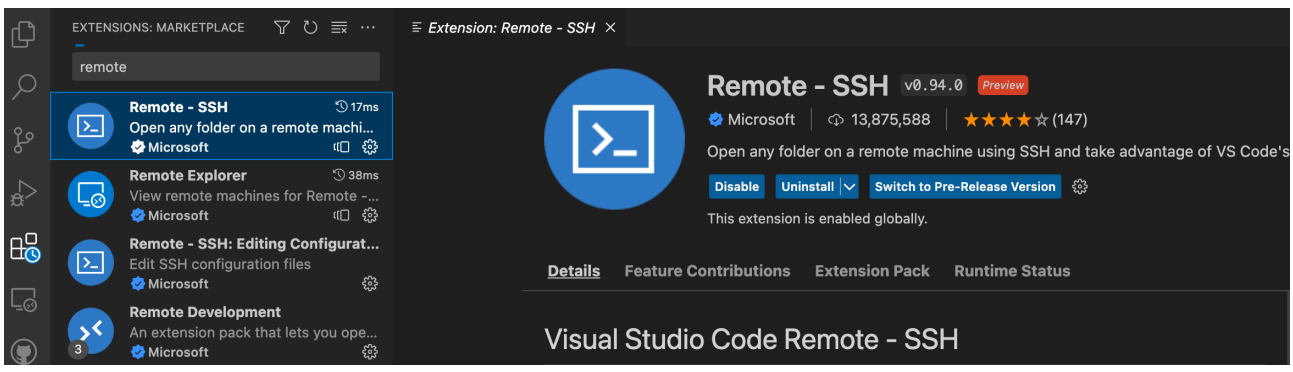
# Use Compute Server with an IDE

You may want to coding in an IDE with the remote servers. Most IDEs provide the function to connect to remote servers. We recommend VS Code to do that. Compared with other IDEs, it is easy and straightforward to use and it provides all kinds of extensions which could be very helpful in coding.

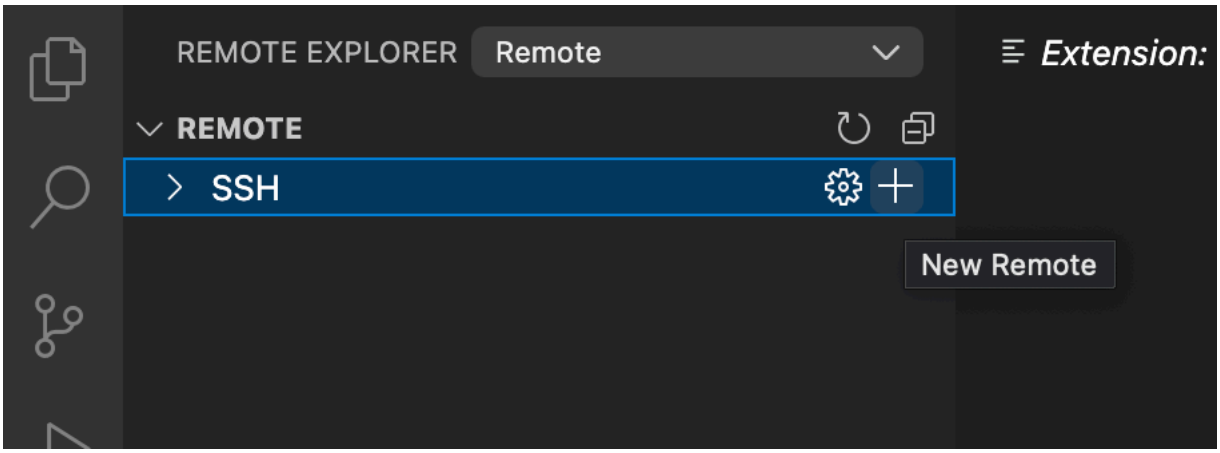
You can download VS Code in here.
After installation, open VS Code and choose Extensions on the left panel.



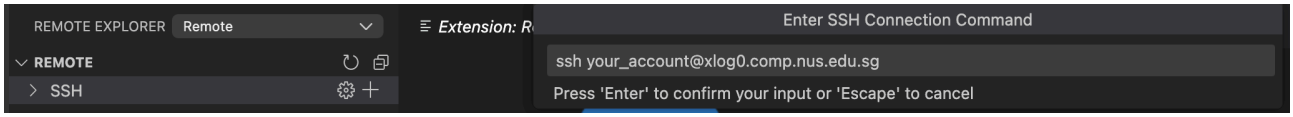

Then search ‘remote’ and install ‘Remote - SSH’.



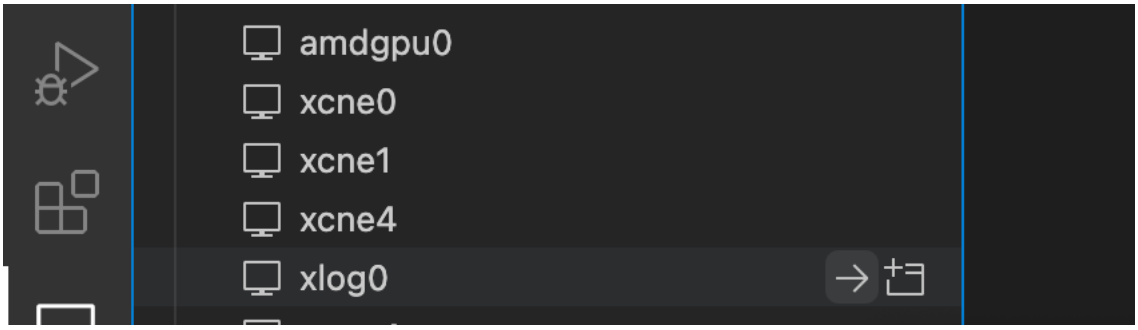
After installing the ‘Remote - SSH’, choose it on the left panel and click the adding symbol to add a ‘New Remote’.



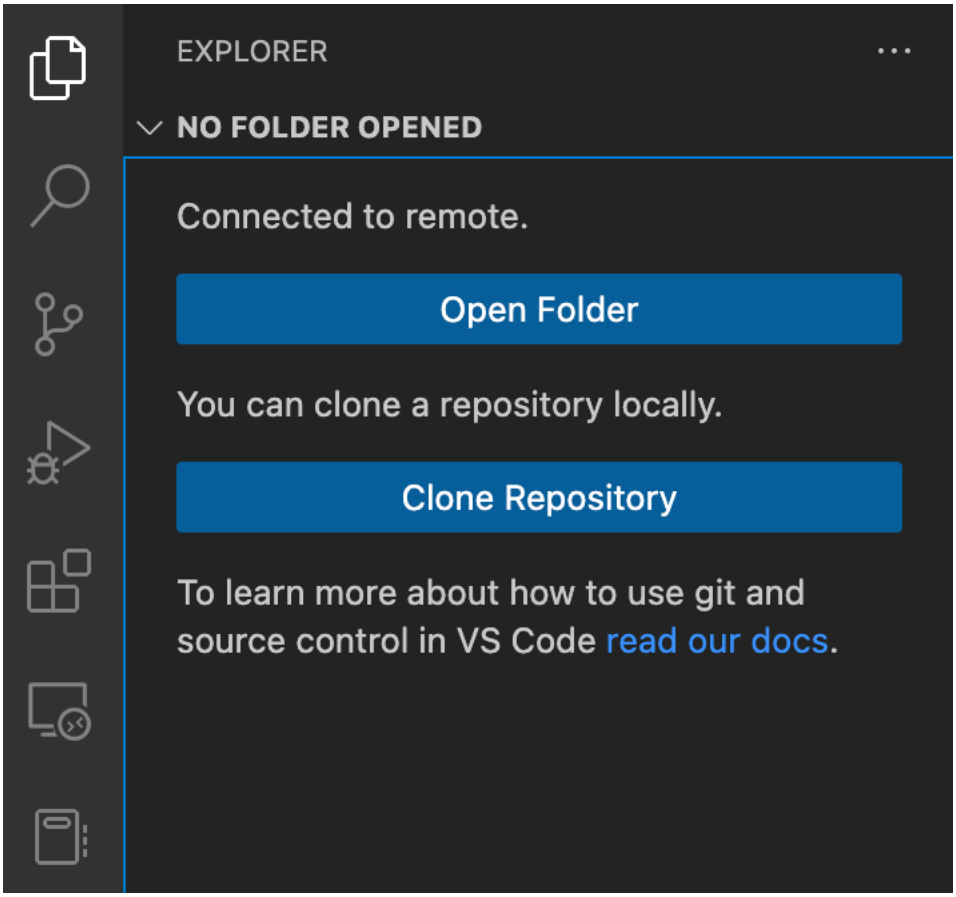

Then it will ask for a SSH command. Let’s take xlog0 for an example. Input your account and the host address of xlog0.



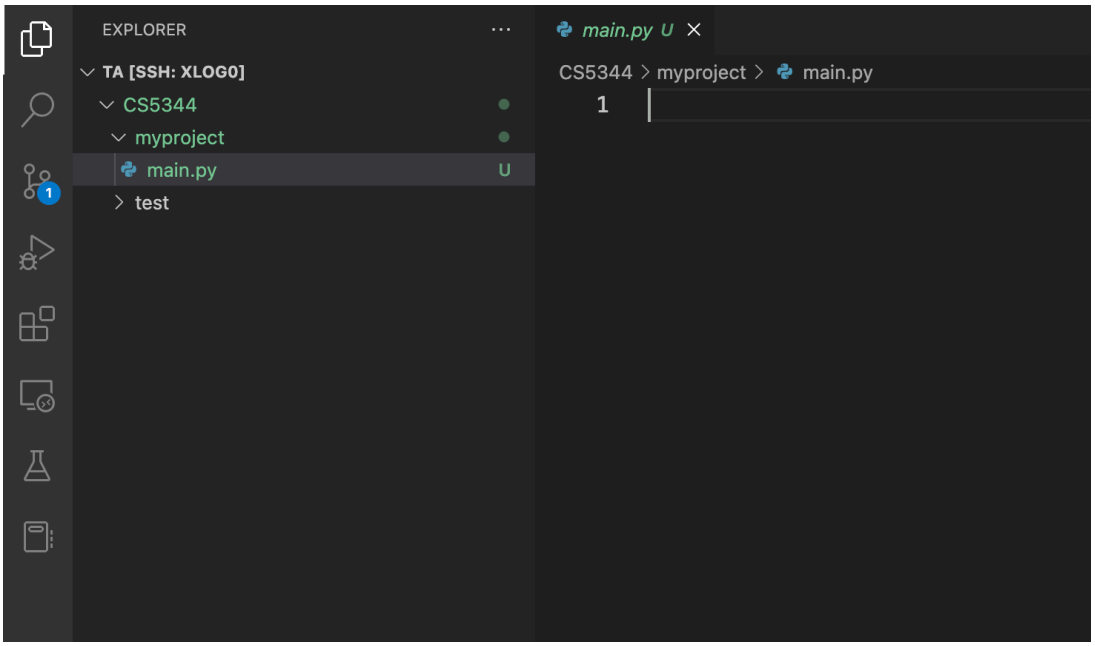

Click the arrow next to SSH, you will see xlog has been added into remote server list.




Open xlog0, then input your password. You will see




It means you have successfully connected to xlog0. Now you can open folders and edit files like being in a local server. For example,



And you can choose which python you want to use to run your code in the right corner. For example, here the python 3.6 in the conda environment cs5344 we have created is chosen.