

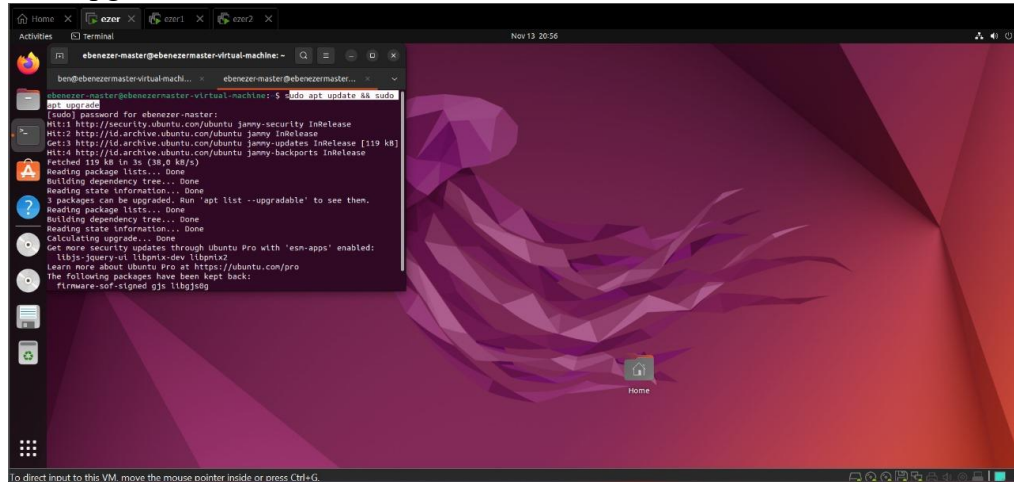
LAPORAN PEMROSESAN PARALEL BUBBLESORT DENGAN MPI



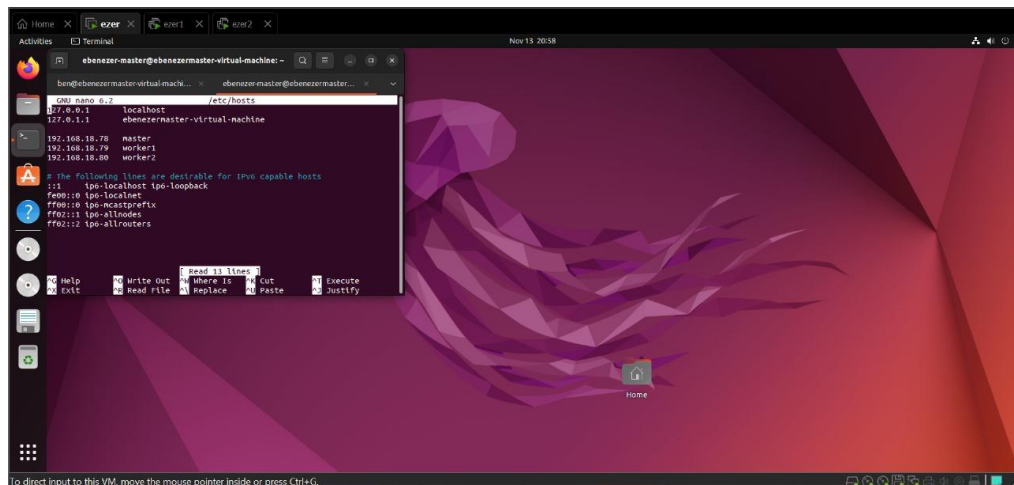
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**PROGRAM STUDI SISTEM KOMPUTER
FAKULTAS ILMU KOMPUTER
UNIVERSITAS SRIWIJAYA
2023**

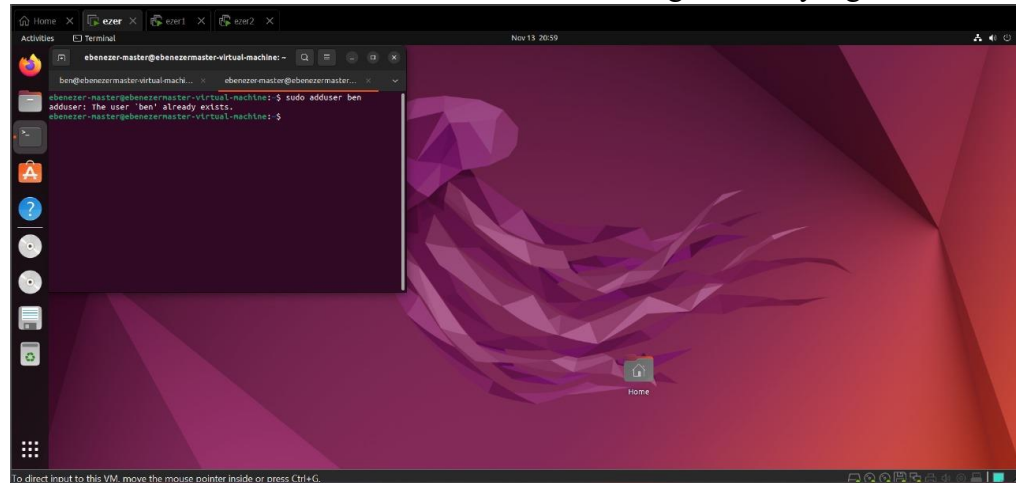
- Device dan Tools yang digunakan
 - 3 Virtual Machine (1 master dan 2 worker/slave)
 - MPI (Message Passing Interface)
 - SSH (Secure Shell)
 - Python
- Update dan Upgrade Ubuntu



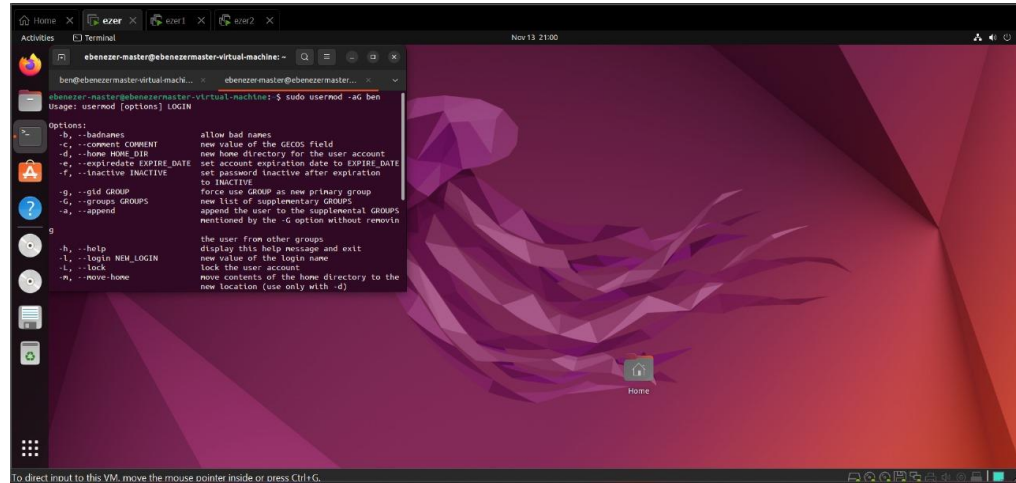
- Konfigurasi MPI
 - Lakukan Konfigurasi /etc/hosts di master dan slave dengan mengisi ip dari master dan slave



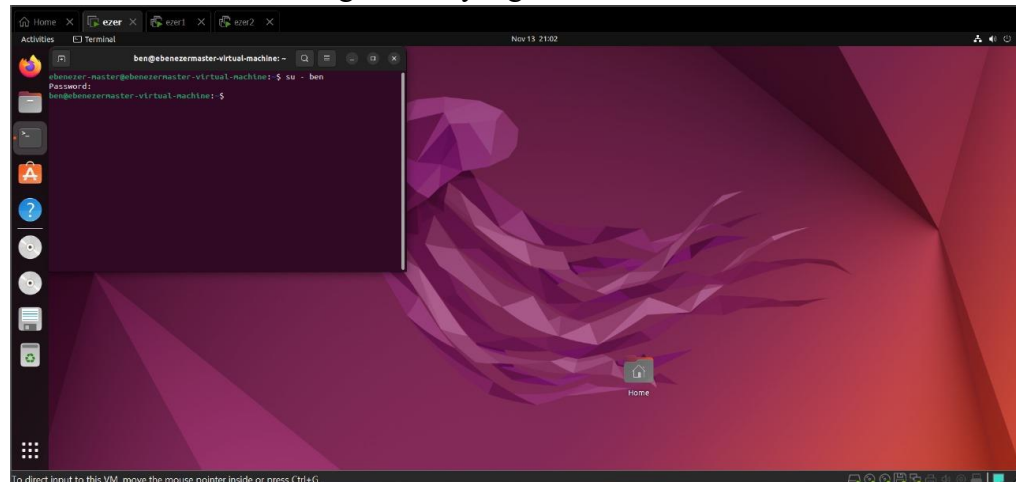
- Buat user baru di master, worker1 dan worker2 dengan nama yang sama



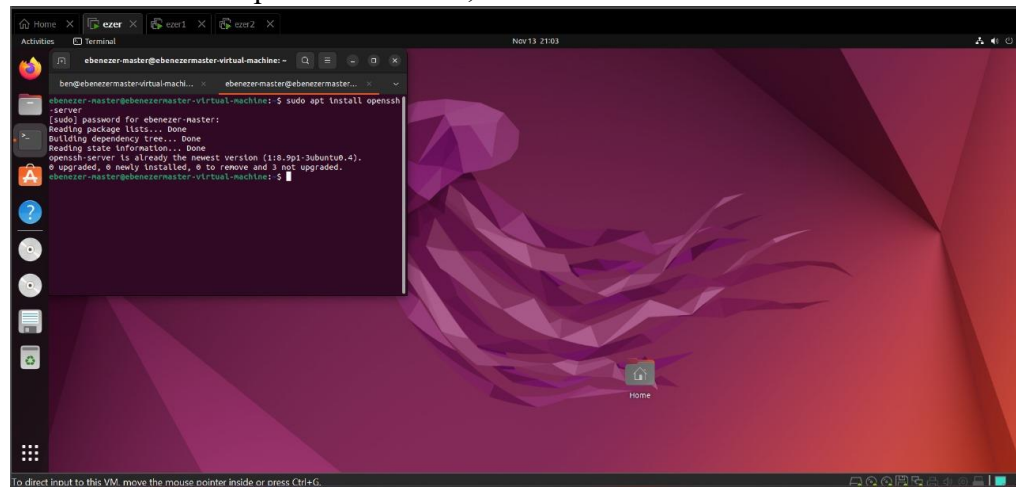
- Berikan akses root ke user baru yang dibuat di master, worker1 dan worker2



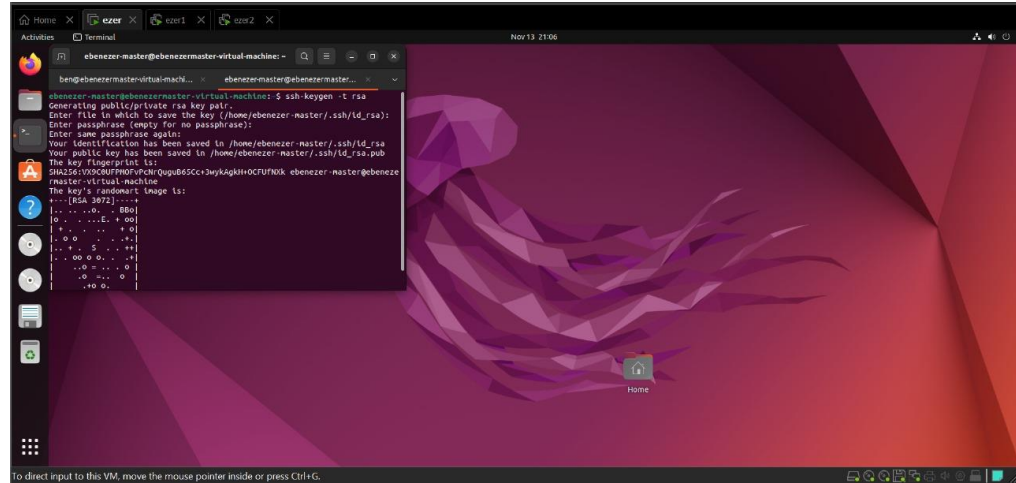
- Kemudian masuklah sebagai “user yang telah dibuat” di master dan kedua worker



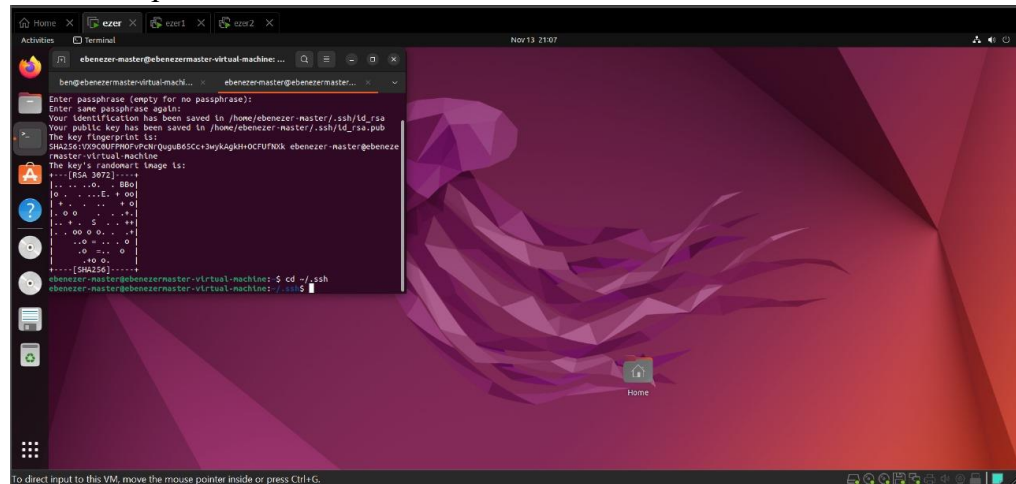
- Kemudian install openssh di master, worker1 dan worker2



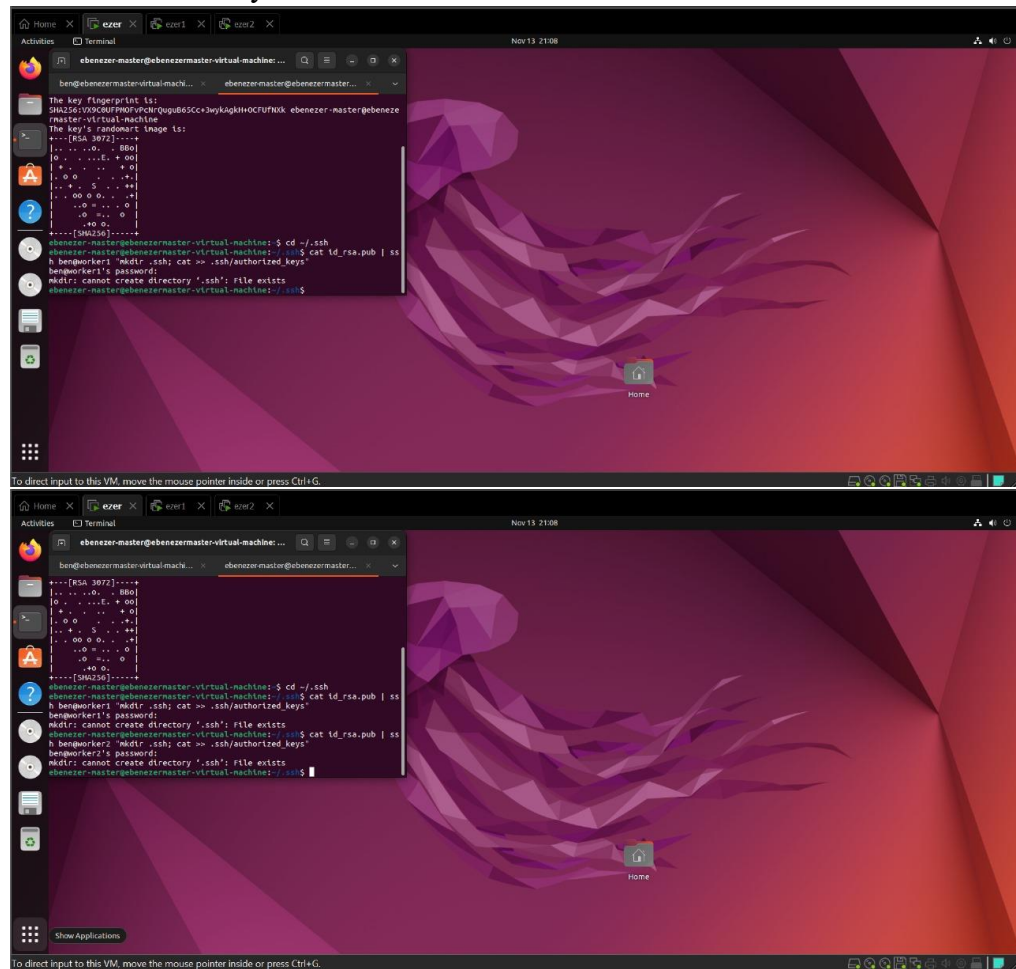
- Kemudian buatlah key ssh di master



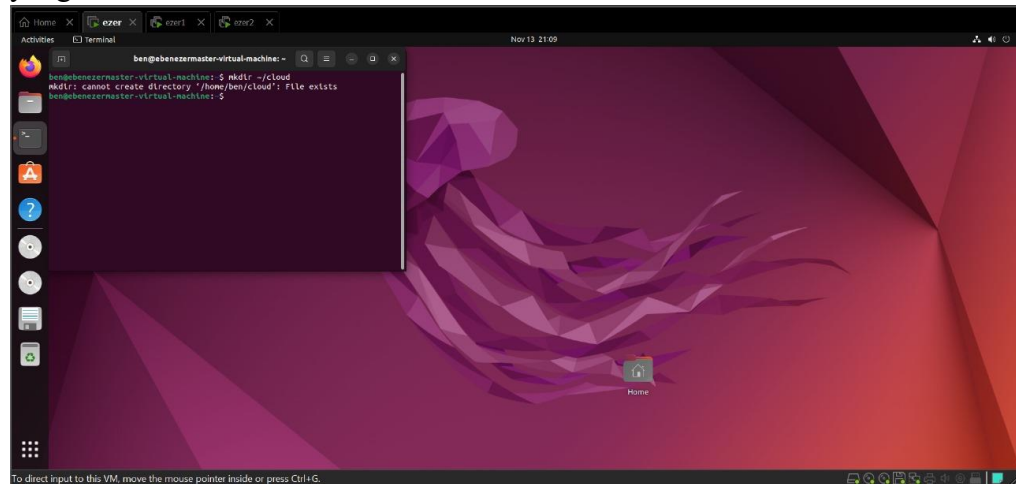
- Kemudian pindah direktori



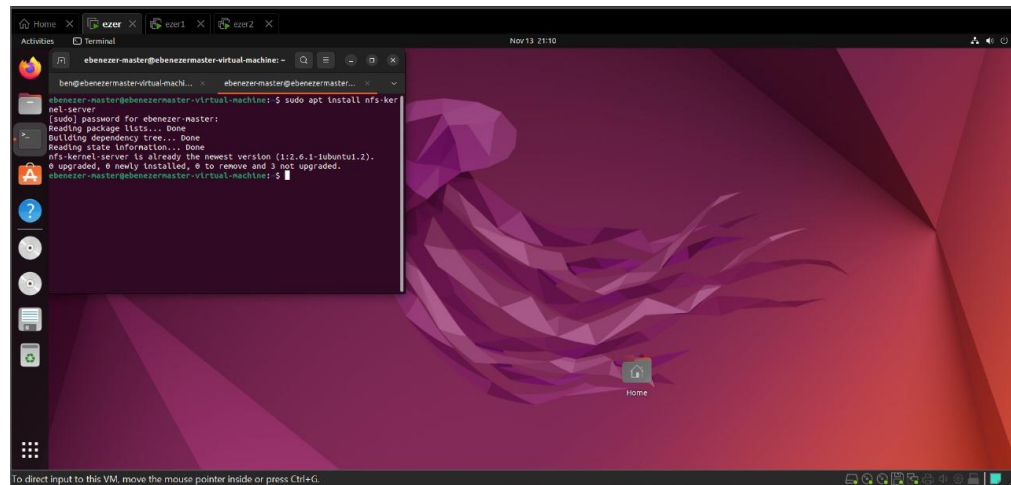
- Kemudian salin key master ke worker 1 dan worker 2



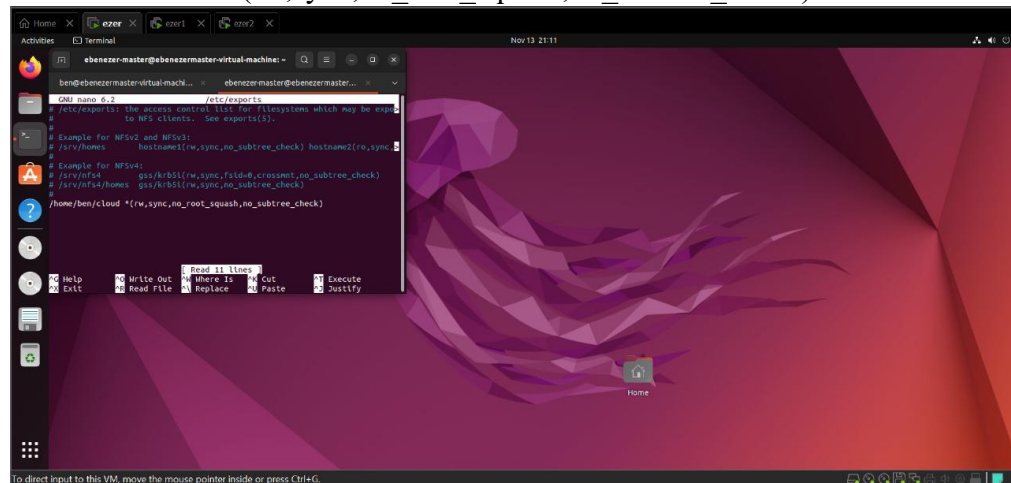
- Buatlah direktori bernama cloud di semua virtual machine, lakukan ini di user yang dibuat tadi



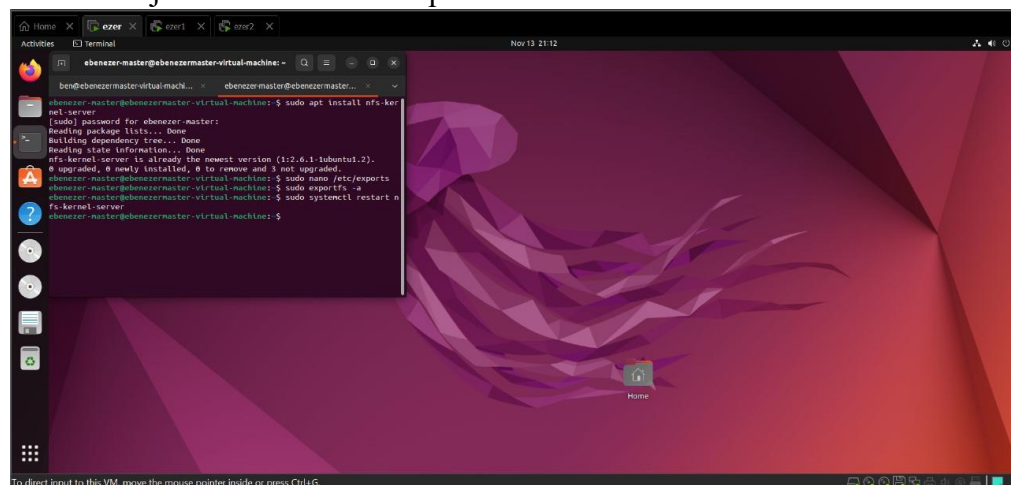
- Setelah itu kemudian install lah nfs di master



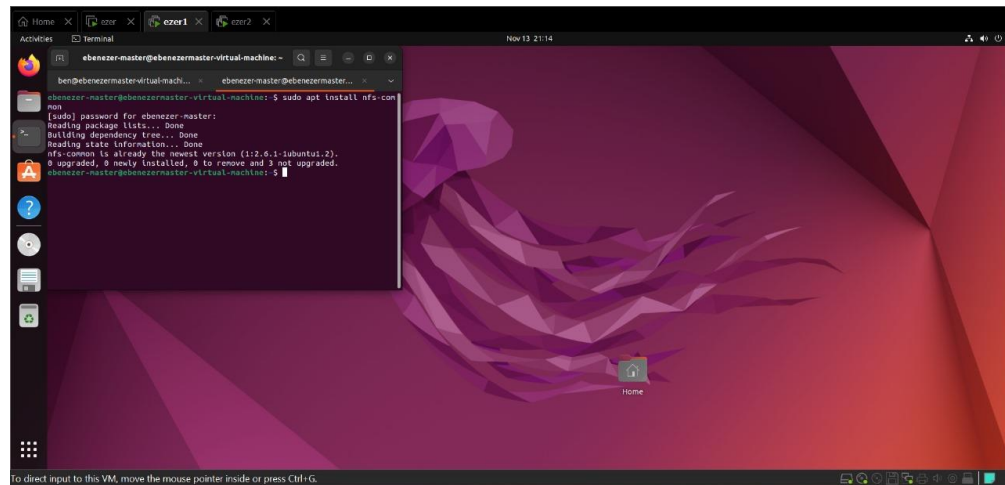
- edit file exports dan tambahkan
`/home/ben/cloud*(rw,sync,no_root_squash,no_subtree_check)`



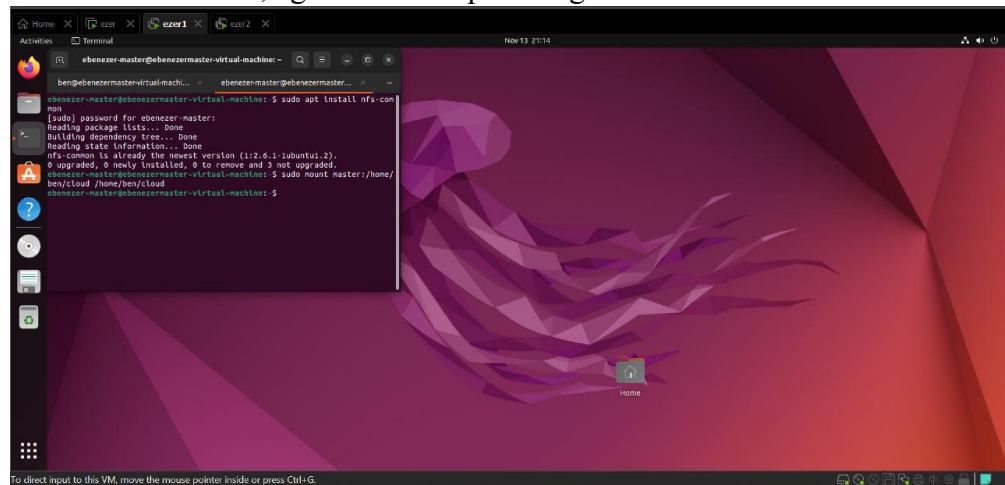
- Kemudian jalankan command seperti dibawah



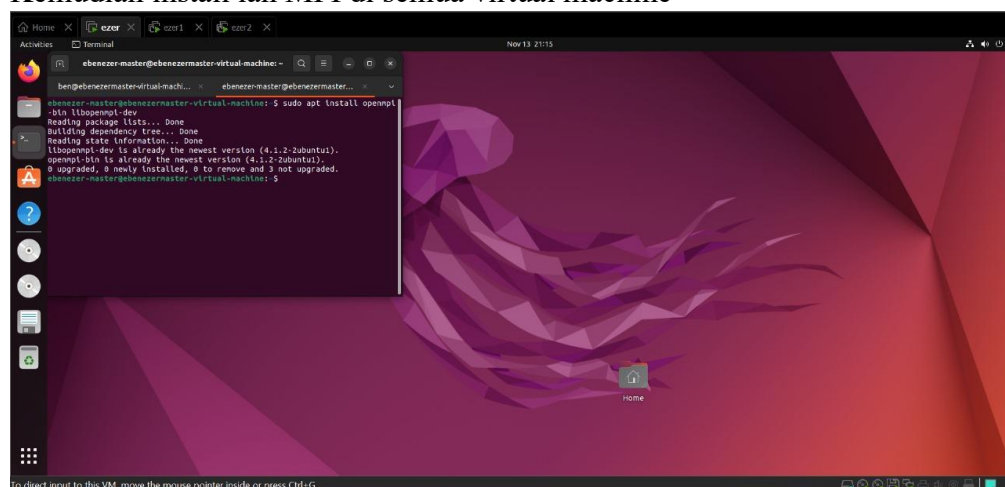
- Kemudian install nfs-common di worker1 dan worker2



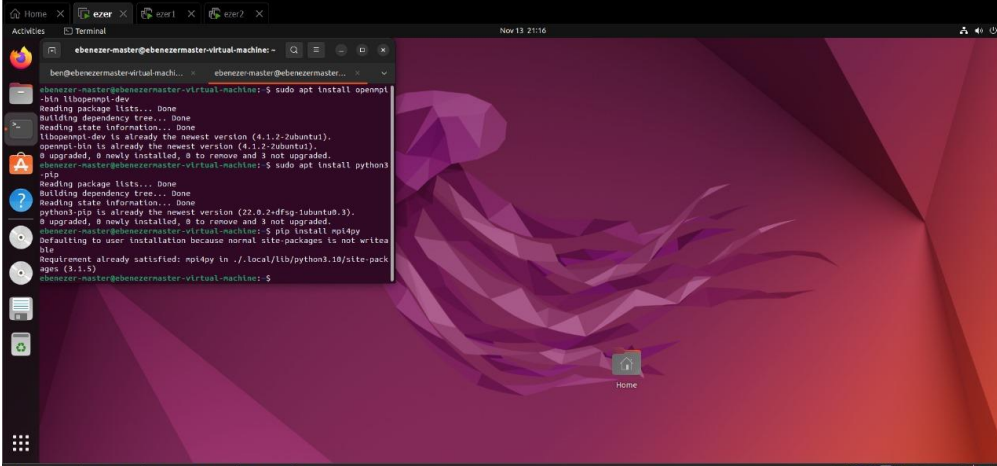
- Kemudian lakukan lah mount direktori cloud yang dibuat tadi, lakukan command ini di kedua worker, agar worker dapat mengakses direktori



- Kemudian install lah MPI di semua virtual machine

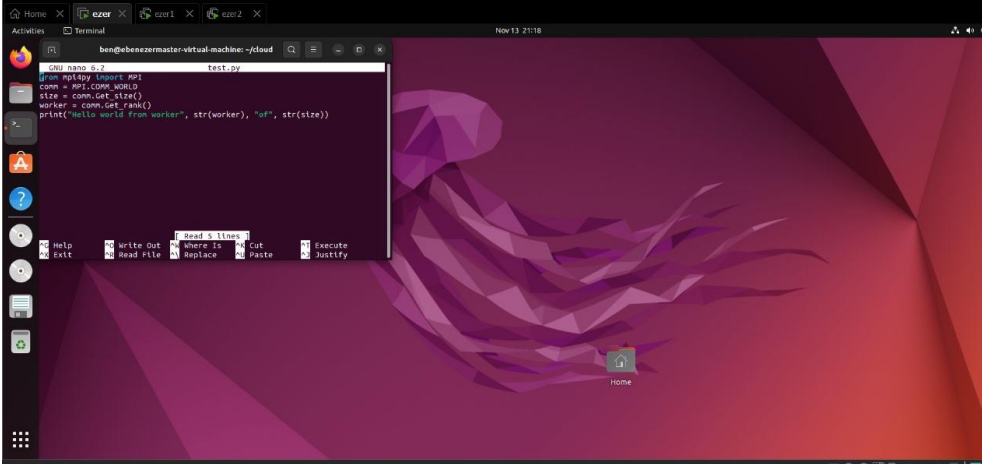


- Setelah terinstall, kemudian lanjutkan dengan menginstall librarynya di semua virtual machine



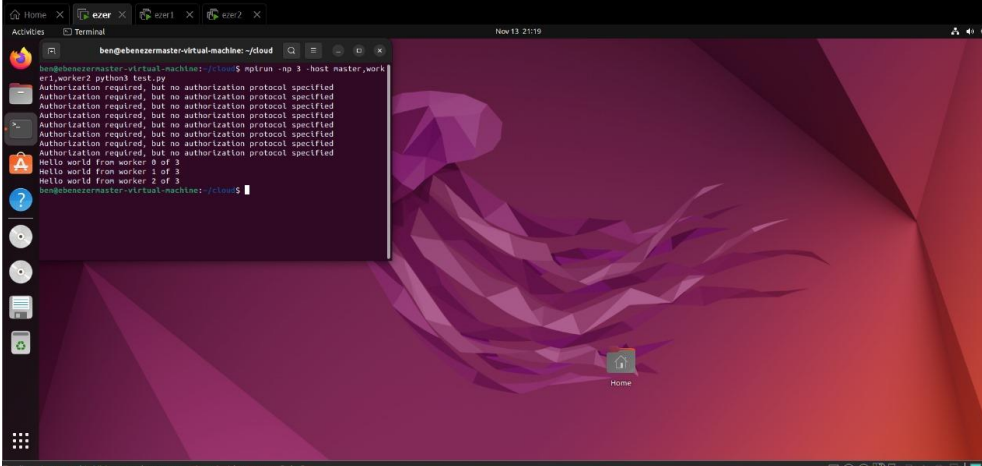
```
ben@ebenezernaster-virtual-machine:~$ sudo apt install openmpi
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openmpi-bin is already the newest version (4.1.2-2ubuntu1).
openmpi-dev is already the newest version (4.1.2-2ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
ben@ebenezernaster-virtual-machine:~$ sudo apt install python3
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-pip is already the newest version (22.0.2dfsg-1ubuntu3).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
ben@ebenezernaster-virtual-machine:~$ pip install mpi4py
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: mpi4py in ./local/lib/python3.10/site-packages (3.1.3)
ben@ebenezernaster-virtual-machine:~$
```

- Batlah program test, untuk menguji apakah mpi sudah dapat dijalankan



```
ben@ebenezernaster-virtual-machine:~/cloud$ nano test.py
# Create a test program
from mpi4py import MPI
comm = MPI.COMM_WORLD
size = comm.Get_size()
worker = comm.Get_rank()
print("Hello world from worker", str(worker), "of", str(size))
```

- Kemudian jalankan program tersebut



```
ben@ebenezernaster-virtual-machine:~/cloud$ mpirun -np 3 -host master,worker1,worker2 python3 test.py
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Hello world from worker 0 of 3
Hello world from worker 1 of 3
Hello world from worker 2 of 3
ben@ebenezernaster-virtual-machine:~/cloud$
```


- Setelah berhasil, kemudian lakukanlah program bubblesort yang berjalan dengan mpi

```

bengebenezmaster-virtual-machine:~$ sudo
Successfully installed numpy-1.26.2
bengebenezmaster-virtual-machine:~/code$ nano bubblesort.py
bengebenezmaster-virtual-machine:~/code$ nano bubblesort.py
bengebenezmaster-virtual-machine:~/code$ mpirun -np 3 ./host_master_work
eri.worker2: python3 bubblesort.py
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Master memulai pengurutan...
worker2 menerima data: [12 22 11 99]
worker2 mengirim data yang sudah diurutkan: [11 12 22 99]
worker1 menerima data: [64 34 25]
worker1 mengirim data yang sudah diurutkan: [25 34 64]
data setelah diurutkan: [11 12 22 25 34 64 99]
waktu eksekusi: 8.125778998611348 detik
bengebenezmaster-virtual-machine:~/code$
  
```

- Berikut adalah perbandingan waktu bubblesort dengan python menggunakan 1 pc dan 3 pc secara paralel, dapat dilihat bahwa waktu yang diperlukan bubblesort menggunakan mpi lebih sedikit karena dilakukan secara paralel processing.

```

bengebenezmaster-virtual-machine:~$ sudo
bengebenezmaster-virtual-machine:~/code$ python3 bubblesortthasa.py
Array yang diurutkan adalah:
11 12 22 25 34 64 99
waktu eksekusi: 2.884884807128982e-05 detik
bengebenezmaster-virtual-machine:~/code$ mpirun -np 3 ./host_master_work
eri.worker2: python3 bubblesort.py
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Authorization required, but no authorization protocol specified
Master memulai pengurutan...
worker1 menerima data: [64 34 25]
worker1 mengirim data yang sudah diurutkan: [25 34 64]
worker2 menerima data: [12 22 11 99]
worker2 mengirim data yang sudah diurutkan: [11 12 22 99]
data setelah diurutkan: [11 12 22 25 34 64 99]
waktu eksekusi: 8.9448644024143105 detik
bengebenezmaster-virtual-machine:~/code$
  
```