

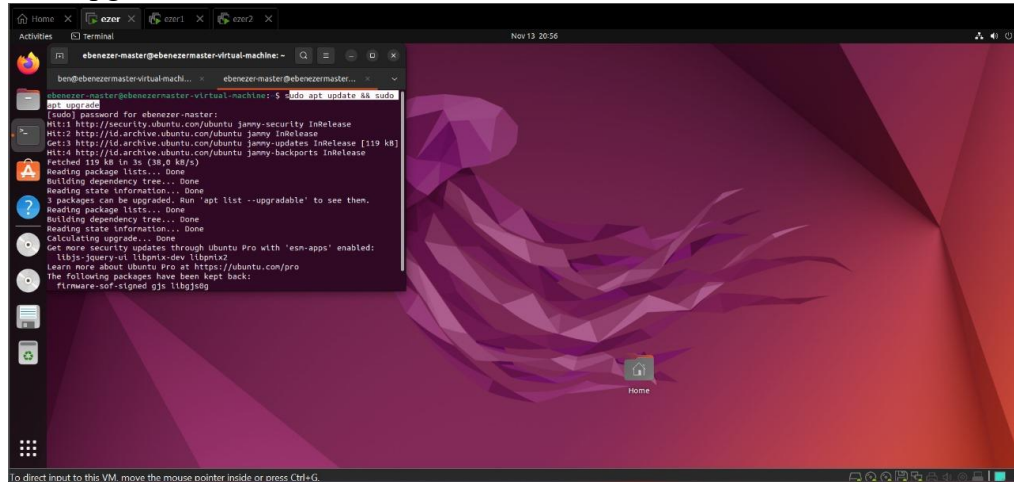
LAPORAN PEMROSESAN PARALEL NUMERIK DENGAN MPI



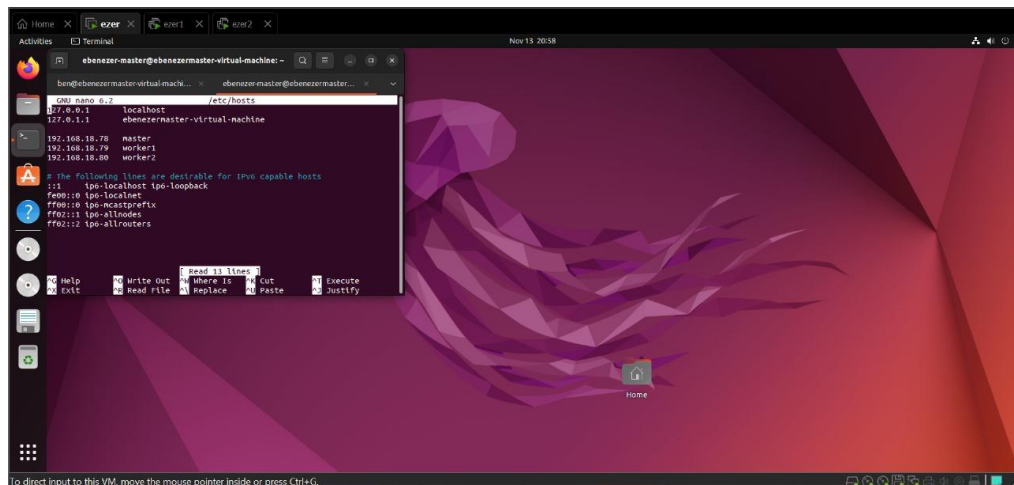
Nama : M. Syekh Ikhwan
NIM : 09011282126086
Kelas : SK 5B
Dosen Pengampu : AHMAD HERYANTO, S.Kom, M.T.
ADI HERMANSYAH, S.Kom., M.T.

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

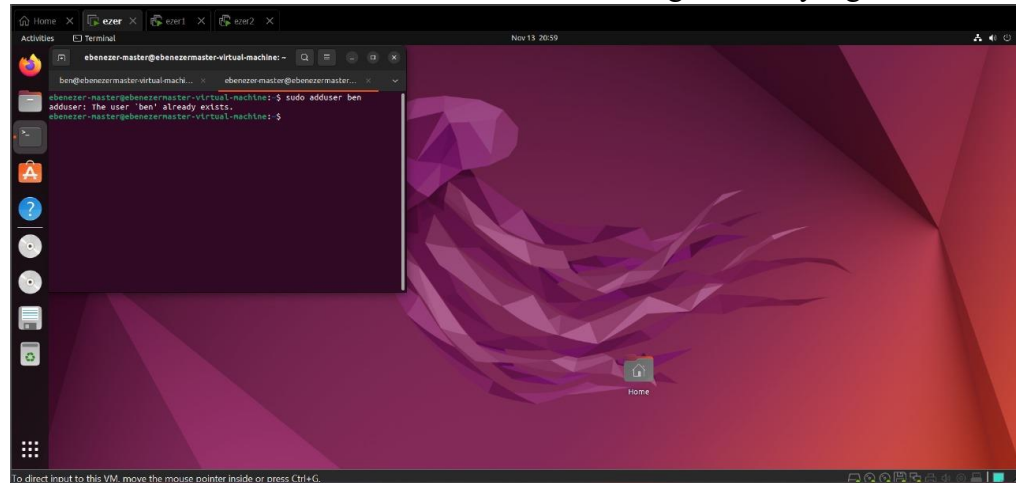
- Device dan Tools yang digunakan
 - 3 Virtual Machine (1 master dan 2 worker/slave)
 - MPI (Message Passing Interface)
 - SSH (Secure Shell)
 - Python
- Update dan Upgrade Ubuntu



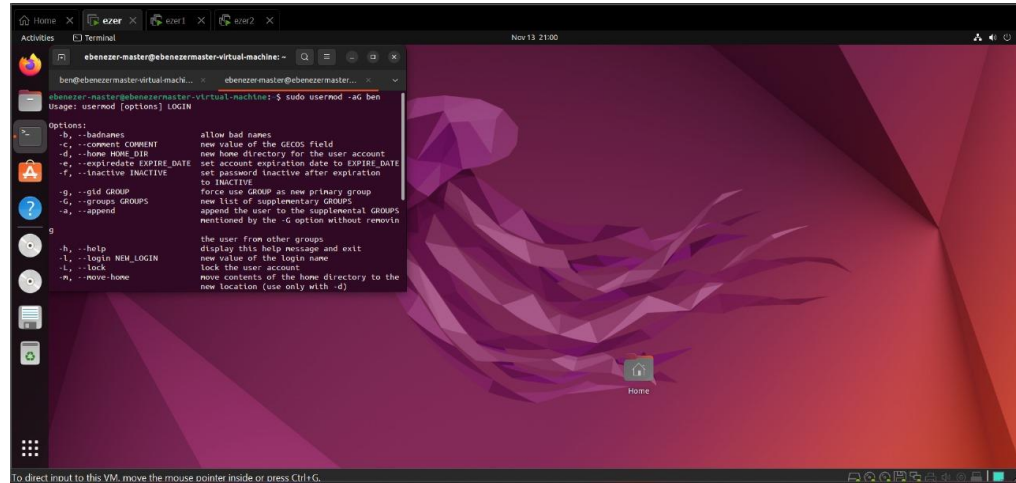
- Konfigurasi MPI
 - Lakukan Konfigurasi /etc/hosts di master dan slave dengan mengisi ip dari master dan slave



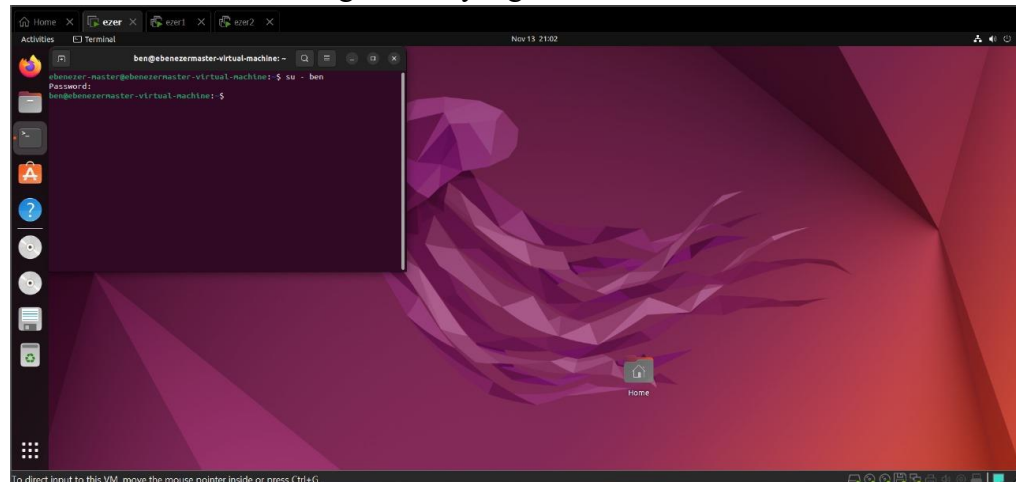
- Buat user baru di master, worker1 dan worker2 dengan nama yang sama



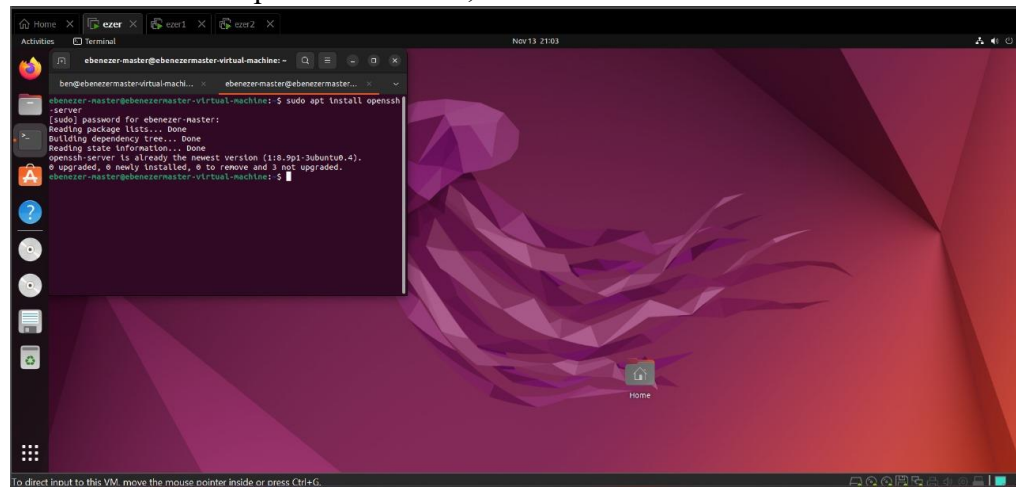
- Berikan akses root ke user baru yang dibuat di master, worker1 dan worker2



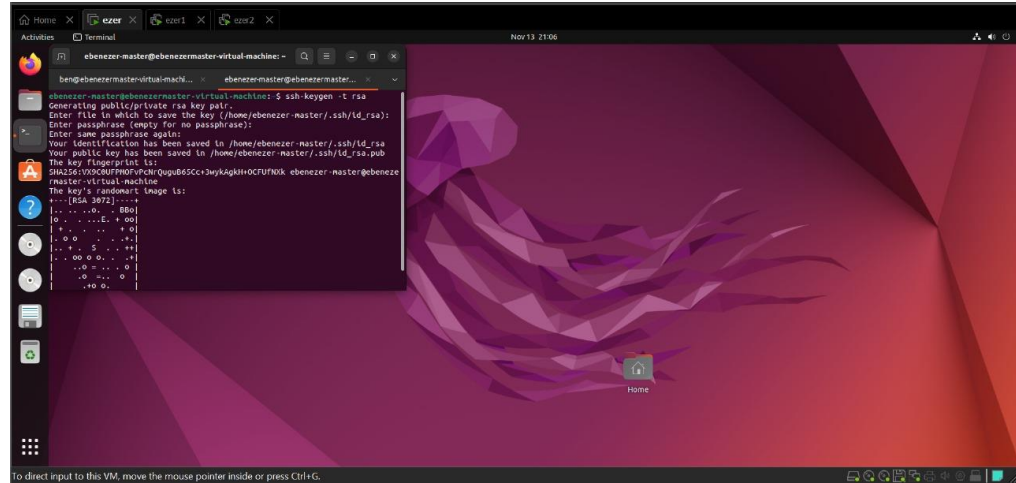
- Kemudian masuklah sebagai “user yang telah dibuat” di master dan kedua worker



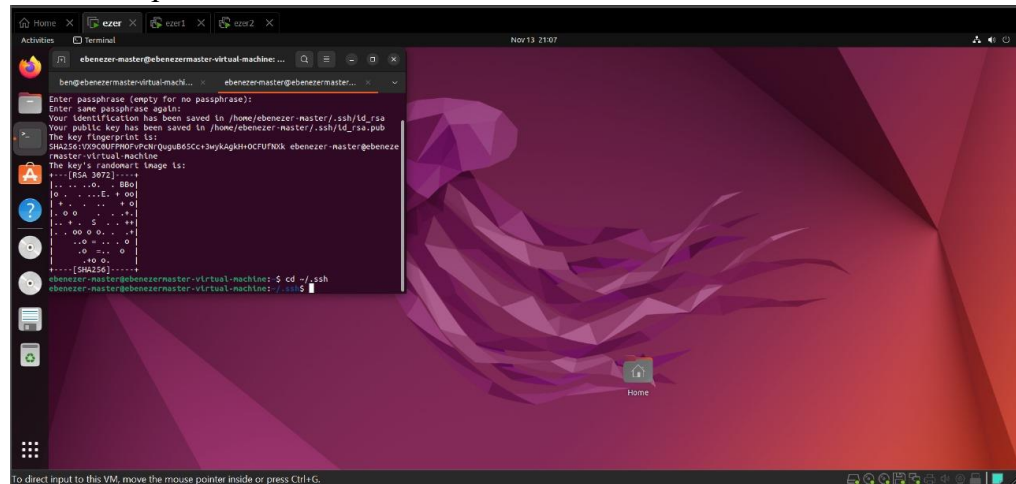
- Kemudian install openssh di master, worker1 dan worker2



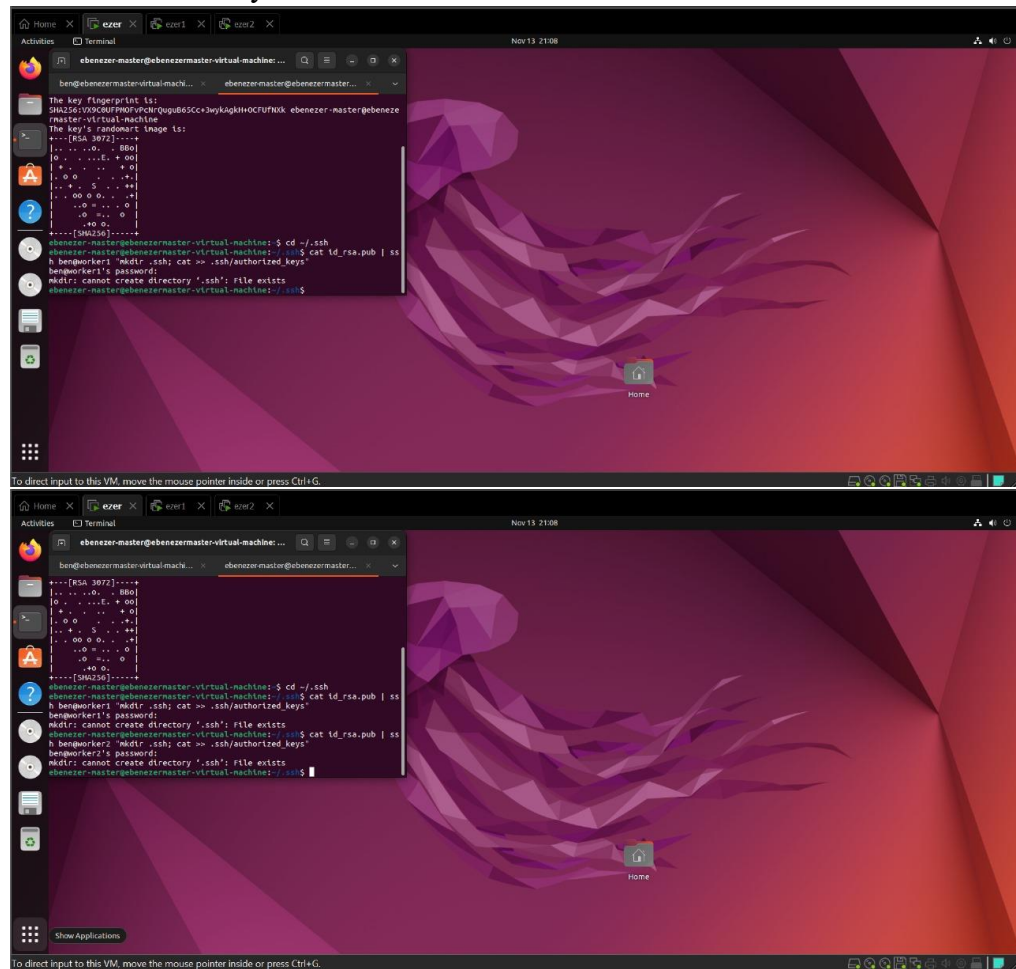
- Kemudian buatlah key ssh di master



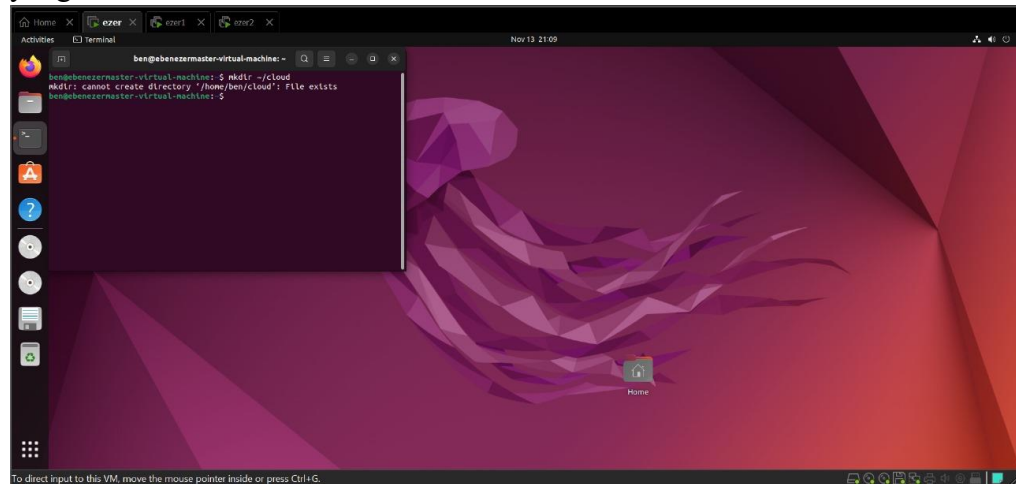
- Kemudian pindah direktori



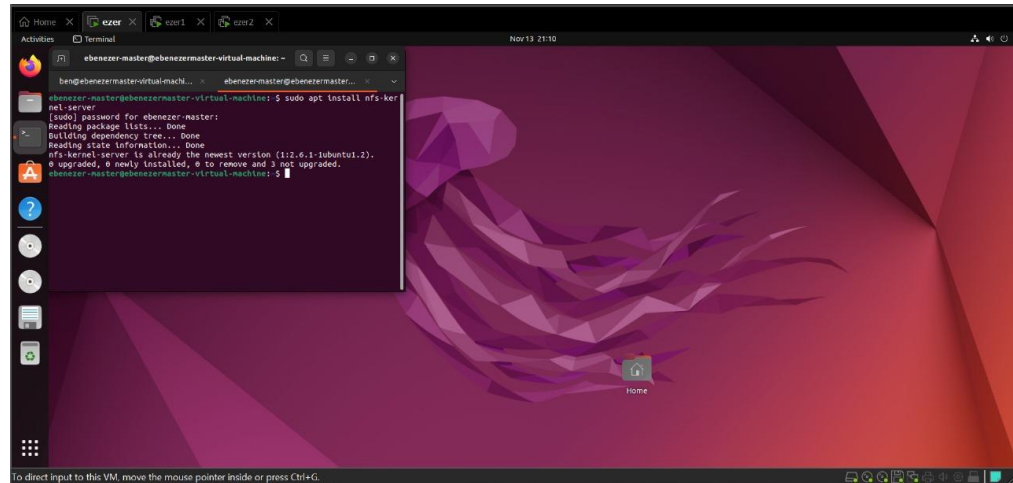
- Kemudian salin key master ke worker 1 dan worker 2



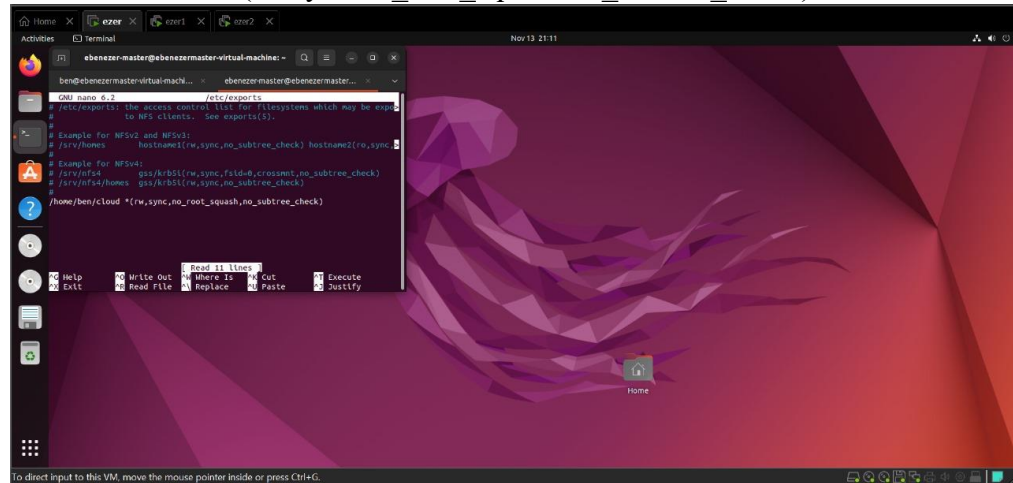
- Buatlah direktori bernama cloud di semua virtual machine, lakukan ini di user yang dibuat tadi



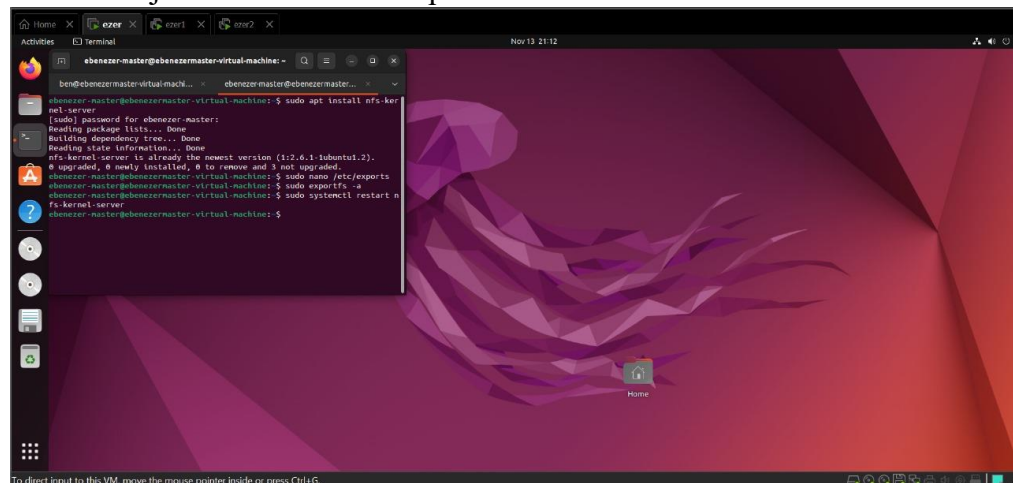
- Setelah itu kemudian install lah nfs di master



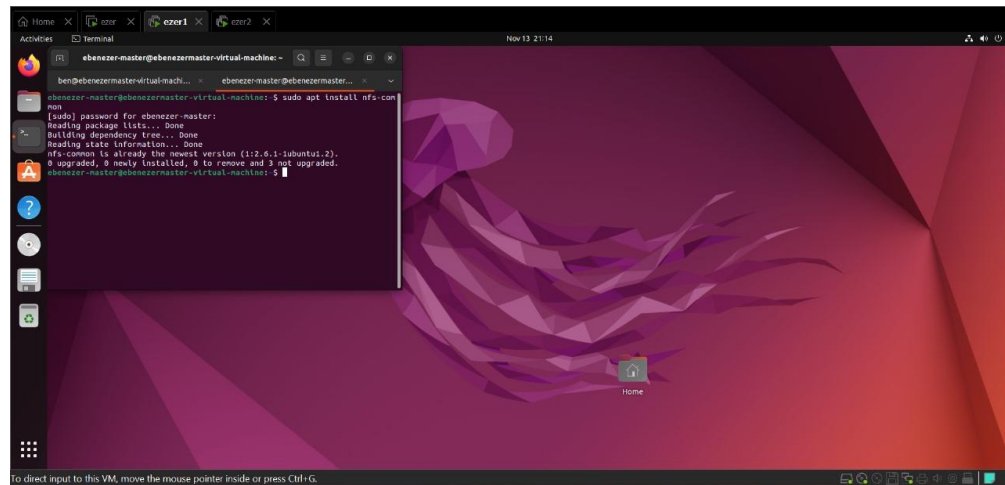
- edit file exports dan tambahkan
`/home/ben/cloud*(rw,sync,no_root_squash,no_subtree_check)`



- Kemudian jalankan command seperti dibawah

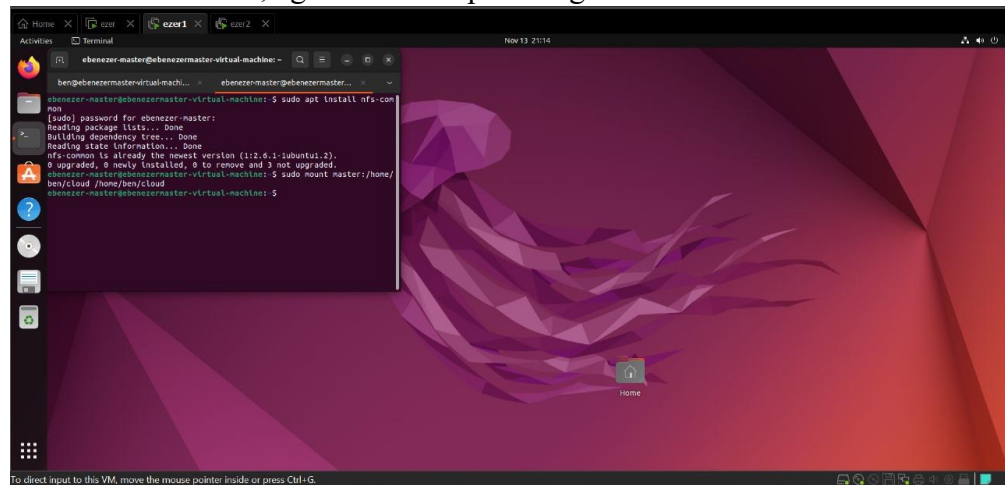


- Kemudian install nfs-common di worker1 dan worker2



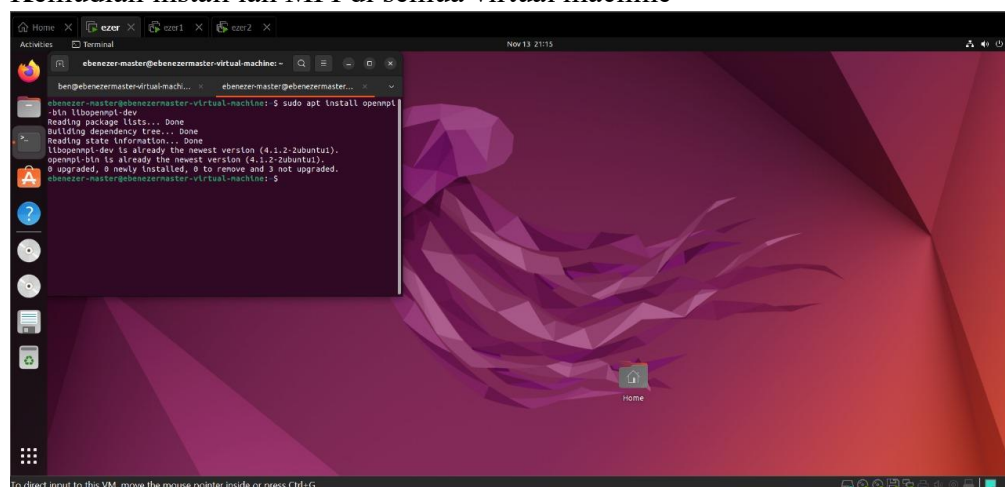
```
ben@ebenezer-master-virtual-machine: ~$ sudo apt install nfs-common
[sudo] password for ebenezer-master:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
nfs-common is already the newest version (1:2.6.1-1ubuntu1.2).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
ben@ebenezer-master-virtual-machine: ~$
```

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



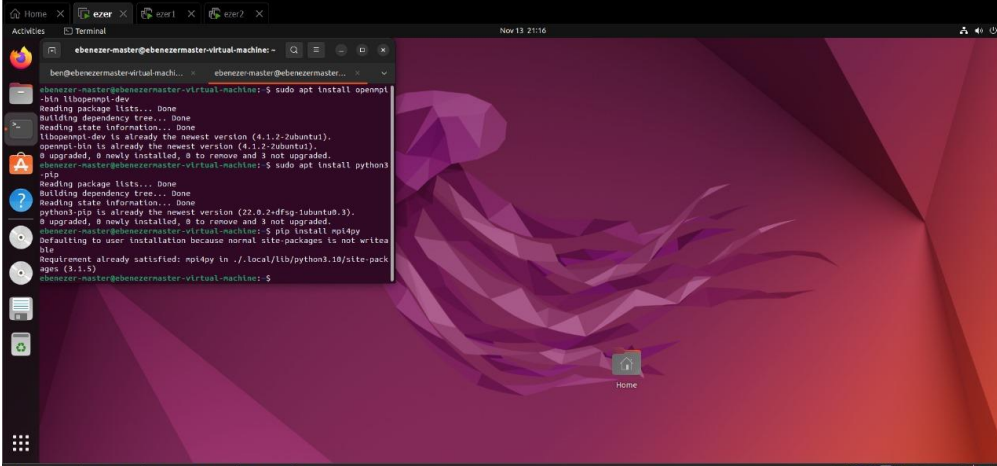
```
ben@ebenezer-master-virtual-machine: ~$ sudo apt install nfs-common
[sudo] password for ebenezer-master:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
nfs-common is already the newest version (1:2.6.1-1ubuntu1.2).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
ben@ebenezer-master-virtual-machine: ~$ sudo mount master:/home/ben/cloud /home/ben/cloud
ben@ebenezer-master-virtual-machine: ~$
```

- Kemudian install lah MPI di semua virtual machine



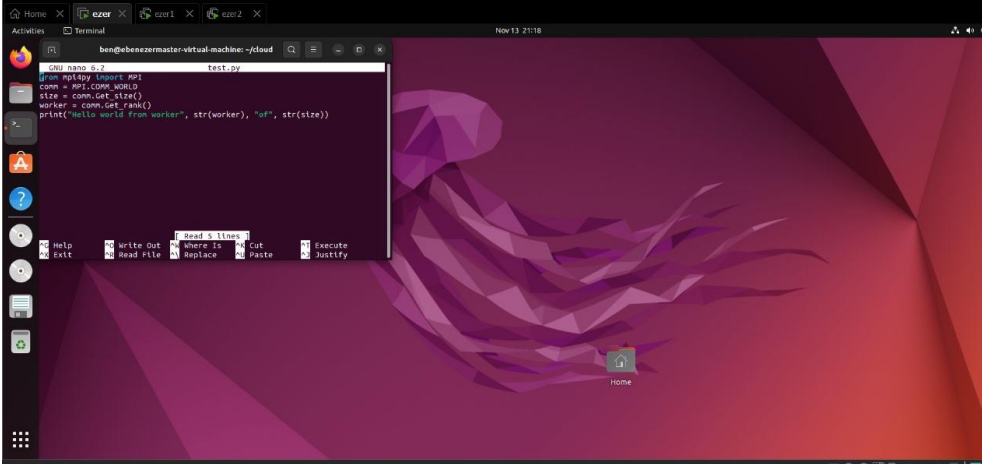
```
ben@ebenezer-master-virtual-machine: ~$ sudo apt install openmpi
-bin libopenmpi-dev
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
libopenmpi-dev is already the newest version (4.1.2-2ubuntu1).
openmpi-bin is already the newest version (4.1.2-2ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 3 not upgraded.
ben@ebenezer-master-virtual-machine: ~$
```

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



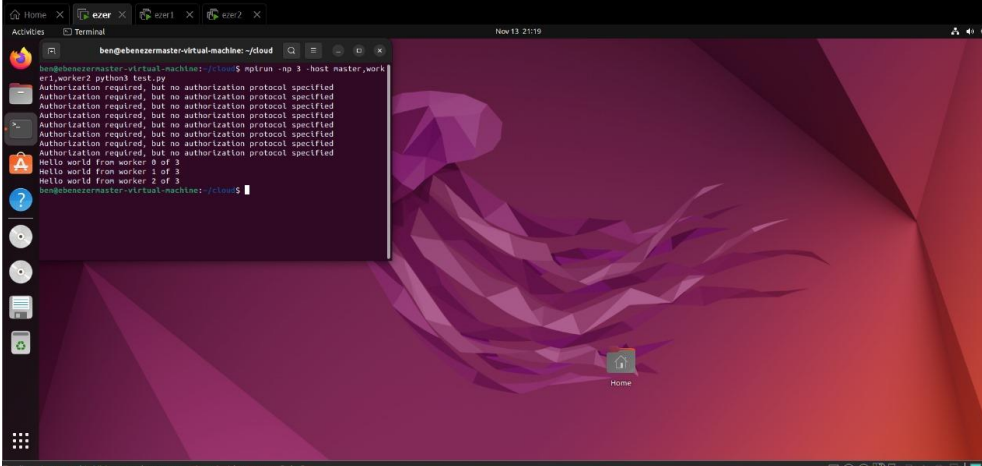
```
ben@ebenezermaster-virtual-machine:~$ sudo apt install openmpi
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openmpi-bin is already the newest version (4.1.2-2ubuntu1).
openmpi-dev is already the newest version (4.1.2-2ubuntu1).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
ben@ebenezermaster-virtual-machine:~$ sudo apt install python3-pip
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-pip is already the newest version (22.0.2dfsg-1ubuntu1.3).
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
ben@ebenezermaster-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)
```

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



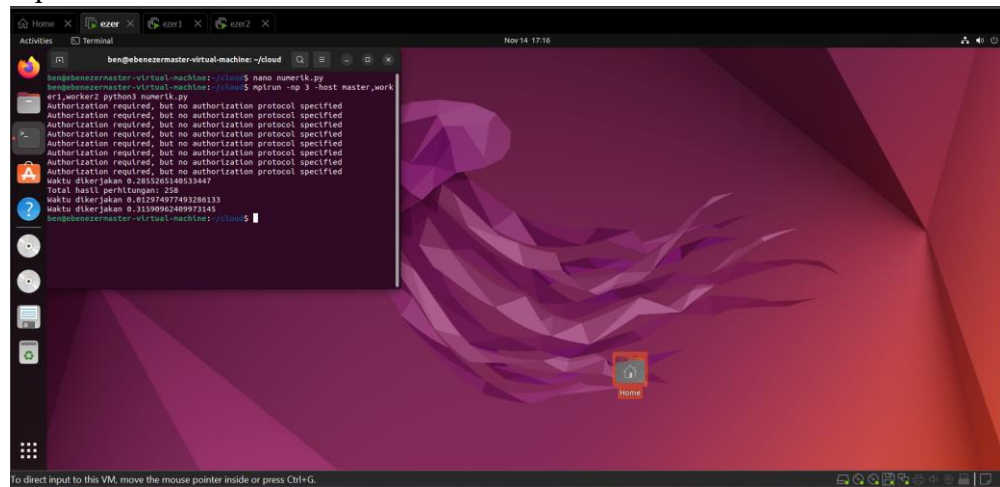
```
ben@ebenezermaster-virtual-machine:~/cloud$ nano test.py
# MPI program test
comm = mpi4py.MPI.Comm.world
size = comm.Get_size()
worker = comm.Get_rank()
print("Hello world from worker", str(worker), "of", str(size))
```

- Kemudian jalankan program tersebut



```
ben@ebenezermaster-virtual-machine:~/cloud$ mpirun -np 4 -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 4
Hello world from worker 1 of 4
Hello world from worker 2 of 4
ben@ebenezermaster-virtual-machine:~/cloud$
```


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



The screenshot shows a terminal window titled "ben@benbenmaster-virtual-machine: ~/cloud" with a search icon and window controls. The terminal output is as follows:

```
ben@benbenmaster-virtual-machine: ~/cloud$ nano numerik.py
ben@benbenmaster-virtual-machine: ~/cloud$ mpirun -np 3 -host master,work
er1,worker2 python3 numerik.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
Total hasil perhitungan: 238
Waktu dikerjakan 0.812874977463386133
Waktu dikerjakan 0.31590962499973145
ben@benbenmaster-virtual-machine: ~/cloud$
```

The background of the terminal window features a stylized, low-poly illustration of a dragon in shades of purple and red. The desktop environment includes a sidebar with application icons (Activities, Home, Files, etc.) and a system tray at the bottom right showing the date and time as "Nov 14 17:16". A status bar at the very bottom reads "To direct input to this VM, move the mouse pointer inside or press Ctrl+G."