

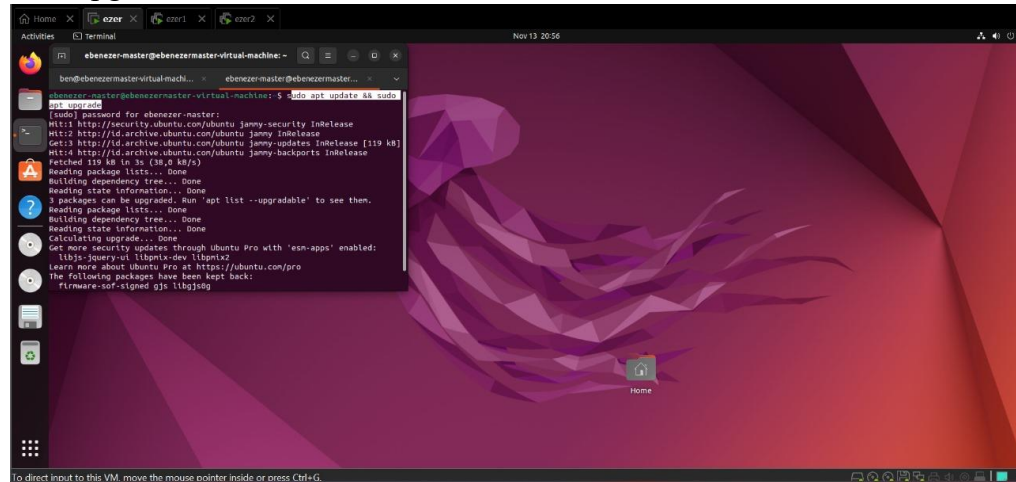
LAPORAN PEMROSESAN PARALEL NUMERIK DENGAN MPI



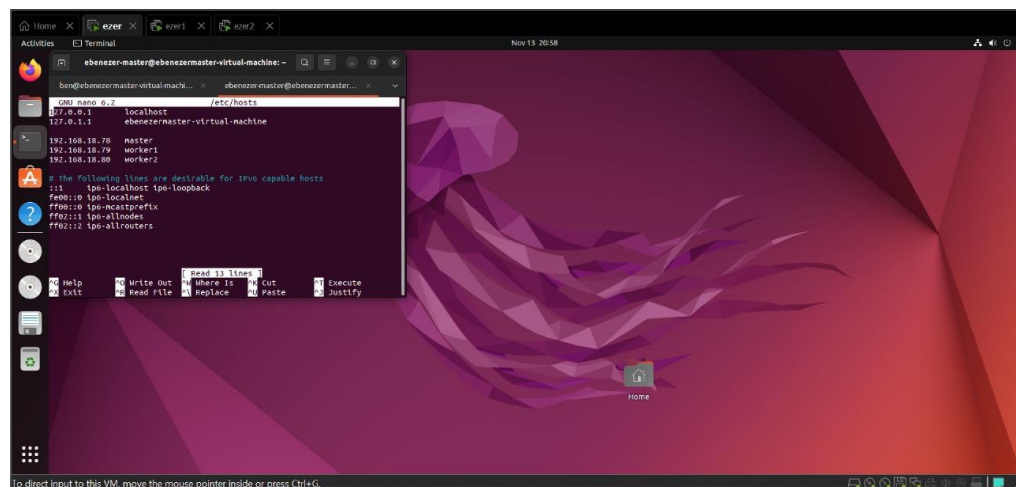
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Kelas : SK5B
Dosen Pengampu : AHMAD HERYANTO, S.KOM, M.T.
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SISTEM KOMPUTER
FAKULTAS ILMU KOMPUTER
UNIVERSITAS SRIWIJAYA
2023

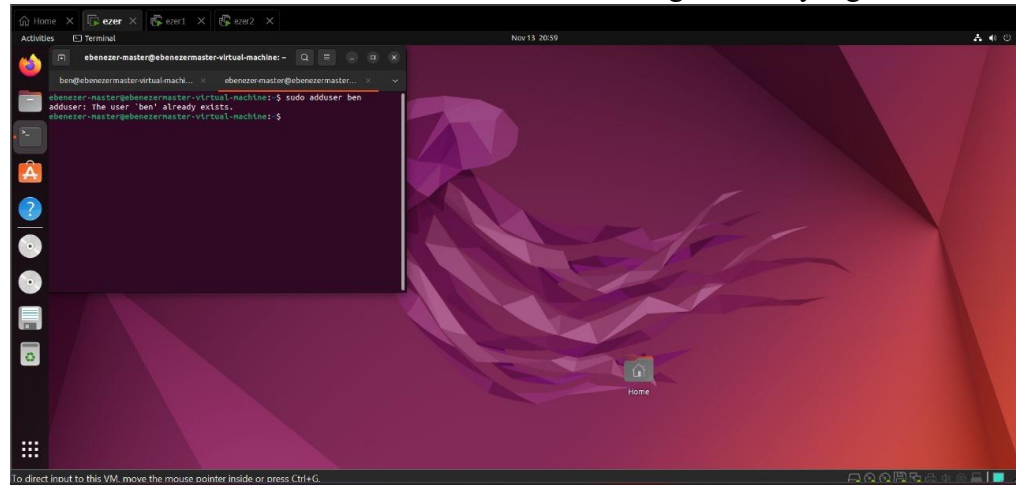
- Device dan Tools yang digunakan
 - 3 Virtual Machine (1 master dan 2 worker/slave)
 - MPI (Message Passing Interface)
 - SSH (Secure Shell)
 - Python
- Update dan Upgrade Ubuntu



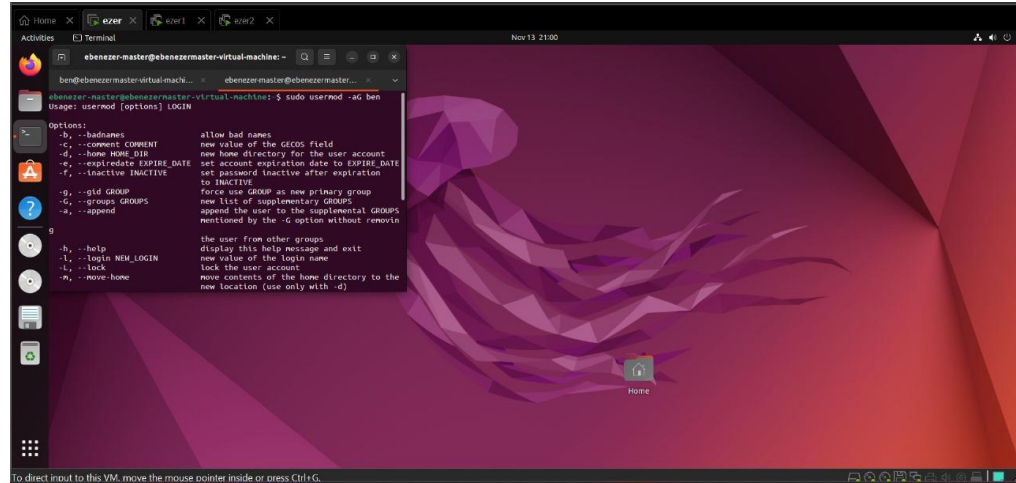
- Konfigurasi MPI
 - Lakukan Konfigurasi `/etc/hosts` di master dan slave dengan mengisi ip dari master dan slave



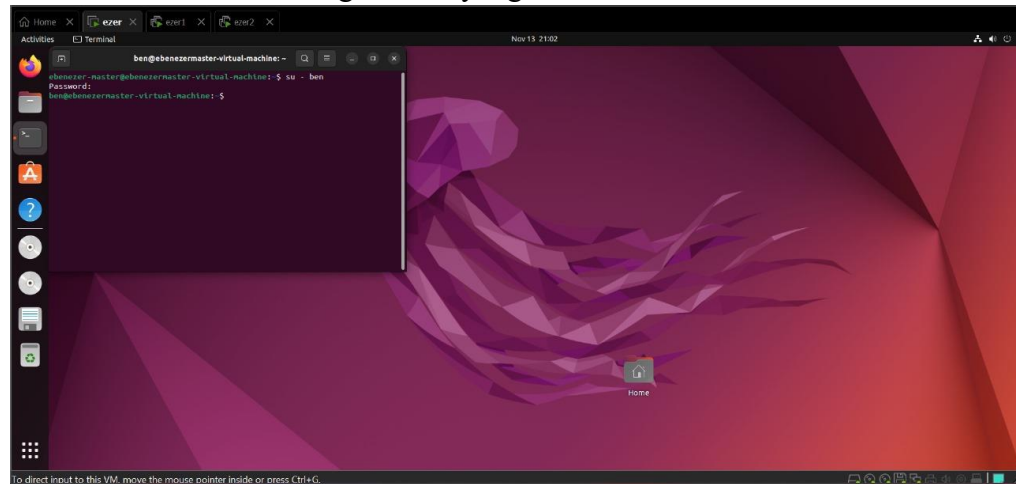
- Buat user baru di master, worker1 dan worker2 dengan nama yang sama



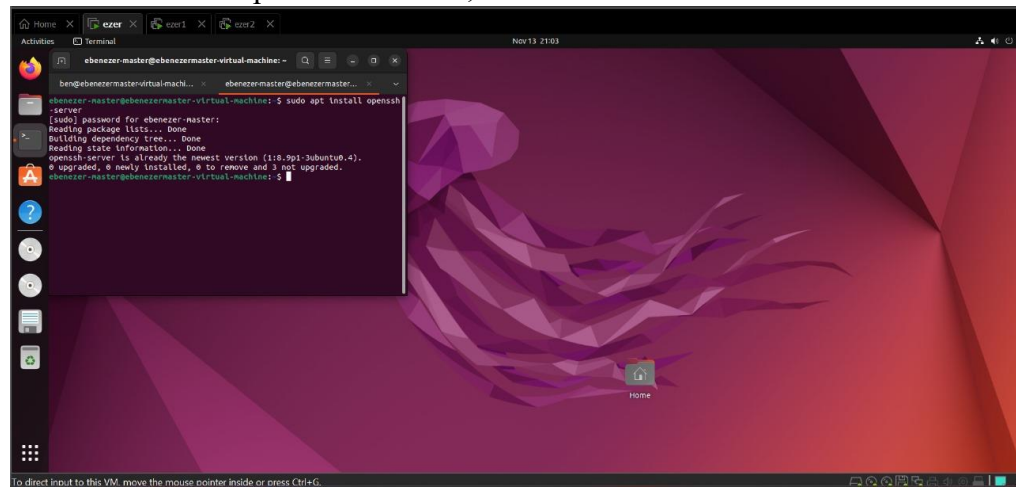
- Berikan akses root ke user baru yang dibuat di master, worker1 dan worker2



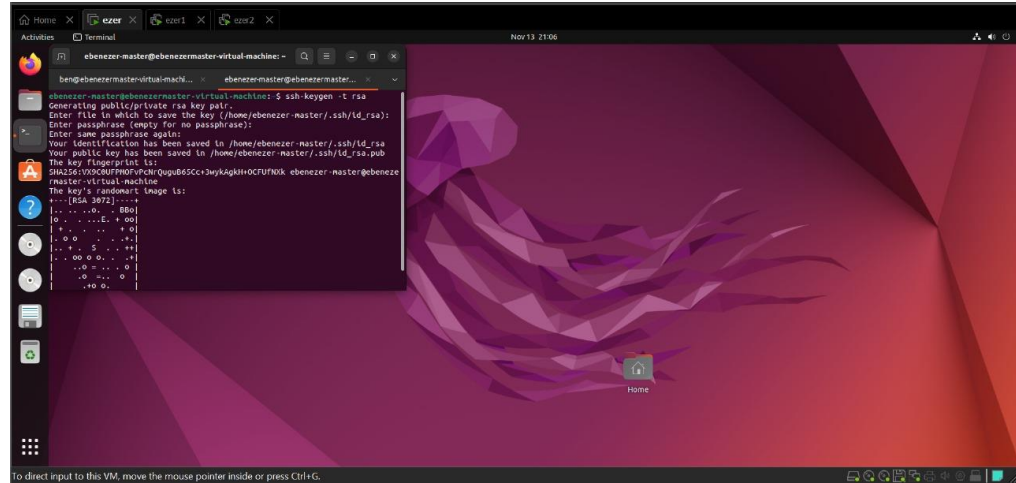
- Kemudian masuklah sebagai “user yang telah dibuat” di master dan kedua worker



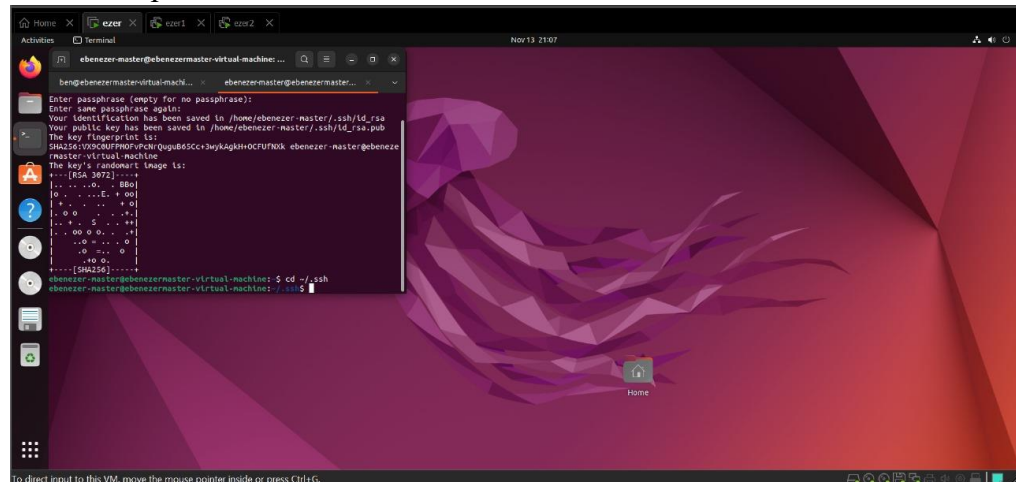
- Kemudian install openssh di master, worker1 dan worker2



- Kemudian buatlah key ssh di master



- Kemudian pindah direktori



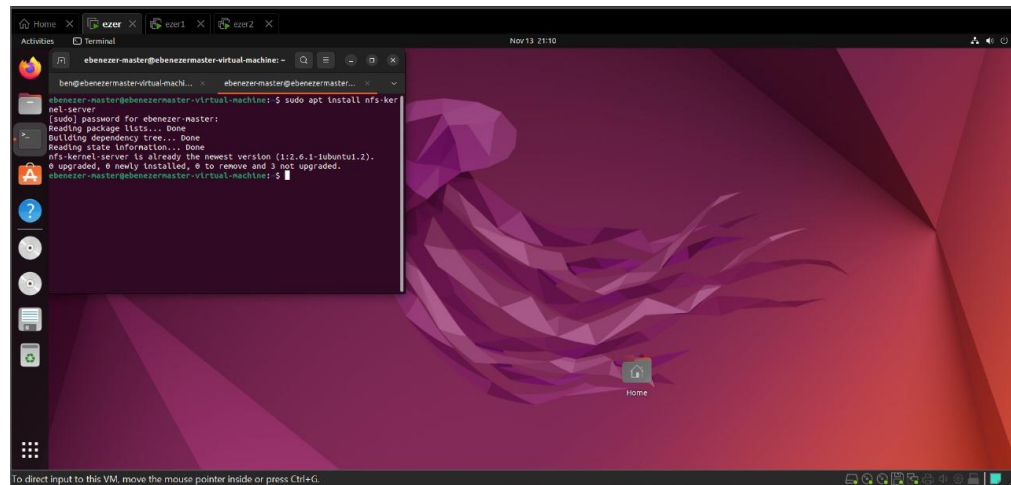
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- The image displays two screenshots of a Kali Linux desktop environment, showing a terminal window with a netcat listener. The desktop background is a dark, abstract, low-poly design. The terminal window is titled "ebenezer-master@ebenezer-master-virtual-machine: ..." and shows the following commands and output:
- ```

The key fingerprint is:
SHA256:V09GBU7P90FVPC8Q9u65Cc3JyKqkshOCUFuXkX ebenezer-master@ebenezer-master-virtual-machine
The key's randomart image is:
+--[RSA 3072]-----
|o. BB=|
| o.E. + oo|
| ++|
| . o+|
| .. o . . .+|
| .. . S . .+|
| .. oo o o . .+|
| ..o . . . o|
| ..o . . . o|
| ..o . . . o|
| ..o . . . o|
+-----[SHA256]-----
ebenezer-master@ebenezer-master-virtual-machine:~$ cd -/.ssh
ebenezer-master@ebenezer-master-virtual-machine:~/.ssh$ cat td_rsa.pub | ss
h benqurker1 mkdir .ssh; cat > .ssh/authorized_keys
benqurker1's password:
mkdir: cannot create directory '.ssh': file exists
ebenezer-master@ebenezer-master-virtual-machine:~/.ssh$

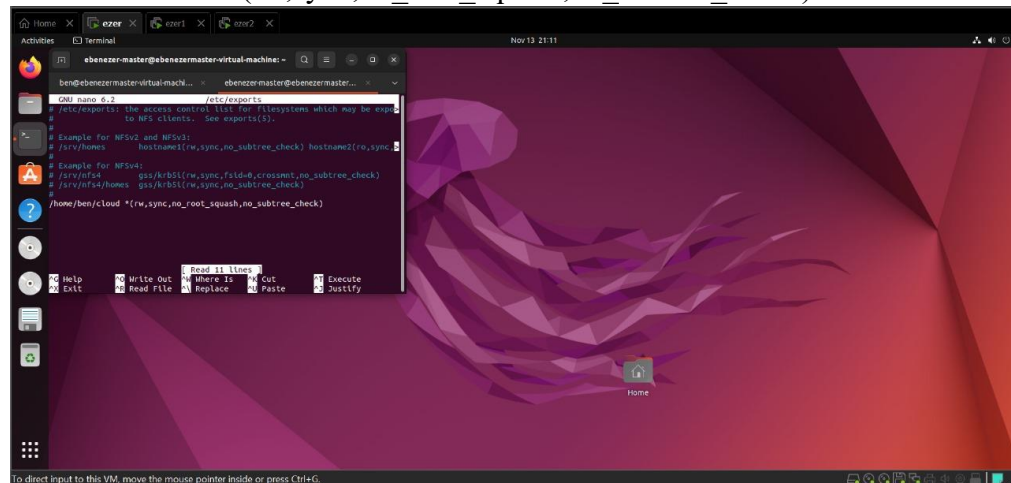
```
- The second screenshot shows the same terminal window with the same commands and output, indicating a repeated execution of the netcat listener and the setup of the SSH server.

- 
- A screenshot of a Kali Linux desktop environment. The desktop background is a dark purple and blue abstract geometric pattern. On the left side, there is a vertical dock containing several application icons: a web browser, a file manager, a terminal, a package manager, a search tool, a system monitor, a network manager, a disk utility, and a power button. At the top of the screen, there is a taskbar with several open windows, including a terminal window titled 'Terminal'. The terminal window is active and shows the following text:
- ```
ben@benecmaster-virtual-machine:~$  
ben@benecmaster-virtual-machine:~$ mkdir ~/cloud  
mkdir: cannot create directory '/home/ben/cloud': File exists  
ben@benecmaster-virtual-machine:~$
```
- The date and time 'Nov 13 21:09' are displayed in the top right corner of the terminal window. In the bottom right corner of the desktop, there is a 'Home' button with a house icon. At the very bottom of the screen, there is a status bar with various system icons and a message that reads: 'To direct input to this VM, move the mouse pointer inside or press Ctrl+G.'

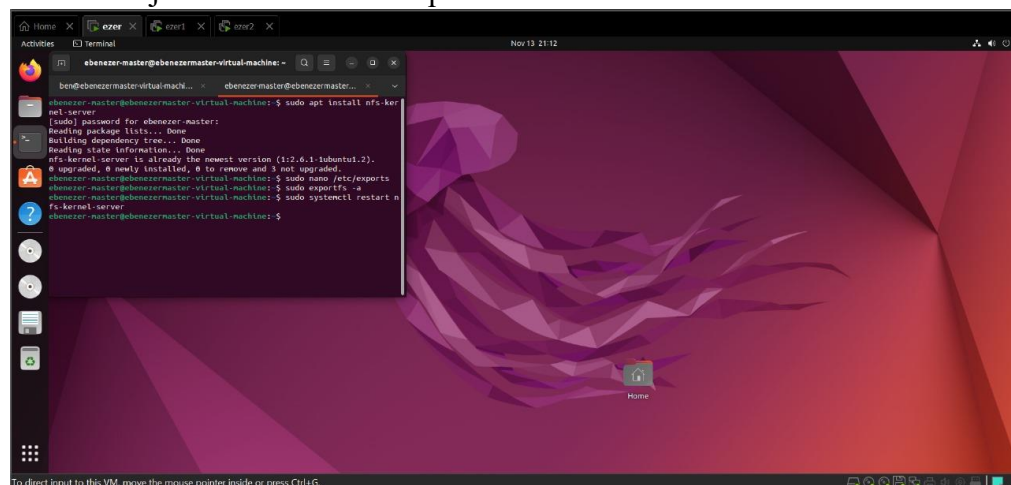
- Setelah itu kemudian install lah nfs di master



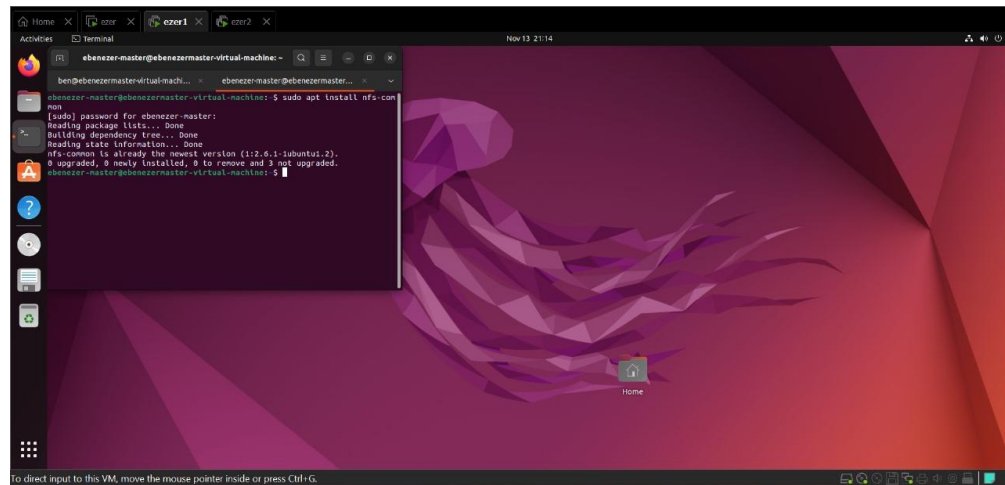
- edit file exports dan tambahkan `/home/ben/cloud*(rw,sync,no_root_squash,no_subtree_check)`



- Kemudian jalankan command seperti dibawah

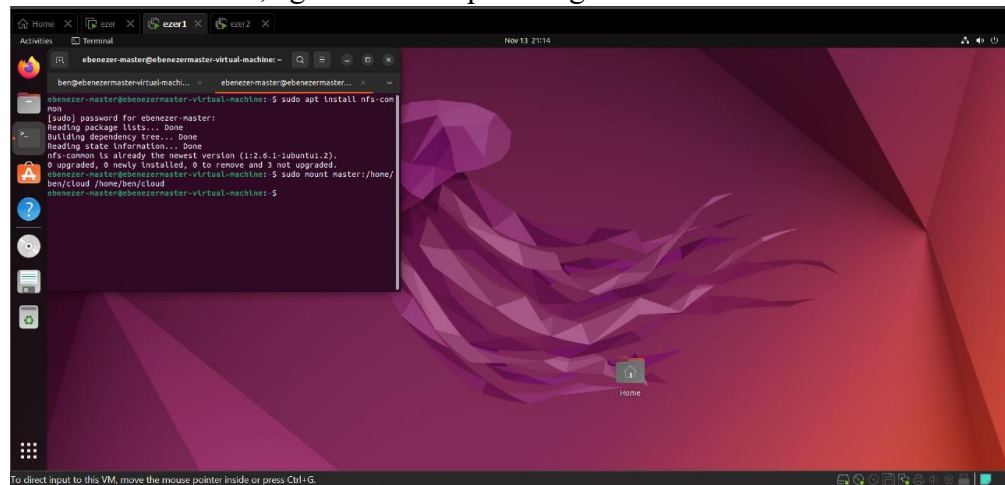


- Kemudian install nfs-common di worker1 dan worker2



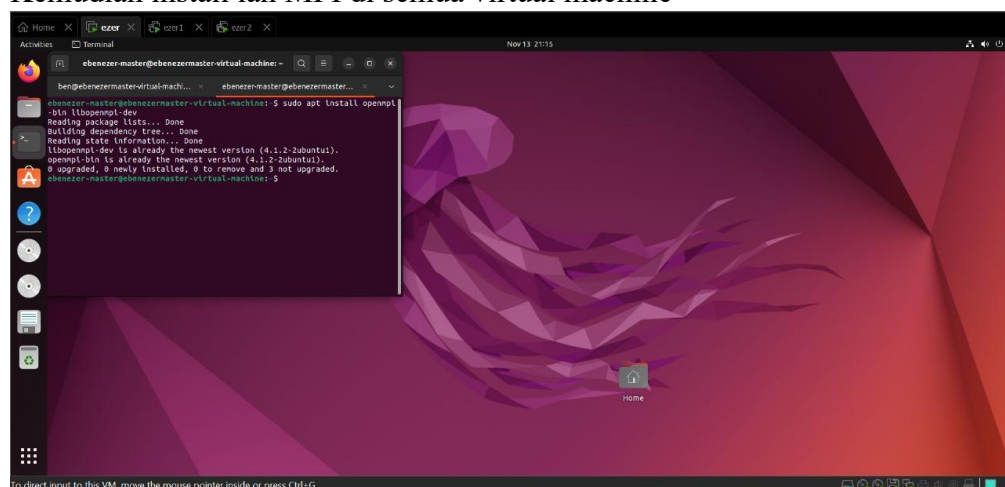
```
ben@ebenezer-master-virtual-machine: ~$ sudo apt install nfs-com
[sudo] password for ebenezer-master:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
nfs-common is already the newest version (1:2.6.1-1ubuntu1.2).
0 upgraded, 0 newly installed, 0 to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

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



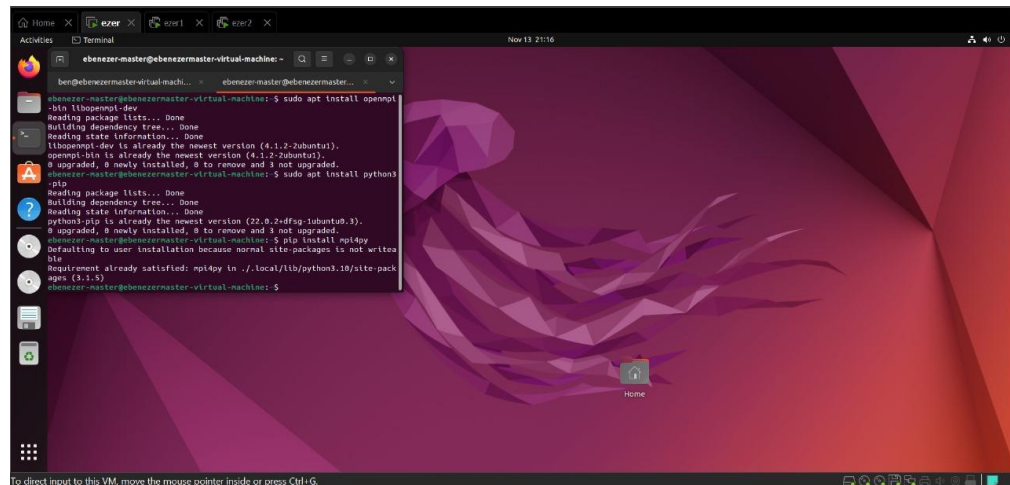
```
ebenezer-master@ebenezer-master-virtual-machine: ~$ sudo apt install nfs-com
[sudo] password for ebenezer-master:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
nfs-common is already the newest version (1:2.6.1-1ubuntu1.2).
0 upgraded, 0 newly installed,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

- Kemudian install lah MPI di semua virtual machine



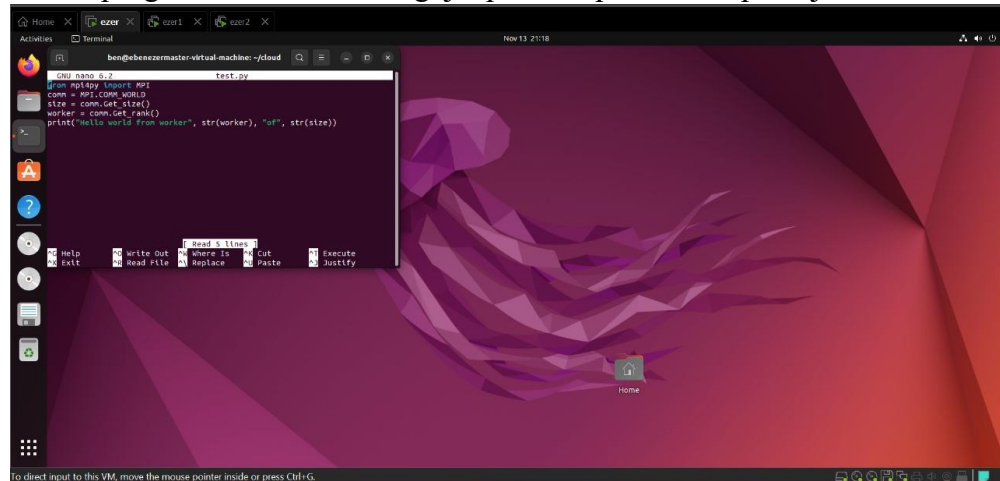
```
ebenezer-master@ebenezer-master-virtual-machine: ~$ sudo apt install openmpi
-bin libopenmpi-dev
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
libopenmpi-dev is already the newest version (4.1.2-2ubuntu1).
openmpi-bin is already the newest version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

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



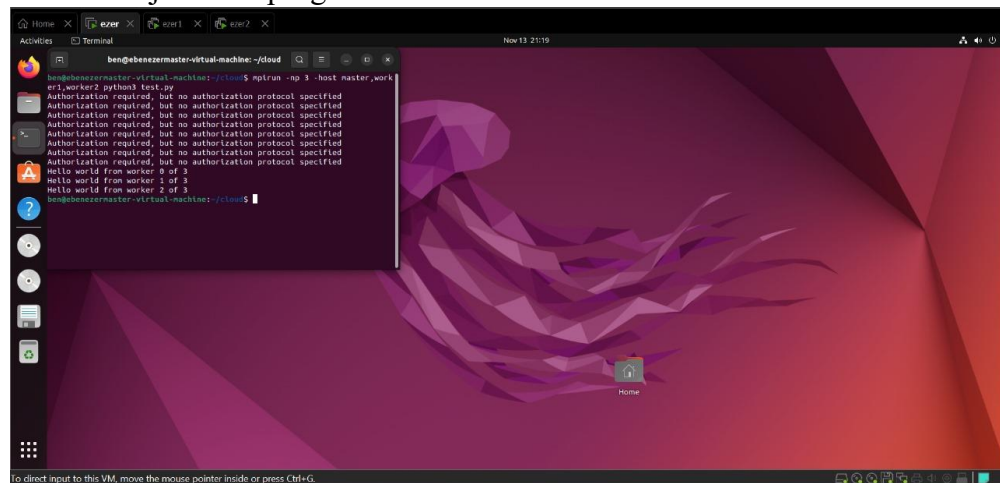
```
ben@ebenezermaster-virtual-machine: ~$ sudo apt install openmpi
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openmpi-bin is already the newest version (4.1.2-2ubuntu1).
openmpi-dev is already the newest version (4.1.2-2ubuntu1).
0 upgraded, 0 newly 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



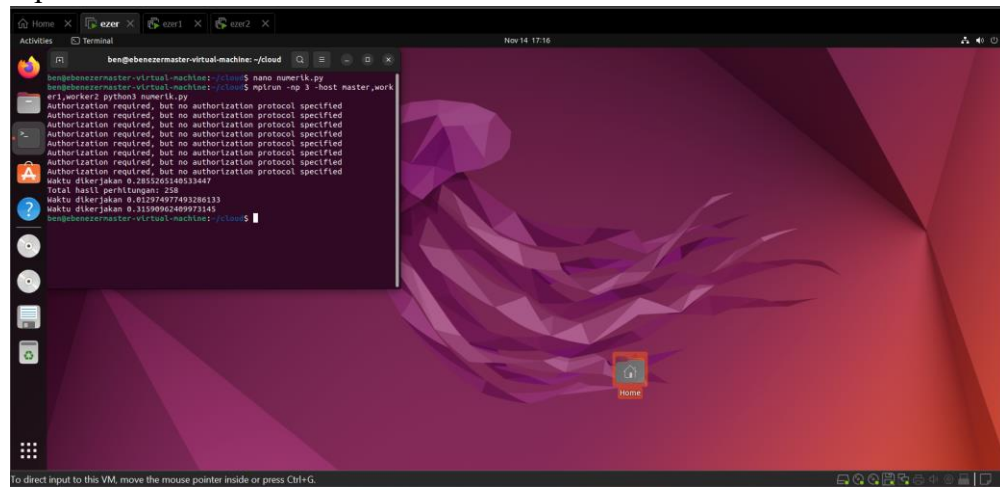
```
ben@ebenezermaster-virtual-machine: ~/cloud$ nano test.py
#GNU nano 2.9.3 test.py
from mpi4py import MPI
comm = MPI.COMM_WORLD
size = comm.Get_size()
worker = comm.Get_rank()
print("Hello world from worker", str(worker), "of", str(size))
```

- Kemudian jalankan program tersebut



```
ben@ebenezermaster-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@ebenezermaster-virtual-machine: ~/cloud$
```


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



```
ben@benbenzermaster-virtual-machine: ~/cloud
ben@benbenzermaster-virtual-machine: ~/cloud$ nano numerik.py
ben@benbenzermaster-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@benbenzermaster-virtual-machine: ~/cloud$
```