TUGAS PEMROSESAN PARAREL

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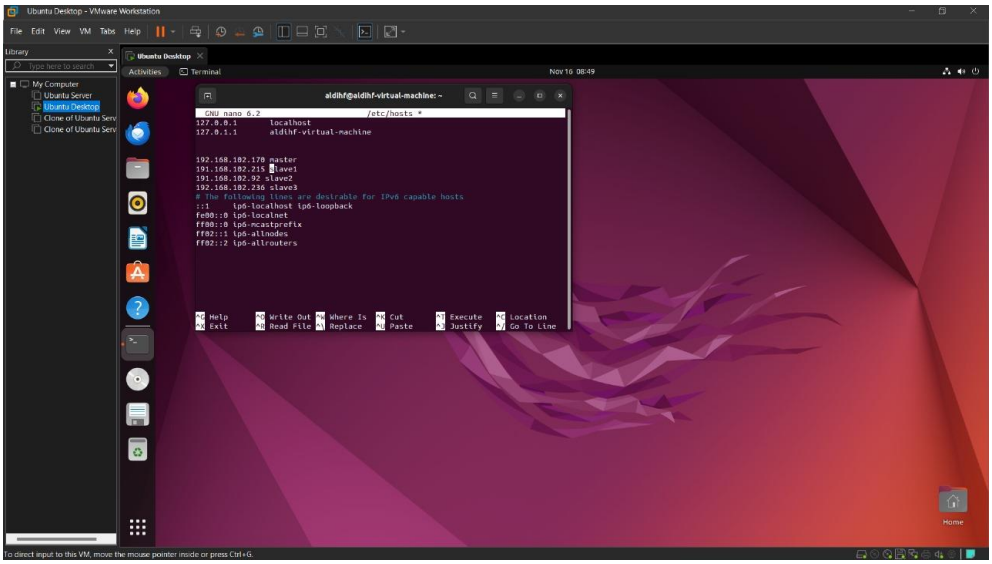
- **Sebelum Pengerjaan**

  1.Memastikan bahwa setiap PC/Laptop dalam satu jaringan yang sama
  2.Menentukan Server dan Slave/worker
  3.Melakukan penginstallan net-tools untuk mengecek IP dan vim untuk teks editor

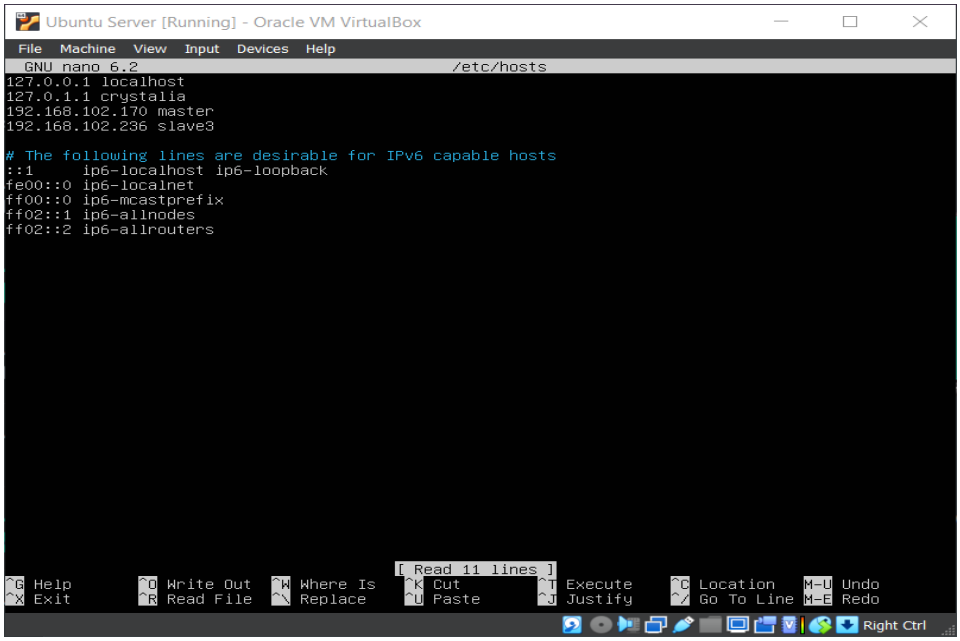
- **Konfigurasi IP Server dan Slave didalam file /etc/hosts**

  1. Untuk server, buka file /etc/hosts menggunakan perintah sudo nano /etc/hosts

  2. Tambahkan IP Master dan Slave/worker ke dalam file /etc/hosts, lalu simpan file dan keluar dari file dengan ctrl+x

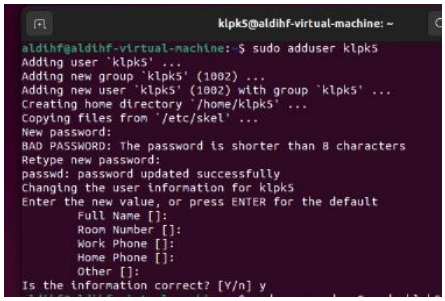


  3. Untuk worker/slave, sama seperti master buka file /etc/hosts kemudian masukkan cukup masukkan IP dari master dan worker pemegang file



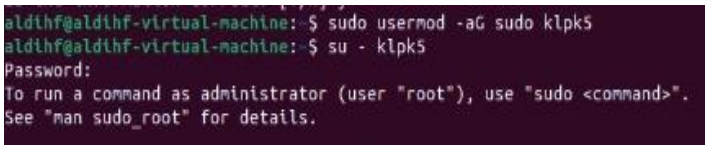
- **Membuat user baru**

  1.Untuk Server dan Worker/slave,Nama user harus sama.Untuk menambahkan User dapat digunakkan perintah sudo adduser (nama user baru)



  2.Kemudian berikan akses root kepada user yang telah dibuat dengan perintah sudo usermod -aG sudo (nama user baru)

  3.Terakhir kita masuk sebagai user baru yang telah dibuat dengan perintah su – (nama user baru)



- **Konfigurasi SSH**

  1.Pertama lakukan penginstalan ssh diserver dan slave dengan perintah sudo apt install openssh-server

```
klpk5@aldihf-virtual-machine:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
openssh-server is already the newest version (1:8.9p1-3ubuntu0.4).
0 upgraded, 0 newly installed, 0 to remove and 2 not upgraded.
klpk5@aldihf-virtual-machine:~$ S
```

Selanjutnya, lakukan pengecekan ssh dengan perintah ssh (nama user)@(host)

```
klpk5@aldihf-virtual-machine:~$ ssh klpk5@slave1
klpk5@slave1's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-88-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Thu Nov 16 02:05:20 AM UTC 2023

  System load:  0.0               Processes:             234
  Usage of /:   54.3% of 9.75GB   Users logged in:       1
  Memory usage: 19%               IPv4 address for ens33: 192.168.102.215
  Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure. Learn how MicroK8s
   just raised the bar for easy, resilient and secure K8s cluster deployment.

   https://ubuntu.com/engage/secure-kubernetes-at-the-edge

Expanded Security Maintenance for Applications is not enabled.

33 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status


Last login: Thu Nov 16 02:05:20 2023 from 192.168.102.170
klpk5@slave1:~$
```

2. Generate keygen di server dengan perintah ssh-keygen -t rsa

```
klpk5@aldihf-virtual-machine:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/klpk5/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/klpk5/.ssh/id_rsa
Your public key has been saved in /home/klpk5/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:fvu9eGkjC1G2krP0HPQLmO2t4+VnCcu4bmVv1JQ4V0c klpk5@aldihf-virtual-machine
The key's randomart image is:
+---[RSA 3072]----+
|                .E|
|                 o|
|            + . +|
|           O = o.|
|        S O = +..|
|       . . O B o.|
|        . + O O..|
|         . =oO=+o|
|          +=B*== |
+----[SHA256]-----+
klpk5@aldihf-virtual-machine:~$
```

3. Copy key publik ke client dengan perintah cd .ssh
cat id_rsa.pub | ssh <nama user>@<host> "mkdir .ssh; cat >> .ssh/authorized_keys".lakukan berkali-kali sesuai dengan jumlah dan host dari setiap slave.

```
klpk5@aldihf-virtual-machine:~$ cd .ssh
klpk5@aldihf-virtual-machine:~/.ssh$ cat id_rsa.pub | ssh klpk5@slave1 "mkdir .ssh; cat >> .ssh/authorized_keys"
klpk5@slave1's password:
mkdir: cannot create directory '.ssh': File exists
klpk5@aldihf-virtual-machine:~/.ssh$
```

- **Pengkonfigurasian NFS**

1. Pada server dan slave, buat sebuah folder dengan nama bebas,gunakan perintah mkdir.Folder setiap pc harus memiliki nama yang sama (nama folder yang ingin dibuat)

```
klpk5@aldihf-virtual-machine:~$ mkdir banyu
klpk5@aldihf-virtual-machine:~$
```

2. Lakukan penginstalan NFS server perintahnnya ialah sudo apt install nfs-kernel-server

```
klpk5@aldihf-virtual-machine:~$ sudo apt install nfs-kernel-server
[sudo] password for klpk5:
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
nfs-kernel-server is already the newest version (1:2.6.1-1ubuntu1.2).
0 upgraded, 0 newly installed, 0 to remove and 2 not upgraded.
klpk5@aldihf-virtual-machine:~$
```

3. Konfigurasi file /etc/exports server,dengan perintah sudo vim /etc/exports
Masukkan kalimat berikut:
<lokasi shared folder> *(rw,sync,no_root_squash,no_subtree_check)
Sesuaikan lokasi shared folder dengan folder yang telah dibuat sebelumnya.

```
klpk5@aldihf-virtual-machine: ~
 GNU nano 6.2                                  /etc/exports *
# /etc/exports: the access control list for filesystems which may be exported
#               to NFS clients.  See exports(5).
#
# Example for NFSv2 and NFSv3:
# /srv/homes       hostname1(rw,sync,no_subtree_check) hostname2(ro,sync,no_subtree_check)
#
# Example for NFSv4:
# /srv/nfs4        gss/krb5i(rw,sync,fsid=0,crossmnt,no_subtree_check)
# /srv/nfs4/homes  gss/krb5i(rw,sync,no_subtree_check)
#
/home/klpk5/banyu *(rw,sync,no_root_squash,no_subtree_check)
```

Lalu, masukkan perintah sudo exportfs -a dan sudo systemctl restart nfs-kernel-server

```
klpk5@aldihf-virtual-machine:~$ sudo nano /etc/exports
klpk5@aldihf-virtual-machine:~$ sudo exportfs -a
klpk5@aldihf-virtual-machine:~$ sudo systemctl restart nfs-kernel-server
klpk5@aldihf-virtual-machine:~$
```

4. Install nfs pada client dengan perintah sudo apt install nfs-common

```
klpk5@crystalia:~$ sudo apt install nfs-common
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 41 not upgraded.
klpk5@crystalia:~$
```

5.Kemudian Mounting dengan perintah sudo mount <server host>:<lokasi shared folder di server> <lokasi shared folder di client> pada slave

```
klpk5@crystalia:~$ mkdir banyu
klpk5@crystalia:~$
```

- **MPI**

  Install MPI dengan perintah sudo apt install openmpi-bin libopenmpi-dev pada server dan slave

```
klpk5@aldihf-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 2 not upgraded.
klpk5@aldihf-virtual-machine:~$
```

- **Menjalankan program bubblesort dan numerik**

  1. Install python dan mpi4py dengan perintah sudo apt install python3-pip dan pip install mpi4py

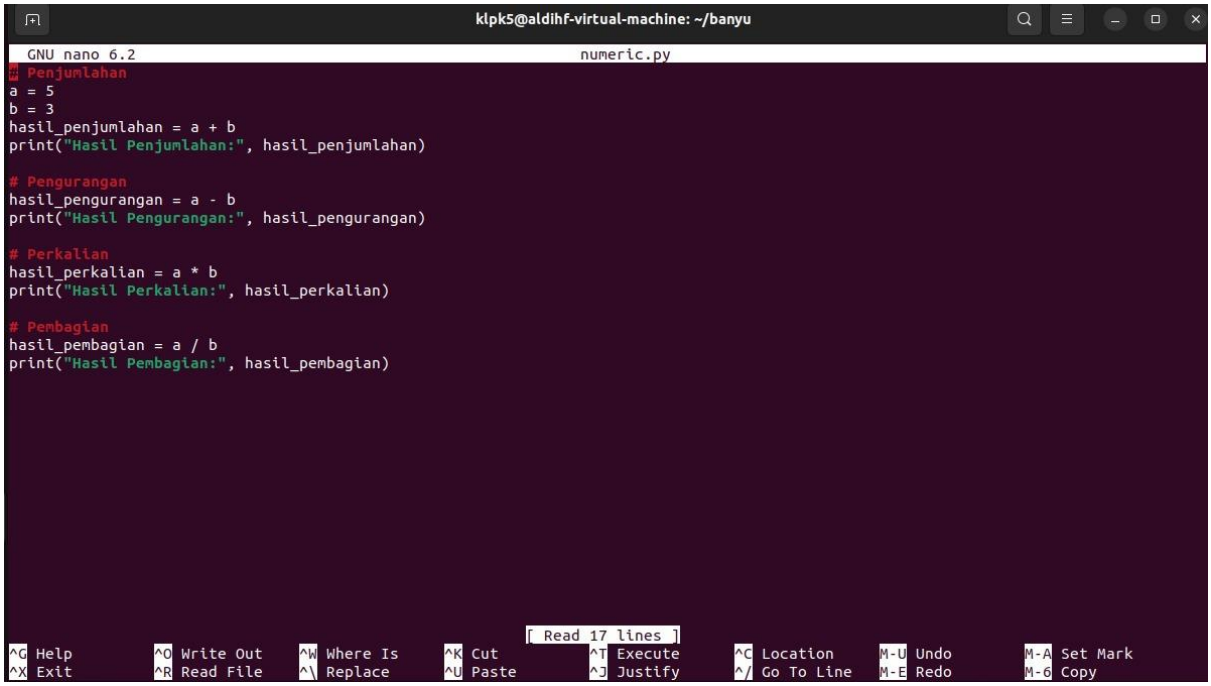
```
klpk5@aldihf-virtual-machine:~$ sudo apt install python3-pip
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
python3-pip is already the newest version (22.0.2+dfsg-1ubuntu0.3).
0 upgraded, 0 newly installed, 0 to remove and 2 not upgraded.
klpk5@aldihf-virtual-machine:~$
```

  2. Buat 2 buah file python yang pertama bernama bubblesort.py untuk file bubblesort dan yang kedua bernama numeric.py untuk file numeric

  3. Masuk kemasing-masing file dan didalam file tersebut masukkan program sesuai dengan jenis nama file.

Program bubblesort

Program numeric



4. Jalankan file menggunakan MPI dengan perintah mpirun -np <jumlah prosesor> -host <daftar host> python3 test.py.

Hasil program bubblesort

```
klpk5@aldihf-virtual-machine:~/banyu$ mpirun -np 2 -host master,slave3 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
Array sebelum diurutkan: [64, 34, 25, 12, 22, 11, 90]
Array setelah diurutkan: [11, 12, 22, 25, 34, 64, 90]
Array sebelum diurutkan: [64, 34, 25, 12, 22, 11, 90]
Array setelah diurutkan: [11, 12, 22, 25, 34, 64, 90]
```

Hasil program numeric

```
klpk5@aldihf-virtual-machine:~/banyu$ mpirun -np 2 -host master,slave3 python3 numeric.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
Hasil Penjumlahan: 8
Hasil Pengurangan: 2
Hasil Perkalian: 15
Hasil Pembagian: 1.6666666666666667
Hasil Penjumlahan: 8
Hasil Pengurangan: 2
Hasil Perkalian: 15
Hasil Pembagian: 1.6666666666666667
klpk5@aldihf-virtual-machine:~/banyu$
```