

TUGAS PEMROSESAN PARAREL



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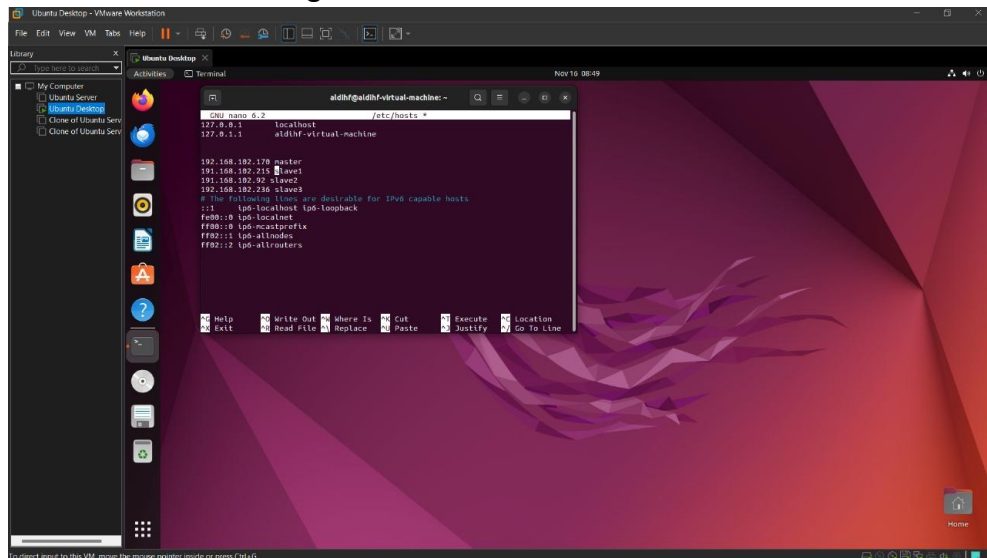
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- **Sebelum Pengerjaan**

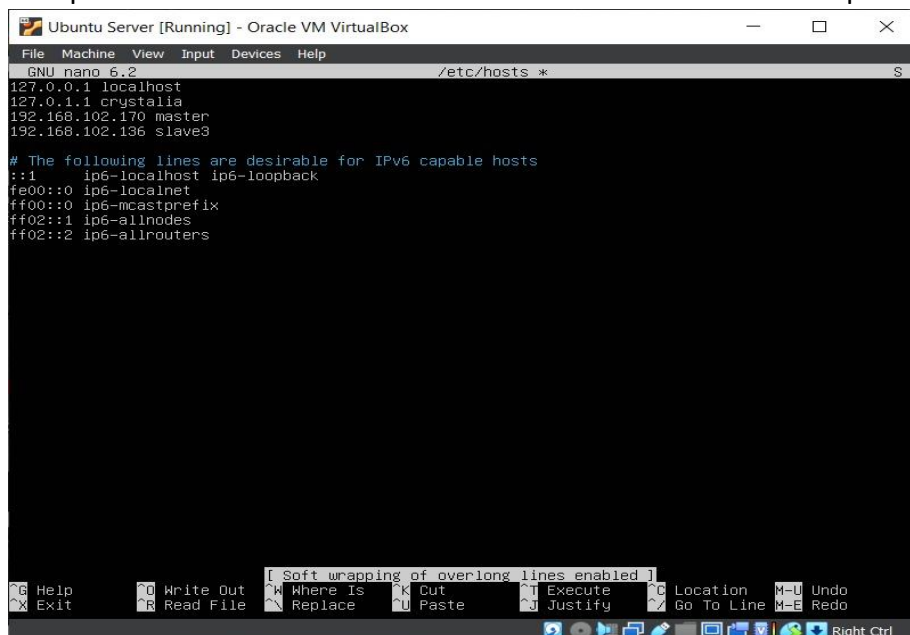
1. Memastikan bahwa setiap PC/Laptop dalam satu jaringan yang sama
2. Menentukan Server dan Slave/worker
3. Melakukan penginstallan net-tools untuk mengecek IP dan vim untuk teks editor

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

1. Untuk server, buka file /etc/hosts menggunakan perintah sudo nano /etc/hosts
2. Di dalam file /etc/hosts tambahkan IP master dan Slave/worker, kemudian save 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 digunakan perintah sudo adduser (nama user baru)

```
klpk5@aldihf-virtual-machine: ~  
aldihf@aldihf-virtual-machine:~$ sudo adduser klpk5  
Adding user 'klpk5' ...  
Adding new group 'klpk5' (1002) ...  
Adding new user 'klpk5' (1002) with group 'klpk5' ...  
Creating home directory '/home/klpk5' ...  
Copying files from '/etc/skel' ...  
New password:  
BAD PASSWORD: The password is shorter than 8 characters  
Retype new password:  
passwd: password updated successfully  
Changing the user information for klpk5  
Enter the new value, or press ENTER for the default  
Full Name []:  
Room Number []:  
Work Phone []:  
Home Phone []:  
Other []:  
Is the information correct? [Y/n] y
```

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)

```
aldihf@aldihf-virtual-machine:~$ sudo usermod -aG sudo klpk5  
aldihf@aldihf-virtual-machine:~$ su - klpk5  
Password:  
To run a command as administrator (user "root"), use "sudo <command>".  
See "man sudo_root" for details.
```

- **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:~$
```

Kemudian 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:~$
```

- Setelahnya lakukan generate keygen diserver 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:fvu9eGkjC1G2krP0HPQLm02t4+VnCcU4bmVv1JQ4V0c klpk5@aldihf-virtual-machine
The key's randomart image is:
+---[RSA 3072]---+
|                 .E|
|                 o|
|          + . +|
|         0 = 0.|
|        S 0 = +..|
|       . . 0 B o.|
|      . + 0 0..|
|     . =o0=+o|
|    +=B*==|
+-----[SHA256]-----+
klpk5@aldihf-virtual-machine:~$
```

- Kemudian lakukan 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$
```

• Pengkonfigurasi NFS

- Di dalam 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:~$
```

- Lakukan penginstalan NFS server perintahnya 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:~$
```

- Lakukan konfigurasi file /etc/exports server, dengan perintah sudo vim /etc/exports

Kemudian masukkan kalimat berikut:

```
<lokasi shared folder> *(rw,sync,no_root_squash,no_subtree_check)
```

Sesuaikan lokasi shared folder dengan folder yang telah dibuat sebelumnya.


```
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)
```

Kemudian 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. Kemudian install nfs pada client dengan perintah `sudo apt install nfs-common`

```
klpk5@slave1:~$ sudo apt install nfs-common
[sudo] password for klpk5:
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 33 not upgraded.
klpk5@slave1:~$
```

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

```
klpk5@slave1:~$ sudo mount master:/home/klpk5/banyu /home/klpk5/banyu
klpk5@slave1:~$
```

• 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. Lakukan penginstalan 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. Pertama buat 2 buah file python yang pertama bernama `bubblesort.py` untuk file `bubblesort` dan yang kedua bernama `numeric.py` untuk file `numeric`

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

Program bubblesort

```
klpk5@aldihf-virtual-machine: ~/banyu
def bubble_sort(arr):
    n = len(arr)

    # Traverse through all elements in the array
    for i in range(n):
        # Last i elements are already sorted, so we don't need to check them
        for j in range(0, n-i-1):
            # Swap if the element found is greater than the next element
            if arr[j] > arr[j+1]:
                arr[j], arr[j+1] = arr[j+1], arr[j]

# Contoh penggunaan
if __name__ == "__main__":
    # Contoh array yang akan diurutkan
    my_array = [64, 34, 25, 12, 22, 11, 90]

    print("Array sebelum diurutkan:", my_array)

    # Panggil fungsi bubble_sort
    bubble_sort(my_array)

    print("Array setelah diurutkan:", my_array)
```

Program numeric

```
GNU nano 6.2 numeric.py
# Penjumlahan
a = 5
b = 3
hasil_penjumlahan = a + b
print("Hasil Penjumlahan:", hasil_penjumlahan)

# Pengurangan
hasil_pengurangan = a - b
print("Hasil Pengurangan:", hasil_pengurangan)

# Perkalian
hasil_perkalian = a * b
print("Hasil Perkalian:", hasil_perkalian)

# Pembagian
hasil_pembagian = a / b
print("Hasil Pembagian:", hasil_pembagian)
```

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$
```