

TUGAS PEMROSESAN PARAREL



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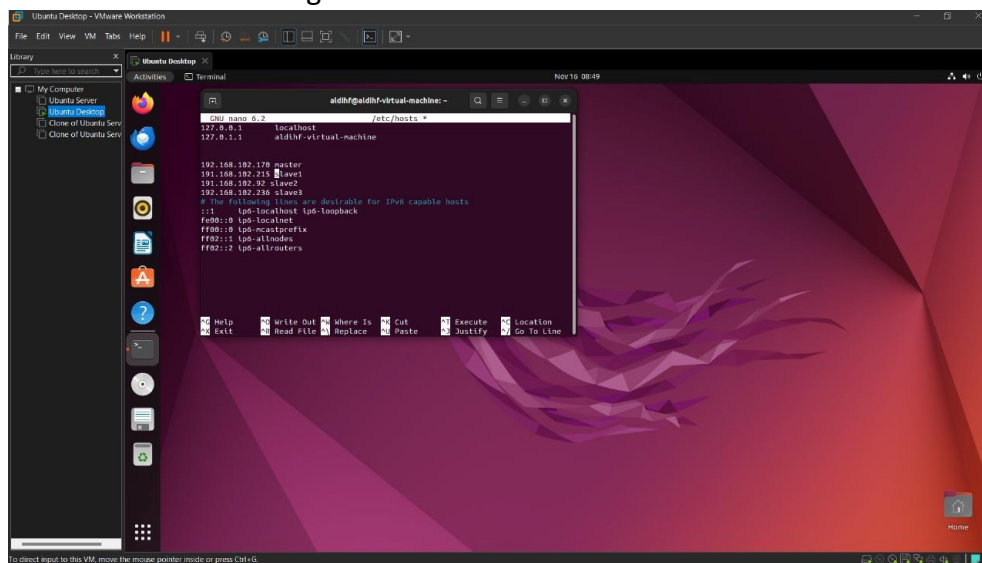
2023

- **Sebelum Pengerjaan**

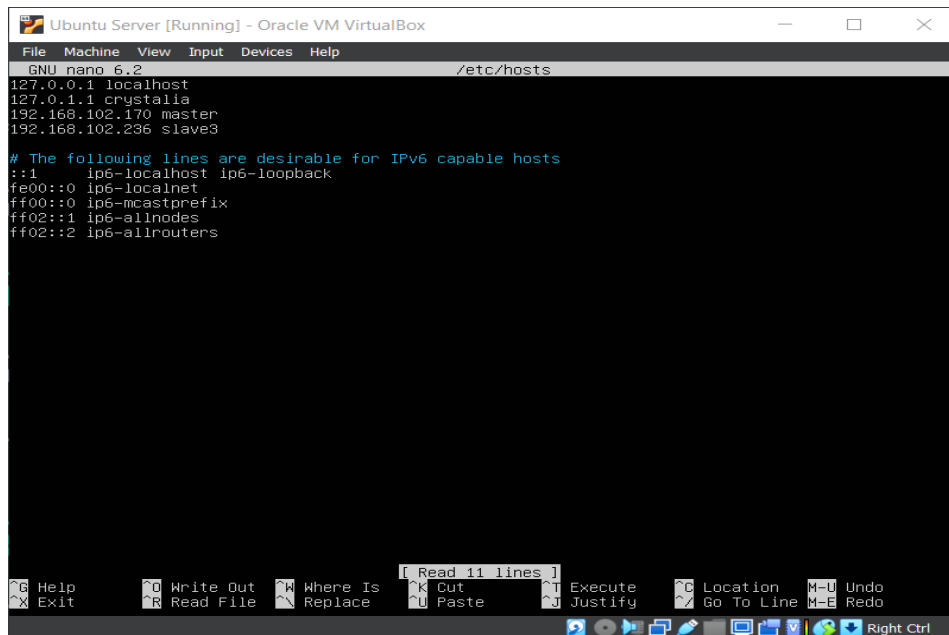
1. Memastikan bahwa setiap PC/Laptop dalam satu jaringan yang sama
2. Menentukan Server dan Slave/worker
3. Melakukan penginstalan net-tools untuk mengecek IP dan vim untuk teks editor

- **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



```
Ubuntu Server [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
GNU nano 6.2 /etc/hosts
127.0.0.1 localhost
127.0.1.1 crystalia
192.168.102.170 master
192.168.102.236 slave3

# The following lines are desirable for IPv6 capable hosts
::1 ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
```

- **Membuat user baru**

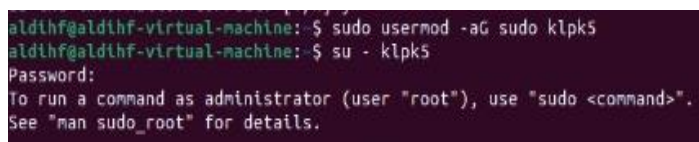
1. Untuk Server dan Worker/slave, Nama user harus sama. Untuk menambahkan User dapat digunakan perintah `sudo adduser` (nama user baru)



```
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 di server dan slave dengan perintah `sudo apt install openssh-server`

```
klpk5@alldihf-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@alldihf-virtual-machine:~$
```

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

```
klpk5@alldihf-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@alldihf-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's fingerprint is:
SHA256:fvu9eGkjC1G2krP0HPQLm02t4+VnCcU4bmVv1JQ4V0c klpk5@alldihf-virtual-machine
The key's randomart image is:
+---[RSA 3072]-----+
|           .E|
|            o|
|         + . +|
|        0 = o.|
|       S 0 = +..|
|      . . 0 B o.|
|     . + 0 0..|
|    . =o0=+o|
|   +=B*==|
+----[SHA256]-----+
klpk5@alldihf-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@aaldiHF-virtual-machine:~$ cd .ssh
klpk5@aaldiHF-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@aaldiHF-virtual-machine:~/.ssh$
```

• Pengkonfigurasi 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@aaldiHF-virtual-machine:~$ mkdir banyu
klpk5@aaldiHF-virtual-machine:~$
```

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

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


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

```
k1pk5@crystallia:~$ 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.
k1pk5@crystallia:~$
```

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

```
k1pk5@crystallia:~$ mkdir banyu
k1pk5@crystallia:~$
```

- **MPI**

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

```
k1pk5@alldihf-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.
k1pk5@alldihf-virtual-machine:~$
```

- **Menjalankan program bubblesort dan numerik**

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

```
k1pk5@alldihf-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.
k1pk5@alldihf-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 ke masing-masing file dan didalam file tersebut masukkan program sesuai dengan jenis nama file.

Program bubblesort

```
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



The screenshot shows a terminal window with the title bar "klpk5@aldihf-virtual-machine: ~/banyu". The window contains a nano 6.2 editor editing a file named "numeric.py". The script defines variables a=5 and b=3, and calculates the sum, difference, product, and quotient of a and b. The bottom status bar shows various keyboard shortcuts and a message "Read 17 lines".

```
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)
```

Read 17 lines

^G Help ^O Write Out ^W Where Is ^K Cut ^T Execute ^C Location M-U Undo M-A Set Mark
^X Exit ^R Read File ^_ Replace ^U Paste ^J Justify ^/_ Go To line M-F Redo M-6 Copy

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

Hasil program bubblesort

```
klpk5@galdihf-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@galdihf-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@galdihf-virtual-machine:~/banyu$
```