

**PRAKTIKUM
ARSITEKTUR DAN ORGANISASI
KOMPUTER**

“MPI (Master, Slave1,Slave2,Slave3)”



Disusun Oleh :

**Nama : Dwi Aurelia Rahmadani
NIM : 09030582226038
Prodi : Teknik Komputer
Dosen : Adi Hermansyah, S. Kom., M.T.**

**LABORATORIUM PERANGKAT KERAS
FAKULTAS ILMU KOMPUTER
UNIVERSITAS SRIWIJAYA PALEMBANG**

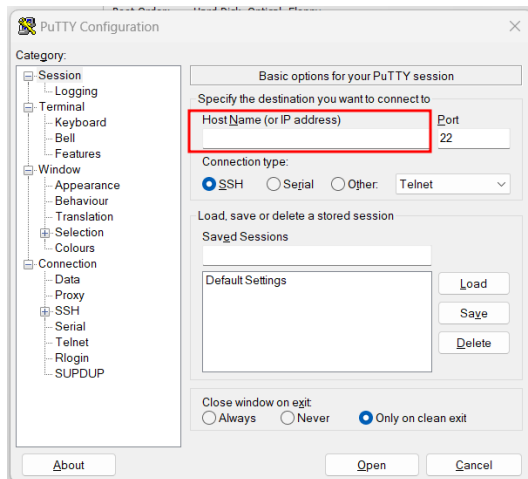
2023

ANGGOTA KELOMPOK :

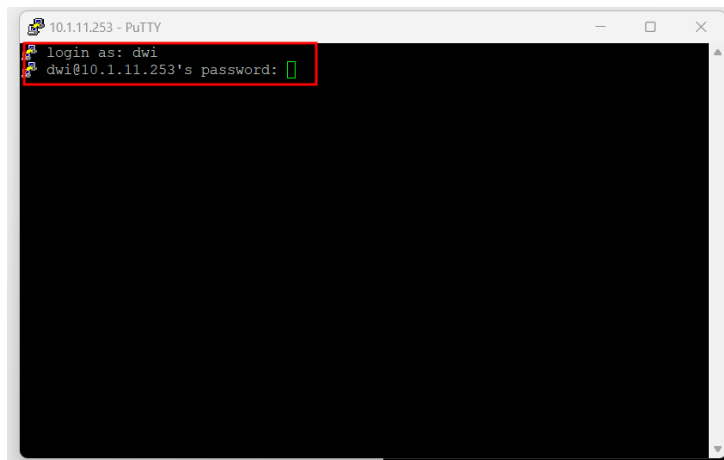
- ☐ **Satryo Pangestu (09030582226008) : MASTER**
- ☐ **Prita Salma (09030582226036) : SLAVE1**
- ☐ **Dwi Aurelia (09030582226038) : SLAVE2**
- ☐ **Azza Adliyah (09030582226040) : SLAVE3**

OPEN MPI (Parallel Computing)

Tahap pertama masukkan ip ke putty



Ketika berhasil masukkan login dan password



Ketik “sudo adduser Dwi”.

```
dwi@aurelia: ~  
login as: dwi  
dwi@10.1.11.253's password:  
Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.4.0-166-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:       https://ubuntu.com/advantage  
  
System information as of Tue 21 Nov 2023 08:28:14 AM UTC  
  
System load:  0.15          Processes:           156  
Usage of /:   55.4% of 11.21GB Users logged in:       1  
Memory usage: 32%          IPv4 address for enp0s3: 10.1.11.253  
Swap usage:   0%  
  
Expanded Security Maintenance for Applications is not enabled.  
  
14 updates can be applied immediately.  
To see these additional updates run: apt list --upgradable  
  
8 additional security updates can be applied with ESM Apps.  
Learn more about enabling ESM Apps service at https://ubuntu.com/esm  
  
New release '22.04.3 LTS' available.  
Run 'do-release-upgrade' to upgrade to it.  
  
Last login: Tue Nov 21 07:54:25 2023 from 10.1.11.116  
dwi@aurelia:~$ sudo adduser mpiuser dwi
```

Ketik “sudo usermod -aG sudo dwi”.

```
dwi@aurelia: ~  
login as: dwi  
dwi@10.1.11.253's password:  
Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.4.0-166-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:       https://ubuntu.com/advantage  
  
System information as of Tue 21 Nov 2023 08:28:14 AM UTC  
  
System load:  0.15          Processes:           156  
Usage of /:   55.4% of 11.21GB Users logged in:       1  
Memory usage: 32%          IPv4 address for enp0s3: 10.1.11.253  
Swap usage:   0%  
  
Expanded Security Maintenance for Applications is not enabled.  
  
14 updates can be applied immediately.  
To see these additional updates run: apt list --upgradable  
  
8 additional security updates can be applied with ESM Apps.  
Learn more about enabling ESM Apps service at https://ubuntu.com/esm  
  
New release '22.04.3 LTS' available.  
Run 'do-release-upgrade' to upgrade to it.  
  
Last login: Tue Nov 21 07:54:25 2023 from 10.1.11.116  
dwi@aurelia:~$ sudo apt-get update  
[sudo] password for dwi:  
Sorry, try again.  
[sudo] password for dwi:  
Hit:1 http://id.archive.ubuntu.com/ubuntu focal InRelease  
Get:2 http://id.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]  
Hit:3 http://id.archive.ubuntu.com/ubuntu focal-backports InRelease  
Hit:4 http://id.archive.ubuntu.com/ubuntu focal-security InRelease  
Fetched 114 kB in 1s (154 kB/s)  
Reading package lists... Done  
dwi@aurelia:~$ sudo adduser dwi  
adduser: The user 'dwi' already exists.  
dwi@aurelia:~$ sudo usermod -aG sudo dwi
```

Ketik “su – dwi”.

```
dwi@aurelia: ~
login as: dwi
dwi@10.1.11.253's password:
Welcome to Ubuntu 20.04.6 LTS (GNU/Linux 5.4.0-166-generic x86_64)

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

System information as of Tue 21 Nov 2023 08:28:14 AM UTC

System load:  0.15          Processes:      156
Usage of /:   55.4% of 11.21GB Users logged in:   1
Memory usage: 32%          IPv4 address for enp0s3: 10.1.11.253
Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

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

8 additional security updates can be applied with ESM Apps.
Learn more about enabling ESM Apps service at https://ubuntu.com/esm

New release '22.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Tue Nov 21 07:54:25 2023 from 10.1.11.116
dwi@aurelia:~$ sudo apt-get update
[sudo] password for dwi:
Sorry, try again.
[sudo] password for dwi:
Hit:1 http://id.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://id.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:3 http://id.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://id.archive.ubuntu.com/ubuntu focal-security InRelease
Fetched 114 kB in 1s (154 kB/s)
Reading package lists... Done
dwi@aurelia:~$ sudo adduser dwi
adduser: The user 'dwi' already exists.
dwi@aurelia:~$ sudo usermod -ag sudo dwi
dwi@aurelia:~$ su - dwi
Password: [redacted]
```

Ketik “sudo apt update && sudo apt upgrade

sudo apt install net-tools vim”.

```
dwi@aurelia: ~
New release '22.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Tue Nov 21 07:54:25 2023 from 10.1.11.116
dwi@aurelia:~$ sudo apt-get update
[sudo] password for dwi:
Sorry, try again.
[sudo] password for dwi:
Hit:1 http://id.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://id.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:3 http://id.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://id.archive.ubuntu.com/ubuntu focal-security InRelease
Fetched 114 kB in 1s (154 kB/s)
Reading package lists... Done
dwi@aurelia:~$ sudo adduser dwi
adduser: The user 'dwi' already exists.
dwi@aurelia:~$ sudo usermod -ag sudo dwi
dwi@aurelia:~$ su - dwi
Password:
dwi@aurelia:~$ sudo apt update && sudo apt upgrade
Hit:1 http://id.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://id.archive.ubuntu.com/ubuntu focal-updates InRelease
Hit:3 http://id.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://id.archive.ubuntu.com/ubuntu focal-security InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
8 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libpython3.9-minimal libpython3.9-stdlib libpython3.9 python3.9
  python3.9-dev python3.9-minimal libpython3.9-dev python3.9-venv
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following NEW packages will be installed:
  linux-headers-5.4.0-167 linux-headers-5.4.0-167-generic linux-image-5.4.0-167-generic
  linux-modules-5.4.0-167-generic linux-modules-extra-5.4.0-167-generic
  ubuntu-pro-client-l10n
The following packages will be upgraded:
  apt apt-utils libapt-pkg6.0 linux-generic linux-headers-generic linux-image-generic
  linux-libc-dev ubuntu-advantage-tools
8 upgraded, 6 newly installed, 0 to remove and 0 not upgraded.
Need to get 80.7 MB of archives.
After this operation, 330 MB of additional disk space will be used.
Do you want to continue? [Y/n] [redacted]
```

```

dwi@aurelia: ~
Hit:1 http://id.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://id.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Hit:3 http://id.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://id.archive.ubuntu.com/ubuntu focal-security InRelease
Fetched 114 kB in 1s (154 kB/s)
Reading package lists... Done
dwi@aurelia:~$ sudo adduser dwi
adduser: The user 'dwi' already exists.
dwi@aurelia:~$ sudo usermod -ag sudo dwi
dwi@aurelia:~$ su - dwi
Password:
dwi@aurelia:~$ sudo apt update && sudo apt upgrade
Hit:1 http://id.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://id.archive.ubuntu.com/ubuntu focal-updates InRelease
Hit:3 http://id.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://id.archive.ubuntu.com/ubuntu focal-security InRelease
Reading package lists... Done
Building dependency tree
Reading state information... Done
8 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree
Reading state information... Done
Calculating upgrade... Done
Get more security updates through Ubuntu Pro with 'esm-apps' enabled:
  libpython3.9-minimal libpython3.9-stdlib libpython3.9 python3.9
  python3.9-dev python3.9-minimal libpython3.9-dev python3.9-venv
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following NEW packages will be installed:
  linux-headers-5.4.0-167 linux-headers-5.4.0-167-generic linux-image-5.4.0-167-generic
  linux-modules-5.4.0-167-generic linux-modules-extra-5.4.0-167-generic
  ubuntu-pro-client-110n
The following packages will be upgraded:
  apt apt-utils libapt-pkg6.0 linux-generic linux-headers-generic linux-image-generic
  linux-libc-dev ubuntu-advantage-tools
8 upgraded, 6 newly installed, 0 to remove and 0 not upgraded.
Need to get 80.7 MB of archives.
After this operation, 380 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Abort.
dwi@aurelia:~$ sudo apt install net-tools vim
Reading package lists... Done
Building dependency tree
Reading state information... Done
net-tools is already the newest version (1.60+git20180626.aebd88e-1ubuntu1).
vim is already the newest version (2:8.1.2269-1ubuntu5.20).
vim set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~$

```

Ketik “sudo apt install openssh-server”.

```

dwi@aurelia: ~
Learn more about Ubuntu Pro at https://ubuntu.com/pro
The following NEW packages will be installed:
  linux-headers-5.4.0-167 linux-headers-5.4.0-167-generic linux-image-5.4.0-167-generic
  linux-modules-5.4.0-167-generic linux-modules-extra-5.4.0-167-generic
  ubuntu-pro-client-110n
The following packages will be upgraded:
  apt apt-utils libapt-pkg6.0 linux-generic linux-headers-generic linux-image-generic
  linux-libc-dev ubuntu-advantage-tools
8 upgraded, 6 newly installed, 0 to remove and 0 not upgraded.
Need to get 80.7 MB of archives.
After this operation, 380 MB of additional disk space will be used.
Do you want to continue? [Y/n] y
Abort.
dwi@aurelia:~$ sudo apt install net-tools vim
Reading package lists... Done
Building dependency tree
Reading state information... Done
net-tools is already the newest version (1.60+git20180626.aebd88e-1ubuntu1).
vim is already the newest version (2:8.1.2269-1ubuntu5.20).
vim set to manually installed.
0 upgraded, 6 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree
Reading state information... Done
openssh-server is already the newest version (1:8.2p1-4ubuntu0.9).
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/dwi/.ssh/id_rsa): /home/dwi/.ssh/id_rsa
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/dwi/.ssh/id_rsa
Your public key has been saved in /home/dwi/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:0tL6UwF0LRjizMjYfElw5bJFb5bWA33ZpZRGhyc6OE dwi@aurelia
The key's randomart image is:
+---[RSA 3072]-----+
|  ++O==o*B=  |
| oX=o.O+=*   |
| .o. +.+B    |
|  oE+        |
|  o S o      |
|   * = .     |
|   . + .     |
|   . .       |
|   ...       |
+---[SHA256]-----+
dwi@aurelia:~$

```

Ketik "cd .ssh
cat id_rsa.pub | ssh mpiuser@slave1 "mkdir .ssh; cat >> .ssh/authorized_keys".

```
dwi@aurelia: ~/ssh
net-tools is already the newest version (1.60+git20180626.aebd88e-1ubuntu1).
vim is already the newest version (2:8.1.2269-1ubuntu5.20).
vim set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~$ sudo apt install openssh-server
Reading package lists... Done
Building dependency tree
Reading state information... Done
openssh-server is already the newest version (1:8.2p1-4ubuntu0.9).
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~$ ssh-keygen -t rsa
Generating public/private rsa key pair.
Enter file in which to save the key (/home/dwi/.ssh/id_rsa): /home/dwi/.ssh/id_rsa
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/dwi/.ssh/id_rsa
Your public key has been saved in /home/dwi/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:0rL6UwfJlRj12MjYFeIw5bJFB5bWA332pERGhyc6OE dwi@aurelia
The key's randomart image is:
+---[RSA 3072]-----+
|  +O==o+Be+      |
| oX=o.O.o+=+     |
| .o. .+.+B       |
|   oE+           |
|   o S o         |
|   * = .         |
|   . + .         |
|   . .           |
|   ...           |
+---[SHA256]-----+
dwi@aurelia:~$ cd .ssh
dwi@aurelia:~/ssh$ cat id_rsa.pub | ssh dwi@slave2 "mkdir .ssh; cat >> .ssh/authorized_keys"
ssh: could not resolve hostname slave2: temporary failure in name resolution
dwi@aurelia:~/ssh$ mkdir /home/dwi/bubble
dwi@aurelia:~/ssh$ sudo apt install nfs-kernel-server
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  keyutils libnfsidmap2 libtirpc-common libtirpc3 nfs-common rpcbind
Suggested packages:
  watchdog
The following NEW packages will be installed:
  keyutils libnfsidmap2 libtirpc-common libtirpc3 nfs-common nfs-kernel-server rpcbind
0 upgraded, 7 newly installed, 0 to remove and 8 not upgraded.
Need to get 504 kB of archives.
After this operation, 1.938 kB of additional disk space will be used.
Do you want to continue? [Y/n]
```

Ketik "sudo exportfs -a
sudo systemctl restart nfs-kernel-server".

```
dwi@aurelia: ~/ssh
Preparing to unpack .../3-keyutils_1.6-6ubuntu1.1_amd64.deb ...
Unpacking keyutils (1.6-6ubuntu1.1) ...
Selecting previously unselected package libnfsidmap2:amd64.
Preparing to unpack .../4-libnfsidmap2_0.25-5.1ubuntu1_amd64.deb ...
Unpacking libnfsidmap2:amd64 (0.25-5.1ubuntu1) ...
Selecting previously unselected package nfs-common.
Preparing to unpack .../5-nfs-common_1:3.4.2-2.5ubuntu3.5_amd64.deb ...
Unpacking nfs-common (1:1.3.4-2.5ubuntu3.5) ...
Selecting previously unselected package nfs-kernel-server.
Preparing to unpack .../6-nfs-kernel-server_1:3.4.2-2.5ubuntu3.5_amd64.deb ...
Unpacking nfs-kernel-server (1:1.3.4-2.5ubuntu3.5) ...
Setting up libtirpc-common (1.2.5-1ubuntu0.1) ...
Setting up keyutils (1.6-6ubuntu1.1) ...
Setting up libnfsidmap2:amd64 (0.25-5.1ubuntu1) ...
Setting up libtirpc3:amd64 (1.2.5-1ubuntu0.1) ...
Setting up rpcbind (1.2.5-8) ...
Created symlink /etc/systemd/system/multi-user.target.wants/rpcbind.service → /lib/systemd/system/rpcbind.service.
Created symlink /etc/systemd/system/sockets.target.wants/rpcbind.socket → /lib/systemd/system/rpcbind.socket.
Setting up nfs-common (1:1.3.4-2.5ubuntu3.5) ...
Creating config file /etc/idmapd.conf with new version
Adding system user 'statd' (UID 116) ...
Adding new user 'statd' (UID 116) with group 'nogroup' ...
Not creating home directory '/var/lib/nfs'.
Created symlink /etc/systemd/system/multi-user.target.wants/nfs-client.target → /lib/systemd/system/nfs-client.target.
Created symlink /etc/systemd/system/remote-fs.target.wants/nfs-client.target → /lib/systemd/system/nfs-client.target.
nfs-utils.service is a disabled or a static unit, not starting it.
Setting up nfs-kernel-server (1:1.3.4-2.5ubuntu3.5) ...
Created symlink /etc/systemd/system/multi-user.target.wants/nfs-server.service → /lib/systemd/system/nfs-server.service.
Job for nfs-server.service canceled.
Creating config file /etc/exports with new version
Creating config file /etc/default/nfs-kernel-server with new version
Processing triggers for systemd (245.4-4ubuntu3.22) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.12) ...
dwi@aurelia:~/ssh$ cd /home/dwi/bubble; * (rw,sync,no_root_squash,no_subtree_check)
-bash: /home/dwi/bubble: is a directory
dwi@aurelia:~/ssh$ sudo exportfs -a
dwi@aurelia:~/ssh$ sudo systemctl restart nfs-kernel-server
dwi@aurelia:~/ssh$ sudo apt install nfs-common
Reading package lists... Done
Building dependency tree
Reading state information... Done
nfs-common is already the newest version (1:1.3.4-2.5ubuntu3.5).
nfs-common set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~/ssh$
```

```

dwi@aurelia: ~/ssh
Adding system user 'statd' (UID 116) ...
Adding new user 'statd' (UID 116) with group 'nogroup' ...
Not creating home directory '/var/lib/nfs'.
Created symlink /etc/systemd/system/multi-user.target.wants/nfs-client.target → /lib/systemd/system/nfs-client.target.
Created symlink /etc/systemd/system/remote-fs.target.wants/nfs-client.target → /lib/systemd/system/nfs-client.target.
nfs-utils.service is a disabled or a static unit, not starting it.
Setting up nfs-kernel-server (1:1.3.4-2.5ubuntu3.5) ...
Created symlink /etc/systemd/system/multi-user.target.wants/nfs-server.service → /lib/systemd/system/nfs-server.service.
Job for nfs-server.service canceled.

Creating config file /etc/exports with new version

Creating config file /etc/default/nfs-kernel-server with new version
Processing triggers for systemd (245.4-4ubuntu3.22) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for libc-bin (2.31-0ubuntu9.12) ...
dwi@aurelia:~/ssh$ /home/dwi/bubble *{rw,sync,no_root_squash,no_subtree_check}
-bash: /home/dwi/bubble: is a directory
dwi@aurelia:~/ssh$ sudo exportfs -a
dwi@aurelia:~/ssh$ sudo systemctl restart nfs-kernel-server
dwi@aurelia:~/ssh$ sudo apt install nfs-common
Reading package lists... Done
Building dependency tree
Reading state information... Done
nfs-common is already the newest version (1:1.3.4-2.5ubuntu3.5).
nfs-common set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 0 not upgraded.
dwi@aurelia:~/ssh$ sudo mount master:/home/dwi/bubble /home/dwi/bubble
^C
dwi@aurelia:~/ssh$ sudo apt install openmpi-bin libopenmpi-dev
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  autoconf automake autotools-dev ibverbs-providers libcaf-openmpi-3 libcoarrays-dev
  libcoarrays-openmpi-dev libevent-dev libevent-extra-2.1-7 libevent-openssl-2.1-7
  libfabric1 libhwloc-dev libibverbs-dev libibverbs1 libltdl-dev libnl-3-dev
  libnl-route-3-200 libnl-route-3-dev libnuma-dev libopenmpi3 libpmix2 libpsm-infinipath1
  libpsm2-2 librdmacm1 libtool m4 openmpi-common
Suggested packages:
  autoconf-archive gnu-stardards autoconf-doc gettext libtool-doc openmpi-doc gcj-jdk
  m4-doc
The following NEW packages will be installed:
  autoconf automake autotools-dev ibverbs-providers libcaf-openmpi-3 libcoarrays-dev
  libcoarrays-openmpi-dev libevent-dev libevent-extra-2.1-7 libevent-openssl-2.1-7
  libfabric1 libhwloc-dev libibverbs-dev libibverbs1 libltdl-dev libnl-3-dev
  libnl-route-3-200 libnl-route-3-dev libnuma-dev libopenmpi-dev libopenmpi3 libpmix2
  libpsm-infinipath1 libpsm2-2 librdmacm1 libtool m4 openmpi-bin openmpi-common
0 upgraded, 29 newly installed, 0 to remove and 8 not upgraded.

```

Ketik “sudo apt install python3-pip
pip install mpi4py”.

```

dwi@aurelia: ~/ssh
Setting up libnuma-dev:amd64 (2.0.12-1) ...
Setting up libnl-route-3-200:amd64 (3.4.0-1ubuntu0.1) ...
Setting up autotools-dev (20180224.1) ...
Setting up libevent-dev (2.1.11-stable-1) ...
Setting up autoconf (2.69-11.1) ...
Setting up libnl-3-dev:amd64 (3.4.0-1ubuntu0.1) ...
Setting up libpsm2-2 (11.2.86-1) ...
Setting up openmpi-common (4.0.3-0ubuntu1) ...
Setting up libpsm-infinipath1 (3.3+20.604756e7-6) ...
update-alternatives: using /usr/lib/libpsm1/libpsm1_infinipath.so.1.16 to provide /usr/lib/x86_64-linux-gnu/libpsm_infinipath.so.1 (libpsm_infinipath.so.1) in auto mode
Setting up automake (1:1.16.1-4ubuntu6) ...
update-alternatives: using /usr/bin/automake-1.16 to provide /usr/bin/automake (automake) in auto mode
Setting up libibverbs1:amd64 (28.0-1ubuntu1) ...
Setting up ibverbs-providers:amd64 (28.0-1ubuntu1) ...
Setting up libtool (2.4.6-14) ...
Setting up libnl-route-3-dev:amd64 (3.4.0-1ubuntu0.1) ...
Setting up libltdl-dev:amd64 (2.4.6-14) ...
Setting up libhwloc-dev:amd64 (2.1.0+dfsg-4) ...
Setting up librdmacm1:amd64 (28.0-1ubuntu1) ...
Setting up libibverbs-dev:amd64 (28.0-1ubuntu1) ...
Setting up libfabric1 (1.6.2-3ubuntu0.1) ...
Setting up libopenmpi3:amd64 (4.0.3-0ubuntu1) ...
Setting up libcaf-openmpi-3:amd64 (2.8.0-1) ...
Setting up openmpi-bin (4.0.3-0ubuntu1) ...
update-alternatives: using /usr/bin/mpirun.openmpi to provide /usr/bin/mpirun (mpirun) in aut
o mode
update-alternatives: using /usr/bin/mpicc.openmpi to provide /usr/bin/mpicc (mpi) in auto mod
e
Setting up libcoarrays-openmpi-dev:amd64 (2.8.0-1) ...
Setting up libopenmpi-dev:amd64 (4.0.3-0ubuntu1) ...
update-alternatives: using /usr/lib/x86_64-linux-gnu/openmpi/include to provide /usr/include/
x86_64-linux-gnu/mpi (mpi-x86_64-linux-gnu) in auto mode
Processing triggers for libc-bin (2.31-0ubuntu9.12) ...
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for install-info (6.8.2-4.1) ...
dwi@aurelia:~/ssh$ sudo apt install python3-pip
Reading package lists... Done
Building dependency tree
Reading state information... Done
python3-pip is already the newest version (20.0.2-5ubuntu1.10).
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
dwi@aurelia:~/ssh$ pip install mpi4py
Processing /home/dwi/.cache/pip/wheels/56/bb/e8/e2ac5b75cacca356a2f270568f7ac5b6c7c6aa223bf8
c2bca/mpi4py-3.1.5-cp38-cp38-linux_x86_64.whl
Installing collected packages: mpi4py
Successfully installed mpi4py-3.1.5
dwi@aurelia:~/ssh$

```

```
dwi@aurelia: ~/bubble
GNU nano 4.8
from mpi4py import MPI

def parallel_bubble_sort(arr):
    comm = MPI.COMM_WORLD
    rank = comm.Get_rank()
    size = comm.Get_size()

    local_arr = arr[rank::size]

    for i in range(len(local_arr)):
        for j in range(0, len(local_arr) - i - 1):
            if local_arr[j] > local_arr[j + 1]:
                local_arr[j], local_arr[j + 1] = local_arr[j + 1], local_arr[j]

    sorted_arr = comm.gather(local_arr, root=0)

    if rank == 0:
        combined_arr = [item for sublist in sorted_arr for item in sublist]
        combined_arr.sort()
        for i in range(len(arr)):
            arr[i] = combined_arr[i]

if __name__ == '__main__':
    comm = MPI.COMM_WORLD
    rank = comm.Get_rank()

    if rank == 0:
        arr = [5, 3, 4, 1, 2]
    else:
        arr = None

    arr = comm.bcast(arr, root=0) # Broadcast the arr from rank 0 to all nodes
    comm.barrier()

    parallel_bubble_sort(arr)

    if rank == 0:
        print(f"List sorted with bubble sort in ascending order: {arr}")

File Name to Write: bubble.py
⌘ Get Help
⌘ Cancel
⌘-S DOS Format
⌘-M Mac Format
⌘-A Append
⌘-I Prepend
```

Berhasil dwi menjadi “Slave2”.

```
dwi@aurelia: ~/bubble
my node: aurelia
target node: master

This is usually an internal programming error that should be
reported to the developers. In the meantime, a workaround may
be to set the MCA param routed=direct on the command line or
in your environment. We apologize for the problem.
-----
[aurelia:06260] 2 more processes have sent help message help-errmgr-base.txt / no-path
[aurelia:06260] Set MCA parameter "orte Base help_aggregate" to 0 to see all help / error messages
dwi@aurelia:~/bubble$ mpirun -np 4 -host master,slave2 python3 bubble.py
ssh: Could not resolve hostname master: Temporary failure in name resolution
ssh: Could not resolve hostname slave2: Temporary failure in name resolution
-----
ORTE was unable to reliably start one or more daemons.
This usually is caused by:

* not finding the required libraries and/or binaries on
  one or more nodes. Please check your PATH and LD_LIBRARY_PATH
  settings, or configure OMPI with --enable-orterun-prefix-by-default

* lack of authority to execute on one or more specified nodes.
  Please verify your allocation and authorities.

* the inability to write startup files into /tmp (/--tmpdir/orte_tmpdir_base).
  Please check with your sys admin to determine the correct location to use.

* compilation of the orted with dynamic libraries when static are required
  (e.g., on Cray). Please check your configure cmd line and consider using
  one of the contrib/platform definitions for your system type.

* an inability to create a connection back to mpirun due to a
  lack of common network interfaces and/or no route found between
  them. Please check network connectivity (including firewalls
  and network routing requirements).
-----
ORTE does not know how to route a message to the specified daemon
located on the indicated node:

my node: aurelia
target node: slave2

This is usually an internal programming error that should be
reported to the developers. In the meantime, a workaround may
be to set the MCA param routed=direct on the command line or
in your environment. We apologize for the problem.
-----
dwi@aurelia:~/bubble$
```