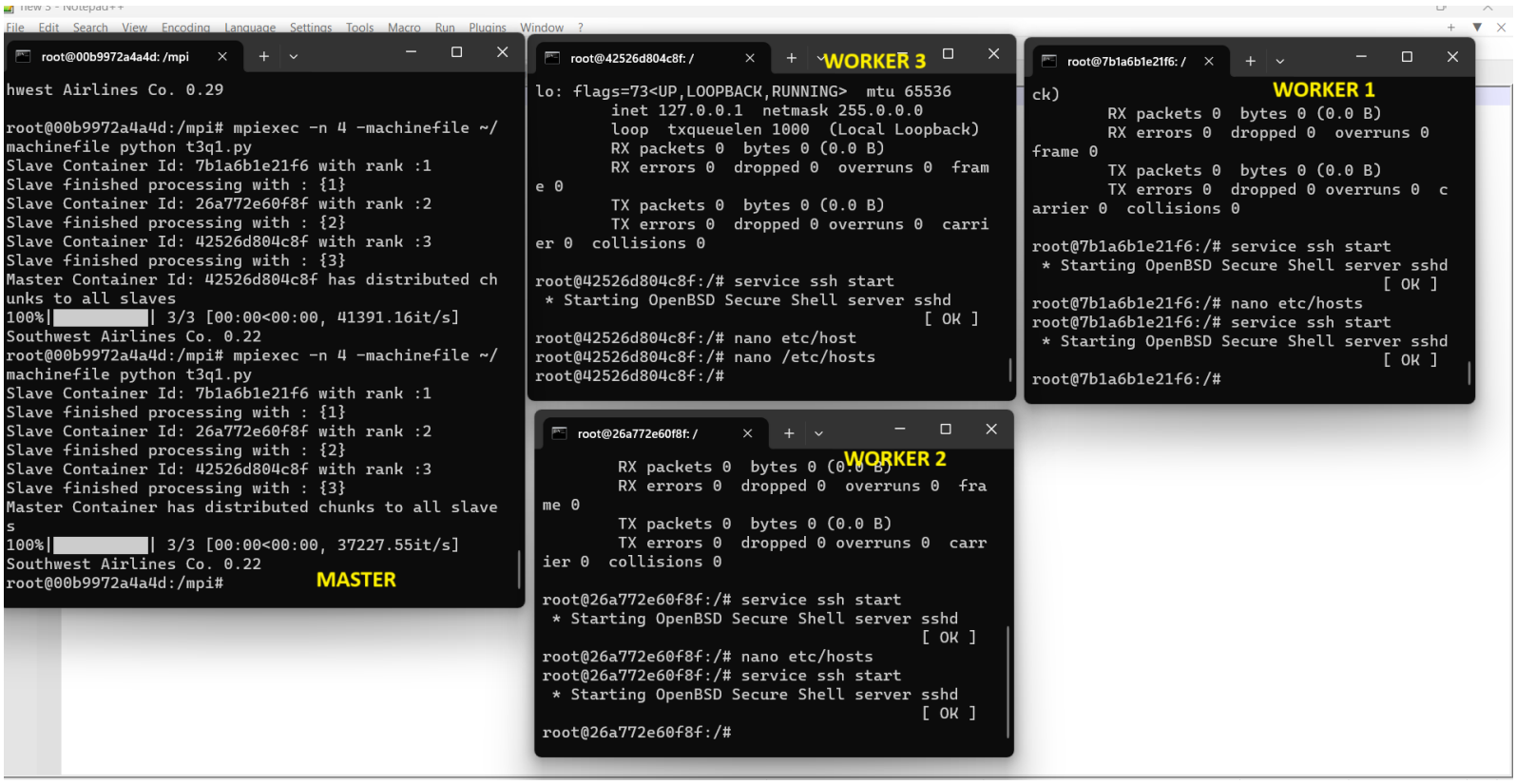
Task 2 Report and MPI Commands Explanation

c) Output from master and worker nodes



d) The IP of each node are as follows:

Master Node : 172.17.0.2

Workers : 172.17.0.3, 172.17.0.4, 172.17.0.5

There are no shared paths as each container runs their own processes with the data given from the Master container and each of them are isolated from each other.

e) Commands used for task 2 and its explanation:

SERVER:

1. docker pull ozxx33/mpi4py-cluster-base
   -> gets the base image for the assignment in order to build containers on top of it

2. docker run -it --mount "type=bind,src=%cd%,target=/mpi" -it --name mpi_prep
   -> creates and starts a container with the name mpi_prep. The mount command is used to mount the host directory with the container's file system. It copies the file present in the current working directory into the mpi folder in the container.

3. passwd
   -> used to set the password for the container. In order to connect with the containers using passwordless ssh

4. apt-get update
   -> updates the container with latest packages

5. apt-get install nano net-tools iputils-ping openssh-client openssh-server
   -> installs necessary packages in order to connect to the nodes using ssh

6. pip install pandas==1.5.0
   -> installs specified pandas version

7. docker commit T2Server mpi_cluster_t2
   -> Creates a new intermediate base image with name mpi_cluster_t2 from T2Server container

8. docker run -it --mount "type=bind,src=%cd%,target=/mpi" -it --name T2Server mpi_cluster_t2 bash
   -> Creates a new container with name T2Server from the intermediate base image

9. ssh-keygen -t rsa
   -> Used to store private keys for connecting with containers

10. ssh-copy-id -i ~/.ssh/id_rsa.pub root@<container_ip>
    -> Stores the public key to connect with all the slave container using ssh

11. ssh root@<container_ip>
    -> Used to connect to the specified container by its IP address for testing

12. exit
    -> To exit from the container shell

13. import tqdm
    -> Install tqdm package

14. Nano ~/machinefile
    -> Used to add the IP addresses of the container nodes to use as worker machines

15. mpiexec -n 4 -machinefile ~/machinefile python t3q1.py
    -> Run MPI program with machine file

WORKER 1:

1. docker run -it --mount "type=bind,src=%cd%,target=/mpi" -it --name T2SlaveOne mpi_cluster_t2 bash
   -> Creates a new container using the intermediate image with the name T2SlaveOne

2. service ssh start
   -> Start the ssh service for master nodes to connect with worker1

3. nano /etc/hosts
   -> Add the IP Address of the master container for worker1 to accept connection from Master container

WORKER 2:

1. docker run -it --mount "type=bind,src=%cd%,target=/mpi" -it --name T2Slave2 mpi_cluster_t2 bash
   -> Creates a new container using the intermediate image with the name T2Slave2

2. service ssh start
   -> Start the ssh service for master nodes to connect with worker2

3. nano /etc/hosts
   -> Add the IP Address of the master container for worker2 to accept connection from Master container

WORKER 3:

1. docker run -it --mount "type=bind,src=%cd%,target=/mpi" -it --name T2Slave3 mpi_cluster_t2 bash
   -> Creates a new container using the intermediate image with the name T2Slave2

2. service ssh start
   -> Start the ssh service for master nodes to connect with worker3

3. nano /etc/hosts
   -> Add the IP Address of the master container for worker3 to accept connection from Master container

g) Yes, I have used an intermediate image to create the final containers.
This image was created with all the necessary installments ready.