[[1]](#footnote-1) *Creating a Beowulf Cluster:*

1. Create Virtual Machine(VM) with Ubuntu 18.04.1 LTS using Oracle VM Virtualbox .
2. Enable Bridged Networking between the noded

After installation, power off the virtual machines and for each node, do -

Settings -> Network -> Check the "Enable Network Adaptor" option -> Select "Bridged Adaptor" and select any one of the options that works-> OK

3.Install SSH on the all the nodes by using sudo apt-get install openssh-server openssh-client

4. Static IP Allocation

Assign a static IP address to nodes

ifconfig -> gives the network name, address, netmask, network address(X.X.0.0) and broadcast address

route -m -> gives the gateway address

cat /etc/resolv.conf -> gives the dns-nameservers address

d /etc/network

sudo gedit interfaces

Add the following lines:

auto {insert-network-name}

iface {insert-network-name} inet static

address {insert-ip-address}

netmask {insert-network-mask}

network {insert-network-address}

broadcast {insert-broadcast-address}

gateway {insert-gateway-address}

dns-nameservers {insert-dns-nameservers-address}

1. Save the file and restart the system network

From home directory, open up hosts file in each node using -

cd /etc

sudo gedit hosts

Add the following info in all the nodes -

{host1 IP address} {master-node-name}

{host2 IP address} {slave1-node-name}

{host3 IP address} {slave2-node-name}

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1. Create Passwordless SSH from master to slave nodes

On the all the node, type ssh-keygen on the terminal. Just hit enter for all other options. This option will create a id\_rsa.pub RSA public key for your node.

On the master node, type ssh-copy-id -i ~/.ssh/id\_rsa.pub <first-node-name> on the terminal. It will prompt you for the password of the first-node, enter that. Repeat this step for all nodes. This will copy your RSA public key of your master node to the id\_rsa.pub of your other nodes, enabling a passwordless SSH from master to all the slave node.

To check if this works, try ssh <node-name>. Try out for all nodes.

1. Setting up NFS on all the nodes

NFS - Network File System. Used to view, store and update files between local and remote systems. Here, we’ll use it to provide a shared memory to the master and slave nodes.

On the master node, run the command sudo apt-get install nfs-kernel-server and install the NFS server. Create the folder that will be shared among the master and slave nodes using mkdir <foldername> . Move to etc folders and open up the exports file using cd /etc and sudo gedit exports . Add the following at the end -

/home/<username>/<foldername> <slave1>(rw,sync,no\_root\_squash,no\_subtree\_check) <slave2>(rw,sync,no\_root\_squash,no\_subtree\_check)

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Go back to home directory, run exportfs -a in the terminal followed by sudo service nfs-kernel-server restart

On the slave nodes, run the command sudo apt-get install nfs-common. Create a file with the same name as the one on the master node <foldername>. Run sudo mount -t nfs <master-node-name>:/home/<username>/<foldername> ~/<foldername>. To check if it’s mounted or not, run df -h. To permanently mount it, go to /etc folder and open up fstab file using cd /etc and sudo gedit fstab. Add the following at the end -

<master-node-name>:/home/<username>/<foldername> /home/<username>/<foldername>

1. Install same version of mpi4py on all nodes of the cluster.

sudo apt-get install python-mpi4py

sudo mkdir mpi4py

cd mpi4py

Download mpi4py-1.3.1 and move it to mpi4py directory.

tar xfz mpi4py-1.3.tar.gz

cd mpi4py-1.3/demo

Sample codes will be available in the demo directory.

1. Create a text file called hostfile.txt in the shared directory. In that directory, save either the nodes names (or their IP addresses) like mentioned below:

<master-node-name>

<slave-node-name-1>

<slave-node-name-2>

...

10.Running the code

To run the mpi code, save the executable object file of the code, in the common shared folder and run the following command in the terminal

chmod -c cc.py

mpirun -n 3 -hostsfile hostfile.txt ./cc.py

1. [↑](#footnote-ref-1)