



Distributed Computing Cluster to run a MPI “Hello world Program”

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Setting Up Starcluster

```
karthik@DESKTOP-1FFJPNQ:~$ starcluster start mycluster
/home/karthik/.local/lib/python2.7/site-packages/paramiko/transport.py:33: CryptographyDeprecationWarning: Python 2 is no longer supported by the Python core team. Support for it is now deprecated in cryptography
  from cryptography.hazmat.backends import default_backend
StarCluster - (http://star.mit.edu/cluster) (v. 0.95.6)
Software Tools for Academics and Researchers (STAR)
Please submit bug reports to starcluster@mit.edu

>>> Using default cluster template: smallcluster
>>> Validating cluster template settings...
>>> Cluster template settings are valid
>>> Starting cluster...
>>> Launching a 2-node cluster...
>>> Creating security group @ec-mycluster...
ReservationID-B4S36600e9c180f45
>>> Waiting for instances to propagate...
2/2 |=====| 100%
>>> Waiting for cluster to come up... (updating every 30s)
/home/karthik/.local/lib/python2.7/site-packages/boto/ec2/connection.py:1339: UserWarning: The 'launch.group.id' filter now requires a security group id (sg-*) and no longer supports filtering by group name. Please update your filters accordingly.
  UserWarning)
>>> Waiting for all nodes to be in a 'running' state...
2/2 |=====| 100%
>>> Waiting for SSH to come up on all nodes...
2/2 |=====| 100%
>>> Waiting for cluster to come up took 1.687 mins
>>> The master node is ec2-52-204-4-241.compute-1.amazonaws.com
>>> Configuring cluster...
>>> Running plugin starcluster.clustersetup.DefaultClusterSetup
>>> Configuring hostnames...
2/2 |=====| 100%
>>> Creating cluster user: sgadmsh (role: S300, gid: 1003)
2/2 |=====| 100%
>>> Configuring scratch space for user(s): sgadmsh
2/2 |=====| 100%
>>> Configuring /etc/hosts on each node
2/2 |=====| 100%
>>> Starting NFS server on master
>>> Configuring NFS exports path(s):
/home
>>> Mounting all NFS export path(s) on 1 worker node(s)
1/1 |=====| 100%
>>> Setting up NFS took 0.356 mins
>>> Configuring passwordless ssh for root
>>> Configuring passwordless ssh for sgadmsh
>>> Running plugin starcluster.plugins.ige.SGEPlugin
>>> Configuring SGE...
>>> Configuring NFS exports path(s):
/opt/sg66
>>> Mounting all NFS export path(s) on 1 worker node(s)
```

karthik@DESKTOP-1FFJPNQ: ~

```
>>> Mounting all NFS export path(s) on 1 worker node(s)
1/1 |=====| 100%
>>> Setting up NFS took 0.263 mins
>>> Installing Sun Grid Engine...
1/1 |=====| 100%
>>> Creating SGE parallel environment 'orte'
2/2 |=====| 100%
>>> Adding parallel environment 'orte' to queue 'all.q'
>>> Configuring cluster took 2.391 mins
>>> Starting cluster took 4.196 mins
```

The cluster is now ready to use. To login to the master node as root, run:

```
$ starcluster sshmaster mycluster
```

If you're having issues with the cluster you can reboot the instances and completely reconfigure the cluster from scratch using:

```
$ starcluster restart mycluster
```

When you're finished using the cluster and wish to terminate it and stop paying for service:

```
$ starcluster terminate mycluster
```

Alternatively, if the cluster uses EBS instances, you can use the 'stop' command to shutdown all nodes and put them into a 'stopped' state preserving the EBS volumes backing the nodes:

```
$ starcluster stop mycluster
```

WARNING: Any data stored in ephemeral storage (usually /mnt) will be lost!

You can activate a 'stopped' cluster by passing the -x option to the 'start' command:

```
$ starcluster start -x mycluster
```

This will start all 'stopped' nodes and reconfigure the cluster.

Login into the Master node

```
karthik@DESKTOP-1FFJPNQ: ~  
karthik@DESKTOP-1FFJPNQ:~$ starcluster sshmaster mycluster  
/home/karthik/.local/lib/python2.7/site-packages/paramiko/transport.py:33: CryptographyDeprecationWarning: Python 2 is no longer supported by the Python core team. Support for it is now deprecated in cryptograph  
y, and will be removed in a future release.  
  from cryptography.hazmat.backends import default_backend  
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The authenticity of host 'ec2-52-204-4-241.compute-1.amazonaws.com (52.204.4.241)' can't be established.  
ECDSA key fingerprint is SHA256:RDY/TC+22zHwGm9S59ubiH0Vprcs8DXtKBZ17tuETt8.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added 'ec2-52-204-4-241.compute-1.amazonaws.com,52.204.4.241' (ECDSA) to the list of known hosts.  
  
starcluster  
  
StarCluster Ubuntu 13.04 AMI  
Software Tools for Academics and Researchers (STAR)  
Homepage: http://star.mit.edu/cluster  
Documentation: http://star.mit.edu/cluster/docs/latest  
Code: https://github.com/jtriley/StarCluster  
Mailing list: http://star.mit.edu/cluster/maillinglist.html  
  
This AMI Contains:  
  
* Open Grid Scheduler (OGS - formerly SGE) queuing system  
* Condor workload management system  
* OpenMPI compiled with Open Grid Scheduler support  
* OpenBLAS - Highly optimized Basic Linear Algebra Routines  
* NumPy/SciPy linked against OpenBLAS  
* Pandas - Data Analysis Library  
* IPython 1.1.0 with parallel and notebook support  
* Julia 0.3pre  
* and more! (use 'dpkg -l' to show all installed packages)  
  
Open Grid Scheduler/Condor cheat sheet:  
  
* qstat/condor_q - show status of batch jobs  
* qhost/condor_status - show status of hosts, queues, and jobs  
* qsub/condor_submit - submit batch jobs (e.g. qsub -cwd ./job.sh)  
* qdel/condor_rm - delete batch jobs (e.g. qdel 7)  
* qconf - configure Open Grid Scheduler system  
  
Current System Stats:  
  
System load: 0.04 Processes: 92  
Usage of /: 34.6% of 7.84GB Users logged in: 0  
Memory usage: 7% IP address for eth0: 172.31.46.87
```

Verify 2 cluster nodes within /etc/hosts

```
root@master:~# cat /etc/hosts
127.0.0.1 localhost

# 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
ff02::3 ip6-allhosts
172.31.46.87 master
172.31.36.141 node001
```

Mount /home in NFS Shared

```
root@master:~# ssh node001 mount
/dev/xvda1 on / type ext4 (rw)
proc on /proc type proc (rw,noexec,nosuid,nodev)
sysfs on /sys type sysfs (rw,noexec,nosuid,nodev)
none on /sys/fs/cgroup type tmpfs (rw)
none on /sys/fs/fuse/connections type fusectl (rw)
none on /sys/kernel/debug type debugfs (rw)
none on /sys/kernel/security type securityfs (rw)
udev on /dev type devtmpfs (rw,mode=0755)
devpts on /dev/pts type devpts (rw,noexec,nosuid,gid=5,mode=0620)
tmpfs on /run type tmpfs (rw,noexec,nosuid,size=10%,mode=0755)
none on /run/lock type tmpfs (rw,noexec,nosuid,nodev,size=5242880)
none on /run/shm type tmpfs (rw,nosuid,nodev)
none on /run/user type tmpfs (rw,noexec,nosuid,nodev,size=104857600,mode=0755)
rpc_pipefs on /run/rpc_pipefs type rpc_pipefs (rw)
/dev/xvdaa on /mnt type ext3 (rw,_netdev)
master:/home on /home type nfs (rw,vers=4,addr=172.31.46.87,clientaddr=172.31.36.141)
master:/opt/sge6 on /opt/sge6 type nfs (rw,vers=4,addr=172.31.46.87,clientaddr=172.31.36.141)
```

Logging into sgeadmin from Master node

```
root@master:~# ssh node001 hostname  
node001  
root@master:~# su - sgeadmin  
sgeadmin@master:~$ ssh node001 hostname  
node001
```

Importing file created through vi editor to cluster
(using put command already done before.)

```
starcluster put mycluster helloworldmpi.c /home/sgeadmin
```

Running the program file in the cluster

```
sgeadmin@master:~$ vi helloworldmpi.c
sgeadmin@master:~$ mpicc helloworldmpi.c -o hellompi
sgeadmin@master:~$ mpirun -n 2 -host master,node001 ./hellompi
master: hello world from process 0 of 1
node001: hello world from process 0 of 1
```

Terminating the Cluster

```
karthik@DESKTOP-1FFJPNG:~$ starcluster terminate mycluster
/home/karthik/.local/lib/python2.7/site-packages/paramiko/transport.py:33: CryptographyDeprecationWarning: Python 2 is no longer supported by the Python core team. Support for it is now deprecated in cryptograph
y, and will be removed in a future release.
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Terminate EBS cluster mycluster (y/n)? y
>>> Running plugin starcluster.plugins.sge.SGEPlugin
>>> Running plugin starcluster.clustersetup.DefaultClusterSetup
>>> Terminating node: master (i-0e937d7f449f82b31)
>>> Terminating node: node001 (i-05f6728353f7dbd3f)
/home/karthik/.local/lib/python2.7/site-packages/boto/ec2/connection.py:1339: UserWarning: The 'launch.group-id' filter now requires a security group id (sg-*) and no longer supports filtering by group name. Plea
se update your filters accordingly.
  UserWarning)
>>> Waiting for cluster to terminate...
>>> Removing security group: @sc-mycluster
karthik@DESKTOP-1FFJPNG:~$
```