

Hadoop Multi Nodes Cluster Setup

底下步驟將建立一個 Hadoop Multi Nodes Cluster，包含三個 VM

伺服器名稱	類別	HDFS	YARN
HadoopMaster	Master	NameNode	ResourceManager
HadoopSlave1	Node	DataNode	NodeManager
HadoopSlave2	Node	DataNode	NodeManager

1. 複製 single node cluster 到 hadoopslave1

- 若下為使用 VMWare 個人版的做法，若為專業版可以非常簡單的複製已存在的 VM
- 先於 VM 儲存資料夾中建立要放置三個 VM 檔案的資料夾

名稱	修改日期	類型	大小
HadoopMaster	2016/12/8 下午 0...	檔案資料夾	
HadoopServer	2016/12/8 下午 0...	檔案資料夾	
HadoopServer_20161112	2016/11/13 上午 ...	檔案資料夾	
HadoopSlave1	2016/12/8 下午 0...	檔案資料夾	
HadoopSlave2	2016/12/8 下午 0...	檔案資料夾	

- 將之前建好的 single node cluster VM 資料夾中的檔案複製到 HadoopSlave1 中

OneDrive > 文件 > Virtual Machines > HadoopSlave1 >			
名稱	修改日期	類型	大小
HadoopServer.vmx.lck	2016/12/3 下午 0...	檔案資料夾	
HadoopServer.nvram	2016/12/3 下午 0...	NVRAM 檔案	9 KB
HadoopServer	2016/12/3 下午 0...	VMware virtual d...	1 KB
HadoopServer.vmsd	2016/12/2 下午 0...	VMSD 檔案	0 KB
HadoopServer	2016/12/3 下午 0...	VMware virtual ...	4 KB
HadoopServer.vmx	2016/12/2 下午 0...	VMXF 檔案	1 KB
HadoopServer-s001	2016/12/3 下午 0...	VMware virtual d...	3,164,544...
HadoopServer-s002	2016/12/3 下午 0...	VMware virtual d...	931,584 KB
HadoopServer-s003	2016/12/3 下午 0...	VMware virtual d...	559,808 KB
HadoopServer-s004	2016/12/3 下午 0...	VMware virtual d...	443,584 KB
HadoopServer-s005	2016/12/3 下午 0...	VMware virtual d...	183,104 KB
HadoopServer-s006	2016/12/3 下午 0...	VMware virtual d...	64 KB
vmware			277 KB
vmware-0			276 KB
vmware-1			358 KB

7-Zip

CRC SHA

Edit with Notepad++

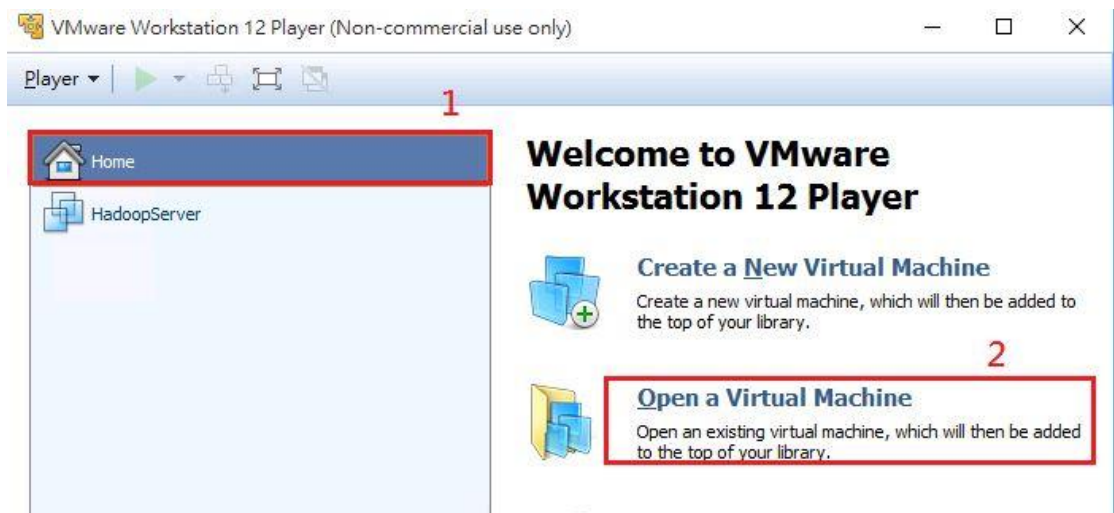
共用對象(H)

傳送到(N)

剪下(T)

複製(C)

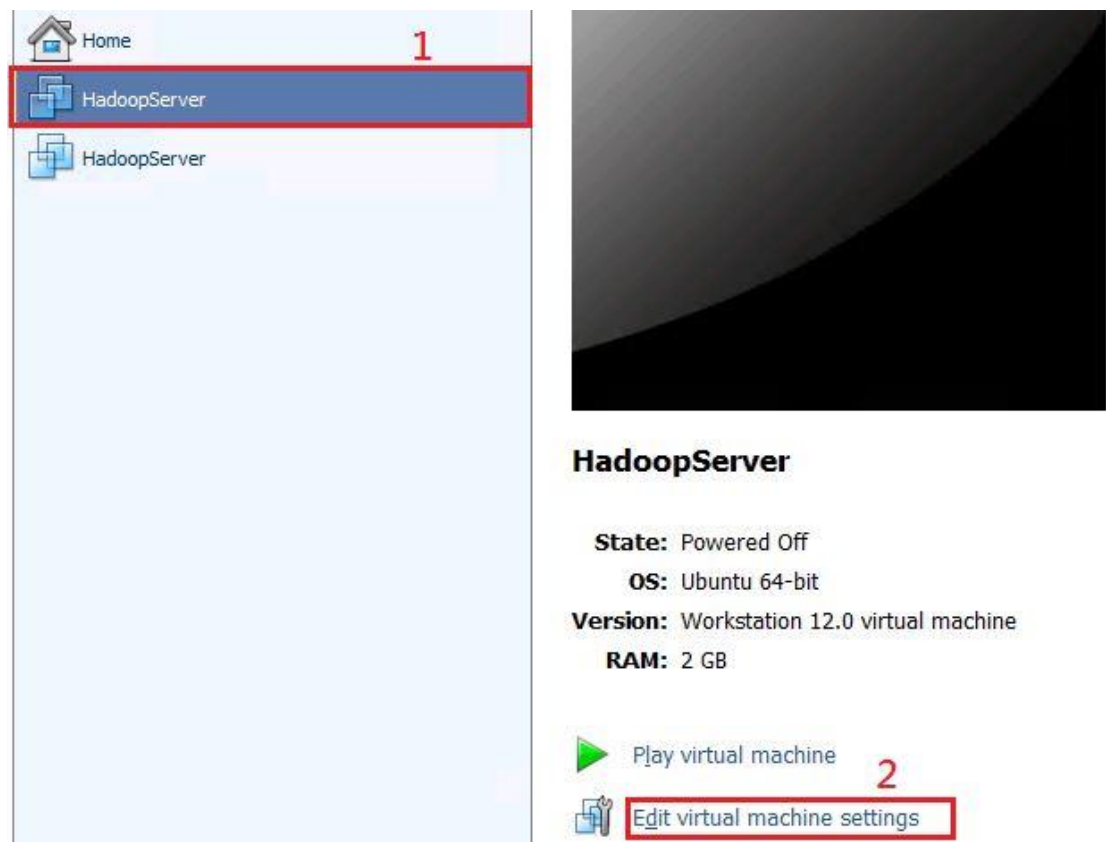
- 到 VM 介面，選擇 [Home]→[Open a Virtual Machine]

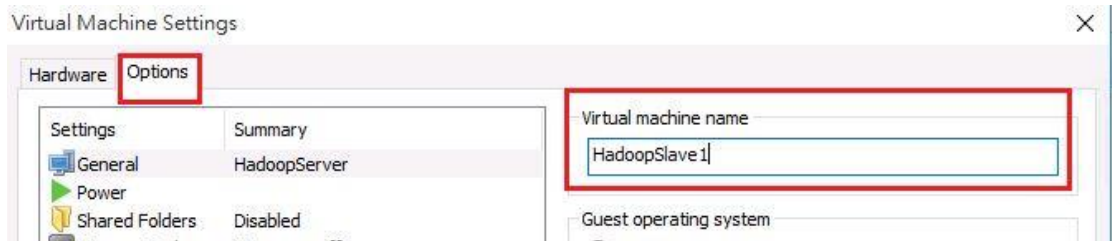


- 到 HadoopSlave1 資料夾選擇 configuration 檔

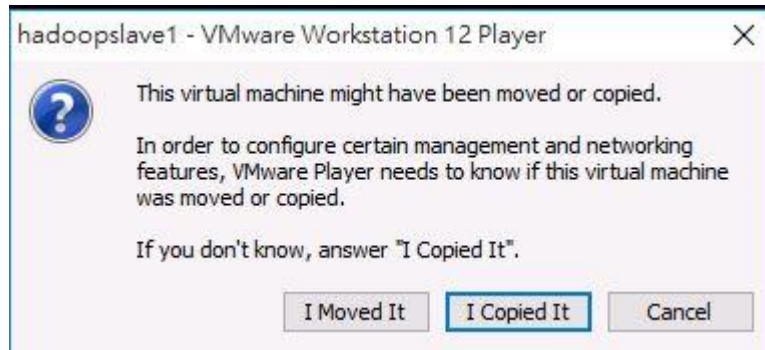


- 依步驟改變 VM 的名稱

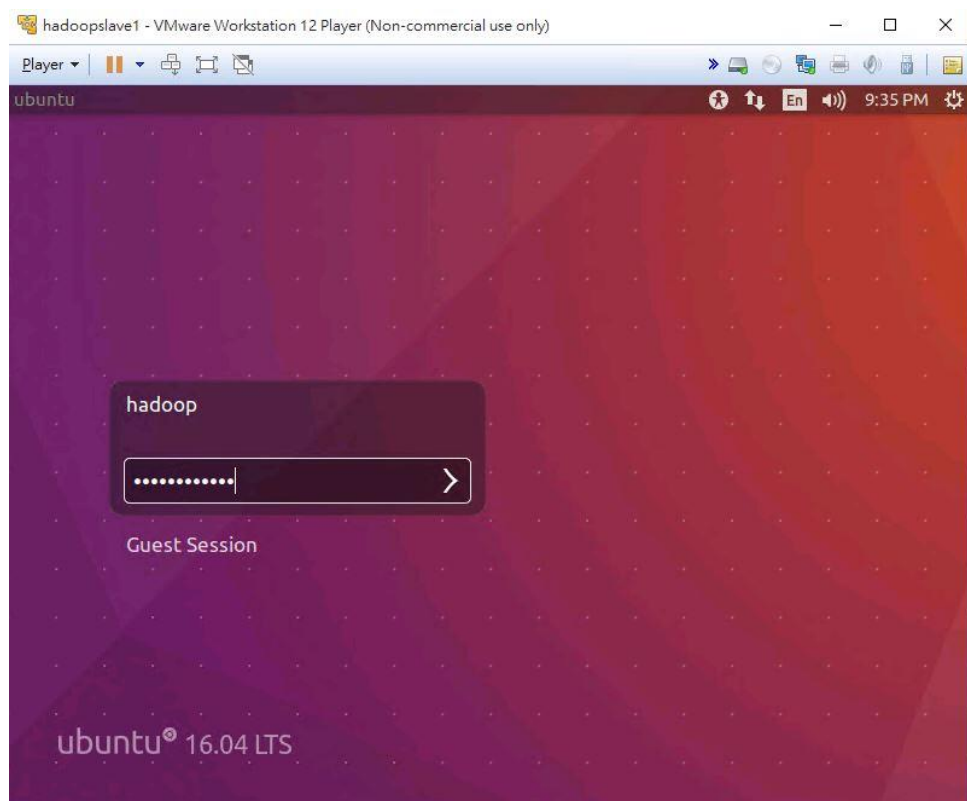




- 啟動 HadoopSlave1，VM 會發現 config 檔有異，選擇 **I Copied It**



- 即可順利複製完成



2. 設定 HadoopSlave1

- 啟動 HadoopSlave1 虛擬機
- 編輯 hostname 主機名稱，執行 `sudo gedit /etc/hostname`

```
hduser@ubuntu: ~  
hduser@ubuntu:~$ sudo gedit /etc/hostname  
(gedit:5676): IBUS-WARNING **: The owner of /home/hduser/.config/ibus/bus is not root!  
hostname  
/etc  
Save  
hadoopslave1
```

- 編輯 core-site.xml，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/core-site.xml`，指定 NameNode 位置，將原本設定 localhost 處改為 hadoopmaster

```
hduser@ubuntu: ~  
hduser@ubuntu:~$ sudo gedit /usr/local/hadoop/etc/hadoop/core-site.xml  
*core-site.xml  
/usr/local/hadoop/etc/hadoop  
Save  
<!-- Put site-specific property overrides in this file. -->  
  
<configuration>  
  <property>  
    <name>fs.default.name</name>  
    <value>hdfs://hadoopmaster:9000</value>  
  </property>  
</configuration>
```

- 編輯 yarn-site.xml，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/yarn-site.xml`，設定 ResourceManager 的屬性，輸入以下指令

```
<property>  
  <name>yarn.resourcemanager.resource-tracker.address</name>  
  <value>hadoopmaster:8025</value>  
</property>  
<property>  
  <name>yarn.resourcemanager.scheduler.address</name>  
  <value>hadoopmaster:8030</value>  
</property>  
<property>  
  <name>yarn.resourcemanager.address</name>  
  <value>hadoopmaster:8050</value>  
</property>
```



```
hduser@ubuntu:~$ sudo gedit /usr/local/hadoop/etc/hadoop/yarn-site.xml

* yarn-site.xml
/usr/local/hadoop/etc/hadoop

<!-- Put site-specific property overrides in this file. -->
<configuration>
  <property>
    <name>yarn.nodemanager.aux-services</name>
    <value>mapreduce_shuffle</value>
  </property>
  <property>
    <name>yarn.nodemanager.aux-services.mapreduce.shuffle.class</name>
    <value>org.apache.hadoop.mapred.ShuffleHandler</value>
  </property>
  <property>
    <name>yarn.resourcemanager.resource-tracker.address</name>
    <value>hadoopmaster:8025</value>
  </property>
  <property>
    <name>yarn.resourcemanager.scheduler.address</name>
    <value>hadoopmaster:8030</value>
  </property>
  <property>
    <name>yarn.resourcemanager.address</name>
    <value>hadoopmaster:8050</value>
  </property>
</configuration>
```

- 編輯 mapred-site.xml，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/mapred-site.xml`，設定監控 MapReduce 的 JobTracker 工作分配狀況，將原本設定 localhost 處改為 hadoopmaster

```
hduser@ubuntu:~$ sudo gedit /usr/local/hadoop/etc/hadoop/mapred-site.xml

* mapred-site.xml
/usr/local/hadoop/etc/hadoop

<!-- Put site-specific property overrides in this file. -->
<configuration>
  <property>
    <name>mapred.job.tracker</name>
    <value>hadoopmaster:54311</value>
  </property>
</configuration>
```

- 編輯 hdfs-site.xml，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/hdfs-site.xml`，設定 HDFS 分散式檔案組態

```
hduser@ubuntu: ~  
hduser@ubuntu:~$ sudo gedit /usr/local/hadoop/etc/hadoop/hdfs-site.xml  
hdfs-site.xml  
/usr/local/hadoop/etc/hadoop  
Save  
<!-- Put site-specific property overrides in this file. -->  
<configuration>  
  <property>  
    <name>dfs.replication</name>  
    <value>2</value>  
  </property>  
  <property>  
    <name>dfs.datanode.data.dir</name>  
    <value> file:/usr/local/hadoop/hadoop_data/hdfs/datanode</value>  
  </property>  
</configuration>
```

- 將 HadoopSlave1 關機



3. 複製 HadoopSlave1 的虛擬機設定檔，來產生 HadoopMaster、HadoopSlave2 等兩台虛擬機，修改 /etc/hostname 內的伺服器名稱分別為 `hadoopmaster` 和 `hadoopslave2`，設定完之後，虛擬機需重開。
4. 設定 HadoopMaster 伺服器
 - 編輯 hostname 主機名稱，執行 `sudo gedit /etc/hostname`，檔案內填入 `hadoopmaster`
 - 重開機 HadoopMaster
 - 編輯 hdfs-site.xml，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/hdfs-site.xml`，設定 NameNode 資料夾

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ sudo gedit /usr/local/hadoop/etc/hadoop/hdfs-site.xml  
*hdfs-site.xml  
/usr/local/hadoop/etc/hadoop  
Save  
See the License for the specific language governing permissions and  
limitations under the License. See accompanying LICENSE file.  
-->  
<!-- Put site-specific property overrides in this file. -->  
<configuration>  
  <property>  
    <name>dfs.replication</name>  
    <value>2</value>  
  </property>  
  <property>  
    <name>dfs.namenode.name.dir</name>  
    <value> file:/usr/local/hadoop/hadoop_data/hdfs/namehnode</value>  
  </property>  
</configuration>
```

- 編輯 masters，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/masters`，告訴 Hadoop 那一台伺服器為 NameNode

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ sudo gedit /usr/local/hadoop/etc/hadoop/masters  
*masters  
/usr/local/hadoop/etc/hadoop  
Save  
hadoopmaster
```

- 編輯 slaves，執行 `sudo gedit /usr/local/hadoop/etc/hadoop/slaves`，告訴 Hadoop 那些伺服器為 DataNode

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ sudo gedit /usr/local/hadoop/etc/hadoop/slaves  
*slaves  
/usr/local/hadoop/etc/hadoop  
Save  
hadoopslave1  
hadoopslave2
```

5. 設定各節點主機名稱和相應的 IP 位址

- 啟動三台虛擬機



- 分別至各虛擬機中，執行 `ifconfig`，取得伺服器 IP


```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ ifconfig  
ens33    Link encap:Ethernet HWaddr 00:0c:29:3f:1b:32  
          inet addr: 192.168.59.137 Bcast:192.168.59.255 Mask:255.255.255.0  
          inet6 addr: fe80::fdbf:c69d:8c33:159f/64 Scope:Link  
          UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1  
          RX packets:170 errors:0 dropped:0 overruns:0 frame:0  
          TX packets:82 errors:0 dropped:0 overruns:0 carrier:0  
          collisions:0 txqueuelen:1000  
          RX bytes:21763 (21.7 KB) TX bytes:8925 (8.9 KB)
```

- 至各虛擬機中，編輯/etc/hosts，執行 `sudo gedit /etc/hosts`，將節點主稱和 IP 位址填入

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ sudo gedit /etc/hosts  
*hosts  
/etc  
Save  
127.0.0.1    localhost  
127.0.1.1    ubuntu  
192.168.59.137 hadoopmaster  
192.168.59.134 hadoopslave1  
192.168.59.135 hadoopslave2  
  
# 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
```

6. Master 連線至 slavel、slave2 建立 HDFS 目錄

- 切換至 HadoopMaster 伺服器
- 由 HadoopMaster 經過 SSH 連至 HadoopSlave1，執行 `ssh hadoopslave1`，注意連線成功後會如圖紅線標示

```
hduser@hadoopslave1: ~  
hduser@hadoopmaster:~$ ssh hadoopslave1  
The authenticity of host 'hadoopslave1 (192.168.59.134)' can't be established.  
ECDSA key fingerprint is SHA256:l5HfVz2GKon2xpmavQSLRqfvPdxuogiqaf/Xjx5XV3E.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added 'hadoopslave1,192.168.59.134' (ECDSA) to the list of  
known hosts.  
hduser@hadoopslave1's password:  
Welcome to Ubuntu 16.04.1 LTS (GNU/Linux 4.4.0-31-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:       https://ubuntu.com/advantage  
  
282 packages can be updated.  
115 updates are security updates.  
hduser@hadoopslave1:~$
```

- 執行
 - i. 移除 hdfs 目錄，`sudo rm -rf /usr/local/hadoop/hadoop_data/hdfs`

- ii. 建立 DataNode 儲存目錄，`mkdir -p /usr/local/hadoop/hadoop_data/hdfs/datanode`
- iii. 修改目錄擁有者，`sudo chown -R hduser:hduser /usr/local/hadoop/`
- iv. 中斷連線

```
hduser@hadoopmaster: ~  
hduser@hadoopslave1:~$ sudo rm -rf /usr/local/hadoop/hadoop_data/hdfs  
[sudo] password for hduser:  
hduser@hadoopslave1:~$ sudo mkdir -p /usr/local/hadoop/hadoop_data/hdfs/datanode  
hduser@hadoopslave1:~$ sudo chown hduser:hduser -R /usr/local/hadoop  
hduser@hadoopslave1:~$ exit  
logout  
Connection to hadoopslave1 closed.  
hduser@hadoopmaster:~$
```

- 重複上述步驟，設定 hadoopslave2
- 建立 NameNode HDFS 目錄
 - i. 首先刪除 HDFS 目錄，執行 `sudo rm -rf /usr/local/hadoop/hadoop_data/hdfs`
 - ii. 建立 NameNode 目錄，執行 `mkdir -p /usr/local/hadoop/hadoop_data/hdfs/namenode`
 - iii. 修改目錄擁有者，`sudo chown -R hduser:hduser /usr/local/hadoop/`

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ sudo rm -rf /usr/local/hadoop/hadoop_data/hdfs  
hduser@hadoopmaster:~$ mkdir -p /usr/local/hadoop/hadoop_data/hdfs/namenode  
hduser@hadoopmaster:~$ sudo chown -R hduser:hduser /usr/local/hadoop  
hduser@hadoopmaster:~$
```

- 格式化 HDFS 目錄，執行 `hadoop namenode -format`

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ hadoop namenode -format  
DEPRECATED: Use of this script to execute hdfs command is deprecated.  
Instead use the hdfs command for it.  
  
16/11/27 20:10:13 INFO namenode.NameNode: STARTUP_MSG:  
/*****  
STARTUP_MSG: Starting NameNode  
STARTUP_MSG: host = hadoopmaster/192.168.59.132  
STARTUP_MSG: args = [-format]  
STARTUP_MSG: version = 2.7.3  
STARTUP_MSG: classpath = /home/hduser/hadoop-2.7.3/etc/hadoop:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/asm-3.2.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/jsp-api-2.1.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/gson-2.2.4.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/jetty-6.1.26.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/jersey-server-1.9.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/activation-1.1.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/commons-io-2.4.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/api-util-1.0.0-M20.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/commons-logging-1.1.3.jar:/home/hduser/hadoop-2.7.3/share/hadoop/common/lib/hadoop-annotations-2.7.3.jar:/home/hduser/hadoop-2.7.3/share/hadoop
```

7. 啟動 Hadoop Multi Nodes Cluster

- 切換至 HadoopMaster
- 執行 `start-all.sh`

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ start-all.sh  
This script is Deprecated. Instead use start-dfs.sh and start-yarn.sh  
Starting namenodes on [hadoopmaster]  
The authenticity of host 'hadoopmaster (192.168.59.137)' can't be established.  
ECDSA key fingerprint is SHA256:l5HfVz2GKon2xpmavQSLRqfvPdxuogiqaf/Xjx5XV3E.  
Are you sure you want to continue connecting (yes/no)? yes  
hadoopmaster: Warning: Permanently added 'hadoopmaster,192.168.59.137' (ECDSA) to the list of known hosts.  
hadoopmaster: starting namenode, logging to /usr/local/hadoop/logs/hadoop-hduser-namenode-hadoopmaster.out  
hadoopslave2: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser-datanode-hadoopslave2.out  
hadoopslave1: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser-datanode-hadoopslave1.out  
  
starting yarn daemons  
starting resourcemanager, logging to /usr/local/hadoop/logs/yarn-hduser-resource-manager-hadoopmaster.out  
hadoopslave1: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduser-nodemanager-hadoopslave1.out  
hadoopslave2: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduser-nodemanager-hadoopslave2.out
```

- 查看 HadoopMaster 所執行的行程，輸入 `jps`

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ jps  
33605 ResourceManager  
33240 NameNode  
33883 Jps  
33454 SecondaryNameNode  
hduser@hadoopmaster:~$
```

- 查看 HadoopSlave1、HadoopSlave2 的行程，輸入 `jps`

```
hduser@hadoopmaster: ~  
hduser@hadoopmaster:~$ ssh hadoopslave1  
Welcome to Ubuntu 16.04.1 LTS (GNU/Linux 4.4.0-31-generic x86_64)  
  
* Documentation:  https://help.ubuntu.com  
* Management:    https://landscape.canonical.com  
* Support:        https://ubuntu.com/advantage  
  
276 packages can be updated.  
109 updates are security updates.  
  
Last login: Sun Nov 27 19:52:55 2016 from 192.168.59.132  
hduser@hadoopslave1:~$ jps  
6273 Jps  
6106 NodeManager  
5980 DataNode  
hduser@hadoopslave1:~$ exit  
logout  
Connection to hadoopslave1 closed.  
hduser@hadoopmaster:~$
```

- 開啟 Hadoop ResourceManager Web 介面，開啟瀏覽器，輸入 <http://hadoopmaster:8088>，可看到如下畫面

All Applications x +

hadoopmaster:8088/cluster

hadoop

Cluster

- About
- Nodes
- Node Labels
- Applications
 - NEW
 - NEW_SAVING
 - SUBMITTED
 - ACCEPTED
 - RUNNING
 - FINISHED
 - FAILED
 - KILLED
- Scheduler

Tools

Cluster Metrics

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Me
0	0	0	0	0	0 B	24

Scheduler Metrics

Scheduler Type	Scheduling Resource Type
Capacity Scheduler	[MEMORY]

Show 20 entries

ID	User	Name	Application Type	Queue	StartTime
Showing 0 to 0 of 0 entries					

- 查看已執行的節點，於瀏覽器→Nodes，可看到目前有三個節點

Nodes of the cluster x +

hadoopmaster:8088/cluster/nodes

hadoop

Cluster

- About
- Nodes
- Node Labels
- Applications
 - NEW
 - NEW_SAVING
 - SUBMITTED
 - ACCEPTED
 - RUNNING
 - FINISHED
 - FAILED
 - KILLED
- Scheduler

Tools

Cluster Metrics

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Me
0	0	0	0	0	0 B	16

Scheduler Metrics

Scheduler Type	Scheduling Resource Type
Capacity Scheduler	[MEMORY]

Show 20 entries

Node Labels	Rack	Node State	Node Address	Node HTTP Address
/default-rack	RUNNING	hadoopslave2:45107	hadoopslave2:45107	
/default-rack	RUNNING	hadoopslave1:37314	hadoopslave1:37314	

- 開啟 NameNode HDFS Web 介面，於瀏覽器，輸入
<http://hadoopmaster:50070>

Namenode information	
hadoopmaster:50070/dfshealth.html#tab-o'	
DFS Remaining:	23.99 GB (68.18%)
Block Pool Used:	48 KB (0%)
DataNodes usages% (Min/Median/Max/stdDev):	0.00% / 0.00% / 0.00% / 0.00%
Live Nodes	2 (Decommissioned: 0)
Dead Nodes	0 (Decommissioned: 0)
Decommissioning Nodes	0

- 查看 DataNodes

Datanode Information

In operation

Node	Last contact	Admin State	Capacity	Used	Non DFS Used	Remaining	Blocks	Block pool used	Failure Volu
hadoopslave2:50010 (192.168.59.135:50010)	1	In Service	17.59 GB	24 KB	5.6 GB	11.99 GB	0	24 KB (0%)	0
hadoopslave1:50010 (192.168.59.134:50010)	1	In Service	17.59 GB	24 KB	5.6 GB	11.99 GB	0	24 KB (0%)	0

- 欲結束 Hadoop，執行 `stop-all.sh`