Novixys Software Dev Blog

How to Setup an Apache Hadoop Cluster on AWS EC2

This article demonstrates how to get Apache Hadoop up and running on an Amazon EC2 cluster.

Contents [hide]

Introduction

Lets talk about how to setup an Apache Hadoop cluster on AWS.

In a previous article, we discussed setting up a Hadoop processing pipeline on a single node (laptop). That involved running all the components of Hadoop on a single machine. In the setup we discuss here, we setup a multi-node cluster to run processing jobs.

Our setup involves a single NameNode and three DataNodes which serve as processing slaves.

Starting with setting up the AWS EC2 resources, we take you all the way through complete configuration of the machines in this arrangement.

We use Apache Hadoop 2.7.3 for this demonstration.

Pre-Requisites

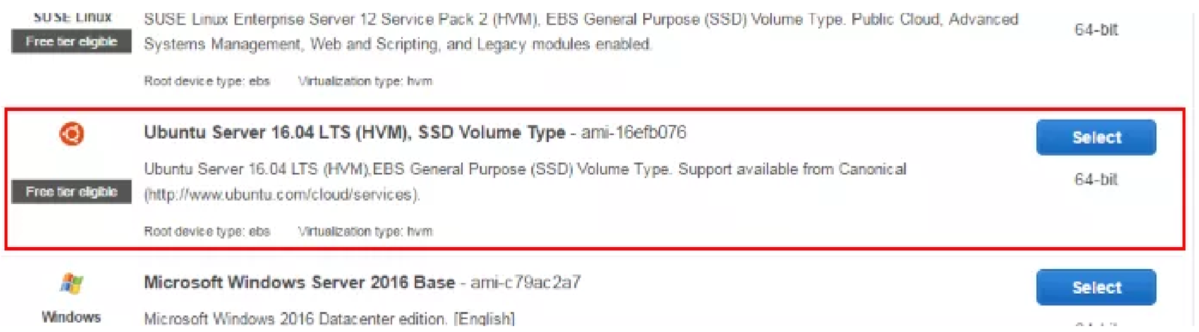
Sign up for an AWS account if you don't already have one. You get some resources free for the first year, including an EC2 Micro Instance.

AWS EC2 Startup

We will now create 4 instances of Ubuntu Server 16.04 LTS using Amazon EC2.

Select Instance

Go to your AWS Console, Click on Launch Instance and select Ubuntu Server 16.04 LTS.

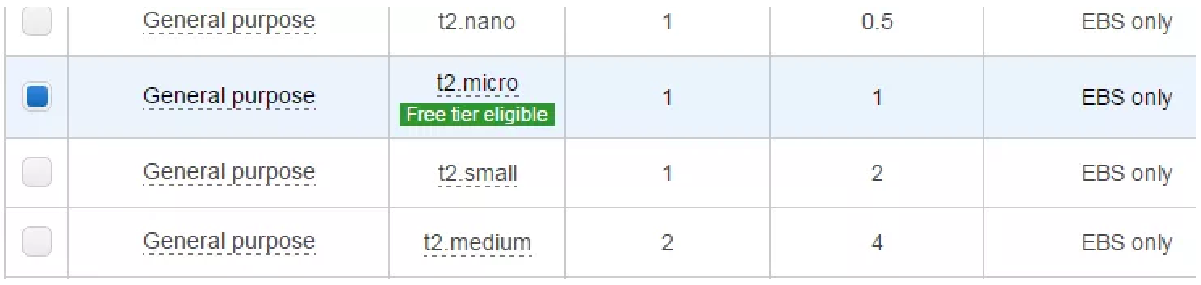

SUSE Linux
Free tier eligible
SUSE Linux Enterprise Server 12 Service Pack 2 (HVM), EBS General Purpose (SSD) Volume Type. Public Cloud, Advanced Systems Management, Web and Scripting, and Legacy modules enabled.
Root device type: ebs Virtualization type: hvm
64-bit

Free tier eligible
Ubuntu Server 16.04 LTS (HVM), SSD Volume Type - ami-16efb076
Ubuntu Server 16.04 LTS (HVM),EBS General Purpose (SSD) Volume Type. Support available from Canonical (http://www.ubuntu.com/cloud/services).
Root device type: ebs Virtualization type: hvm
Select
64-bit

Windows
Microsoft Windows Server 2016 Base - ami-c79ac2a7
Microsoft Windows 2016 Datacenter edition. [English]
Select

Instance Type

For the instance type, we choose **t2.micro** since that is sufficient for the purposes of the demo. If you have a need for a high-memory or high-cpu instance, you can select one of those.

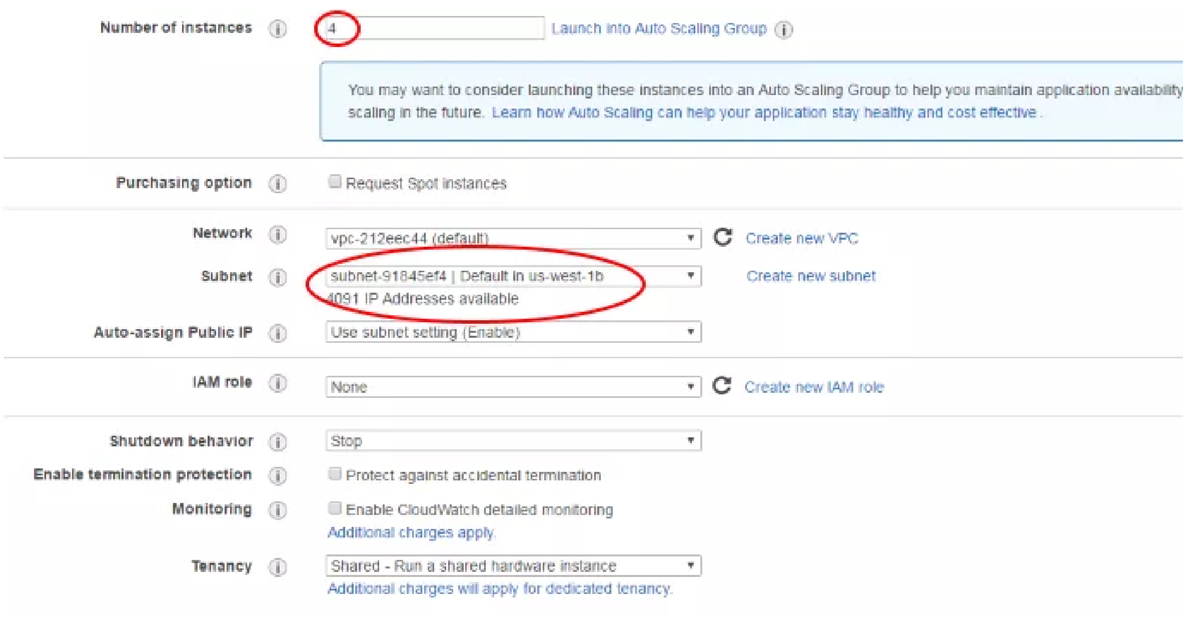


☐	General purpose	t2.nano	1	0.5	EBS only
☑	General purpose	t2.micro Free tier eligible	1	1	EBS only
☐	General purpose	t2.small	1	2	EBS only
☐	General purpose	t2.medium	2	4	EBS only

Click Next to Configure Instance Details

Instance Details

Here, we request 4 instances of the selected machine type. We also choose a subnet (us-west-1b) just so we can launch into the same location if we need more machines.


Number of instances: 4 | Launch into Auto Scaling Group

You may want to consider launching these instances into an Auto Scaling Group to help you maintain application availability
scaling in the future. Learn how Auto Scaling can help your application stay healthy and cost effective.

Purchasing option: ☐ Request Spot instances

Network: vpc-212eec44 (default) | Create new VPC

Subnet: subnet-91845ef4 | Default in us-west-1b
4091 IP Addresses available | Create new subnet

Auto-assign Public IP: Use subnet setting (Enable)

IAM role: None | Create new IAM role

Shutdown behavior: Stop

Enable termination protection: ☐ Protect against accidental termination

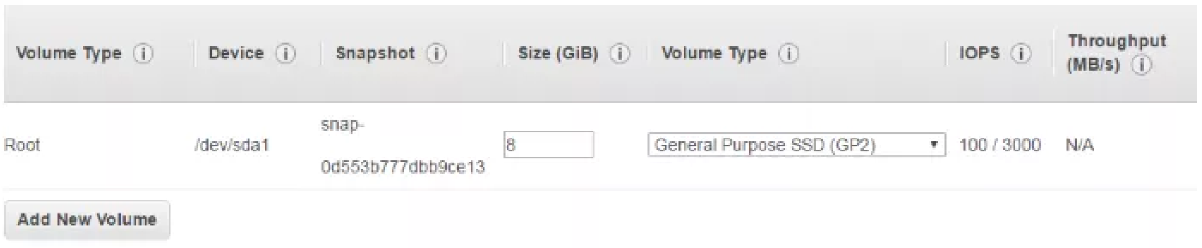
Monitoring: ☐ Enable CloudWatch detailed monitoring
Additional charges apply.

Tenancy: Shared - Run a shared hardware instance
Additional charges will apply for dedicated tenancy.

Click Next to Add Storage

Storage

For our purpose, the default instance storage of 8GB is sufficient. If you need more storage, either increase the size or attach a disk by clicking “Add Volume”. If you add a volume, you will need to attach the volume to your instance, format it and mount it. Since this is a beginner tutorial, these steps are not covered here.



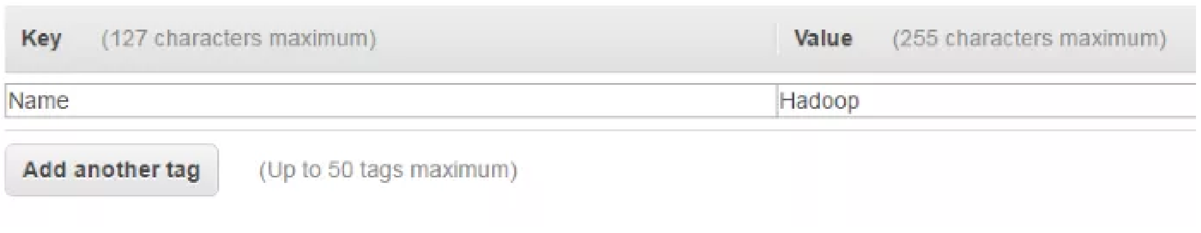
Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)
Root	/dev/sda1	snap-0d553b777dbb9ce13	8	General Purpose SSD (GP2)	100 / 3000	N/A

Click Next to Add Tags to your instances.

Instance Tags

A tag allows you to identify your instance with a name you can choose.

Click Add Tag, set the Key to “Name” and value to “Hadoop”. We will use this tag to re-label our instances as “namenode”, “datanode1” and so on later on. For now leave the value of all the instances as “Hadoop”.

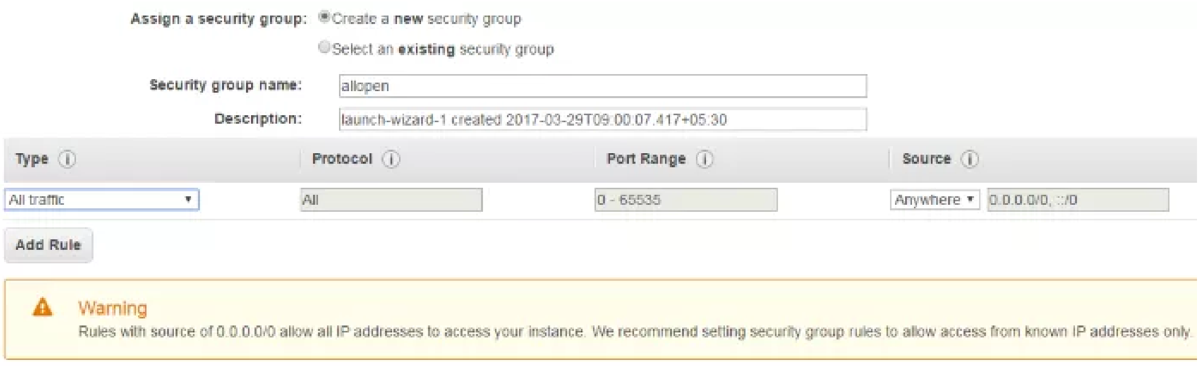


Key (127 characters maximum)	Value (255 characters maximum)
Name	Hadoop

Click Next to configure Security Group for the instances.

Security Group

For the security group, we create a completely open security group for the purposes of testing.



Assign a security group: [✓ Create a **new** security group] Select an **existing** security group

Security group name: allopen

Description: launch-wizard-1 created 2017-03-29T09:00:07.417+05:30

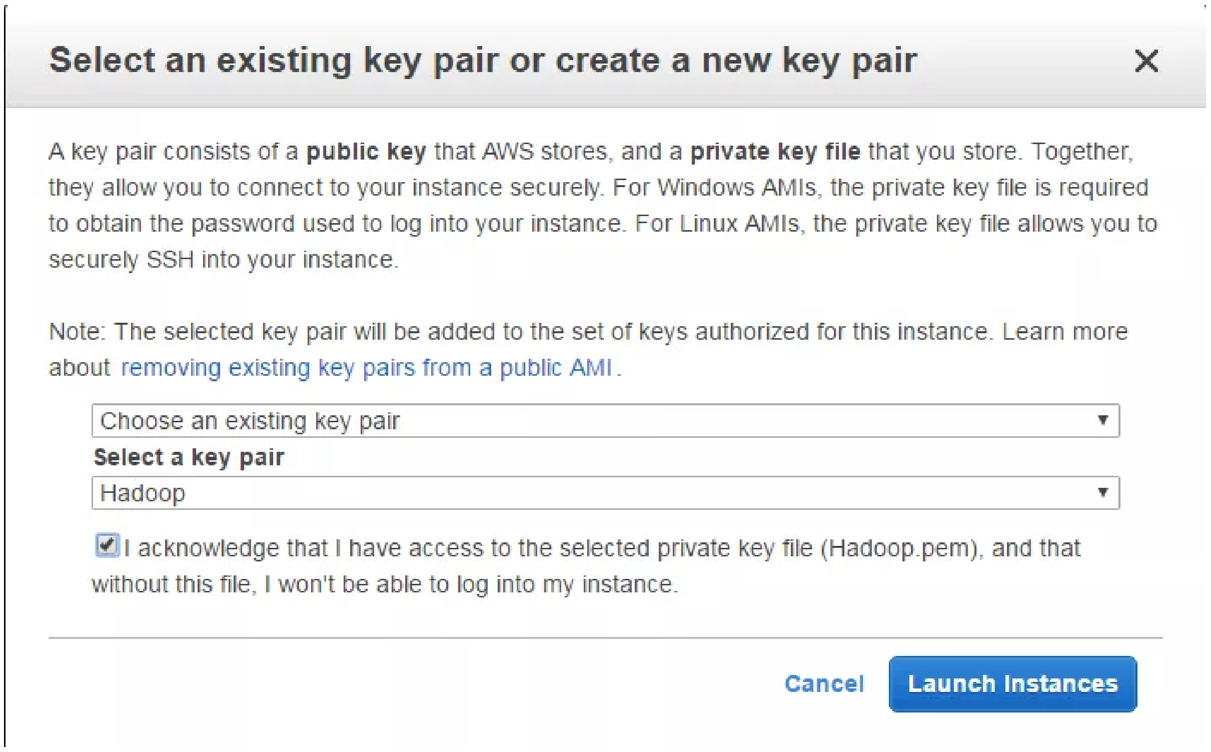
Type	Protocol	Port Range	Source
All traffic	All	0 - 65535	Anywhere 0.0.0.0/0, ::/0

Warning
Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

Finally we get to the Launch screen.

Launch Instances

Review the information again and click Launch to start the instances. You will need to create a key pair or use an existing key pair. Follow the instructions on the Launch Wizard to create a new key pair. Then click “I acknowledge ..” and then Launch Instances.



Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about removing existing key pairs from a public AMI .

Choose an existing key pair

Select a key pair

Hadoop

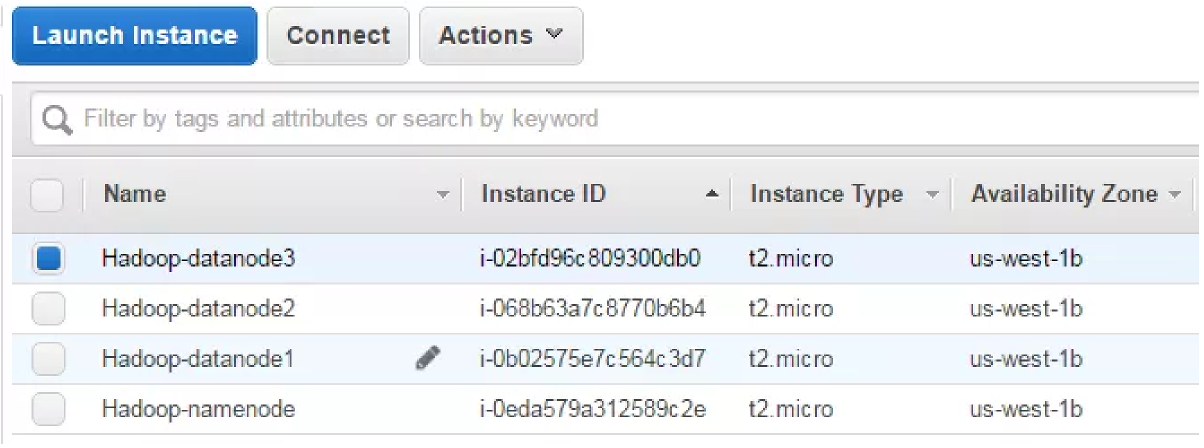
☑ I acknowledge that I have access to the selected private key file (Hadoop.pem), and that without this file, I won't be able to log into my instance.

You can now go to the instances page and check on the status of the instances.

Naming the Instances

On the instances page, let us setup the names of the instances. These are not DNS names, but names we assign to help us distinguish between them.

Click the pencil icon next to the name and setup the names as shown.



Name	Instance ID	Instance Type	Availability Zone
Hadoop-datanode3	i-02bfd96c809300db0	t2.micro	us-west-1b
Hadoop-datanode2	i-068b63a7c8770b6b4	t2.micro	us-west-1b
Hadoop-datanode1	i-0b02575e7c564c3d7	t2.micro	us-west-1b
Hadoop-namenode	i-0eda579a312589c2e	t2.micro	us-west-1b

Setting Up Instances

Once the instances are up and running, it is time to set them up for our purpose. This includes the following:

- Setup password-less login between the namenode and the datanodes.
- Install java.
- Setup Hadoop.

Copy Instance Public DNS Name

We now need to copy the Public DNS Name of each node (1 namenode and 3 datanodes). These names are used in the configuration steps below. Since the DNS is specific to each setup, we refer to the names as follows.

For example, in the description below, if you see <nnode>, substitute with the value of <NameNode Public DNS>. Similarly for <dnode1> and so on.

nnode	<NameNode Public DNS>

dnode1	<DataNode1 Public DNS>
dnode2	<DataNode2 Public DNS>
dnode3	<DataNode3 Public DNS>

Common Setup on All Nodes

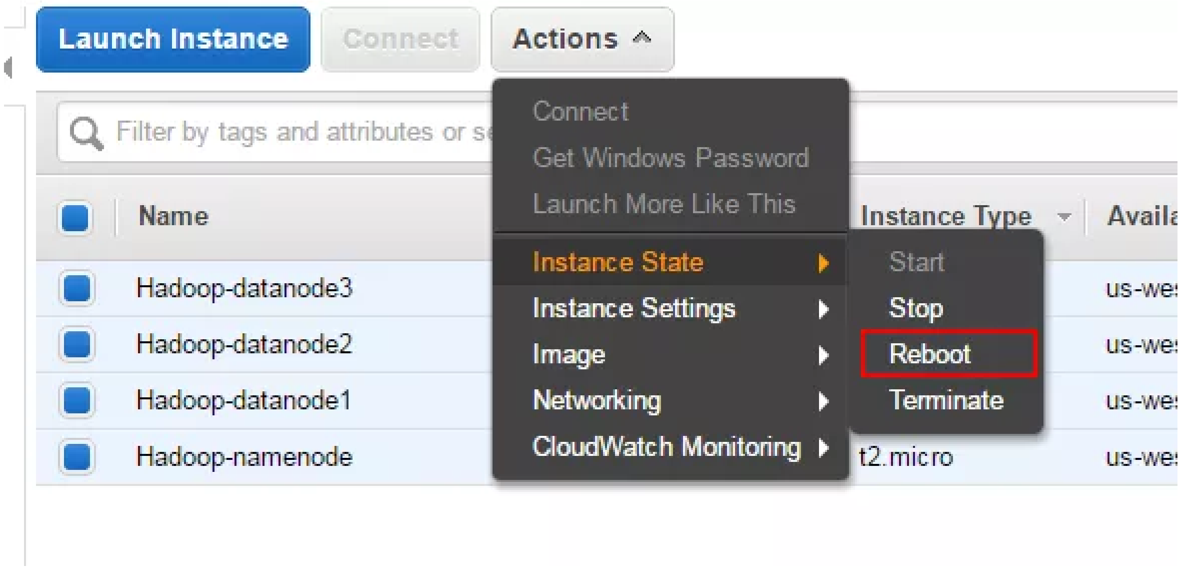
Some setup is common to all the nodes: NameNode and DataNodes. This is covered in this section.

All Nodes: Update the instance

Let us update the OS with latest available software patches.

```
sudo apt-get update && sudo apt-get -y dist-upgrade
```

After the updates, the system might require a restart. Perform a Reboot from the EC2 Instances page.



All Nodes: Install Java

Let us now install Java. We install the package: openjdk-8-jdk-headless on all the nodes.

```
sudo apt-get -y install openjdk-8-jdk-headless
```

All Nodes: Install Apache Hadoop

Install Apache Hadoop 2.7.3 on all the instances. Obtain the link to download from the Apache website and run the following commands. We install Hadoop under a directory `server` in the home directory.

```
mkdir server
cd server
wget <Link to Hadoop 2.7.3>
tar xvzf hadoop-2.7.3.tar.gz
```

All Nodes: Setup JAVA_HOME

On each of the nodes, edit `~/server/hadoop-2.7.3/etc/hadoop/hadoop-env.sh`.

Replace this line:

```
export JAVA_HOME=${JAVA_HOME}
```

With the following line:

```
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-amd64
```

All Nodes: Update `core_site.xml`

On each node, edit `~/server/hadoop-2.7.3/etc/hadoop/core-site.xml` and replace the following lines:

```
<configuration>
</configuration>
```

with these (as mentioned above, replace <nnode> with NameNode's public DNS):

```
<configuration>
  <property>
    <name>fs.defaultFS</name>
    <value><nnode>:9000</value>
  </property>
</configuration>
```

All Nodes: Create Data Dir

HDFS needs the data directory to be present on each node: 1 name node and 3 data nodes. Create this directory as shown and change ownership to user ubuntu.

```
sudo mkdir -p /usr/local/hadoop/hdfs/data
sudo chown -R ubuntu:ubuntu /usr/local/hadoop/hdfs/dat
```

Configuring NameNode

After performing configuration common to all nodes, let us now setup the NameNode.

Namenode: Password Less SSH

As mentioned before, we need password-less SSH between the name nodes and the data nodes. Let us create a public-private key pair for this purpose on the namenode.

```
namenode> ssh-keygen
```

Use the default (`/home/ubuntu/.ssh/id_rsa`) for the key location and hit enter for an empty passphrase.

Datanodes: Setup Public Key

The public key is saved in `/home/ubuntu/.ssh/id_rsa.pub`. We need to copy this file from the namenode to each data node and append the contents to `/home/ubuntu/.ssh/authorized_keys` on each data node.

```
datanode1> cat id_rsa.pub >> ~/.ssh/authorized_keys
datanode2> cat id_rsa.pub >> ~/.ssh/authorized_keys
datanode3> cat id_rsa.pub >> ~/.ssh/authorized_keys
```

Namenode: Setup SSH Config

SSH uses a configuration file located at `~/.ssh/config` for various parameters. Set it up as shown below. Again, substitute each node's Public DNS for the HostName parameter (for example, replace <nnode> with EC2 Public DNS for NameNode).

```
Host nnode
  HostName <nnode>
  User ubuntu
```

```
    IdentityFile ~/.ssh/id_rsa

  Host dnode1
    HostName <dnode1>
    User ubuntu
    IdentityFile ~/.ssh/id_rsa

  Host dnode2
    HostName <dnode2>
    User ubuntu
    IdentityFile ~/.ssh/id_rsa

  Host dnode3
    HostName <dnode3>
    User ubuntu
    IdentityFile ~/.ssh/id_rsa
```

At this point, verify that password-less operation works on each node as follows (the first time, you will get a warning that the host is unknown and whether you want to connect to it. Type *yes* and hit enter. This step is needed once only):

```
namenode> ssh nnode
namenode> ssh dnode1
namenode> ssh dnode2
namenode> ssh dnode3
```

Namenode: Setup HDFS Properties

On the NameNode, edit the following file: `~/server/hadoop-2.7.3/etc/hadoop/hdfs-site.xml`

Replace:

```
<configuration>
</configuration>
```

With:

```
<configuration>
  <property>
    <name>dfs.replication</name>
    <value>3</value>
  </property>
  <property>
    <name>dfs.namenode.name.dir</name>
    <value>file:///usr/local/hadoop/hdfs/data</value>
  </property>
</configuration>
```

Namenode: Setup MapReduce Properties

On the NameNode, copy the file (`~/server/hadoop-2.7.3/etc/hadoop/mapred-site.xml.template`) to (`~/server/hadoop-2.7.3/etc/hadoop/mapred-site.xml`). Replace:

```
<configuration>
</configuration>
```

With this (as above replace <nnode> with NameNode's public DNS):

```
<configuration>
  <property>
    <name>mapreduce.jobtracker.address</name>
    <value><nnode>:54311</value>
  </property>
  <property>
    <name>mapreduce.framework.name</name>
    <value>yarn</value>
  </property>
</configuration>
```

Namenode: Setup YARN Properties

Next we need to set up `~/server/hadoop-2.7.3/etc/hadoop/yarn-site.xml` on the NameNode. Replace the following:

```
<configuration>

<!-- Site specific YARN configuration properties -->

</configuration>
```

With (as before, replace <nnode> with NameNode's public DNS):

```
<configuration>

  <!-- Site specific YARN configuration properties -->
  <property>
    <name>yarn.nodemanager.aux-services</name>
    <value>mapreduce_shuffle</value>
  </property>
  <property>
    <name>yarn.nodemanager.aux-services.mapreduce.shuf
    <value>org.apache.hadoop.mapred.ShuffleHandler</va
  </property>
  <property>
    <name>yarn.resourcemanager.hostname</name>
    <value><nnode></value>
  </property>

</configuration>
```

Namenode: Setup Master and Slaves

On the NameNode, create `~/server/hadoop-2.7.3/etc/hadoop/masters` with the following (replace <nnode> with the NameNode's public DNS):

```
<nnode>
```

Also replace all content in `~/server/hadoop-2.7.3/etc/hadoop/slaves` with (replace each of <dnode1>, etc with the appropriate DateNode's public DNS):

```
<dnode1>
<dnode2>
<dnode3>
```

Configuring Data Nodes

After covering configuration common to both NameNode and DataNodes, we have a little bit of configuring specific to DataNodes. On each data node, edit the file `~/server/hadoop-2.7.3/etc/hadoop/hdfs-site.xml` and replace the following:

```
<configuration>
</configuration>
```

With:

```
<property>
  <name>dfs.replication</name>
  <value>3</value>
</property>
<property>
  <name>dfs.datanode.data.dir</name>
  <value>file:///usr/local/hadoop/hdfs/data</value>
</property>
```

Starting the Hadoop Cluster

After all that configuration, it is now time to test drive the cluster. First, format the HDFS file system on the NameNode:

```
namenode> cd ~/server
namenode> ./hadoop-2.7.3/bin/hdfs namenode -format
```

Finally, startup the Hadoop Cluster. After this step you should have all the daemons running on the NameNode and the DataNodes.

```
namenode> ./hadoop-2.7.3/sbin/start-dfs.sh
namenode> ./hadoop-2.7.3/sbin/start-yarn.sh
namenode> ./hadoop-2.7.3/sbin/mr-jobhistory-daemon.sh
```

Check the console carefully for any error messages. If everything looks OK, check for the daemons using `jps` .

```
namenode> jps
```

You can also check on the datanodes for java processes.

```
datanode1> jps
```

Check the Web UI

Once the cluster is running, we can check the web UI for the status of the data nodes. Go to <nnode>:50070 for the Web UI and verify that the 3 data nodes added are online.

Summary

This article showed you how to setup Apache Hadoop on an Amazon EC2 cluster. Starting with standard Ubuntu 16.04 LTS instances, we configured the machines with Java and Apache Hadoop. Next we covered setting up various Hadoop components according to the role on each node. In the next article in this series on Apache Hadoop, we look into running jobs on the cluster.

See Also

[Apache Spark - Setup Cluster on AWS]

[Hadoop Tutorial]

[Apache POI Excel Example - Part 2]

Jay Sridhar / March 30, 2017 / Uncategorized / apache, hadoop