

Hadoop Multi-Node Cluster Setup

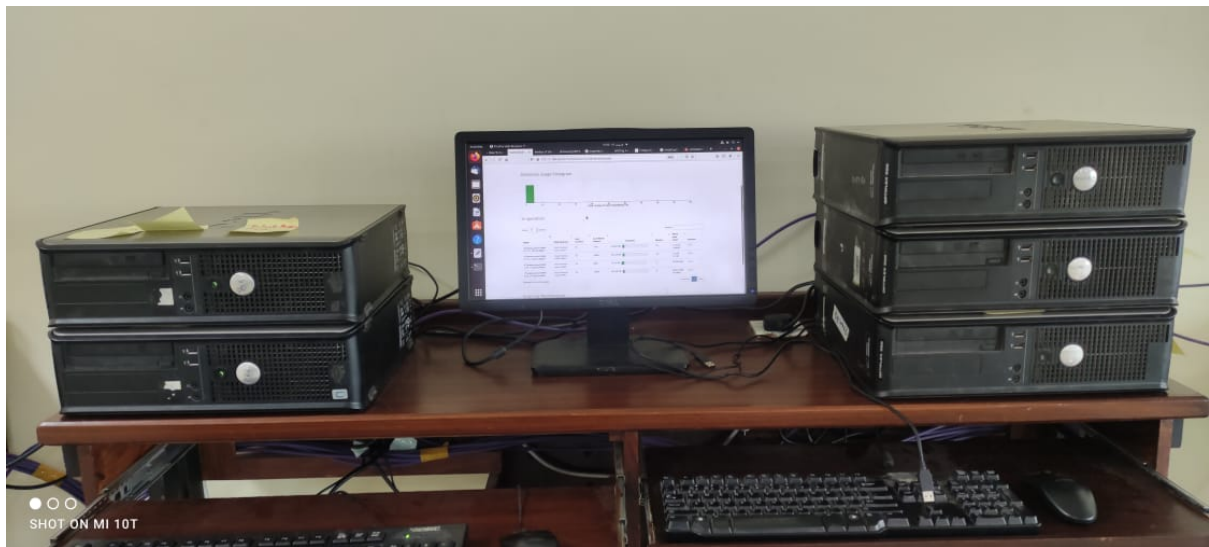
BDA LAB PROJECT

Follow the tutorial at the link below for multimode cluster setup for Hadoop

https://medium.com/@jootorres_11979/how-to-set-up-a-hadoop-3-2-1-multi-node-cluster-on-ubuntu-18-04-2-nodes-567ca44a3b12

Few things to keep in mind:

1. There are some issues with the tutorial. To counter that after performing each step try to verify if that step worked properly.
2. Going through the comments can be very helpful (you can find solutions there)
3. You are allowed to follow any tutorial as long as you get the job done and meet all the requirements.
4. I personally followed this tutorial and I can tell you that it works but not straight away there were problems that I had to fix myself.
5. This can be done in 1-2 days Max on virtual machines.
6. It took me 5 days to set up the whole cluster on physical machines which required Issuing Systems from IT, sending back the faulty drives, Shifting the machines to AIM Lab, physically installing Ubuntu on all 5, Physical Networking of Machines, Requesting Unrestricted access from IT Department, and Debugging of course.



1:Cluster showing 4 data nodes under resource manager



2: Showing the active nodes and pooled memory

You can ssh from your machine into the cluster using “ssh [172.17.180.26@h-user](https://172.17.180.26)” and password “master” .

Here are the static IP-configurations of the cluster:

```
172.17.180.26    hadoop-master
172.17.180.30    hadoop-slave1
172.17.180.32    hadoop-slave2
172.17.180.36    hadoop-slave3
172.17.180.38    hadoop-slave4
```

Cluster is only accessible from University Network (Private IP's)

Learning Outcomes:

- Networking
- Virtual Machines
- Password less remote log in
- Better understanding of UNIX/Linux
- Understanding of Yarn Resource Manager
- Deeper Understanding of Hadoop components
- Stepping in the direction of becoming Big Data Architect

Personal Growth:

- If you manage to do this project on your own, you would be able to setup and deploy “OpenStack” as well which is an alternate to Amazon Web Services i.e., Complete cloud deployment. Since it requires similar skill set (other than the theory).
- These skills are highly in demand and people get paid “Big Bucks” for these skills.
- Finally, and most importantly self-problem-solving and debugging which is the most sought-after trait in a CS professional and is hard to come by.
- In professional settings no one has time to guide you and help you figure out every single detail. **You either do it or you don't.** This would be a great practice to prepare you for that.

Requirements

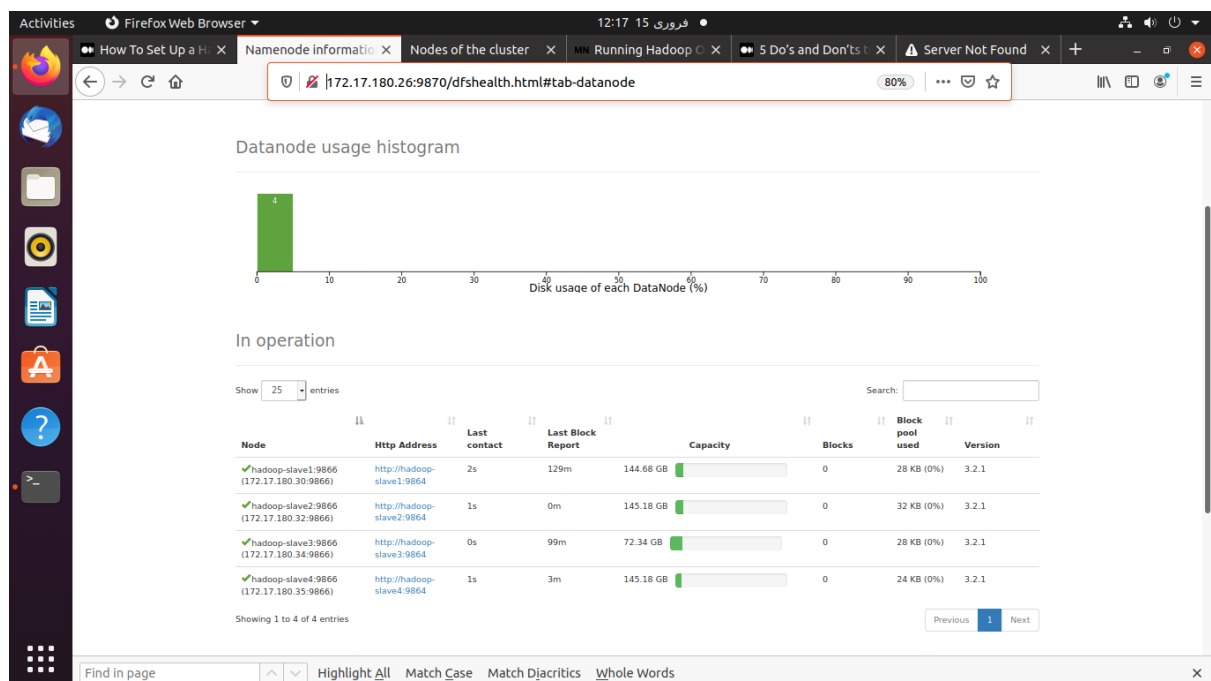
Requirement 1:

There need to be minimum 3 nodes configured for multi node setup.

Requirement 2:

The cluster is to be evaluated on the text file provided ("books_large_p1.txt" 2.52/2.3 GB).

<https://drive.google.com/file/d/1-PMjUSEPDluBiPRlg1EcHbFm9wQ1CUWq/view?usp=sharing>



Requirement 3: Data Nodes

A Screenshot displaying all the data nodes that are up and sending their heartbeat to the Master Node.

The screenshot shows the Hadoop cluster management interface. The top navigation bar includes links for 'Cluster', 'Nodes', 'Node Labels', 'Applications', and 'Tools'. The 'Nodes' link is selected. The main content area displays 'Nodes of the cluster' with a sidebar on the left showing a list of nodes. The 'Cluster Metrics' section shows the following data:

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Memory Used	Memory Total	Memory Reserved	VCores Used	VCores Total	VCores Reserved
0	0	0	0	0	0 B	32 GB	0 B	0	32	0

The 'Cluster Nodes Metrics' section shows the following data:

Active Nodes	Decommissioning Nodes	Decommissioned Nodes	Lost Nodes	Unhealthy Nodes	Rebooted Nodes	Shutdown Nodes
4	0	0	0	0	0	3

The 'Scheduler Metrics' section shows the following data:

Scheduler Type	Scheduling Resource Type	Minimum Allocation	Maximum Allocation	Maximum Cluster Application Priority
Capacity Scheduler	[memory-mb (unit=M), vcores]	<memory:1024, vCores:1>	<memory:8192, vCores:4>	0

The 'Nodes' table shows the following data:

Node Labels	Rack	Node State	Node Address	Node HTTP Address	Last health-update	Health-report	Containers	Allocation Tags	Mem Used	Mem Avail	VCores Used	VCores Avail	Version
/default-rack	RUNNING	hadoop-slave3:32929	hadoop-slave3:8042	Mon Feb 15 12:12:46 +0500 2021	0	0 B	8 GB	0	8	3.2.1			
/default-rack	RUNNING	hadoop-slave1:34343	hadoop-slave1:8042	Mon Feb 15 12:12:45 +0500 2021	0	0 B	8 GB	0	8	3.2.1			
/default-rack	RUNNING	hadoop-slave2:44093	hadoop-slave2:8042	Mon Feb 15 12:13:52 +0500 2021	0	0 B	8 GB	0	8	3.2.1			
/default-rack	RUNNING	hadoop-slave4:46369	hadoop-slave4:8042	Mon Feb 15 12:12:56 +0500 2021	0	0 B	8 GB	0	8	3.2.1			

Requirement 1: Node States (here showing 32 GB Pooled Memory 8GB each)

A Screen shot showing the cluster metrics including total Pooled Memory and the number of Active Nodes.

The screenshot shows the Hadoop cluster management interface. The top navigation bar includes links for 'Hadoop', 'Overview', 'Datanodes', 'Datanode Volume Failures', 'Snapshot', 'Startup Progress', and 'Utilities'. The 'Browse Directory' view is selected. The main content area displays the directory path '/LabWordCount/Output' with a search bar and a table of files. The table shows the following data:

Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
-rw-r--r--	h-user	supergroup	0 B	Feb 15 14:15	2	128 MB	._SUCCESS
-rw-r--r--	h-user	supergroup	10.95 MB	Feb 15 14:15	2	128 MB	part-r-00000

Requirement 2: Success on 2.5 GB Text file

A Screenshot displaying the directory of the cluster.

Configured Capacity:	507.38 GB
Configured Remote Capacity:	0 B
DFS Used:	3.96 GB (0.78%)
Non DFS Used:	35.95 GB
DFS Remaining:	441.45 GB (87.01%)
Block Pool Used:	3.96 GB (0.78%)
DataNodes usages% (Min/Median/Max/stdDev):	0.35% / 0.87% / 1.69% / 0.50%
Live Nodes	4 (Decommissioned: 0, In Maintenance: 0)
Dead Nodes	0 (Decommissioned: 0, In Maintenance: 0)
Decommissioning Nodes	0
Entering Maintenance Nodes	0
Total Datanode Volume Failures	0 (0 B)
Number of Under-Replicated Blocks	0
Number of Blocks Pending Deletion (including replicas)	0
Block Deletion Start Time	Mon Feb 15 09:12:30 +0500 2021
Last Checkpoint Time	Mon Feb 15 14:04:24 +0500 2021
Enabled Erasure Coding Policies	RS-6-3-1024k

Requirement 3: Cluster Overview

A Screenshot showing live nodes, total configured capacity etc.

File information - part-r-00000

Block Information -- Block 0

Block ID: 1073741841
 Block Pool ID: BP-58951415-172.17.180.26-1613111556784
 Generation Stamp: 1017
 Size: 11484111
 Availability:

- hadoop-slave4
- hadoop-slave2
- hadoop-slave3

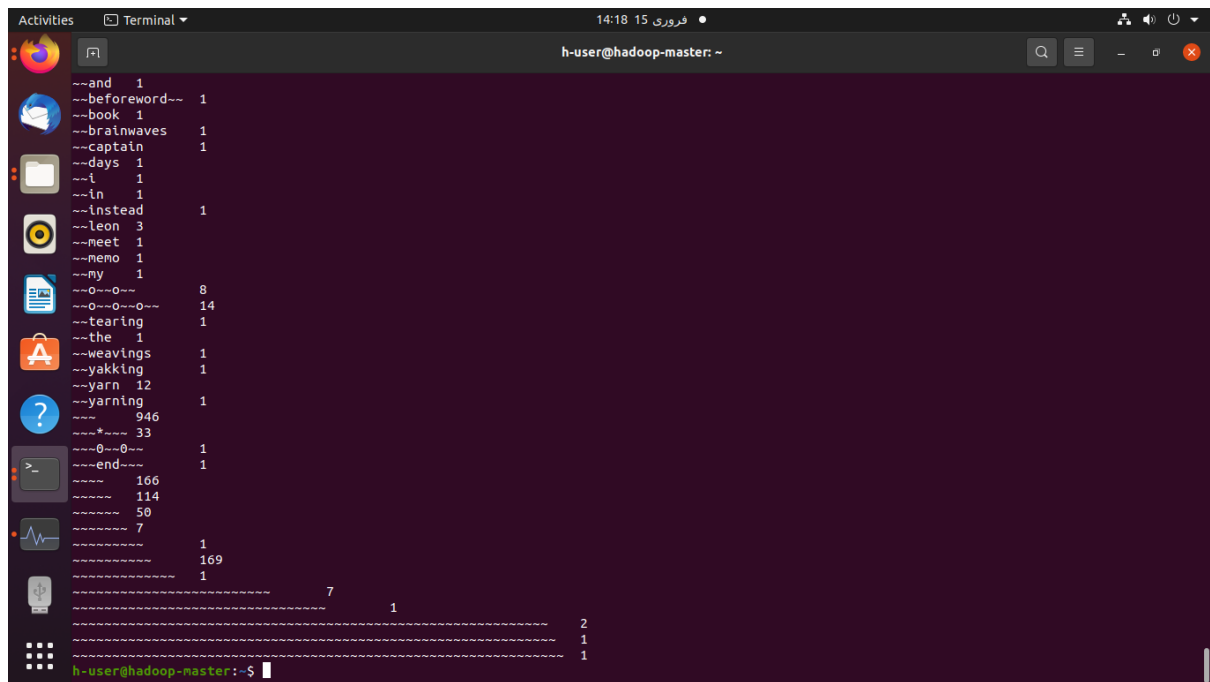
File contents

```

zaha 1
zahara 5
zaharoff 3
zahd 4
zahedan 4
zahel 160
zaher 11
zahi 7
  
```

Requirement 4: GUI Results with Active Nodes

A Screenshot That shows the head of the results with “Availability” parameter showing how many slave nodes were involved in processing these results. (I had 5 Machines out of which one was reserved as Master node only. I did not configure Master Node to act as a data node. It was just for pure monitoring).



```
h-user@hadoop-master: ~  
--and 1  
--beforeword-- 1  
--book 1  
--brainwaves 1  
--captain 1  
--days 1  
--i 1  
--in 1  
--instead 1  
--leon 3  
--meet 1  
--memo 1  
--my 1  
--o--o--o-- 8  
--o--o--o--o-- 14  
--tearing 1  
--the 1  
--weavings 1  
--yakking 1  
--yarn 12  
--yarning 1  
--- 946  
---*--- 33  
---0---0--- 1  
---end--- 1  
----- 166  
----- 114  
----- 50  
----- 7  
----- 1  
----- 169  
----- 1  
----- 7  
----- 1  
----- 2  
----- 1  
----- 1  
h-user@hadoop-master:~$
```

Requirement 5: CAT out the results in terminal

Screenshot of the output using cat command running on “part-00000”

Requirement 7:

- Prove that the 2.5 GB file was chunked, distributed, and processed on multiple nodes.
- Change the number of reducers to be equal to the number of Data Nodes.
- Prove how many mappers and reducers are configured on the cluster. By default, there is only one reducer which becomes the bottleneck of the whole process.

Potential Pitfalls:

1. Make sure all the machines have the same cluster id.
2. Knowing what cloning a machine does so that what commands need to be run on the new machine and not to repeat those commands (which can mess up things).
3. Being careful in setting up SSH keys and adding authorized keys
4. Properly setting up the paths
5. PAY VERY CLOSE ATTENTION to the user groups under which you are setting up the cluster in my case my Hadoop user name was “h-user”. This directly relates to where you will be running your commands. i.e., you are not logged in as your Hadoop user and trying to run the commands and wondering where did all your configurations go and why they are not working as expected, trying to SSH into the same machine with different username and getting errors etc.
6. Making your IP’s static so that every time you start your machine the DHCP server don’t allocate a new IP address (Because you have already set up your configurations and allowed SSH access to the resource manager using these IP addresses).