



Vidyavardhini's College of Engineering & Technology

Department of Computer Engineering

Experiment No.1
Hadoop HDFS Practical
Date of Performance:17/07/2023
Date of Submission:24/08/2023

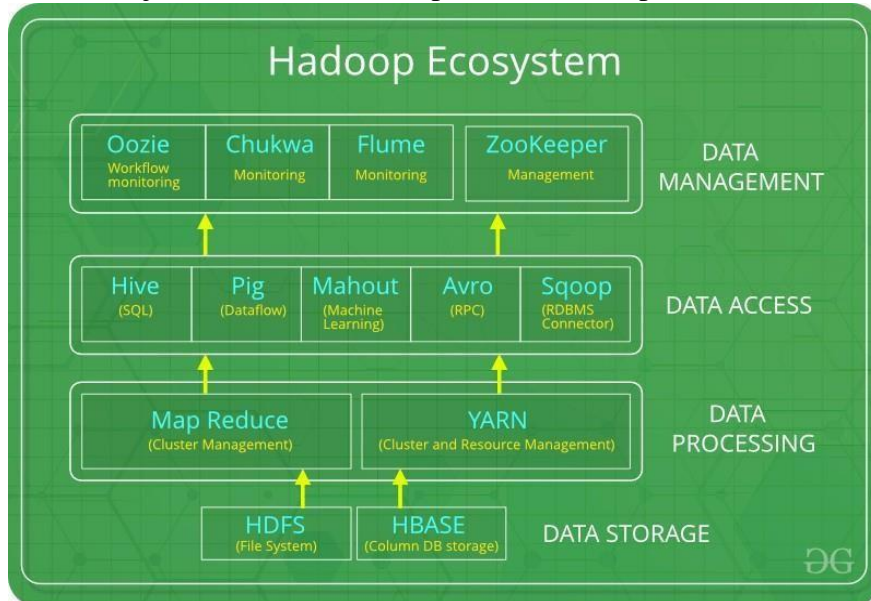


AIM : Installation, Configuration of hadoop and performing basic file management operations in hadoop.

THEORY :

What is the Hadoop Ecosystem?

Hadoop Ecosystem is a platform or a suite which provides various services to solve the big data problems. It includes Apache projects and various commercial tools and solutions. There are four major elements of Hadoop i.e. HDFS, MapReduce, YARN, and Hadoop Common.



Following are the components that collectively form a Hadoop ecosystem:

- HDFS: Hadoop Distributed File System
- YARN: Yet Another Resource Negotiator
- MapReduce: Programming based Data Processing
- Spark: In-Memory data processing
- PIG, HIVE: Query based processing of data services
- HBase: NoSQL Database
- Mahout, Spark MLlib: Machine Learning algorithm libraries
- Solar, Lucene: Searching and Indexing
- Zookeeper: Managing cluster
- Oozie: Job Scheduling

HDFS:

HDFS is the primary or major component of Hadoop ecosystem and is responsible for storing large data sets of structured or unstructured data across various nodes and thereby maintaining the metadata in the form of log files.

HDFS consists of two core components i.e.

- Name node
- Data Node

Name Node is the prime node which contains metadata (data about data) requiring comparatively fewer resources than the data nodes that stores the actual data. These data nodes are commodity hardware in the distributed environment.



HDFS maintains all the coordination between the clusters and hardware.

YARN:

Yet Another Resource Negotiator, as the name implies, YARN is the one who helps to manage the resources across the clusters. In short, it performs scheduling and resource allocation for the Hadoop System.

Resource manager has the privilege of allocating resources for the applications in a system whereas Node managers work on the allocation of resources such as CPU, memory, bandwidth per machine and later on acknowledges the resource manager. Application manager works as an interface between the resource manager and node manager and performs negotiations as per the requirement of the two.

MapReduce:

MapReduce makes the use of two functions i.e. Map() and Reduce() whose task is:

Map() performs sorting and filtering of data and thereby organizing them in the form of group. Map generates a key-value pair based result which is later on processed by the Reduce() method.

Reduce(), as the name suggests does the summarization by aggregating the mapped data. In simple, Reduce() takes the output generated by Map() as input and combines those tuples into smaller set of tuples.

HIVE:

Hive is an ETL and Data warehousing tool used to query or analyze large datasets stored within the Hadoop ecosystem. Hive has three main functions: data summarization, query, and analysis of unstructured and semi-structured data in Hadoop. It features a SQL-like interface, HQL language that works similar to SQL and automatically translates queries into MapReduce jobs.

PIG:

Pig was basically developed by Yahoo which works on a pig Latin language, which is Query based language similar to SQL. It is a platform for structuring the data flow, processing and analyzing huge data sets. Pig does the work of executing commands and in the background, all the activities of MapReduce are taken care of. After the processing, pig stores the result in HDFS.

Apache Spark:

It's a platform that handles all the process consumptive tasks like batch processing, interactive or iterative real-time processing, graph conversions, and visualization, etc.

It consumes in memory resources hence, thus being faster than the prior in terms of optimization.

Installation of Hadoop

Download Hadoop 2.8.0 (Link: <http://www-eu.apache.org/dist/hadoop/common/hadoop-2.8.0/hadoop-2.8.0.tar.gz> OR <http://archive.apache.org/dist/hadoop/core/hadoop-2.8.0/hadoop-2.8.0.tar.gz>)

Java JDK 1.8.0.zip (Link: <http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html>)

Check either Java 1.8.0 is already installed on your system or not, use "Javac -version" to check.



```
C:\Windows\System32\cmd.exe

C:\>javac -version
javac 1.8.0_192

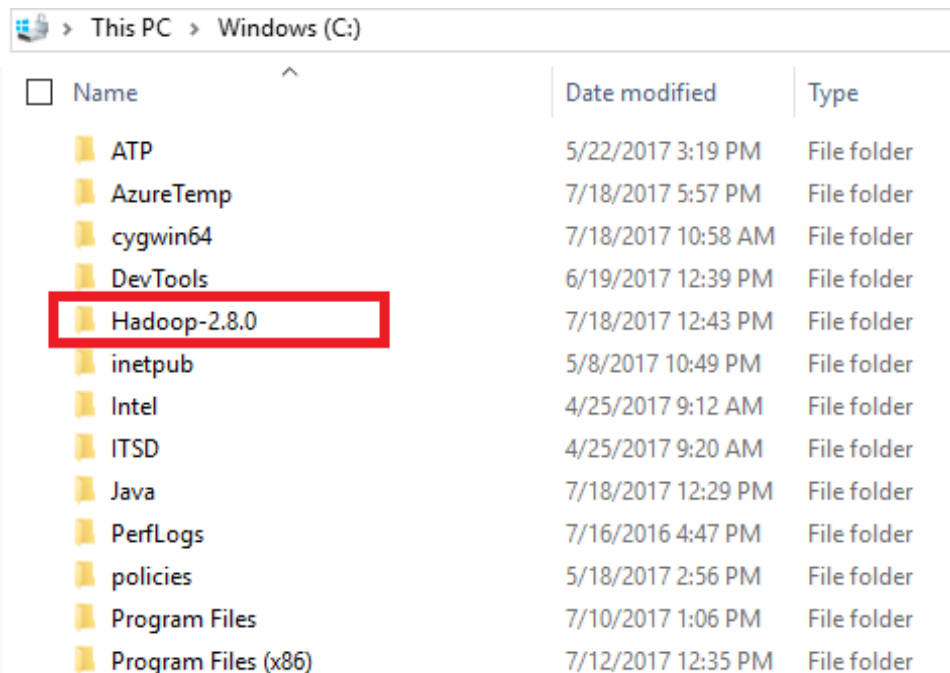
C:\>
```

If Java is not installed on your system then first install java under "C:\JAVA"

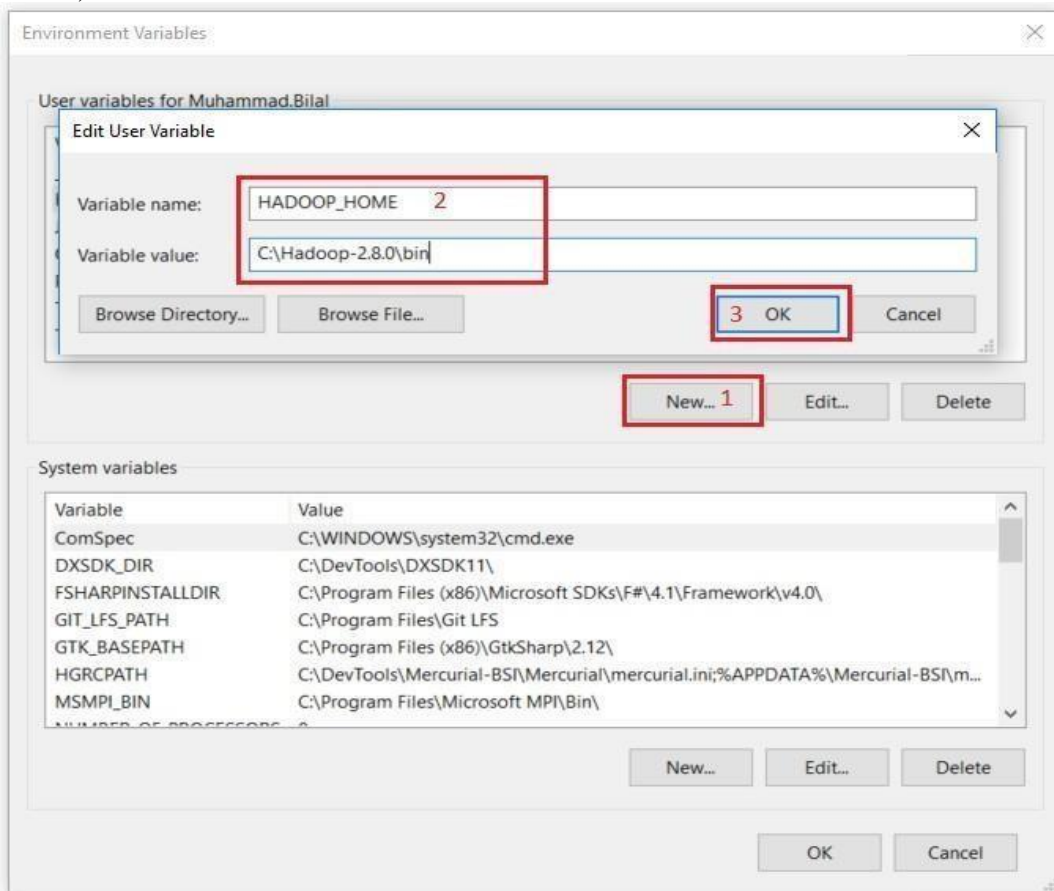
This PC > Windows (C:)

<input type="checkbox"/> Name	Date modified	Type
ATP	5/22/2017 3:19 PM	File folder
AzureTemp	7/18/2017 5:57 PM	File folder
cygwin64	7/18/2017 10:58 AM	File folder
DevTools	6/19/2017 12:39 PM	File folder
Hadoop-2.8.0	7/18/2017 12:43 PM	File folder
inetpub	5/8/2017 10:49 PM	File folder
Intel	4/25/2017 9:12 AM	File folder
ITSD	4/25/2017 9:20 AM	File folder
Java	7/18/2017 12:29 PM	File folder
PerfLogs	7/16/2016 4:47 PM	File folder
policies	5/18/2017 2:56 PM	File folder
Program Files	7/10/2017 1:06 PM	File folder
Program Files (x86)	7/12/2017 12:35 PM	File folder

Extract file Hadoop 2.8.0.tar.gz or Hadoop-2.8.0.zip and place under "C:\Hadoop-2.8.0".

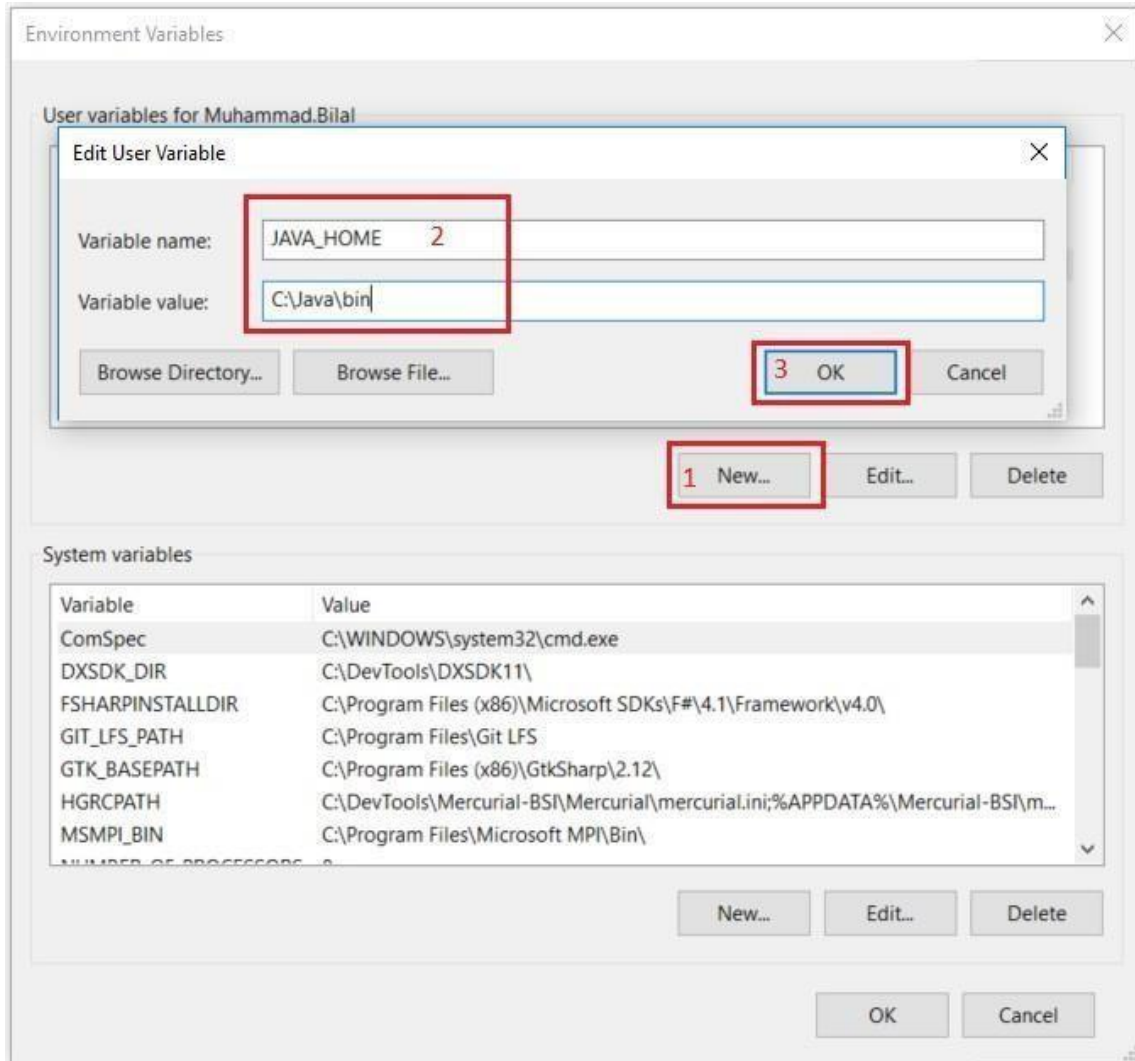


Set the path HADOOP_HOME Environment variable on windows 10(see Step 1,2,3 and 4 below).

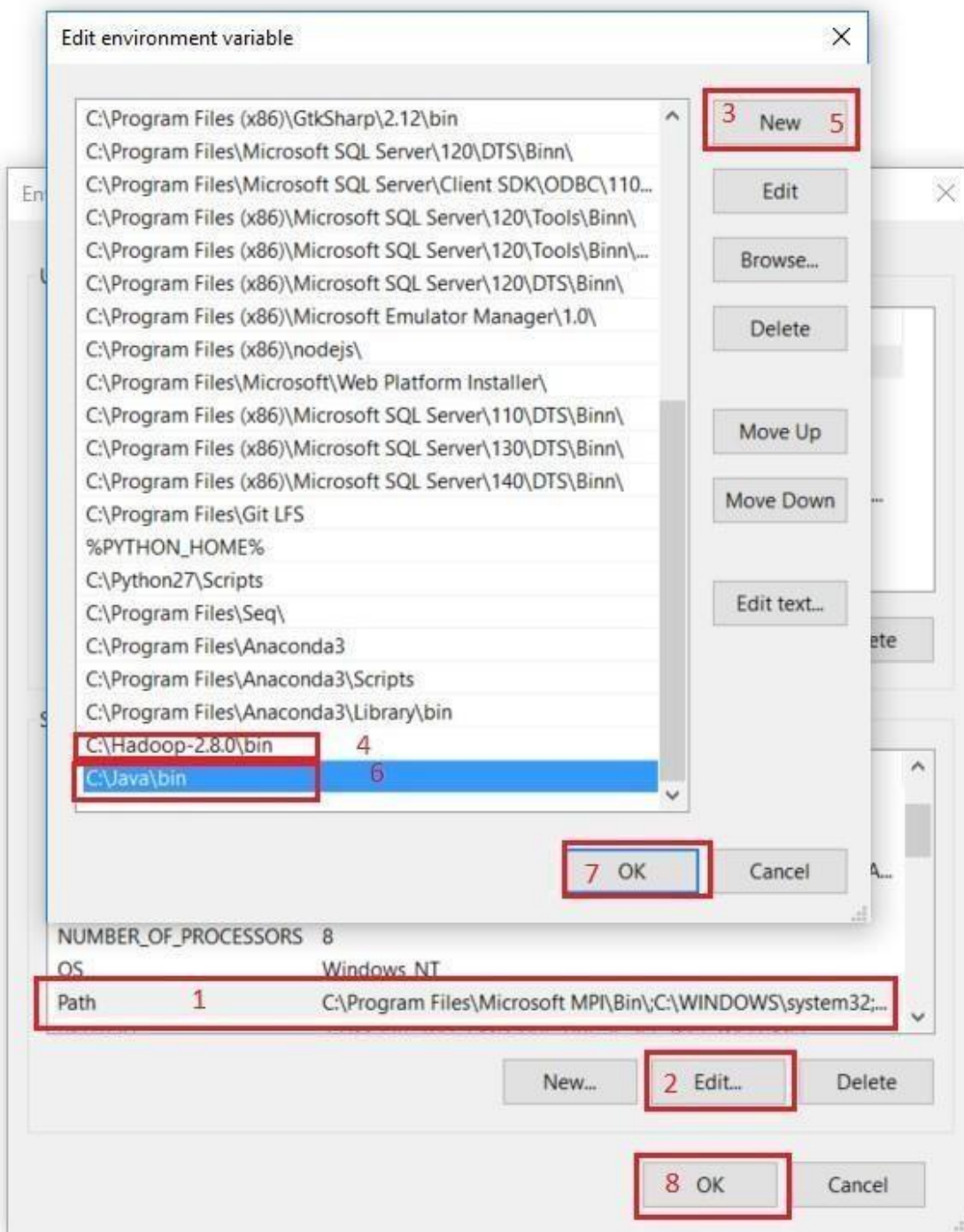




Set the path JAVA_HOME Environment variable on windows 10(see Step 1,2,3 and 4 below).



Next we set the Hadoop bin directory path and JAVA bin directory path.



CONFIGURATION :

Edit file C:/Hadoop-2.8.0/etc/hadoop/core-site.xml, paste below xml paragraph and save this file.

```
<configuration>
```

```
  <property>
```

```
    <name>fs.defaultFS</name>
```



```
<value>hdfs://localhost:9000</value>
</property>
</configuration>
```

Rename "mapred-site.xml.template" to "mapred-site.xml" and edit this file C:/Hadoop-2.8.0/etc/hadoop/mapred-site.xml, paste below xml paragraph and save this file.

```
<configuration>
<property>
<name>mapreduce.framework.name</name>
<value>yarn</value>
</property>
</configuration>
```

Create folder "data" under "C:\Hadoop-2.8.0"

Create folder "datanode" under "C:\Hadoop-2.8.0\data"

Create folder "namenode" under "C:\Hadoop-2.8.0\data"

<input type="checkbox"/> Name	Date modified	Type	Size
bin	7/20/2017 2:14 PM	File folder	
<input checked="" type="checkbox"/> data	7/20/2017 2:47 PM	File folder	
etc	7/20/2017 2:14 PM	File folder	
include	7/20/2017 2:14 PM	File folder	
lib	7/20/2017 2:14 PM	File folder	
libexec	7/20/2017 2:14 PM	File folder	
sbin	7/20/2017 2:14 PM	File folder	
share	7/20/2017 2:20 PM	File folder	
LICENSE.txt	3/17/2017 10:31 AM	TXT File	97 KB
NOTICE.txt	3/17/2017 10:31 AM	TXT File	16 KB
README.txt	3/17/2017 10:31 AM	TXT File	2 KB

Edit file C:\Hadoop-2.8.0/etc/hadoop/hdfs-site.xml, paste below xml paragraph and save this file.

```
<configuration>
<property>
<name>dfs.replication</name>
<value>1</value>
</property>
<property>
<name>dfs.namenode.name.dir</name>
<value>C:\hadoop-2.8.0\data\namenode</value>
</property>
<property>
<name>dfs.datanode.data.dir</name>
<value>C:\hadoop-2.8.0\data\datanode</value>
</property>
</configuration>
```




Edit file C:/Hadoop-2.8.0/etc/hadoop/yarn-site.xml, paste below xml paragraph and save this file.

```
<configuration>
  <property>
    <name>yarn.nodemanager.aux-services</name>
    <value>mapreduce_shuffle</value>
  </property>
  <property>
    <name>yarn.nodemanager.auxservices.mapreduce.shuffle.class</name>
    <value>org.apache.hadoop.mapred.ShuffleHandler</value>
  </property>
</configuration>
```

Edit file C:/Hadoop-2.8.0/etc/hadoop/hadoop-env.cmd by closing the command line "JAVA_HOME=%JAVA_HOME%" instead of set JAVA_HOME="C:\Java\jdk\bin" (On C:\java this is path to file jdk.18.0)

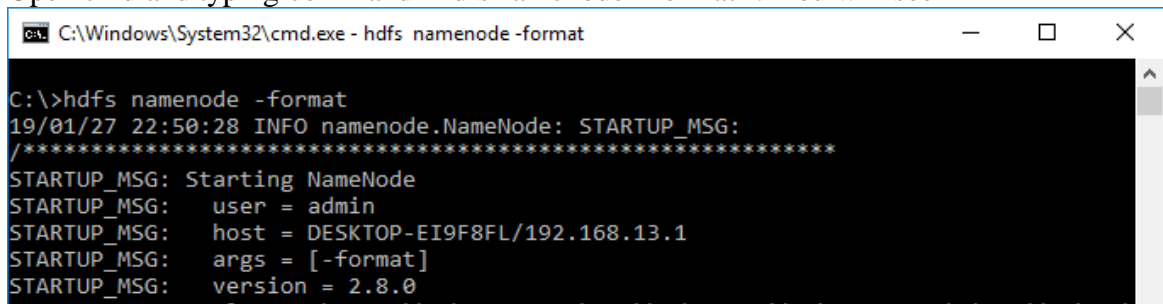
```
@rem The java implementation to use. Required.
@rem set JAVA_HOME=%JAVA_HOME%
set JAVA_HOME=C:\java
```

HADOOP CONFIGURATION :

Download file Hadoop Configuration.zip (Link: <https://github.com/MuhammadBilalYar/HADOOP-INSTALLATION-ON-WINDOWS/blob/master/Hadoop%20Configuration.zip>)

Delete file bin on C:\Hadoop-2.8.0\bin, replaced by file bin on file just download (from Hadoop Configuration.zip).

Open cmd and typing command "hdfs namenode -format" . You will see



```
C:\Windows\System32\cmd.exe - hdfs namenode -format

C:\>hdfs namenode -format
19/01/27 22:50:28 INFO namenode.NameNode: STARTUP_MSG:
/*****
STARTUP_MSG: Starting NameNode
STARTUP_MSG:   user = admin
STARTUP_MSG:   host = DESKTOP-EI9F8FL/192.168.13.1
STARTUP_MSG:   args = [-format]
STARTUP_MSG:   version = 2.8.0
STARTUP_MSG:   ...
```

TESTING :

Open cmd and change directory to "C:\Hadoop-2.8.0\sbin" and type "start-all.cmd" to start apache.



```
C:\>cd Hadoop-2.8.0\sbin

C:\Hadoop-2.8.0\sbin>start-all.cmd
This script is Deprecated. Instead use start-dfs.cmd and start-yarn.cmd
starting yarn daemons

C:\Hadoop-2.8.0\sbin>
```

Make sure these apps are running :

Hadoop Namenode

Hadoop datanode

YARN Resourc Manager

YARN Node Manager

```
Apache Hadoop Distribution - hadoop_namenode
17/07/2017 15:50:09 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:12 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:15 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:18 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:21 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:24 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:27 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:30 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:33 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:36 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:39 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:42 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:46 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:49 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:52 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:55 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:50:58 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:01 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:04 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:07 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:10 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:13 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:16 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:19 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:22 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:25 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:29 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:32 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/2017 15:51:35 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
```

Open: <http://localhost:8088>



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← → ↻ local:localhost:8088/cluster

hadoop

Logged in as: dr.who

All Applications

Cluster

About Nodes

Node Labels

Applications

NEW

NEW_SAVING

SUBMITTED

ACCEPTED

RUNNING

FINISHED

FAILED

KILLED

Scheduler

Tools

Cluster Metrics

Apps Submitted	0	Apps Pending	0	Apps Running	0	Apps Completed	0	Containers Running	0	Memory Used	0 B	Memory Total	8 GB	Memory Reserved	0 B	VCoers Used	0	VCoers Total	8	VCoers Reserved	0
----------------	---	--------------	---	--------------	---	----------------	---	--------------------	---	-------------	-----	--------------	------	-----------------	-----	-------------	---	--------------	---	-----------------	---

Cluster Nodes Metrics

Active Nodes	0	Decommissioning Nodes	0	Decommissioned Nodes	0	Lost Nodes	0	Unhealthy Nodes	0	Rebooted Nodes	0	Shutdown Nodes	0
--------------	---	-----------------------	---	----------------------	---	------------	---	-----------------	---	----------------	---	----------------	---

Scheduler Metrics

Scheduler Type	Capacity Scheduler	Scheduling Resource Type	[MEMORY]	Minimum Allocation	<memory:1024, vCores:1>	Maximum Allocation	<memory:8192, vCores:4>	Maximum Cluster Application Priority	0
----------------	--------------------	--------------------------	----------	--------------------	-------------------------	--------------------	-------------------------	--------------------------------------	---

Show: 20 entries

Search:

ID	User	Name	Application Type	Queue	Application Priority	StartTime	FinishTime	State	FinalStatus	Running Containers	Allocated CPU VCoers	Allocated Memory MB	% of Queue	% of Cluster	Progress	Tracking UI	Blacklisted Nodes
No data available in table																	

Showing 0 to 0 of 0 entries

First Previous Next Last

Open: <http://localhost:50070>

localhost:50070/dfshealth.html#tab-overview

Hadoop

Overview

Datanodes

Datanode Volume Failures

Snapshot

Startup Progress

Utilities

Overview 'localhost:9000' (active)

Started:	Thu Jul 20 15:44:11 +0500 2017
Version:	2.8.0, r91f2b7a13d1e97b7cc29ac0009
Compiled:	Fri Mar 17 09:12:00 +0500 2017 by jdu from branch-2.8.0
Cluster ID:	CID-098b09fc-fc7f7b674
Block Pool ID:	BP-10805049-7106632

Summary

Security is off.

Safemode is off.

1 files and directories, 0 blocks = 1 total filesystem object(s).

Heap Memory used 36.53 MB of 311 MB Heap Memory. Max Heap Memory is 889 MB.

Non Heap Memory used 40.68 MB of 41.53 MB Committed Non Heap Memory. Max Non Heap Memory is <unbounded>.

Configured Capacity:	475.24 GB
DFS Used:	321 B (0%)
Non DFS Used:	261.08 GB

File management tasks in hadoop

In order to perform operations on Hadoop like copy, delete, move etc., following steps can be used:

Basic operations:

1. Create a directory in HDFS at given path(s).

Usage:

`hadoop fs -mkdir <paths>`



2. List the contents of a directory.

Usage :

`hadoop fs -ls <args>`

3. See contents of a file

Same as unix cat command:

Usage:

`hadoop fs -cat <path[filename]>`

4. Copy a file from source to destination

This command allows multiple sources as well in which case the destination must be a directory.

Usage:

`hadoop fs -cp <source> <dest>`

5. Copy a file from/To Local file system to HDFS

`copyFromLocal`

Usage:

`hadoop fs -copyFromLocal <localsrc> URI`

Similar to put command, except that the source is restricted to a local file reference.

`copyToLocal`

Usage:

`hadoop fs -copyToLocal [-ignorecrc] [-crc] URI <localdst>`

Similar to get command, except that the destination is restricted to a local file reference.

7. Move file from source to destination.

Note:- Moving files across filesystem is not permitted.

Usage :

`hadoop fs -mv <src> <dest>`

8. Remove a file or directory in HDFS.

Remove files specified as argument. Deletes directory only when it is empty

Usage :

`hadoop fs -rm <arg>`

Steps for copying file

1) Go to Hadoop folder and then to sbin

`C:\>cd C:\hadoop-2.8.0\sbin`

2) Start namenode and datanode with this command, Two more cmd windows will open

`C:\hadoop-2.8.0\sbin>start-dfs.cmd`

3) Now start yarn through following command, Two more windows will open, one for yarn resource manager and one for yarn node manager

`C:\hadoop-2.8.0\sbin>start-yarn.cmd`

4) Create a directory named 'sample' in the hadoop directory using the following command

`C:\hadoop-2.8.0\sbin>hdfs dfs -mkdir /sample`

5) To verify if the directory is created

`C:\hadoop-2.8.0\sbin>hdfs dfs -ls /`

6) Copy text file from D drive to sample

`C:\hadoop-2.8.0\sbin>hdfs dfs -copyFromLocal d:\rally.txt /sample`



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7) To verify if the file is copied
C:\hadoop-2.8.0\sbin>hdfs dfs -ls /sample

OUTPUT:

The screenshot shows the Hadoop Overview page in a web browser. The browser tabs include 'NameNode information', 'DataNode Information', 'All Applications', and 'BDA Lab Manual 23-24'. The address bar shows 'localhost:9870/dfshealth.html#tab-overview'. The page has a green header with 'Hadoop' and 'Overview' tabs. The main content area is titled 'Overview 'localhost:9820' (active)'. It contains a table with the following data:

Started:	Wed Aug 23 10:38:08 +0530 2023
Version:	3.2.4, r7e5d9983b388e372fe640f21f048f2f2ae6e9eba
Compiled:	Tue Jul 12 17:28:00 +0530 2022 by ubuntu from branch-3.2.4
Cluster ID:	CID-146566e0-df7a-44ee-a644-d41c94627871
Block Pool ID:	BP-1532262397-192.168.12.89-1692767105768

Below the table is a 'Summary' section with the following text:

Security is off.
Safemode is off.
1 files and directories, 0 blocks (0 replicated blocks, 0 erasure coded block groups) = 1 total filesystem object(s).
Heap Memory used 85.15 MB of 195 MB Heap Memory. Max Heap Memory is 889 MB.
Non Heap Memory used 49.6 MB of 51.52 MB Committed Non Heap Memory. Max Non Heap Memory is <unbounded>.

Configured Capacity:	417.65 GB
Configured Remote Capacity:	0 B
DFS Used:	149 B (0%)

The screenshot shows the DataNode on DESKTOP-J6282R6:9866 page in a web browser. The browser tabs include 'NameNode information', 'DataNode Information', 'All Applications', and 'BDA Lab Manual 23-24'. The address bar shows 'localhost:3864/datanode.html'. The page has a green header with 'Hadoop' and 'Utilities' tabs. The main content area is titled 'DataNode on DESKTOP-J6282R6:9866'. It contains a table with the following data:

Cluster ID:	CID-146566e0-df7a-44ee-a644-d41c94627871
Started:	Wed Aug 23 10:38:08 +0530 2023
Version:	3.2.4, r7e5d9983b388e372fe640f21f048f2f2ae6e9eba

Below the table is a 'Block Pools' section with a table showing the following data:

NameNode Address	Block Pool ID	Actor State	Last Heartbeat	Last Block Report	Last Block Report Size (Max Size)
localhost:9820	BP-1532262397-192.168.12.89-1692767105768	RUNNING	0s	3 minutes	0 B (64 MB)

Below the table is a 'Volume Information' section with a table showing the following data:

Directory	Storage Type	Capacity Used	Capacity Left	Capacity Reserved	Reserved Space for Replicas	Blocks
C:\hadoopsetup\hadoop-3.2.4\data\dfs\datanode	DISK	149 B	208.94 GB	0 B	0 B	0



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The screenshot displays the Hadoop All Applications web interface. The top navigation bar includes links for 'NameNode information', 'DataNode Information', 'All Applications', and 'BDA Lab Manual 23-24'. The main content area is titled 'All Applications' and features a sidebar with navigation options: 'Cluster', 'About Nodes', 'Node Labels', 'Applications', 'NEW', 'NEW SAVING', 'SUBMITTED', 'ACCEPTED', 'RUNNING', 'FINISHED', 'FAILED', 'KILLED', and 'Scheduler'. The main content area is divided into several sections: 'Cluster Metrics', 'Cluster Nodes Metrics', 'Scheduler Metrics', and a table of applications. The 'Cluster Metrics' section shows various metrics such as 'Apps Submitted', 'Apps Pending', 'Apps Running', 'Apps Completed', 'Containers Running', 'Used Resources', 'Total Resources', 'Reserved Resources', and 'Physical Mem Us'. The 'Cluster Nodes Metrics' section shows 'Active Nodes', 'Decommissioning Nodes', 'Decommissioned Nodes', 'Lost Nodes', 'Unhealthy Nodes', and 'Rebooted Nodes'. The 'Scheduler Metrics' section shows 'Scheduler Type', 'Scheduling Resource Type', 'Minimum Allocation', 'Maximum Allocation', and 'Maximum Cluster Application Priority'. The table of applications is currently empty, showing 'No data available in table'.

- C:\hadoopFiles\hadoop-3.2.4\sbin>hdfs dfs -mkdir /sample
- C:\hadoopFiles\hadoop-3.2.4\sbin>hdfs dfs -ls /
Found 1 items
drwxr-xr-x - admin supergroup 0 2023-08-23 10:58 /sample
- C:\hadoopFiles\hadoop-3.2.4\sbin>hdfs dfs -copyFromLocal C:\Users\admin\Desktop\hello.txt /sample
- C:\hadoopFiles\hadoop-3.2.4\sbin>hdfs dfs -ls /sample
Found 1 items
-rw-r--r-- 1 admin supergroup 12 2023-08-23 10:59 /sample/hello.txt

CONCLUSION:

The main goal of the experiment was to install and configure Hadoop, a platform for distributed data processing. It skillfully illustrated how to set up essential Hadoop components like HDFS and MapReduce, showcasing the system's capacity to manage massive data volumes and bounce back from errors. It also covered the basics of using Hadoop for file management, including importing data, making directories, and modifying files. The experiment demonstrated the value of data replication, the idea of data localization, and the benefits of parallel processing with MapReduce. It emphasised that, while having a learning curve, Hadoop is an important talent to have in the big data era, providing effective data processing and administration for extensive applications.