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Department of Computer Engineering

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Experiment No.1
Hadoop HDFS Practical
Date of Performance: 17/07/23
Date of Submission: 31/07/23

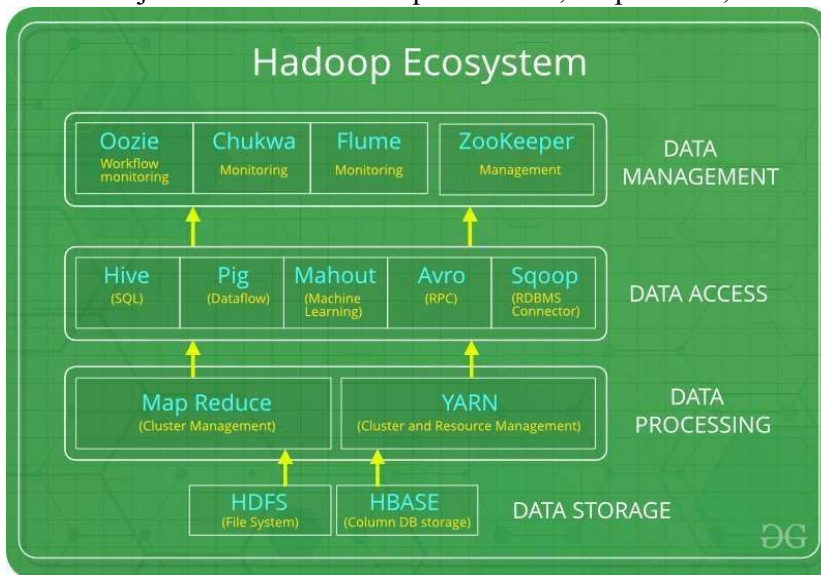


AIM : Installation, Configuration of hadoop and performing basic file management operations in hadoop.

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



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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>)



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Java JDK 1.8.0.zip (Link:  
<http://www.oracle.com/technetwork/java/javase/downloads/jdk8downloads-2133151.html>)  
Check either Java 1.8.0 is already installed on your system or not, use "Javac -version" to check.

A screenshot of a Windows command prompt window. The title bar shows "C:\Windows\System32\cmd.exe". The command prompt shows the command "C:\>javac -version" and the output "javac 1.8.0\_192". The prompt "C:\>" is visible at the bottom.

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

C:\>javac -version
javac 1.8.0_192

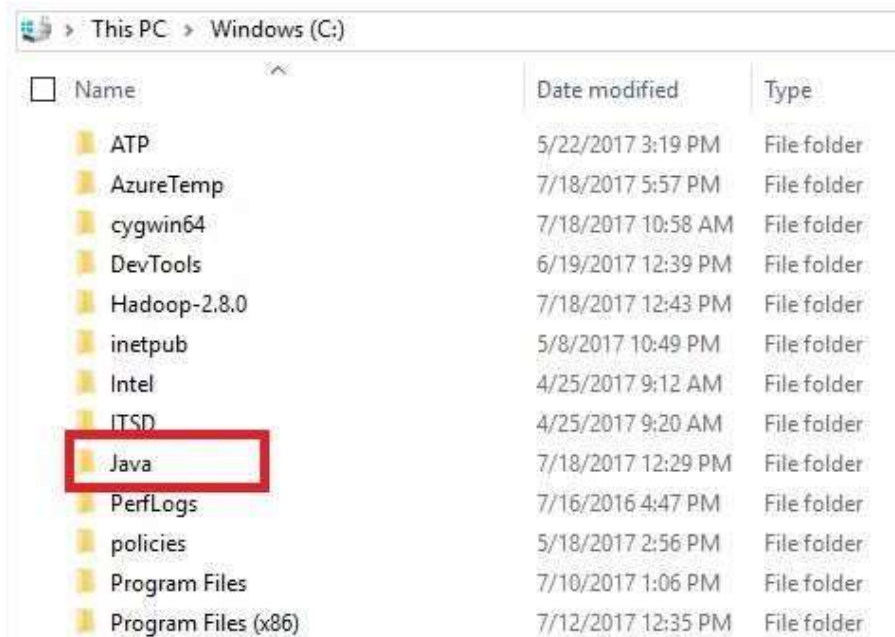
C:\>
```

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



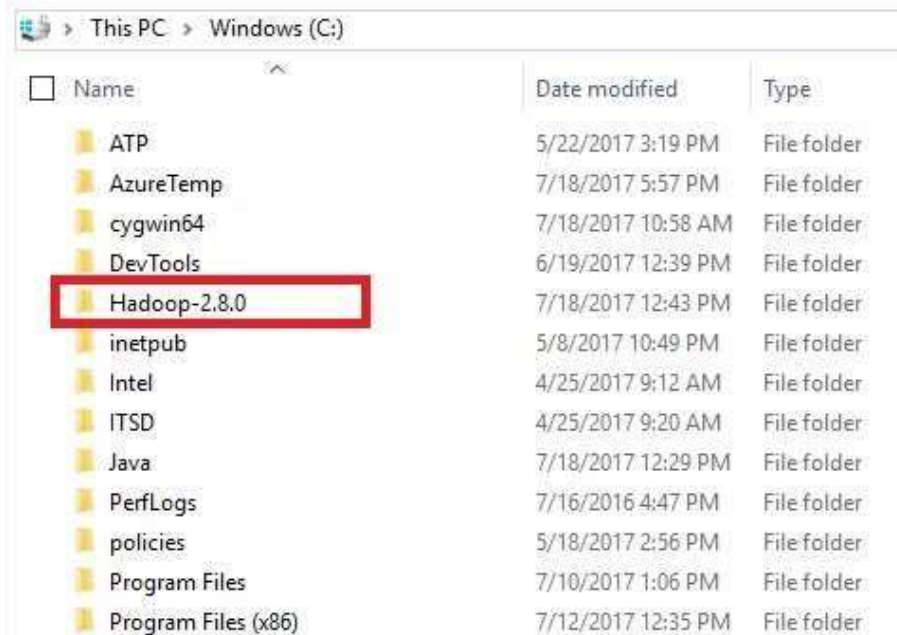
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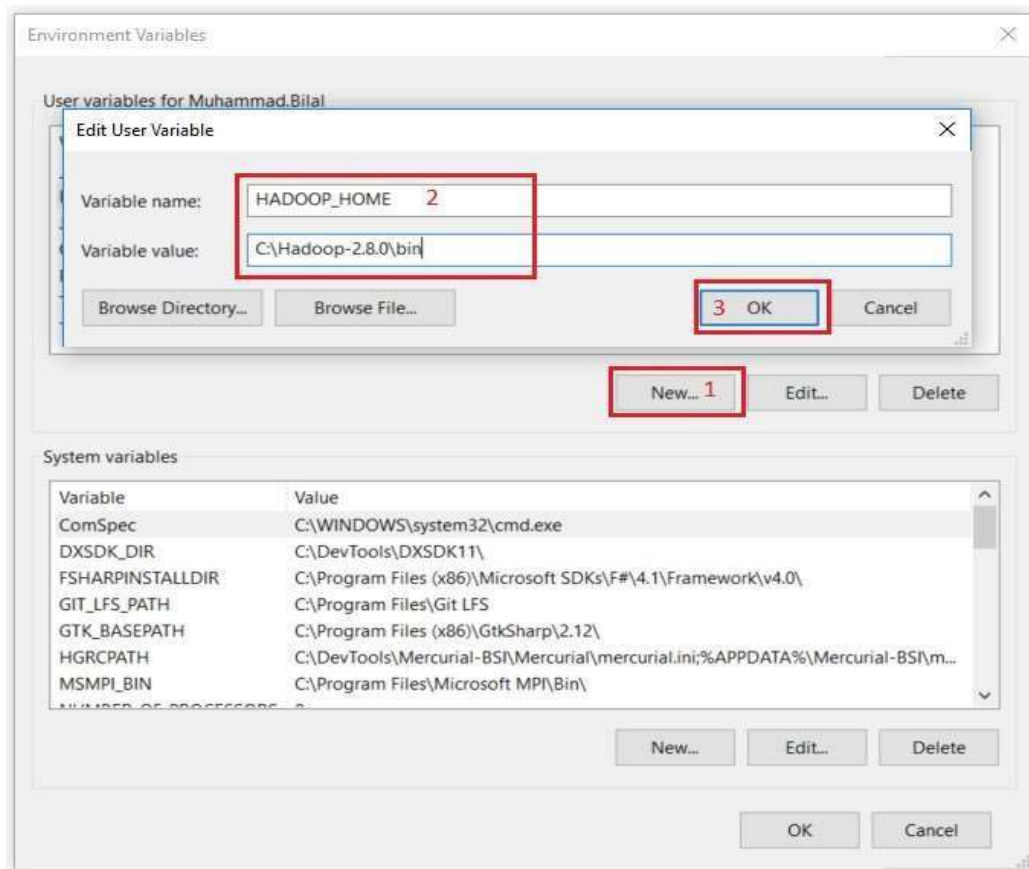
Name	Date modified	Type
ATP	5/22/2017 3:19 PM	File folder
AzureTemp	7/18/2017 5:57 PM	File folder
cygwin64	7/18/2017 10:58 AM	File folder
DevTools	6/19/2017 12:39 PM	File folder
Hadoop-2.8.0	7/18/2017 12:43 PM	File folder
inetpub	5/8/2017 10:49 PM	File folder
Intel	4/25/2017 9:12 AM	File folder
ITSD	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".

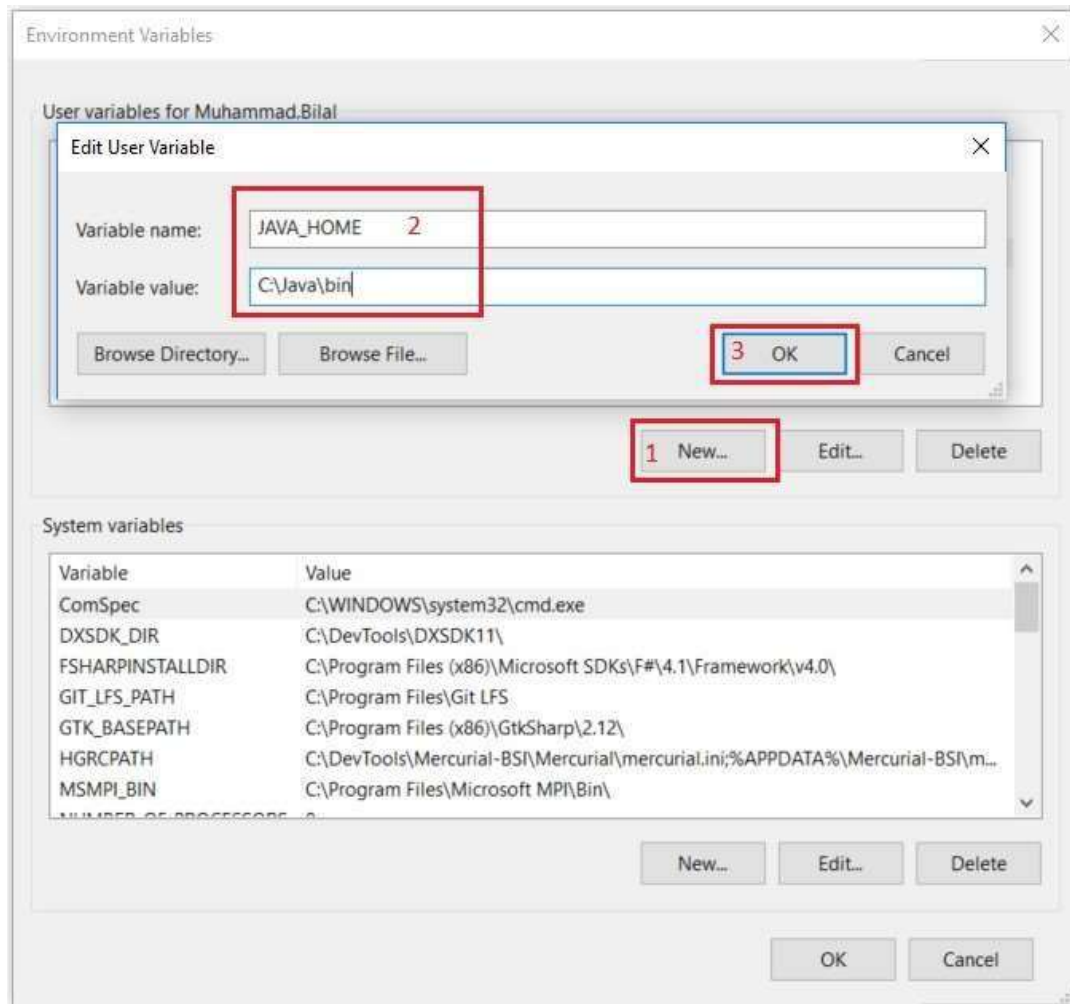


Name	Date modified	Type
ATP	5/22/2017 3:19 PM	File folder
AzureTemp	7/18/2017 5:57 PM	File folder
cygwin64	7/18/2017 10:58 AM	File folder
DevTools	6/19/2017 12:39 PM	File folder
Hadoop-2.8.0	7/18/2017 12:43 PM	File folder
inetpub	5/8/2017 10:49 PM	File folder
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policies	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

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

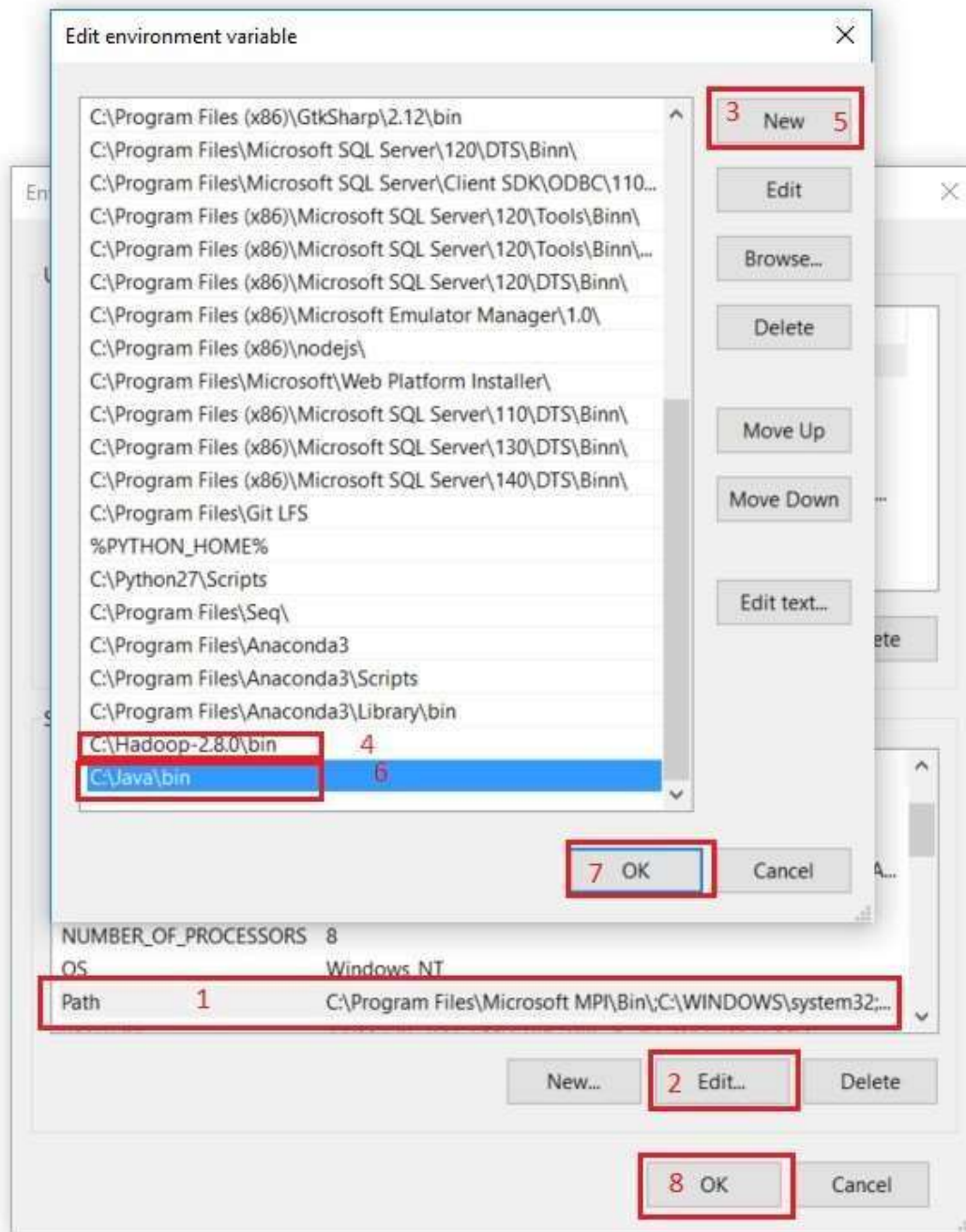


Set the path JAVA\_HOME Environment variable on windows 10(see Step 1,2,3 and 4 below).



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.





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```
<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:/Hadoop2.8.0/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>
```



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```
<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.

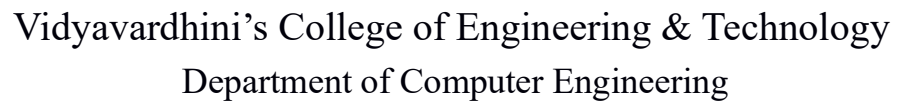
```
<configuration>
  <property>
    <name>yarn.nodemanager.aux-services</name>
    <value>mapreduce_shuffle</value>
  </property>
  <property>
    <name>yarn.nodemanager.auxservices.mapreduce.shuffle.class</name>
    <value>org.apache.hadoop.mapred.ShuffleHandler</value>
  </property>
</configuration>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

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-ONWINDOW10/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



### TESTING :

Make sure these apps are running :

## Hadoop Namenode

Hadoop datanode

## YARN Resourc Manager

## YARN Node Manager



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```
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>

Cluster Metrics

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

Cluster Nodes Metrics

Active Nodes	Decommissioning Nodes	Decommissioned Nodes	Lost Nodes	Unhealthy Nodes	Rebooted Nodes	Shutdown Nodes
1	0	0	0	0	0	0

Scheduler Metrics

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

Showing 0 to 0 of 0 entries

Open: <http://localhost:50070>



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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-fc7b674
Block Pool ID:	BP-10805047106632

### 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



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



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OUTPUT:

The screenshot displays the Hadoop All Applications web interface. The top navigation bar includes links for Namenode information, DataNode Information, and All Applications. The main content area is titled "All Applications" and shows various cluster metrics and application details. The interface is logged in as "dr:who".

**Cluster Metrics**

Apps Submitted	Apps Pending	Apps Running	Apps Completed	Containers Running	Used Resources	Total Resources	Reserved Resources	Physical Mem Used %	Physical VCores Used %
0	0	0	0	0	<memory:0 B, vCores:0>	<memory:8 GB, vCores:8>	<memory:0 B, vCores:0>	90	0

**Cluster Nodes Metrics**

Active Nodes	Decommissioning Nodes	Decommissioned Nodes	Lost Nodes	Unhealthy Nodes	Rebooted Nodes	Shutdown Nodes
1	0	0	0	0	0	0

**Scheduler Metrics**

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

**Applications Table**

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

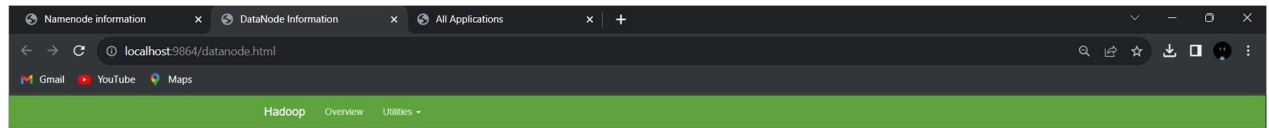
Showing 0 to 0 of 0 entries





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### DataNode on Shubham:9866

Cluster ID:	CID-8522f14d-a9d-422d-90eb-69d22659b532
Started:	Thu Oct 19 22:37:40 +0530 2023
Version:	3.2.4, r7e5d9983b388e372fe640f21f048f22ae6e9eba

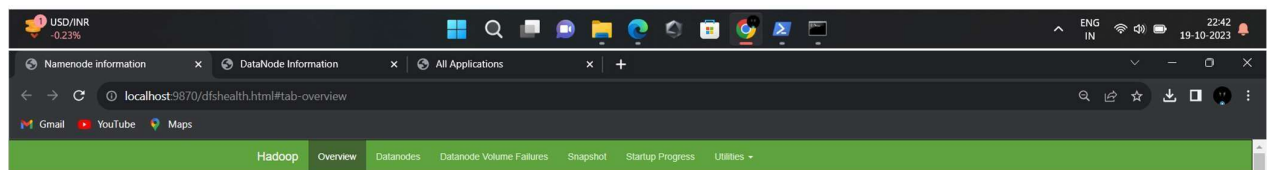
### Block Pools

namenode address	Block Pool ID	Actor State	Last Heartbeat	Last Block Report	Last Block Report Size (Max Size)
localhost:9820	BP-446742625-192.168.73.157-1697140882384	RUNNING	1s	4 minutes	0 B (64 MB)

### Volume Information

Directory	Storage Type	Capacity Used	Capacity Left	Capacity Reserved	Reserved Space for Replicas	Blocks
C:\hadoop-3.2.4\data\dfs\datanode	DISK	340 B	48.9 GB	0 B	0 B	0

Hadoop, 2022.



### Overview 'localhost:9820' (active)

Started:	Thu Oct 19 22:37:39 +0530 2023
Version:	3.2.4, r7e5d9983b388e372fe640f21f048f22ae6e9eba
Compiled:	Tue Jul 12 17:28:00 +0530 2022 by ubuntu from branch-3.2.4
Cluster ID:	CID-8522f14d-a9d-422d-90eb-69d22659b532
Block Pool ID:	BP-446742625-192.168.73.157-1697140882384

### Summary

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 36.49 MB of 209.5 MB Heap Memory. Max Heap Memory is 889 MB.

Non Heap Memory used 51.25 MB of 52.98 MB Committed Non Heap Memory. Max Non Heap Memory is <unbounded>.

Configured Capacity:	280.09 GB
Configured Remote Capacity:	0 B
DFS Used:	340 B (0%)
Non DFS Used:	231.19 GB
DFS Remaining:	48.9 GB (17.46%)
Block Pool Used:	340 B (0%)



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```
Administrator: Windows PowerShell
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\WINDOWS\system32> cd \
PS C:\> cd .\hadoop-3.2.4\
PS C:\hadoop-3.2.4> cd sbin
PS C:\hadoop-3.2.4\sbin> .\start-dfs.cmd
PS C:\hadoop-3.2.4\sbin> .\start-yarn.cmd
starting yarn daemons
PS C:\hadoop-3.2.4\sbin> jps
21648 NodeManager
3472 NameNode
24024 ResourceManager
13628 Jps
15884 DataNode
PS C:\hadoop-3.2.4\sbin>
```

```
Administrator: Windows PowerShell
PS C:\hadoop-3.2.4\sbin> hdfs dfs -mkdir /prac_1
PS C:\hadoop-3.2.4\sbin> hdfs dfs -ls /
Found 1 items
drwxr-xr-x - sdnak supergroup          0 2023-10-19 22:50 /prac_1
PS C:\hadoop-3.2.4\sbin> hdfs dfs -copyFromLocal C:\Users\sdnak\OneDrive\Desktop /prac_1
PS C:\hadoop-3.2.4\sbin> hdfs dfs -ls /prac_1
Found 1 items
drwxr-xr-x - sdnak supergroup          0 2023-10-19 22:52 /prac_1/Desktop
PS C:\hadoop-3.2.4\sbin>
```



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### CONCLUSION :

The Experiment centred around the installation and configuration of Hadoop, a distributed data processing framework. It effectively demonstrated the setup of various Hadoop components, such as HDFS and MapReduce, illustrating its scalability and resilience to faults. We delved into fundamental file management tasks within Hadoop, including actions like uploading data, creating directories, and manipulating files. The advantages of parallel processing through MapReduce, the significance of data replication, and the importance of data locality became evident. The experiment underscored the learning curve associated with Hadoop while highlighting its potential for efficient data management and processing in large-scale applications, positioning it as a valuable skill in the age of big data.



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