Vidyavardhini's
College of Engineering & Technology

Vasai Road (W)

Department of Computer Engineering

Laboratory Manual

Semester	VII	**Class**	B.E
Course Code	CSL702		
Course Name	Big Data Analytics Lab		

Vidyavardhini's College of Engineering & Technology

Vision

To be a premier institution of technical education; always aiming at becoming a valuable resource for industry and society.

Mission

- To provide technologically inspiring environment for learning.
- To promote creativity, innovation and professional activities.
- To inculcate ethical and moral values.
- To cater personal, professional and societal needs through quality education.

Department Vision:

To evolve as a center of excellence in the field of Computer Engineering to cater to industrial and societal needs.

Department Mission:

- To provide quality technical education with the aid of modern resources.
- Inculcate creative thinking through innovative ideas and project development.
- To encourage life-long learning, leadership skills, entrepreneurship skills with ethical & moral values.

Program Education Objectives (PEOs):

PEO1: To facilitate learners with a sound foundation in the mathematical, scientific and engineering fundamentals to accomplish professional excellence and succeed in higher studies in Computer Engineering domain
PEO2: To enable learners to use modern tools effectively to solve real-life problems in the field of Computer Engineering.
PEO3: To equip learners with extensive education necessary to understand the impact of computer technology in a global and social context.
PEO4: To inculcate professional and ethical attitude, leadership qualities, commitment to societal responsibilities and prepare the learners for life-long learning to build up a successful career in Computer Engineering.

Program Specific Outcomes (PSOs):

PSO1: Analyze problems and design applications of database, networking, security, web technology, cloud computing, machine learning using mathematical skills, and computational tools.

PSO2: Develop computer-based systems to provide solutions for organizational, societal problems by working in multidisciplinary teams and pursue a career in the IT industry.

Program Outcomes (POs):

Engineering Graduates will be able to:

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO12. Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Objectives

1	Solve Big Data problems using Map Reduce Technique and apply to various algorithms.
2	Identify various types of NoSQL databases and execute NOSQL commands
3	Understand implementation of various analytic techniques using Hive/PIG/R/Tableau, etc.
4	Apply streaming analytics to real time applications.

Course Outcomes

At the end of the course student will be able to:		Action verb	Bloom Level
CSL702.1	Use Sqoop tool in Hadoop ecosystem for big data analytics.	Identify	Understand (Level 2)
CSL702.2	Implement Map Reduce algorithm on structured and unstructured data	Apply	Apply (Level 3)
CSL702.3	Perform NoSQL commands on Cassandra, Hadoop HBase and MongoDB	Identify	Use (Level 4)
CSL702.4	Implement filtering, counting distinct element and counting ones in window algorithms on data stream.	Apply	Apply (Level 3)
CSL702.5	Implement data visualization techniques on social network graphs using R	Analyze	Analyze (Level 4)
CSL702.6	Built real life application on big data analytics	Apply	Apply(Level 3)

Mapping of Experiments with Course Outcomes

Course Modules	Course Outcomes					
	CSL702.1	CSL702.2	CSL702.3	CSL702.4	CSL702.5	CSL702.6
Hadoop HDFS Practical	3	--	--	--	--	--
Use of Sqoop tool	3	--	--	--	--	--
To install and configure MongoDB	--	--	3	--	--	--
Experiment on Hadoop Map-Reduce	--	3	--	--	--	--
Create HIVE Database and Descriptive analytics- basic statistics.	--	--	--	3	--	--
Data Stream Algorithms	--	--	--	3	--	--
Social Network Analysis using R	--	--	--	--	3	--
Data Visualization using Hive/PIG/R/Tableau/.	--	--	--	--	--	3
Mini-Project	2	2	2	2	2	3

Enter correlation level 1, 2 or 3 as defined below
1: Slight (Low) 2: Moderate (Medium) 3: Substatial (High)

If there is no correlation put "—".

INDEX

D.O.P: Date of performance

D.O.C : Date of correction

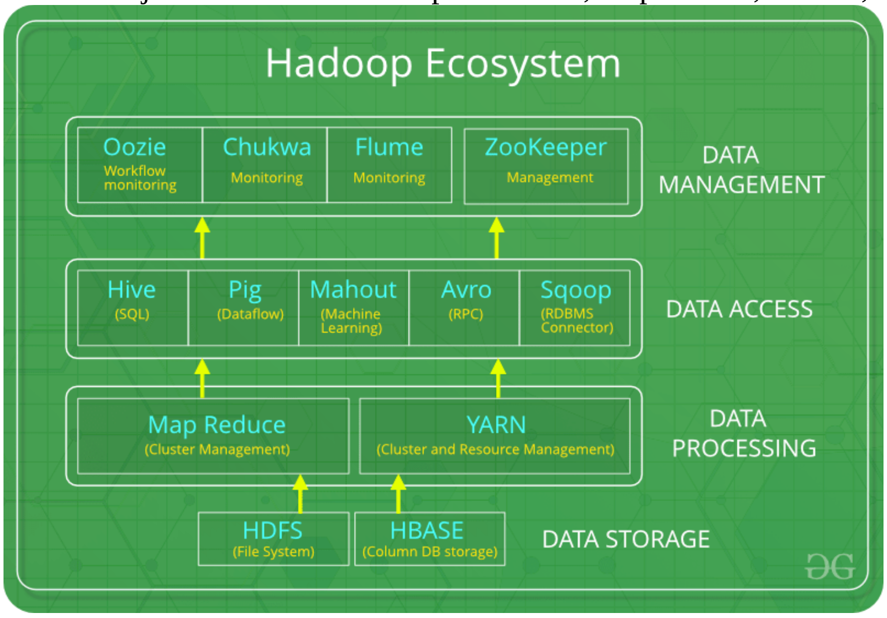
Experiment No.1
Hadoop HDFS Practical
Date of Performance:
Date of Submission:

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:

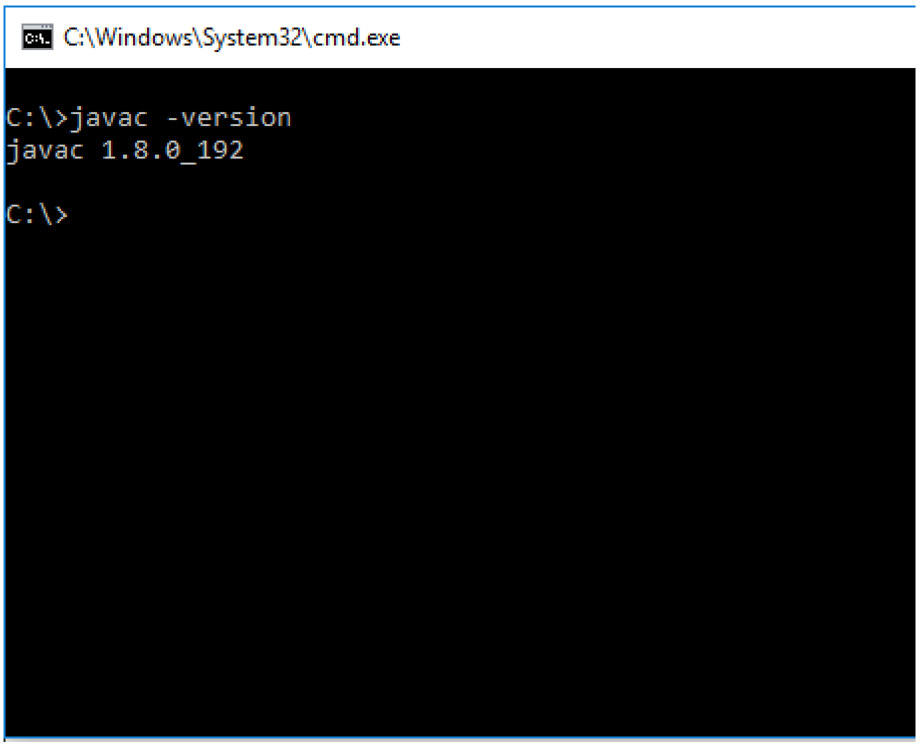
HDFS is the primary or major component of Hadoop ecosystem and is responsible for storing large data sets of structured or unstructured data across various nodes and thereby maintaining the metadata in the form of log files.

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.
<u>Installation of Hadoop</u>
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.

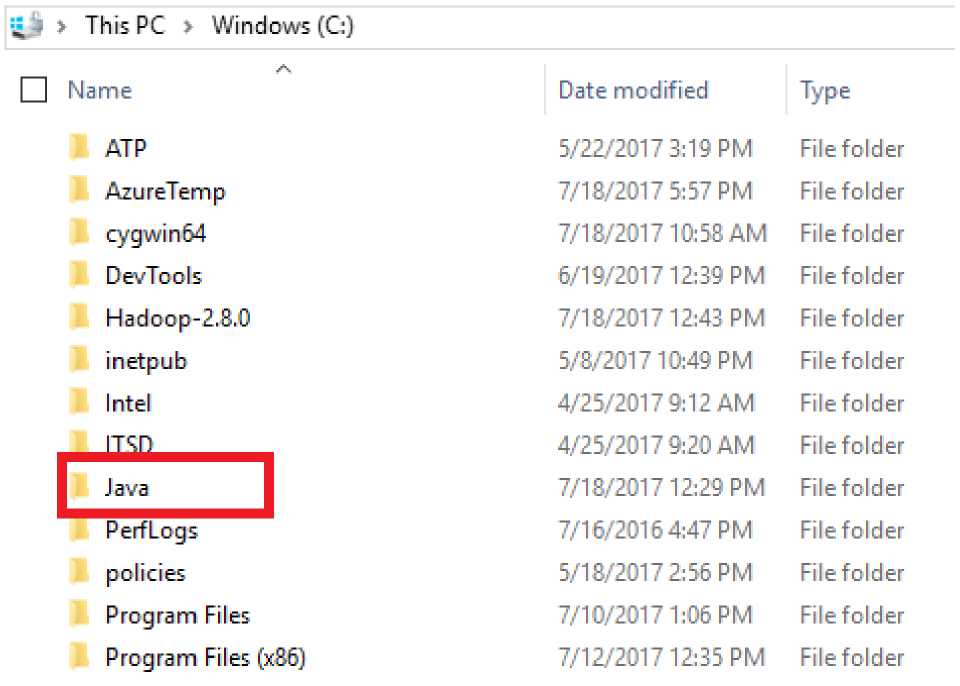


C:\Windows\System32\cmd.exe

```
C:\>javac -version
javac 1.8.0_192

C:\>
```

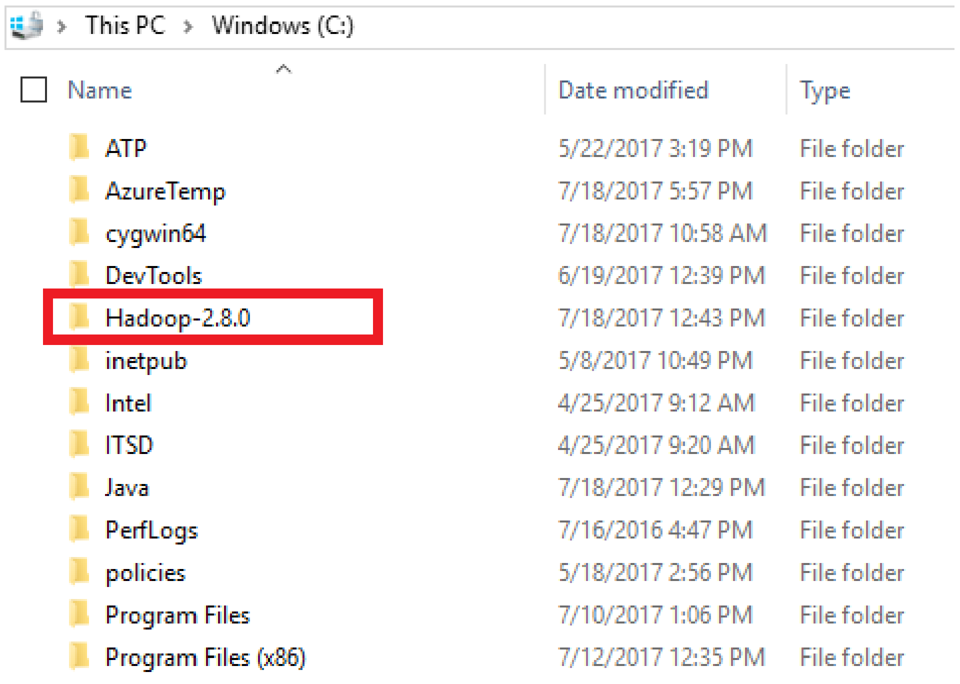
If Java is not installed on your system then first install java under "C:\JAVA"



This PC › Windows (C:)

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".



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inetpub	5/8/2017 10:49 PM	File folder
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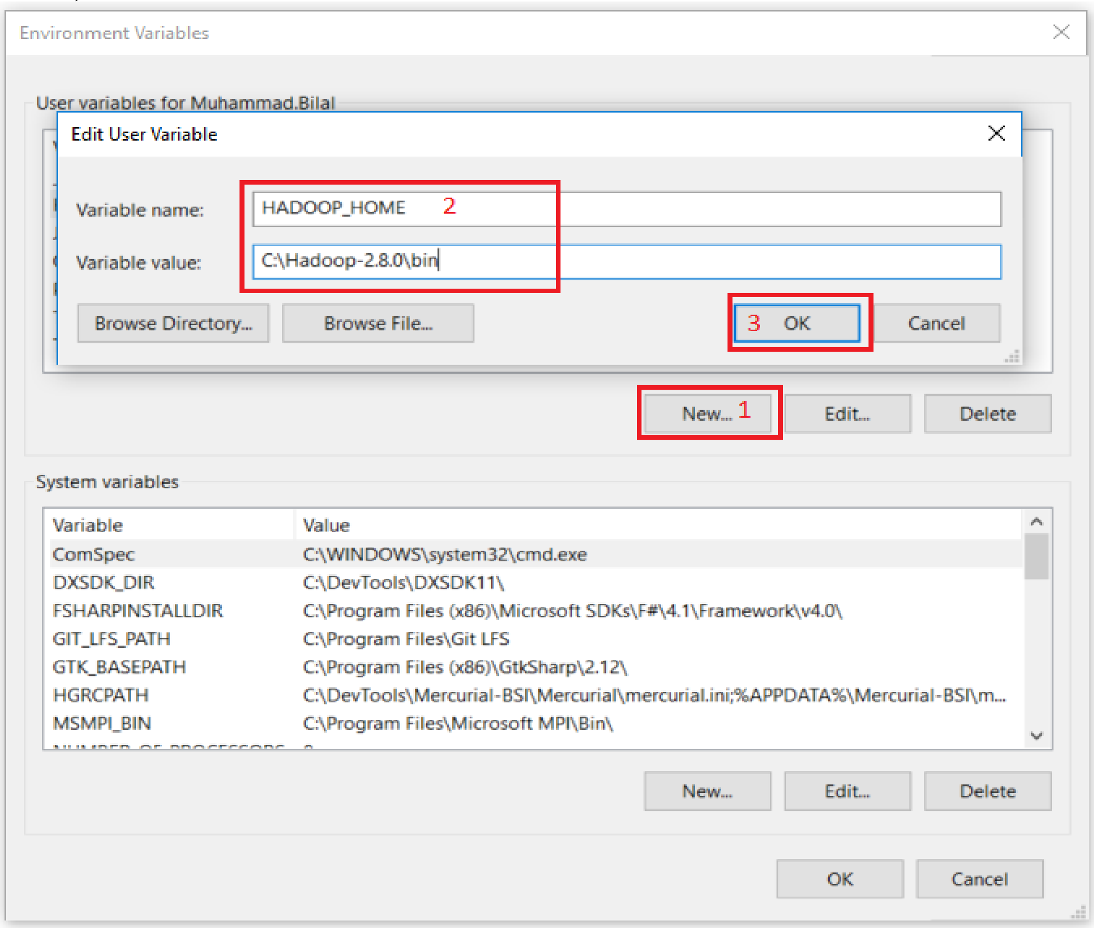
policies	5/18/2017 2:56 PM	File folder
Program Files	7/10/2017 1:06 PM	File folder
Program Files (x86)	7/12/2017 12:35 PM	File folder

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



Environment Variables

User variables for Muhammad.Bilal

Edit User Variable

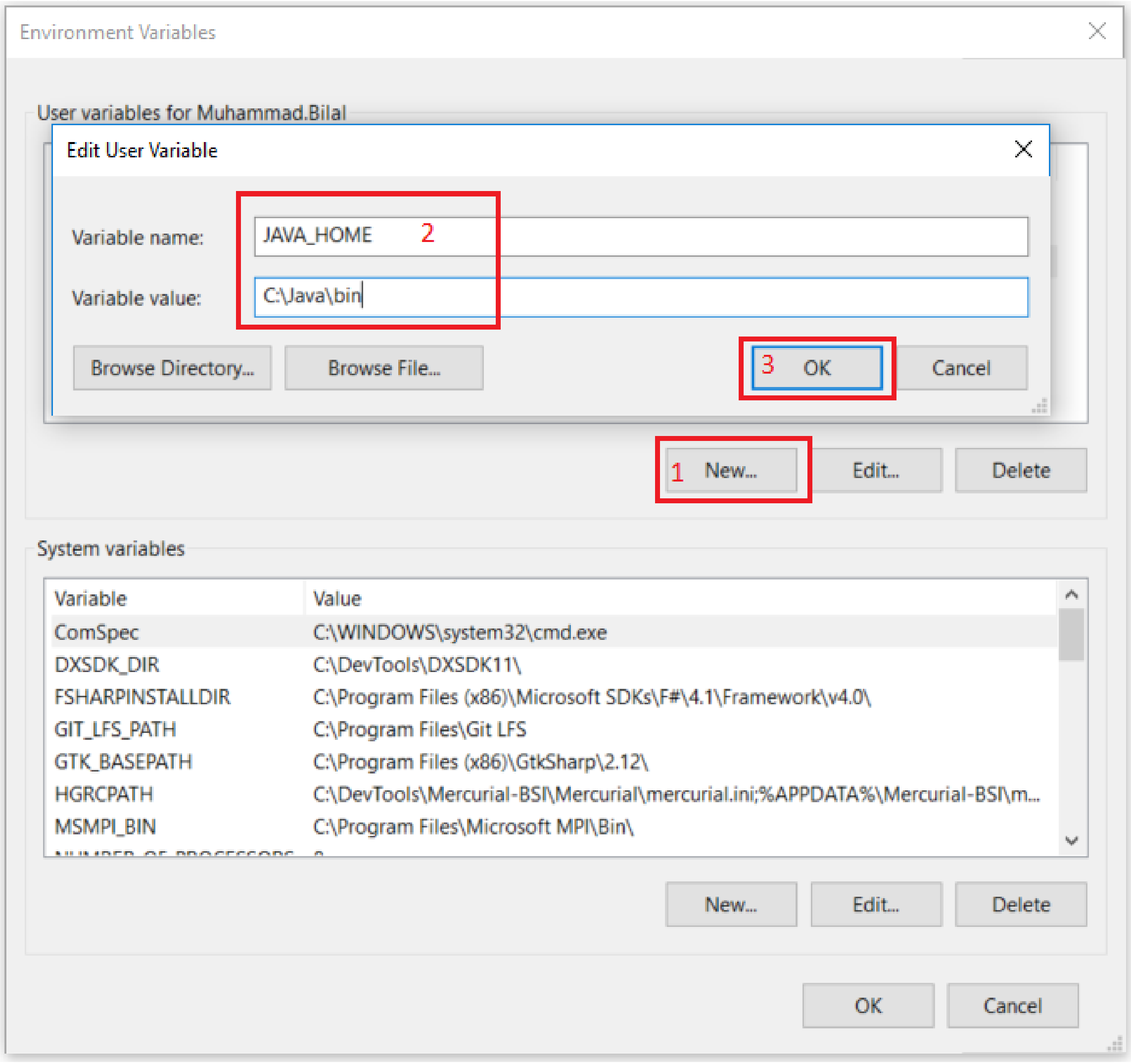
Variable name: HADOOP_HOME 2

Variable value: C:\Hadoop-2.8.0\bin

System variables

Variable	Value
ComSpec	C:\WINDOWS\system32\cmd.exe
DXSDK_DIR	C:\DevTools\DXSDK11\
FSHARPINSTALLDIR	C:\Program Files (x86)\Microsoft SDKs\F#\4.1\Framework\v4.0\
GIT_LFS_PATH	C:\Program Files\Git LFS
GTK_BASEPATH	C:\Program Files (x86)\GtkSharp\2.12\
HGRCPATH	C:\DevTools\Mercurial-BSI\Mercurial\mercurial.ini;%APPDATA%\Mercurial-BSI\m...
MSMPI_BIN	C:\Program Files\Microsoft MPI\Bin\

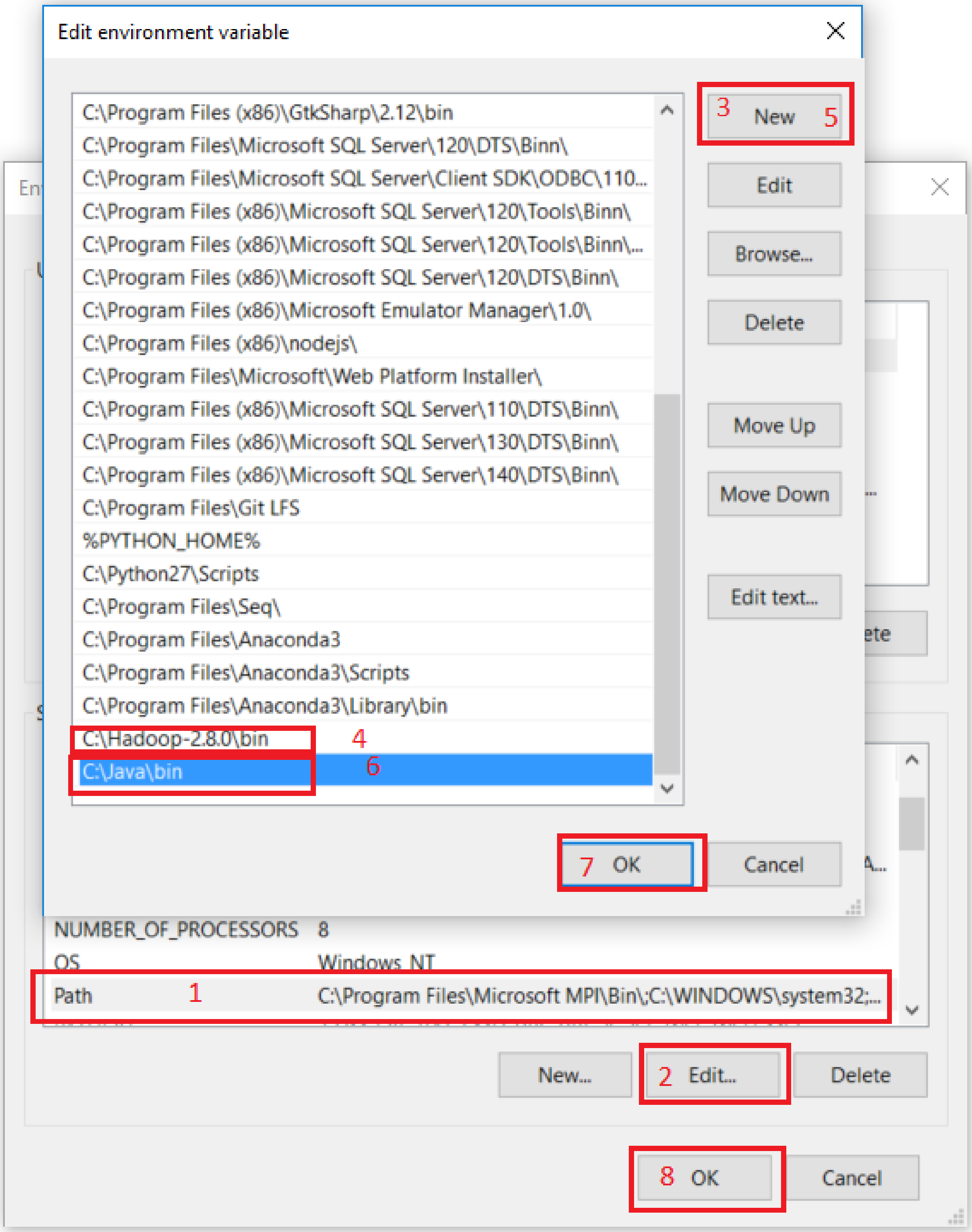
Set the path JAVA_HOME Environment variable on windows 10(see Step 1,2,3 and 4 below).



Variable name: JAVA_HOME 2
Variable value: C:\Java\bin

Variable	Value
ComSpec	C:\WINDOWS\system32\cmd.exe
DXSDK_DIR	C:\DevTools\DXSDK11\
FSHARPINSTALLDIR	C:\Program Files (x86)\Microsoft SDKs\F#\4.1\Framework\v4.0\
GIT_LFS_PATH	C:\Program Files\Git LFS
GTK_BASEPATH	C:\Program Files (x86)\GtkSharp\2.12\
HGRCPATH	C:\DevTools\Mercurial-BSI\Mercurial\mercurial.ini;%APPDATA%\Mercurial-BSI\m...
MSMPI_BIN	C:\Program Files\Microsoft MPI\Bin\

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


Edit environment variable

C:\Program Files (x86)\GtkSharp\2.12\bin
C:\Program Files\Microsoft SQL Server\120\DTS\Binn\
C:\Program Files\Microsoft SQL Server\Client SDK\ODBC\110...
C:\Program Files (x86)\Microsoft SQL Server\120\Tools\Binn\
C:\Program Files (x86)\Microsoft SQL Server\120\Tools\Binn\...
C:\Program Files (x86)\Microsoft SQL Server\120\DTS\Binn\
C:\Program Files (x86)\Microsoft Emulator Manager\1.0\
C:\Program Files (x86)\nodejs\
C:\Program Files\Microsoft\Web Platform Installer\
C:\Program Files (x86)\Microsoft SQL Server\110\DTS\Binn\
C:\Program Files (x86)\Microsoft SQL Server\130\DTS\Binn\
C:\Program Files (x86)\Microsoft SQL Server\140\DTS\Binn\
C:\Program Files\Git LFS
%PYTHON_HOME%
C:\Python27\Scripts
C:\Program Files\Seq\
C:\Program Files\Anaconda3
C:\Program Files\Anaconda3\Scripts
C:\Program Files\Anaconda3\Library\bin
C:\Hadoop-2.8.0\bin
C:\Java\bin

NUMBER_OF_PROCESSORS	8
OS	Windows_NT
Path	C:\Program Files\Microsoft MPI\Bin\;C:\WINDOWS\system32;...

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

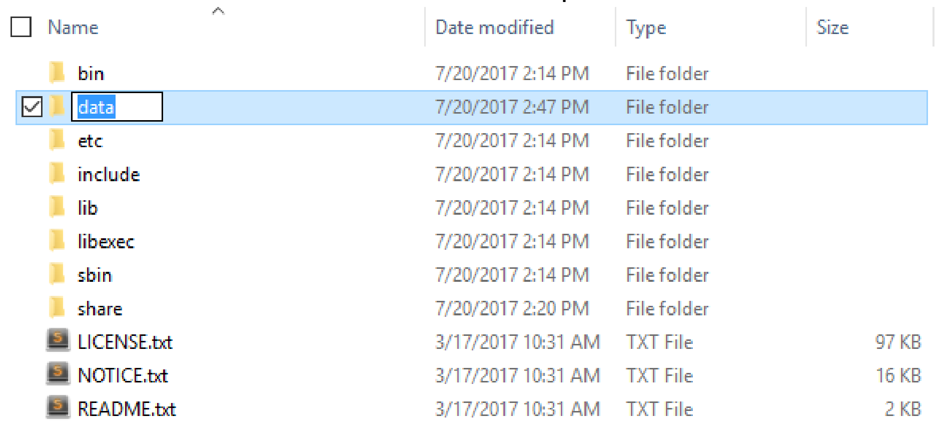
```
<configuration>
   <property>
       <name>fs.defaultFS</name>
```

```
      <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"



Name	Date modified	Type	Size
bin	7/20/2017 2:14 PM	File folder	
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

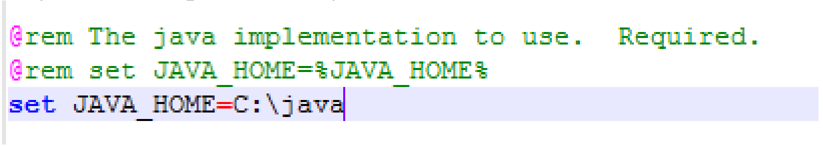
Edit file C:\Hadoop-2.8.0/etc/hadoop/hdfs-site.xml, paste below xml paragraph and save this file.

```
<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)



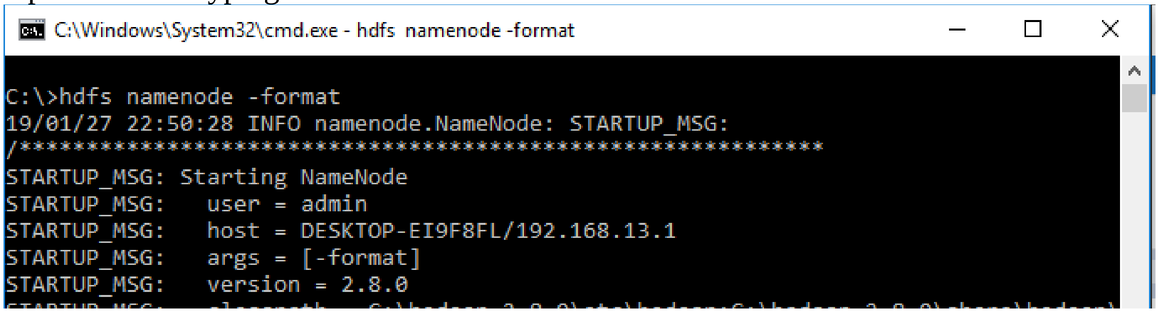
```
@rem The java implementation to use.  Required.
@rem set JAVA_HOME=%JAVA_HOME%
set JAVA_HOME=C:\java
```

<u>HADOOP CONFIGURATION</u> :

Dowload file Hadoop Configuration.zip (Link: https://github.com/MuhammadBilalYar/HADOOP-INSTALLATION-ON-WINDOW-10/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).

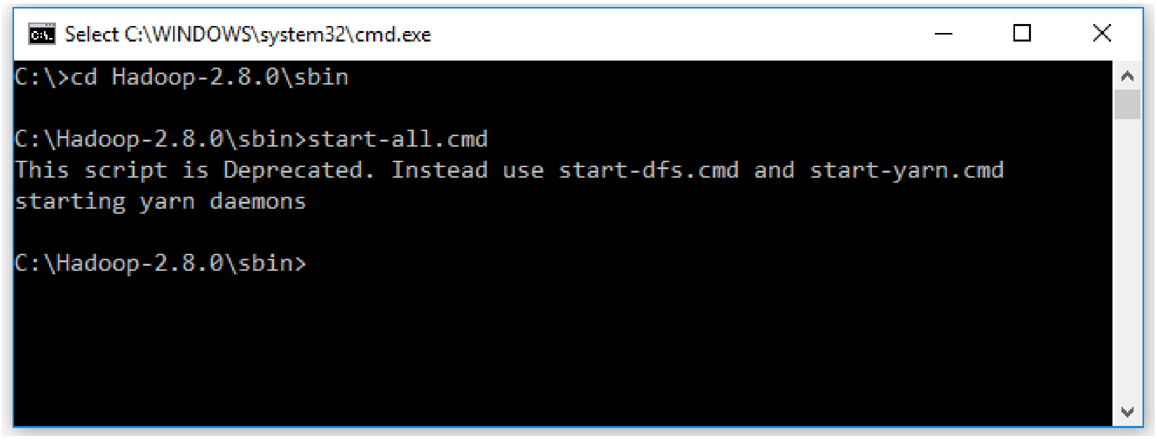
Open cmd and typing command "hdfs namenode –format" . You will see



```
C:\>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
```

<u>TESTING</u> :

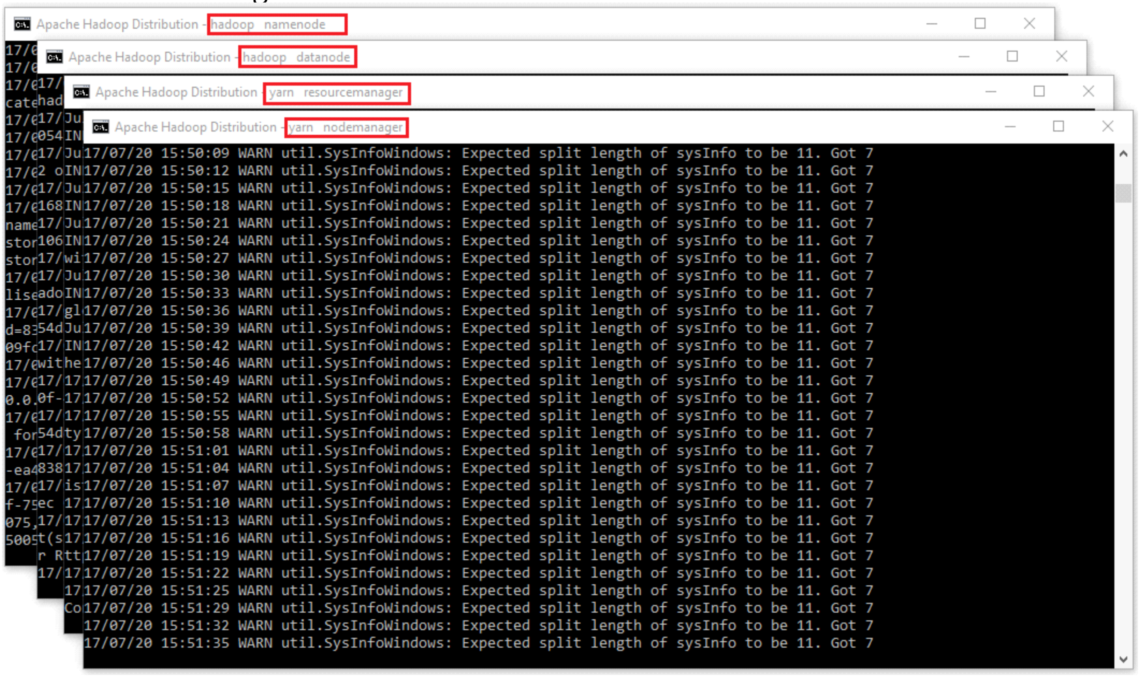
Open cmd and change directory to "C:\Hadoop-2.8.0\sbin" and type "start-all.cmd" to start apache.



Select C:\WINDOWS\system32\cmd.exe

```
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>
```

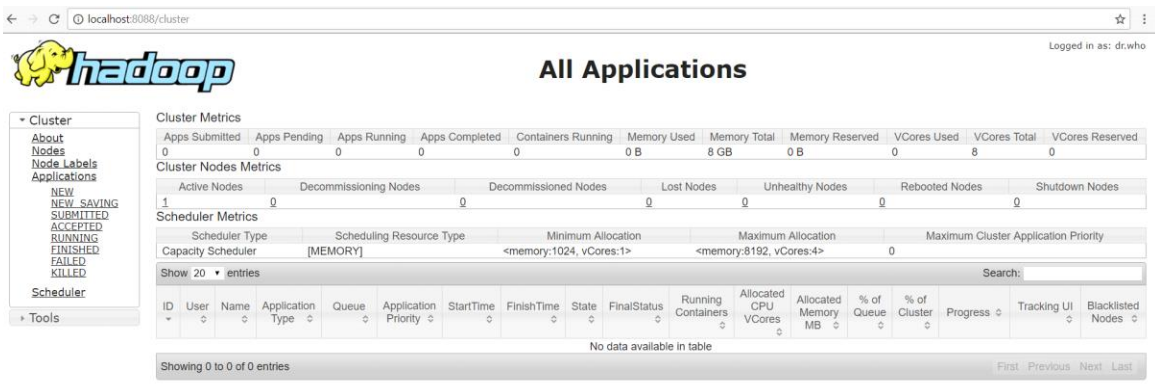
Make sure these apps are running :
Hadoop Namenode
Hadoop datanode
YARN Resourc Manager
YARN Node Manager



Apache Hadoop Distribution - hadoop namenode
Apache Hadoop Distribution - hadoop datanode
Apache Hadoop Distribution - yarn resourcemanager
Apache Hadoop Distribution - yarn nodemanager

```
17/07/20 15:50:09 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:12 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:15 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:18 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:21 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:24 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:27 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:30 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:33 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:36 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:39 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:42 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:46 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:49 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:52 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:55 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:50:58 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:01 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:04 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:07 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:10 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:13 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:16 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:19 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:22 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:25 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:29 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:32 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
17/07/20 15:51:35 WARN util.SysInfoWindows: Expected split length of sysInfo to be 11. Got 7
```

Open: http://localhost:8088



All Applications

Cluster Metrics

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	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

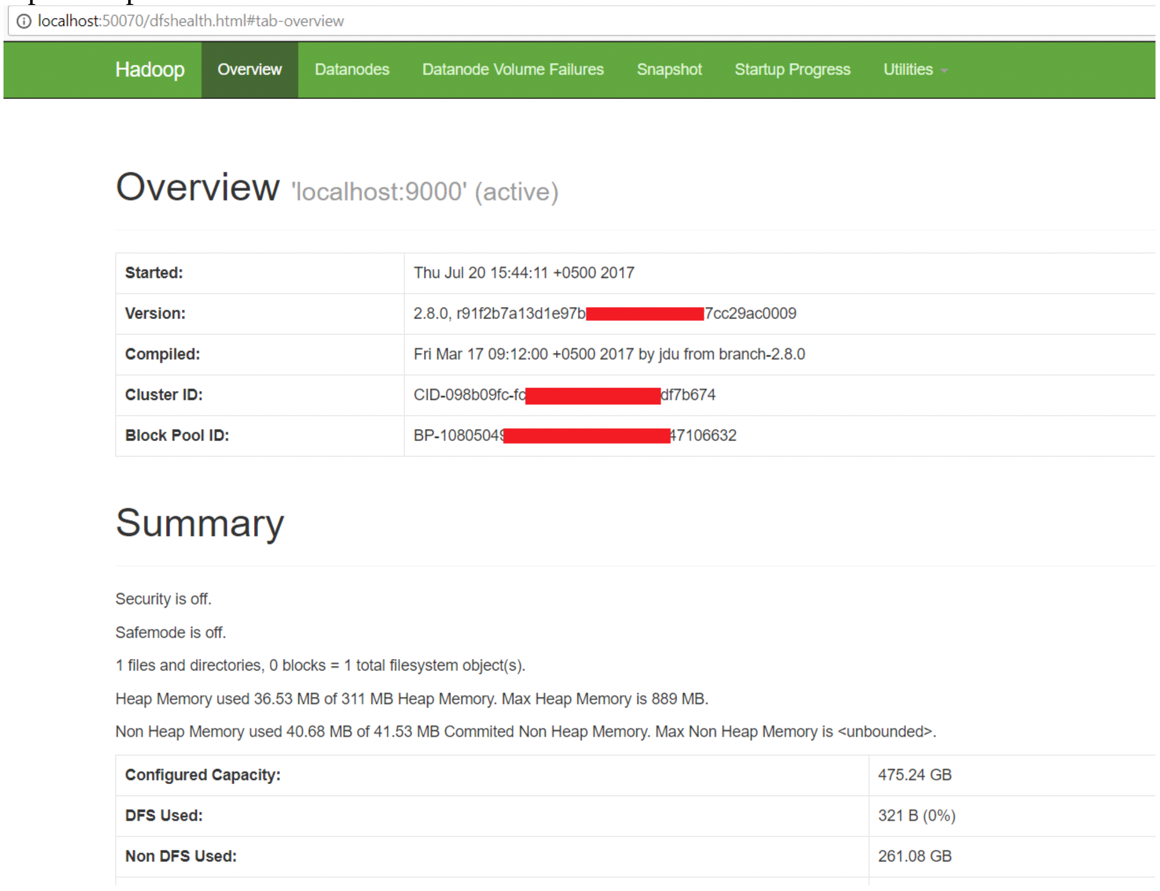
Scheduler Type	Scheduling Resource Type	Minimum Allocation	Maximum Allocation	Maximum Cluster Application Priority
Capacity Scheduler	[MEMORY]	<memory:1024, vCores:1>	<memory:8192, vCores:4>	0

Show 20 entries Search:

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

Showing 0 to 0 of 0 entries

Open: http://localhost:50070



Overview 'localhost:9000' (active)

Started:	Thu Jul 20 15:44:11 +0500 2017
Version:	2.8.0, r91f2b7a13d1e97b[redacted]7cc29ac0009
Compiled:	Fri Mar 17 09:12:00 +0500 2017 by jdu from branch-2.8.0
Cluster ID:	CID-098b09fc-fc[redacted]df7b674
Block Pool ID:	BP-10805049[redacted]47106632

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 Commited 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>

<u>Steps for copying file</u>

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
```

CONCLUSION :

Experiment No. 2
Use of Sqoop tool
Date of Performance:
Date of Submission:

AIM: To install SQOOP and execute basic commands of Hadoop eco system componentSqoop.

THEORY:

Installation and configuration of SQOOP

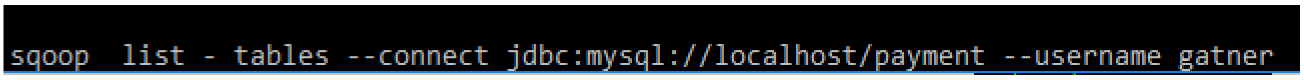
1) Download SQOOP from https://sqoop.apache.org
2) Unzip and Install SQOOP

   After Downloading the SQOOP, we need to Unzip the sqoop-1.4.7.bin__hadoop-2.6.0.tar.gz file.
3) Create a folder and move the final extracted file in it.
4) Set up the environment variables
   a. Set SQOOP_HOME
   b. Set up path variable
5) Configure SQOOP

Basic SQOOP commands:

1. List Table

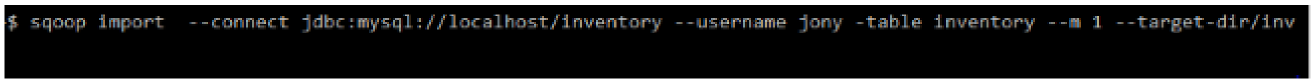
This command lists the particular table of the database in MYSQL server.



```
sqoop  list - tables --connect jdbc:mysql://localhost/payment --username gatner
```

2. Target directory

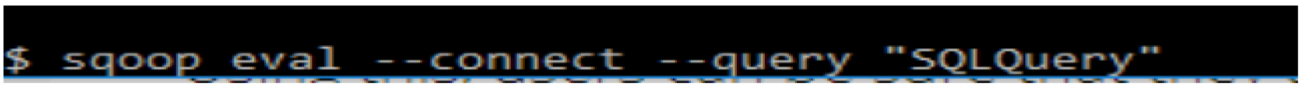
This command import table in a specific directory in HDFS. -m denotes mapper argument. They have an integer value.



```
$ sqoop import  --connect jdbc:mysql://localhost/inventory --username jony -table inventory --m 1 --target-dir/inv
```

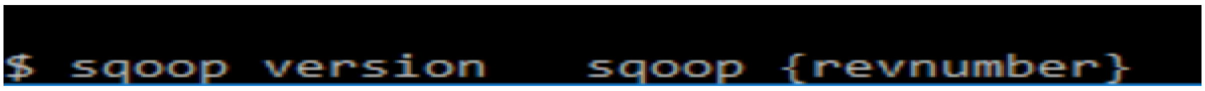
3. sqoop-eval

This command runs quickly SQL queries of the respective database.



```
$ sqoop eval --connect --query "SQLQuery"
```

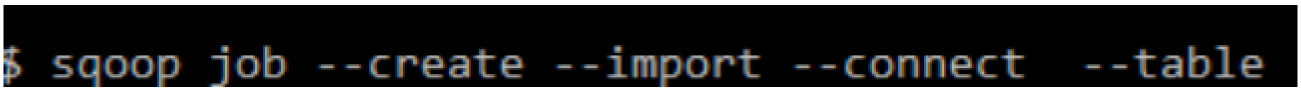
4. sqoop – version
This command displays version of the sqoop.



```
$ sqoop version   sqoop {revnumber}
```

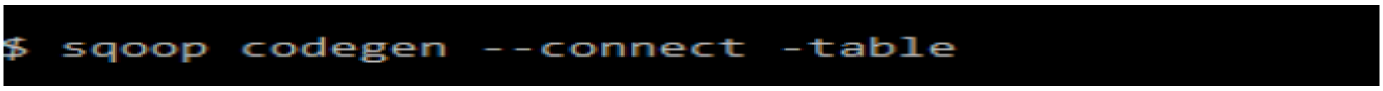
5. sqoop-job

This command allows us to create a job, the parameters that are created can be invoked at any time. They take options like (–create,–delete,–show,–exit).



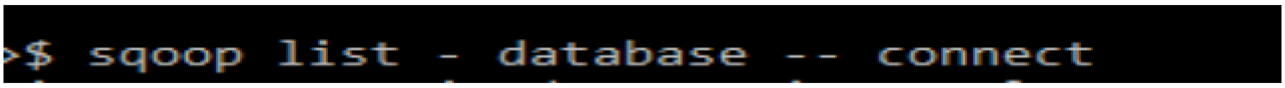
```
$ sqoop job --create --import --connect  --table
```

6. code gen
This Sqoop command creates java class files which encapsulate the imported records. All the java files are recreated, and new versions of a class are generated. They generate code to interact with database records. Retrieves a list of all the columns and their datatypes.



```
$ sqoop codegen --connect -table
```

7. List Database
This Sqoop command lists have all the available database in the RDBMS server.



```
>$ sqoop list - database -- connect
```

<u>CONCLUSION</u>:

Experiment No.3
To install and configure MongoDB to execute NoSQL commands
Date of Performance:
Date of Submission:

AIM: To install and configure MongoDB/ Cassandra/ HBase/ Hypertable and to execute NoSQL commands.

THEORY:

MongoDB can be downloaded from https://www.mongodb.com/try/download/community2

Now open command prompt and run the following command

```
C:\>move mongodb-win64-* mongodb

    1 dir(s) moved.
```

MongoDB requires a data folder to store its files. The default location for the MongoDB data directory is c:\data\db. So create the folder using the Command Prompt. Execute the following command sequence.

```
C:\>md data

C:\md data\db
```

In case mongodb is stored in some other location, navigate to that folder.

In command prompt navigate to the bin directory present into the mongodb installation folder. Suppose the installation folder is D:\set up\mongodb

```
C:\Users\XYZ>d:

D:\>cd "set up"

D:\set up>cd mongodb

D:\set up\mongodb>cd bin

D:\set up\mongodb\bin>mongod.exe --dbpath "d:\set up\mongodb\data"
```

Now to run the mongodb, open another command prompt and issue the following command:

```
D:\set up\mongodb\bin>mongo.exe

MongoDB shell version: 2.4.6

connecting to: test

>db.test.save( { a: 1 } )

>db.test.find()

{ "_id" : ObjectId(5879b0f65a56a454), "a" : 1 }

>
```

The use Command

MongoDB use DATABASE_NAME is used to create database. The command will create a new database, if it doesn't exist otherwise it will return the existing database

Syntax:

use DATABASE_NAME

The dropDatabase () Method

MongoDB db.dropDatabase () command is used to drop an existing database.

Syntax:

db.dropDatabase()

The createCollection() Method

MongoDB db.createCollection(name, options) is used to create collection.

Syntax:

db.createCollection(name, options)

Insert Document

To insert data into MongoDB collection, you need to use MongoDB's insert() or save()method

Syntax

>db.COLLECTION_NAME.insert(document)

Example:

```
>db.post.insert([
{
 title: 'MongoDB Overview',
 description: 'MongoDB is no sql database',
 tags: ['mongodb', 'database', 'NoSQL'],
 likes: 100
},
{
 title: 'NoSQL Database',
 description: 'NoSQL database doesn't have tables',
 tags: ['mongodb', 'database', 'NoSQL'],
 likes: 20,
 comments: [
 {
 user:'user1',
 message: 'My first comment',
 dateCreated: new Date(2022,11,10,2,35),
 like: 0
 }
 ]
}
])
```

Creating sample document:

Example

Suppose a client needs a database design for his blog website. Website has the following requirements.

 Every post has the unique title, description and url.

 Every post can have one or more tags.

 Every post has the name of its publisher and total number of likes.

 Every Post have comments given by users along with their name, message, data-time and likes.

 On each post there can be zero or more comments.

Document:

```
{
 _id: POST_ID
 title: TITLE_OF_POST,
 description: POST_DESCRIPTION,
 by: POST_BY,
 url: URL_OF_POST,
 tags: [TAG1, TAG2, TAG3],
 likes: TOTAL_LIKES,
 comments: [
 {
 user:'COMMENT_BY',
 message: TEXT,
 dateCreated: DATE_TIME,
 like: LIKES
 },
 {
 user:'COMMENT_BY',
 message: TEXT,
 dateCreated: DATE_TIME,
 like: LIKES
 }
 ]
}
```

CONCLUSION:

Experiment No.4
Experiment on Hadoop Map-Reduce
Date of Performance:
Date of Submission:

AIM: -To write a program to implement a word count program using MapReduce.

THEORY:

WordCount is a simple program which counts the number of occurrences of each word in a given text input data set. WordCount fits very well with the MapReduce programming model making it a great example to understand the Hadoop Map/Reduce programming style. The implementation consists of three main parts:

1. Mapper

2. Reducer

3. Driver

Step-1. Write a Mapper

A Mapper overrides the ―map‖ function from the Class "org.apache.hadoop.mapreduce.Mapper" which provides <key, value> pairs as the input. A Mapper implementation may output <key,value> pairs using the provided Context .

Input value of the WordCount Map task will be a line of text from the input data file and the key would be the line number <line_number, line_of_text> . Map task outputs <word, one> for each word in the line of text.

Pseudo-code

```
void Map (key, value){
for each word x in value:
output.collect(x,1);
}
```

Step-2. Write a Reducer

A Reducer collects the intermediate <key,value> output from multiple map tasks and assemble a single result. Here, the WordCount program will sum up the occurrence of each word to pairs as <word, occurrence>.

Pseudo-code

```
void Reduce (keyword, <list of value>){ for
each x in <list of value>:
sum+=x;
final_output.collect(keyword, sum);
}
```

Code:

```
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.Reducer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.lib.input.TextInputFormat;
import org.apache.hadoop.mapreduce.lib.output.TextOutputFormat;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.fs.Path;
public class WordCount
{
public static class Map extends Mapper<LongWritable,Text,Text,IntWritable> {
public void map(LongWritable key, Text value,Context context) throws
IOException,InterruptedException{
String line = value.toString();
StringTokenizer tokenizer = new StringTokenizer(line);
while (tokenizer.hasMoreTokens()) {
value.set(tokenizer.nextToken());
context.write(value, new IntWritable(1));
}
}
}
public static class Reduce extends Reducer<Text,IntWritable,Text,IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values,Context context)
throws IOException,InterruptedException {
int sum=0;
for(IntWritable x: values)
{
sum+=x.get();
}
context.write(key, new IntWritable(sum));
}
}
public static void main(String[] args) throws Exception {
Configuration conf= new Configuration();
Job job = new Job(conf,"My Word Count Program");
job.setJarByClass(WordCount.class);
job.setMapperClass(Map.class);
job.setReducerClass(Reduce.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
job.setInputFormatClass(TextInputFormat.class);
job.setOutputFormatClass(TextOutputFormat.class);
Path outputPath = new Path(args[1]);
//Configuring the input/output path from the filesystem into the job
FileInputFormat.addInputPath(job, new Path(args[0]));
```

```
FileOutputFormat.setOutputPath(job, new Path(args[1]));
//deleting the output path automatically from hdfs so that we don't have to
delete it explicitly
outputPath.getFileSystem(conf).delete(outputPath);
//exiting the job only if the flag value becomes false
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
}
```

CONCLUSION:

Experiment No.5
Create HIVE Database and Descriptive analytics-basic statistics.
Date of Performance:
Date of Submission:

Aim: Create HIVE Database and Descriptive analytics-basic statistics.

Theory:

Hive is a database technology that can define databases and tables to analyze structured data. The theme for structured data analysis is to store the data in a tabular manner, and pass queries to analyze it. This chapter explains how to create Hive database. Hive contains a default database named default.

Create Database Statement

Create Database is a statement used to create a database in Hive. A database in Hive is a namespace or a collection of tables. The syntax for this statement is as follows:

```
CREATE DATABASE|SCHEMA [IF NOT EXISTS] <database name>
```

Here, IF NOT EXISTS is an optional clause, which notifies the user that a database with the same name already exists. We can use SCHEMA in place of DATABASE in this command. The following query is executed to create a database named userdb:

```
hive> CREATE DATABASE [IF NOT EXISTS] userdb;

hive> CREATE SCHEMA userdb;
```

The following query is used to verify a databases list:

```
hive> SHOW DATABASES;

default

userdb
```

Program:

The JDBC program to create a database is given below.

```
import java.sql.SQLException;

import java.sql.Connection;

import java.sql.ResultSet;
import java.sql.Statement;
import java.sql.DriverManager;

public class HiveCreateDb {
  private static String driverName = "org.apache.hadoop.hive.jdbc.HiveDriver";

  public static void main(String[] args) throws SQLException {
    // Register driver and create driver instance

    Class.forName(driverName);
    // get connection

    Connection con = DriverManager.getConnection("jdbc:hive://localhost:10000/default",
"", "");
    Statement stmt = con.createStatement();

    stmt.executeQuery("CREATE DATABASE userdb");
    System.out.println("Database userdb created successfully.");

    con.close();
  }
}
```

Output:

```
Database userdb created successfully.
```

CONCLUSION:

Experiment No.6
Data Stream Algorithms: Implement Flajolet Martin algorithm using any programming language
Date of Performance:
Date of Submission:

Aim: Data Stream Algorithms:

Implement Flajolet Martin algorithm using any programming language

Theory:

Flajolet-Martin algorithm approximates the number of unique objects in a stream or a database in one pass. If the stream contains n elements with m of them unique, this algorithm runs in O(n) time and needs O(log(m)) memory.

Algorithm:

1. Create a bit vector (bit array) of sufficient length L, such that 2L>n, the number of elements in the stream. Usually a 64-bit vector is sufficient since 264 is quite large for most purposes.

2.The i-th bit in this vector/array represents whether we have seen a hash function value whose binary representation ends in 0i. So initialize each bit to 0.

3.The i-th bit in this vector/array represents whether we have seen a hash function value whose binary representation ends in 0i. So initialize each bit to 0.

4.The i-th bit in this vector/array represents whether we have seen a hash function value whose binary representation ends in 0i. So initialize each bit to 0.

5.Once input is exhausted, get the index of the first 0 in the bit array (call this R). By the way, this is just the number of consecutive 1s (i.e. we have seen 0,00,...,0R−1 as the output of the hash function) plus one.

6.Calculate the number of unique words as 2R/ϕ, where ϕ is 0.77351. A proof for this can be found in the original paper listed in the reference section.

7.The standard deviation of R is a constant: σ(R)=1.12. (In other words, R can be off by about 1 for 1 - 0.68 = 32% of the observations, off by 2 for about 1 - 0.95 = 5% of the observations, off by 3 for 1 - 0.997 = 0.3% of the observations using the Empirical rule of statistics). This implies that our count can be off by a factor of 2 for 32% of the observations, off by a factory of 4 for 5% of the observations, off by a factor of 8 for 0.3% of the observations and so on.

CODE:

```
stream=[1,2,3,4,5,6,4,2,5,9,1,6,3,7,1,2,2,4,2,1]
print('Using Flajolet Martin Algorithm:')
maxnum=0
for i in range(0,len(stream)):
   val= bin((1*stream[i] + 6) % 32)[2:]
   sum=0
   for j in range(len(val)-1,0,-1):
      if val[j]=='0':
         sum+=1
      else:
         break
   if sum>maxnum:
      maxnum=sum
print('distict elements', 2**maxnum)
```

Output:

```
Using Flajolet Martin Algorithm:
distict elements 8
```

CONCLUSION:

Experiment No.7
Social Network Analysis using R (for example: Community Detection Algorithm)
Date of Performance:
Date of Submission:

Aim: Social Network Analysis using R (for example: Community Detection Algorithm)

Theory:

Online social platforms have enabled people around the world to interact with each other and build relationships with others they share common interests with. This can be observed in real life — naturally, we tend to develop and maintain relationships with others that are similar to us. People with similar interests tend to gravitate towards each other and become associated in communities — clusters or groups of people that share similar traits with each other. Since people tend to cluster with others similar to them, we can use community detection to identify users with a high number of degrees (connections) and see how far their reach can travel in the network.

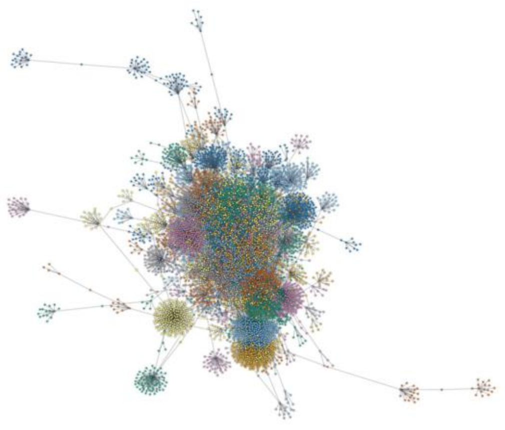
User Data Extraction — Since we are only interested in user data, we will only extract the following variables:

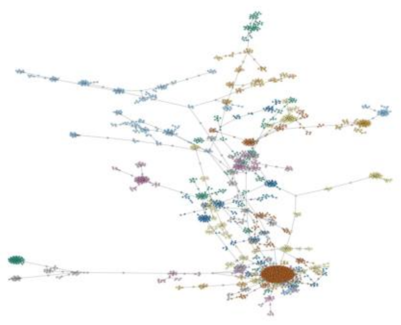
User_id — Yelp user ID; this is needed to make nodes and edges
Name — user's first name
Review count — the number of reviews user has written
Yelping since — date user joined Yelp
Friends — a list containing all of the user's friends by user_id
Fans — number of fans user has
Elite — number of years the user has Elite status
Average stars — user's average rating of all reviews written

CODE:

```
#remove users with no friends

sample <- subset(user_df, friends != "None")

#make a subset; we only need to retain data of users with some social activity

sub <- subset(sample, year == 2005 & review_count >= 2 & no_of_friends >= 2)

#make links (nodes and edges)

sample_friends <- sub %>% select(user_id, friends)

sample_users <- strsplit(sample_friends$friends, split = ",")

sample_dat <- data.frame(user_id = rep(sample_friends$user_id, sapply(sample_users, length)), friends = unlist(sample_users))

#network is still too big, take a random sample of 100k nodes

samp_net <- sample_n(sample_dat, 100000)
```

```
#make network
network <- graph.data.frame(samp_net)
network_s <- simplify(network)
net_deg <- degree(network_s)
all_degree <- degree(network, mode = 'all')
#graph user with max degrees
sub_all <- subcomponent(network_s, which(all_degree == max(all_degree)), 'all')
g_sub <- induced_subgraph(network_s, sub_all)
#communities
graph.com <- fastgreedy.community(as.undirected(g_sub))
V(g_sub)$color <- graph.com$membership + 1
#create pdf graph for high resolution (try zooming in!)
pdf("communities2005.pdf", 10,10)
plot(g_sub,
    vertex.color = V(g_sub)$color,
    vertex.size = 1,
    vertex.label = NA,
    vertex.frame.color = adjustcolor("#41424c", alpha.f = 0.25),
    edge.arrow.size = 0.1,
    edge.color = adjustcolor("#41424c", alpha.f = 0.20),
    edge.width = 1.5,
    edge.arrow.mode=0,
    layout=layout_with_lgl,
    asp = 0.9,
    dpi=300
)
dev.off()
```





CONCLUSION:

Experiment No.8
Data Visualization using Hive/PIG/R/Tableau/.
Date of Performance:
Date of Submission:

Aim: Data Visualization using Hive/PIG/R/Tableau/.

Theory:

Data visualization is the technique used to deliver insights in data using visual cues such as graphs, charts, maps, and many others. This is useful as it helps in intuitive and easy understanding of the large quantities of data and thereby make better decisions regarding it. Data Visualization in R Programming Language

The popular data visualization tools that are available are Tableau, Plotly, R, Google Charts, Infogram, and Kibana. The various data visualization platforms have different capabilities, functionality, and use cases. They also require a different skill set. This article discusses the use of R for data visualization.

R is a language that is designed for statistical computing, graphical data analysis, and scientific research. It is usually preferred for data visualization as it offers flexibility and minimum required coding through its packages.

Consider the following *airquality* data set for visualization in R:

Ozone	Solar R.	Wind	Temp	Month	Day
41	190	7.4	67	5	1
36	118	8.0	72	5	2
12	149	12.6	74	5	3
18	313	11.5	62	5	4
NA	NA	14.3	56	5	5
28	NA	14.9	66	5	6

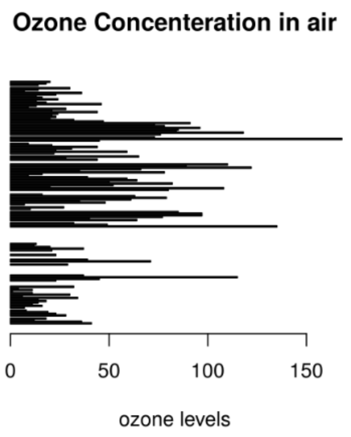
1.Bar Plot

There are two types of bar plots- horizontal and vertical which represent data points as horizontal or vertical bars of certain lengths proportional to the value of the data item. They are generally used for continuous and categorical variable plotting. By setting the horiz parameter to true and false, we can get horizontal and vertical bar plots respectively.

Example 1:

```
# Horizontal Bar Plot for

# Ozone concentration in air

barplot(airquality$Ozone,

        main = 'Ozone Concenteration in air',

        xlab = 'ozone levels', horiz = TRUE)
```

Output:

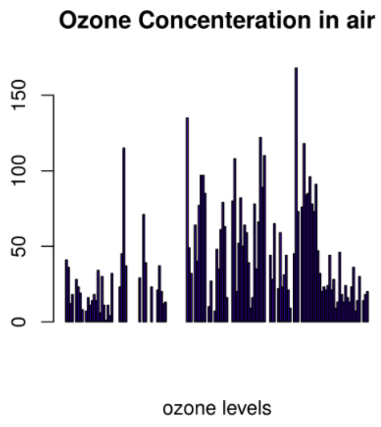


Example 2:

```
# Vertical Bar Plot for

# Ozone concentration in air
```

barplot(airquality$Ozone, main = 'Ozone Concenteration in air',

xlab = 'ozone levels', col ='blue', horiz = FALSE)



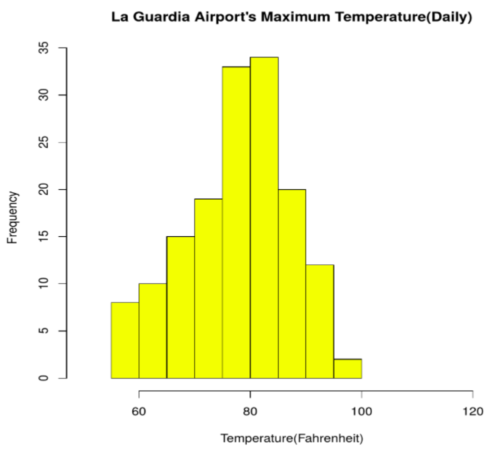
2. Histogram

A histogram is like a bar chart as it uses bars of varying height to represent data distribution. However, in a histogram values are grouped into consecutive intervals called bins. In a Histogram, continuous values are grouped and displayed in these bins whose size can be varied.

Example:

```
# Histogram for Maximum Daily Temperature

data(airquality)


hist(airquality$Temp, main ="La Guardia Airport's\

Maximum Temperature(Daily)",

   xlab ="Temperature(Fahrenheit)",

   xlim = c(50, 125), col ="yellow",

   freq = TRUE)
```

Output:

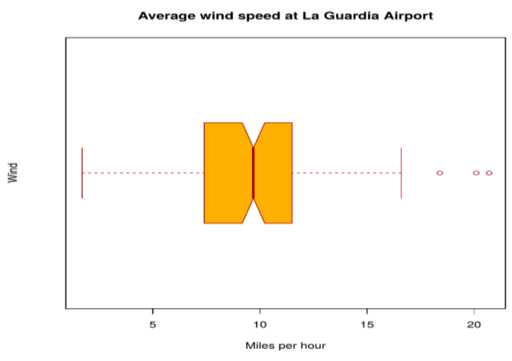


3. Box Plot

The statistical summary of the given data is presented graphically using a boxplot. A boxplot depicts information like the minimum and maximum data point, the median value, first and third quartile, and interquartile range.

Example:

```
# Box plot for average wind speed

data(airquality)

boxplot(airquality$Wind, main = "Average wind speed\

at La Guardia Airport",

          xlab = "Miles per hour", ylab = "Wind",

          col = "orange", border = "brown",

          horizontal = TRUE, notch = TRUE)
```

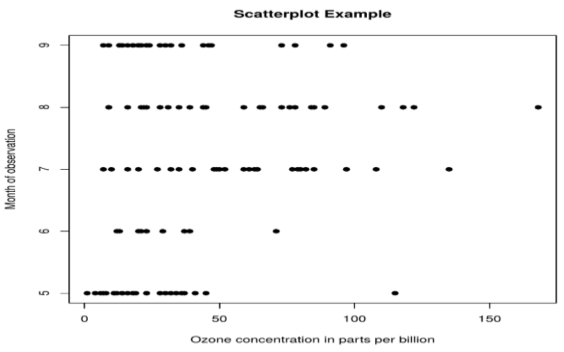


4.Scatter Plot

A scatter plot is composed of many points on a Cartesian plane. Each point denotes the value taken by two parameters and helps us easily identify the relationship between them.

Example:.

```
# Scatter plot for Ozone Concentration per month

data(airquality)

plot(airquality$Ozone, airquality$Month,

     main ="Scatterplot Example",

    xlab ="Ozone Concentration in parts per billion",

    ylab =" Month of observation ", pch = 19)
```



5. Heat Map

Heatmap is defined as a graphical representation of data using colors to visualize the value of the matrix. heatmap() function is used to plot heatmap.

Syntax: heatmap(data)

Parameters: data: It represent matrix data, such as values of rows and columns

Return: This function draws a heatmap.

```
# Set seed for reproducibility

# set.seed(110)

# Create example data

data <- matrix(rnorm(50, 0, 5), nrow = 5, ncol = 5)
```

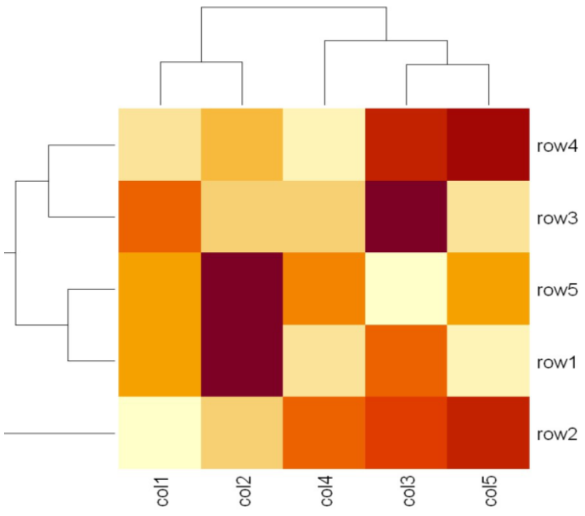
# Column names

colnames(data) <- paste0("col", 1:5)

rownames(data) <- paste0("row", 1:5)

# Draw a heatmap

heatmap(data)



6. Map visualization in R

Here we are using maps package to visualize and display geographical maps using an R programming language.

# Read dataset and convert it into

# Dataframe

data <- read.csv("worldcities.csv")

df <- data.frame(data)

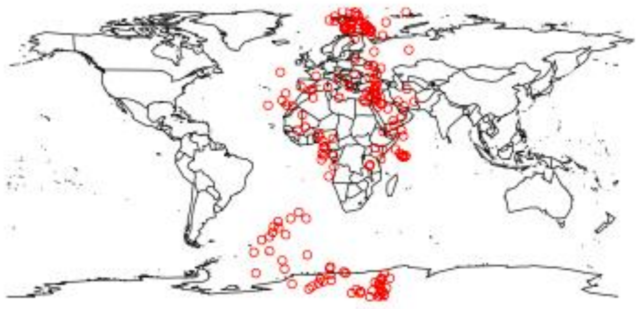
# Load the required libraries

library(maps)

map(database = "world")

# marking points on map

points(x = df$lat[1:500], y = df$lng[1:500], col = "Red")install.packages("maps")



7. 3D Graphs in R

Here we will use preps() function, This function is used to create 3D surfaces in perspective view. This function will draw perspective plots of a surface over the x–y plane.

Syntax: persp(x, y, z)

Parameter: This function accepts different parameters i.e. x, y and z where x and y are vectors defining the location along x- and y-axis. z-axis will be the height of the surface in the matrix z.

Return Value: persp() returns the viewing transformation matrix for projecting 3D coordinates (x, y, z) into the 2D plane using homogeneous 4D coordinates (x, y, z, t).

# Adding Titles and Labeling Axes to Plot

cone <- function(x, y){

sqrt(x ^ 2 + y ^ 2)

}

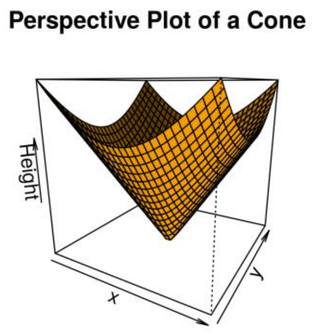
# prepare variables.

x <- y <- seq(-1, 1, length = 30)

z <- outer(x, y, cone)

# plot the 3D surface

```
# Adding Titles and Labeling Axes to Plot
persp(x, y, z,
main="Perspective Plot of a Cone",
zlab = "Height",
theta = 30, phi = 15,
col = "orange", shade = 0.4)
```



CONCLUSION: