LAB SHEET 01

Sabaragamuwa University of Sri Lanka

Faculty of Computing

Software Engineering

SE6103 – Parallel and Distributed Systems

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Lab Sheet: Single-Node Hadoop Cluster with Docker

1. Confirming Pre-requisites

Command:

```
docker--version
```

Output:

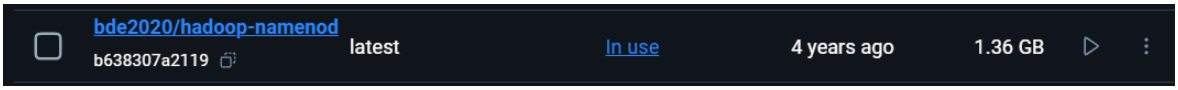
```
PS C:\Users\HP> docker --version
Docker version 27.2.0, build 3ab4256
```

2. Step 1: Pull the Hadoop Docker image

Command:

```
docker pull bde2020/hadoop-namenode:latest
```

Output:



3. Verify the Download

Command:

```
docker images
```

Output:

```
PS C:\Users\HP> docker images
REPOSITORY                TAG       IMAGE ID       CREATED         SIZE
nginx                     latest    3b25b682ea82   4 weeks ago     192MB
alpine                    latest    91ef0af61f39   8 weeks ago     7.8MB
hello-world               latest    d2c94e258dcb   18 months ago   13.3kB
bde2020/hadoop-namenode   latest    b638307a2119   4 years ago     1.37GB
```

4. Step 2: Start the Hadoop Container

Command:

```
docker run-it--name hadoop-cluster-p 9870:9870-p 8088:8088-p
50070:50070 bde2020/hadoop-namenode:latest /bin/bash
```

Output:

```
Configuring core
 - Setting dfs.namenode.name.dir=file:///hadoop/dfs/name
Configuring yarn
Configuring httpfs
Configuring kms
Configuring mapred
Configuring for multihomed network
root@069201a88d8a:/#
```

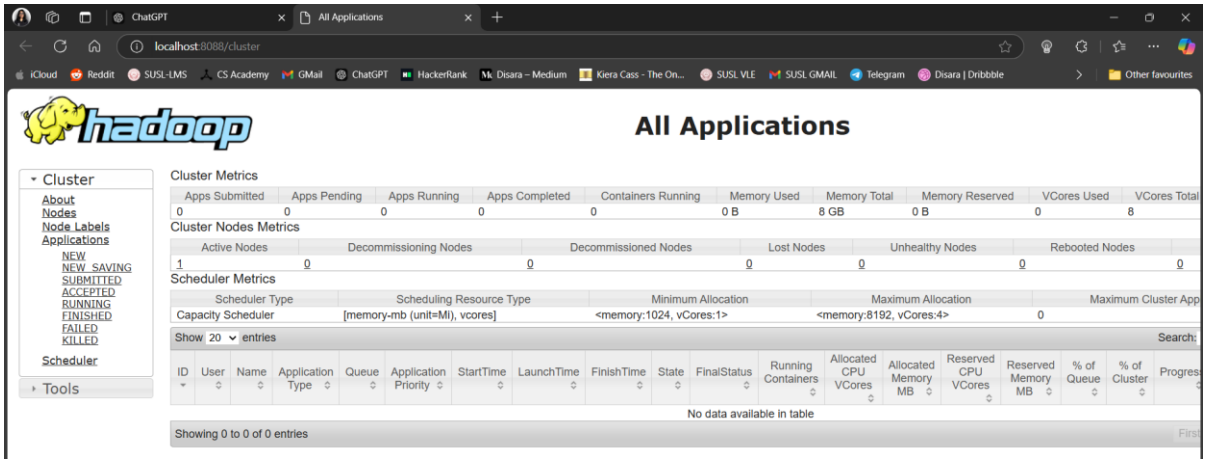
5. Start Hadoop Services

Commands to run each service separately:

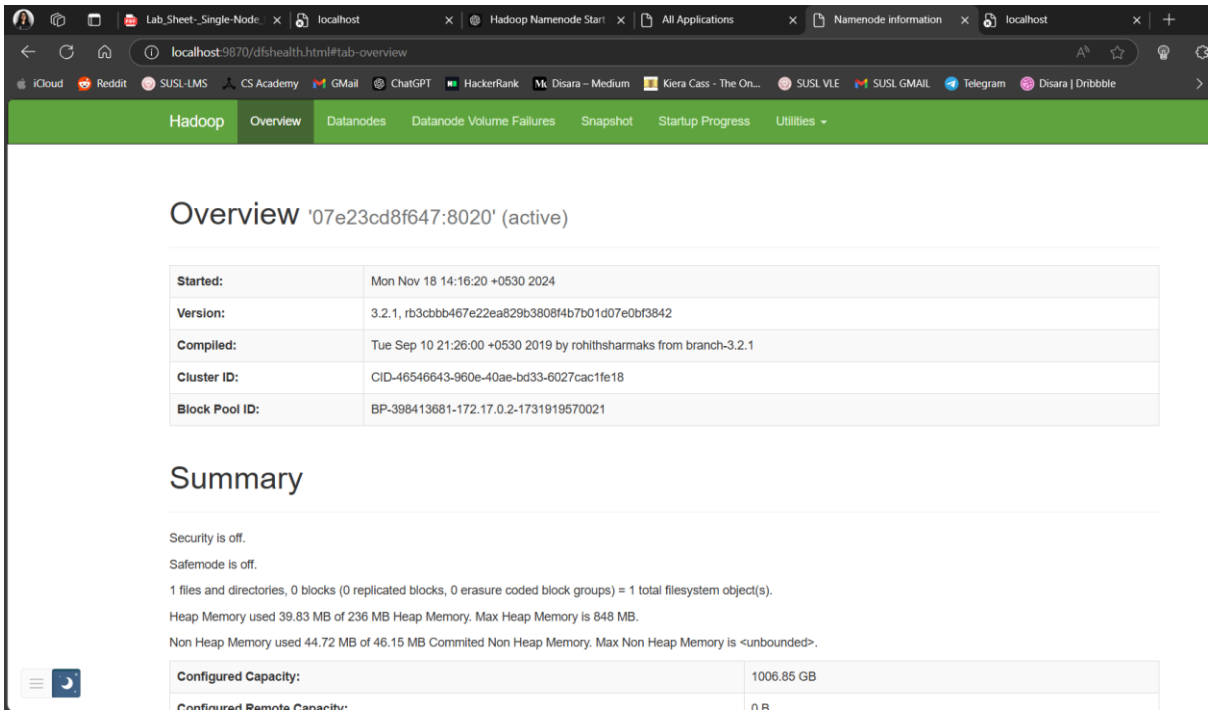
```
/opt/hadoop-3.2.1/bin/hdfs --daemon start namenode

/opt/hadoop-3.2.1/bin/hdfs --daemon start datanode

/opt/hadoop-3.2.1/bin/yarn --daemon start resourcemanager

/opt/hadoop-3.2.1/bin/yarn --daemon start nodemanager
```

6. Step 3: Access Hadoop Web Interfaces

- HDFS Web Interface (Resource Manager):



- YARN Web Interface (NameNode Web UI):



7. Step 4: Running a Sample MapReduce Job

7.1. Upload Sample Data to HDFS

Command and Output:

```
root@07e23cd8f647:/# hdfs dfs -mkdir -p /user/hadoop/input

root@07e23cd8f647:/#
```

Files uploaded successfully:

```
root@07e23cd8f647:/# hdfs dfs -ls /user/hadoop/input
Found 9 items
-rw-r--r--   3 root supergroup       8260 2024-11-18 08:53 /user/hadoop/input/capacity-scheduler.xml
-rw-r--r--   3 root supergroup        860 2024-11-18 08:53 /user/hadoop/input/core-site.xml
-rw-r--r--   3 root supergroup      11392 2024-11-18 08:53 /user/hadoop/input/hadoop-policy.xml
-rw-r--r--   3 root supergroup       1385 2024-11-18 08:53 /user/hadoop/input/hdfs-site.xml
-rw-r--r--   3 root supergroup        620 2024-11-18 08:53 /user/hadoop/input/httpfs-site.xml
-rw-r--r--   3 root supergroup       3518 2024-11-18 08:53 /user/hadoop/input/kms-acls.xml
-rw-r--r--   3 root supergroup        682 2024-11-18 08:53 /user/hadoop/input/kms-site.xml
-rw-r--r--   3 root supergroup        841 2024-11-18 08:53 /user/hadoop/input/mapred-site.xml
-rw-r--r--   3 root supergroup       1031 2024-11-18 08:53 /user/hadoop/input/yarn-site.xml
```

7.2. Run the WordCount Job

```
root@07e23cd8f647:/# hadoop jar $HADOOP_HOME/share/hadoop/mapreduce/hadoop-mapreduce-examples-*.jar word
count /user/hadoop/input /user/hadoop/output
2024-11-18 08:57:53,407 INFO impl.MetricsConfig: Loaded properties from hadoop-metrics2.properties
2024-11-18 08:57:53,515 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot period at 10 second(s).
2024-11-18 08:57:53,515 INFO impl.MetricsSystemImpl: JobTracker metrics system started
2024-11-18 08:57:54,027 INFO input.FileInputFormat: Total input files to process : 9
2024-11-18 08:57:54,096 INFO mapreduce.JobSubmitter: number of splits:9
2024-11-18 08:57:54,278 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_local382613832_0001
2024-11-18 08:57:54,278 INFO mapreduce.JobSubmitter: Executing with tokens: []
2024-11-18 08:57:54,442 INFO mapreduce.Job: The url to track the job: http://localhost:8080/
2024-11-18 08:57:54,444 INFO mapreduce.Job: Running job: job_local382613832_0001
2024-11-18 08:57:54,445 INFO mapred.LocalJobRunner: OutputCommitter set in config null
2024-11-18 08:57:54,463 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2024-11-18 08:57:54,464 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary fol
```

7.3. Check the output:

```
root@07e23cd8f647:/# hdfs dfs -cat /user/hadoop/output/part-r-00000
2024-11-18 08:58:29,191 INFO sasl.SaslDataTransferClient: SASL encryption trust check: localHostTrusted
= false, remoteHostTrusted = false
"*"     21
"AS     9
"License");     9
"alice,bob      21
"clumping"      1
(ASF)   1
(root   1
(the    9
-->     18
-1      1
-1,     1
0.0     1
1-MAX_INT.      1
1.      1
1.0.    1
2.0     9
```

8. Step 5: Exiting the Container

8.1. Stop the container:

```
root@07e23cd8f647:/# exit
exit
PS C:\Users\HP> docker stop hadoop-cluster
hadoop-cluster
```

8.2. Restart the container:

```
PS C:\Users\HP> docker start -i hadoop-cluster
Configuring core
 - Setting fs.defaultFS=hdfs://07e23cd8f647:8020
Configuring hdfs
 - Setting dfs.namenode.name.dir=file:///hadoop/dfs/name
Configuring yarn
Configuring httpfs
Configuring kms
Configuring mapred
Configuring for multihomed network
root@07e23cd8f647:/#
```

9. Task 1: Customize HDFS Configurations

9.1. Edit core-site.xml and hdfs-site.xml

Inside the container, navigate to the Hadoop configuration directory:

Command:

cd $HADOOP_HOME/etc/hadoop

Output:

```
root@07e23cd8f647:/# cd $HADOOP_HOME/etc/hadoop
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop#
```

Open the configuration files for editing using nano core-site.xml. Add or modify configurations such as:

```
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# sed -i '/<\/configuration>/i \
> <property>\n\
>   <name>fs.defaultFS</name>\n\
>   <value>hdfs://localhost:9000</value>\n\
> </property>' core-site.xml
```

Customizing HDFS configuration

```
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# sed -i '/<\/configuration>/i \
> <property>\n\
>   <name>dfs.replication</name>\n\
>   <value>1</value>\n\
> </property>\n\
> <property>\n\
>   <name>dfs.blocksize</name>\n\
>   <value>134217728</value>\n\
> </property>' hdfs-site.xml
```

Restarting Hadoop:

```
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# $HADOOP_HOME/sbin/hadoop-daemon.sh stop namenode
WARNING: Use of this script to stop HDFS daemons is deprecated.
WARNING: Attempting to execute replacement "hdfs --daemon stop" instead.
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# $HADOOP_HOME/sbin/hadoop-daemon.sh start namenode
WARNING: Use of this script to start HDFS daemons is deprecated.
WARNING: Attempting to execute replacement "hdfs --daemon start" instead.
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# $HADOOP_HOME/sbin/hadoop-daemon.sh stop datanode
WARNING: Use of this script to stop HDFS daemons is deprecated.
WARNING: Attempting to execute replacement "hdfs --daemon stop" instead.
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# $HADOOP_HOME/sbin/hadoop-daemon.sh start datanode
WARNING: Use of this script to start HDFS daemons is deprecated.
WARNING: Attempting to execute replacement "hdfs --daemon start" instead.
root@07e23cd8f647:/opt/hadoop-3.2.1/etc/hadoop# $HADOOP_HOME/sbin/hadoop-daemon.sh stop secondarynamenod
e
WARNING: Use of this script to stop HDFS daemons is deprecated.
WARNING: Attempting to execute replacement "hdfs --daemon stop" instead.
```