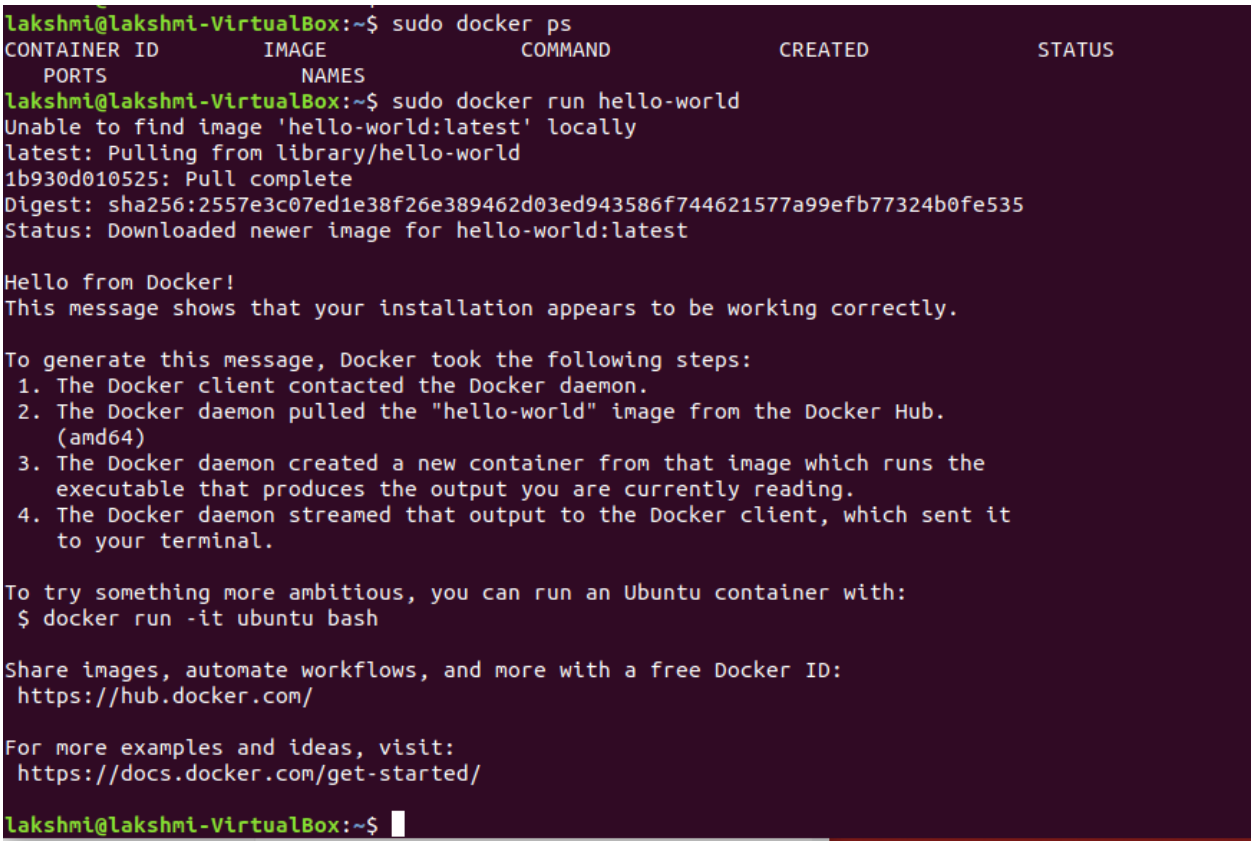
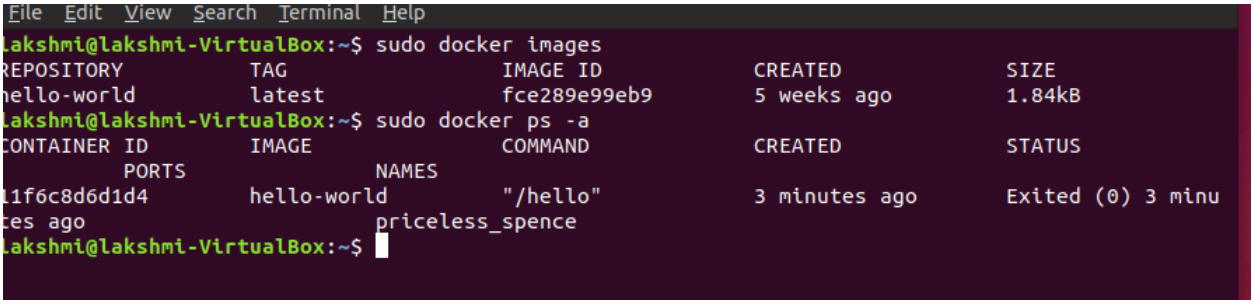
HW 3: Hadoop using Docker

HW 3A: Setting up Hadoop inside Docker

Steps:

1. Install docker and run a simple hello-world example.

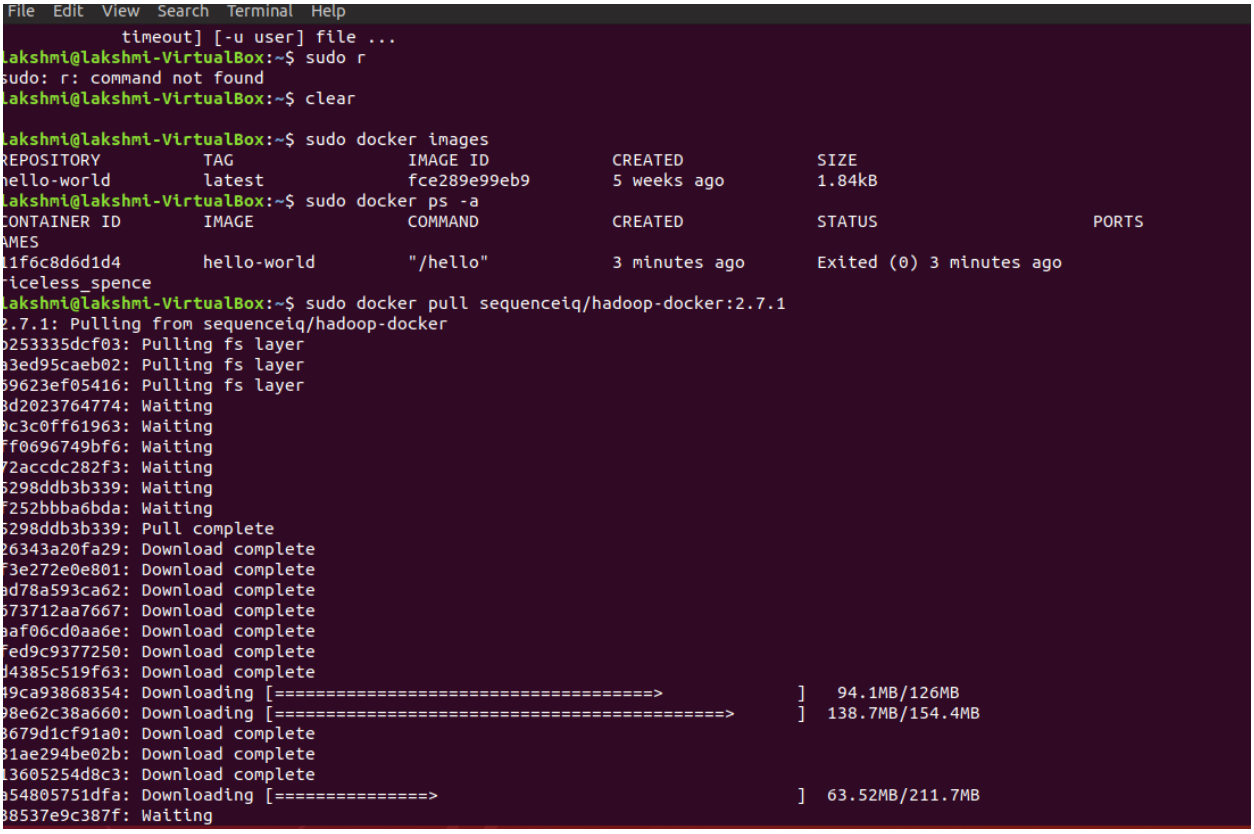


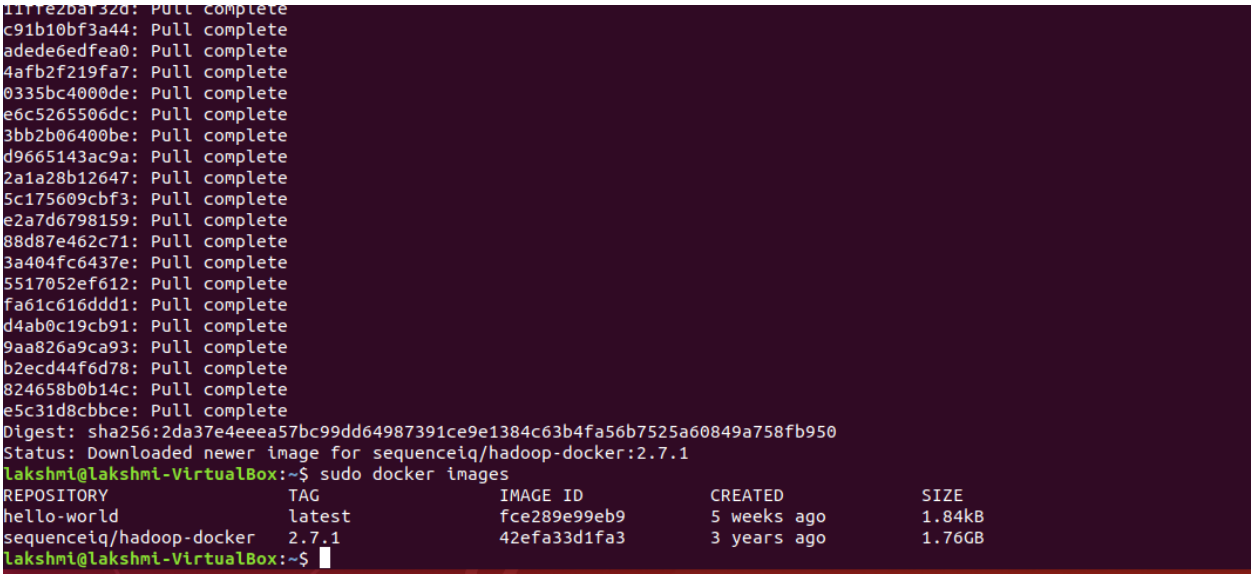


2. To install hadoop-2.7.1 docker image in a docker container and check whether the hadoop docker image got downloaded correctly.

$ docker pull sequenceiq/hadoop-docker:2.7.1

$ docker images





3. Create a docker container where Hadoop 2.7.1 will run and run jps command to see if the Hadoop services are up and running

$ docker run -it -p 50070:50070 sequenceiq/hadoop-docker:2.7.1 /etc/bootstrap.sh –bash
 # jps
 # ifconfig

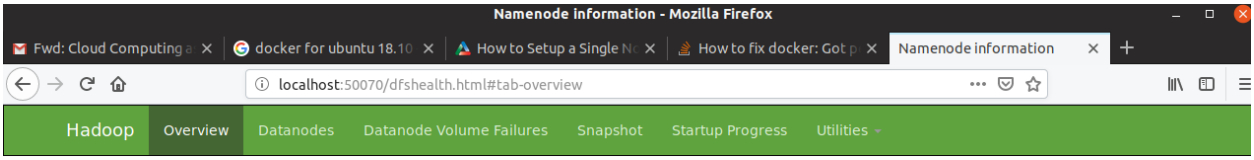
```
lakshmi@lakshmi-VirtualBox:~$ sudo docker run -it -p 50070:50070 sequenceiq/hadoop-docker:2.7.1 /etc/bootstrap.sh -bash
/
Starting sshd:                                             [  OK  ]
19/02/09 17:35:48 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java class
es where applicable
Starting namenodes on [160a2bc6b259]
160a2bc6b259: starting namenode, logging to /usr/local/hadoop/logs/hadoop-root-namenode-160a2bc6b259.out
localhost: starting datanode, logging to /usr/local/hadoop/logs/hadoop-root-datanode-160a2bc6b259.out
Starting secondary namenodes [0.0.0.0]
0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/logs/hadoop-root-secondarynamenode-160a2bc6b259.out
19/02/09 17:36:06 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java class
es where applicable
starting yarn daemons
starting resourcemanager, logging to /usr/local/hadoop/logs/yarn--resourcemanager-160a2bc6b259.out
localhost: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-root-nodemanager-160a2bc6b259.out
bash-4.1# jps
236 DataNode
547 ResourceManager
939 Jps
396 SecondaryNameNode
637 NodeManager
121 NameNode
bash-4.1#
```

```
bash-4.1# ifconfig
eth0      Link encap:Ethernet  HWaddr 02:42:AC:11:00:02
          inet addr:172.17.0.2  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:44 errors:0 dropped:0 overruns:0 frame:0
          TX packets:19 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:5804 (5.6 KiB)  TX bytes:1444 (1.4 KiB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:347 errors:0 dropped:0 overruns:0 frame:0
          TX packets:347 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:57876 (56.5 KiB)  TX bytes:57876 (56.5 KiB)

bash-4.1#
```

4. As seen in the previous steps since all services are running, we can check namenode ui on the browser by going to http://localhost:50070.



Overview '160a2bc6b259:9000' (active)

Started:	Sat Feb 09 17:35:51 EST 2019
Version:	2.7.1, r15ecc87ccf4a0228f35af08fc56de536e6ce657a
Compiled:	2015-06-29T06:04Z by jenkins from (detached from 15ecc87)
Cluster ID:	CID-5e691286-4de5-4dde-800b-c02a7a8bf44a
Block Pool ID:	BP-1961412683-172.17.0.32-1450036414523

Summary

Security is off.

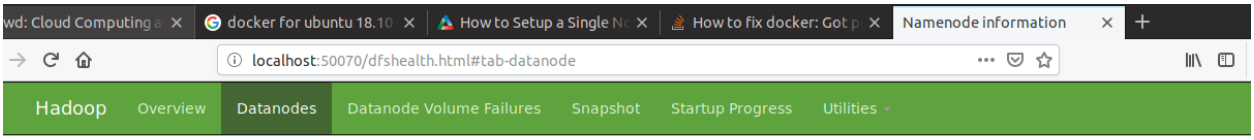
Safemode is off.

35 files and directories, 31 blocks = 66 total filesystem object(s).

Heap Memory used 80.22 MB of 170 MB Heap Memory. Max Heap Memory is 889 MB.

Non Heap Memory used 29.62 MB of 30.94 MB Commited Non Heap Memory. Max Non Heap Memory is 130 MB.

Configured Capacity:	39.12 GB
DFS Used:	320 KB (0%)
Non DFS Used:	10.21 GB



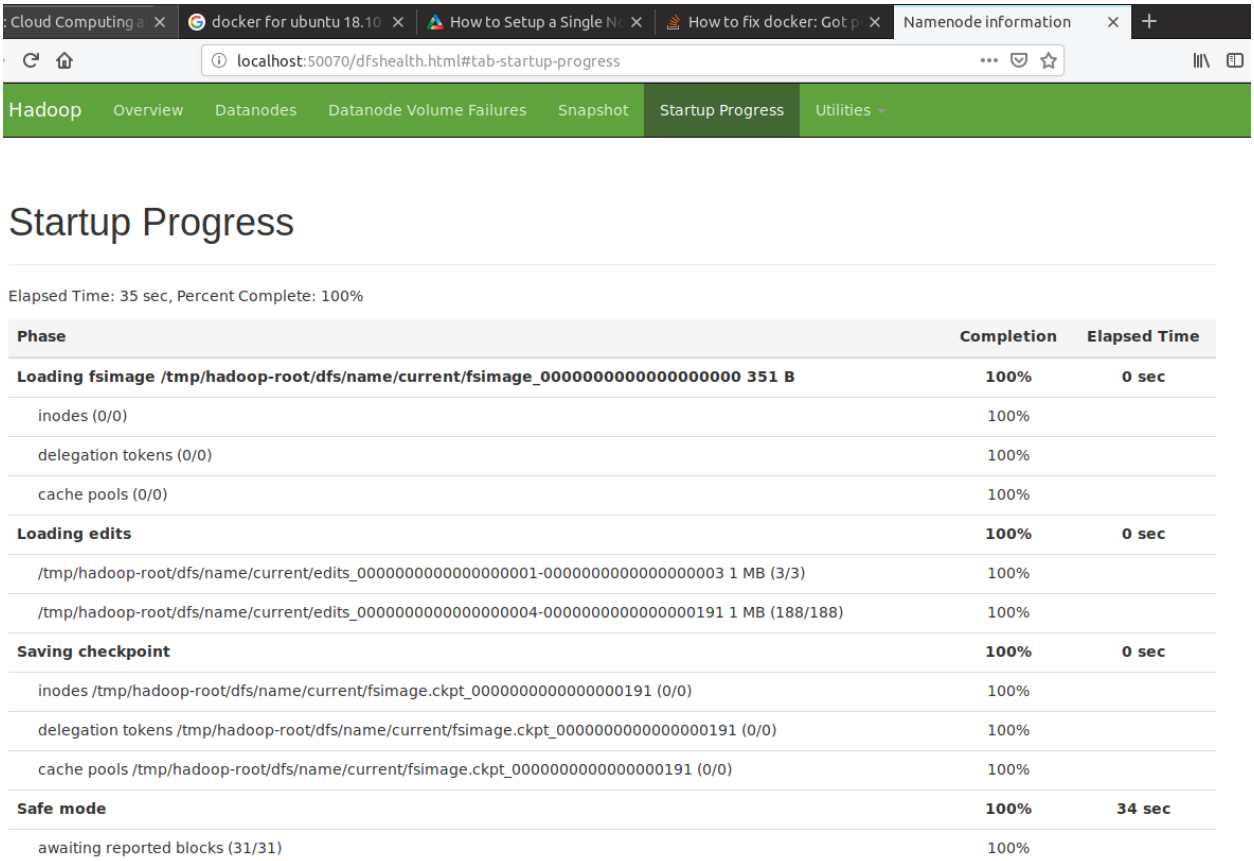
Datanode Information

In operation

Node	Last contact	Admin State	Capacity	Used	Non DFS Used	Remaining	Blocks	Block pool used	Failed Volumes	Version
160a2bc6b259:50010 (172.17.0.2:50010)	2	In Service	39.12 GB	320 KB	10.21 GB	28.91 GB	31	320 KB (0%)	0	2.7.1

Decomissioning

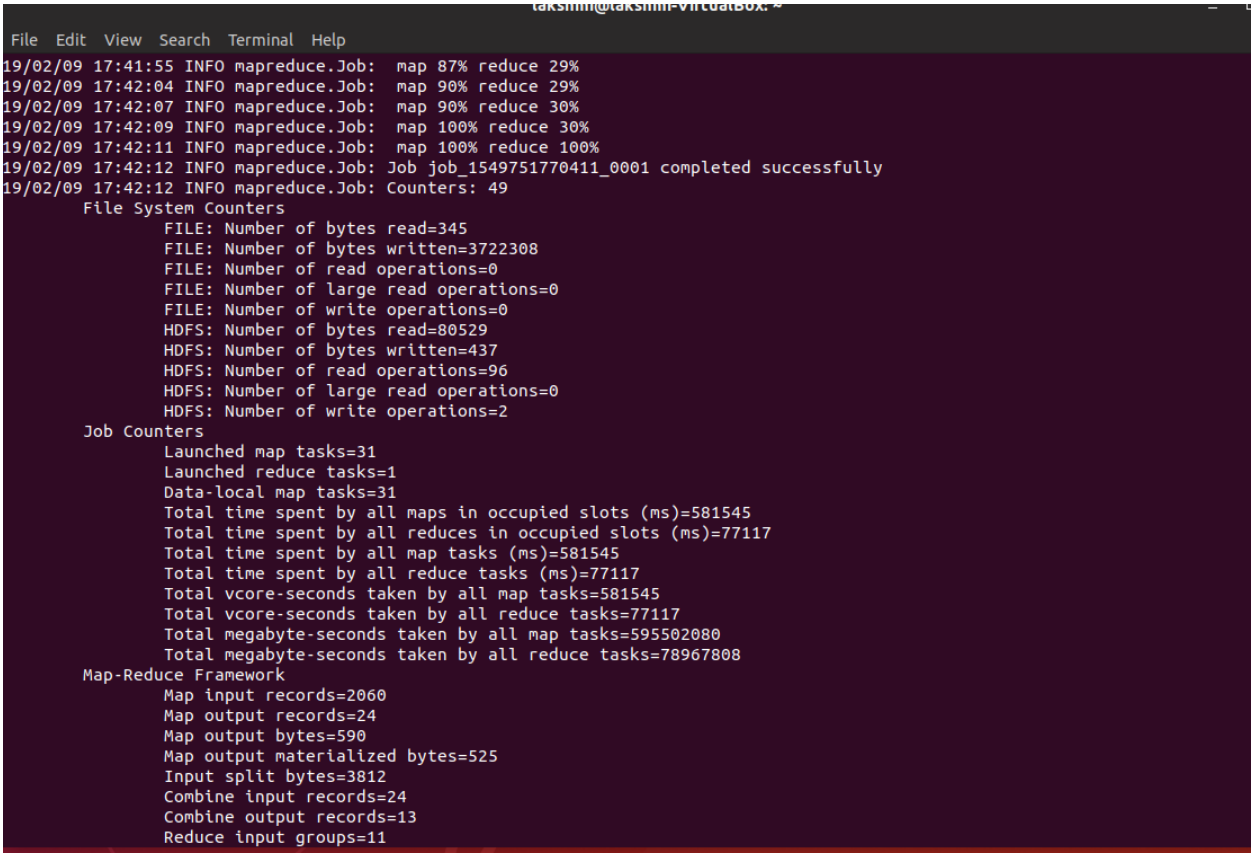
Node	Last contact	Under replicated blocks	Blocks with no live replicas	Under Replicated Blocks In files under construction

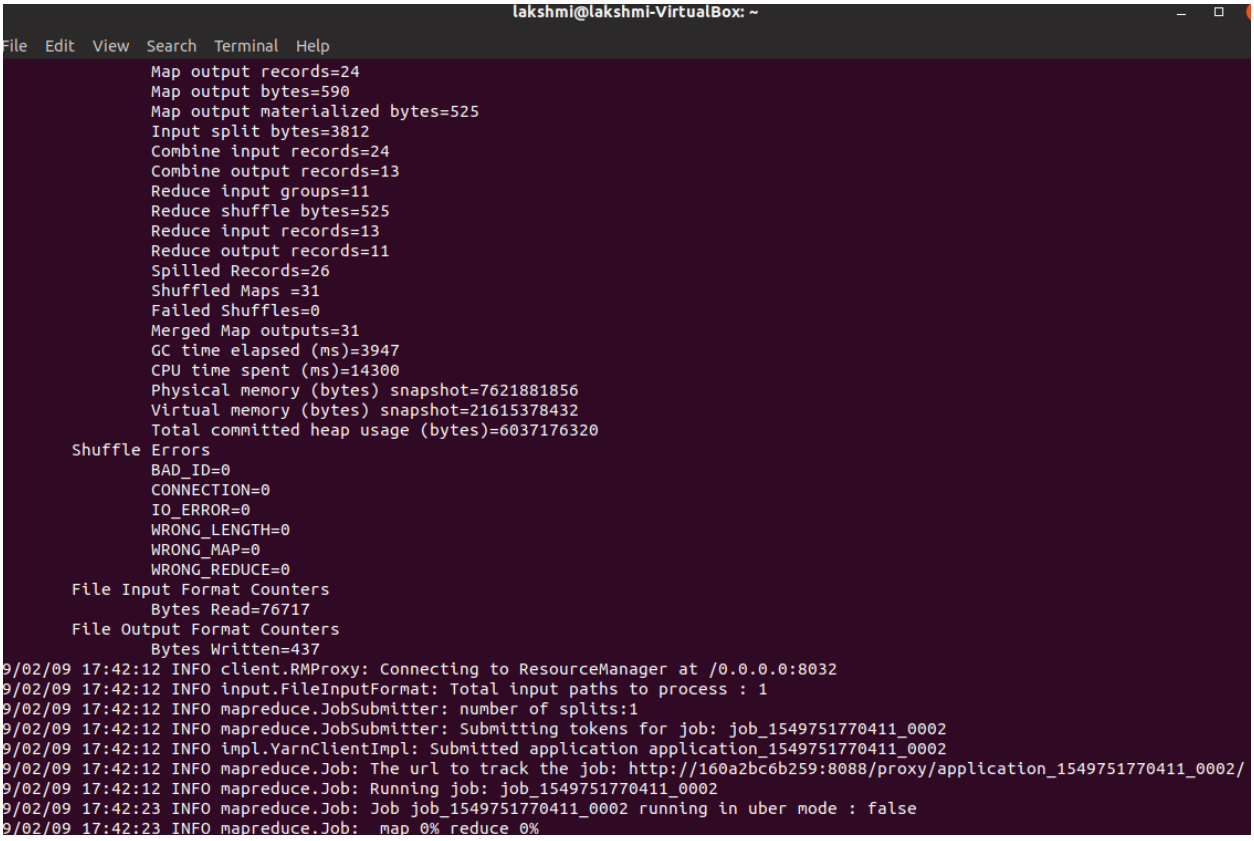


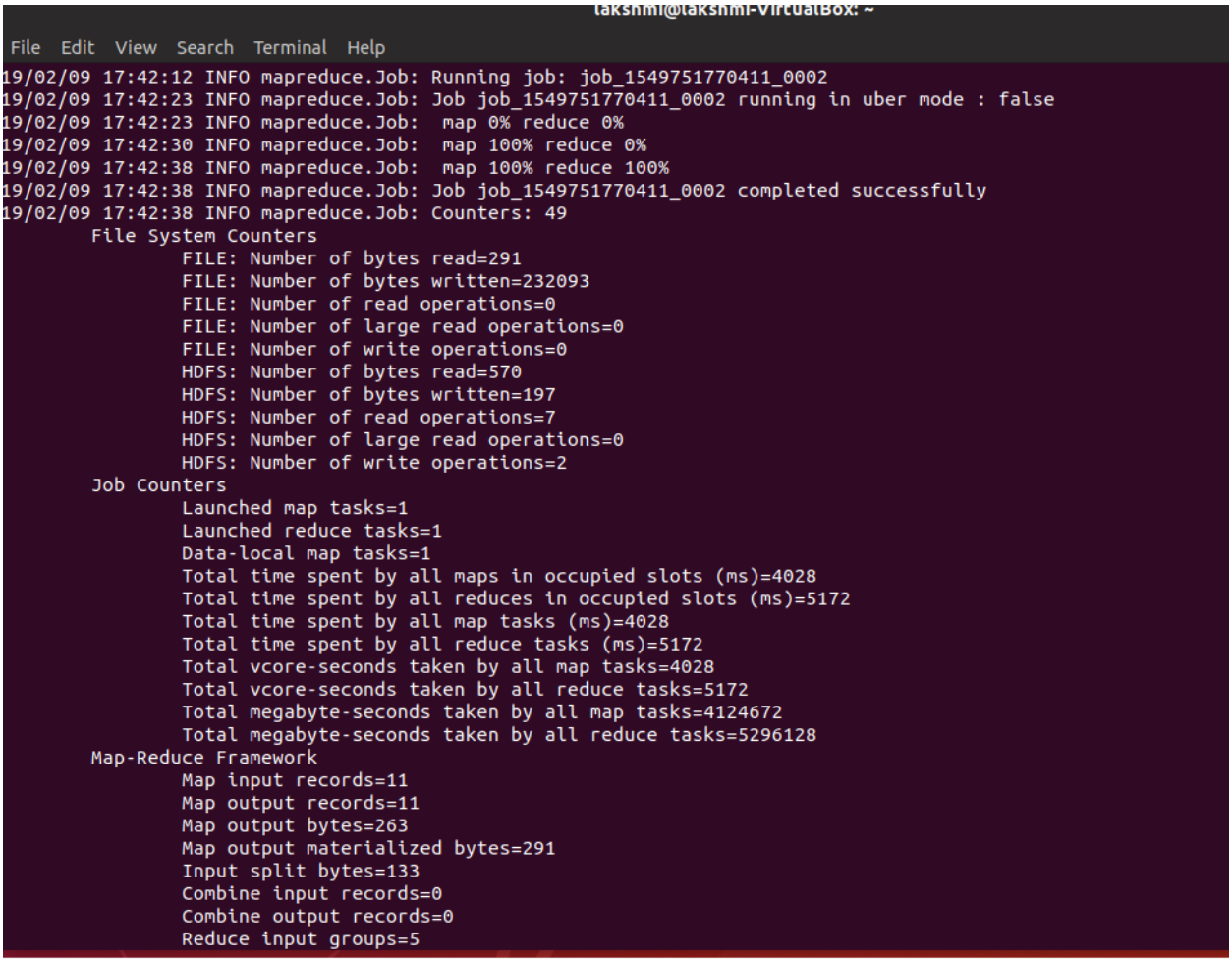
5. To run a Hadoop mapreduce in the docker container follow the below commands.

bash-4.1# cd $HADOOP_PREFIX
bash-4.1# bin/hadoop jar share/hadoop/mapreduce/hadoop-mapreduce-examples-2.7.1.jar grep input output 'dfs[a-z.]+'

```
bash-4.1# cd $HADOOP_PREFIX
bash-4.1# bin/hadoop jar share/hadoop/mapreduce/hadoop-mapreduce-examples-
Not a valid JAR: /usr/local/hadoop-2.7.1/share/hadoop/mapreduce/hadoop-mapreduce-examples-
bash-4.1# bin/hadoop jar share/hadoop/mapreduce/hadoop-mapreduce-examples-2.7.1.jar grep input output 'dfs[a-z.]+'
19/02/09 17:39:56 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java class
es where applicable
19/02/09 17:39:57 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
19/02/09 17:39:58 INFO input.FileInputFormat: Total input paths to process : 31
19/02/09 17:39:58 INFO mapreduce.JobSubmitter: number of splits:31
19/02/09 17:39:59 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1549751770411_0001
19/02/09 17:39:59 INFO impl.YarnClientImpl: Submitted application application_1549751770411_0001
19/02/09 17:39:59 INFO mapreduce.Job: The url to track the job: http://160a2bc6b259:8088/proxy/application_1549751770411_0001/
19/02/09 17:39:59 INFO mapreduce.Job: Running job: job_1549751770411_0001
19/02/09 17:40:08 INFO mapreduce.Job: Job job_1549751770411_0001 running in uber mode : false
19/02/09 17:40:08 INFO mapreduce.Job:  map 0% reduce 0%
19/02/09 17:40:33 INFO mapreduce.Job:  map 19% reduce 0%
19/02/09 17:40:53 INFO mapreduce.Job:  map 32% reduce 0%
19/02/09 17:40:54 INFO mapreduce.Job:  map 39% reduce 0%
19/02/09 17:41:13 INFO mapreduce.Job:  map 39% reduce 13%
19/02/09 17:41:14 INFO mapreduce.Job:  map 45% reduce 13%
19/02/09 17:41:15 INFO mapreduce.Job:  map 55% reduce 13%
19/02/09 17:41:16 INFO mapreduce.Job:  map 55% reduce 18%
19/02/09 17:41:28 INFO mapreduce.Job:  map 58% reduce 18%
19/02/09 17:41:31 INFO mapreduce.Job:  map 61% reduce 19%
19/02/09 17:41:33 INFO mapreduce.Job:  map 71% reduce 19%
19/02/09 17:41:34 INFO mapreduce.Job:  map 71% reduce 22%
19/02/09 17:41:37 INFO mapreduce.Job:  map 71% reduce 24%
19/02/09 17:41:45 INFO mapreduce.Job:  map 74% reduce 24%
19/02/09 17:41:46 INFO mapreduce.Job:  map 74% reduce 25%
19/02/09 17:41:50 INFO mapreduce.Job:  map 77% reduce 25%
19/02/09 17:41:52 INFO mapreduce.Job:  map 81% reduce 26%
19/02/09 17:41:53 INFO mapreduce.Job:  map 84% reduce 26%
19/02/09 17:41:54 INFO mapreduce.Job:  map 87% reduce 26%
19/02/09 17:41:55 INFO mapreduce.Job:  map 87% reduce 29%
19/02/09 17:42:04 INFO mapreduce.Job:  map 90% reduce 29%
19/02/09 17:42:07 INFO mapreduce.Job:  map 90% reduce 30%
```


File Edit View Search Terminal Help
19/02/09 17:41:55 INFO mapreduce.Job: map 87% reduce 29%
19/02/09 17:42:04 INFO mapreduce.Job: map 90% reduce 29%
19/02/09 17:42:07 INFO mapreduce.Job: map 90% reduce 30%
19/02/09 17:42:09 INFO mapreduce.Job: map 100% reduce 30%
19/02/09 17:42:11 INFO mapreduce.Job: map 100% reduce 100%
19/02/09 17:42:12 INFO mapreduce.Job: Job job_1549751770411_0001 completed successfully
19/02/09 17:42:12 INFO mapreduce.Job: Counters: 49
File System Counters
FILE: Number of bytes read=345
FILE: Number of bytes written=3722308
FILE: Number of read operations=0
FILE: Number of large read operations=0
FILE: Number of write operations=0
HDFS: Number of bytes read=80529
HDFS: Number of bytes written=437
HDFS: Number of read operations=96
HDFS: Number of large read operations=0
HDFS: Number of write operations=2
Job Counters
Launched map tasks=31
Launched reduce tasks=1
Data-local map tasks=31
Total time spent by all maps in occupied slots (ms)=581545
Total time spent by all reduces in occupied slots (ms)=77117
Total time spent by all map tasks (ms)=581545
Total time spent by all reduce tasks (ms)=77117
Total vcore-seconds taken by all map tasks=581545
Total vcore-seconds taken by all reduce tasks=77117
Total megabyte-seconds taken by all map tasks=595502080
Total megabyte-seconds taken by all reduce tasks=78967808
Map-Reduce Framework
Map input records=2060
Map output records=24
Map output bytes=590
Map output materialized bytes=525
Input split bytes=3812
Combine input records=24
Combine output records=13
Reduce input groups=11


lakshmi@lakshmi-VirtualBox: ~
File Edit View Search Terminal Help
Map output records=24
Map output bytes=590
Map output materialized bytes=525
Input split bytes=3812
Combine input records=24
Combine output records=13
Reduce input groups=11
Reduce shuffle bytes=525
Reduce input records=13
Reduce output records=11
Spilled Records=26
Shuffled Maps =31
Failed Shuffles=0
Merged Map outputs=31
GC time elapsed (ms)=3947
CPU time spent (ms)=14300
Physical memory (bytes) snapshot=7621881856
Virtual memory (bytes) snapshot=21615378432
Total committed heap usage (bytes)=6037176320
Shuffle Errors
BAD_ID=0
CONNECTION=0
IO_ERROR=0
WRONG_LENGTH=0
WRONG_MAP=0
WRONG_REDUCE=0
File Input Format Counters
Bytes Read=76717
File Output Format Counters
Bytes Written=437
9/02/09 17:42:12 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
9/02/09 17:42:12 INFO input.FileInputFormat: Total input paths to process : 1
9/02/09 17:42:12 INFO mapreduce.JobSubmitter: number of splits:1
9/02/09 17:42:12 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1549751770411_0002
9/02/09 17:42:12 INFO impl.YarnClientImpl: Submitted application application_1549751770411_0002
9/02/09 17:42:12 INFO mapreduce.Job: The url to track the job: http://160a2bc6b259:8088/proxy/application_1549751770411_0002/
9/02/09 17:42:12 INFO mapreduce.Job: Running job: job_1549751770411_0002
9/02/09 17:42:23 INFO mapreduce.Job: Job job_1549751770411_0002 running in uber mode : false
9/02/09 17:42:23 INFO mapreduce.Job: map 0% reduce 0%


lakshmi@lakshmi-VirtualBox: ~
File Edit View Search Terminal Help
19/02/09 17:42:12 INFO mapreduce.Job: Running job: job_1549751770411_0002
19/02/09 17:42:23 INFO mapreduce.Job: Job job_1549751770411_0002 running in uber mode : false
19/02/09 17:42:23 INFO mapreduce.Job: map 0% reduce 0%
19/02/09 17:42:30 INFO mapreduce.Job: map 100% reduce 0%
19/02/09 17:42:38 INFO mapreduce.Job: map 100% reduce 100%
19/02/09 17:42:38 INFO mapreduce.Job: Job job_1549751770411_0002 completed successfully
19/02/09 17:42:38 INFO mapreduce.Job: Counters: 49
File System Counters
FILE: Number of bytes read=291
FILE: Number of bytes written=232093
FILE: Number of read operations=0
FILE: Number of large read operations=0
FILE: Number of write operations=0
HDFS: Number of bytes read=570
HDFS: Number of bytes written=197
HDFS: Number of read operations=7
HDFS: Number of large read operations=0
HDFS: Number of write operations=2
Job Counters
Launched map tasks=1
Launched reduce tasks=1
Data-local map tasks=1
Total time spent by all maps in occupied slots (ms)=4028
Total time spent by all reduces in occupied slots (ms)=5172
Total time spent by all map tasks (ms)=4028
Total time spent by all reduce tasks (ms)=5172
Total vcore-seconds taken by all map tasks=4028
Total vcore-seconds taken by all reduce tasks=5172
Total megabyte-seconds taken by all map tasks=4124672
Total megabyte-seconds taken by all reduce tasks=5296128
Map-Reduce Framework
Map input records=11
Map output records=11
Map output bytes=263
Map output materialized bytes=291
Input split bytes=133
Combine input records=0
Combine output records=0
Reduce input groups=5

```
                Total megabyte-seconds taken by all reduce tasks=5296128
        Map-Reduce Framework
                Map input records=11
                Map output records=11
                Map output bytes=263
                Map output materialized bytes=291
                Input split bytes=133
                Combine input records=0
                Combine output records=0
                Reduce input groups=5
                Reduce shuffle bytes=291
                Reduce input records=11
                Reduce output records=11
                Spilled Records=22
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=86
                CPU time spent (ms)=1480
                Physical memory (bytes) snapshot=409325568
                Virtual memory (bytes) snapshot=1365807104
                Total committed heap usage (bytes)=325582848
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=437
        File Output Format Counters
                Bytes Written=197
bash-4.1#
```

6. To check the output run the command:

bash-4.1# bin/hdfs dfs -cat output/*

```
bash-4.1# bin/hdfs dfs -cat output/*
19/02/09 17:45:17 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java class
es where applicable
6       dfs.audit.logger
4       dfs.class
3       dfs.server.namenode.
2       dfs.period
2       dfs.audit.log.maxfilesize
2       dfs.audit.log.maxbackupindex
1       dfsmetrics.log
1       dfsadmin
1       dfs.servers
1       dfs.replication
1       dfs.file
bash-4.1#
```

7. Hadoop Framework and Mapreduce program model:

Hadoop Framework

Hadoop is an open source, Java-based programming framework that supports the processing and storage of extremely large data sets in a distributed computing environment. It is part of the Apache project sponsored by the Apache Software Foundation.Hadoop enables resilient, distributed processing of massive

unstructured data sets across commodity computer clusters, in which each node of the cluster includes its own storage

The project includes these modules:

- Hadoop Common: The common utilities that support the other Hadoop modules.
- Hadoop Distributed File System (HDFS): A distributed file system that provides high-throughput access to application data.
- Hadoop YARN: A framework for job scheduling and cluster resource management.
- Hadoop MapReduce: A YARN-based system for parallel processing of large data sets.

MapReduce

MapReduce is a core component of the Apache Hadoop software framework. MapReduce serves two essential functions: It parcels out work to various nodes within the cluster or map, and it organizes and reduces the results from each node into a cohesive answer to a query.

MapReduce is composed following components:

- JobTracker - the master node that manages all jobs and resources in a cluster
- TaskTrackers - agents deployed to each machine in the cluster to run the map and reduce tasks
- JobHistoryServer - a component that tracks completed jobs and is typically deployed as a separate function or with JobTracker.