**Exercise n**

*Get started with Hadoop*

**Prior Knowledge**

Unix Command Line Shell

Simple Python

**Learning Objectives**

Understand how to start and stop HDFS, and transfer files into and out of the Hadoop filesystem.

Understand how to create a Python mapper/reducer and execute this on a single-node setup of Hadoop.

Stop and start YARN.

**Software Requirements**

(see separate document for installation of these)

* Apache Hadoop 2.7.1
* Python 2.7.x
* Nano text editor or other text editor

**Part A: Hadoop File System (HDFS)**

1. Make sure you are running the Ubuntu VM, and start a fresh terminal window.
2. Type  
   sudo su hduser  
   You will be prompted  
   [sudo] password for oxclo:  
   Type *oxclo* and enter.
3. Type cd and then enter, to switch to the home directory of user *hduser.*
4. Now let’s format the HDFS filesystem:  
   hadoop namenode -format
5. You should see a lot of output ending something similar to this:

15/10/22 09:15:20 INFO namenode.FSNamesystem: Retry cache on namenode is enabled

15/10/22 09:15:20 INFO namenode.FSNamesystem: Retry cache will use 0.03 of total heap and retry cache entry expiry time is 600000 millis

15/10/22 09:15:20 INFO util.GSet: Computing capacity for map NameNodeRetryCache

15/10/22 09:15:20 INFO util.GSet: VM type = 64-bit

15/10/22 09:15:20 INFO util.GSet: 0.029999999329447746% max memory 889 MB = 273.1 KB

15/10/22 09:15:20 INFO util.GSet: capacity = 2^15 = 32768 entries

15/10/22 09:15:20 INFO namenode.FSImage: Allocated new BlockPoolId: BP-420615264-127.0.1.1-1445501720083

15/10/22 09:15:20 INFO common.Storage: Storage directory /usr/local/hadoop\_store/hdfs/namenode has been successfully formatted.

15/10/22 09:15:20 INFO namenode.NNStorageRetentionManager: Going to retain 1 images with txid >= 0

15/10/22 09:15:20 INFO util.ExitUtil: Exiting with status 0

15/10/22 09:15:20 INFO namenode.NameNode: SHUTDOWN\_MSG:

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SHUTDOWN\_MSG: Shutting down NameNode at oxclo/127.0.1.1

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1. Now let’s start the Hadoop filesystem. Type:   
     
   start-dfs.sh  
     
   You should see output like:

15/10/22 09:18:52 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

Starting namenodes on [localhost]

localhost: starting namenode, logging to /usr/local/hadoop/logs/hadoop-hduser-namenode-oxclo.out

localhost: starting datanode, logging to /usr/local/hadoop/logs/hadoop-hduser-datanode-oxclo.out

Starting secondary namenodes [0.0.0.0]

0.0.0.0: starting secondarynamenode, logging to /usr/local/hadoop/logs/hadoop-hduser-secondarynamenode-oxclo.out

15/10/22 09:19:08 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

1. Now let’s make a directory:  
     
   hadoop fs -mkdir -p /usr/hduser/input
2. And check it worked:

hadoop fs -ls -R /

You should see:

15/10/22 09:24:48 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

drwxr-xr-x - hduser supergroup 0 2015-10-22 09:23 /usr

drwxr-xr-x - hduser supergroup 0 2015-10-22 09:23 /usr/hduser

drwxr-xr-x - hduser supergroup 0 2015-10-22 09:23 /usr/hduser/input

1. Now let’s copy some datafiles from the local filesystem into the HDFS:  
     
   hadoop fs -put datafiles/wind/2015/\* /usr/hduser/input

If you repeat the command to list the files on the hadoop filesystem:

hadoop fs -ls -R /

you should see the new files in place:  
15/10/22 09:45:07 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

drwxr-xr-x - hduser supergroup 0 2015-10-22 09:23 /usr

drwxr-xr-x - hduser supergroup 0 2015-10-22 09:23 /usr/hduser

drwxr-xr-x - hduser supergroup 0 2015-10-22 09:44 /usr/hduser/input

-rw-r--r-- 1 hduser supergroup 2716705 2015-10-22 09:44 /usr/hduser/input/SF04.csv

-rw-r--r-- 1 hduser supergroup 7896961 2015-10-22 09:44 /usr/hduser/input/SF15.csv

-rw-r--r-- 1 hduser supergroup 7250586 2015-10-22 09:44 /usr/hduser/input/SF17.csv

-rw-r--r-- 1 hduser supergroup 5538010 2015-10-22 09:44 /usr/hduser/input/SF18.csv

-rw-r--r-- 1 hduser supergroup 5818496 2015-10-22 09:44 /usr/hduser/input/SF36.csv

-rw-r--r-- 1 hduser supergroup 4952077 2015-10-22 09:44 /usr/hduser/input/SF37.csv

1. Congratulations you have successfully completed part A.

**Part B. Creating a mapper and reducer, and running map reduce**

1. We have a lot of environmental and wind data from San Francisco, which we can analyse for various information.
2. First, let’s look at the format of the input data.  
   Type   
   hadoop fs -cat /usr/hduser/input/SF37.csv | head  
   You should see:

15/10/22 10:33:52 WARN util.NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable

Station\_ID,Station\_Name,Location\_Label,Interval\_Minutes,Interval\_End\_Time,Wind\_Velocity\_Mtr\_Sec,Wind\_Direction\_Variance\_Deg,Wind\_Direction\_Deg,Ambient\_Temperature\_Deg\_C,Global\_Horizontal\_Irradiance

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:15,3.59,0,263.1,8.61,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:20,3.342,0,268.3,8.58,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:25,3.175,0,271.3,8.45,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:30,2.586,0,279.7,8.45,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:35,3.137,0,273.8,8.44,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:40,2.781,0,277.9,8.54,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:45,3.177,0,269.9,8.66,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:50,2.802,0,277.5,8.72,0

SF37,"Chinatown Medical Center","Chinatown Medical Center",5,2015-01-5? 06:55,3.135,0,273.1,8.65,0

cat: Unable to write to output stream.

1. There is a header line and then a set of data, all in comma separated value (CSV) format.
2. Let’s start by calculating maximum wind velocity for each district over the given period (the current year).
3. To do this, we can simply extract the Station\_ID and the Wind\_Velocity\_Mtr\_sec from each line using the mapper, and then we can summarize this information in the Reducer.
4. There is a skeleton mapper written for you in the directory:  
   ~/wind-analysis/mapper.py
5. Change to that directory:  
   cd ~/wind-analysis
6. Edit this mapper to output the right key/value pairs.
   1. You can use any Unix text editor. If you know how, then nano is a good terminal based editor. Otherwise I would suggest using gedit, which is called “Text Editor” in the Ubuntu windowing system.
   2. The usual way of passing the key/value pairs from the mapper to the reducer is to use Tab delimited lines. A quick and easy way of printing those out in Python is to create an array of results and then use the join function to link them up with tabs:

result = [ k, v ]  
print (‘\t’.join(result))

* 1. Don’t forget that Python is tab/space sensitive!

1. Before we run this using Hadoop, we can simply test our script using the command-line.   
   1. We first need to make the mapper.py executable:  
      chmod +x ./mapper.py
   2. We will use the local copy of one of the files
   3. Type:   
      cat ~/datafiles/wind/2015/SF37.csv | ./mapper.py
   4. You should see data lines like this printed:  
       SF37 1.229
2. Now we need to create a reducer:  
   1. Once again start with the skeleton that is provided in reducer.py
   2. Edit this file
   3. I recommend using a python dictionary (<https://docs.python.org/2/tutorial/datastructures.html#dictionaries>) to collect the maximum value by station id, but you could also rely on the fact that Hadoop will sort the data by key before passing it to the reducer. (In other words, if the station id is different from the last station id, then that station id is no longer going to appear).
   4. Hint: you need to convert the number to a string before printing it with the join function, you can do this by using str(max)
3. Check that your code works locally before we try it with Hadoop  
   cat ~/datafiles/wind/2015/SF37.csv | ./mapper.py | ./reducer.py
4. You should see:   
   SF37 2.325  
   printed out.
5. Now we are ready to run this as a map-reduce job using Hadoop. Firstly, this will run different files on (potentially) different systems and processes. Secondly, it will access the data from HDFS instead of the local file system.
6. Before we can run the map-reduce job, we need to start up YARN, the job scheduler.
   1. Type:

start-yarn.sh

* 1. You should see:  
       
     starting yarn daemons

starting resourcemanager, logging to /usr/local/hadoop/logs/yarn-hduser-resourcemanager-oxclo.out

localhost: starting nodemanager, logging to /usr/local/hadoop/logs/yarn-hduser-nodemanager-oxclo.out