

Assignment 9

1. Hadoop Assignment

Prerequisites:

- Python 2/3
- Unix command-line tools like cd, sort
- Basic knowledge of piping, ex: ls | grep name
- Working installation of Hadoop¹

In this assignment we shall make use of the Hadoop streaming api to write our map reduce code. Hadoop Streaming uses Unix standard streams as the interface between Hadoop and your program, so you can use any language that can read standard input and write to standard output to write your MapReduce program. However, we shall use Python for this assignment. All we need to do is write a script for the mapper and reducer, and hadoop will take care of the rest.

First, we shall simulate the behavior of a map reduce program using simple unix commands to understand how the mapper and reducer works in Section 2.1.

2.1 Map Reduce Simulation

For this simulation we shall do a simple word count. The problem statement is: Given a text file (<https://norvig.com/big.txt>), get the count of every word in it. Now, the first order of business is to write the mapper.

2.1.1 Word Count Mapper

The job of the mapper is simple, read lines from stdin and spit out the key value pairs to stdout . Write a python script for the same. An example of expected output from the input is given in Table 2.1.1. Make sure to include the python shebang in your scripts and chmod +x yourscrip.py . Test your script by running cat inputfile | ./mapper.py

Input File	Mapper Output
hello world	hello,1
testing testing	world,1
hello	testing,1
	testing,1
	hello,1

Table 1: Mapper Example

¹Hadoop Installation Guide for Ubuntu 16.04: <https://tinyurl.com/hhe9f4f>

2.1.2 Word Count Reducer

The next task is to write the script for the reducer. The reducer job is to take the output of the mapper and spit out the final count of every word to stdout . We will simulate the sorting phase of the hadoop framework with sort com- mand, so that all the same words are ordered together. Test your script by `cat inputfile | ./mapper.py | sort -t ',' -k1 | ./reducer.py`

Mapper Output		Reducer Output
hello,1	hello,1	hello,2
world,1	testing,1	world,1
testing,1	testing,1	testing,2
testing,1	world,1	
hello,1		

Table 2: Reducer Example

```
#!/usr/bin/python

"""mapper.py"""

import sys

# input comes from STDIN (standard input)

for line in sys.stdin:
    # remove leading and trailing whitespace

    line = line.strip()
    # split the line into words

    words = line.split()
    # increase counters
    for word in words:

        # write the results to STDOUT (standard output);
        # what we output here will be the input for the #
        Reduce step, i.e. the input for reducer.py

        #

        # comma delimited; the trivial word count is 1

        print(f'{word},1')
```

```
#!/usr/bin/env python
```

```
"""reducer.py"""
```

```
import sys
```

```
current_word=None current_count=0
```

```
#This loop will only work when the input #to  
the script is sorted for line in sys.stdin:
```

```
#read line and split by comma
```

```
#recall, we used comma as delimiter in mapper
```

```
line=line.strip().split(',')
```

```
#get the key and val, in this case #word  
is the key and count is the val
```

```
word,count=line[0],int(line[1])
```

```
if current_word==None: #initialie
```

```
    current_word=word
```

```
    current_count=count
```

```
elif current_word==word: #increment the count
```

```
    current_count+=count else:
```

```
#spit current word and
```

```
    print(f' {current_word}, {current_count}') current_word=word
```

```
    current_count=count
```

```
#spit last word
```

```
print(f' {current_word}, {count}')
```

2.1.3 Run it in Hadoop

Now that we have written our mapper and reducer, we are ready to execute our program in Hadoop.

```
hadoop jar /usr/local/hadoop/share/hadoop/tools/lib/hadoop-streaming-*.jar  
-input path/to/inputfile -output path/to/outputdir -mapper path/to/mapper.py  
-reducer reducer.py
```

2.2 Hadoop Assignment

Now that you have learnt how a basic map reduce program works, solve the following.

1. Implement a map reduce program to find all distinct words in the file. Perform data cleaning in the mapper such that all punctuations are removed and all words are lowercased.

inputfile	Map Reduce output
Hello World!	
Apache hadoop.	apache
apache spark.	hadoop
	hello
	spark
	world

Table 3: Distinct Words MR example

2. Extend the word count example to include a combiner. Simply use `-combiner combiner.py` option.
3. You are given a dataset of N points and you are given the C candidate points. Implement a map reduce program to assign each of the N points to the nearest (Euclidean distance) candidate point and update the candidate points by taking the average of all the points that were assigned to it. You may hard code the candidate points in your mapper if you want. Make use of the iris² dataset, which is in the format

sepalength, sepalwidth, petallength, petalwidth, class

Use the following three points given in Table 4 as candidate points. For this exercise you may use consider the sepal length and sepal width, and remove the rest.

5.8,4.0,1.2,0.2,Iris-setosa
6.1,2.8,4.0,1.3,Iris-versicolor
6.3,2.7,4.9,1.8,Iris-virginica

Table 4: Candidate Points

HINT: creating the multi-key,val pairs in mapper like << Ni, Ci >, 1 > may be useful.

²<http://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.dat>
a

Ready to use Dockerfile to create an image with Hadoop already set up. or you can use the steps to set up hadoop on your own machine. Save the following as in a file named Dockerfile, and run sudo docker build .

```
apt-get update
apt-get install default-jdk wget -y apt-
get install python3 -y
wget
http://mirrors.estointernet.in/apache/hadoop/common/hadoop-2.10.0/
hadoop-2.10.0.tar.gz
tar -xzf hadoop-2.10.0.tar.gz
ENVJAVA_HOME $(readlink -f /usr/bin/java | sed "s:bin/java::")
RUNmv
hadoop-2.10.0 /usr/local/hadoop
ENVPATH /usr/local/hadoop/bin:$PATH
rm -rf hadoop-2*
```