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CSC 555 – Mining Big Data

Summer 2019

Assignment 1

PART 1 – Computation Problems

a) Discrete Computations

- 2^{10} = **1024**
- 4^5 = **1024**
- 8^5 = **32768**
- 837 MOD 100 = **37**
- 842 MOD 20 = **2**
- 16 MOD 37 = **16**
- 37 MOD 16 = **5**

b) Vector Calculations

- V2 – V1 = (2-1, 1-2, 2-3) = **(1, -1, -1)**
- V1 + V1 = (1+1, 2+2, 3+3) = **(2, 4, 6)**

- |V1| = SQRT($1^2 + 2^2 + 3^2$) = SQRT(14) = $\sqrt{\mathbf{14}}$
- |V2| = SQRT($2^2 + 1^2 + 2^2$) = SQRT(9) = **3**

- M * V2 = **(11, 8, 6)**

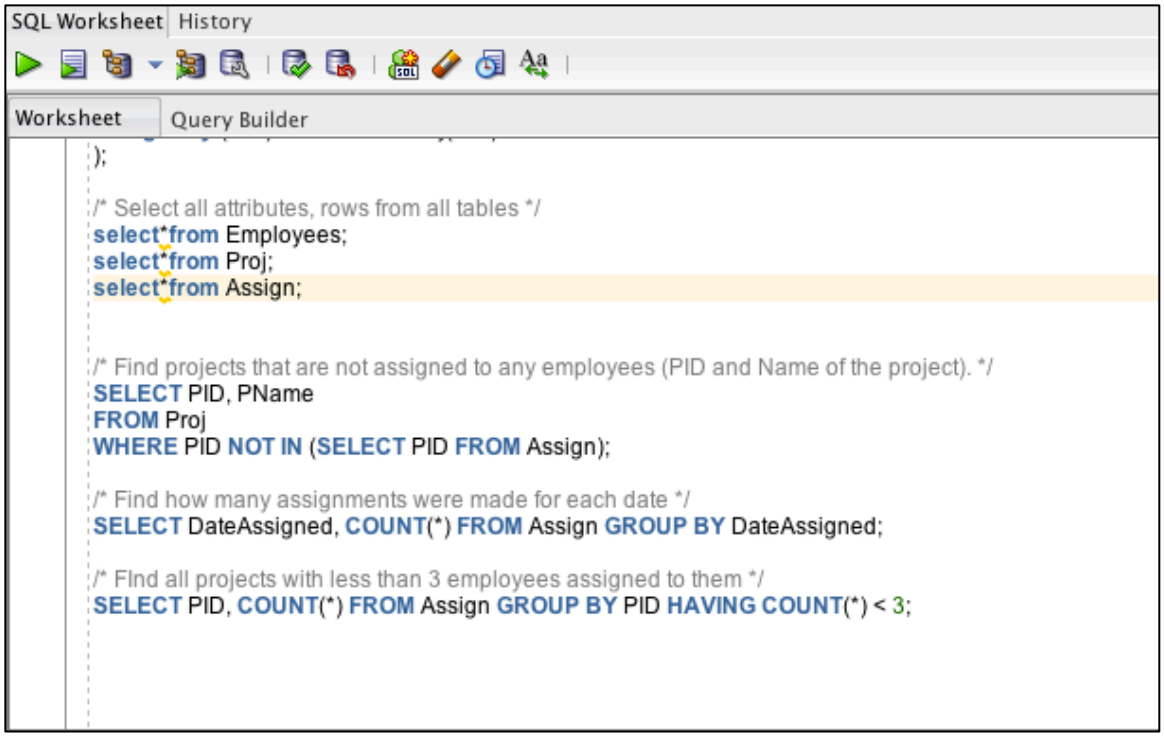
- M^2 = **[(8, 4, 14), (6, 5, 11), (4, 1, 7)]**

- M^3 = **[(34, 16, 60), (28, 16, 50), (16, 6, 28)]**

c) Coin Flip Probabilities

- HTHT = 0.6 x 0.4 x 0.6 x 0.4 = **0.0576**
- THTT = 0.4 x 0.6 x 0.4 x 0.4 = **0.0384**
- Exactly 1 Head = {HTTT, THTT, TTHT, TTTH} = **0.1536**
- Exactly 1 Tail = {THHH, HTHH, HHTH, HHHT} = 4 x 0.0864 = **0.3456**

d) SQL Queries



e) Mining of Massive Datasets, Ex. 1.3.3

The hash function h(x) will only give values between 0 and 15 since it is x MOD 15. If we choose c = 1, then we can get hash keys that are divided equally into all of the buckets, but we choose c = 2 then we only get hash key distributions across buckets 0,2,4,6,8, … etc. Similar for c = 3, c = 4, etc. But for c = 16, we again get equal distribution, so **c should be one more than multiple of bucket size**. The number should be co-prime. So 2 and 4 and 16 are indeed good, but 3 is actually bad because 15 is 3x5.

f) MapReduce Implementation

The Map function transforms input into meaningful key-value pairs. For example, if you were dealing with a dataset containing cities and states, it would combine those two attributes to form a key; the value would be a combination of other attributes related to that city. So, a MapReduce job generally divides the input data into smaller blocks that are processed in parallel by the map tasks.

PART 2 – Linux Problems

1) Contents of copied file displayed on terminal screen

```
Desktop — ec2-user@ip-172-31-10-146:~ — ssh -i schaphekar.pem ec2-user@ec2-54-153-117-2...
Siddharths-MBP:~ Siddharth$ chmod 600 private_key_file.pem
chmod: private_key_file.pem: No such file or directory
Siddharths-MBP:~ Siddharth$ ssh -i "schaphekar.pem" ec2-user@ec2-54-153-117-22.us-west-1.compute.amazonaws.com
Warning: Identity file schaphekar.pem not accessible: No such file or directory.
The authenticity of host 'ec2-54-153-117-22.us-west-1.compute.amazonaws.com (54.153.117.22)' can't be established
.
ECDSA key fingerprint is SHA256:sFJJO/kQODLuQtFC3UnwhtiKukPGcsHCrTnto6RprV4.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'ec2-54-153-117-22.us-west-1.compute.amazonaws.com' (ECDSA) to the list of known hosts
.
ec2-user@ec2-54-153-117-22.us-west-1.compute.amazonaws.com: Permission denied (publickey,gssapi-keyex,gssapi-with
-mic).
Siddharths-MBP:~ Siddharth$ chmod 400 schaphekar.pem
chmod: schaphekar.pem: No such file or directory
Siddharths-MBP:~ Siddharth$ cd Desktop
Siddharths-MBP:Desktop Siddharth$ chmod 400 schaphekar.pem
Siddharths-MBP:Desktop Siddharth$ ssh -i "schaphekar.pem" ec2-user@ec2-54-153-117-22.us-west-1.compute.amazonaws.
com

       __|  __|_  )
       _|  (     /   Amazon Linux 2 AMI
      ___|\___|___|

https://aws.amazon.com/amazon-linux-2/
[ec2-user@ip-172-31-10-146 ~]$ nano myfile.txt
[ec2-user@ip-172-31-10-146 ~]$ ls
myfile.txt
[ec2-user@ip-172-31-10-146 ~]$ cat myfile.txt
This is my text file for CSC555.
[ec2-user@ip-172-31-10-146 ~]$ cp myfile.txt mycopy.txt
[ec2-user@ip-172-31-10-146 ~]$ ls
mycopy.txt  myfile.txt
[ec2-user@ip-172-31-10-146 ~]$ nano mycopy.txt
[ec2-user@ip-172-31-10-146 ~]$ cat mycopy.txt
This is my other text file for CSC555.
[ec2-user@ip-172-31-10-146 ~]$
```

2) Files in CSC555 directory

```
Desktop — ec2-user@ip-172-31-10-146:~/CSC555 — ssh -i schaphekar.pem ec2-user@ec2-54-1...

       __|  __|_  )
       _|  (     /   Amazon Linux 2 AMI
      ___|\___|___|

https://aws.amazon.com/amazon-linux-2/
[[ec2-user@ip-172-31-10-146 ~]$ nano myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ ls
myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ cat myfile.txt
This is my text file for CSC555.
[[ec2-user@ip-172-31-10-146 ~]$ cp myfile.txt mycopy.txt
[[ec2-user@ip-172-31-10-146 ~]$ ls
mycopy.txt  myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ nano mycopy.txt
[[ec2-user@ip-172-31-10-146 ~]$ cat mycopy.txt
This is my other text file for CSC555.
[[ec2-user@ip-172-31-10-146 ~]$ cp myfile.txt filetodelete.txt
[[ec2-user@ip-172-31-10-146 ~]$ ls
filetodelete.txt  mycopy.txt  myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ rm filetodelete.txt
[[ec2-user@ip-172-31-10-146 ~]$ ls
mycopy.txt  myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ mkdir CSC555
[[ec2-user@ip-172-31-10-146 ~]$ cd CSC555
[[ec2-user@ip-172-31-10-146 CSC555]$ pwd
/home/ec2-user/CSC555
[[ec2-user@ip-172-31-10-146 CSC555]$ cd ..
[[ec2-user@ip-172-31-10-146 ~]$ ls
CSC555  mycopy.txt  myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ mv myfile.txt CSC555/
[[ec2-user@ip-172-31-10-146 ~]$ mv mycopy.txt CSC555/
[[ec2-user@ip-172-31-10-146 ~]$ cd CSC555
[[ec2-user@ip-172-31-10-146 CSC555]$ ls
mycopy.txt  myfile.txt
[ec2-user@ip-172-31-10-146 CSC555]$
```

3) Unzipping myzipfile.zip

```
[[ec2-user@ip-172-31-10-146 CSC555]$ mv myzipfile.zip /home/ec2-user/
[[ec2-user@ip-172-31-10-146 CSC555]$ unzip myzipfile.zip
unzip:  cannot find or open myzipfile.zip, myzipfile.zip.zip or myzipfile.zip.ZIP.
[[ec2-user@ip-172-31-10-146 CSC555]$ cd
[[ec2-user@ip-172-31-10-146 ~]$ unzip myzipfile.zip
Archive:  myzipfile.zip
  extracting: mycopy.txt
  extracting: myfile.txt
[ec2-user@ip-172-31-10-146 ~]$
```

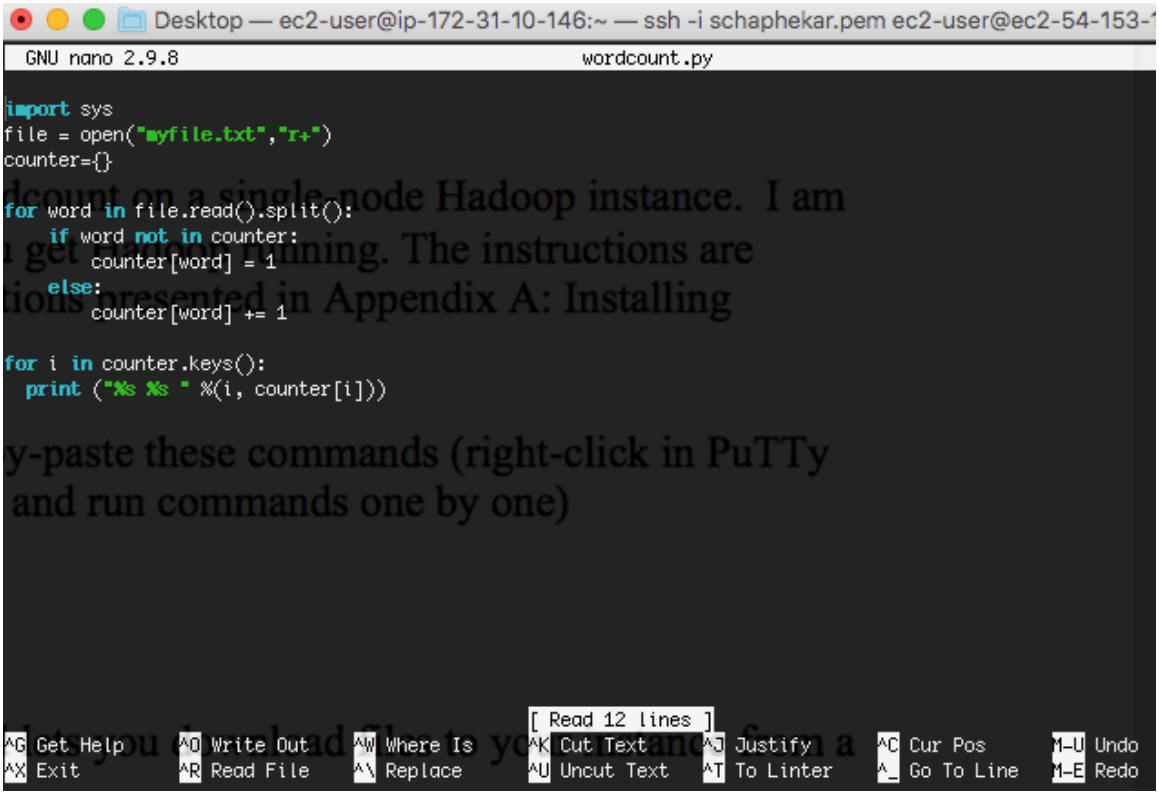
3) Size of grail file = 9 bytes + Permission denied

```
Desktop — ec2-user@ip-172-31-10-146:~ — ssh -i schaphekar.pem ec2-user@ec2-54-153-117-2...
     7
     8
     9
    10                  Written as was performed in the feature film
    11                                  ---------
    12                          Transcribed by Adam R. Jones
    13      Helpers:  Hans ten Cate, Rich Jackman, Malcolm Dickinson, Bret Shefter
    14
    15
    16    Monty Python and the Holy Grail - (c) 1974 - Python (Monty) Pictures, Ltd.
    17
    18
    19                 ____________________________________
    20                |                                    |
    21                |  The Cast: (in order of appearance) |
    22                |____________________________________|
    23
    24                        KING ARTHUR  Graham Chapman
    25                              PATSY  Terry Gilliam
    26                         SOLDIER #1  Michael Palin
    27                         SOLDIER #2  John Cleese
    28                        CART-MASTER  Eric Idle
[[ec2-user@ip-172-31-10-146 ~]$ cat myfile.txt > redirect1.txt
[[ec2-user@ip-172-31-10-146 ~]$ ls -lh > redirect2.txt
[[ec2-user@ip-172-31-10-146 ~]$ cat mycopy.txt >> myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ chmod u-r myfile.txt
[[ec2-user@ip-172-31-10-146 ~]$ cat myfile.txt
cat: myfile.txt: Permission denied
[ec2-user@ip-172-31-10-146 ~]$
```

4) Python word counter, executed on myfile.txt

```
[ec2-user@ip-172-31-10-146 ~]$ nano wordcount.py
[ec2-user@ip-172-31-10-146 ~]$ python wordcount.py
for 2
This 2
text 2
is 2
other 1
file 2
my 2
CSC555. 2
[ec2-user@ip-172-31-10-146 ~]$
```

5) Python word counter code

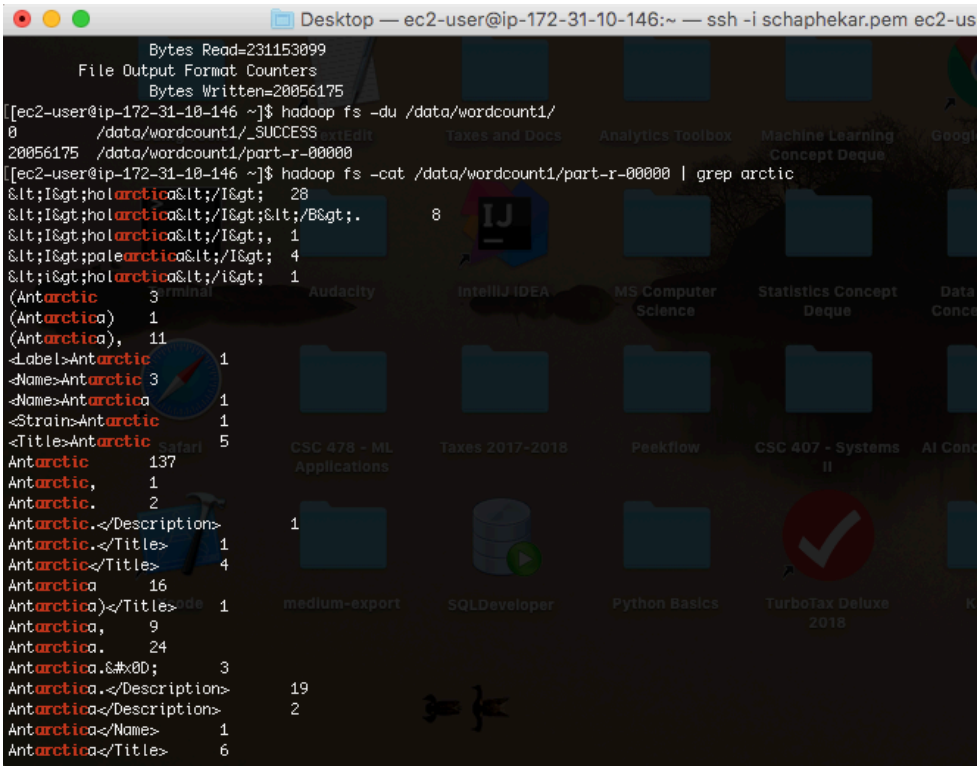


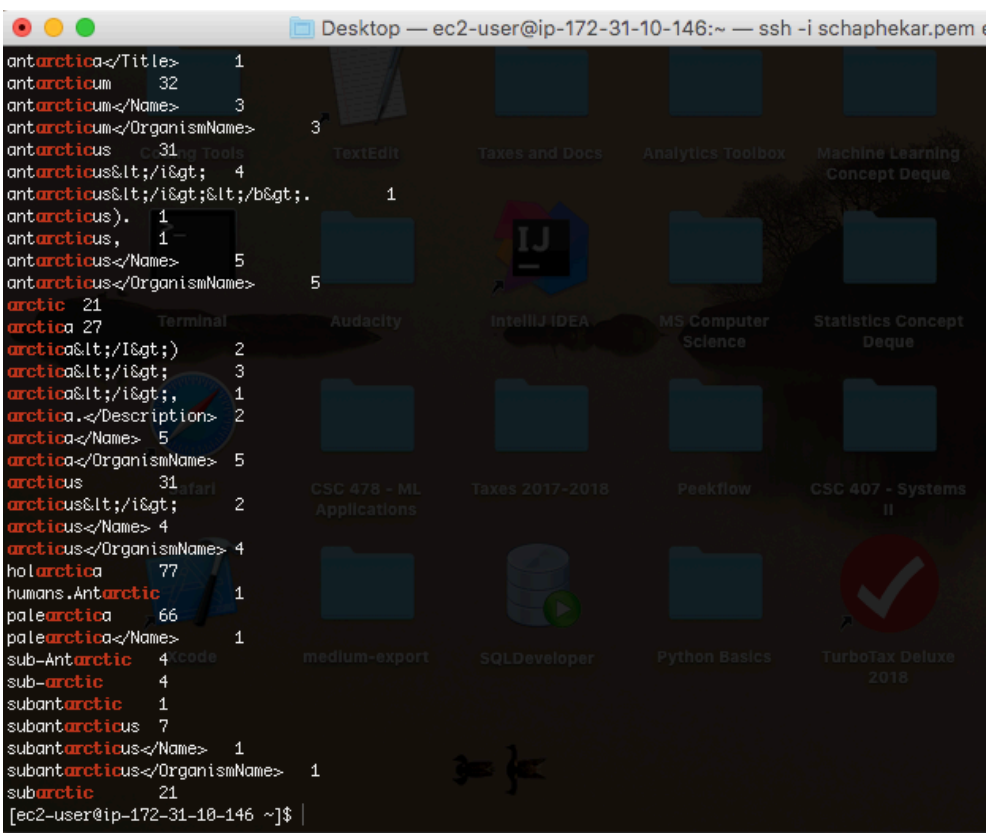
PART 3 – Word Count Lab

1) Verifying that the file was uploaded to HDFS

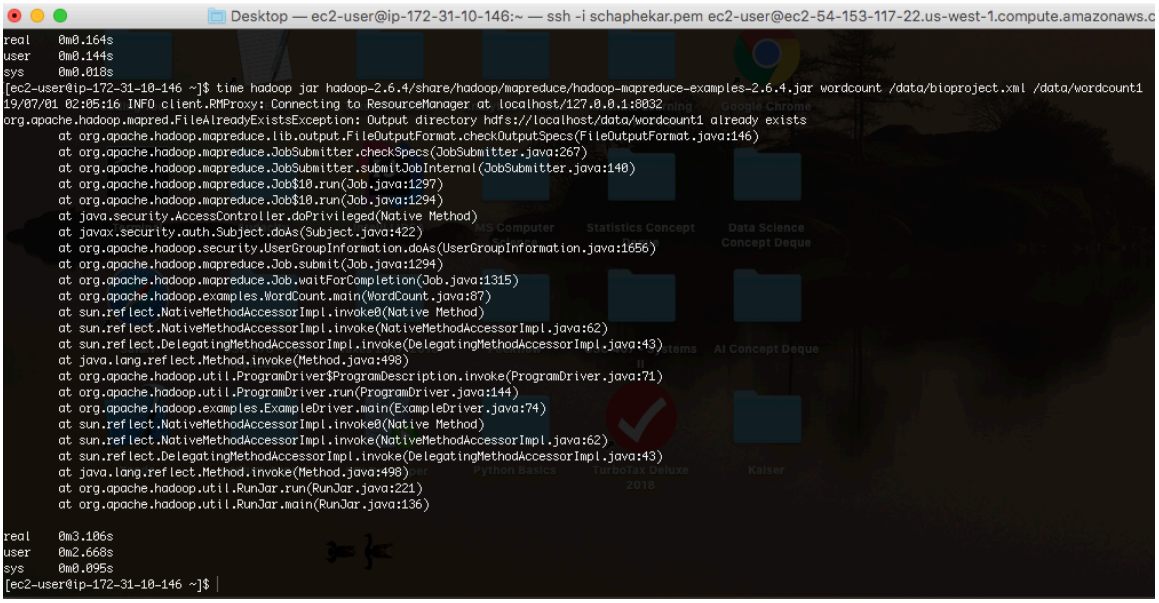
```
Desktop — ec2-user@ip-172-31-10-146:~ — ssh -i schaphekar.pem ec2-user@ec2-54-153-117-22.us-west-1.compute.am...
[[ec2-user@ip-172-31-10-146 ~]$ start-yarn.sh
starting yarn daemons
starting resourcemanager, logging to /home/ec2-user/hadoop-2.6.4/logs/yarn-ec2-user-resourcemanager-ip-172-31-10-146.us-west-1.compute.int
ernal.out
localhost: starting nodemanager, logging to /home/ec2-user/hadoop-2.6.4/logs/yarn-ec2-user-nodemanager-ip-172-31-10-146.us-west-1.compute.
internal.out
[[ec2-user@ip-172-31-10-146 ~]$ mr-jobhistory-daemon.sh start historyserver
starting historyserver, logging to /home/ec2-user/hadoop-2.6.4/logs/mapred-ec2-user-historyserver-ip-172-31-10-146.us-west-1.compute.inter
nal.out
[[ec2-user@ip-172-31-10-146 ~]$ jps
833 SecondaryNameNode
1090 NodeManager
1397 JobHistoryServer
969 ResourceManager
506 NameNode
655 DataNode
1439 Jps
[[ec2-user@ip-172-31-10-146 ~]$ hadoop fs -mkdir /data
[[ec2-user@ip-172-31-10-146 ~]$ wget http://rasinsrv07.cstcis.cti.depaul.edu/CSC555/bioproject.xml
--2019-07-01 01:40:37--  http://rasinsrv07.cstcis.cti.depaul.edu/CSC555/bioproject.xml
Resolving rasinsrv07.cstcis.cti.depaul.edu (rasinsrv07.cstcis.cti.depaul.edu)... 140.192.39.95
Connecting to rasinsrv07.cstcis.cti.depaul.edu (rasinsrv07.cstcis.cti.depaul.edu)|140.192.39.95|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 231149003 (220M) [text/xml]
Saving to: 'bioproject.xml'

100%[===================================================================================>] 231,149,003 10.4MB/s   in 22s

2019-07-01 01:40:59 (10.3 MB/s) - 'bioproject.xml' saved [231149003/231149003]

[[ec2-user@ip-172-31-10-146 ~]$ hadoop fs -put bioproject.xml /data/
[[ec2-user@ip-172-31-10-146 ~]$ hadoop fs -ls /data
Found 1 items
-rw-r--r--   1 ec2-user supergroup  231149003 2019-07-01 01:42 /data/bioproject.xml
[ec2-user@ip-172-31-10-146 ~]$
```

2) Occurrences of “arctic”





3) Job completion time



```
Desktop — ec2-user@ip-172-31-10-146:~ — ssh -i schaphekar.pem ec2-user@ec2-54-153-117-22.us-west-1.compute.amazonaws.c
real    0m0.164s
user    0m0.144s
sys     0m0.018s
[ec2-user@ip-172-31-10-146 ~]$ time hadoop jar hadoop-2.6.4/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.6.4.jar wordcount /data/bioproject.xml /data/wordcount1
19/07/01 02:05:16 INFO client.RMProxy: Connecting to ResourceManager at localhost/127.0.0.1:8032
org.apache.hadoop.mapred.FileAlreadyExistsException: Output directory hdfs://localhost/data/wordcount1 already exists
        at org.apache.hadoop.mapreduce.lib.output.FileOutputFormat.checkOutputSpecs(FileOutputFormat.java:146)
        at org.apache.hadoop.mapreduce.JobSubmitter.checkSpecs(JobSubmitter.java:267)
        at org.apache.hadoop.mapreduce.JobSubmitter.submitJobInternal(JobSubmitter.java:140)
        at org.apache.hadoop.mapreduce.Job$10.run(Job.java:1297)
        at org.apache.hadoop.mapreduce.Job$10.run(Job.java:1294)
        at java.security.AccessController.doPrivileged(Native Method)
        at javax.security.auth.Subject.doAs(Subject.java:422)
        at org.apache.hadoop.security.UserGroupInformation.doAs(UserGroupInformation.java:1656)
        at org.apache.hadoop.mapreduce.Job.submit(Job.java:1294)
        at org.apache.hadoop.mapreduce.Job.waitForCompletion(Job.java:1315)
        at org.apache.hadoop.examples.WordCount.main(WordCount.java:87)
        at sun.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
        at sun.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.java:62)
        at sun.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:43)
        at java.lang.reflect.Method.invoke(Method.java:498)
        at org.apache.hadoop.util.ProgramDriver$ProgramDescription.invoke(ProgramDriver.java:71)
        at org.apache.hadoop.util.ProgramDriver.run(ProgramDriver.java:144)
        at org.apache.hadoop.examples.ExampleDriver.main(ExampleDriver.java:74)
        at sun.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
        at sun.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.java:62)
        at sun.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:43)
        at java.lang.reflect.Method.invoke(Method.java:498)
        at org.apache.hadoop.util.RunJar.run(RunJar.java:221)
        at org.apache.hadoop.util.RunJar.main(RunJar.java:136)

real    0m3.106s
user    0m2.668s
sys     0m0.095s
[ec2-user@ip-172-31-10-146 ~]$
```