DISTRIBUTED SYSTEMS LABS -- WEEK5

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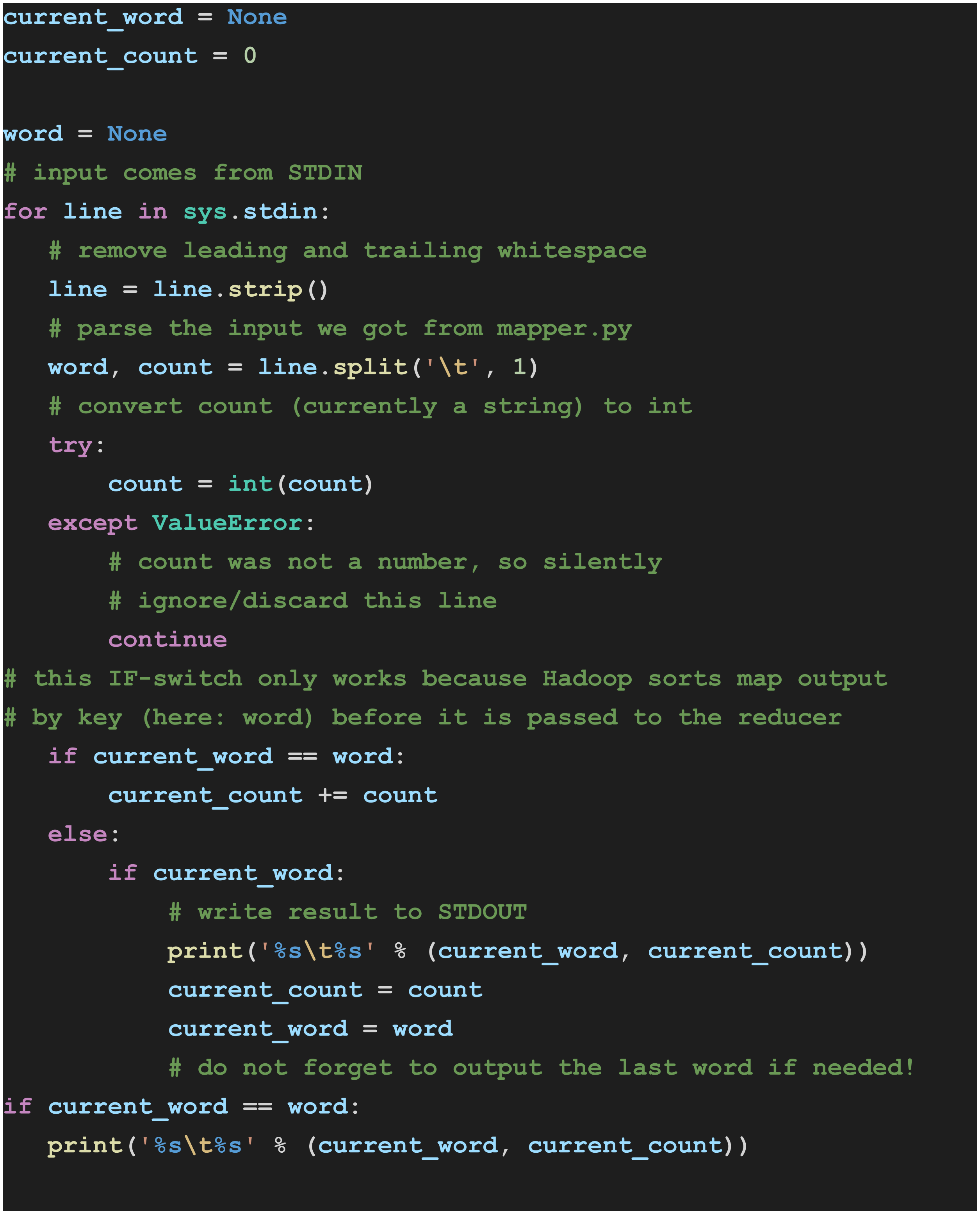
Solved Examples:

1.Word Count Example
Mapper.py

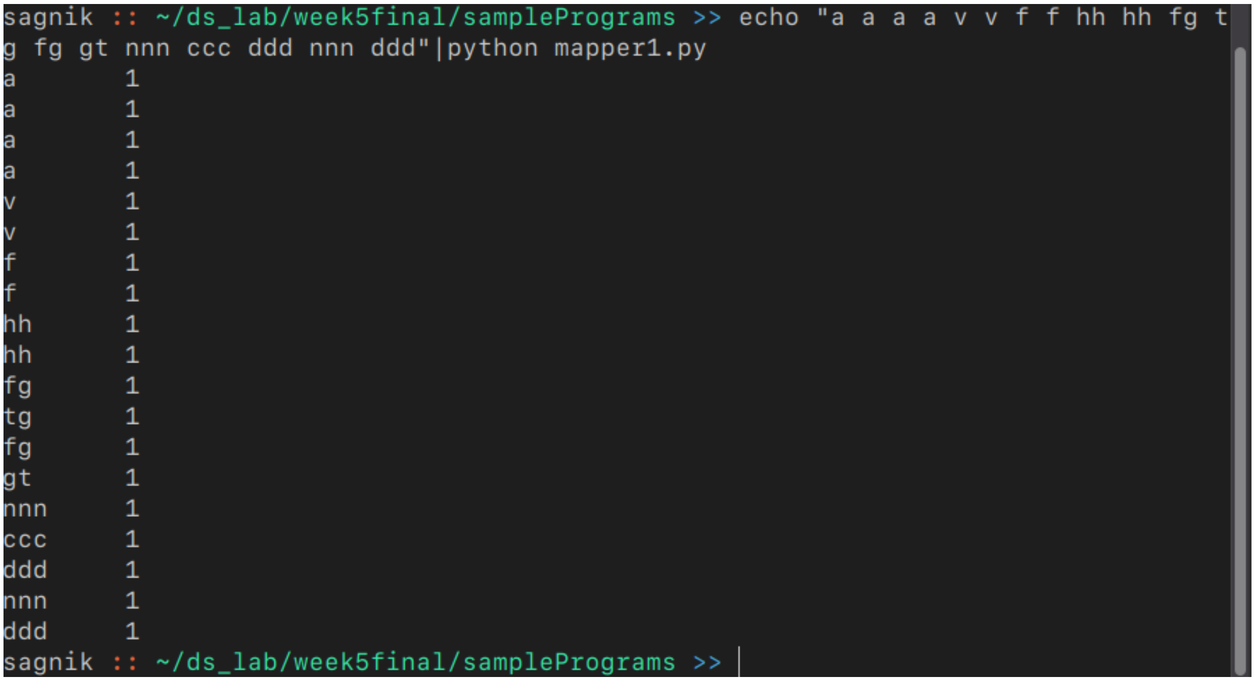
```python
import sys
# input comes from STDIN (standard input)
for line in sys.stdin:
   # remove leading and trailing whitespace
   line = line.strip()
   # split the line into words
   words = line.split()
   # increase counters
   for word in words:
       # write the results to STDOUT (standard output);
       # what we output here will be the input for the
       # Reduce step, i.e. the input for reducer.py
       #
       # tab-delimited; the trivial word count is 1
       print ('%s\t%s' % (word, 1))
```

Reducer.py

```python
#!/usr/bin/env python
"""reducer.py"""
from operator import itemgetter
import sys
```



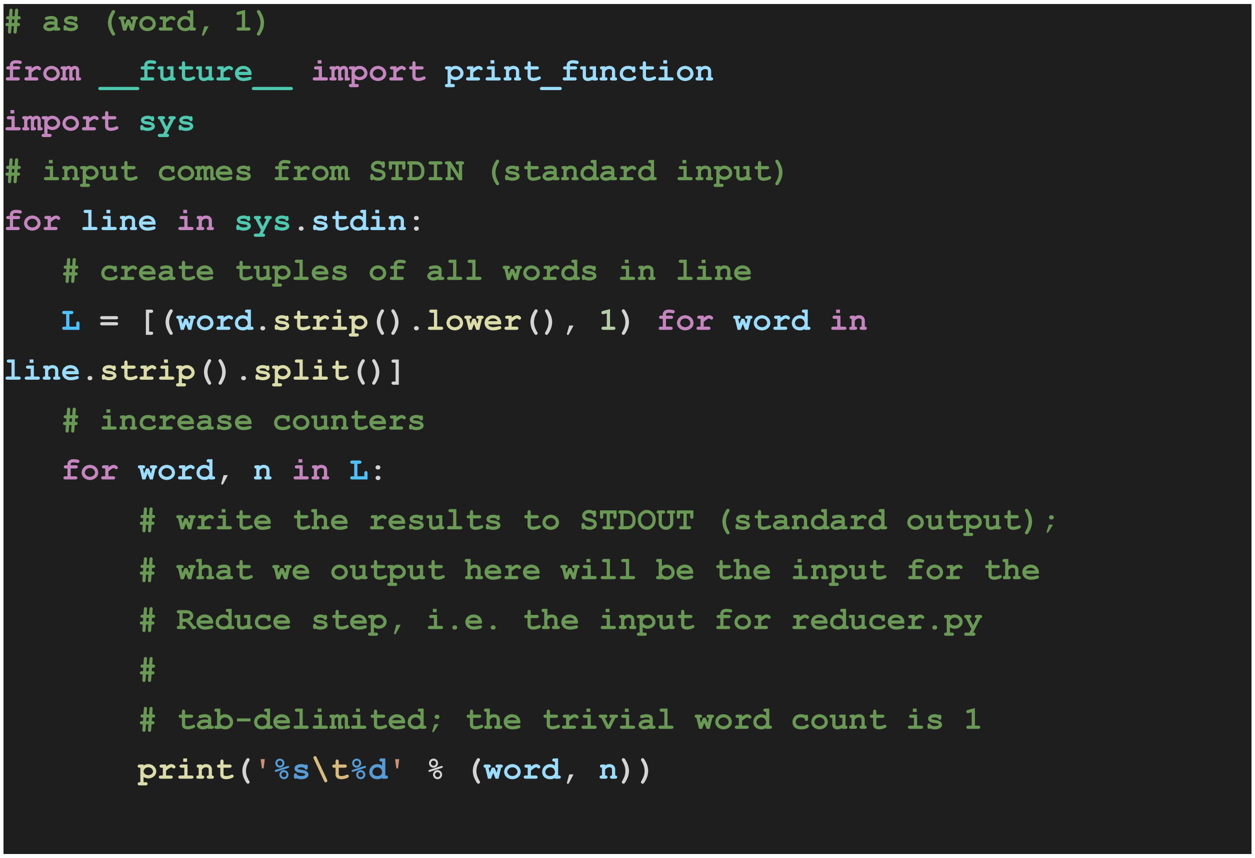
```
current_word = None
current_count = 0

word = None
# input comes from STDIN
for line in sys.stdin:
   # remove leading and trailing whitespace
   line = line.strip()
   # parse the input we got from mapper.py
   word, count = line.split('\t', 1)
   # convert count (currently a string) to int
   try:
       count = int(count)
   except ValueError:
       # count was not a number, so silently
       # ignore/discard this line
       continue
# this IF-switch only works because Hadoop sorts map output
# by key (here: word) before it is passed to the reducer
   if current_word == word:
       current_count += count
   else:
       if current_word:
           # write result to STDOUT
           print('%s\t%s' % (current_word, current_count))
           current_count = count
           current_word = word
           # do not forget to output the last word if needed!
if current_word == word:
   print('%s\t%s' % (current_word, current_count))
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "a a a a v v f f hh hh fg t
g fg gt nnn ccc ddd nnn ddd"|python mapper1.py
a       1
a       1
a       1
a       1
v       1
v       1
f       1
f       1
hh      1
hh      1
fg      1
tg      1
fg      1
gt      1
nnn     1
ccc     1
ddd     1
nnn     1
ddd     1
sagnik :: ~/ds_lab/week5final/samplePrograms >> 
```

2. MapReduce program to find frequent words

Freqmap1.py



```
# as (word, 1)
from __future__ import print_function
import sys
# input comes from STDIN (standard input)
for line in sys.stdin:
   # create tuples of all words in line
   L = [(word.strip().lower(), 1) for word in
line.strip().split()]
   # increase counters
   for word, n in L:
       # 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
       #
       # tab-delimited; the trivial word count is 1
       print('%s\t%d' % (word, n))
```

Freqred1.py

```
#!/usr/bin/env python
# reducer.py
from __future__ import print_function
import sys
lastWord = None
sum = 0
for line in sys.stdin:
   word, count = line.strip().split('\t', 1)
   count = int(count)
   if lastWord == None:
       lastWord = word
       sum = count
       continue
   if word == lastWord:
       sum += count
   else:
       print("%s\t%d" % (lastWord, sum))
       sum = count
       lastWord = word
       # output last word
if lastWord == word:
   print('%s\t%s' % (lastWord, sum))
```

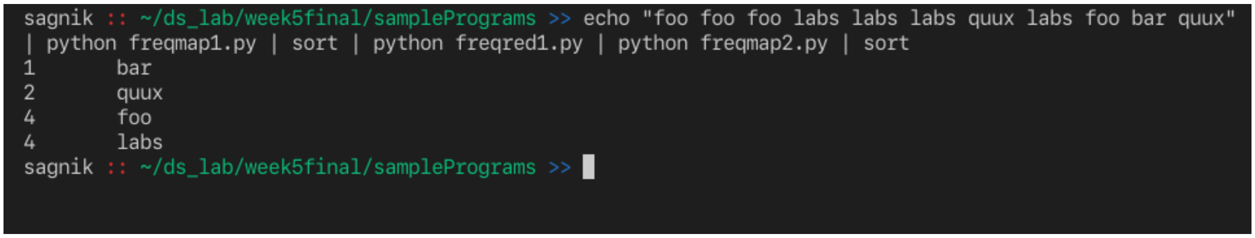
Freqmap2.py

```
#!/usr/bin/env python
# A basic mapper function/program that
# takes whatever is passed on the input and
# outputs tuples of all the words formatted
# as (word, 1)
from __future__ import print_function
import sys
```

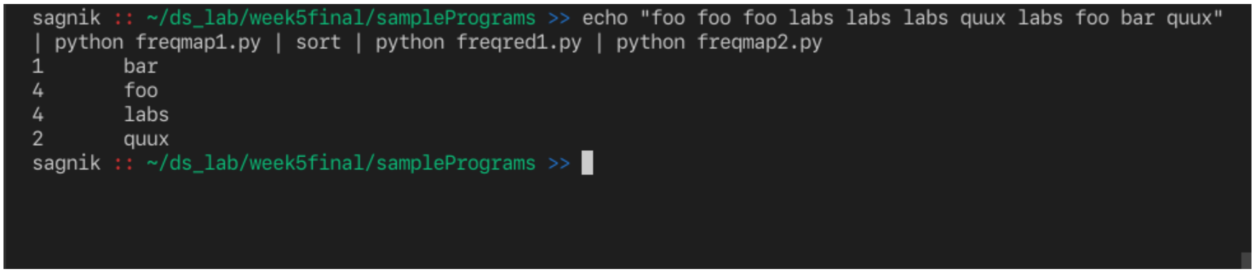
```
# input comes from STDIN (standard input)
for line in sys.stdin:
    word, count = line.strip().split('\t', 1)
    count = int(count)
    print('%d\t%s' % (count, word))
```

Freqred2.py

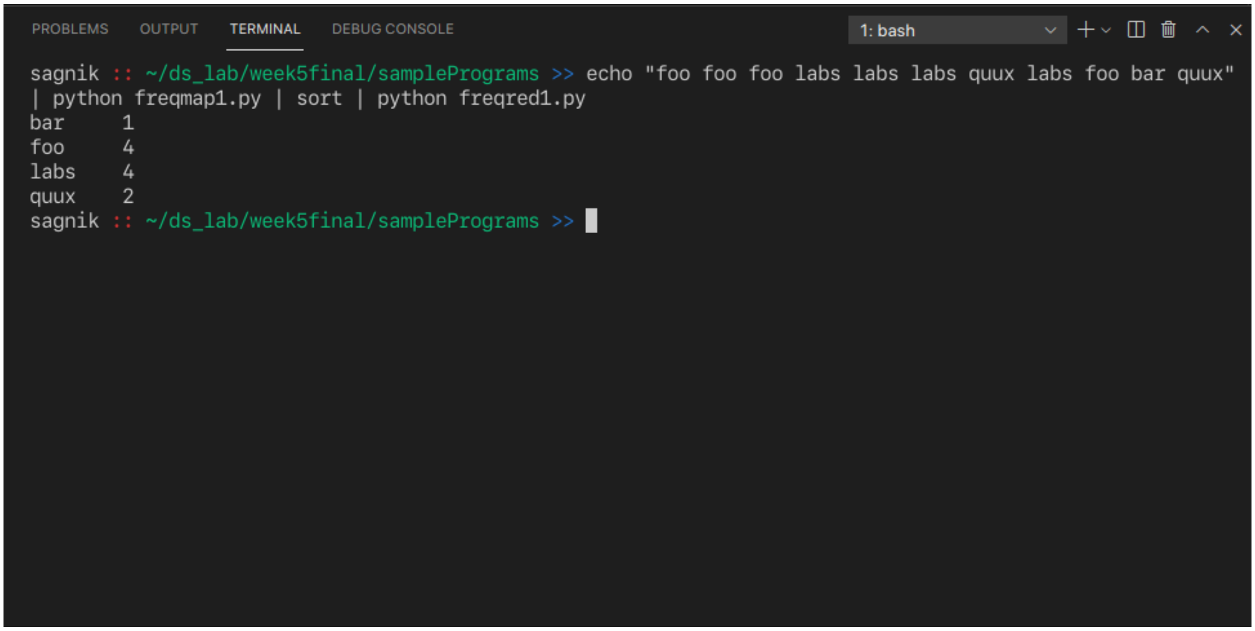
```
#!/usr/bin/env python
# reducer.py
from __future__ import print_function
import sys
mostFreq = []
currentMax = -1
for line in sys.stdin:
    count, word = line.strip().split('\t', 1)
    count = int(count)
    if count > currentMax:
        currentMax = count
        mostFreq = [word]
    elif count == currentMax:
        mostFreq.append(word)
        # output mostFreq word(s)
for word in mostFreq:
    print('%s\t%s' % (word, currentMax))
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "foo foo foo labs labs labs quux labs foo bar quux"
| python freqmap1.py | sort | python freqred1.py | python freqmap2.py | sort
1       bar
2       quux
4       foo
4       labs
sagnik :: ~/ds_lab/week5final/samplePrograms >>
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "foo foo foo labs labs labs quux labs foo bar quux"
| python freqmap1.py | sort | python freqred1.py | python freqmap2.py
1       bar
4       foo
4       labs
2       quux
sagnik :: ~/ds_lab/week5final/samplePrograms >>
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "foo foo foo labs labs labs quux labs foo bar quux"
| python freqmap1.py | sort | python freqred1.py
bar     1
foo     4
labs    4
quux    2
sagnik :: ~/ds_lab/week5final/samplePrograms >>
```

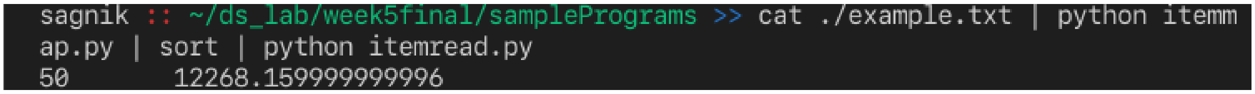
3. MapReduce program to explore the dataset and perform the filtering (typically creating key/value pairs) by mapper and perform the count and summary operation on the instances.

Mapper.py

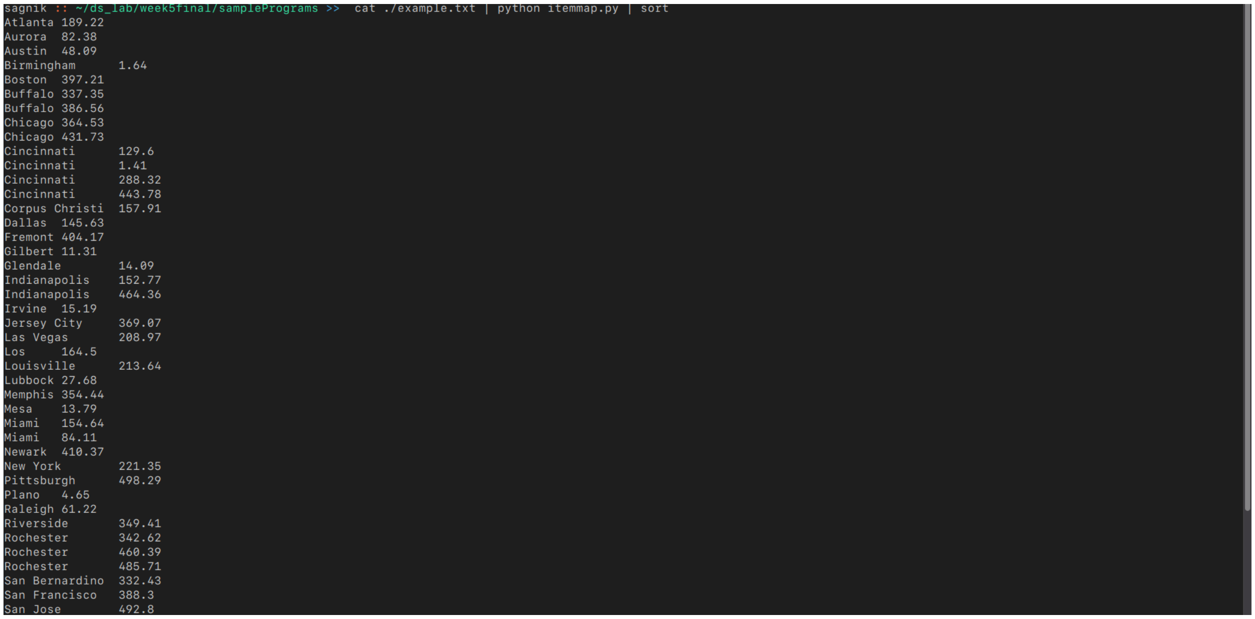
```python
import fileinput
for line in fileinput.input():
    data = line.strip().split("\t")
    if len(data) == 6:
       date, time, location, item, cost, payment = data
       print("{0}\t{1}".format(location, cost))
       # can try with different instances.....
       #print ("{0}\t{1}".format(payment, cost))
       #print ("{0}\t{1}".format(item, cost))
```

Reducer.py

```
import fileinput
transactions_count = 0
sales_total = 0

for line in fileinput.input():
   data = line.strip().split("\t")
   if len(data) != 2:
       # Something has gone wrong. Skip this line.
       continue
   current_key, current_value = data
   transactions_count += 1
   sales_total += float(current_value)
print(transactions_count, "\t", sales_total)
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> cat ./example.txt | python itemm
ap.py | sort | python itemread.py
50      12268.159999999996
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >>  cat ./example.txt | python itemmap.py | sort
Atlanta 189.22
Aurora  82.38
Austin  48.09
Birmingham      1.64
Boston  397.21
Buffalo 337.35
Buffalo 386.56
Chicago 364.53
Chicago 431.73
Cincinnati      129.6
Cincinnati      1.41
Cincinnati      288.32
Cincinnati      443.78
Corpus Christi  157.91
Dallas  145.63
Fremont 404.17
Gilbert 11.31
Glendale        14.09
Indianapolis    152.77
Indianapolis    464.36
Irvine  15.19
Jersey City     369.07
Las Vegas       208.97
Los     164.5
Louisville      213.64
Lubbock 27.68
Memphis 354.44
Mesa    13.79
Miami   154.64
Miami   84.11
Newark  410.37
New York        221.35
Pittsburgh      498.29
Plano   4.65
Raleigh 61.22
Riverside       349.41
Rochester       342.62
Rochester       460.39
Rochester       485.71
San Bernardino  332.43
San Francisco   388.3
San Jose        492.8
```

4. Write a mapper and reducer program for word count by defining separator instead of using “\t”

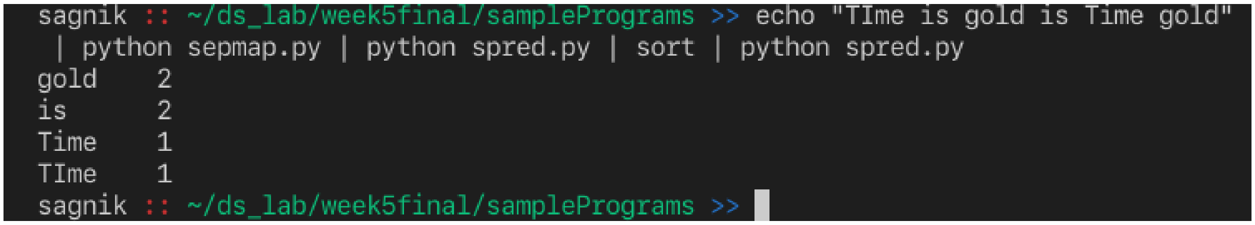
Mapper.py

```
#!/usr/bin/env python
"""A more advanced Mapper, using Python iterators and
generators."""
import sys


def read_input(file):
   for line in file:
       # split the line into words
       yield line.split()


def main(separator='\t'):
   # input comes from STDIN (standard input)
```

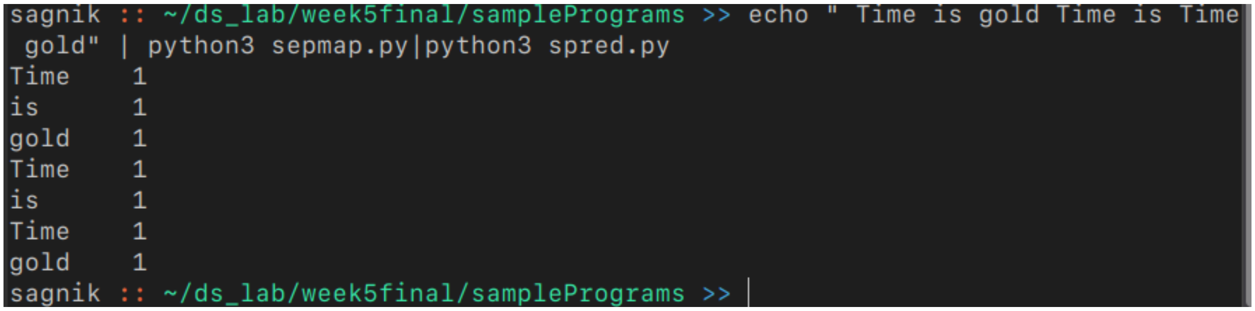
```
    data = read_input(sys.stdin)
    for words in data:
        # write the results to STDOUT (standard output);
        # what we output here will be the input for the
        # Reduce step, i.e. the input for reducer.py
        # tab-delimited; the trivial word count is 1
        for word in words:
            print('%s%s%d' % (word, separator, 1))


if __name__ == "__main__":
    main()
```

Reducer.py

```
from itertools import groupby
from operator import itemgetter
import sys


def read_mapper_output(file, separator='\t'):
    for line in file:
        yield line.rstrip().split(separator, 1)


def main(separator='\t'):

    # input comes from STDIN (standard input)
    data = read_mapper_output(sys.stdin, separator=separator)
    # groupby groups multiple word-count pairs by word,
    # and creates an iterator that returns consecutive keys and
their group:
    # current_word - string containing a word (the key)
    # group - iterator yielding all ["&lt;current_word&gt;", "&lt;count&gt;"] items
    for current_word, group in groupby(data, itemgetter(0)):
        try:
            total_count = sum(int(count) for current_word, count in group)
            print("%s%s%d" % (current_word, separator, total_count))
        except ValueError:
            # count was not a number, so silently discard this item
            pass


if __name__ == "__main__":
    main()
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "TIme is gold is Time gold"
 | python sepmap.py | python spred.py | sort | python spred.py
gold    2
is      2
Time    1
TIme    1
sagnik :: ~/ds_lab/week5final/samplePrograms >>
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo " Time is gold Time is Time
 gold" | python3 sepmap.py|python3 spred.py
Time    1
is      1
gold    1
Time    1
is      1
Time    1
gold    1
sagnik :: ~/ds_lab/week5final/samplePrograms >> |
```

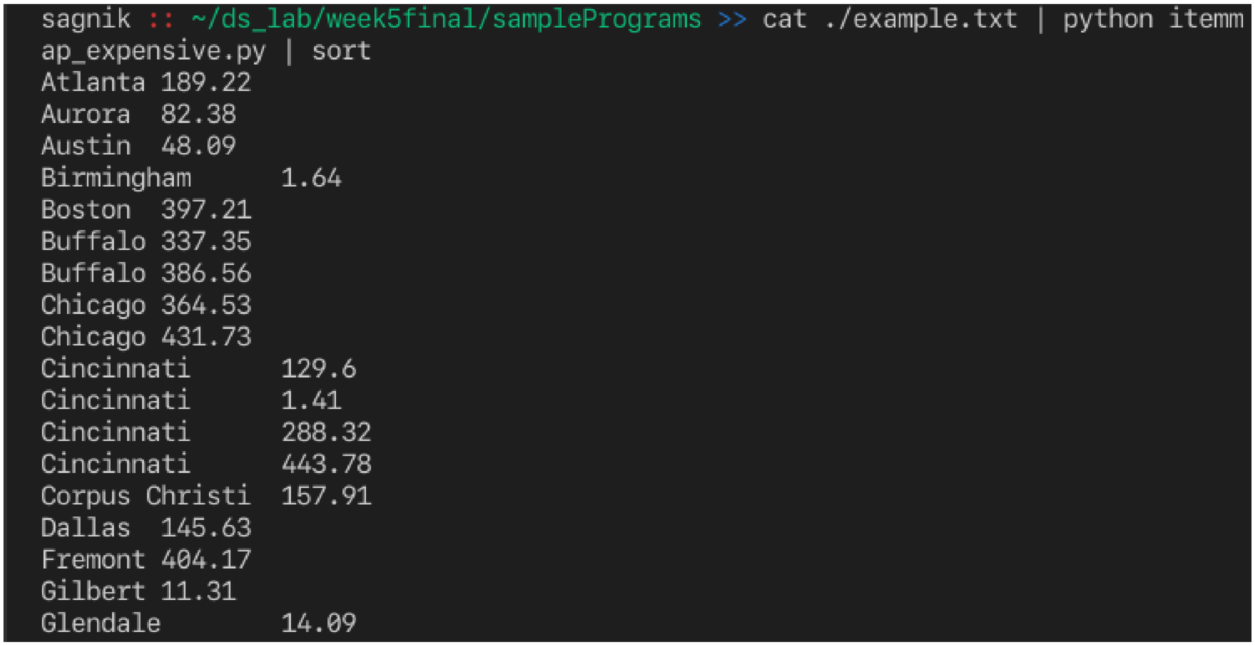
5. Write a map reduce program that returns the cost of the item that is most expensive, for each location in the dataset example.txt

Mapper.py

```
import fileinput

for line in fileinput.input():
    data = line.strip().split("\t")
    if len(data) == 6:
        date, time, location, item, cost, payment = data
        print("{0}\t{1}".format(location, cost))
```

Reducer.py

```
import fileinput
max_value = 0
old_key = None

for line in fileinput.input():
    data = line.strip().split("\t")
    if len(data) != 2:
        # Something has gone wrong. Skip this line.
        continue
    current_key, current_value = data
    # Refresh for new keys (i.e. locations in the example
context)
    if old_key and old_key != current_key:
        print(old_key, "\t", max_value)
        old_key = current_key
        max_value = 0
        old_key = current_key
        if float(current_value) > float(max_value):
            max_value = float(current_value)
if old_key != None:
    print(old_key, "\t", max_value)
```



```
sagnik :: ~/ds_lab/week5final/samplePrograms >> cat ./example.txt | python itemm
ap_expensive.py | sort
Atlanta 189.22
Aurora  82.38
Austin  48.09
Birmingham      1.64
Boston  397.21
Buffalo 337.35
Buffalo 386.56
Chicago 364.53
Chicago 431.73
Cincinnati      129.6
Cincinnati      1.41
Cincinnati      288.32
Cincinnati      443.78
Corpus Christi  157.91
Dallas  145.63
Fremont 404.17
Gilbert 11.31
Glendale        14.09
```

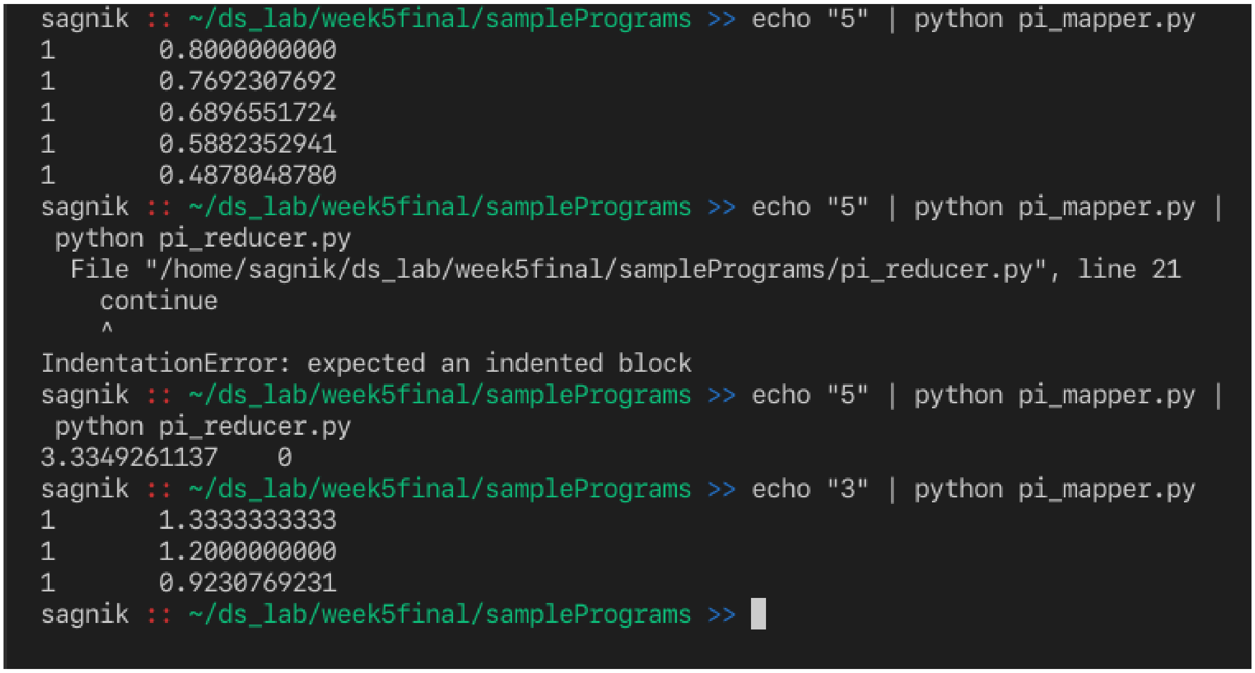
6. Write a mapreduce program to evaluate the PI.

Mapper.py

```
import sys


def f(x):
   return 4.0 / (1.0 + x*x)


# 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()
   N = int(words[0])
   deltaX = 1.0 / N
   for i in range(0, N):
       print("1\t%1.10f" % (f(i * deltaX)*deltaX))
```

Reducer.py

```
#!/usr/bin/env python
from __future__ import print_function
from operator import itemgetter
import sys

sum1 = 0

# input comes from STDIN
for line in sys.stdin:
    # remove leading and trailing whitespace
    line = line.strip()
    # parse the input we got from mapper.py
    word, count = line.split('\t', 1)
    # convert count (currently a string) to int
    try:
        count = float(count)
    except ValueError:
        # count was not a number, so silently
        # ignore/discard this line
        #print( "--skipping (%s, %s)" % ( str(word), str(count) )
)
        continue
    sum1 += count
# do not forget to output the last word if needed!
print('%1.10f\t0' % sum1)
```

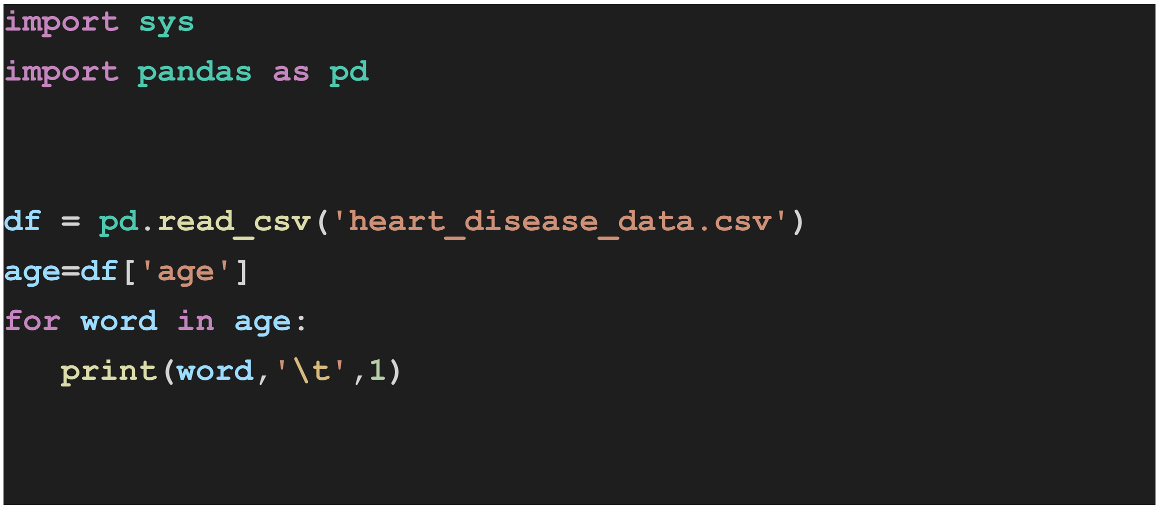


```
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "5" | python pi_mapper.py
1       0.8000000000
1       0.7692307692
1       0.6896551724
1       0.5882352941
1       0.4878048780
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "5" | python pi_mapper.py |
 python pi_reducer.py
  File "/home/sagnik/ds_lab/week5final/samplePrograms/pi_reducer.py", line 21
    continue
    ^
IndentationError: expected an indented block
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "5" | python pi_mapper.py |
 python pi_reducer.py
3.3349261137    0
sagnik :: ~/ds_lab/week5final/samplePrograms >> echo "3" | python pi_mapper.py
1       1.3333333333
1       1.2000000000
1       0.9230769231
sagnik :: ~/ds_lab/week5final/samplePrograms >> 
```

Exercises

1. **Try the above word count program for the Heart Disease dataset, covid_19_data dataset, example dataset and German Credit dataset.Students can decide their own way of displaying results (can work on any columns in the dataset) on the dataset mentioned.**

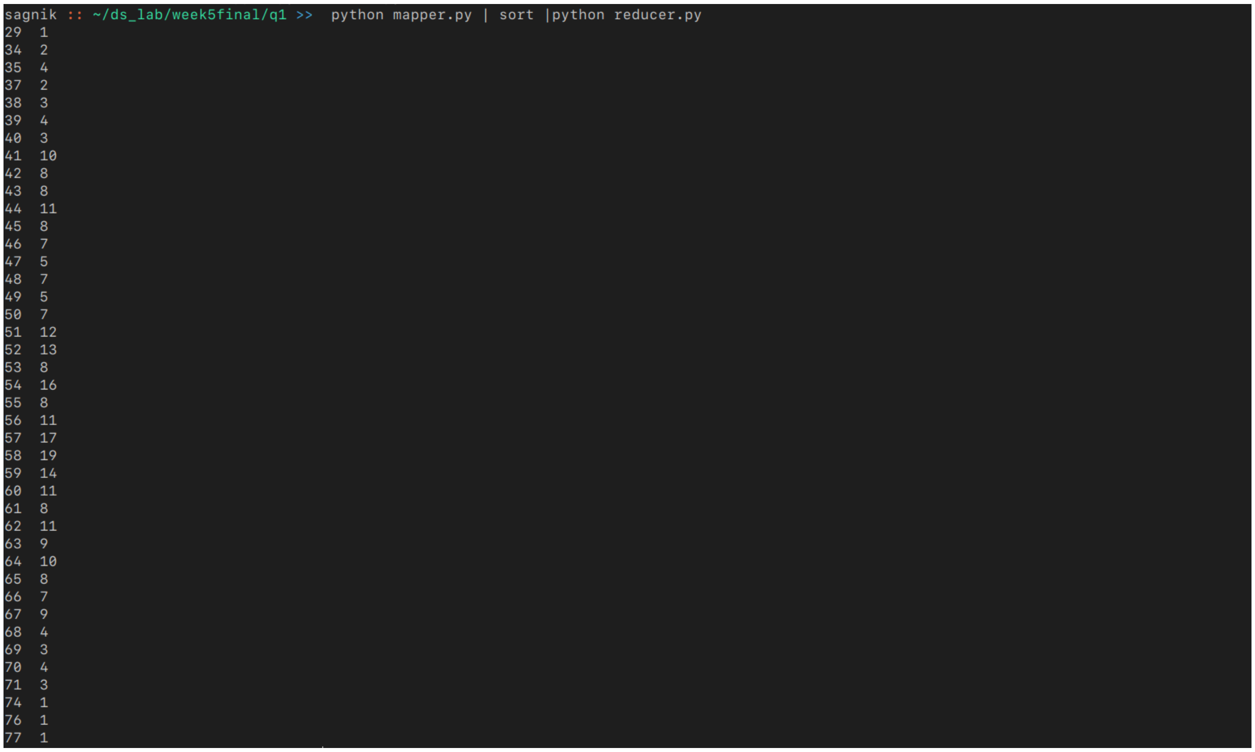
   On the heart Deiseasse dataset
   Mapper.py



```
import sys
import pandas as pd


df = pd.read_csv('heart_disease_data.csv')
age=df['age']
for word in age:
   print(word,'\t',1)
```

Reducer.py

```
from operator import itemgetter
import sys

current_word = None
current_count = 0
word = None

# input from stdin
for line in sys.stdin:
    line = line.strip()
    word, count = line.split('\t', 1)
    try:
        count = int(count)
    except ValueError:
        continue
    if current_word == word:
        current_count += count
    else:
        if current_word:
            print(f"{current_word} {current_count}")
        current_count = count
        current_word = word

if current_word == word:
    print(f"{current_word} {current_count}")
```



```
sagnik :: ~/ds_lab/week5final/q1 >>  python mapper.py | sort |python reducer.py
29  1
34  2
35  4
37  2
38  3
39  4
40  3
41  10
42  8
43  8
44  11
45  8
46  7
47  5
48  7
49  5
50  7
51  12
52  13
53  8
54  16
55  8
56  11
57  17
58  19
59  14
60  11
61  8
62  11
63  9
64  10
65  8
66  7
67  9
68  4
69  3
70  4
71  3
74  1
76  1
77  1
```

2. **Try the above frequent word count program for the Heart Disease dataset,**
   covid_19_data dataset, example dataset and German Credit data.
   Students can decide their own way of displaying results (can work on any columns in the dataset) on the dataset mentioned.

Freqmap1.py

```
from __future__ import print_function
import sys
import pandas as pd

df = pd.read_csv('covid_19_data.csv')
country = df['Deaths']
for word in country:
   print(word, '\t', 1)
```

Freqmap2.py

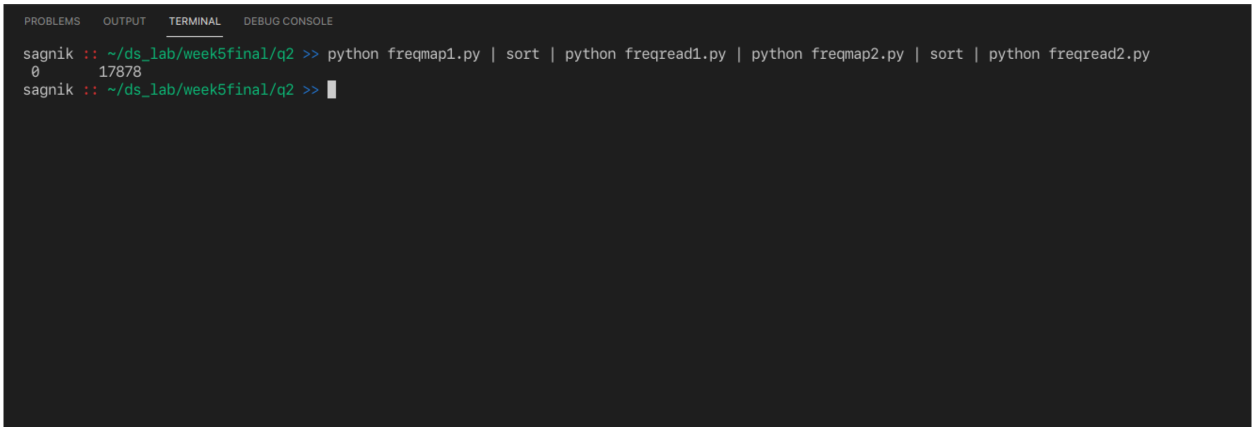
```
from __future__ import print_function
import sys

for line in sys.stdin:
   word,count = line.strip().split('\t',1)
   count = int(count)
   print(count,'\t',word)
```

Freqread1.py

```
from __future__ import print_function
import sys
lastWord = None

sum = 0

for line in sys.stdin:
   word,count = line.strip().split('\t',1)
   count = int(count)
   if lastWord == None:
       lastWord = word
       sum = count
       continue
   if word == lastWord:
       sum += count
   else:
       print(lastWord,'\t',sum)
       sum = count
       lastWord = word

#output the last word
if lastWord == word:
   print(lastWord,'\t',sum)
```

Freqread2.py

```python
from __future__ import print_function

import sys

mostFreq = []
currentMax = -1
for line in sys.stdin:
   count,word = line.strip().split('\t',1)
   count = int(count)
   if count > currentMax :
       currentMax = count
       mostFreq = [word]
   elif count == currentMax:
       mostFreq.append(word)
#output the mostFreq word(s)
for word in mostFreq:
   print(word,'\t',currentMax)
```



```
sagnik :: ~/ds_lab/week5final/q2 >> python freqmap1.py | sort | python freqread1.py | python freqmap2.py | sort | python freqread2.py
 0       17878
sagnik :: ~/ds_lab/week5final/q2 >>
```

3. **Try the above ‘Item explore and count program’ for the Heart Disease dataset,**
   covid_19_data dataset, example dataset and German Credit dataset.
   Students can decide their own way of displaying results (can work on any columns in the
   dataset) on the dataset mentioned.

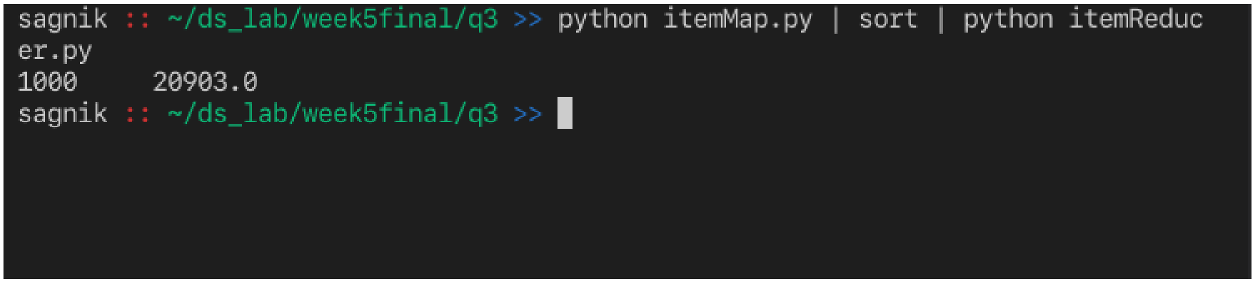
Mapper.py

```
import pandas as pd
import numpy as np

dataFrame  = pd.read_excel('German_Credit.xlsx')
x = dataFrame["CreditAmount"]
y = dataFrame["DurationOfCreditInMonths"]

for i in range(len(x)):
   print(f"{x[i]}\t{y[i]}")
```

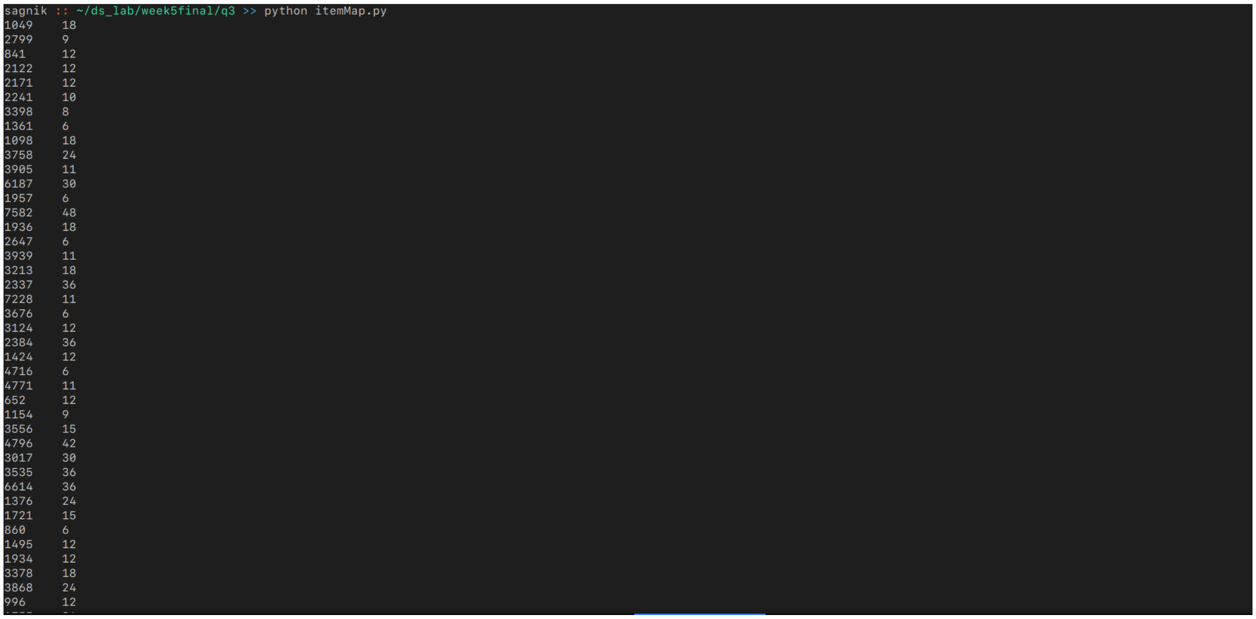
Reducer.py

```
import fileinput
transactions_count = 0

sales_total = 0
for line in fileinput.input():
   data= line.strip().split("\t")
   if len(data)!=2:
       #skip line
       continue
   current_key,current_value=data
   transactions_count +=1
   sales_total+=float(current_value)
```

```
print(transactions_count,"\t",sales_total)
```



```
sagnik :: ~/ds_lab/week5final/q3 >> python itemMap.py | sort | python itemReduc
er.py
1000     20903.0
sagnik :: ~/ds_lab/week5final/q3 >> 
```



```
sagnik :: ~/ds_lab/week5final/q3 >> python itemMap.py
1049    18
2799    9
841     12
2122    12
2171    12
2241    10
3398    8
1361    6
1098    18
3758    24
3905    11
6187    30
1957    6
7582    48
1936    18
2647    6
3939    11
3213    18
2337    36
7228    11
3676    6
3124    12
2384    36
1424    12
4716    6
4771    11
652     12
1154    9
3556    15
4796    42
3017    30
3535    36
6614    36
1376    24
1721    15
860     6
1495    12
1934    12
3378    18
3868    24
996     12
```

4. **Try to include separator using map reducing for the output of Heart Disease dataset, covid_19_data dataset, example dataset and German Credit dataset**

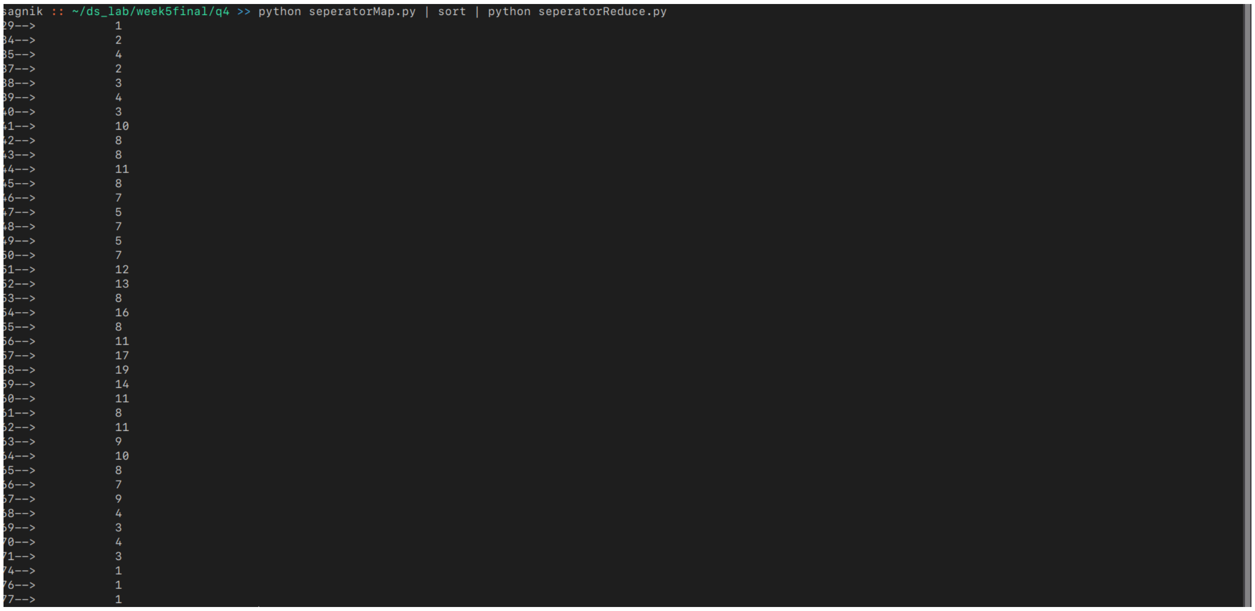
Mapper.py

```
import pandas as pd
import numpy as np

def dateframe_input(dataframe):
   for x in dataframe['age']:
       yield x
```

```
def main(separator='\t'):
    dataFrame = pd.read_csv('heart_disease_data.csv')
    data = dateframe_input(dataFrame)
    for x in data:
        print('%s%s%d' %(x,separator,1))

if __name__=='__main__':
    main()
```

Reducer.py

```
from itertools import groupby
from operator import itemgetter

import sys

def read_file_input(file,separator="\t"):
    for line in file:
        yield line.rstrip().split(separator,1)

def main(separator='\t'):
    data = read_file_input(sys.stdin,separator=separator)
    for current_word,group in groupby(data,itemgetter(0)):
        try:
            total_count = sum(int(count) for
current_word,count in group)
            print("%s--> %s\t%d"
%(current_word,separator,total_count))
        except Exception as e:
            print(e)

if __name__ =='__main__':
    main()
```



```
sagnik :: ~/ds_lab/week5final/q4 >> python seperatorMap.py | sort | python seperatorReduce.py
29-->           1
34-->           2
35-->           4
37-->           2
38-->           3
39-->           4
40-->           3
41-->           10
42-->           8
43-->           8
44-->           11
45-->           8
46-->           7
47-->           5
48-->           7
49-->           5
50-->           7
51-->           12
52-->           13
53-->           8
54-->           16
55-->           8
56-->           11
57-->           17
58-->           19
59-->           14
60-->           11
61-->           8
62-->           11
63-->           9
64-->           10
65-->           8
66-->           7
67-->           9
68-->           4
69-->           3
70-->           4
71-->           3
74-->           1
76-->           1
77-->           1
```

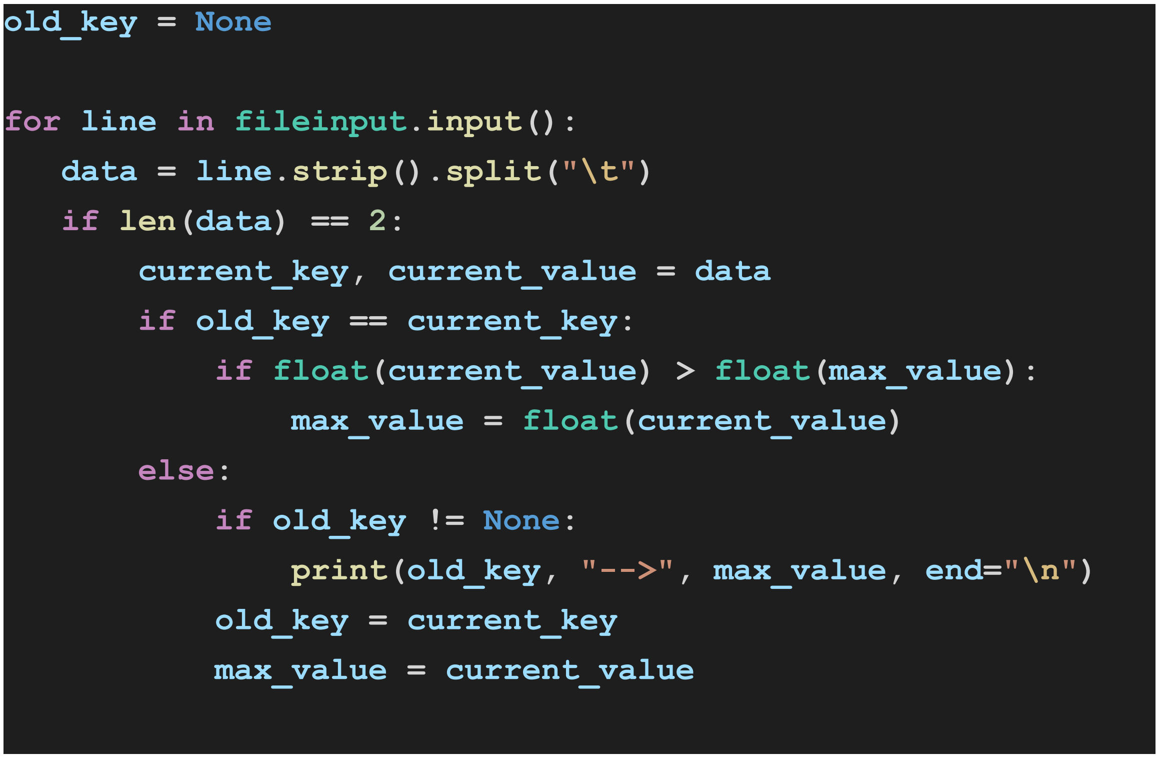
5. **Try to apply finding max value using map reduce concept for the output of Heart Disease dataset, covid_19_data dataset, example dataset and German Credit dataset. Students can decide their own way of displaying results (can work on any columns in the dataset) on the dataset mentioned**

Mapper.py

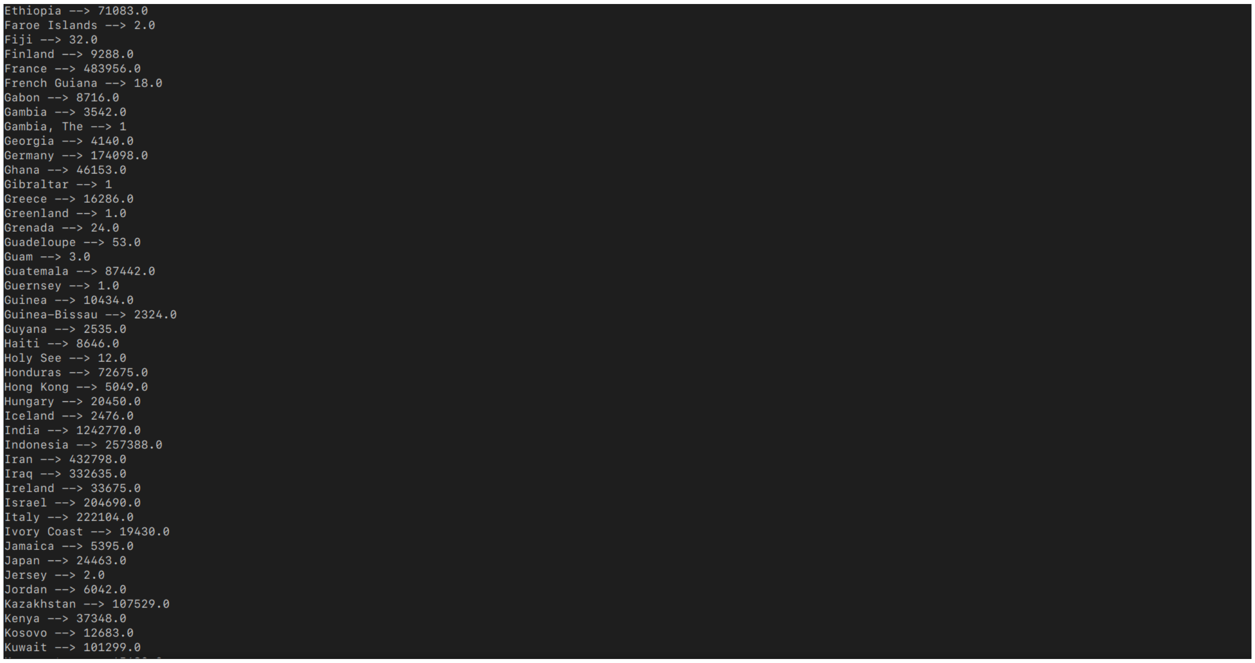
```
import numpy as np
import pandas as pd

dataframe = pd.read_csv("covid_19_data.csv")
country_name = dataframe["Country/Region"]
peak_cases = dataframe["Confirmed"]

for x in range(len(country_name)):
   print("%s\t%d" %(country_name[x],peak_cases[x]))
```

Reducer.py

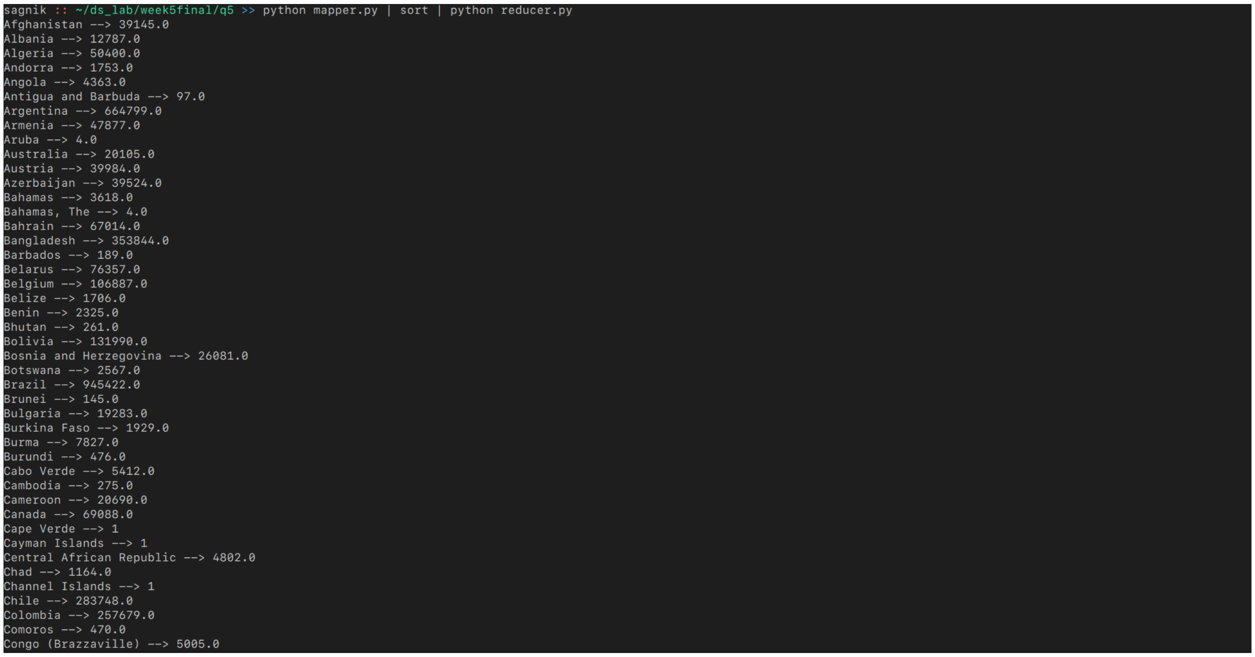
```
import fileinput
max_value = -1
```



```
old_key = None

for line in fileinput.input():
   data = line.strip().split("\t")
   if len(data) == 2:
       current_key, current_value = data
       if old_key == current_key:
           if float(current_value) > float(max_value):
               max_value = float(current_value)
       else:
           if old_key != None:
               print(old_key, "-->", max_value, end="\n")
           old_key = current_key
           max_value = current_value
```



```
Ethiopia --> 71083.0
Faroe Islands --> 2.0
Fiji --> 32.0
Finland --> 9288.0
France --> 483956.0
French Guiana --> 18.0
Gabon --> 8716.0
Gambia --> 3542.0
Gambia, The --> 1
Georgia --> 4140.0
Germany --> 174098.0
Ghana --> 46153.0
Gibraltar --> 1
Greece --> 16286.0
Greenland --> 1.0
Grenada --> 24.0
Guadeloupe --> 53.0
Guam --> 3.0
Guatemala --> 87442.0
Guernsey --> 1.0
Guinea --> 10434.0
Guinea-Bissau --> 2324.0
Guyana --> 2535.0
Haiti --> 8646.0
Holy See --> 12.0
Honduras --> 72675.0
Hong Kong --> 5049.0
Hungary --> 20450.0
Iceland --> 2476.0
India --> 1242770.0
Indonesia --> 257388.0
Iran --> 432798.0
Iraq --> 332635.0
Ireland --> 33675.0
Israel --> 204690.0
Italy --> 222104.0
Ivory Coast --> 19430.0
Jamaica --> 5395.0
Japan --> 24463.0
Jersey --> 2.0
Jordan --> 6042.0
Kazakhstan --> 107529.0
Kenya --> 37348.0
Kosovo --> 12683.0
Kuwait --> 101299.0
```



```
sagnik :: ~/ds_lab/week5final/q5 >> python mapper.py | sort | python reducer.py
Afghanistan --> 39145.0
Albania --> 12787.0
Algeria --> 50400.0
Andorra --> 1753.0
Angola --> 4363.0
Antigua and Barbuda --> 97.0
Argentina --> 664799.0
Armenia --> 47877.0
Aruba --> 4.0
Australia --> 20105.0
Austria --> 39984.0
Azerbaijan --> 39524.0
Bahamas --> 3618.0
Bahamas, The --> 4.0
Bahrain --> 67014.0
Bangladesh --> 353844.0
Barbados --> 189.0
Belarus --> 76357.0
Belgium --> 106887.0
Belize --> 1706.0
Benin --> 2325.0
Bhutan --> 261.0
Bolivia --> 131990.0
Bosnia and Herzegovina --> 26081.0
Botswana --> 2567.0
Brazil --> 945422.0
Brunei --> 145.0
Bulgaria --> 19283.0
Burkina Faso --> 1929.0
Burma --> 7827.0
Burundi --> 476.0
Cabo Verde --> 5412.0
Cambodia --> 275.0
Cameroon --> 20690.0
Canada --> 69088.0
Cape Verde --> 1
Cayman Islands --> 1
Central African Republic --> 4802.0
Chad --> 1164.0
Channel Islands --> 1
Chile --> 283748.0
Colombia --> 257679.0
Comoros --> 470.0
Congo (Brazzaville) --> 5005.0
```

7. Write a MapReduce program to count even or odd numbers in randomly
generated natural numbers

randGen.py

```
import random
```

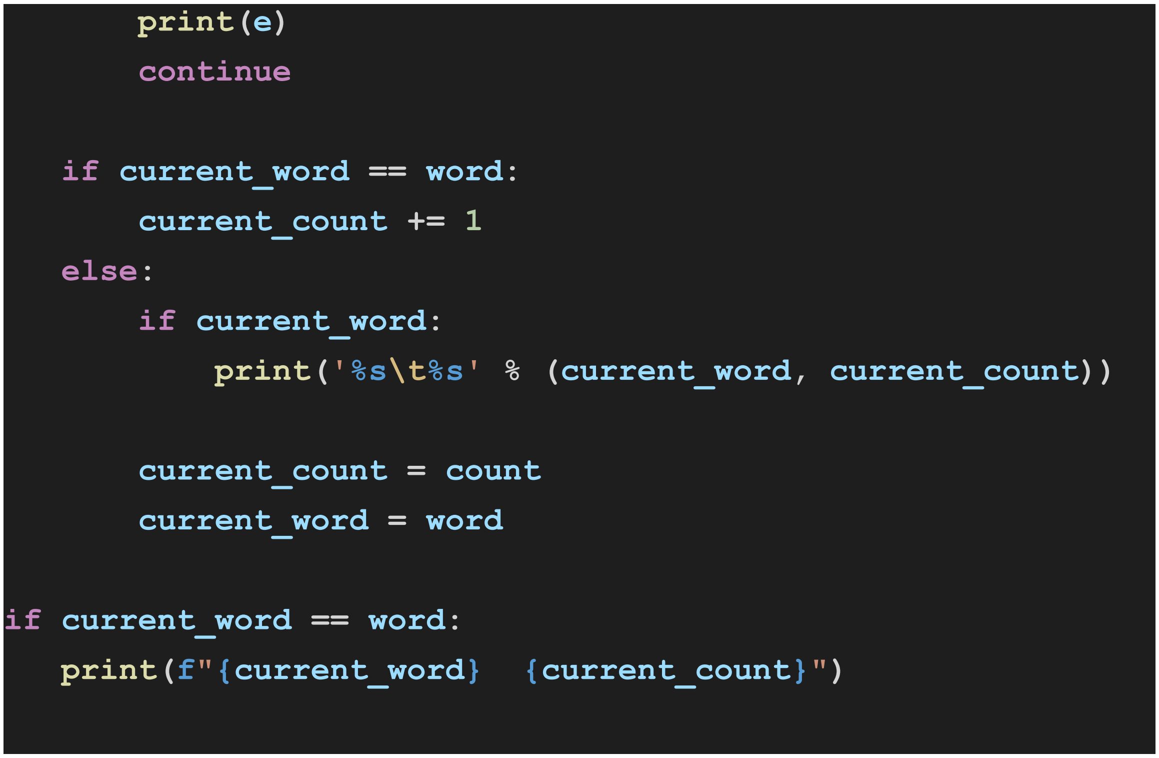
```
for i in range(1000):
    n = random.randint(1,1000)
    print(n)
```

Mapper.py

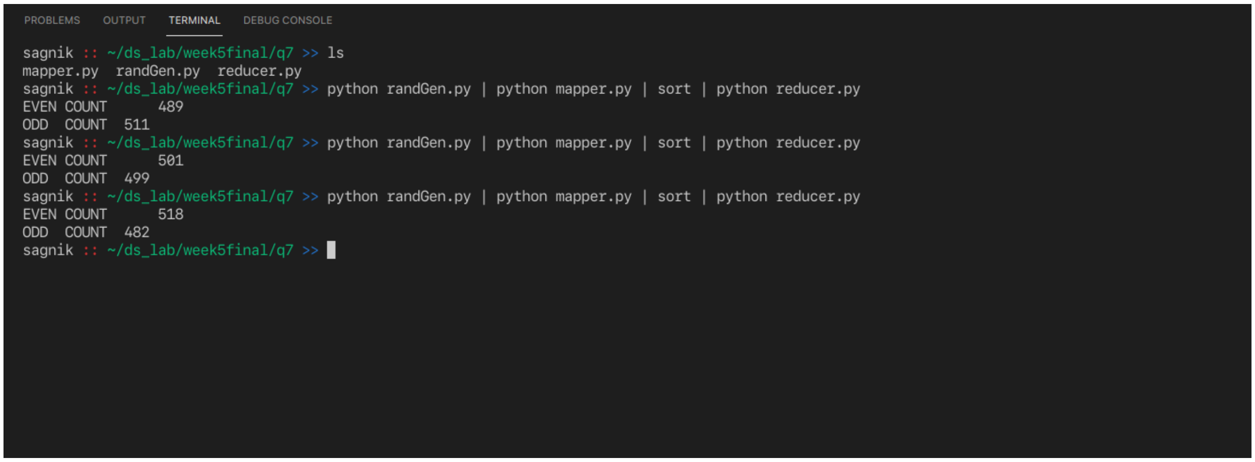
```
import sys

for line in sys.stdin:
    line = line.strip()
    nums = line.split()
    for num in nums:
        val = int(num)
        if val % 2 == 0:
            print('%s\t%s' %("EVEN COUNT",1))
        else:
            print('%s\t%s' %("ODD  COUNT",1))
```

Reducer.py

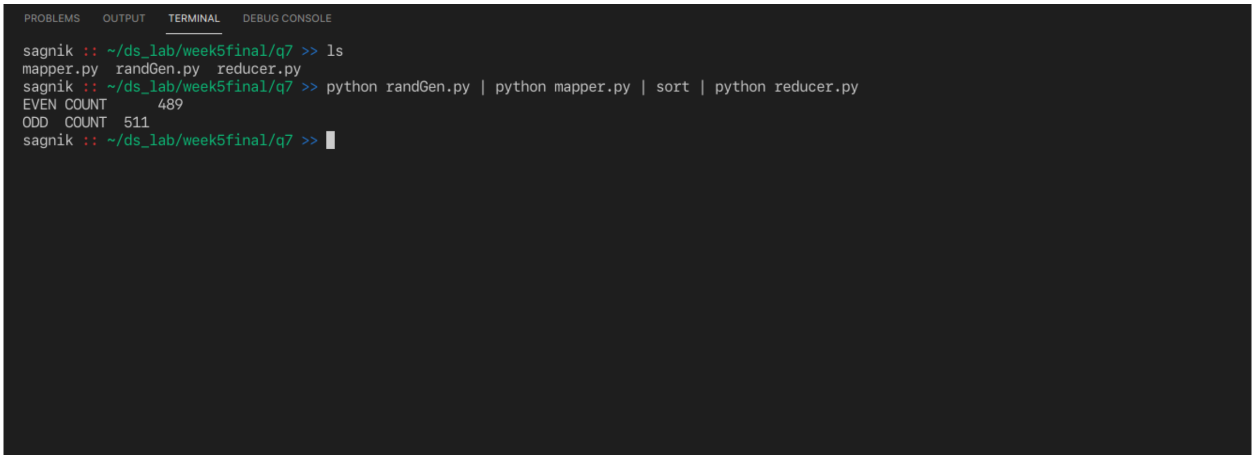
```
from operator import itemgetter
import sys

current_word = None
current_count = 0
word = None

for line in sys.stdin:
    line = line.strip()
    word, count = line.split('\t', 1)

    try:
        count = int(count)
    except ValueError as e:
        # case when count NaN , debug this and continue
```



```
        print(e)
        continue

    if current_word == word:
        current_count += 1
    else:
        if current_word:
            print('%s\t%s' % (current_word, current_count))

        current_count = count
        current_word = word

if current_word == word:
    print(f"{current_word}  {current_count}")
```



```
sagnik :: ~/ds_lab/week5final/q7 >> ls
mapper.py  randGen.py  reducer.py
sagnik :: ~/ds_lab/week5final/q7 >> python randGen.py | python mapper.py | sort | python reducer.py
EVEN COUNT      489
ODD  COUNT  511
sagnik :: ~/ds_lab/week5final/q7 >> python randGen.py | python mapper.py | sort | python reducer.py
EVEN COUNT      501
ODD  COUNT  499
sagnik :: ~/ds_lab/week5final/q7 >> python randGen.py | python mapper.py | sort | python reducer.py
EVEN COUNT      518
ODD  COUNT  482
sagnik :: ~/ds_lab/week5final/q7 >> 
```



```
sagnik :: ~/ds_lab/week5final/q7 >> ls
mapper.py  randGen.py  reducer.py
sagnik :: ~/ds_lab/week5final/q7 >> python randGen.py | python mapper.py | sort | python reducer.py
EVEN COUNT      489
ODD  COUNT  511
sagnik :: ~/ds_lab/week5final/q7 >> 
```