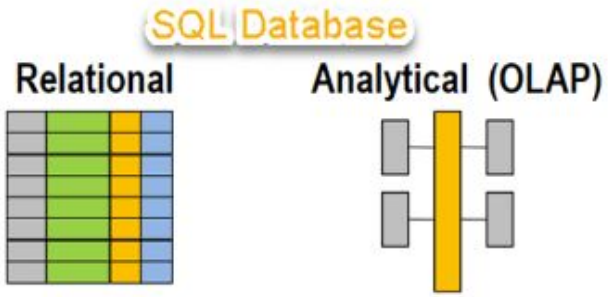
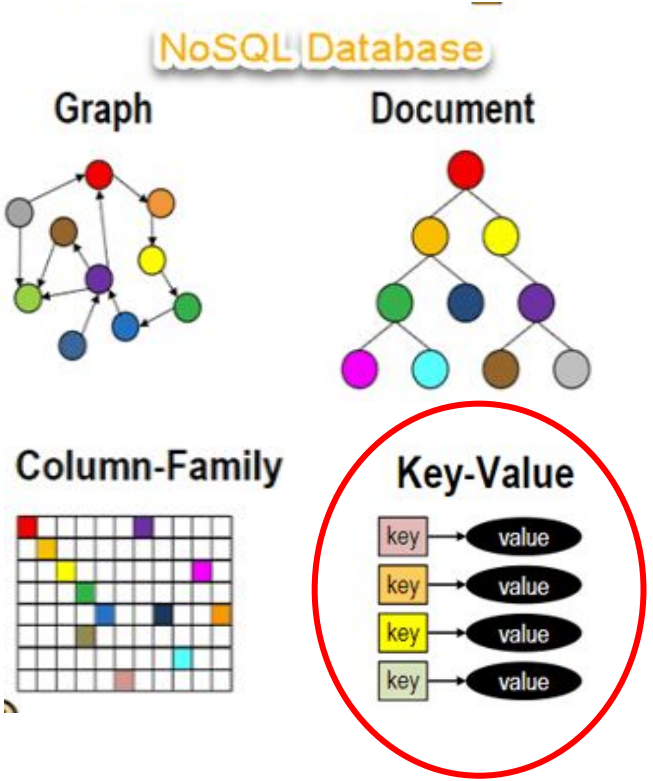
Assignment 6 NoSQL

Computing Lab - II (CS69012)
IIT Kharagpur

What is NoSQL?

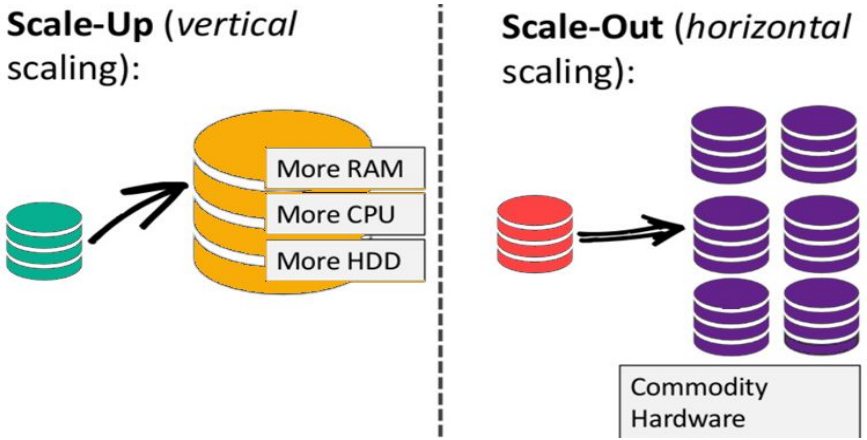
- "Not Only SQL" or "Not SQL" is a non-relational Database Management System, that does not require a fixed schema, avoids joins, and is easy to scale
- Used for distributed data stores with humongous data storage needs (Big data and real-time web apps)
- Can store structured, semi-structured, unstructured and polymorphic data





Why NoSQL?

- System response time becomes slow when RDBMS is used for massive volumes of data
- To resolve this problem, we could "scale up" our systems by upgrading existing hardware, which is expensive
- The alternative for this problem is to distribute database load on multiple hosts whenever the load increases. This method is known as "scaling out"
- NoSQL database is non-relational, so it scales out better than relational databases



Understanding Map-Reduce

Map:

- Grab the relevant data from the source.
- User function gets called for each chunk of input.
- Spit out (key, value) pairs.

Reduce:

- Aggregate the results.
- User function gets called for each unique key with all values corresponding to that key.

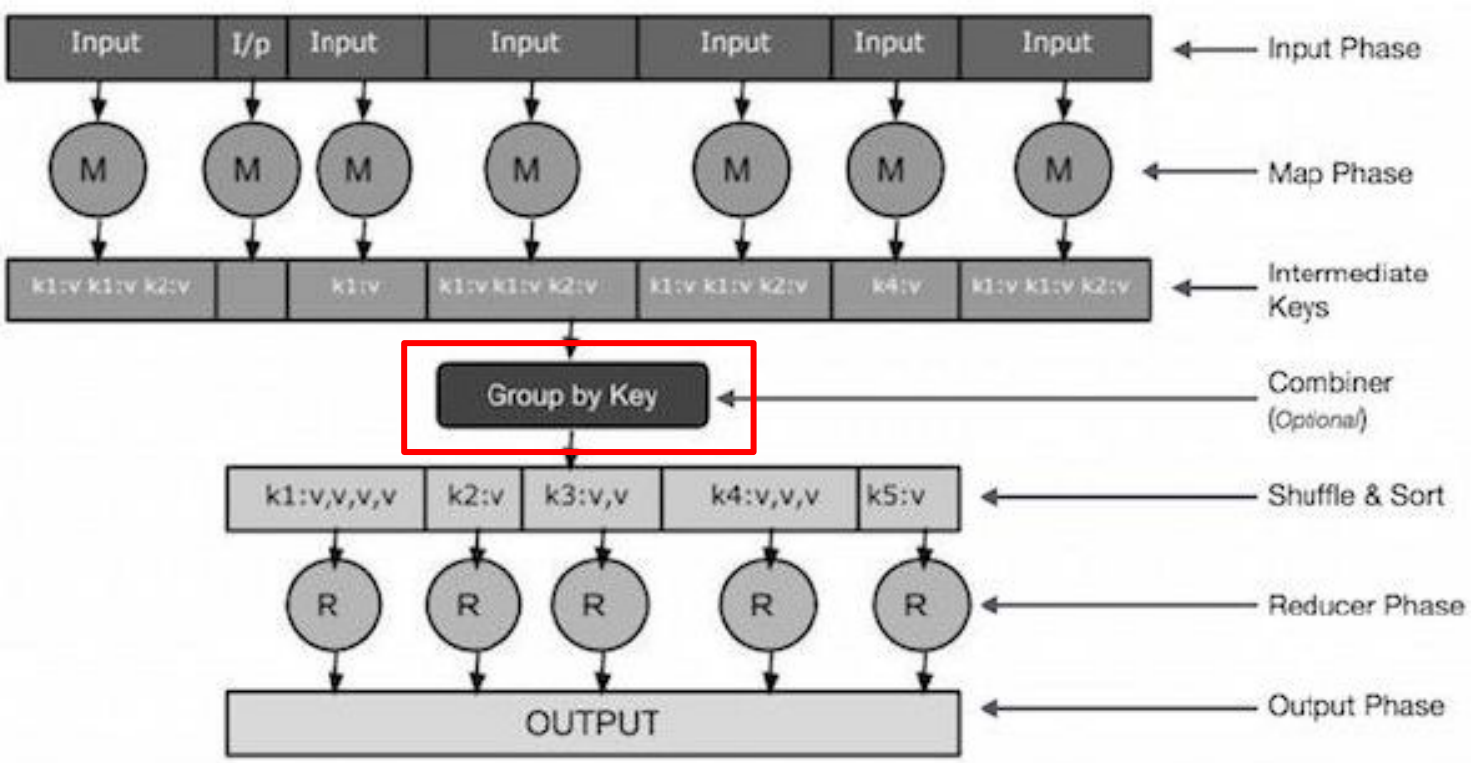
Map-Reduce: What happens in between?

- Map
  - Grab the relevant data from the source (parse into key, value)
  - Write it to an intermediate file
- Partition
  - Partitioning: identify which of *R* reducers will handle which keys
  - Map partitions data to target it to one of *R* Reduce workers based on a partitioning function (both *R* and partitioning function user defined)

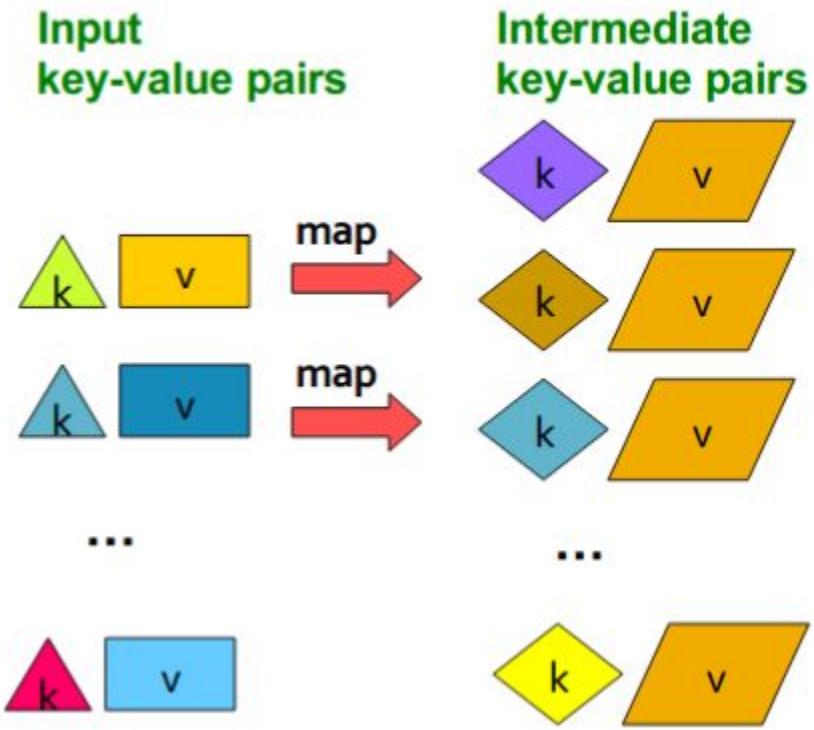
Map Worker

- Shuffle & Sort
  - Shuffle: Fetch the relevant partition of the output from all mappers
  - Sort by keys (different mappers may have sent data with the same key)
- Reduce
  - Input is the sorted output of mappers
  - Call the user *Reduce* function per key with the list of values for that key to aggregate the results

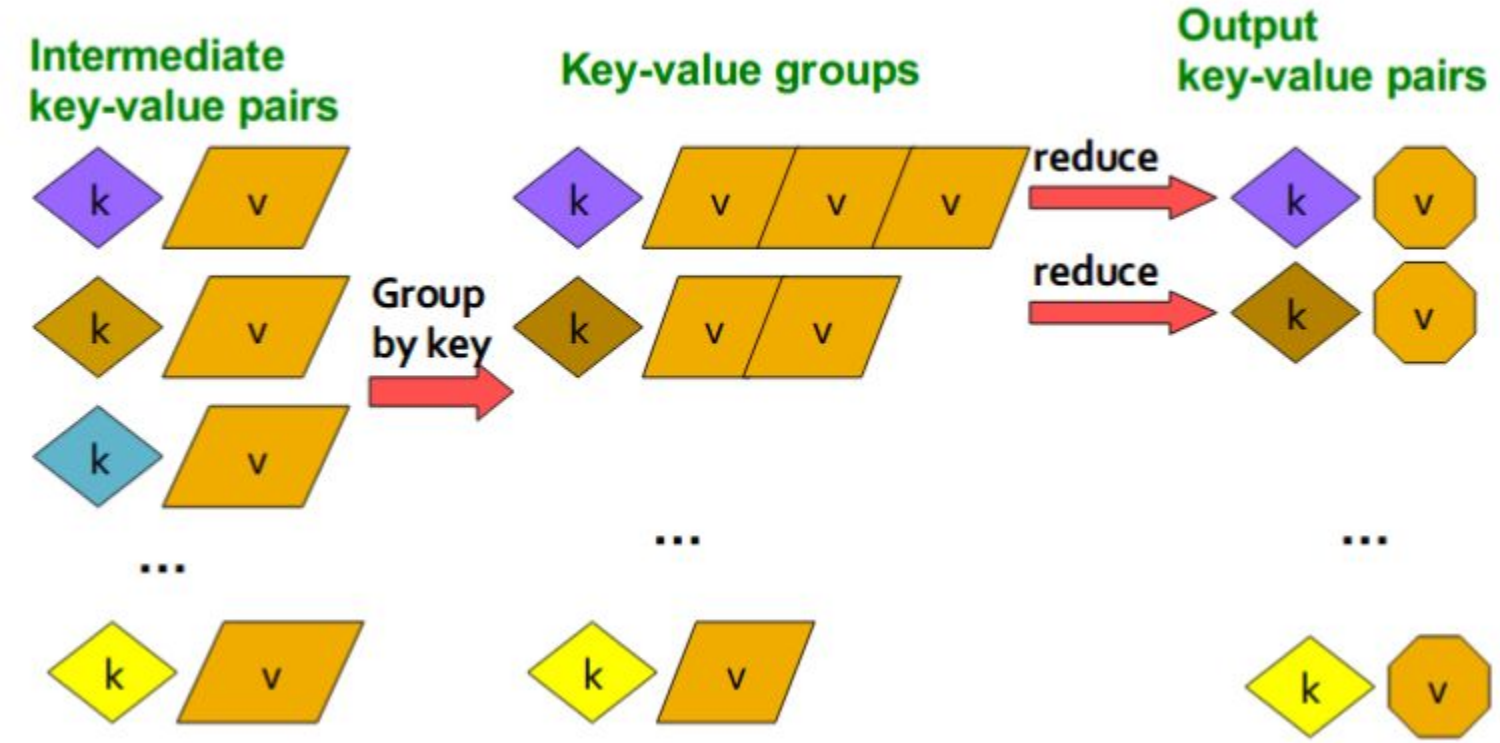
Reduce Worker

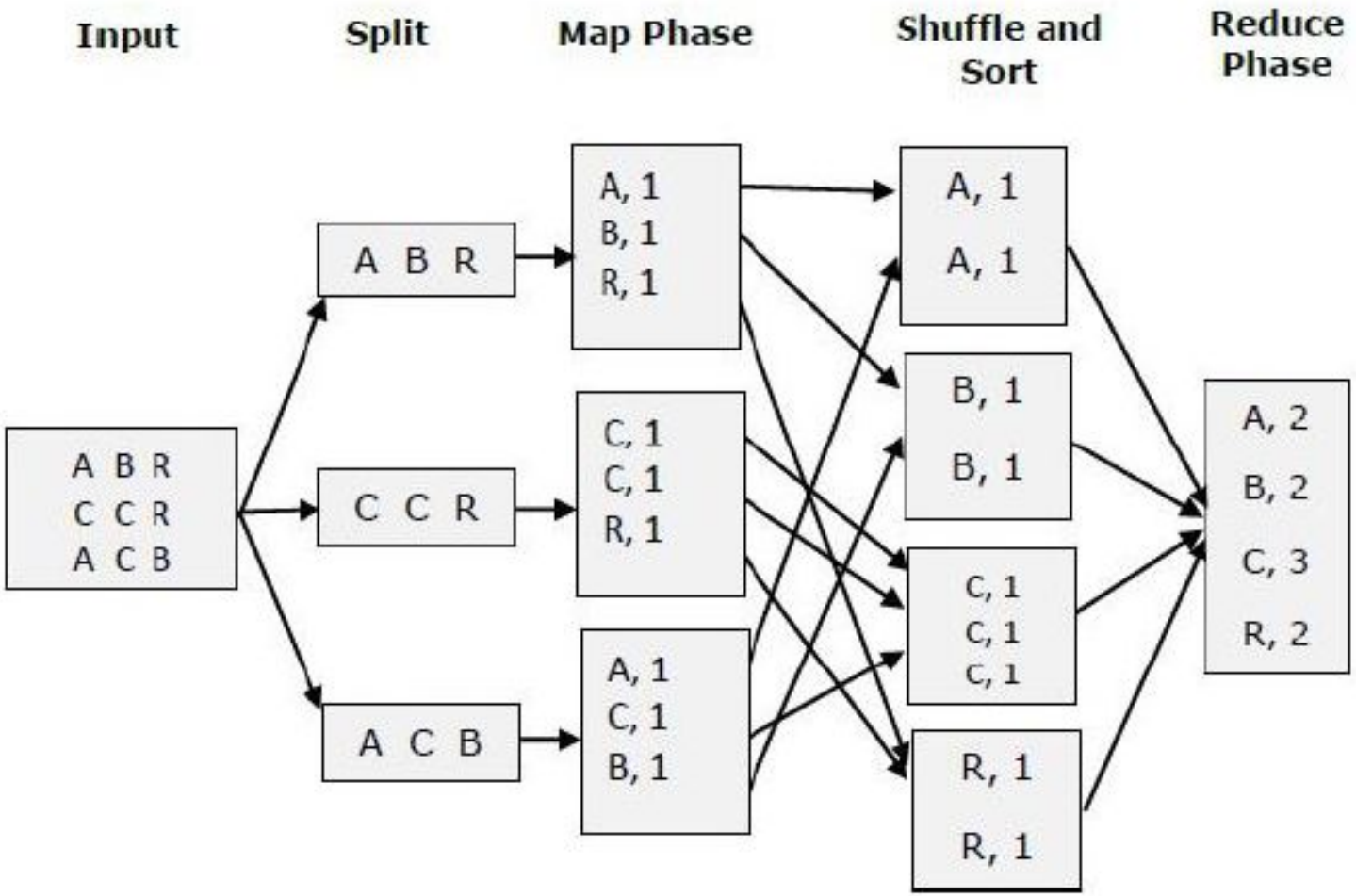

Input
I/p
Input
Input
Input
Input
Input
Input Phase
M
Map Phase
k1:v k1:v k2:v
k1:v
k1:v k1:v k2:v
k4:v
Intermediate Keys
Group by Key
Combiner
(Optional)
k1:v,v,v,v
k2:v
k3:v,v
k4:v,v,v
k5:v
Shuffle & Sort
R
Reducer Phase
OUTPUT
Output Phase

Mapper Phase

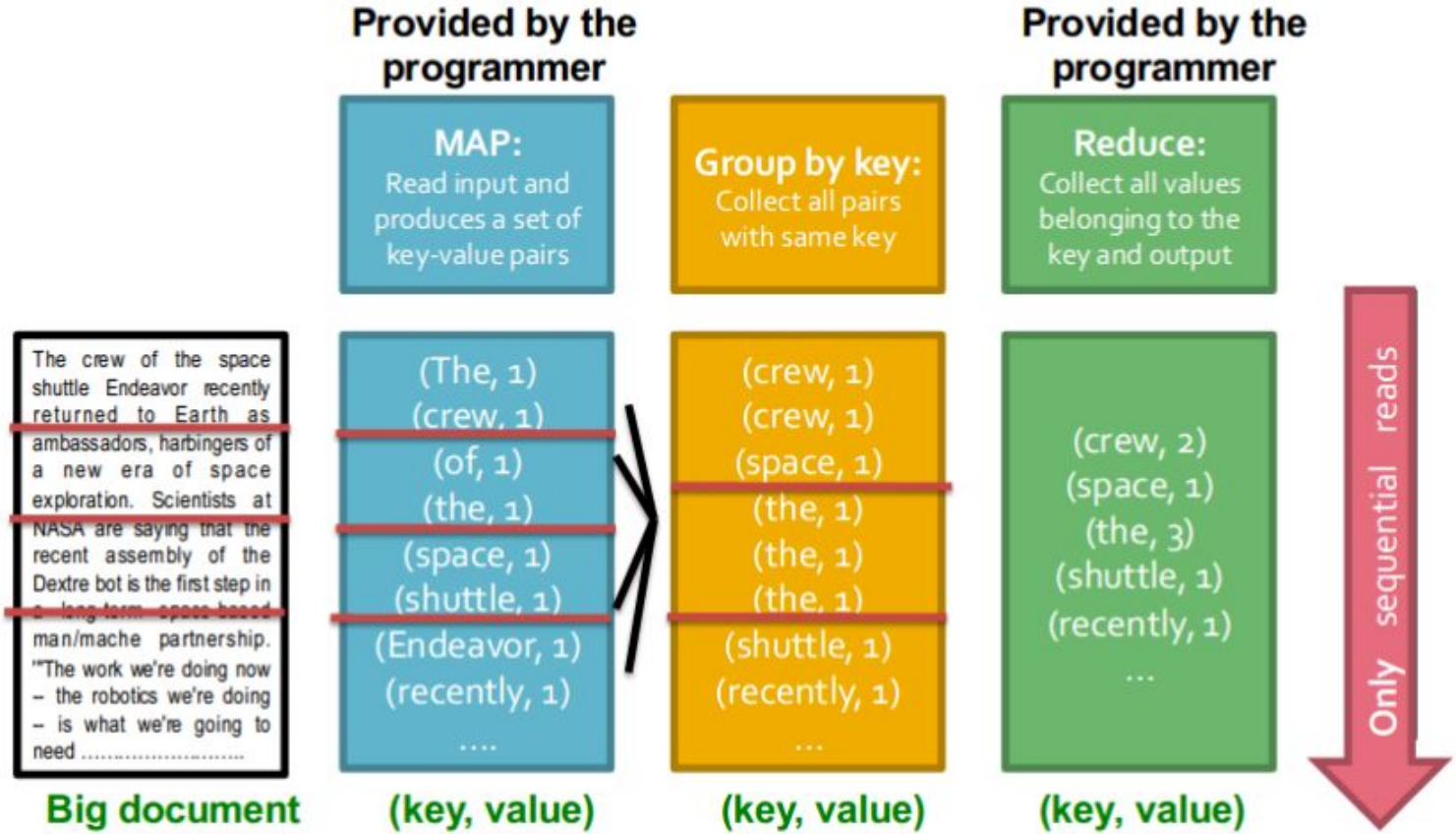


Reducer Phase




Input
Split
Map Phase
Shuffle and Sort
Reduce Phase
A B R
C C R
A C B
A B R
C C R
A C B
A, 1
B, 1
R, 1
C, 1
C, 1
R, 1
A, 1
C, 1
B, 1
A, 1
A, 1
B, 1
B, 1
C, 1
C, 1
C, 1
R, 1
R, 1
A, 2
B, 2
C, 3
R, 2

Map-Reduce Example



Sample Code (Word Count):

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
        #
        # tab-delimited; the trivial word count is 1
        print '%s\t%s' % (word, 1)
```

Reducer.py

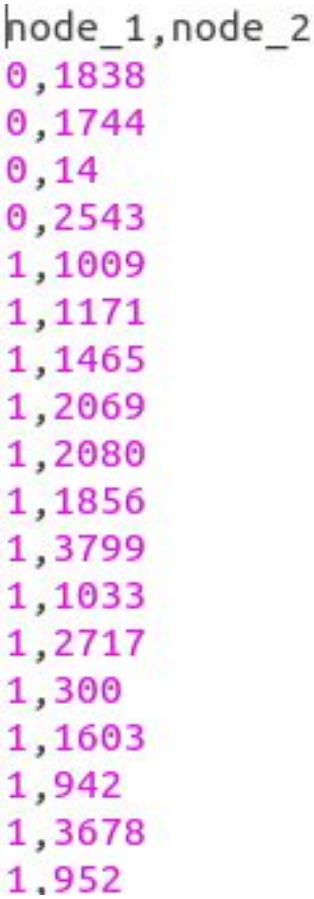
```
from operator import itemgetter
import sys
current_word = None
current_count = 0
word = None
# input comes from STDIN
for line in sys.stdin:
    # remove leading and trailing whitespace
    line = line.strip()
    # parse the input we got from mapper.py
    word, count = line.split('\t', 1)
    # convert count (currently a string) to int
    try:
        count = int(count)
    except ValueError:
        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)
```

Understanding the Assignment

Data Set:

- The dataset describes **a Facebook network**.
- There is only 1 file (listing all edges).
- Node: a facebook user

  Edge: friendship
- Edges are undirected.



Example Query

- Find the users with more than 10 friends.

➔ Write a script mapper.py which takes data as input and transforms it into key-value pairs. (here <node-id,1>)

➔ Print the key-value pairs and use sort function to arrange it.

➔ The sorted key-value pairs are then passed to the reducer to group by key and perform necessary actions.

➔ Here reducer should count the degree for each particular node and if it is greater than 10, then it should print that node-id or the user.

***Since we do not have access to a hadoop cluster, we will be testing our codes on a linux system as follows:**

```
cat input_file | python mapper.py | sort | python reducer.py
```

```
python mapper.py | sort | python reducer.py
```

Deliverables

- For each of the query, make a directory with name “Query<no.>”
- Each directory should contain mapper + reducer + result + Makefile.
- In total, your submission should have
  - 4 mapper.py
  - 4 reducer.py
  - 4 result.txt
  - 4 Makefile
  - 1 readme

Thank you.