MapReduce Programming Model

- **Review of Map function, shuffle & sort, Reduce function**

the quick brown fox
the fox ate the mouse
how now brown cow

Document 1

(0, ”the quick brown fox”)

(20, ”the fox ate the mouse”)

(42, ”how now brown cow”)

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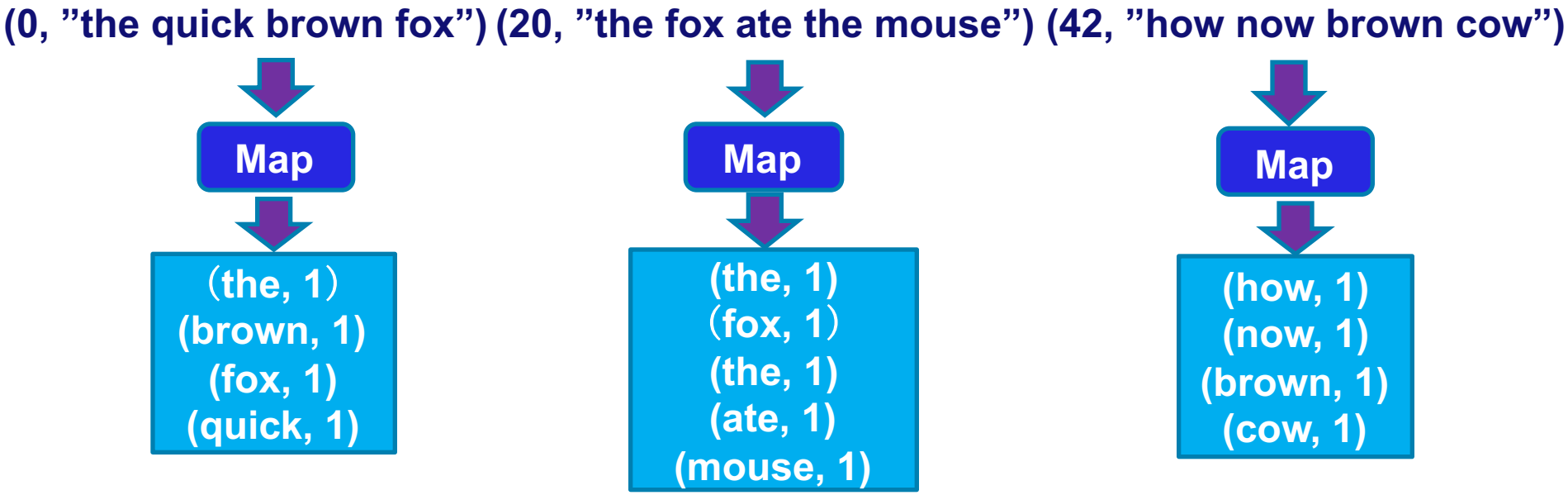
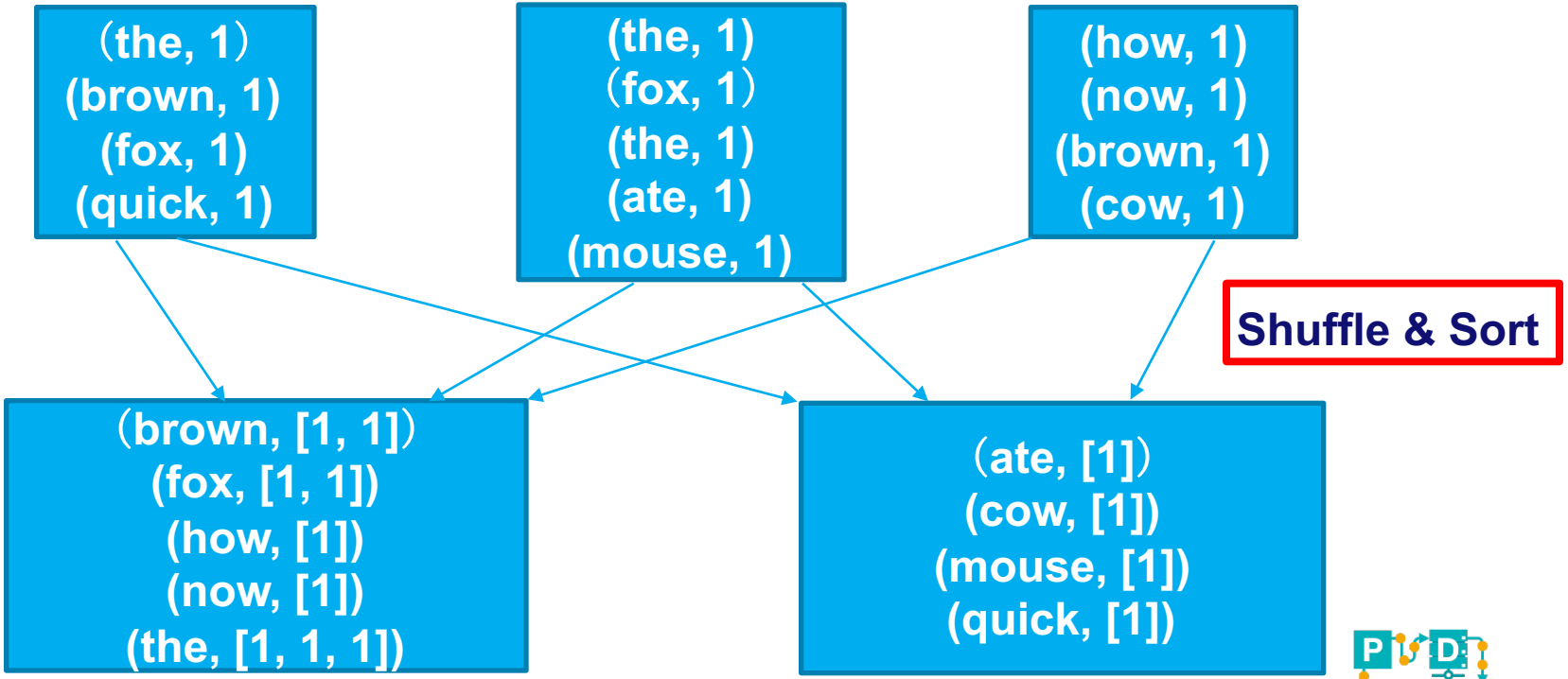
MapReduce Programming Model



MapReduce Programming Model



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MapReduce Programming Model

(brown, [1, 1])
(fox, [1, 1])
(how, [1])
(now, [1])
(the, [1, 1, 1])

→ **Reduce** →

(brown, 2)
(fox, 2)
(how, 1)
(now, 1)
(the, 3)

(ate, [1])
(cow, [1])
(mouse, [1])
(quick, [1])

→ **Reduce** →

(ate, 1)
(cow, 1)
(mouse, 1)
(quick, 1)

MapReduce Programming Model

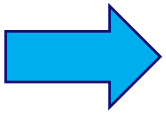
- **Exercise 1: For the input document, calculate the total price for each invoice ID. Presume you use MapReduce to do this, please write down the output of each Map function, the output after shuffle & sort, the output of Reduce function.**

Invoice ID	Price
000	3
001	2
003	12
000	4
001	21
003	8
000	3
002	15

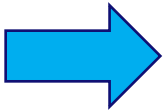
Input document

MapReduce Programming Model

(0, ”000 3”)
(6, ”001 2”)
(12, ”003 12”)

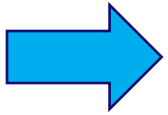


Map

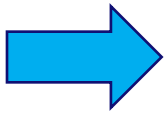


?????

(19, ”000 4”)
(25, ”001 21”)
(32, ”003 8”)

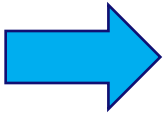


Map

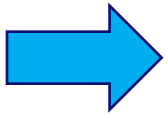


?????

(38, ”000 3”)
(44, ”002 15”)



Map



?????

Invoice ID	Price
000	3
001	2
003	12
000	4
001	21
003	8
000	3
002	15

Input document

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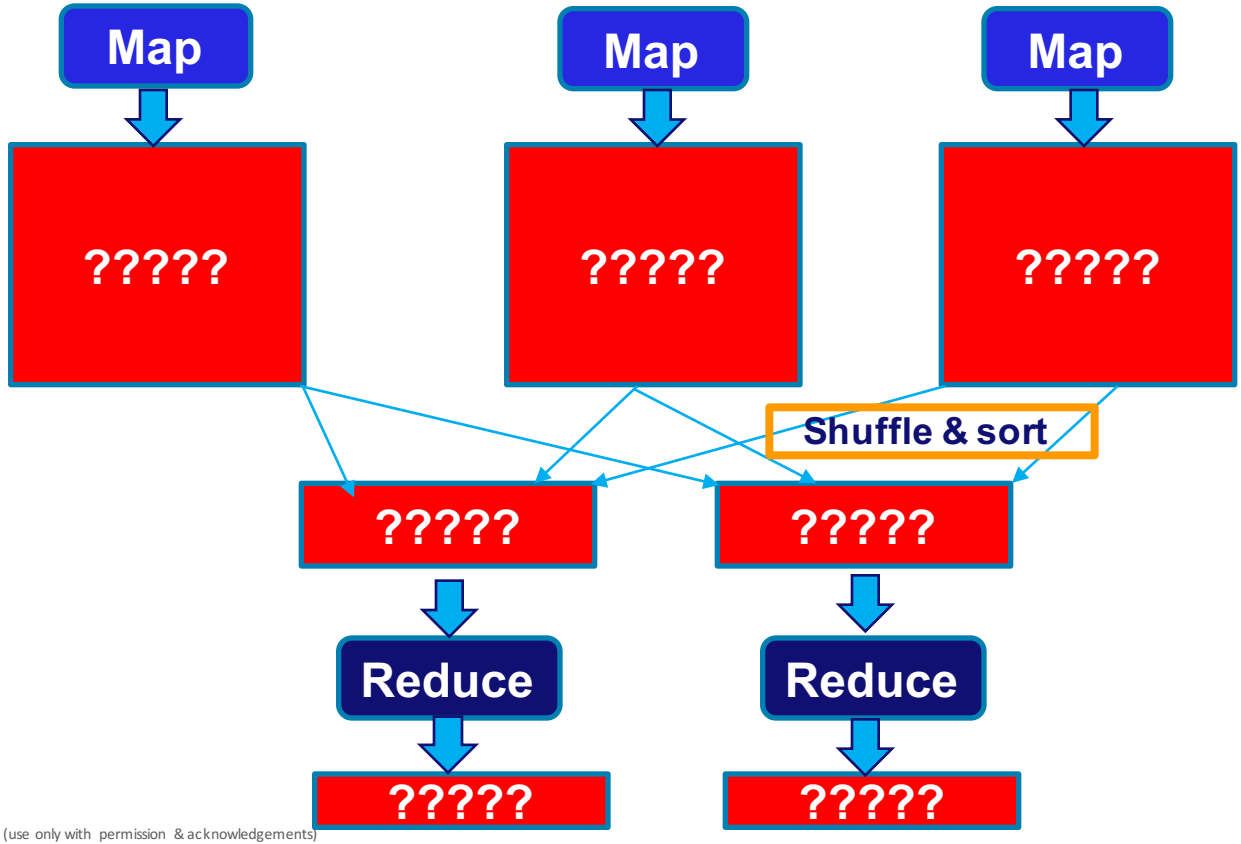
MapReduce Programming Model



Invoice ID	Price
000	3
001	2
003	12
000	4
001	21
003	8
000	3
002	15

Input document

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MapReduce Programming Model

- **Before running Hadoop:**

For Windows users, make sure you open your command terminal with administrator role, for both starting Hadoop and latter running MapReduce program

yarn-site.xml

```
<configuration>
    <property>
        <name>yarn.nodemanager.aux-services</name>
        <value>mapreduce_shuffle</value>
    </property>
</configuration>
```

Hadoop Shell Commands

- **Basic Hadoop shell commands**
  - **hadoop fs –cat**
    - **hadoop fs -cat /file1**
    - **hadoop fs –cat /file1 /file2**

Hadoop Shell Commands

- **Basic Hadoop shell commands**
  - **hadoop fs –copyFromLocal**
    - **hadoop fs –copyFromLocal file:///file1 /folder1**
    - **hadoop fs –copyFromLocal file:///file1 /folder1/file2**
    - **hadoop fs –copyFromLocal file:///folder1 /**
    - **hadoop fs –copyFromLocal file:///folder1 /folder2**

  - **hadoop fs -copyToLocal**

Hadoop Shell Commands

- **Basic Hadoop shell commands**
  - **hadoop fs –cp**
    - **hadoop fs –cp /file1 /folder1**
    - **hadoop fs –cp /file1 /file2 /folder1**
    - **hadoop fs –cp /folder1 /folder2**

Hadoop Shell Commands

- **Basic Hadoop shell commands**
  - **hadoop fs –ls**
    - **hadoop fs –ls /folder1**
    - **hadoop fs –ls /file1**

Hadoop Shell Commands

- **Basic Hadoop shell commands**
  - **hadoop fs –mkdir**
    - **hadoop fs –mkdir /folder1**
    - **hadoop fs –mkdir –p /folder1/folder2/folder3**

Hadoop Shell Commands

- **Basic Hadoop shell commands**
  - **hadoop fs –rm**
    - **hadoop fs –rm -r /folder1**
    - **hadoop fs –rm /file1**
    - **hadoop fs –rm –r /folder1**

Hadoop Shell Commands

- **Exercise 2:**
  - **Build the folders /test/input in your HDFS**
  - **Build the folders /test/output in your HDFS**
  - **Copy the file PriceSum1.txt into folder /test/input**
  - **Show the contents of PriceSum1.txt in your terminal**
  - **Copy the file /test/input/PriceSum1.txt and generate two new files PriceSum2.txt and PriceSum3.txt which are put in folder /test/input**
  - **Delete the file /test/input/PriceSum3.txt**

MapReduce Coding: MRJob

- **Python code for WordCount: MRJob version**

```
1. from mrjob.job import MRJob
2. class MRWordCount(MRJob):
3.     def mapper(self, _, line):
4.         for word in line.split():
5.             yield word, 1
6.     def reducer(self, key, values):
7.         yield key, sum(values)
8. if __name__ == '__main__':
9.     MRWordCount.run()
```

MapReduce Coding: MRJob

- **Command to run WordCount with MRJob**

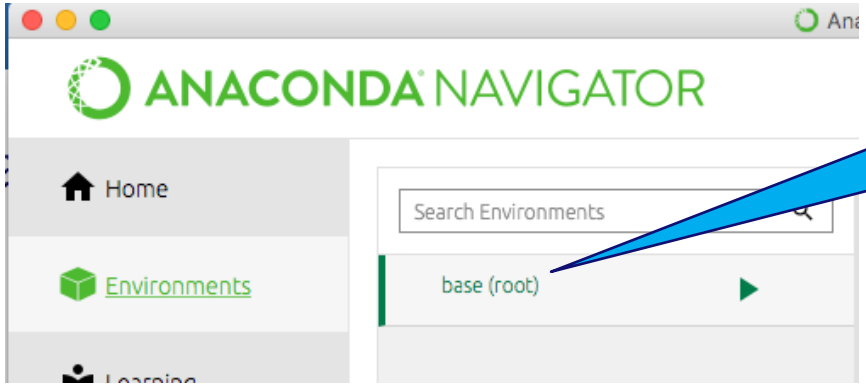
  - **python /Users/yaguangsun/PriceSum.py /Users/yaguangsun/PriceSum1.txt**

If you use Windows operation system, pay attention to address format

MapReduce Coding: MRJob

- **Command to run WordCount with MRJob**

  - **python /Users/yaguangsun/PriceSum.py /Users/yaguangsun/PriceSum1.txt**



If you installed MRJob with conda, then you need to open the terminal in ANACONDA

MapReduce Coding: MRJob

- **Exercise 3**: write down the **MapReduce code** to solve the problem from **exercise 1**: **calculate** the **total price** for each **invoice id** for a given document with the same format as shown in exercise 1. **Run your code** over the file **PriceSum1.txt** stored in your local file system.

Invoice ID	Price
000	3
001	2
003	12
000	4
001	21
003	8
000	3
002	15

MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**

mapper.py

```
import sys

1. for line in sys.stdin:
2.     n = line.strip()
3.     m = n.split()
4.     for word in m:
5.         print('%s\t%s' % (word, 1))
```

MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**

reducer.py

```
import sys

current_word = None
current_count = 0
word = None

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

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

if current_word == word:
    print '%s\t%s' % (current_word, current_count)
```

MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**

reducer.py

```
import sys

current_word = None
current_count = 0
word = None

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

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

if current_word == word:
  print '%s\t%s' % (current_word, current_count)
```

Difference

```
def reducer(self, key, values):
    yield key, sum(values)
```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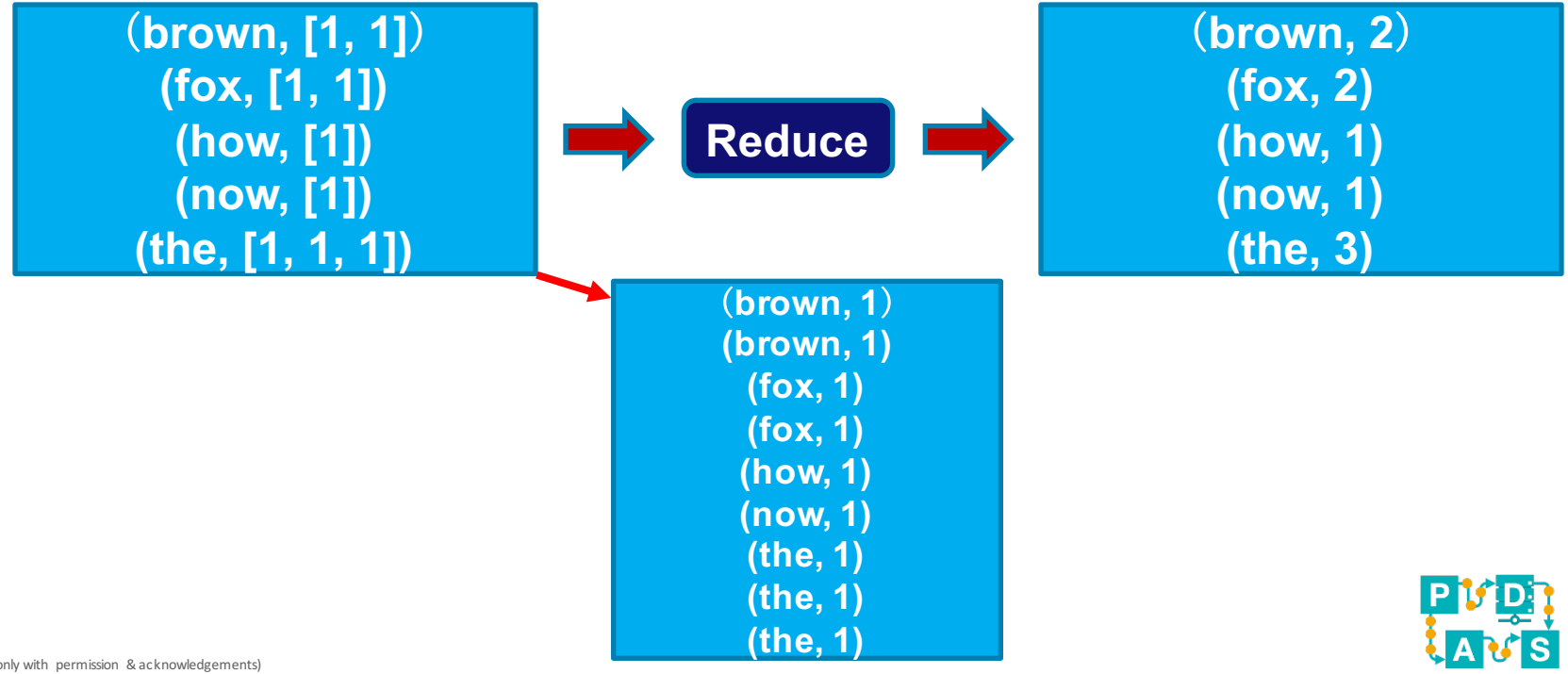
MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**



MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**

reducer.py

```
import sys

current_word = None
current_count = 0
word = None

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

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

if current_word == word:
  print '%s\t%s' % (current_word, current_count)
```

Difference

```
def reducer(self, key, values):
    yield key, sum(values)
```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MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**
  - **Command for running WordCound with Hadoop**

```
hadoop jar /Users/yaguangsun/file/mix/hadoop/hadoop-2.8.4/share/hadoop/tools/lib/hadoop-streaming-2.8.4.jar
-D mapred.map.tasks=2
-input hdfs:///test/input
-output hdfs:///test/output/WordCountOutput
-mapper "python /Users/yaguangsun/mapper.py"
-reducer "python /Users/yaguangsun/reducer.py"
-file /Users/yaguangsun/mapper.py
-file /Users/yaguangsun/reducer.py
```

MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**
  - **Command for running WordCound with Hadoop**

```
hadoop jar /Users/yaguangsun/file/mix/hadoop/hadoop-2.8.4/share/hadoop/tools/lib/hadoop-streaming-2.8.4.jar
-D mapred.map.tasks=2
-input hdfs:///test/input
-output hdfs:///test/output/WordCountOutp
-mapper "python /Users/yaguangsun/mapper.py"
-reducer "python /Users/yaguangsun/reducer.py"
-file /Users/yaguangsun/mapper.py
-file /Users/yaguangsun/reducer.py
```

-D should appear before the other parameters

MapReduce Coding: Pure Python

- **Python code for WordCount: pure python**
  - **Command for running WordCound with Hadoop**

```
hadoop jar /Users/yaguangsun/file/mix/hadoop/hadoop-2.8.4/share/hadoop/tools/lib/hadoop-streaming-2.8.4.jar –D mapred.map.tasks=2 -input hdfs:///test/input -output hdfs:///test/output/WordCountOutput -mapper "python /Users/yaguangsun/mapper.py" -reducer "python /Users/yaguangsun/reducer.py" -file/Users/yaguangsun/mapper.py -file /Users/yaguangsun/reducer.py
```

When writing the command in terminal, keep a space between different parameter settings.

MapReduce Coding: Pure Python

- **Execrise 4: write down the MapReduce code to solve the problem from exercise 1: calculate the total price for each invoice id for a given document with the same format as shown in exercise 1. Run your code over the file PriceSum1.txt and PriceSum2.txt stored in /test/input**

Invoice ID	Price
000	3
001	2
003	12
000	4
001	21
003	8
000	3
002	15