Homework 4: Hadoop & MapReduce

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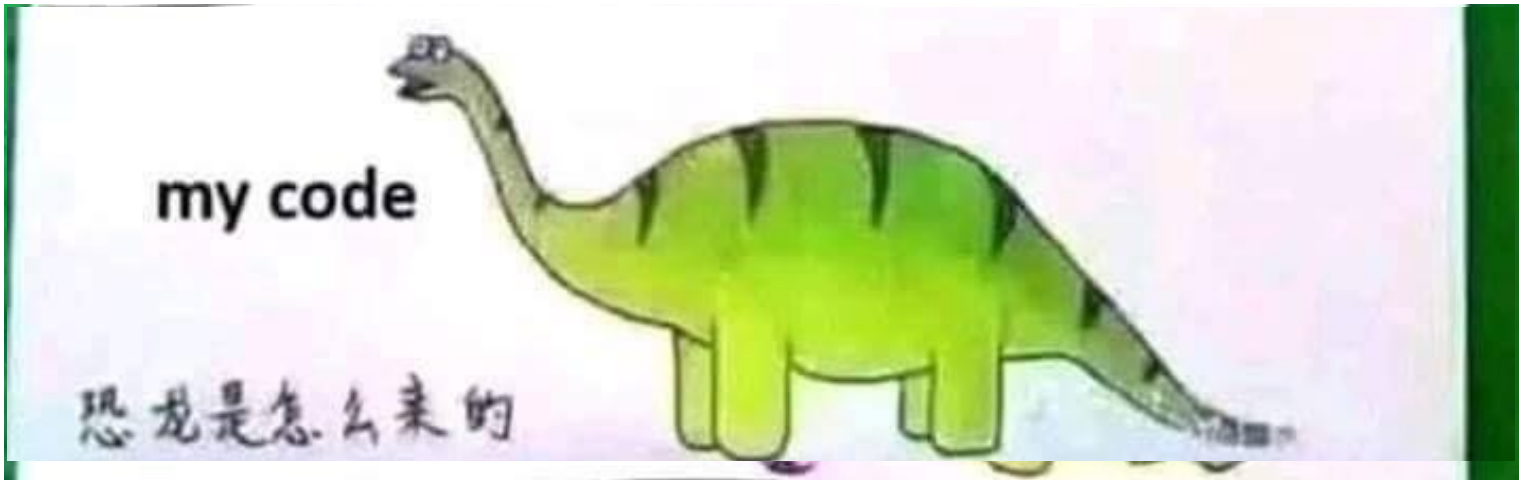
How to create dinosaurs?

Using Python to write
MapReduce and Spark

Hadoop Streaming API

Hadoop Streaming API



Preparation

- Virtual Machine
- Cloudera
  - https://drive.google.com/file/d/1pP50RRj2P3FlrmZyrtSK1y9R3wyFjKYa/view?usp=share_link
  - Rename as training.exe
  - Double click (Unzip)
  - Machine -> Add
  - https://drive.google.com/file/d/1h0rkmea8yQVDaX3PClAFz02Ny8Jm38-z/view?usp=sharing

Questions before we go through the code

https://kahoot.it/

Block size of HDFS

- The default data block size of HDFS is 64/128MB.
  - If you store a file that's 1k or 60Mb, it'll take up one block. Once you cross the 64Mb boundary, you need a second block.
- The block size in disk is generally 4KB.
- A 1000Mb file.
  - With a 4k block size, you'd have to make 256,000 requests to get that file (1 request per block).
  - In HDFS, those requests go across a network and come with a lot of overhead. Each request has to be processed by the Name Node to figure out where that block can be found. That's a lot of traffic! If you use 128Mb blocks, the number of requests goes down to 7, greatly reducing the cost of overhead and load on the Name Node.

Walking through the code

- Calculating the total sales per store
  - Scoop can be used for importing the database
- Input data
  - 2012-01-01 12:01 San Jose Music 12.99 Amex
- How to find the total sales per store?
- Here are the options:

	KEY	VALUE
(a)	time	store
(b)	cost	store
(c)	store name	cost
(d)	store name	product type

Defensive mapper code


```
def mapper():
    for line in sys.stdin:
        data = line.strip().split("\t")
        date, time, store, item, cost, payment = data
        print "{0}\t{1}".format(store, cost)
```

2012-01-01 12:01 San Jose Music 12.99 Amex
2012-01-02 There was an error trying to connect to the database.

Defensive mapper code


```
def mapper():
    for line in sys.stdin:
        data = line.strip().split("\t")

        if len(data) == 6:

            date, time, store, item, cost, payment = data

            print "{0}\t{1}".format(store, cost)
```

2012-01-01 12:01 San Jose Music 12.99 Amex
2012-01-02 There was an error trying to connect to the database.

Between Map and Reduce

- Questions: What happens between generate <key,value> pairs and reducer?

Reducing

- Reducer will get data coming in something like this

Miami 12.34

Miami 99.07

Miami 97.87

NYC 99.77

NYC 88.99

- Hadoop streaming is used here for writing in Python.

Question

- What variable we need to keep track of to calculate the total sales per store?
  - (a) Previous cost
  - (b) current cost
  - (c) total sales per store
  - (d) previous store
  - (e) current store
  - (f) all store names

Reducer Code


```
def reducer():

    salesTotal = 0
    oldKey = None

    for line in sys.stdin:
        data = line.strip().split("\t")

        if len(data) != 2:
            continue

        thisKey, thisSale = data

        if oldKey and oldKey != thisKey:
            print "{0}\t{1}".format(oldKey, salesTotal)

            salesTotal = 0

        oldKey = thisKey
        salesTotal += float(thisSale)
```

Miami	12.34
Miami	99.07
Miami	97.87
NYC	99.77
NYC	88.99

Reducer Code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        if oldKey and oldKey != thisKey:
            print "{0}\t{1}".format(oldKey, salesTotal)

            salesTotal = 0

        oldKey = thisKey
        salesTotal += float(thisSale)

    if oldKey != None:
        print "{0}\t{1}".format(oldKey, salesTotal)
```

Miami	12.34
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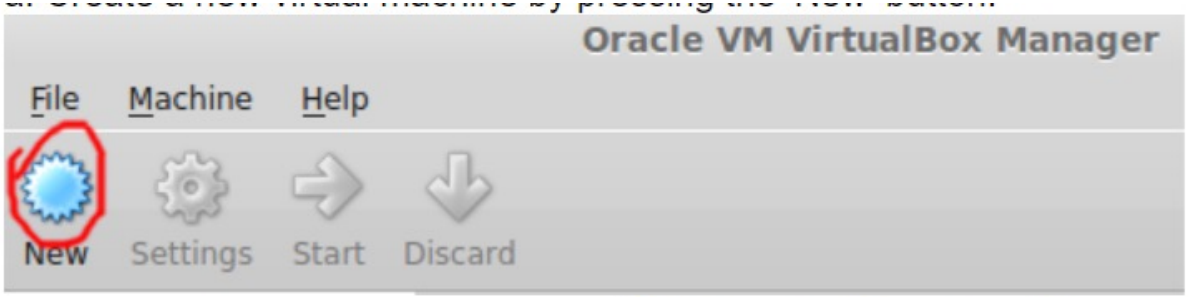
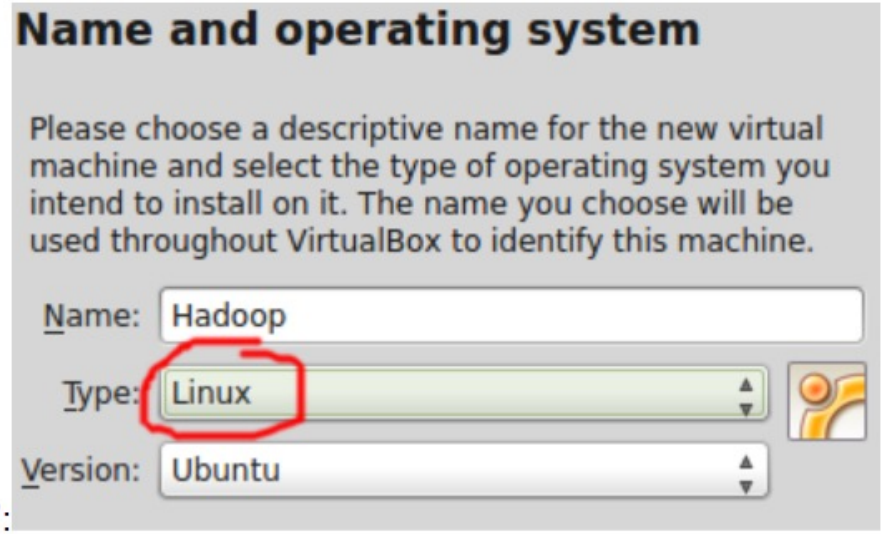
Hadoop Streaming

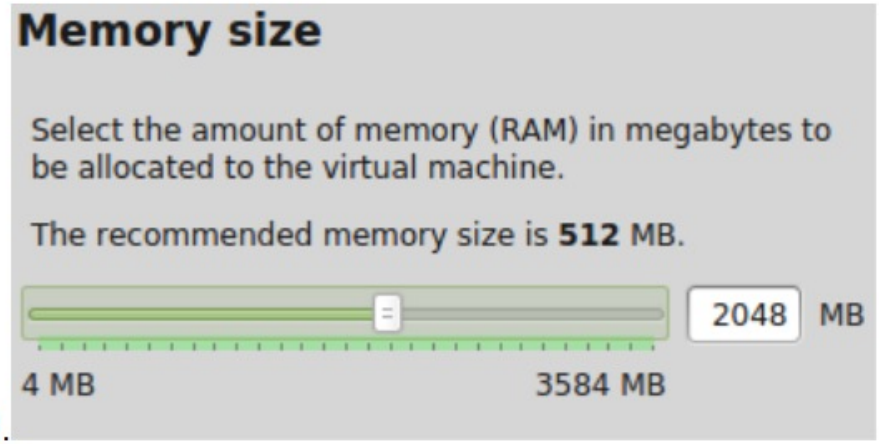
- https://hadoop.apache.org/docs/r1.2.1/streaming.html#Hadoop+Streaming
- Hadoop can access stdin and stdout.
  - Use stdin and stdout as channel to combine Hadoop framework and python
- It is worth noting that mapper.py and reducer.py are stored in local, while DATA is stored in Hadoop environments (HDFS).
  - If the locations are incorrect, the program cannot be executed.
- Make sure the file has execution permission
  - If not, chmod +x /home/hduser/mapper.py should do the trick or you will run into problems.
- If you want to modify some Hadoop settings on the fly like increasing the number of Reduce tasks, you can use the -D option:

Problem: Sales Statistics





b. Choose a name, use ‘Type’: ‘Linux’:
c. Press Next



d. Select memory size for the VM.

Upload purchases.txt to HDFS

- cd udacity_training/data
- **#Put purchase.txt into HDFS**
- hadoop fs –ls
- hadoop fs –put purchases.txt
- hadoop fs –ls
- **# Make directory and put txt into it**
- hadoop fs –mkdir myinput
- hadoop fs –put purchases.txt myinput
- **#Useful Comments**
- hadoop fs –tail/hadoop fs –cat
- Rename: -mv, Delete: -rm New directory: -mkdir

Running a job

- cd code
- **#How to run?**
- #Full command
- hadoop jar /usr/lib/hadoop-0.20-mapreduce/contrib/streaming/hadoop-streaming-2.0.0-mr1-cdh4.1.1.jar –mapper mapper.py -reducer reducer.py -file mapper.py -file reducer.py –input myinput -output joboutput
- #Alias
- hs mapper.py reducer.py myinput joboutput

Find results

- **#List files**
- hadoop fs –ls
- **#Browse part of results**
- hadoop fs –cat joboutput/part-00000 | less
- **#Take the file out of HDFS**
- hadoop fs –get joboutput/part-00000 mylocalfile.txt

Pipe (stdin stdout)

- **#Find the results of first 50 lines and write to testfile**
- head -50 ./data/purchases.txt > testfile
- **#Read testfile and pipe to mapper.py**
- cat testfile | ./mapper.py
- **#Read testfile, pipe to mapper.py, sort, and pipe to reducer.py**
- cat testfile | ./mapper.py | sort | ./reducer.py

Exercise 1 (1pt)

- Instead of breaking the sales down by store, give us a sales breakdown by product category across all of our stores.
- (Hint) variables should be modified with type casting before counting
- **[Implicit Example]**
- num_int = 123, num_flo = 1.23
- num_new = num_int + num_flo
- num_int = 123
- num_str = "456"
- num_int+ num_str
- **[Explicit Example]**
- num_str = int(num_str), y=float(x)

Check point


```
Baby    57491808.44
Books   57450757.91
CDs     57410753.04
Cameras     57299046.64
Children's Clothing     57624820.94
Computers   57315406.32
Consumer Electronics    57452374.13
Crafts  57418154.5
DVDs    57649212.14
Garden  57539833.11
Health and Beauty   57481589.56
Men's Clothing  57621279.04
Music   57495489.7
Pet Supplies    57197250.24
Sporting Goods  57599085.89
Toys    57463477.11
Video Games     57513165.58
Women's Clothing    57434448.97
```

Exercise 2 (2pts)

- Find the monetary value for the highest individual sale for each separate store.

Check point


```
Albuquerque      499.98
Anaheim      499.98
Anchorage    499.99
Arlington    499.95
Atlanta      499.96
Aurora   499.97
Austin   499.97
Bakersfield      499.97
Baltimore    499.99
Baton Rouge      499.98
Birmingham   499.99
Boise    499.98
Boston   499.99
Buffalo      499.99
Chandler     499.98
Charlotte    499.98
Chesapeake   499.98
Chicago      499.99
Chula Vista      499.99
Cincinnati   499.98
Cleveland    499.98
```

Exercise 3 (2pts)

- Find the total sales value across all the stores, and the total number of sales. Assume there is only one reducer.

Check point

- Total sales across all the stores: 1034457953.26
- Total number of sales: 4138476