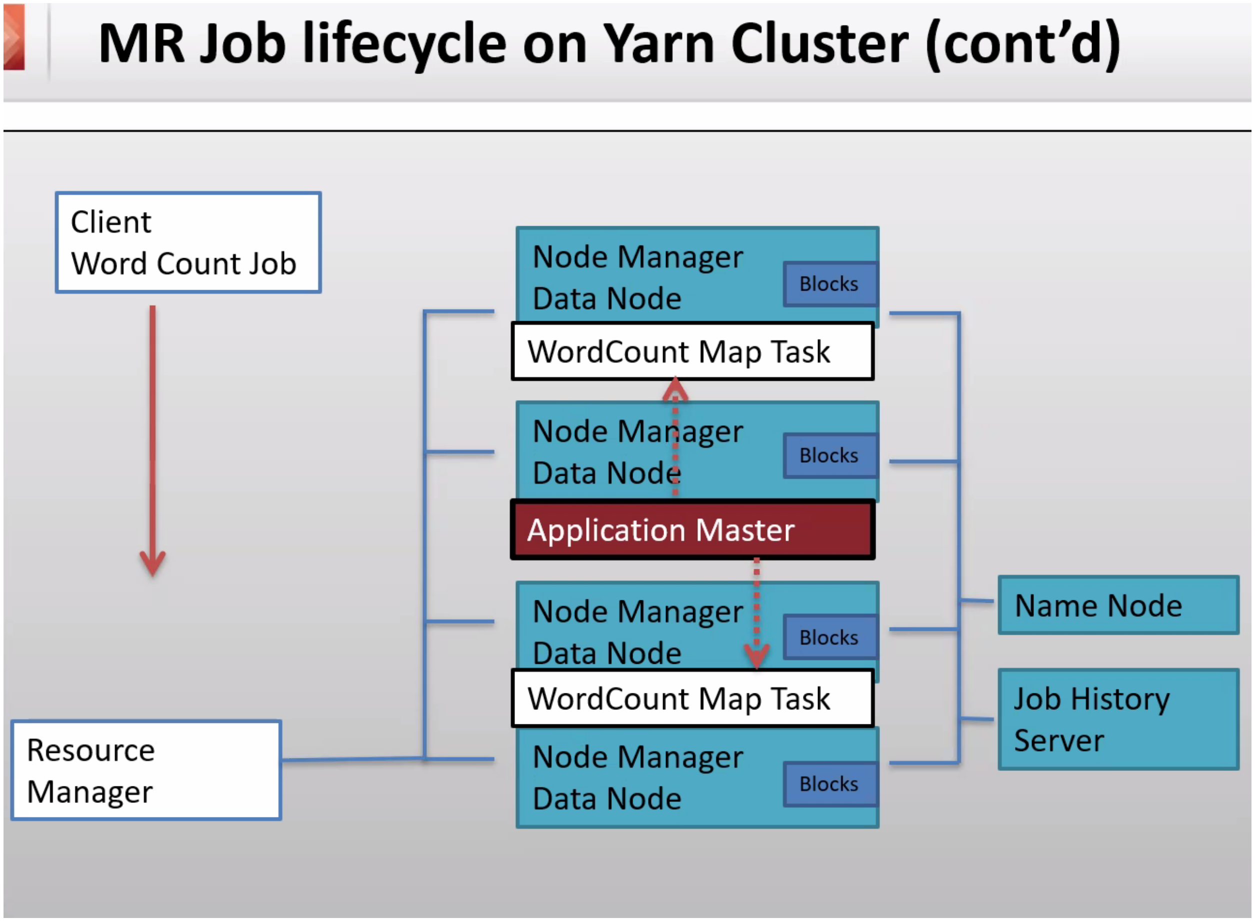
→ YARN cluster - MapReduce Life Cycle



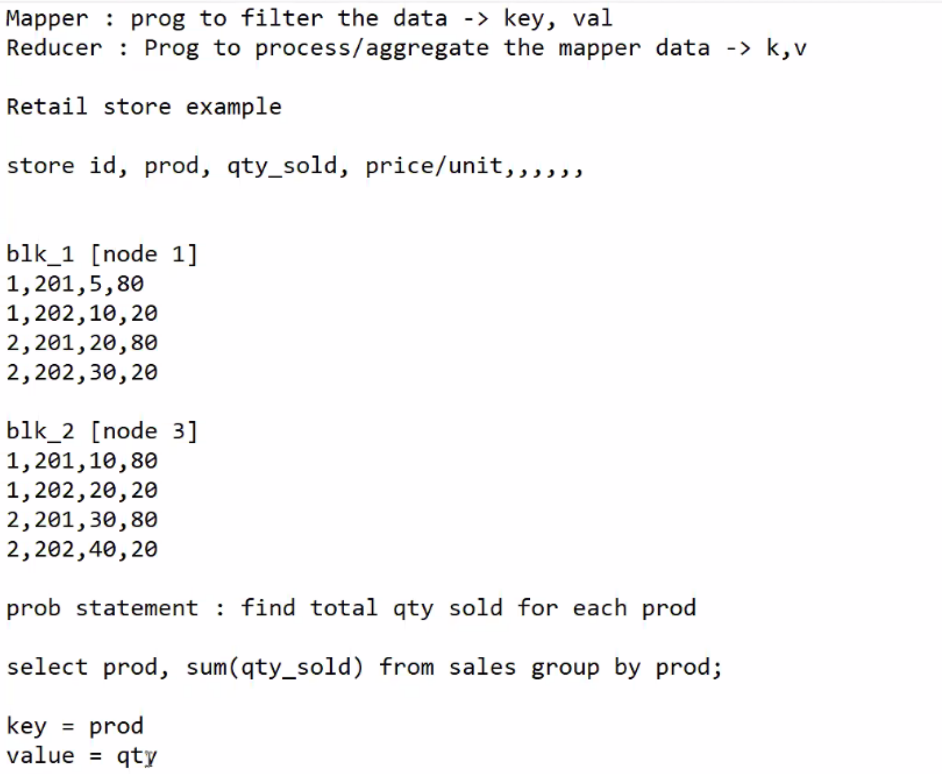
MR Job lifecycle on Yarn Cluster (cont'd)

→ Application Master (AM):

a. Is a temporary Service
b. coordinator for jobs
c. Can be on any DataNode containing requested resources
d. Does not process data, but will coordinate the processing, while actual processing is performed by respective Nodemanager on each DataNode
e. Data is processed locally by Nodemanager on each DataNode

→ Map-Reduce

a. Mapper : program to filter the data → key, value
b. Reducer : program to process/aggregate the mapper → key, value



```
Mapper : prog to filter the data -> key, val
Reducer : Prog to process/aggregate the mapper data -> k,v

Retail store example

store id, prod, qty_sold, price/unit,,,,,,


blk_1 [node 1]
1,201,5,80
1,202,10,20
2,201,20,80
2,202,30,20

blk_2 [node 3]
1,201,10,80
1,202,20,20
2,201,30,80
2,202,40,20

prob statement : find total qty sold for each prod

select prod, sum(qty_sold) from sales group by prod;

key = prod
value = qty
```

→ Map-Reduce: Disk Based processing (local disk storage - local node storage)
→ Spark: memory based processing (in-memory storage)

→ Three stages in Map-Reduce:

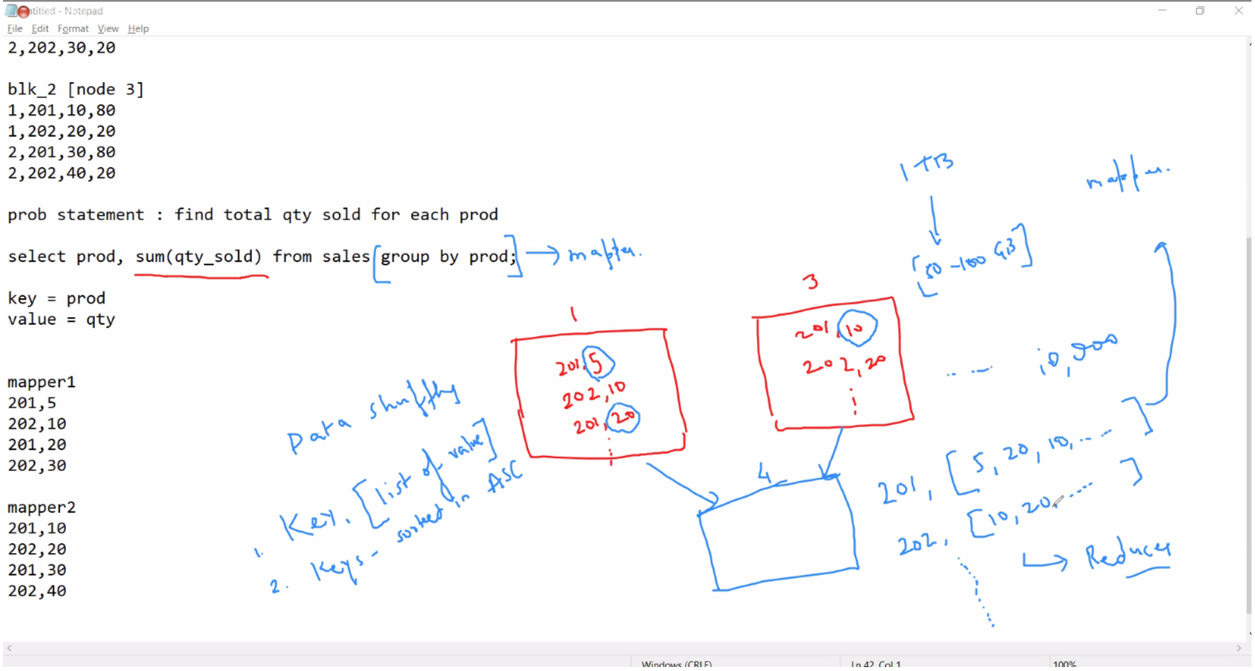
a. Map
b. Shuffle
c. Reduce

→ Mappers are launched parallel for single job/query
→ Mapper:

a. Data is filtered
b. Input is text format, output in key-value format

→ Data shuffling:

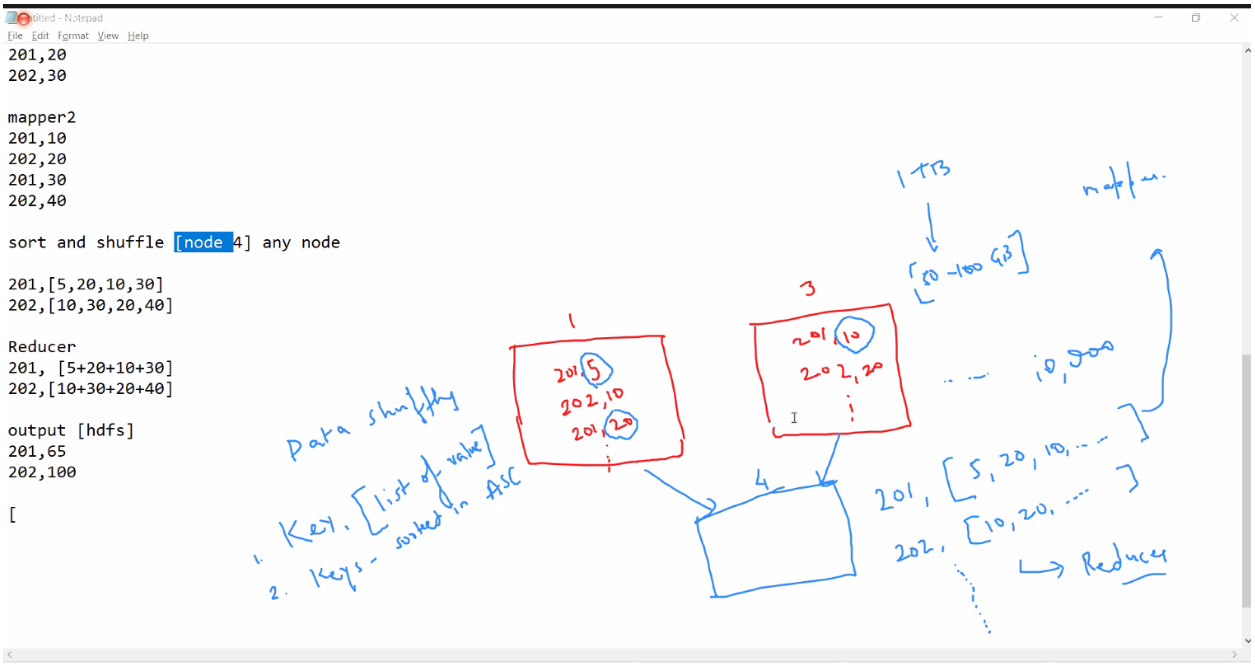
a. First resource container is created for Sort and shuffle stage
b. Sort & shuffle is processed on separate node
c. merging and then processing data on another node
d. Format is key,[list of values from different nodes]
e. Keys are sorted in ASC order, while values are in random order
f. Output of shuffling in mapper stage is now input for reducer



```
2,202,30,20

blk_2 [node 3]
1,201,10,80
1,202,20,20
2,201,30,80
2,202,40,20

prob statement : find total qty sold for each prod

select prod, sum(qty_sold) from sales group by prod;

key = prod
value = qty


mapper1
201,5
202,10
201,20
202,30

mapper2
201,10
202,20
201,30
202,40
```

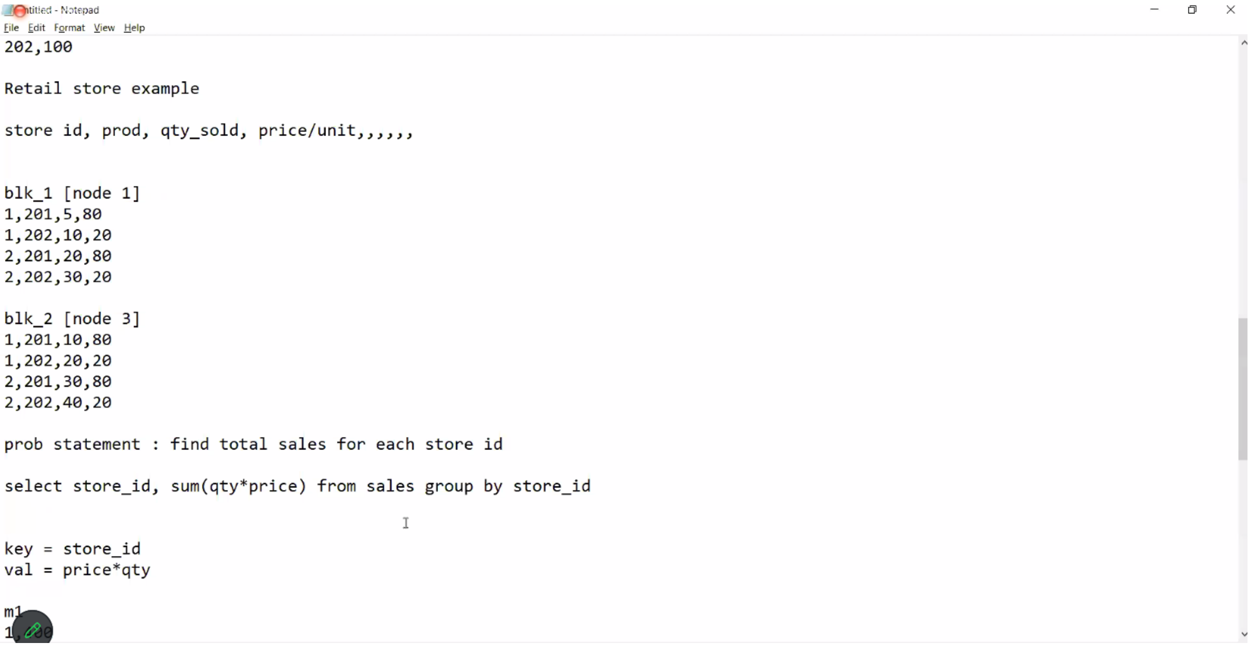
→ Reducer:

a. First resource container is launched for reduce, Then reducer computes the final result And then it writes the final output to the HDFS
b. Reducer is launched only once all the mapping-shuffling is done
c.

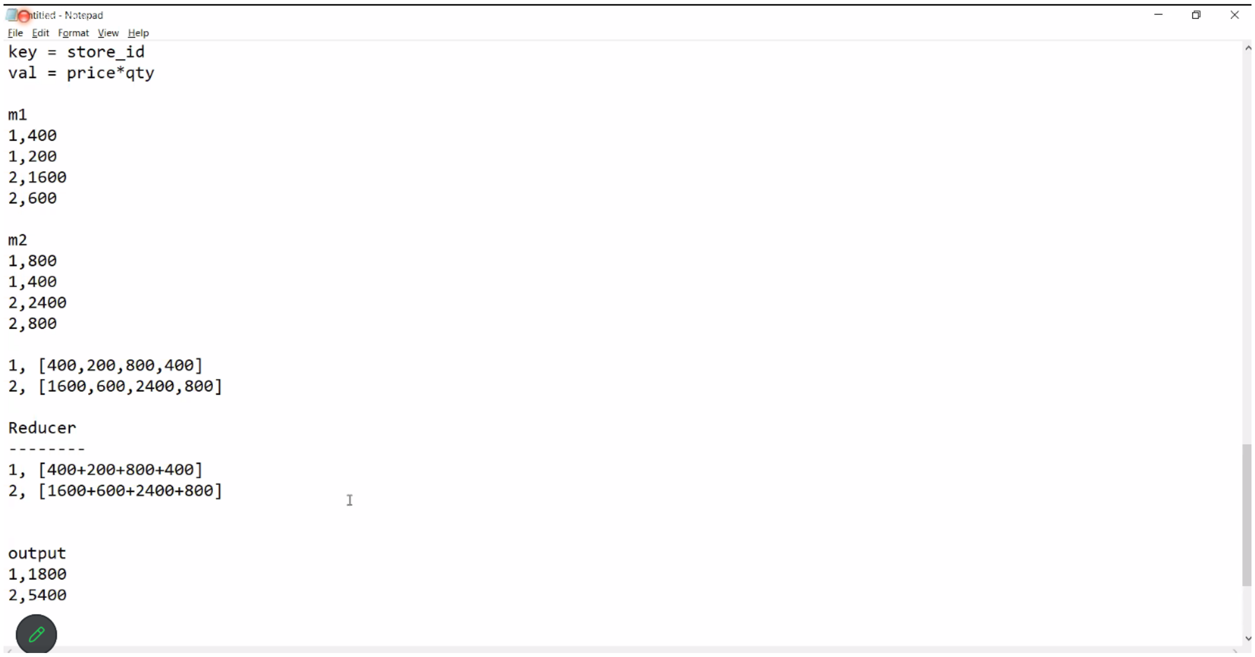


```
201,20
202,30

mapper2
201,10
202,20
201,30
202,40

sort and shuffle [node 4] any node

201,[5,20,10,30]
202,[10,30,20,40]

Reducer
201, [5+20+10+30]
202,[10+30+20+40]

output [hdfs]
201,65
202,100

[
```

→ find total volume for each stockID



```
202,100

Retail store example

store id, prod, qty_sold, price/unit,,,,,,


blk_1 [node 1]
1,201,5,80
1,202,10,20
2,201,20,80
2,202,30,20

blk_2 [node 3]
1,201,10,80
1,202,20,20
2,201,30,80
2,202,40,20

prob statement : find total sales for each store id

select store_id, sum(qty*price) from sales group by store_id


key = store_id
val = price*qty

m1
1,400
```



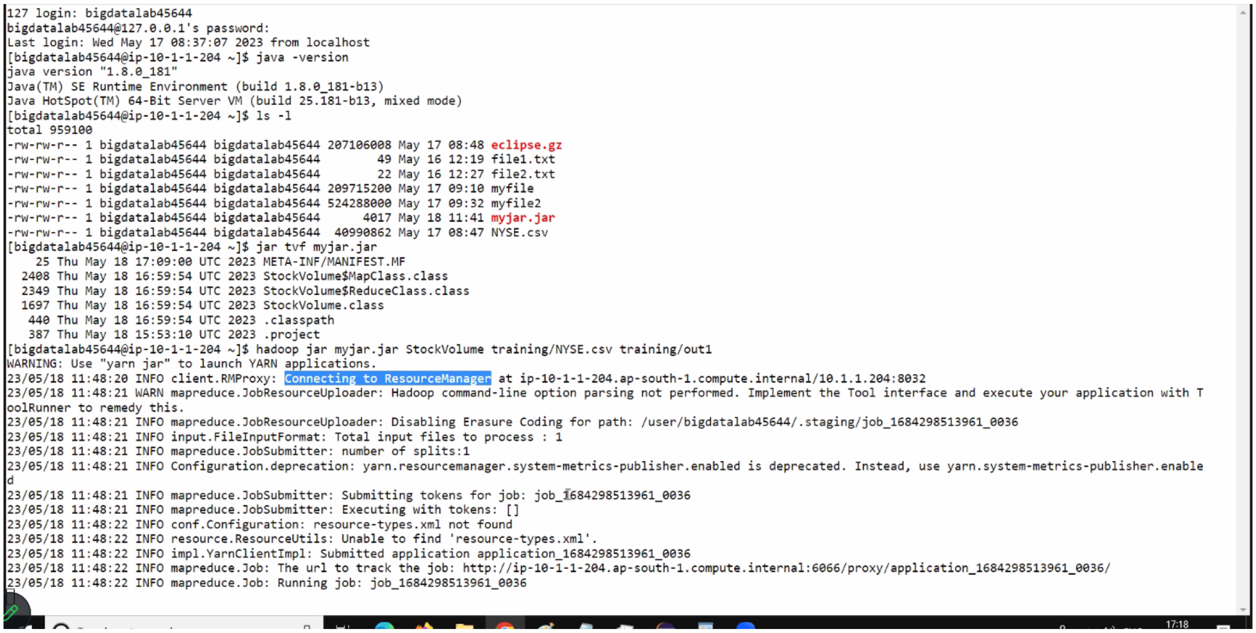
```
key = store_id
val = price*qty

m1
1,400
1,200
2,1600
2,600

m2
1,800
1,400
2,2400
2,800

1, [400,200,800,400]
2, [1600,600,2400,800]

Reducer
--------
1, [400+200+800+400]
2, [1600+600+2400+800]


output
1,1800
2,5400
```

# first upload myjar.jar file using ftp

```
[bigdatalab456422@ip-10-1-1-204 ~]$ ll
total 959100
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422 207106008 May 17 12:44
eclipse.gz
```

```
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422        50 May 16 12:19
file1.txt
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422        20 May 16 12:30
file2.txt
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422 209715200 May 17 09:16
myfile
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422 524288000 May 17 09:35
myfile2
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422      4088 May 18 11:41
myjar.jar
-rw-rw-r-- 1 bigdatalab456422 bigdatalab456422  40990862 May 17 09:21
NYSE.csv

[bigdatalab456422@ip-10-1-1-204 ~]$ jar tvf myjar.jar
   25 Thu May 18 17:09:20 UTC 2023 META-INF/MANIFEST.MF
  387 Thu May 18 15:53:20 UTC 2023 .project
 2408 Thu May 18 17:00:02 UTC 2023 StockVolume$MapClass.class
 2349 Thu May 18 17:00:02 UTC 2023 StockVolume$ReduceClass.class
 1697 Thu May 18 17:00:02 UTC 2023 StockVolume.class
  640 Thu May 18 17:00:00 UTC 2023 .classpath
```

# run map & reduce task
# generates part-r-0000 file, ‘r’ means reducer output

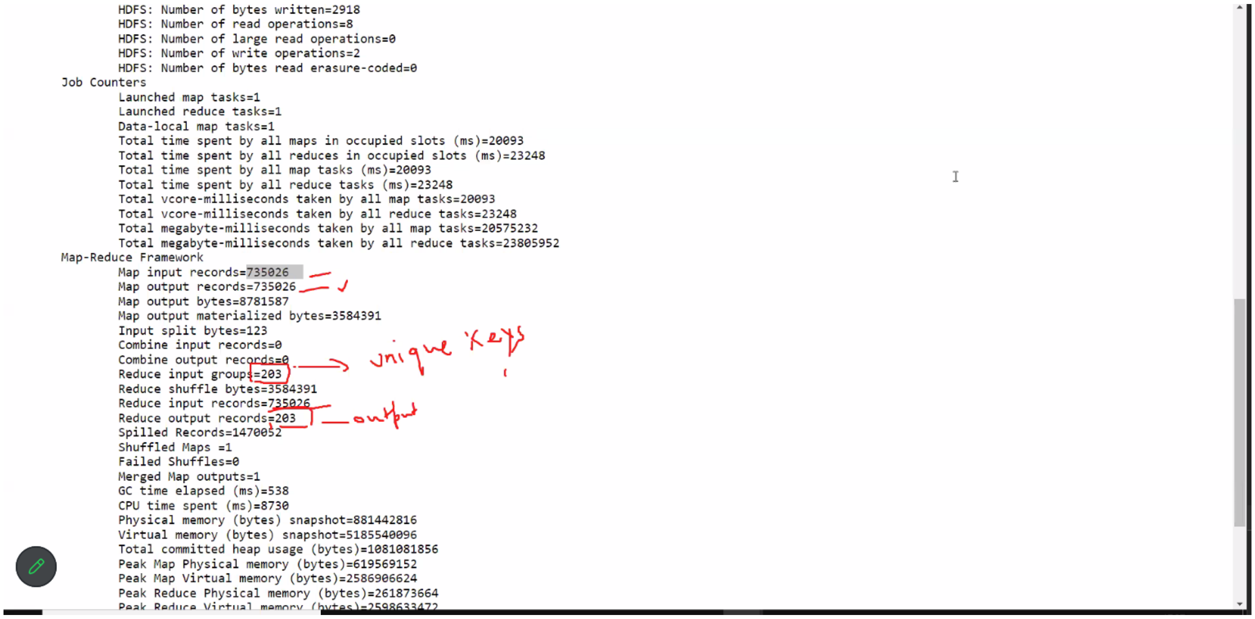


```
127 login: bigdatalab45644
bigdatalab45644@127.0.0.1's password:
Last login: Wed May 17 08:37:07 2023 from localhost
[bigdatalab45644@ip-10-1-1-204 ~]$ java -version
java version "1.8.0_181"
Java(TM) SE Runtime Environment (build 1.8.0_181-b13)
Java HotSpot(TM) 64-Bit Server VM (build 25.181-b13, mixed mode)
[bigdatalab45644@ip-10-1-1-204 ~]$ ls -l
total 959100
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644 207106008 May 17 08:48 eclipse.gz
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644        49 May 16 12:19 file1.txt
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644        22 May 16 12:27 file2.txt
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644 209715200 May 17 09:10 myfile
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644 524288000 May 17 09:32 myfile2
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644      4017 May 18 11:41 myjar.jar
-rw-rw-r-- 1 bigdatalab45644 bigdatalab45644  40990862 May 17 08:47 NYSE.csv
[bigdatalab45644@ip-10-1-1-204 ~]$ jar tvf myjar.jar
    25 Thu May 18 17:09:00 UTC 2023 META-INF/MANIFEST.MF
  2408 Thu May 18 16:59:54 UTC 2023 StockVolume$MapClass.class
  2349 Thu May 18 16:59:54 UTC 2023 StockVolume$ReduceClass.class
  1697 Thu May 18 16:59:54 UTC 2023 StockVolume.class
   440 Thu May 18 16:59:54 UTC 2023 .classpath
   387 Thu May 18 15:53:10 UTC 2023 .project
[bigdatalab45644@ip-10-1-1-204 ~]$ hadoop jar myjar.jar StockVolume training/NYSE.csv training/out1
WARNING: Use "yarn jar" to launch YARN applications.
23/05/18 11:48:20 INFO client.RMProxy: Connecting to ResourceManager at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
23/05/18 11:48:21 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with T
oolRunner to remedy this.
23/05/18 11:48:21 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /user/bigdatalab45644/.staging/job_1684298513961_0036
23/05/18 11:48:21 INFO input.FileInputFormat: Total input files to process : 1
23/05/18 11:48:21 INFO mapreduce.JobSubmitter: number of splits:1
23/05/18 11:48:21 INFO Configuration.deprecation: yarn.resourcemanager.system-metrics-publisher.enabled is deprecated. Instead, use yarn.system-metrics-publisher.enable
d
23/05/18 11:48:21 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1684298513961_0036
23/05/18 11:48:21 INFO mapreduce.JobSubmitter: Executing with tokens: []
23/05/18 11:48:22 INFO conf.Configuration: resource-types.xml not found
23/05/18 11:48:22 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
23/05/18 11:48:22 INFO impl.YarnClientImpl: Submitted application application_1684298513961_0036
23/05/18 11:48:22 INFO mapreduce.Job: The url to track the job: http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/application_1684298513961_0036/
23/05/18 11:48:22 INFO mapreduce.Job: Running job: job_1684298513961_0036
```

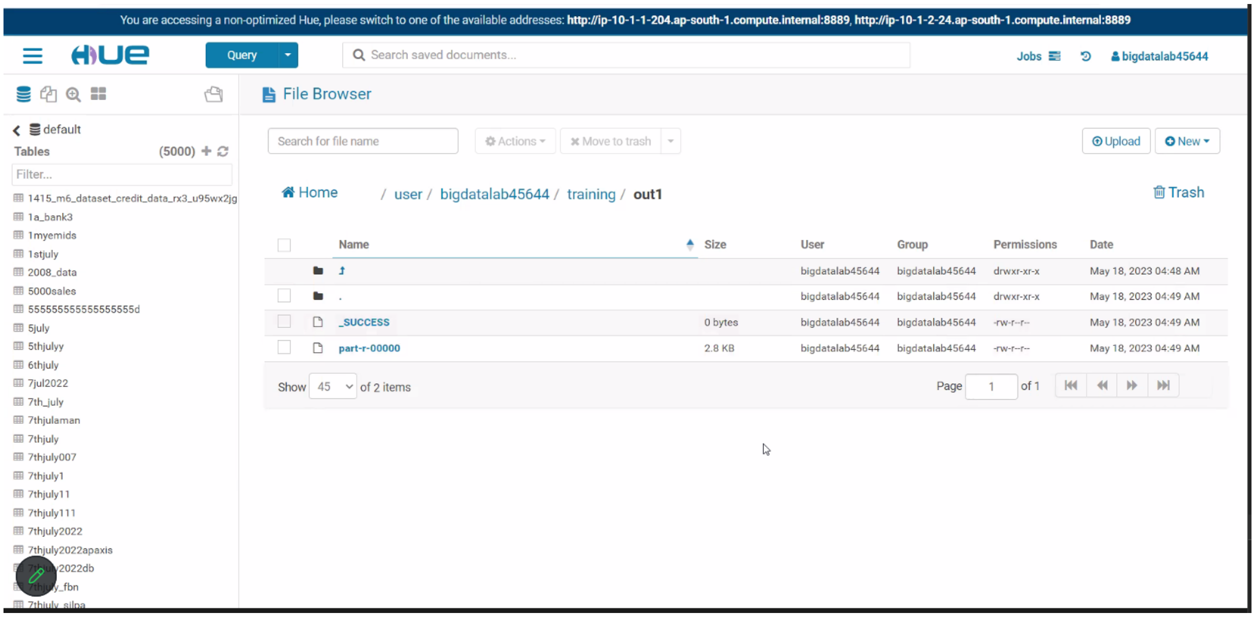
```
[bigdatalab456422@ip-10-1-1-204 ~]$ hadoop jar myjar.jar StockVolume
training/NYSE.csv training/out1
WARNING: Use "yarn jar" to launch YARN applications.
23/05/18 11:48:33 INFO client.RMProxy: Connecting to ResourceManager
at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
23/05/18 11:48:33 WARN mapreduce.JobResourceUploader: Hadoop
command-line option parsing not performed. Implement the Tool
interface and execute your application with T
oolRunner to remedy this.
23/05/18 11:48:33 INFO mapreduce.JobResourceUploader: Disabling
Erasure Coding for path:
/user/bigdatalab456422/.staging/job_1684298513961_0041
23/05/18 11:48:34 INFO input.FileInputFormat: Total input files to
process : 1
23/05/18 11:48:34 INFO mapreduce.JobSubmitter: number of splits:1
23/05/18 11:48:34 INFO Configuration.deprecation:
yarn.resourcemanager.system-metrics-publisher.enabled is deprecated.
Instead, use yarn.system-metrics-publisher.enable
d
23/05/18 11:48:34 INFO mapreduce.JobSubmitter: Submitting tokens for
job: job_1684298513961_0041
23/05/18 11:48:34 INFO mapreduce.JobSubmitter: Executing with tokens:
[]
23/05/18 11:48:34 INFO conf.Configuration: resource-types.xml not
found
23/05/18 11:48:34 INFO resource.ResourceUtils: Unable to find
'resource-types.xml'.
23/05/18 11:48:34 INFO impl.YarnClientImpl: Submitted application
application_1684298513961_0041
23/05/18 11:48:34 INFO mapreduce.Job: The url to track the job:
http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/applicati
on_1684298513961_0041/
23/05/18 11:48:34 INFO mapreduce.Job: Running job:
job_1684298513961_0041
23/05/18 11:48:58 INFO mapreduce.Job: Job job_1684298513961_0041
running in uber mode : false
23/05/18 11:48:58 INFO mapreduce.Job:  map 0% reduce 0%
23/05/18 11:49:27 INFO mapreduce.Job:  map 67% reduce 0%
23/05/18 11:49:29 INFO mapreduce.Job:  map 100% reduce 0%
23/05/18 11:50:00 INFO mapreduce.Job:  map 100% reduce 100%
23/05/18 11:50:01 INFO mapreduce.Job: Job job_1684298513961_0041
completed successfully
23/05/18 11:50:01 INFO mapreduce.Job: Counters: 54
       File System Counters
```

```
               FILE: Number of bytes read=3584395
               FILE: Number of bytes written=7613961
               FILE: Number of read operations=0
               FILE: Number of large read operations=0
               FILE: Number of write operations=0
               HDFS: Number of bytes read=40990986
               HDFS: Number of bytes written=2918
               HDFS: Number of read operations=8
               HDFS: Number of large read operations=0
               HDFS: Number of write operations=2
               HDFS: Number of bytes read erasure-coded=0
       Job Counters
               Launched map tasks=1
               Launched reduce tasks=1
               Data-local map tasks=1
               Total time spent by all maps in occupied slots
(ms)=26310
               Total time spent by all reduces in occupied slots
(ms)=28739
               Total time spent by all map tasks (ms)=26310
               Total time spent by all reduce tasks (ms)=28739
               Total vcore-milliseconds taken by all map tasks=26310
               Total vcore-milliseconds taken by all reduce
tasks=28739
               Total megabyte-milliseconds taken by all map
tasks=26941440
               Total megabyte-milliseconds taken by all reduce
tasks=29428736
       Map-Reduce Framework
               Map input records=735026
               Map output records=735026
               Map output bytes=8781587
               Map output materialized bytes=3584391
               Input split bytes=124
               Combine input records=0
               Combine output records=0
               Reduce input groups=203
               Reduce shuffle bytes=3584391
               Reduce input records=735026
               Reduce output records=203
               Spilled Records=1470052
               Shuffled Maps =1
               Failed Shuffles=0
               Merged Map outputs=1
               GC time elapsed (ms)=575
```

```
                CPU time spent (ms)=8990
                Physical memory (bytes) snapshot=882450432
                Virtual memory (bytes) snapshot=5186535424
                Total committed heap usage (bytes)=1075314688
                Peak Map Physical memory (bytes)=621236224
                Peak Map Virtual memory (bytes)=2586968064
                Peak Reduce Physical memory (bytes)=261267456
                Peak Reduce Virtual memory (bytes)=2599567360
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=40990862
        File Output Format Counters
                Bytes Written=2918
```



```
                HDFS: Number of bytes written=2918
                HDFS: Number of read operations=8
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=1
                Launched reduce tasks=1
                Data-local map tasks=1
                Total time spent by all maps in occupied slots (ms)=20093
                Total time spent by all reduces in occupied slots (ms)=23248
                Total time spent by all map tasks (ms)=20093
                Total time spent by all reduce tasks (ms)=23248
                Total vcore-milliseconds taken by all map tasks=20093
                Total vcore-milliseconds taken by all reduce tasks=23248
                Total megabyte-milliseconds taken by all map tasks=20575232
                Total megabyte-milliseconds taken by all reduce tasks=23805952
        Map-Reduce Framework
                Map input records=735026
                Map output records=735026   ✓
                Map output bytes=8781587
                Map output materialized bytes=3584391
                Input split bytes=123
                Combine input records=0
                Combine output records=0
                Reduce input groups=203   → unique keys
                Reduce shuffle bytes=3584391
                Reduce input records=735026
                Reduce output records=203   — output
                Spilled Records=1470052
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=538
                CPU time spent (ms)=8730
                Physical memory (bytes) snapshot=881442816
                Virtual memory (bytes) snapshot=5185540096
                Total committed heap usage (bytes)=1081081856
                Peak Map Physical memory (bytes)=619569152
                Peak Map Virtual memory (bytes)=2586906624
                Peak Reduce Physical memory (bytes)=261873664
                Peak Reduce Virtual memory (bytes)=2598633472
```

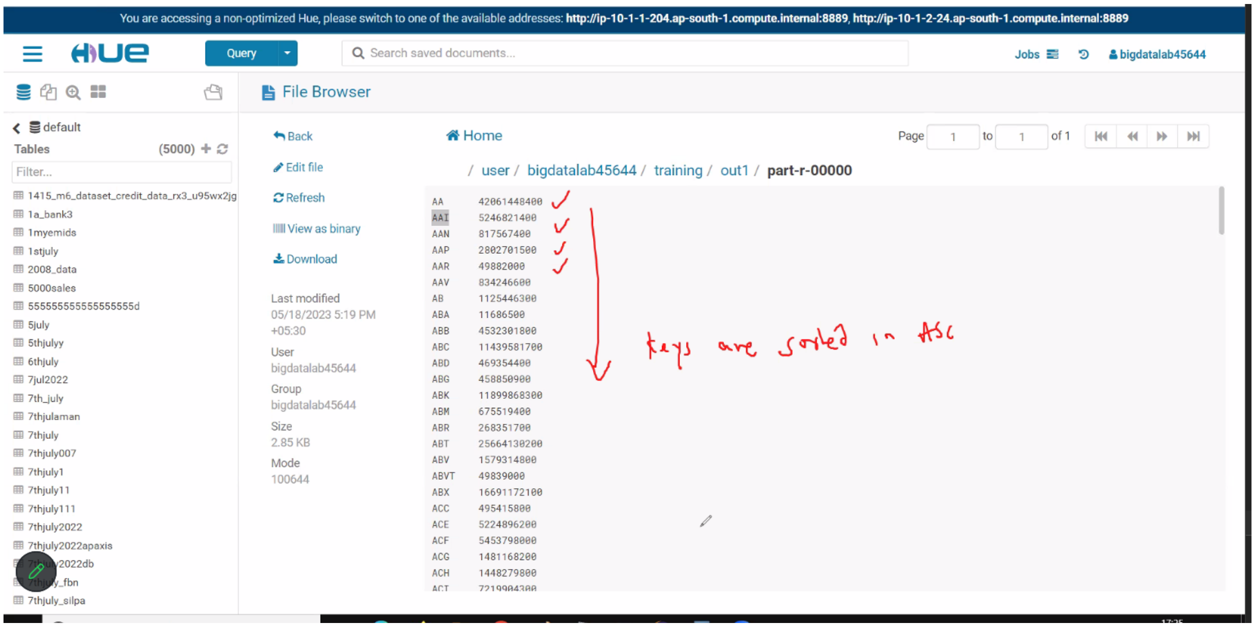


You are accessing a non-optimized Hue, please switch to one of the available addresses: **http://ip-10-1-1-204.ap-south-1.compute.internal:8889, http://ip-10-1-2-24.ap-south-1.compute.internal:8889**

Home / user / bigdatalab45644 / training / **out1**

Name	Size	User	Group	Permissions	Date
↥		bigdatalab45644	bigdatalab45644	drwxr-xr-x	May 18, 2023 04:48 AM
.		bigdatalab45644	bigdatalab45644	drwxr-xr-x	May 18, 2023 04:49 AM
_SUCCESS	0 bytes	bigdatalab45644	bigdatalab45644	-rw-r--r--	May 18, 2023 04:49 AM
part-r-00000	2.8 KB	bigdatalab45644	bigdatalab45644	-rw-r--r--	May 18, 2023 04:49 AM

Show 45 of 2 items Page 1 of 1



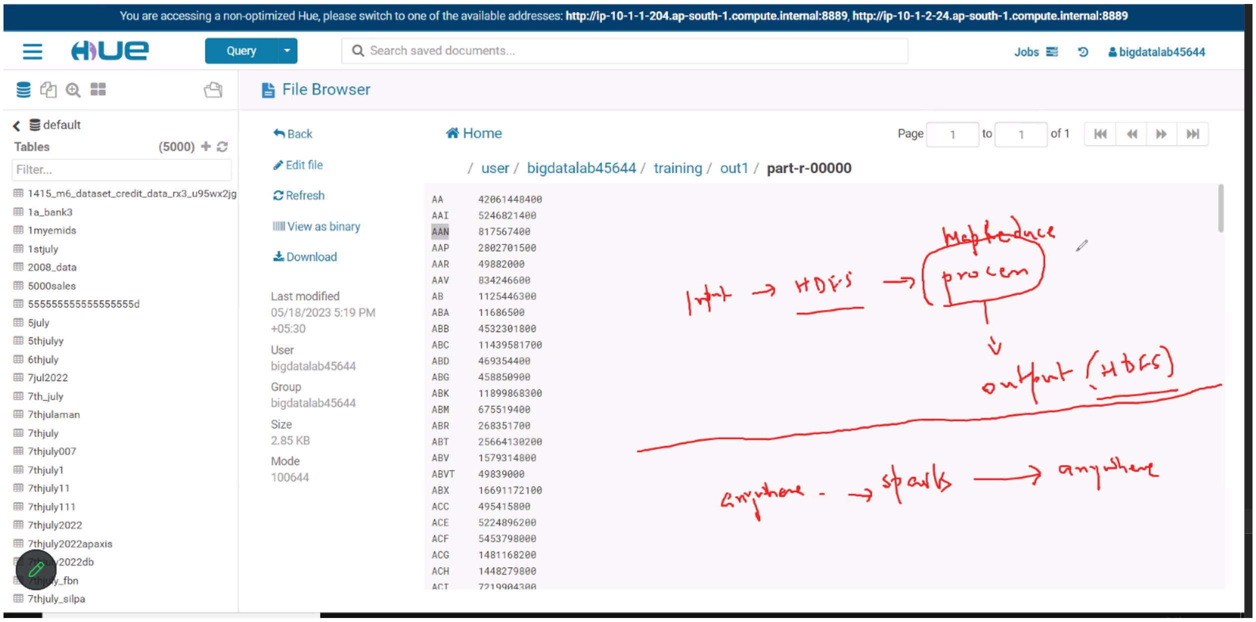
You are accessing a non-optimized Hue, please switch to one of the available addresses: **http://ip-10-1-1-204.ap-south-1.compute.internal:8889, http://ip-10-1-2-24.ap-south-1.compute.internal:8889**

Last modified
05/18/2023 5:19 PM +05:30
User
bigdatalab45644
Group
bigdatalab45644
Size
2.85 KB
Mode
100644

Home / user / bigdatalab45644 / training / out1 / **part-r-00000**

```
AA      42061448400 ✓
AAI     5246821400 ✓
AAN     817567400 ✓
AAP     2802701500 ✓
AAR     49882000 ✓
AAV     834246600
AB      1125446300
ABA     11686500
ABB     4532301800
ABC     11439581700
ABD     469354400
ABG     458850900
ABK     11899868300
ABM     675519400
ABR     268351700
ABT     25664130200
ABV     1579314800
ABVT    49839000
ABX     16691172100
ACC     495415800
ACE     5224896200
ACF     5453798000
ACG     1481168200
ACH     1448279800
ACT     7219904300
```

keys are sorted in Asc



You are accessing a non-optimized Hue, please switch to one of the available addresses: **http://ip-10-1-1-204.ap-south-1.compute.internal:8889, http://ip-10-1-2-24.ap-south-1.compute.internal:8889**

1415_m6_dataset_credit_data_rx3_u95wx2jg
1a_bank3
1myemids
1stjuly
2008_data
5000sales
555555555555555555d
5july
5thjulyy
6thjuly
7jul2022
7th_july
7thjulaman
7thjuly
7thjuly007
7thjuly1
7thjuly11
7thjuly111
7thjuly2022
7thjuly2022apaxis
7thjuly2022db
7thjuly_fbn
7thjuly_silpa

Last modified
05/18/2023 5:19 PM +05:30

User
bigdatalab45644

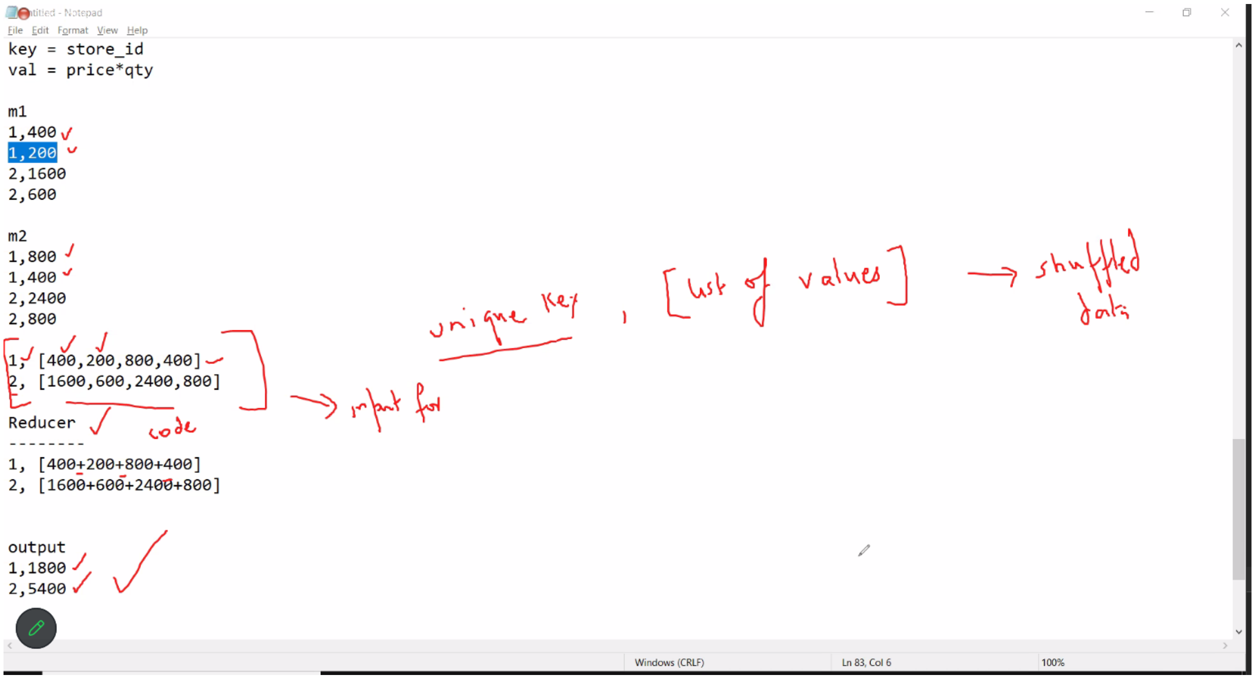
Group
bigdatalab45644

Size
2.85 KB

Mode
100644

/ user / bigdatalab45644 / training / out1 / **part-r-00000**

```
AA      42061448400
AAI     5246821400
AAN     817567400
AAP     2802701500
AAR     49882000
AAV     834246600
AB      1125446300
ABA     11686500
ABB     4532301800
ABC     11439581700
ABD     469354400
ABG     458850900
ABK     11899868300
ABM     675519400
ABR     268351700
ABT     25664130200
ABV     1579314800
ABVT    49839000
ABX     16691172100
ACC     495415800
ACE     5224896200
ACF     5453798000
ACG     1481168200
ACH     1448279800
ACT     7219904300
```



```
key = store_id
val = price*qty

m1
1,400
1,200
2,1600
2,600

m2
1,800
1,400
2,2400
2,800

1, [400,200,800,400]
2, [1600,600,2400,800]

Reducer
--------
1, [400+200+800+400]
2, [1600+600+2400+800]


output
1,1800
2,5400
```

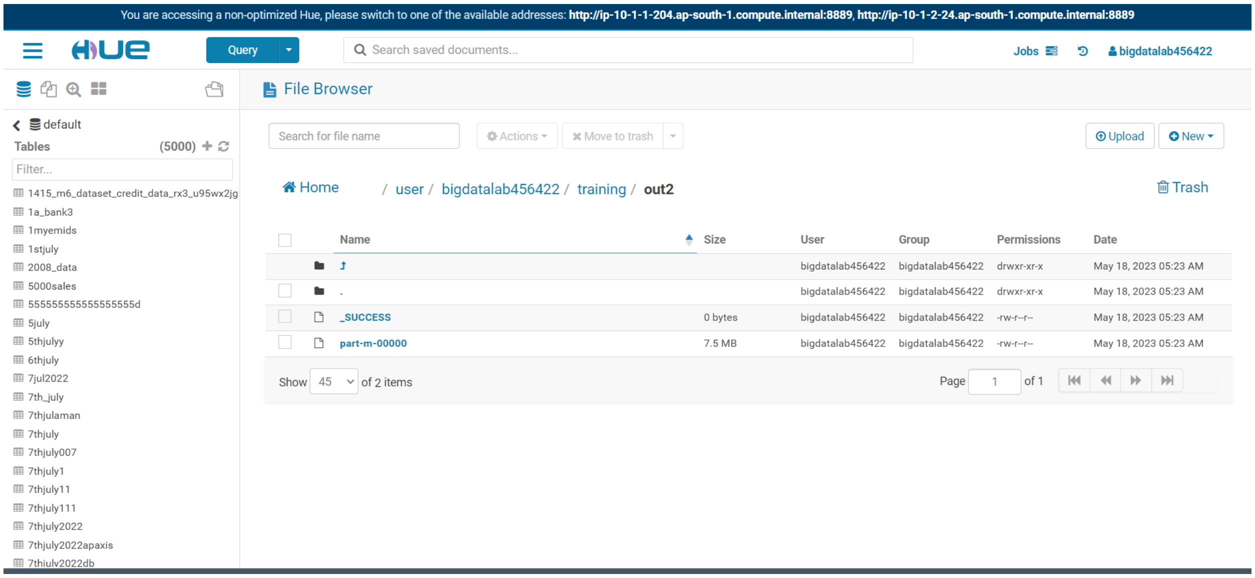
→
# run only map task

# change java code for reducerTask as ‘0’

```
job.setNumReduceTasks(0);
```

# generates part-r-0000 file, ‘r’ means reducer output

```
[bigdatalab456422@ip-10-1-1-204 ~]$ hadoop jar myjar.jar StockVolume
training/NYSE.csv training/out2
WARNING: Use "yarn jar" to launch YARN applications.
23/05/18 12:23:09 INFO client.RMProxy: Connecting to ResourceManager
at ip-10-1-1-204.ap-south-1.compute.internal/10.1.1.204:8032
23/05/18 12:23:10 WARN mapreduce.JobResourceUploader: Hadoop
command-line option parsing not performed. Implement the Tool
interface and execute your application with T
oolRunner to remedy this.
23/05/18 12:23:10 INFO mapreduce.JobResourceUploader: Disabling
Erasure Coding for path:
/user/bigdatalab456422/.staging/job_1684298513961_0137
23/05/18 12:23:10 INFO input.FileInputFormat: Total input files to
process : 1
23/05/18 12:23:10 INFO mapreduce.JobSubmitter: number of splits:1
23/05/18 12:23:10 INFO Configuration.deprecation:
yarn.resourcemanager.system-metrics-publisher.enabled is deprecated.
Instead, use yarn.system-metrics-publisher.enable
d
23/05/18 12:23:10 INFO mapreduce.JobSubmitter: Submitting tokens for
job: job_1684298513961_0137
23/05/18 12:23:10 INFO mapreduce.JobSubmitter: Executing with tokens:
[]
23/05/18 12:23:11 INFO conf.Configuration: resource-types.xml not
found
23/05/18 12:23:11 INFO resource.ResourceUtils: Unable to find
'resource-types.xml'.
23/05/18 12:23:11 INFO impl.YarnClientImpl: Submitted application
application_1684298513961_0137
23/05/18 12:23:11 INFO mapreduce.Job: The url to track the job:
http://ip-10-1-1-204.ap-south-1.compute.internal:6066/proxy/applicati
on_1684298513961_0137/
23/05/18 12:23:11 INFO mapreduce.Job: Running job:
job_1684298513961_0137
23/05/18 12:23:20 INFO mapreduce.Job: Job job_1684298513961_0137
running in uber mode : false
23/05/18 12:23:20 INFO mapreduce.Job:  map 0% reduce 0%
23/05/18 12:23:26 INFO mapreduce.Job:  map 100% reduce 0%
23/05/18 12:23:26 INFO mapreduce.Job: Job job_1684298513961_0137
completed successfully
23/05/18 12:23:26 INFO mapreduce.Job: Counters: 33
       File System Counters
               FILE: Number of bytes read=0
               FILE: Number of bytes written=222430
               FILE: Number of read operations=0
               FILE: Number of large read operations=0
               FILE: Number of write operations=0
               HDFS: Number of bytes read=40990986
               HDFS: Number of bytes written=7842509
               HDFS: Number of read operations=7
               HDFS: Number of large read operations=0
               HDFS: Number of write operations=2
               HDFS: Number of bytes read erasure-coded=0
       Job Counters
               Launched map tasks=1
               Data-local map tasks=1
               Total time spent by all maps in occupied slots
(ms)=4102
               Total time spent by all reduces in occupied slots
(ms)=0
               Total time spent by all map tasks (ms)=4102
               Total vcore-milliseconds taken by all map tasks=4102
               Total megabyte-milliseconds taken by all map
tasks=4200448
       Map-Reduce Framework
               Map input records=735026
               Map output records=735026
               Input split bytes=124
               Spilled Records=0
               Failed Shuffles=0
               Merged Map outputs=0
               GC time elapsed (ms)=69
               CPU time spent (ms)=3170
               Physical memory (bytes) snapshot=361504768
               Virtual memory (bytes) snapshot=2584989696
               Total committed heap usage (bytes)=480772096
               Peak Map Physical memory (bytes)=361504768
               Peak Map Virtual memory (bytes)=2584989696
       File Input Format Counters
               Bytes Read=40990862
       File Output Format Counters
               Bytes Written=7842509
```



You are accessing a non-optimized Hue, please switch to one of the available addresses: **http://ip-10-1-1-204.ap-south-1.compute.internal:8889, http://ip-10-1-2-24.ap-south-1.compute.internal:8889**

1415_m6_dataset_credit_data_rx3_u95wx2jg
1a_bank3
1myemids
1stjuly
2008_data
5000sales
5555555555555555d
5july
5thjulyy
6thjuly
7jul2022
7th_july
7thjulaman
7thjuly
7thjuly007
7thjuly1
7thjuly11
7thjuly111
7thjuly2022
7thjuly2022apaxis
7thjuly2022db

Home / user / bigdatalab456422 / training / out2

Name	Size	User	Group	Permissions	Date
↥		bigdatalab456422	bigdatalab456422	drwxr-xr-x	May 18, 2023 05:23 AM
.		bigdatalab456422	bigdatalab456422	drwxr-xr-x	May 18, 2023 05:23 AM
_SUCCESS	0 bytes	bigdatalab456422	bigdatalab456422	-rw-r--r--	May 18, 2023 05:23 AM
part-m-00000	7.5 MB	bigdatalab456422	bigdatalab456422	-rw-r--r--	May 18, 2023 05:23 AM

Show 45 of 2 items   Page 1 of 1

here , in part-m-0000, ‘m’ means output from mapper