CS525: Advanced Topics In Database Systems

Large-Scale Data Management

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Project 1

Group Members:

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Liu Ya's Version

These two pictures below show the differences between Query2 using a combiner and without using a combiner.

```
13/02/01 04:14:13 INFO mapred.JobClient: Job complete: job_201302010410_0002
13/02/01 04:14:13 INFO mapred.JobClient: Counters: 30
13/02/01 04:14:13 INFO mapred.JobClient:   Job Counters
13/02/01 04:14:13 INFO mapred.JobClient:     Launched reduce tasks=3
13/02/01 04:14:13 INFO mapred.JobClient:     SLOTS_MILLIS_MAPS=30281
13/02/01 04:14:13 INFO mapred.JobClient:     Total time spent by all reduces wai
ting after reserving slots (ms)=0
13/02/01 04:14:13 INFO mapred.JobClient:     Total time spent by all maps waitin
g after reserving slots (ms)=0
13/02/01 04:14:13 INFO mapred.JobClient:     Launched map tasks=5
13/02/01 04:14:13 INFO mapred.JobClient:     Data-local map tasks=5
13/02/01 04:14:13 INFO mapred.JobClient:     SLOTS_MILLIS_REDUCES=112360
13/02/01 04:14:13 INFO mapred.JobClient:   File Input Format Counters
13/02/01 04:14:13 INFO mapred.JobClient:     Bytes Read=303393977
13/02/01 04:14:13 INFO mapred.JobClient:   File Output Format Counters
13/02/01 04:14:13 INFO mapred.JobClient:     Bytes Written=1373855
13/02/01 04:14:13 INFO mapred.JobClient:   FileSystemCounters
13/02/01 04:14:13 INFO mapred.JobClient:     FILE_BYTES_READ=177317561
13/02/01 04:14:13 INFO mapred.JobClient:     HDFS_BYTES_READ=303394492
13/02/01 04:14:13 INFO mapred.JobClient:     FILE_BYTES_WRITTEN=262880149
13/02/01 04:14:13 INFO mapred.JobClient:     HDFS_BYTES_WRITTEN=1373855
13/02/01 04:14:13 INFO mapred.JobClient:   Map-Reduce Framework
13/02/01 04:14:13 INFO mapred.JobClient:     Map output materialized bytes=87562
386
13/02/01 04:14:13 INFO mapred.JobClient:     Map input records=5000000
13/02/01 04:14:13 INFO mapred.JobClient:     Reduce shuffle bytes=87562386
13/02/01 04:14:13 INFO mapred.JobClient:     Spilled Records=15000000
13/02/01 04:14:13 INFO mapred.JobClient:     Map output bytes=77562296
13/02/01 04:14:13 INFO mapred.JobClient:     Total committed heap usage (bytes)=
1070559232
13/02/01 04:14:13 INFO mapred.JobClient:     CPU time spent (ms)=22800
13/02/01 04:14:13 INFO mapred.JobClient:     Map input bytes=302869689
13/02/01 04:14:13 INFO mapred.JobClient:     SPLIT_RAW_BYTES=515
13/02/01 04:14:13 INFO mapred.JobClient:     Combine input records=0
13/02/01 04:14:13 INFO mapred.JobClient:     Reduce input records=5000000
13/02/01 04:14:13 INFO mapred.JobClient:     Reduce input groups=49999
13/02/01 04:14:13 INFO mapred.JobClient:     Combine output records=0
13/02/01 04:14:13 INFO mapred.JobClient:     Physical memory (bytes) snapshot=11
82900224
13/02/01 04:14:13 INFO mapred.JobClient:     Reduce output records=49999
13/02/01 04:14:13 INFO mapred.JobClient:     Virtual memory (bytes) snapshot=307
6075520
13/02/01 04:14:13 INFO mapred.JobClient:     Map output records=5000000
```

Query 2 without using a combiner

```
13/02/01 04:12:22 INFO mapred.JobClient: Job complete: job_201302010410_0001
13/02/01 04:12:22 INFO mapred.JobClient: Counters: 30
13/02/01 04:12:22 INFO mapred.JobClient:   Job Counters
13/02/01 04:12:22 INFO mapred.JobClient:     Launched reduce tasks=3
13/02/01 04:12:22 INFO mapred.JobClient:     SLOTS_MILLIS_MAPS=27393
13/02/01 04:12:22 INFO mapred.JobClient:     Total time spent by all reduces wai
ting after reserving slots (ms)=0
13/02/01 04:12:22 INFO mapred.JobClient:     Total time spent by all maps waitin
g after reserving slots (ms)=0
13/02/01 04:12:22 INFO mapred.JobClient:     Launched map tasks=5
13/02/01 04:12:22 INFO mapred.JobClient:     Data-local map tasks=5
13/02/01 04:12:22 INFO mapred.JobClient:     SLOTS_MILLIS_REDUCES=85330
13/02/01 04:12:22 INFO mapred.JobClient:   File Input Format Counters
13/02/01 04:12:22 INFO mapred.JobClient:     Bytes Read=303393977
13/02/01 04:12:22 INFO mapred.JobClient:   File Output Format Counters
13/02/01 04:12:22 INFO mapred.JobClient:     Bytes Written=1239306
13/02/01 04:12:22 INFO mapred.JobClient:   FileSystemCounters
13/02/01 04:12:22 INFO mapred.JobClient:     FILE_BYTES_READ=38448642
13/02/01 04:12:22 INFO mapred.JobClient:     HDFS_BYTES_READ=303394492
13/02/01 04:12:22 INFO mapred.JobClient:     FILE_BYTES_WRITTEN=41361957
13/02/01 04:12:22 INFO mapred.JobClient:     HDFS_BYTES_WRITTEN=1239306
13/02/01 04:12:22 INFO mapred.JobClient:   Map-Reduce Framework
13/02/01 04:12:22 INFO mapred.JobClient:     Map output materialized bytes=65519
89
13/02/01 04:12:22 INFO mapred.JobClient:     Map input records=5000000
13/02/01 04:12:22 INFO mapred.JobClient:     Reduce shuffle bytes=6551989
13/02/01 04:12:22 INFO mapred.JobClient:     Spilled Records=1562505
13/02/01 04:12:22 INFO mapred.JobClient:     Map output bytes=77562296
13/02/01 04:12:22 INFO mapred.JobClient:     Total committed heap usage (bytes)=
896024576
13/02/01 04:12:22 INFO mapred.JobClient:     CPU time spent (ms)=20970
13/02/01 04:12:22 INFO mapred.JobClient:     Map input bytes=302869689
13/02/01 04:12:22 INFO mapred.JobClient:     SPLIT_RAW_BYTES=515
13/02/01 04:12:22 INFO mapred.JobClient:     Combine input records=6062517
13/02/01 04:12:22 INFO mapred.JobClient:     Reduce input records=249994
13/02/01 04:12:22 INFO mapred.JobClient:     Reduce input groups=49999
13/02/01 04:12:22 INFO mapred.JobClient:     Combine output records=1312511
13/02/01 04:12:22 INFO mapred.JobClient:     Physical memory (bytes) snapshot=10
67130880
13/02/01 04:12:22 INFO mapred.JobClient:     Reduce output records=49999
13/02/01 04:12:22 INFO mapred.JobClient:     Virtual memory (bytes) snapshot=307
6022272
13/02/01 04:12:22 INFO mapred.JobClient:     Map output records=5000000
```

Query2 using a combiner

In these two experiments, the CPU time spent went from 22800ms to 20970ms. The filesystem stats and shuffle stats are also reduced significantly.   From these two pictures,   we can see that combiner can optimize/minimize the number of key value pairs that will be shuffled across the network between mappers and reducers and thus to save as most bandwidth as possible.

Zhou Hao's Version

```
13/02/01 04:19:41 INFO mapred.JobClient:      FILE_BYTES_WRITTEN=150193509
13/02/01 04:19:41 INFO mapred.JobClient:      HDFS_BYTES_WRITTEN=1324015
13/02/01 04:19:41 INFO mapred.JobClient:    Map-Reduce Framework
13/02/01 04:19:41 INFO mapred.JobClient:      Map output materialized bytes=50000090
13/02/01 04:19:41 INFO mapred.JobClient:      Map input records=5000000
13/02/01 04:19:41 INFO mapred.JobClient:      Reduce shuffle bytes=50000090
13/02/01 04:19:41 INFO mapred.JobClient:      Spilled Records=15000000
13/02/01 04:19:41 INFO mapred.JobClient:      Map output bytes=40000000
13/02/01 04:19:41 INFO mapred.JobClient:      Total committed heap usage (bytes)=989220864
13/02/01 04:19:41 INFO mapred.JobClient:      CPU time spent (ms)=21140
13/02/01 04:19:41 INFO mapred.JobClient:      Map input bytes=307581293
13/02/01 04:19:41 INFO mapred.JobClient:      SPLIT_RAW_BYTES=530
13/02/01 04:19:41 INFO mapred.JobClient:      Combine input records=0
13/02/01 04:19:41 INFO mapred.JobClient:      Reduce input records=5000000
13/02/01 04:19:41 INFO mapred.JobClient:      Reduce input groups=49999
13/02/01 04:19:41 INFO mapred.JobClient:      Combine output records=0
13/02/01 04:19:41 INFO mapred.JobClient:      Physical memory (bytes) snapshot=1124466688
13/02/01 04:19:41 INFO mapred.JobClient:      Reduce output records=49999
13/02/01 04:19:41 INFO mapred.JobClient:      Virtual memory (bytes) snapshot=3076468736
13/02/01 04:19:41 INFO mapred.JobClient:      Map output records=5000000
ubuntu@ubuntu-VirtualBox:~/Workspace/hadoop-1.1.0/bin$
```

Query without Combiner:

CPU time: 25260ms.

```
13/02/01 03:53:34 INFO mapred.JobClient:    File Input Format Counters
13/02/01 03:53:34 INFO mapred.JobClient:      Bytes Read=308105581
13/02/01 03:53:34 INFO mapred.JobClient:    File Output Format Counters
13/02/01 03:53:34 INFO mapred.JobClient:      Bytes Written=1324015
13/02/01 03:53:34 INFO mapred.JobClient:    FileSystemCounters
13/02/01 03:53:34 INFO mapred.JobClient:      FILE_BYTES_READ=102051456
13/02/01 03:53:34 INFO mapred.JobClient:      HDFS_BYTES_READ=308106111
13/02/01 03:53:34 INFO mapred.JobClient:      FILE_BYTES_WRITTEN=150193549
13/02/01 03:53:34 INFO mapred.JobClient:      HDFS_BYTES_WRITTEN=1324015
13/02/01 03:53:34 INFO mapred.JobClient:    Map-Reduce Framework
13/02/01 03:53:34 INFO mapred.JobClient:      Map output materialized bytes=50000090
13/02/01 03:53:34 INFO mapred.JobClient:      Map input records=5000000
13/02/01 03:53:34 INFO mapred.JobClient:      Reduce shuffle bytes=50000090
13/02/01 03:53:34 INFO mapred.JobClient:      Spilled Records=15000000
13/02/01 03:53:34 INFO mapred.JobClient:      Map output bytes=40000000
13/02/01 03:53:34 INFO mapred.JobClient:      Total committed heap usage (bytes)=988700672
13/02/01 03:53:34 INFO mapred.JobClient:      CPU time spent (ms)=20500
13/02/01 03:53:34 INFO mapred.JobClient:      Map input bytes=307581293
13/02/01 03:53:34 INFO mapred.JobClient:      SPLIT_RAW_BYTES=530
13/02/01 03:53:34 INFO mapred.JobClient:      Combine input records=0
13/02/01 03:53:34 INFO mapred.JobClient:      Reduce input records=5000000
13/02/01 03:53:34 INFO mapred.JobClient:      Reduce input groups=49999
13/02/01 03:53:34 INFO mapred.JobClient:      Combine output records=0
13/02/01 03:53:34 INFO mapred.JobClient:      Physical memory (bytes) snapshot=1131061248
13/02/01 03:53:34 INFO mapred.JobClient:      Reduce output records=49999
13/02/01 03:53:34 INFO mapred.JobClient:      Virtual memory (bytes) snapshot=3076587520
13/02/01 03:53:34 INFO mapred.JobClient:      Map output records=5000000
```

Query with Combiner:

CPU time: 20500ms.

It may be wield. I believe the reason why I get this result is that I use different ways to deal with the data in each query.   (Source files show more details.)