# HW #1 Spark SQL

*2조 김정훈,한정민,모유찬*

**(1) SQL query (1점*Query2개)**

문제1) select project,title,count  from wiki
where project='de' and title<>'Woodkid' and count >=800 and count<1000
order by count desc

문제2) select owner,avg(count) as avg_count  from wiki
natural join owner
group by owner

**(2) jupyter notebook에 보여지는 Query 실행결과 스크린샷 (1점*Query2개)**

문제1)

```
In [30]: # df.createOrReplaceTempView("...")
         # selected = ss.sql("...")
         # selected.show()
         df.createOrReplaceTempView('wiki') # create temp view
         no1 = ss.sql("select project,title,count ₩
                     from wiki ₩
                     where project='de' and title<>'Woodkid' and count >=800 and count<1000 ₩
                     order by count desc")
         no1.show()
```

```
+-------+--------------------+-----+
|project|               title|count|
+-------+--------------------+-----+
|     de|Wikipedia:Auskunf...|  900|
|     de|Spezial:Beobachtu...|  882|
|     de|Spezial:Beobachtu...|  804|
+-------+--------------------+-----+
```

문제2)

```
In [31]: ownertable_raw = [('Woodkid','Lila'),('Sia','Jane'),('Ryuichi_Sakamoto','Sam')]
         ownerrdd = sc.parallelize(ownertable_raw)
         ownerdf = ss.createDataFrame(ownerrdd,['title','owner'])
         ownerdf.show()
```

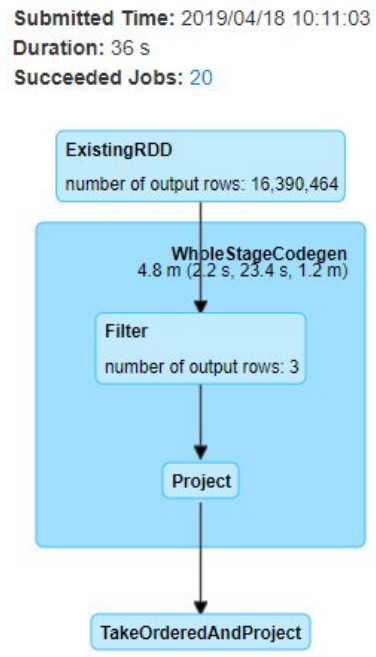
```
+---------------+-----+
|          title|owner|
+---------------+-----+
|        Woodkid| Lila|
|            Sia| Jane|
|Ryuichi_Sakamoto|  Sam|
+---------------+-----+
```

```
In [32]: ownerdf.createOrReplaceTempView('owner')
         no2 = ss.sql('select owner,avg(count) as avg_count₩
                     from wiki₩
                     natural join owner₩
                     group by owner')
         no2.show()
```

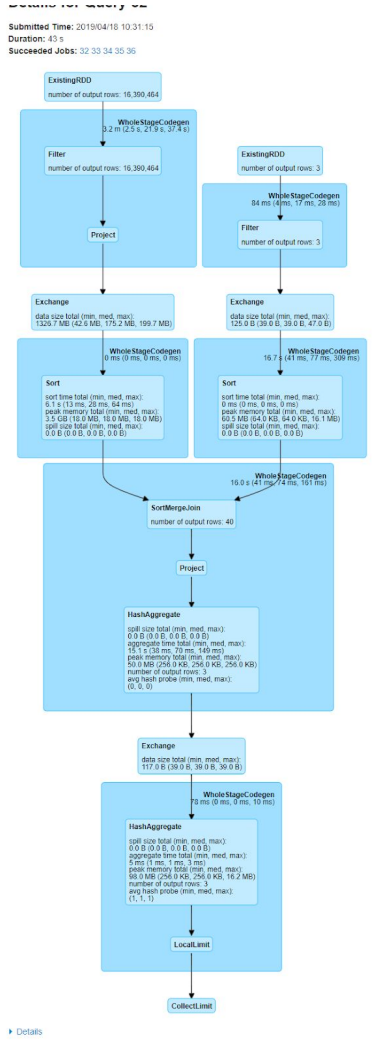
```
+-----+---------+
|owner|avg_count|
+-----+---------+
| Lila|      2.3|
|  Sam|     14.0|
| Jane|     10.0|
+-----+---------+
```

**(3) Spark Web UI 'SQL' tab 에서 보여지는 Query plan 그래프의 스크린샷 (1점*Query2개)**

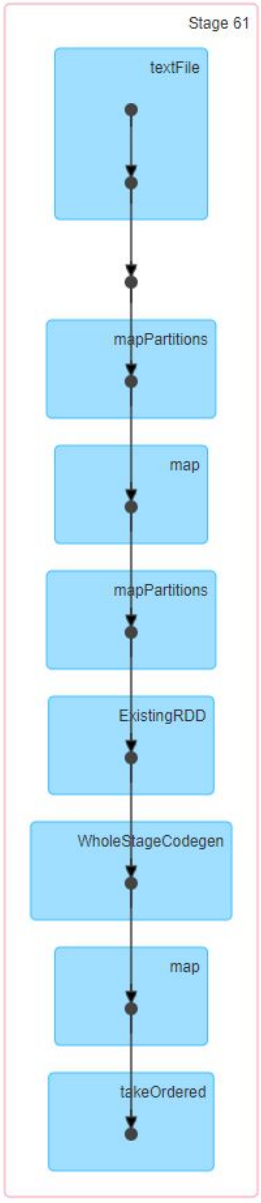
문제1)




문제2)



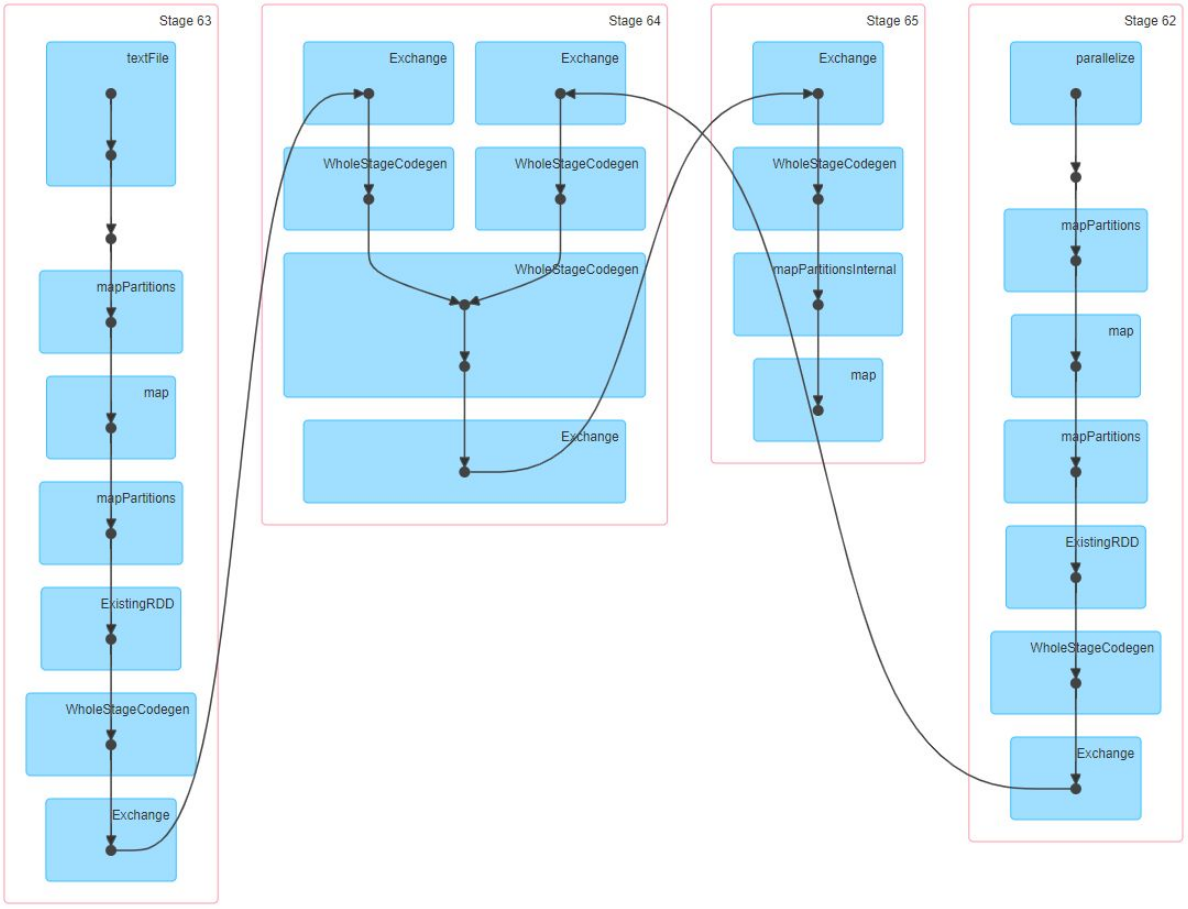

**(4) Spark Web UI ‘Jobs’ tab 에서 보여지는 DAG Visualization 그래프의 스크린샷**
(1점*Query2개)
문제1)



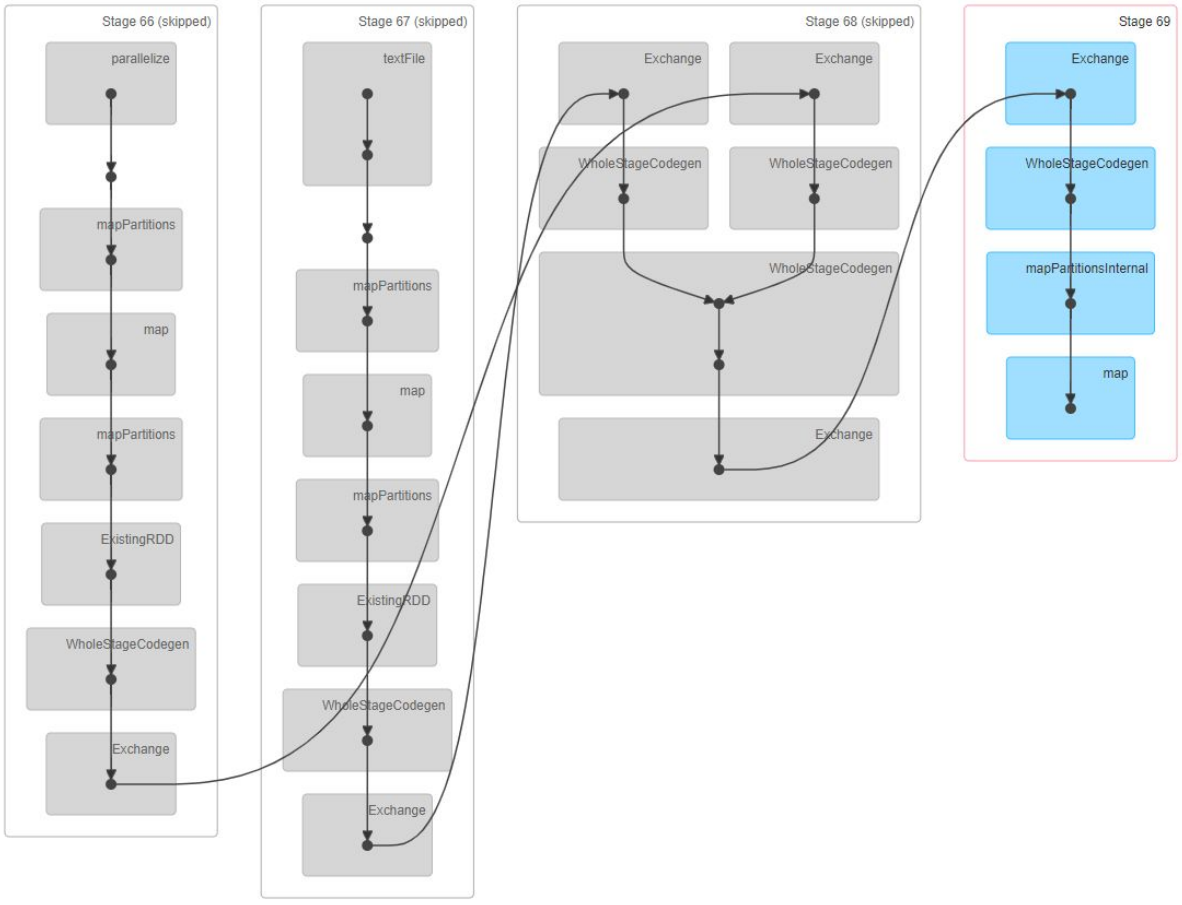

문제2) 총 5개의 Job 으로 진행됨

| Job Id ▾ | Description | Submitted | Duration | Stages: Succeeded/Total | Tasks (for all stages): Succeeded/Total |
|---|---|---|---|---|---|
| 36 | showString at NativeMethodAccessorImpl.java:0<br>showString at NativeMethodAccessorImpl.java:0 | 2019/04/18 10:31:58 | 0.2 s | 1/1 (3 skipped) | 75/75 (215 skipped) |
| 35 | showString at NativeMethodAccessorImpl.java:0<br>showString at NativeMethodAccessorImpl.java:0 | 2019/04/18 10:31:57 | 0.2 s | 1/1 (3 skipped) | 100/100 (215 skipped) |
| 34 | showString at NativeMethodAccessorImpl.java:0<br>showString at NativeMethodAccessorImpl.java:0 | 2019/04/18 10:31:57 | 48 ms | 1/1 (3 skipped) | 20/20 (215 skipped) |
| 33 | showString at NativeMethodAccessorImpl.java:0<br>showString at NativeMethodAccessorImpl.java:0 | 2019/04/18 10:31:57 | 25 ms | 1/1 (3 skipped) | 4/4 (215 skipped) |
| 32 | showString at NativeMethodAccessorImpl.java:0<br>showString at NativeMethodAccessorImpl.java:0 | 2019/04/18 10:31:15 | 42 s | 4/4 | 216/216 |

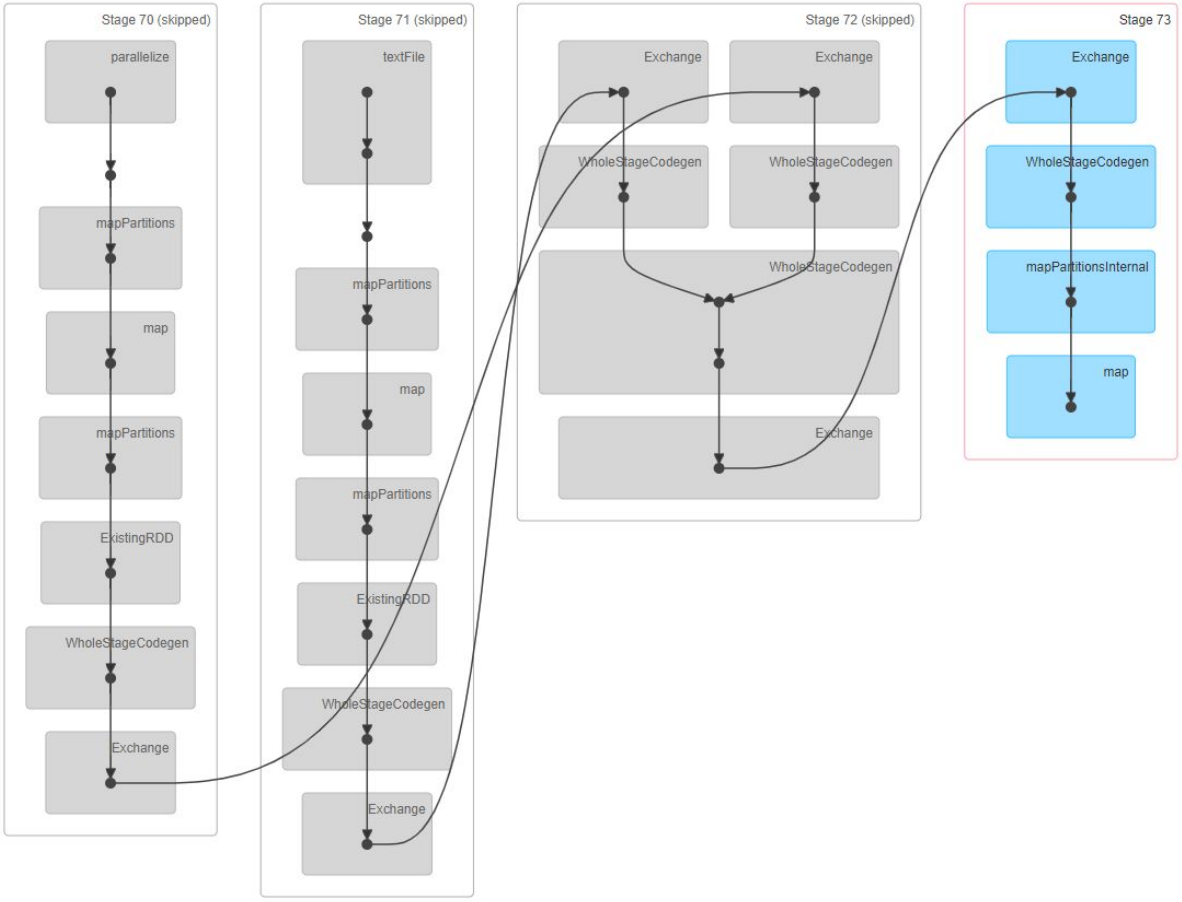
JobID 32 (Stages 4/4)



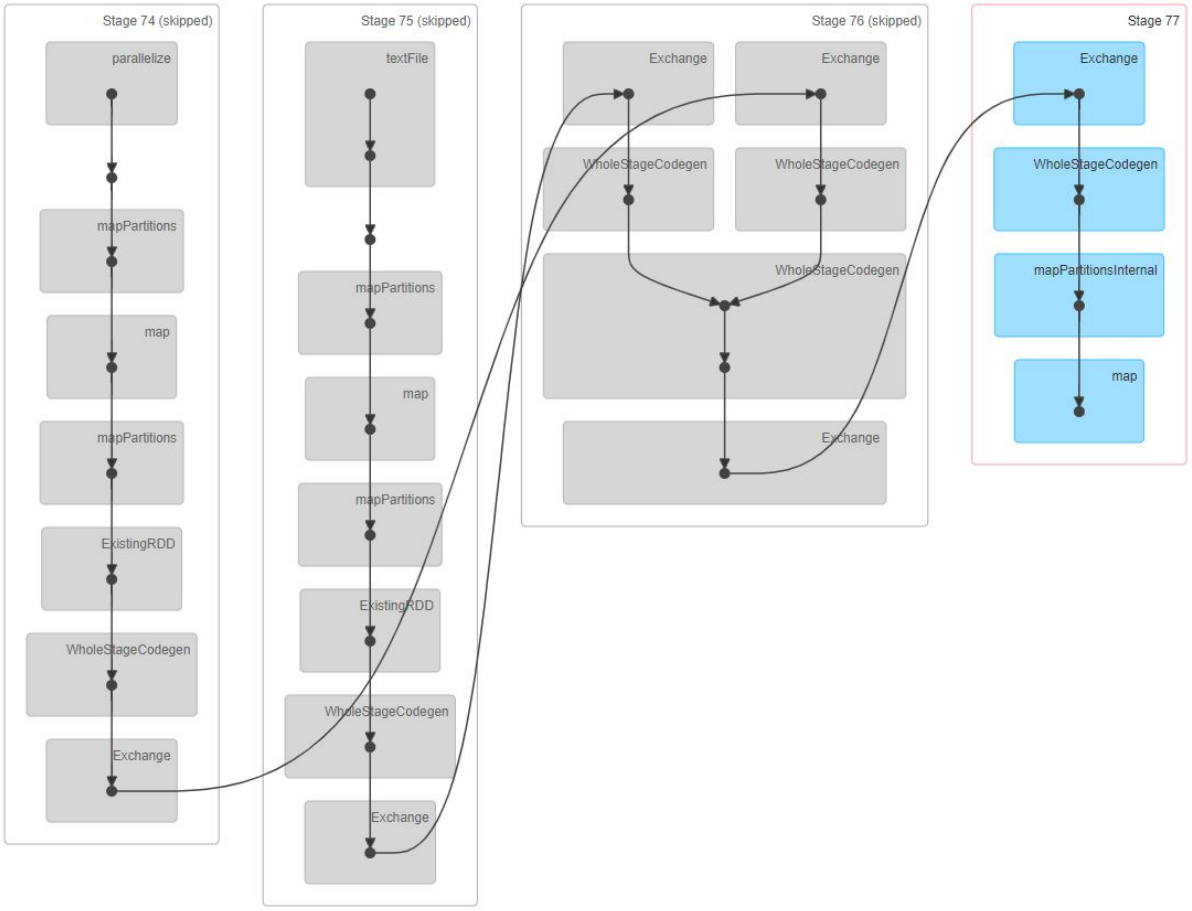

JobID 33 (1/1 (3 skipped))



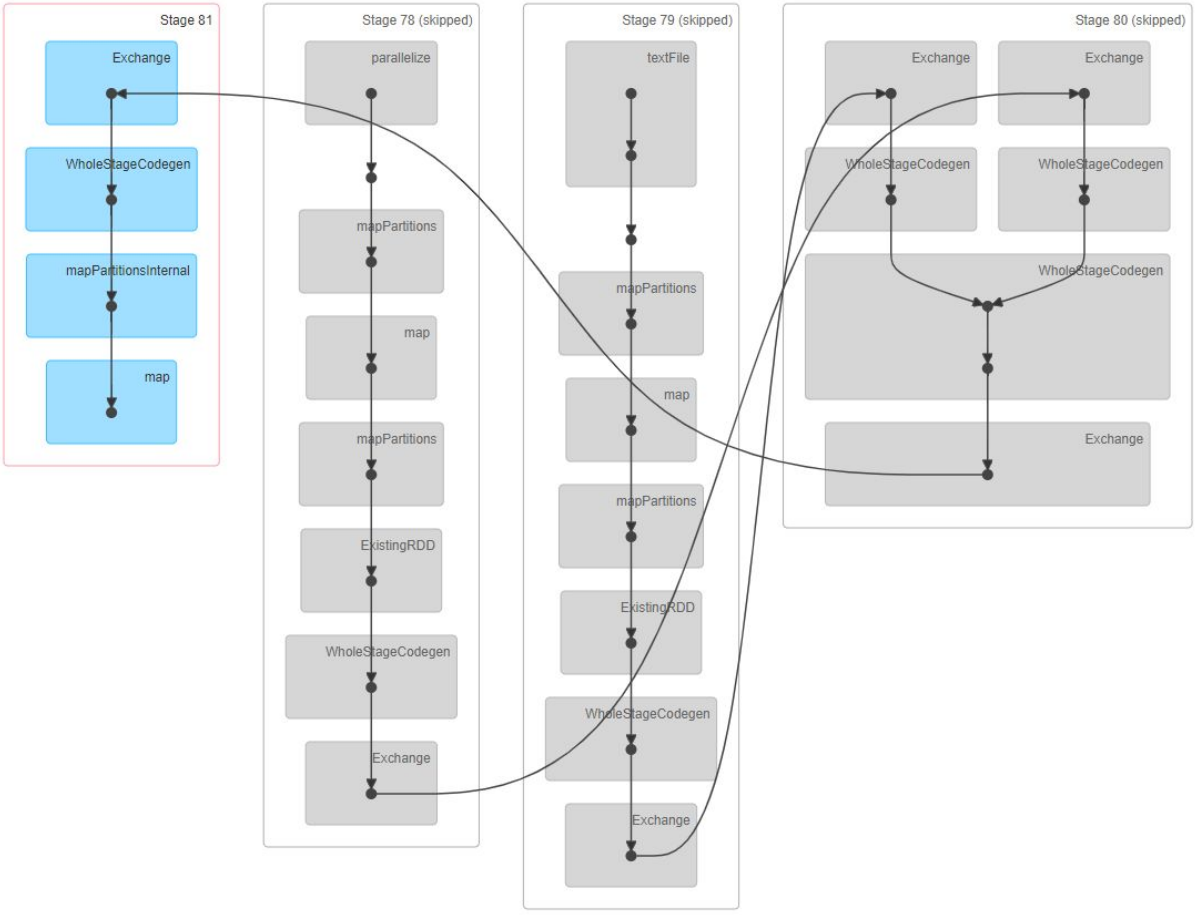

JobID 34 (1/1 (3 skipped))




JobID 35 (1/1 (3 skipped))




JobID 36 (1/1 (3 skipped))




**(5) Spark Web UI 'Stages' tab에서 보여지는, 해당 Query에 대응하는 Job에 속하는 모든 Stage들의 'Summary Metrics for N Completed Tasks' 테이블의 스크린샷 (1점*Query2개)**

문제1)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 62 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:15 | 98 ms | 6/6 | | | | 258.0 B |

**Summary Metrics for 9 Completed Tasks**

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 2 s | 7 s | 24 s | 32 s | 34 s |
| GC Time | 40 ms | 0.1 s | 0.3 s | 0.4 s | 0.4 s |
| Input Size / Records | 39.2 MB / 148050 | 96.7 MB / 521200 | 128.1 MB / 2133942 | 128.1 MB / 3159349 | 128.1 MB / 3261669 |

문제2)

| Stage Id | Description | Submitted | Duration | Tasks: Succeeded/Total | Input | Output | Shuffle Read | Shuffle Write |
|---|---|---|---|---|---|---|---|---|
| 81 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:58 | 0.1 s | 75/75 | | | 78.0 B | |
| 77 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:57 | 0.2 s | 100/100 | | | 156.0 B | |
| 73 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:57 | 40 ms | 20/20 | | | | |
| 69 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:57 | 21 ms | 4/4 | | | | |
| 65 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:57 | 15 ms | 1/1 | | | | |
| 64 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:54 | 3 s | 200/200 | | | 550.8 MB | 234.0 B |
| 63 | showString at NativeMethodAccessorImpl.java:0 +details | 2019/04/18 10:31:15 | 39 s | 9/9 | 966.5 MB | | | 550.8 MB |

## Details for Stage 63 (Attempt 0)

**Total Time Across All Tasks:** 3.2 min
**Locality Level Summary:** Any: 9
**Input Size / Records:** 966.5 MB / 16390464
**Shuffle Write:** 550.8 MB / 16390464

- DAG Visualization
- Show Additional Metrics
- Event Timeline

### Summary Metrics for 9 Completed Tasks

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 3 s | 8 s | 22 s | 32 s | 38 s |
| GC Time | 57 ms | 0.2 s | 0.5 s | 0.6 s | 0.6 s |
| Input Size / Records | 39.2 MB / 148050 | 96.7 MB / 521200 | 128.1 MB / 2133942 | 128.1 MB / 3159349 | 128.1 MB / 3261669 |
| Shuffle Write Size / Records | 12.5 MB / 148050 | 30.0 MB / 521200 | 73.8 MB / 2133942 | 92.1 MB / 3159349 | 93.6 MB / 3261669 |

## Details for Stage 64 (Attempt 0)

**Total Time Across All Tasks:** 18 s
**Locality Level Summary:** Node local: 200
**Shuffle Read:** 550.8 MB / 16390467
**Shuffle Write:** 234.0 B / 3

- DAG Visualization
- Show Additional Metrics
- Event Timeline

### Summary Metrics for 200 Completed Tasks

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 47 ms | 77 ms | 86 ms | 98 ms | 0.2 s |
| GC Time | 0 ms | 0 ms | 0 ms | 0 ms | 74 ms |
| Shuffle Read Size / Records | 2.7 MB / 80568 | 2.7 MB / 81610 | 2.8 MB / 81978 | 2.8 MB / 82249 | 2.8 MB / 83177 |
| Shuffle Write Size / Records | 0.0 B / 0 | 0.0 B / 0 | 0.0 B / 0 | 0.0 B / 0 | 78.0 B / 1 |

## Details for Stage 65 (Attempt 0)

**Total Time Across All Tasks:** 6 ms
**Locality Level Summary:** Process local: 1

- DAG Visualization
- Show Additional Metrics
- Event Timeline

### Summary Metrics for 1 Completed Tasks

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 6 ms | 6 ms | 6 ms | 6 ms | 6 ms |
| GC Time | 0 ms | 0 ms | 0 ms | 0 ms | 0 ms |

## Details for Stage 69 (Attempt 0)

**Total Time Across All Tasks:** 21 ms
**Locality Level Summary:** Process local: 4

- DAG Visualization
- Show Additional Metrics
- Event Timeline

### Summary Metrics for 4 Completed Tasks

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 1 ms | 3 ms | 5 ms | 12 ms | 12 ms |
| GC Time | 0 ms | 0 ms | 0 ms | 0 ms | 0 ms |

## Details for Stage 73 (Attempt 0)

**Total Time Across All Tasks:** 60 ms
**Locality Level Summary:** Process local: 20

- DAG Visualization
- Show Additional Metrics
- Event Timeline

### Summary Metrics for 20 Completed Tasks

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 1 ms | 2 ms | 2 ms | 4 ms | 10 ms |
| GC Time | 0 ms | 0 ms | 0 ms | 0 ms | 0 ms |

## Details for Stage 77 (Attempt 0)

**Total Time Across All Tasks:** 0.3 s
**Locality Level Summary:** Node local: 2; Process local: 98
**Shuffle Read:** 156.0 B / 2

- DAG Visualization
- Show Additional Metrics
- Event Timeline

**Summary Metrics for 100 Completed Tasks**

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 1 ms | 1 ms | 2 ms | 3 ms | 9 ms |
| GC Time | 0 ms | 0 ms | 0 ms | 0 ms | 0 ms |
| Shuffle Read Size / Records | 0.0 B / 0 | 0.0 B / 0 | 0.0 B / 0 | 0.0 B / 0 | 78.0 B / 1 |

## Details for Stage 81 (Attempt 0)

**Total Time Across All Tasks:** 0.2 s
**Locality Level Summary:** Node local: 1; Process local: 74
**Shuffle Read:** 78.0 B / 1

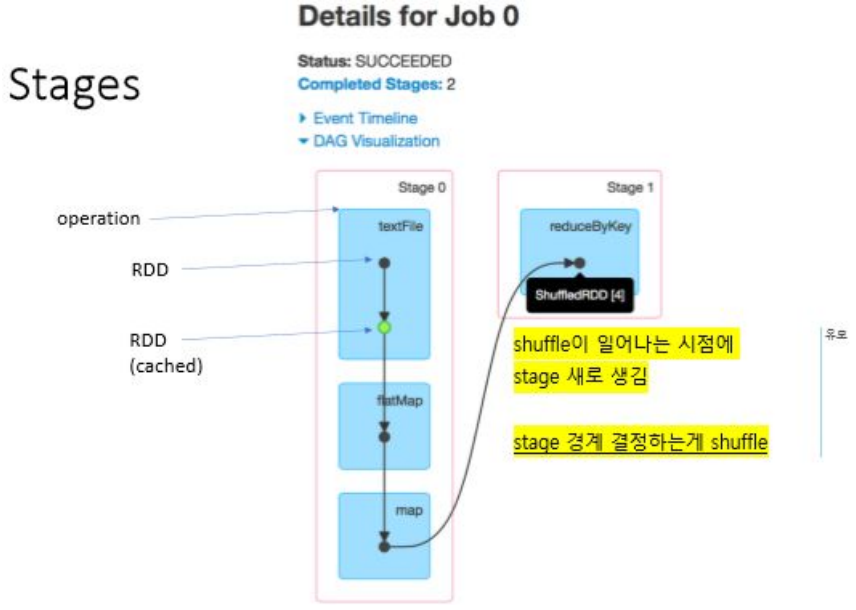
- DAG Visualization
- Show Additional Metrics
- Event Timeline

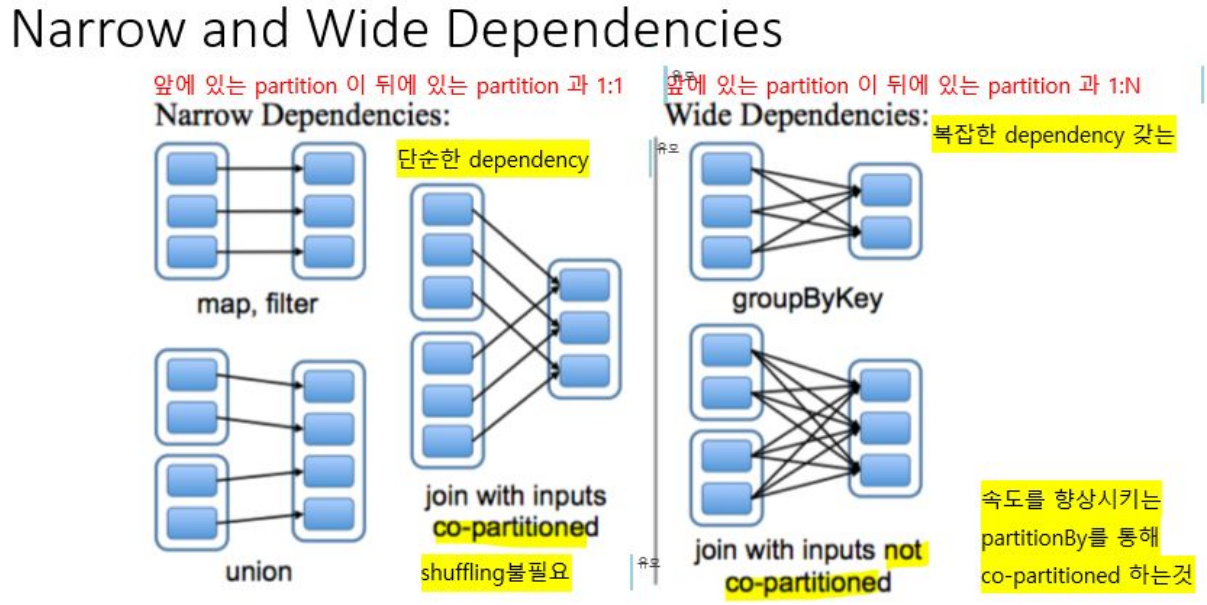
**Summary Metrics for 75 Completed Tasks**

| Metric | Min | 25th percentile | Median | 75th percentile | Max |
|---|---|---|---|---|---|
| Duration | 1 ms | 1 ms | 2 ms | 3 ms | 12 ms |
| GC Time | 0 ms | 0 ms | 0 ms | 0 ms | 0 ms |
| Shuffle Read Size / Records | 0.0 B / 0 | 0.0 B / 0 | 0.0 B / 0 | 0.0 B / 0 | 78.0 B / 1 |

**(6) (보너스 점수 2점 - 각각 1점) 수행하면서 발견한 재미있는 현상 2개에 대해 기술**
**발견한 사항)**

1) DAG 관점 발견 사항 (문제1 vs 문제2)
   a) 문제1 : 1 Stage 에서 완료됨 => shuffle 이 일어나지 않았다는 점. 그것은 Narrow dependencies(map,filter,union등) 동일한 partition에 의한 연산만 수행된다고 판단됨
   b) 문제2 : 총 5job(총8stage : 12개 stage 는 skipped) 에 거쳐 연산이 수행되는데, 잦은 shuffling이 발생하는 것으로 보아 Wide dependencies 연산으로 보인다. 해당 연산이 많이 발생하는 이유로는 join, groupBy(avg 연산)을 진행할 때 partition 간의 shuffling 이 다수 일어난 것으로 보인다.





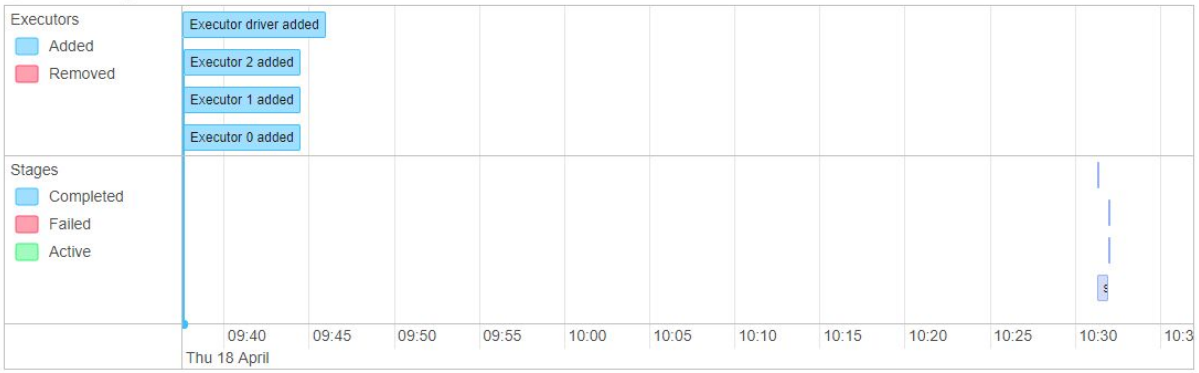

2) 문제2의 DAG Graph의 수많은 Skipped stage와 Summary Metrics 의 Garbage collection time 로 부터 들은 궁금점을 Stack over flow를 통해 해답을 얻었다. 일단 Stage 에서 Skipped 된 것은 후속 stage 에서 HDFS로부터 데이터를 가져오는 것이 아닌 자주 연산되는 것을 caching하여 연산을 최적화 한것으로 보이고, 첫 Stage외에 모든 Garbage Collection time 이 0 인 점이 모든 것을 in mermory 에서 caching하여 후속 처리를 하는 것에 따라 발생 된 결과로 생각된다.

https://stackoverflow.com/questions/34580662/what-does-stage-skipped-mean-in-apache-spark-web-ui

일반적으로 캐시에서 데이터를 가져오고 지정된 스테이지를 다시 실행할 필요가 없음을 의미합니다. 다음 단계에서 셔플이 필요함을 보여주는 DAG와 일치합니다 ( `reduceByKey`). 셔플 링이있을 때마다 Spark는 자동으로 생성 된 데이터를 캐시합니다 .

Shuffle은 또한 디스크에 많은 수의 중간 파일을 생성합니다. Spark 1.3에서이 파일들은 해당 RDD가 더 이상 사용되지 않고 가비지 수집 될 때까지 보존됩니다. 이는 계보가 다시 계산 될 때 셔플 파일을 다시 만들 필요가 없도록하기 위해 수행됩니다.

job32


Executors
Added
Removed
Executor driver added
Executor 2 added
Executor 1 added
Executor 0 added
Stages
Completed
Failed
Active
09:40
09:45
09:50
09:55
10:00
10:05
10:10
10:15
10:20
10:25
10:30
Thu 18 April