Hive Bucketing in Apache Spark

Tejas Patil

Facebook

Agenda

- Why bucketing ?
- Why is shuffle bad ?
- How to avoid shuffle ?
- When to use bucketing ?
- Spark's bucketing support
- Bucketing semantics of Spark vs Hive
- Hive bucketing support in Spark
- SQL Planner improvements

Why bucketing ?

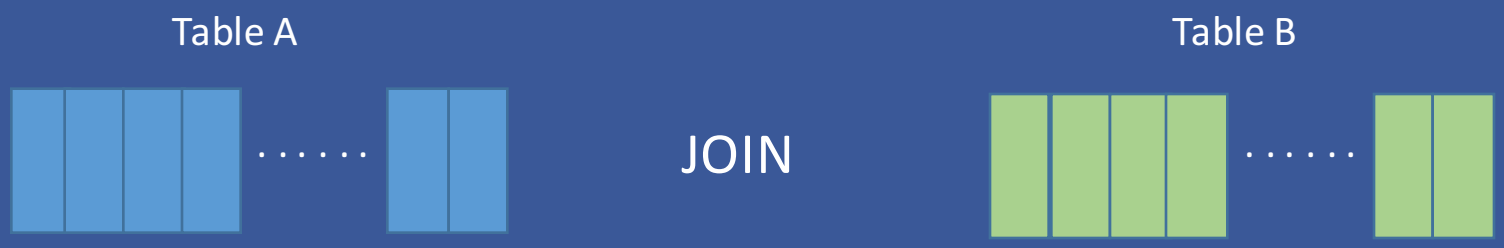
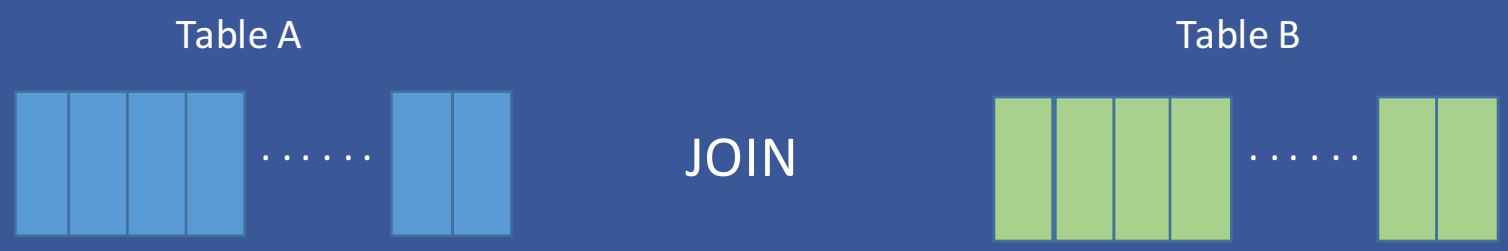
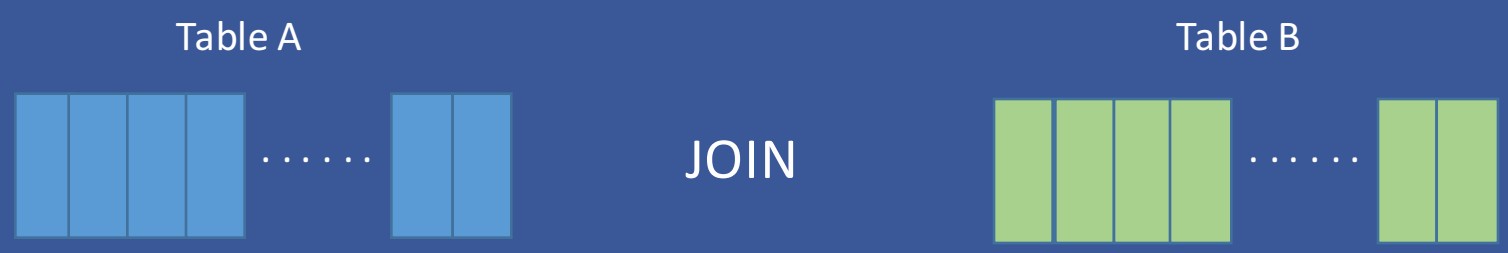


Table A
JOIN
Table B



Broadcast hash join

- Ship smaller table to all nodes
- Stream the other table



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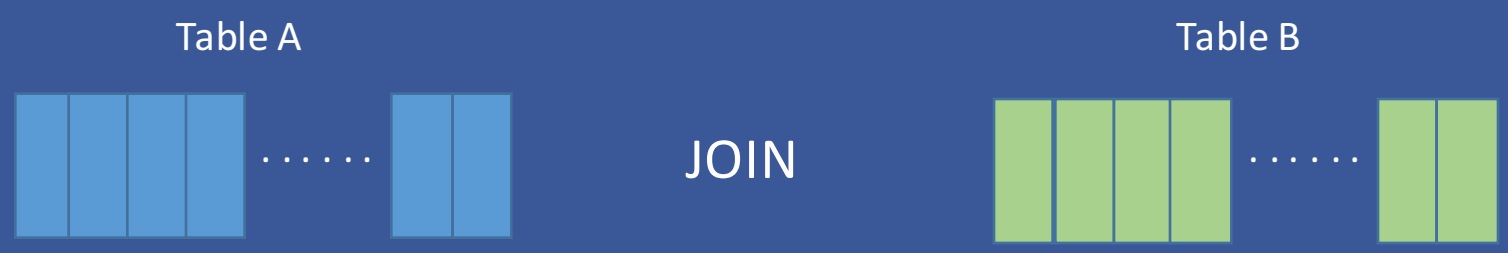

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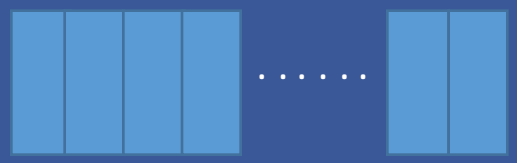

JOIN

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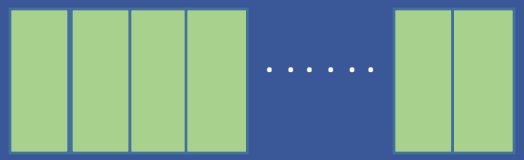

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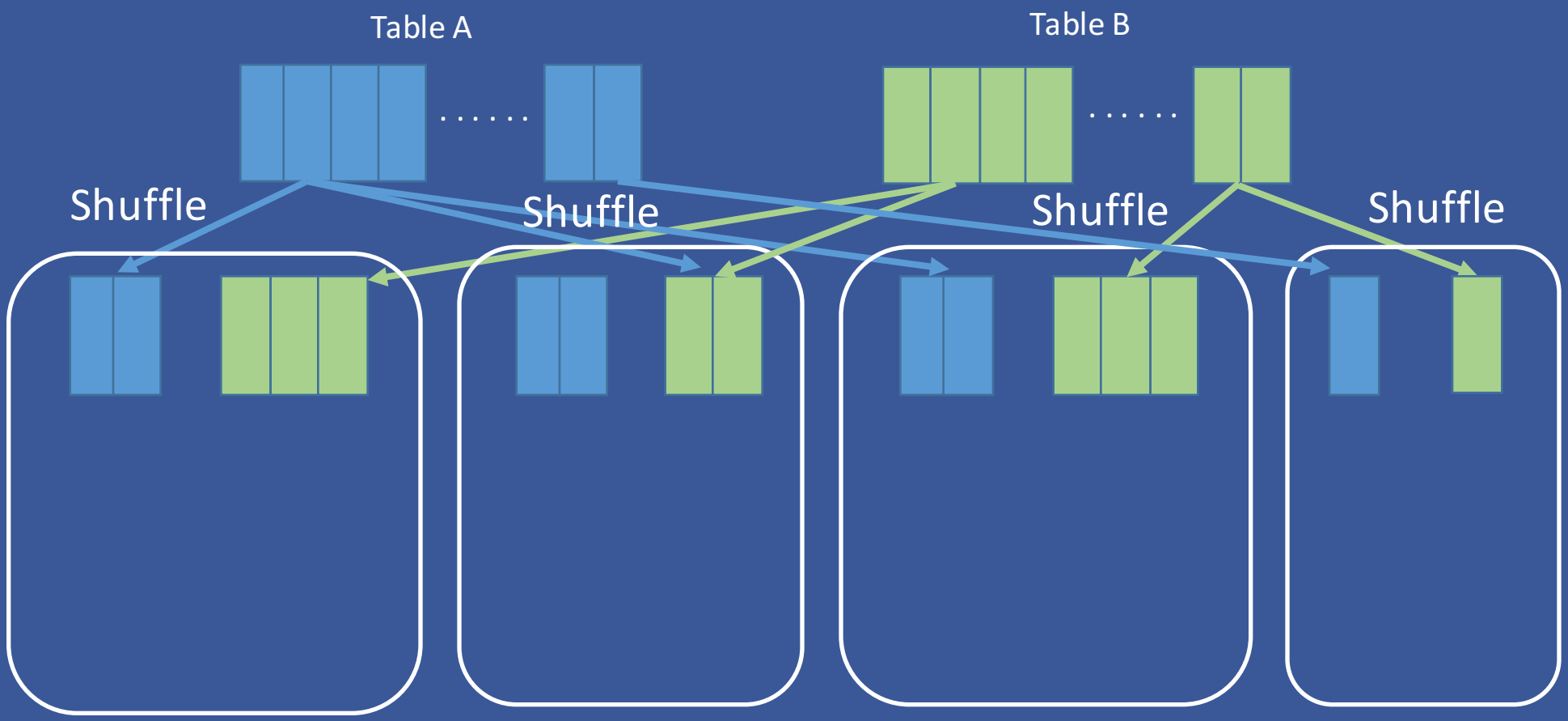

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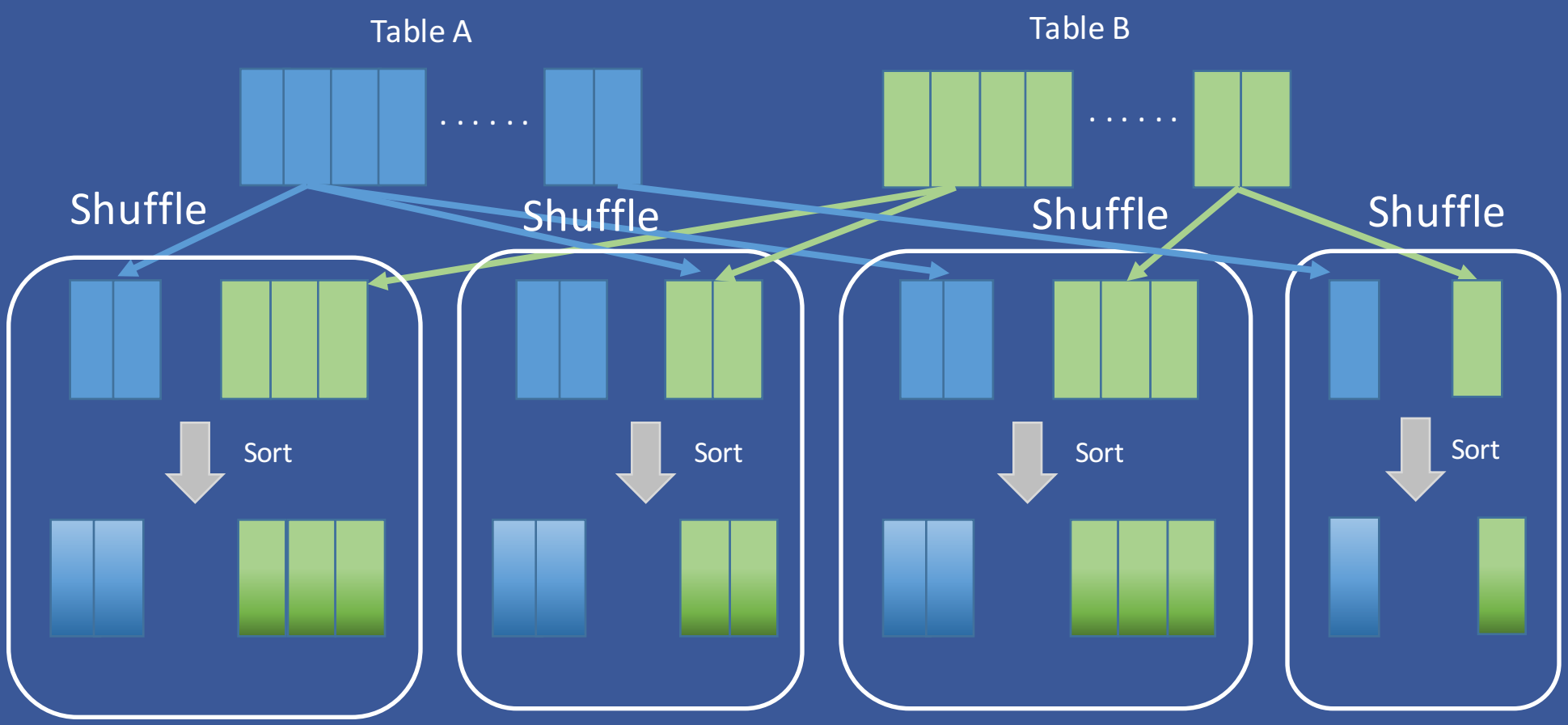

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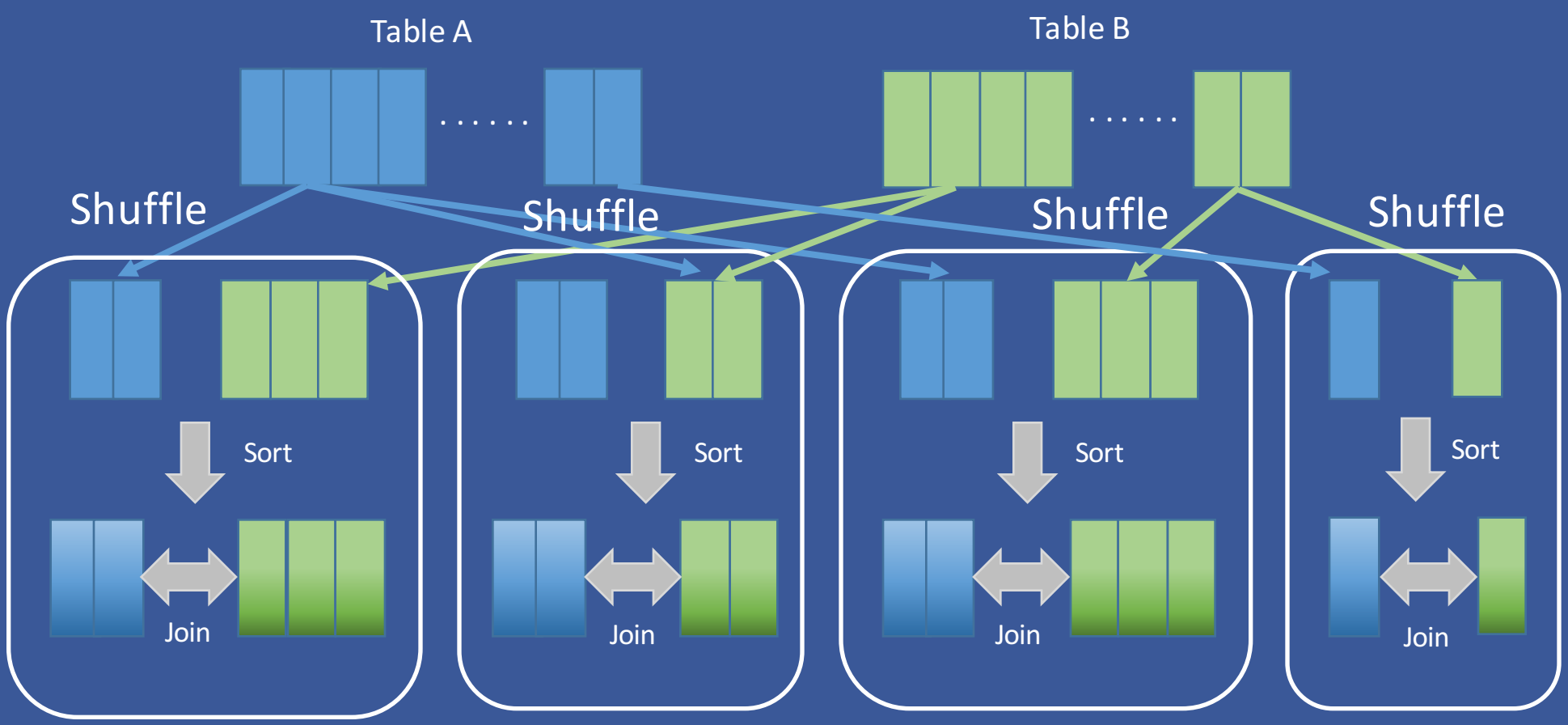

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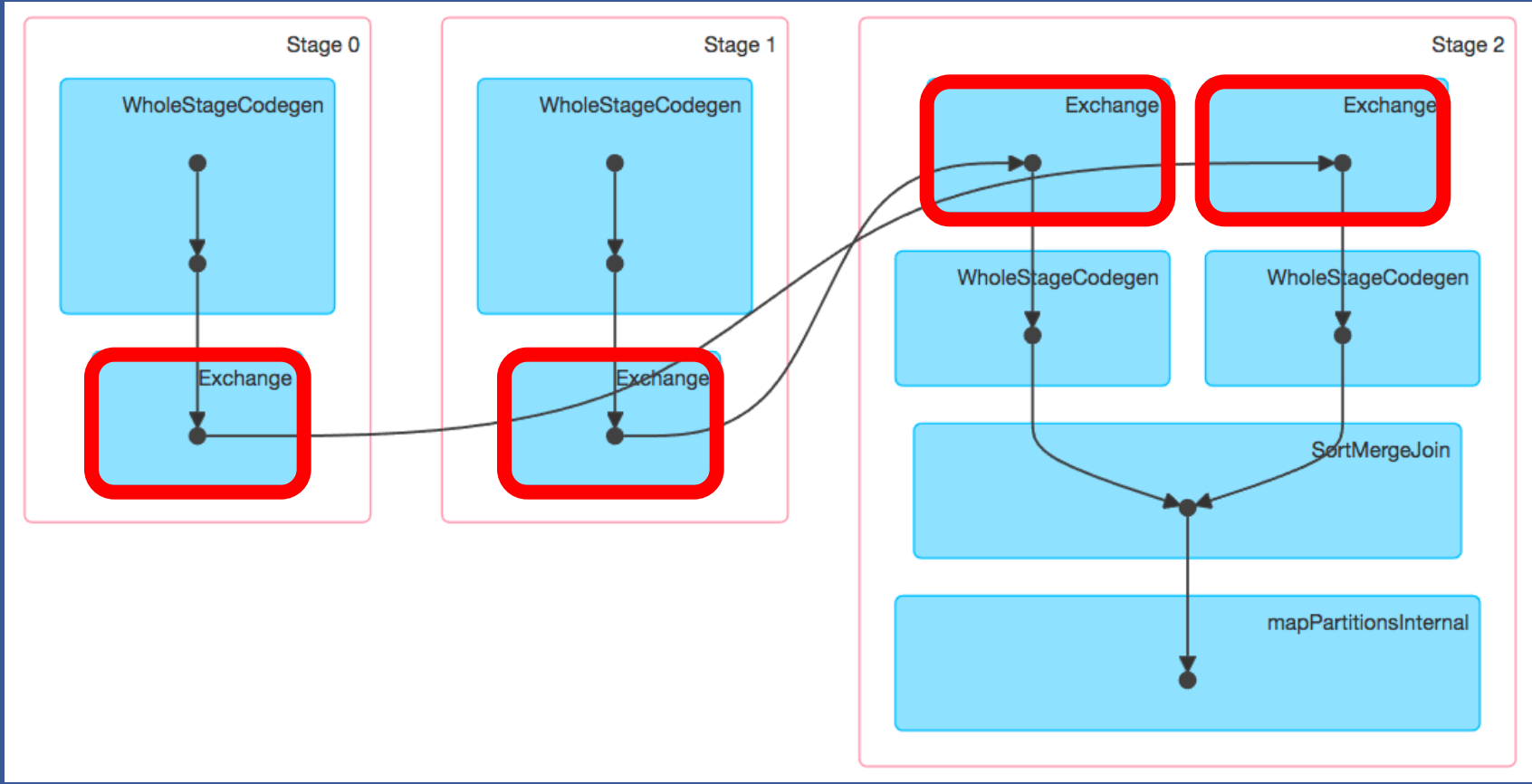

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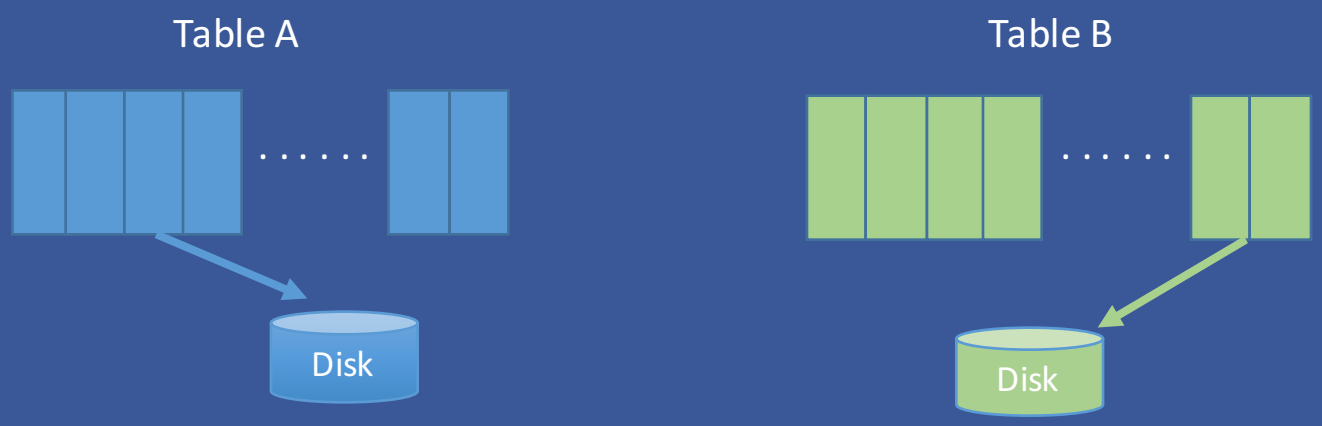
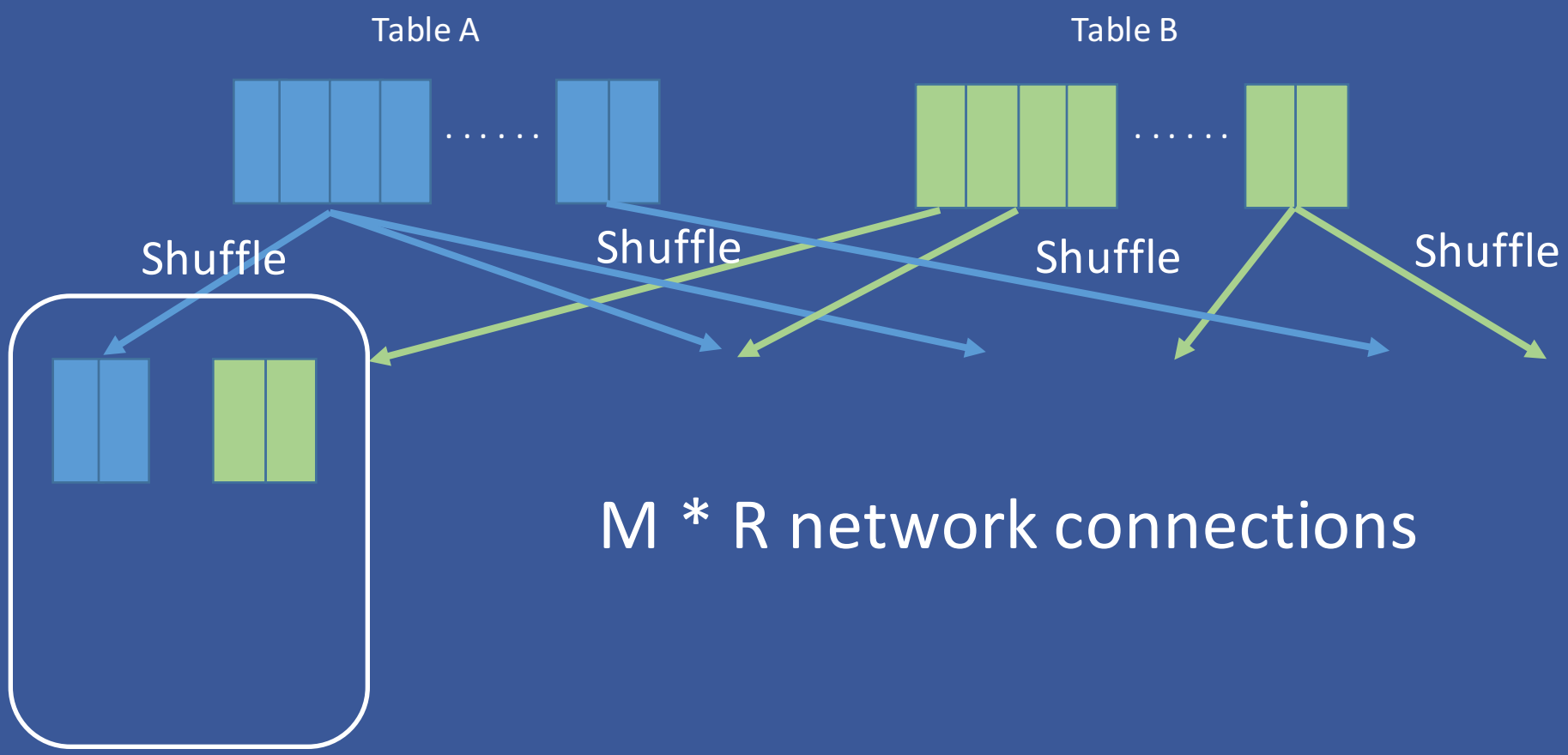


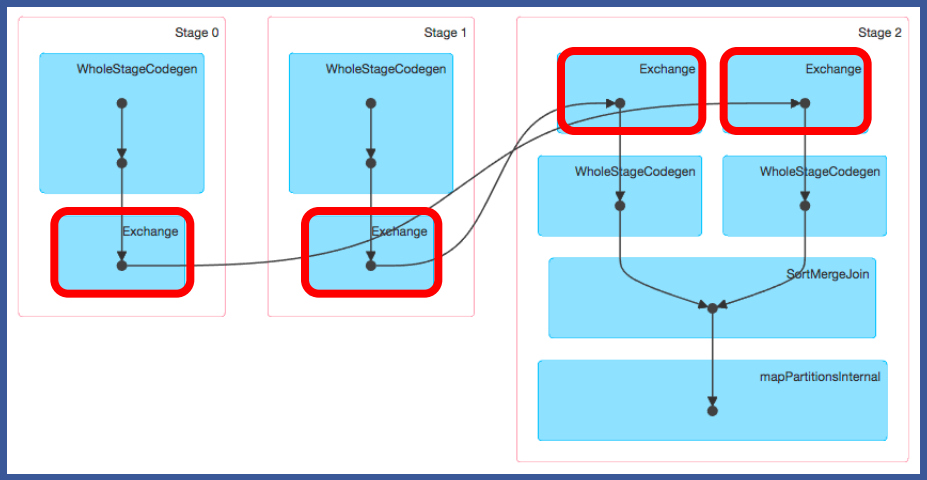
Disk IO for shuffle outputs

Why is shuffle bad ?



M * R network connections

How to avoid shuffle ?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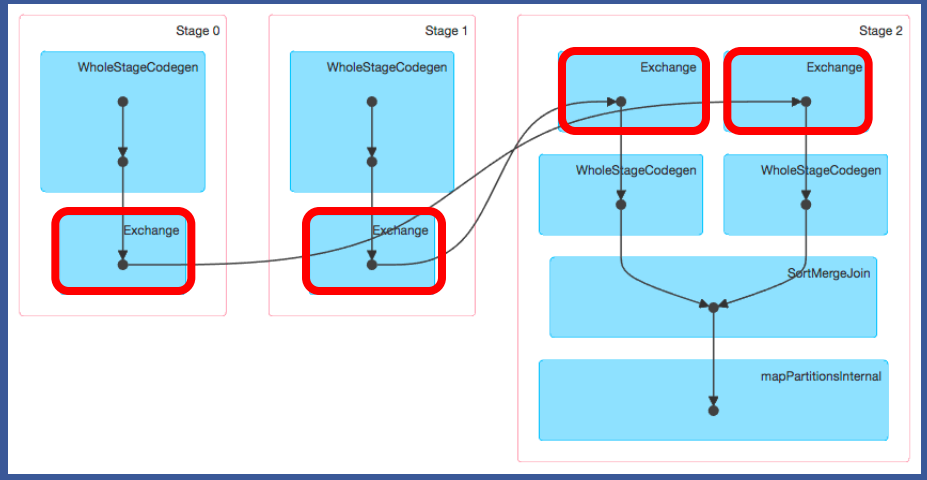
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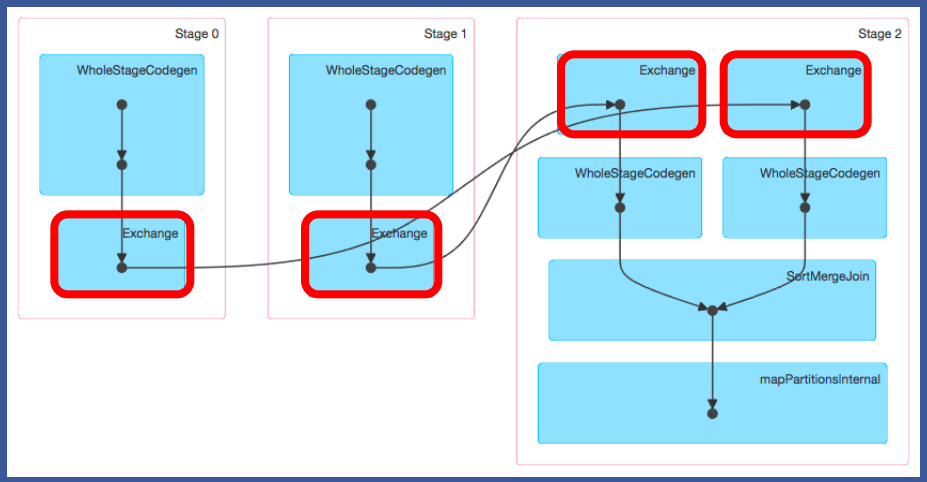
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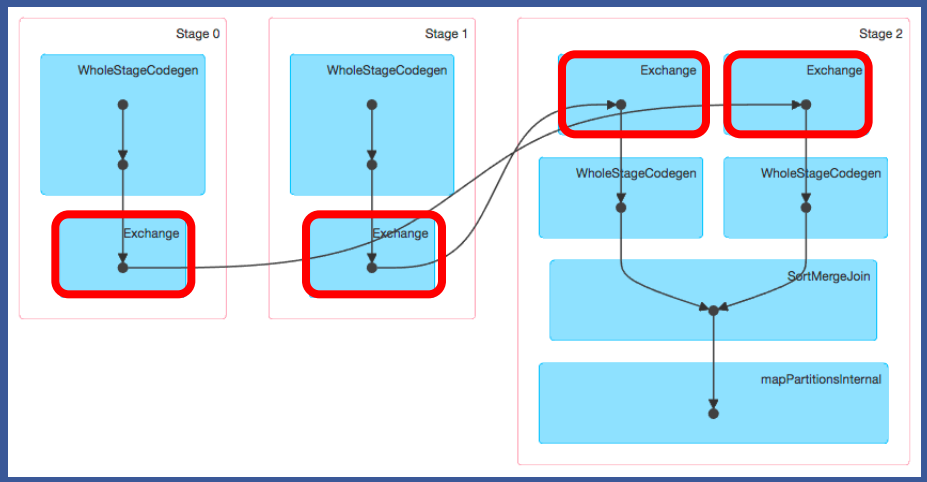
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ON s.id = a.student_id

student s JOIN results r
ON s.id = r.student_id

.....

.....

student s JOIN course_registration c
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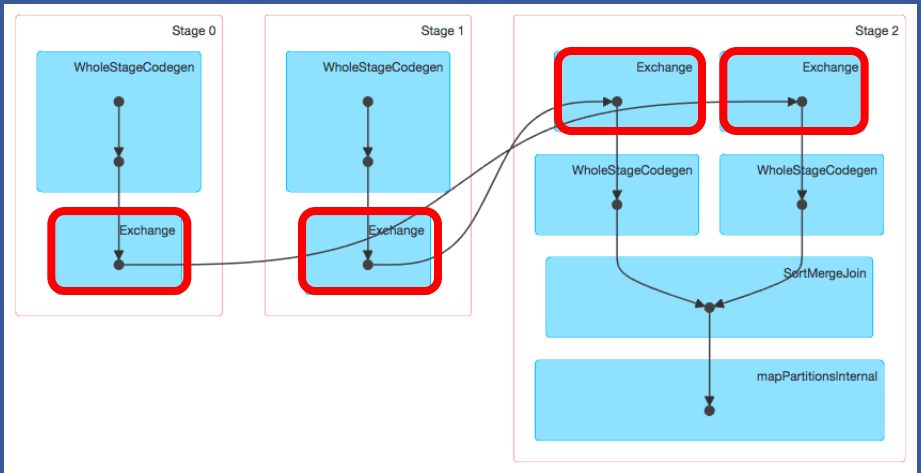

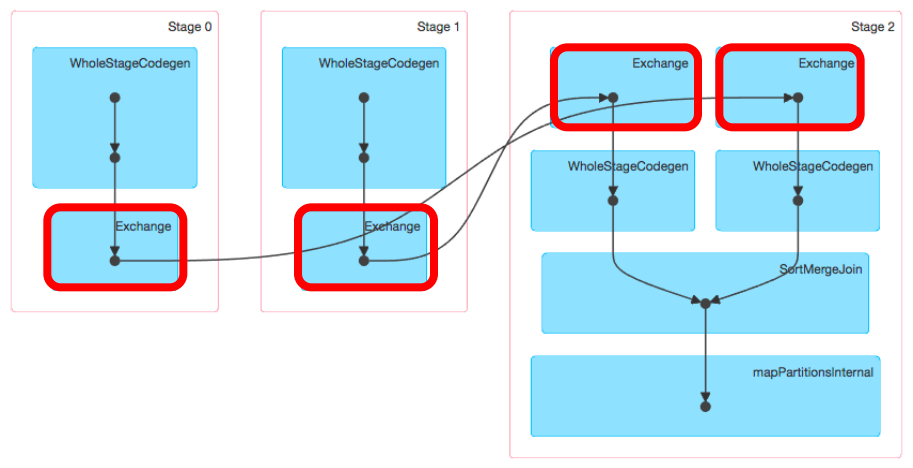

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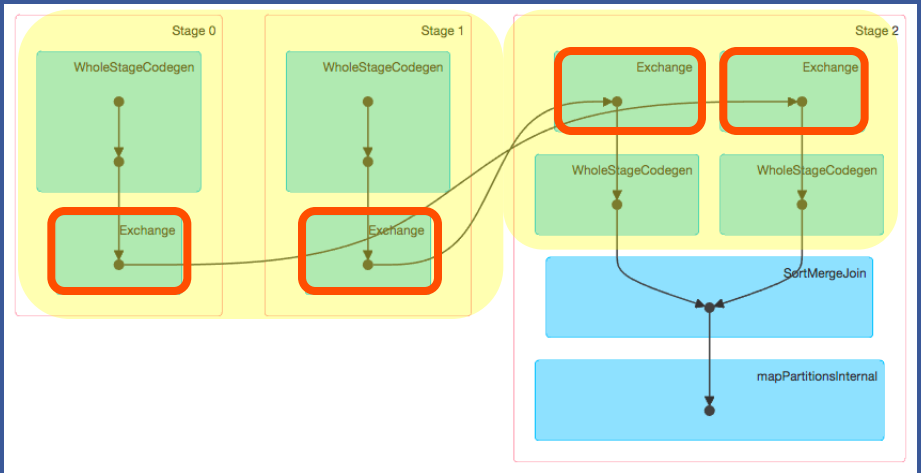

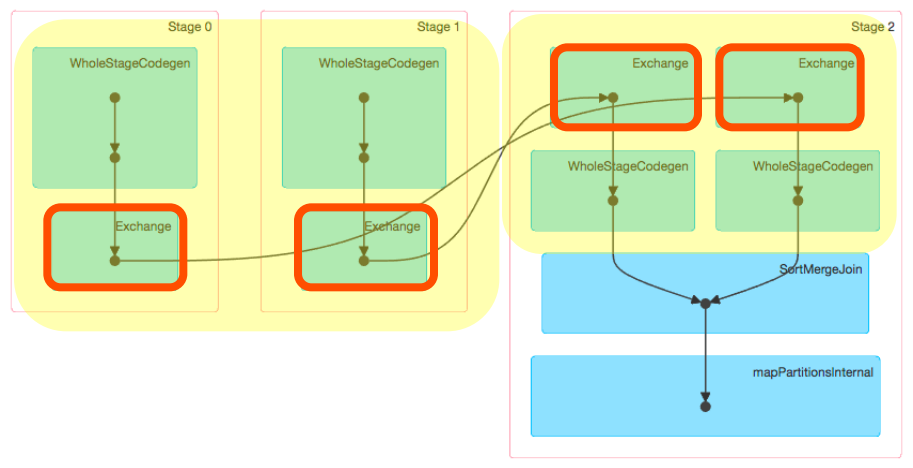

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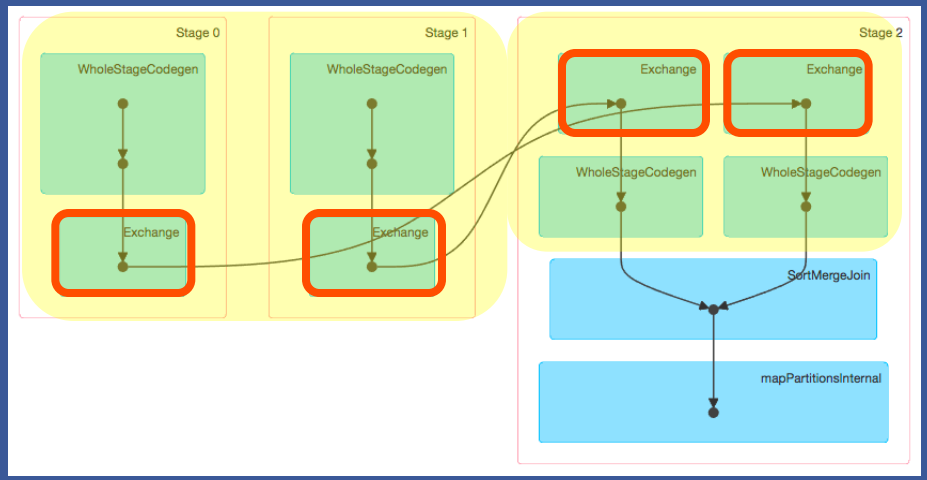
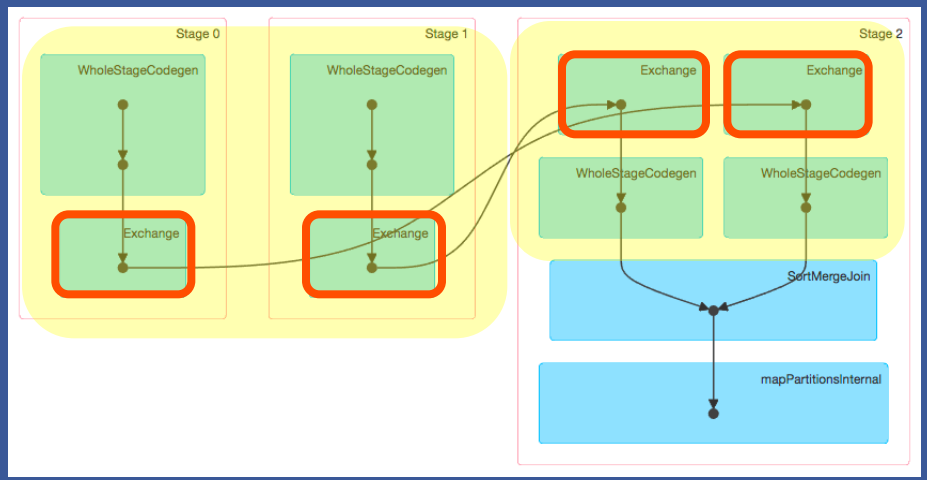
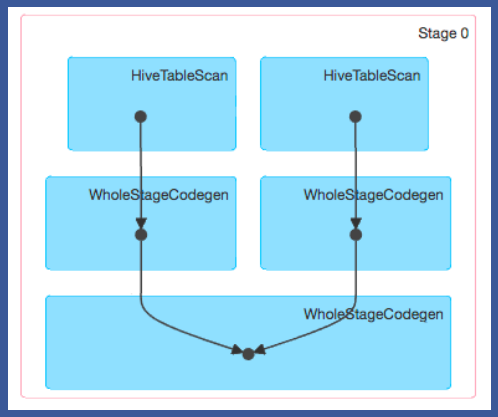
Pre-compute at
table creation

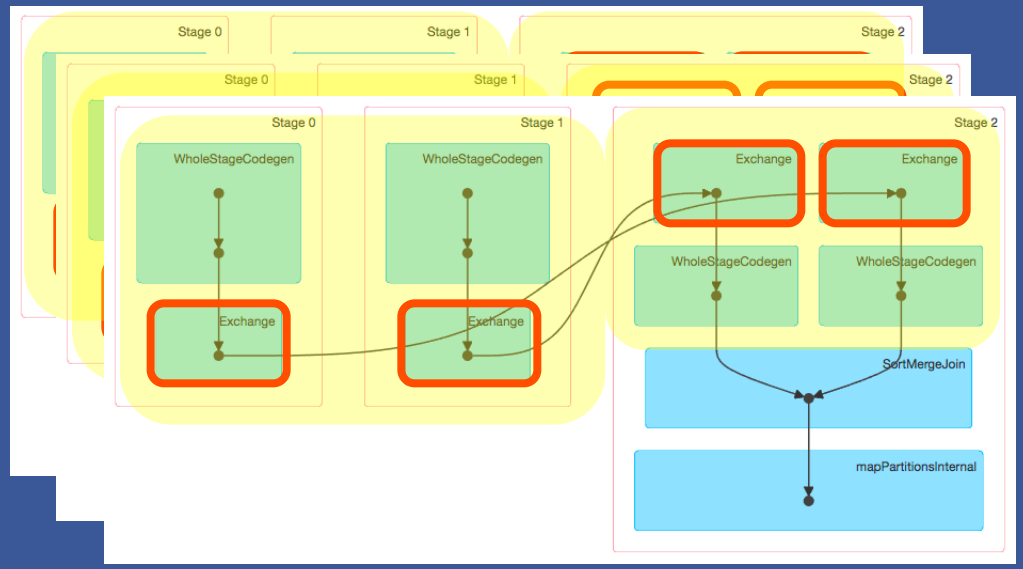




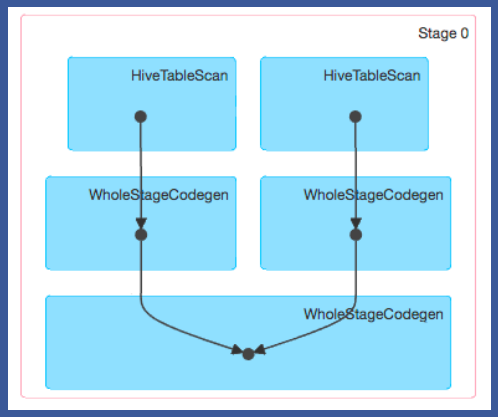
Bucketing =
pre-(shuffle + sort) inputs
on join keys



Without bucketing



Job(s) populating input table



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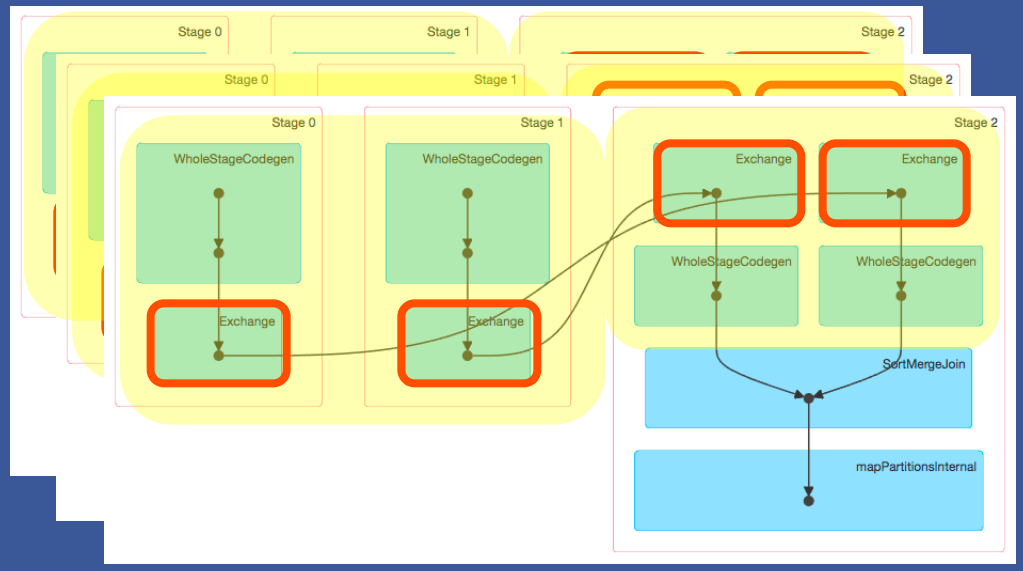

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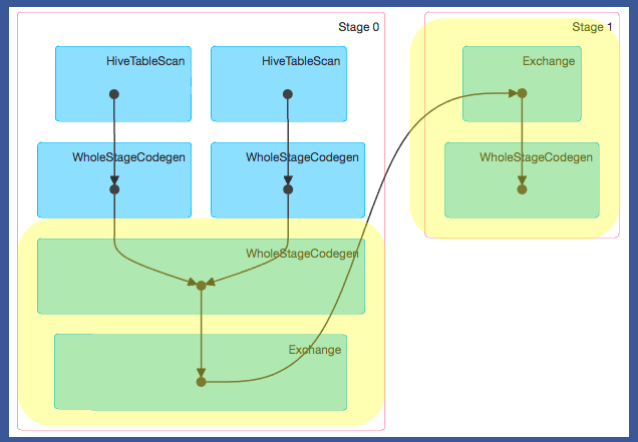
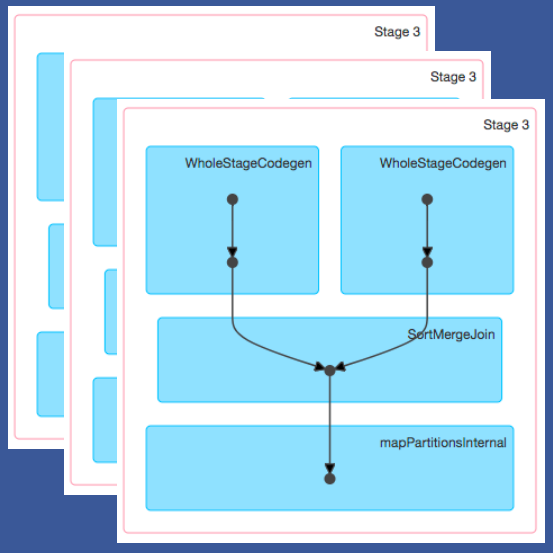
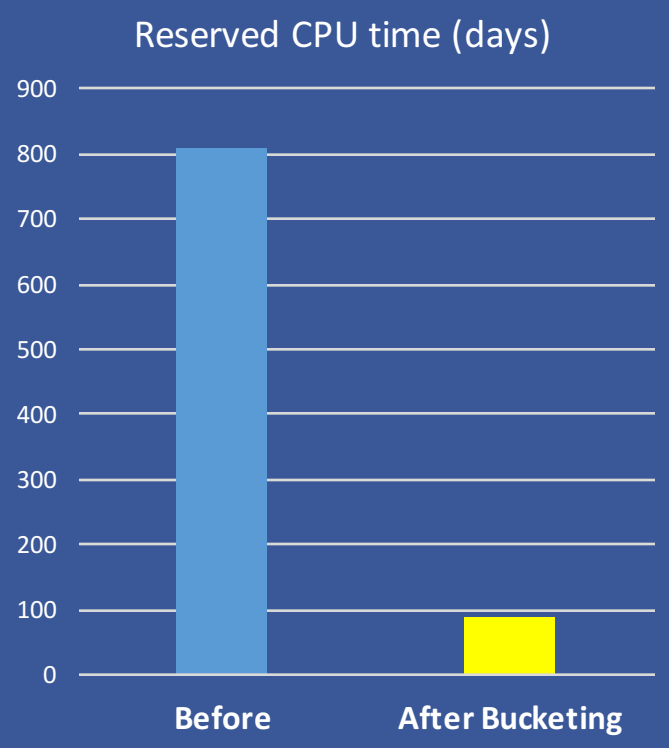
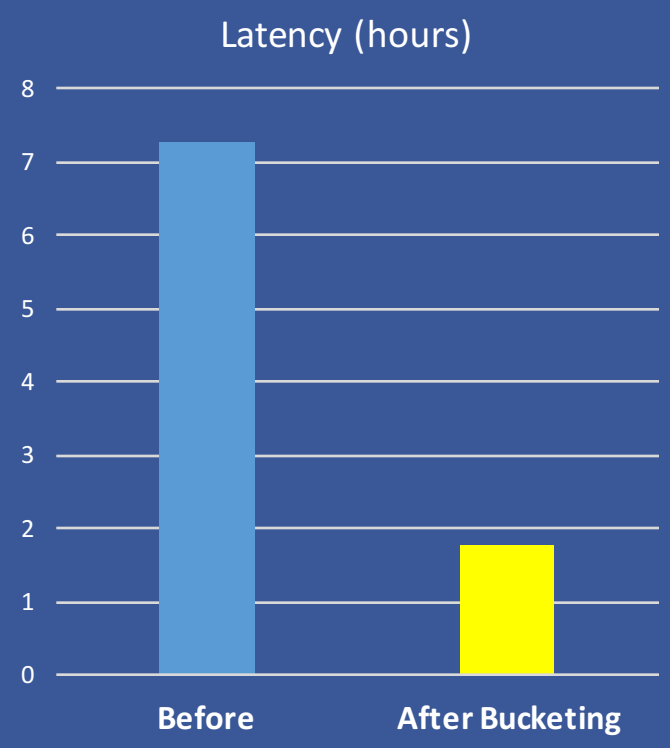


With bucketing



Performance comparison





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- Tables used frequently in JOINs with same key
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…. => Dimension tables

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- Indexing capability

Spark’s bucketing support

Spark / SPARK-12538

bucketed table support

Edit | Comment | Agile Board | More | Close Issue | Reopen Issue | Export

Details

Type:	New Feature	Status:	RESOLVED
Priority:	Major	Resolution:	Fixed
Affects Version/s:	None	Fix Version/s:	2.0.0
Component/s:	SQL		
Labels:	None		
Target Version/s:	2.0.0		

Description

cc Nong Li , please attach the design doc.

Issue Links

People

Assignee:	Wenchen Fan
Reporter:	Wenchen Fan
Votes:	0 Vote for this issue
Watchers:	5 Start watching this issue

Dates

Created:	28/Dec/15 05:54
Updated:	15/Jan/16 17:22
Resolved:	15/Jan/16 17:21

Creation of bucketed tables

via Dataframe API

```
df.write
  .bucketBy(numBuckets,  "col1", ...)
  .sortBy("col1", ...)
  .saveAsTable("bucketed_table")
```

Creation of bucketed tables

via SQL statement

```
CREATE TABLE bucketed_table(
   column1 INT,
   ...
) USING parquet
CLUSTERED BY (column1, ...)
SORTED BY (column1, ...)
INTO `n` BUCKETS
```

Check bucketing spec

```
scala> sparkContext.sql("DESC  FORMATTED student").collect.foreach(println)
[# col_name,data_type,comment]
[student_id,int,null]
[name,int,null]
[# Detailed Table Information,,]
[Database,default,]
[Table,table1,]
[Owner,tejas,]
[Created,Fri May 12 08:06:33  PDT 2017,]
[Type,MANAGED,]
[Num Buckets,64,]
[Bucket Columns,[`student_id`],]
[Sort Columns,[`student_id`],]
[Properties,[serialization.format=1],]
[Serde Library,org.apache.hadoop.hive.serde2.lazy.LazySimpleSerDe,]
[InputFormat,org.apache.hadoop.mapred.SequenceFileInputFormat,]
```

Bucketing config

```
SET spark.sql.sources.bucketing.enabled=true
```

[SPARK-15453] Extract bucketing info in FileSourceScanExec

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SELECT * FROM tableA JOIN tableB ON tableA.i= tableB.i AND tableA.j= tableB.j
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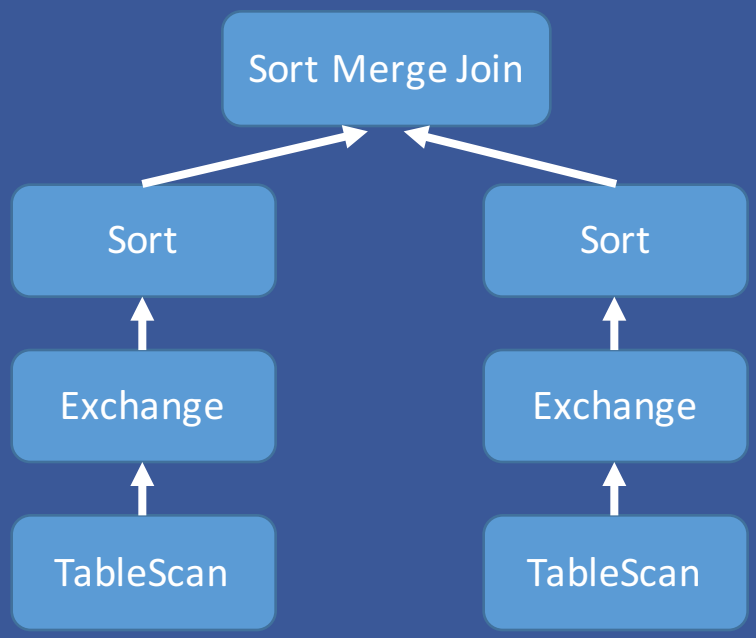

Join on [i,j], [i,j] respectively of relations

Sort on columns (i, j)

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Already bucketed on columns (i, j)

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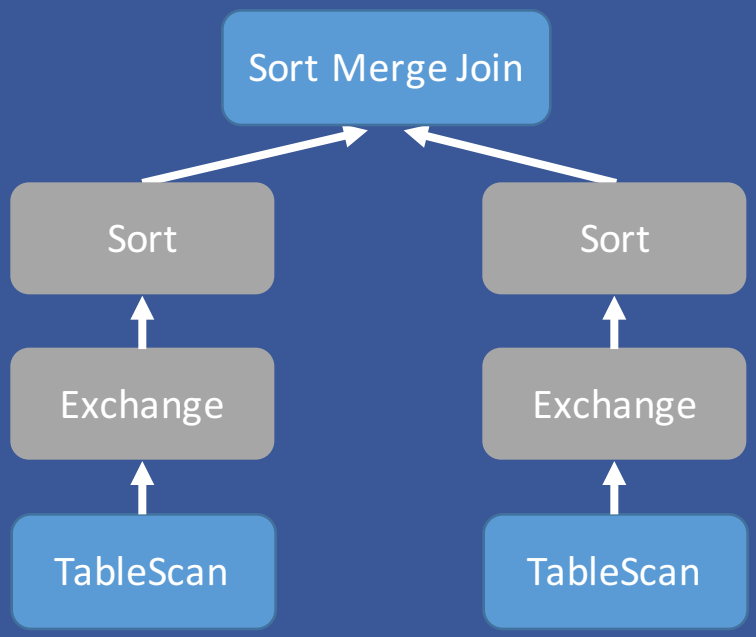

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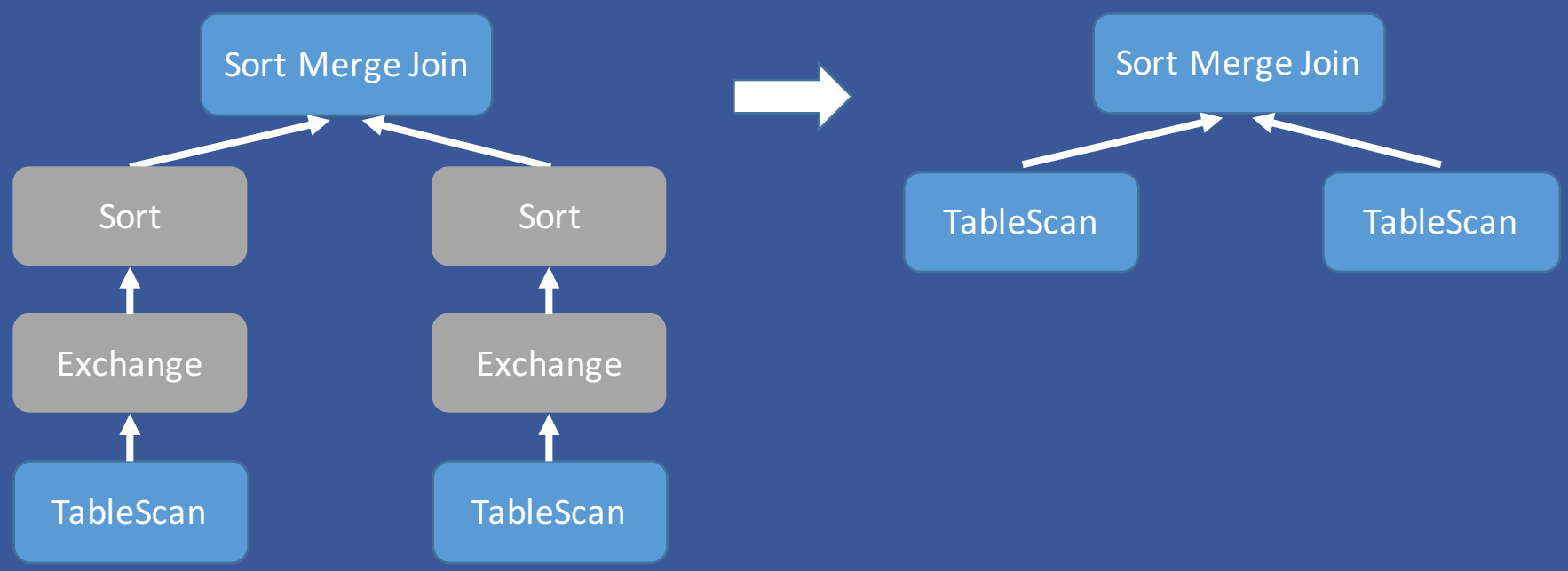

Bucketing semantics of Spark vs Hive

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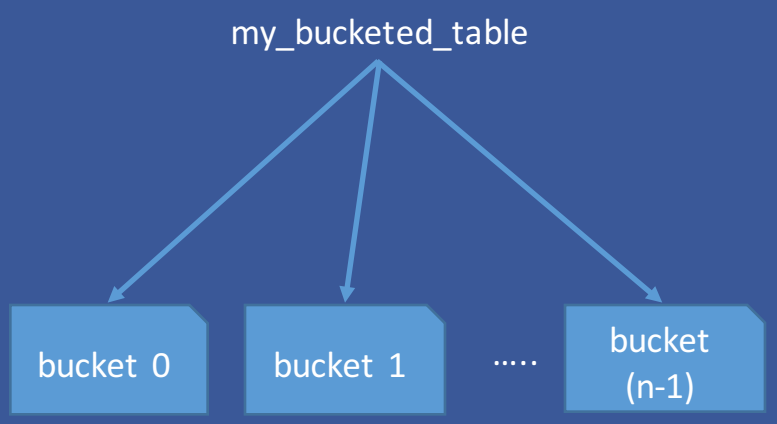
Hive



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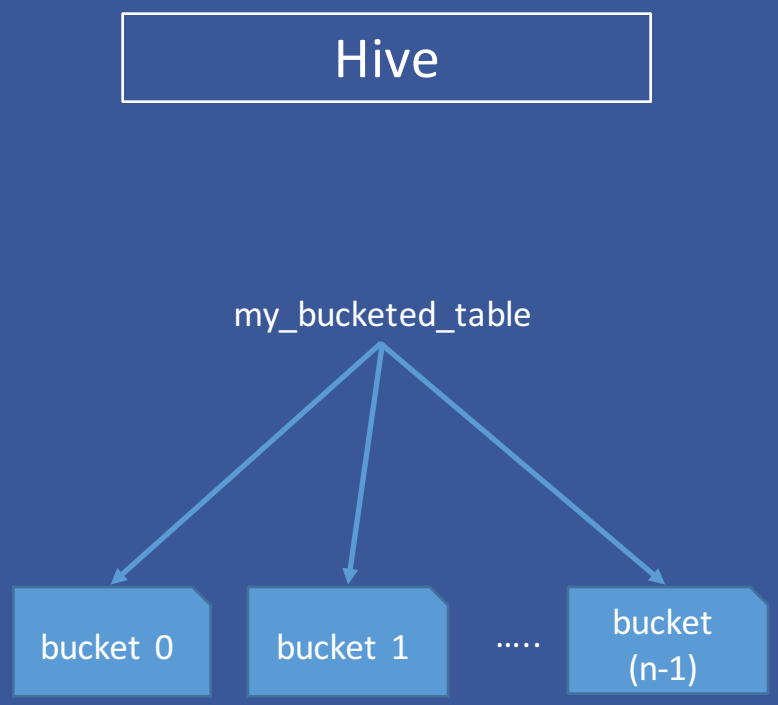

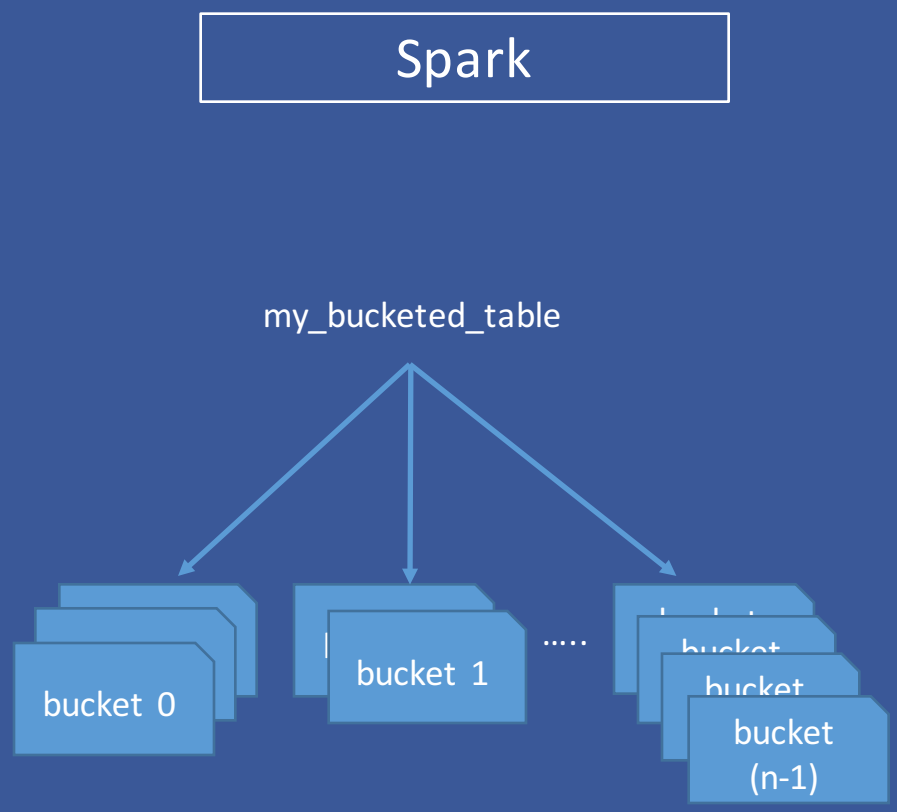

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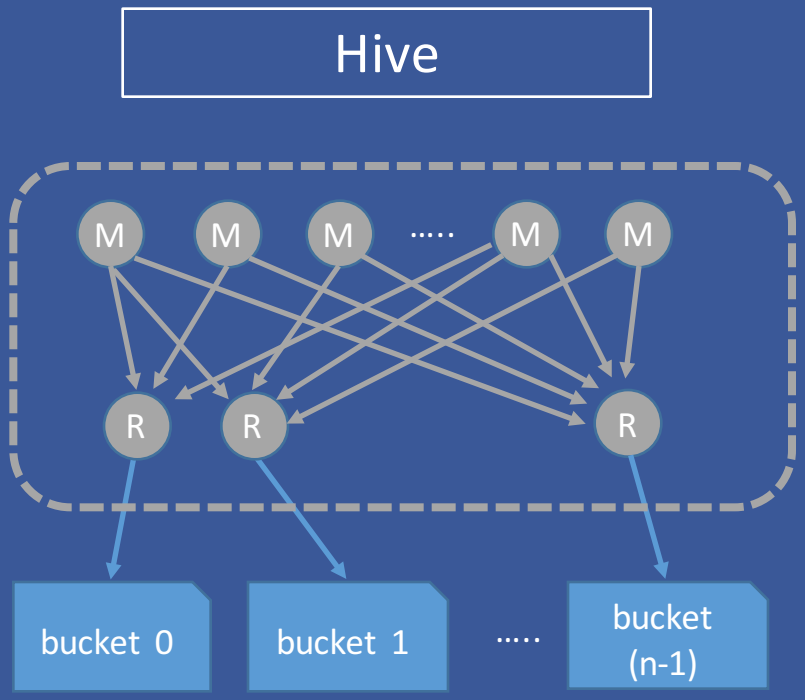

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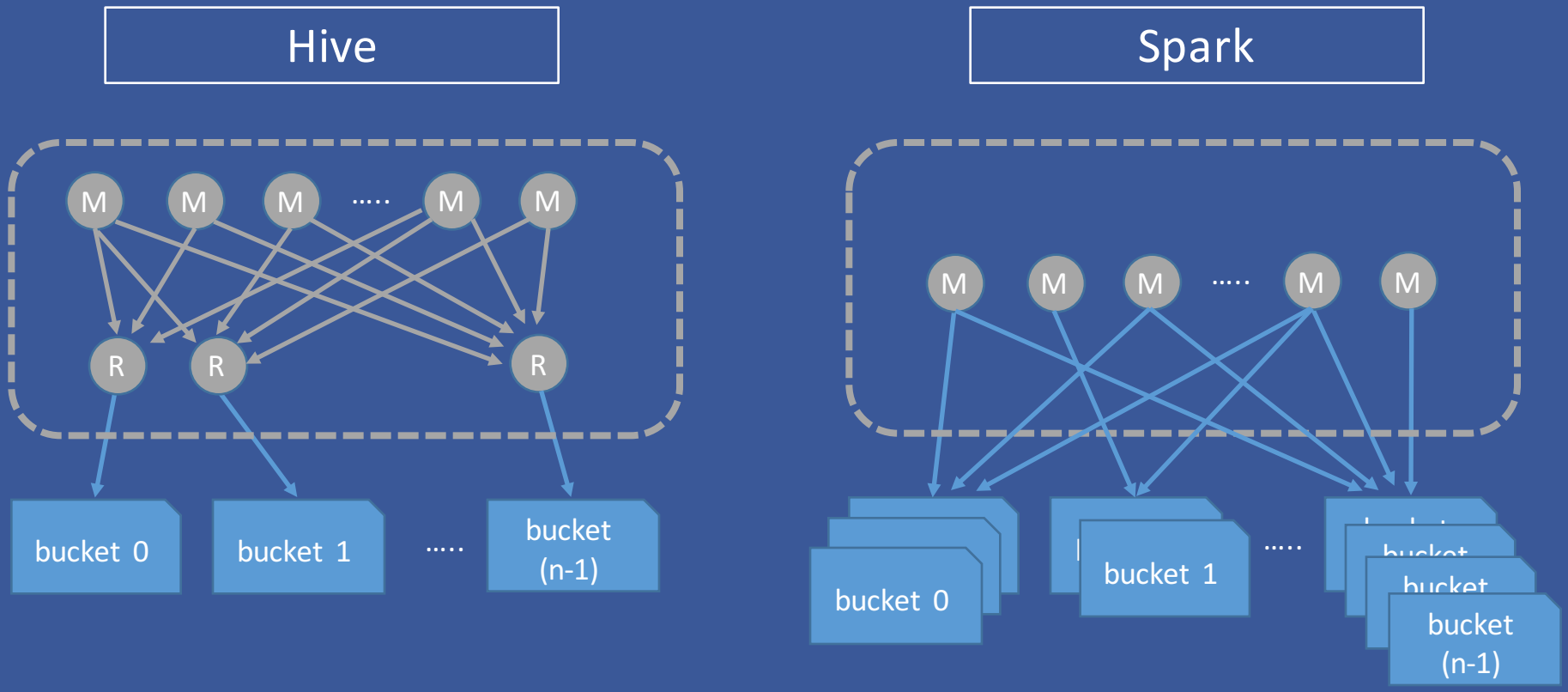

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Hashing function	Hive’s inbuilt hash	Murmur3Hash

[SPARK-19256] Hive bucketing support

- Introduce Hive's hashing function [SPARK-17495]
- Enable creating hive bucketed tables [SPARK-17729]
- Support Hive's `Bucketed file format`
- Propagate Hive bucketing information to planner [SPARK-17654]
  - Expressing outputPartitioning and requiredChildDistribution
  - Creating empty bucket files when no data for a bucket
- Allow Sort Merge join over tables with number of buckets multiple of each other
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Merged in upstream

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FB-prod (6 months)

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SQL Planner improvements

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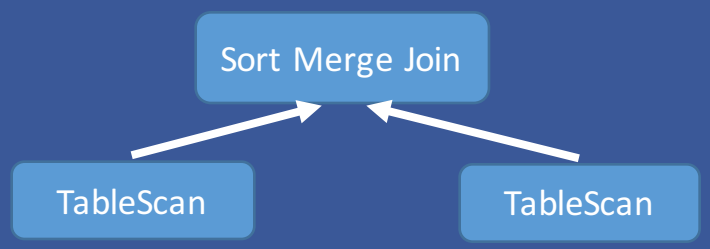

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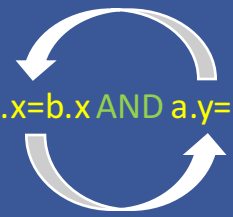

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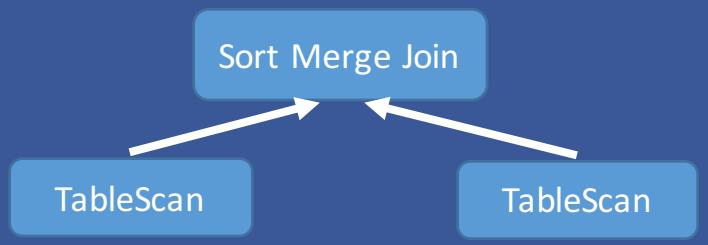
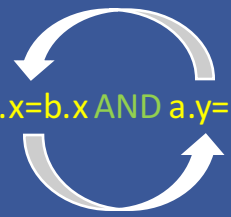
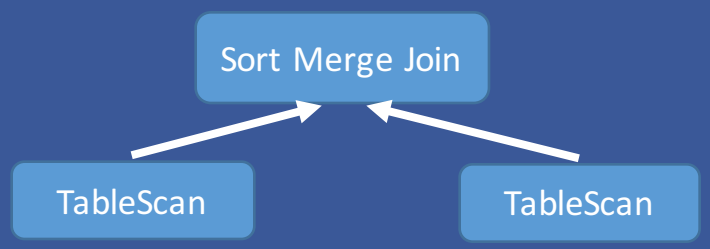


[SPARK-19122] Unnecessary shuffle+sort added if join predicates ordering differ from bucketing and sorting order

SELECT * FROM a JOIN b ON a.x=b.x AND a.y=b.y





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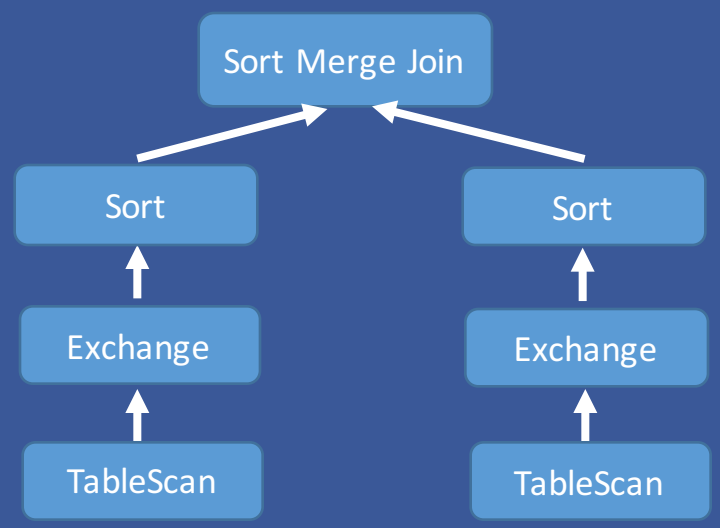

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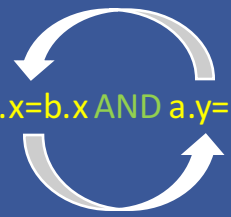

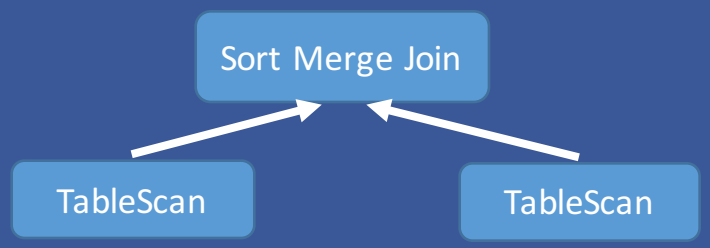

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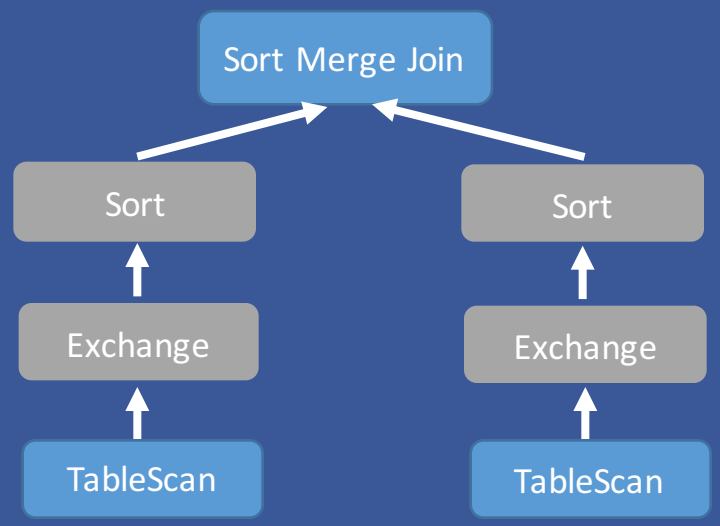

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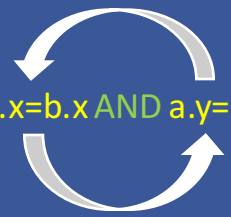

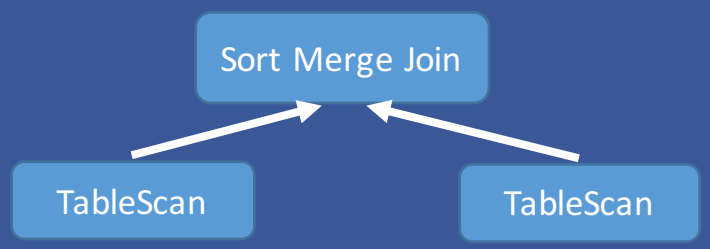

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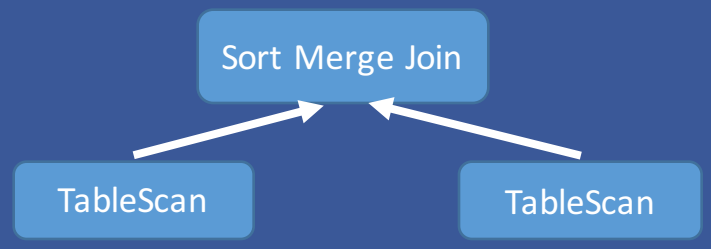

[SPARK-17271] Planner adds un-necessary Sort even if child ordering is semantically same as required ordering

```
SELECT * FROM table1 a JOIN table2 b ON a.col1=b.col1
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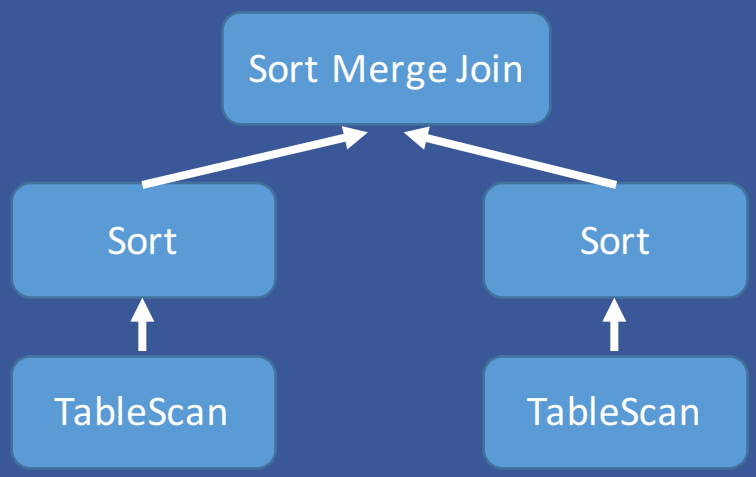
[SPARK-17271] Planner adds un-necessary Sort even if child ordering is semantically same as required ordering

SELECT * FROM table1 a JOIN table2 b ON a.col1=b.col1



Join on [col1], [col1] respectively of relations

Sort on columns (a.col1 and b.col1)

Already bucketed on column `col1`

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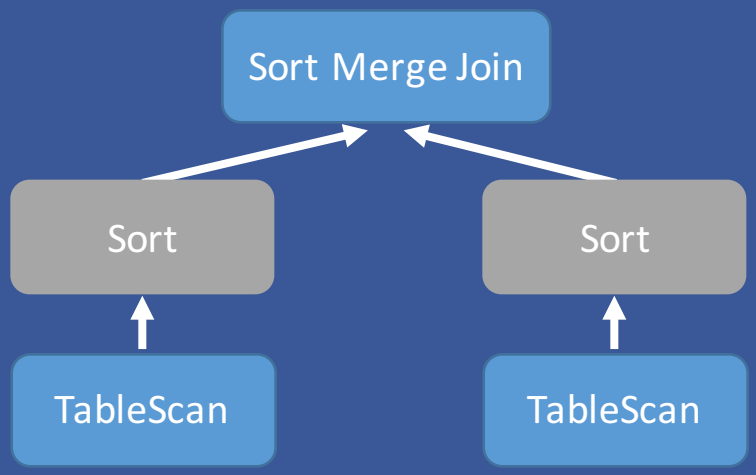

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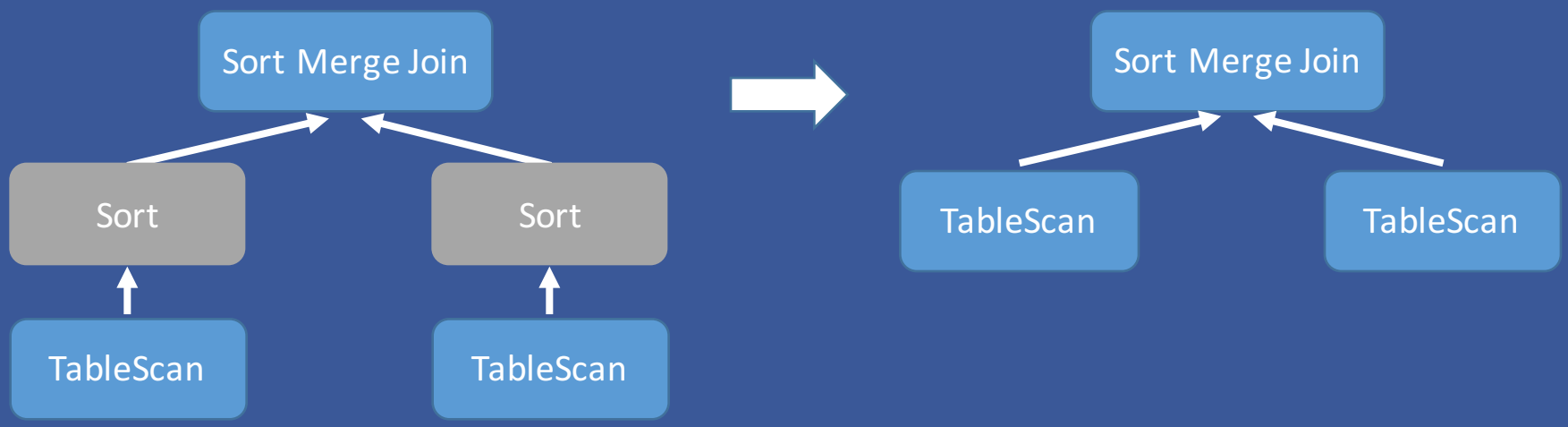
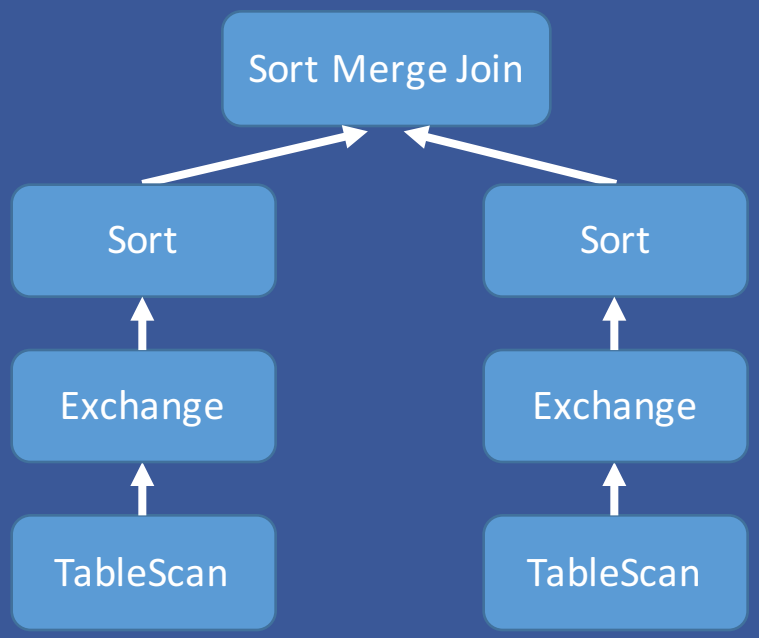


[SPARK-17698] Join predicates should not contain filter clauses

```
SELECT a.id, b.id FROM table1 a FULL OUTER JOIN table2 b ON a.id = b.id AND a.id='1' AND b.id='1'
```

[SPARK-17698] Join predicates should not contain filter clauses

SELECT a.id, b.id FROM table1 a FULL OUTER JOIN table2 b ON a.id = b.id AND a.id='1' AND b.id='1'



Join on [id, id, 1], [id, 1, id] respectively of relations

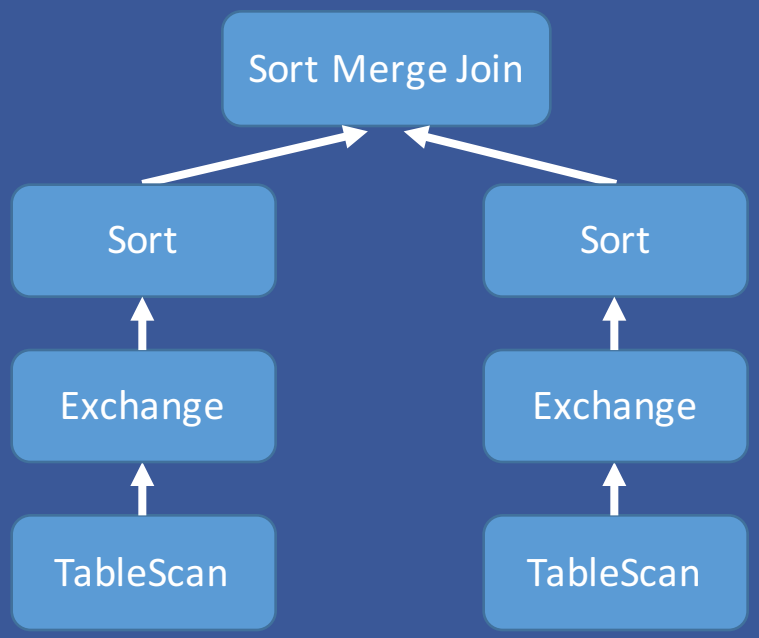
Sort on columns [id, id, 1] and [id, 1, id]

Shuffle on columns [id, 1, id] and [id, id, 1]

Already bucketed on column [id]

[SPARK-17698] Join predicates should not contain filter clauses

SELECT a.id, b.id FROM table1 a FULL OUTER JOIN table2 b ON **a.id = b.id** AND **a.id='1'** AND **b.id='1'**



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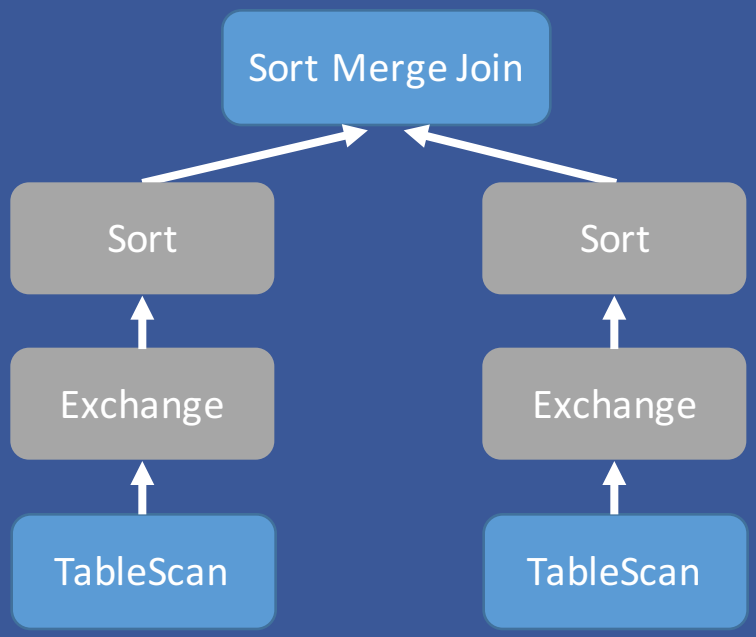

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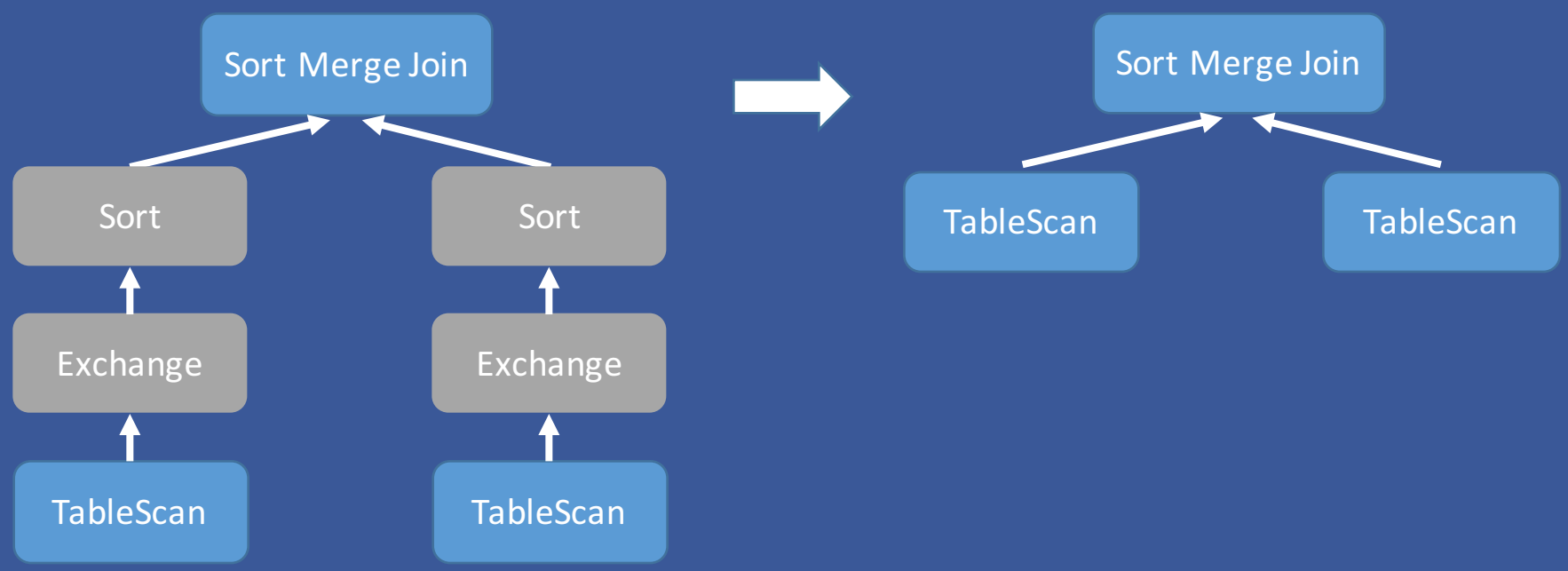

[SPARK-13450] Introduce ExternalAppendOnlyUnsafeRowArray

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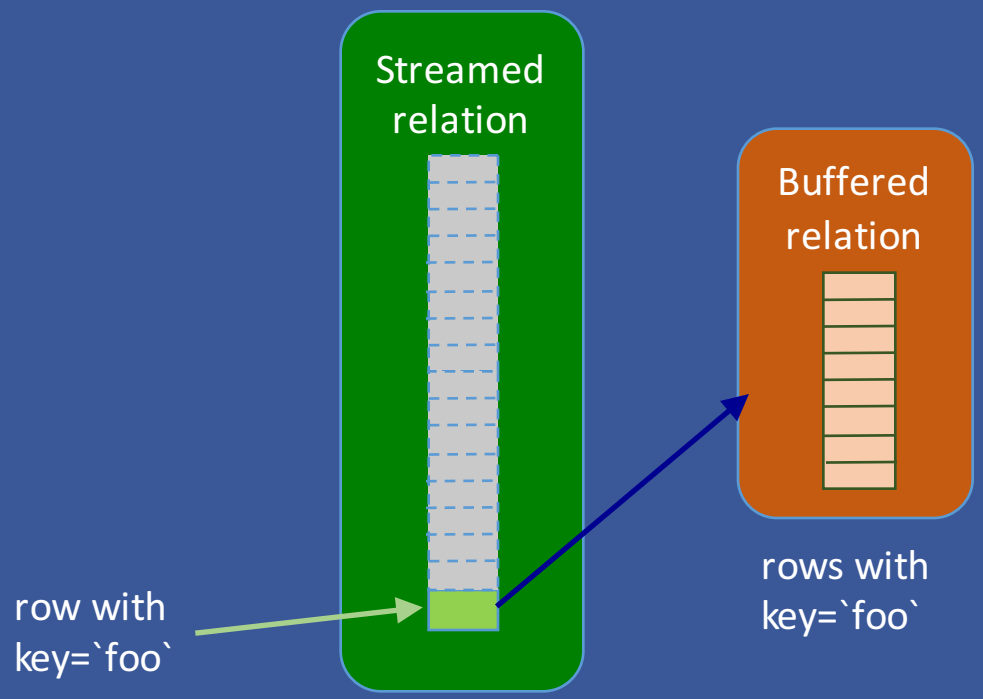
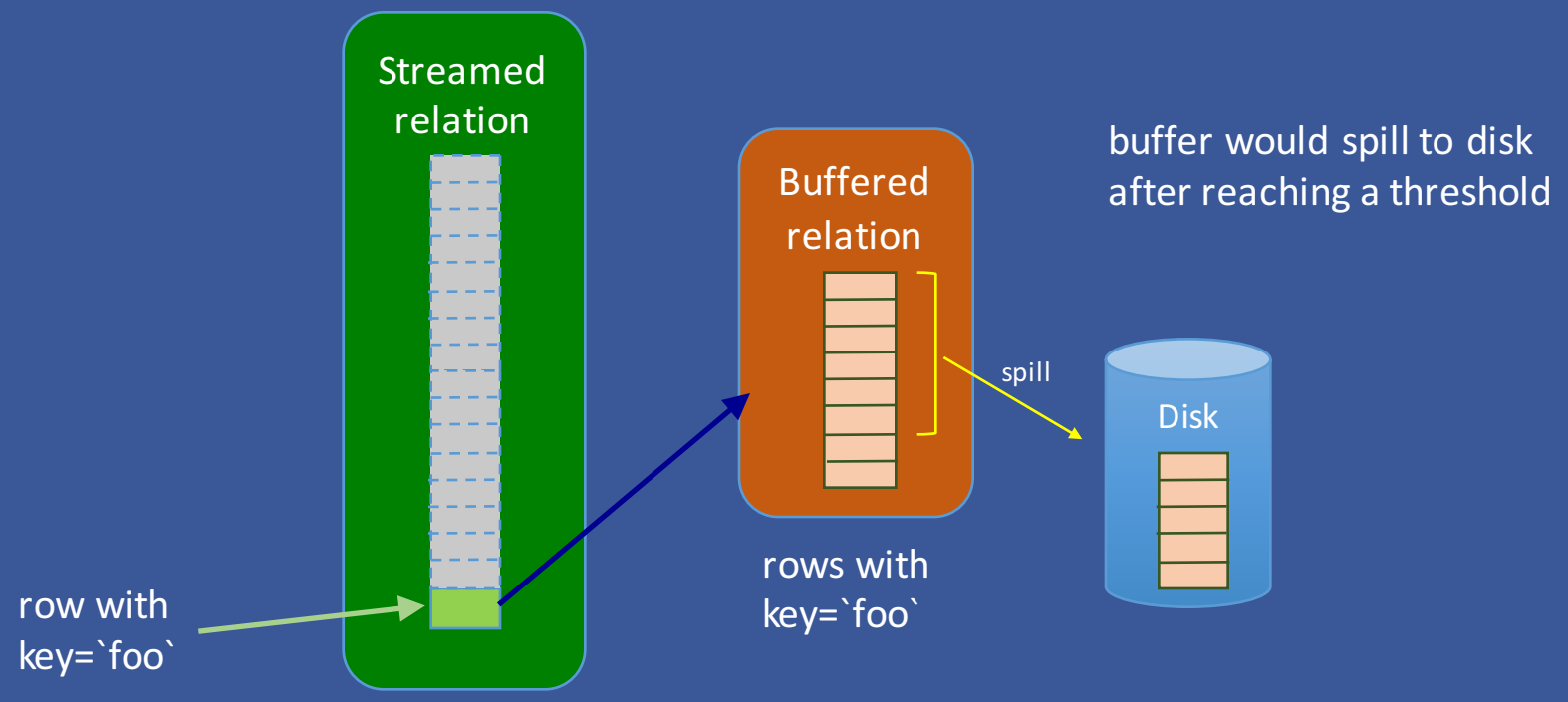


If there are a lot of rows to be buffered (eg. Skew), the query would OOM

[SPARK-13450] Introduce ExternalAppendOnlyUnsafeRowArray



Summary

- Shuffle and sort is costly due to disk and network IO
- Bucketing will pre-(shuffle and sort) the inputs
- Expect at least 2-5x gains after bucketing input tables for joins
- Candidates for bucketing:
  - Tables used frequently in JOINs with same key
  - Loading of data in cumulative tables
- Spark's bucketing is not compatible with Hive's bucketing

Questions ?