CS 378 – Big Data Programming

Lecture 12

Join Patterns

Review

- Assignment 5 – User Sessions

- We'll look at implementation details of:
  - Parsing logs
  - Avro schema
  - Populating Avro object with data
  - Mapper
  - Combiner
    - Should we use one? Can we use one?
  - Reducer

Assignment 5

- User Sessions
- Our user sessions have redundant data
  - VIN, make, model, year, features, …
- What could we do to reduce redundant data?
  - Would this make a combiner more useful?

Join Patterns

- It is almost always the case that our "big data" is coming from multiple sources
  - Web logs (of different types)
  - Databases (RDBMS, column-oriented DB, NoSQL, …)
  - Key/value store (redis, …)
  - …
- And we need to combine/integrate this data for
  - Reporting, analysis, BI, ETL, …

Join Patterns

- We're familiar with "join" in RDBMS (using SQL)
  - Aren't we?

- A join combines data from two or more data sets
  - Based on a field or set of fields – the *foreign key*
  - In RDBMS, the *foreign key* field matches values in the column of another table
  - Effectively a cross-reference between two or more tables

Join Example

Tables 5-1, 5-2 from MapReduce Design Patterns

Table 5-1. Table A

User ID	Reputation	Location
3	3738	New York, NY
4	12946	New York, NY
5	17556	San Diego, CA
9	3443	Oakland, CA

Table 5-2. Table B

User ID	Post ID	Text
3	35314	Not sure why this is getting downvoted.
3	48002	Hehe, of course, it's all true!
5	44921	Please see my post below.
5	44920	Thank you very much for your reply.
8	48675	HTML is not a subset of XML!

Join Example – Inner Join

Table 5-3 from MapReduce Design Patterns

A.User ID	A.Reputation	A.Location	B.User ID	B.Post ID	B.Text
3	3738	New York, NY	3	35314	Not sure why this is getting downvoted.
3	3738	New York, NY	3	48002	Hehe, of course, it's all true!
5	17556	San Diego, CA	5	44921	Please see my post below.
5	17556	San Diego, CA	5	44920	Thank you very much for your reply.

Join Example – Left Outer Join

Table 5-4 from MapReduce Design Patterns

A.User ID	A.Reputation	A.Location	B.User ID	B.Post ID	B.Text
3	3738	New York, NY	3	35314	Not sure why this is getting downvoted.
3	3738	New York, NY	3	48002	Hehe, of course, it's all true!
4	12946	New York, NY	null	null	null
5	17556	San Diego, CA	5	44921	Please see my post below.
5	17556	San Diego, CA	5	44920	Thank you very much for your reply.
9	3443	Oakland, CA	null	null	null

Reduce Side Join

- The simplest implementation of mapReduce join is the *reduce side join*

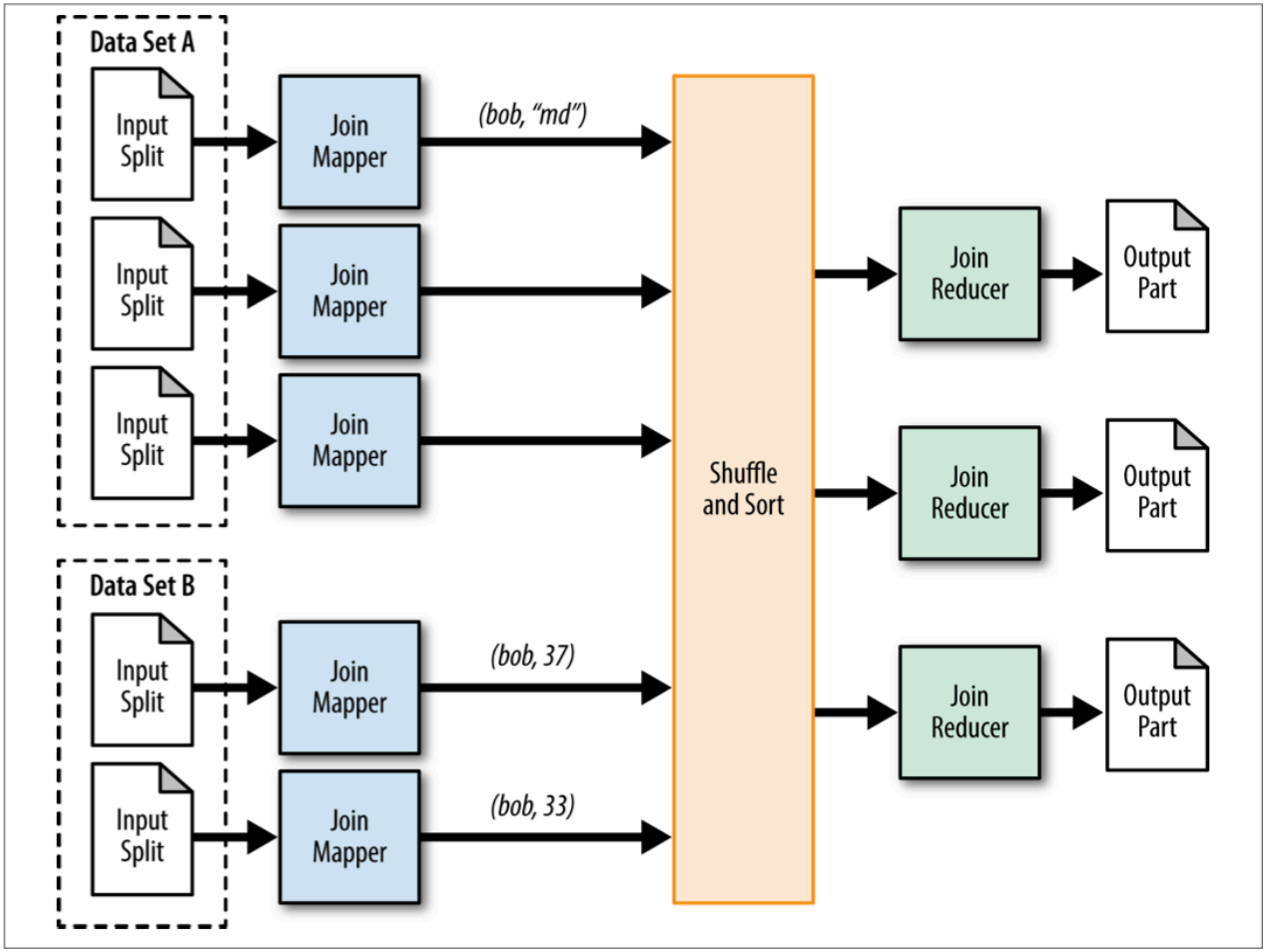
- Reduce side join can accomplish any of the joins we discussed
  - Inner join, full outer join, left outer join, right outer join
  - Anti-join, full Cartesian product
- Requires that all data be sent over the network to reducers
- Can join as many data sets as you need (need a common key)

Reduce Side Join - Steps

- Mapper reads its data source, extracts *foreign key*
  - Foreign key output as the key, input record as value
- A partitioner can be used
  - If you understand the key distribution
  - Want to equally distribute keys across reducers
- Reducer performs the join operation
  - Inner join, outer join, …..

Reduce Side Join - Data Flow

Figure 5-1 from MapReduce Design Patterns



MultipleInputs

- The `MultipleInputs` class allows different mappers to handle different input data
- The reducer requires the key and value from each mapper to be the same type
- How do we get the different mappers to send objects of the same type to reduce?
  - When each mappers is processing a different data source

Reduce Side Join - Example

- Join multiple sources of data
  - User sessions
  - Other impression data
- Key is VIN (vehicle identification number)
  - Combine VIN impression data from multiple sources
- Join output is VIN impression stats with
  - Stats from user sessions
  - Stats from another source

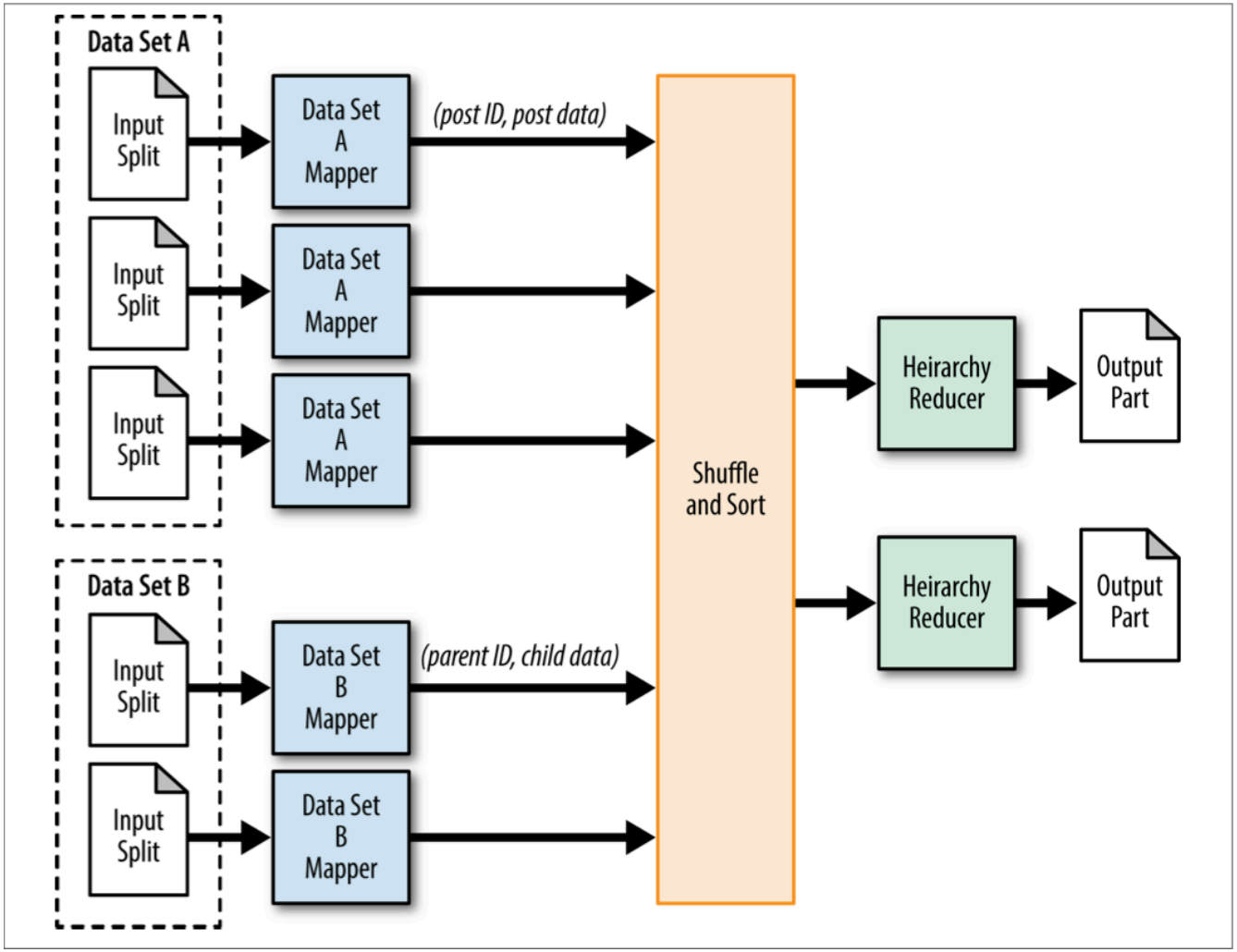
MultipleInputs

- The `MultipleInputs` class allows different mappers to handle different input data

- One mapper will read user sessions
- Another mapper will read impression counts
  - Two impression count files, so we'll create a mapper for each

Data Flow

Figure 4-1 from MapReduce Design Patterns



Assignment 6

- Reduce-side join of impression stats for VINs

- `MultipleInputs` (multiple mappers)
  - One reads sessions and collects stats
  - Another reads stats data from another source

- An Avro "union" schema is provided

Assignment 6

- Modify SessionGenerator
  - Output sessions to AVRO container file (binary)
  - Use **`AvroKeyValueOutputFormat`**
- Define a mapper to read sessions
  - Use **`AvroKeyValueInputFormat`**
- Define a mapper to read impression files (CSV)
- Associate mappers with input files
  - Use **`MultipleInputs`**