CS 378 – Big Data Programming

Lecture 16

Join Patterns

Review

- Assignment 7 – Reduce-side join
  - User session and impression data
- Questions/issues?

Join Patterns

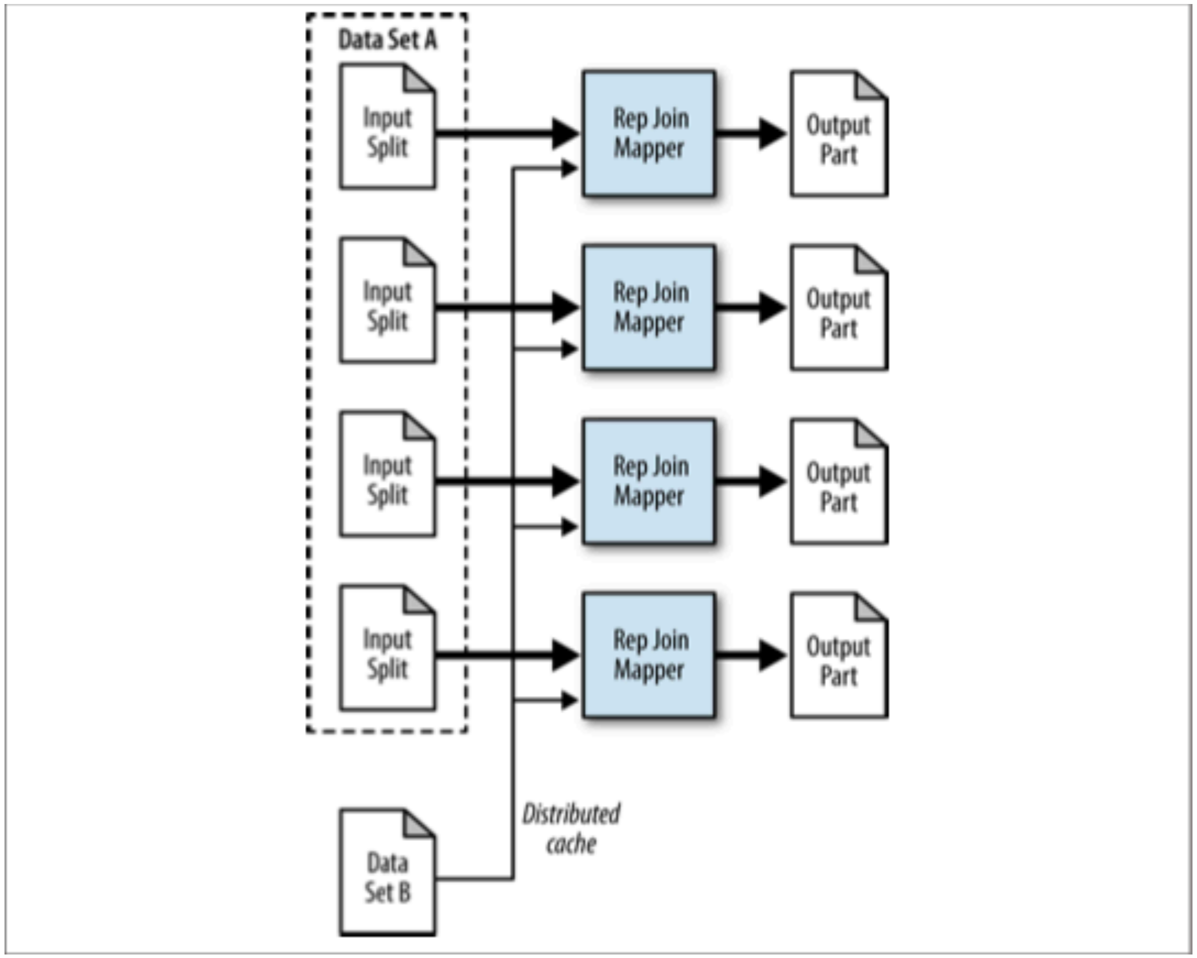
- Review: Suppose we want to join many sources, only one of which is large
  - User sessions (large)
  - Map from cities to DMA (demographic marketing area)
  - …
- This is called a *replicated* join
  - All the small files will be replicated to all machines

Replicated Join

- Can be done completely in mappers
  - No need for sort, shuffle, or reduce
  - Files are replicated with `DistributedCache`
- Restrictions:
  - All but one of the inputs must fit in memory
  - Can only accomplish an inner join, or
  - A left outer join where the large data source is "left" part

Replicated Join - Data Flow

Figure 5-2 from MapReduce Design Patterns



Join Patterns

- OK, so replicated join was interesting, but more than one of my data sources is large.
- Is there a way to do a map-side join in this case?
- Or is reduce-side join my only option?

- If we organize the input data in a specific way,
- We can do this on the map-side.

Composite Join

- Hadoop class `CompositeInputFormat`

- Restricted to inner, or full outer join
- Input data sets must have the same # of partitions
  - Each input partition must be sorted by key
  - All records for a particular key must be in the same partition

- Seems pretty restrictive …

Composite Join

- These conditions might exist for data from other mapReduce jobs where:

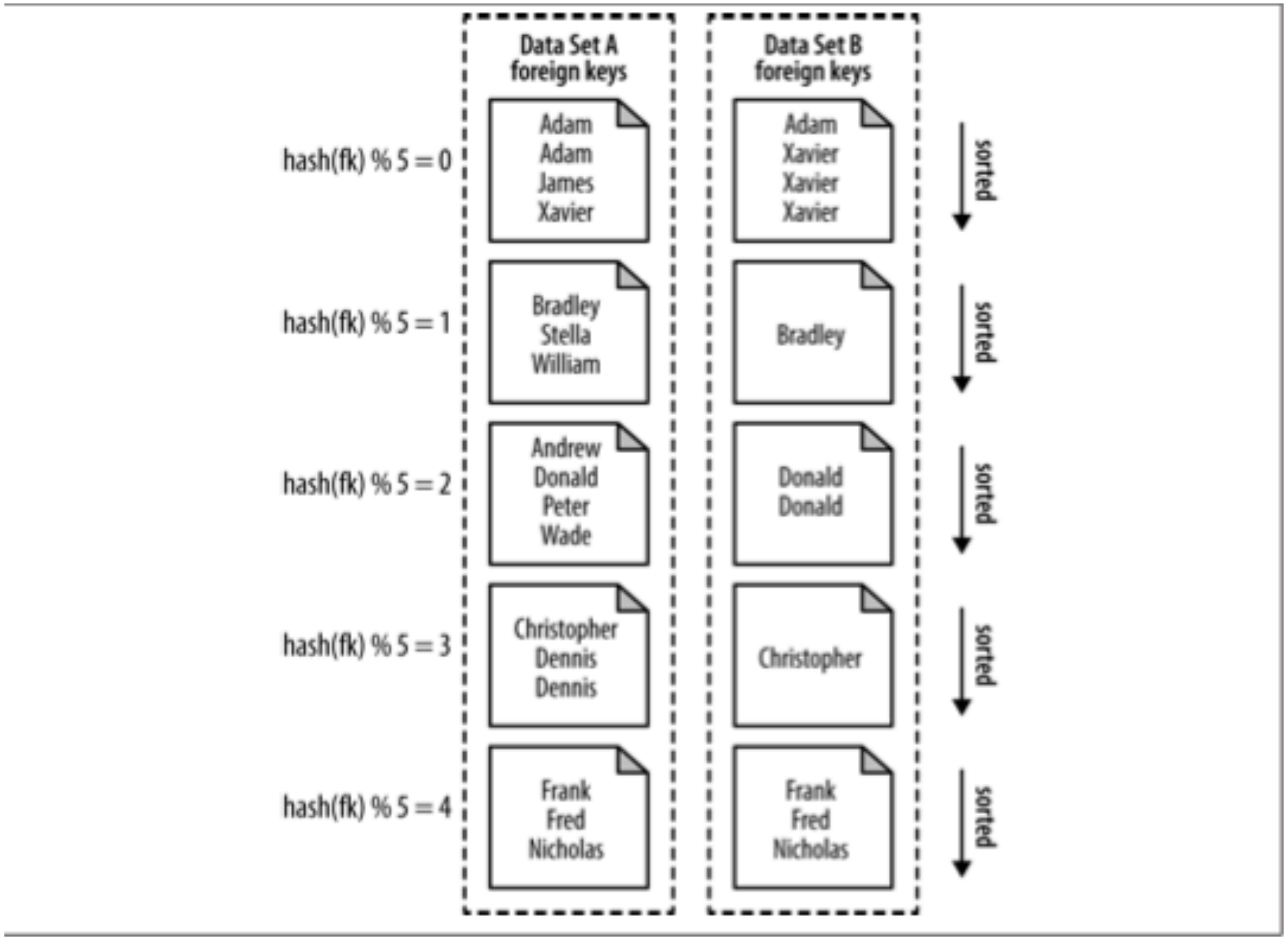
- The jobs had the same # of reducers
  - Recall that input data sets must be partitioned in same way
- The jobs had the same foreign key
- Output files aren't splittable

Composite Join

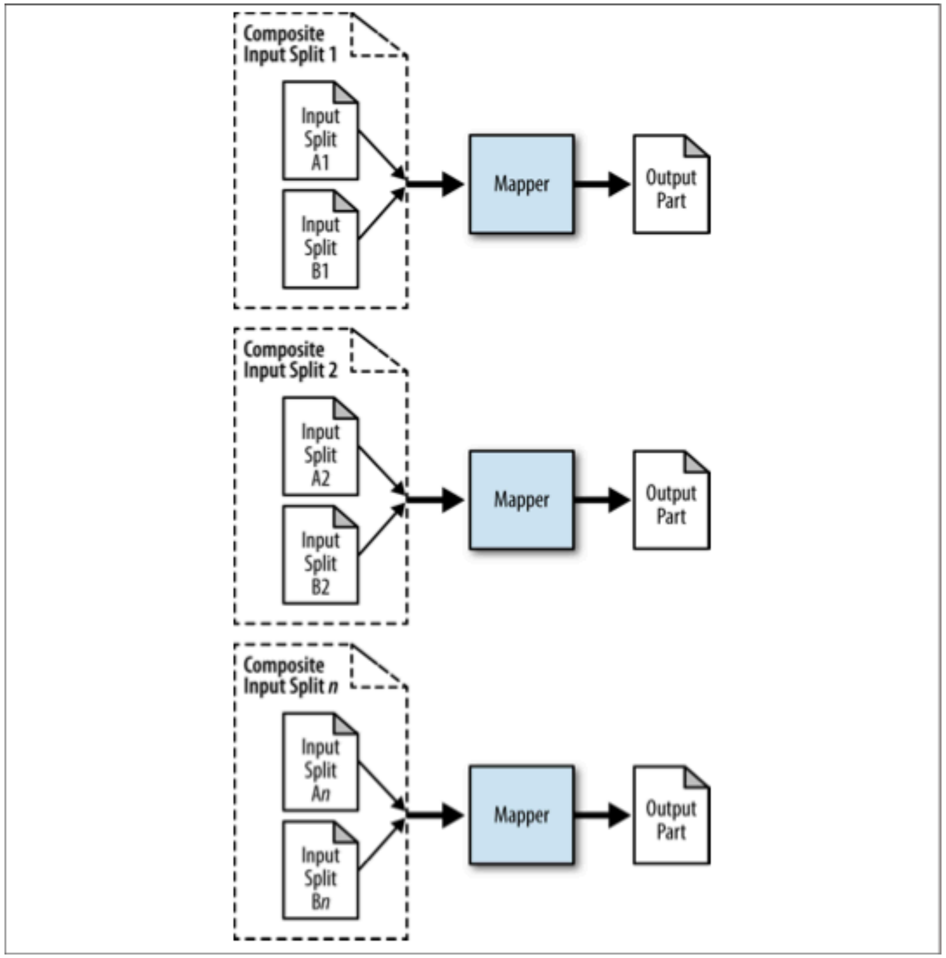
- If all those conditions are true, this join works
  - Map-side only, so it's efficient if we can use it.

- If you find that you are preparing and formatting the data only to be able to use composite join
- It's probably not worth it.
- Just use a reduce-side join.

Composite Join – Data



Composite Join – Data Flow



CompositeJoinInput

- In the driver code (`run()` method)
  - Get the file names from the command line
  - Specify the input format, join type, and files

```
conf.setInputFormat(CompostieInputFormat.class);

conf.set(“mapred.join.expr”,
   CompositeInputFormat.compose(“inner”,
      KeyValueTextInputFormat.class, file1, file2));
```

CompositeJoinInput

- How might this implement inner join?
- Outer join?
- Could we do any other join type?
  - Left outer? Anti-join?

One More Join Pattern

- Suppose we wanted to compare all cars currently available (for sale) to all other cars
  - To identify “similar” cars
  - Usage: “I like this car, show me others like it”

- This join is called “Cartesian Product”
  - Compare N items to M items requires NxM comparisons
  - Not straightforward to do with map-reduce

Cartesian Product

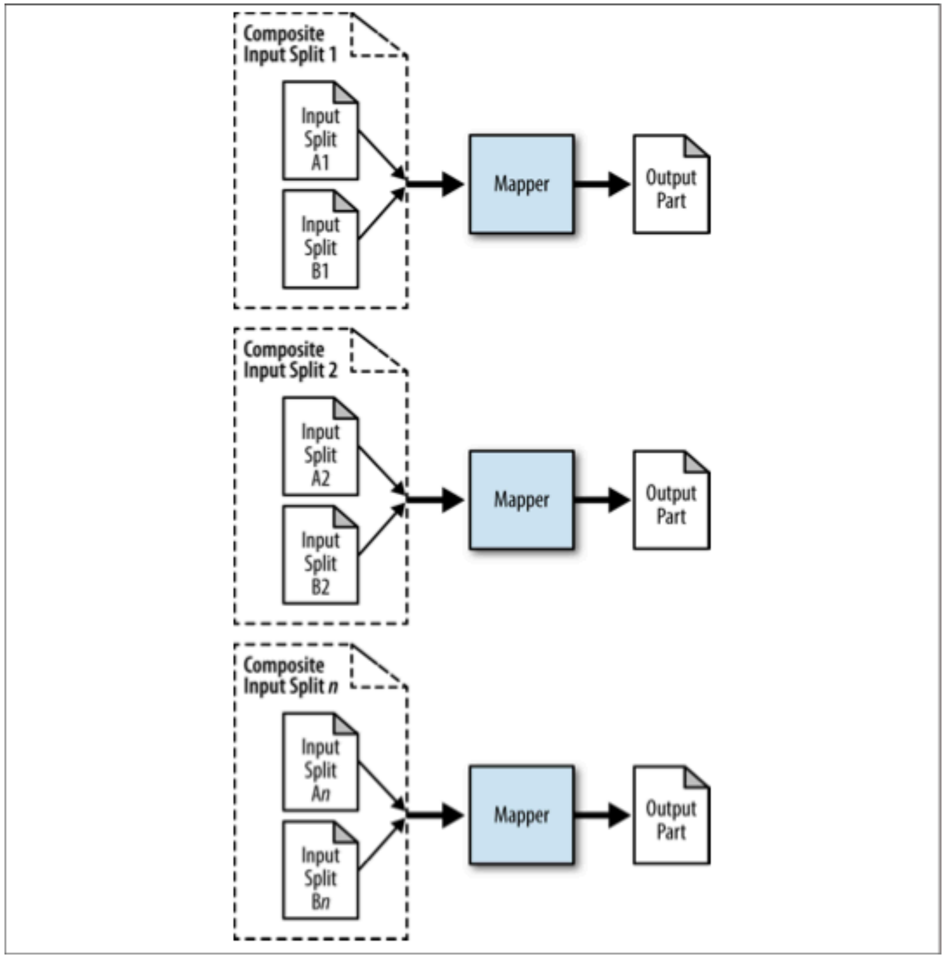
- Pairs every record with every other record
  - No keys needed
  - N x M results, for datasets of size N, M

- Map-only job
- But still expensive to compute
- Hadoop class: `CartesianInputFormat`

Cartesian Product

- To accomplish this join, we’ll need to pair every record with every other record
- We can start with the approach for composite join
- For composite join, each mapper read two files
  - They had the same key set
  - The data was sorted by key
  - We don’t care about the keys, just the ‘two file input ’

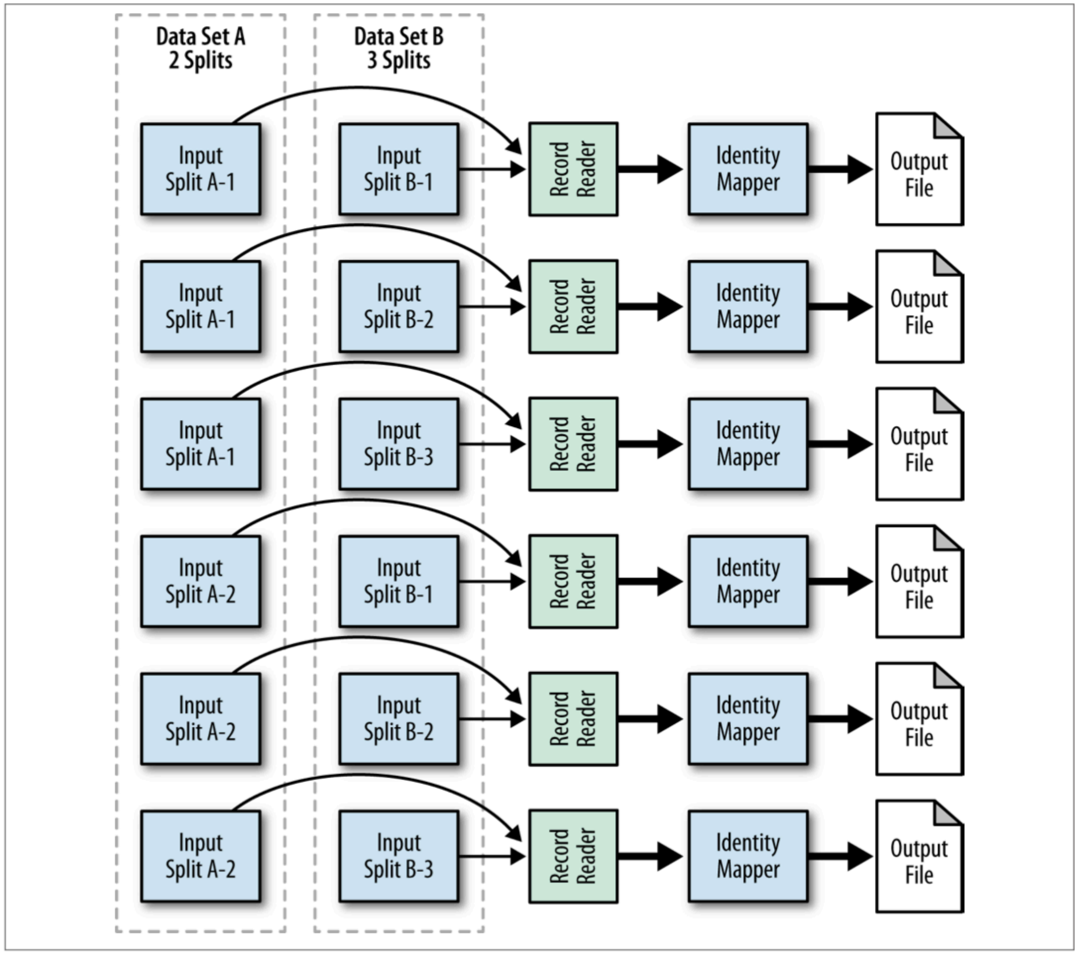
Composite Join – Data Flow



One Mapper, Two Inputs

- For composite join, the key order allowed us to:
  - Read each of the two files only once
  - Worked very much like merge sort
- For Cartesian product
  - For each record in data set 1
  - We'll read every record in data set 2
  - This pair of records is passed to the mapper
- We'd accomplish this with a custom input format
  - RecordReader resets data set 2 for each input of data set 1

Cartesian Product – Data Flow


Data Set A
2 Splits
Data Set B
3 Splits
Input Split A-1
Input Split B-1
Input Split A-1
Input Split B-2
Input Split A-1
Input Split B-3
Input Split A-2
Input Split B-1
Input Split A-2
Input Split B-2
Input Split A-2
Input Split B-3
Record Reader
Identity Mapper
Output File