STA321—Project Report

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Problem Description

Given the *Order* data and *Trade* data, compute the lowest transaction price level of each recorded market order using HDFS and MapReduce.

Task Comprehension

- All the market orders are stored in *Order* data, while all the transactions are recorded in the *Trade* data. Therefore, the core of the task is to use the primary key `ApplSeqNum` to link the two part of data.
- Difficulties Analysis: There are some difficulties or crucial details in this task.
    1. In the reduce phase, how to select the records from *Traded* for counting and ignore others?
    2. There may be a case where an order is released before 09:30 but traded in the continuous auction period. How to ignore these orders?
    3. After counting for the answer, how to sort the records in the order of time, and how to sort the transaction data by *ApplSeqNum* if they are at the same time?

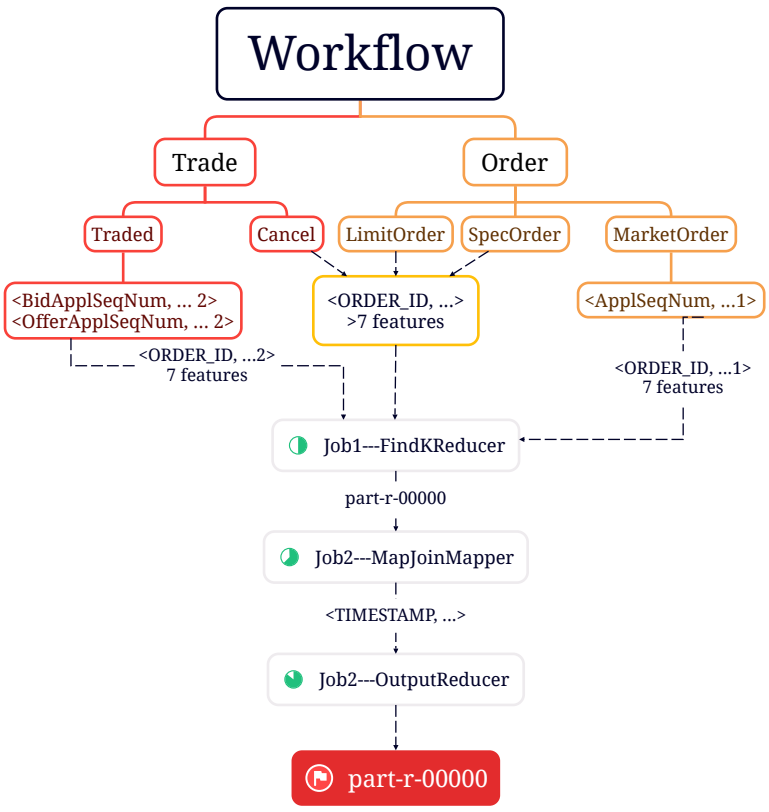
Code Design

Now we introduce the code design:

- The `Driver` class integrates the two MapReduce jobs, with the `runJob1()` function instructs the first job and `join_sort()` instructs the second.
- We design two mapper classes `OrderInputMapper` and `TradeInputMapper` for `MAP1`, responsible for reading and processing the data from *Order* and *Trade* data respectively;
- We implement the counting program as the reducer class `FindKReducer` for `REDUCE1`;
- The mapper class `MapJoinMapper` undertakes the task of `MAP2`, while the reducer class `OutputReducer` is written for the final output;

Concrete workflow

The concrete workflow of our work is shown below.



Our work is assigned to two MapReduce jobs.

- The map phase of the first job (`MAP1` in short) first separates *MarketOrder*, *LimitOrder* and *SpecOrder* from the *Order* data, and *Cancel* and *Traded* from the *Trade* data. Then `MAP1` emits all the data with `ApplSeqNum` as the key (for *Traded*, outputs two `<k,v>` pairs for each traded record with `BidApplSeqNum` and `OfferApplSeqNum` as the key respectively).

  Solution for difficulty 1:

  While emits the data in the `MAP1` , arrange each record here in the final output form (which is of 8 fields) except for the data from *MarketOrder* (7 fields), *Traded* (7 fields) and *Cancel* (9 fields), so that the data to be submitted into the reducers can be distinguished.

  In `REDUCER1` , for each key (ORDED_ID, that is,ApplSeqNum), we have the value with different lengths:

  - 7 -> (TIMESTAMP, PRICE, SIZE, BUY_SELL_FLAG, ORDER_TYPE, CANCEL_TYPE, AUX) -> findK and output AUX=1, from the table MarketOrder; AUX=0, from the table Traded.
  - 8 -> (TIMESTAMP, PRICE, SIZE, BUY_SELL_FLAG, ORDER_TYPE, ORDED_ID, MARKET_ORDER_TYPE, CANCEL_TYPE) -> just output
  - 9 -> (TIMESTAMP, PRICE, SIZE, BUY_SELL_FLAG, ORDER_TYPE, ORDED_ID, MARKET_ORDER_TYPE, CANCEL_TYPE, a feature for sorting in Job2) -> just output

- Afterward `<k,v>` pairs from the *Traded* with the same `ApplSeqNum` are submitted to `REDUCE1` for counting (which just yields the number `K` of transaction price levels of the market order).

  Solution for difficulty 2:

  In our program each market order will yield two part of records at the end of `MAP1` (with the first part from *Order* and the second from *Traded*), which is marked by an auxiliary fields. For an order posted beyond the continuous auction period, the part from *Order* is missing, this way we can detect and drop this type of order.

- In the job 2, `MAP2` takes in the output of job1 and emits them with the `TIMESTAMP` as the key, so that all the records are automatically sorted in the order of time in the shuffle phase before committed to the `REDUCE2` for a final adjustment for the required format.

  Solution for difficulty 3:

  1. To sort the final output in time order, we take the `TIMESTAMP` as the key to submit the records to `OutputReducer` , taking advantage of the shuffle phase.
  2. If the transaction data are at the same time, the cancel data will be behind the order data. As there is a additional field in cancel data, the programme can easily detect the cancel data, which will be stored as well as sorted(ORDER_ID as key) in the `TreeMap` . Then we can output them in sequence from `TreeMap` at last.