Cost-efficiency and Performance Robustness in Serverless Data Exchange

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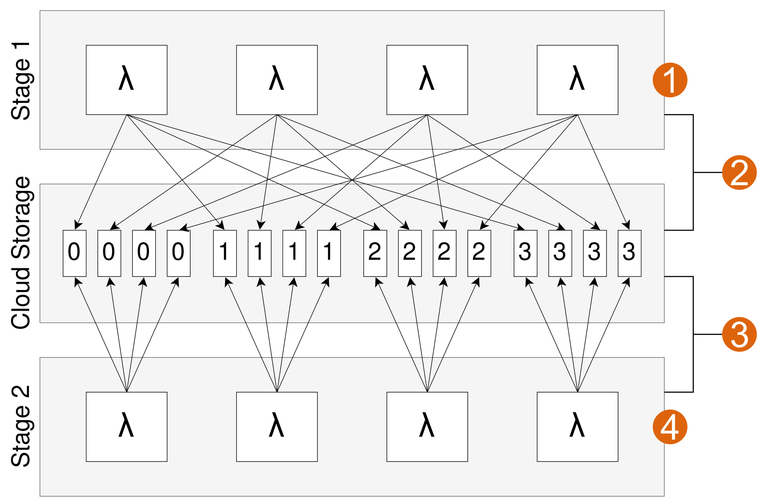
Contribution

A *cost-efficient* data exchange strategy with *robust performance* for query processing on *cloud functions,* considering these problems:

- Worker-to-worker communication only possible via cloud storage
- High storage request prices
- Tight request rate limits
- Input load imbalance from data skew

General Approach



Data exchange between cloud functions

1) Partition input data in each cloud function
2) Export partitions to shared cloud storage
3) Import and combine partitions
4) Execute next pipeline on distinct partitions

Strategy

Storage Request Management

Multi-partition Writes

- Write all partitions into one single output file
- Append partition row ranges to file footer
- Read multi-partitioned files partially in consumer stage

→ **n** writes instead of **n*m**

n: producer stage worker count
m: consumer stage worker count

Multi-stage Exchange

- Re-shuffle data with an additional stage
- Group workers that process the same input objects and pre-combine them

→ **nc + mg** reads instead of **n*m**

g: group count in combiner stage
c: worker count per group

Data Skew Mitigation

Over-partitioning

- Create **p** times as many partitions than workers in the next stage
- Aggregate partition sizes
- Assign each worker in the consumer stage **1..m*p** partitions to even out partition size differences

Partitioned Cartesian Join

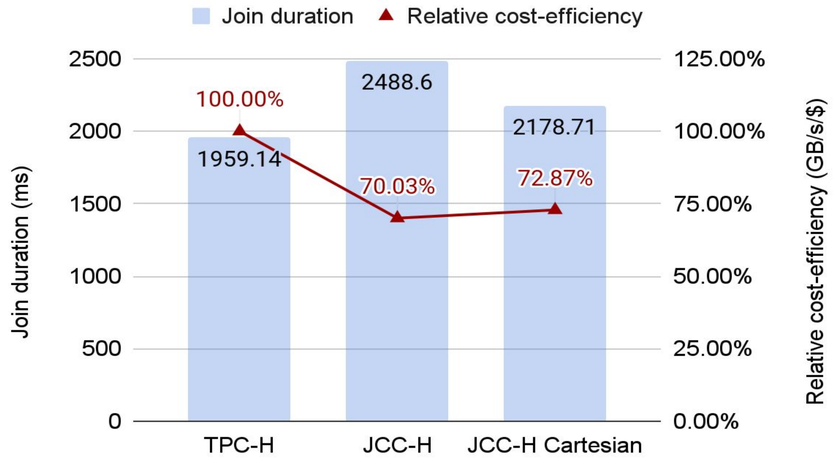
- For skewed joins, divide heavy hitter partitions horizontally into **r** (right) and **s** (left) sub-partitions
- Invoke **r*s** additional workers to join each partition on the right side with every partition from the left side

Evaluation

Single-stage vs. 2-stage Data Exchange

Shuffle TPC-H SF100 **lineitem** table on **l_orderkey** column

Data Skew Unmitigated vs. Partitioned Cartesian Join



Join SF10 **lineitem** table with **order** table from TPC-H and JCC-H

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