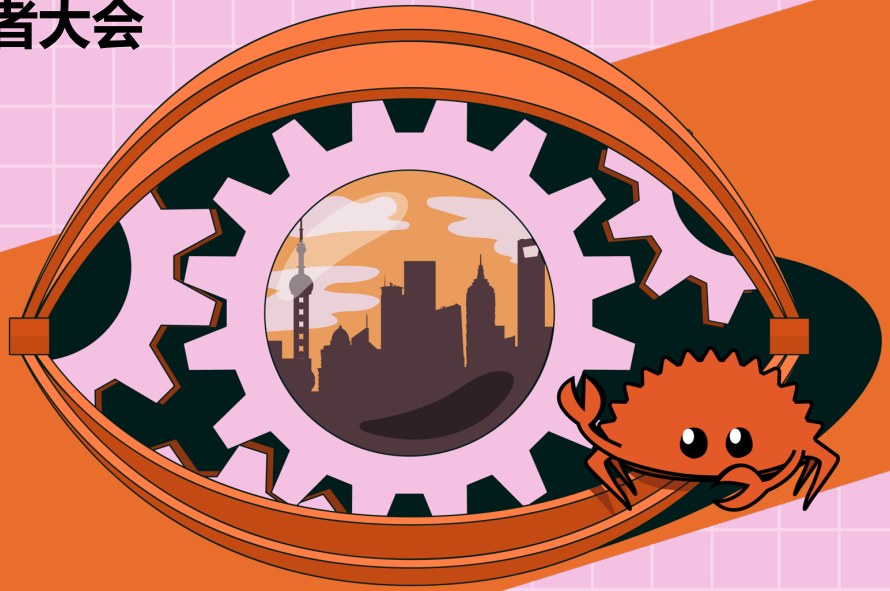
RUST CHINA CONF 2023

第三届中国Rust开发者大会



6.17-6.18 @Shanghai

Apache Ballista Introduction

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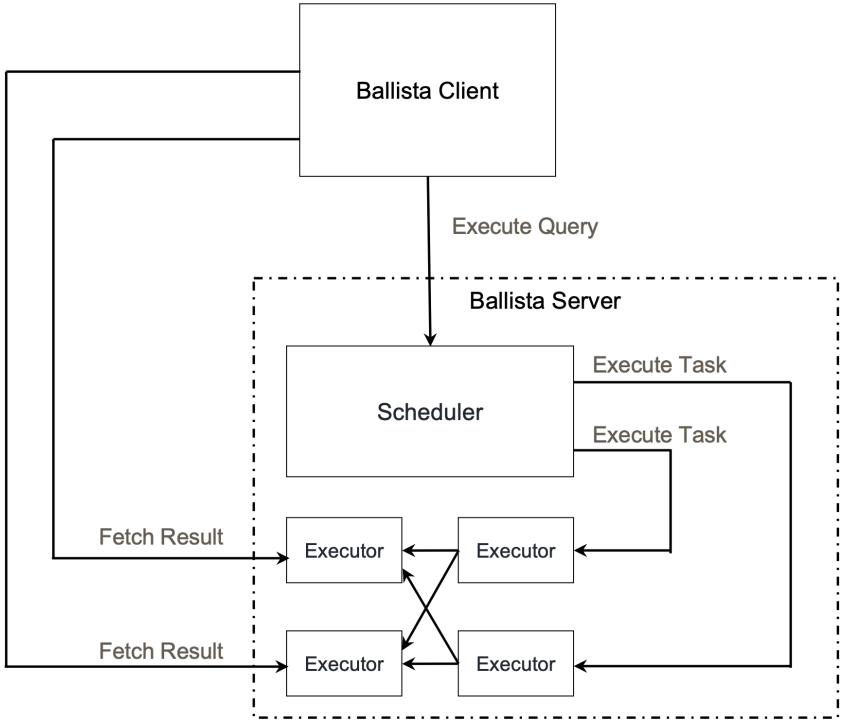
Agenda

- Overview
- Cluster Setup
- SQL Execution
- Data Cache
- Future

Overview

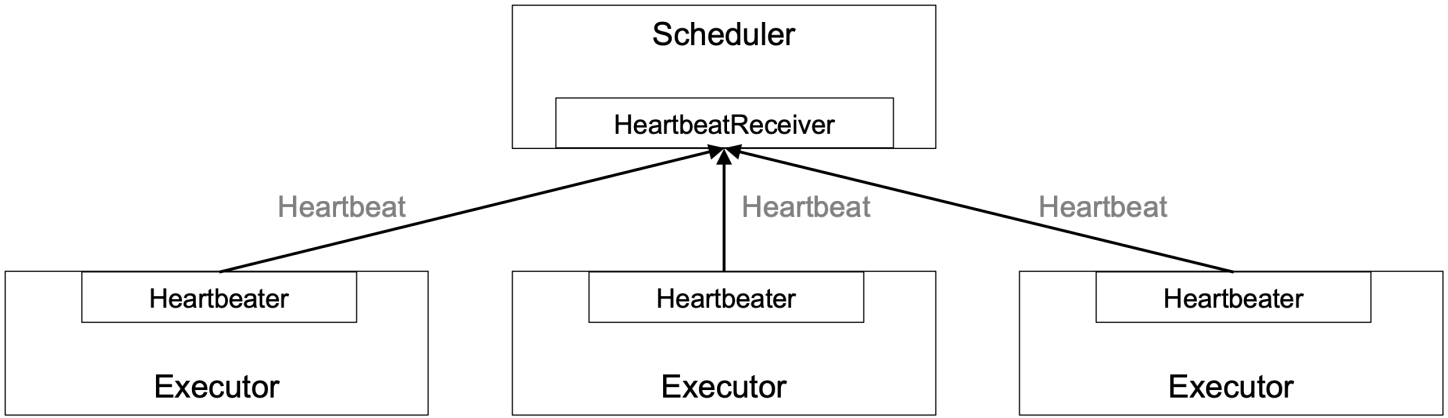
Apache Ballista is a distributed SQL query engine powered by the Rust implementation of Apache Arrow and DataFusion. It's mainly for interactive queries of low latency.

- Support DAG and fault tolerance
- Support data exchange
- Support different kinds of object stores, like HDFS, S3, Azure, etc
- Support data cache and cache aware task scheduling



Cluster Setup

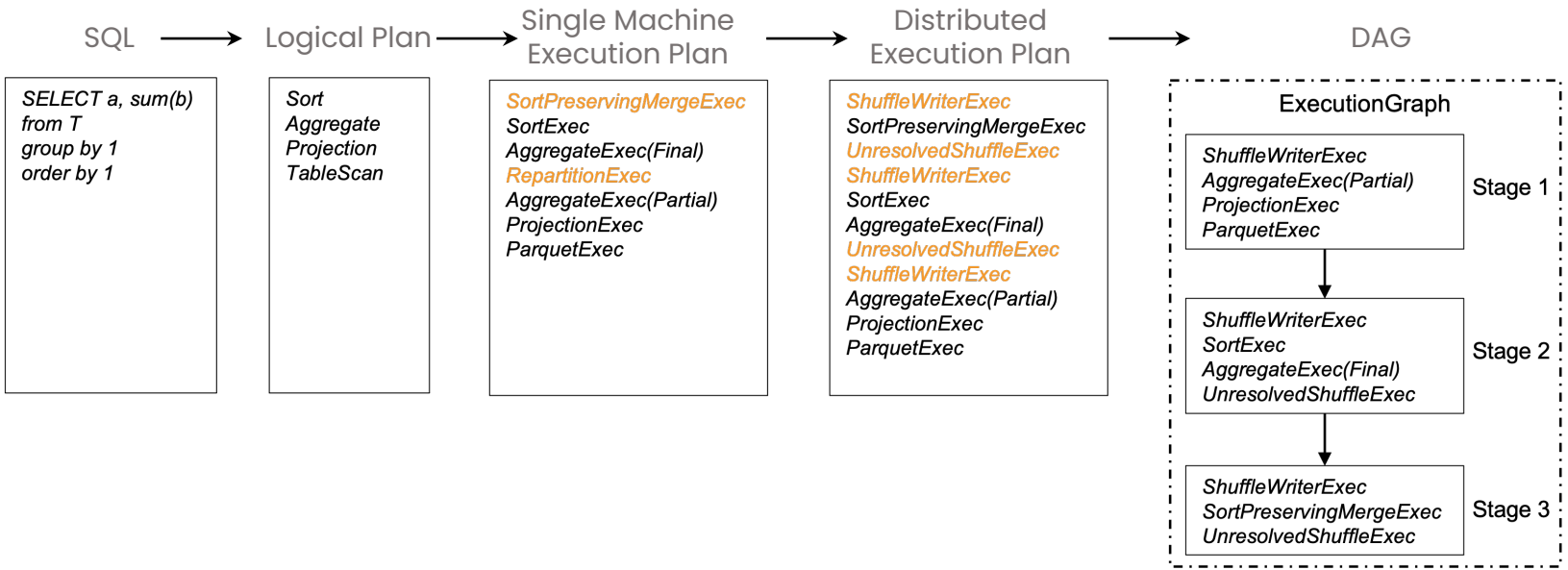
The cluster consists of one scheduler and a number of executors. Both of scheduler and executor can be deployed on K8S. Executors can be added to the cluster flexibly by registering to the cluster scheduler.



SQL Execution

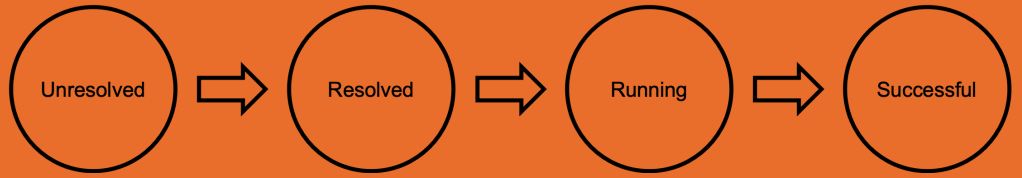
- SQL -> DAG (Directed Acyclic Graph)
- DAG State Machine
- Task Assignment
- Event Loop based Processing

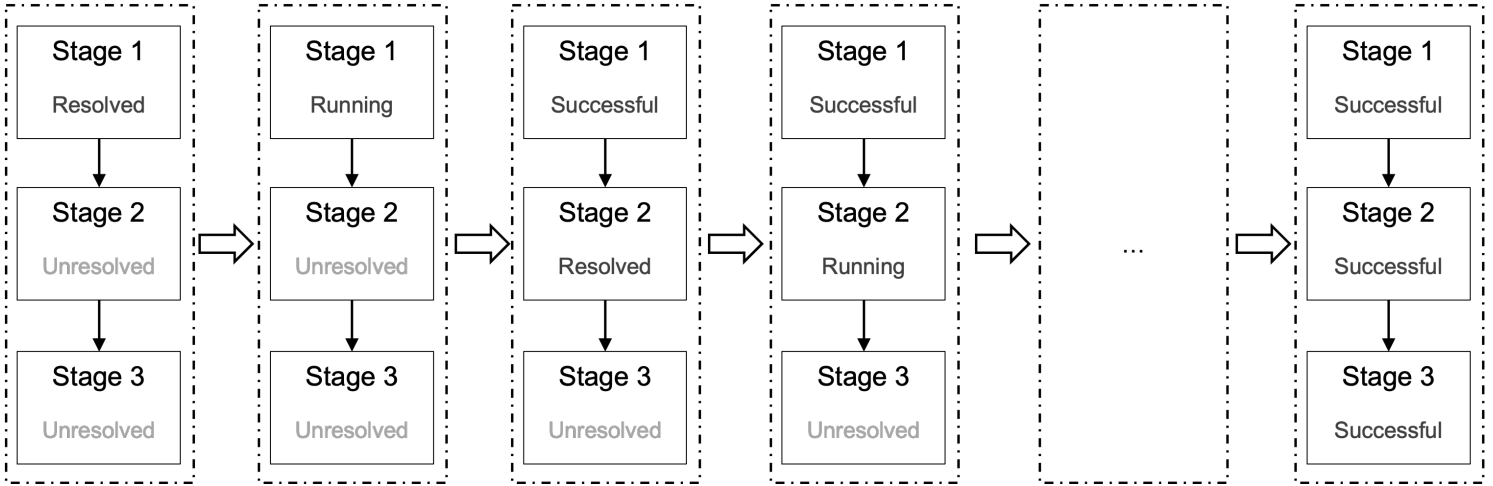
SQL Execution —— DAG Generation



SQL Execution —— DAG State Machine

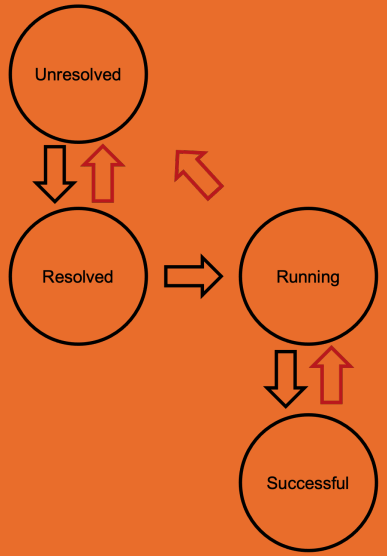
Normal Stage State Machine

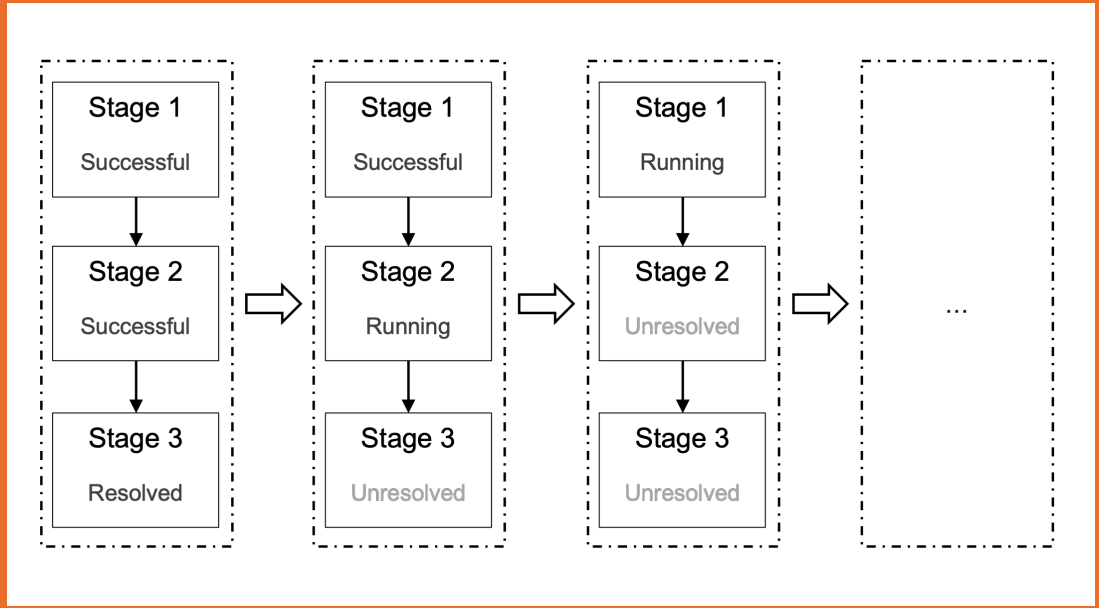




SQL Execution —— Fault Tolerance

Stage State Machine
for Executor Lost

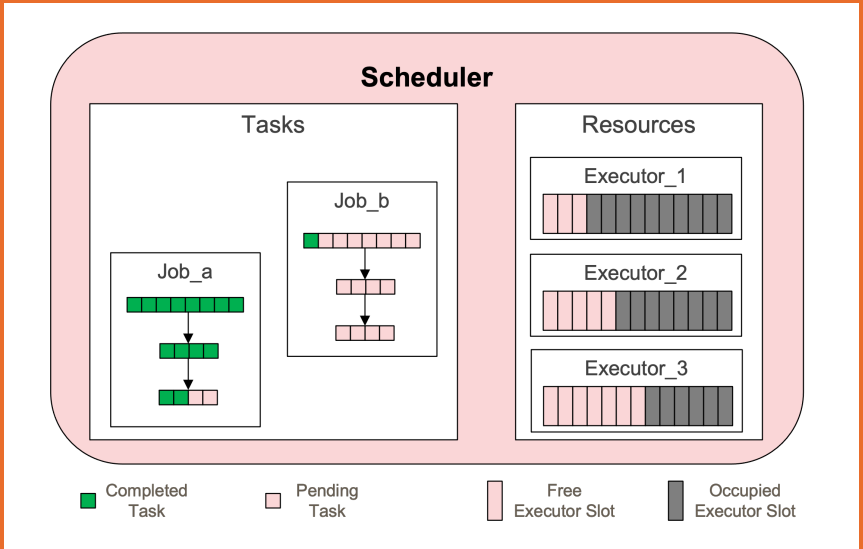




SQL Execution —— Task Assignment

Task: each execution stage for a number of data partitions.
one task for each data partition.

Executor slot: each executor has a number of slots for task execution.



One round task assignment will bind pending tasks with available executor slots as many as possible.

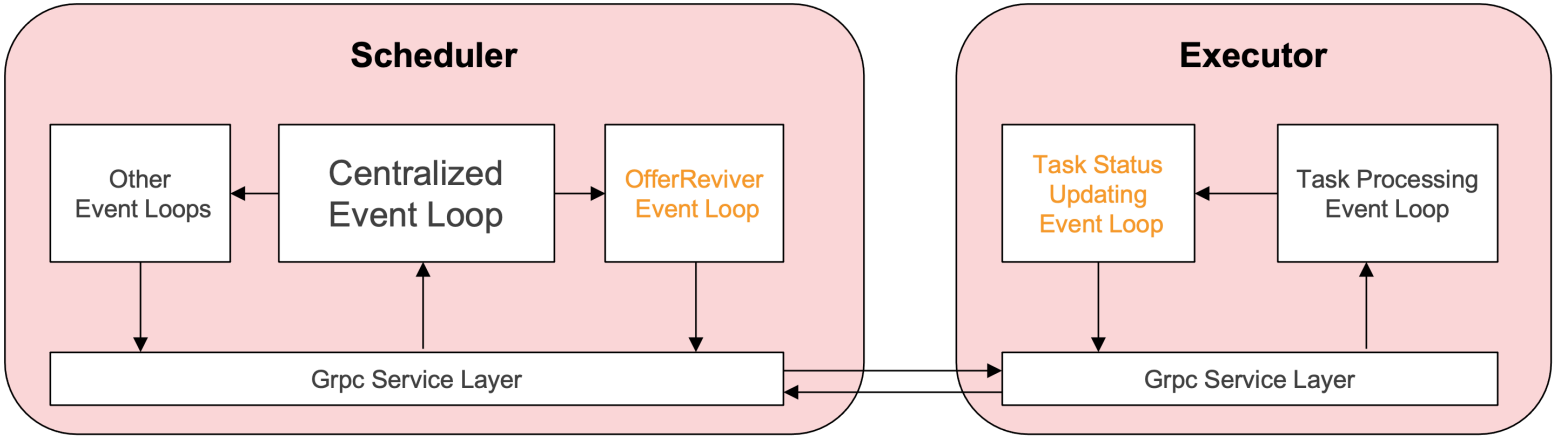
Two assignment policies:

Policy	Result of One Round
Round-robin	Job_a: 1 slot from executor_3 1 slot from executor_2 Job_b: 3 slots from executor_3 2 slots from executor_2 2 slots from executor_1
Bias	Job_a: 2 slots from executor_3 Job_b: 5 slots from executor_3 2 slots from executor_2

SQL Execution —— Event Loop based Processing

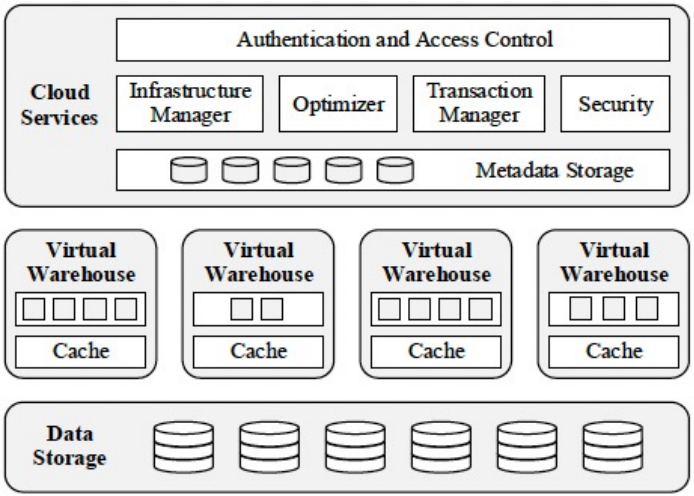
Advantages:

- Decoupled
- Efficient processing for batch events

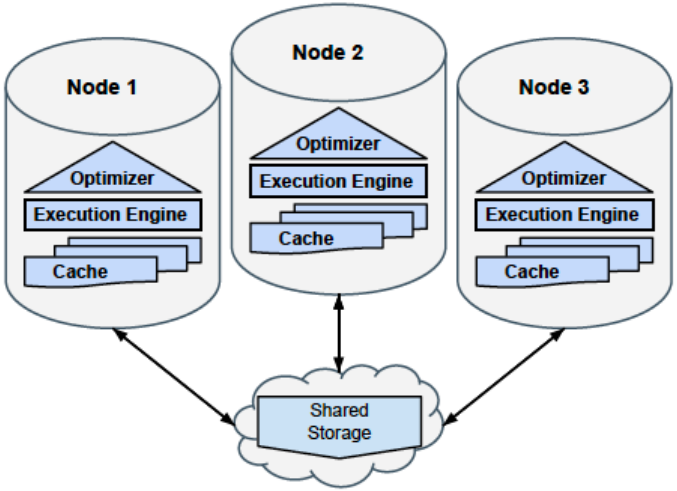


Data Cache

Data cache is a very common feature for the cloud data warehouses for accelerating the access to the data source.



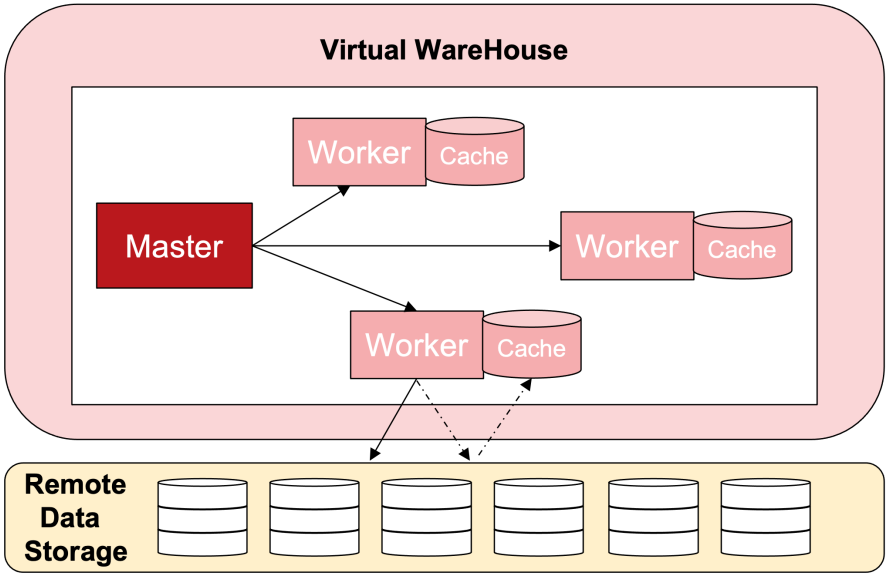
Snowflake – Multi-Cluster Shared Data Architecture



Vertica – Eon Architecture

Data Cache

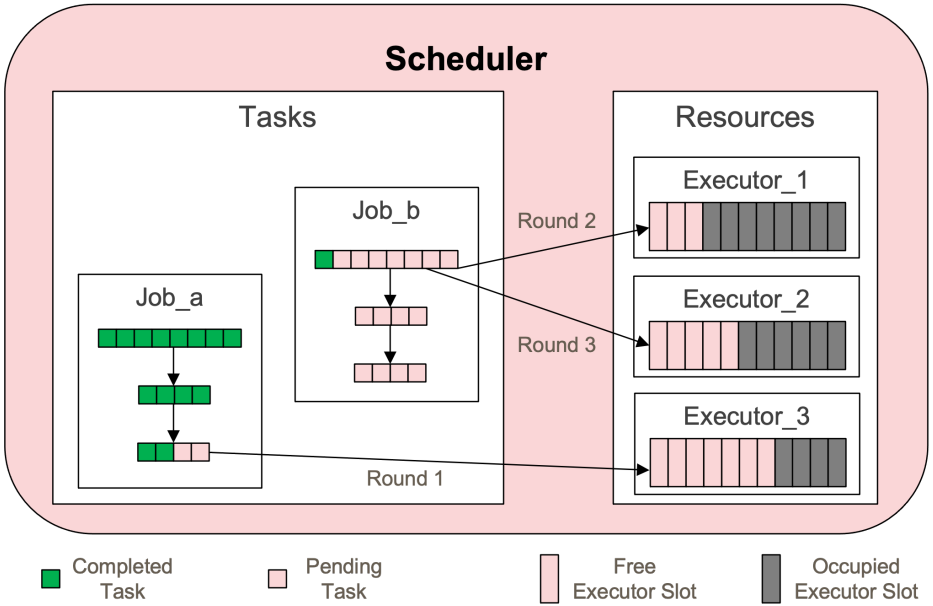
- Consistent hashing-based assignment (Snowflake)
- LRU based retirement
- Cache aware scheduling
- Consistent hashing tolerance-based work stealing
- Currently it's file-level



Data Cache

Three rounds cache aware task Scheduling:

- Assign non-map stage tasks(without scanning files) in a round robin way
- Assign map stage tasks (scanning files) based on the consistent hashing policy on the hash value of the file name and the executor topology
- Assign tasks with scanning files based on the consistent hashing policy on the hash value of the file name and the executor topology with N tolerance



Future

- Scheduler HA
- Shuffle Improvement
  - Self-adjustable shuffle partition number
  - Sort-based shuffle writer for pull-based shuffling
  - Push-based shuffling

Reference

- Eon Mode: Bringing the Vertica Columnar Database to the Cloud
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- Apache Arrow Ballista
  https://github.com/apache/arrow-ballista

Thank you !