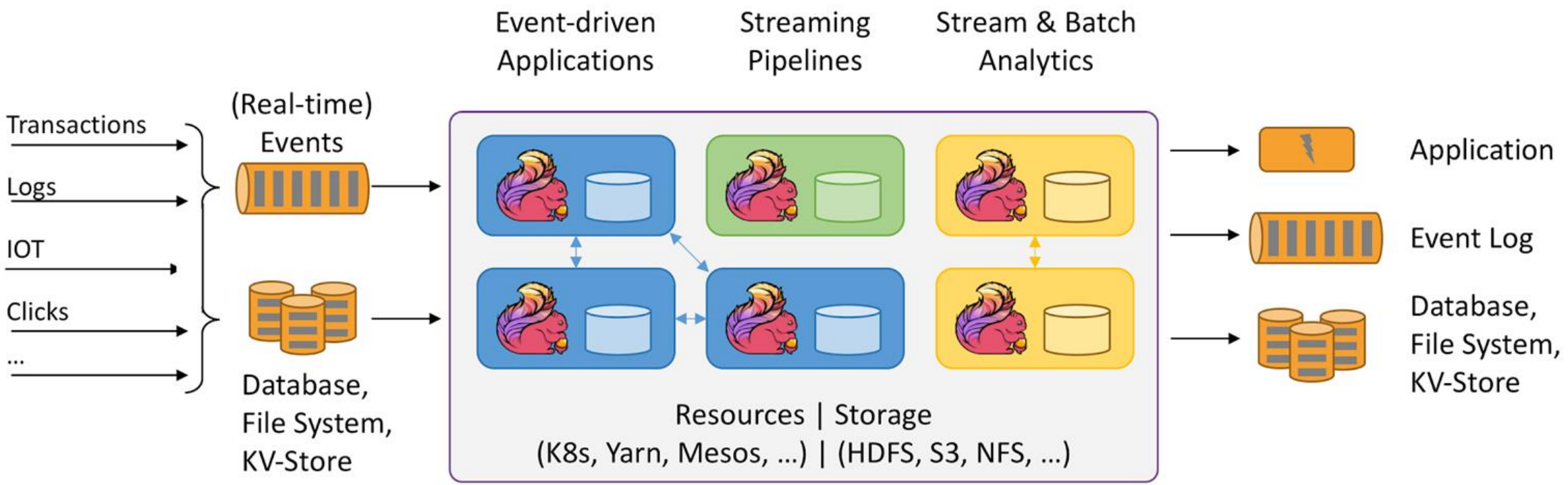
Introduction to SQL on Apache Flink®

Flink SQL Training

https://github.com/ververica/sql-training

Apache Flink is a Distributed Data Processing System



Scalable and Consistent Data Processing

- Flexible and expressive APIs
- Guaranteed correctness
  - Exactly-once state consistency
  - Event-time semantics
- In-memory processing at massive scale
  - Runs on 10000s of cores
  - Manages 10s TBs of state

Powered By Apache Flink

Details about their use cases and more users are listed on Flink's website at https://flink.apache.org/poweredby.html
Also check out the Flink Forward YouTube channel with more than 350 recorded talks at https://www.youtube.com/channel/UCY8_lgiZLZErZPF47a2hXMA

Why SQL for Stream Processing?

- Implementing Flink stream processing apps requires special skills
  - Java/Scala experience
  - In-depth knowledge of streaming concepts like time and state
  - Knowledge of distributed data processing
- Everybody knows and uses SQL
- SQL queries are optimized and efficiently executed
- Unified syntax and semantics for batch & streaming data

Flink SQL in a Nutshell

A standard-compliant SQL service

to query static and streaming data alike

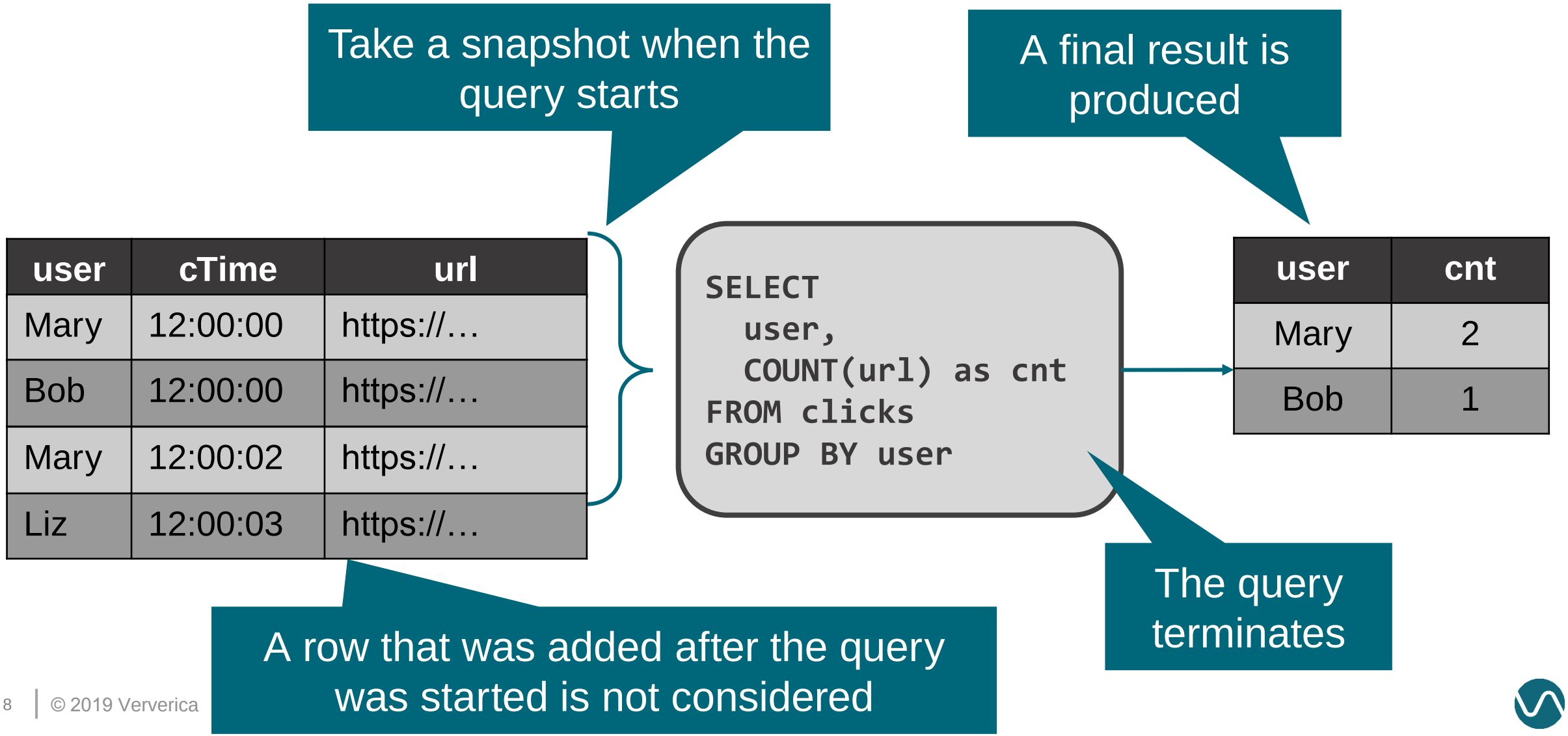
that leverages the performance, scalability, and consistency

of Apache Flink.

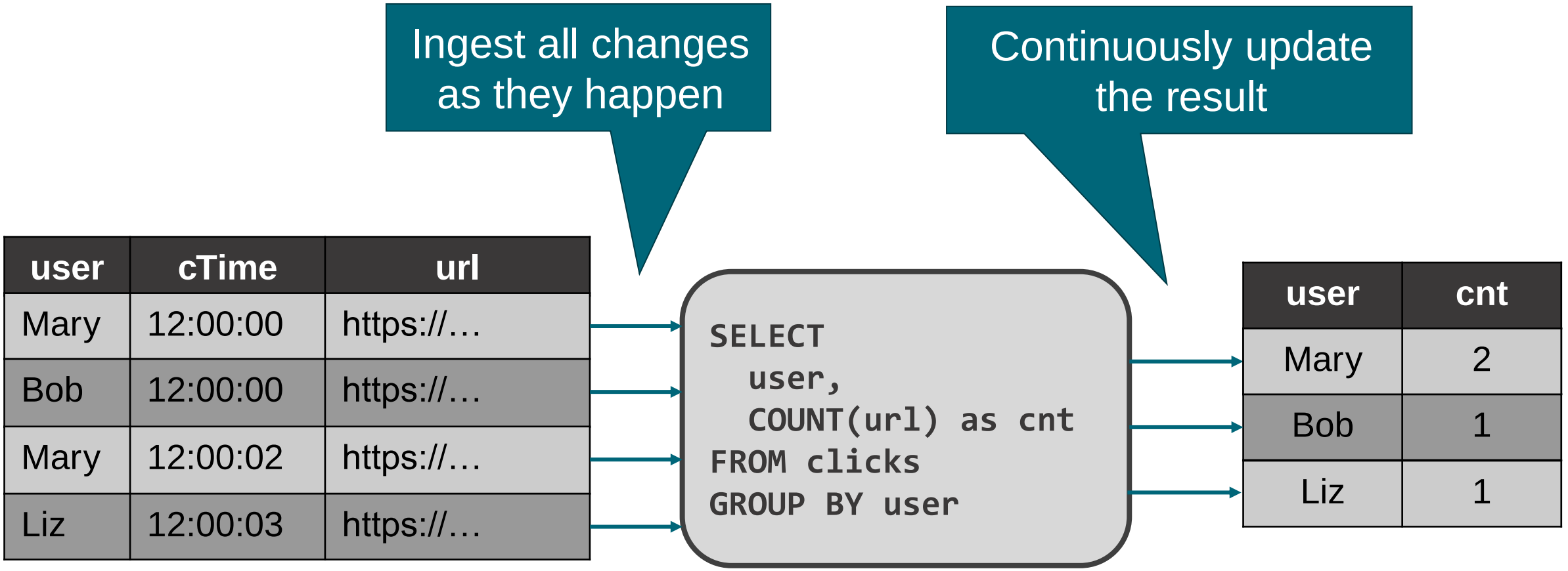
How is streaming SQL different from traditional SQL?

- Basically all tables that are processed with SQL queries change over time
  - Transactions from applications
  - Bulk inserts from ETL processes
- Traditional processors run SQL queries on static snapshots of the tables
  - The query input is finite
  - The query result is final and finite
- Stream SQL processors run continuous queries on changing (dynamic) tables
  - The query input is unbounded
  - The query result is never final, continuously updated, and potentially unbounded
- The semantics of a query are the same regardless whether it is executed one-time on a table snapshot or continuously on a changing table

Running a One-time Query on a Changing Table



Running a Continuous Query on a Changing Table



The result is identical to the one-time query (at this point)

SQL Feature Set in Flink 1.11

STREAMING & BATCH

- `SELECT FROM WHERE`
- `GROUP BY [HAVING]`
  - Non-windowed
  - `TUMBLE, HOP, SESSION` windows
- `JOIN`
  - Time-Windowed `INNER` + `OUTER JOIN`
  - Non-windowed `INNER` + `OUTER JOIN`
- User-Defined Functions
  - Scalar
  - Aggregation
  - Table-valued

STREAMING ONLY

- `OVER` / `WINDOW`
  - `UNBOUNDED` + `BOUNDED PRECEDING`
- `INNER JOIN` with
  - Time-versioned table
  - External lookup table
- `MATCH_RECOGNIZE`
  - Pattern Matching/CEP (SQL:2016)

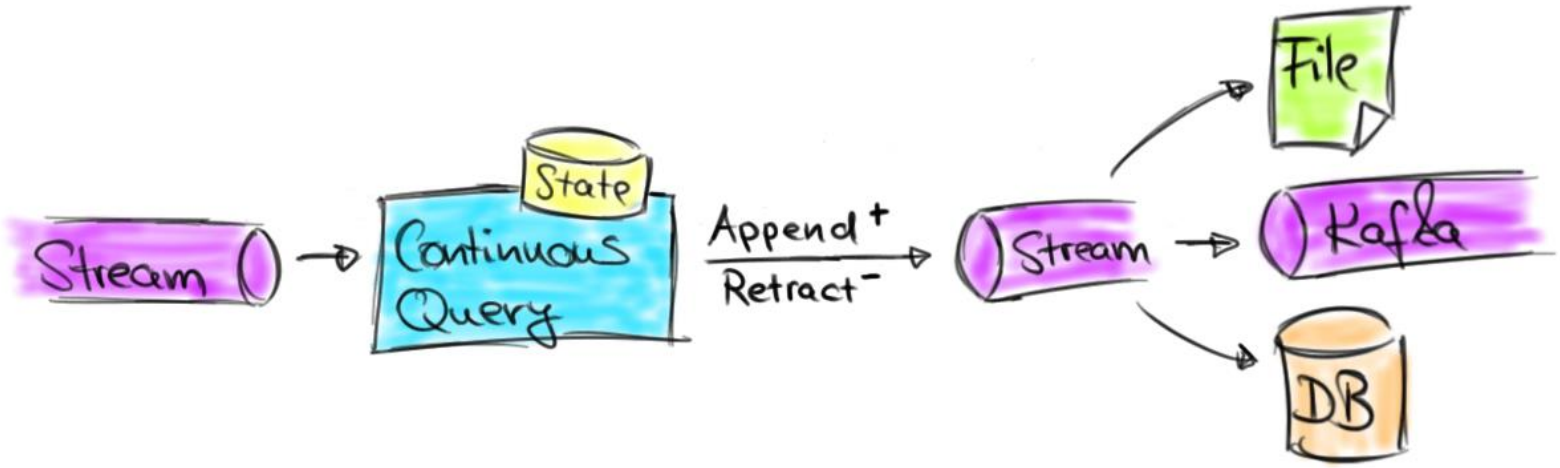
BATCH ONLY

- Full TPC-DS support

Data Pipelines

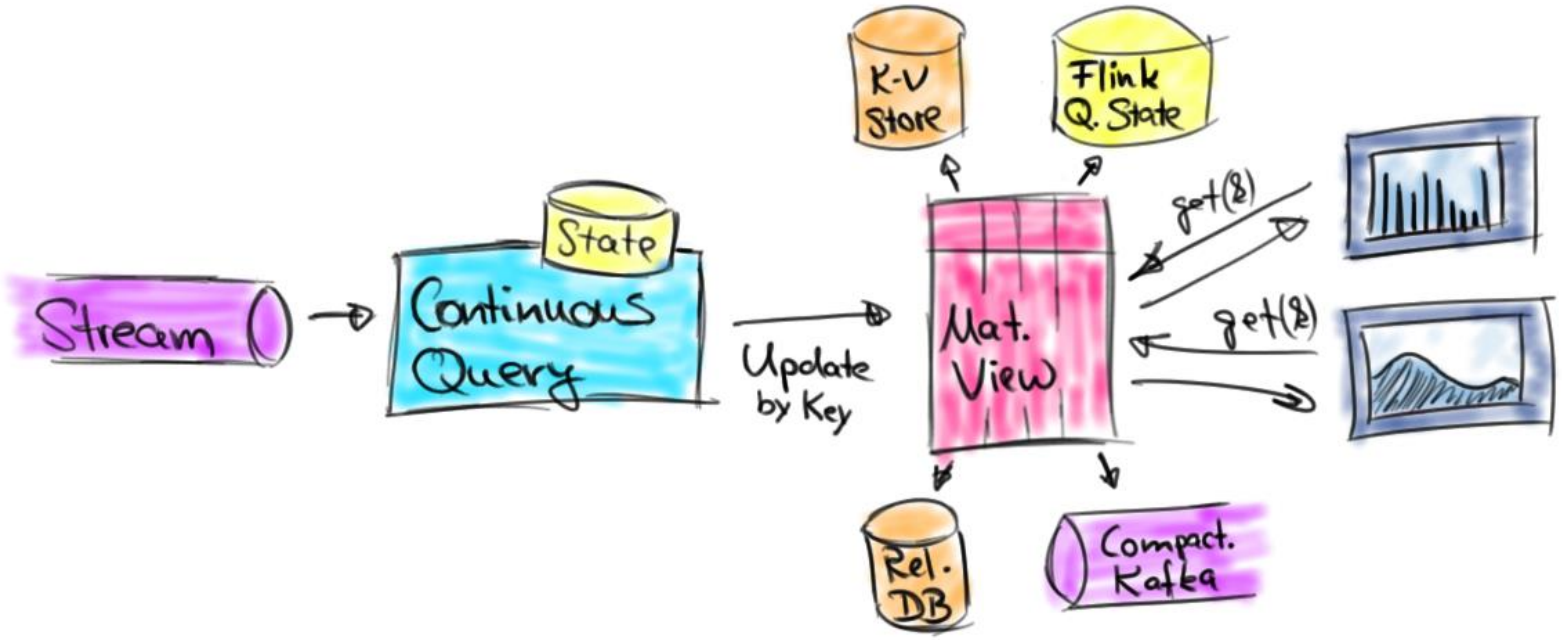
- Transform, aggregate, and move events in real-time

- Low-latency ETL
  - Convert and write streams to file systems, DBMS, K-V stores, indexes, …
  - Ingest appearing files to produce streams



Stream & Batch Analytics

- Stream & Batch Analytics
  - Run analytical queries over bounded and unbounded data
  - Query and compare historic and real-time data
  - Compute and update data to visualize in real-time



Training Environment

https://github.com/ververica/sql-training/

What You Will Learn in This Training?

- Querying streaming data with SQL
- Expressing common stream processing operations with SQL
  - Window aggregations, stream joins, and pattern matching
- Piping the results of continuous queries into Kafka and S3
- Materializing the results of continuous queries in MySQL
- Using Flink's SQL CLI client

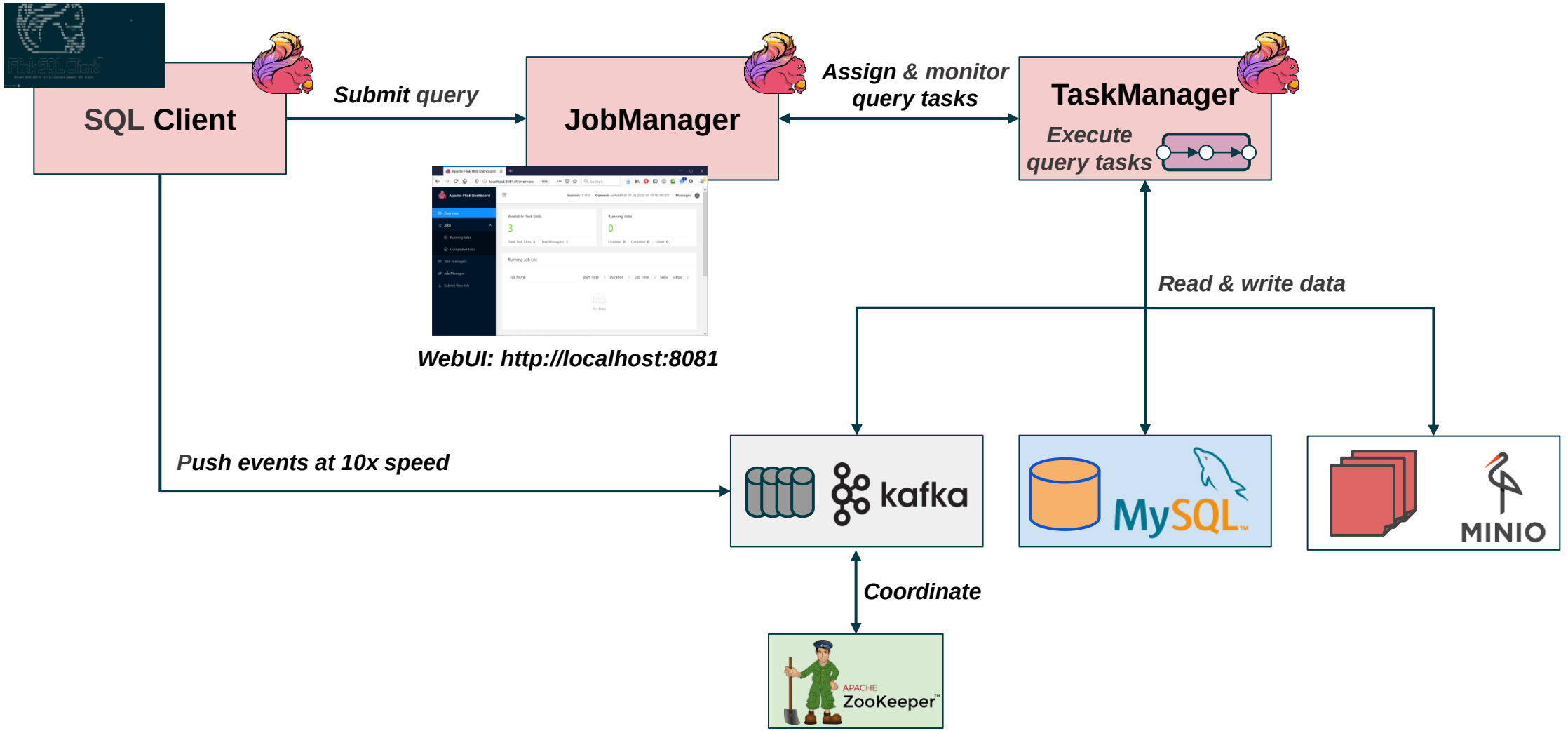
Training Scenario: Taxi Ride Data

- We are working with data about taxi rides in New York
- Three tables
  - `Rides` — One start and one end event for each ride
  - `Fares` — One payment event for each ride
  - `DriverChanges` — One event for each driver change of a taxi
- All tables are registered and available in the environment
- Each tables is backed by a Kafka topic

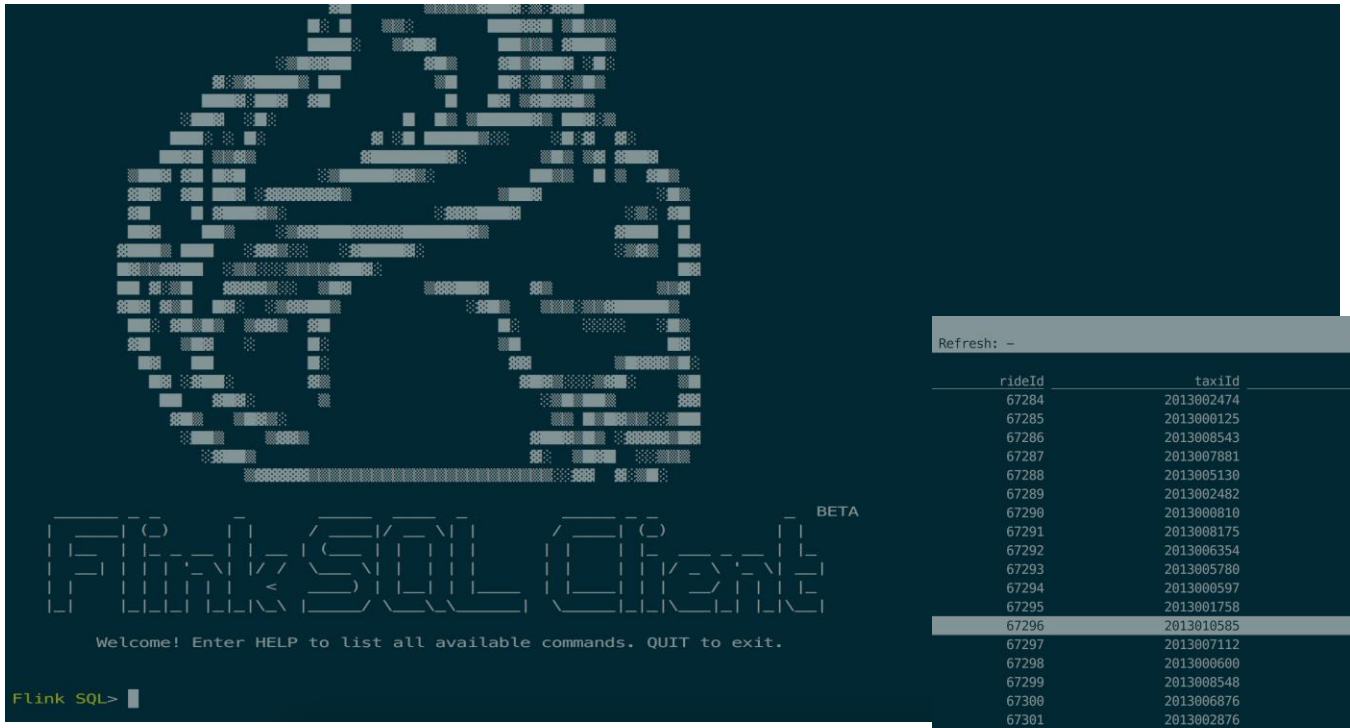
Training Scenario: Taxi Ride Data

```
Flink SQL> SELECT * FROM Rides;

rideId          taxiId     isStart              lon              lat             rideTime      psgCnt
     1      2013000001        true       -73.99078         40.76088      2013-01-01T00:00           1
     2      2013000002        true      -73.978325         40.77809      2013-01-01T00:00           5
     3      2013000003        true       -73.98962         40.72999      2013-01-01T00:00           1


Flink SQL> SELECT * FROM Fares;

rideId                  payTime      payMethod        tip       toll      fare
    65      2013-01-01T00:00:36            CSH        0.0        0.0       3.5
   137         2013-01-01T00:01            CSH        0.0        0.0       3.5
    77      2013-01-01T00:01:22            CSH        0.0        0.0       4.0


Flink SQL> SELECT * FROM DriverChanges;

    taxiId       driverId           usageStartTime
2013000061     2013000061       2013-01-01T00:00:02
2013000062     2013000062       2013-01-01T00:00:03
2013000063     2013000063       2013-01-01T00:00:08
```


Our Training Environment



Introduction to SQL Client



SQL Query Result (Table)

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rideId	taxiId	driverId	isStart	lon	lat	rowTime
67284	2013002474	2013002471	true	-73.99392	40.766483	2013-01-01 02:13:00.0
67285	2013000125	2013000125	true	-73.9902	40.73164	2013-01-01 02:13:00.0
67286	2013008543	2013008539	true	-73.988106	40.741108	2013-01-01 02:13:00.0
67287	2013007881	2013007877	true	-73.976776	40.7886	2013-01-01 02:13:00.0
67288	2013005130	2013005127	true	-73.93579	40.749916	2013-01-01 02:13:00.0
67289	2013002482	2013002479	true	-74.00155	40.72888	2013-01-01 02:13:00.0
67290	2013000810	2013000807	true	-73.95563	40.77609	2013-01-01 02:13:00.0
67291	2013008175	2013008171	true	-73.99869	40.74534	2013-01-01 02:13:00.0
67292	2013006354	2013006350	true	-73.99083	40.75019	2013-01-01 02:13:00.0
67293	2013005780	2013005777	true	-74.01012	40.719673	2013-01-01 02:13:00.0
67294	2013000597	2013000594	true	-74.00884	40.738075	2013-01-01 02:13:00.0
67295	2013001758	2013001755	true	-73.97829	40.74584	2013-01-01 02:13:00.0
67296	2013010585	2013010626	true	-73.97319	40.792835	2013-01-01 02:13:00.0
67297	2013007112	2013007108	true	-73.959915	40.77376	2013-01-01 02:13:00.0
67298	2013000600	2013000597	true	-73.970215	40.76242	2013-01-01 02:13:00.0
67299	2013008548	2013008544	true	-73.949066	40.781593	2013-01-01 02:13:00.0
67300	2013006876	2013006872	true	-73.97647	40.75168	2013-01-01 02:13:00.0
67301	2013002876	2013002873	true	-73.97031	40.757233	2013-01-01 02:13:00.0
67302	2013001431	2013001428	true	-73.98575	40.73183	2013-01-01 02:13:00.0
67303	2013001094	2013001091	true	-73.981995	40.772144	2013-01-01 02:13:00.0
67304	2013003286	2013003282	true	-73.97425	40.731556	2013-01-01 02:13:00.0
67305	2013004072	2013004069	true	-73.97144	40.79806	2013-01-01 02:13:00.0
67306	2013001433	2013001430	true	-73.971405	40.755013	2013-01-01 02:13:00.0
67307	2013010091	2013010091	true	-73.993805	40.76684	2013-01-01 02:13:00.0
67308	2013004447	2013004444	true	-73.94932	40.713917	2013-01-01 02:13:00.0
67309	2013009698	2013009697	true	-73.96828	40.762447	2013-01-01 02:13:00.0
67310	2013004806	2013004803	true	-73.96799	40.755592	2013-01-01 02:13:00.0
67311	2013006093	2013006089	true	-74.0027	40.742493	2013-01-01 02:13:00.0
67312	2013002498	2013002495	true	-73.957306	40.76597	2013-01-01 02:13:00.0
67313	2013009517	2013010348	true	-73.98775	40.754333	2013-01-01 02:13:00.0
67314	2013000819	2013000816	true	-73.99196	40.749355	2013-01-01 02:13:00.0

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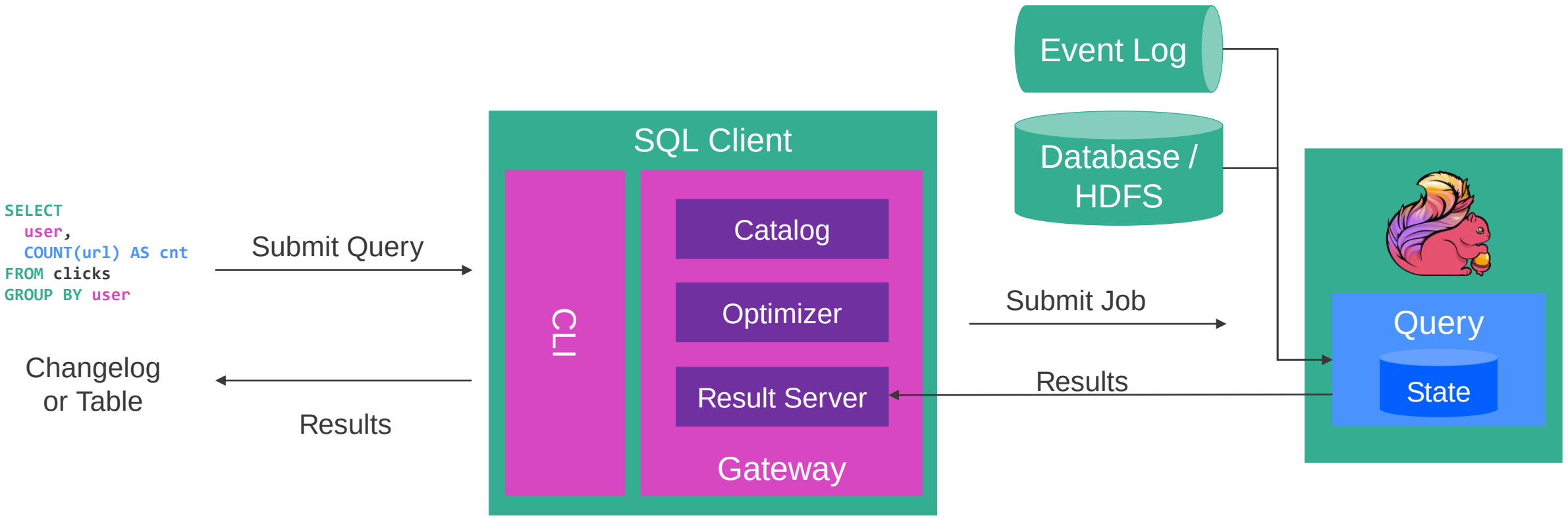
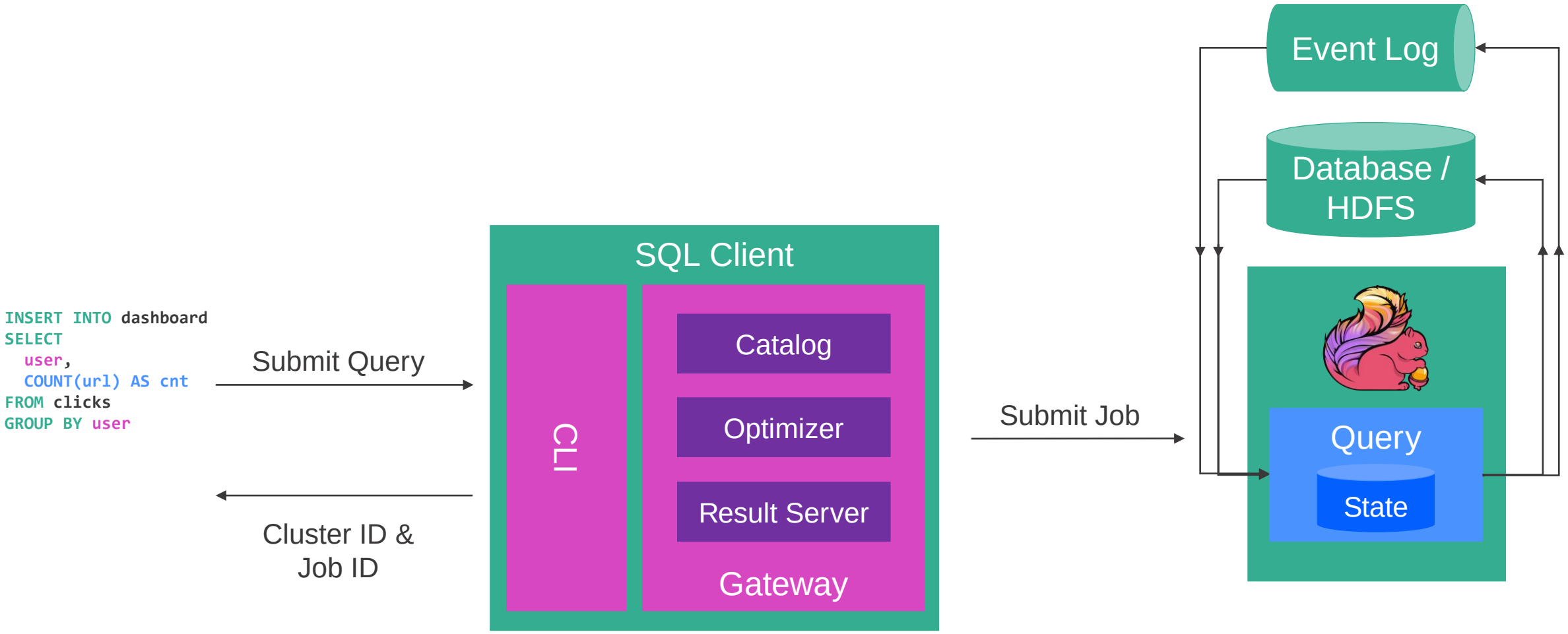
Interactive Query Submission via SQL Client



Detached Query Submission via SQL Client



Hands On Exercises

Introduction to SQL on Flink

Continue with the “Introduction to the Training Environment”
in “Introduction to SQL on Flink”

https://github.com/ververica/sql-training/wiki/Introduction-to-SQL-on-Flink

We are here to help!

www.ververica.com

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