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Production-Ready Flink and Hive Integration

- what story you can tell now

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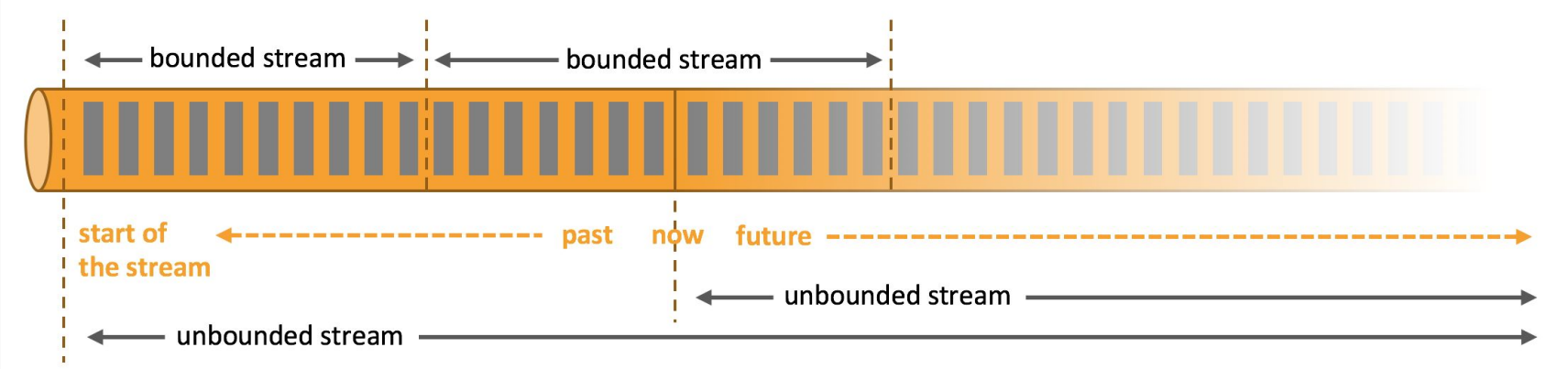
Agenda

- Background
- Flink 1.10 - State of Union
- Flink 1.11 - Upcoming Features
- Stories You’d be able to tell now
- Q&A

Background



- Apache Flink is a framework and distributed processing engine for stateful computations over **unbounded (streaming)** and **bounded (batch)** data streams.

- Flink’s philosophy: Batch is a special case of Streaming

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Background

We annouced Flink + Hive integration as beta in Flink 1.9 to aim at

- Help to shift businesses to more real-time fashion
- Bring Flink’s cutting-edge Streaming capabilities to Batch
- Unify companies’ tech stack of online and offline data infrastructure
- Simplify deployments and operations
- Lower entry bar and learning cost for end users
  - developers, data scientists, analysts, etc

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Flink 1.10 - State of the Union

more on https://ci.apache.org/projects/flink/flink-docs-stable/dev/table/hive/

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Unified Metadata Management

Background

- Hive Metastore (HMS) has become the de facto metadata hub in the Hadoop
- Many companies have a single HMS to manage all of their metadata, either Hive or non-Hive metadata, as the single source of truth

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Unified Metadata Management

Flink’s HiveCatalog

- introduced in Flink 1.9
- production-ready in Flink 1.10
  - compatible with almost all HMS versions
  - can store Flink’s own metadata of tables, views, UDFs, statistics in HMS
  - also being the bridge for Flink to leverage Hive’s own metadata

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HiveCatalog E2E Example

Example to store a Flink's Kafka table thru HiveCatalog into HMS and later query the table with Flink SQL

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HiveCatalog E2E Example

Step 1: Configure the HiveCatalog in Flink SQL CLI

```
execution:
    planner: blink
    type: streaming
    ...
    current-catalog: myhive
    current-database: mydatabase

catalogs:
   - name: myhive
     type: hive
     hive-conf-dir: /opt/hive-conf  # contains hive-site.xml
```

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HiveCatalog E2E Example

Step 2: Create a Kafka table in HMS from Flink SQL CLI

```
Flink SQL> CREATE TABLE mykafka (name String, age Int) WITH (
   'connector.type' = 'kafka',
   'connector.version' = 'universal',
   'connector.topic' = 'test',
   'connector.properties.zookeeper.connect' = 'localhost:2181',
   'connector.properties.bootstrap.servers' = 'localhost:9092',
   'format.type' = 'csv',
   'update-mode' = 'append'
);
[INFO] Table has been created.
```

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HiveCatalog E2E Example

Step 3: Describe the Kafka table in HMS via Hive CLI

```
hive> describe formatted mykafka;
Database:               default
Table Parameters:
    flink.connector.properties.bootstrap.servers localhost:9092
    flink.connector.properties.zookeeper.connect localhost:2181
    flink.connector.topic  test
    flink.connector.type   kafka
    flink.format.type      csv
    flink.generic.table.schema.0.data-type VARCHAR(2147483647)
    flink.generic.table.schema.0.name         name
    flink.generic.table.schema.1.data-type INT
    flink.generic.table.schema.1.name         age
    ....
```

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HiveCatalog E2E Example

Step 4: Query the Kafka table in Flink SQL CLI

```
Flink SQL> select * from mykafka;
```

```
SQL Query Result (Table)
 Refresh: 1 s    Page: Last of 1
```

name	age
tom	15
john	21
kitty	30
amy	24
kaiky	18

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Supported Hive Versions

- Flink 1.9 - Hive 2.3.4 and 1.2.1
- Flink 1.10 - Most Hive versions include
  - 1.0, 1.1, 1.2
  - 2.0, 2.1, 2.2, 2.3
  - 3.1

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Reuse Hive Functions

- Flink 1.9: Supports reusing all Hive UDFs
- Flink 1.10: Support reusing all Hive **built-in functions**
  - Hive has developed a few hundreds of super handy built-in functions over the years
  - supported via Module mechanism, introduced in 1.10 to improve Flink SQL's extensibility
    - e.g. lay the road to custom data types in, say, geo and machine learning
  - provided by **HiveModule**

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Enhanced Read of Hive Data

- Flink 1.9
  - read non-partitioned and partitioned Hive tables
- Flink 1.10
  - read Hive views
  - vectorized reader of ORC files
  - enhanced optimizations:
    - partition-pruning
    - projection pushdown
    - limit pushdown

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Enhanced Write of Hive Data

- Flink 1.9
  - write to non-partitioned Hive tables
- Flink 1.10
  - write to partitioned tables, both static and dynamic partitions
  - support “INSERT OVERWRITE” syntax

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What's coming in Flink 1.11

- Hive near-real-time streaming sink
  - bring a bit more real-time experience to Hive
- Native Parquet reader for better performance
- Better interoperabilities
  - How about creating Hive tables, views, functions within Flink? :D

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What's coming in Flink 1.11

- Better out-of-box dependency management
  - Yes, we are fully aware of the mess of Hive's dependencies
- JDBC Driver/Gateway so users can reuse existing tools to run SQL jobs on Flink
- Support a bit more Hive syntax

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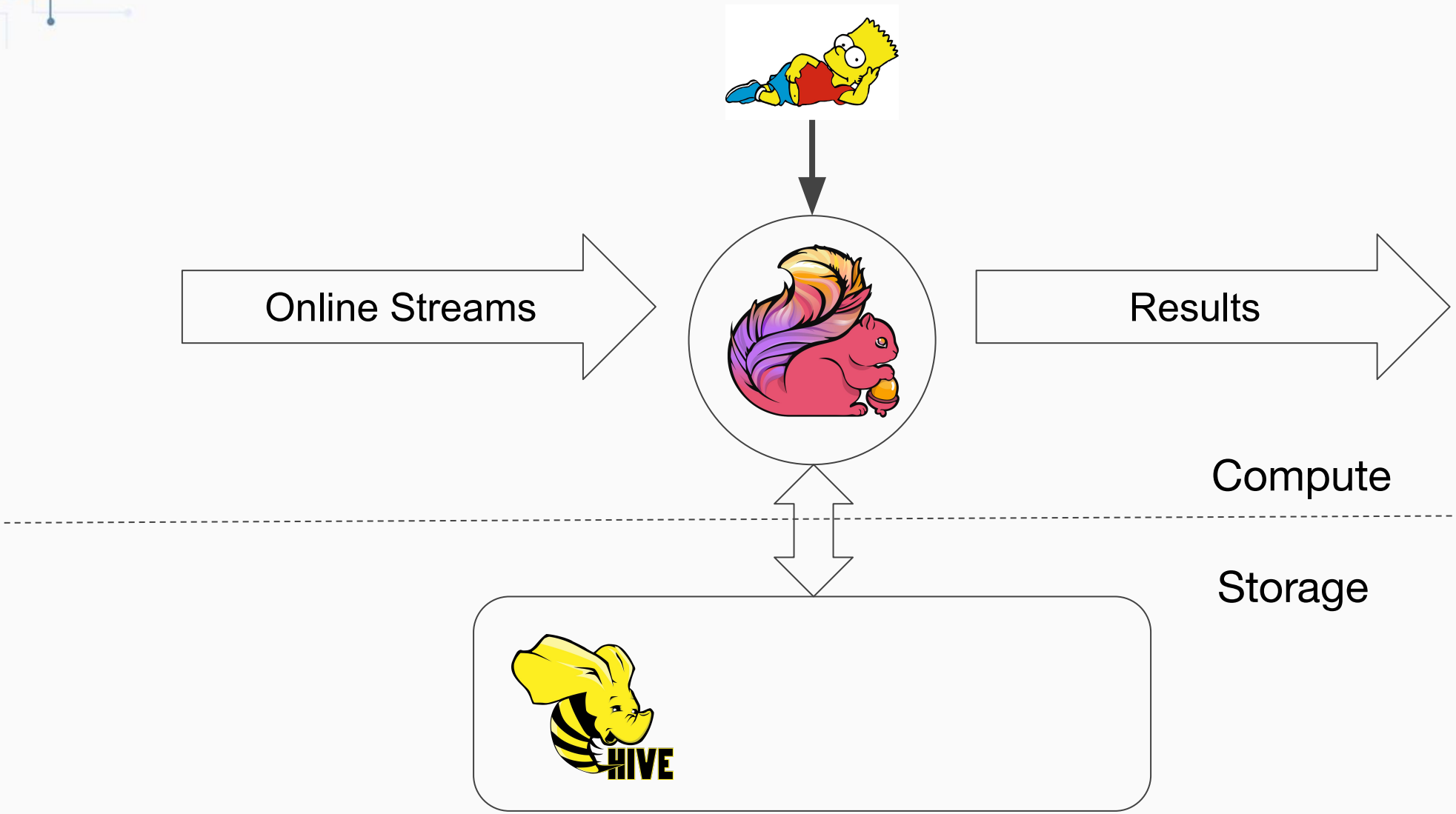
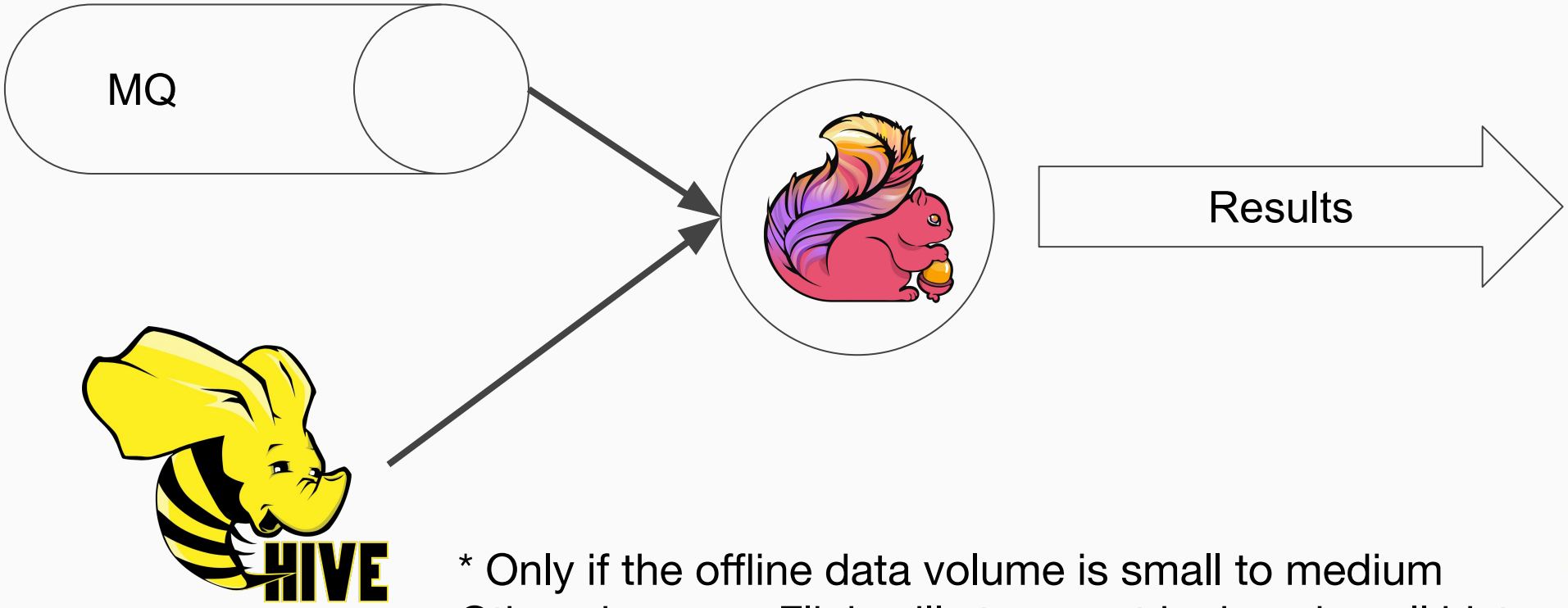
What use cases do these Flink capabilities enable?

Story 1 - Unify Compute Infrastructure



Story 2 - Join real-time data with offline data



* Only if the offline data volume is small to medium
Otherwise, your Flink will stress out by keeping all history data in state

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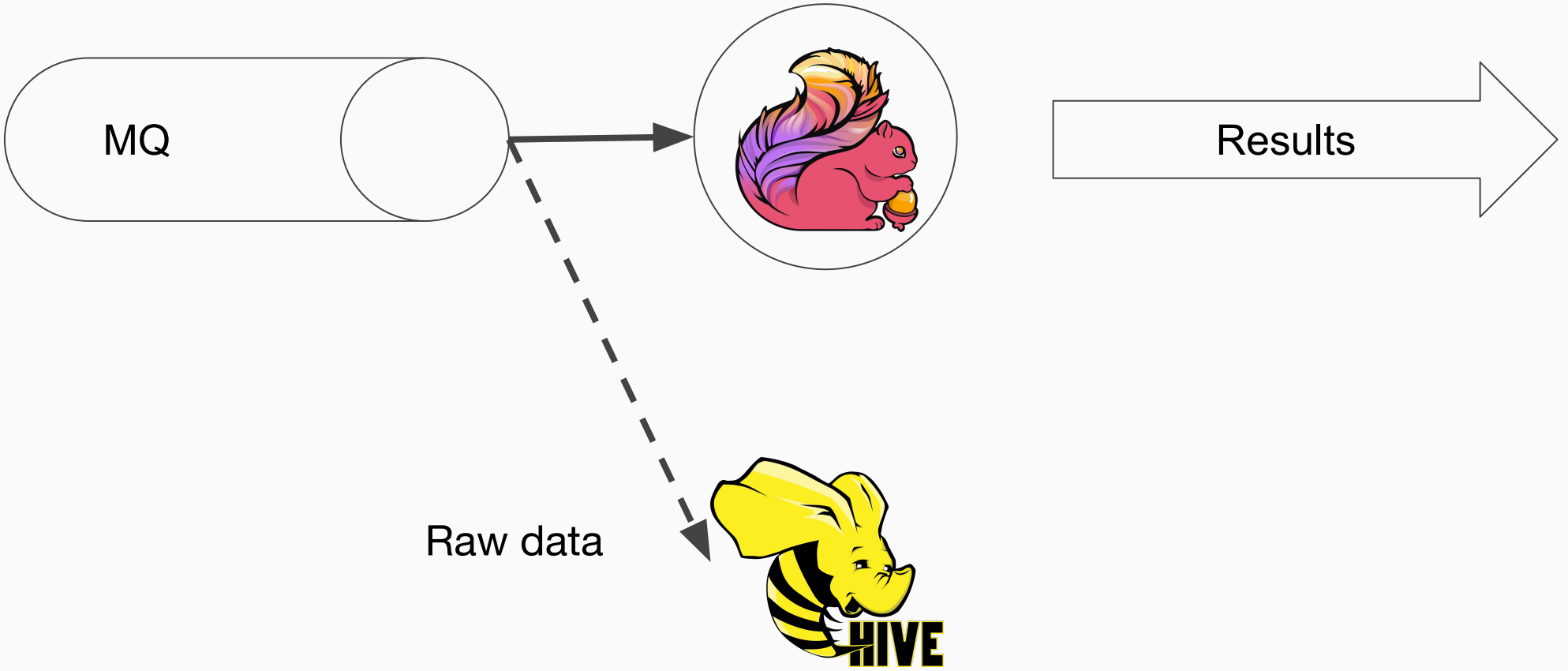
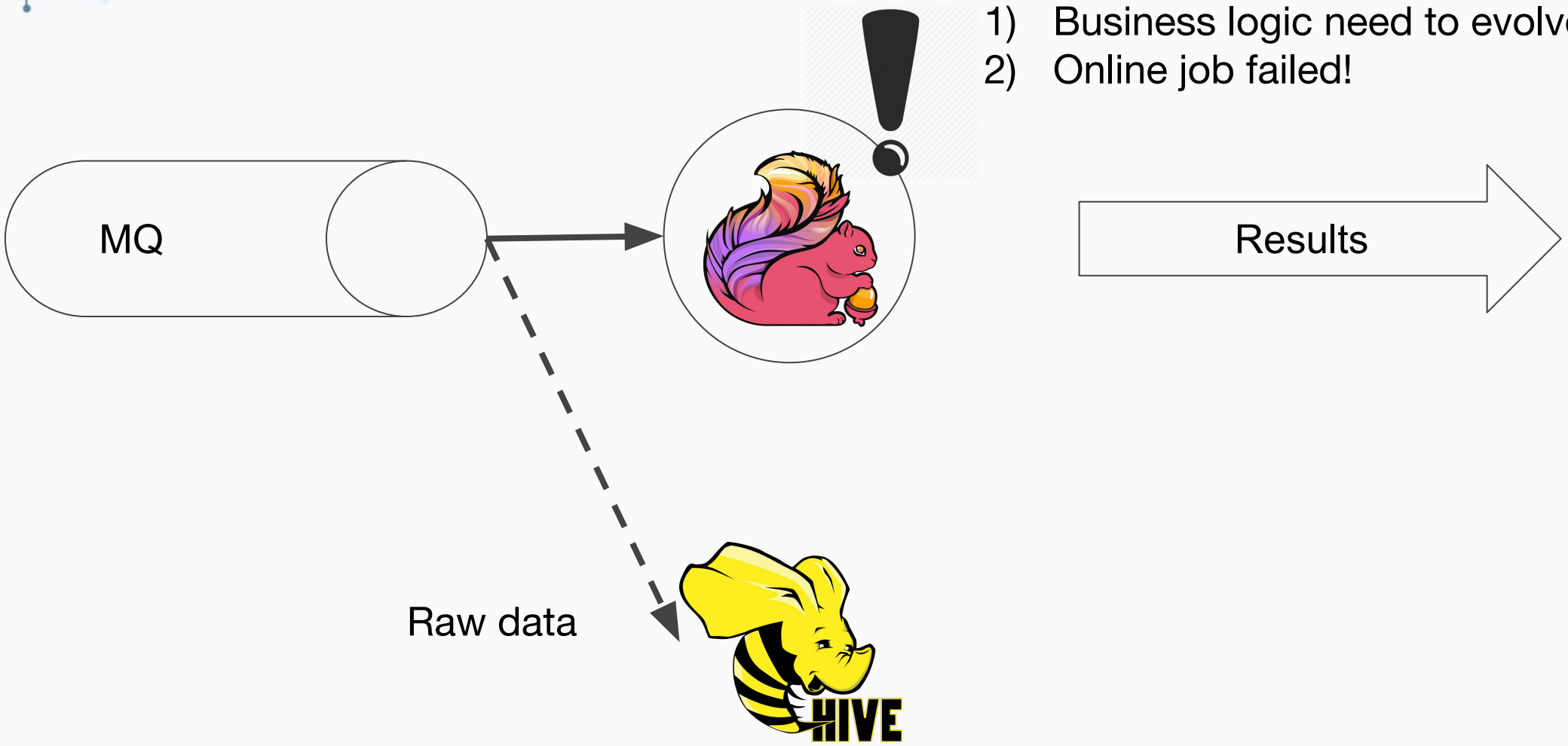
Story 3 - Backfill data on demand or on failures



1) Business logic need to evolve!
2) Online job failed!



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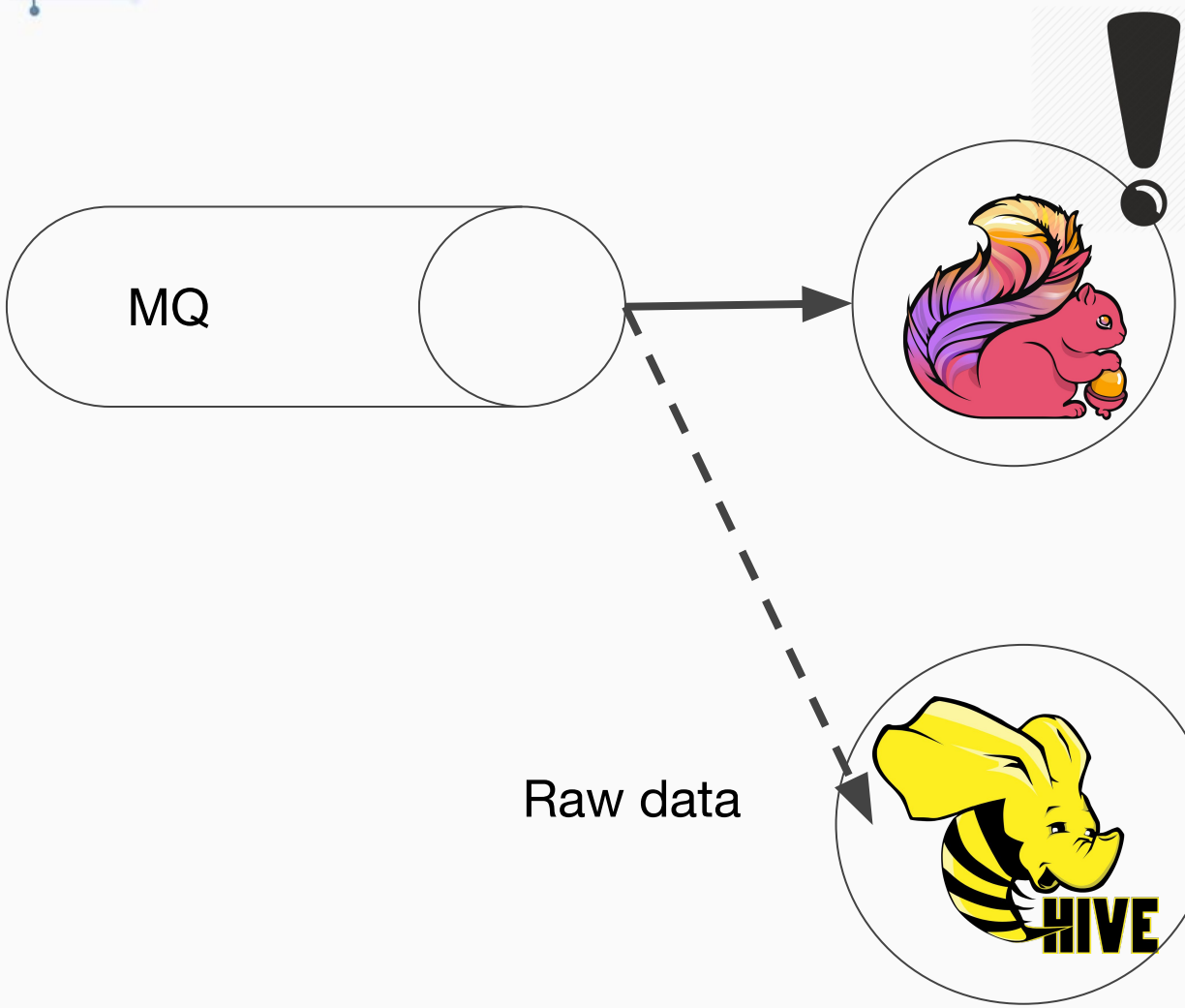
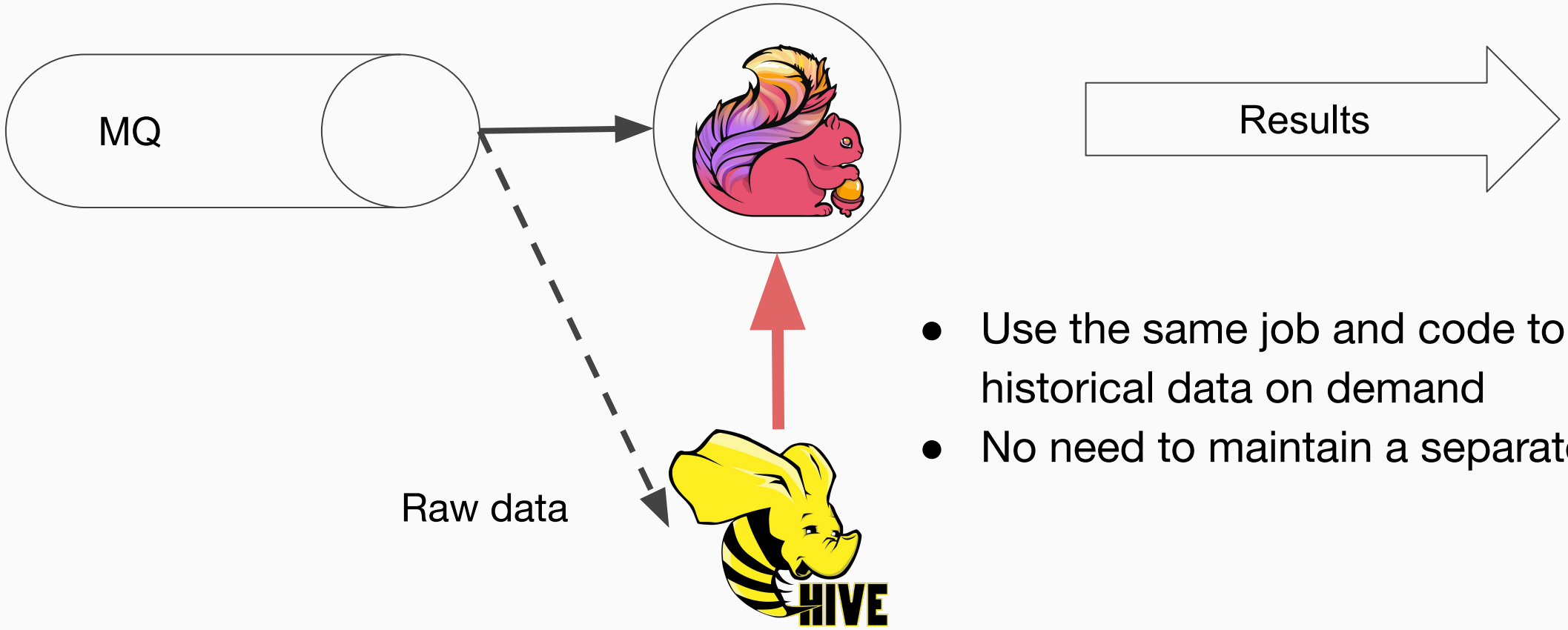


Results

In the past, you woud need a 2nd Hive job to do the backfill

Results

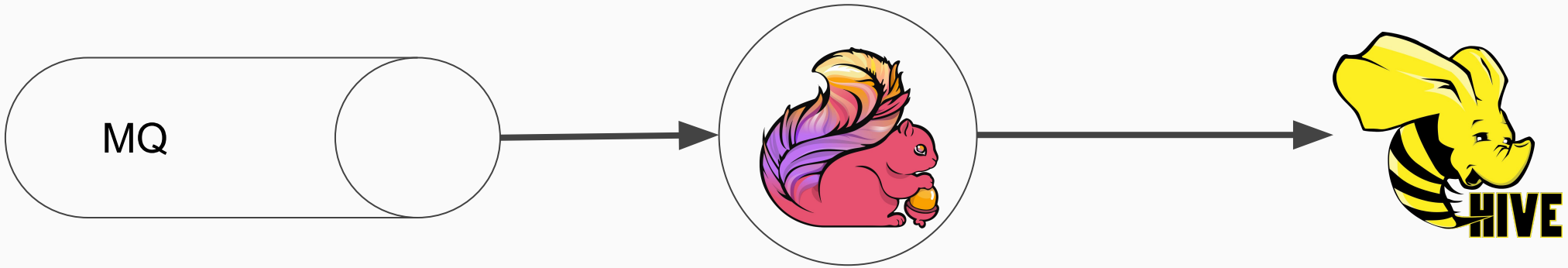
Online pipeline resumes and continue from the latest record because you don’t want to it to process piled-up data to increase pipeline latency and further sacrifice SLAs



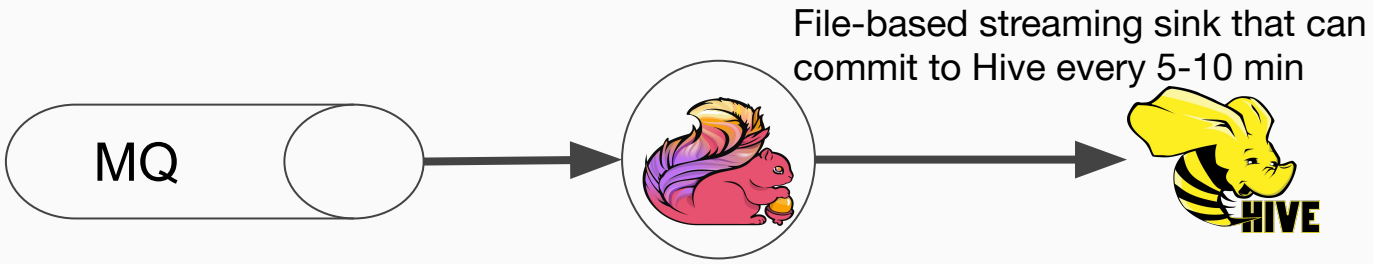
- Use the same job and code to reprocess historical data on demand
- No need to maintain a separate Hive job

Story 4 - Near-real-time data ingestion to Hive (upcoming)

File-based streaming sink that can commit to Hive every 5-10 min



Near-real-time data ingestion to Hive



Is this too good to be true, or is there any pitfalls?

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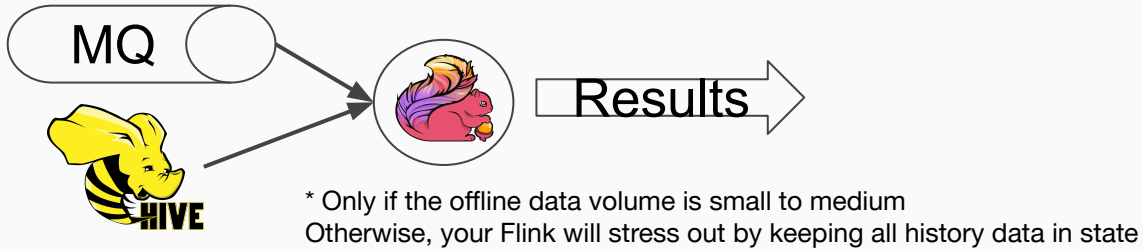
A general question at the end though:

Is traditional data warehouses or data lake really a good fit for streaming-native engine like Flink?

A Few Unsolved Problems - Example 1



What if you want to join real-time data with huge amount of historical data?

- You can't put into Flink as the volume is too big for Flink state to handle
- Maybe point-lookup?
  - Well, traditional dw/data lake don't support point-lookup, they only scan
- Maybe bring in Cassandra/HBase/Redis/…..?
  - You're indeed going the opposite direction of unification by diligently adding one additional infra at a time

A Few Unsolved Problems : Example 2

Does near-real-time come without a limit and a price?

- Pipeline latency **cannot** go below **5-10mins**, otherwise too many small files are created
  - any latency you've saved in Kafka and Flink is caped by the file commit interval in dw/dl
- Still a lot of small files even Flink commits every **5-10mins**. How do you handle them?
  - maybe commit every 1h? please, how dare you call it near-real-time when there's 1h delay
  - maybe have some hourly + daily Airflow jobs? Good luck going back to batch world

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Is there a Solution?

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Is there a Solution?

Yes, we are launching a new purpose-built product **Hologres**

check out the session presented by Xiaowei Jiang

“Data Warehouse, Data Lakes, What’s Next?”

April 23 11am-11:40am PDT, Room5

Conclusions

- Flink 1.10 brings production-read integration with Hive on both metadata management and data handling sides
- There are still many unsolved challenges when integrating Flink with traditional data warehouse and data lakes

Thanks!

Q&A

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