Carnegie Mellon University
School of Computer Science

15-319 / 15-619 Cloud Computing

Weekly Overview 10
November 2nd, 2021

Overview

- Last Week's Reflection
  - Project 4
  - OLI Module
    - Module 15: Case Studies: Distributed File Systems
    - Module 16: Case Studies: NoSQL Databases
    - Module 17: Case Studies: Cloud Object Storage
- This week's schedule
  - Phase 2
    - Deadline **Sunday**, Nov 07, 23:59:59 ET
  - OLI Module
    - Module 18: Introduction to Distributed Programming for the Cloud
    - Quiz Deadline **Friday**, Nov 05, 23:59:59 ET
  - Project 5
    - Deadline next **Sunday**, Nov 14, 23:59:59 ET

Big Data Processing

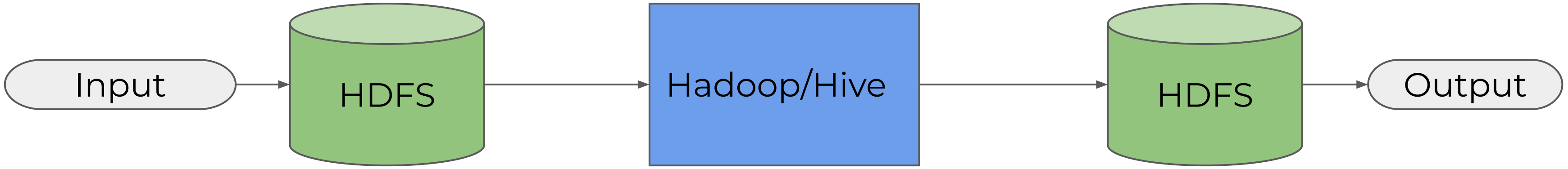
- Project 4
  - Iterative Programming Using Apache Spark
- Project 5
  - Stream Processing using Kafka & Samza

Stream vs. Batch Processing

- Batch processing
  - Data parallel, graph parallel
  - Iterative, non-iterative
  - Runs once in few hours/days
  - Historical data analysis
  - Not well suited for real time events streams
- Stream processing
  - Process events as they come
  - Real time decision making
  - Sensor streams/web event data

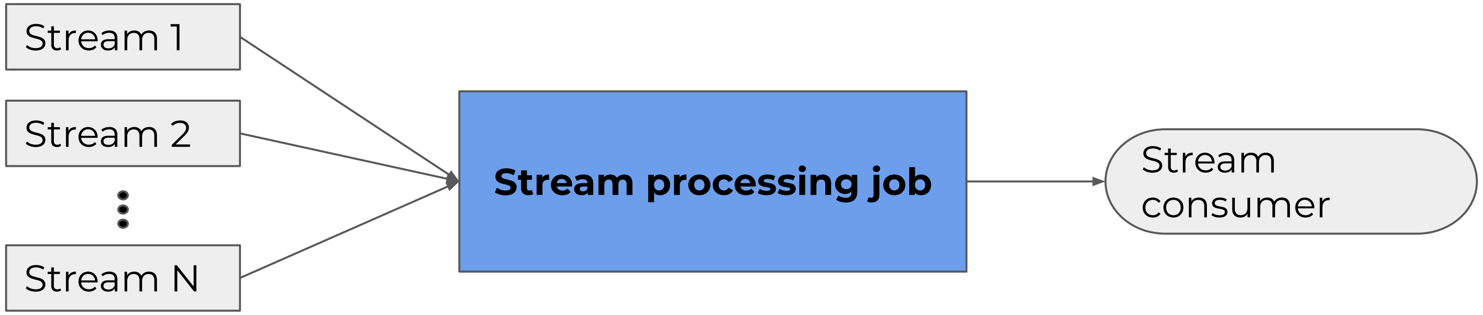
Typical Batch Processing Job

- Input is collected into static “batches” and processed holistically
  - Represents a single point in time
- Output is consumed sometime later
  - Data (analysis) retains “value” with time



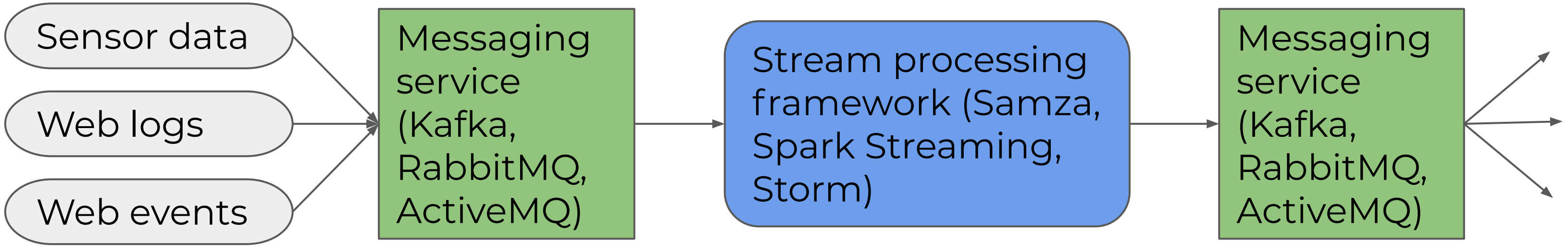
Typical Stream Processing Job

- Data is processed immediately*
  - *Upon queueing
- The processed data is available to downstream consumers for real time decision/analytics



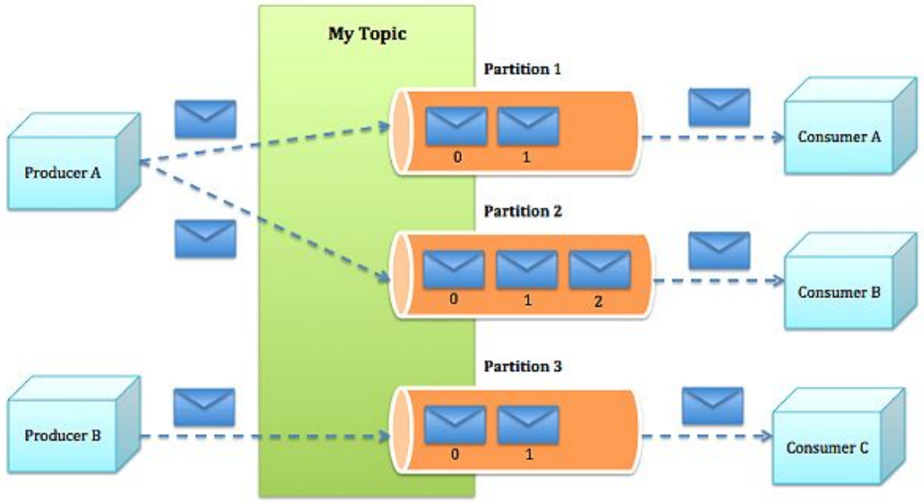
Components of a Stream Processing Job

- An event producer - Sensors, web logs, web events
- A messaging service - Kafka, RabbitMQ, ActiveMQ
- A stream processing framework - Samza, Storm, Spark Streaming


Sensor data
Web logs
Web events
Messaging service (Kafka, RabbitMQ, ActiveMQ)
Stream processing framework (Samza, Spark Streaming, Storm)
Messaging service (Kafka, RabbitMQ, ActiveMQ)

Apache Kafka

- A distributed messaging system developed at LinkedIn.

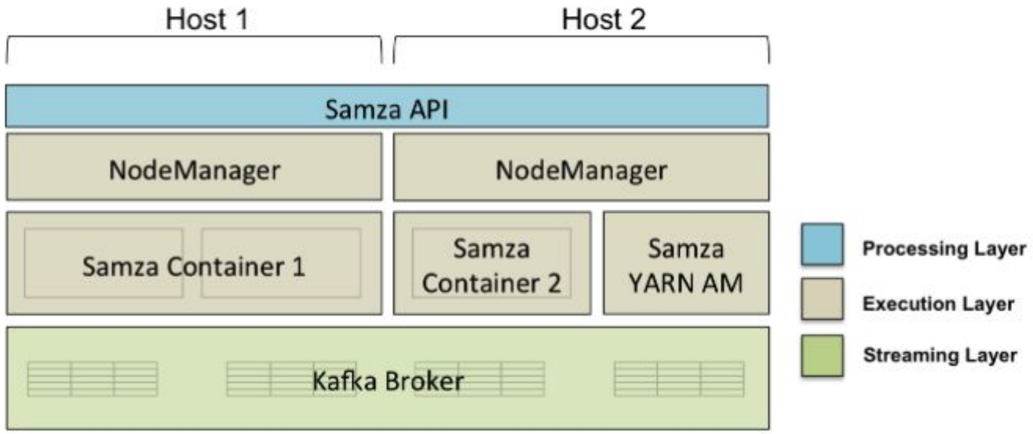


Semantic partitioning in Kafka

- Each topic (stream) is partitioned for scalability across all nodes in the Kafka cluster
- Default partitioning attempts message load balancing
- Streams can also be partitioned semantically by user - key of the message
- All messages with the same key arrive to the same partition
- Fault-tolerance: Replication
  - One leader and zero/more followers
  - Replication factor
  - ISR (in-sync replicas)

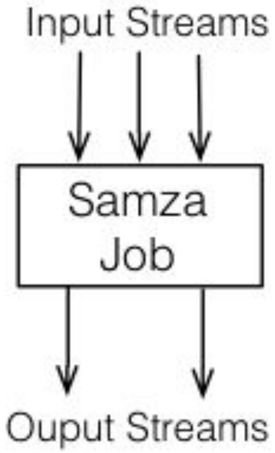
Apache Samza

- Stream processing framework developed at LinkedIn
- Consists of 3 layers:
  - streaming, execution and processing (Samza) layer
- Most common use: Kafka for streaming, YARN for execution



Partitioning in Apache Samza

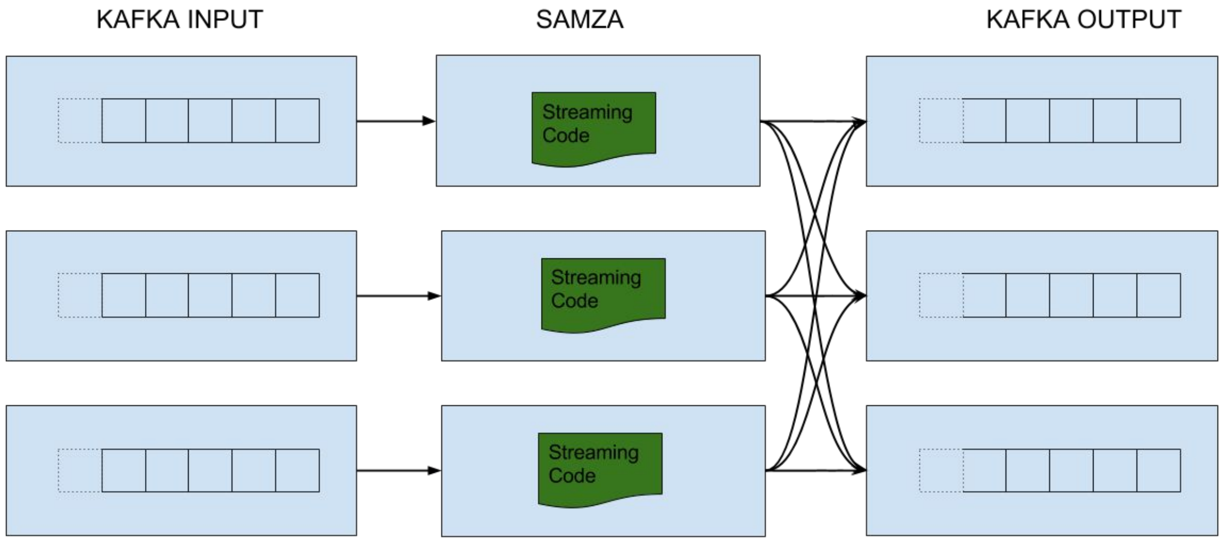
- Programmer uses the Samza API to perform stream processing
- Each partition in Kafka is assigned to a single Samza task instance



Stateful stream processing in Apache Samza

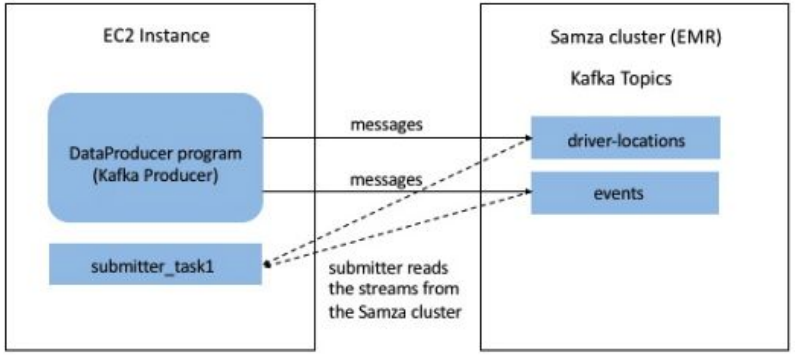
- Calculate sum, avg, count, etc.
- State in remote data store? - slow
- State in local memory? - machine might crash
- Solution - persistent KV store provided by Samza
  - Changes to KV store persisted to a different stream (usually Kafka) - replay on failure
  - RocksDB currently supported as a persistent KV store
    - You **MUST** use a persistent KV store for P5!

Kafka and Samza, Together



Project 5 - NYCabs (NYC based Taxi Service)

- Stream Processing with Kafka/Samza
  - Stream 1: Car GPS coordinates
  - Stream 2: Riders
- Task:
  - Match riders with drivers to minimize travel time & other constraints

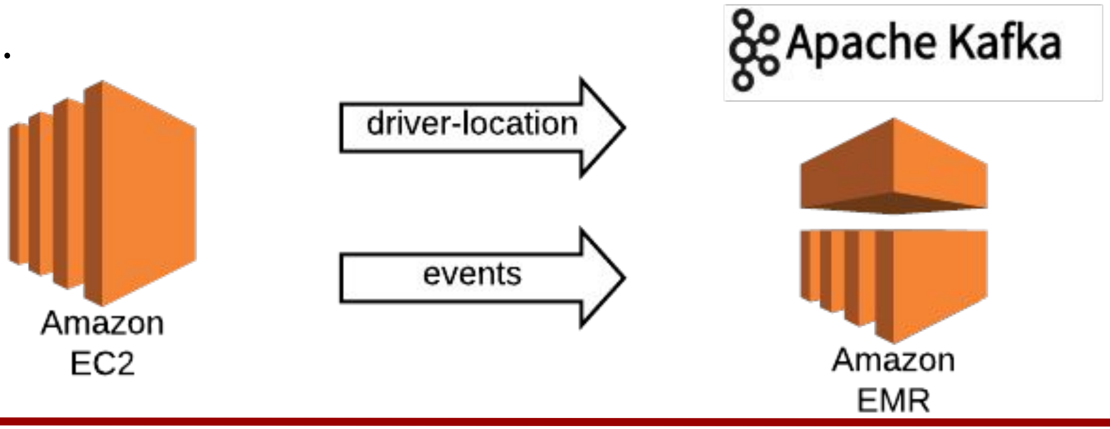


Project 5 - Task 1

- Simulate the scenario that the **drivers** update their locations on a regular basis as they move in the city and the **clients** request rides at some time.
- Data
    - Tracefile -> Two streams
    - Type:
        - DRIVER_LOCATION -> driver_locations stream
        - LEAVING_BLOCK, ENTERING_BLOCK, RIDE_REQUEST, RIDE_COMPLETE
          -> events stream

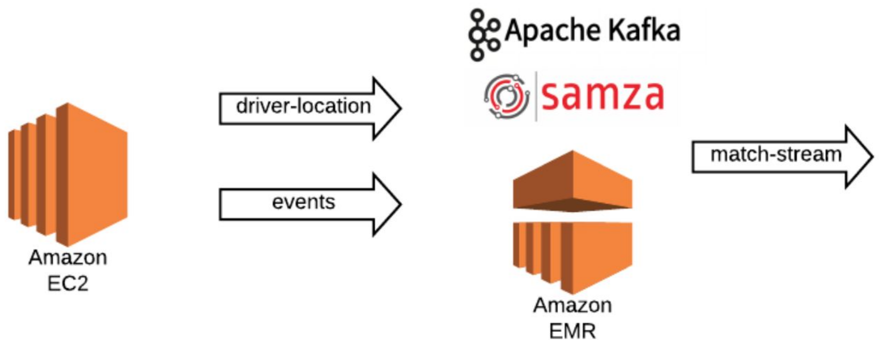
Project 5 - Task 1

- You will run your producer program on your student AMI instance.
- The producer program will publish the data into Kafka brokers.
- The submitter for Task 1 is located on the student AMI instance.



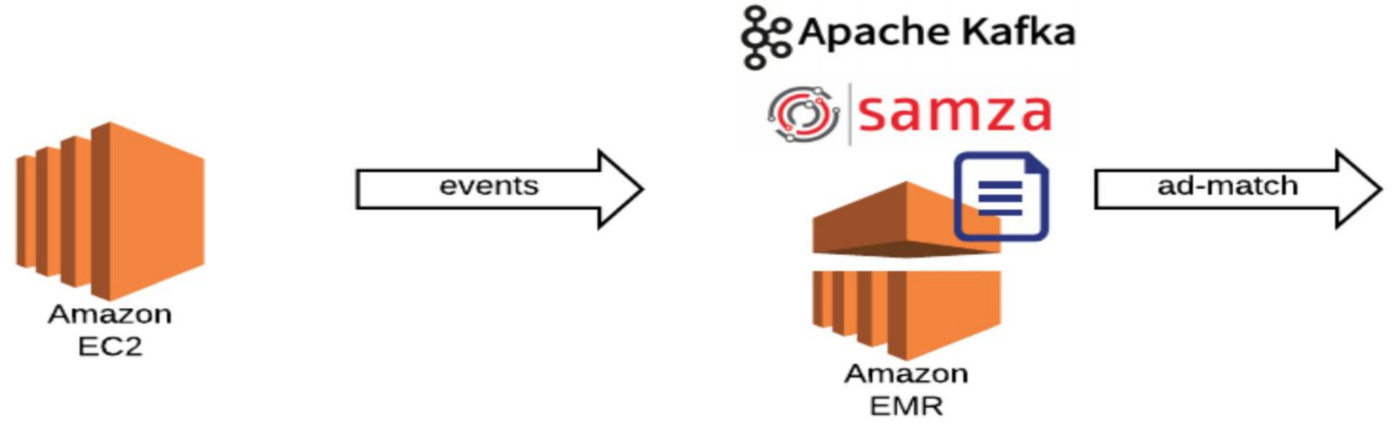
Project 5 - Task 2

- Use the same producer program used in Task 1.
- Find the best match for a ride request with a driver located in the **same block** as the rider based on published data.



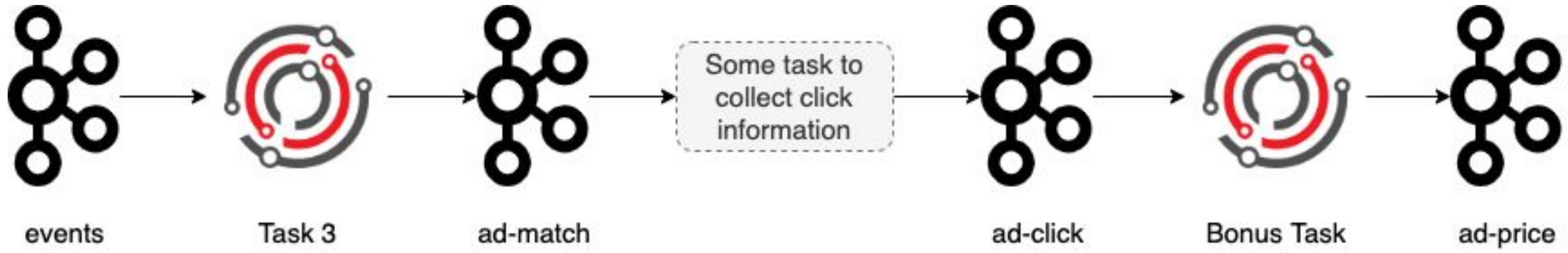
Project 5 - Task 3

- Find the best advertisement to place for a specific user.
- Utilize BOTH static data(user profile, health status and interests) and stream data to make this decision.



Project 5 - Bonus Task

- Find the advertisement price that a restaurant is paying to NYCabs and the advertising company.
- Write **at least 2** unit test test cases.



Project 5 - Debugging

- Debugging (IMPORTANT!)
  - Use the YARN UI
  - Output a kafka stream for debugging
  - Yarn application commands
    - yarn application -list
  - YARN container logs
    - on the machine where the YARN container is running
  - Read the debugging section in the primer carefully!
  - Include the error message when you post on Piazza!

Thank you!