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DeepLearning.AI

Data Ingestion

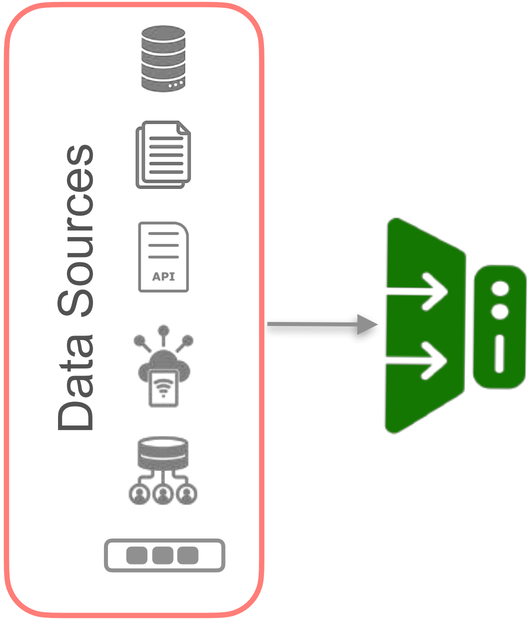
Week 2

DeepLearning.AI

Data Ingestion Overview

Week 2 Overview

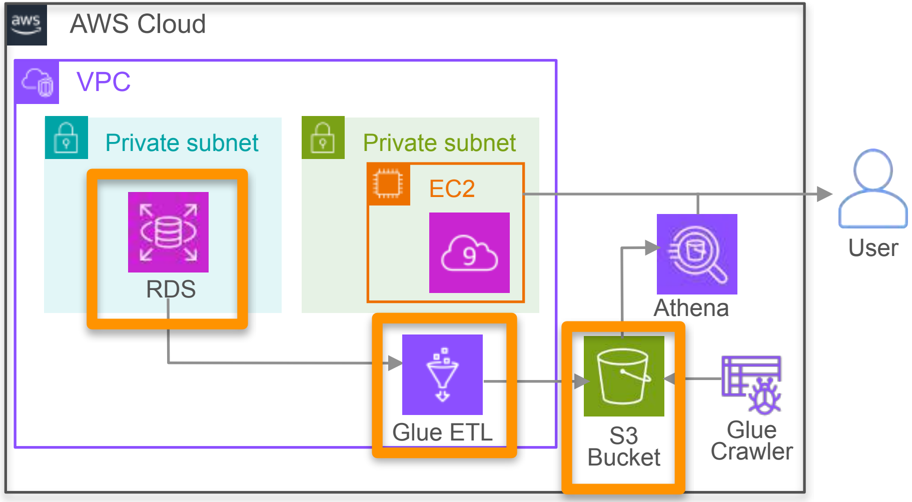
Data Ingestion



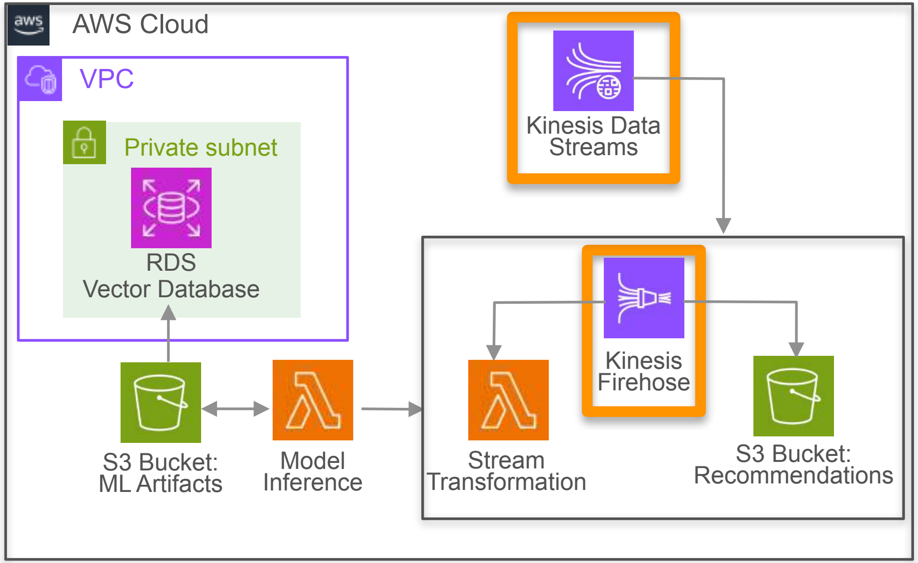
Get raw data → Turn it into something useful → Make it available for downstream use cases

Data Ingestion

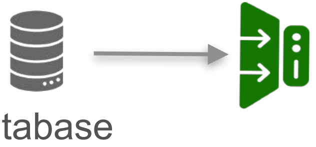
Course 1 Week 2 Lab



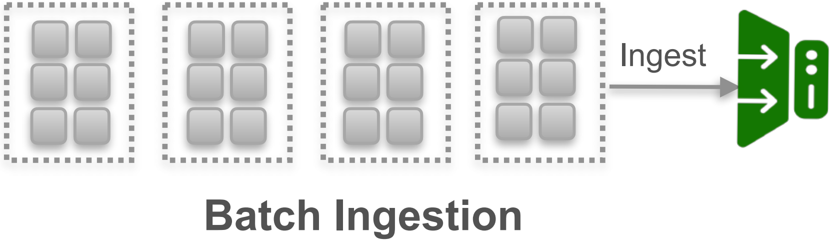
Course 1 Week 4 Lab



Course 2 Week 1 Lab

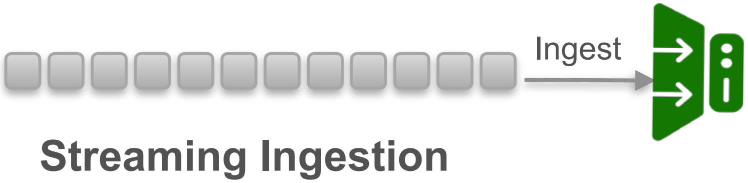


Week 2 Overview



Batch Ingestion

Processing data in chunks or batches



Streaming Ingestion

Processing a continuous stream of events

Week 2 Overview

Lab: streaming ingestion

Investigate requirements for **streaming ingestion**:

- the data payload and event rates
- how to configure the streaming pipeline

Lab: batch ingestion

Identify requirements for **batch ingestion** from a **REST API**

Software Engineers

Data Engineer

Marketing Analyst

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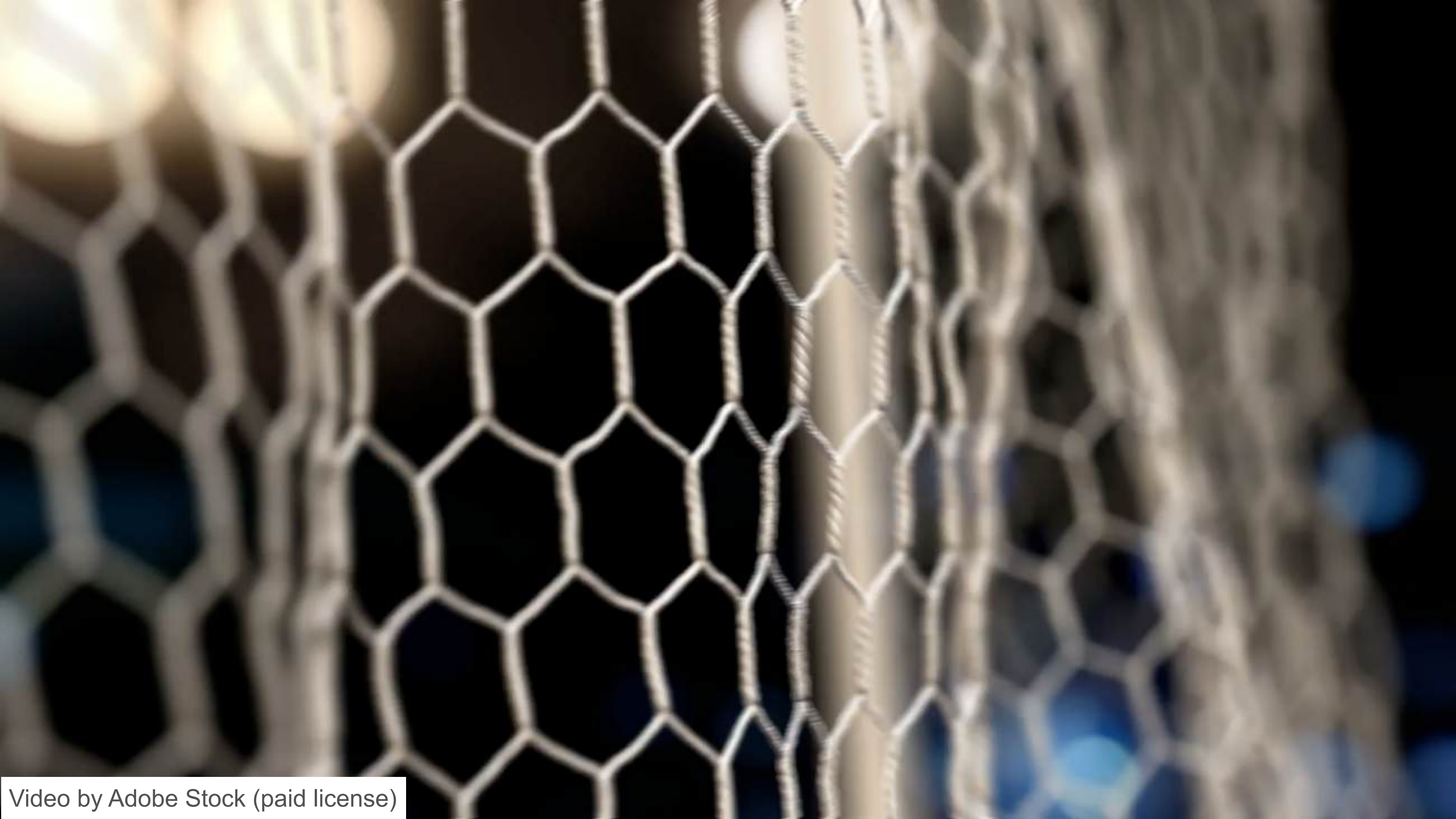
Data Ingestion

Data Ingestion on a Continuum

Video by Adobe Stock (paid license)



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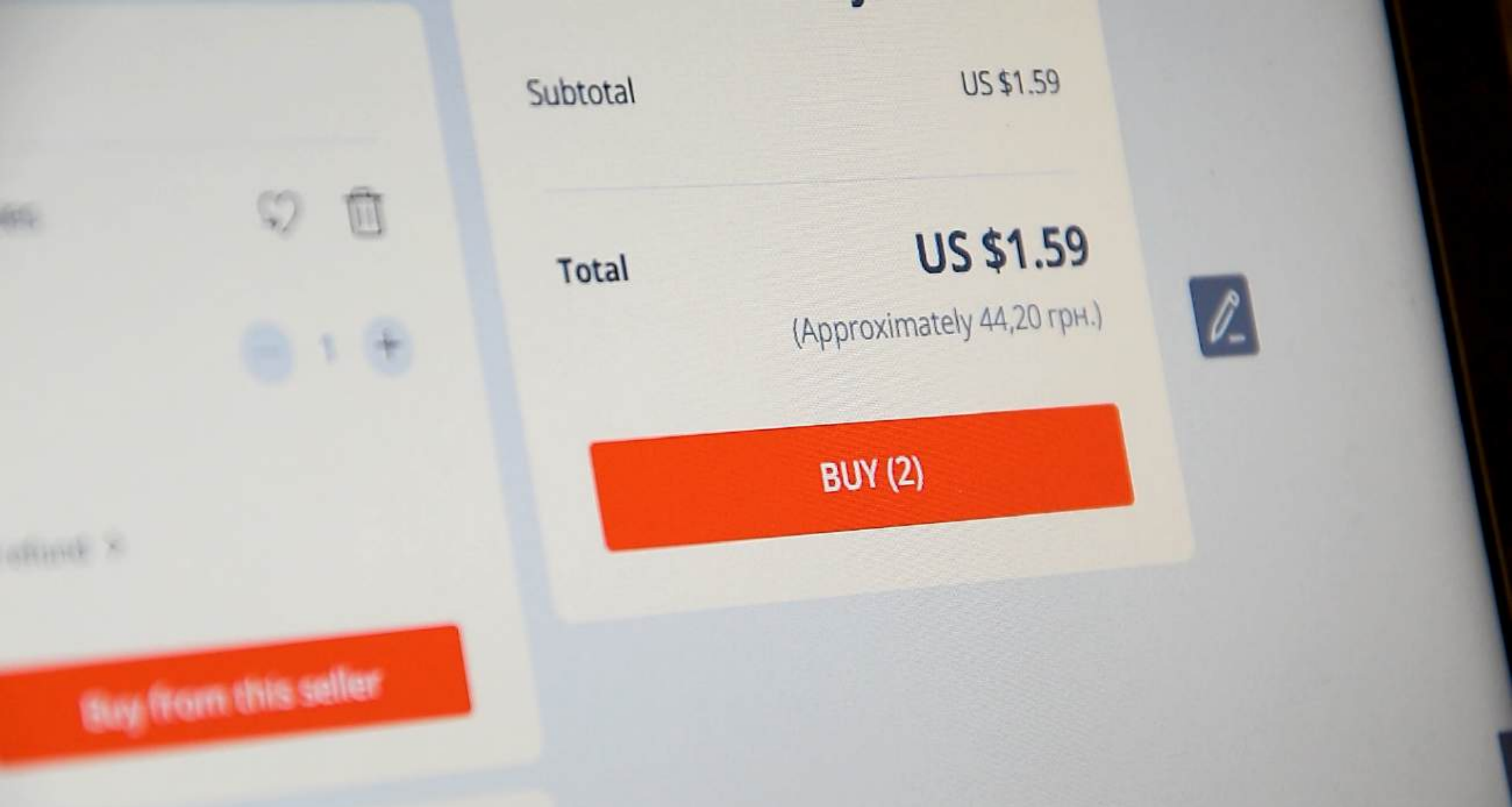


Subtotal US $1.59

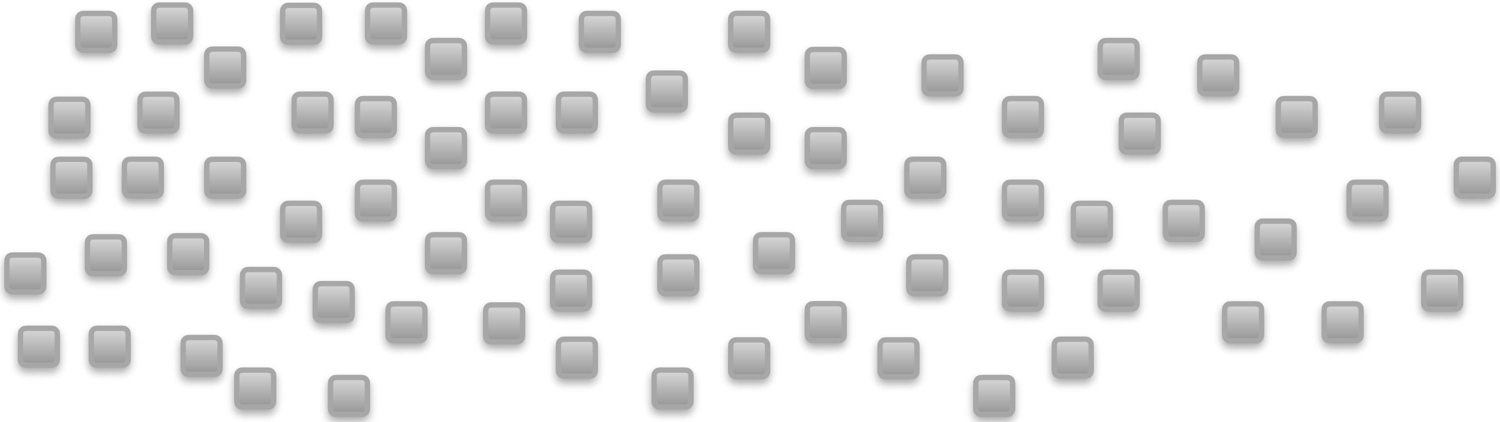
Total US $1.59

(Approximately 44,20 грн.)

Video by Adobe Stock (paid license)

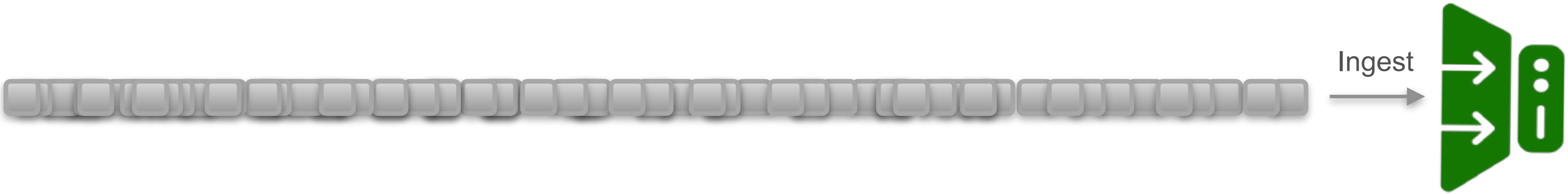
Data Ingestion

Unbounded Data: continuous stream of events



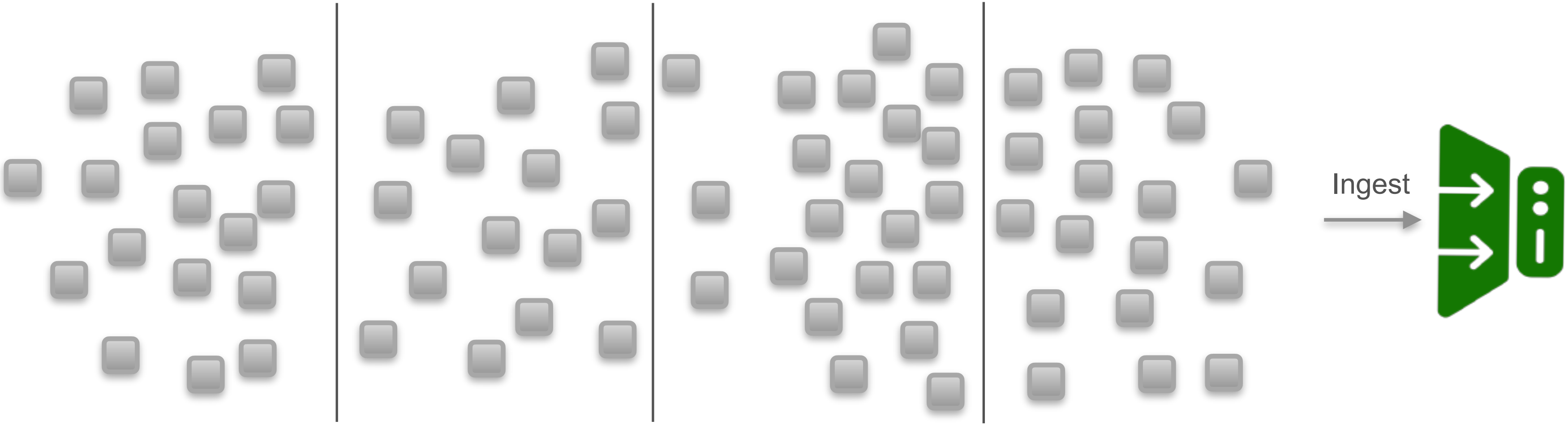
Data Ingestion

Stream Ingestion



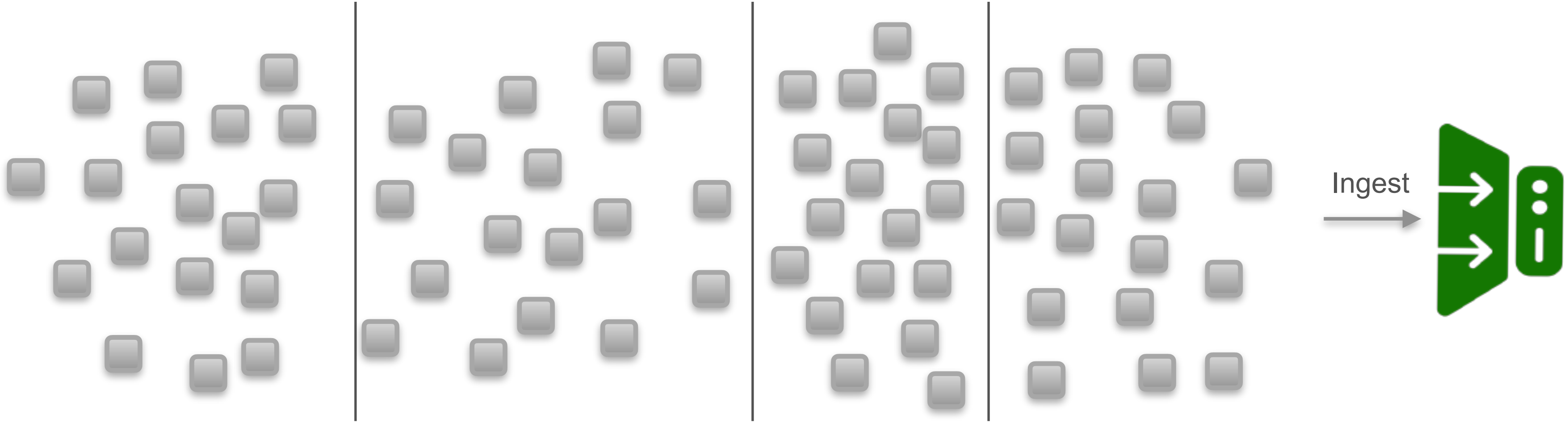
Data Ingestion

Batch Ingestion



Data Ingestion

Size-Based Batch Ingestion



10 GB

1000 events

10 GB

1000 events

10 GB

1000 events

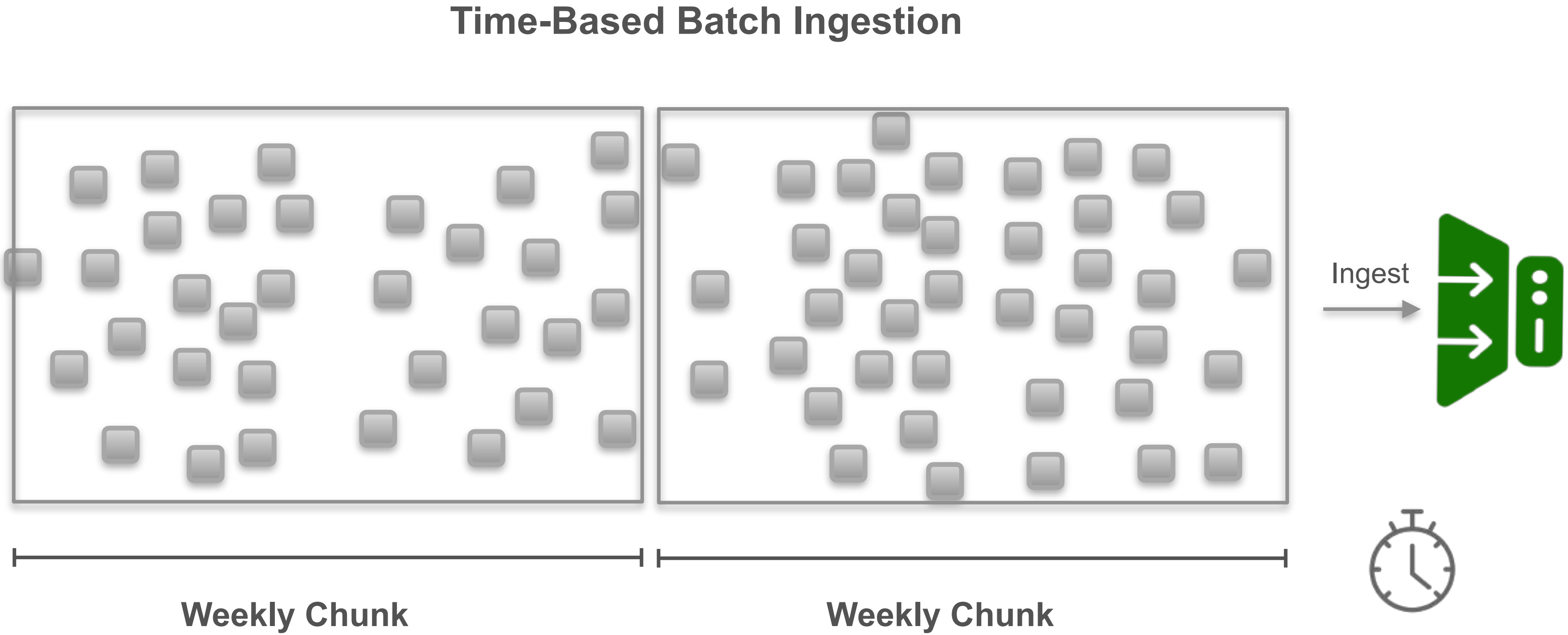
10 GB

1000 events

Size-threshold

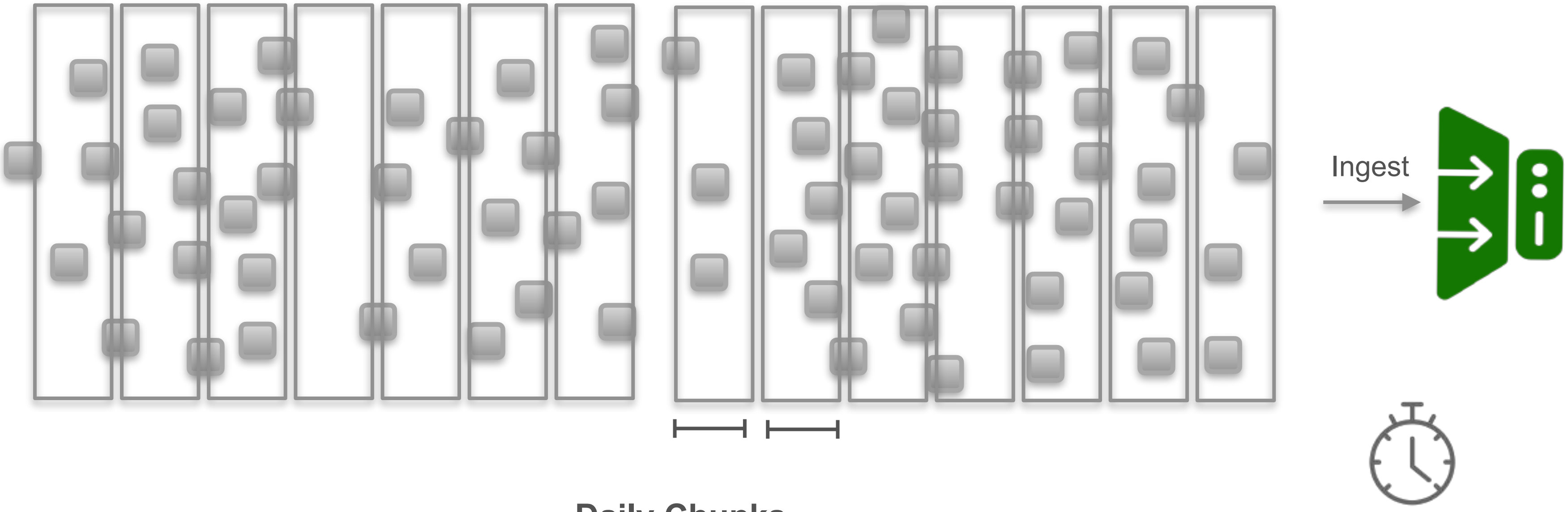
Total number of records

Data Ingestion



Data Ingestion

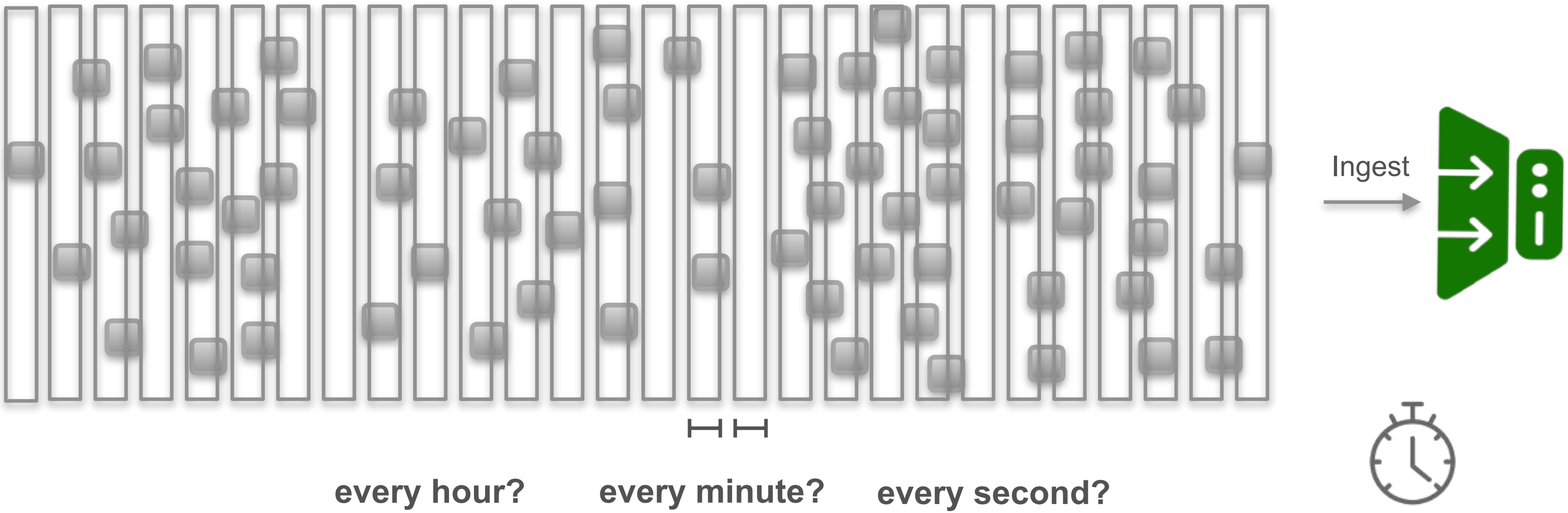
Time-Based Batch Ingestion



Daily Chunks

Data Ingestion

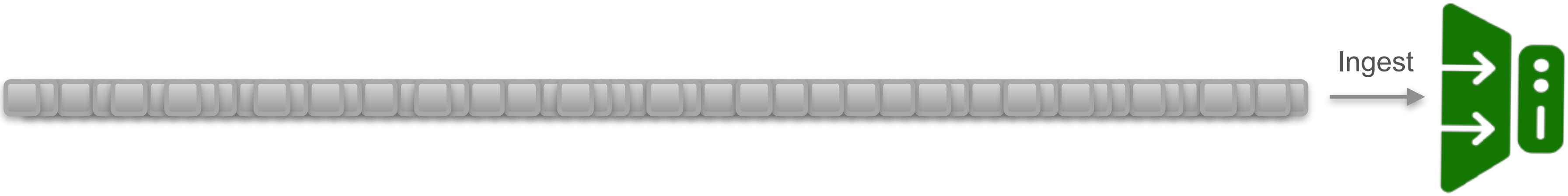
Time-Based Batch Ingestion



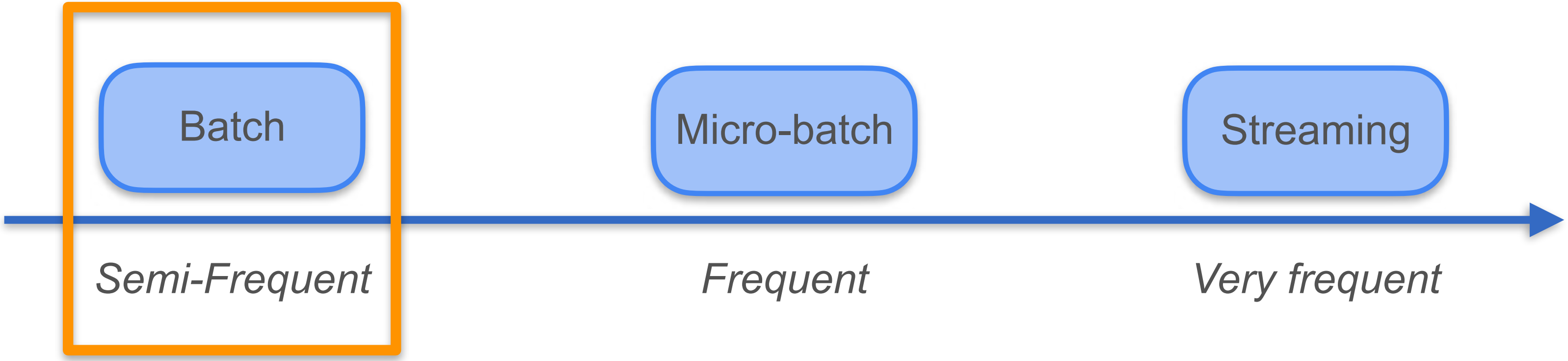
every hour? every minute? every second?

Data Ingestion

Stream Ingestion



Ingestion Frequencies

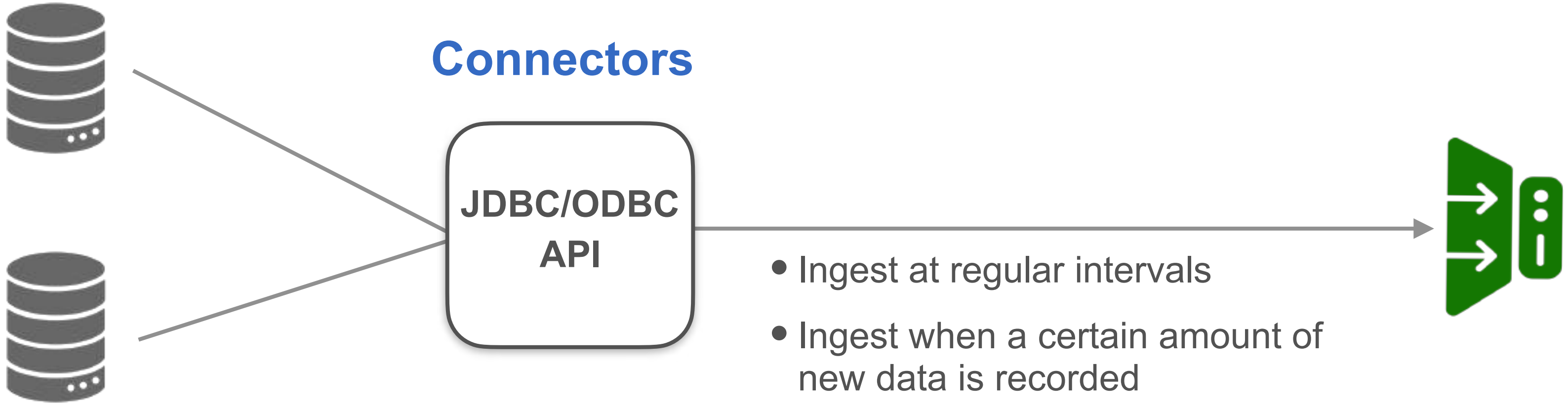


Choice of ingestion frequency depends on:

- the source systems you’re working with
- the end use case

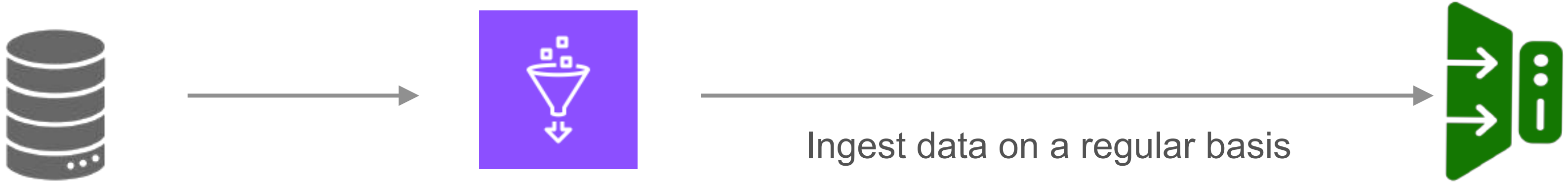
Ways to Ingest Data from Databases

Connectors



- Ingest at regular intervals
- Ingest when a certain amount of new data is recorded

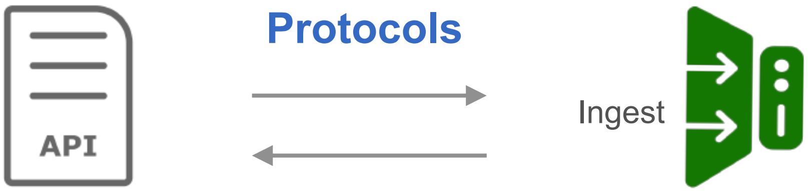
Ingestion Tool



AWS Glue ETL

Ingest data on a regular basis

Ways to Ingest Data from APIs



API

Protocols

Ingest

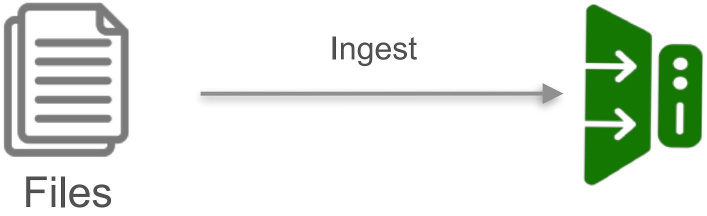
- How much can you ingest in one go?
- How frequently can you call the API?

Reading API documentation

Communicating with data owners

Writing custom API connection code

Ways to Ingest Data from Files



Manual File Download

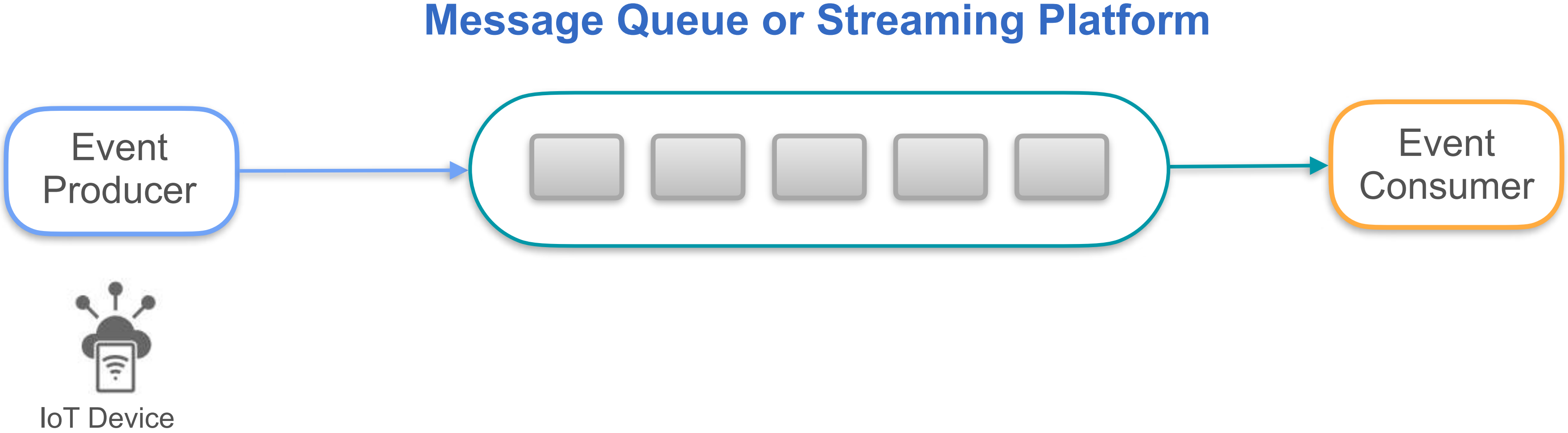
Secure File Transfer

File Transfer Protocols

SFTP: Secure File Transfer Protocol

SCP: Secure Copy Protocol

Ways to Ingest Data from Streaming Systems



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Batch Ingestion

Conversation with a Marketing Analyst

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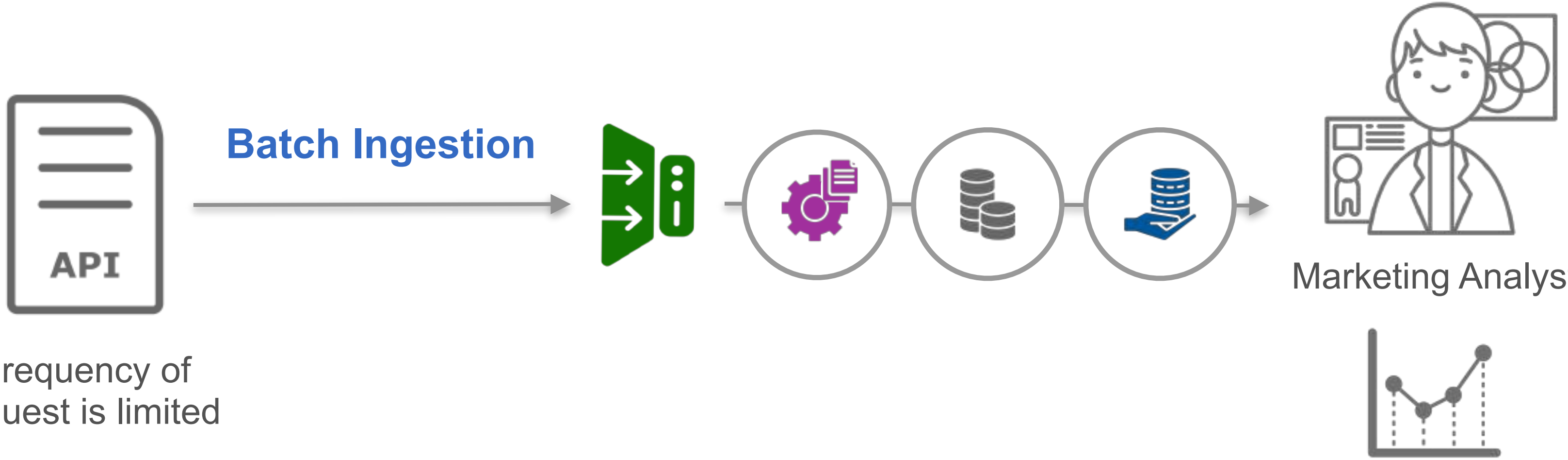
Batch Ingestion

ETL vs. ELT

Goals of the Marketing Analyst



Batch Ingestion

Frequency of request is limited

Marketing Analyst

Analysis of Historical Trends

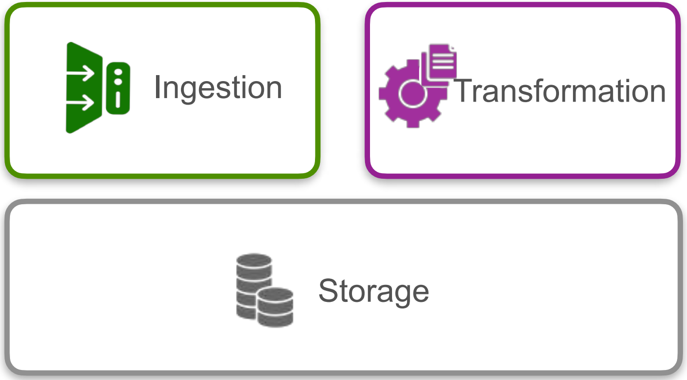
No need for real-time analysis

Batch Ingestion Patterns

ETL **Extract - Transform - Load**

Tradeoffs

ELT **Extract - Load - Transform**



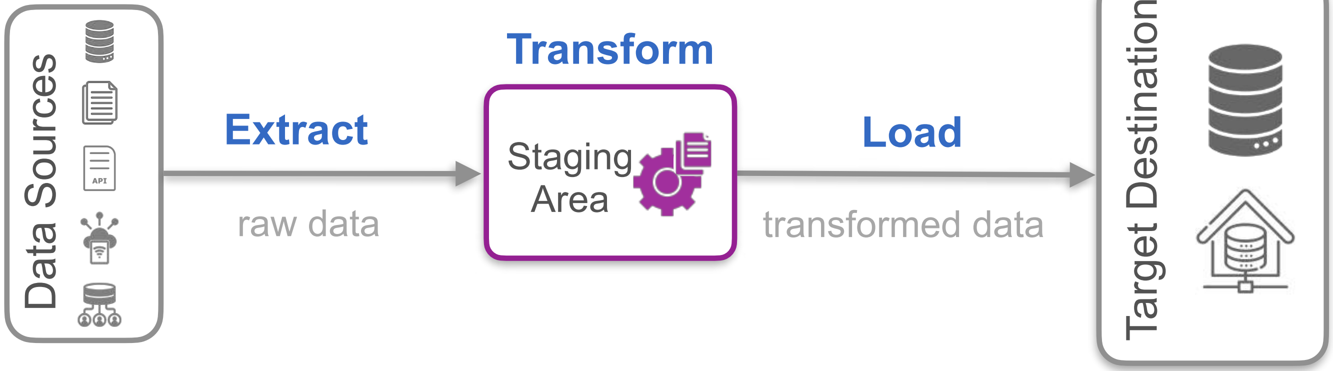
Batch Ingestion Patterns

ETL Extract - Transform - Load

ELT Extract - Load - Transform

Batch Ingestion Patterns

ETL

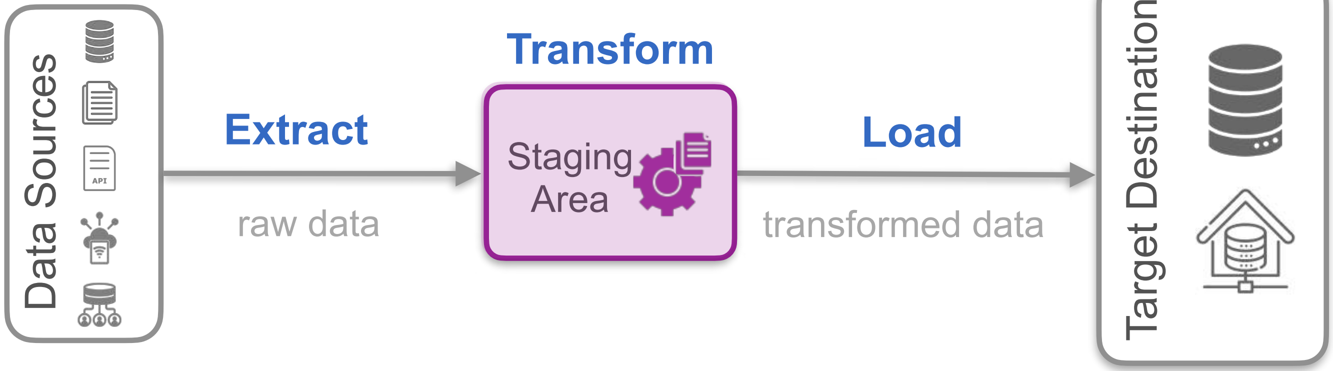


ELT

Extract - Load - Transform

Batch Ingestion Patterns

ETL



ELT

Extract - Load - Transform

Emergence of Cloud Storage Systems

Early 2010s: Highly scalable cloud storage

Data Lake

built on top of object storage

Cloud Data Warehouse

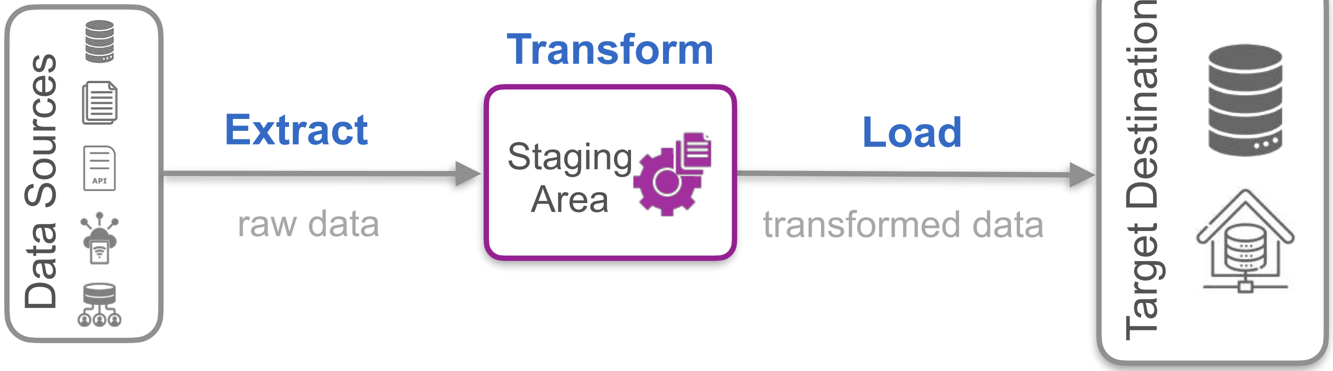
Amazon Redshift

snowflake

- Store enormous amounts of data for relatively cheap
- Perform data transformations directly in the data warehouse

Batch Ingestion Patterns

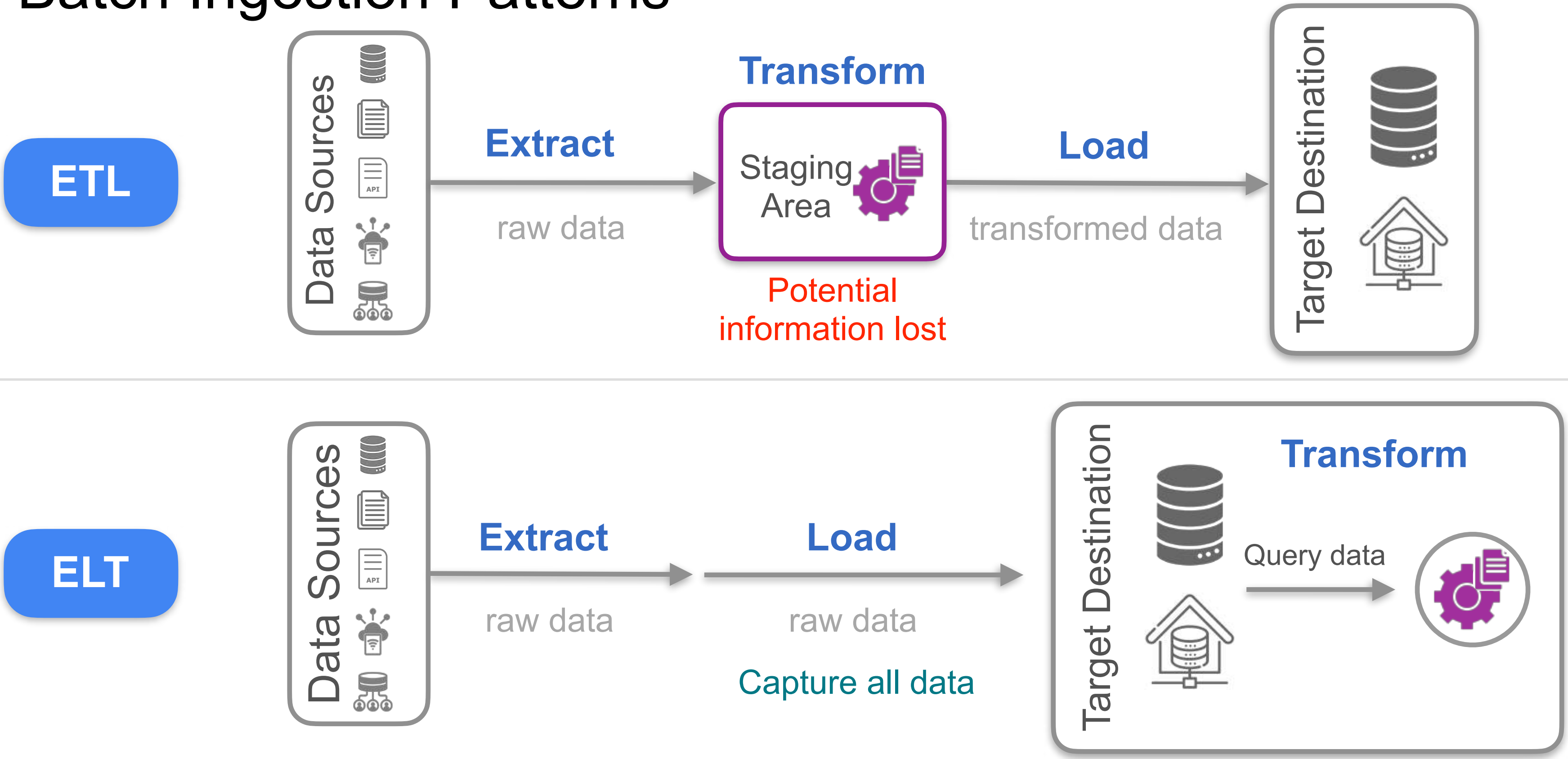
ETL



ELT

Extract - Load - Transform

Batch Ingestion Patterns



Advantages of Extract-Load-Transform

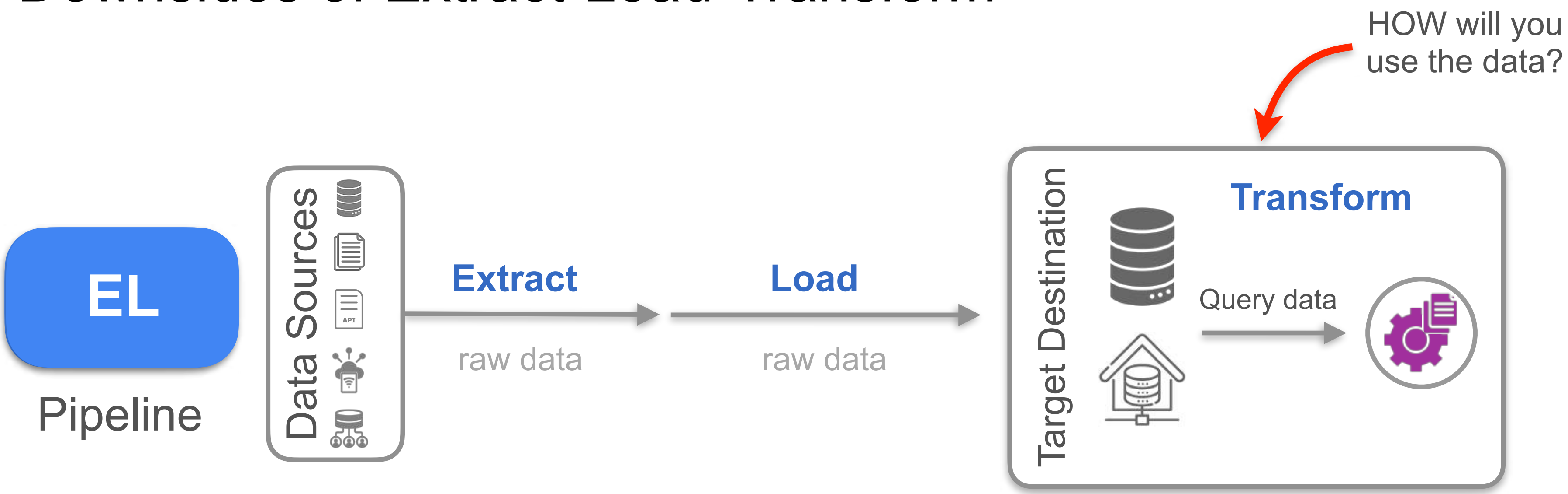
It is faster to implement.

It makes data available more quickly to end users.

Transformations can still be done efficiently.

You can decide later to adopt different transformations.

Downsides of Extract-Load-Transform



Data Swamp

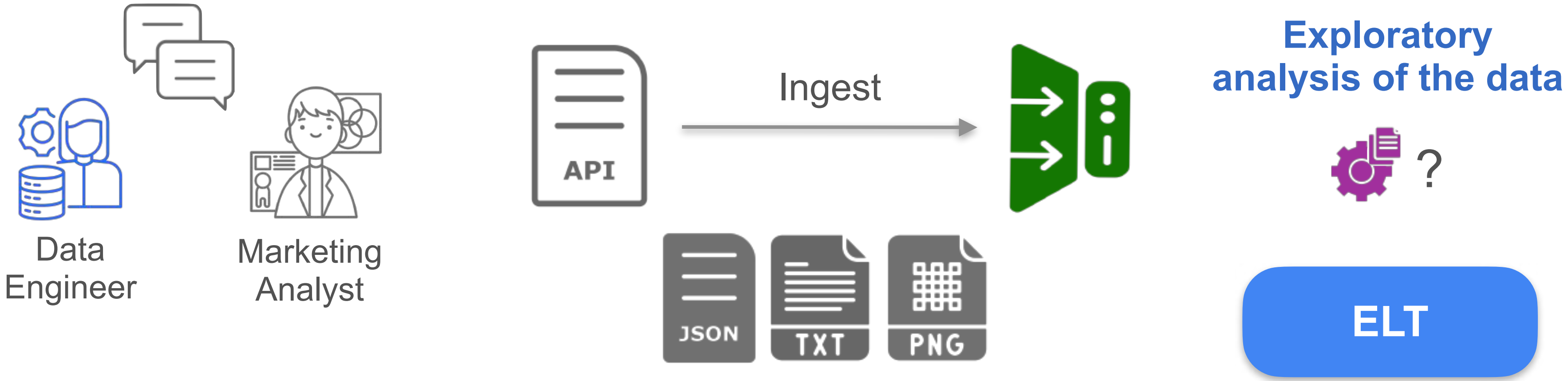
Data has become unorganized, unmanageable, and essentially useless.

Downsides of Extract-Load-Transform

Data Swamp

Video by Adobe Stock (paid license)

Conversation with the Marketing Analyst



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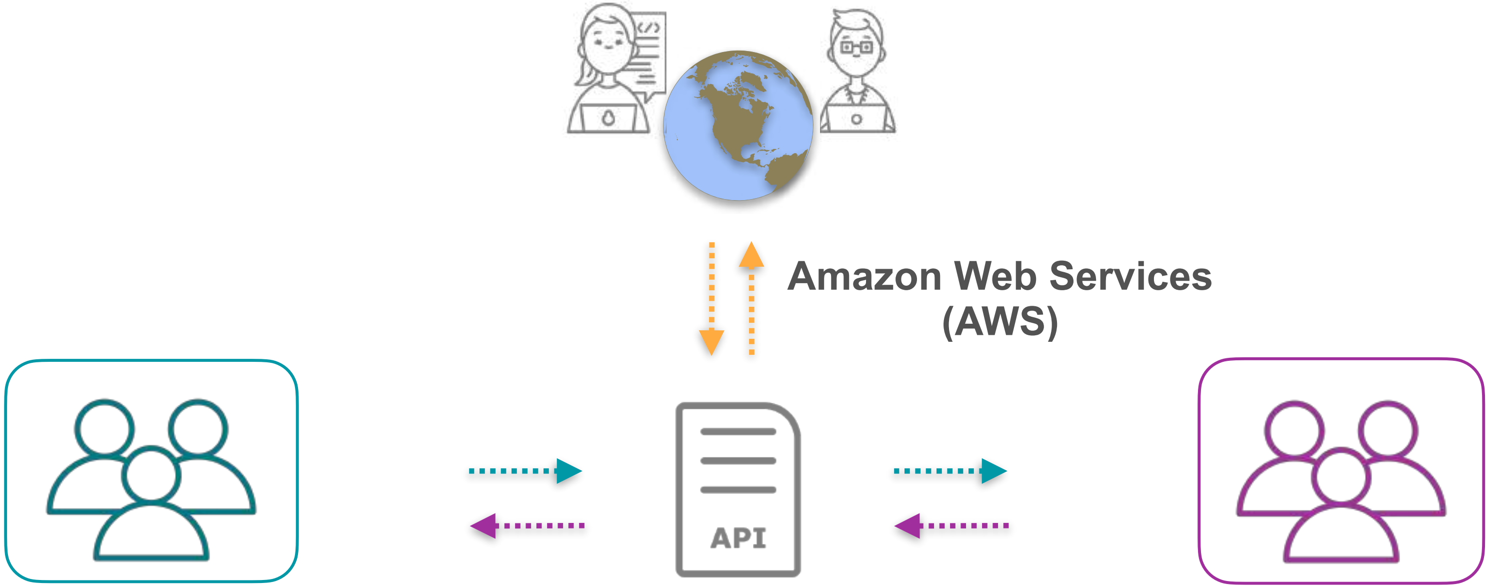
Batch Ingestion

REST API

API Mandate



Amazon Web Services (AWS)

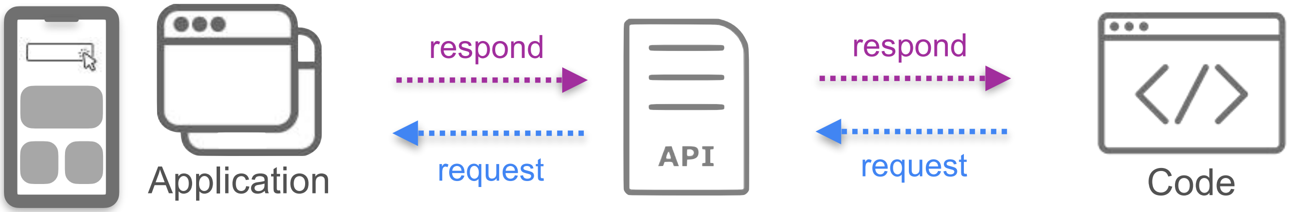
Application Programming Interface

Stable & Predictable

What is an API?

API

A set of rules and specifications that allows you to programmatically communicate and exchange data with an application.

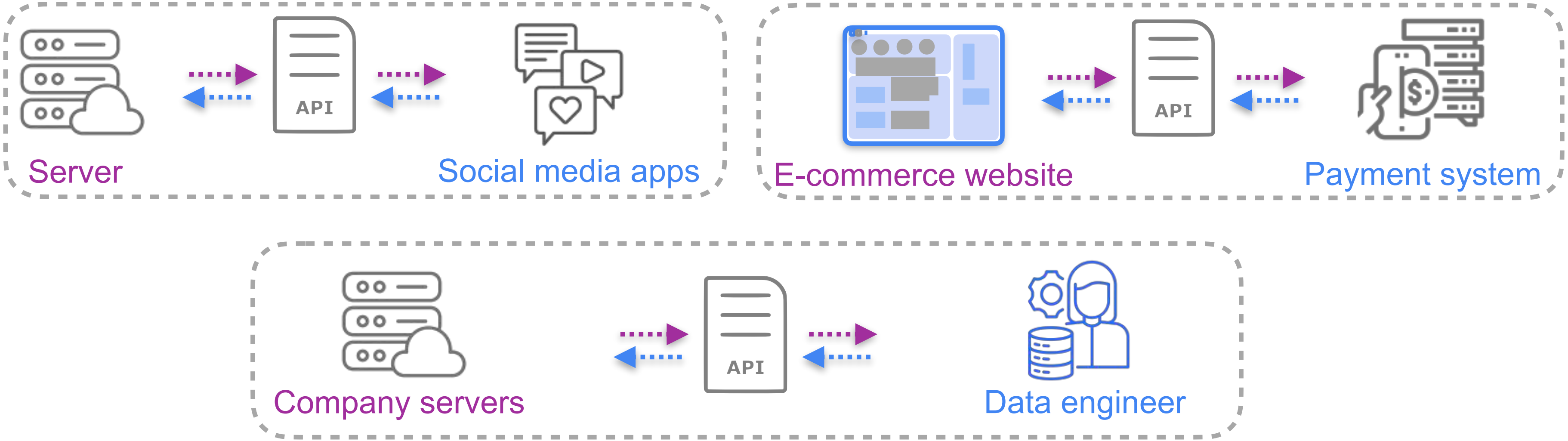


Built into a wide range of software applications

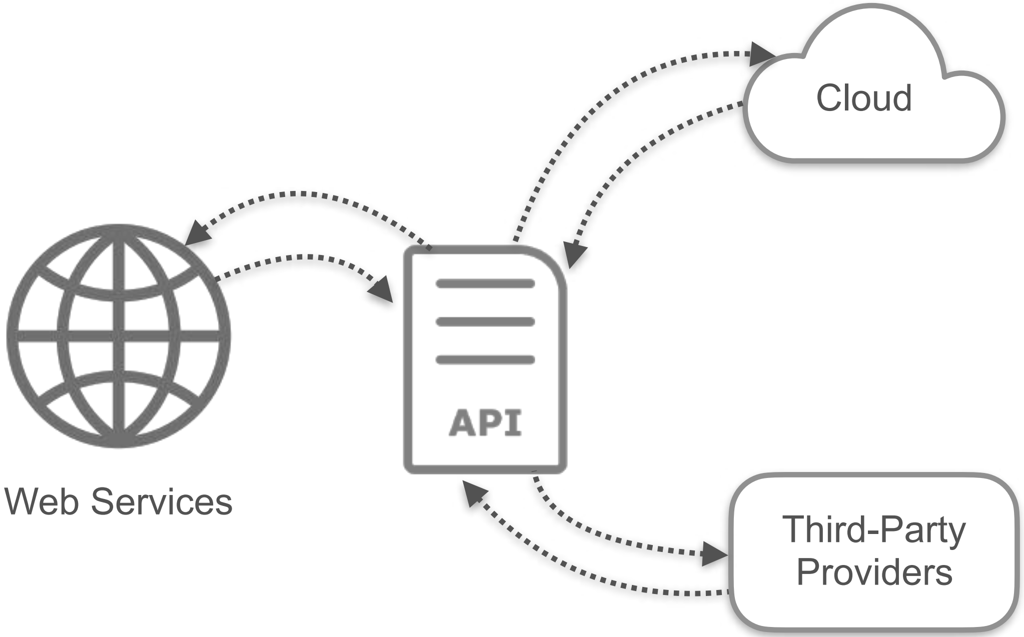
What is an API?

API

A set of rules and specifications that allows you to programmatically communicate and exchange data with an application.



What is an API?



API Features

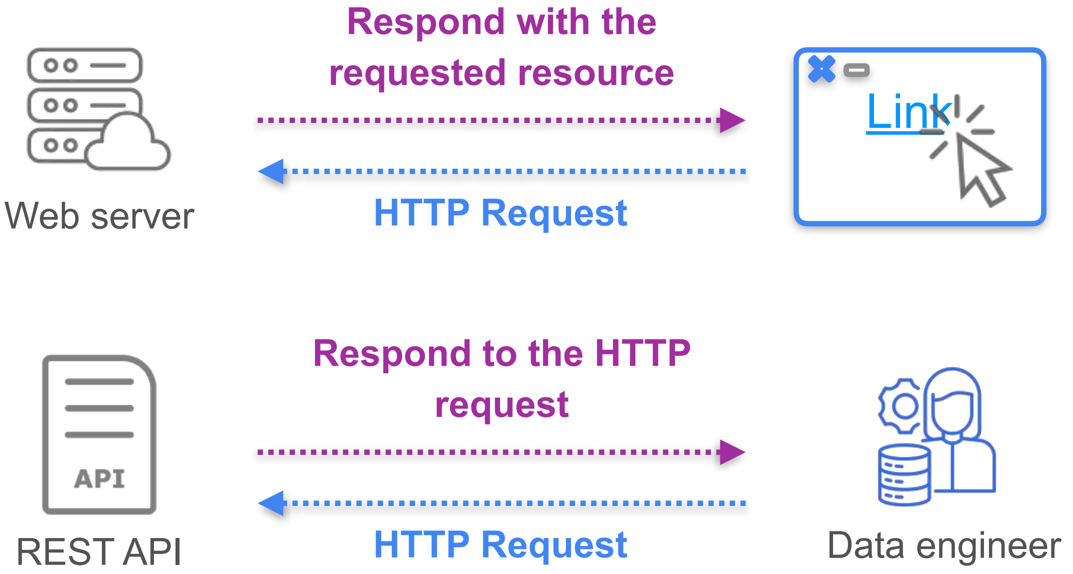
- Metadata
- Documentation
- Authentication
- Error handling

REST API

REST API

Representational State Transfer API

Use Hypertext Transfer Protocol (HTTP) as the basis for communication


Respond with the requested resource
Link
Web server
HTTP Request
Respond to the HTTP request
API
REST API
HTTP Request
Data engineer

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Lab Walkthrough

Batch Processing to Get Data From an API

Batch Processing from an API

Upcoming Lab

Spotify

- Extract data from the Spotify API
- Explore what pagination means
- Send an API request that requires authorization

In this video,

- Go through some API concepts
- Give you an overview of the lab tasks

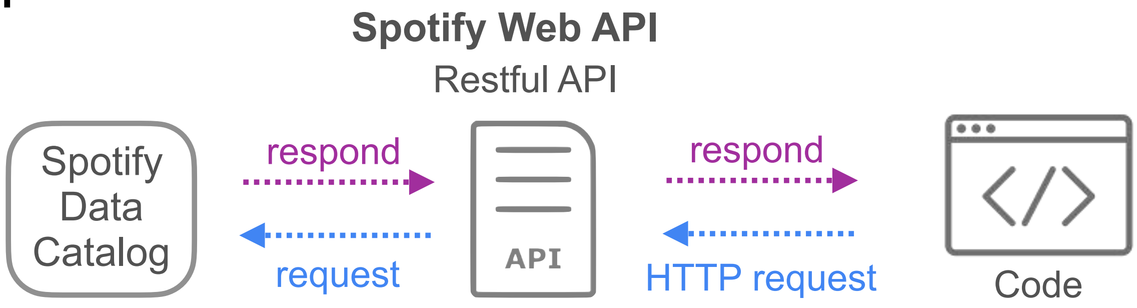
What you need

- Spotify account https://developer.spotify.com/

  When working with an API, it’s very common that you’ll have to sign up for an account

- Spotify Documentation https://developer.spotify.com/documentation/web-api

API Concepts



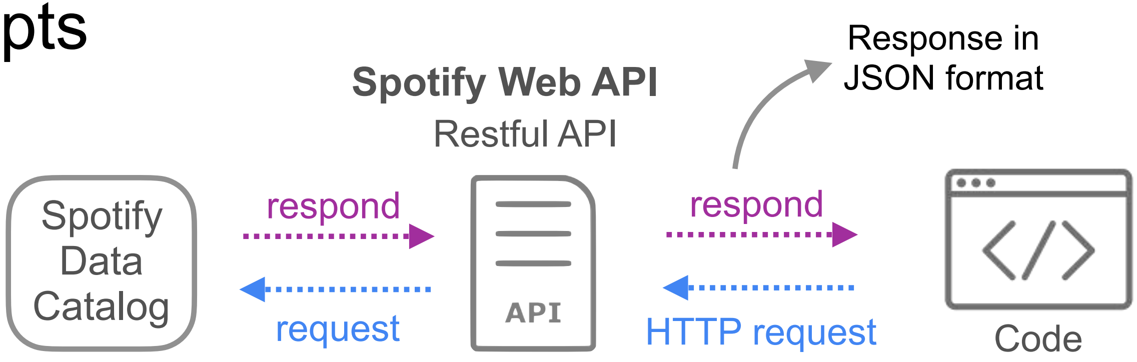
Each resource is represented by an **endpoint**.

Resource

- Music
- Artists
- Albums
- Tracks
- Playlist

HTTP Request	Action
GET	Retrieve a resource
POST	Create a resource
PUT	Change/Replace a resource
Delete	Delete a resource

API Concepts



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HTTP Request	Action
GET	Retrieve a resource
POST	Create a resource
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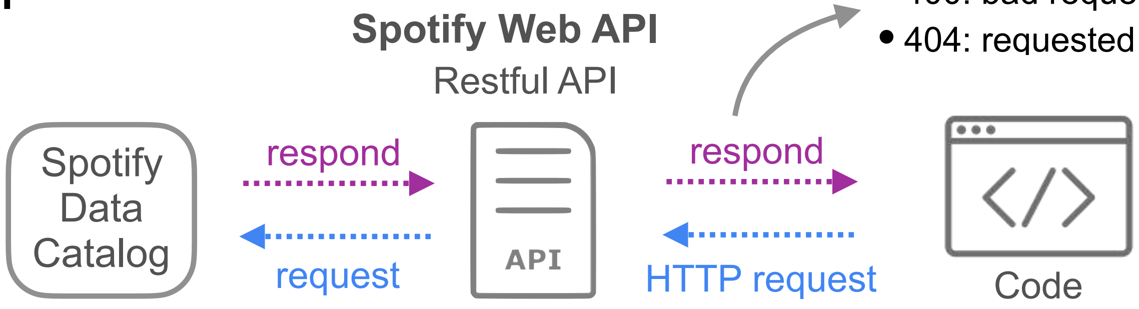
Delete	Delete a resource

API Concepts

Error object containing a status code:

- 400: bad request
- 404: requested resource not found



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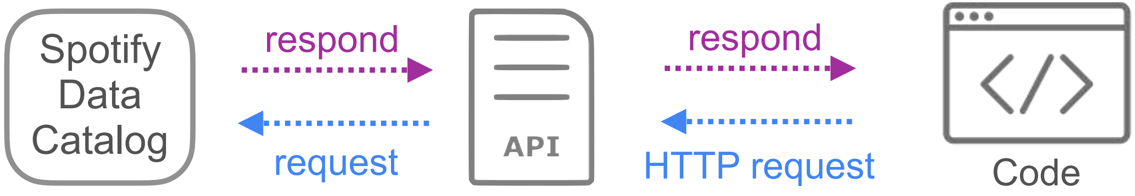
API Concepts

Spotify Web API

Restful API



: Endpoint + Access token

Each resource is represented by an **endpoint**.

Resource

- Music
- Artists
- Albums
- Tracks
- Playlist

Access token: string that contains the permissions to access a given resource. *(valid for 1 hour)*

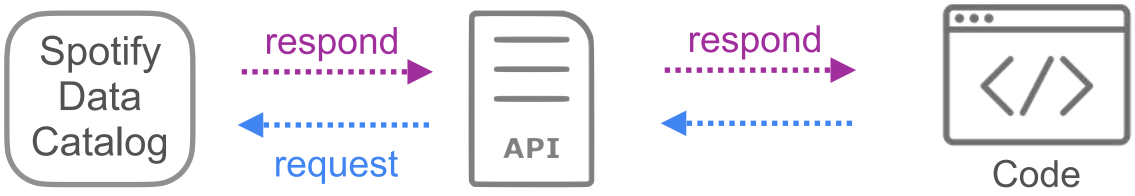
- create a Spotify account
- get a client ID and a client secret and use them to generate the access token *(provided with the code)*

https://developer.spotify.com/documentation/web-api/concepts/authorization

API Concepts

Spotify Web API

Restful API

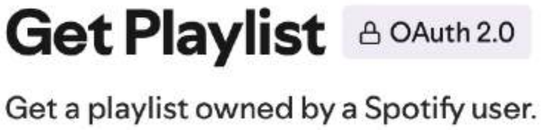


https://developer.spotify.com/documentation/web-api s token

Resource

- Music
- Artists
- Albums
- -
- F

Each resource is represented by an **endpoint**.



Get Playlist 🔒 OAuth 2.0

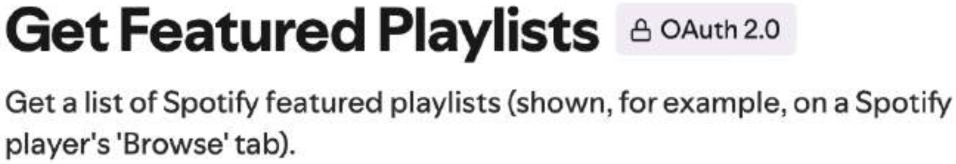
Get a playlist owned by a Spotify user.

ontains the permissions to access

hour)

: secret and use them to generate

de)



Get Featured Playlists 🔒 OAuth 2.0

Get a list of Spotify featured playlists (shown, for example, on a Spotify player's 'Browse' tab).

https authorization

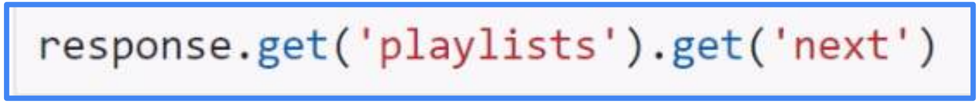
Pagination

Extract the items chunk by chunk.

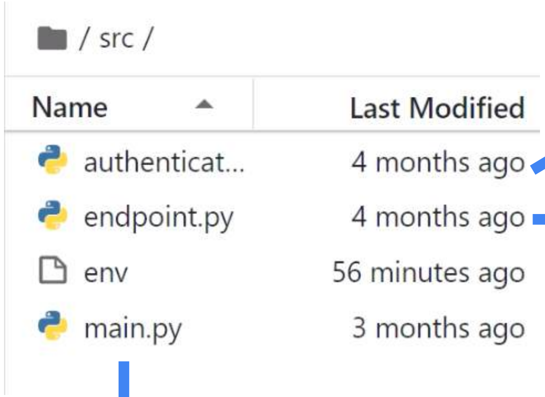
- Using offset and limit

```
https://api.spotify.com/v1/me/shows?offset=0&limit=20
https://api.spotify.com/v1/me/shows?offset=20&limit=20
https://api.spotify.com/v1/me/shows?offset=40&limit=20
https://api.spotify.com/v1/me/shows?offset=60&limit=20
https://api.spotify.com/v1/me/shows?offset=80&limit=20
```

- Using the next field



```
response.get('playlists').get('next')
```



/ src /

Name	Last Modified
authenticat...	4 months ago
endpoint.py	4 months ago
env	56 minutes ago
main.py	3 months ago

Contains the scripts of the get_token function

1. Paginated call to the endpoint “Get featured playlists”
2. Paginated call to the endpoint “Get playlist”
3. Automatically generate a new token

1. Get the ids of the featured playlists
2. Extract the track information for each playlist id

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Streaming Ingestion

Conversation with a Software Engineer

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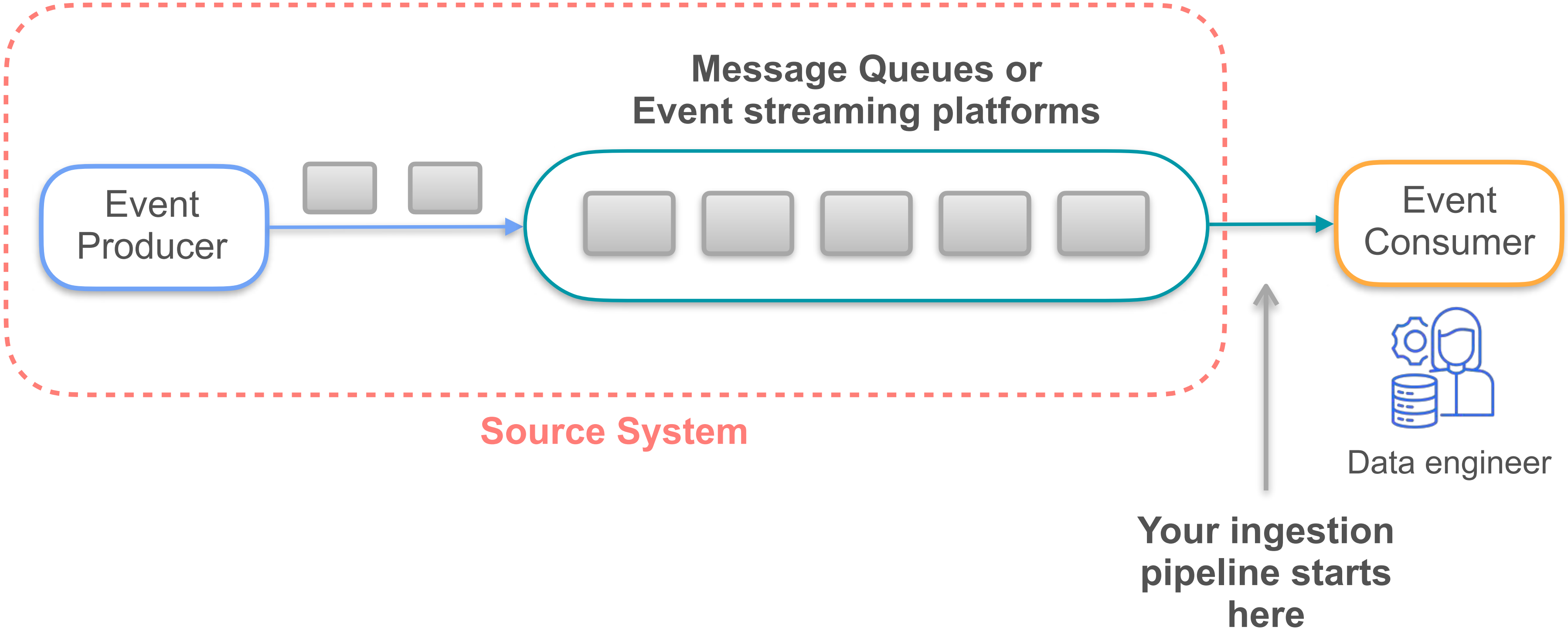
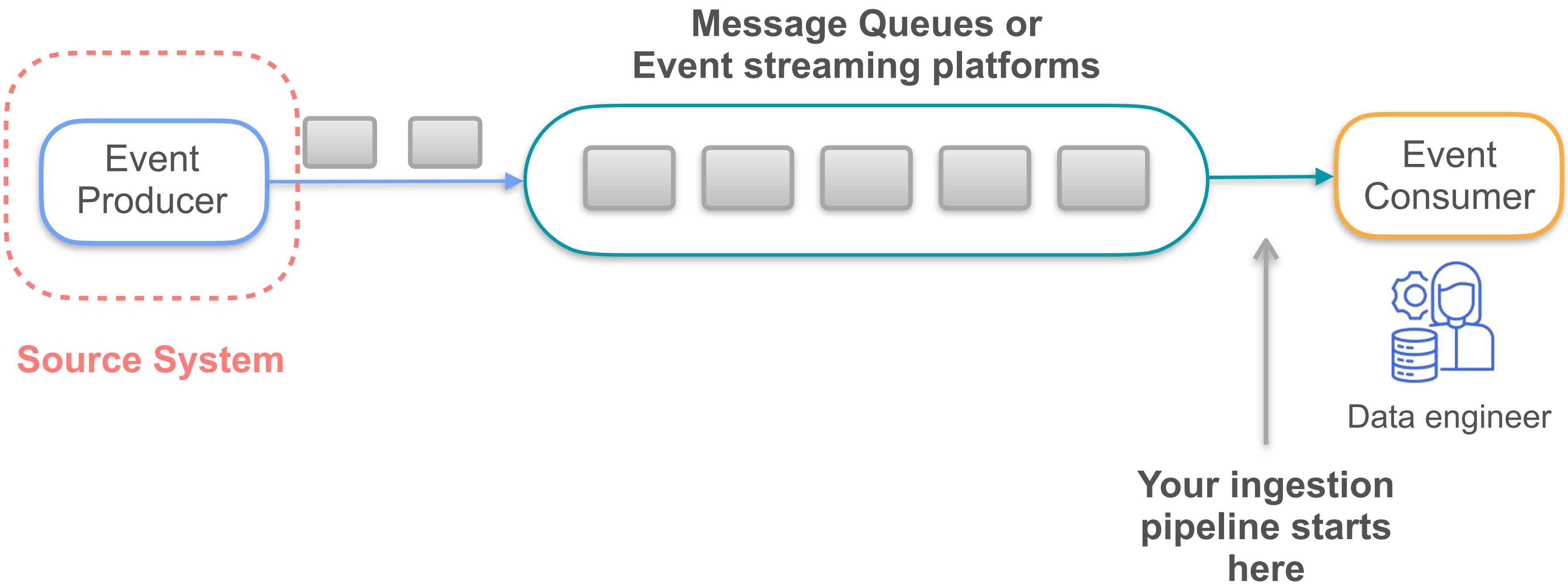
Streaming Ingestion

Streaming Ingestion Details

Streaming Systems



Streaming Systems



Message Queues or Event streaming platforms

Event Producer

Source System

Event Consumer

Data engineer

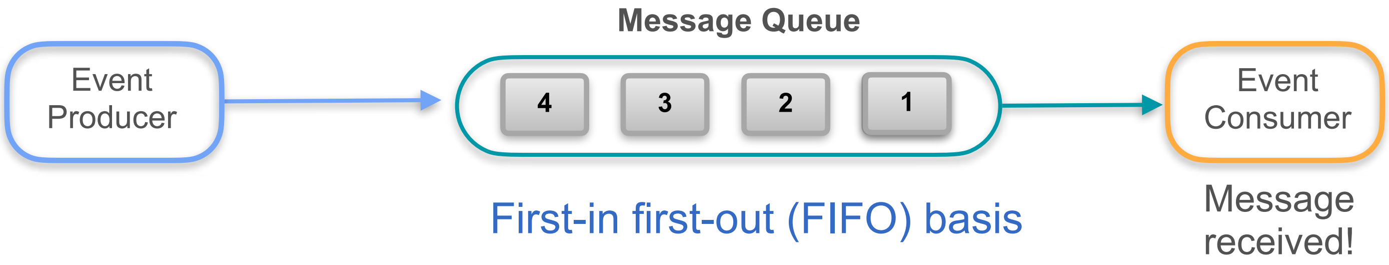
Your ingestion pipeline starts here

Message Queue

Event Streaming Platform

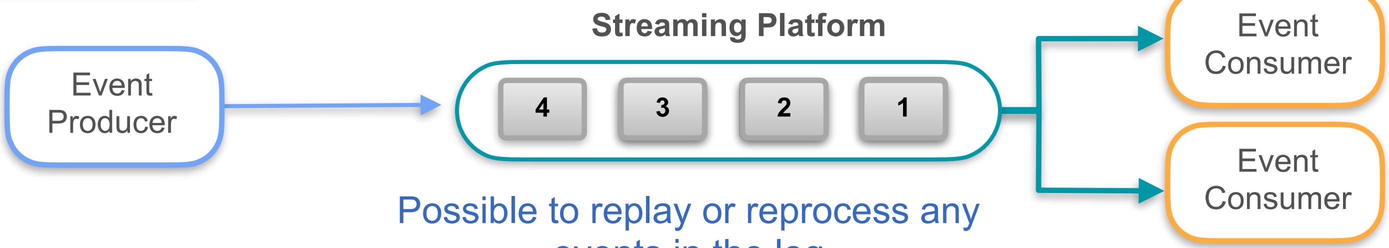
Message Queue

A buffer used to deliver messages asynchronously



Event Streaming Platform

Append-only persistent log



Possible to replay or reprocess any events in the log

Event Streaming Platforms

In this week's lab:

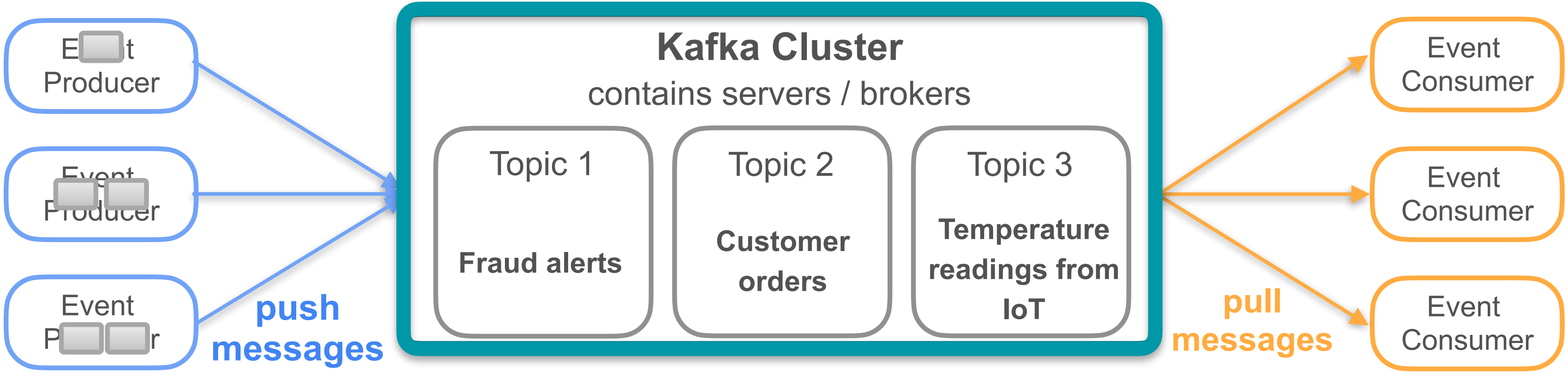
Amazon Kinesis
Data Streams

In this video:

kafka

Apache Kafka

kafka Open-source event streaming platform



E[redacted]t Producer

[redacted] Event Producer

Event P[redacted]r

push messages

Kafka Cluster

contains servers / brokers

Topic 1

Fraud alerts

Topic 2

Customer orders

Topic 3

Temperature readings from IoT

pull messages

Event Consumer

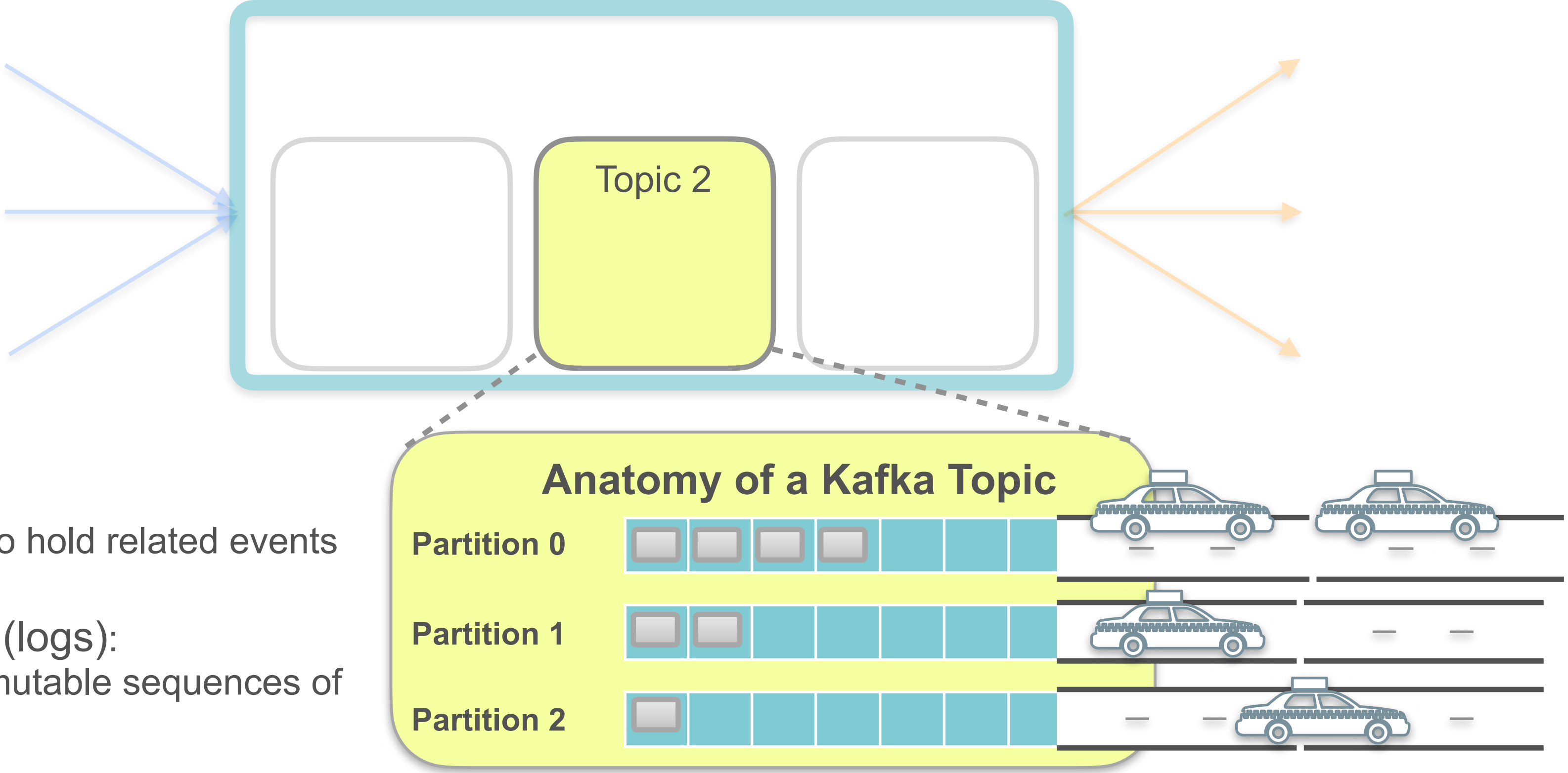
Event Consumer

Event Consumer

Topics:

Categories to hold related events

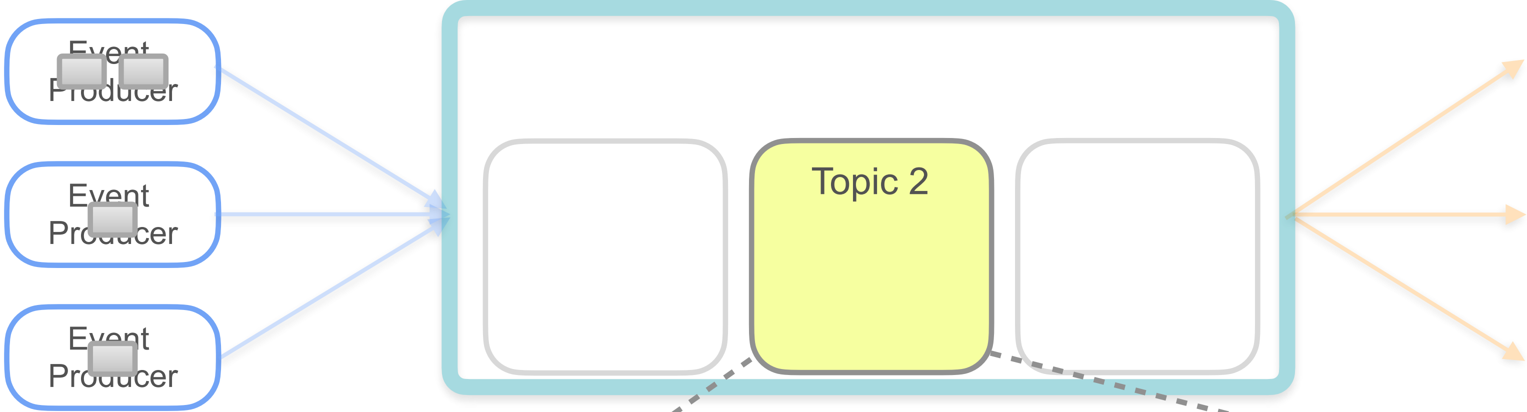
kafka Open-source event streaming platform



Topics:
Categories to hold related events

Partitions (logs):
Ordered immutable sequences of messages

kafka Open-source event streaming platform



Topics:
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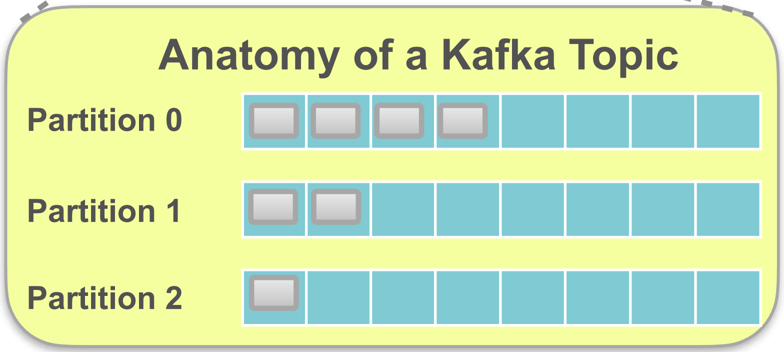
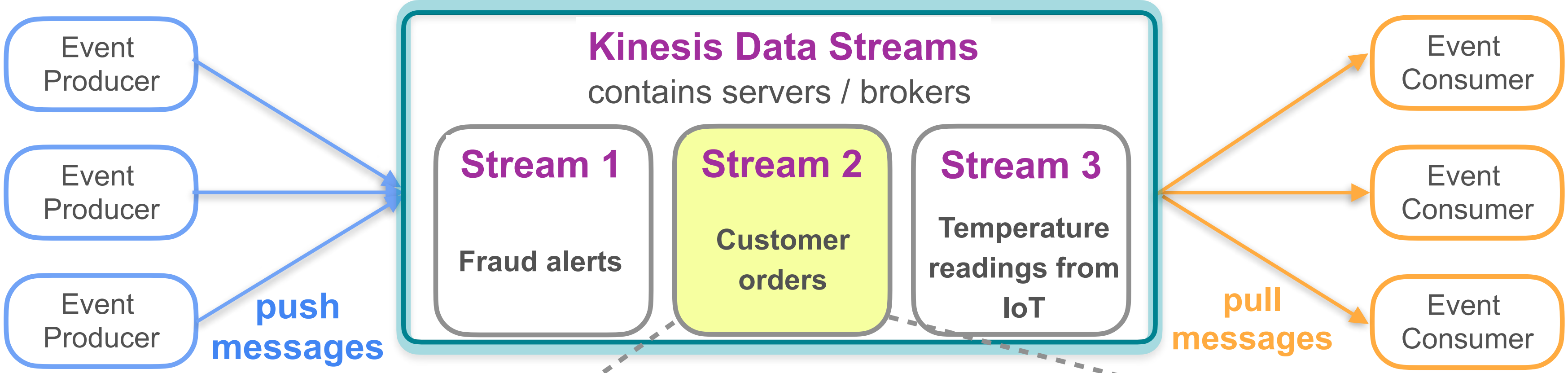
Partitions (logs):
Ordered immutable sequences of messages



Partition decision:

- Round-robin strategy
- Message key

Amazon Kinesis Data Stream



Event Producer

Event Producer

Event Producer

push messages

Kinesis Data Streams

contains servers / brokers

Stream 1

Fraud alerts

Stream 2

Customer orders

Stream 3

Temperature readings from IoT

pull messages

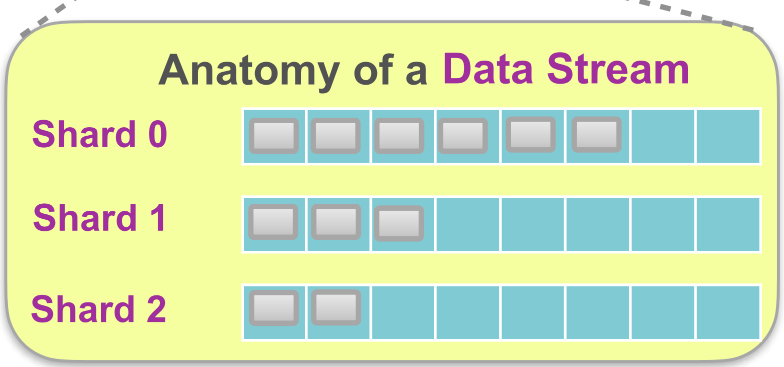
Event Consumer

Event Consumer

Event Consumer

Stream:
Categories to hold related events

Shard (logs):
Ordered immutable sequences of messages



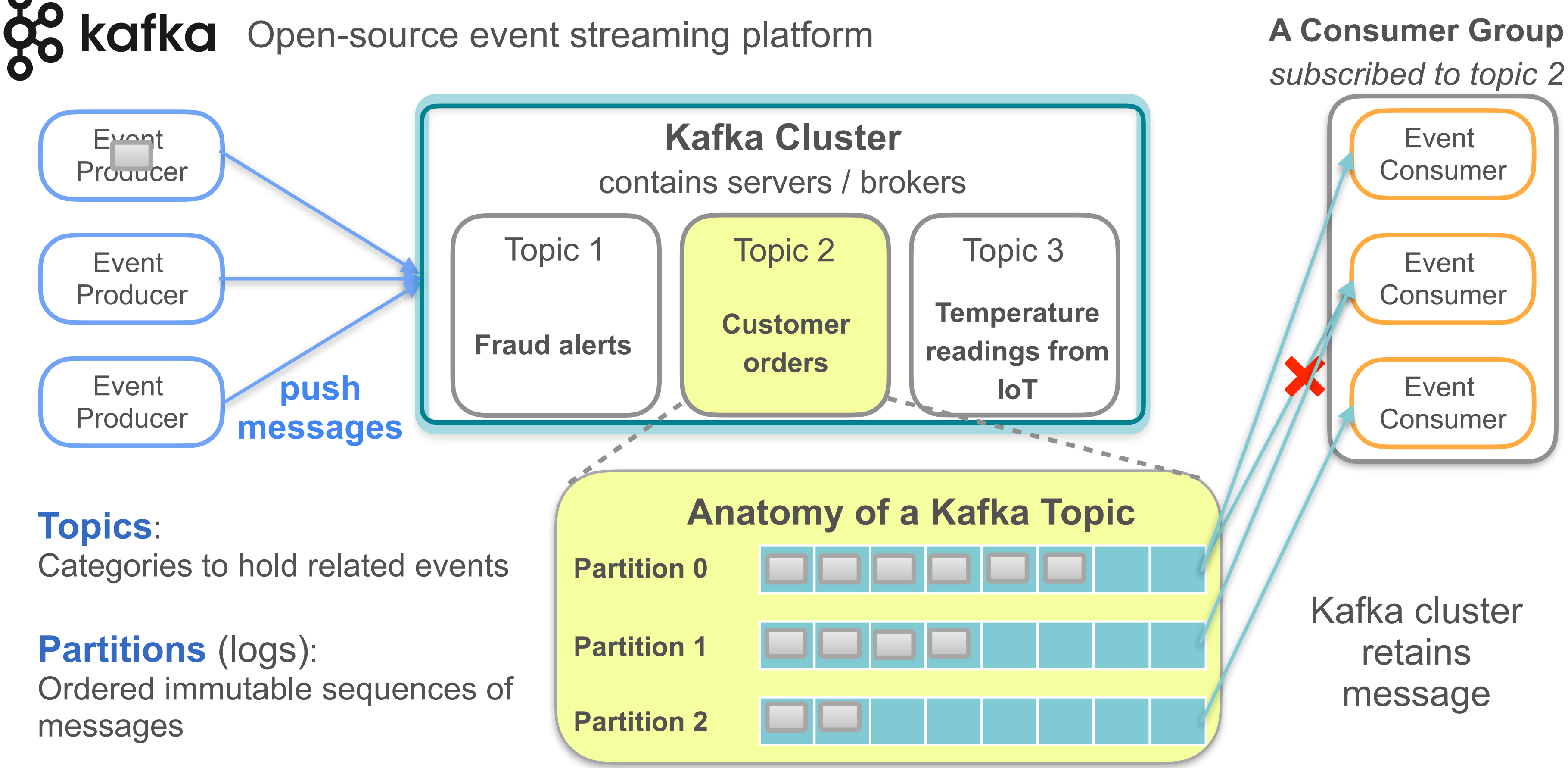
Anatomy of a **Data Stream**

Shard 0

Shard 1

Shard 2

kafka Open-source event streaming platform



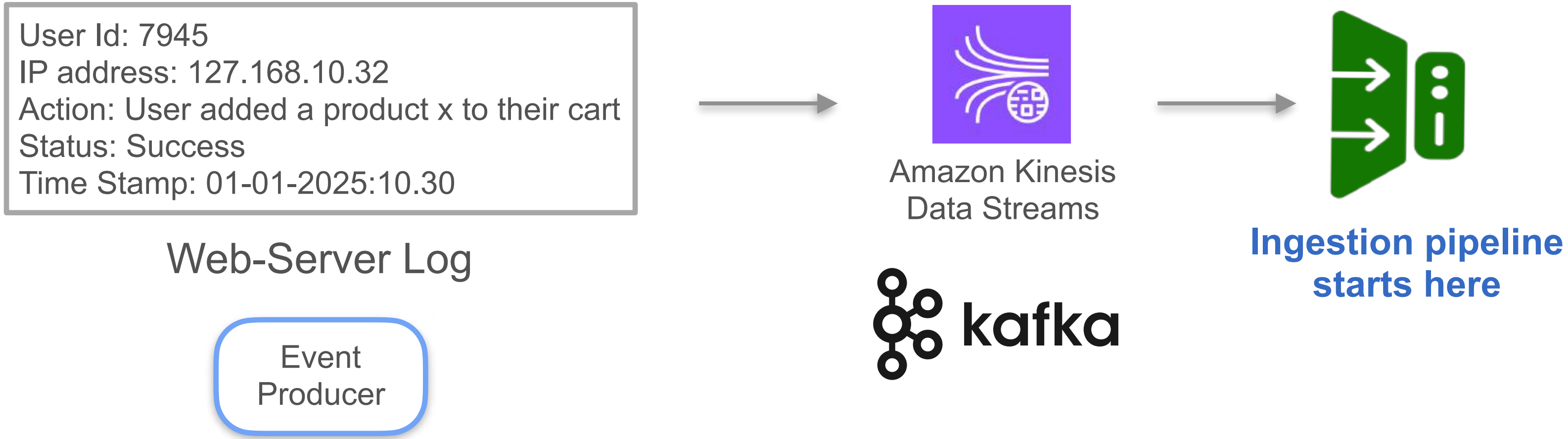
Topics:
Categories to hold related events

Partitions (logs):
Ordered immutable sequences of messages

Conversation with the Software Engineer

Software Engineers

Data Engineer



User Id: 7945
IP address: 127.168.10.32
Action: User added a product x to their cart
Status: Success
Time Stamp: 01-01-2025:10.30

Web-Server Log

Event Producer

Amazon Kinesis Data Streams

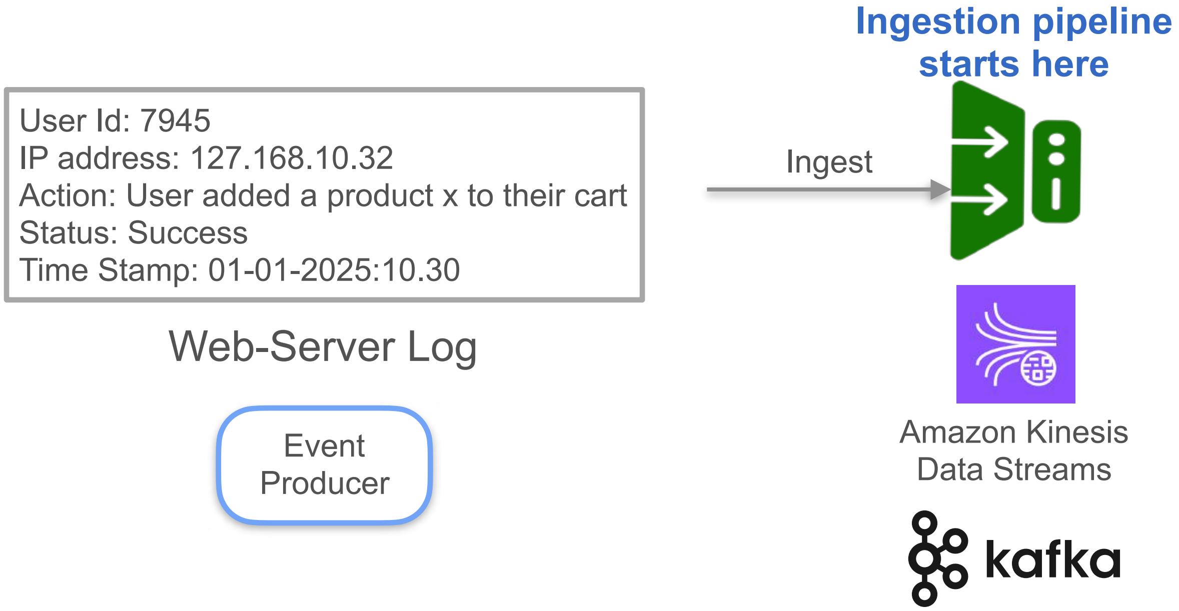
kafka

Ingestion pipeline starts here

Conversation with the Software Engineer

Software Engineers

Data Engineer



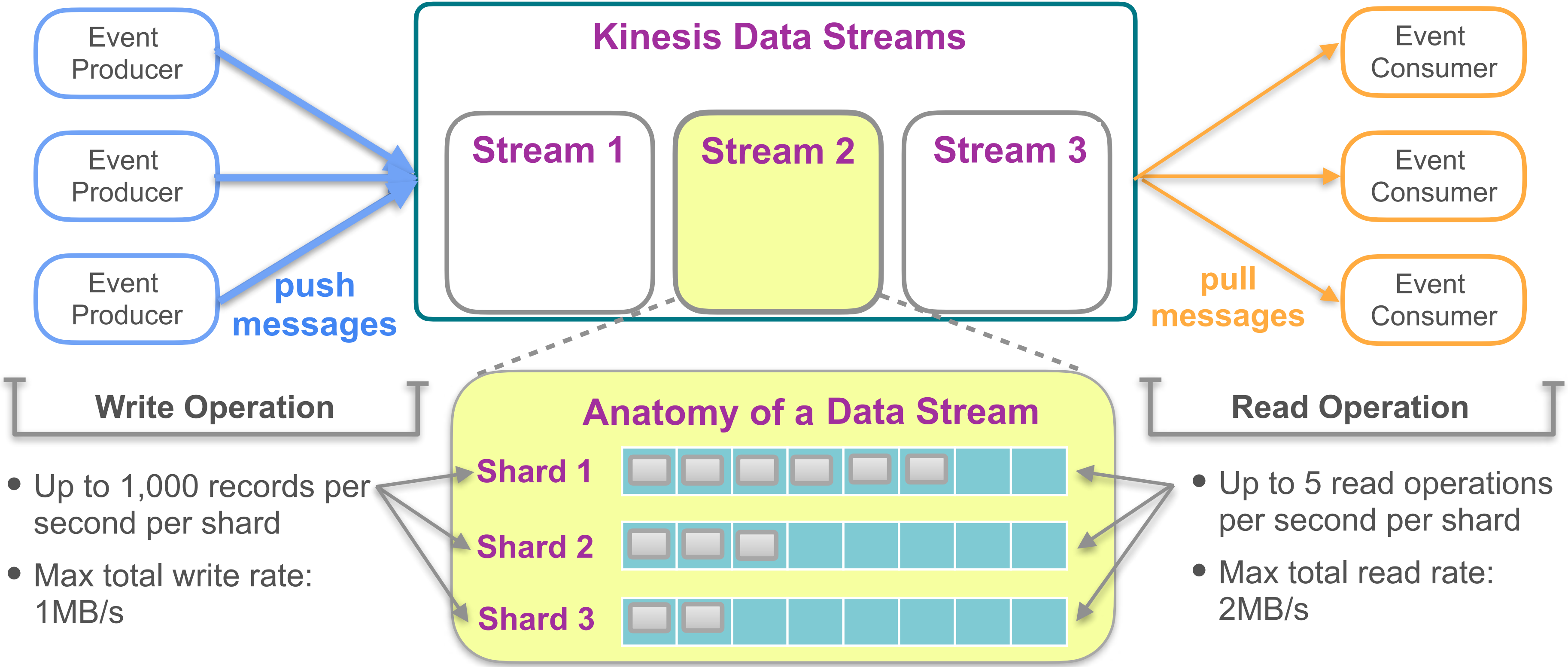
User Id: 7945
IP address: 127.168.10.32
Action: User added a product x to their cart
Status: Success
Time Stamp: 01-01-2025:10.30

Web-Server Log

DeepLearning.AI

Streaming Ingestion

Amazon Kinesis Data Streams Details



Write Operation

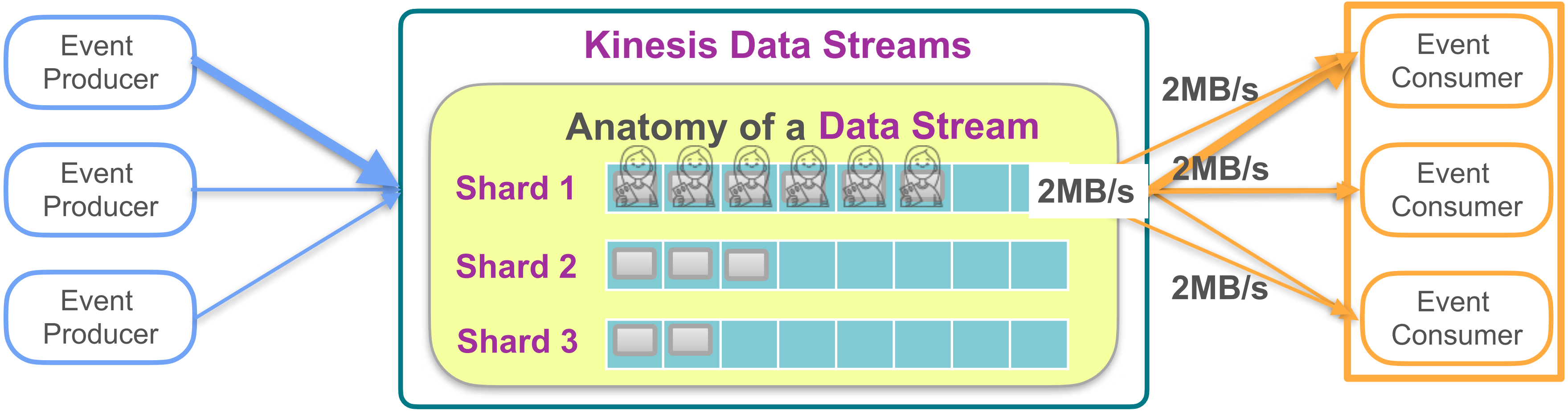
- Up to 1,000 records per second per shard
- Max total write rate: 1MB/s

Read Operation

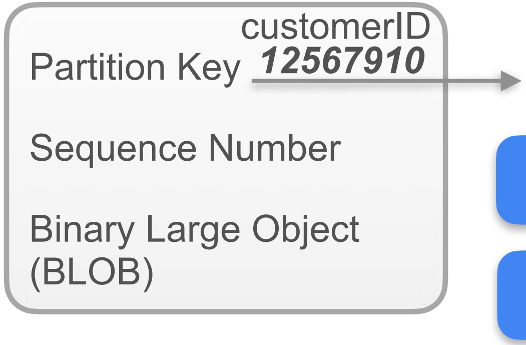
- Up to 5 read operations per second per shard
- Max total read rate: 2MB/s

Size and rate of write and read operations

Kinesis in “on-demand” Mode	Kinesis in “Provisioned” Mode
• Automatically manage the scaling of the shards up or down as needed • Only charged for what you use • More convenient from an operational perspective	• Specify the number of shards necessary for your application based on the expected write and read request rate • Manually add more shards or re-shard when needed • A good fit if… • you have predictable application traffic • you are able to control your costs more carefully



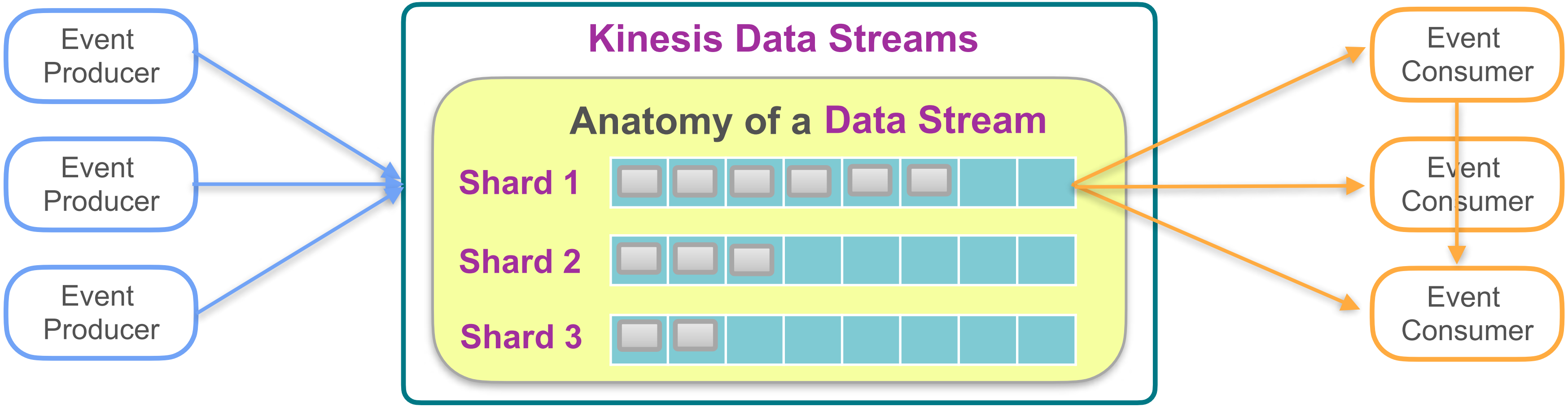
Data Record



Used to determine which shard the data record is placed into

Shared Fan-Out When consumers share a shard’s read capacity

Enhanced Fan-Out When consumers are able to read at the full read capacity of the shard



Event Producer

Event Producer

Event Producer

Kinesis Data Streams

Anatomy of a Data Stream

Shard 1

Shard 2

Shard 3

Event Consumer

Event Consumer

Event Consumer

AWS Lambda

Amazon Managed Service for Apache Flink

AWS Glue

Amazon Data Firehose

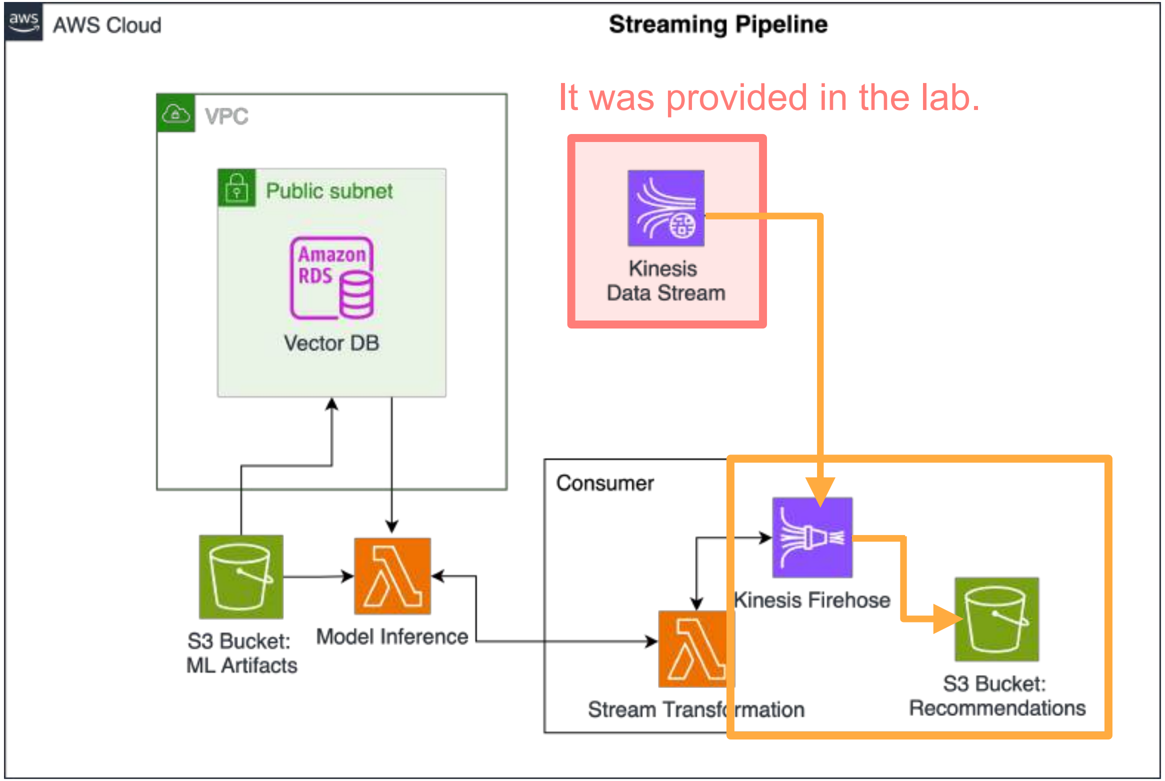
Amazon Kinesis Client Library (KCL)

DeepLearning.AI

Lab Walkthrough

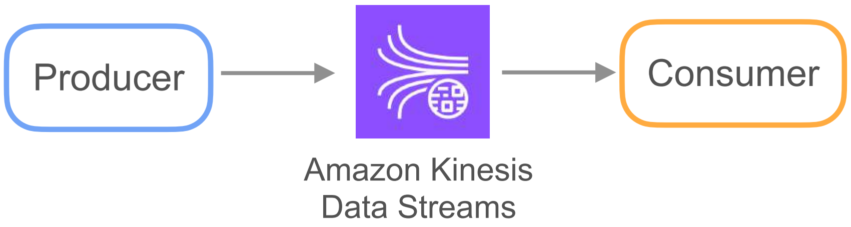
Streaming Ingestion

Course 1 Lab



It was provided in the lab.

Part 1

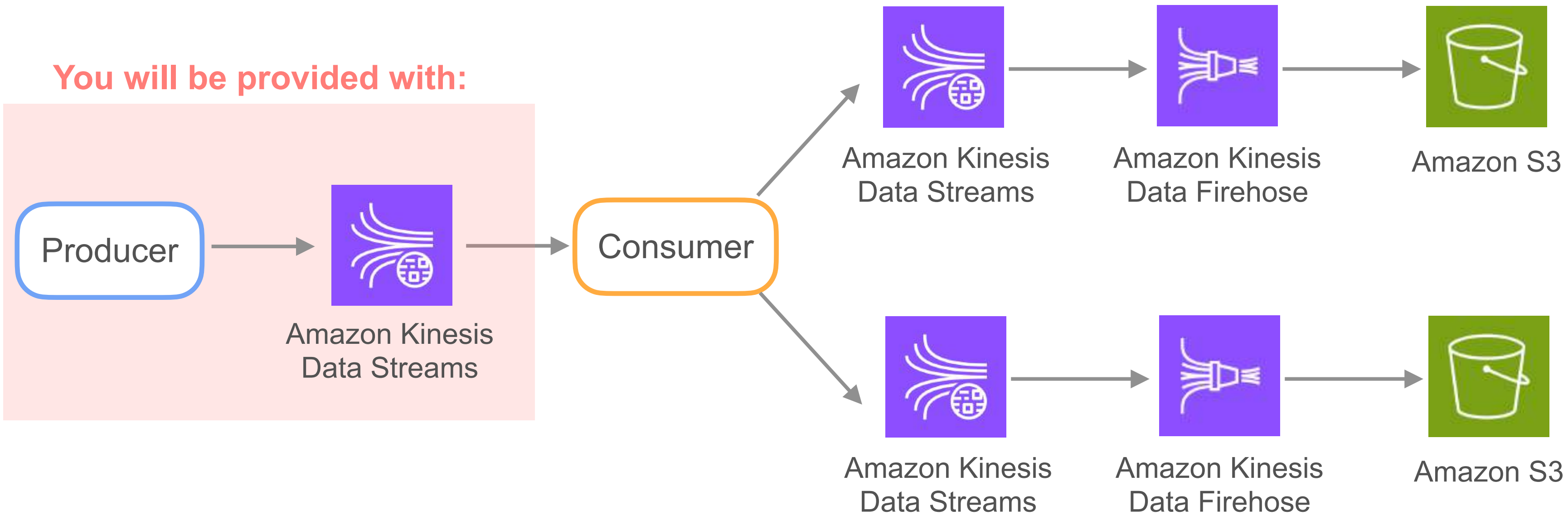


Producer

Amazon Kinesis Data Streams

Consumer

Part 2



You will be provided with:

Producer

Amazon Kinesis Data Streams

Consumer

Amazon Kinesis Data Streams

Amazon Kinesis Data Firehose

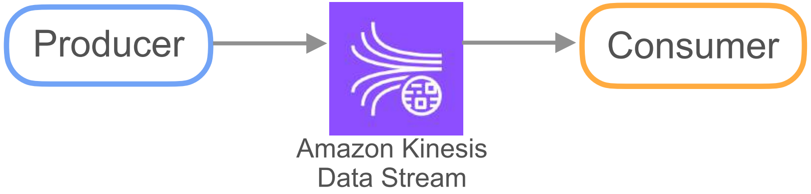
Amazon S3

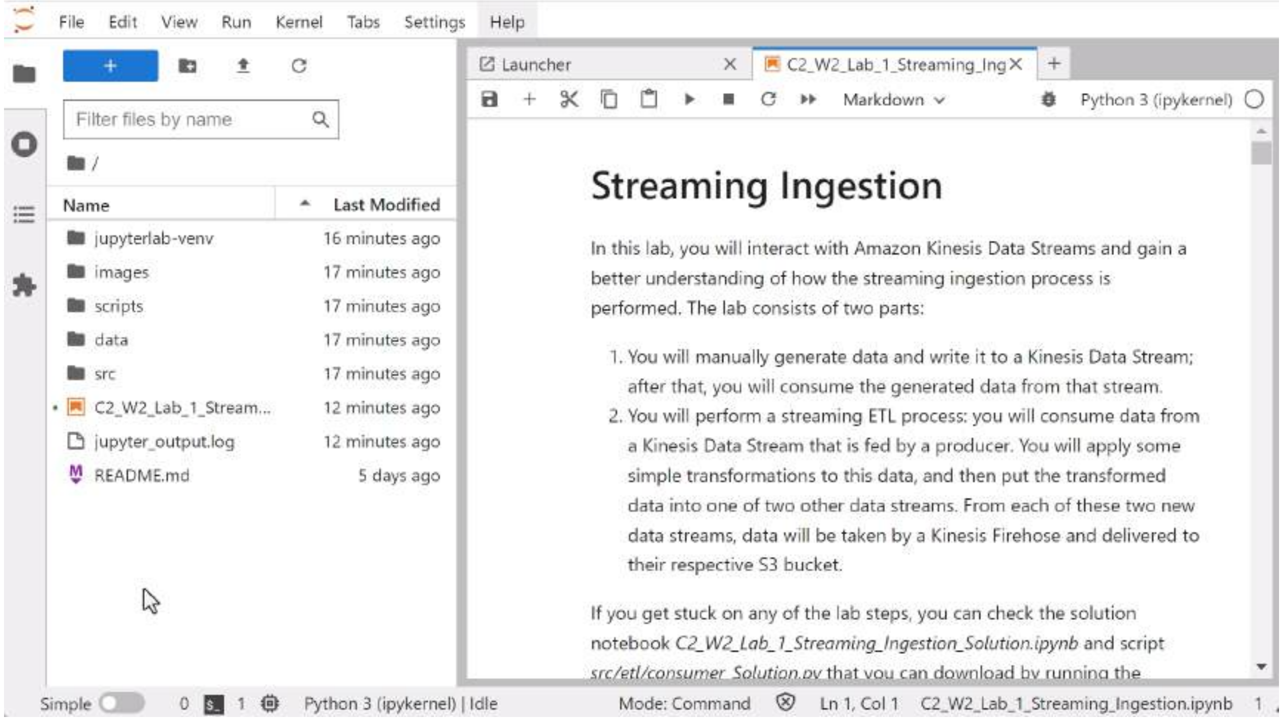
Amazon Kinesis Data Streams

Amazon Kinesis Data Firehose

Amazon S3

Part 1




File Edit View Run Kernel Tabs Settings Help
Filter files by name
/
Name
Last Modified
jupyterlab-venv 16 minutes ago
images 17 minutes ago
scripts 17 minutes ago
data 17 minutes ago
src 17 minutes ago
C2_W2_Lab_1_Stream... 12 minutes ago
jupyter_output.log 12 minutes ago
README.md 5 days ago
Launcher
C2_W2_Lab_1_Streaming_Ing
Markdown
Python 3 (ipykernel)
Simple 0 1 Python 3 (ipykernel) | Idle Mode: Command Ln 1, Col 1 C2_W2_Lab_1_Streaming_Ingestion.ipynb 1

Streaming Ingestion

In this lab, you will interact with Amazon Kinesis Data Streams and gain a better understanding of how the streaming ingestion process is performed. The lab consists of two parts:

1. You will manually generate data and write it to a Kinesis Data Stream; after that, you will consume the generated data from that stream.
2. You will perform a streaming ETL process: you will consume data from a Kinesis Data Stream that is fed by a producer. You will apply some simple transformations to this data, and then put the transformed data into one of two other data streams. From each of these two new data streams, data will be taken by a Kinesis Firehose and delivered to their respective S3 bucket.

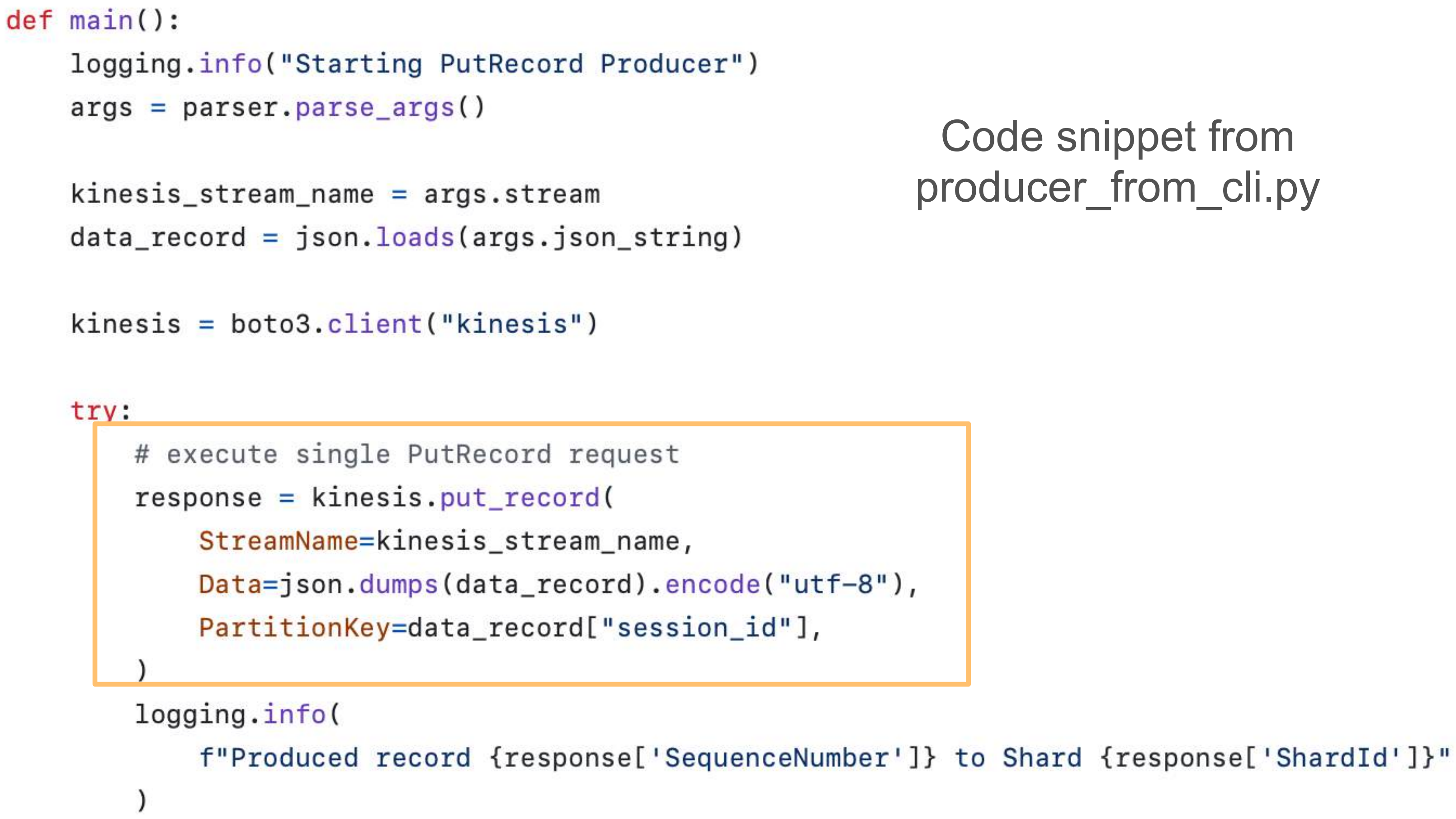
If you get stuck on any of the lab steps, you can check the solution notebook *C2_W2_Lab_1_Streaming_Ingestion_Solution.ipynb* and script *src/etl/consumer_Solution.py* that you can download by running the

Part 1

produ

- write
- uses
- can

```
pytho
```



```
def main():
    logging.info("Starting PutRecord Producer")
    args = parser.parse_args()

    kinesis_stream_name = args.stream
    data_record = json.loads(args.json_string)

    kinesis = boto3.client("kinesis")

    try:
        # execute single PutRecord request
        response = kinesis.put_record(
            StreamName=kinesis_stream_name,
            Data=json.dumps(data_record).encode("utf-8"),
            PartitionKey=data_record["session_id"],
        )
        logging.info(
            f"Produced record {response['SequenceNumber']} to Shard {response['ShardId']}"
        )
```

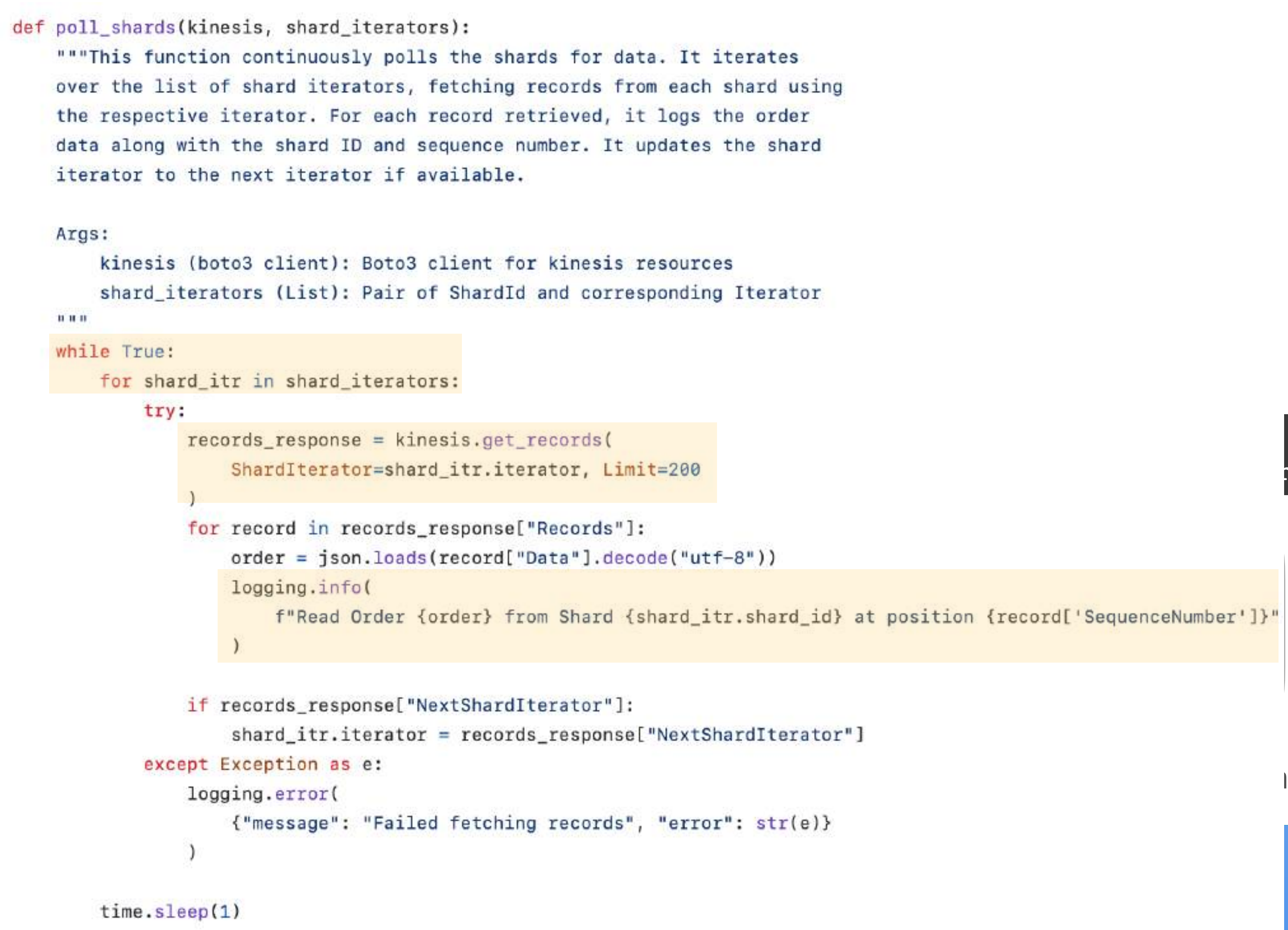
Code snippet from producer_from_cli.py

Part 1

producer_

- writes a s
- uses botc
- can be ru

```
python pr
      --
      --
```



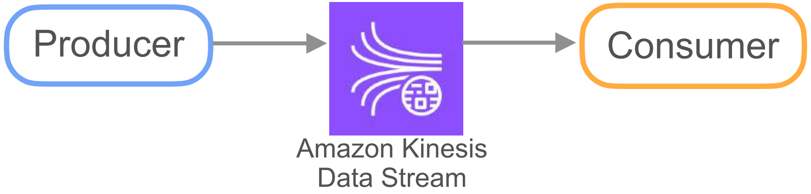
```python
def poll_shards(kinesis, shard_iterators):
    """This function continuously polls the shards for data. It iterates
    over the list of shard iterators, fetching records from each shard using
    the respective iterator. For each record retrieved, it logs the order
    data along with the shard ID and sequence number. It updates the shard
    iterator to the next iterator if available.

    Args:
        kinesis (boto3 client): Boto3 client for kinesis resources
        shard_iterators (List): Pair of ShardId and corresponding Iterator
    """
    while True:
        for shard_itr in shard_iterators:
            try:
                records_response = kinesis.get_records(
                    ShardIterator=shard_itr.iterator, Limit=200
                )
                for record in records_response["Records"]:
                    order = json.loads(record["Data"].decode("utf-8"))
                    logging.info(
                        f"Read Order {order} from Shard {shard_itr.shard_id} at position {record['SequenceNumber']}"
                    )

                if records_response["NextShardIterator"]:
                    shard_itr.iterator = records_response["NextShardIterator"]
            except Exception as e:
                logging.error(
                    {"message": "Failed fetching records", "error": str(e)}
                )

        time.sleep(1)
```

```
eam>
```

record

DeepLe

Part 1



producer_from_cli.py

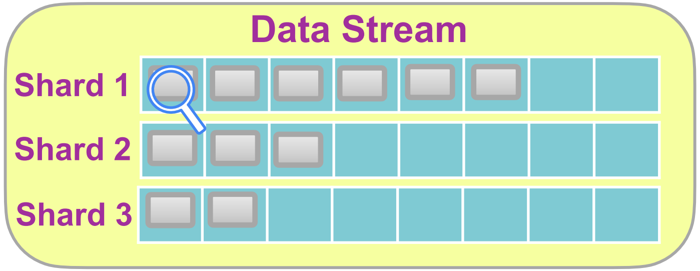
- writes a single data record into the data stream
- uses boto3 to interact with Kinesis
- can be run from the terminal:

```
python producer_from_cli.py
       --stream <name of the data stream>
       --json_string <record as json string>
```

consumer_from_cli.py

- simple consumer application
- uses boto3 to interact with Kinesis
- can be run from the terminal:

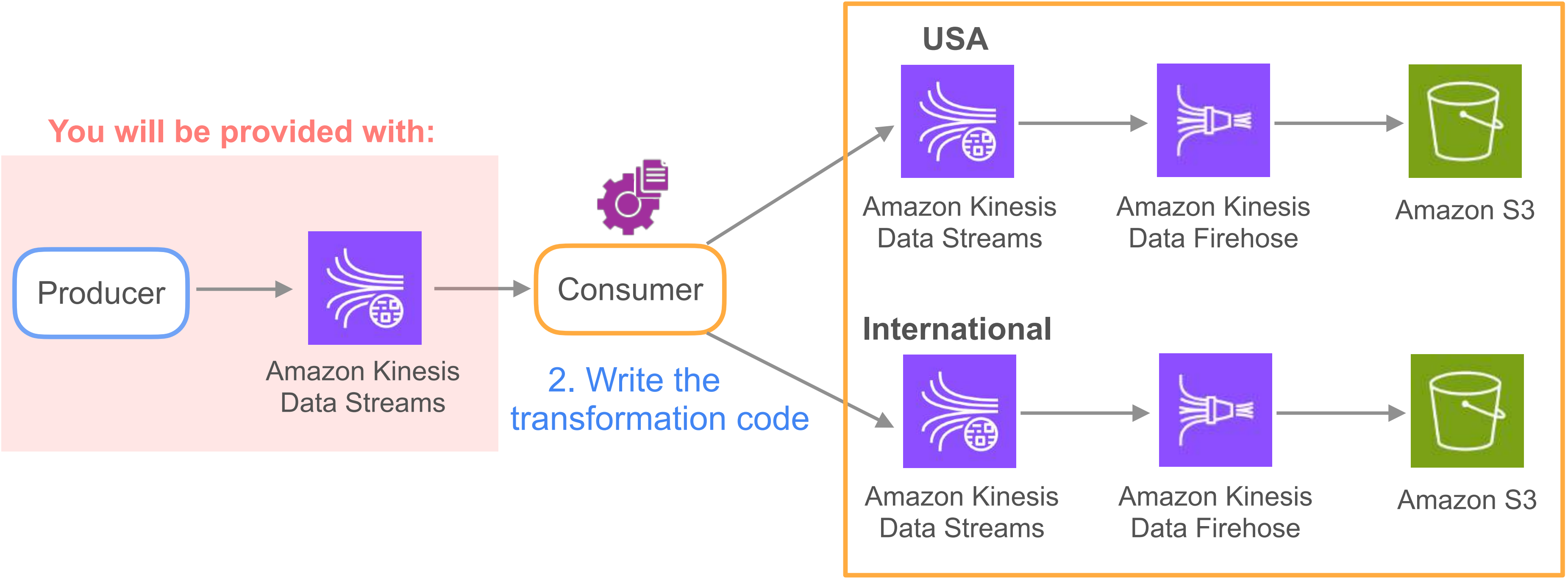
```
python consumer_from_cli.py
       --stream <name of the data stream>
```



print information in the terminal about each record

Part 2

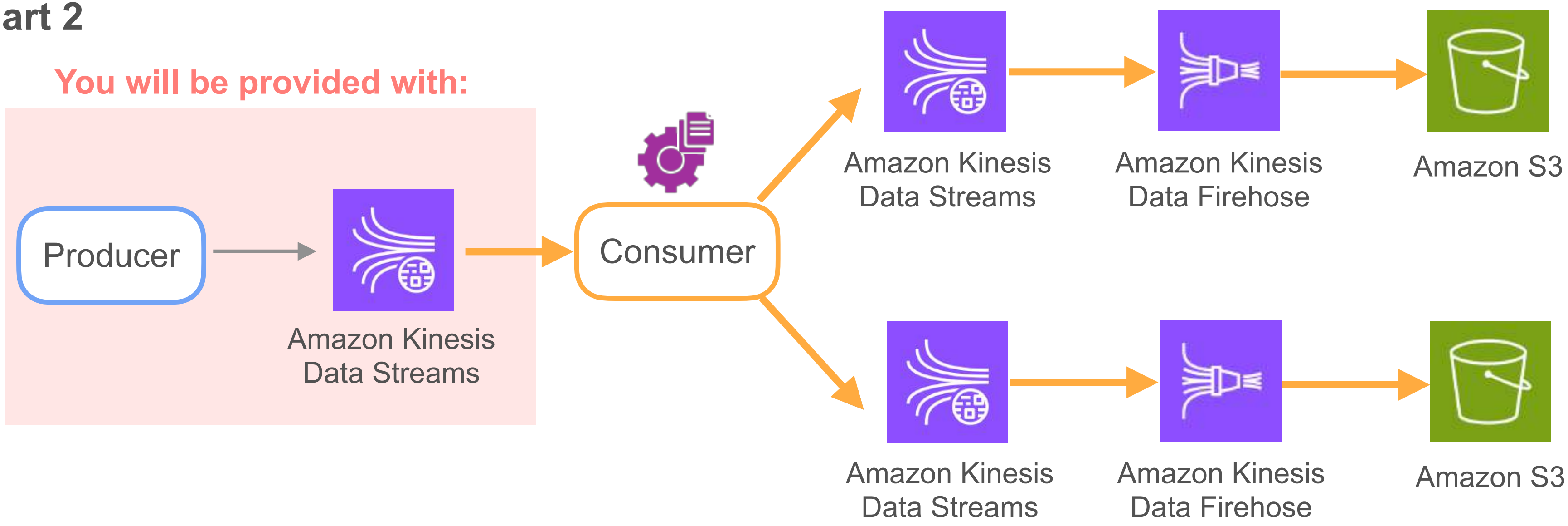
Streaming ETL Pipeline

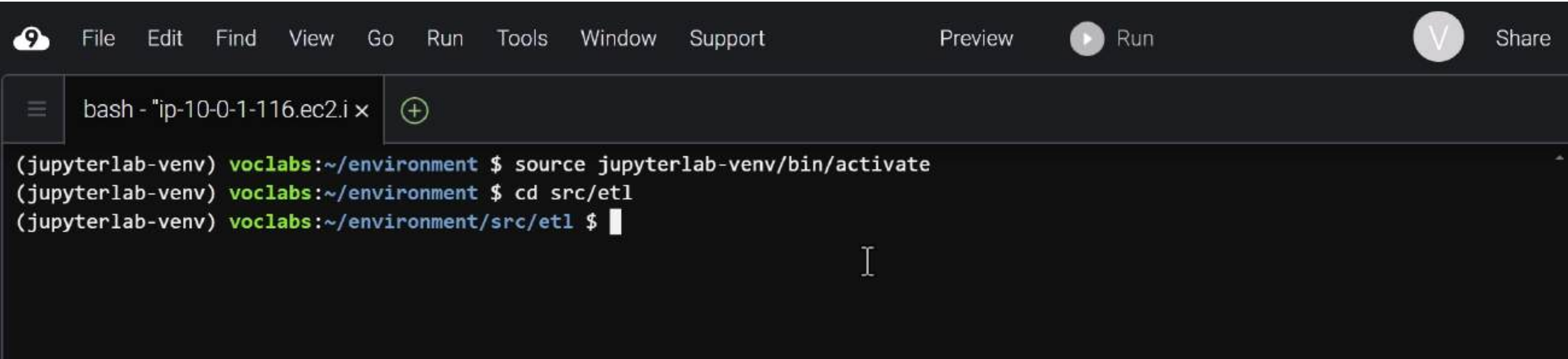

You will be provided with:
Producer
Amazon Kinesis Data Streams
Consumer
USA
Amazon Kinesis Data Streams
Amazon Kinesis Data Firehose
Amazon S3
International
Amazon Kinesis Data Streams
Amazon Kinesis Data Firehose
Amazon S3

2. Write the transformation code

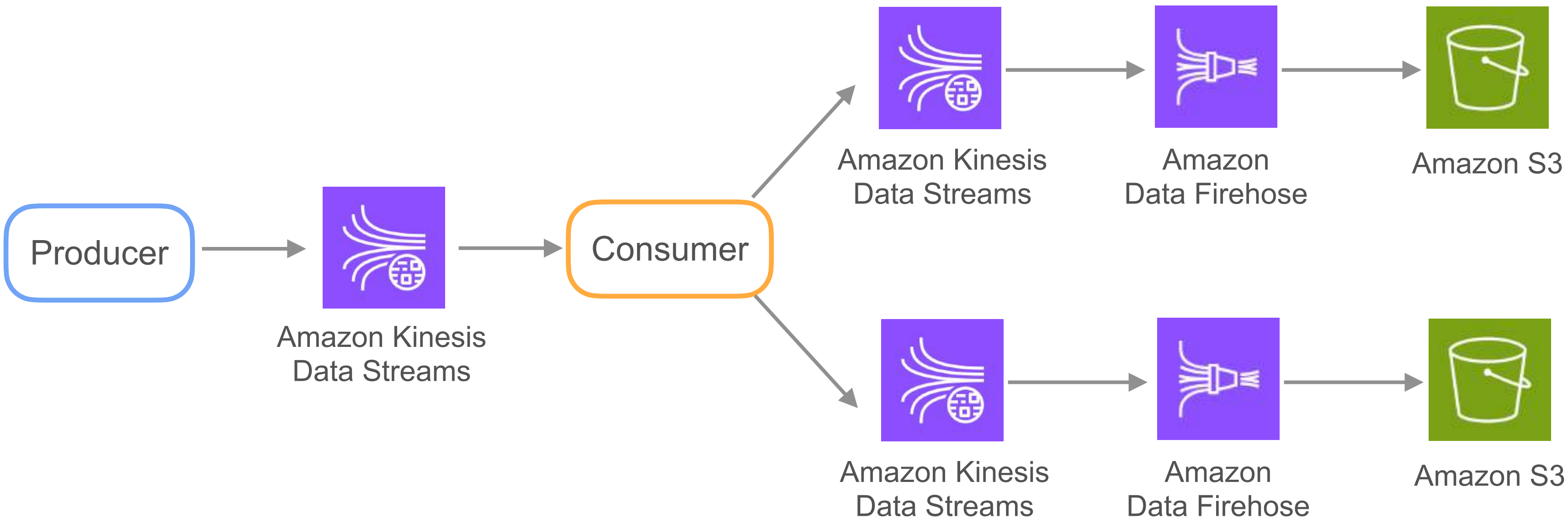
1. Create these resources

Part 2


You will be provided with:
Producer
Amazon Kinesis Data Streams
Consumer
Amazon Kinesis Data Streams
Amazon Kinesis Data Firehose
Amazon S3
Amazon Kinesis Data Streams
Amazon Kinesis Data Firehose
Amazon S3



```
(jupyterlab-venv) voclabs:~/environment $ source jupyterlab-venv/bin/activate
(jupyterlab-venv) voclabs:~/environment $ cd src/etl
(jupyterlab-venv) voclabs:~/environment/src/etl $
```

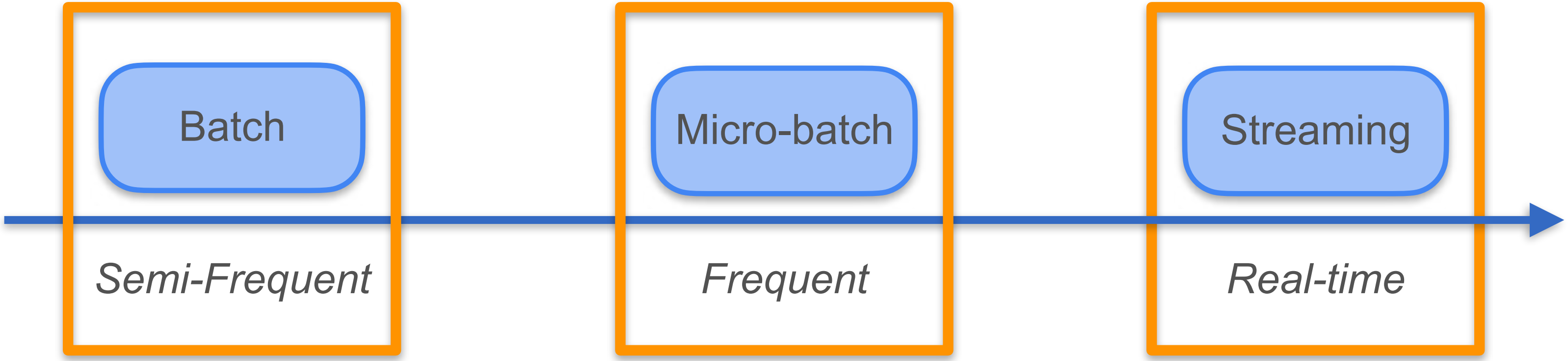

Producer
Amazon Kinesis Data Streams
Consumer
Amazon Kinesis Data Streams
Amazon Data Firehose
Amazon S3
Amazon Kinesis Data Streams
Amazon Data Firehose
Amazon S3

DeepLearning.AI

Data Ingestion

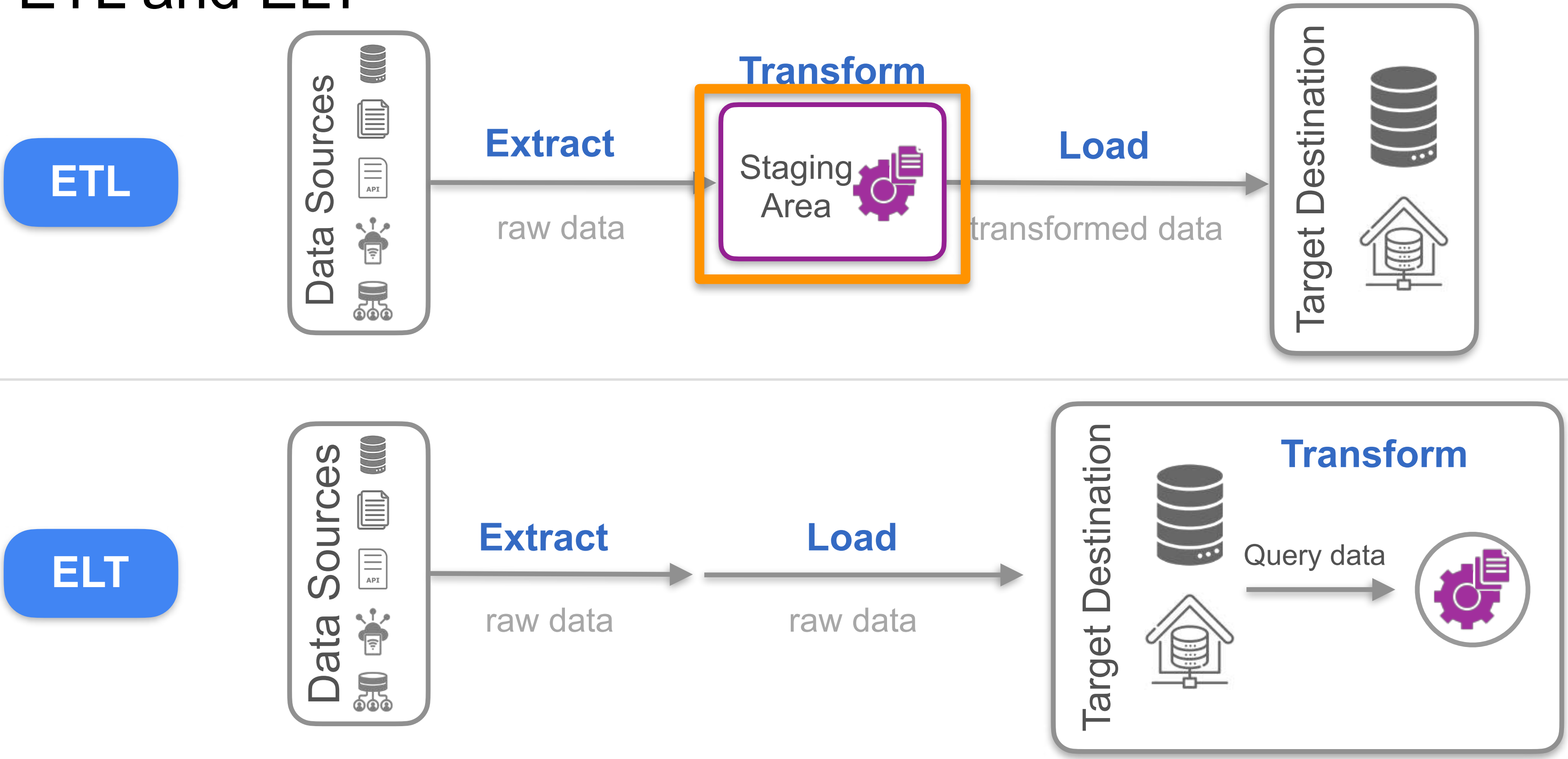
Week 2 Summary

Batch and Streaming Ingestion


Batch
Micro-batch
Streaming
Semi-Frequent
Frequent
Real-time

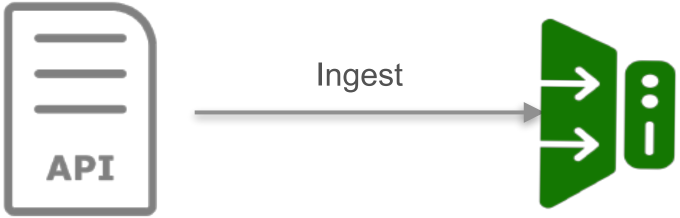
You determine your approach based on the stakeholder needs.

ETL and ELT


ETL
Data Sources
API
Extract
raw data
Transform
Staging Area
Load
transformed data
Target Destination
ELT
Data Sources
API
Extract
raw data
Load
raw data
Target Destination
Transform
Query data

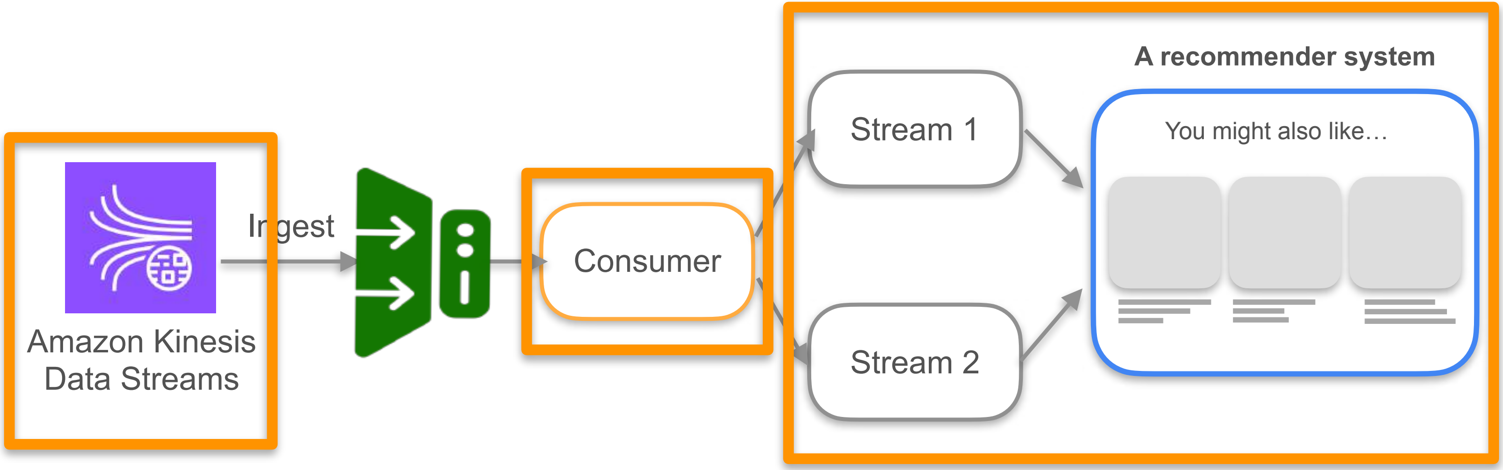
Week 2 Labs

Lab 1



- Connection to API
- Authentication
- Pagination

Lab 2


Amazon Kinesis Data Streams
Ingest
Consumer
A recommender system
Stream 1
Stream 2
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