MLOps

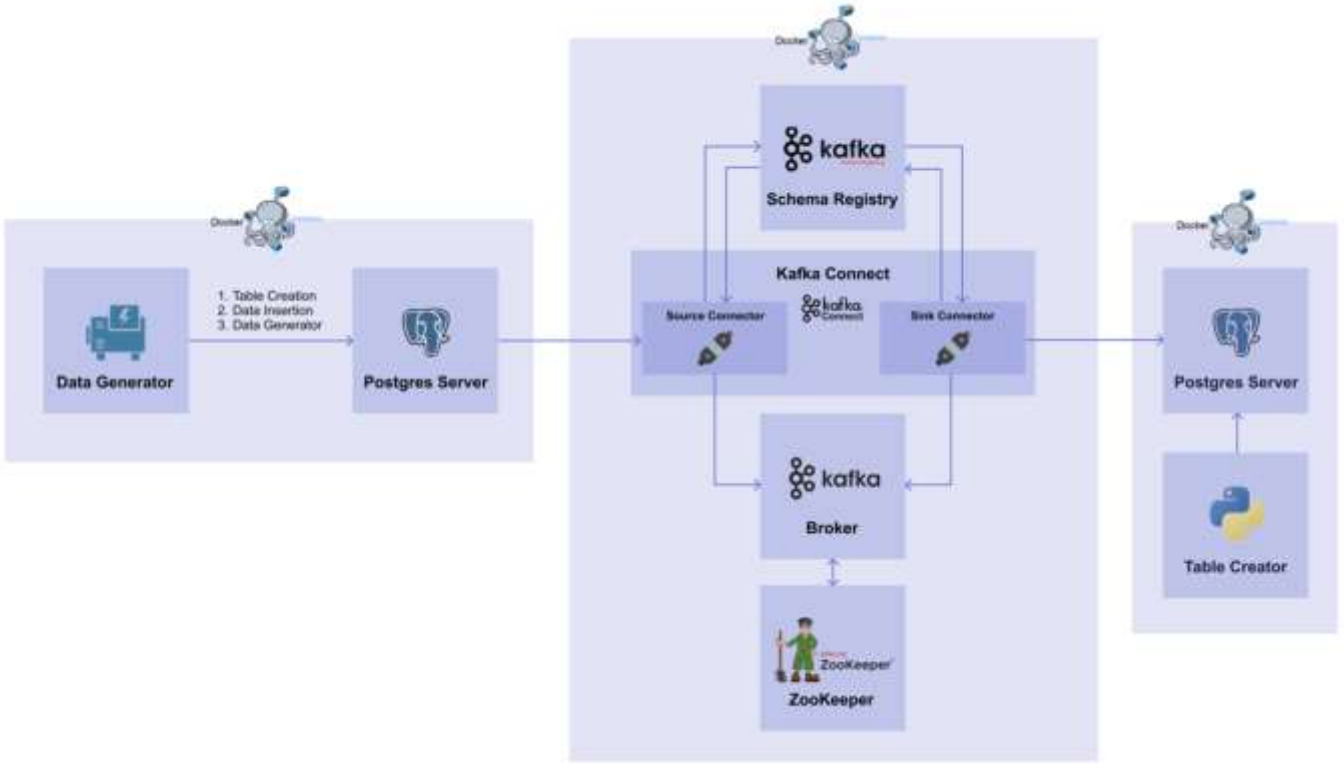
6강

최민우

Kafka

목차

Overview


Docker
Data Generator
1. Table Creation
2. Data Insertion
3. Data Generator
Postgres Server
kafka
Schema Registry
Kafka Connect
Source Connector
kafka Connect
Sink Connector
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Broker
ZooKeeper
ZooKeeper
Docker
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Overview

1.데이터 파이프라인

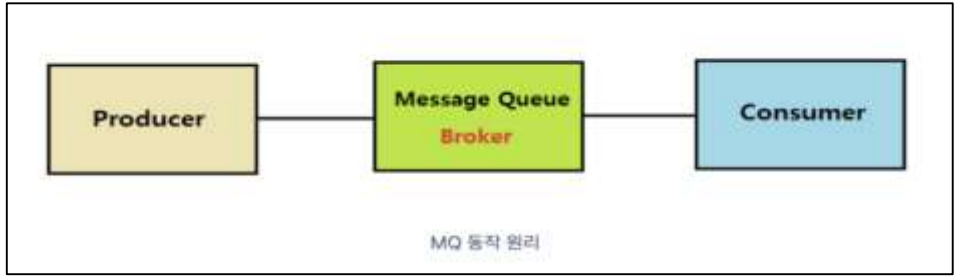
2.Source DB: 데이터가 계속해서 쌓이고 있는 외부 DB(01 - Database)

3.Target DB: 외부에서 가져온 데이터를 처리한 뒤 쌓이는 내부 DB(06 - Kafka)

Kafka Introduction

1.메시징 시스템: 서로 다른 애플리케이션끼리 정보를 교환(생성, 전송, 전달, 저장)
- 메시지 생산자(message producer)와 메시지 소비자(message consumer) 사이에 약한 결합성
- 높은 확장성, 통합성, 안정성

2.카프카: 파이프라인, 스트리밍 분석 등을 위한 고성능 분산 이벤트 스트리밍 플랫폼
- Apache Kafka
- Pub-Sub 모델의 메시지 큐 형태로 동작(분산처리)

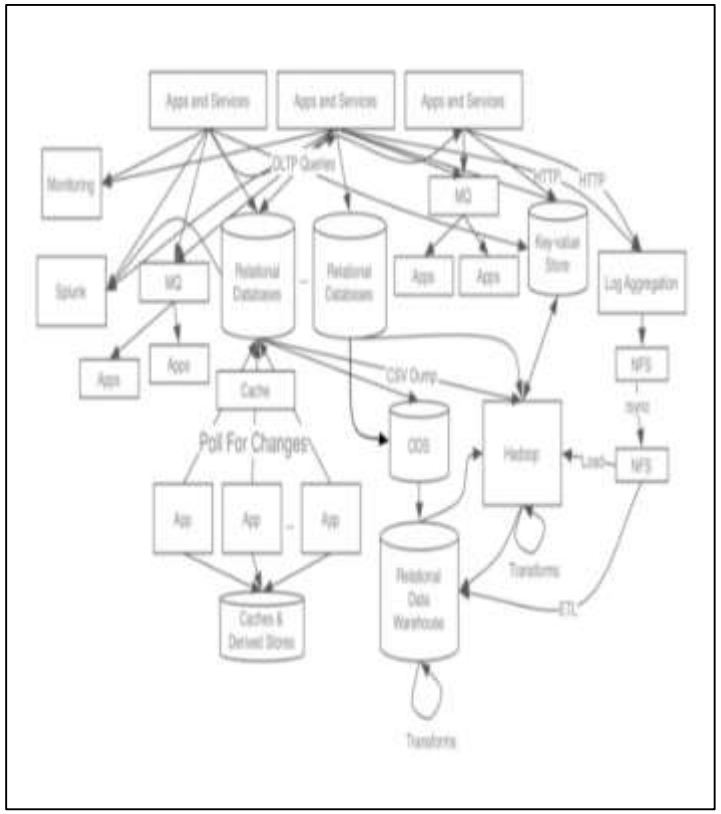


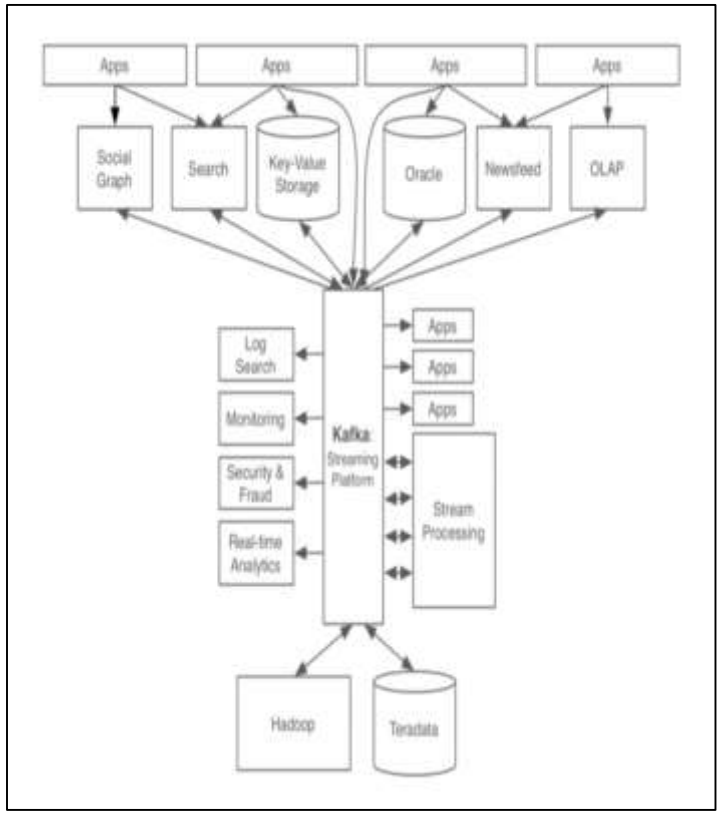
Kafka Introduction

3.카프카 구성요소

- Producer: Kafka에 데이터를 제공하는 서버
- Consumer: Kafka로부터 데이터를 제공받아 사용하는 서버
- Broker: 메시징 서비스를 담당해주는 서버
- Kafka Cluster: 여러 개의 브로커로 이루어진 집합체
- Topic: Broker에서 event(데이터)를 저장하는 기준
- Partition: Topic에 존재하며, Producer로부터 전달된 데이터를 저장
- Zookeeper: 분산 처리를 관리하기 위한 오픈소스 서버

Kafka Introduction





Producer & Consumer

1.Zookeeper & Broker 설치(naive-docker-compose.yaml)

naive-docker-compose.yaml

```yaml
# naive-docker-compose.yaml
version: "3"

services:
  zookeeper:
    image: confluentinc/cp-zookeeper:7.3.0
    container_name: zookeeper
    ports:
      - 2181:2181
    environment:
      ZOOKEEPER_SERVER_ID: 1
      ZOOKEEPER_CLIENT_PORT: 2181
  broker:
    image: confluentinc/cp-kafka:7.3.0
    container_name: broker
    depends_on:
      - zookeeper
    ports:
      - 9092:9092
    environment:
      KAFKA_BROKER_ID: 1
      KAFKA_ZOOKEEPER_CONNECT: zookeeper:2181
      KAFKA_ADVERTISED_LISTENERS: PLAINTEXT://broker:29092,PLAINTEXT_HOST://localhost:9092
      KAFKA_LISTENER_SECURITY_PROTOCOL_MAP: PLAINTEXT:PLAINTEXT,PLAINTEXT_HOST:PLAINTEXT
      KAFKA_INTER_BROKER_LISTENER_NAME: PLAINTEXT
      KAFKA_OFFSETS_TOPIC_REPLICATION_FACTOR: 1
      KAFKA_GROUP_INITIAL_REBALANCE_DELAY_MS: 0
```

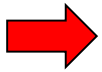
Producer & Consumer

2.Zookeeper & Broker 실행

```
$ docker compose -p class6-naive-docker-compose.yaml up -d
```

3.Zookeeper & Broker 이미지 확인

```
$ docker ps
```



```
$ docker ps
CONTAINER ID   IMAGE                              COMMAND
0a0599db4d96   confluentinc/cp-kafka:7.3.0        "/etc/confluent/dock…"
35cdc624ac34   confluentinc/cp-zookeeper:7.3.0    "/etc/confluent/dock…"
```

Producer & Consumer

4.Producer & Consumer 설치

- Topic 생성

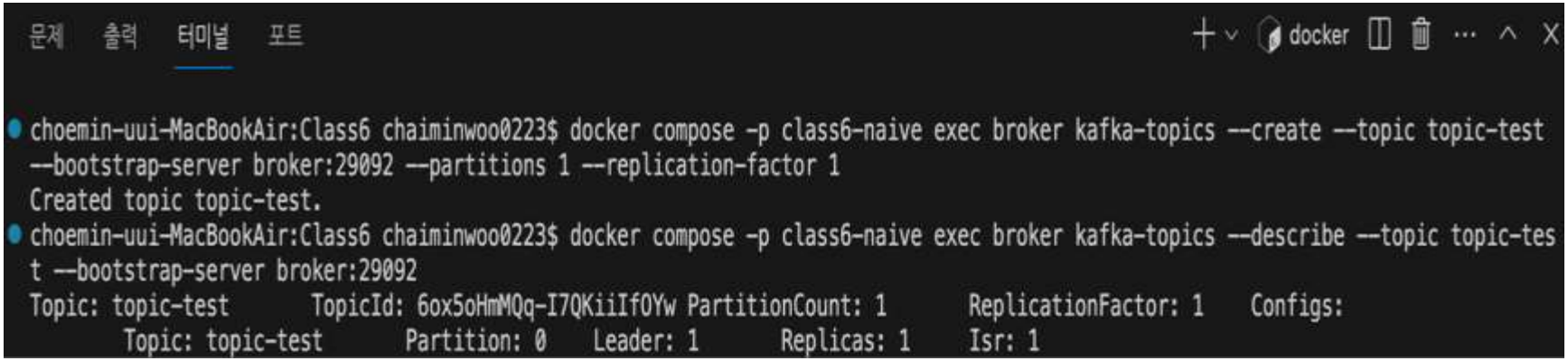
```
$ docker compose -p class6-naive exec broker kafka-topics --create --topic topic-test --bootstrap-server broker:29092 --partitions 1 --replication-factor 1
```

- Topic 확인

```
$ docker compose -p class6-naive exec broker kafka-topics --describe --topic topic-test --bootstrap-server broker:29092
```

Producer & Consumer

4.Producer & Consumer 설치



Producer & Consumer

4.Producer & Consumer 설치

- Consumer 접속(Broker Container)

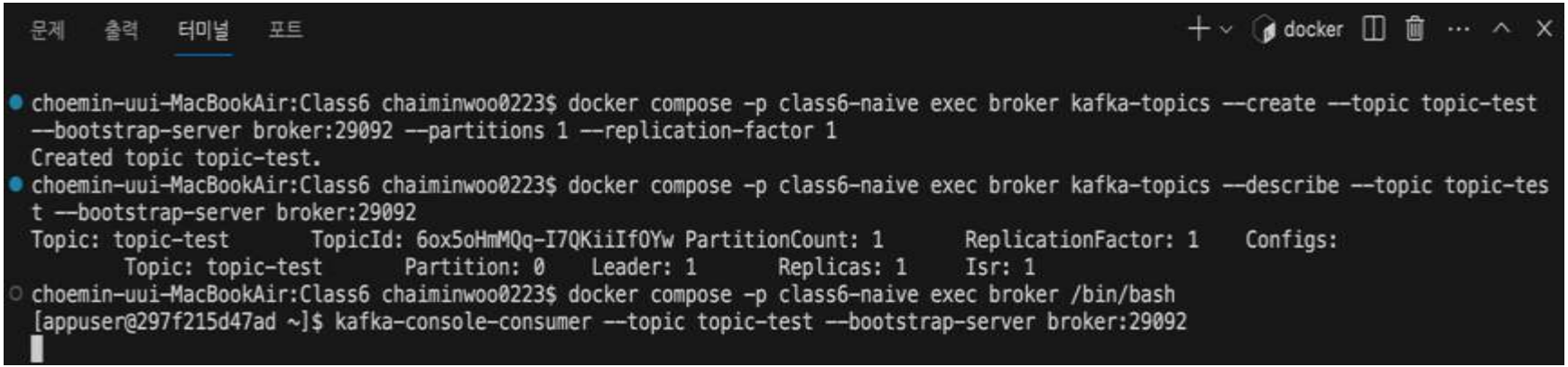
```
$ docker compose -p class6-naive exec broker /bin/bash
```

- Consumer 실행

```
$ kafka-console-consumer --topic topic-test --bootstrap-server broker:29092
```

Producer & Consumer

4.Producer & Consumer 설치



Producer & Consumer

4.Producer & Consumer 설치

- Producer 접속(Broker Container): 반드시 새로운 터미널에서 실행

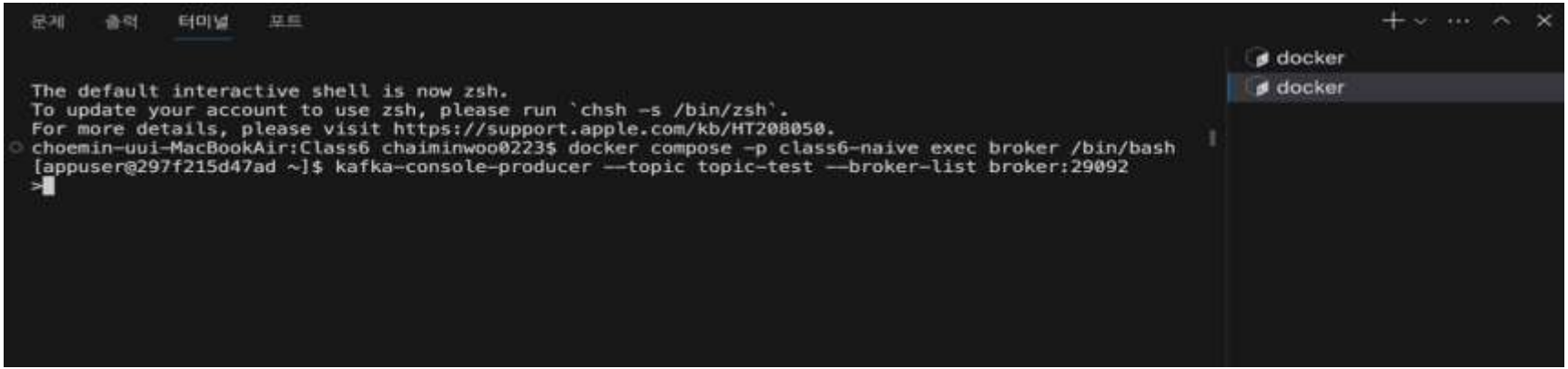
```
$ docker compose -p class6-naive exec broker /bin/bash
```

- Producer 실행

```
$ kafka-console-producer --topic topic-test --broker-list broker:29092
```

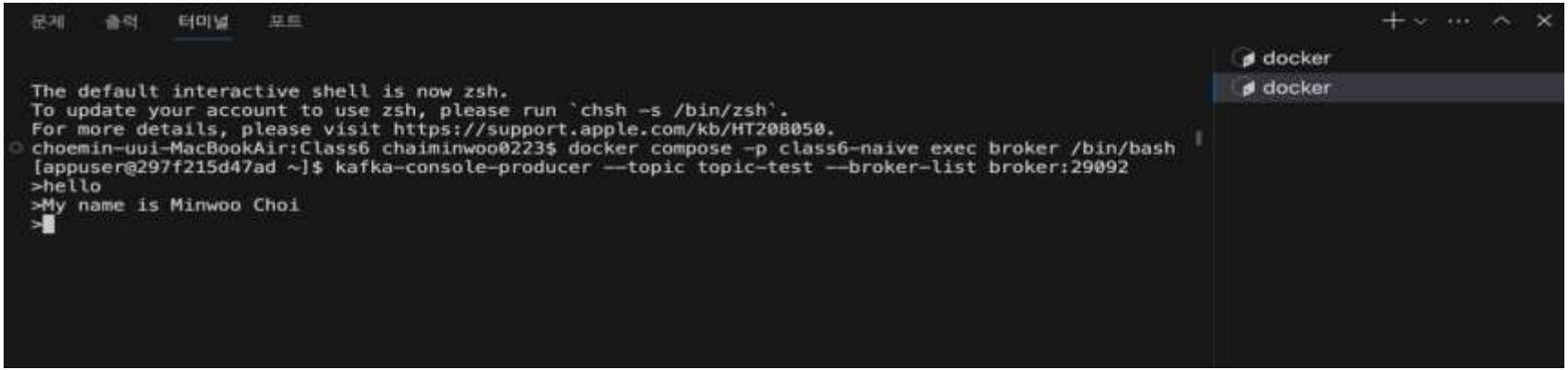
Producer & Consumer

4.Producer & Consumer 설치



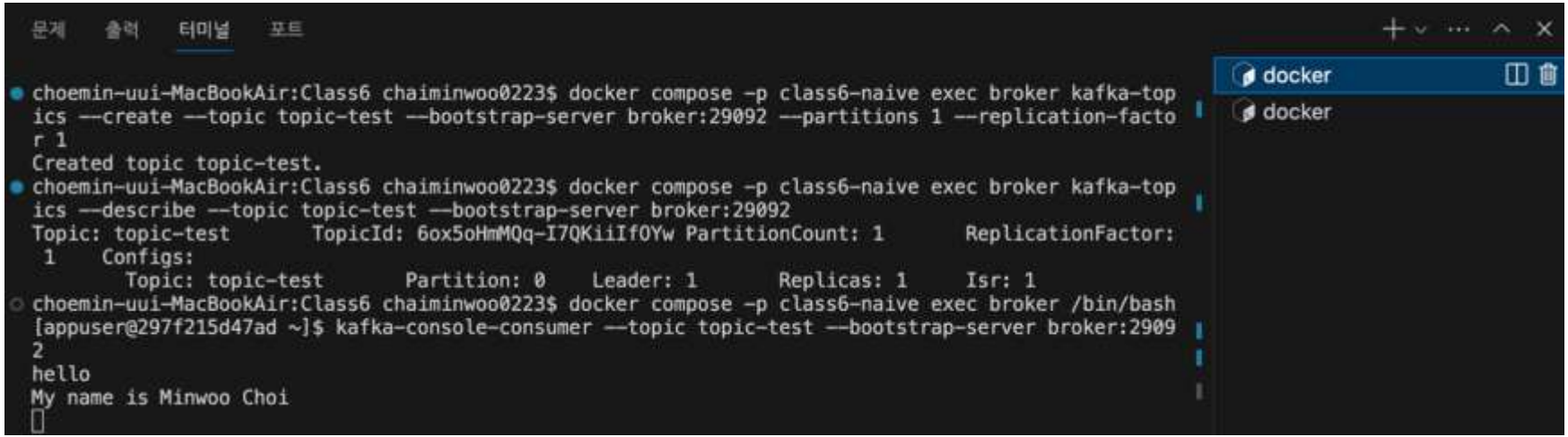
Producer & Consumer

4.Producer & Consumer 설치



Producer & Consumer

4.Producer & Consumer 설치



Producer & Consumer

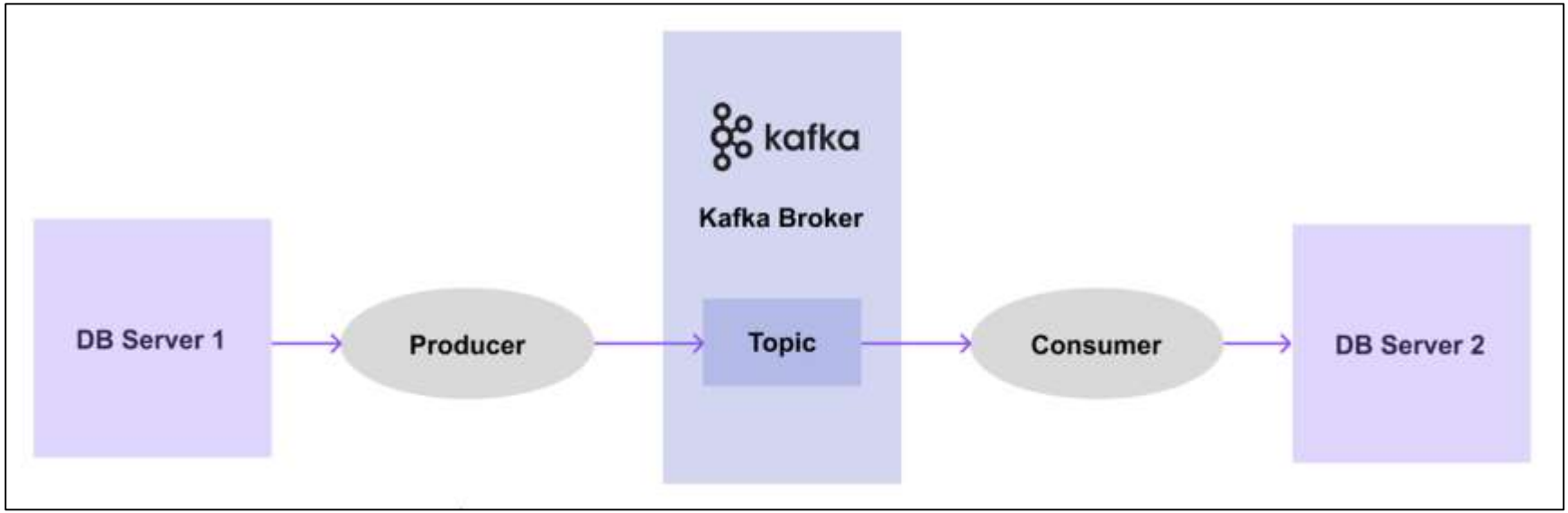
4.Producer $ Consumer 종료

- 반드시 새로운 터미널에서 실행

```
$ docker compose -p class6-naive down -v
```

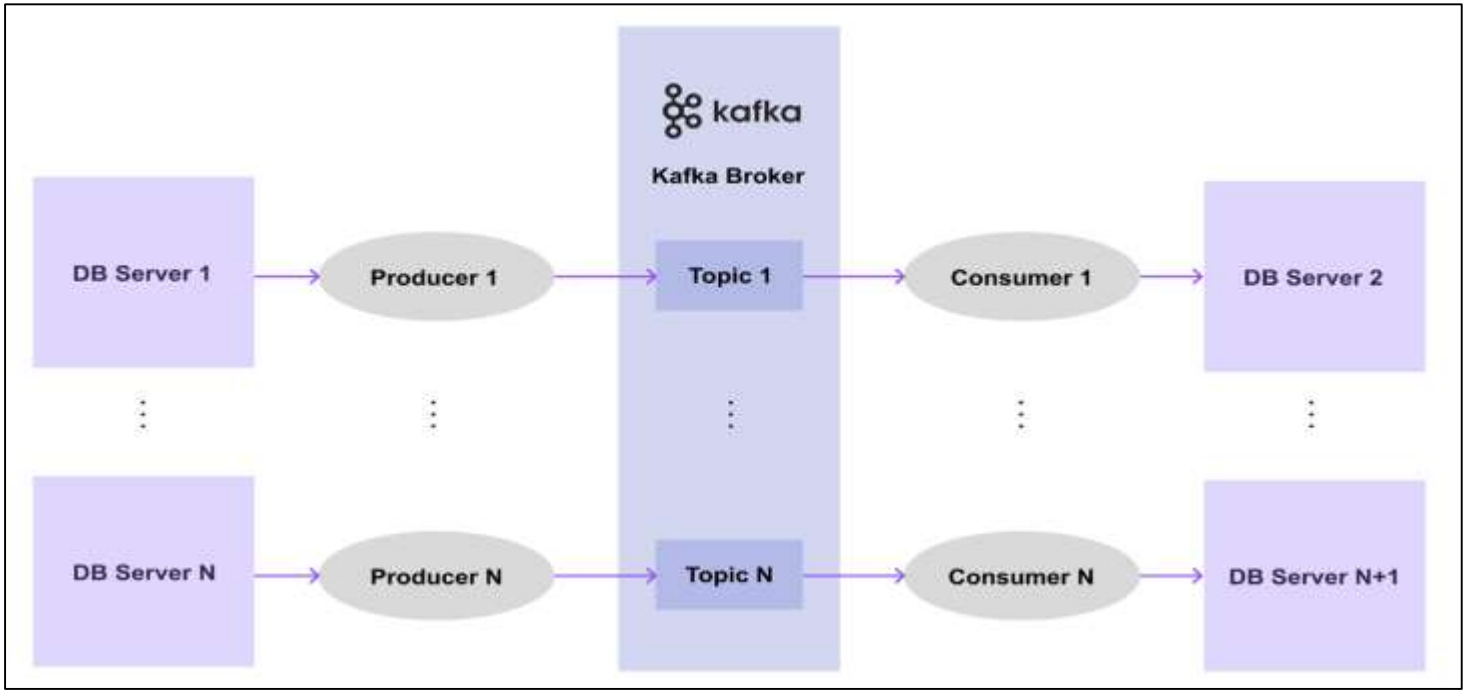
Connect & Connector

1.Producer $ Consumer에서 데이터 파이프라인을 구축



Connect & Connector

2.한계

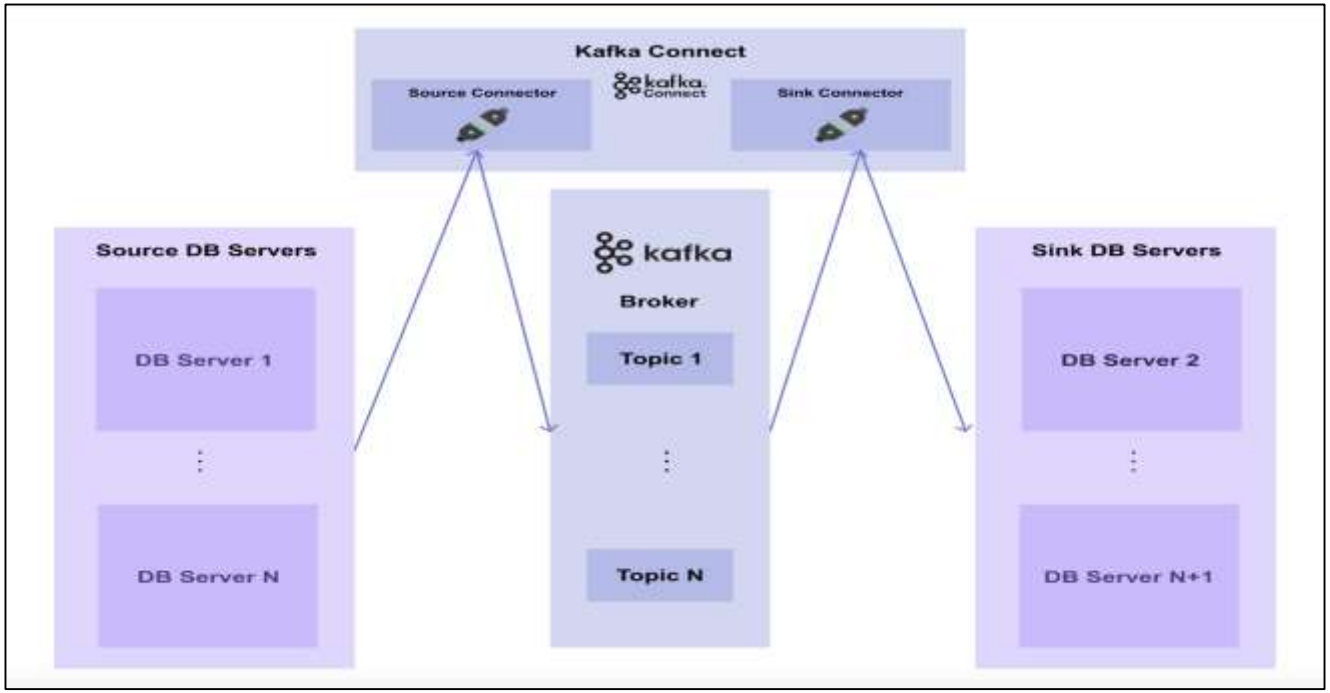


Connect & Connector

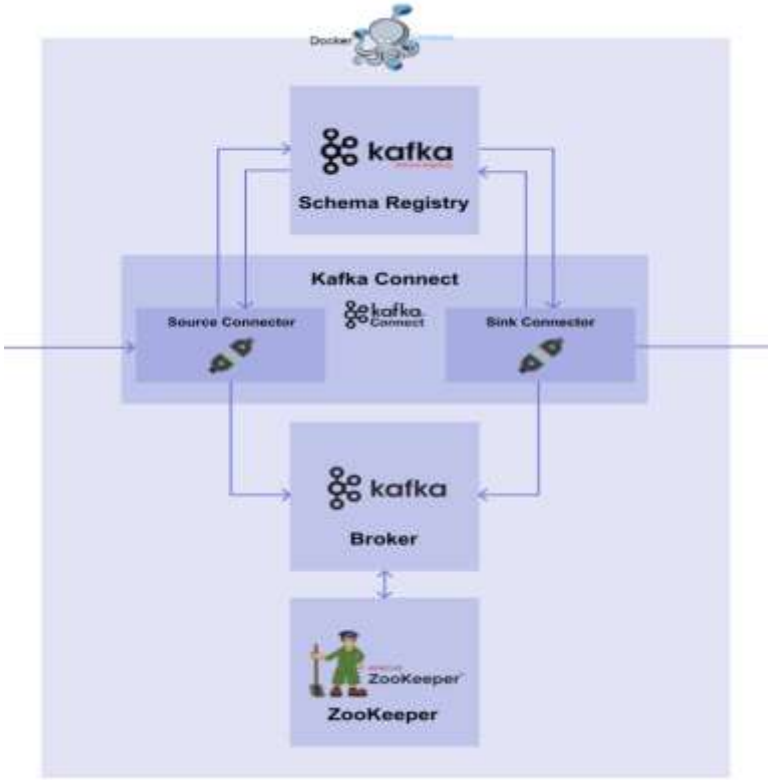
3.Connect: DB 서버와 Kafka 간의 데이터를 확장하고,
안전한 방법으로 데이터를 전송하기 위한 도구(프레임워크)

4.Connector: 데이터를 어디로부터 가져오는지, 어디에다가 전달해야 하는지 정의
- Source Connector: Producer의 역할을 하는 Connector
- Sink Connector: Consumer의 역할을 하는 Connector

Connect & Connector



Kafka System



Kafka System

1.Zookeeper & Broker & Schema Registry 설치(kafka-docker-compose.yaml)

kafka-docker-compose.yaml

```yaml
version: "3"

services:
  zookeeper:
    image: confluentinc/cp-zookeeper:7.3.0
    container_name: zookeeper
    ports:
      - 2181:2181
    environment:
      ZOOKEEPER_SERVER_ID: 1
      ZOOKEEPER_CLIENT_PORT: 2181
  broker:
    image: confluentinc/cp-kafka:7.3.0
    container_name: broker
    depends_on:
      - zookeeper
    ports:
      - 9092:9092
    environment:
      KAFKA_BROKER_ID: 1
      KAFKA_ZOOKEEPER_CONNECT: zookeeper:2181
      KAFKA_ADVERTISED_LISTENERS: PLAINTEXT://broker:29092,PLAINTEXT_HOST://localhost:9092
      KAFKA_LISTENER_SECURITY_PROTOCOL_MAP: PLAINTEXT:PLAINTEXT,PLAINTEXT_HOST:PLAINTEXT
      KAFKA_INTER_BROKER_LISTENER_NAME: PLAINTEXT
      KAFKA_OFFSETS_TOPIC_REPLICATION_FACTOR: 1
      KAFKA_GROUP_INITIAL_REBALANCE_DELAY_MS: 0
```

Kafka System

2.Connect: 이미지를 build하기 위한 Dockerfile이 필요(connect.Dockerfile)

connect.Dockerfile

```
# connect.Dockerfile
FROM confluentinc/cp-kafka-connect:7.3.0

ENV CONNECT_PLUGIN_PATH="/usr/share/java,/usr/share/confluent-hub-components"

RUN confluent-hub install --no-prompt snowflakeinc/snowflake-kafka-connector:1.5.5 &&\
  confluent-hub install --no-prompt confluentinc/kafka-connect-jdbc:10.2.2 &&\
  confluent-hub install --no-prompt confluentinc/kafka-connect-json-schema-converter:7.3.
```

Kafka System

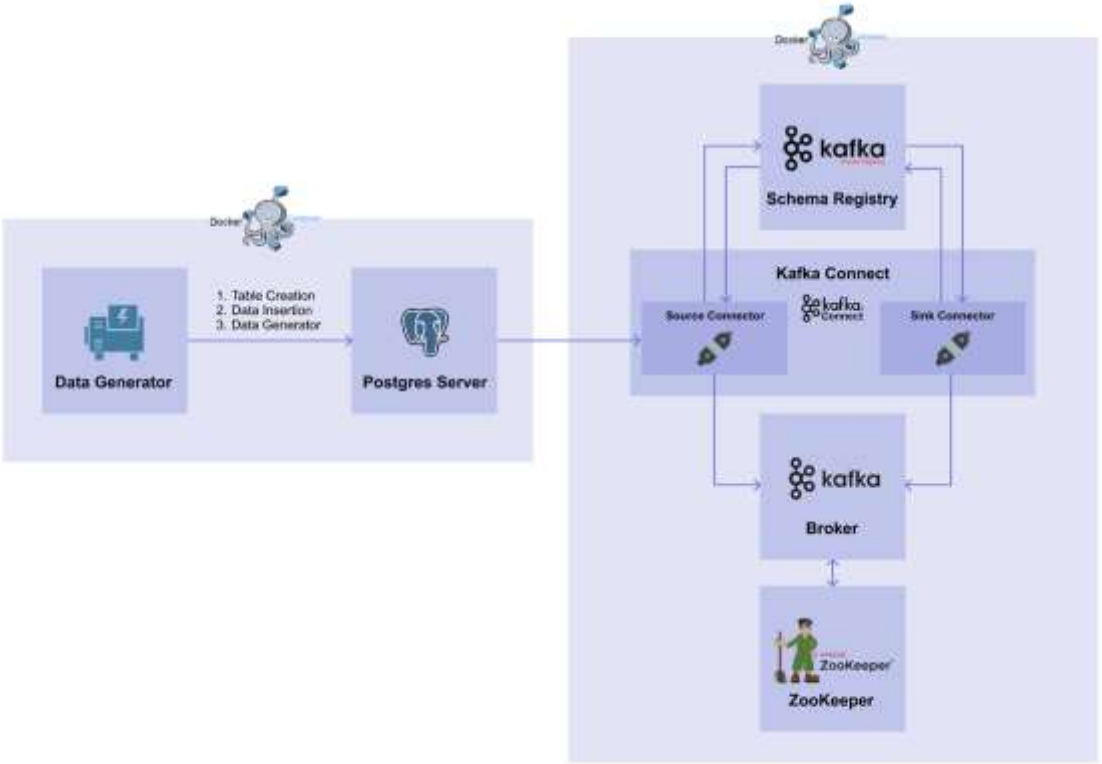
3.Kafka System 실행

```
$ docker compose -p class6-kafka -f kafka-docker-compose.yaml up -d
```

4.Kafka System 이미지 확인

```
$ docker ps
```

Source Connector



Source Connector

1.source_connector.json

source_connector.json

```
{
    "name": "postgres-source-connector",
    "config": {
        "connector.class": "io.confluent.connect.jdbc.JdbcSourceConnector",
        "connection.url": "jdbc:postgresql://postgres-server:5432/mydatabase",
        "connection.user": "myuser",
        "connection.password": "mypassword",
        "table.whitelist": "iris_data",
        "topic.prefix": "postgres-source-",
        "topic.creation.default.partitions": 1,
        "topic.creation.default.replication.factor": 1,
        "mode": "incrementing",
        "incrementing.column.name": "id",
        "tasks.max": 2,
        "transforms": "TimestampConverter",
        "transforms.TimestampConverter.type": "org.apache.kafka.connect.transforms.Timest
        "transforms.TimestampConverter.field": "timestamp",
        "transforms.TimestampConverter.format": "yyyy-MM-dd HH:mm:ss.S",
        "transforms.TimestampConverter.target.type": "string"
    }
}
```

Source Connector

2.curl 명령어를 이용하여 POST method 로 Source Connector 를 생성

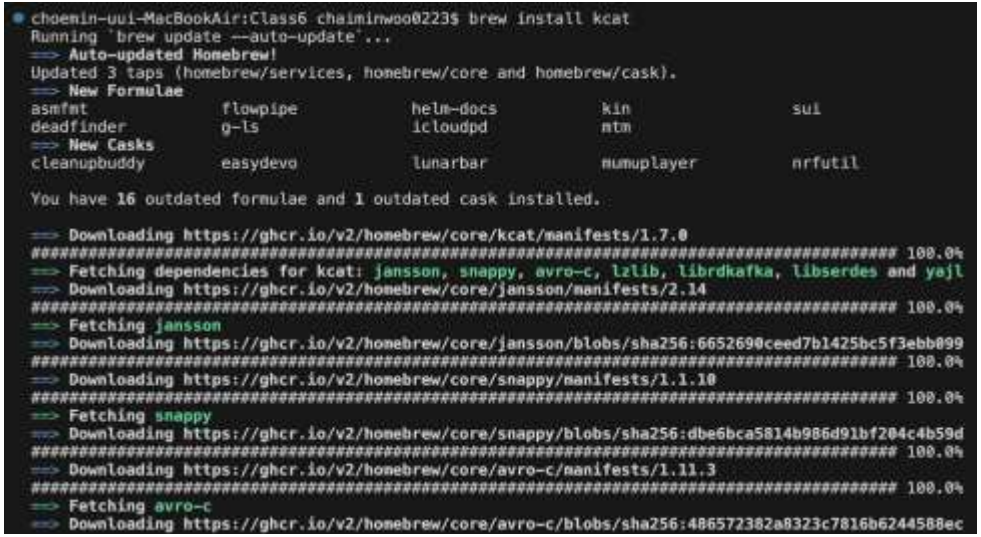
```
$ curl -X POST http://localhost:8083/connectors -H "Content-Type: application/json" -d @source_connector.json
```

```
choemin-uui-MacBookAir:Class6 chaiminwoo0223$ curl -X POST http://localhost:8083/connectors -H "Content-Type: application/json" -d @source_connector.json
{"name":"postgres-source-connector","config":{"connector.class":"io.confluent.connect.jdbc.JdbcSourceConnector","connection.url":"jdbc:postgresql://postgres-server:5432/mydatabase","connection.user":"myuser","connection.password":"mypassword","table.whitelist":"iris_data","topic.prefix":"postgres-source-","topic.creation.default.partitions":"1","topic.creation.default.replication.factor":"1","mode":"incrementing","incrementing.column.name":"id","tasks.max":"2","transforms":"TimestampConverter","transforms.TimestampConverter.type":"org.apache.kafka.connect.transforms.TimestampConverter$Value","transforms.TimestampConverter.field":"timestamp","transforms.TimestampConverter.format":"yyyy-MM-dd HH:mm:ss.S","transforms.TimestampConverter.target.type":"string","name":"postgres-source-connector"},"tasks":[],"type":"source"}choemin-uui-MacBookAir:Class6 chaiminwoo0223$
```

Source Connector

3.kafkacat 설치

```
$ brew install kcat
```



Source Connector

4.모든 Topic 리스트 확인

```
$ kcat -L -b localhost:9092
```

```
.
.
.
topic "postgres-source-iris_data" with 1 partitions:
    partition 0, leader 1, replicas: 1, isrs: 1
.
.
.
```

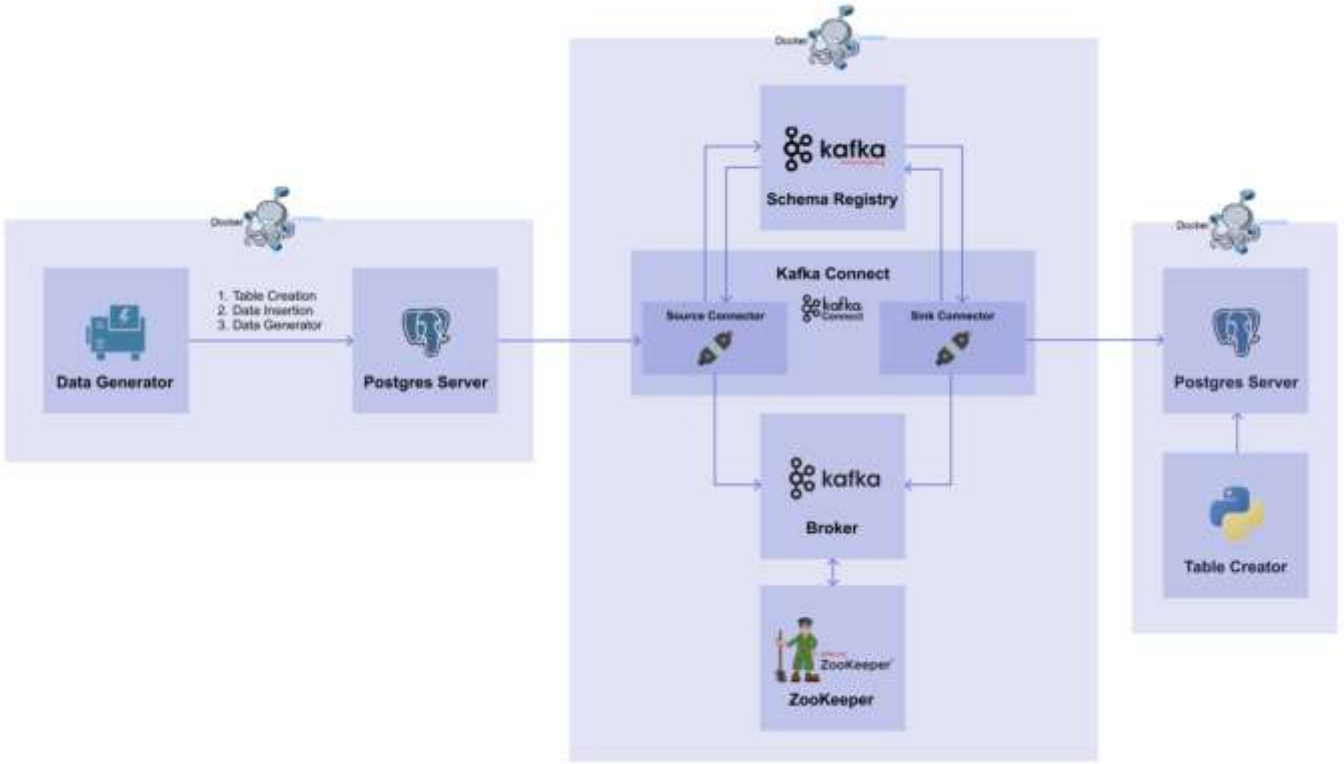
Source Connector

5.postgres-source-iris-data

```
$ kcat -b localhost:9092 -t postgres-source-iris_data
```


```
{"schema":{"type":"struct","fields":[{"type":"int32","optional":false,"field":"id"},{"type":"
{"schema":{"type":"struct","fields":[{"type":"int32","optional":false,"field":"id"},{"type":"
{"schema":{"type":"struct","fields":[{"type":"int32","optional":false,"field":"id"},{"type":"
{"schema":{"type":"struct","fields":[{"type":"int32","optional":false,"field":"id"},{"type":"
{"schema":{"type":"struct","fields":[{"type":"int32","optional":false,"field":"id"},{"type":"
% Reached end of topic postgres-source-iris_data [0] at offset 191
```

Sink Connector



Sink Connector

1.create_table.py

```python
# create_table.py
import psycopg2


def create_table(db_connect):
    create_table_query = """
    CREATE TABLE IF NOT EXISTS iris_data (
        id SERIAL PRIMARY KEY,
        timestamp timestamp,
        sepal_length float8,
        sepal_width float8,
        petal_length float8,
        petal_width float8,
        target int
    );"""
    print(create_table_query)
    with db_connect.cursor() as cur:
        cur.execute(create_table_query)
        db_connect.commit()


if __name__ == "__main__":
    db_connect = psycopg2.connect(
        user="targetuser",
        password="targetpassword",
        host="target-postgres-server",
        port=5432,
        database="targetdatabase",
    )
    create_table(db_connect)
```

Sink Connector

2.target.Dockerfile

target.Dockerfile

```
# target.Dockerfile
FROM amd64/python:3.9-slim

WORKDIR /usr/app

RUN pip install -U pip &&\
    pip install psycopg2-binary

COPY create_table.py create_table.py

ENTRYPOINT ["python", "create_table.py"]
```

Sink Connector

3.target-docker-compose.yaml

target-docker-compose.yaml

```yaml
# target-docker-compose.yaml
version: "3"

services:
  target-postgres-server:
    image: postgres:14.0
    container_name: target-postgres-server
    ports:
      - 5433:5432
    environment:
      POSTGRES_USER: targetuser
      POSTGRES_PASSWORD: targetpassword
      POSTGRES_DB: targetdatabase
    healthcheck:
      test: ["CMD", "pg_isready", "-q", "-U", "targetuser", "-d", "targetdatabase"]
      interval: 10s
      timeout: 5s
      retries: 5

  table-creator:
    build:
      context: .
      dockerfile: target.Dockerfile
    container_name: table-creator
    depends_on:
      target-postgres-server:
        condition: service_healthy
```

Sink Connector

4.Target DB 서버와 Table Creator 생성

```
$ docker compose -p class6-target f target-docker-compose.yaml up -d
```

Sink Connector

5.sink_connector.json

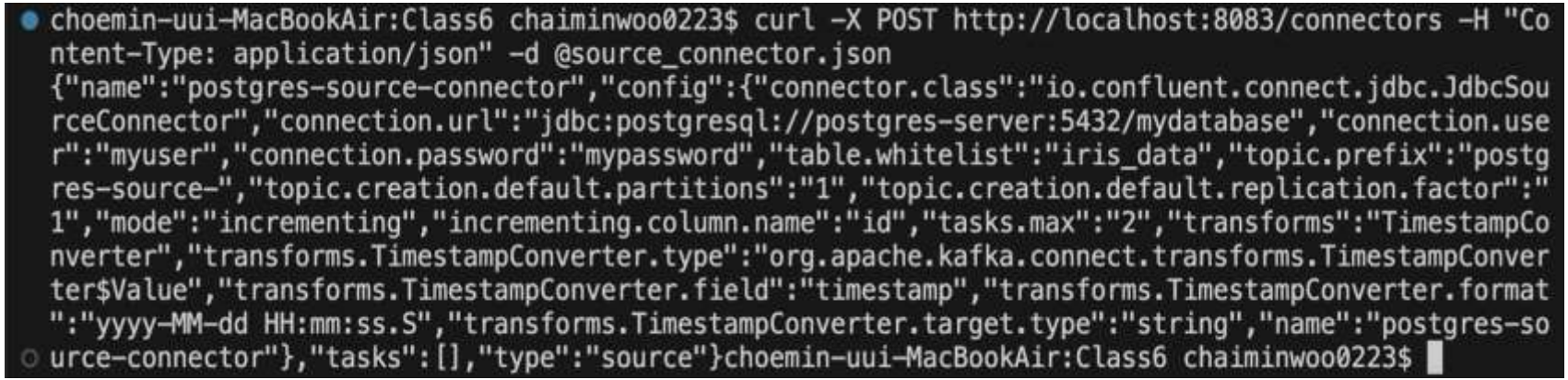
sink_connector.json

```
{
    "name": "postgres-sink-connector",
    "config": {
        "connector.class": "io.confluent.connect.jdbc.JdbcSinkConnector",
        "connection.url": "jdbc:postgresql://target-postgres-server:5432/targetdatabase",
        "connection.user": "targetuser",
        "connection.password": "targetpassword",
        "table.name.format": "iris_data",
        "topics": "postgres-source-iris_data",
        "auto.create": false,
        "auto.evolve": false,
        "tasks.max": 2,
        "transforms": "TimestampConverter",
        "transforms.TimestampConverter.type": "org.apache.kafka.connect.transforms.Timest
        "transforms.TimestampConverter.field": "timestamp",
        "transforms.TimestampConverter.format": "yyyy-MM-dd HH:mm:ss.S",
        "transforms.TimestampConverter.target.type": "Timestamp"
    }
}
```

Sink Connector

2.curl 명령어를 이용하여 POST method 로 Source Connector 를 생성

```
$ curl -X POST http://localhost:8083/connectors -H "Content-Type: application/json" -d @sink_connector.json
```

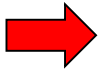


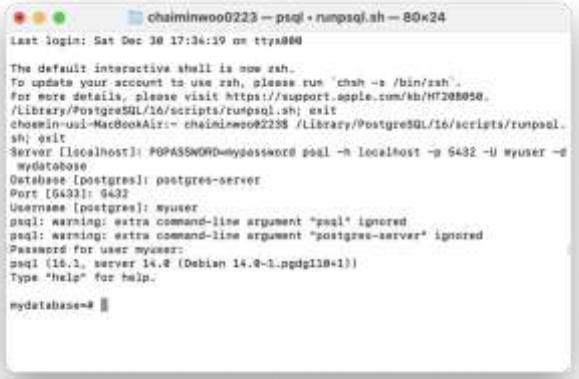
Sink Connector

3.데이터 확인
- psql 실행
- Target DB에 접속하고, 데이터 확인

```
PGPASSWORD=targetpassword psql -h localhost -p 5433 -U targetuser -d targetdatabase
```

- Target DB Server
  - *Image* : `postgres:14.0`
  - *Container name* : `target-postgres-server`
  - *POSTGRES_USER* : `targetuser`
  - *POSTGRES_PASSWORD* : `targetpassword`
  - *POSTGRES_DB* : `targetdatabase`
  - *Port forwarding* : `5433:5432`





Sink Connector

3.데이터 확인
- psql 실행
- Target DB에 접속하고, 데이터 확인

```
targetdatabase=# SELECT * FROM iris_data LIMIT 10;
```

참고자료

- https://mlops-for-mle.github.io/tutorial/
- https://velog.io/@holicme7/Apache-Kafka-%EC%B9%B4%ED%94%84%EC%B9%B4%EB%9E%80-%EB%AC%B4%EC%97%87%EC%9D%B8%EA%B0%80
- ChatGPT 4

Thank You