Introduction

NDC Melbourne Workshop Event driven : All roads lead to Kafka

Build a taxi booking application with Apache Kafka.

During this workshop we'll discuss what Kafka is and how to use this exciting, modern distributed streaming platform in your next data project. From the ground up we'll build a practical data management system to stream data, aggregate results and deliver live visual mapping of a taxi booking application.

This hands-on labs you'll build an application that can

- Publish data to Kafka and subscribe to consume data from Kafka
- Serialize data in AVRO and Protobuf
- Register schemas and handle changes with schema evolution
- Leverage APIs in for producing and consuming messages against Kafka topics
- Build topologies to transform and aggregate streaming payloads
- Understand the Kafka connect framework to easily connect to external databases and elastic
- Build a live mapping dashboard with Kibana

This workshop is ideal for application developers, data engineers, or data scientists who need to interact with distributed messaging and streaming data platforms.

Get started

Prerequisites & setup

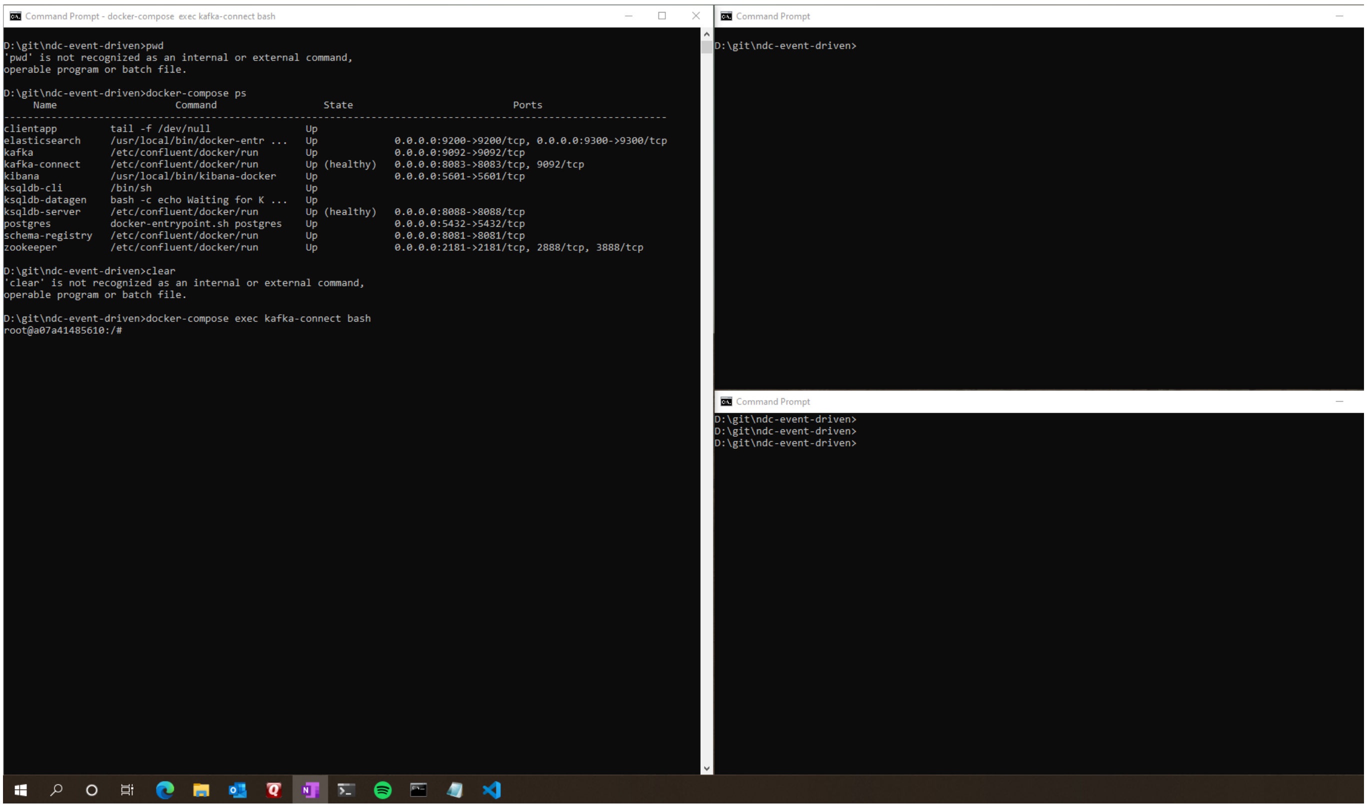
- install docker/docker-compose
- set your Docker maximum memory to something really big, such as 10GB. (preferences -> advanced -> memory)
- clone this repo!

```
mkdir ~/git
cd ~/git
git clone https://github.com/saubury/ndc-event-driven.git
cd ndc-event-driven
```

How you'll work

You'll need *three* terminals for these exercises. Each one you should `cd ~/git/ndc-event-driven`

For simplicity arrange your three terminals so you can see the first and second at the same time (perhaps split horizontally if you're using iTerm2) Something like below.



```
D:\git\ndc-event-driven>pwd
'pwd' is not recognized as an internal or external command,
operable program or batch file.

D:\git\ndc-event-driven>docker-compose ps
     Name                  Command                  State                           Ports
----------------------------------------------------------------------------------------------------------------
clientapp         tail -f /dev/null               Up
elasticsearch     /usr/local/bin/docker-entr ...   Up             0.0.0.0:9200->9200/tcp, 0.0.0.0:9300->9300/tcp
kafka             /etc/confluent/docker/run        Up             0.0.0.0:9092->9092/tcp
kafka-connect     /etc/confluent/docker/run        Up (healthy)   0.0.0.0:8083->8083/tcp, 9092/tcp
kibana            /usr/local/bin/kibana-docker     Up             0.0.0.0:5601->5601/tcp
ksqldb-cli        /bin/sh                          Up
ksqldb-datagen    bash -c echo Waiting for K ...   Up
ksqldb-server     /etc/confluent/docker/run        Up (healthy)   0.0.0.0:8088->8088/tcp
postgres          docker-entrypoint.sh postgres    Up             0.0.0.0:5432->5432/tcp
schema-registry   /etc/confluent/docker/run        Up             0.0.0.0:8081->8081/tcp
zookeeper         /etc/confluent/docker/run        Up             0.0.0.0:2181->2181/tcp, 2888/tcp, 3888/tcp

D:\git\ndc-event-driven>clear
'clear' is not recognized as an internal or external command,
operable program or batch file.

D:\git\ndc-event-driven>docker-compose exec kafka-connect bash
root@a07a41485610:/#
```

```
D:\git\ndc-event-driven>
```

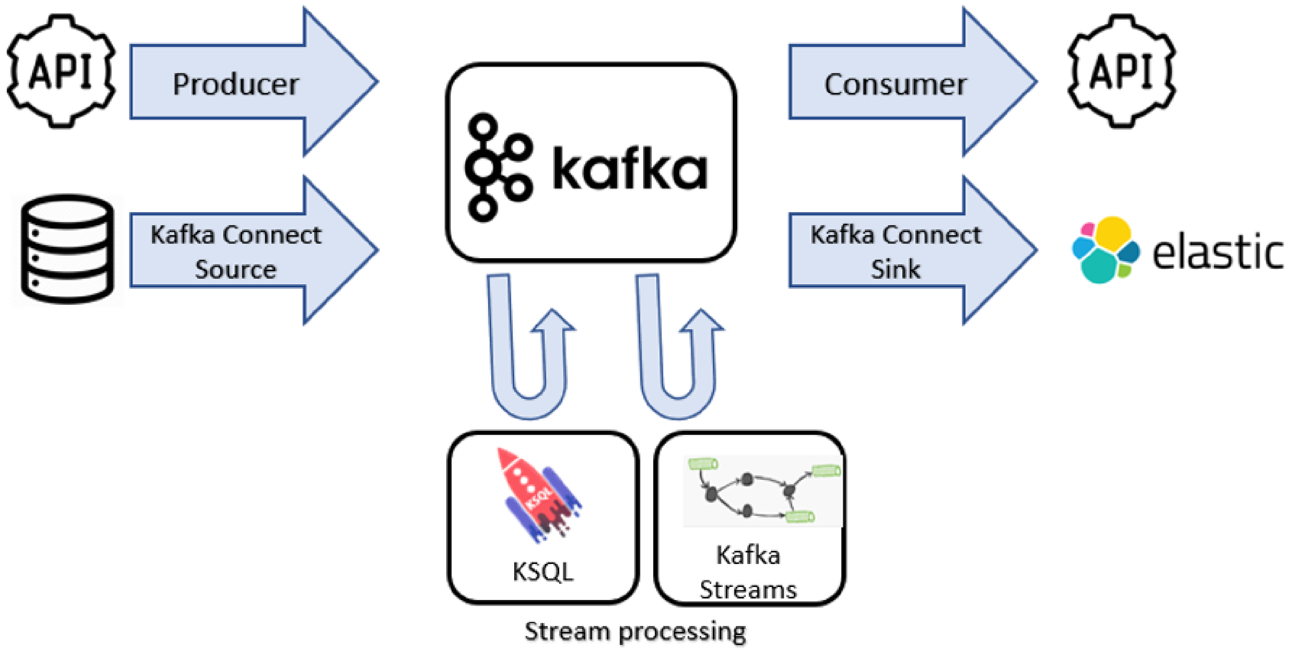
```
D:\git\ndc-event-driven>
D:\git\ndc-event-driven>
D:\git\ndc-event-driven>
```

Docker Startup

Terminal 1

```
docker-compose up -d
```

Workshop 1 – Producers and Consumers



Terminal 1

```
docker-compose exec kafka-connect bash
```

Create a topic

```
kafka-topics --bootstrap-server kafka:29092 --create --partitions 1 --replication-factor 1 --topic MYTOPIC
```

Check it's there

```
kafka-topics --list --bootstrap-server kafka:29092
```

Create a topic with 8 partitions

```
kafka-topics --bootstrap-server kafka:29092 --create --partitions 8 --replication-factor 1 --topic MYTOPIC8
```

Describe a topic - check it has 8 partitions

```
kafka-topics --describe --bootstrap-server kafka:29092 --topic MYTOPIC8
```

Create a topic with replication greater than number of brokers

```
kafka-topics --bootstrap-server kafka:29092 --create --replication-factor 2 --topic MYTOPIC_REPLICATED
```

Create a Producer

Write some text from STDIN

```
kafka-console-producer --broker-list kafka:29092 --topic MYTOPIC
```

Now type some things into first (original) terminal (and press ENTER).

Terminal 2

Create a Consumer

Start another terminal

```
docker-compose exec kafka-connect bash
```

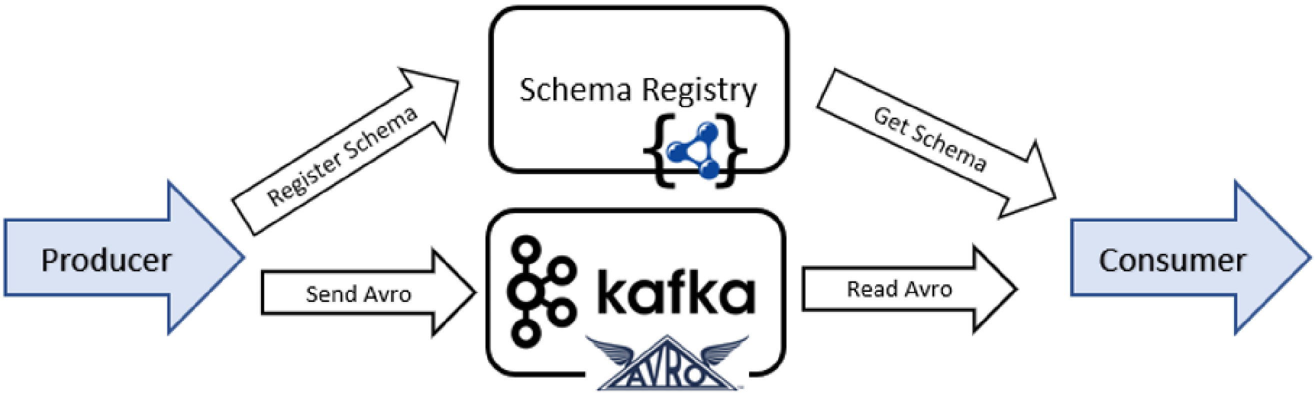
In the newly created (second) terminal let's start reading from new Kafka topic

```
kafka-console-consumer --bootstrap-server kafka:29092 --topic MYTOPIC --from-beginning
```

Each line you type in the first terminal should appear in second terminal

What have we learnt? It's easy to be a producer or consumer. Out of the box Kafka doesn't care what you're writing - it's just a bunch of bytes

Structured Data with AVRO



Terminal 1

At UNIX prompt, (Note: Press Ctrl C to exit the producer script)

```
kafka-topics --bootstrap-server kafka:29092 --create --partitions 1 --replication-factor 1 --topic COMPLAINTS_AVRO

kafka-avro-console-producer  --broker-list kafka:29092 --property
schema.registry.url="http://schema-registry:8081"  --topic COMPLAINTS_AVRO \
--property value.schema='
{
  "type": "record",
  "name": "myrecord",
  "fields": [
      {"name": "customer_name",  "type": "string" }
    , {"name": "complaint_type", "type": "string" }
    , {"name": "trip_cost", "type": "float" }
    , {"name": "new_customer", "type": "boolean"}
  ]
}' << EOF
{"customer_name":"Carol", "complaint_type":"Late arrival", "trip_cost": 19.60,
"new_customer": false}
EOF
```

Terminal 2

Press Ctrl+C and Ctrl+D and run the following curl command.

BTW, this is AVRO

```
curl -s -X GET http://localhost:8081/subjects/COMPLAINTS_AVRO-value/versions/1
```

AVRO Schema Evolution

Let's add a loyality concept to our complaints topic - we'll add "number_of_rides" to the payload

Terminal 1

```
kafka-avro-console-producer  --broker-list kafka:29092 --property
schema.registry.url="http://schema-registry:8081"  --topic COMPLAINTS_AVRO \
--property value.schema='
{
  "type": "record",
  "name": "myrecord",
  "fields": [
      {"name": "customer_name",  "type": "string" }
    , {"name": "complaint_type", "type": "string" }
    , {"name": "trip_cost", "type": "float" }
    , {"name": "new_customer", "type": "boolean"}
    , {"name": "number_of_rides", "type": "int", "default" : 1}
  ]
}' << EOF
{"customer_name":"Ed", "complaint_type":"Dirty car", "trip_cost": 29.10,
"new_customer": false, "number_of_rides": 22}
EOF
```

Terminal 2

Let's see what schemas we have registered now

```
curl -s -X GET http://localhost:8081/subjects/COMPLAINTS_AVRO-value/versions

curl -s -X GET http://localhost:8081/subjects/COMPLAINTS_AVRO-value/versions/1 |
jq '.'
```

```
curl -s -X GET http://localhost:8081/subjects/COMPLAINTS_AVRO-value/versions/2 |
jq '.'

or you can also use:

curl -s -X GET http://localhost:8081/subjects/COMPLAINTS_AVRO-value/versions/2 |
jq -r .schema | jq .
```

Workshop 2 – Kafka Connect

Let's copy data from an upstream database which has a list of ride users. Connecting Kafka to and from other systems (such as a database or object store) is a very common task. The Kafka Connect framework has a plug in archecture which allows you to *source* from an upstream system or *sink* into a downstream system.

Setup Postgres source database

in Terminal 1:

Exit the kafka-connect container by pressing Ctrl+D.

```
cat scripts/postgres-setup.sql

docker-compose exec postgres psql -U postgres -f /scripts/postgres-setup.sql
```

To look at the Postgres table

```
docker-compose exec postgres psql -U postgres -c "select * from users;"
```

Kafka Connect Setup

Our goal now is to source data continuously from our Postgres database and produce into Kafka. We'll use Kafka connect as the framework, and a JDBC Postgres Source connector coto connect to the database

Have a look at `scripts/connect_source_postgres.json`

Load connect config

```
curl -k -s -S -X PUT -H "Accept: application/json" -H "Content-Type:
application/json" --data @./scripts/connect_source_postgres.json
http://localhost:8083/connectors/src_pg/config
```

```
curl -s -X GET http://localhost:8083/connectors/src_pg/status | jq '.'
```

Terminal 2

Now let's consume the topic by starting a consumer inside the kafka-connect container to

```
kafka-avro-console-consumer --bootstrap-server kafka:29092 --topic db-users --from-beginning --property  schema.registry.url="http://schema-registry:8081"
```

Terminal 1

Insert a new database row into Postgres

```
docker exec -it postgres psql -U postgres -c "INSERT INTO users (userid, username) VALUES ('J', 'Jane');"
```

You *should* see Jane arrive automatically into the Kafka topic

Workshop 3 – Stream Processing

Generate ride request data

Create a stream of rider requests

Terminal 3

```
docker-compose exec ksqldb-datagen ksql-datagen schema=/scripts/riderequest.avro format=avro topic=riderequest key=rideid msgRate=1 iterations=10 bootstrap-server=kafka:29092 schemaRegistryUrl=http://schema-registry:8081 value-format=avro
```

In Terminal 2, (Exit the existing consumer by pressing Ctrl+C) Check the AVRO output of the `riderequest` topic. Press ^C when you've seen a few records.

```
kafka-avro-console-consumer --bootstrap-server kafka:29092 --topic riderequest --from-beginning --property  schema.registry.url="http://schema-registry:8081"
```

Build a stream processor

We have a constant steam of rider requests arriving in the `riderequest` topic. But each request has only a `userid` (such as `J`) and no name (like `Jane`). Also, the rider location has seperate latitide and longtitude fields; we want to be able to join them together as single string field (to form a geom - `cast(rr.LATITUDE as varchar) || ',' || cast(rr.LONGITUDE as varchar)`)

Let's build a stream processor to consume from the `riderequest` topic and `db-users` topics, join them and produce into a new topic along with a new location attribute.

Will build our stream processor in ksql.

ksqlDB CLI

Build a stream processor

Terminal 2

```
docker-compose exec ksqldb-cli ksql http://ksqldb-server:8088
```

Run the KSQL script:

```
ksql
ksql> run script '/scripts/join_topics.ksql';
exit;
```

And if you want to check

Terminal 1 from inside the Kafka-connect container

```
kafka-console-consumer --bootstrap-server kafka:29092 --topic RIDESANDUSERSJSON
```

Workshop 4 – Visualizations

Sink to Elastic/Kibana

Setup dynamic elastic templates

Terminal 2

At the console prompt

```
./scripts/load_elastic_dynamic_template
```

Now we need a sink connector to read from the topic RIDESANDUSERSJSON

Load connect config.

```
curl -k -s -S -X PUT -H "Accept: application/json" -H "Content-Type:
application/json" --data @./scripts/connect_sink_elastic.json
http://localhost:8083/connectors/sink_elastic/config
```

```
curl -s -X GET http://localhost:8083/connectors/sink_elastic/status | jq '.'
```

Kibana Dashboard Import

- Navigate to http://localhost:5601/app/kibana#/management/kibana/objects
- Click Import
- Select file 06_kibana_export.json
- Click Automatically overwrite all saved objects? and select Yes, overwrite all objects
- Kibana - Open Dashboard
- Open http://localhost:5601/app/kibana#/dashboards

Workshop 5 – Producers & Protobuf

Build a Python producer

Application Binding - Protobuf classes with Python

Let us now build an application demonstrating protobuf classes.

```
docker-compose exec clientapp bash
```

Generate protobuf classes

To generate protobuf classes you must first install the protobuf compiler `protoc`. See the protocol buffer docs for instructions on installing and using protoc.

Python compile schema

```
cd /python-app
cat ./meal.proto
```

```
protoc -I=. --python_out=. ./meal.proto
```

This will create the `meal_pb2.py` Python class file.

You can now build protobuf classes and produce into Kafka with code like this

```
pip install -r requirements.txt
```

Review the producer code. Note the `meal_pb2.py` Python class file is included. This class is used to construct a payload in protobuf. The produecr will send the schema to the schema registry and the payload to the `MEAL_DELIVERY` topic.

```
cat producer-protobuf.py
```

Run the producer

```
python producer-protobuf.py
```

Review the topic

Now to check the contents of the `MEAL_DELIVERY` topic. We will use the `kafka-protobuf-console-consumer` command line consumer tool to inspect the protobuf payload.

```
docker-compose exec kafka-connect bash
```

```
kafka-protobuf-console-consumer --bootstrap-server kafka:29092 --topic
MEAL_DELIVERY --from-beginning --property  schema.registry.url="http://schema-
registry:8081"
```

Verify schema

Check this is Protobuf

```
curl -s -X GET http://localhost:8081/subjects/MEAL_DELIVERY-value/versions/1
```