KAFKA#IOT

DATA ANALYTICS - A.Y. 2020-21

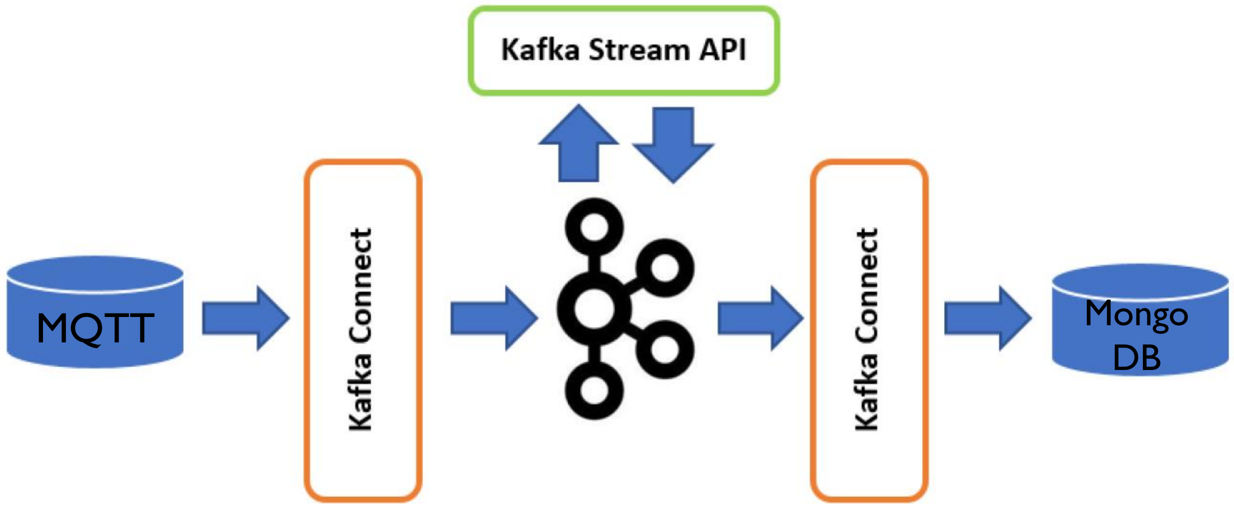
DIEGO DIOMEDI - LUCIA PASSERI

DESCRIPTION AND OBJECTIVE

Objective: perform data analysis on IoT data with Kafka Streams and ksqlDB.

Description:

- Data are provided by Filippetti Device Simulator
- Data are ingested in real time from MQTT broker and analysed with Kafka Streams and ksqlDB
- Output analytics was saved on an external system: MongoDB



TECHNOLOGIES

- Ubuntu 18.04
- Java 8
- Mqtt-spy
- Mosquitto
- Apache Kafka
- Confluent Platform
- KsqlDB
- MongoDB
- MongoDB Compass
- Git and Github

TECHNOLOGIES

Thanks to Mosquitto and mqtt-spy, we were able to read the messages published by the sensors.

Confluent Platform allows us to make a streaming analytics and filtering data that comes from mqtt broker.

We decided to use MongoDB as the source sink to save the data.

TECHNICAL IMPLEMENTATION

What to install:

- Ubuntu 18.04
- Java 8
- JavaFX
- Mqtt-spy
- Mosquitto
- Filippetti Simulator
- Confluent Platform
- Connectors from confluent-hub

TECHNICAL IMPLEMENTATION

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Start with command:

```
confluent local services start
```

TECHNICAL IMPLEMENTATION

Once all services are [UP] we can procede:

```
lucia@lucia-VirtualBox:~$ confluent local services start
The local commands are intended for a single-node development environment only,
NOT for production usage. https://docs.confluent.io/current/cli/index.html

Using CONFLUENT_CURRENT: /tmp/confluent.396829
ZooKeeper is [UP]
Kafka is [UP]
Schema Registry is [UP]
Kafka REST is [UP]
Connect is [UP]
ksqlDB Server is [UP]
Control Center is [UP]
```

TECHNICAL IMPLEMENTATION

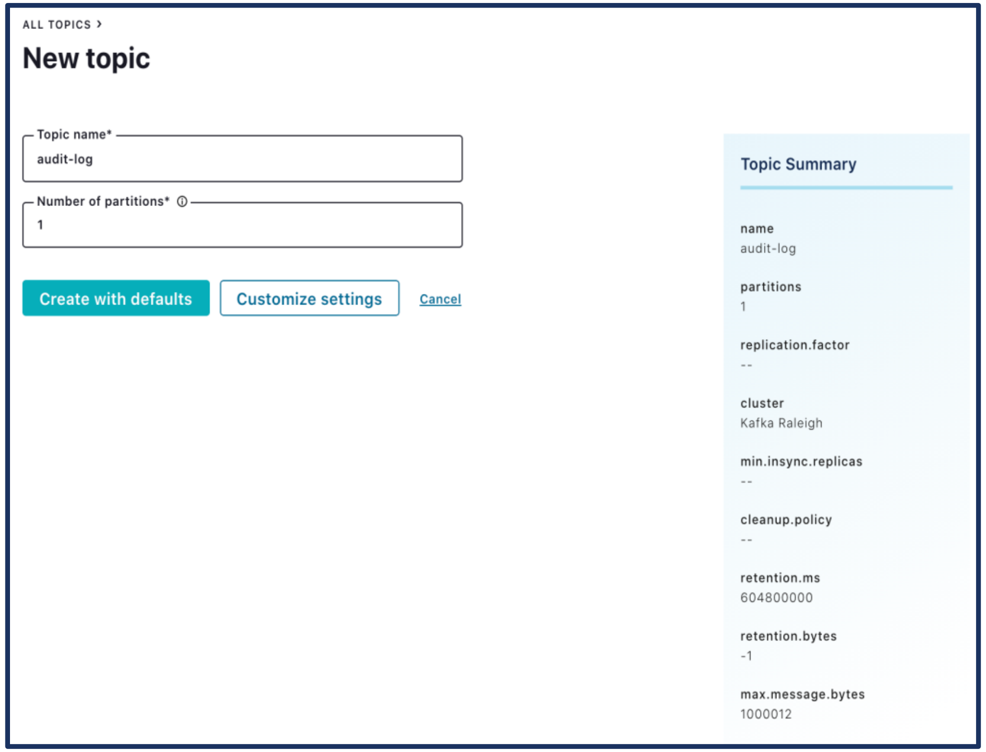
Once all services are [UP] we can procede:

- Browse http://localhost:9021/clusters and select your *cluster*

TECHNICAL IMPLEMENTATION

Once all services are [UP] we can procede:

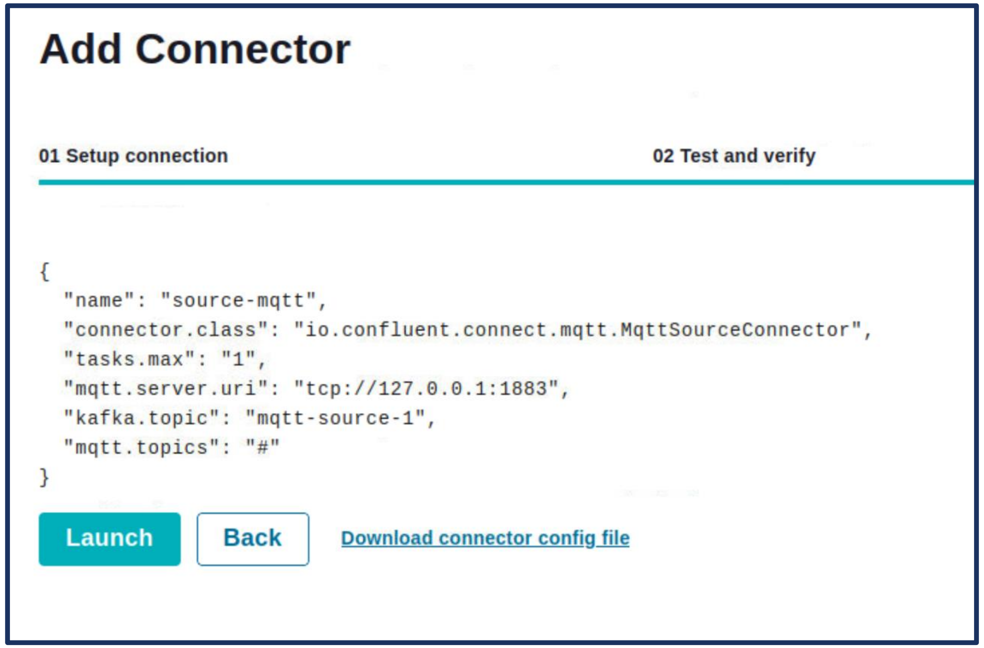
- Browse http://localhost:9021/clusters and select your *cluster*
- Add kafka *topic*



TECHNICAL IMPLEMENTATION

Once all services are [UP] we can procede:

- Browse http://localhost:9021/clusters and select your *cluster*
- Add kafka *topic*
- Add *MQTT Source connector* and set appropriate configurations



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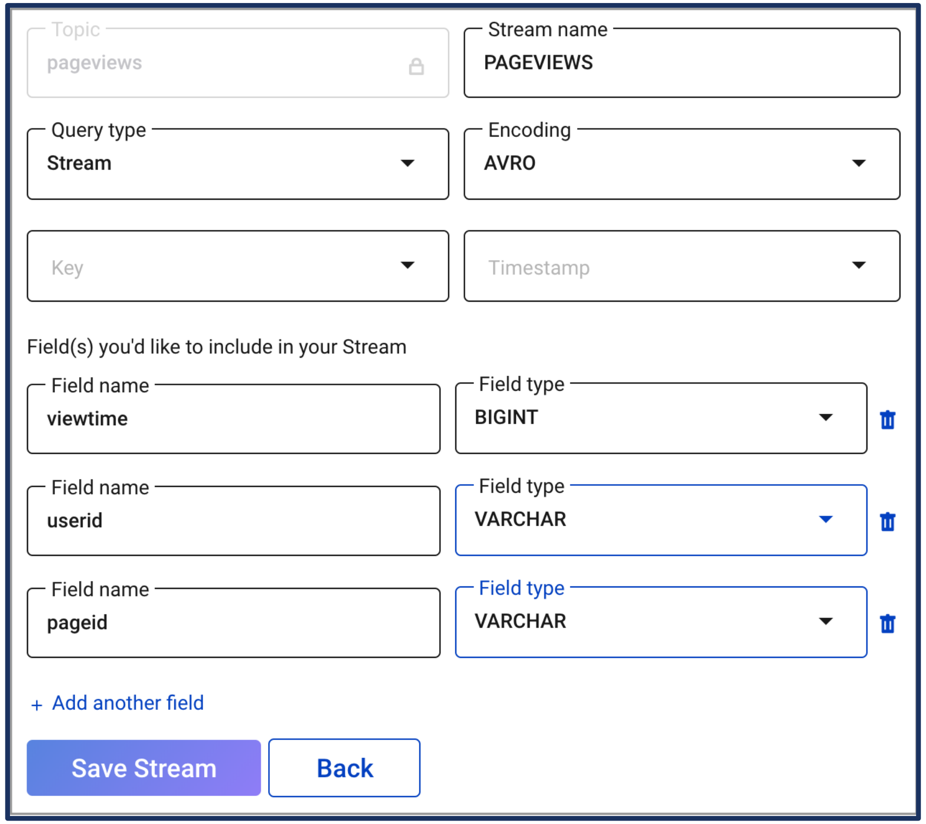
- Create KSQL *Streams* and *Tables*



TECHNICAL IMPLEMENTATION

Once all services are [UP] we can procede:

- Browse http://localhost:9021/clusters and select your *cluster*
- Add kafka *topic*
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- Create KSQL *Streams* and *Tables*
- Write *queries* in KSQL EDITOR page and run them:
    1. Non-persistent query: `SELECT column FROM stream EMIT CHANGES;`
    2. Persistent query: `CREATE STREAM name AS SELECT column FROM stream WHERE column=‘FAMALE’;`

TECHNICAL IMPLEMENTATION

Once all services are [UP] we can procede:

- Browse http://localhost:9021/clusters and select your *cluster*
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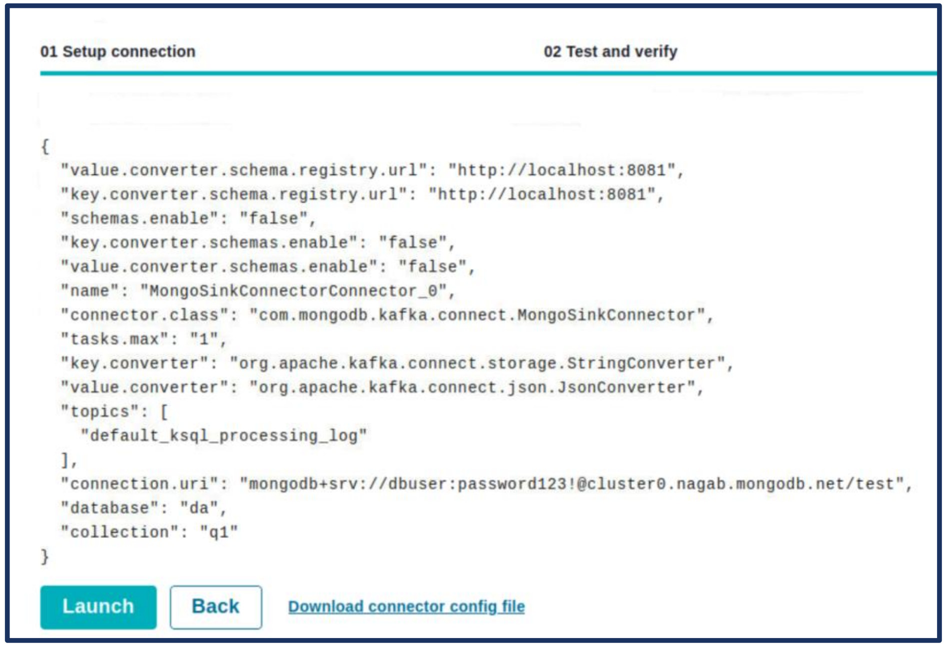
  1. Non-persistent query: `SELECT column FROM stream EMIT CHANGES;`
  2. Persistent query: `CREATE STREAM name AS SELECT column FROM stream WHERE column=‘FAMALE’;`
- Add *MongoDB Sink connector* and set appropriate configurations to save data into database



SIMULATOR DATA FORMAT

It is the data format for each sensor.

```
{
"t": timestamp in secondi
"tz": timestamp in HHMMDDtHHMMSS
"uuid": identificativo univoco del messaggio
"cuid":
"ref": "jzp://edv#0503.0000" identificativo fisico del device
"type": "presence" tipo di messaggio del sensore
"cat": "0610"
"sn": "integer(0, 255)",
"m": [
 {
  "t": "nowTimestamp()",
  "tz": "now()",
  "k": "device_temperature" tipo di misura: temperatura del device
  "v": "double(0, 40)", valore della misura
  "u": "C" unità di misura
 },
```

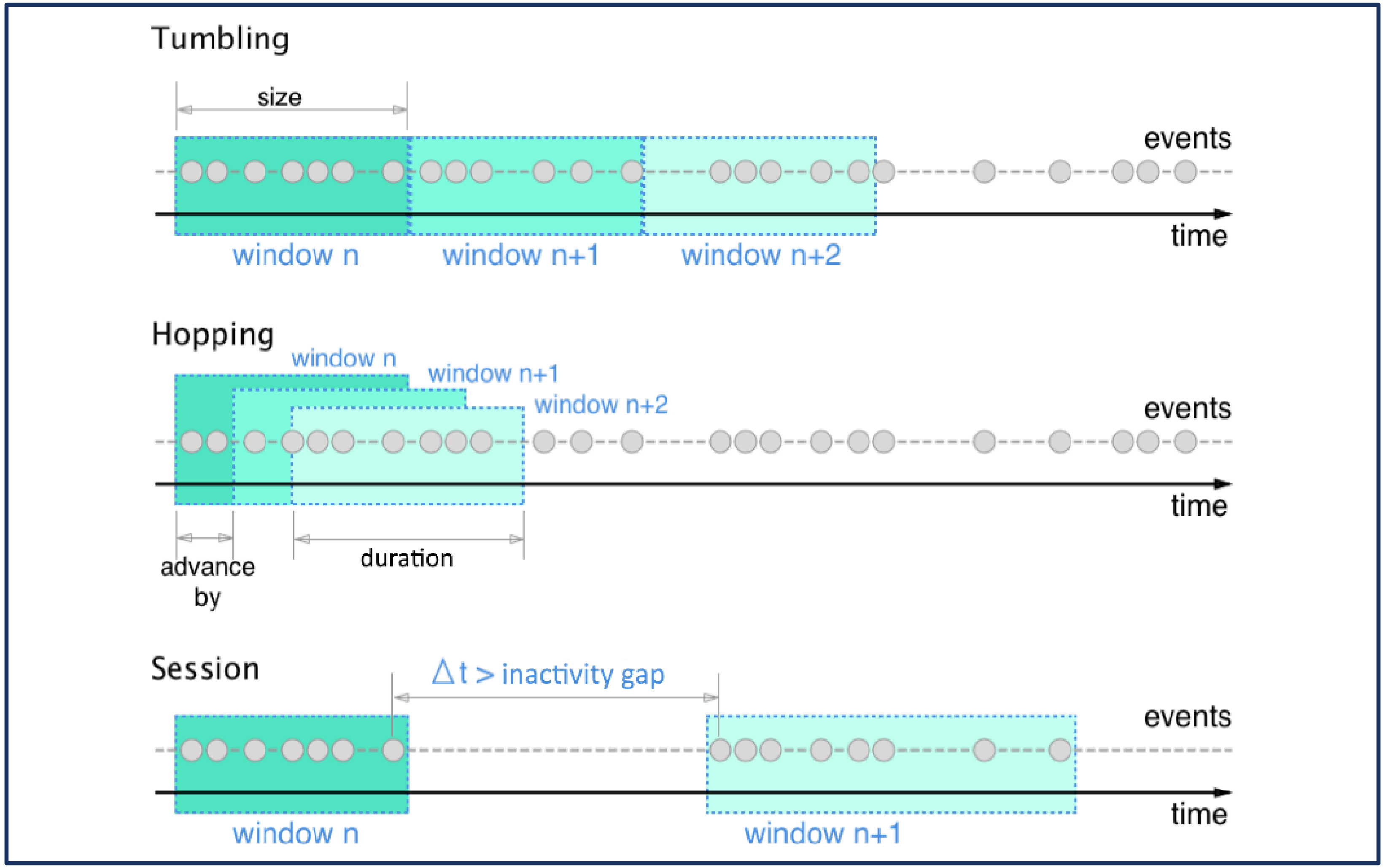
QUERIES

- [BASE]

```
CREATE STREAM base_stream (ref varchar KEY, type varchar, m array<struct<k varchar, v double>>)
WITH (kafka_topic='mqtt', value_format='JSON_SR');

CREATE STREAM exploded_base AS
SELECT ref, type, EXPLODE(m)->k AS name, EXPLODE(m)->v AS value
FROM base_stream
EMIT CHANGES;
```

WINDOW TIME



Tumbling
size
events
time
window n
window n+1
window n+2
Hopping
window n
window n+1
window n+2
events
time
advance by
duration
Session
Δt > inactivity gap
events
time
window n
window n+1

QUERIES

- [QUESTION A] – numero messaggi letti in una finestra temporale

```
CREATE TABLE questiona WITH (value_format='JSON') AS
SELECT 1, TIMESTAMPTOSTRING(WINDOWSTART,'yyyy-MM-dd HH:mm:ss','Europe/London') AS start_ts,
count(*) AS count
FROM base_stream WINDOW TUMBLING (SIZE 60 SECONDS)
GROUP BY 1
EMIT CHANGES;
```

QUERIES

- [QUESTION B] – numero messaggi letti e categorizzati per tipologia di device (type) in una finestra temporale

```
CREATE TABLE questionb WITH (value_format='JSON') AS
SELECT type, TIMESTAMPTOSTRING(WINDOWSTART,'yyyy-MM-dd HH:mm:ss','Europe/London') AS start_ts,
count(*) AS count
FROM base_stream WINDOW TUMBLING (SIZE 60 SECONDS)
GROUP BY type
EMIT CHANGES;
```

QUERIES

- [QUESTION C] – numero messaggi letti e categorizzati per ID di device (ref) in una finestra temporale

  CREATE TABLE questionc WITH (value_format='JSON') AS
  SELECT ref, TIMESTAMPTOSTRING(WINDOWSTART,'yyyy-MM-dd HH:mm:ss','Europe/London') AS start_ts, count(*) AS count
  FROM base_stream WINDOW TUMBLING (SIZE 60 SECONDS)
  GROUP BY ref
  EMIT CHANGES;

QUERIES

- [QUESTION D] – calcolo min, max, avg per ciascuna misura in una finestra di messaggi (vedi i campi k e v negli array ‘m’ del json)

```
CREATE TABLE questiond WITH (value_format='JSON') AS
SELECT ref, name, MIN(value) AS min, MAX(value) AS max, AVG(value) AS average
FROM exploded_base WINDOW TUMBLING (SIZE 5 MINUTES)
WHERE value > 0
GROUP BY ref, name
EMIT CHANGES;
```

QUERIES

- [QUESTION E] – generare un evento alla lettura di una specifica misura di un sensore con valore x (ad esempio se il pir riporta 1 nel campo presence.. didi struttura della m)

```
CREATE STREAM questione WITH (value_format='JSON') AS
SELECT ref, name, value
FROM exploded_base
WHERE name='device_temperature' AND value > 35;
```

QUERIES

- [QUESTION F] – generare un evento se una specifica misura di un sensore ha superato un valore x (ad esempio, se nella finestra ho registrato almeno 5 presenza del sensore pir...)

```
CREATE TABLE questionf WITH (value_format='JSON') AS
SELECT ref, name, value, count(*) AS count
FROM exploded_base WINDOW TUMBLING (SIZE 60 SECONDS)
WHERE name='device_temperature' AND value > 35
GROUP BY ref, name, value
HAVING count(*) > 5;
```

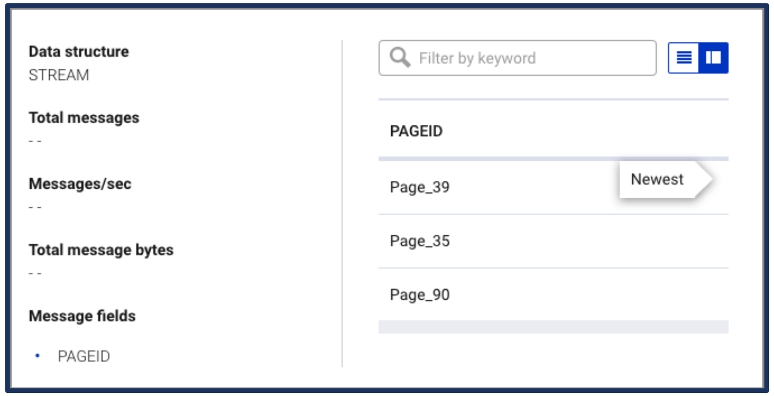
QUERIES

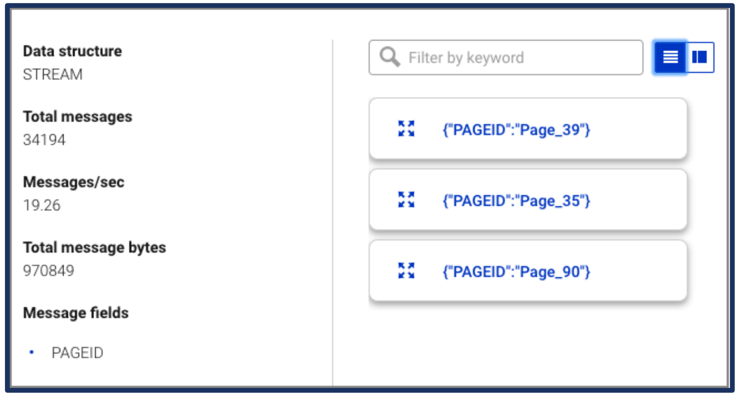
- [QUESTION G] – generare un evento se una specifica misura di un sensore ha superato un valore Y ed un altro sensore ha come media un valore Y nella stessa finestra (ad esempio, se nella finestra ho registrato almeno 5 presenza del sensore pir ed il valore di lux è mediamente K - lo date come predefinito all'avvio del job.....)

  ```
  CREATE TABLE questiong WITH (value_format='JSON') AS
  SELECT ref, avg(value) AS average
  FROM exploded_base WINDOW TUMBLING (SIZE 60 SECONDS)
  WHERE name='device_temperature‘
  GROUP BY ref
  HAVING (count(*) > 2 AND avg(value) > 25)
  EMIT CHANGES;
  ```

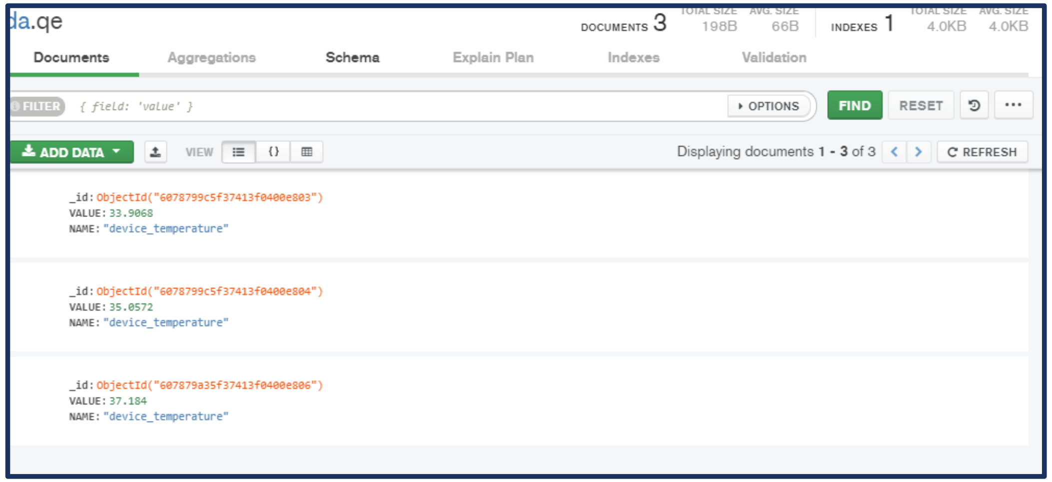
ACHIEVED RESULTS

We observed in *Confluent Platform Editor page* that all the queries produced the expected results (in two views).





The results obtained are made persistent thanks to the saving action in *MongoDB*.



Repo: https://github.com/LuciaPasseri/Kafka

FUTURE WORKS

- Work with data provided by the *Filippetti sensors* (in this project we worked with the Simulator)
- Realization of new *queries* to obtain other different results
- Use *ElasticSearch* as Sink connector to save the data

THANKS FOR THE ATTENTION!