

Assignment 9.3

By Kurt Stoneburner

```
In [1]: 1 import os
2 import shutil
3 import json
4 from pathlib import Path
5
6 import pandas as pd
7
8 from kafka import KafkaProducer, KafkaAdminClient
9 from kafka.admin.new_topic import NewTopic
10 from kafka.errors import TopicAlreadyExistsError
11
12 from pyspark.sql import SparkSession
13 from pyspark.streaming import StreamingContext
14 from pyspark import SparkConf
15 from pyspark.sql.functions import window, from_json, col, expr, to_js
16 from pyspark.sql.types import StringType, TimestampType, DoubleType,
17 from pyspark.sql.functions import udf
18
19 current_dir = Path(os.getcwd()).absolute()
20 checkpoint_dir = current_dir.joinpath('checkpoints')
21 joined_checkpoint_dir = checkpoint_dir.joinpath('joined')
22 locations_checkpoint_dir = checkpoint_dir.joinpath('locations')
23 accelerations_checkpoint_dir = checkpoint_dir.joinpath('accelerations')
24
25 if joined_checkpoint_dir.exists():
26     shutil.rmtree(joined_checkpoint_dir)
27
28
```

Configuration Parameters

TODO: Change the configuration parameters to the appropriate values for your setup.

```
In [4]: 1 config = dict(
2     bootstrap_servers=['kafka.kafka.svc.cluster.local:9092'],
3     first_name='Kurt',
4     last_name='Stoneburner'
5 )
6
7 config['client_id'] = '{}{}'.format(
8     config['last_name'],
9     config['first_name']
10 )
11 config['topic_prefix'] = '{}{}'.format(
```

```

12     config['last_name'],
13     config['first_name']
14 )
15
16 config['locations_topic'] = '{}-locations'.format(config['topic_prefix'])
17 config['accelerations_topic'] = '{}-accelerations'.format(config['topic_prefix'])
18 config['joined_topic'] = '{}-joined'.format(config['topic_prefix'])
19

```

```

Out[4]: {'bootstrap_servers': ['kafka.kafka.svc.cluster.local:9092'],
        'first_name': 'Kurt',
        'last_name': 'Stoneburner',
        'client_id': 'StoneburnerKurt',
        'topic_prefix': 'StoneburnerKurt',
        'locations_topic': 'StoneburnerKurt-locations',
        'accelerations_topic': 'StoneburnerKurt-accelerations',
        'joined_topic': 'StoneburnerKurt-joined'}

```

Create Topic Utility Function

The `create_kafka_topic` helps create a Kafka topic based on your configuration settings.

For instance, if your first name is *John* and your last name is *Doe*,

`create_kafka_topic('locations')` will create a topic with the name `DoeJohn-locations`. The function will not create the topic if it already exists.

```

In [5]: 1 def create_kafka_topic(topic_name, config=config, num_partitions=1, replication_factor=1):
        2     bootstrap_servers = config['bootstrap_servers']
        3     client_id = config['client_id']
        4     topic_prefix = config['topic_prefix']
        5     name = '{}-{}'.format(topic_prefix, topic_name)
        6
        7     admin_client = KafkaAdminClient(
        8         bootstrap_servers=bootstrap_servers,
        9         client_id=client_id
10     )
11
12     topic = NewTopic(
13         name=name,
14         num_partitions=num_partitions,
15         replication_factor=replication_factor
16     )
17
18     topic_list = [topic]
19     try:
20         admin_client.create_topics(new_topics=topic_list)
21         print('Created topic "{}".format(name))
22     except TopicAlreadyExistsError as e:
23         print('Topic "{}" already exists'.format(name))
24

```

```
Topic "StoneburnerKurt-joined" already exists
```

TODO: This code is identical to the code used in 9.1 to publish acceleration and location data to

the `LastNameFirstname-simple` topic. You will need to add in the code you used to create the `df_accelerations` dataframe. In order to read data from this topic, make sure that you are running the notebook you created in assignment 8 that publishes acceleration and location data to the `LastNameFirstname-simple` topic.

```
In [6]: 1 spark = SparkSession\
2         .builder\
3         .appName("Assignment09")\
4         .getOrCreate()
5
6 df_locations = spark \
7     .readStream \
8     .format("kafka") \
9     .option("kafka.bootstrap.servers", "kafka.kafka.svc.cluster.local:9
10    .option("subscribe", config['locations_topic']) \
11    .load()
12
13 ## TODO: Add code to create the df_accelerations dataframe
14 df_accelerations = spark \
15     .readStream \
16     .format("kafka") \
17     .option("kafka.bootstrap.servers", "kafka.kafka.svc.cluster.local:9
18     .option("subscribe", config['accelerations_topic']) \
19     .load()
20
```

The following code defines a Spark schema for location and acceleration data as well as a user-defined function (UDF) for parsing the location and acceleration JSON data.

```
In [7]: 1 location_schema = StructType([
2         StructField('offset', DoubleType(), nullable=True),
3         StructField('id', StringType(), nullable=True),
4         StructField('ride_id', StringType(), nullable=True),
5         StructField('uuid', StringType(), nullable=True),
6         StructField('course', DoubleType(), nullable=True),
7         StructField('latitude', DoubleType(), nullable=True),
8         StructField('longitude', DoubleType(), nullable=True),
9         StructField('geohash', StringType(), nullable=True),
10        StructField('speed', DoubleType(), nullable=True),
11        StructField('accuracy', DoubleType(), nullable=True),
12    ])
13
14 acceleration_schema = StructType([
15     StructField('offset', DoubleType(), nullable=True),
16     StructField('id', StringType(), nullable=True),
17     StructField('ride_id', StringType(), nullable=True),
18     StructField('uuid', StringType(), nullable=True),
19     StructField('x', DoubleType(), nullable=True),
20     StructField('y', DoubleType(), nullable=True),
21     StructField('z', DoubleType(), nullable=True),
22 ])
23
24 udf_parse_acceleration = udf(lambda x: json.loads(x.decode('utf-8')),
25 udf_parse_location = udf(lambda x: json.loads(x.decode('utf-8')), loc
```

TODO:

- Complete the code to create the `accelerationsWithWatermark` dataframe.
 - Select the `timestamp` field with the alias `acceleration_timestamp`
 - Use the `udf_parse_acceleration` UDF to parse the JSON values
 - Select the `ride_id` as `acceleration_ride_id`
 - Select the `x`, `y`, and `z` columns
 - Use the same watermark timespan used in the `locationsWithWatermark` dataframe

```
In [8]: 1 locationsWithWatermark = df_locations \
2       .select(
3         col('timestamp').alias('location_timestamp'),
4         udf_parse_location(df_locations['value']).alias('json_value')
5       ) \
6       .select(
7         col('location_timestamp'),
8         col('json_value.ride_id').alias('location_ride_id'),
9         col('json_value.speed').alias('speed'),
10        col('json_value.latitude').alias('latitude'),
11        col('json_value.longitude').alias('longitude'),
12        col('json_value.geohash').alias('geohash'),
13        col('json_value.accuracy').alias('accuracy')
14      ) \
15      .withWatermark('location_timestamp', "2 seconds")
16
17
```

```
In [14]: 1
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```
In [10]: 1 accelerationsWithWatermark = df_accelerations \
2       .select(
3         col('timestamp').alias('accelerations_timestamp'),
4         udf_parse_acceleration(df_accelerations['value']).alias('json_val
5       ) \
6       .select(
7         col('accelerations_timestamp'),
8         col('json_value.ride_id').alias('acceleration_ride_id'),
9         col('json_value.x').alias('x'),
10        col('json_value.y').alias('y'),
11        col('json_value.z').alias('z'),
12      ) \
13      .withWatermark('accelerations_timestamp', "2 seconds")
14 accelerationsWithWatermark.printSchema()
```

```

root
|-- accelerations_timestamp: timestamp (nullable = true)
|-- acceleration_ride_id: string (nullable = true)
|-- x: double (nullable = true)
|-- y: double (nullable = true)

```

TODO:

- Complete the code to create the `df_joined` dataframe. See <http://spark.apache.org/docs/latest/structured-streaming-programming-guide.html#stream-stream-joins> (<http://spark.apache.org/docs/latest/structured-streaming-programming-guide.html#stream-stream-joins>) for additional information.

```

In [11]: 1 df_joined = ''
          2 df_joined = locationsWithWatermark \
          3 .join(accelerationsWithWatermark,
          4         expr("""
          5             location_ride_id = acceleration_ride_id
          6             """)
          7         )) \
          8 .select(
          9     col('location_ride_id').alias('ride_id'),
         10     col('location_timestamp'),
         11     col('speed'),
         12     col('latitude'),
         13     col('longitude'),
         14     col('geohash'),
         15     col('accuracy'),
         16     col('accelerations_timestamp'),
         17     col('x'),
         18     col('y'),
         19     col('z'),
         20
         21 )
         22
         23
         24

```

```

root
|-- ride_id: string (nullable = true)
|-- location_timestamp: timestamp (nullable = true)
|-- speed: double (nullable = true)
|-- latitude: double (nullable = true)
|-- longitude: double (nullable = true)
|-- geohash: string (nullable = true)
|-- accuracy: double (nullable = true)
|-- accelerations_timestamp: timestamp (nullable = true)
|-- x: double (nullable = true)
|-- y: double (nullable = true)
|-- z: double (nullable = true)

```

```

In [12]: 1 #df_joined = locationsWithWatermark \
          2 #.join(accelerationsWithWatermark)

```

If you correctly created the `df_joined` dataframe, you should be able to use the following code to create a streaming query that outputs results to the `LastnameFirstname-joined` topic.

```
In [13]: 1 ds_joined = df_joined \
2         .withColumn(
3           'value',
4           to_json(
5             struct(
6               'ride_id', 'location_timestamp', 'speed',
7               'latitude', 'longitude', 'geohash', 'accuracy',
8               'accelerations_timestamp', 'x', 'y', 'z'
9             )
10          )
11        ).withColumn(
12          'key', col('ride_id')
13        ) \
14        .selectExpr("CAST(key AS STRING)", "CAST(value AS STRING)") \
15        .writeStream \
16        .format("kafka") \
17        .option("kafka.bootstrap.servers", "kafka.kafka.svc.cluster.local:9
18        .option("topic", config['joined_topic']) \
19        .option("checkpointLocation", str(joined_checkpoint_dir)) \
20        .start()
21
22 try:
23     ds_joined.awaitTermination()
24 except KeyboardInterrupt:
25     print("CLOSING STREAMING QUERY")
```

```

-----
-----
StreamingQueryException                                Traceback (most recent call
last)
<ipython-input-13-493b02e2e50e> in <module>
    21
    22 try:
--> 23     ds_joined.awaitTermination()
    24 except KeyboardInterrupt:
    25     print("STOPPING STREAMING DATA")

/usr/local/spark/python/pyspark/sql/streaming.py in awaitTermination(s
elf, timeout)
    101         return self._jsq.awaitTermination(int(timeout * 10
00))
    102     else:
--> 103         return self._jsq.awaitTermination()
    104
    105     @property

/usr/local/spark/python/lib/py4j-0.10.9-src.zip/py4j/java_gateway.py i
n __call__(self, *args)
    1302
    1303         answer = self.gateway_client.send_command(command)
-> 1304         return_value = get_return_value(
    1305             answer, self.gateway_client, self.target_id, self.
name)
    1306

/usr/local/spark/python/pyspark/sql/utils.py in deco(*a, **kw)
    135         # Hide where the exception came from that show
s a non-Pythonic
    136         # JVM exception message.
--> 137         raise_from(converted)
    138     else:
    139         raise

/usr/local/spark/python/pyspark/sql/utils.py in raise_from(e)

StreamingQueryException: Writing job aborted.
=== Streaming Query ===
Identifier: [id = 46058cd5-ae85-417e-bebc-70a3138b6ea4, runId = d25b00
93-fa9f-40c3-8638-34efab131f8a]
Current Committed Offsets: {KafkaV2[Subscribe[StoneburnerKurt-location
s]]: {"StoneburnerKurt-locations":{"0":10705}},KafkaV2[Subscribe[Stone
burnerKurt-accelerations]]: {"StoneburnerKurt-accelerations":{"0":1060
2}}}
Current Available Offsets: {KafkaV2[Subscribe[StoneburnerKurt-location
s]]: {"StoneburnerKurt-locations":{"0":10706}},KafkaV2[Subscribe[Stone
burnerKurt-accelerations]]: {"StoneburnerKurt-accelerations":{"0":1060
2}}}

Current State: ACTIVE
Thread State: RUNNABLE

Logical Plan:

```

```
WriteToMicroBatchDataSource org.apache.spark.sql.kafka010.KafkaStreamingWrite@5f1eb19a
+- Project [cast(key#145 as string) AS key#159, cast(value#132 as string) AS value#160]
    +- Project [ride_id#120, location_timestamp#42-T2000ms, speed#48, latitude#49, longitude#50, geohash#51, accuracy#52, accelerations_timestamp#66-T2000ms, x#72, y#73, z#74, value#132, ride_id#120 AS key#145]
        +- Project [ride_id#120, location_timestamp#42-T2000ms, speed#48, latitude#49, longitude#50, geohash#51, accuracy#52, accelerations_timestamp#66-T2000ms, x#72, y#73, z#74, to_json(struct(ride_id, ride_id#120, location_timestamp, location_timestamp#42-T2000ms, speed, speed#48, latitude, latitude#49, longitude, longitude#50, geohash, geohash#51, accuracy, accuracy#52, accelerations_timestamp, accelerations_timestamp#66-T2000ms, x, x#72, y, y#73, z, z#74), Some(Etc/UTC)) AS value#132]
            +- Project [location_ride_id#47 AS ride_id#120, location_timestamp#42-T2000ms, speed#48, latitude#49, longitude#50, geohash#51, accuracy#52, accelerations_timestamp#66-T2000ms, x#72, y#73, z#74]
                +- Join Inner, (location_ride_id#47 = acceleration_ride_id#71)
```