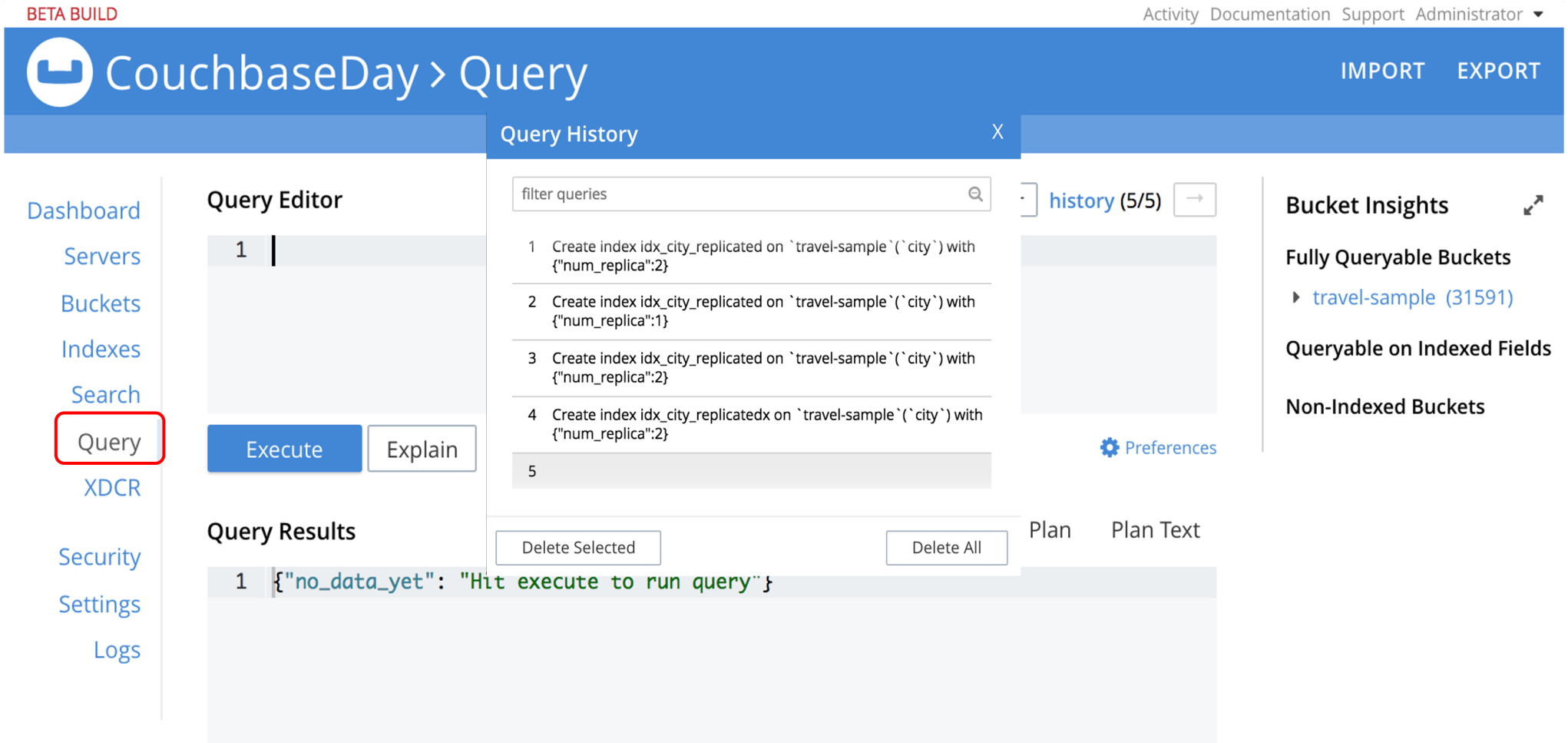
N1QL & FTS Lab

Lab Objectives

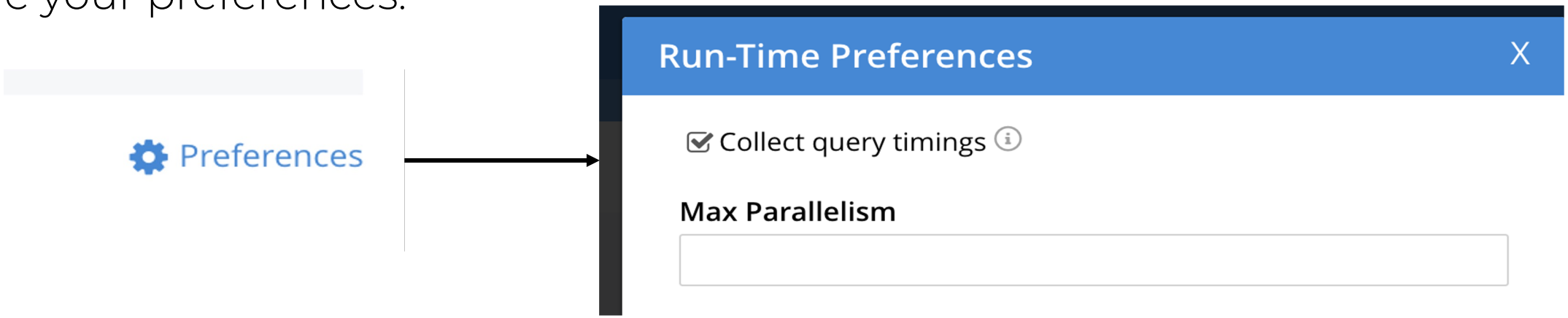
- Identify key parts of the query bench
- Query execution from the terminal
- Understand query performance and explain plans
- Review impact of indexes on query performance
- Exploring various N1QL SELECT features

Query Workbench



Exercise – Run-Time preferences

1. Open the Run-Time Preferences window, select “Collect Query Timings” and save your preferences.

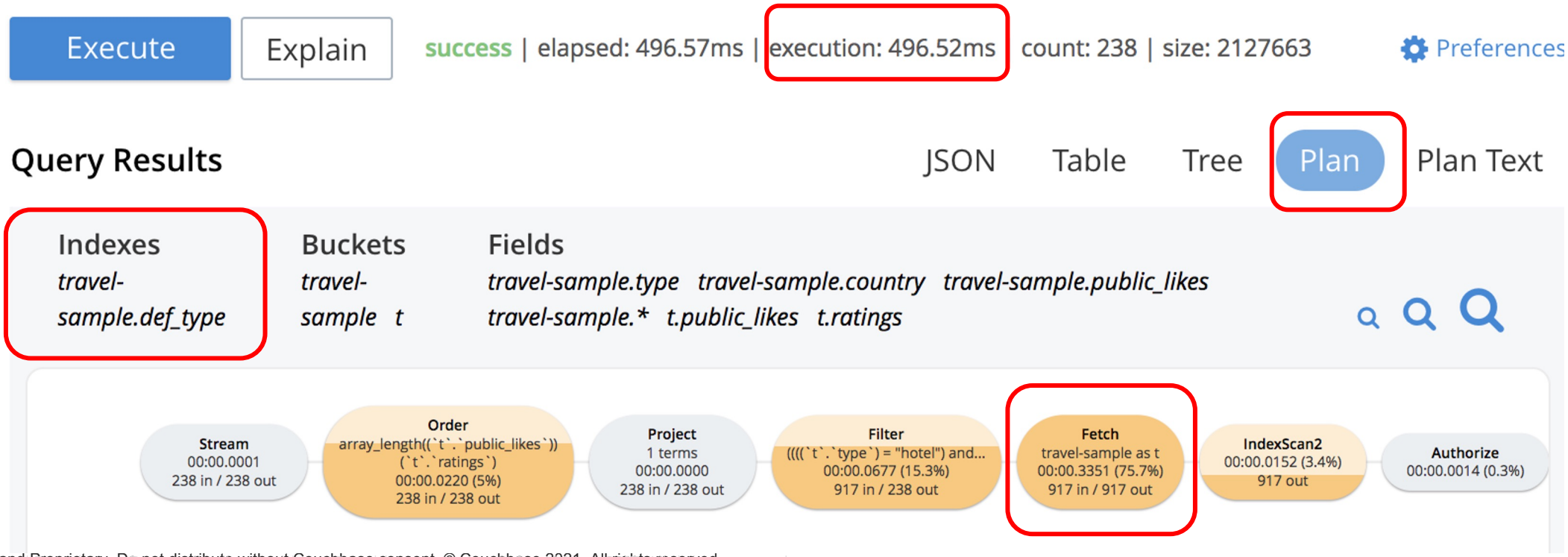


1. Open the query workbench and execute the following statement:

```
SELECT *
FROM `travel-sample` t
WHERE type = "hotel"
AND country = "United Kingdom"
AND ARRAY_LENGTH(public_likes) > 3
ORDER BY ARRAY_LENGTH(public_likes), ratings DESC
```

Exercise – Query visual plan

1. Navigate to visual query plan
2. What is the execution time ?
3. What indexes are used ?
4. Where does the query spend most of the time ?



N1QL – Simple SELECT

- Run a basic query

```
SELECT * FROM `travel-sample` WHERE name = 'Atifly'
```

- Find out what is the key of the returned object (use META().id)
- Write a query that returns the same object using `USE KEYS`
- Observe the difference in query execution time


```
[
    {
        "travel-sample": {
            "callsign": "atifly",
            "country": "United States",
            "iata": "A1",
            "icao": "A1F",
            "id": 10226,
            "name": "Atifly",
            "type": "airline"
        }
]
```

Impact of Indexes for Query Execution

- Try running the original query again:

```
SELECT * FROM `travel-sample` WHERE name = 'Atifly';

EXPLAIN SELECT * FROM `travel-sample` WHERE name = 'Atifly';
```

- Now, lets create an index on the name field:

```
CREATE INDEX idx_airline_name ON `travel-sample`(name);
```

- Now rerun the query:

```
SELECT * FROM `travel-sample` WHERE name = 'Atifly';

EXPLAIN SELECT * FROM `travel-sample` WHERE name = 'Atifly';
```

- Did the indexed field reduced the query time by an order of magnitude?

N1QL – JOIN

- Run a query with a JOIN

```
SELECT air.name, route.sourceairport,
       route.destinationairport
FROM `travel-sample` AS route
     JOIN `travel-sample` AS air
     ON KEYS route.airlineid
LIMIT 2;
```

- Optional: Try out changing to `LEFT JOIN`. Why may you get empty objects? Now try adding filter on `WHERE route.type = "route"`


```
[
    {
      "destinationairport": "ATL",
      "name": "Air France",
      "sourceairport": "XNA"
    },
    {
      "destinationairport": "CDG",
      "name": "Air France",
      "sourceairport": "VIE"
    }
]
```

N1QL - Children in the Tree

- Run a basic query with nested Arrays

```
SELECT *
FROM `travel-sample` AS route
WHERE ANY child IN route.schedule SATISFIES
child.flight = 'AF443' END LIMIT 2;
```

- Try to create the following array index and check how it improves query performance

```
CREATE INDEX idx_route_flights ON `travel-
sample` (DISTINCT ARRAY child.flight FOR
child IN schedule END);
```

- Optional: Modify the query to select routes that contain flights after 23:00:00 and create a suitable index


```
[
    {
      "route": {
        "airline": "AF",
        "airlineid": "airline_137",
        "destinationairport": "MRS",
        "distance": 2881.617376098415,
        "equipment": "320",
        "id": 10000,
        "schedule": [
          {
            "day": 0,
            "flight": "AF443",
            "utc": "20:59:00"
          },
        .....
```

N1QL Queries over the Terminal

- SSH into server running the query service (using PuTTY or Mac Terminal):
  - **`ssh root@192.168.61.101`**
  - **`couchbase123!`**
- Start the Couchbase query shell and try to run a query
  - **`/opt/couchbase/bin/cbq --user Administrator --password password`**
  - **`SELECT * FROM `travel-sample` WHERE name = 'Atifly';`**

N1QL Query Service Over REST

- The Query Service (port 8093) responds to GET requests
- Try this from a terminal:
  - `curl -v http://192.168.61.101:8093/query/service -d 'statement=SELECT name FROM system:keyspaces&creds=[{"user": "Administrator", "pass": "password"}]'`
- The Query service always returns timing statistics for how long it took to retrieve the information, and to send it to you.
- For a more detailed look at what the query service is doing try passing the same query, with “explain”:
  - `curl -v http://192.168.61.101:8093/query/service -d 'statement=EXPLAIN SELECT name FROM system:keyspaces&creds=[{"user": "Administrator", "pass": "password"}]'`

Index Optimization

Lab Objectives

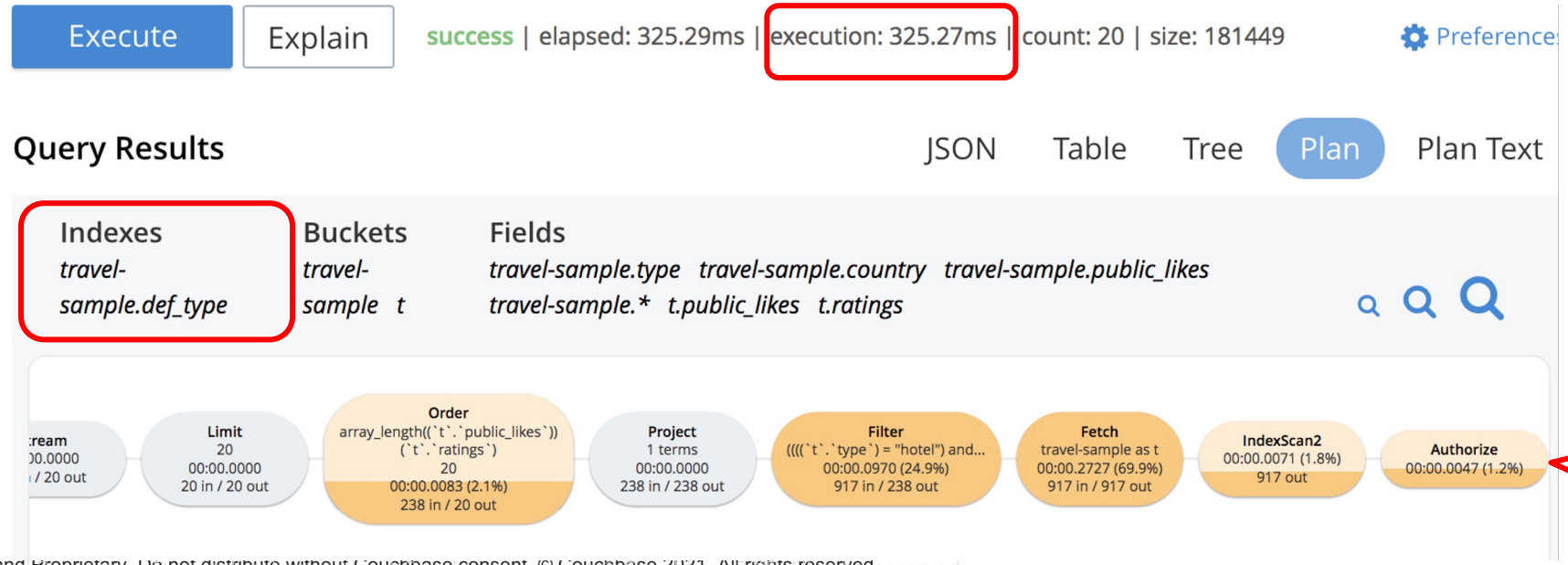
- Exploring different types of indexes – composite, partial and covering – and their effect on performance
- Observe pagination pushdown into index

Initial Query Performance

Open the query workbench and execute the following statement:

```
SELECT * FROM `travel-sample` t
WHERE type = "hotel" AND country = "United Kingdom" AND ARRAY_LENGTH(public_likes) > 3
ORDER BY ARRAY_LENGTH(public_likes), ratings DESC
OFFSET 0
LIMIT 20;
```

What is the execution time? What indexes are used?



The index returns 917 results before the filtering

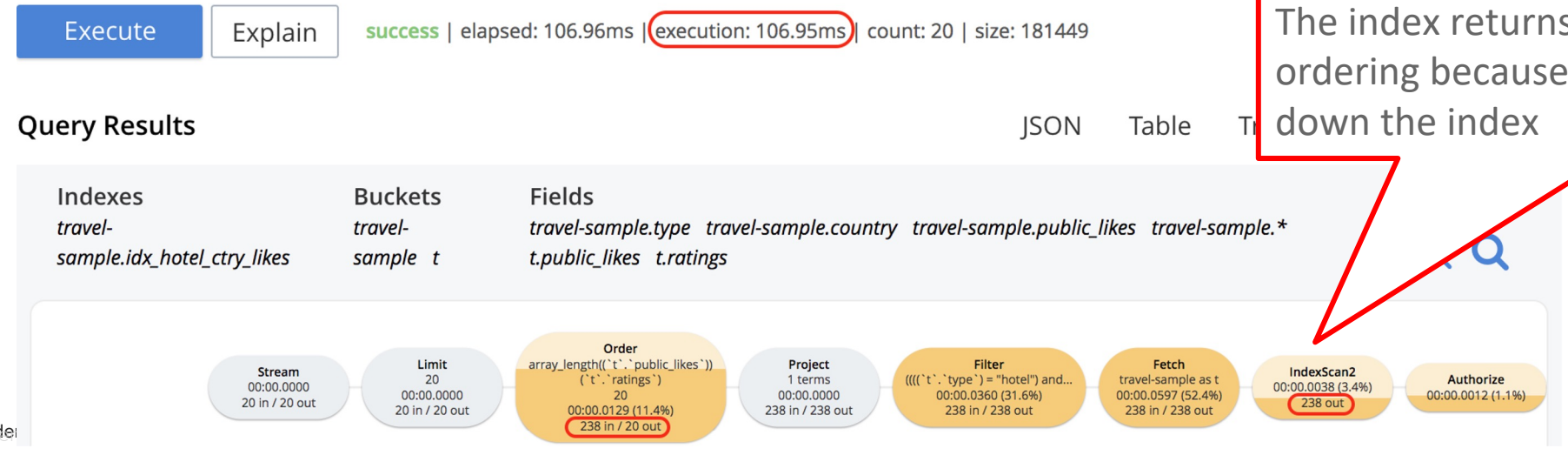
Using a More Suitable Composite Index

Open the query workbench and execute the following statements (one at a time)

```
CREATE INDEX idx_hotel_ctry_likes
ON `travel-sample`(country, ARRAY_LENGTH(public_likes))
WHERE type = "hotel";

SELECT * FROM `travel-sample` t WHERE type = "hotel" AND country = "United Kingdom" AND
ARRAY_LENGTH(public_likes) > 3
ORDER BY ARRAY_LENGTH(public_likes), ratings DESC
OFFSET 0
LIMIT 20;
```

Why is the execution time better? Can it be improved?



The index returns 238 results before the ordering because the DESC order is not pushed down the index

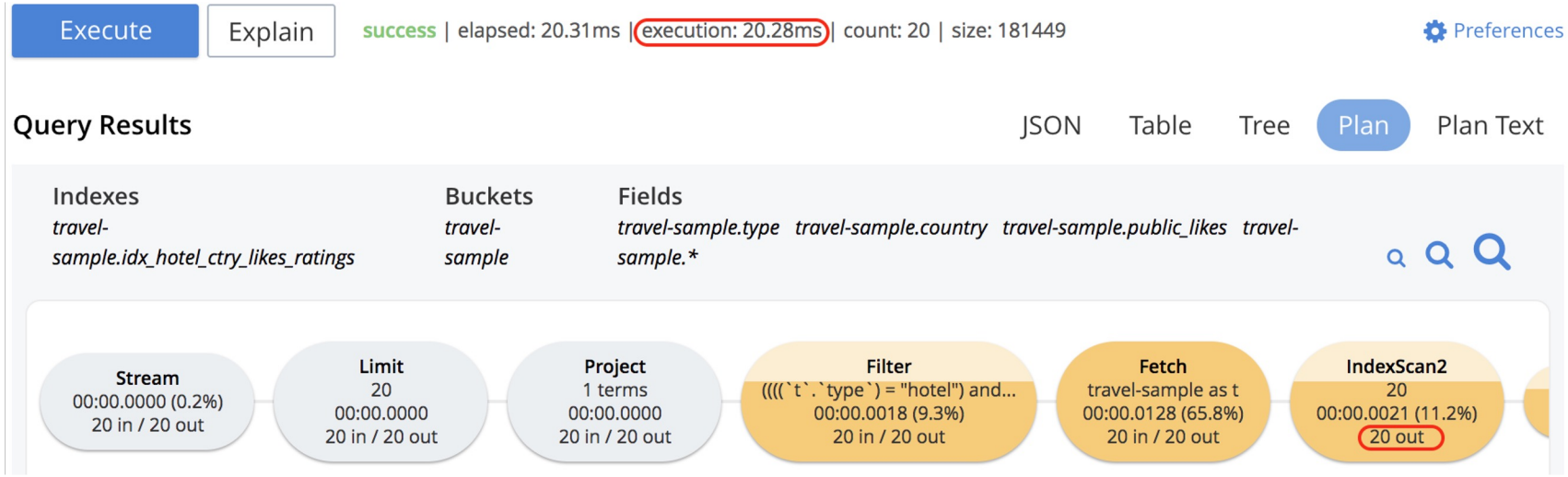
Using a Partial Index

Open the query workbench and execute the following statement (one at a time):

```
DROP INDEX `travel-sample`.idx_hotel_ctry_likes;

CREATE INDEX idx_hotel_ctry_likes_ratings
ON `travel-sample`(country, ARRAY_LENGTH(public_likes), ratings DESC)
WHERE type = "hotel";
```

Rerun the previous query again. Why is the query execution time better?




```
"#operator": "IndexScan2",
"#stats": {...},
"index": "idx_hotel_ctry_likes_ratings",
"index_id": "1e1bb81a3f2e21c8",
"index_projection": {
  "primary_key": true
},
"keyspace": "travel-sample",
"limit": "20",
```

Limit has been pushed down the index.

Offset & Limit Push Down to Index Scan

Rerun the previous query with different offsets (40, 100, 200) and compare the results.

```
1  SELECT * FROM `travel-sample` t WHERE type = "hotel" AND country = "United Kingdom"
2  AND ARRAY_LENGTH(public_likes) > 3
3  ORDER BY ARRAY_LENGTH(public_likes), ratings DESC
4  OFFSET 100
5  LIMIT 20;
```

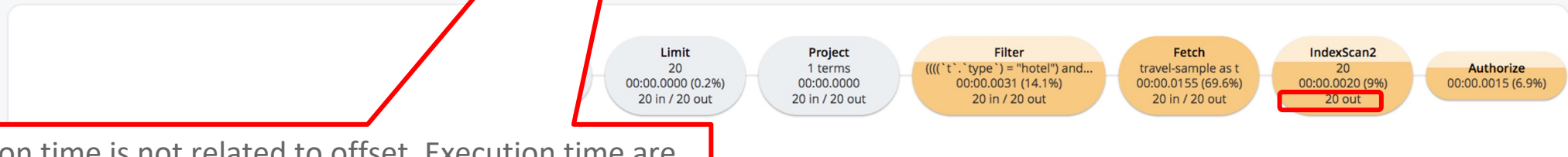
Execute | Explain | success | elapsed: 23.57ms | execution: 23.55ms | count: 20 | size: 178376 | Preferences

Query Results | JSON | Table | Tree | Plan | Plan Text

Indexes: *travel-sample.idx_hotel_ctry_likes_ratings*

Buckets: *travel-sample*

Fields: *travel-sample.type travel-sample.country travel-sample.public_likes travel-sample.**



Execution time is not related to offset. Execution time are the same (offset=0 or offset=100) and independent from the offset value because the offset has been pushed down.

Using a Covering Index

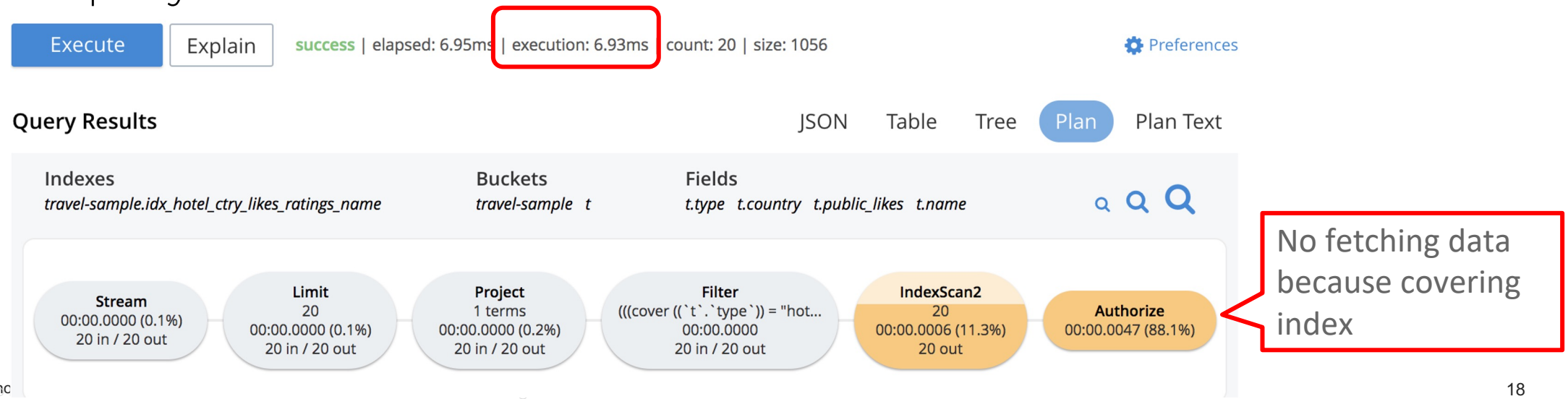
Execute the following statements (one at a time)

```
DROP INDEX `travel-sample`.idx_hotel_ctry_likes_ratings;

CREATE INDEX `idx_hotel_ctry_likes_ratings_name`
ON `travel-sample`(`country`,array_length(`public_likes`),`ratings` DESC, name)
WHERE (`type` = "hotel");

SELECT name FROM `travel-sample` t WHERE type = "hotel" AND country = "United Kingdom"
AND ARRAY_LENGTH(public_likes) > 3
ORDER BY ARRAY_LENGTH(public_likes), ratings DESC
OFFSET 0 LIMIT 20;
```

Why is the query so much faster now?

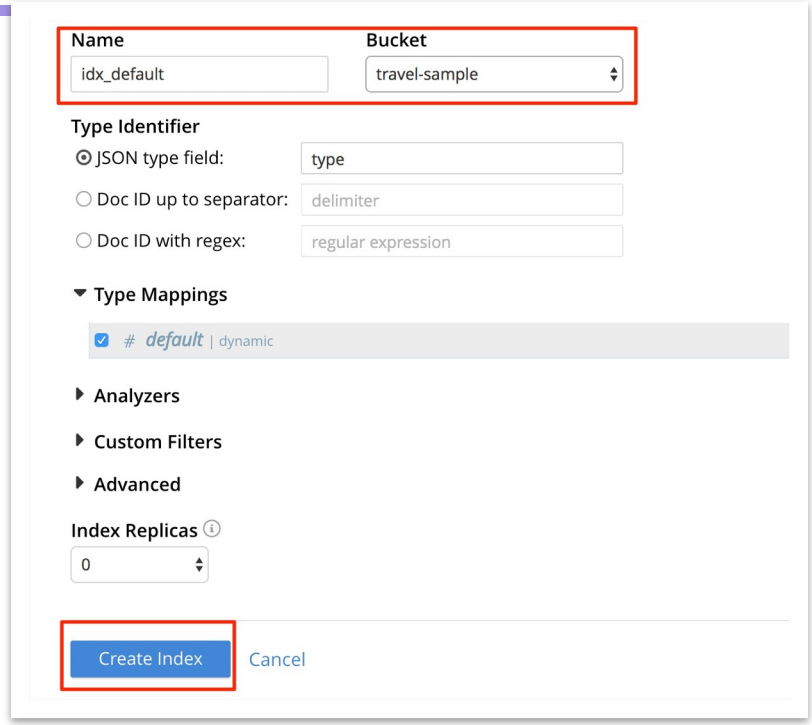


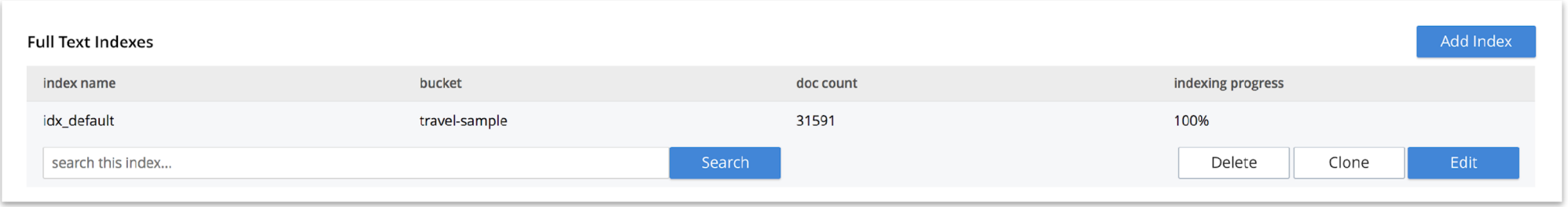
FTS Basics

FTS: Create a default Index

Let's build the default Index on `travel-sample` bucket.

- Build a new default Index
  - Give index name "idx_default"
  - Select bucket "travel-sample"
  - Create Index
- Observe time to create default index. (~60s)
- Check the size on disk of the default index. (~ 915Mb)
- Search default index & review search results

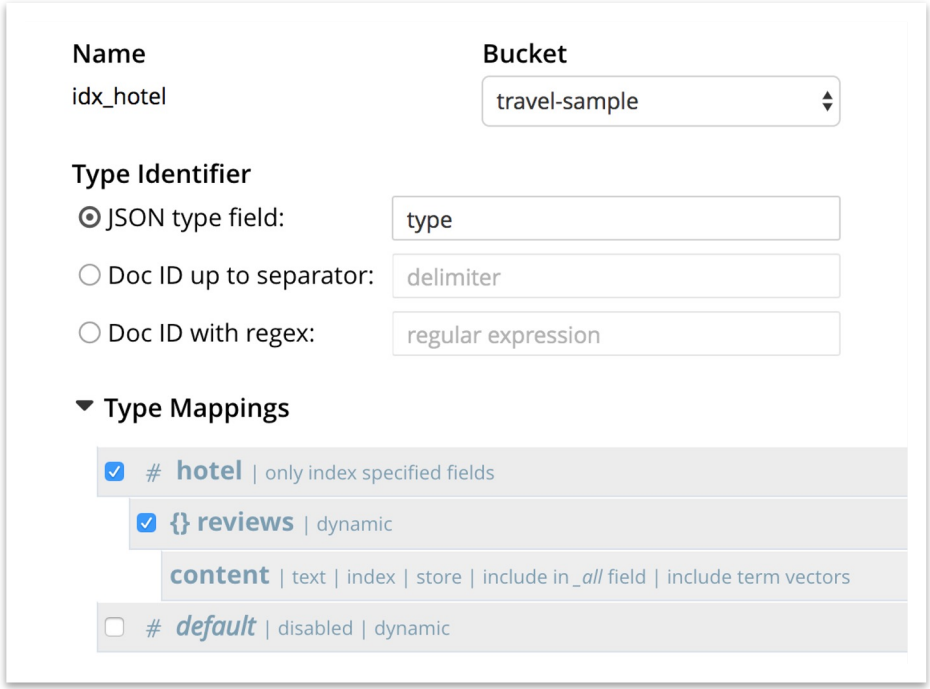




Note: Default index are not recommended in a production environment

FTS: Create a custom Index on type = hotel

Let's build a new Index on `travel-sample` bucket.



- Build a new Index
  - Give index name "idx_hotel"
  - Select bucket "travel-sample"
  - Add a Type mapping = hotel (only index specified fields)
  - Disable the default mapping.
  - Add a child mapping on reviews (array)
  - Add a field mapping on content
    (only index specified fields and store)
- Observe time to create default index. (~5s)
- Check the size on disk of the default index. (~ 79Mb)
- Search "friendly" in the UI with the hotel index & review search results

Bonus: Run the same search with the REST API. (you can find the curl command in the UI)