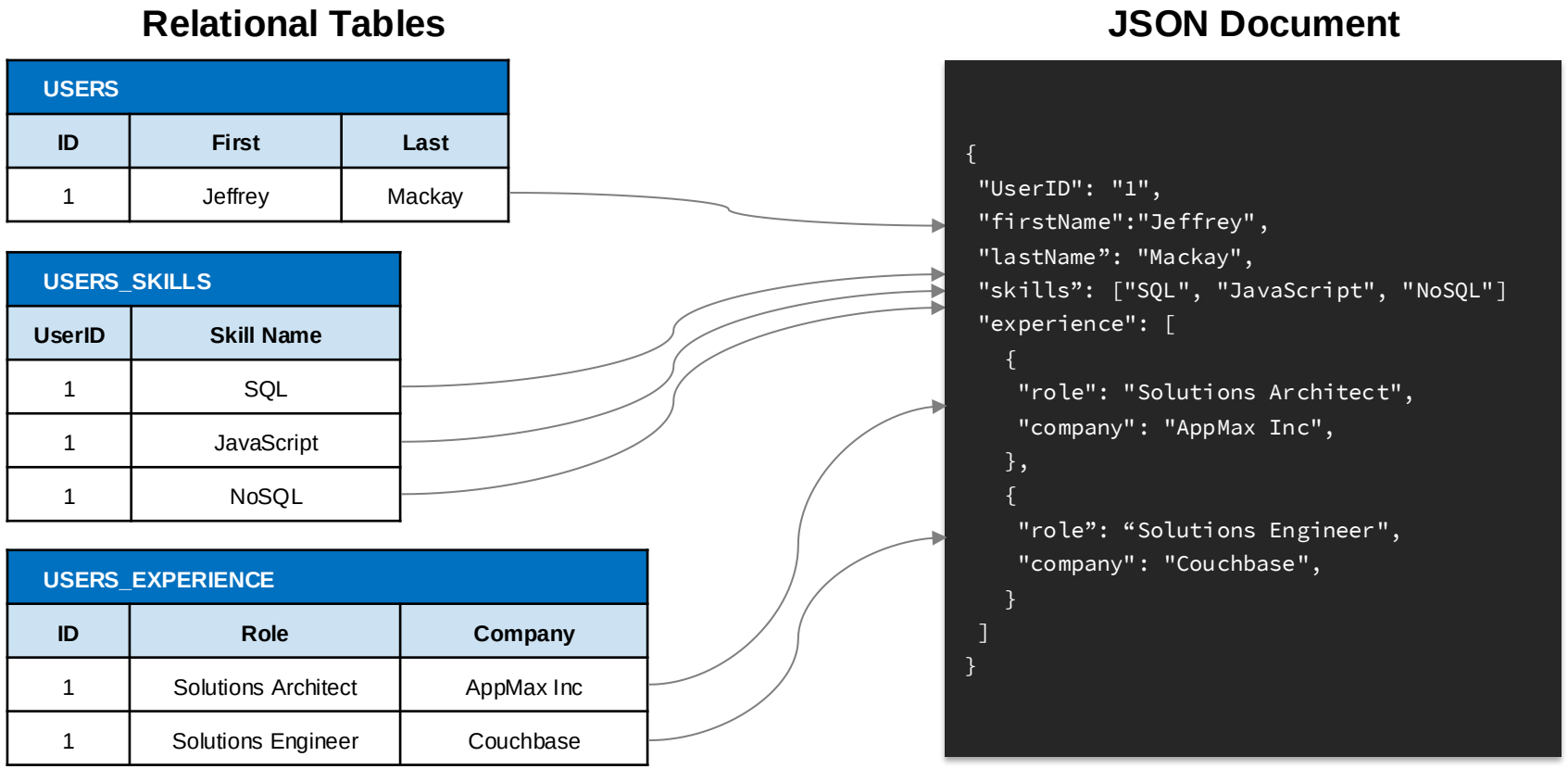
Couchbase

# 2교시.
# Data/Query/Index 서비스 소개 및 실습

1 UI 설명 및 Data 서비스 소개
2 Query/Index 서비스 소개
3 실습
A JSON 데이터 모델

# 2-1.
# UI 설명 및 Data 서비스 소개

# **Flexibility of JSON** | Relaxed Normalization




- Rigid Schema, Fixed length columns
- Normalization means a lot of costly joins

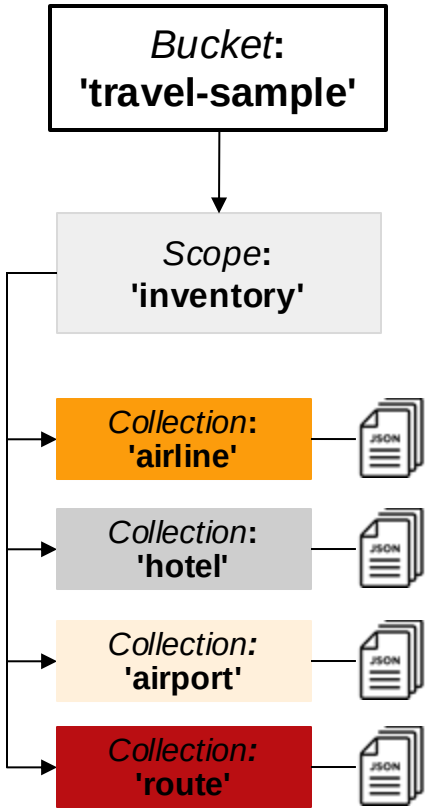
- Document format aligns to application needs
- Less joins than RDBMS, improving performance

# **Flexibility of JSON** | Simple mapping from RDBMS to Couchbase

| Relational | Couchbase |
|---|---|
| Server | Cluster |
| Database | Bucket |
| Schema | Scope |
| Table | Collection |
| Row | Document |

- Distributed highly available and scalable data platform
- Buckets are similar to a relational database
- Scopes define namespaces
- Collections are tables with flexible schemas
- JSON Documents provide a flexible way to store data

# **Flexibility of JSON** | Travel Sample Example




*Collection*: **'airline'**

Document Key

airline_24

```
{
  "id": 24,
  "type": "airline",
  "name": "American Airlines",
  "iata": "AA",
  "icao": "AAL",
  "callsign": "AMERICAN",
  "country": "United States"
}
```

*Collection*: **'route'**

route_5966

```
{
  "id": "5966",
  "type": "route",
  "airline": "AA",
  "airlineid": "airline_24",
  "sourceairport": "MCO",
  "destinationairport": "SEA",
  "stops": "0",
  "equipment": "737",
  "schedule": [
      {"day": 1, "utc": "13:25:00", "flight": "AA788"},
      {"day": 4, "utc": "13:25:00", "flight": "AA419"},
      {"day": 5, "utc": "13:25:00", "flight": "AA519"}
  ]
}
```

Array

*Collection*: **'airport'**

airport_357

```
{
  "id": 3577,
  "type": "airport",
  "airportname": "Seattle Tacoma Intl",
  "city": "Seattle",
  "country": "United States",
  "faa": "SEA",
  "icao": "KSEA",
  "tz": "America/Los_Angeles",
  "geo": {
    "lat": 47.449,
    "lon": -122.309306,
    "alt": 433
  }
}
```

Nested Object

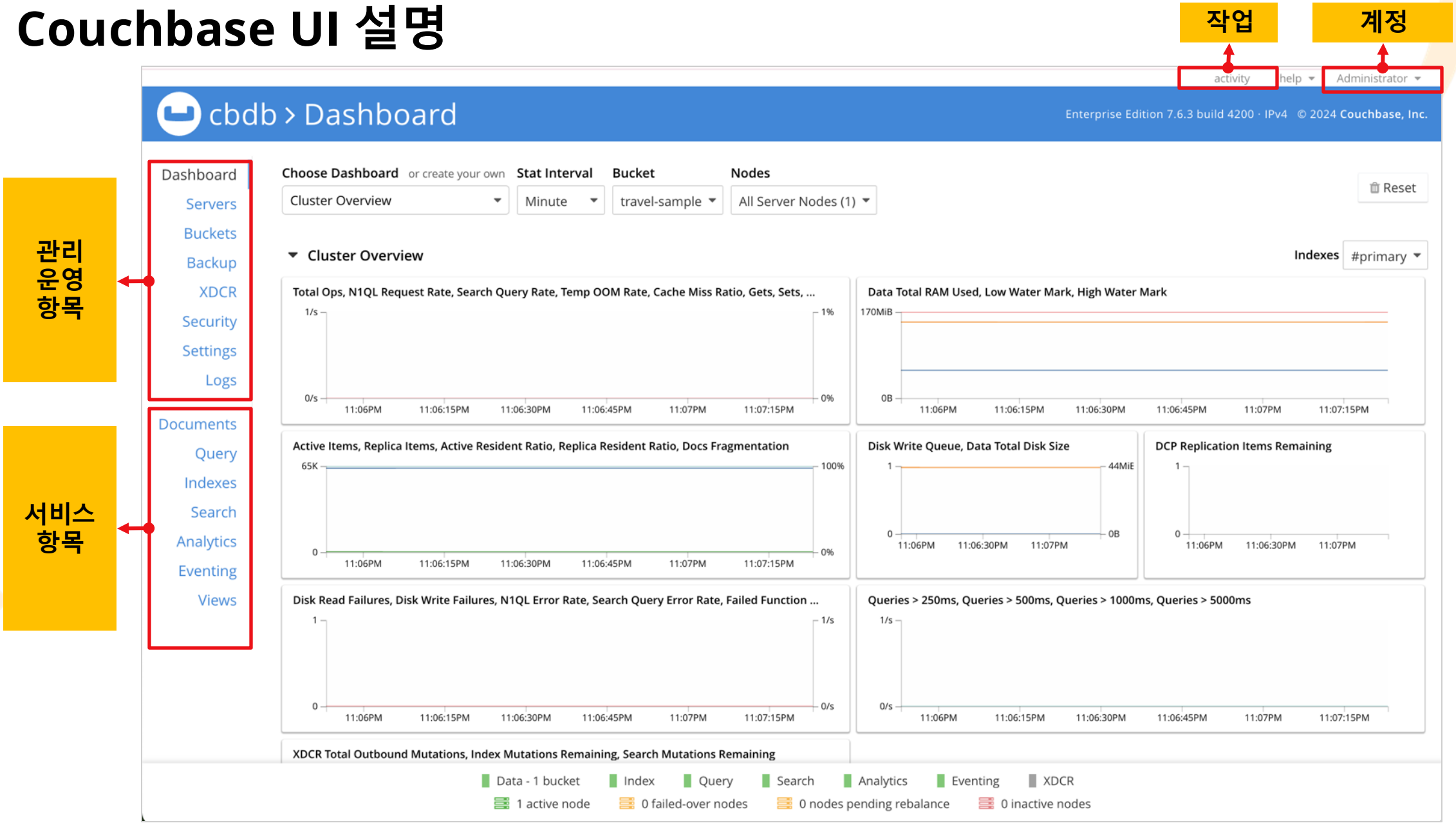
*Collection*: **'hotel'**

hotel_10180

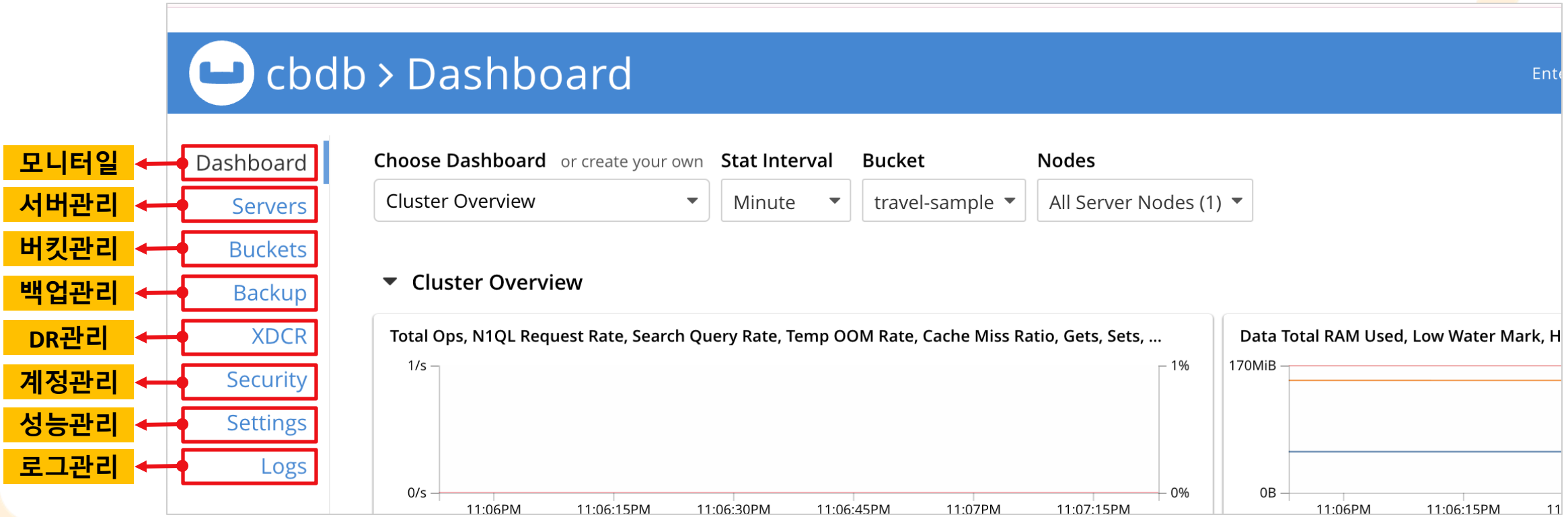
```
{
    "id": 10180,
    "type": "hotel",
    "name": "Bacara Resort Spa",
    "address": "8301 Hollister Ave",
    "city": "Santa Barbara",
    "country": "United States",
    "description": "Located on 78 acres of oceanfront...",
    "price": "$300-$1000+",
    "url": "http://www.bacararesort.com/",
    "reviews": [...]
}
```

Array of Nested Objects

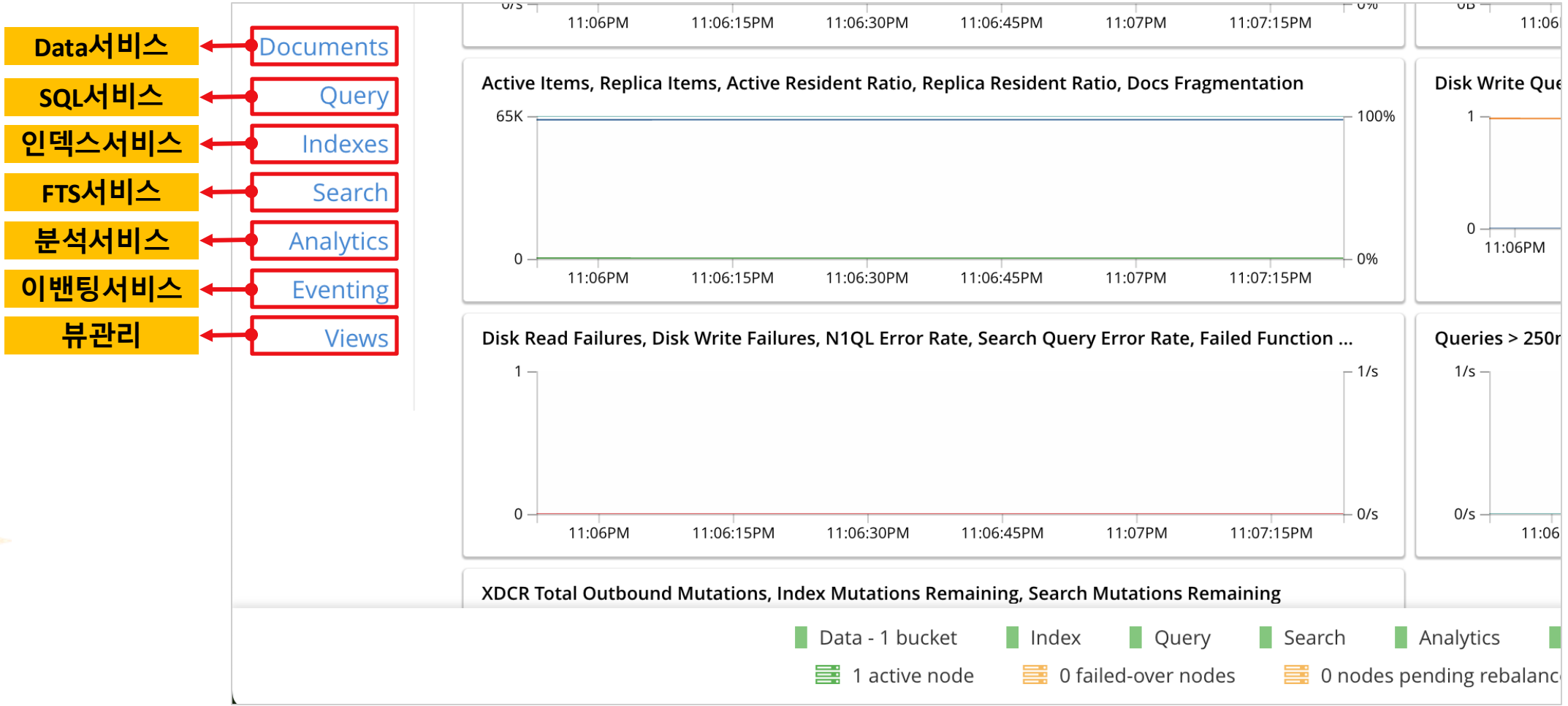
# Couchbase UI 설명



# Couchbase UI 설명

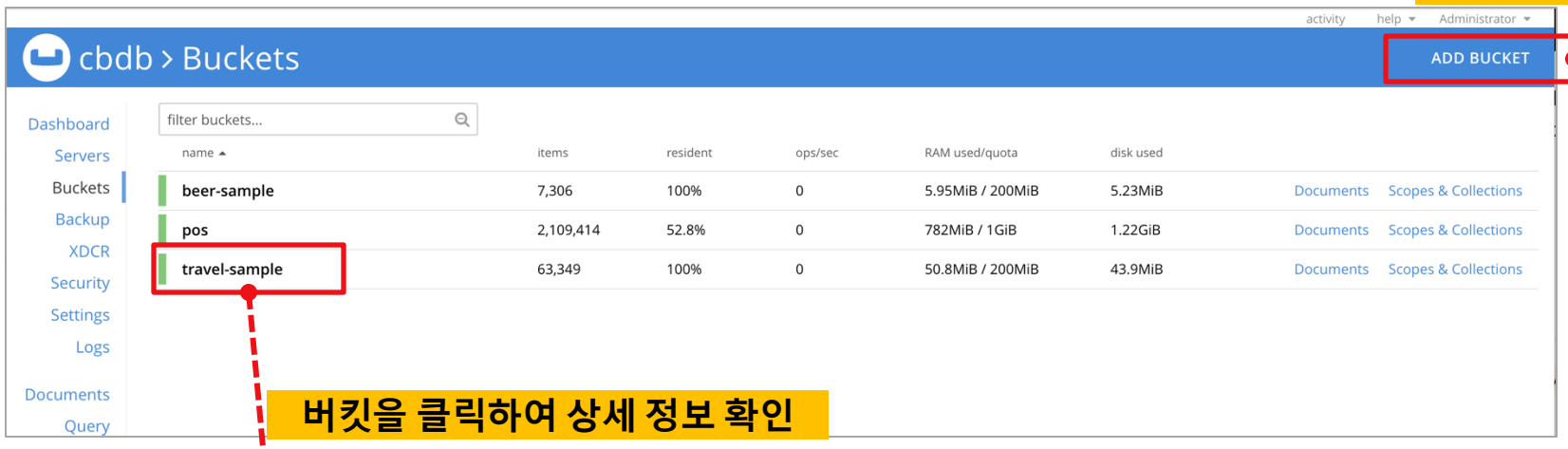


# Couchbase UI 설명

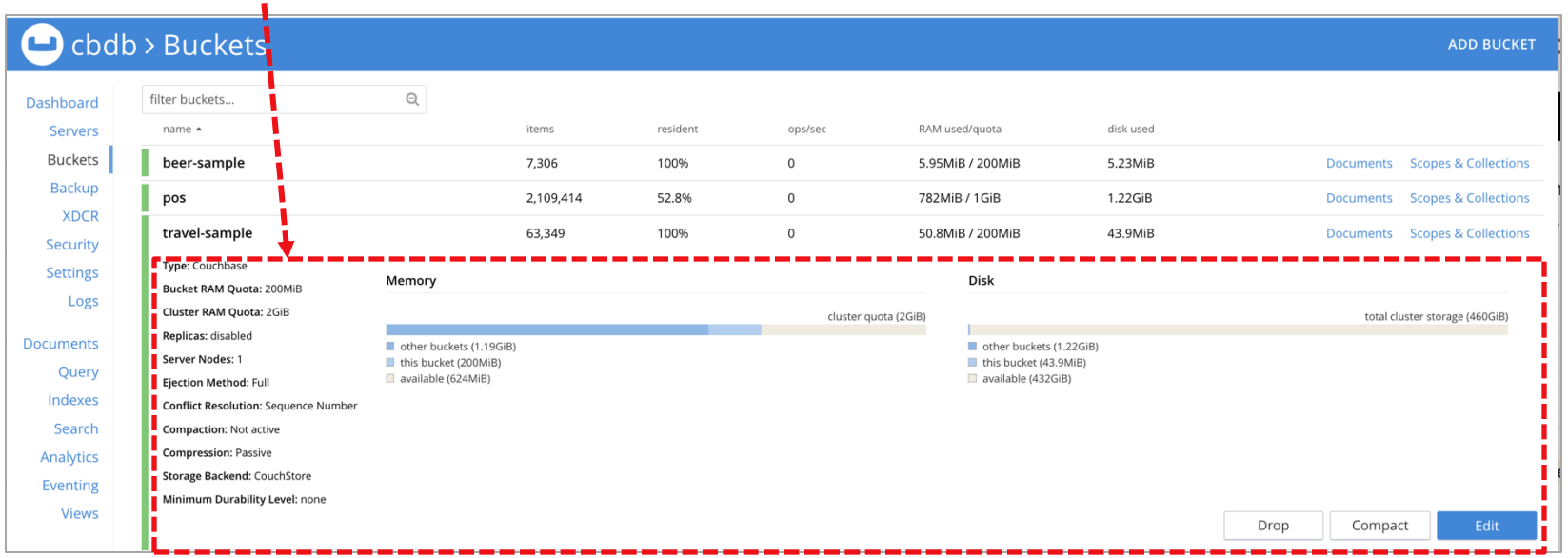


# Couchbase UI 설명 – Bucket/Scope/Collection 생성/삭제

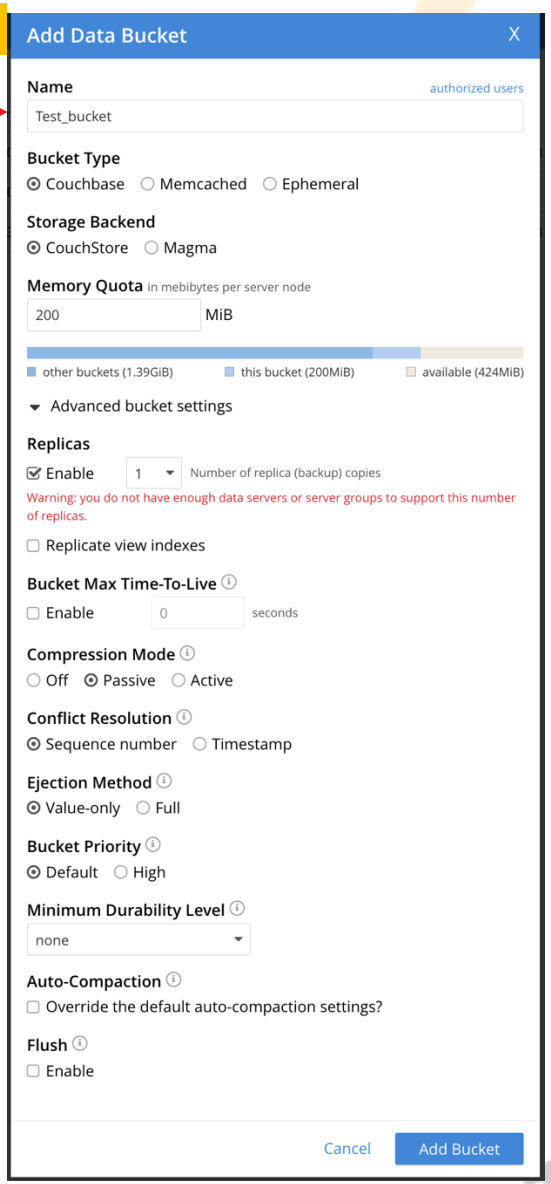
참고 : https://docs.couchbase.com/server/current/manage/manage-buckets/create-bucket.html



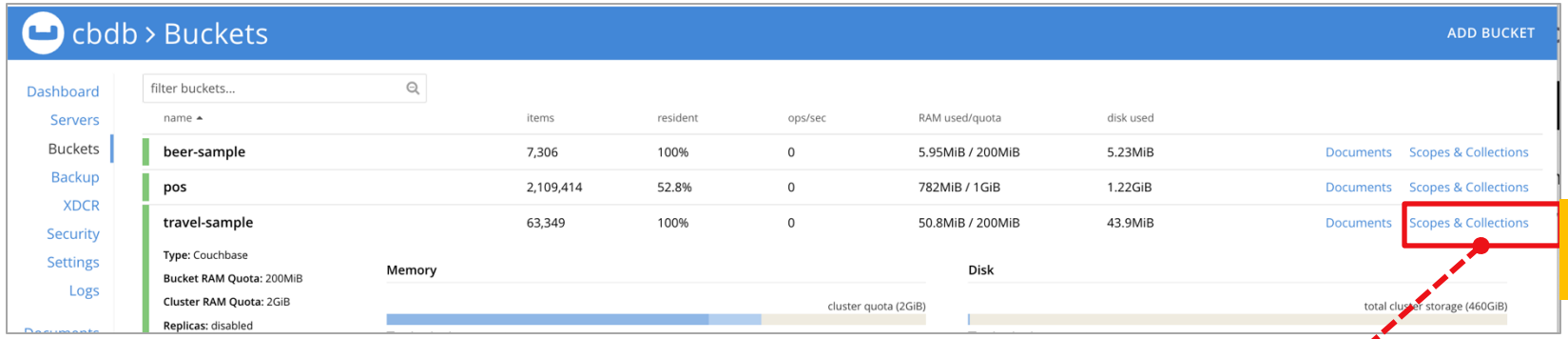

버킷을 클릭하여 상세 정보 확인




버킷 생성



# Couchbase UI 설명 – Bucket/Scope/Collection 생성/삭제




Scope & Collection 클릭하여 상세 정보 확인


Scope 생성

Collection 생성

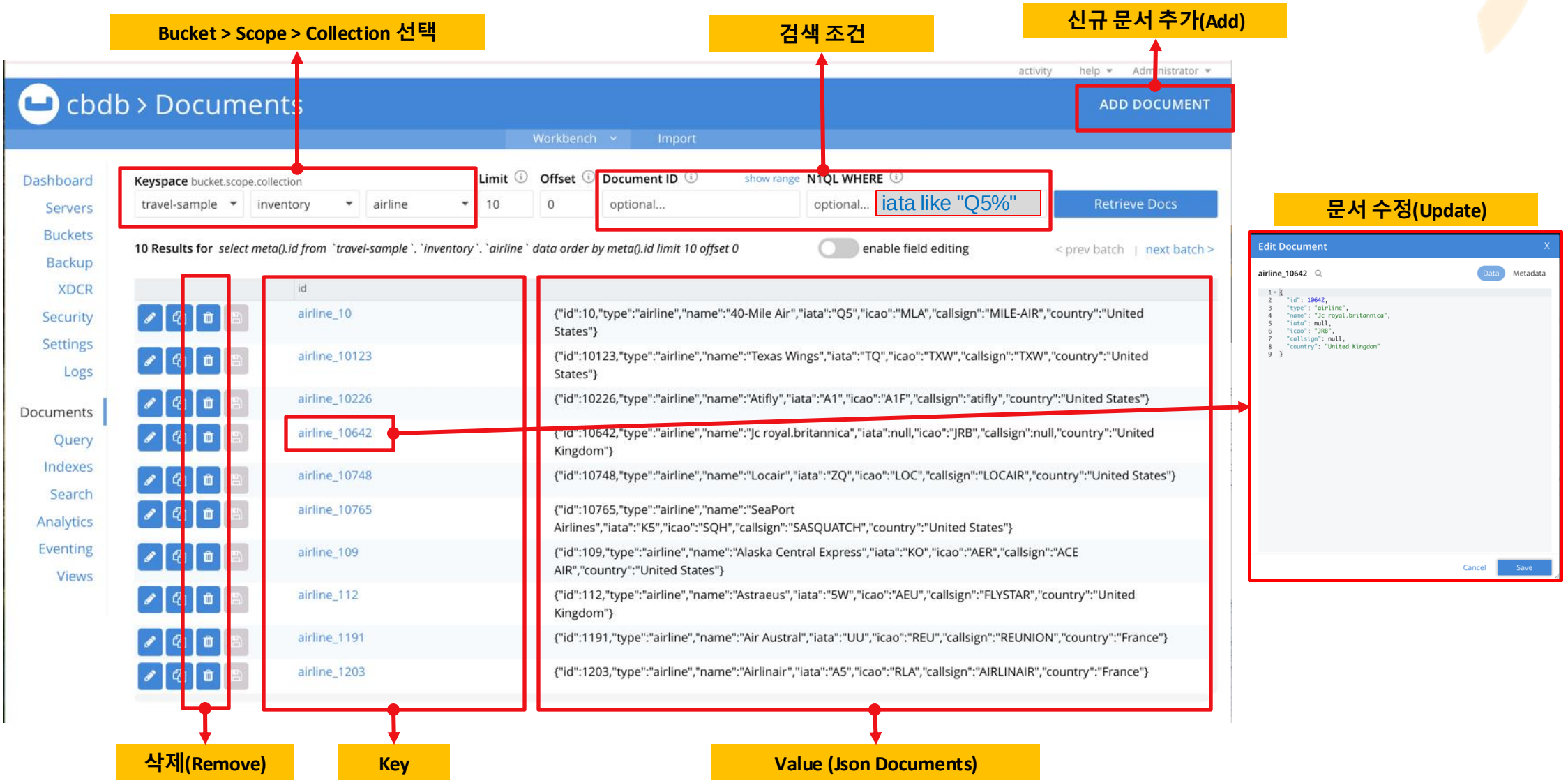
Document 서비스 화면으로이동

Scope 삭제

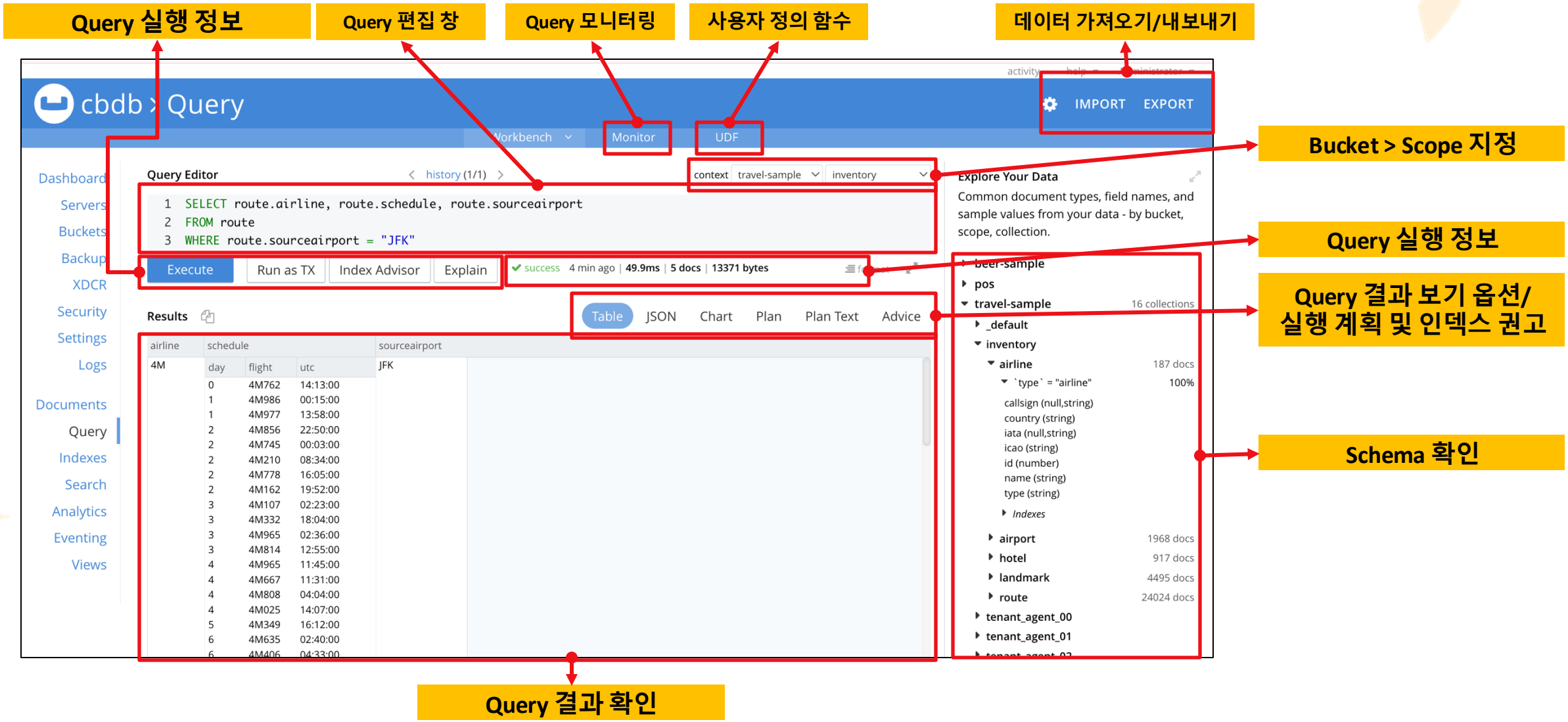
```
CREATE SCOPE `travel-sample`.events
CREATE COLLECTION `travel-sample`.inventory.city
```

Scope & Collection 생성은 SQL 로도 가능

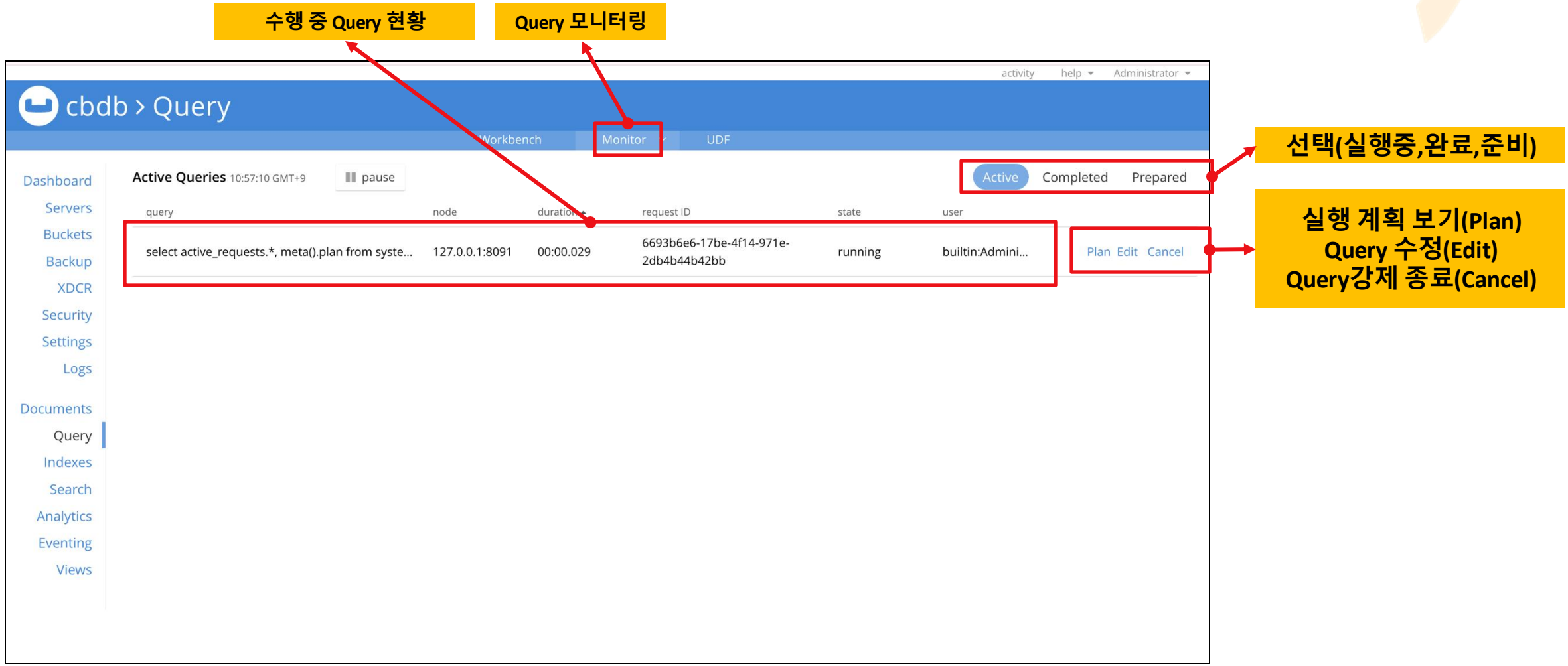
# Couchbase UI 설명 – Documents (Data Service)



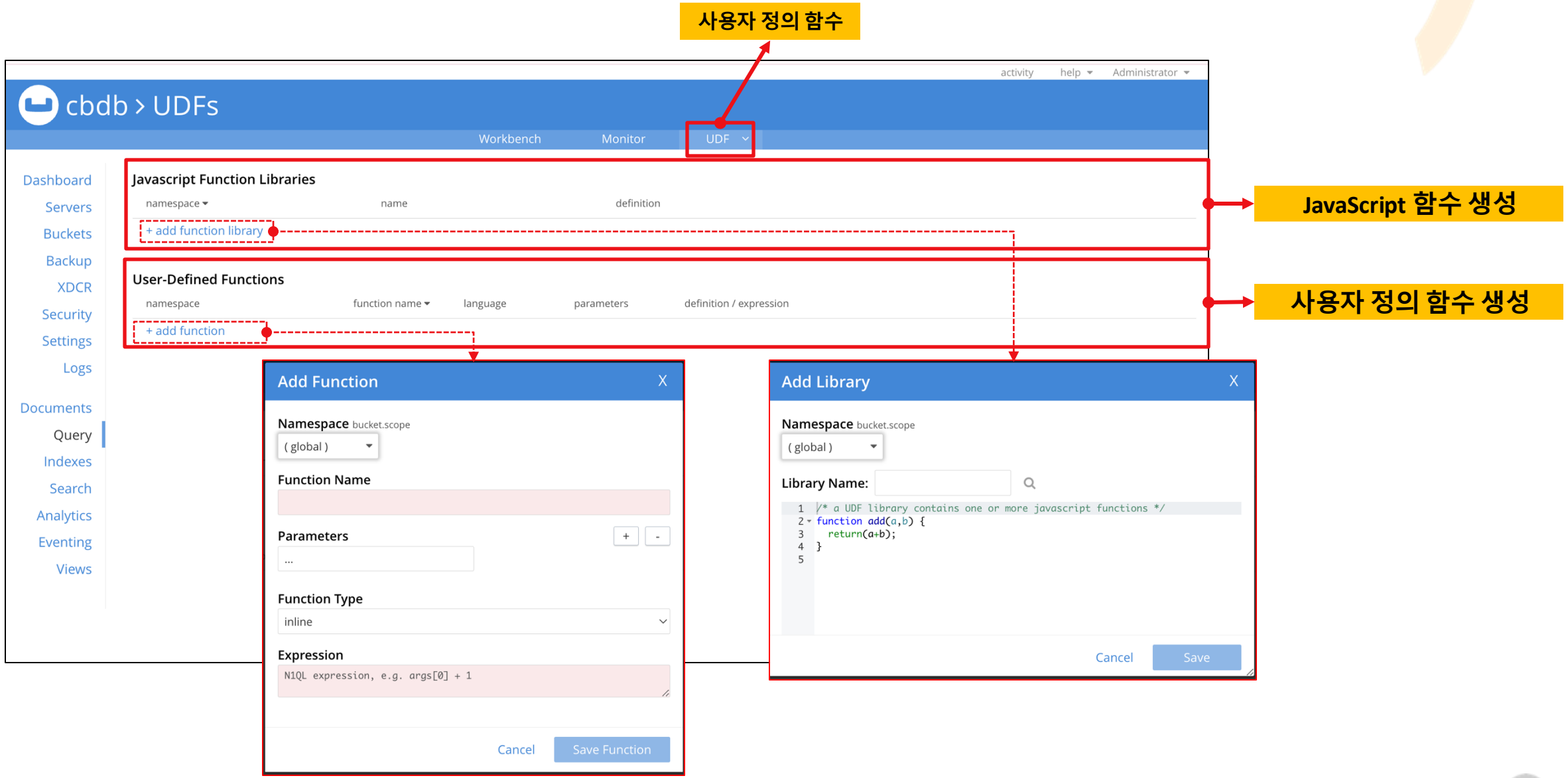
# Couchbase UI 설명 – Query Service



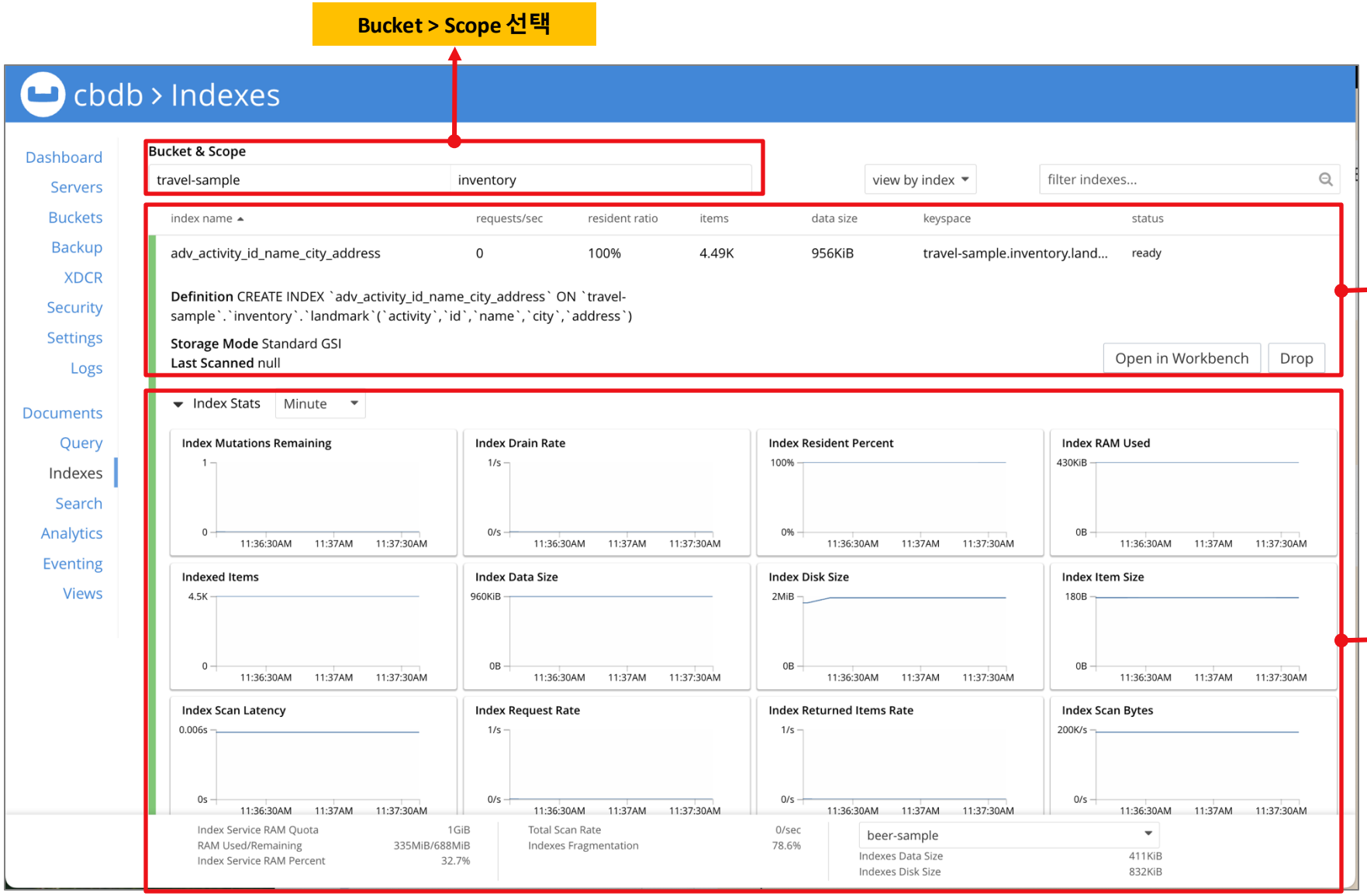
# Couchbase UI 설명 – Query Monitoring



# Couchbase UI 설명 – User Defined Function



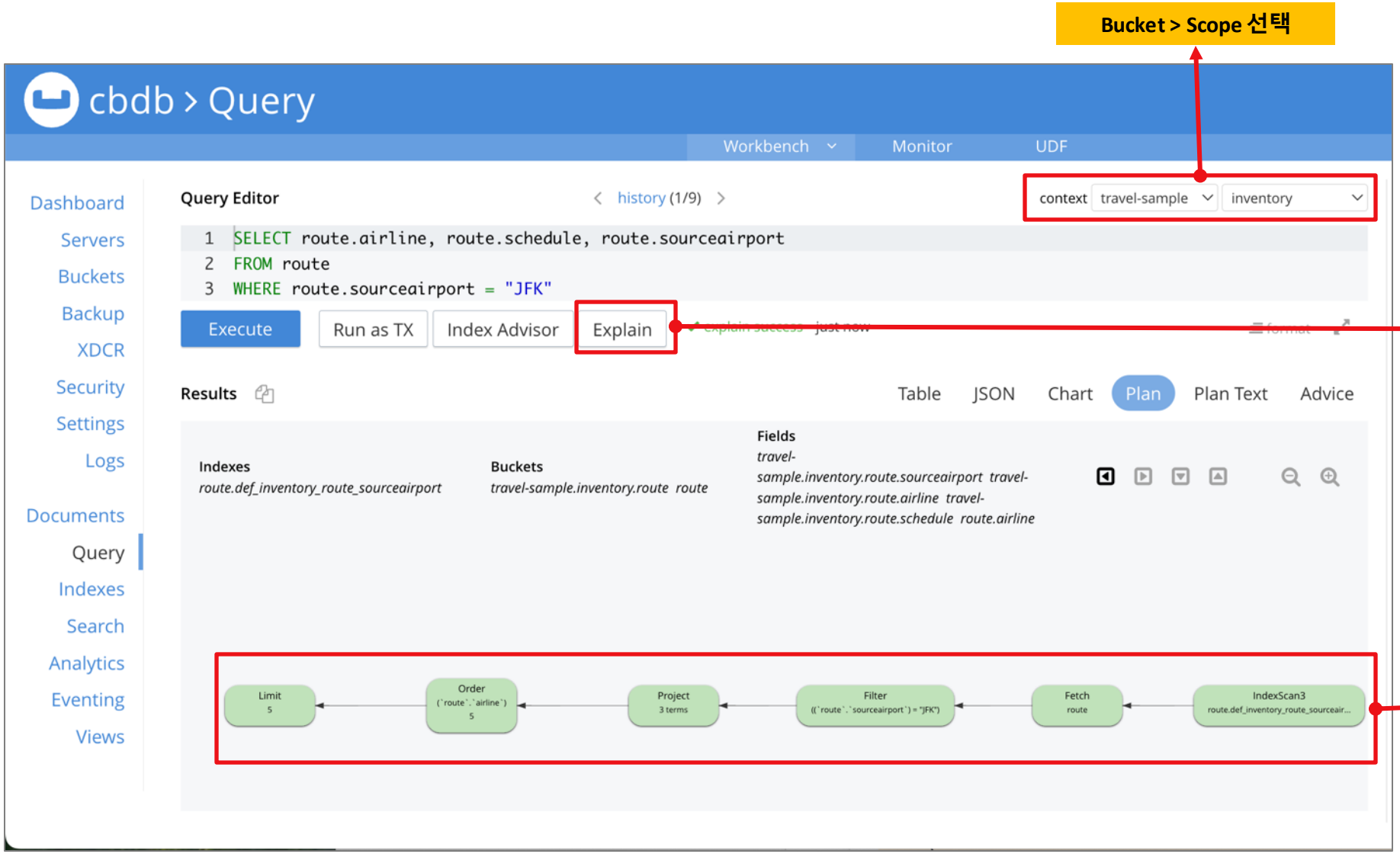
# Couchbase UI 설명 – Index Service




인덱스 확인

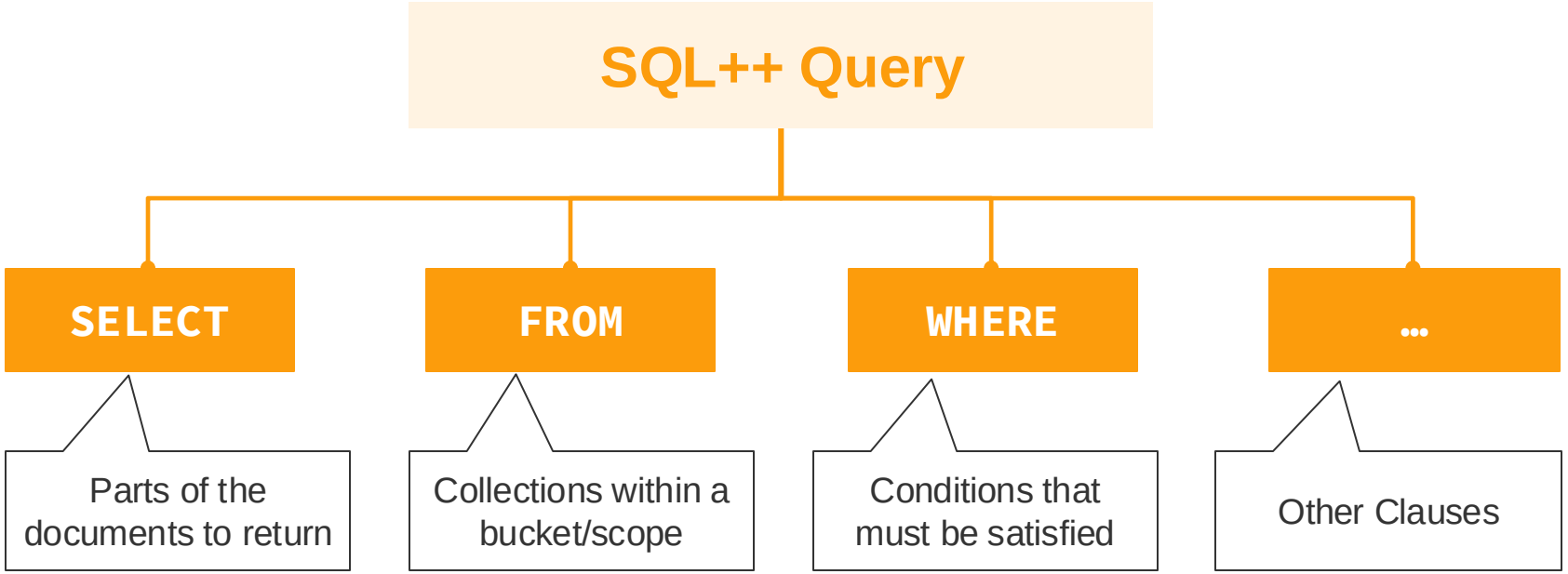
인덱스
사용 현황 모니터링

# Couchbase UI 설명 – Query Plan 확인



# 2-2.
# Query/Index 서비스 소개

# **SQL-like queries** | Looks familiar?




```
SELECT airportname, city, country
FROM `travel-sample`.inventory.airport
WHERE country = "France"
LIMIT 4;
```

OR

```
# Query Context: `travel-sample`.inventory
SELECT airportname, city, country
FROM airport
WHERE country = "France"
LIMIT 4;
```

*You can set the query context in the UI or the SDK. It will resolve partial keyspace reference and simplify the request*

# SQL++ Queries design

Modelling data using Collections simplifies queries and indexes

```
set query_context = "default:CRM._default"

CREATE COLLECTION Orders;
CREATE COLLECTION  Individuals;
```

Set query context.  Here `_default` scope of bucket `CRM`.

Create collections in that context

```
INSERT INTO Individuals (key,value)
VALUES ("Ind:110", { "Id": "110","Name": "Mary Joe",
                     "Email": "mj@email.com" });

INSERT INTO Orders (key,value)
VALUES ("Ord:123", { "Id": "123", "Indid": "110",
       "Items": [ "Qty": "1","Name": "Shoes XX"}] });
```

Insert Json docs into collections.
There is no `type` field.

```
CREATE INDEX Orders_Indid ON Orders(Indid);
CREATE INDEX Individuals_Id ON Individuals(Id);
```

Create indexes into a collection.
There is no `WHERE type='Orders'`.

```
SELECT i.Name, o.Items
FROM Orders o
JOIN Individuals i ON i.Id = o.Indid;
```

Query with JOIN between collections

# **SQL-like queries** | Includes DML (Data Manipulation Language)

| DML Statement | Examples | Description |
|---|---|---|
| INSERT | **INSERT** INTO `travel-sample`.inventory.hotel (KEY, VALUE)<br>**VALUES** ("hotel_9999", { "type" : "hotel", "name" : "new hotel" }); | Create one or more new documents into a collection. Each INSERT statement requires a unique document key and well-formed JSON as values. |
| DELETE | **DELETE** FROM `travel-sample`.inventory.airline f<br>**WHERE** f.callsign = "AIR-X"; | Immediately removes the specified document from your collection. |
| UPDATE | **UPDATE** `travel-sample`.inventory.airport<br>**SET** city = "San Francisco"<br>**WHERE** lower(city) = "san francisco"; | Replaces a document that already exists with updated values. |
| UPSERT | **UPSERT** INTO `travel-sample`.inventory.hotel (KEY, VALUE)<br>**VALUES** ("key1", { "type" : "hotel", "name" : "new hotel" }); | Insert a new record or update an existing one. If the document doesn't exist it will be created. UPSERT is a combination of INSERT and UPDATE. |
| MERGE | (See Next slide) | |

DML statements allow you to create, delete, and modify the **data stored in JSON documents** by specifying and executing simple commands

# SQL-like queries | MERGE

***Finds all routes for airline BA whose source airport is in France.***

- *If any flights are using equipment 319, they are updated to use equipment 797.*
- *If any flights are using equipment 757, they are deleted.*

*Collection*: **'route'**

```
{
  "id": "14452",
  "type": "route",
  "airline": "BA",
  "airlineid": "airline_1355",
  "sourceairport": "BOD",
  "destinationairport": "LGW",
  "equipment": "734 319",
  "stops": "0",
  "distance": 99.89861063028253
  "schedule": [
      {"day": 0, "utc": "19:41:00", "flight": "BA977"},
      {"day": 0, "utc": "14:03:00", "flight": "BA938"},
      {"day": 1, "utc": "08:40:00", "flight": "BA394"},
      {"day": 1, "utc": "06:54:00", "flight": "BA427"},
      {"day": 1, "utc": "06:00:00", "flight": "BA916"}
  ]
}
```

*Collection*: **'airport'**

```
{
  "id": 1264,
  "type": "airport",
  "airportname": "Merignac",
  "city": "Bordeaux",
  "country": "France",
  "faa": "BOD",
  "icao": "LFBD",
  "tz": "Europe/Paris",
  "geo": {
    "lat": 44.828335,
    "lon": -0.715556,
    "alt": 162
  }
}
```

***Before updating or deleting** some routes,*
***you first need to JOIN** route and airport because the country of the source airport is in the airport collection*

# SQL-like queries | MERGE

```
MERGE INTO `travel-sample`.inventory.route
USING `travel-sample`.inventory.airport
ON route.sourceairport = airport.faa
WHEN MATCHED THEN
  UPDATE
  SET route.old_equipment = route.equipment,
      route.equipment = "797"
  WHERE airport.country = "France" AND route.airline = "BA" AND CONTAINS(route.equipment, "319")
WHEN MATCHED THEN
  DELETE
  WHERE airport.country = "France" AND route.airline = "BA"AND CONTAINS(route.equipment, "757")
RETURNING route.old_equipment, route.equipment, airport.faa;
```

Collection to modify

Collection to join with

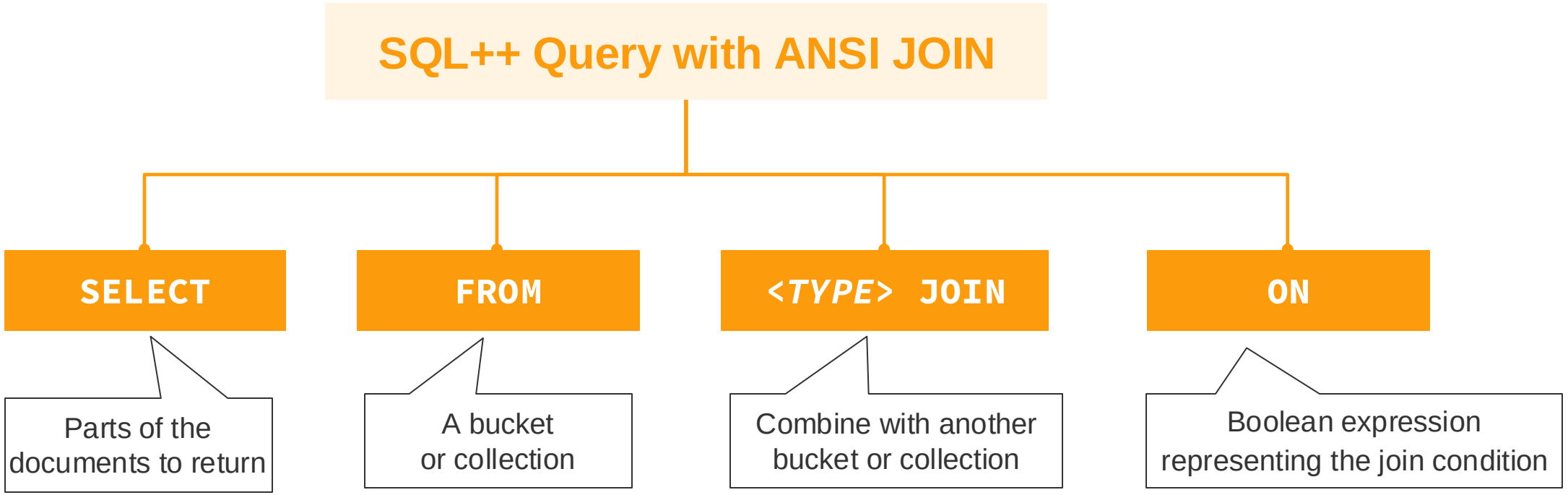
JOIN predicate

Update the routes using equipment 319

Delete routes having 757 equipment

- Provides the ability to modify a collection based on the results of a join with another collection.
- Based on a match or no match in the join, actions can be INSERT, UPDATE, DELETE.
- Multiple actions can be specified.

# SQL-like queries | ANSI JOINS



# SQL-like queries | ANSI JOINS

| JOIN TYPE | Examples |
|---|---|
| ANSI JOIN | SELECT .. FROM customer c<br>**JOIN** orders o **ON** o.customer_id = c.id |
| ANSI JOIN Complex | SELECT .. FROM airline<br>**JOIN** route<br>**ON** route.airlineid = "airline_" \|\| tostring(airline.id) **AND** route.type = "route" |
| ANSI JOIN with IN CLAUSE | SELECT .. FROM `travel-sample` route<br>**JOIN** airport<br>**ON** airport.faa **IN** [ route.sourceairport, route.destinationairport ] **AND** airport.type = "airport" |
| ANSI LEFT OUTER | SELECT .. FROM airport<br>**LEFT JOIN** route<br>**ON** airport.faa = route.sourceairport **AND** route.type = "route" |
| ANSI JOIN with HASH JOIN | SELECT .. FROM airport<br>**JOIN** route **USE HASH(**build**)**<br>**ON** airport.faa = route.sourceairport **AND** route.type = "route" |

ANSI JOIN can join arbitrary fields of the documents and can be chained together.

# SQL-like queries | Arrays

*Retrieve the details of KL flight schedules from Albuquerque (ABQ) to Atlanta (ATL) if any of the flights are after 23:40.*

```
SELECT *
FROM `travel-sample`.inventory.route
WHERE airline="KL"
  AND sourceairport="ABQ"
  AND destinationairport="ATL"
  AND ANY departure IN schedule
      SATISFIES departure.utc > "23:40" END;
```


```
[
  {
    "travel-sample": {
      "airline": "KL",
      "airlineid": "airline_3090",
      "destinationairport": "ATL",
      "distance": 2038.3535078909663,
      "equipment": "757 320",
      "id": 36159,
      "schedule": [
        {"day": 0, "flight": "KL938", "utc": "03:54:00"},
        // ...
        {"day": 5, "flight": "KL169", "utc": "23:41:00"},
        // ...
        {"day": 6, "flight": "KL636", "utc": "17:40:00"}
      ],
      "sourceairport": "ABQ",
      "stops": 0,
      "type": "route"
    }
  }
]
```


- Range predicates (ANY, EVERY) enable you to evaluate expressions over every element in an array
- They are particularly useful when used to evaluate expressions over an array of objects

# SQL-like queries | Subqueries

*Find total number of airports by country where each city has more than 5 airports.*

```
SELECT t1.country,
       array_agg(t1.city),
       sum(t1.city_cnt) as apnum
FROM
    (SELECT city,
            city_cnt,
            array_agg(airportname) as apnames,
            country
     FROM `travel-sample`.inventory.airport
     GROUP BY city,
            country LETTING city_cnt = count(city)
     ) AS t1
WHERE t1.city_cnt > 5
GROUP BY t1.country;
```


```
[
  {
    "$1": [
      "Paris"
    ],
    "apnum": 9,
    "country": "France"
  },
  {
    "$1": [
      "London"
    ],
    "apnum": 13,
    "country": "United Kingdom"
  },
  {
    "$1": [
      "Houston",
      "New York",
      "San Diego"
    ],
    "apnum": 22,
    "country": "United States"
  }
]
```


- A subquery is a query within another query
- Subqueries can be embedded anywhere a valid expression can go

# SQL-like queries | Built-in Functions

| Category | Functions |
|---|---|
| Aggregate functions | ARRAY_AGG() ARRAY_AGG(DISTINCT) AVG(), AVG(DISTINCT) COUNT() COUNT(DISTINCT) MAX() MIN() SUM() SUM(DISTINCT) |
| Object functions | OBJECT_LENGTH() OBJECT_NAMES() OBJECT_PAIRS() OBJECT_INNER_PAIRS() OBJECT_VALUES() OBJECT_INNER_VALUES() OBJECT_ADD() OBJECT_PUT() OBJECT_REMOVE() OBJECT_UNWRAP() |
| Array functions | ARRAY_APPEND() ARRAY_AVG() ARRAY_CONCAT() ARRAY_CONTAINS() ARRAY_COUNT() ARRAY_DISTINCT() ARRAY_IFNULL() ARRAY_LENGTH() ARRAY_MAX() ARRAY_MIN() ARRAY_POSITION() ARRAY_PREPEND() ARRAY_PUT() ARRAY_RANGE() ARRAY_REMOVE() ARRAY_REPEAT() ARRAY_REPLACE() ARRAY_REVERSE() ARRAY_SORT() ARRAY_SUM() |
| Comparison functions | GREATEST() LEAST() |
| Conditional functions | IFMISSING() IFMISSINGORNULL() IFNULL() MISSINGIF() NULLIF() IFINF() IFNAN() IFNANORINF() NANIF() NEGINFIF() POSINFIF() |
| Number functions | ABS() ACOS() ASIN() ATAN() ATAN2() CEIL() COS() DEGREES() E() EXP() LN() LOG() FLOOR() PI() POWER() RADIANS() RANDOM() ROUND() SIGN() SIN() SQRT() TAN() TRUNC() |
| Date functions | CLOCK_MILLIS() CLOCK_STR() DATE_ADD_MILLIS() DATE_ADD_STR() DATE_DIFF_MILLIS() DATE_DIFF_STR() DATE_PART_MILLIS() DATE_PART_STR() DATE_TRUNC_MILLIS() DATE_TRUNC_STR() STR_TO_MILLIS() MILLIS_TO_STR() MILLIS_TO_UTC() MILLIS_TO_ZONE_NAME() NOW_MILLIS() NOW_STR() STR_TO_MILLIS() STR_TO_UTC() STR_TO_ZONE_NAME() |
| JSON functions | DECODE_JSON() ENCODE_JSON() ENCODED_SIZE() POLY_LENGTH() |
| Meta and UUID functions | BASE64() BASE64_ENCODE() BASE64_DECODE() META() UUID() |
| Pattern-matching functions | REG_CONTAINS() REG_LIKE() REG_POSITION() REG_REPLACE() |
| String functions | CONTAINS() INITCAP() LENGTH() LOWER() LTRIM() POSITION() REPEAT() REPLACE() RTRIM() SPLIT() SUBSTR() TITLE() TRIM() UPPER() |
| Type-Checking Functions | ISARRAY() ISATOM() ISBOOLEAN() ISNUMBER() ISOBJECT() ISSTRING() TYPE() |
| Type-Conversion Functions | TOARRAY() TOATOM() TOBOOLEAN() TONUMBER() TOOBJECT() TOSTRING() |

# SQL-like queries | User Defined Functions (UDF)

### Simple Inline Example

```
CREATE FUNCTION to_meters(...) {
  args[0] * 0.3048
};
```

```
SELECT airportname, ROUND(to_meters(geo.alt)) AS mamsl
FROM `travel-sample`.inventory.airport
LIMIT 5;
```

```
[
  {"airportname": "Calais Dunkerque","mamsl": 4},
  {"airportname": "Peronne St Quentin","mamsl": 90},
  {"airportname": "Les Loges","mamsl": 130},
  {"airportname": "Couterne", "mamsl": 219},
  {"airportname": "Bray","mamsl": 111}
]
```

### Inline Example with SQL++ query inside

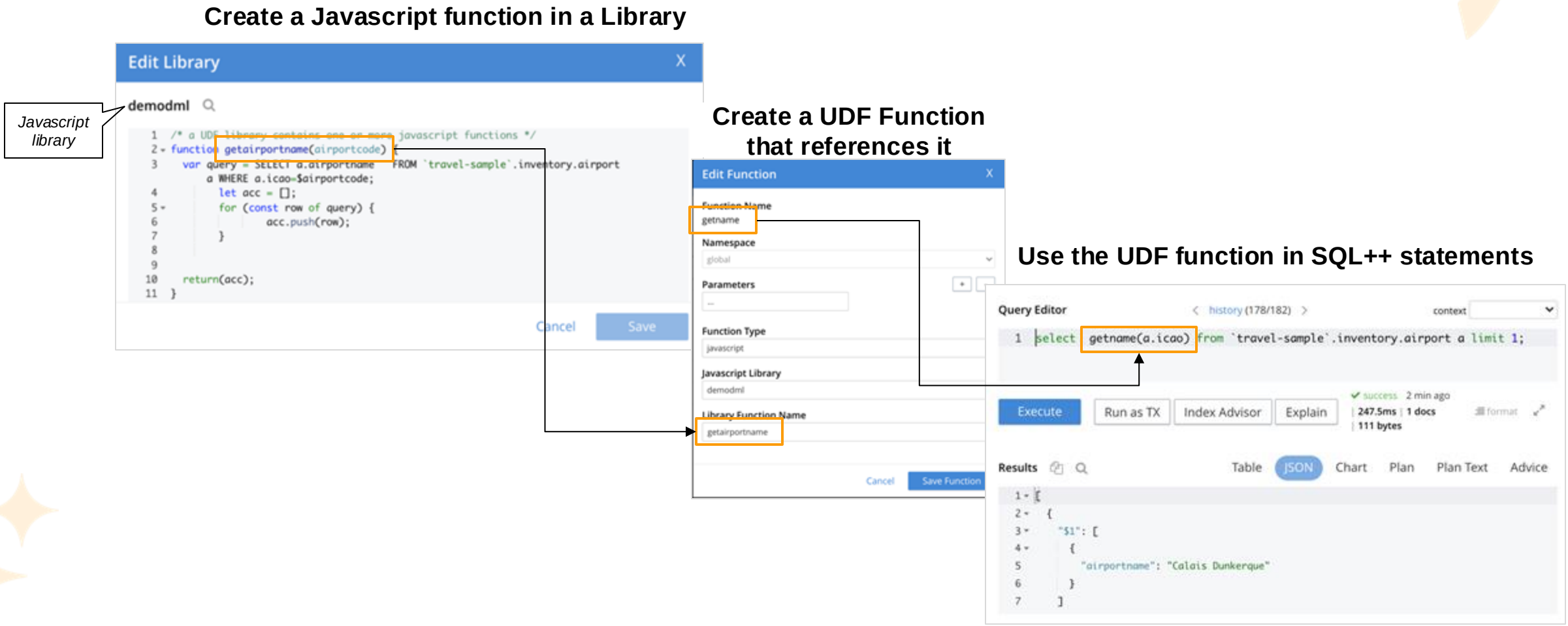
```
CREATE FUNCTION locations(vActivity) {
  (SELECT id, name, address, city
  FROM `travel-sample`.inventory.landmark
  WHERE activity = vActivity) };
```

```
SELECT l.name, l.city
FROM locations("eat") AS l
WHERE l.city = "Gillingham";
```

```
[
  {"city": "Gillingham","name": "Hollywood Bowl"},
  {"city": "Gillingham","name": "Thai Won Mien"},
  {"city": "Gillingham","name": "Spice Court"},
  {"city": "Gillingham","name": "Beijing Inn"},
  {"city": "Gillingham","name": "Ossie's Fish and
Chips"}
]
```

- Inline functions are defined using SQL++ expressions, including subqueries.
- You can name and reuse complex or repetitive expressions in order to simplify your queries.

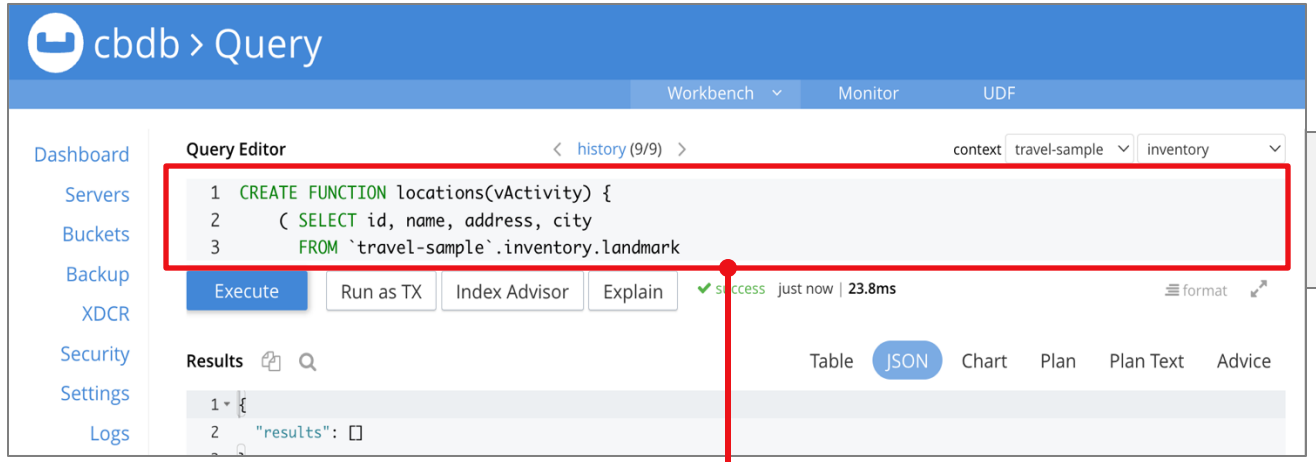
# SQL-like queries | UDF with JavaScript & SQL++




- UDFs with JavaScript allows developers to provide custom functions to extend SQL++ capabilities

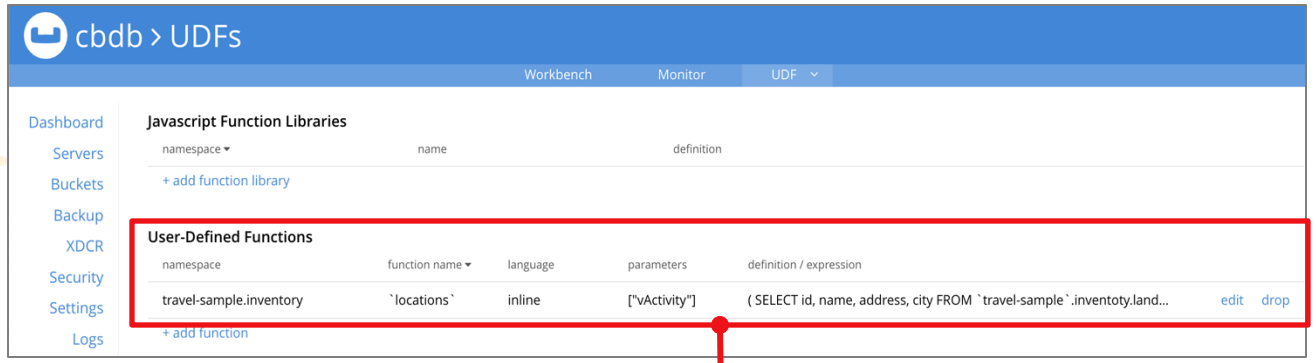
# SQL-like queries | UDF with SQL++

참고 : https://docs.couchbase.com/server/current/n1ql/n1ql-language-reference/userfun.html



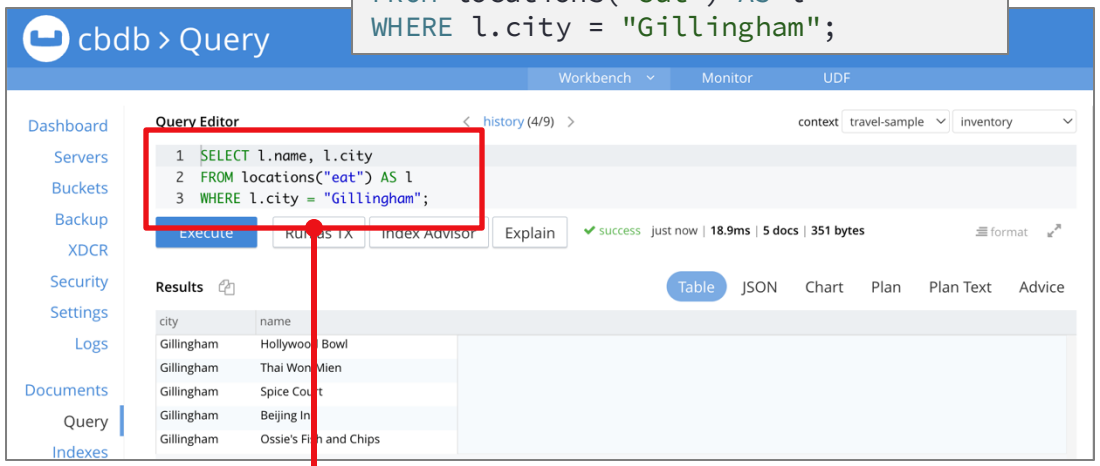

```
CREATE FUNCTION locations(vActivity) {
          ( SELECT id, name, address, city
            FROM landmark
          WHERE activity = vActivity) };
```

**1. UDF 생성**




**2. UDF 확인**

```
SELECT l.name, l.city
FROM locations("eat") AS l
WHERE l.city = "Gillingham";
```




**3. UDF 실행**

# **SQL-like queries** | Search Functions

*Find the name of the hotels in United Kingdom where the reviews match the term 'bathrobes'*

```
SELECT t1.name, meta().id
FROM `travel-sample`.inventory.hotel AS t1
WHERE SEARCH(t1, {
  "match": "bathrobes",
  "field": "reviews.content",
  "analyzer": "standard"
})
AND country="United Kingdom"
LIMIT 3;
```

```
[
  {
    "id": "hotel_12068",
    "name": "Castle Hotel"
  },
  {
    "id": "hotel_18819",
    "name": "Bistro Prego With Rooms"
  },
  {
    "id": "hotel_3622",
    "name": "Premier Inn Birmingham Central East"
  }
]
```

- Search functions enable you to use full text search (FTS) queries directly within a SQL++ query.
- It is recommended that you create suitable full text indexes for the searches that you need to perform.

# SQL-like queries | Prepared Statement

### Positional Parameters

```
PREPARE NumParam AS
SELECT * FROM `travel-sample`.inventory.hotel
WHERE city=$1 AND country=$2;
```

```
EXECUTE NumParam
USING ["Paris", "France"];
```

### Named Parameters

```
PREPARE NameParam AS
SELECT * FROM `travel-sample`.inventory.hotel
WHERE city=$city AND country=$country;
```

```
EXECUTE NameParam
USING {"city": "Paris", "country": "France"};
```

- You can add placeholder parameters to a statement, so that you can supply variable values when you run the statement.
- If you need to run a statement more than once, you can prepare the execution plan for the statement.

# SQL-like queries | Transactions

**Ensures database consistency when multiple documents are updated in a single or multiple SQL++ statements**

```
START TRANSACTION;
UPDATE customer SET balance = balance + 100 WHERE cid = 4872;
SELECT cid, name, balance  FROM customer;
SAVEPOINT s1;
UPDATE customer SET balance = balance - 100 WHERE cid = 1924;
SELECT cid, name, balance FROM customer;
ROLLBACK WORK TO SAVEPOINT s1;
SELECT cid, name, balance FROM customer;
COMMIT;
```

Couchbase provides the following statements for transactions:

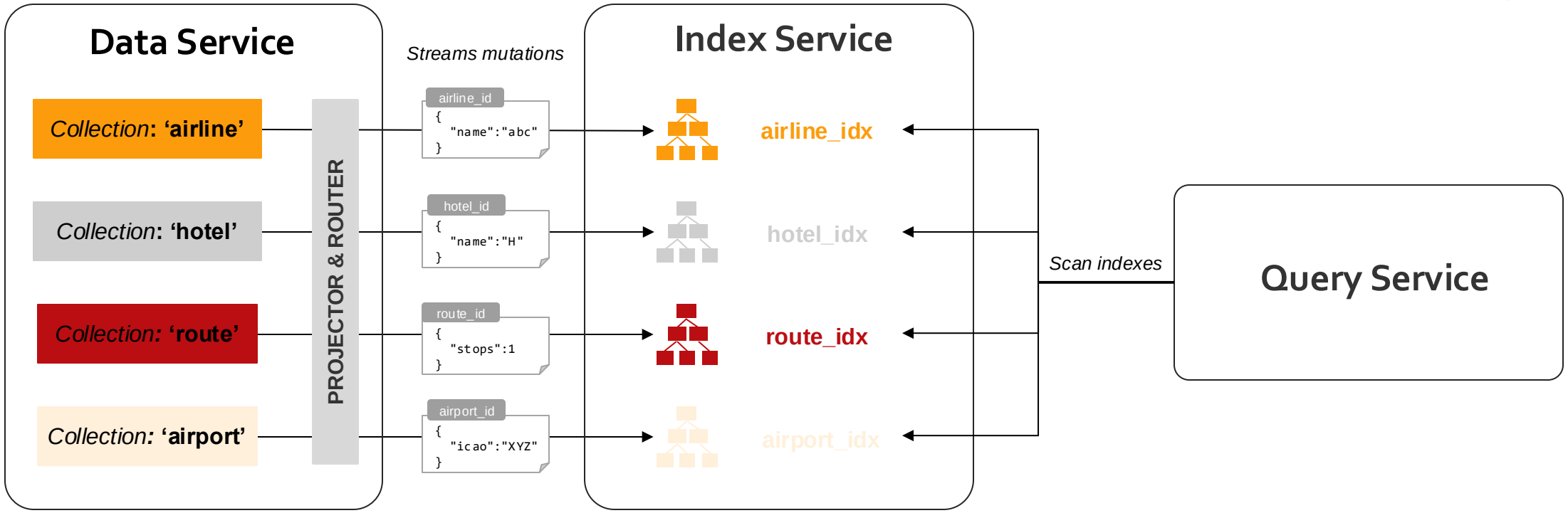
- BEGIN TRANSACTION
- SET TRANSACTION (optional)
- SAVEPOINT
- ROLLBACK TRANSACTION
- COMMIT TRANSACTION

# **Built-In Indexer** | For better queries performance

Indexes will efficiently look up documents meeting specified criteria

| Index Type | Definition |
|---|---|
| **Primary** | Index on the document key on a whole bucket or collection, to support full scans |
| **Named Primary** | Primary index with an assigned name, to allow multiple primary indexes in a cluster |
| **Secondary** | Index on a field (key-value pair) or document-key |
| **Composite** | Index on more than one field |
| **Functional** | Index on values resulting from a function of expression applied to a field |
| **Array** | Index on individual elements of array fields |
| **Partial** | Index on filtered subset of documents in a bucket |
| **Covering** | Describes any index which fully responds to a query without the need for a document fetch |
| **Adaptive** | Describes an indexing feature providing an arrayed approach to generically indexing all or specific doc fields, to support increased query flexibility |

# **Built-In Indexer** | Continuous Ingestion from the Data Service



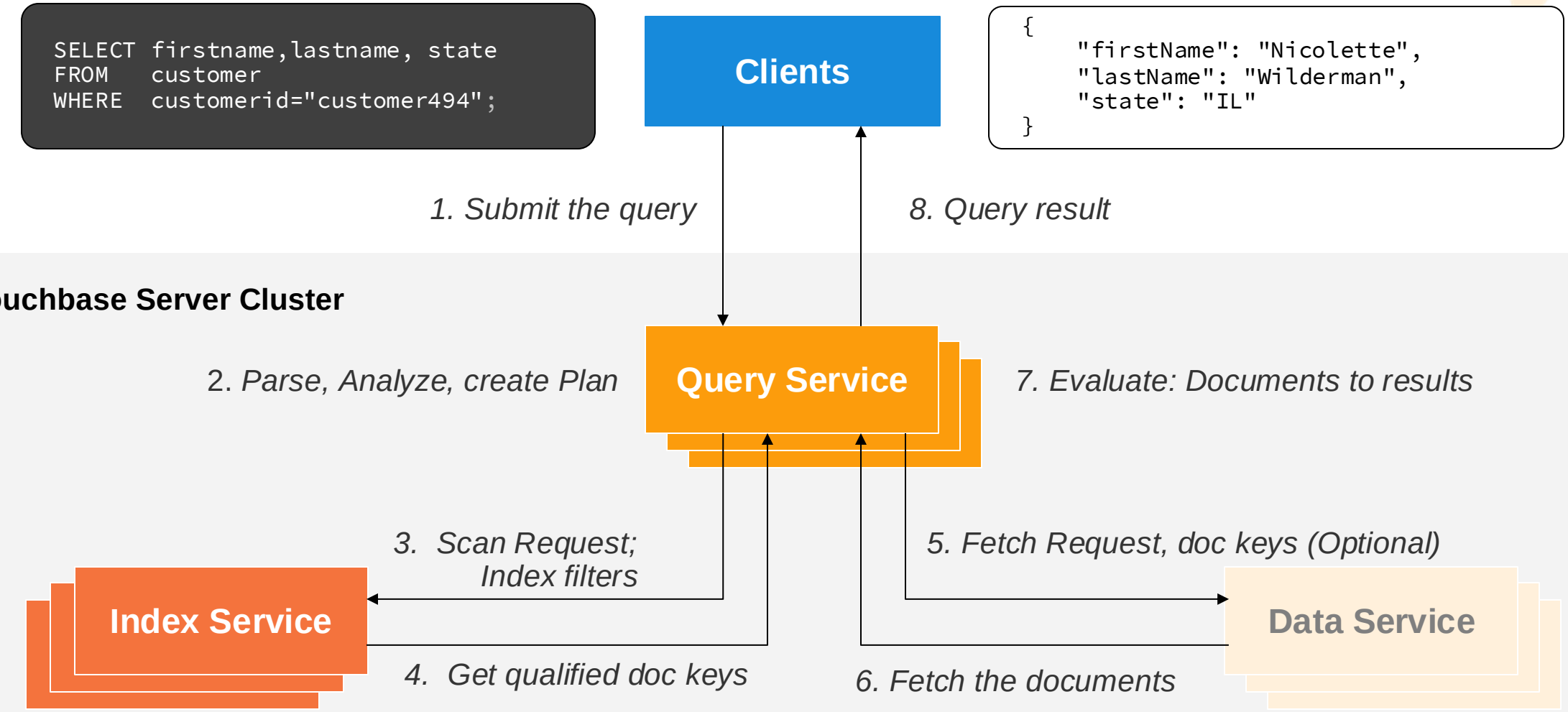

- Data Service streams copies of all mutations that occur to documents to the relevant Indexes.
- Indexes are constantly and automatically updated. They are *eventually consistent* with changes on documents.
- Queries are forwarded to the relevant indexes and done based on indexed informations.

# **Built-In Indexer** | Query Consistency

**Indexes are eventually consistent with respect to data mutations. You can specify consistency-options per query.**

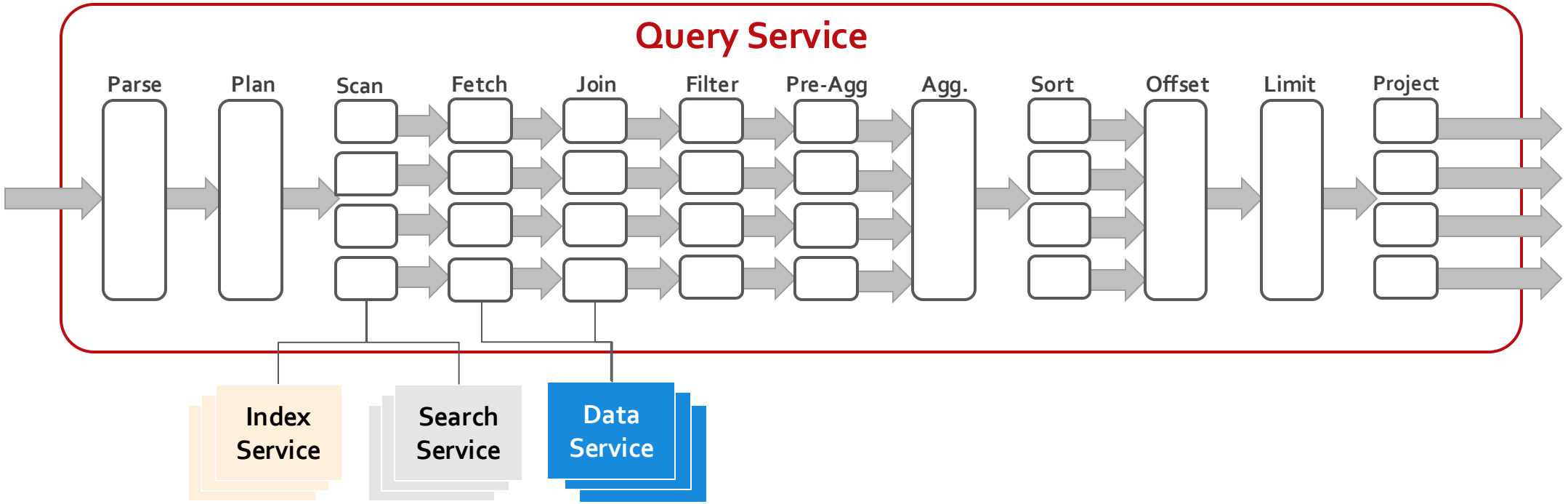
| | |
|---|---|
| **not_bounded** | (default) Will not wait for any indexes to finish updating before running the query and returning results. The results are returned **quickly**, but the query will not return any documents that are yet to be indexed. |
| **request_plus** | All document changes and index updates are processed before the query is run. Select this when **consistency** is always more important than performance. |
| **at_plus** | A "read your own write" (**RYOW**) option, which means it just waits for the new documents that you specify to be indexed, rather than an entire index of multiple documents. |

# **Queries & Indexes** | SQL++ Query Execution Flow



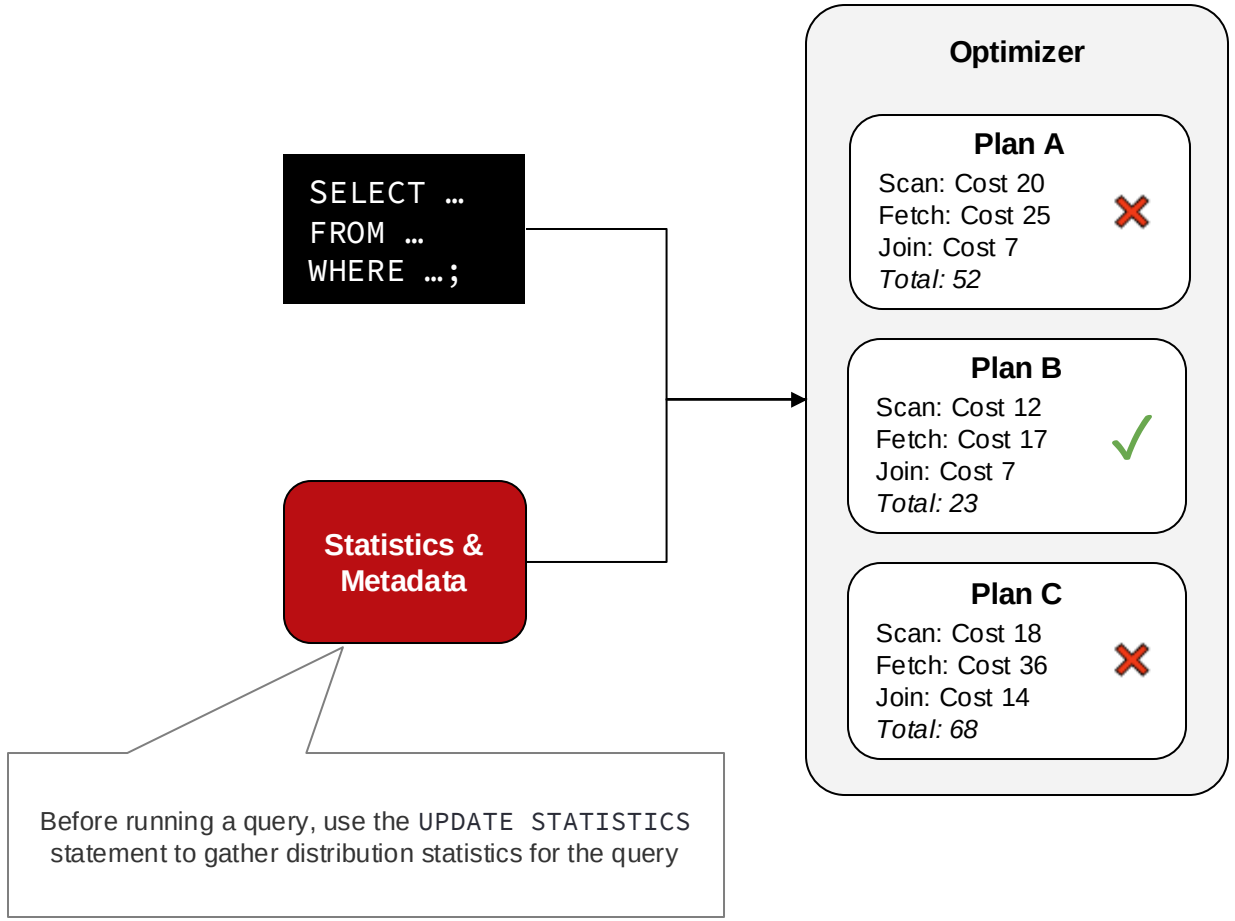
# High Performance Query Engine

The degree of parallelism is represented by the vertically aligned groups of right-pointing arrows.



# Cost Based Optimizer

CBO generates the optimal access path based on statistics without the need to provide optimizer hint

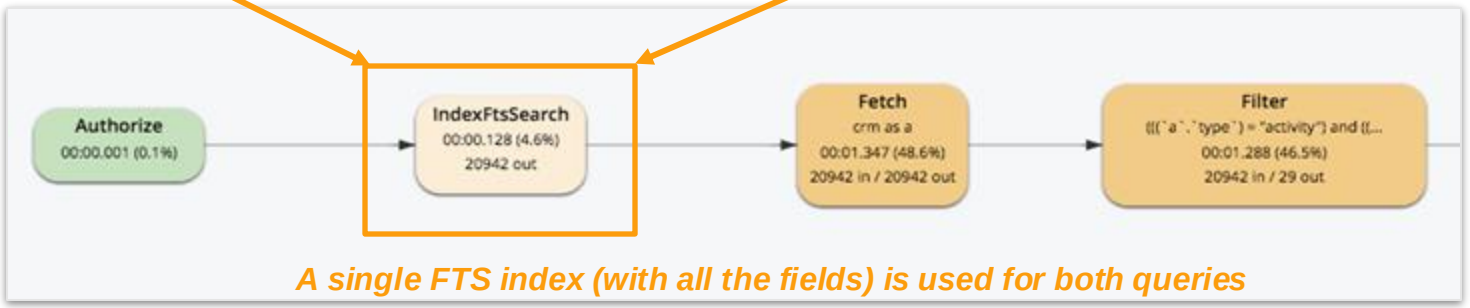



1. Estimate the cost of each plan based on the available statistics on data indexes
2. Choose the one that optimize the query latency

# Flex indexing

```
SELECT *
FROM crm a
USE INDEX (USING FTS)
WHERE a.type='activity'
AND ( a.dept = 'iA88'  OR a.region > '59416' )
AND a.priority = 'High'
AND ( a.act_date BETWEEN '2022-01-01' AND '2022-08-31'
    OR a.event.location = 'Moscone Center' )
AND ( a.account.id = 'acc100' OR a.owner.name = 'Amanda Morrison')
```

```
SELECT *
FROM crm a
USE INDEX (USING FTS)
WHERE a.type='activity'
AND a.priority = 'High'
AND a.act_date > '2020-01-31'
AND a.owner.name = 'Amanda Morrison')
```



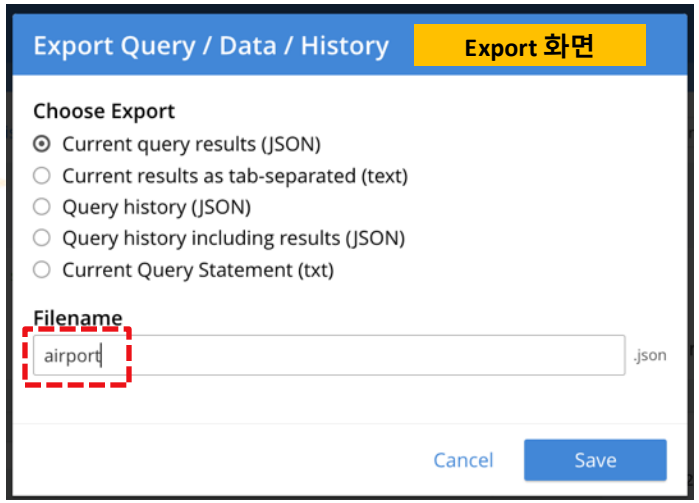

*A single FTS index (with all the fields) is used for both queries*

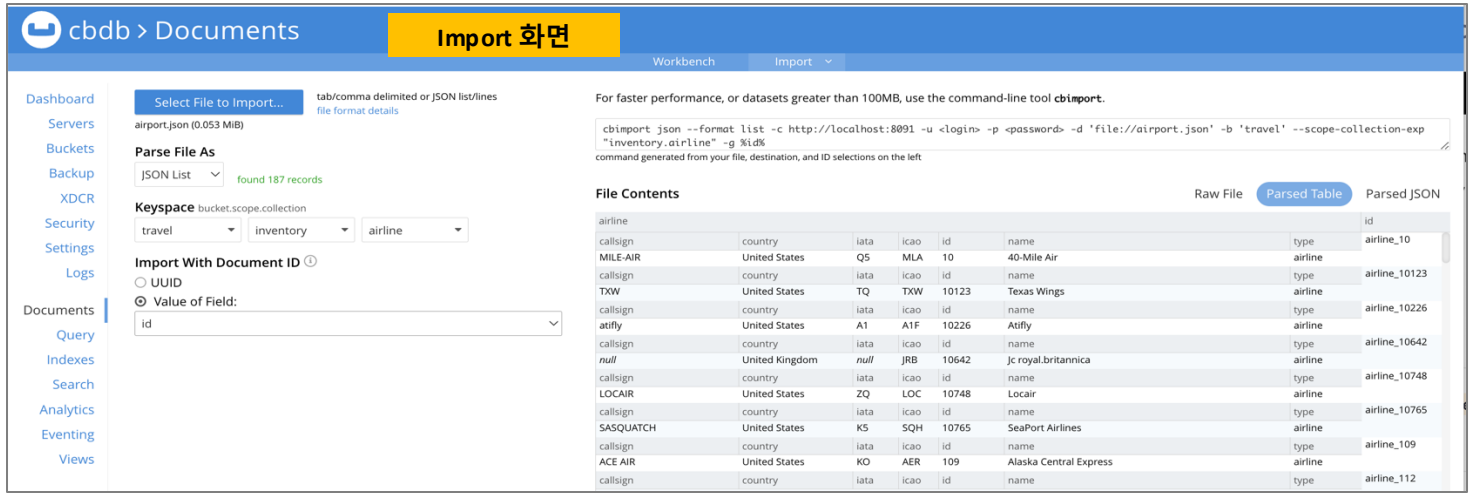
- Flex Index allows query service to **leverage Search index, using only the standard SQL++ predicates**
- Can greatly **reduce the number of indexes** and resource needed to support ad hoc queries.
- Existing applications can benefit without any query modifications (parameter `use_fts`)

# 2-3.
# 실습

# 실습

| | 실습 항목 | 상세 실습 내용 | 기타 |
|---|---|---|---|
| 1 | Data Export | 1. Query Workbench<br>2. SELECT meta().id, * FROM `travel-sample`.inventory.airline 실행<br>3. 우측 상단의 Export 선택 후, airline.json 파일로 export 수행 | airline, airport, hotel, route, landmark |
| 2 | Bucket, Scope, Collection 생성 | 1. travel 버킷 생성<br>2. inventory Scope 생성<br>3. airline, airport, hotel, route, landmark Collection 생성 | Bucket 메모리 200MB |
| 3 | Data Import | 1. Document 페이지 이동.<br>2. Import 선택<br>3. 위 1항에서 Export 한 json 파일 Import 수행, Document ID 는 id 로 지정 | airline, airport, hotel, route, landmark |
| 4 | Index 생성 | • travel-sample 버킷에 있는 index 참고하여, 생성. | |
| 5 | Query 수행 | • 43, 44 페이지 SQL 수행 | |
| 6 | Query Plan 확인 | • 5항 SQL 수행 수 Query Plan 확인 | |



# SQL Sample from Capella Playground

```
SELECT route.airline, route.schedule, route.sourceairport
FROM route
WHERE route.sourceairport = "JFK"
ORDER BY route.airline LIMIT 5;
```

```
SELECT h.city, AVG(r.ratings.Overall) AS hotel_rating
FROM hotel AS h
UNNEST h.reviews AS r
WHERE h.country = "United Kingdom"
GROUP BY h.city
HAVING AVG(r.ratings.Overall) > 4.9
```

```
SELECT DISTINCT airline.name, airline.callsign, route.schedule,
route.sourceairport, route.destinationairport
FROM route
INNER JOIN airline
ON route.airlineid = META(airline).id
WHERE route.sourceairport = "JFK"
AND route.destinationairport = "SFO"
AND airline.callsign = "UNITED";
```

```
SELECT h.name, h.address
FROM hotel h
WHERE h.city = 'San Francisco'
AND ANY r IN h.reviews
SATISFIES r.ratings.Overall > 3 END
```

```
SELECT h.city, h.name,
AVG(r.ratings.Overall) AS avg_rating,
RANK() OVER (PARTITION BY h.city ORDER BY AVG(r.ratings.Overall) DESC) as city_rank
FROM hotel as h
UNNEST h.reviews r
WHERE h.country = "France"
GROUP BY h.city, h.name
```

# SQL Sample from Capella Playground

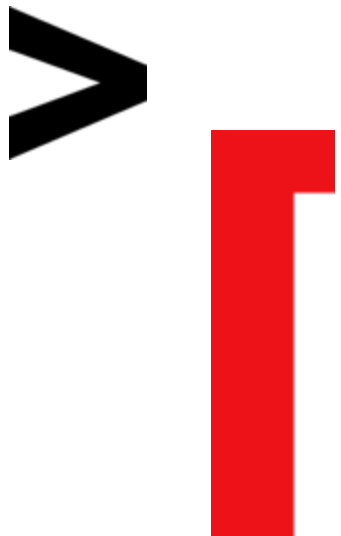
```
WITH AirlineDestinations AS (
  SELECT r.destinationairport,
  ARRAY_COUNT(r.schedule) AS flights
  FROM `travel-sample`.inventory.route AS r
  WHERE r.airline = "UA"
  GROUP BY r.destinationairport, r.schedule
)
SELECT ad.destinationairport, SUM(ad.flights) AS total_flights
FROM AirlineDestinations AS ad
GROUP BY ad.destinationairport
ORDER BY ad.destinationairport;
```

```
SELECT h.city,
 ARRAY_AGG(h.name)
  FILTER (WHERE ANY AND EVERY r IN h.reviews
  SATISFIES r.ratings.Overall >= 3 END) AS good_hotels,
 ARRAY_AGG(h.name)
  FILTER (WHERE ANY r IN h.reviews
  SATISFIES r.ratings.Overall < 3 END) AS other_hotels
FROM hotel as h
GROUP BY h.city;
```

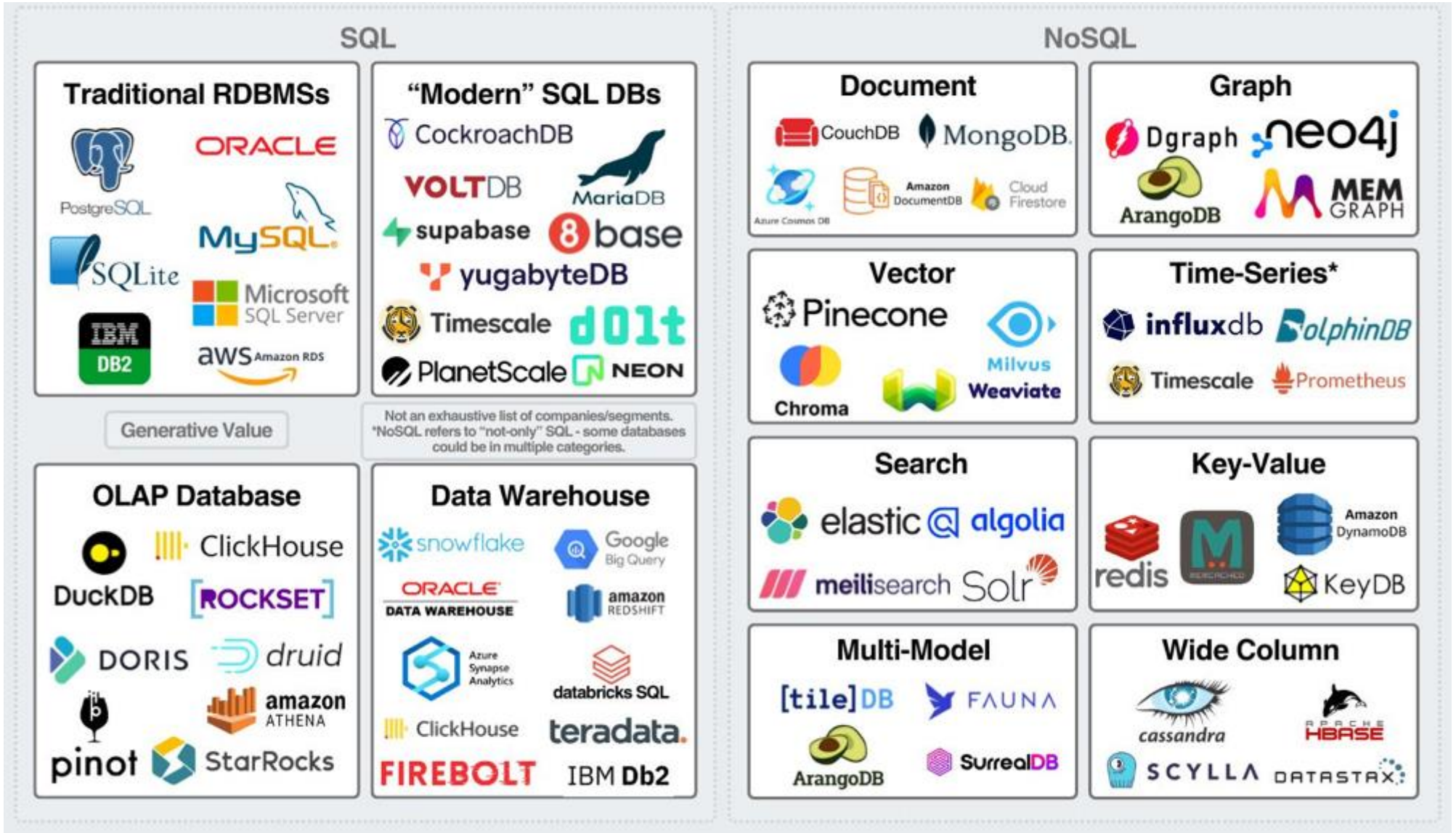
```
select a.name, count(1) as numRoutes
from route r
join airline a on r.airlineid = meta(a).id
group by a.name
having count(1) > 2000
order by count(1) desc;
```

```
select meta().id as _id, * from route
```

# Appendix. JSON 데이터 모델



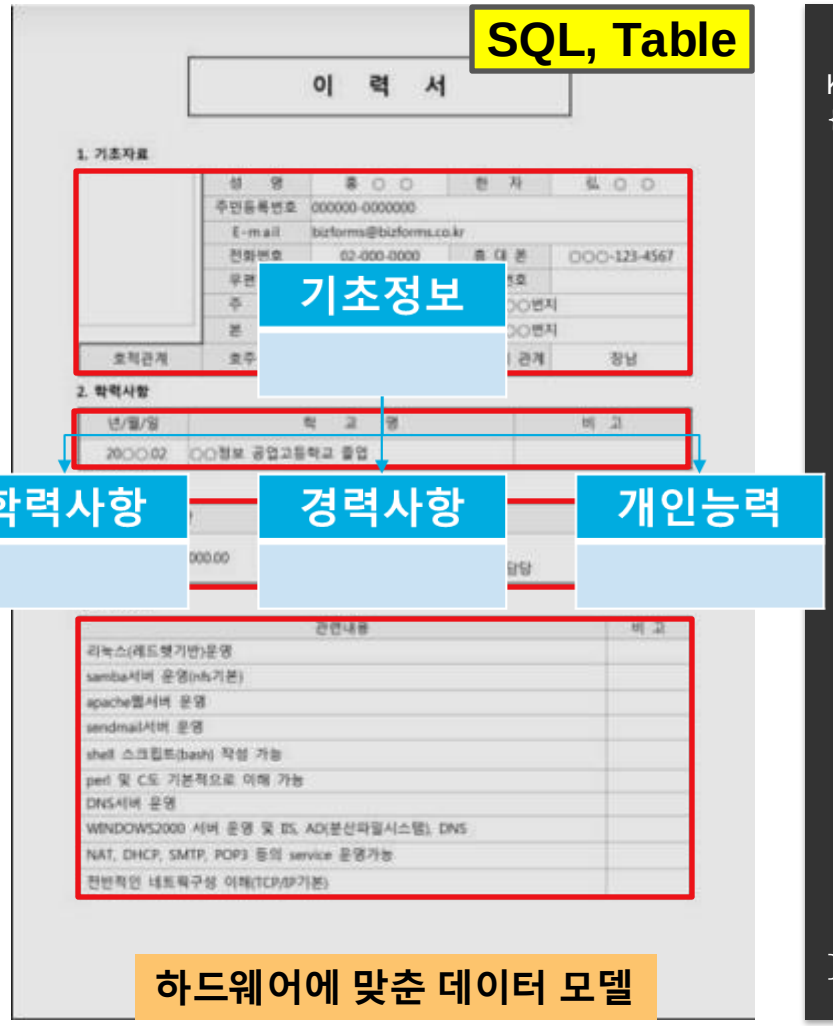
# 데이터 모델 : SQL(Table)과 NoSQL(Real World)



# 데이터 모델 : JSON 도큐먼트

**JSON은 텍스트로 이루어져 있으므로, 사람과 기계 모두 읽고 쓰기 쉽다. 프로그래밍 언어와 플랫폼에 독립적이므로, 서로 다른 시스템 간에 객체를 교환하기에 좋다.**

- JSON 도큐먼트의 장점
  - 단일 도큐먼트 내에 다양한 정보를 계층 구조를 활용하여 저장
  - 정보 추가/삭제가 유연한 구조 제공
  - 데이터 전달을 위한 표준 인터페이스 역할
- RDB와 차별점
  - 여러 테이블로 분리, 저장되는 데이터를 단일 도큐먼트에 저장
  - 테이블 간 조인을 최소화하여 데이터 처리 속도 향상




**NoSQL, JSON 도큐먼트**

```
KEY : 1001
{
    "성명": "홍길동",
    "주소": "서울시 OO구 OO동 OOO-OOO",
    "E-mail": "HongKildong@couchbase.com",
    …
    "학력사항": [
        {
            "졸업년도": "2019년",
            "학교명": "OO정보 공업고등학교"
        }
    ],
    "경력사항": [
        {
            "기간": "2019 ~ 현재",
            "관련내용": "XX글로벌 IT팀 Unix 서버 담당"
        }
    ]
    "개인능력": [
        {
            "관련내용": "리눅스 운영"
            "비고": NULL
        },
        …
    ]
}
```

**실제 세계에 맞춘 데이터 모델**

# 논리 / 물리 모델

- RDBMS와 유사한 구조의 논리 계층 구조로 구성하여 편리한 데이터 관리
- Data 서비스를 완전 메모리DB로 사용도 가능하며 용도에 따라 물리 저장 방식을 선택할 수 있음

| RDBMS | Couchbase |
|---|---|
| Server | Cluster |
| **Database** | **Bucket** |
| **Schema** | **Scope** |
| **Table** | **Collection** |
| **Row** | **Document (JSON)** |
| Value | Sub-Document, Array |

| Feature | Ephemeral Bucket | Couchbase Bucket | Magma Bucket |
|---|---|---|---|
| Bucket memory quota (per node) | Min 256MB | Min 256MB | Min 1024MB |
| Max Object Size | 20MB | 20MB | 20MB |
| Persistence | no | yes | yes |
| Replication and XDCR | yes | yes | yes |
| Encrypted data access | yes | yes | yes |
| Rebalance | yes | yes | yes |
| N1QL, Seach, Analytics, Eventing | yes | yes | yes |
| Indexing | yes | yes | yes |
| Backup | yes | yes | yes |

# 관계형 vs. 다큐멘터 데이터 모델

| 관계형 데이터 모델 | 다큐멘트 데이터 모델 |
| --- | --- |
| ***Required* 정규화** | ***Relaxed* 정규화** |
| • Schema enforced by the database (스키마가 데이터베이스에 의해 강제짐)<br>• Same fields required in all records (모든 레코드는 같은 필드를 가져야 함) | • Schema inferred from structure (시키마는 구조로 부터 추론됨)<br>• Fields may vary, be duplicate or missing (필드에 어떤 제약도 없음) |
| • Optimized for data entry(데이터 구성에 최적화)<br>• Reduced duplicated data (중복 감소,제거)<br>• Minimize data inconsistencies (데이터 불일치 최소화) | • Optimized based on access patterns (사용 패턴에 최적화)<br>• Flexible and agile development(유연하고 빠른 개발)<br>• Supports clustered, scalable architecture(확장성 보장) |

# Real World Data 를 JSON으로 표현

**Customer**

| CustomerID | Name | DoB |
|---|---|---|
| CBL2017 | Jane Smith | 1990-01-30 |

Customer Document Key: CBL2017

```
{
    "Name" : "Jane Smith",
    "DOB"  : "1990-01-30”
}
```

OR

Customer Document Key: CBL2017

```
{
    "Name" : {
         "fname": "Jane",
         "lname": "Smith"
     }
    "DOB"  : "1990-01-30"
}
```

- **The Primary Key becomes the Document Key**
- **Column name-Column value become KEY-VALUE pair**

# 고객의 카드 정보를 JSON으로 표현

## Customer

| CustomerID | Name | DoB |
|---|---|---|
| CBL2017 | Jane Smith | 1990-01-30 |

## Billing

| CustomerID | Type | CardNum | Expiry |
|---|---|---|---|
| CBL2017 | Visa | 5827-2842-2847-3222 | 2025-03 |
| CBL2017 | Master | 6274-2542-5847-3949 | 2024-12 |

Customer Document Key: CBL2017

```
{
    "Name" : "Jane Smith",
    "DOB"  : "1990-01-30",
    "Billing" : [
        {
            "type"    : "visa",
            "cardnum" : "5827-2842-2847-3222",
            "expiry"  : "2025-03"
        },
        {
            "type"    : "master",
            "cardnum" : "6274-2542-5847-3949",
            "expiry"  : "2024-12"
        }
    ]
}
```

- **Denormalization simplifies data access and offers the best performance**
  **비정규화는 데이터 사용을 단순화 해주고, 최고의 성능을 제공함**
- **Value evolution: Simply add additional array element or update a value**

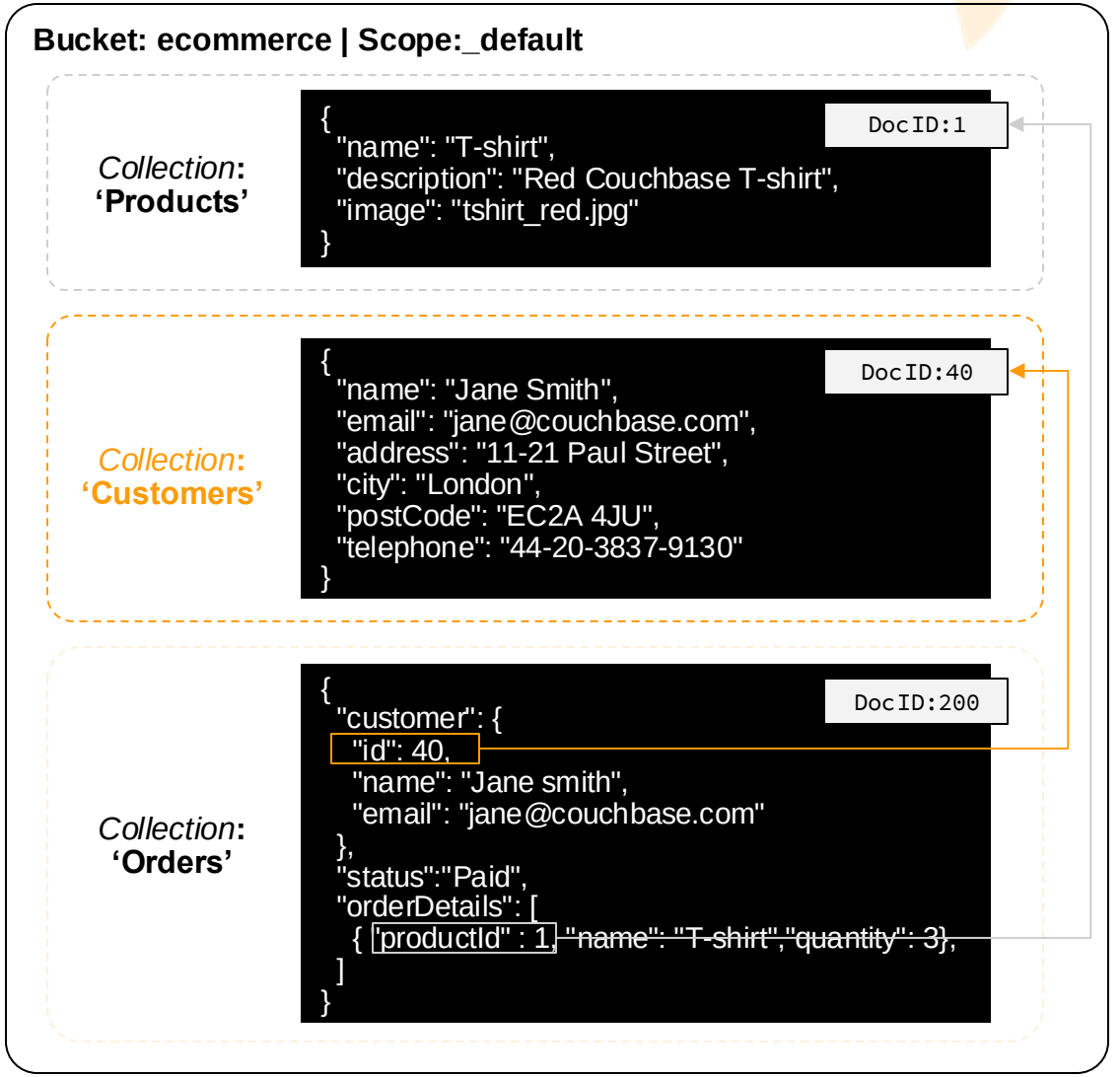
# 테이블(RDBMS)을 컬렉션(NoSQL)에 매핑 | eCommerce 예제

| Orders | |
|---|---|
| id | 200 |
| customer | 40 |
| status | Paid |

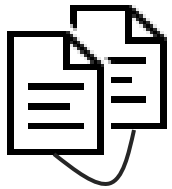
| Customers | |
|---|---|
| id | 40 |
| name | Jane Smith |
| email | jane@couchbase.com |
| address | 11-21 Paul Street |
| city | London |
| postcode | EC2Q 4JU |
| telephone | 44-20-3837-9130 |

| Orders Details | |
|---|---|
| id | 3000 |
| order | 200 |
| item | 1 |
| quantity | 3 |

| Products | |
|---|---|
| id | 1 |
| name | T-shirt |
| description | Red Couchbase T-shirt |
| image | tshirt_red.jpg |

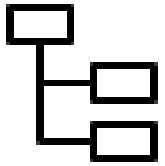


# JSON 데이터 모델시 고려사항



## EMBED WHEN

- There is an Ownership Relationship
  **오너쉽 관계가 명확할 때**
- Both docs are frequently accessed together
  **두 문서가 동시에 사용되는 경우가 많을 때**
- Reads greatly outnumber writes
  **읽기가 쓰기에 비해 많을 때**
- Data is small
  **데이터 사이즈가 작을 때**



## REFER WHEN

- There is not an Ownership Relationship
  **오너쉽 관계가 명확하지 않을 때**
- Both docs are not frequently accessed together
  **두 문서가 동시에 사용되는 경우이 작을 때**
- Document is updated frequently
  **문서가 자주 변경될 때**
- Need to reduce the document size
  **문서의 크기를 줄일 필요가 있을 때**

Try to embed first, refer when it makes sense

**먼저 Embed를 시도해 보고, 그 다음 Refer 고려**

# Relationships에 따른 Embed 와 Refer

- **1-1**

  **Embed** Example: Satellite and Manufacturer

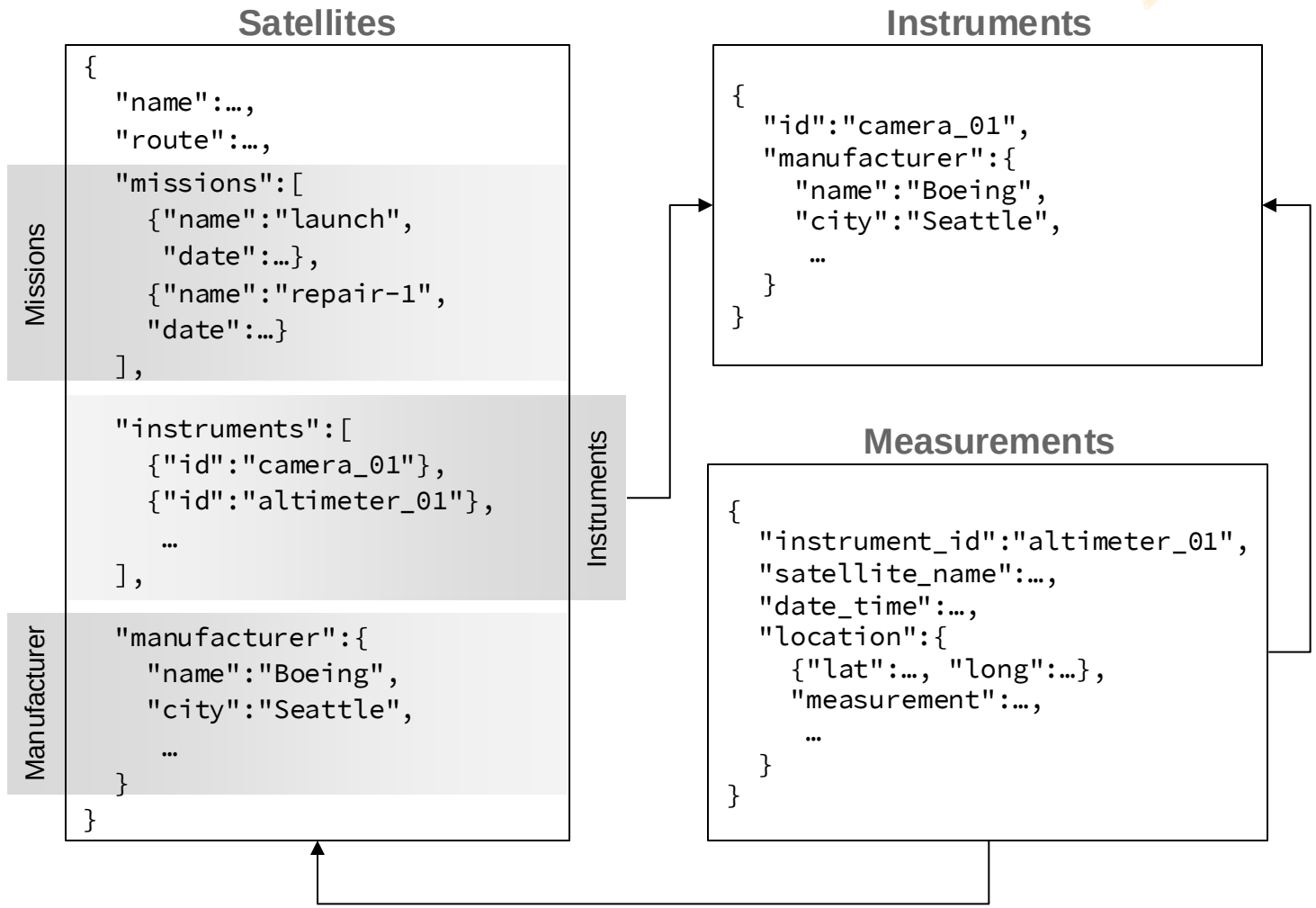
- **1-Many**

  **Embed** Example: Satellite and Missions

  **Reference** Example: Measurements, Satellites and Instruments

- **Many-Many**

  **Reference** Example: Satellite and Instruments



# 수고하셨습니다.

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