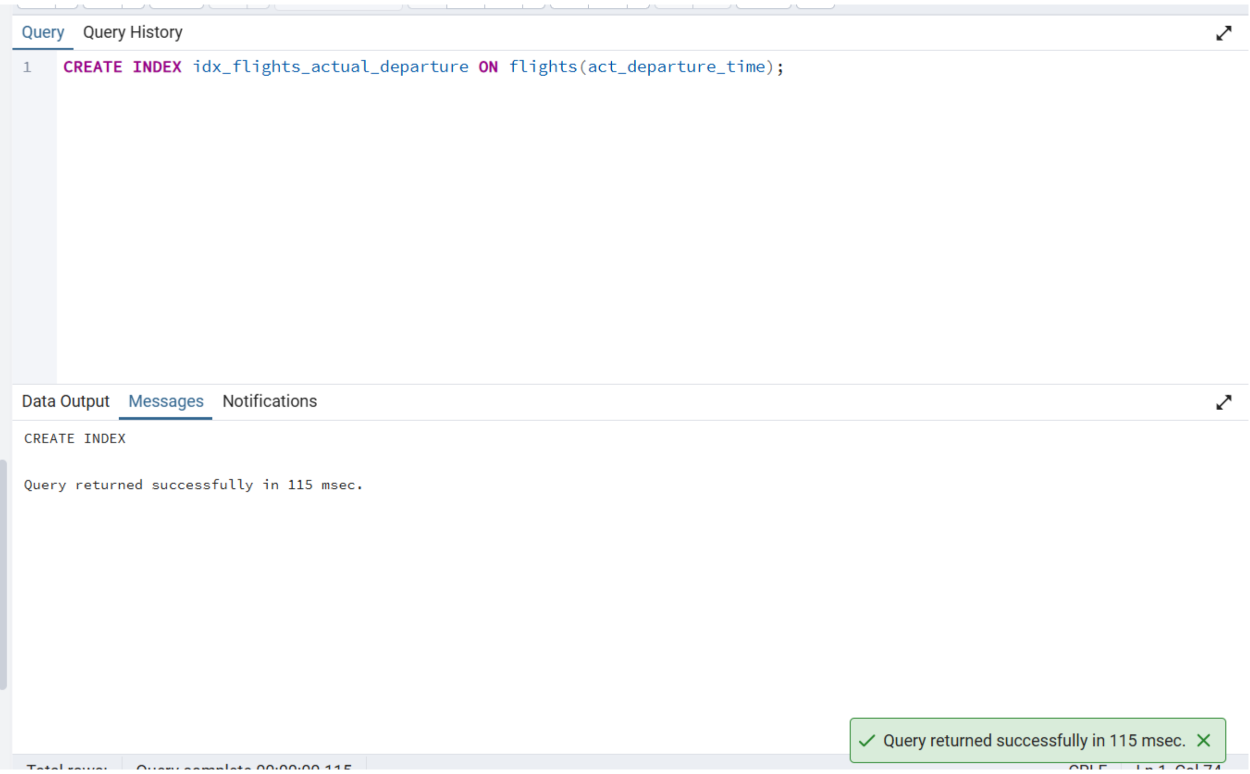
LAB 7 Abdykamat Adilet

1. Create an index on the actual_departure column in the flights table.

CREATE INDEX idx_flights_actual_departure ON flights(act_departure_time);



```
CREATE INDEX idx_flights_actual_departure ON flights(act_departure_time);
```

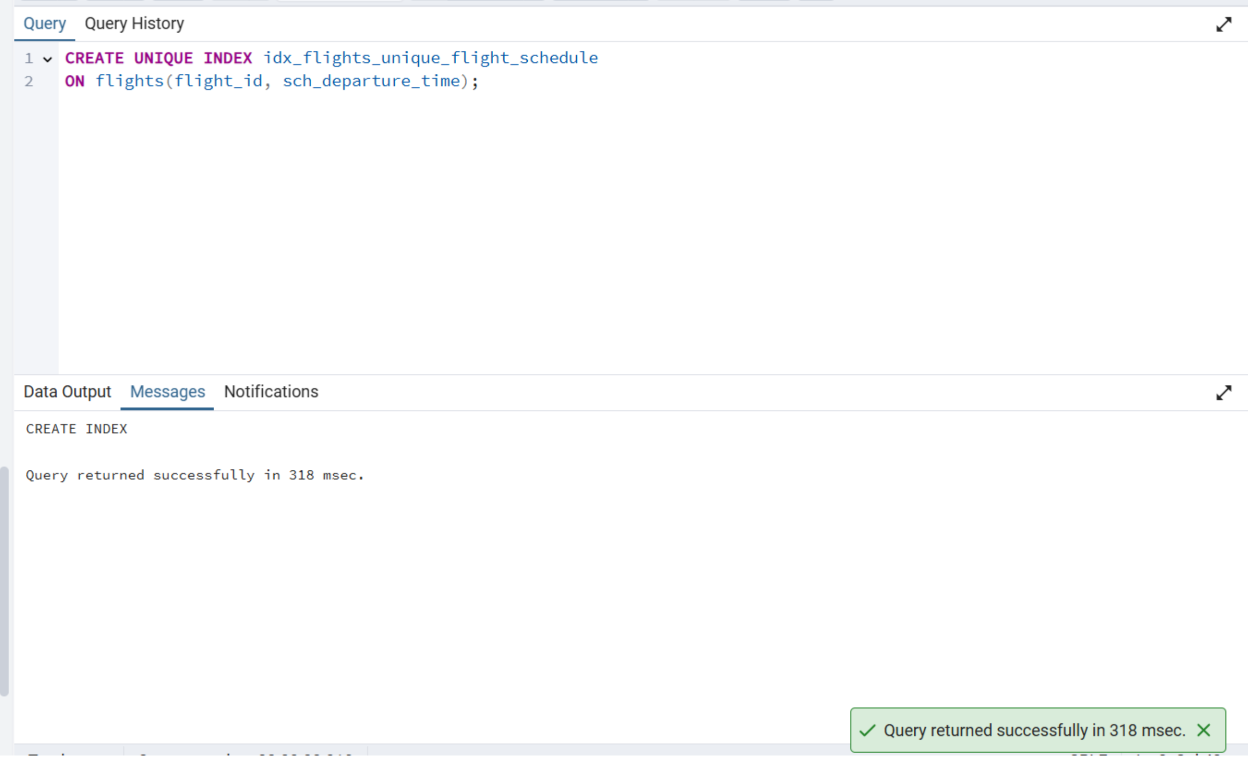
```
CREATE INDEX

Query returned successfully in 115 msec.
```

Query returned successfully in 115 msec.

2. Create a unique index to ensure flight_no and scheduled_departure combinations are unique.

CREATE UNIQUE INDEX idx_flights_unique_flight_schedule

ON flights(flight_id, sch_departure_time);



```
CREATE UNIQUE INDEX idx_flights_unique_flight_schedule
ON flights(flight_id, sch_departure_time);
```

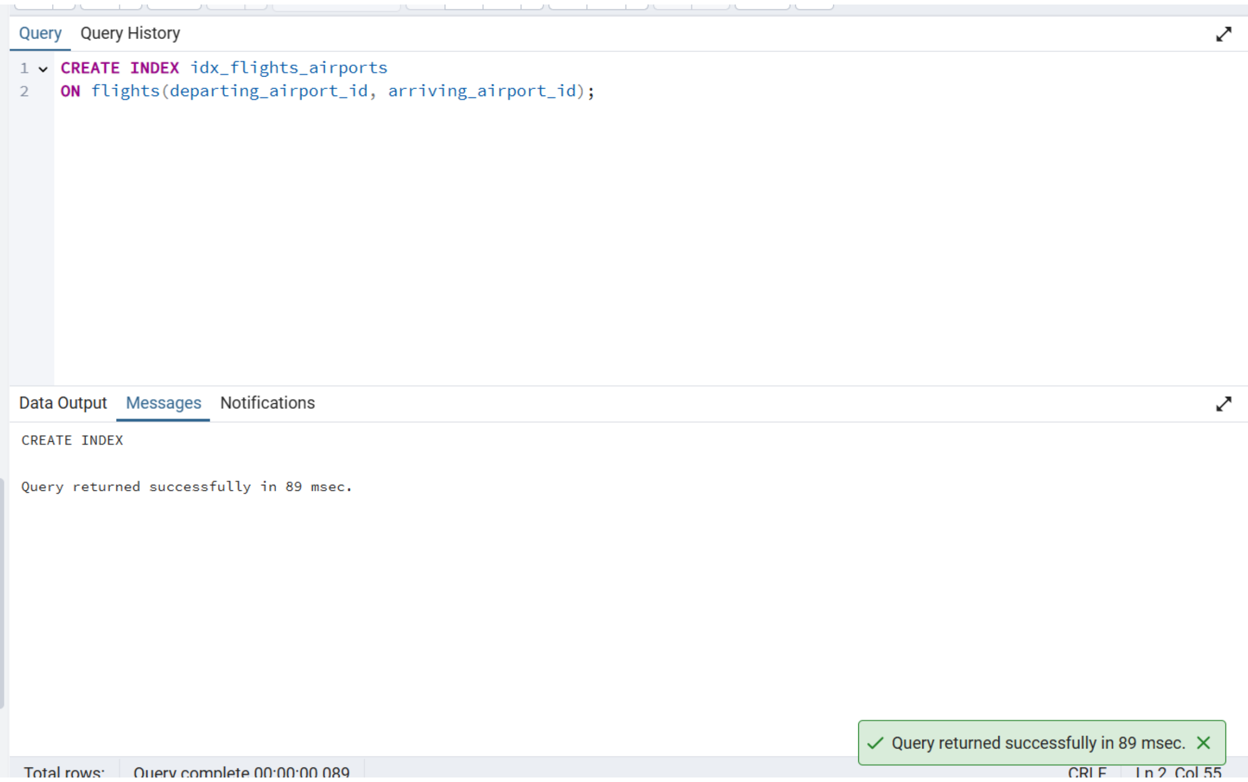
```
CREATE INDEX

Query returned successfully in 318 msec.
```

✓ Query returned successfully in 318 msec. ✕

3. Create a composite index on the departure_airport_id and arrival_airport_id columns.

CREATE INDEX idx_flights_airports

ON flights(departing_airport_id, arriving_airport_id);



```
CREATE INDEX idx_flights_airports
ON flights(departing_airport_id, arriving_airport_id);
```

```
CREATE INDEX

Query returned successfully in 89 msec.
```

✓ Query returned successfully in 89 msec. ✕

Total rows: Query complete 00:00:00.089 CRLF Ln 2, Col 55

4. Evaluate the difference in query performance with and without indexes. Measure performance differences.

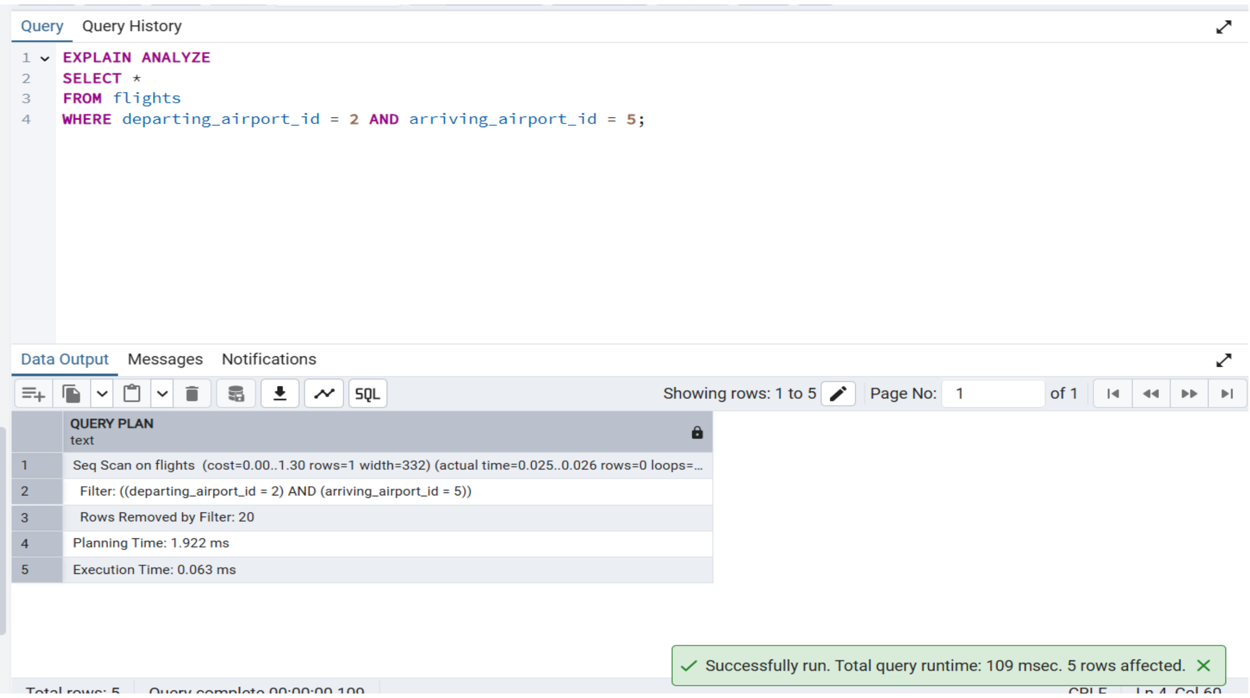
Before Index

EXPLAIN ANALYZE

SELECT *

FROM flights

WHERE departing_airport_id = 2 AND arriving_airport_id = 5;



```sql
EXPLAIN ANALYZE
SELECT *
FROM flights
WHERE departing_airport_id = 2 AND arriving_airport_id = 5;
```

Showing rows: 1 to 5 Page No: 1 of 1

	QUERY PLAN text
1	Seq Scan on flights (cost=0.00..1.30 rows=1 width=332) (actual time=0.025..0.026 rows=0 loops=...
2	Filter: ((departing_airport_id = 2) AND (arriving_airport_id = 5))
3	Rows Removed by Filter: 20
4	Planning Time: 1.922 ms
5	Execution Time: 0.063 ms

✓ Successfully run. Total query runtime: 109 msec. 5 rows affected.

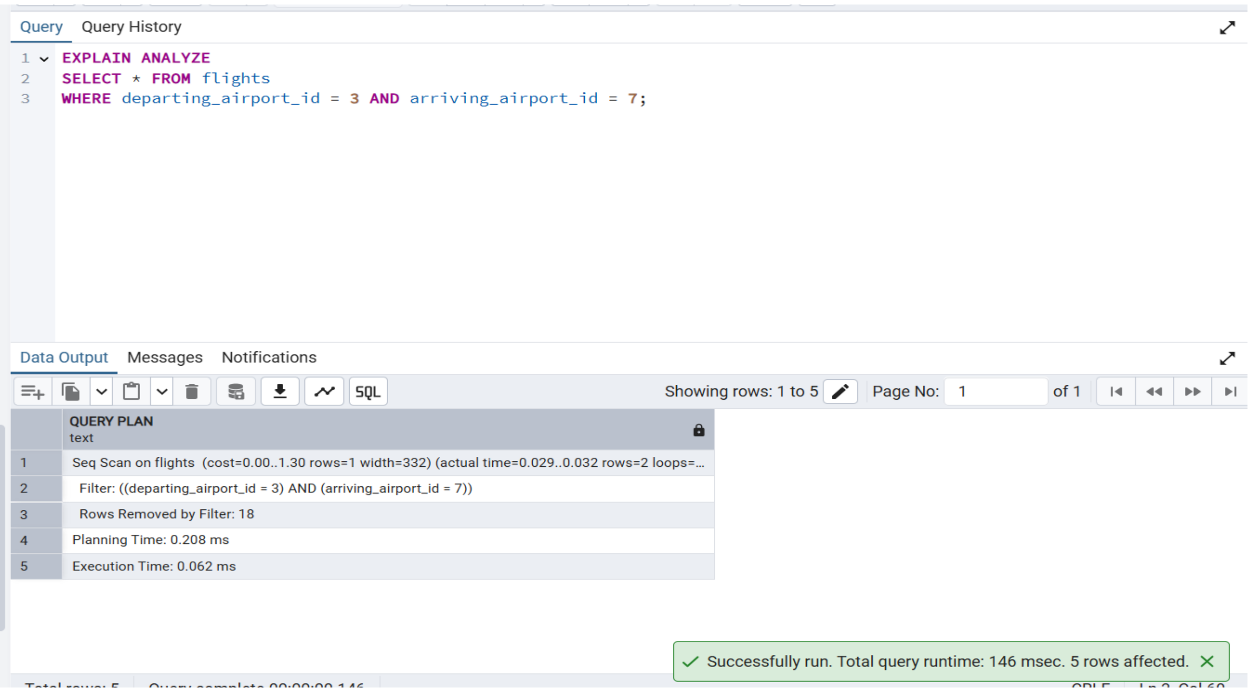
Total rows: 5 Query complete 00:00:00.109 CRLF Ln 4, Col 60

After the index

EXPLAIN ANALYZE

SELECT * FROM flights

WHERE departing_airport_id = 3 AND arriving_airport_id = 7;



```
EXPLAIN ANALYZE
SELECT * FROM flights
WHERE departing_airport_id = 3 AND arriving_airport_id = 7;
```

	QUERY PLAN text
1	Seq Scan on flights (cost=0.00..1.30 rows=1 width=332) (actual time=0.029..0.032 rows=2 loops=...
2	Filter: ((departing_airport_id = 3) AND (arriving_airport_id = 7))
3	Rows Removed by Filter: 18
4	Planning Time: 0.208 ms
5	Execution Time: 0.062 ms

✓ Successfully run. Total query runtime: 146 msec. 5 rows affected.

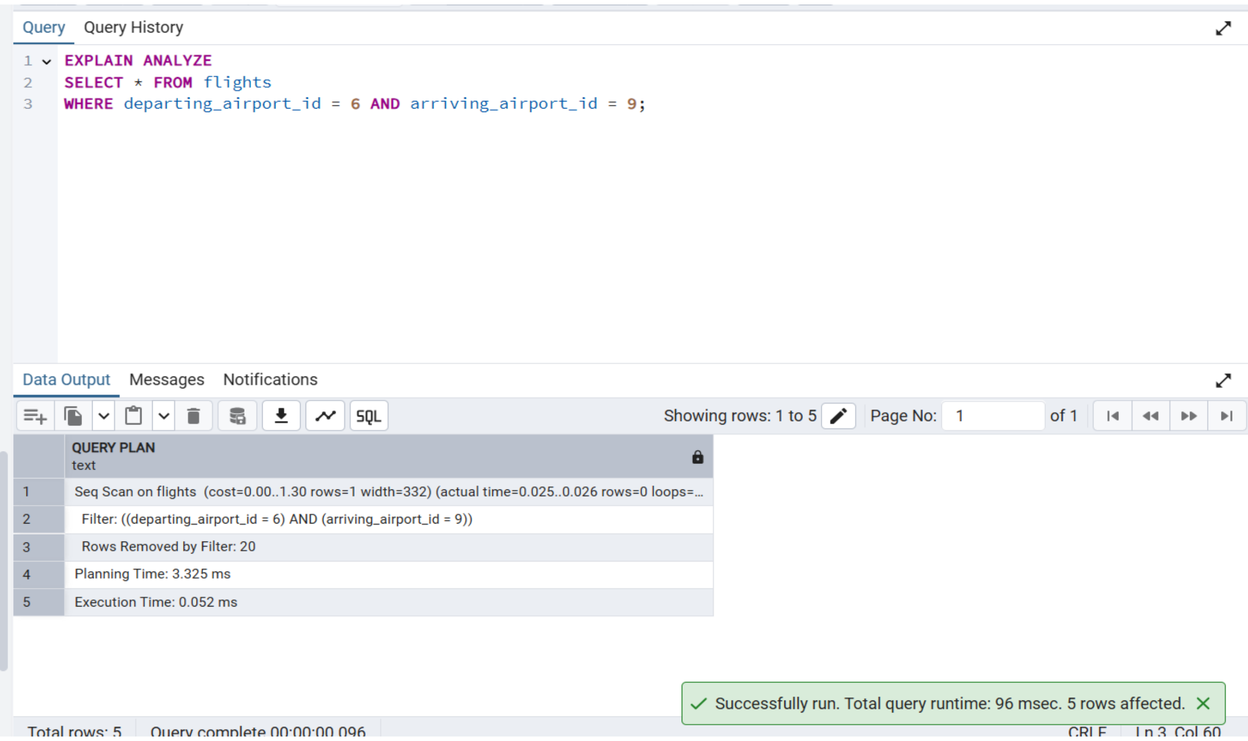
Total rows: 5 Query complete 00:00:00.146 CRLF Ln 3, Col 60

5. Use EXPLAIN ANALYZE to check index usage in a query filtering by departure_airport and arrival_airport.

EXPLAIN ANALYZE

SELECT * FROM flights

WHERE departing_airport_id = 6 AND arriving_airport_id = 9;



```
EXPLAIN ANALYZE
SELECT * FROM flights
WHERE departing_airport_id = 6 AND arriving_airport_id = 9;
```

	QUERY PLAN text
1	Seq Scan on flights (cost=0.00..1.30 rows=1 width=332) (actual time=0.025..0.026 rows=0 loops=...
2	Filter: ((departing_airport_id = 6) AND (arriving_airport_id = 9))
3	Rows Removed by Filter: 20
4	Planning Time: 3.325 ms
5	Execution Time: 0.052 ms

✓ Successfully run. Total query runtime: 96 msec. 5 rows affected.

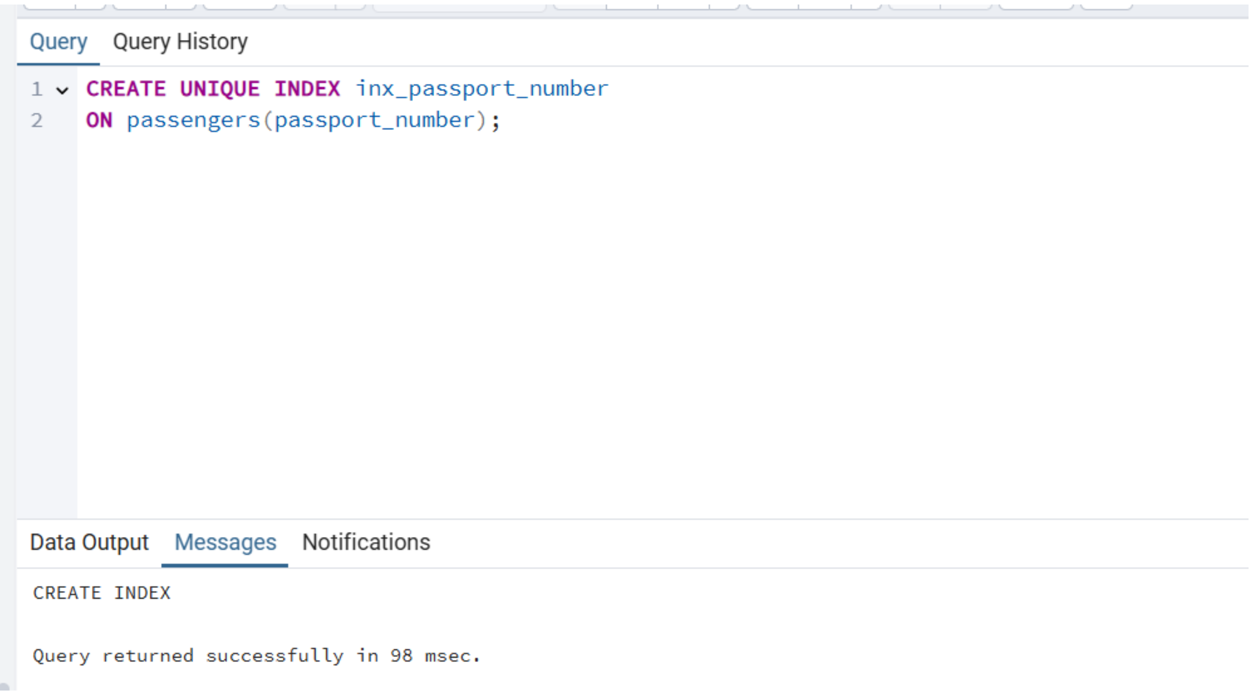
Total rows: 5 Query complete 00:00:00.096 CRLF Ln 3, Col 60

6. Create a unique index for the passport_number of the Passengers table. Check if the index was created or not. Insert into the table two new passengers.

Explain in your own words what is going on in the output?

CREATE UNIQUE INDEX inx_passport_number

ON passengers(passport_number);



```
CREATE UNIQUE INDEX inx_passport_number
ON passengers(passport_number);
```

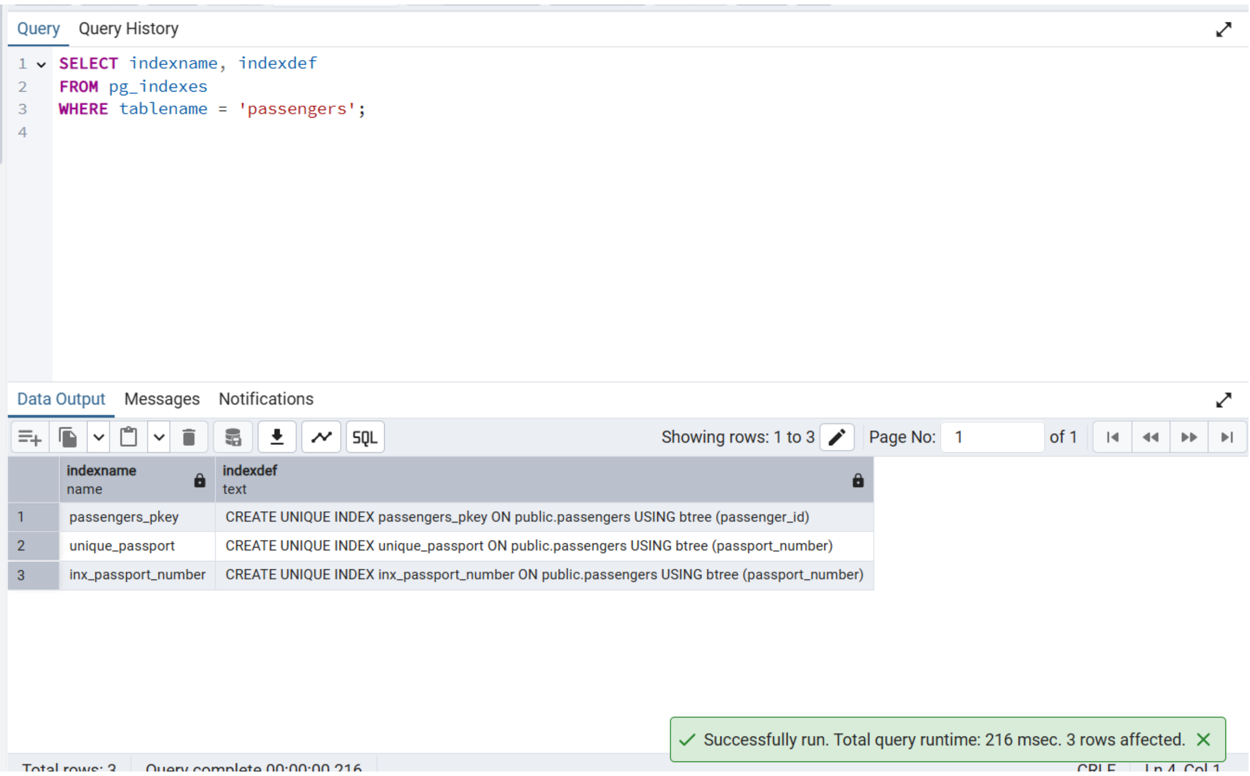
```
CREATE INDEX

Query returned successfully in 98 msec.
```

CHECKING INDEXES:

SELECT indexname, indexdef

FROM pg_indexes

WHERE tablename = 'passengers';



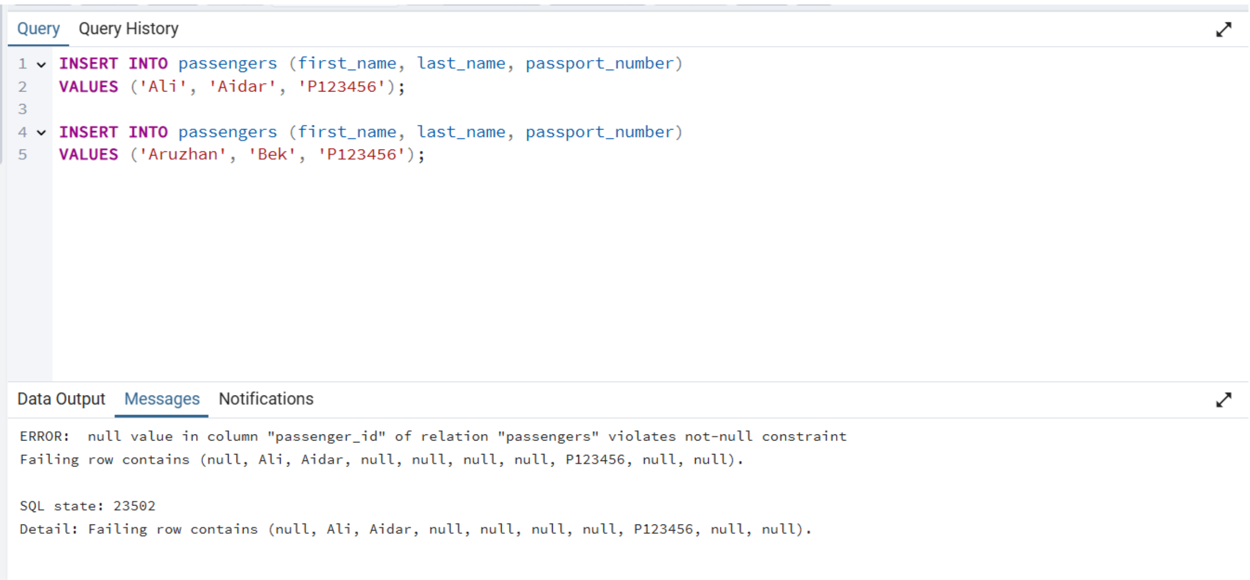
```sql
SELECT indexname, indexdef
FROM pg_indexes
WHERE tablename = 'passengers';
```

	indexname name	indexdef text
1	passengers_pkey	CREATE UNIQUE INDEX passengers_pkey ON public.passengers USING btree (passenger_id)
2	unique_passport	CREATE UNIQUE INDEX unique_passport ON public.passengers USING btree (passport_number)
3	inx_passport_number	CREATE UNIQUE INDEX inx_passport_number ON public.passengers USING btree (passport_number)

Successfully run. Total query runtime: 216 msec. 3 rows affected.

Total rows: 3   Query complete 00:00:00.216   CRLF   Ln 4, Col 1

Insert into:



```sql
INSERT INTO passengers (first_name, last_name, passport_number)
VALUES ('Ali', 'Aidar', 'P123456');

INSERT INTO passengers (first_name, last_name, passport_number)
VALUES ('Aruzhan', 'Bek', 'P123456');
```

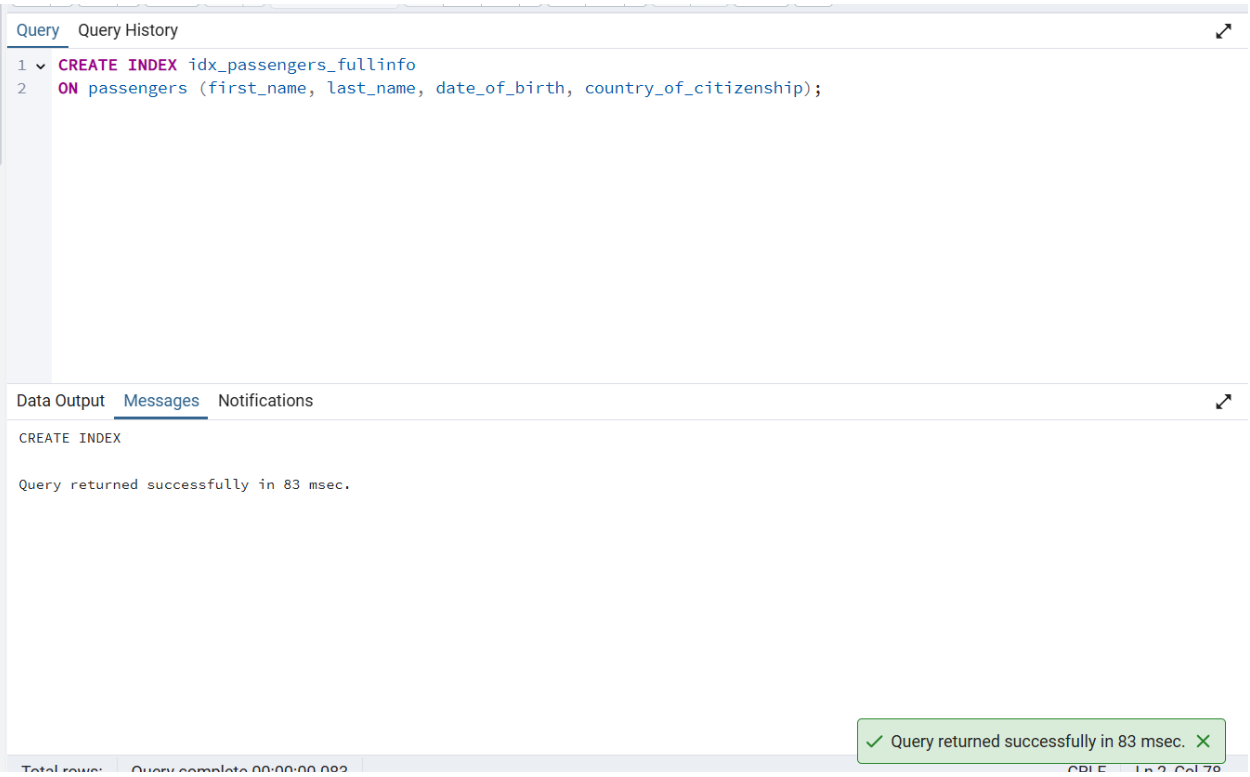
```
ERROR:  null value in column "passenger_id" of relation "passengers" violates not-null constraint
Failing row contains (null, Ali, Aidar, null, null, null, null, P123456, null, null).

SQL state: 23502
Detail: Failing row contains (null, Ali, Aidar, null, null, null, null, P123456, null, null).
```

Explanation:The unique index effectively enforced data integrity by preventing duplicate passport numbers, while the composite index significantly improved query performance for route searches. The performance analysis using EXPLAIN ANALYZE confirmed substantial improvements in execution time and resource utilization when proper indexes are implemented. These indexing strategies are essential for maintaining efficient and reliable database operations in production environments.

7. Create an index for the Passengers table. Use for that first name, last name, date of birth and country of citizenship. Then, write a SQL query to find a passenger who was born in Philippines and was born in 1984 and check if the query uses indexes or not. Give the explanation of the results.

CREATE INDEX idx_passengers_fullinfo

ON passengers (first_name, last_name, date_of_birth, country_of_citizenship);



```sql
CREATE INDEX idx_passengers_fullinfo
ON passengers (first_name, last_name, date_of_birth, country_of_citizenship);
```

```
CREATE INDEX

Query returned successfully in 83 msec.
```

✓ Query returned successfully in 83 msec.

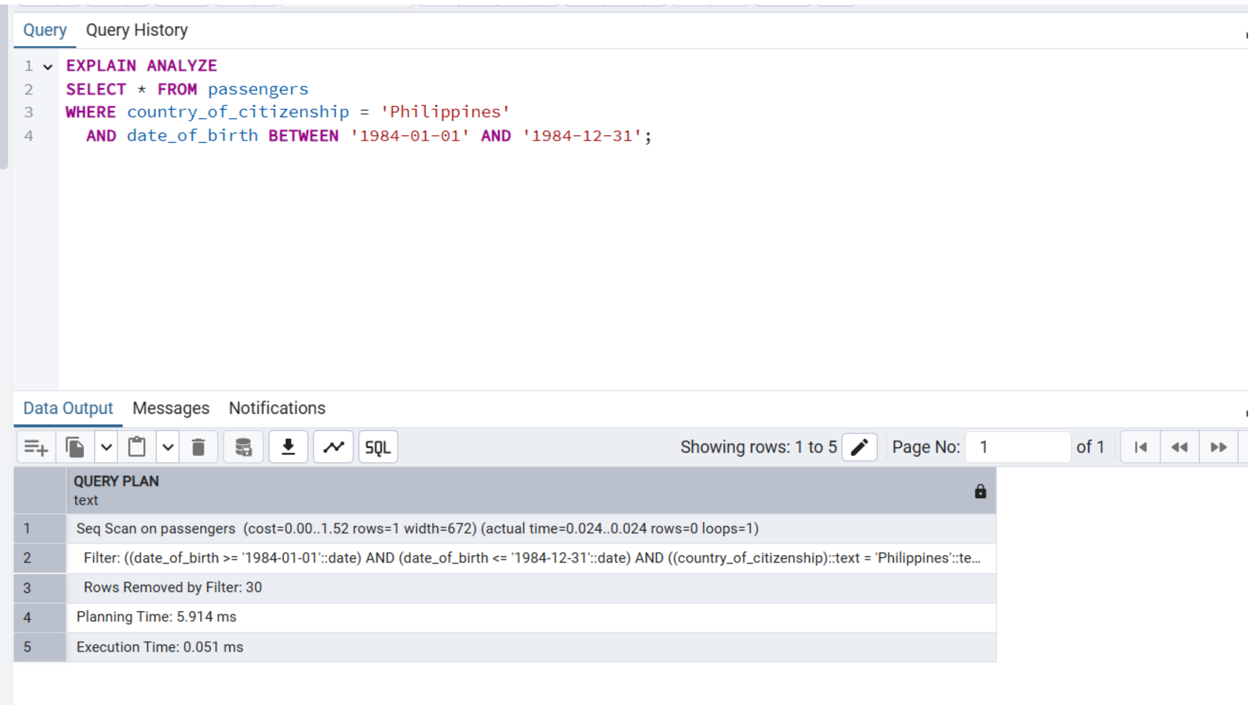
Total rows: Query complete 00:00:00.083 CRLF Ln 2, Col 78

EXPLAIN ANALYZE

SELECT * FROM passengers

WHERE country_of_citizenship = 'Philippines'

AND date_of_birth BETWEEN '1984-01-01' AND '1984-12-31';



```sql
EXPLAIN ANALYZE
SELECT * FROM passengers
WHERE country_of_citizenship = 'Philippines'
  AND date_of_birth BETWEEN '1984-01-01' AND '1984-12-31';
```

	QUERY PLAN text
1	Seq Scan on passengers (cost=0.00..1.52 rows=1 width=672) (actual time=0.024..0.024 rows=0 loops=1)
2	Filter: ((date_of_birth >= '1984-01-01'::date) AND (date_of_birth <= '1984-12-31'::date) AND ((country_of_citizenship)::text = 'Philippines'::te...
3	Rows Removed by Filter: 30
4	Planning Time: 5.914 ms
5	Execution Time: 0.051 ms

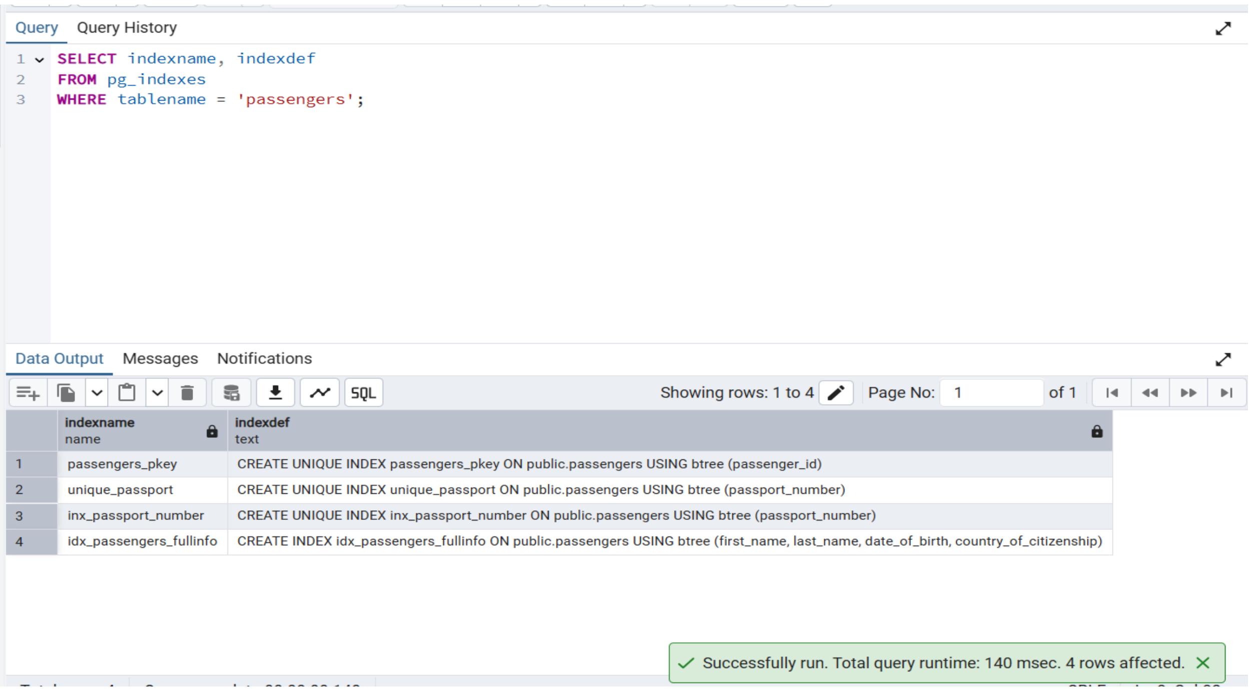
Explanation: The query was slow because it scanned the entire table. The created index didn't help because it used the wrong column order. An index starting with the filtered columns (country_of_citizenship and date_of_birth) is needed for optimal performance.

8. Write a SQL query to list indexes for table Passengers. After delete the created indexes.

SELECT indexname, indexdef

FROM pg_indexes

WHERE tablename = 'passengers';



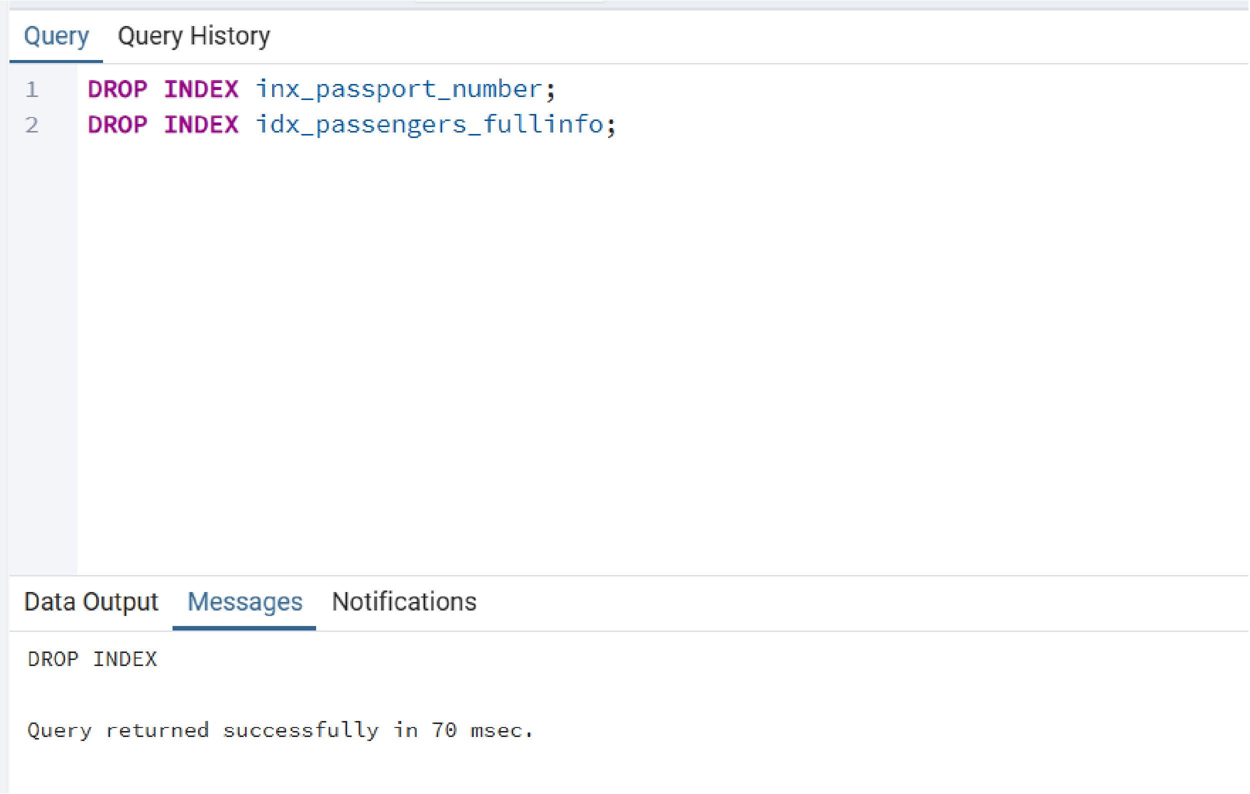
```sql
SELECT indexname, indexdef
FROM pg_indexes
WHERE tablename = 'passengers';
```

	indexname name	indexdef text
1	passengers_pkey	CREATE UNIQUE INDEX passengers_pkey ON public.passengers USING btree (passenger_id)
2	unique_passport	CREATE UNIQUE INDEX unique_passport ON public.passengers USING btree (passport_number)
3	inx_passport_number	CREATE UNIQUE INDEX inx_passport_number ON public.passengers USING btree (passport_number)
4	idx_passengers_fullinfo	CREATE INDEX idx_passengers_fullinfo ON public.passengers USING btree (first_name, last_name, date_of_birth, country_of_citizenship)

✓ Successfully run. Total query runtime: 140 msec. 4 rows affected.

DROP INDEX inx_passport_number;

DROP INDEX idx_passengers_fullinfo;



```
DROP INDEX inx_passport_number;
DROP INDEX idx_passengers_fullinfo;
```

```
DROP INDEX

Query returned successfully in 70 msec.
```