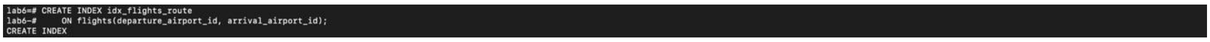
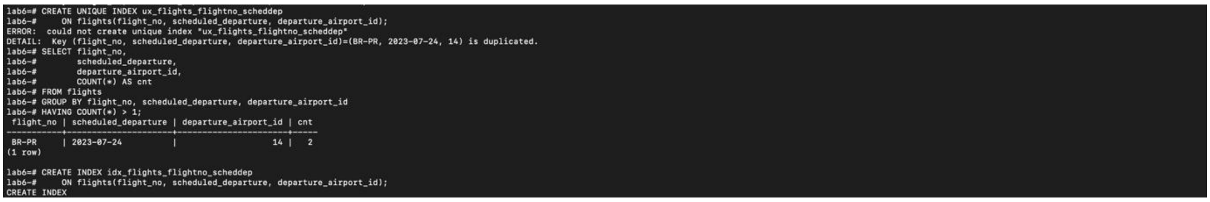
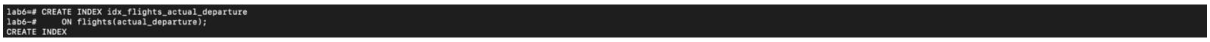


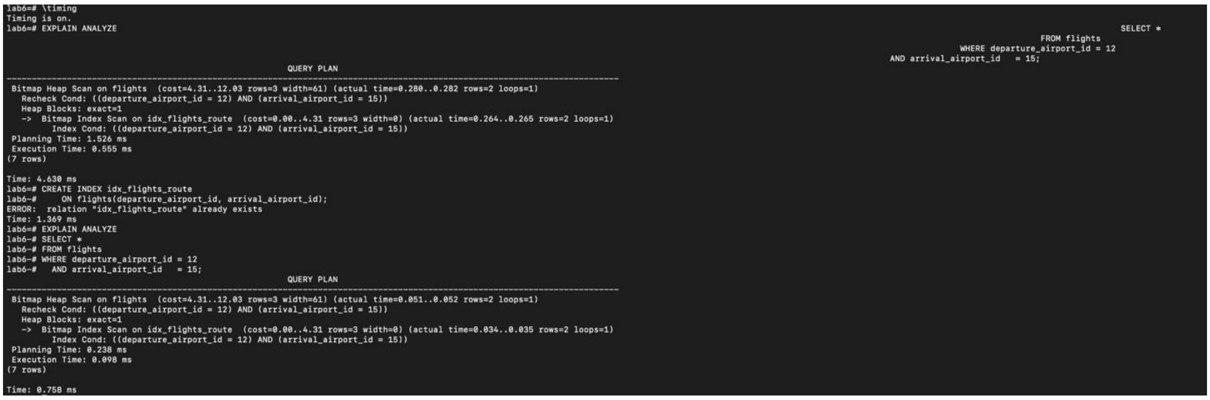
```
lab6=# CREATE INDEX idx_flights_route
lab6-#     ON flights(departure_airport_id, arrival_airport_id);
CREATE INDEX
```



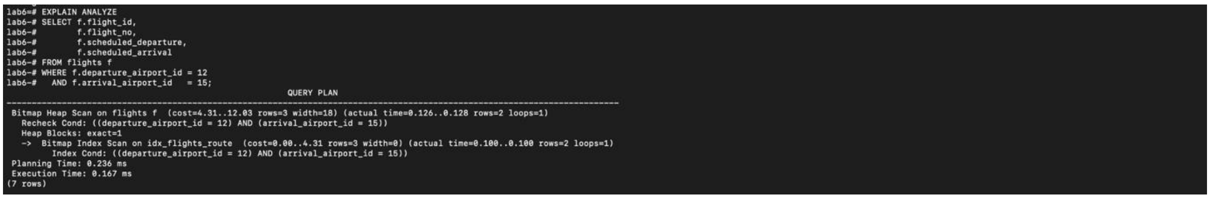
```
lab6=# CREATE UNIQUE INDEX ux_flights_flightno_scheddep
lab6-#     ON flights(flight_no, scheduled_departure, departure_airport_id);
ERROR:  could not create unique index "ux_flights_flightno_scheddep"
DETAIL:  Key (flight_no, scheduled_departure, departure_airport_id)=(BR-PR, 2023-07-24, 14) is duplicated.
lab6=# SELECT flight_no,
lab6-#        scheduled_departure,
lab6-#        departure_airport_id,
lab6-#        COUNT(*) AS cnt
lab6-# FROM flights
lab6-# GROUP BY flight_no, scheduled_departure, departure_airport_id
lab6-# HAVING COUNT(*) > 1;
 flight_no | scheduled_departure | departure_airport_id | cnt
-----------+---------------------+----------------------+-----
 BR-PR     | 2023-07-24          |                   14 |   2
(1 row)

lab6=# CREATE INDEX idx_flights_flightno_scheddep
lab6-#     ON flights(flight_no, scheduled_departure, departure_airport_id);
CREATE INDEX
```



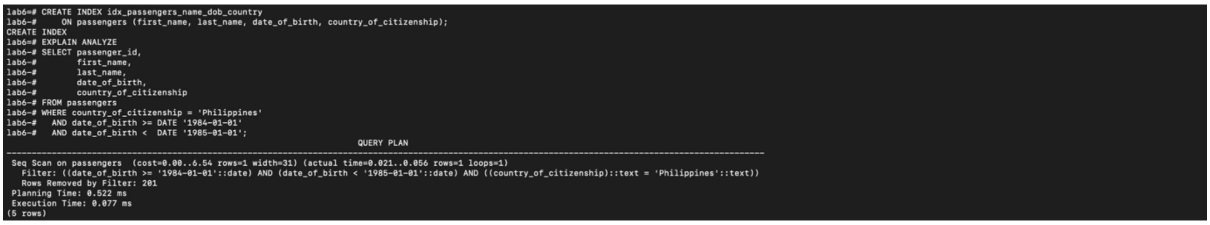
```
lab6=# CREATE INDEX idx_flights_actual_departure
lab6-#     ON flights(actual_departure);
CREATE INDEX
```



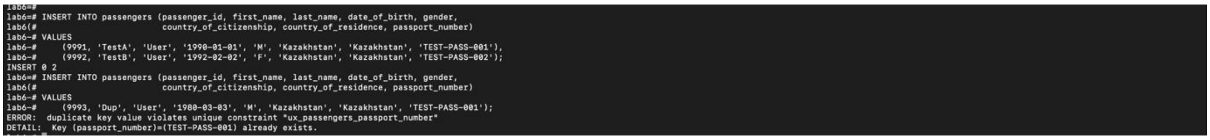
```
lab6=# \timing
Timing is on.
lab6=# EXPLAIN ANALYZE                                                                                                                                                                   SELECT *
                                                                                                                                                            FROM flights
                                                                                                                                                WHERE departure_airport_id = 12
                                                                                                                                  AND arrival_airport_id   = 15;
                                                      QUERY PLAN
-----------------------------------------------------------------------------------------------------------------------
 Bitmap Heap Scan on flights  (cost=4.31..12.03 rows=3 width=61) (actual time=0.280..0.282 rows=2 loops=1)
   Recheck Cond: ((departure_airport_id = 12) AND (arrival_airport_id = 15))
   Heap Blocks: exact=1
   ->  Bitmap Index Scan on idx_flights_route  (cost=0.00..4.31 rows=3 width=0) (actual time=0.264..0.265 rows=2 loops=1)
         Index Cond: ((departure_airport_id = 12) AND (arrival_airport_id = 15))
 Planning Time: 1.526 ms
 Execution Time: 0.555 ms
(7 rows)

Time: 4.630 ms
lab6=# CREATE INDEX idx_flights_route
lab6-#     ON flights(departure_airport_id, arrival_airport_id);
ERROR:  relation "idx_flights_route" already exists
Time: 1.369 ms
lab6=# EXPLAIN ANALYZE
lab6-# SELECT *
lab6-# FROM flights
lab6-# WHERE departure_airport_id = 12
lab6-#   AND arrival_airport_id   = 15;
                                                      QUERY PLAN
-----------------------------------------------------------------------------------------------------------------------
 Bitmap Heap Scan on flights  (cost=4.31..12.03 rows=3 width=61) (actual time=0.051..0.052 rows=2 loops=1)
   Recheck Cond: ((departure_airport_id = 12) AND (arrival_airport_id = 15))
   Heap Blocks: exact=1
   ->  Bitmap Index Scan on idx_flights_route  (cost=0.00..4.31 rows=3 width=0) (actual time=0.034..0.035 rows=2 loops=1)
         Index Cond: ((departure_airport_id = 12) AND (arrival_airport_id = 15))
 Planning Time: 0.238 ms
 Execution Time: 0.098 ms
(7 rows)

Time: 0.758 ms
```



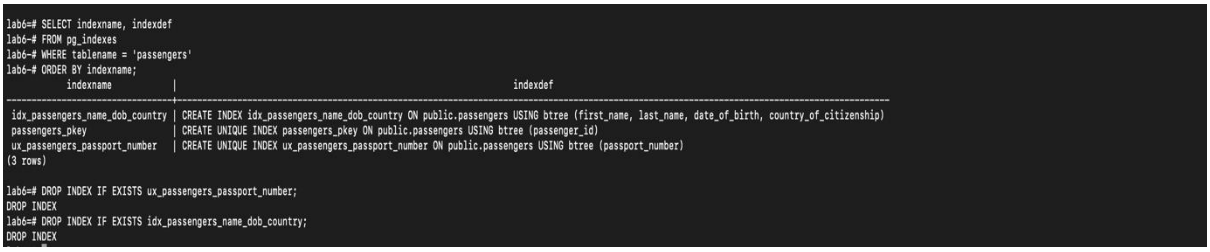
```
lab6=# EXPLAIN ANALYZE
lab6-# SELECT f.flight_id,
lab6-#        f.flight_no,
lab6-#        f.scheduled_departure,
lab6-#        f.scheduled_arrival
lab6-# FROM flights f
lab6-# WHERE f.departure_airport_id = 12
lab6-#   AND f.arrival_airport_id   = 15;
                                                      QUERY PLAN
-----------------------------------------------------------------------------------------------------------------------
 Bitmap Heap Scan on flights f  (cost=4.31..12.03 rows=3 width=18) (actual time=0.126..0.128 rows=2 loops=1)
   Recheck Cond: ((departure_airport_id = 12) AND (arrival_airport_id = 15))
   Heap Blocks: exact=1
   ->  Bitmap Index Scan on idx_flights_route  (cost=0.00..4.31 rows=3 width=0) (actual time=0.100..0.100 rows=2 loops=1)
         Index Cond: ((departure_airport_id = 12) AND (arrival_airport_id = 15))
 Planning Time: 0.236 ms
 Execution Time: 0.167 ms
(7 rows)
```



```
lab6=# CREATE INDEX idx_passengers_name_dob_country
lab6-#     ON passengers (first_name, last_name, date_of_birth, country_of_citizenship);
CREATE INDEX
lab6=# EXPLAIN ANALYZE
lab6-# SELECT passenger_id,
lab6-#        first_name,
lab6-#        last_name,
lab6-#        date_of_birth,
lab6-#        country_of_citizenship
lab6-# FROM passengers
lab6-# WHERE country_of_citizenship = 'Philippines'
lab6-#   AND date_of_birth >= DATE '1984-01-01'
lab6-#   AND date_of_birth <  DATE '1985-01-01';
                                                                    QUERY PLAN
---------------------------------------------------------------------------------------------------------------------------------------------------
 Seq Scan on passengers  (cost=0.00..6.54 rows=1 width=31) (actual time=0.021..0.056 rows=1 loops=1)
   Filter: ((date_of_birth >= '1984-01-01'::date) AND (date_of_birth < '1985-01-01'::date) AND ((country_of_citizenship)::text = 'Philippines'::text))
   Rows Removed by Filter: 201
 Planning Time: 0.522 ms
 Execution Time: 0.077 ms
(5 rows)
```



```
lab6=#
lab6=# INSERT INTO passengers (passenger_id, first_name, last_name, date_of_birth, gender,
lab6(#                         country_of_citizenship, country_of_residence, passport_number)
lab6-# VALUES
lab6-#     (9991, 'TestA', 'User', '1990-01-01', 'M', 'Kazakhstan', 'Kazakhstan', 'TEST-PASS-001'),
lab6-#     (9992, 'TestB', 'User', '1992-02-02', 'F', 'Kazakhstan', 'Kazakhstan', 'TEST-PASS-002');
INSERT 0 2
lab6=# INSERT INTO passengers (passenger_id, first_name, last_name, date_of_birth, gender,
lab6(#                         country_of_citizenship, country_of_residence, passport_number)
lab6-# VALUES
lab6-#     (9993, 'Dup', 'User', '1980-03-03', 'M', 'Kazakhstan', 'Kazakhstan', 'TEST-PASS-001');
ERROR:  duplicate key value violates unique constraint "ux_passengers_passport_number"
DETAIL:  Key (passport_number)=(TEST-PASS-001) already exists.
```



```
lab6=# SELECT indexname, indexdef
lab6-# FROM pg_indexes
lab6-# WHERE tablename = 'passengers'
lab6-# ORDER BY indexname;
           indexname            |                                                                 indexdef
--------------------------------+------------------------------------------------------------------------------------------------------------------------------------------
 idx_passengers_name_dob_country | CREATE INDEX idx_passengers_name_dob_country ON public.passengers USING btree (first_name, last_name, date_of_birth, country_of_citizenship)
 passengers_pkey                 | CREATE UNIQUE INDEX passengers_pkey ON public.passengers USING btree (passenger_id)
 ux_passengers_passport_number   | CREATE UNIQUE INDEX ux_passengers_passport_number ON public.passengers USING btree (passport_number)
(3 rows)

lab6=# DROP INDEX IF EXISTS ux_passengers_passport_number;
DROP INDEX
lab6=# DROP INDEX IF EXISTS idx_passengers_name_dob_country;
DROP INDEX
```