Database Systems – Term Project 2023

Project Name: Airline Management System

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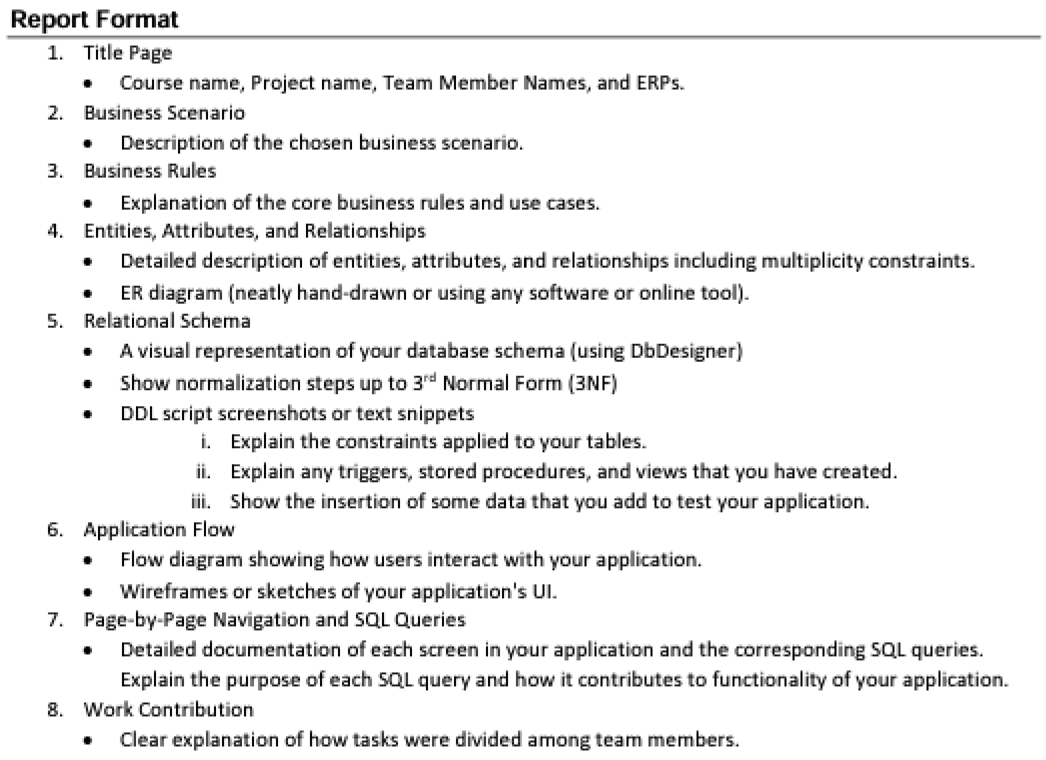


2) Business Scenario

This database schema represents an Airline Management System designed to handle various aspects of airline operations. It includes features for both customer-facing tasks like booking flights and managing reservations, as well as internal tasks like creating flights, adding aircrafts, managing employee assignments.

Customers can search for flights, book reservations, and make payments. The system tracks flight schedules, availability, and prices. It also allows passengers to manage their reservations and cancel them if needed or update them.

Internally, the system assigns pilots and crew members to flights and tracks their assignments. It also manages aircraft maintenance by assigning engineers to specific tasks and monitoring their progress. The system provides a comprehensive solution for managing all aspects of an airline's operations.

2) Business Rules and Use Cases

Users:

- User accounts are required to book flights and view or cancel their reservations if they are customers.
- User accounts have two types: customer and administrator(root admin with exclusive access to the entire application).
- Email addresses should follow a valid format.
- Passwords must be at least 8 characters long.
- A user can book multiple flights on his/her behalf.

Reservations:

- Only one flight can be booked per reservation.
- Payment is required to confirm a reservation else your reservation will be tentative and payment status will be “pending”.
- Confirmed reservations decrease available seats on the flight.

Flights:

- Flights have a unique identifier, aircraft assigned, departure and arrival cities, times, duration, seats, status, and price.
- Flight departure and arrival cities must be different.
- Departure time must be before arrival time.
- Available seats must be non-negative.
- Flight price must be non-negative.

- Only scheduled flights are available for booking.

Passengers:

- Passenger accounts are created automatically upon booking a flight.
- Passenger information includes name, phone number, email, passport number, date of birth, and gender.

Payments:

- Payments are linked to reservations.
- Payment status can be "Successful" or "Failed".
- Payment amount must be equal to the flight price.

Employees:

- There will be four types of employees:Manager, Pilot, Cabin crew and Engineer.
- An employee will be managed by single manager while a manager manages multiple employees.
- Pilots, Cabin crews and Engineers should have separate interface for them to view their assignments.
- The employees should be able to login.
- A manager is responsible to give, edit, and mark as “complete”   assignments to employees, and should be able to view employees data.
- Engineer will also have his/her assignment start and completion date.

3) Entity Attributes and Relationship

Entities:

1. User:

- Description: Represents a system user, either a customer or an administrator with different privileges and functionalities.
- Attributes:
  - id: (Primary Key) Unique identifier for the user.
  - name: Full name of the user.
  - isAdmin: Boolean flag indicating whether the user is an administrator (TRUE) or a customer (FALSE).
  - email: Unique email address of the user.
  - password: Hashed password for user authentication.
- Multiplicity:
  - One-to-many:
    - Has many Reservations.
    - Has many Payments.

2. Aircraft:

- Description: Represents an airplane used for airline operations.
- Attributes:
  - aircraftid: (Primary Key) Unique identifier for the aircraft.
  - aname: Aircraft model name.
  - totalseats: Total number of seats available on the aircraft.
  - astatus: Current status of the aircraft (e.g., Active, Maintenance, Retired).
- Multiplicity:
  - One-to-many:
    - Has many Flights.
    - Has many EngineerAssignments.

3. Flight:

- Description: Represents a scheduled flight with specific details like departure and arrival cities, times, duration, price, and available seats.
- Attributes:
  - flightid: (Primary Key) Unique identifier for the flight.
  - aircraftid: Foreign key referencing Aircraft.aircraftid.
  - dep: Departure city airport code.
  - arr: Arrival city airport code.
  - deptime: Departure time of the flight.

    - arrtime: Arrival time of the flight.
    - avbseats: Number of available seats remaining on the flight.
    - date: Date of the flight.
    - status: Current status of the flight (e.g., Scheduled, Delayed, Cancelled).
    - duration: Flight duration in minutes.
    - price: Price of a ticket for the flight.
- Multiplicity:
    - One-to-many:
        - Has many Reservations.
    - Many-to-one:
        - Belongs to one Aircraft.

4. Passenger:

- Description: Represents a person who has booked a reservation on a flight.
- Attributes:
    - passengerid: (Primary Key) Unique identifier for the passenger.
    - id: Foreign key referencing User.id.
    - name: Full name of the passenger.
    - phone: Phone number of the passenger.
    - email: Email address of the passenger.
    - passport: Passport number of the passenger (if applicable).
    - dob: Date of birth of the passenger.
    - gender: Gender of the passenger.
- Multiplicity:
    - One-to-one:
        - Belongs to one User.
- Many-to-one: * Has many Reservations.

5. Payment:

- Description: Represents a payment made for a confirmed reservation.
- Attributes:
    - paymentid: (Primary Key) Unique identifier for the payment.
    - reservationid: Foreign key referencing Reservation.reservationid (optional).
    - id: Foreign key referencing User.id.
    - status: Payment status (e.g., Successful, Failed).
    - amount: Payment amount for the reservation.
    - date: Payment confirmation date.
    - time: Payment confirmation time.
- Multiplicity:
    - One-to-one:
        - Belongs to one Reservation.
    - Many-to-one:
        - Belongs to one User.

6. Employee:

- Description: Represents an airline employee with a specific job type like pilot, engineer, or crew member.
- Attributes:
  - employeeid: (Primary Key) Unique identifier for the employee.
  - managerid: Foreign key referencing User.id (optional).
  - name: Full name of the employee.
  - type: Employee job type (e.g., pilot, engineer, crew).
  - email: Email address of the employee.
  - password: Hashed password for employee authentication.
- Multiplicity:
  - One-to-many:
    - Has many PilotAssignments.
    - Has many CrewAssignments.
    - Has many EngineerAssignments.

– A manager manages multiple employees, and an employee is managed by one manager

Relationships:

1. PilotAssignment:

- Description: Represents an assignment of a pilot to a specific flight.
- Attributes:
  - AssignmentID: (Primary Key) Unique identifier for the pilot assignment.
  - employeeid: Foreign key referencing Employee.employeeid.
  - flightid: Foreign key referencing Flight.flightid.
- Multiplicity:
  - Many-to-one:
    - Belongs to one Employee.
    - Belongs to one Flight.

2. CrewAssignment:

- Description: Represents an assignment of crew members to a specific flight.
- Attributes:
  - AssignmentID: (Primary Key) Unique identifier for the crew assignment.
  - employeeid: Foreign key referencing Employee.employeeid.
  - flightid: Foreign key referencing Flight.flightid.
- Multiplicity:

    - Many-to-one:
        - Belongs to one Employee.
        - Belongs to one Flight.

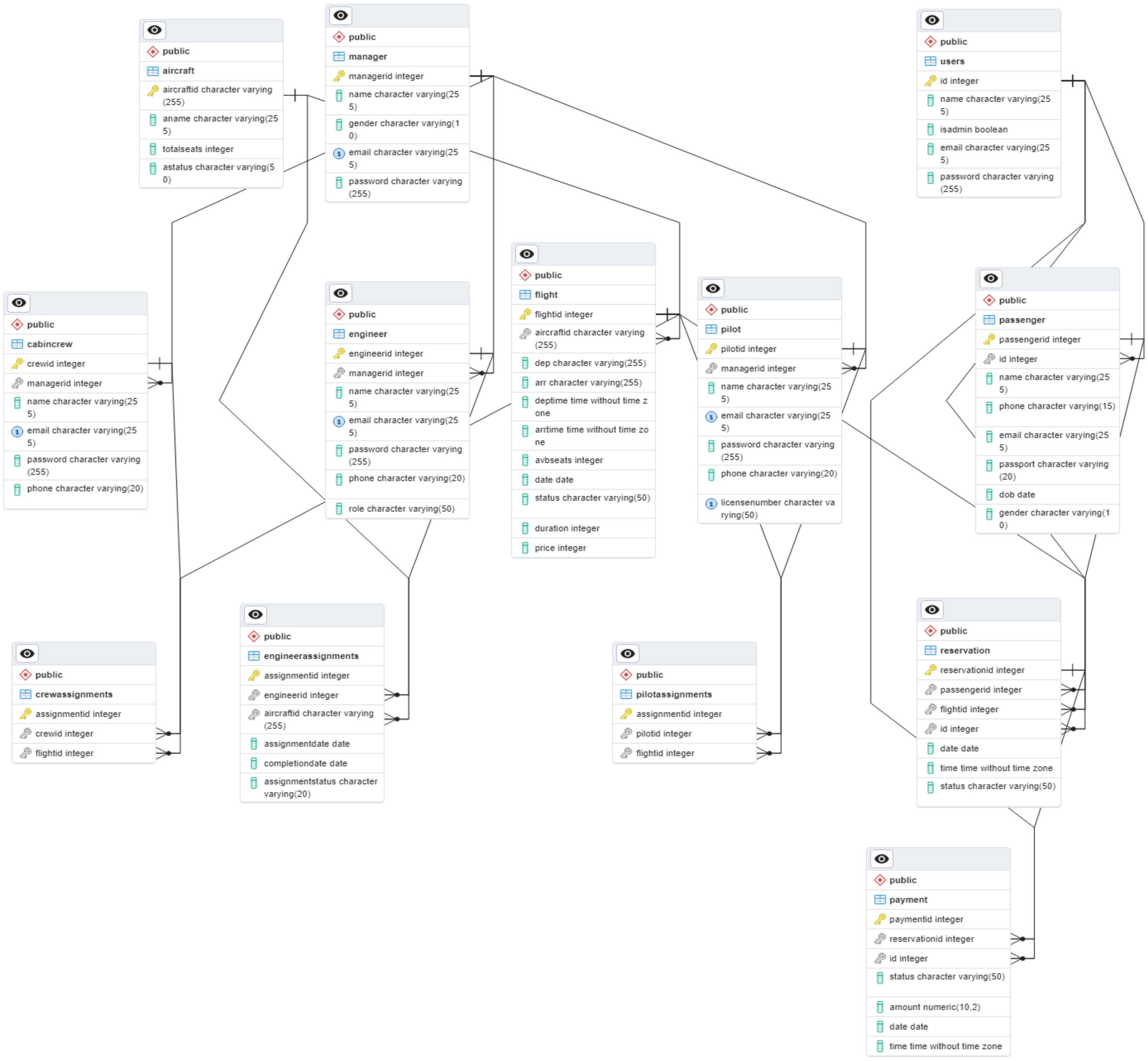
3. EngineerAssignment:

- Description: Represents an assignment of an engineer to an aircraft maintenance task.
- Attributes:
    - AssignmentID: (Primary Key) Unique identifier for the engineer assignment.
    - employeeid: Foreign key referencing Employee.employeeid.
    - aircraftid: Foreign key referencing Aircraft.aircraftid.
    - AssignmentDate: Date the assignment was created.
    - CompletionDate: Date the assignment was completed (optional).
    - AssignmentStatus: Current status of the assignment (e.g., Open, In Progress, Completed).
- Multiplicity:
    - Many-to-one:
        - Belongs to one Employee.
        - Belongs to one Aircraft.

4. Reservation:

- Description: Represents a booking made by a user for a specific flight.
- Attributes:
    - reservationid: (Primary Key) Unique identifier for the reservation.
    - passengerid: Foreign key referencing Passenger.passengerid.
    - flightid: Foreign key referencing Flight.flightid.
    - id: Foreign key referencing User.id.
    - date: Reservation confirmation date.
    - time: Reservation confirmation time.
    - status: Current status of the reservation (e.g., Waiting, Confirmed, Cancelled).
- Multiplicity:
    - One-to-one:
        - Has one Passenger.
        - Has one Payment (optional).
    - Many-to-one:
        - Belongs to one Flight.

        - Belongs to one User.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aircraft
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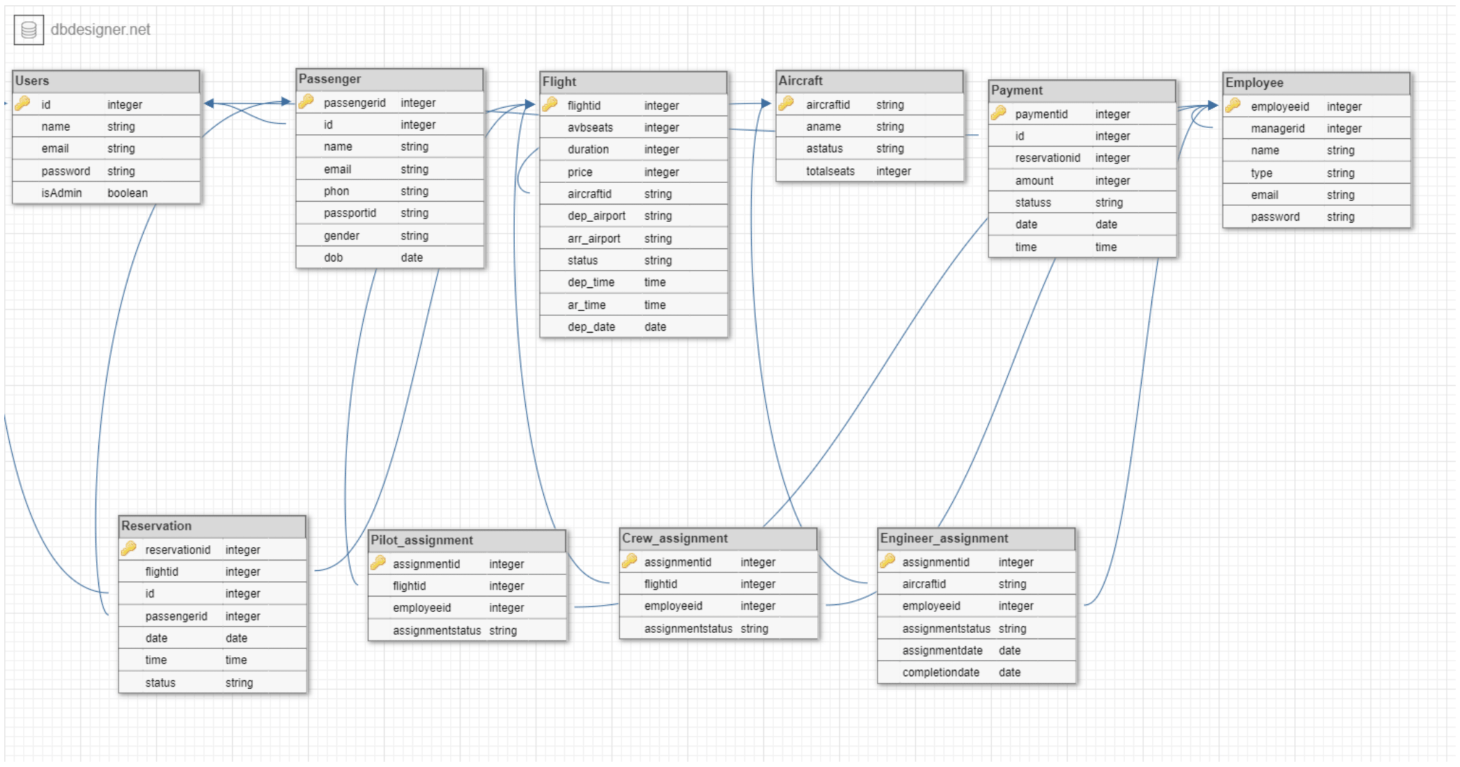
aname character varying(255)
totalseats integer
astatus character varying(50)
public
manager
managerid integer
name character varying(255)
gender character varying(10)
email character varying(255)
password character varying(255)
public
users
id integer
name character varying(255)
isadmin boolean
email character varying(255)
password character varying(255)
public
cabincrew
crewid integer
managerid integer
name character varying(255)
email character varying(255)
password character varying(255)
phone character varying(20)
public
engineer
engineerid integer
managerid integer
name character varying(255)
email character varying(255)
password character varying(255)
phone character varying(20)
role character varying(50)
public
flight
flightid integer
aircraftid character varying(255)
dep character varying(255)
arr character varying(255)
deptime time without time zone
arrtime time without time zone
avbseats integer
date date
status character varying(50)
duration integer
price integer
public
pilot
pilotid integer
managerid integer
name character varying(255)
email character varying(255)
password character varying(255)
phone character varying(20)
licensenumber character varying(50)
public
passenger
passengerid integer
id integer
name character varying(255)
phone character varying(15)
email character varying(255)
passport character varying(20)
dob date
gender character varying(10)
public
crewassignments
assignmentid integer
crewid integer
flightid integer
public
engineerassignments
assignmentid integer
engineerid integer
aircraftid character varying(255)
assignmentdate date
completiondate date
assignmentstatus character varying(20)
public
pilotassignments
assignmentid integer
pilotid integer
flightid integer
public
reservation
reservationid integer
passengerid integer
flightid integer
id integer
date date
time time without time zone
status character varying(50)
public
payment
paymentid integer
reservationid integer
id integer
status character varying(50)
amount numeric(10,2)
date date
time time without time zone

5) Relational Schema



Users

id	integer
name	string
email	string
password	string
isAdmin	boolean

Passenger

passengerid	integer
id	integer
name	string
email	string
phon	string
passportid	string
gender	string
dob	date

Flight

flightid	integer
avbseats	integer
duration	integer
price	integer
aircraftid	string
dep_airport	string
arr_airport	string
status	string
dep_time	time
ar_time	time
dep_date	date

Aircraft

aircraftid	string
aname	string
astatus	string
totalseats	integer

Payment

paymentid	integer
id	integer
reservationid	integer
amount	integer
statuss	string
date	date
time	time

Employee

employeeid	integer
managerid	integer
name	string
type	string
email	string
password	string

Reservation

reservationid	integer
flightid	integer
id	integer
passengerid	integer
date	date
time	time
status	string

Pilot_assignment

assignmentid	integer
flightid	integer
employeeid	integer
assignmentstatus	string

Crew_assignment

assignmentid	integer
flightid	integer
employeeid	integer
assignmentstatus	string

Engineer_assignment

assignmentid	integer
aircraftid	string
employeeid	integer
assignmentstatus	string
assignmentdate	date
completiondate	date

Normalization Steps:

Tables:

1) USERS
2) Aircraft
3) Flight
4) Passenger
5) Reservation
6) Payment
7) Employee
8) PilotAssignments
9) CrewAssignments
10) EngineerAssignments

First Normal Form (1NF):

- Atomic Values: All columns should contain atomic (indivisible) values.
- For all the tables, the columns seem to contain atomic values, so they already meet 1NF requirements.

Second Normal Form (2NF):

- Remove Partial Dependencies: No non-prime attribute should be functionally dependent on a part of a composite primary key.
- In this schema, the tables have simple primary keys and don't exhibit composite keys, so there are no partial dependencies to remove.

Third Normal Form (3NF):

Remove Transitive Dependencies: No non-prime attribute should be transitively dependent on the primary key.

Let's check each table:

- Users: No transitive dependencies.
- Aircraft: No transitive dependencies.
- Flight: No transitive dependencies.
- Passenger: No transitive dependencies.
- Reservation: No transitive dependencies.
- Payment: No transitive dependencies.
- Employee: No transitive dependencies.

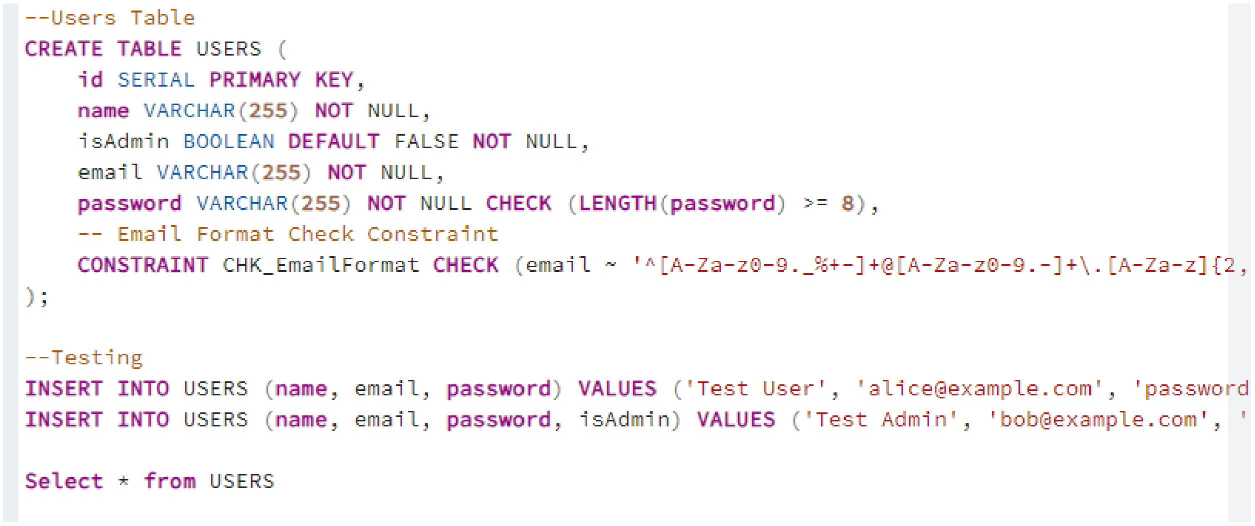
- PilotAssignments, CrewAssignments, EngineerAssignments: These tables exhibit redundancy, but no evident transitive dependencies.

Conclusion:

Our schema is in 3NF. Each table represents a unique entity without significant transitive dependencies or other violations of normalization principles.

DDL Script

1) Users Table:

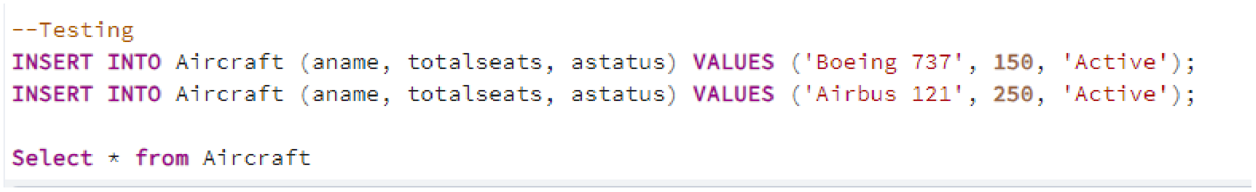


```
--Users Table
CREATE TABLE USERS (
    id SERIAL PRIMARY KEY,
    name VARCHAR(255) NOT NULL,
    isAdmin BOOLEAN DEFAULT FALSE NOT NULL,
    email VARCHAR(255) NOT NULL,
    password VARCHAR(255) NOT NULL CHECK (LENGTH(password) >= 8),
    -- Email Format Check Constraint
    CONSTRAINT CHK_EmailFormat CHECK (email ~ '^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,
);

--Testing
INSERT INTO USERS (name, email, password) VALUES ('Test User', 'alice@example.com', 'password
INSERT INTO USERS (name, email, password, isAdmin) VALUES ('Test Admin', 'bob@example.com', '

Select * from USERS
```

- id: SERIAL data type is used to create an auto-incrementing column for the primary key.
- name: VARCHAR(255) data type is used for a variable-length string with a maximum length of 255 characters. It cannot contain NULL values.
- isAdmin: BOOLEAN data type with a default value of FALSE and cannot contain NULL values.
- email: VARCHAR(255) data type is used for storing email addresses. It cannot contain NULL values, and it is also constrained by the regular expression specified in the CHK_EmailFormat constraint.
- password: VARCHAR(255) data type is used for storing passwords with a minimum length check of 8 characters.

2) Aircraft Table:

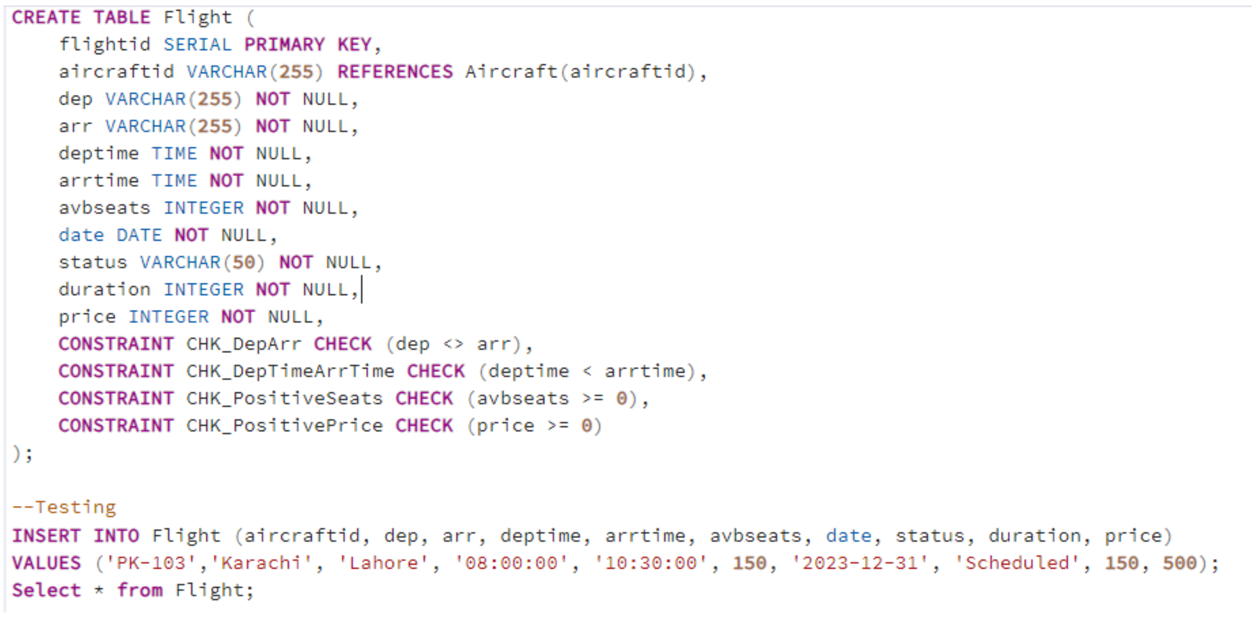
```
CREATE TABLE Aircraft (
    aircraftid VARCHAR(255) PRIMARY KEY,
    aname VARCHAR(255) NOT NULL,
    totalseats INTEGER NOT NULL,
    astatus VARCHAR(50) NOT NULL
);


--Aircraft ID Generation
CREATE SEQUENCE aircraft_sequence START 101;

CREATE OR REPLACE FUNCTION set_aircraft_id()
RETURNS TRIGGER AS $$
BEGIN
    NEW.aircraftid := 'PK-' || nextval('aircraft_sequence')::TEXT;
    RETURN NEW;
END;
$$ LANGUAGE plpgsql;

CREATE TRIGGER set_aircraft_id_trigger
BEFORE INSERT ON Aircraft
FOR EACH ROW EXECUTE FUNCTION set_aircraft_id();
```



```
--Testing
INSERT INTO Aircraft (aname, totalseats, astatus) VALUES ('Boeing 737', 150, 'Active');
INSERT INTO Aircraft (aname, totalseats, astatus) VALUES ('Airbus 121', 250, 'Active');

Select * from Aircraft
```

- aircraftid: VARCHAR(255) data type is used for a variable-length string with a maximum length of 255 characters. It is the primary key for the table.
- aname: VARCHAR(255) data type is used for a variable-length string with a maximum length of 255 characters. It cannot contain NULL values.
- totalseats: INTEGER data type is used for storing the total number of seats in the aircraft. It cannot contain NULL values.
- astatus: VARCHAR(50) data type is used for a variable-length string with a maximum length of 50 characters. It cannot contain NULL values.

3) Flight Table:



```sql
CREATE TABLE Flight (
    flightid SERIAL PRIMARY KEY,
    aircraftid VARCHAR(255) REFERENCES Aircraft(aircraftid),
    dep VARCHAR(255) NOT NULL,
    arr VARCHAR(255) NOT NULL,
    deptime TIME NOT NULL,
    arrtime TIME NOT NULL,
    avbseats INTEGER NOT NULL,
    date DATE NOT NULL,
    status VARCHAR(50) NOT NULL,
    duration INTEGER NOT NULL,
    price INTEGER NOT NULL,
    CONSTRAINT CHK_DepArr CHECK (dep <> arr),
    CONSTRAINT CHK_DepTimeArrTime CHECK (deptime < arrtime),
    CONSTRAINT CHK_PositiveSeats CHECK (avbseats >= 0),
    CONSTRAINT CHK_PositivePrice CHECK (price >= 0)
);

--Testing
INSERT INTO Flight (aircraftid, dep, arr, deptime, arrtime, avbseats, date, status, duration, price)
VALUES ('PK-103','Karachi', 'Lahore', '08:00:00', '10:30:00', 150, '2023-12-31', 'Scheduled', 150, 500);
Select * from Flight;
```

- flightid: SERIAL data type is used to create an auto-incrementing column for the primary key.
- aircraftid: VARCHAR(255) data type is a foreign key that references the aircraftid column in the Aircraft table.
- dep and arr: VARCHAR(255) data types are used for departure and arrival locations. They cannot contain NULL values.
- deptime and arrtime: TIME data types are used for departure and arrival times. They cannot contain NULL values.
- avbseats: INTEGER data type is used for storing the available seats. It cannot contain NULL values, and there is a constraint to ensure it's not negative.
- date: DATE data type is used for the flight date. It cannot contain NULL values.
- status: VARCHAR(50) data type is used for a variable-length string with a maximum length of 50 characters. It cannot contain NULL values.
- duration, and price: INTEGER data types are used for storing the flight duration and price, respectively. They cannot contain NULL values, and there are constraints to ensure they are not negative.
- Additional constraints (CHK_DepArr, CHK_DepTimeArrTime, CHK_PositiveSeats, CHK_PositivePrice) are applied to ensure specific conditions are met.

4) Passenger Table:

```
--Passenger Table
CREATE TABLE Passenger (
    passengerid SERIAL PRIMARY KEY,
    id INTEGER REFERENCES USERS(id),
    name VARCHAR(255) NOT NULL,
    phone VARCHAR(15) NOT NULL,
    email VARCHAR(255) NOT NULL,
    passport VARCHAR(20) NOT NULL,
    dob DATE NOT NULL,
    gender VARCHAR(10) NOT NULL
);

--Testing
INSERT INTO Passenger (id, name, phone, email, passport, dob, gender) VALUES
(1, 'Test Passenger', '1234567890', 'testpassenger@example.com', 'AB123456', '1990-01-15', 'Male');

Select * from Passenger;
```

- passengerid: SERIAL data type is used to create an auto-incrementing column for the primary key.
- id: INTEGER data type is a foreign key that references the id column in the USERS table.
- name, phone, email, passport, dob, and gender: VARCHAR and INTEGER data types are used for various attributes of a passenger. They cannot contain NULL values.

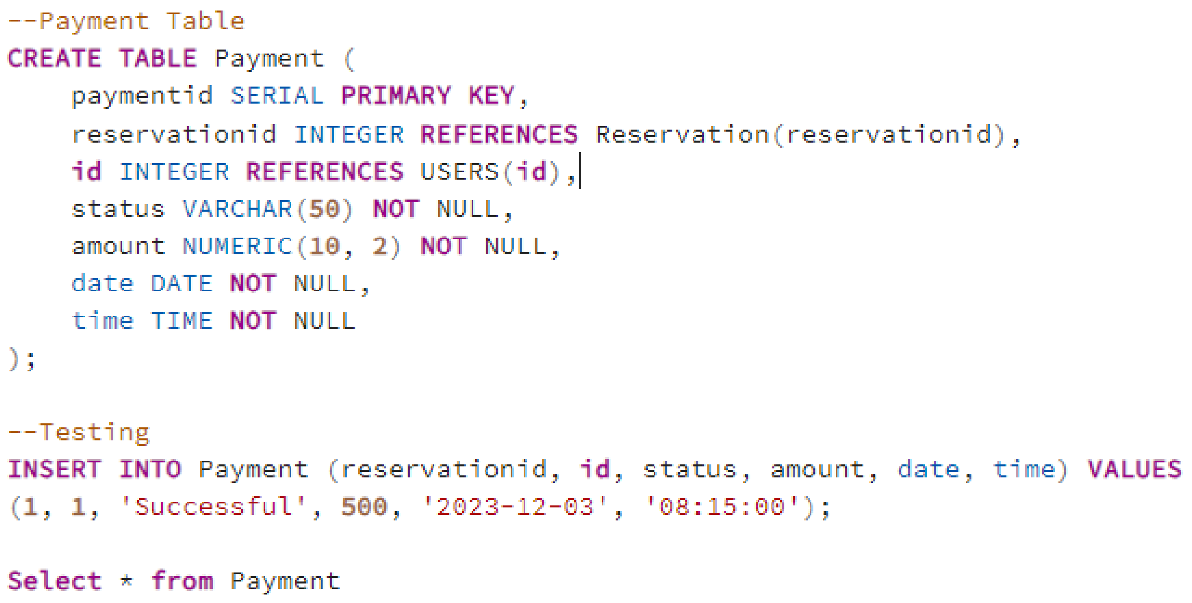
5) Reservation Table: (Kind of a bridge table between passenger and flight)

```
CREATE TABLE Reservation (
    reservationid SERIAL PRIMARY KEY,
    passengerid INTEGER REFERENCES Passenger(passengerid),
    flightid INTEGER REFERENCES Flight(flightid),
    id INTEGER REFERENCES USERS(id),
    date DATE NOT NULL,
    time TIME NOT NULL,
    status VARCHAR(50) NOT NULL
);


--Testing
INSERT INTO Reservation (passengerid, flightid, id, date, time, status) VALUES
(1, 1, 3, '2023-12-03', '08:00:00', 'Waiting');

Select * from Reservation
Select * from USERS
```

- reservationid: SERIAL data type is used to create an auto-incrementing column for the primary key.

- passengerid: INTEGER data type is a foreign key that references the passengerid column in the Passenger table.
- flightid: INTEGER data type is a foreign key that references the flightid column in the Flight table.
- id: INTEGER data type is a foreign key that references the id column in the USERS table.
- date and time: DATE and TIME data types are used for reservation date and time. They cannot contain NULL values.
- status: VARCHAR(50) data type is used for a variable-length string with a maximum length of 50 characters. It cannot contain NULL values.

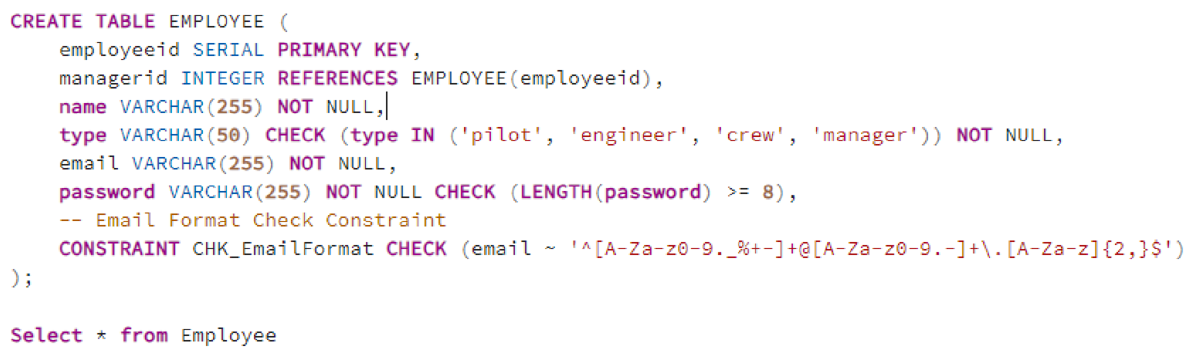
6) Payment Table:



```
--Payment Table
CREATE TABLE Payment (
    paymentid SERIAL PRIMARY KEY,
    reservationid INTEGER REFERENCES Reservation(reservationid),
    id INTEGER REFERENCES USERS(id),
    status VARCHAR(50) NOT NULL,
    amount NUMERIC(10, 2) NOT NULL,
    date DATE NOT NULL,
    time TIME NOT NULL
);

--Testing
INSERT INTO Payment (reservationid, id, status, amount, date, time) VALUES
(1, 1, 'Successful', 500, '2023-12-03', '08:15:00');

Select * from Payment
```

- paymentid: SERIAL data type is used to create an auto-incrementing column for the primary key.
- reservationid: INTEGER data type is a foreign key that references the reservationid column in the Reservation table.
- id: INTEGER data type is a foreign key that references the id column in the USERS table.
- status: VARCHAR(50) data type is used for a variable-length string with a maximum length of 50 characters. It cannot contain NULL values.
- amount: NUMERIC(10, 2) data type is used for storing the payment amount with two decimal places. It cannot contain NULL values.
- date and time: DATE and TIME data types are used for payment date and time. They cannot contain NULL values.

7) Employee Table:



```
CREATE TABLE EMPLOYEE (
    employeeid SERIAL PRIMARY KEY,
    managerid INTEGER REFERENCES EMPLOYEE(employeeid),
    name VARCHAR(255) NOT NULL,
    type VARCHAR(50) CHECK (type IN ('pilot', 'engineer', 'crew', 'manager')) NOT NULL,
    email VARCHAR(255) NOT NULL,
    password VARCHAR(255) NOT NULL CHECK (LENGTH(password) >= 8),
    -- Email Format Check Constraint
    CONSTRAINT CHK_EmailFormat CHECK (email ~ '^[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,}$')
);

Select * from Employee
```

- employeeid: Auto-incrementing primary key.
- managerid: Foreign key referencing employeeid in the same table.
- name: Variable-length string (max 255), cannot be NULL.
- type: Specifies employee type, limited to 'pilot', 'engineer', 'crew', 'manager', cannot be NULL.
- email: Stores email addresses, must adhere to a specified format, cannot be NULL.
- password: Stores passwords, minimum length constraint: 8 characters, cannot be NULL.

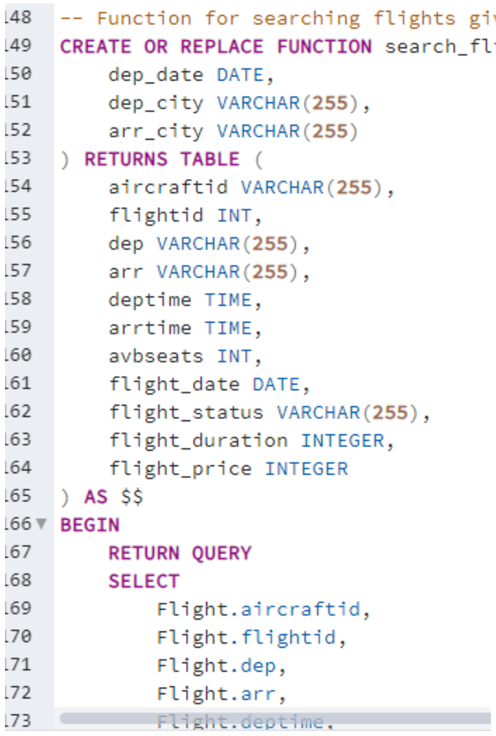
8) Assignments Tables

```sql
CREATE TABLE PilotAssignments (
  AssignmentID SERIAL PRIMARY KEY,
  employeeid INT REFERENCES EMPLOYEE(employeeid) NOT NULL,
  flightid INT REFERENCES Flight(flightid),
  AssignmentStatus VARCHAR(20) NOT NULL
);

CREATE TABLE CrewAssignments (
  AssignmentID SERIAL PRIMARY KEY,
  employeeid INT REFERENCES EMPLOYEE(employeeid) NOT NULL,
  flightid INT REFERENCES Flight(flightid),
  AssignmentStatus VARCHAR(20) NOT NULL
);

CREATE TABLE EngineerAssignments (
  AssignmentID SERIAL PRIMARY KEY,
  employeeid INT REFERENCES EMPLOYEE(employeeid) NOT NULL,
  aircraftid VARCHAR(255) REFERENCES Aircraft(aircraftid),
  AssignmentDate DATE NOT NULL,
  CompletionDate DATE,
  AssignmentStatus VARCHAR(20) NOT NULL
);
```

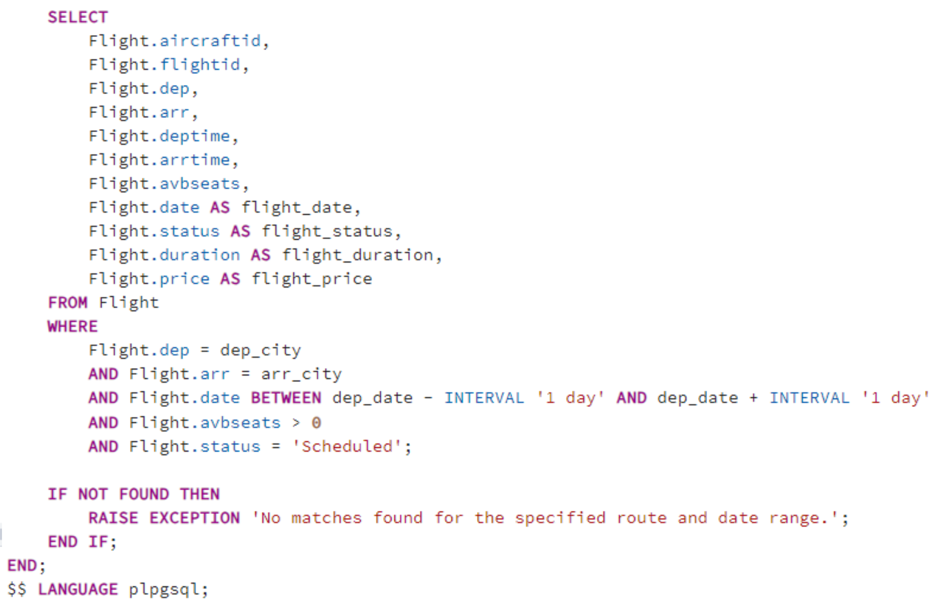
- AssignmentID: SERIAL data type is used to create an auto-incrementing column for the primary key.
- employeeid: INT data type, and it is a foreign key that references the employeeid column in the EMPLOYEE table. The NOT NULL constraint ensures that this field cannot contain NULL values.

Functions

1) search_flights



```
-- Function for searching flights given date, dep_city, and arr_city
CREATE OR REPLACE FUNCTION search_flights(
    dep_date DATE,
    dep_city VARCHAR(255),
    arr_city VARCHAR(255)
) RETURNS TABLE (
    aircraftid VARCHAR(255),
    flightid INT,
    dep VARCHAR(255),
    arr VARCHAR(255),
    deptime TIME,
    arrtime TIME,
    avbseats INT,
    flight_date DATE,
    flight_status VARCHAR(255),
    flight_duration INTEGER,
    flight_price INTEGER
) AS $$
BEGIN
    RETURN QUERY
    SELECT
        Flight.aircraftid,
        Flight.flightid,
        Flight.dep,
        Flight.arr,
        Flight.deptime,
```



```
    SELECT
        Flight.aircraftid,
        Flight.flightid,
        Flight.dep,
        Flight.arr,
        Flight.deptime,
        Flight.arrtime,
        Flight.avbseats,
        Flight.date AS flight_date,
        Flight.status AS flight_status,
        Flight.duration AS flight_duration,
        Flight.price AS flight_price
    FROM Flight
    WHERE
        Flight.dep = dep_city
        AND Flight.arr = arr_city
        AND Flight.date BETWEEN dep_date - INTERVAL '1 day' AND dep_date + INTERVAL '1 day'
        AND Flight.avbseats > 0
        AND Flight.status = 'Scheduled';

    IF NOT FOUND THEN
        RAISE EXCEPTION 'No matches found for the specified route and date range.';
    END IF;
END;
$$ LANGUAGE plpgsql;
```

Purpose:

Searches for flights based on departure date, departure city, and arrival city.

Parameters:

dep_date (DATE): Departure date.

dep_city (VARCHAR(255)): Departure city.

arr_city (VARCHAR(255)): Arrival city.

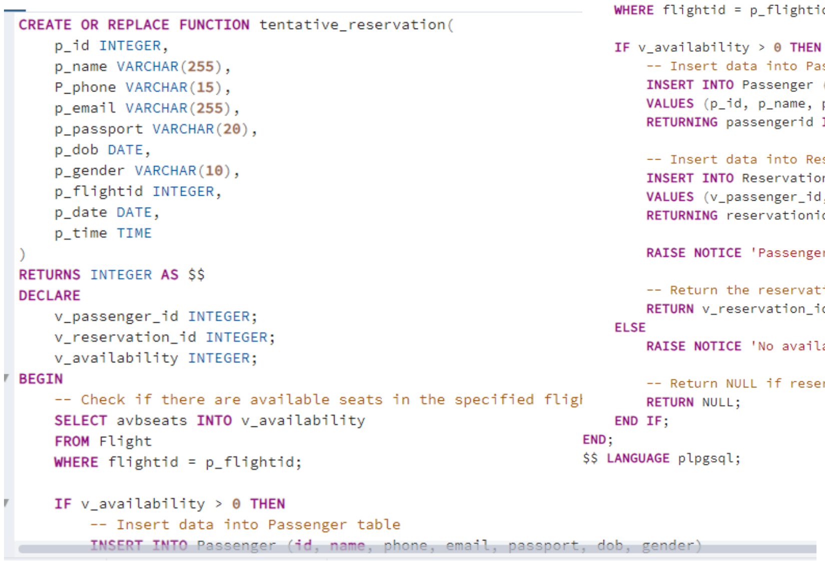
Returns:

Table with flight details (aircraftid, flightid, dep, arr, deptime, arrtime, avbseats, flight_date, flight_status, flight_duration, flight_price).

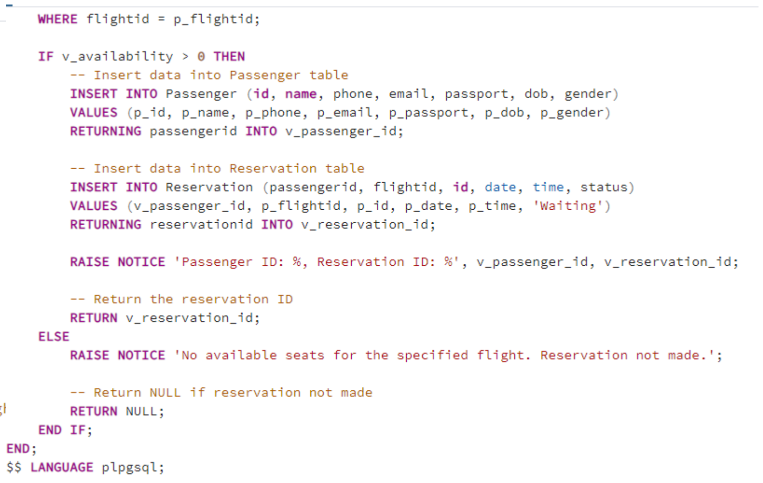
Constraints:

Filters flights by departure and arrival cities, date range (within 1 day of the given date), available seats, and status 'Scheduled'.

2) tentative_reservation



```
CREATE OR REPLACE FUNCTION tentative_reservation(
    p_id INTEGER,
    p_name VARCHAR(255),
    P_phone VARCHAR(15),
    p_email VARCHAR(255),
    p_passport VARCHAR(20),
    p_dob DATE,
    p_gender VARCHAR(10),
    p_flightid INTEGER,
    p_date DATE,
    p_time TIME
)
RETURNS INTEGER AS $$
DECLARE
    v_passenger_id INTEGER;
    v_reservation_id INTEGER;
    v_availability INTEGER;
BEGIN
    -- Check if there are available seats in the specified flig
    SELECT avbseats INTO v_availability
    FROM Flight
    WHERE flightid = p_flightid;

    IF v_availability > 0 THEN
        -- Insert data into Passenger table
        INSERT INTO Passenger (id, name, phone, email, passport, dob, gender)
```



```
    WHERE flightid = p_flightid;

    IF v_availability > 0 THEN
        -- Insert data into Passenger table
        INSERT INTO Passenger (id, name, phone, email, passport, dob, gender)
        VALUES (p_id, p_name, p_phone, p_email, p_passport, p_dob, p_gender)
        RETURNING passengerid INTO v_passenger_id;

        -- Insert data into Reservation table
        INSERT INTO Reservation (passengerid, flightid, id, date, time, status)
        VALUES (v_passenger_id, p_flightid, p_id, p_date, p_time, 'Waiting')
        RETURNING reservationid INTO v_reservation_id;

        RAISE NOTICE 'Passenger ID: %, Reservation ID: %', v_passenger_id, v_reservation_id;

        -- Return the reservation ID
        RETURN v_reservation_id;
    ELSE
        RAISE NOTICE 'No available seats for the specified flight. Reservation not made.';

        -- Return NULL if reservation not made
        RETURN NULL;
    END IF;
END;
$$ LANGUAGE plpgsql;
```

Purpose:

Attempts to make a tentative reservation with reservation status waiting and also an entry in the passenger for a passenger on a specified flight.

Parameters:

Various passenger details (p_id, p_name, p_phone, etc.).

p_flightid (INTEGER): Flight ID for the reservation.

p_date (DATE): Reservation date.

p_time (TIME): Reservation time.

Returns:

Returns the reservation ID if successful, otherwise NULL.

Actions:

Checks seat availability in the specified flight.

Inserts passenger details into the Passenger table.

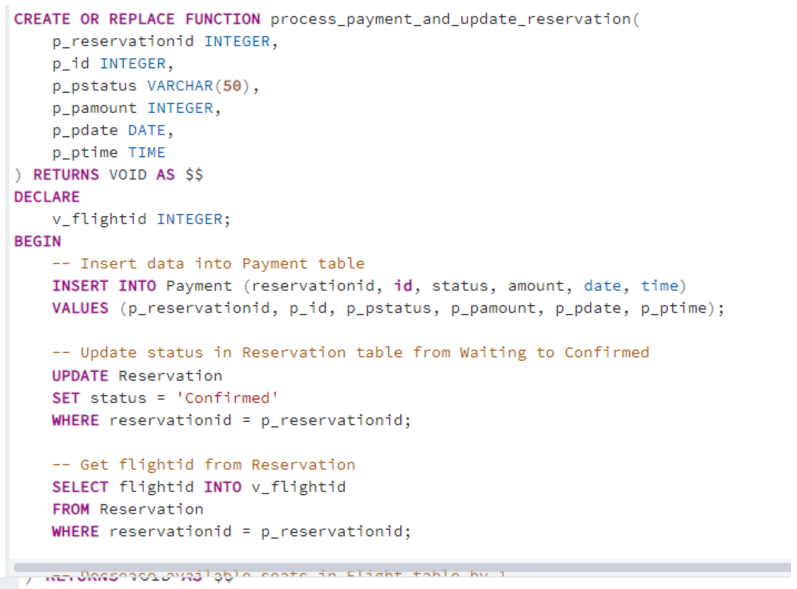
Inserts reservation details into the Reservation table.

Updates available seats in the Flight table.

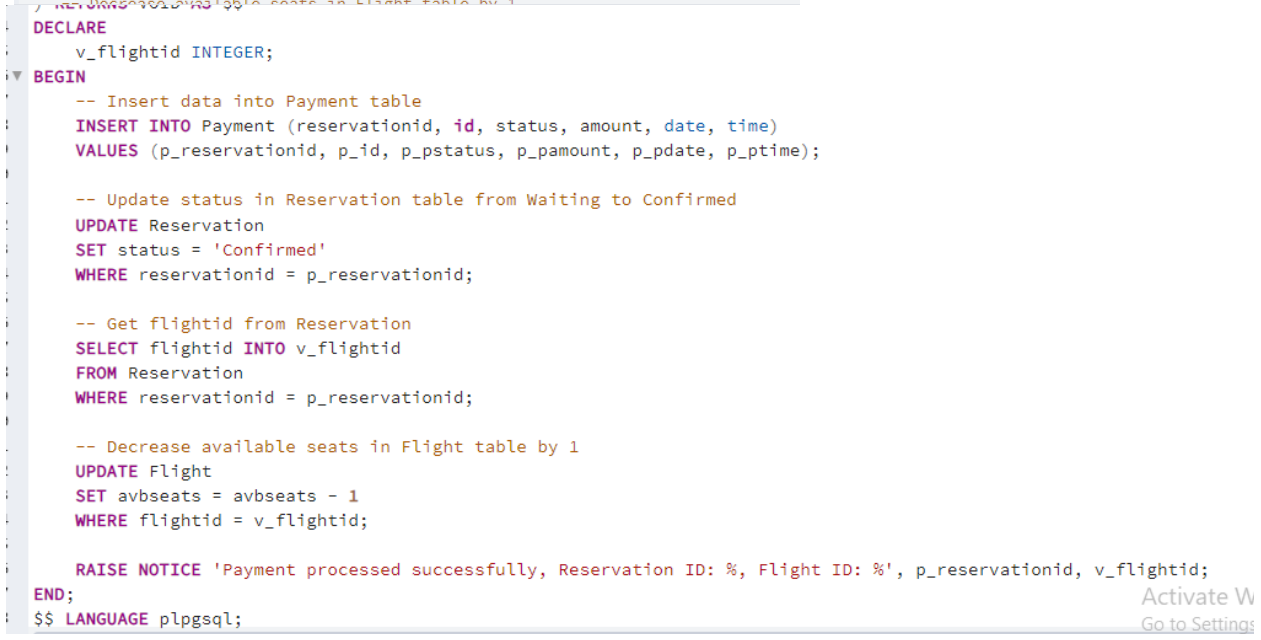
Outputs Passenger ID and Reservation ID if successful.

Procedures

1)process_payment_and_update_reservation



```sql
CREATE OR REPLACE FUNCTION process_payment_and_update_reservation(
    p_reservationid INTEGER,
    p_id INTEGER,
    p_pstatus VARCHAR(50),
    p_pamount INTEGER,
    p_pdate DATE,
    p_ptime TIME
) RETURNS VOID AS $$
DECLARE
    v_flightid INTEGER;
BEGIN
    -- Insert data into Payment table
    INSERT INTO Payment (reservationid, id, status, amount, date, time)
    VALUES (p_reservationid, p_id, p_pstatus, p_pamount, p_pdate, p_ptime);

    -- Update status in Reservation table from Waiting to Confirmed
    UPDATE Reservation
    SET status = 'Confirmed'
    WHERE reservationid = p_reservationid;

    -- Get flightid from Reservation
    SELECT flightid INTO v_flightid
    FROM Reservation
    WHERE reservationid = p_reservationid;
```



```sql
DECLARE
    v_flightid INTEGER;
BEGIN
    -- Insert data into Payment table
    INSERT INTO Payment (reservationid, id, status, amount, date, time)
    VALUES (p_reservationid, p_id, p_pstatus, p_pamount, p_pdate, p_ptime);

    -- Update status in Reservation table from Waiting to Confirmed
    UPDATE Reservation
    SET status = 'Confirmed'
    WHERE reservationid = p_reservationid;

    -- Get flightid from Reservation
    SELECT flightid INTO v_flightid
    FROM Reservation
    WHERE reservationid = p_reservationid;

    -- Decrease available seats in Flight table by 1
    UPDATE Flight
    SET avbseats = avbseats - 1
    WHERE flightid = v_flightid;

    RAISE NOTICE 'Payment processed successfully, Reservation ID: %, Flight ID: %', p_reservationid, v_flightid;
END;
$$ LANGUAGE plpgsql;
```

Purpose:

Processes payment and updates the reservation status to 'Confirmed'.

Parameters:

p_reservationid (INTEGER): Reservation ID.

p_id (INTEGER): User ID making the payment.

p_pstatus (VARCHAR(50)): Payment status ('Paid' or other).

p_pamount (INTEGER): Payment amount.

p_pdate (DATE): Payment date.

p_ptime (TIME): Payment time.

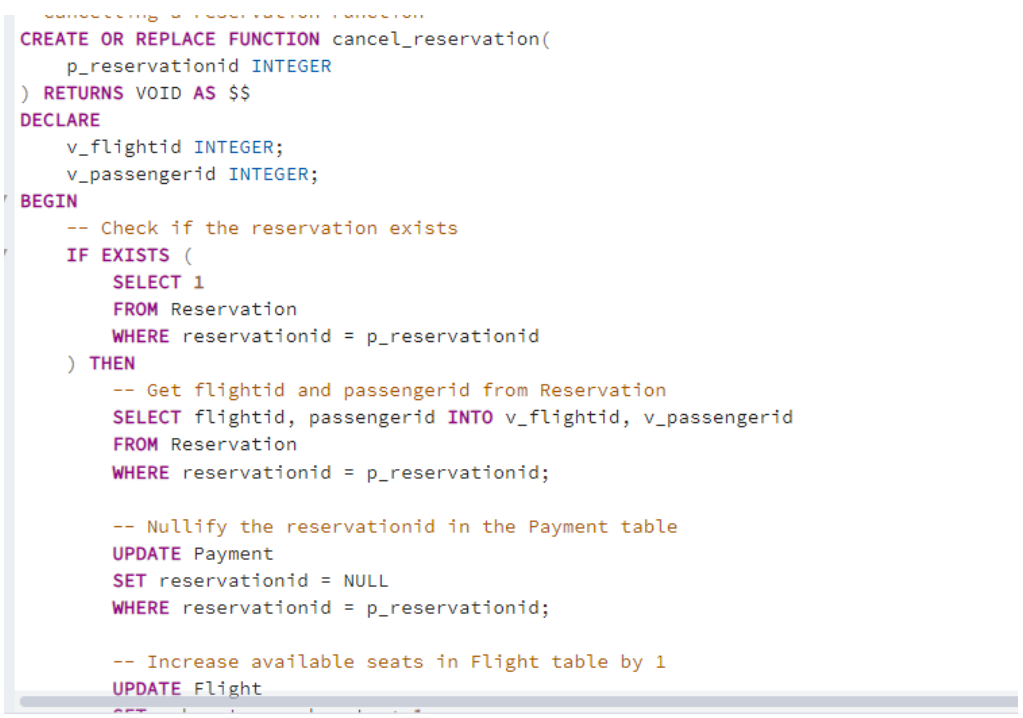
Actions:

Inserts payment details into the Payment table.

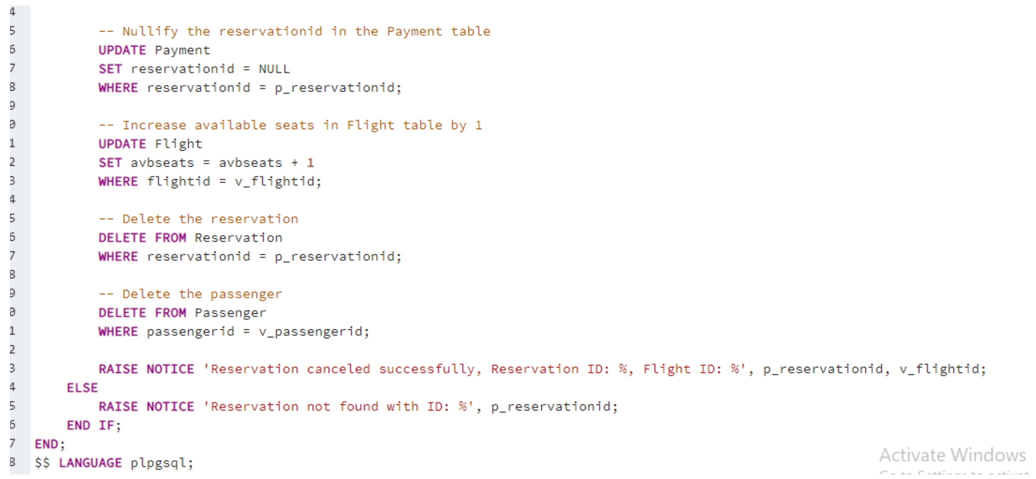
Updates reservation status to 'Confirmed'.

Decreases available seats in the corresponding flight by 1.

2) cancel_reservation



```sql
CREATE OR REPLACE FUNCTION cancel_reservation(
    p_reservationid INTEGER
) RETURNS VOID AS $$
DECLARE
    v_flightid INTEGER;
    v_passengerid INTEGER;
BEGIN
    -- Check if the reservation exists
    IF EXISTS (
        SELECT 1
        FROM Reservation
        WHERE reservationid = p_reservationid
    ) THEN
        -- Get flightid and passengerid from Reservation
        SELECT flightid, passengerid INTO v_flightid, v_passengerid
        FROM Reservation
        WHERE reservationid = p_reservationid;

        -- Nullify the reservationid in the Payment table
        UPDATE Payment
        SET reservationid = NULL
        WHERE reservationid = p_reservationid;

        -- Increase available seats in Flight table by 1
        UPDATE Flight
```



```sql
        -- Nullify the reservationid in the Payment table
        UPDATE Payment
        SET reservationid = NULL
        WHERE reservationid = p_reservationid;

        -- Increase available seats in Flight table by 1
        UPDATE Flight
        SET avbseats = avbseats + 1
        WHERE flightid = v_flightid;

        -- Delete the reservation
        DELETE FROM Reservation
        WHERE reservationid = p_reservationid;

        -- Delete the passenger
        DELETE FROM Passenger
        WHERE passengerid = v_passengerid;

        RAISE NOTICE 'Reservation canceled successfully, Reservation ID: %, Flight ID: %', p_reservationid, v_flightid;
    ELSE
        RAISE NOTICE 'Reservation not found with ID: %', p_reservationid;
    END IF;
END;
$$ LANGUAGE plpgsql;
```

Purpose:

Cancels a reservation, updating related tables.

Parameters:

p_reservationid (INTEGER): Reservation ID to be canceled.

Actions:

Checks if the reservation exists.

Nullifies the reservation ID in the Payment table.

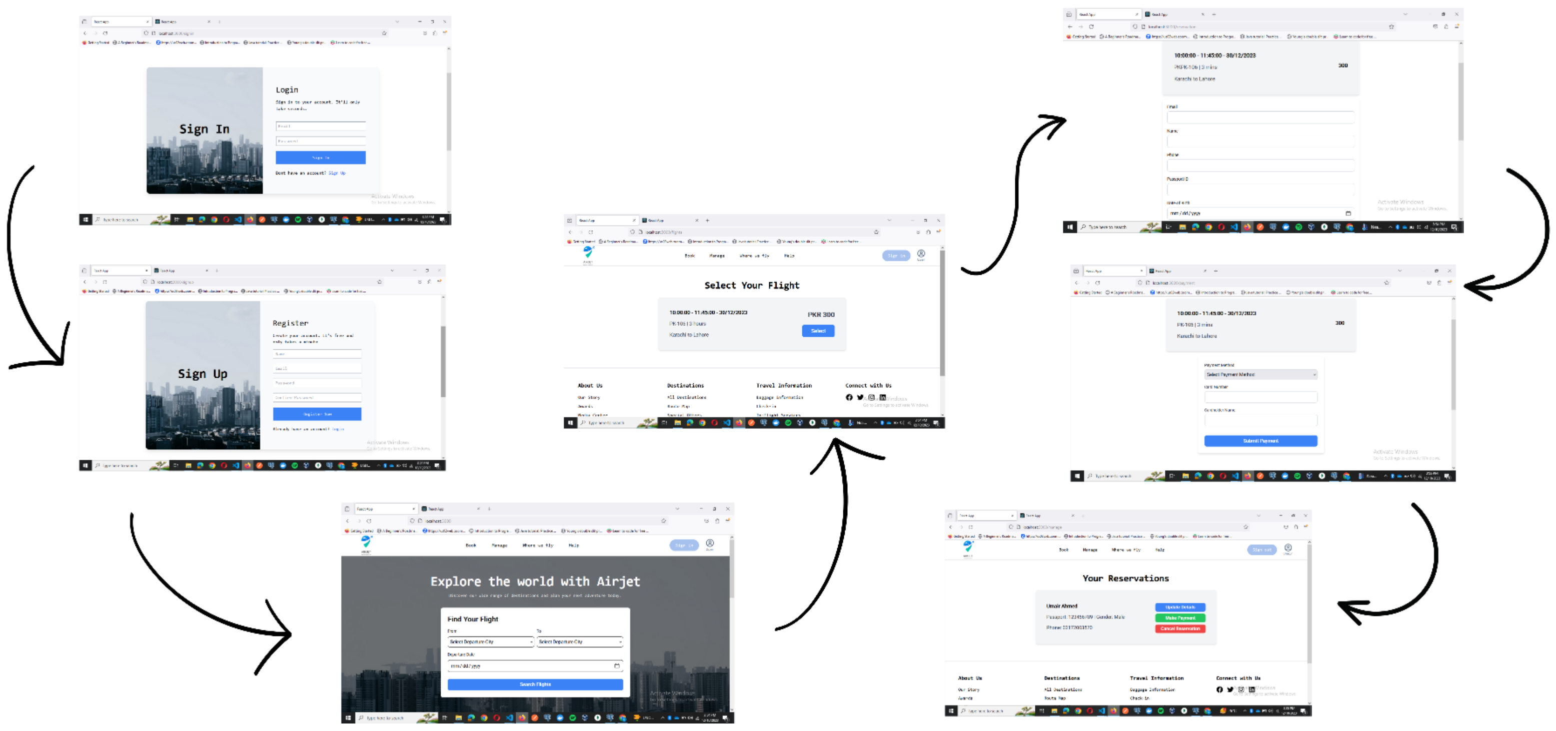
Increases available seats in the corresponding flight by 1.

Deletes the reservation from the Reservation table.

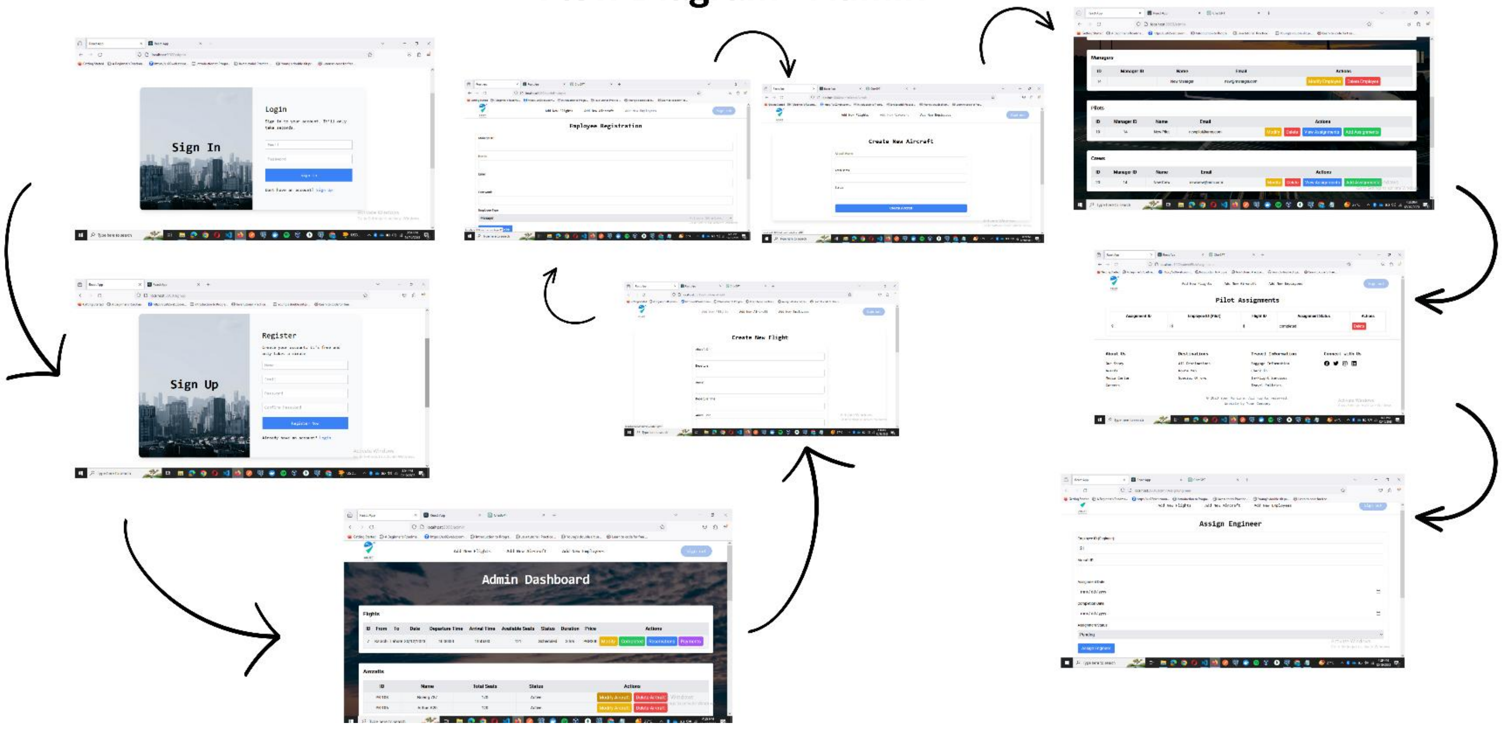
Deletes the corresponding passenger from the Passenger table.

6) Application Flow

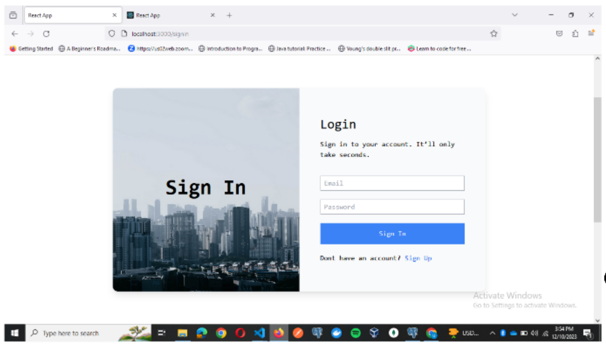
Flow Diagram - User



Flow Diagram - Admin



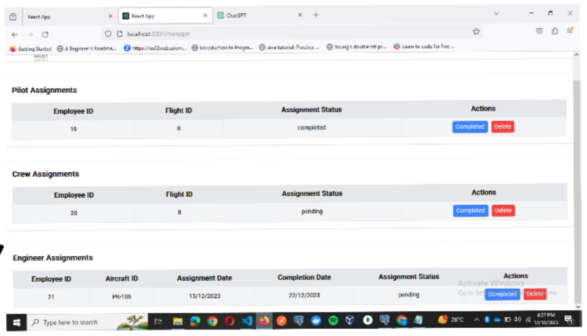
Flow Diagram - Employees



Login

Sign in to your account. It'll only take seconds.

Manager



localhost:3001/manager

Pilot Assignments

Employee ID	Flight ID	Assignment Status	Actions
19	8	completed	Completed Delete

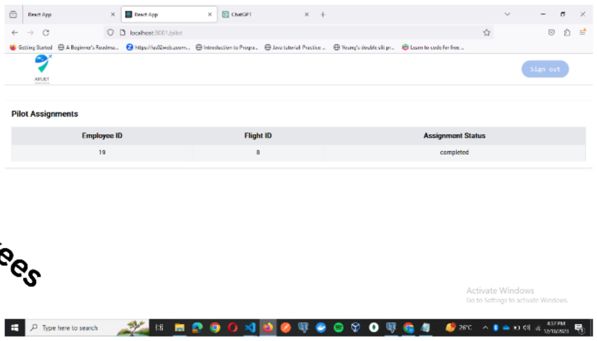
Crew Assignments

Employee ID	Flight ID	Assignment Status	Actions
20	8	pending	Completed Delete

Engineer Assignments

Employee ID	Aircraft ID	Assignment Date	Completion Date	Assignment Status	Actions
21	PK-106	15/12/2023	22/12/2023	pending	Completed Delete

Other Employees



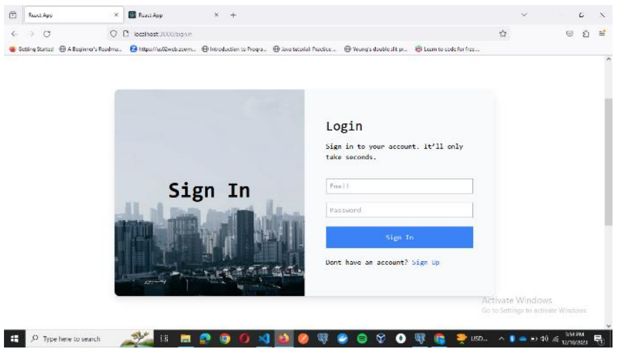
localhost:3001/pilot

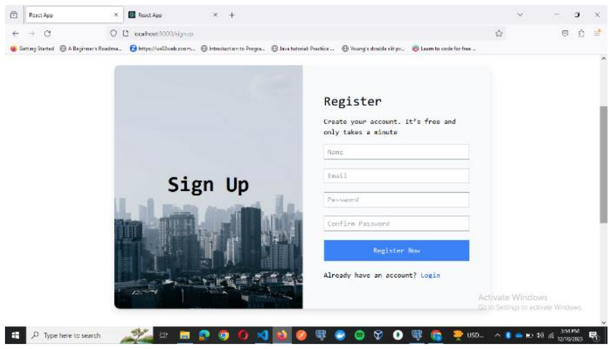
Pilot Assignments

Employee ID	Flight ID	Assignment Status
19	8	completed

7) Page-by-Page Navigation and SQL Queries

Login Page/Register Page:


Sign In
Login
Sign in to your account. It'll only take seconds.
Email
Password
Sign In
Dont have an account? Sign Up


Sign Up
Register
Create your account. It's free and only takes a minute
Name
Email
Password
Confirm Password
Register Now
Already have an account? Login

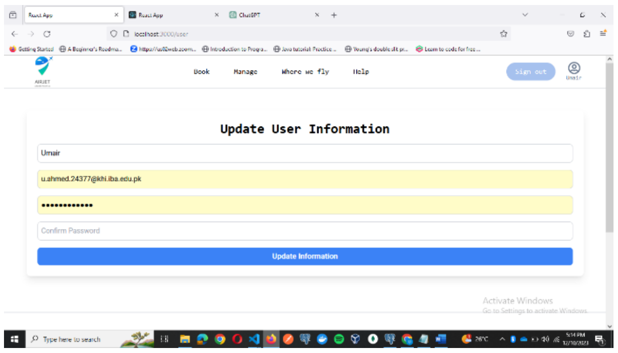
Main Queries used:

For Register: `INSERT INTO users (name, email, password, isadmin) VALUES ($1, $2, $3, $4) RETURNING id, name, email, isadmin`

For Login: `SELECT * FROM users WHERE email = $1`

We have a Users table which contains the attributes name, email, password and isadmin (Boolean). Users which will have isadmin = true will have global access of the website. In case of register we are inserting into the users table the values taken from the user and in case of log in we are just finding if a user exists by email. If it does then we move on to comparing the password entered by the user.

Update User Details Page:



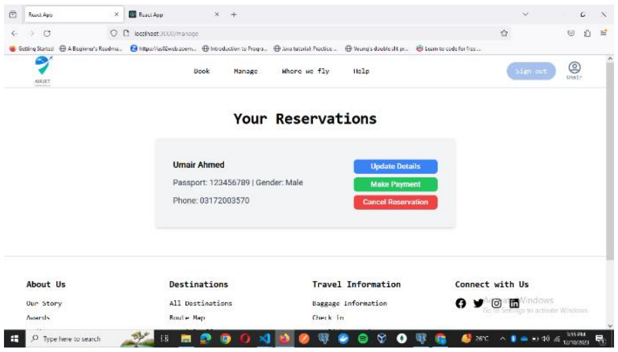
Main Queries used:

Used the process_payment_and_update_reservation function mentioned above in the document.

`SELECT process_payment_and_update_reservation($1, $2, $3, $4, $5, $6)`

What it does is taken in the reservationid and first creates an insert in the payments table, then it updates the reservationid in the reservation to mark the status as Confirmed. Then it selects the flightid from that reservationid row and updates the seats in that flight, decrements it.

Manage Page :

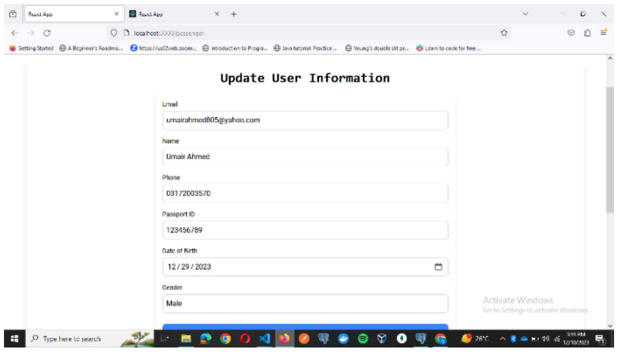


Your Reservations

Umair Ahmed

Passport: 123456789 | Gender: Male

Phone: 03172003570



Update User Information

Email: umairahmed805@yahoo.com

Name: Umair Ahmed

Phone: 03172003570

Passport ID: 123456789

Date of Birth: 12 / 29 / 2023

Gender: Male

Main Queries used:

Used the cancel_reservation function for cancel part:

```
SELECT cancel_reservation($1)
```

Used this for updating the passenger details:

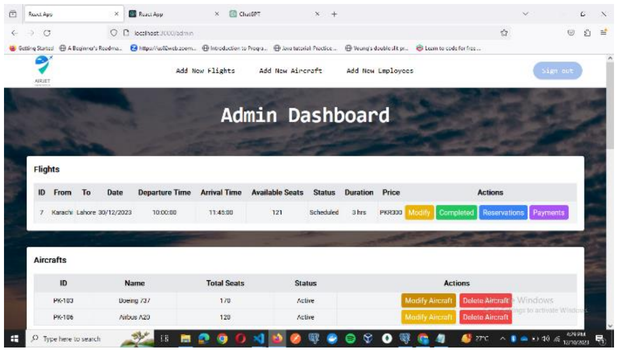
```
UPDATE Passenger SET id = $1, name = $2, phone = $3, email = $4, passport = $5,
dob = $6, gender = $7 WHERE passengerid = $8 RETURNING *
```

The cancel reservation function just takes in the reservationid and cancels the reservation updates the available seats in flight and delete from reservation and payments table.

The make payment button simple does the same which happens in the payment page.

The update passenger button simply updates the passenger details in the passenger table.

Admin Dashboard Page :



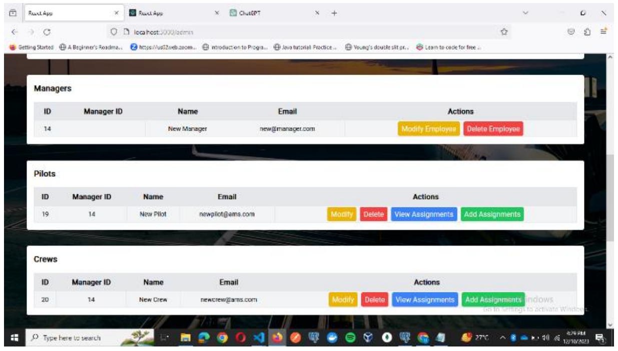
Admin Dashboard

Flights

ID	From	To	Date	Departure Time	Arrival Time	Available Seats	Status	Duration	Price	Actions
7	Karachi	Lahore	30/12/2023	10:00:00	11:45:00	121	Scheduled	3 hrs	PKR300	Modify Completed Reservations Payments

Aircrafts

ID	Name	Total Seats	Status	Actions
PK-103	Boeing 737	170	Active	Modify Aircraft Delete Aircraft
PK-106	Airbus A20	120	Active	Modify Aircraft Delete Aircraft



Managers

ID	Manager ID	Name	Email	Actions
14		New Manager	new@manager.com	Modify Employee Delete Employee

Pilots

ID	Manager ID	Name	Email	Actions
19	14	New Pilot	newpilot@ams.com	Modify Delete View Assignments Add Assignments

Crews

ID	Manager ID	Name	Email	Actions
20	14	New Crew	newcrew@ams.com	Modify Delete View Assignments Add Assignments

Main Queries used:

`SELECT * FROM Reservation WHERE flightid = $1` Get All Reservation for a specific flight.

`SELECT * FROM Flight WHERE status = $1 ORDER BY date ASC',['Scheduled']` Displays all flights where status is scheduled

`SELECT * FROM Aircraft` Get All Aircrafts in the system currently.

`SELECT * FROM EMPLOYEE where type = \'crew\(gets any of the four types)` Get All (Crew/Pilot/Engineer/Manager) Employees

`DELETE FROM EMPLOYEE WHERE employeeId = $1 RETURNING` Delete an employee

`UPDATE Aircraft SET aname = $1, totalseats = $2, astatus = $3 WHERE aircraftid = $4 RETURNING *` Modify an aircraft, can change status from active to non active or vice versa.

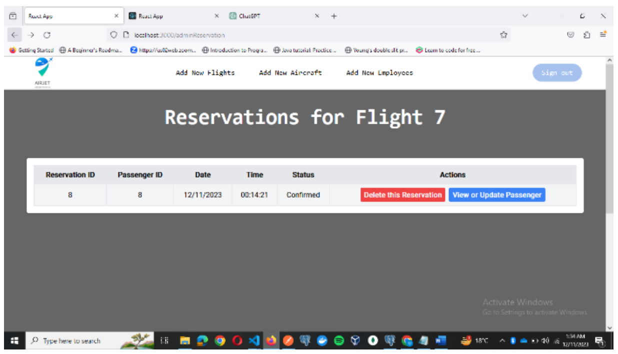
`DELETE FROM Aircraft WHERE aircraftid = $1 RETURNING *` Delete an aircraft

`UPDATE EMPLOYEE SET name = $1, email = $2, password = $3, managerId = $4 WHERE employeeId = $5 RETURNING employeeId, name, email, managerId` Modify the employee details such as name email password

`UPDATE Flight SET status = $1 WHERE flightid = $2 RETURNING *',['Completed', flightid]` Mark the status of the flight as completed which will remove it from the table

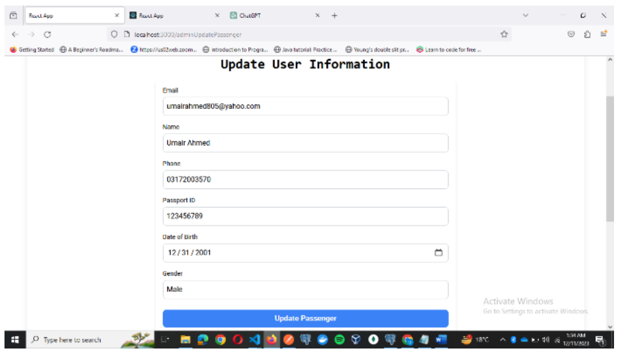
`SELECT * FROM Payment WHERE reservationid IN (SELECT reservationid FROM Reservation WHERE flightid = $1)` Get all the payments for a specific flight.

View Reservations for a flight and view or edit the passenger for that reservation :



Reservations for Flight 7

Reservation ID	Passenger ID	Date	Time	Status	Actions
8	8	12/11/2023	00:14:21	Confirmed	Delete this Reservation View or Update Passenger



Update User Information

Email
umairahmed805@yahoo.com

Name
Umair Ahmed

Phone
03172003570

Passport ID
123456789

Date of Birth
12 / 31 / 2001

Gender
Male

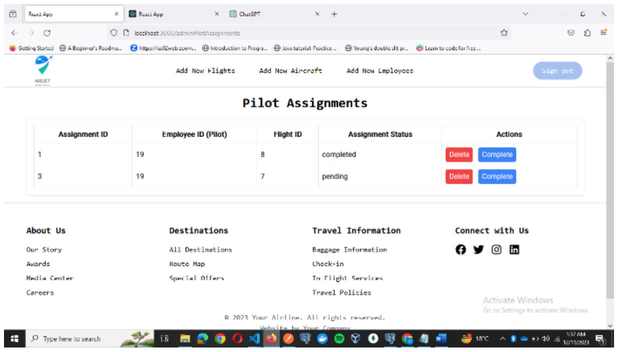
Main Queries used:

`SELECT * FROM Reservation WHERE flightid = $1` Used to get all reservations for a flight

`UPDATE Passenger SET id = $1, name = $2, phone = $3, email = $4, passport = $5, dob = $6, gender = $7 WHERE passengerid = $8 RETURNING *` Update the details of a passenger by passengerid

`SELECT * FROM Passenger WHERE passengerid = $1', [passengerid]` Viewing the details of a passenger

View Assignments for an employee and Add assignments for an employee :



Add New Flights Add New Aircraft Add New Employees Sign out

Pilot Assignments

Assignment ID	Employee ID (Pilot)	Flight ID	Assignment Status	Actions
1	19	8	completed	Delete Complete
3	19	7	pending	Delete Complete

About Us: Our Story, Awards, Media Center, Careers
Destinations: All Destinations, Route Map, Special Offers
Travel Information: Baggage Information, Check-in, In-Flight Services, Travel Policies
Connect with Us

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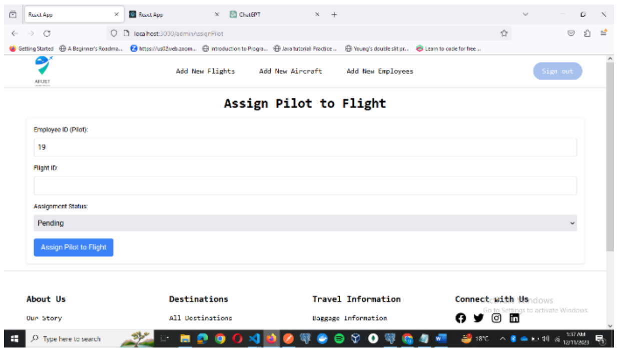


Assign Pilot to Flight

Employee ID (Pilot): 19
Flight ID:
Assignment Status: Pending

Main Queries used:

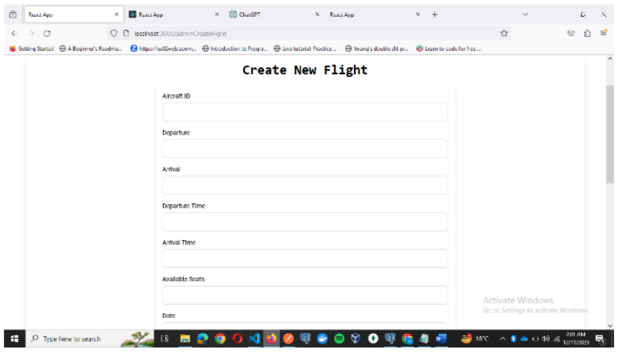
`SELECT * FROM PilotAssignments where employeeid = $1', [id]` Used to get the assignments for a specific employee(pilot in this case)

`INSERT INTO PilotAssignments (employeeid, flightid, AssignmentStatus) VALUES ($1, $2, $3) RETURNING *` Used to create an assignment for an employee (pilot in this case)

`UPDATE PilotAssignments SET AssignmentStatus = $1 WHERE AssignmentID = $2'` Used to mark an assignment as completed

`DELETE FROM PilotAssignments WHERE AssignmentID = $1` To delete an assignment

Add a Flight :



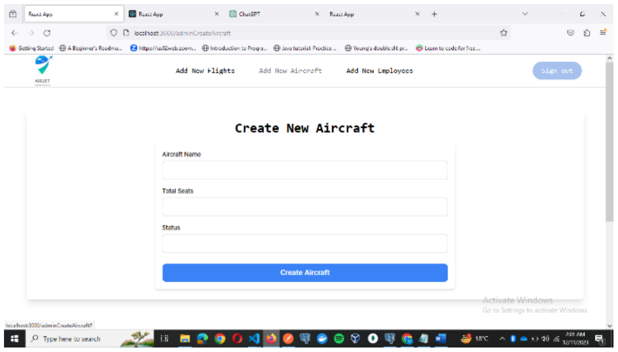
Create New Flight

Aircraft ID:
Departure:
Arrival:
Departure Time:
Arrival Time:
Available Seats:
Date:

Main Queries used:

`INSERT INTO Flight (aircraftid, dep, arr, deptime, arrtime, avbseats, date, status, duration, price) VALUES ($1, $2, $3, $4, $5, $6, $7, $8, $9, $10) RETURNING *` To create a new flight

Add an Aircraft :

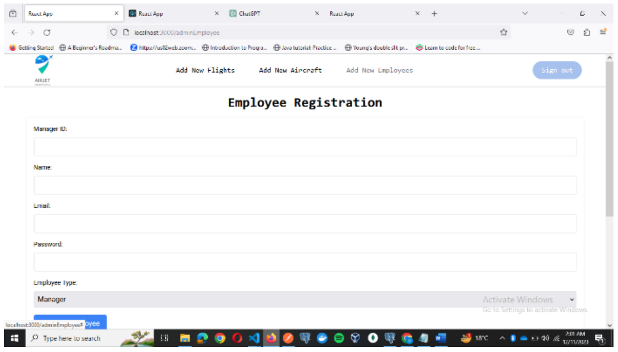


Main Queries used:

```
INSERT INTO Aircraft (aname, totalseats, astatus) VALUES ($1, $2, $3) RETURNING *
```

To create a new aircraft

Add an Employee :

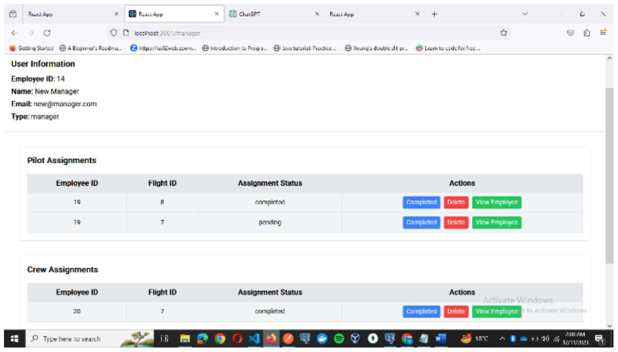


Main Queries used:

```
INSERT INTO EMPLOYEE (managerid, name, email, password, type) VALUES ($1, $2, $3,
$4, $5) RETURNING employeeId, name, email, type
```

To create a new employee with the relevant type.

Manager Screen :


User Information

Employee ID: 14

Name: New Manager

Email: new@manager.com

Type: manager

Pilot Assignments

Employee ID	Flight ID	Assignment Status	Actions
19	8	completed	Completed Delete View Employee
19	7	pending	Completed Delete View Employee

Crew Assignments

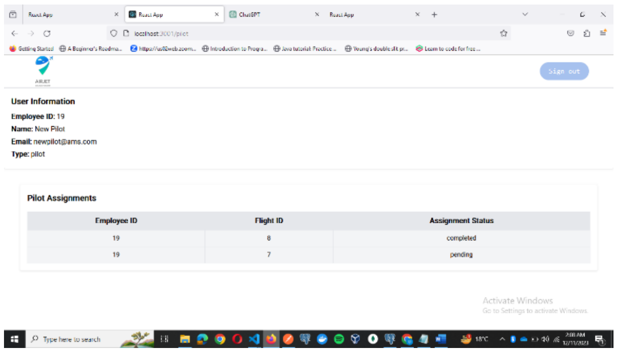
Employee ID	Flight ID	Assignment Status	Actions
20	7	completed	Completed Delete View Employee

`UPDATE PilotAssignments SET AssignmentStatus = $1 WHERE AssignmentID = $2'` Used to mark an assignment as completed

`DELETE FROM PilotAssignments WHERE AssignmentID = $1` To delete an assignment

`UPDATE EMPLOYEE SET name = $1, email = $2, password = $3, managerId = $4 WHERE employeeId = $5 RETURNING employeeId, name, email, managerId` View and Modify the employee details such as name email password

Employee Screen :


User Information

Employee ID: 19

Name: New Pilot

Email: newpilot@ams.com

Type: pilot

Pilot Assignments

Employee ID	Flight ID	Assignment Status
19	8	completed
19	7	pending

Main Queries used:

`SELECT * FROM PilotAssignments where employeeid = $1', [id]` Get assignments for an employee and display it for the employee to view.

8)Work Breakdown among team Members

Ali Iqbal :

- Designed the Initial Database Schema on OracleDB.
- Backend API Logic Building

Ali Khurram:

- Backend API creation and testing.
- Report and Powerpoint Creation

Umair Ahmed:

- Converting the database to postgres and fine tuning it according to backend api needs.
- Frontend Design and Backend connection.

9) Technical Stack Used and Why?

PERN Stack Overview:
The Airline Management System will be developed using the PERN stack, a comprehensive technology stack using PostgreSQL, Express.js, React.js, Node.js, and Redux. Each component of the stack is carefully selected to provide a solid foundation for building a scalable, efficient, and user-friendly application.

PostgreSQL (Relational Database Management System):
PostgreSQL is chosen as the relational database management system (RDBMS) for the Airline Management System. Key features that make PostgreSQL a suitable choice include:

- ACID Compliance: PostgreSQL ensures data integrity and reliability through its adherence to ACID (Atomicity, Consistency, Isolation, Durability) properties, making it suitable for transactional applications such as our airline management system.

- Extensibility and Customization: PostgreSQL supports custom data types, functions, and extensions, allowing for the implementation of specific requirements tailored to the airline industry.

Express.js (Back-End Framework):
Express.js is chosen as the back-end framework for the Airline Management System. Key attributes include:

- Routing and Middleware: Express.js simplifies the creation of robust APIs and handles middleware functions efficiently, facilitating the implementation of authentication, logging, and other crucial functionalities.

- Modularity: The modular structure of Express.js allows for the organization of code into separate, manageable components, enhancing code maintainability and scalability.

React.js (Front-End Framework):

React.js, a JavaScript library for building user interfaces, serves as the front-end framework for the Airline Management System. Key advantages include:

- Component-Based Architecture: React's component-based structure enables the creation of reusable UI components, promoting code reusability and maintainability.

- Virtual DOM: React's virtual DOM optimizes rendering performance, ensuring a smooth and responsive user interface for the airline management application.

- Declarative Syntax: The declarative nature of React simplifies the development process and enhances code readability, making it easier to understand and maintain.

Redux (State Management):
Redux is integrated into the front-end architecture as the state management solution. Key features and advantages of using Redux in the Airline Management System include:

- Predictable State Management: Redux follows a predictable state management pattern, facilitating a clear understanding of how the application state changes over time.

- Centralized State:Redux provides a centralized store to manage the state of the application, enabling efficient data flow and reducing the complexity of state management.

- State Immutability:By encouraging the use of immutable data, Redux helps prevent unintended side effects and makes it easier to track and understand state changes.
- Enhanced Debugging:

- The Redux DevTools extension offers powerful debugging capabilities, allowing real-time inspection of state changes and actions for easier troubleshooting.

Node.js (Runtime Environment):

Node.js is chosen as the runtime environment for the server side. Key features include:

- Non-blocking I/O: Node.js operates on a non-blocking, event-driven architecture, making it suitable for handling concurrent connections and enhancing the performance of real-time applications like the Airline Management System.

- Package Management: Node Package Manager (NPM) provides a vast ecosystem of packages and modules, streamlining the integration of third-party libraries and tools.

The selection of the PERN stack with Redux for the Airline Management System represents a strategic choice to create a robust, scalable, and user-friendly application. This technology stack combines the strengths of a reliable relational database, a flexible back-end framework, a dynamic front-end library, and a sophisticated state management solution.