Bilkent University

Department of Computer Engineering

CS 353 - Database Management Systems

Airline Company Data Management System

Design Report

Group 16

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1. REVISED E/R MODEL

1.1. Changes Made in the E/R Diagram

After we received feedback from our assistant, we made the following changes in our E/R model in order to provide a better database structure for our project:

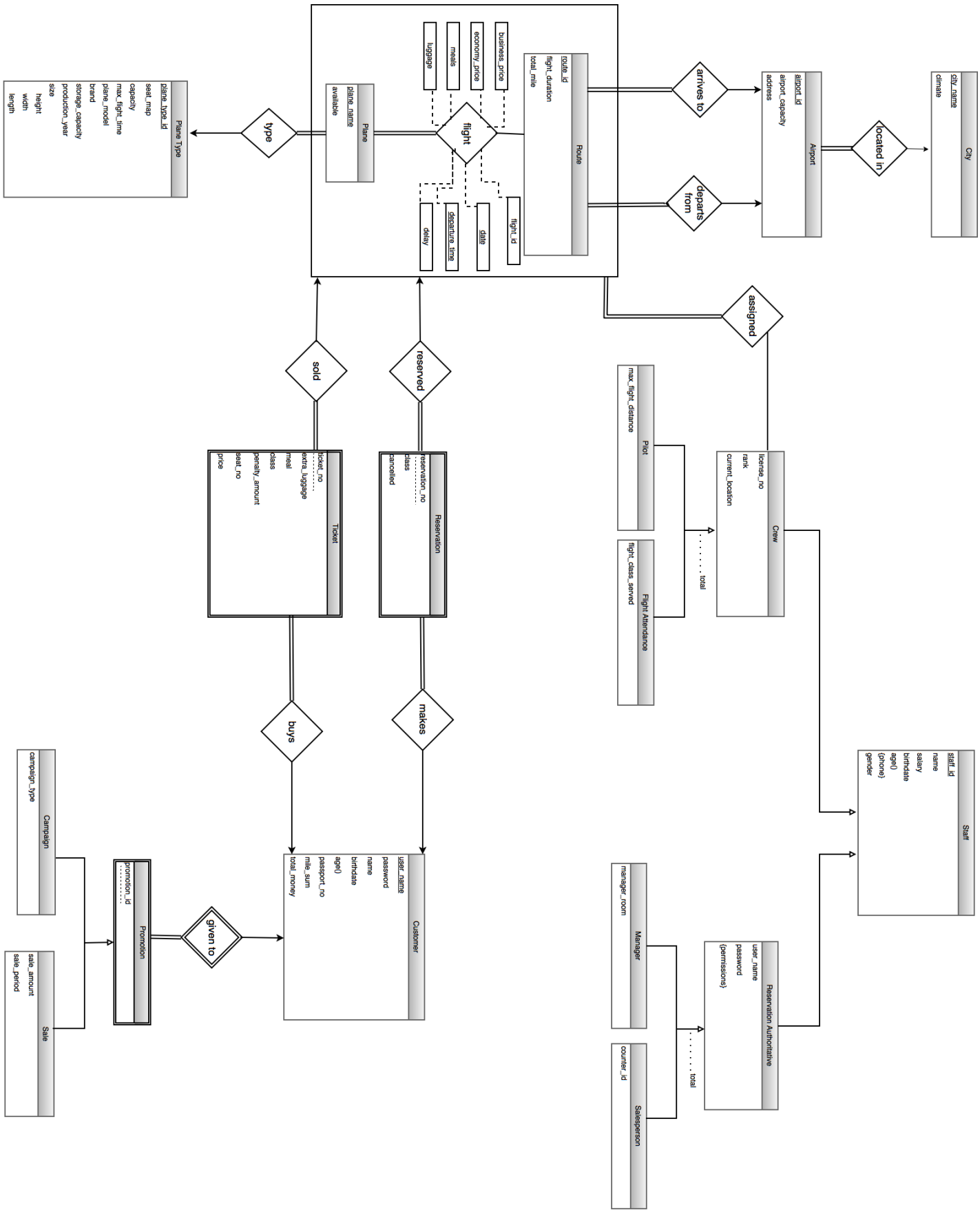
- ✓ Instead of making city an attribute, we represented city as an entity. Besides city name, we keep the climate of the city as well.
- ✓ We removed the 'sold' attribute from the reservation. When a reservation is purchased by the customer a related ticket is created in the system. Instead of a sold attribute we will join the tables when tickets and reservations need to be linked.
- ✓ We removed the primary key attribute of user_name in Reservation authority since we already have a primary key staff_id in the parent class.
- ✓ In order to distinguish subclasses of ReservationAuthority entity, we extended our diagram as follows:
    - We added manager_room info to Manager entity in order to track the room number of the manager.
    - We added counter_id to Salesperson in order to track which counter the salesperson is currently assigned to.

During the design process we also discovered new attributes and new aspects of the system. We made the following changes to improve the E/R model:

- ✓ Most importantly we eliminated Ticketing/Gate Agent from our system since the duties of the agent were already covered by other staff. Hence, we deleted the Ticketing/Gate Agent entity.
- ✓ We added price attribute to ticket to track the price that is paid for each ticket.
- ✓ We added total_money attribute to the customer in order to perform purchasing operations.

- ✓ We previously had many-to-many relation between ticket/reservation and customer. However, we decided to allow a ticket or reservation to be owned by only one customer. Hence, we made the relations one-to-many instead.
- ✓ We decided to identify a flight with date and departure_time properties along with plane_name and route_id attributes.
- ✓ We inserted available attribute to plane to indicate whether the plane is currently available for flight or it is unavailable (on repair, etc.).
- ✓ We added delay attribute to flight to track how many minutes of delay the flight has.
- ✓ We added penalty_amount attribute to ticket in order to track the amount of penalty in cancellation.
- ✓ We made the relation between promotion and customer one-to-many instead of many-to-many in order to make sure that a promotion belongs to one customer.
- ✓ We added business_price and economy_price attributes to flight to record prices of flights.
- ✓ We added meals and luggage attribute to flight in order to track the meals available for the flight and the total luggage registered.

1.2. Revised E/R Diagram



2. RELATION SCHEMAS

2.1. Staff

Relational Model:

Staff(staff_id, name, salary, birthdate, age, gender)

Functional Dependencies:

staff_id ->name, salary, birthdate, age, gender

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

```
create table staff
        (staff_id       int PRIMARY KEY,
        name            varchar(32) NOT NULL,
        salary          int NOT NULL,
        birthdate       date,
        age             int,
        gender          char(1) );
```

2.2. Staff Phones

Relational Model:

Staff_Phones(staff_id, phone)

Functional Dependencies:

No nontrivial dependencies

Candidate Keys:

{(staff_id, phone)}

Normal Form:

BCNF

Table Definition:

create table staff_phones

(staff_id int PRIMARY KEY,

phone char(15) NOT NULL

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.3. Reservation Authoritative

Relational Model:

Reservation_Authoritative (staff_id, user_name, password)

Functional Dependencies:

staff_id -> user_name, password

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

create table reservation_authoritative

(staff_id int PRIMARY KEY,

user_name varchar(32) NOT NULL,

password varchar(32) NOT NULL,

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.4. Permissions

Relational Model:

Permissions (staff_id, permission_name)

Functional Dependencies:

No nontrivial dependencies

Candidate Keys:

{(staff_id, permission_name)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE permissions

(staff_id int PRIMARY KEY,

permission_name varchar(32),

FOREIGN KEY (staff_id) REFERENCES reservation_authoritative) ENGINE = InnoDB;

2.5. Manager

Relational Model:

Manager(staff_id, manager_room)

Functional Dependencies:

staff_id -> manager_room

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE manager

(staff_id int PRIMARY KEY,

manager_room varchar(4)

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.6. Salesperson

Relational Model:

Salesperson(staff_id, counter_id)

Functional Dependencies:

staff_id -> counter_id

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE salesperson

(staff_id int PRIMARY KEY,

counter_id int

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.7. Crew

Relational Model:

Crew(staff_id, license_no, rank, current_location)

Functional Dependencies:

staff_id -> license_no, rank, current_location

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE crew

(staff_id int PRIMARY KEY,

license_no char(10) NOT NULL,

rank int NOL NULL,

current_location varchar(16) NOT NULL,

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.8. Pilot

Relational Model:

Pilot(staff_id, max_flight_distance)

Functional Dependencies:

staff_id -> max_flight_distance

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE pilot

(staff_id int PRIMARY KEY,

max_flight_distance int NOT NULL

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.9. Flight Attendance

Relational Model:

Flight_Attendance(staff_id, flight_class_served)

Functional Dependencies:

staff_id -> flight_class_served

Candidate Keys:

{(staff_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE flight_attendance

(staff_id int PRIMARY KEY,

flight_class_served char(1) NOT NULL,

FOREIGN KEY (staff_id) REFERENCES staff) ENGINE = InnoDB;

2.10. City

Relational Model:

City(city_name, climate)

Functional Dependencies:

city_name -> climate

Candidate Keys:

{(city_name)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE city
        (city_name          varchar(20) PRIMARY KEY,
        climate             varchar(10));
```

2.11. Airport

Relational Model:

Airport(airport_id, airport_capacity, address, city_name)

Functional Dependencies:

airport_id -> airport_capacity, address, city_name

Candidate Keys:

{(airport_id)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE airport
        (airport_id         int PRIMARY KEY,
        airport_capacity    int NOT NULL,
        address             varchar(100),
        city_name           varchar(20),
        foreign key (city_name) REFERENCES city) ENGINE InnoDB;
```

2.12. Route

Relational Model:

Route(route_id, flight_duration, total_mile, departs, arrives)

Functional Dependencies:

route_id -> flight_duration, total_mile, departs, arrives

Candidate Keys:

{(route_id)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE route
        (route_id           int PRIMARY KEY,
        flight_duration     time NOT NULL,
        total_mile          int NOT NULL,
        departs             int NOT NULL,
        arrives             int NOT NULL,
        FOREIGN KEY (departs) REFERENCES airport,
        FOREIGN KEY (arrives) REFERENCES airport) ENGINE InnoDB;
```

2.13. Plane Type

Relational Model:

Plane_Type(plane_type_id, seat_map, capacity, max_flight_time, plane_model, brand, storage_capacity, production_year, width, height, length)

Functional Dependencies:

plane_type_id -> seat_map, capacity, max_flight_time, plane_model, brand, storage_capacity, production_year, width, height, length

Candidate Keys:

{(plane_type_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE plane_type

(plane_type_id	varchar(4) PRIMARY KEY,
seatmap	varchar(200) NOT NULL,
capacity	int NOT NULL,
max_flight_time	time NOT NULL,
plane_model	varchar(4),
brand	varchar(10),
storage_capacity	int NOT NULL,
production_year	int,
width	int,
height	int,
length	int);

2.14. Plane

Relational Model:

Plane(plane_name, available, plane_type_id)

Functional Dependencies:

plane_name -> available, plane_type_id

Candidate Keys:

{(plane_name)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE plane

(plane_name	varchar(20) PRIMARY KEY,
available	char(1) NOT NULL,
FOREIGN KEY (plane_type_id) REFERENCES plane_type) ENGINE InnoDB;	

2.15. Flight

Relational Model:

Flight(plane_name, route_id, date, departure_time, flight_id, delay, business_price, economy_price, meals, luggage)

Functional Dependencies:

plane_name, route_id , date, departure_time -> flight_id, delay, business_price, economy_price , meals, luggage

Candidate Keys:

{(plane_name, route_id, date, departure_time)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE flight
        (plane_name         varchar(20) PRIMARY KEY,
        route_id            int PRIMARY KEY,
        date                date NOT NULL,
        departure_time      time NOT NULL,
        flight_id           int NOT NULL,
        delay               int,
        business_price      int NOT NULL,
        economy_price       int NOT NULL,
        meals               varchar(50),
        luggage             int,
        FOREIGN KEY (route_id) REFERENCES route,
        FOREIGN KEY (plane_name) REFERENCES plane) ENGINE = InnoDB;
```

2.16. Flight Crew

Relational Model:

Flight_Crew(staff_id, plane_name, route_id, date, departure_time)

Functional Dependencies:

No nontrivial dependencies

Candidate Keys:

{(staff_id, plane_name, route_id, date, departure_time)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE flight_crew
        (staff_id           int PRIMARY KEY,
        plane_name          varchar(20) PRIMARY KEY,
        route_id            int PRIMARY KEY,
        date                date NOT NULL,
        departure_time      time NOT NULL,
        FOREIGN KEY (staff_id) REFERENCES staff,
        FOREIGN KEY (plane_name, route_id, date, departure_time) REFERENCES flight)
        ENGINE = InnoDB;
```

2.17. Customer

Relational Model:

Customer(user_name, password, name, birthdate, age, passport_no, mile_sum, total_money)

Functional Dependencies:

user_name -> password, name, birthdate, age, passport_no, mile_sum, total_money

Candidate Keys:

{(user_name)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE customer
        (user_name          varchar(32) PRIMARY KEY,
        password            varchar(32) NOT NULL,
```

```
name            varchar(32) NOT NULL,
birthdate       date,
age             int,
passport_no     char(9),
mile_sum        int
totalMoney      int NOT NULL);
```

2.18. Reservation

Relational Model:

Reservation(user_name, plane_name, route_id, date, departure_time, reservation_no, class, cancelled)

Functional Dependencies:

user_name, plane_name, route_id, date, departure_time, reservation_no -> class, cancelled

Candidate Keys:

{(user_name, plane_name, route_id, date, departure_time, reservation_no)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE reservation
    (user_name          varchar(32) PRIMARY KEY,
    plane_name          varchar(20) PRIMARY KEY,
    route_id            int PRIMARY KEY,
    reservation_no      int PRIMARY KEY AUTO_INCREMENT,
    date                date NOT NULL,
    departure_time      time NOT NULL,
    class               char(1) NOT NULL,
    cancelled           char(1) NOT NULL,
    FOREIGN KEY (user_name) REFERENCES customer,
```

FOREIGN KEY (plane_name, route_id, date, departure_time) REFERENCES flight)

ENGINE = InnoDB;

2.19. Ticket

Relational Model:

Ticket(user_name, plane_name, date, departure_time, route_id, ticket_no, extra_luggage, meal, class, penalty_amount, seat_no, price)

Functional Dependencies:

user_name, plane_name, route_id, date, departure_time, ticket_no -> extra_luggage, meal, class, penalty_amount, seat_no, price

Candidate Keys:

{(user_name, plane_name, route_id, date, departure_time, ticket_no)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE ticket

(user_name varchar(32) PRIMARY KEY,

plane_name varchar(20) PRIMARY KEY,

route_id int PRIMARY KEY,

date date PRIMARY KEY,

departure_time time PRIMARY KEY,

ticket_no int PRIMARY KEY,

extra_luggage int,

meal varchar(20),

class char(1) NOT NULL,

penalty_amount int NOT NULL,

seat_no varchar(4),

price int NOT NULL,

FOREIGN KEY (user_name) REFERENCES customer,

FOREIGN KEY (plane_name, route_id, date, departure_time) REFERENCES flight)

ENGINE = InnoDB;

2.20. Promotion

Relational Model:

Given_Promotion(user_name, promotion_id)

Functional Dependencies:

No nontrivial dependencies

Candidate Keys:

{(user_name, promotion_id)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE given_promotion
        (user_name          varchar(32) PRIMARY KEY,
        promotion_id        int PRIMARY KEY,
        FOREIGN KEY user_name REFERENCES customer);
```

2.21. Campaign

Relational Model:

Campaign(user_name, promotion_id, campaign_type)

Functional Dependencies:

user_name, promotion_id -> campaign_type

Candidate Keys:

{(user_name, promotion_id)}

Normal Form:

BCNF

Table Definition:

```
CREATE TABLE campaign
        (user_name          varchar(32) PRIMARY KEY,
        promotion_id        int PRIMARY KEY,
        campaign_type       varchar(10) NOT NULL,
```

FOREIGN KEY(user_name, promotion_id) REFERENCES given_promotion);

2.22. Sale

Relational Model:

Sale(user_name, promotion_id, sale_amount, sale_period)

Functional Dependencies:

user_name, promotion_id -> sale_amount, sale_period

Candidate Keys:

{(user_name, promotion_id)}

Normal Form:

BCNF

Table Definition:

CREATE TABLE sale

(user_name varchar(32) PRIMARY KEY,

promotion_id int PRIMARY KEY,

sale_amount int,

sale_period interval,

FOREIGN KEY (user_name, promotion_id) REFERENCES given_promotion);

3. FUNCTIONAL DEPENDENCIES AND NORMALIZATION OF TABLES

In Relation Schemas part of the report, the normal form of all tables are indicated. Since all the relations are either in BCNF or 3NF form, no decomposition or further normalization was needed.

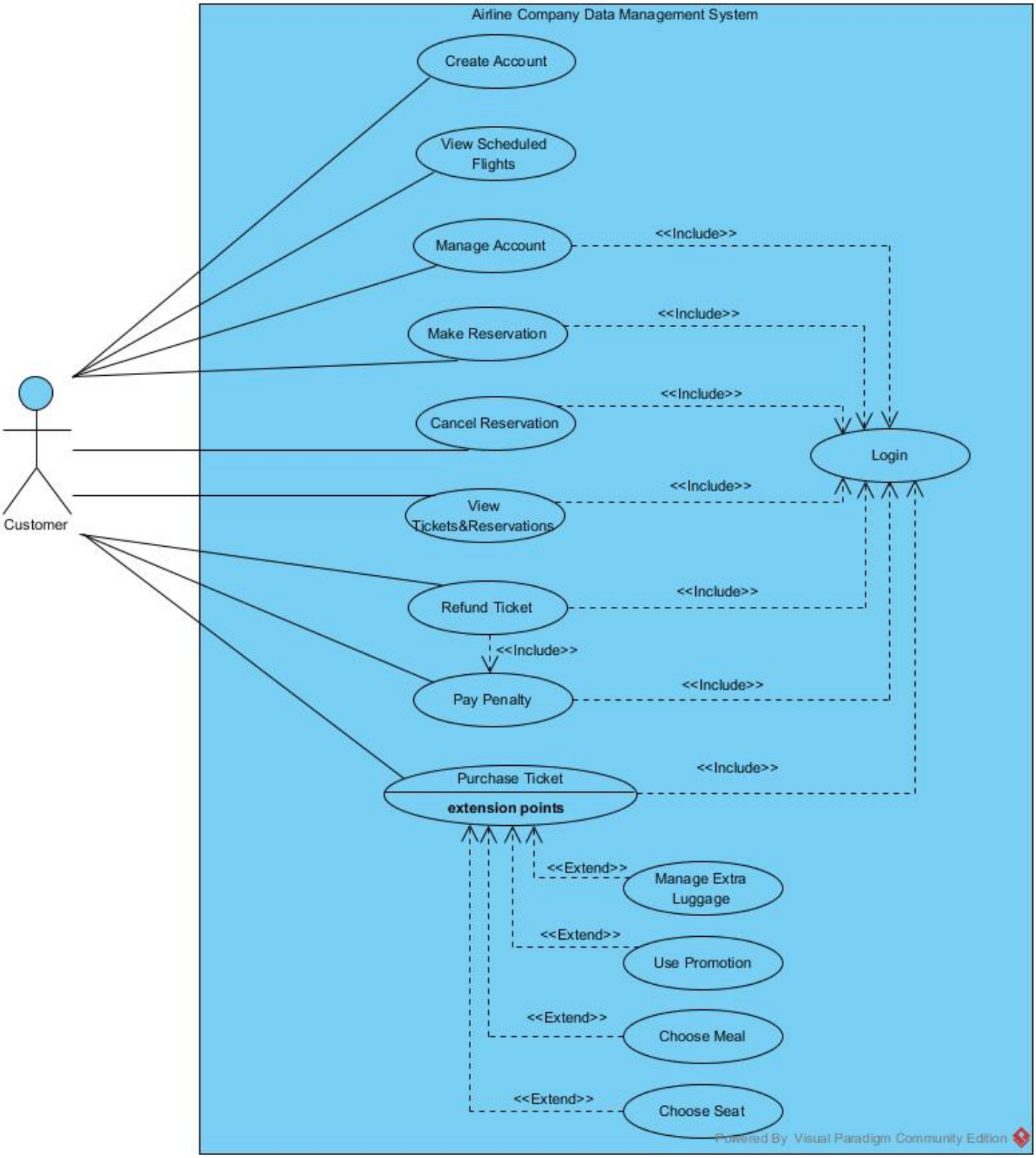
4. FUNCTIONAL COMPONENTS

4.1. Use Cases/Scenarios

Airline Company Data Management System is responsible from providing reservation services to users along with allowing related managers to control flight, employee, airport, and flight details. The service details of the system vary according to the user. Airline Company Data Management System has 3 users: Customer, Manager, and Salesperson. Even though some services are common to all users, each user is allowed to access different functionalities of the system. Ticketing/Gate Agent user was removed from the system since it was seen unnecessary.

- Customer is able to perform actions related to reservations such as viewing flight details and making payment.
- Manager is the admin of the system and can manage planes, flights, airports, reservations, crew, and staff.
- Salesperson is responsible from helping the customer to complete the reservation and purchasing services.

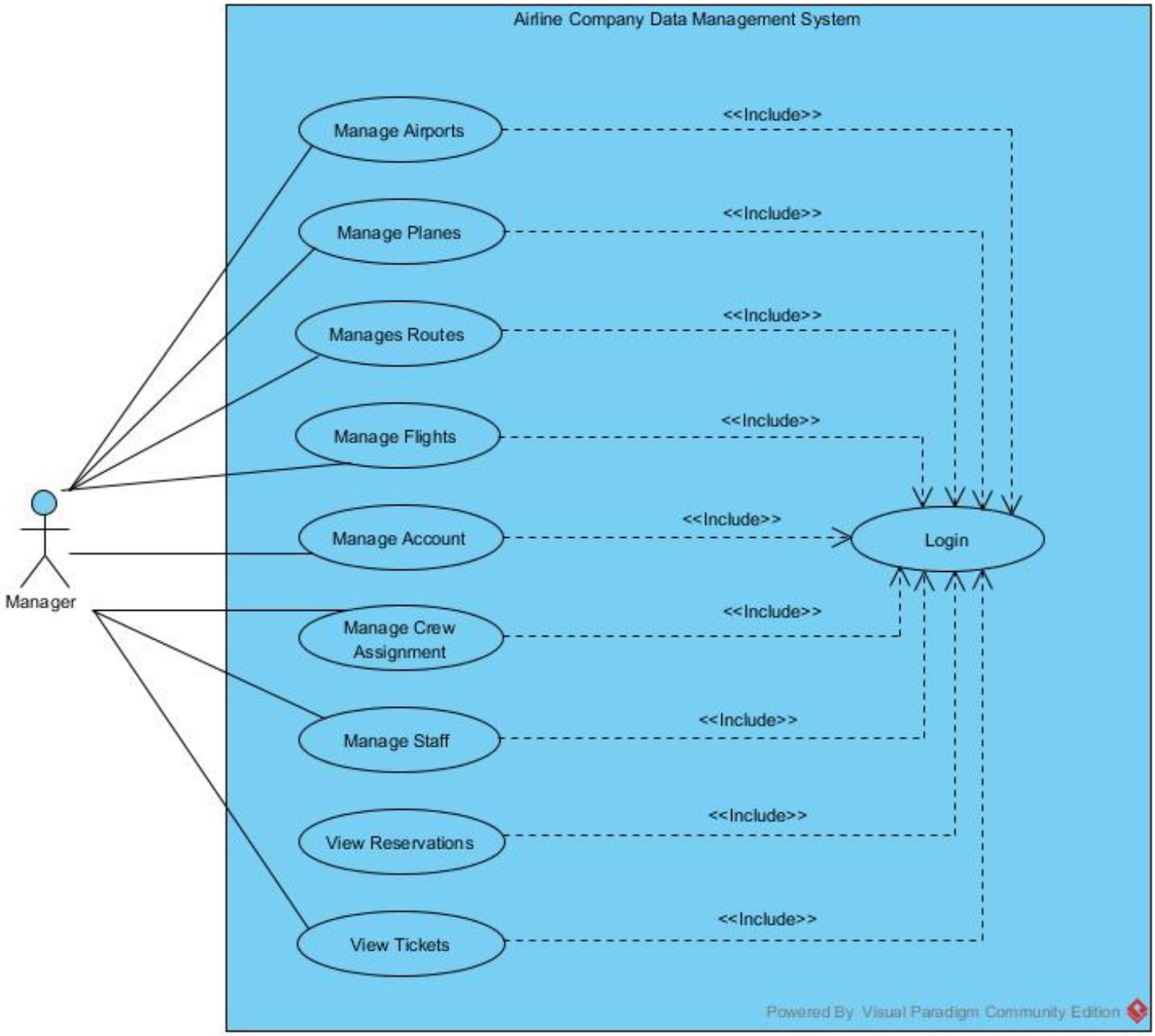
4.1.1. Customer Use Cases



- **Login:** The customer can login to the system using his/her username and password in order to be able make reservation/purchasing operations. Except Create Account and View Scheduled Flights use cases, login is required before all operations.
- **Create Account:** The customer can create an account in the system by specifying his/her unique username, password, name, birthdate, and passport number. The user can use this account information to login to the system for reservations. The total miles travelled and the account balance is set to 0 automatically.
- **Manage Account:** The customer can update his/her account information. The username, name, password, birthday, passport details can be updated by the customer when it is necessary.
- **View Scheduled Flights:** The customer can view all flights that are registered to system. He/she can specify date, arrival city and airport, and departure city and airport in order to view the flights he/she is interested in. The customer can also search for one-way or return flights.
- **Make Reservation:** The customer can make reservations to the flights they select from the list of available flights.
- **Cancel Reservation:** The customer can cancel their reservations if the system allows them to. He/she can select the reservation to cancel from the list of his/her reservations.
- **View Tickets & Reservations:** The customer can view all his/her reserved flights and purchased flights. Past and cancelled flights can also be viewed. The reserved flight information includes departure/arrival airports, date, departure time, price, and class details. The departure/arrival airports, date, departure time, meals, class, seat number, extra luggage, price details are visible for the purchased flights. The flight selections such as meal and luggage can be updated by the customer.
- **Refund Ticket:** The customer can refund his/her tickets if the system allows by selecting the flight from the list of his/her flights. He/she can cancel his/her ticket and the money will be refunded. The Refund Ticket use case includes paying the penalty amount for cancelling the ticket.

- **Pay Penalty:** The customer can pay the penalty amount from his/her account when a ticket is refunded. The amount of the penalty will be deducted from the customer account.
- **Purchase Ticket:** The customer can purchase flights that exist in the list of available flights or the flights that he/she reserved. Purchase ticket use case can also cover adding/cancelling extra luggage, selecting promotion to use, choosing meal and seat number. The details of any purchasing operations such as credit card operations and loading money, is out of the scope of the system and handled by purchasing helper systems such as PayPal.
- **Manage Extra Luggage:** The customer can buy extra luggage for the flights they bought a ticket from. They can indicate the extra luggage amount and make the necessary payment. The customer can also cancel the bought extra luggage. In this case their money will be refunded. Managing extra luggage can be done during purchasing the ticket or after the purchase.
- **Use Promotion:** The customer can benefit from the given promotions while purchasing a flight. The list of all campaigns and sales available are shown to user during purchase operation. The customer can select a sale or campaign to use, and the price of the ticket is updated accordingly.
- **Choose Meal:** The customer can choose meal for the purchased flight and make the necessary payment. The meal selection can be updated after the purchase if the system allows the operation.
- **Choose Seat:** The customer can choose his/her seat for the flights they bought a ticket from if the seat map information is available. The seat options are determined according to the flight class. The seat number can be updated after the purchase if the system allows the operation.

4.1.2. Manager Use Cases



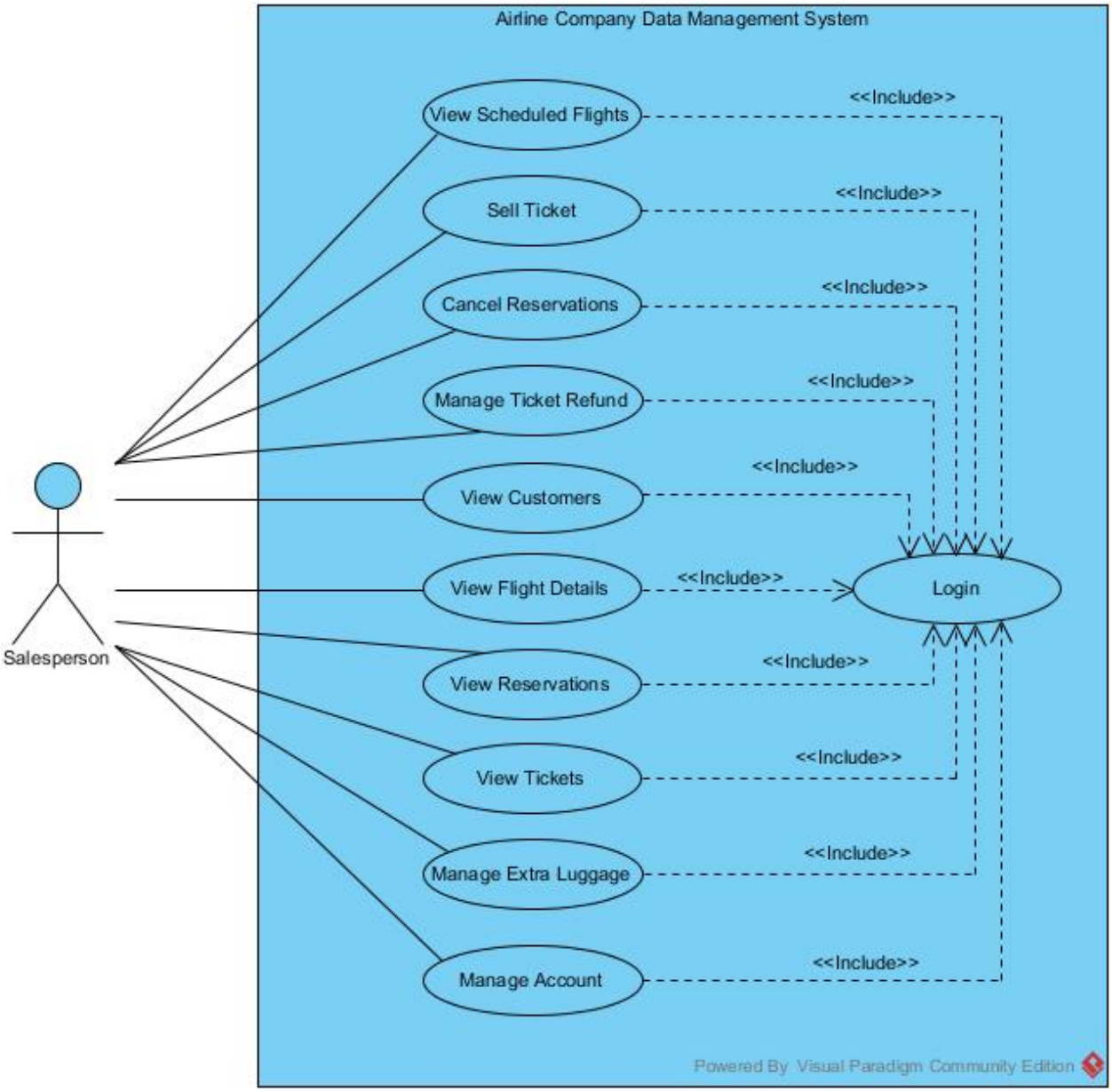
- **Login:** Manager can login to the system with his/her username and password. The manager will be given access to manager functions when the account details are approved. Manager needs to login to the system to be able to perform other operations.
- **Manage Airports:** The manager can view all airports registered to the system and their details: capacity, address, city, id, assigned routes and flights. He/she can

register new airports to the system and delete existing airports. The manager can also change details of the airports such as airport capacity.

- **Manage Planes:** The manager can view all the planes registered to the system. He/she can register new planes to the system by specifying the id and the plane type and delete the existing ones. Furthermore, the manager can send the planes to repair and update the status of the planes as unavailable. He/she can also mark the planes returned from repair as available.
- **Manage Routes:** The manager can view all routes registered to the system. He/she can add new routes by specifying the route id, source and destination airports, and the flight time. The manager is also able to delete the existing routes. The details of the routes can also be changed, the flight time and associated airports can be modified.
- **Manage Flights:** The manager can view all current flights in the system with airport, time, status, crew details. He/she can add new flights by specifying date, time, flight, route details. The manager can also delete or cancel the existing flights. Furthermore, he/she can change the details of the flights, changed assigned planes, modify date, time or route details.
- **Manage Account:** The manager is able to view the details of his account, see username, password details. He/she can also update his account, change username/password, name details.
- **Manage Crew Assignment:** The manager can assign crew to the flights according to the date and flight time of the flight and location of the crew. The manager is able to assign both pilots and flight attendance. He/she can also take back the assigned crew from flights.
- **Manage Staff:** The manager is able to see all details of the information of staff: pilots, flight attendance and salespersons. The manager is able to hire new staff by entering id, name, salary, birthday, gender, phone, license, duty details. He/she can also delete the existing staff, fire them. The manager is also able to change the information of the staff, raise or lower their salaries, update their licenses, change their flight distance and flight class.

- **View Reservations:** The manager is able to view all reservations and view the associated customer, date, route, plane, and, class details.
- **View Tickets:** The manager is able to view all tickets and view the associated customer, date, route, plane, crew, meal, seat, luggage and class details.

4.1.3. Salesperson Use Cases



- **Login:** Salesperson can login to the system with his/her username and password. The salesperson will be given access to salesperson functions when the account details

are approved. The salesperson is required to login to the system in order to be able to perform any operation.

- **View Scheduled Flights:** The salesperson can view all flights that are registered to system. He/she can specify date, arrival city and airport, and departure city and airport in order to help the customers to make reservations.
- **Sell Ticket:** The salesperson can complete the ticket purchasing operations for the customers. From the customer reservations, the salesperson can complete the purchasing operations. The salesperson can also select the ticket details such as meal, class, seat number for the customer.
- **Cancel Reservation:** The salesperson can cancel customer reservations when necessary by deleting the reservation from the system.
- **Manage Ticket Refund:** The salesperson can refund the tickets of the customers when necessary. He/she can cancel the ticket –delete it from the system, refund the money to the customer account and also charge the penalty.
- **View Customers:** The salesperson can view the list of customers and choose the customer to handle reservation and purchase operations.
- **View Flight Details:** The salesperson can view the status of all existing flights including their delay amount, class options and available meals.
- **View Reservations:** The salesperson is able to view all reservations of a customer and view date, time, route, and, class details.
- **View Tickets:** The salesperson is able to view all tickets of a customer and view the associated customer, date, route, plane, crew, meal, seat, luggage and class details.
- **Manage Extra Luggage:** The salesperson can register extra luggage for the customers. He/she can also make payment operations for the customer in order to buy extra luggage. The manager is also able to cancel the bought extra luggage and refund the money back to customers.
- **Manage Account:** The salesperson is able to view the details of his account, see username, password details. He/she can also update his account, change username/password, phone details.

4.2. Algorithms

4.2.1. Price Related Algorithms

Every customer interacting with the application has to buy a ticket in order to have a trip. In our system, the ticket information is kept under Ticket table and this entity has an important role while maintaining the system. Since buying a ticket will affect Customer's attributes directly, mile_sum and total_amount, it is very crucial to hold Ticket's price.
Prices of the tickets will be set according to their flight locations by default. However, as the time passes, their prices will change regarding the days left until the flight.

Flights' prices, which was set by default in the beginning, will stay in their first amounts until there are two weeks until the flight. At this time, the price will be increased by 25%. After a week, the price will be once again increased by 25%. For instance, if a flight between Ankara and Istanbul is set to be 100TL at the beginning, its price will be 125TL when there are two weeks until the flight time. A week later, when there is a week left until the flight time, its price will be 156.25TL and the price will change no more. The prices are different for the classes. All initial prices are set by the manager.

Meal and extra_luggage prices are the same for each flight and for all times. Whenever the user selects meal and luggage the price of the ticket is recalculated.

The penalty_amount associated with each flight follows the same algorithm with the ticket price. The penalty_amount will be increased 25% in the last 2 weeks and will be increased 25% again in the last week.

4.2.2. Promotion Related Algorithms

The system will have promotions to encourage customers to tickets more frequent or to offer them ticket prices in a reasonable amount. Since the promotions are distinguished with a primary key of promotion_id, no other customer than the owner of the promotion will be able to use it.

Promotions are divided into two other entities which are defined by disjoint specialization. First one, Campaign, rewards the customer with a free ticket depending on the mile_sum the customer has. For customers who have a total of 10,000 miles, a free one-way

ticket will be given to be used only inside Europe. For a total of 25,000 miles, the customer will be given a one-way overseas flight.

Other type of Promotion, Sale, provides the customer with a percentage of discount under a specific time period. The discount of 15% will be given on customer's birthday within a time period of one week. Moreover, for each customer, for every 5,000 miles they travel, they will be given a discount of 20% in a time period of two weeks.

The flight history of the customer also affects the promotions. For every 3 cancellations one future or available sale or promotion is cancelled.

4.2.3. Reservation Related Algorithms

Customers can reserve their tickets with a unique reservation_no. They are able to choose the class of their ticket as well. However, if they cancel their flights, then there is no returning back. They will no longer be able to have their reservation turned into a ticket.
In order to prevent customers making more reservations than they need, they will be given 2 days to buy their tickets or else, the price of their tickets will be increased by 10%. In this way, they will be deterred from occupying tickets. Moreover, if the reservation is not turned into ticket in 24 hours before the flight, the reservation is cancelled directly.

4.3. Data Structures

In our relation schemas we use Numeric type, String type, Time type, Date type, and Interval type. String type is required to store any character-composed attributes such as names, ids, addresses, phones. Attributes with Numeric domain is used in order to store numeric data such as age, capacity, mile sum. Time type is used to keep time interval values such as flight time. Date type is used to specify birthdates, flight dates and any other day specifications. The Interval domain was necessary to keep track of the sale period.

5. USER INTERFACE DESIGN AND CORRESPONDING SQL STATEMENTS

5.1. Customer User Interface Design

The screens customer can access are described in detail.

5.1.1. Customer Home Screen

Inputs: @to, @from, @departuredate, @arrivaldate, @class

Process: The homepage of the Airline Company Data Management system is in the above figure. When the 'Login' button is clicked the user is directed to the login screen. 'Register' button allows the customer to create an account in the system. Login is not necessary to search for flights. In order to search for flights for a round trip, the user needs to select airport-city pair for the to and from fields from the list of available airport-city pairs. The user also selects the departure date and return date. The class is also selected by the user.

When the select button is clicked all matching flights are displayed in the available flights page. The shown flights can also be connected flights.

SQL Statements:

Listing the Airports

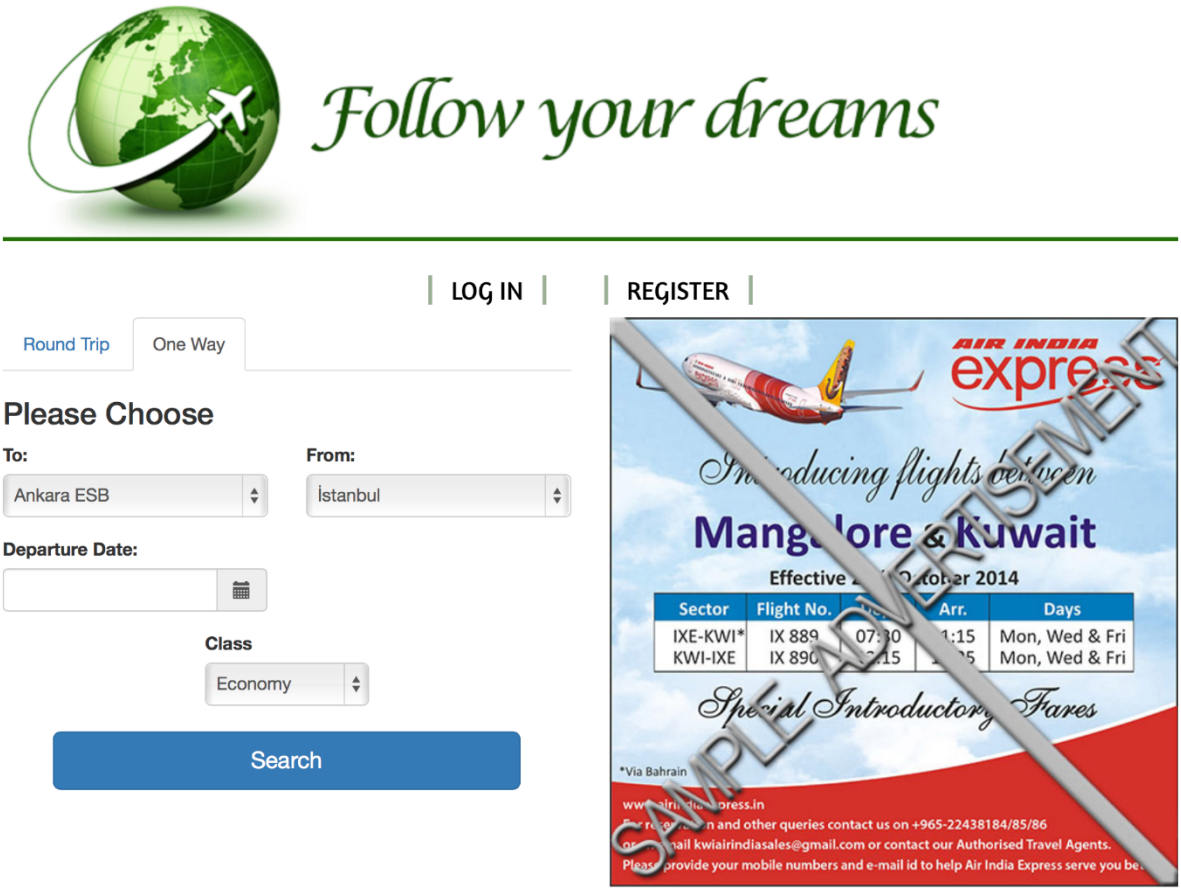
```
SELECT airport_name, city_name
FROM airport
```

Searching Matching Flights:

(Lists all matching flights that are within 2 days after and before user selected dates)

```
( SELECT flight_id, date, departure_time,
        CASE WHEN @class = 1 business_price
                ELSE economy_price
                END
FROM CustomerFlightView C
WHERE       departs = @to AND
            arrives = @from AND
            depatureDate = between @departuredate - 2 and @departuredate + 2)
UNION
( SELECT flight_id, date, departure_time,
        CASE WHEN @class = 'Business' business_price
                ELSE economy_price
                END
FROM CustomerFlightView C
WHERE       departs = @from AND
            arrives = @to AND
            depatureDate = between @arrivaldate - 2 and @arrivaldate + 2 )
```

5.1.2. Customer Search Flight Screen with One Way Ticket



Inputs: @to, @from, @departuredate, @class

Process: In order to search for flights for one way flights, the user first selects the 'One Way' tab. Then, he/she selects airport-city pair for the to and from fields from the list of available airport-city pairs. The user also selects the departure date and the class. When the select button is clicked all matching flights are displayed in the available flights page.

SQL Statements:

Listing the Airports

SELECT airport_name, city_name

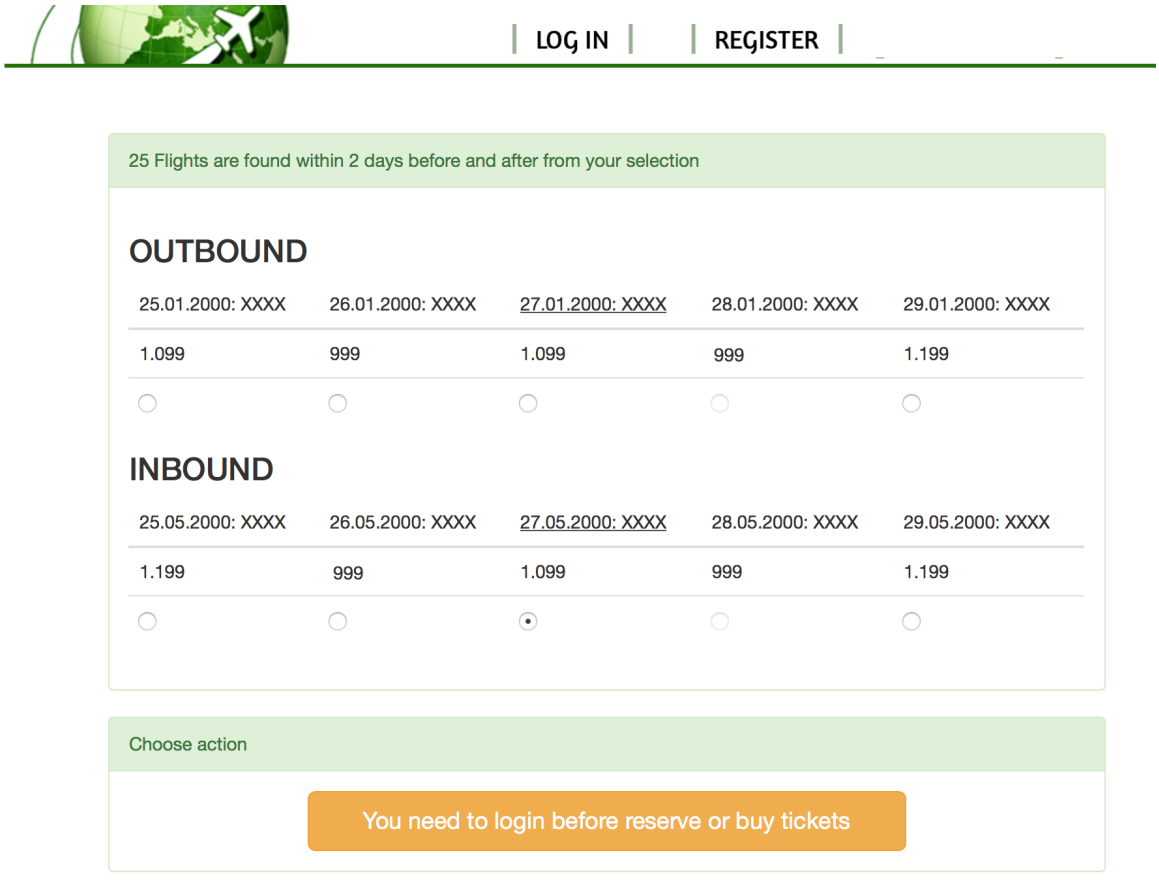
FROM airport

Searching Matching Flights:

(Lists all matching flights that are within 2 days after and before user selected dates)

```
SELECT flight_id, date, departure_time,
        CASE WHEN @class = 1 business_price
                ELSE economy_price
                END
FROM CustomerFlightView C
WHERE       departs = @to AND
            arrives = @from AND
            depatureDate = between @departuredate - 2 and @departuredate + 2
```

5.1.3. Result of Flight Search Screen



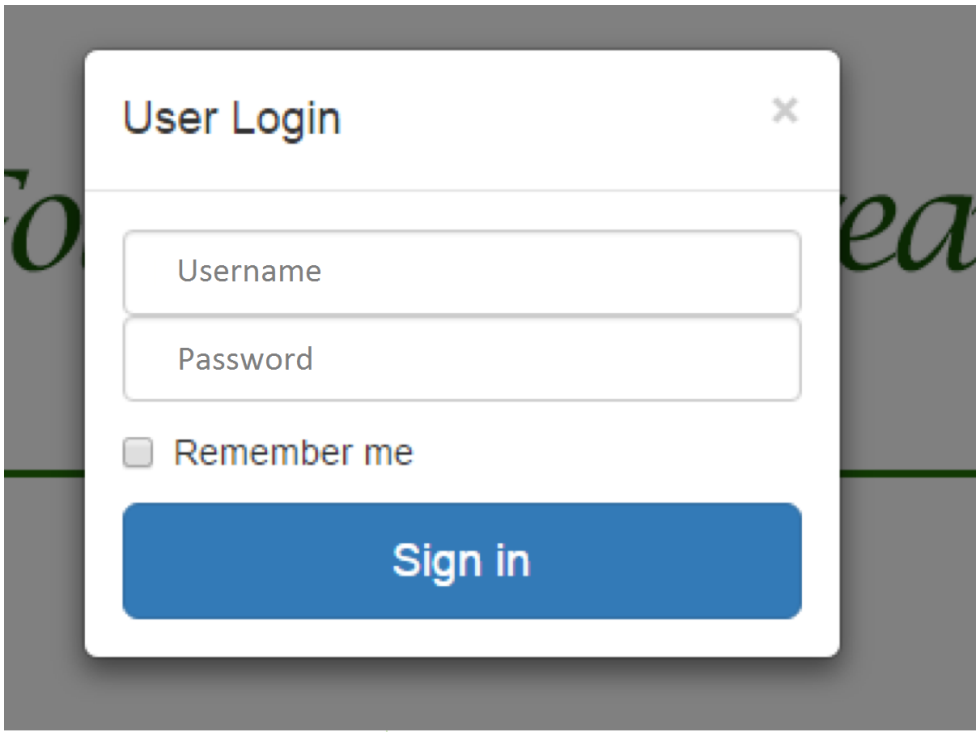
Inputs: No input since without login no further operation can be done.

Process: When the user enters flight details in pages 5.1.1. and 5.1.2. and clicks 'Search' button the list of available flights are displayed to him/her. As shown in the above page, the departure flights are listed under 'Outbound' and the arrival flights are listed under 'Inbound'. The number of available flights are also shown to user. The date, time and price of each flight is shown in detail where price is shown with respect to the previously selected class in search. The customers are able to search for flights; however, they are required to log in to the system to be able make reservations or buy tickets.

SQL Statements:

The result of SQL statements in 5.1.1. and 5.1.2. are shown in this page. Flights page do not have additional queries.

5.1.4. Login Screen



Inputs: @username, @password

In the homepage, a pop-up window box appears when ‘Login’ is clicked. The box asks for access details in order to proceed. Users will be distinguished according to the details they have entered.

SQL Statements:

Login Operation

```
SELECT *
FROM customer
WHERE user_name = @username AND
        password = @password
```

5.1.5. Create Account Screen

UserName

Username

Name

Your Name

Password

New Password

Repeat Password

New Password

Birthdate

11.11.1111

Passport Number

A0000000

Register

Inputs: @username, @password, @passwordagain, @name, @birthdate, @passportno

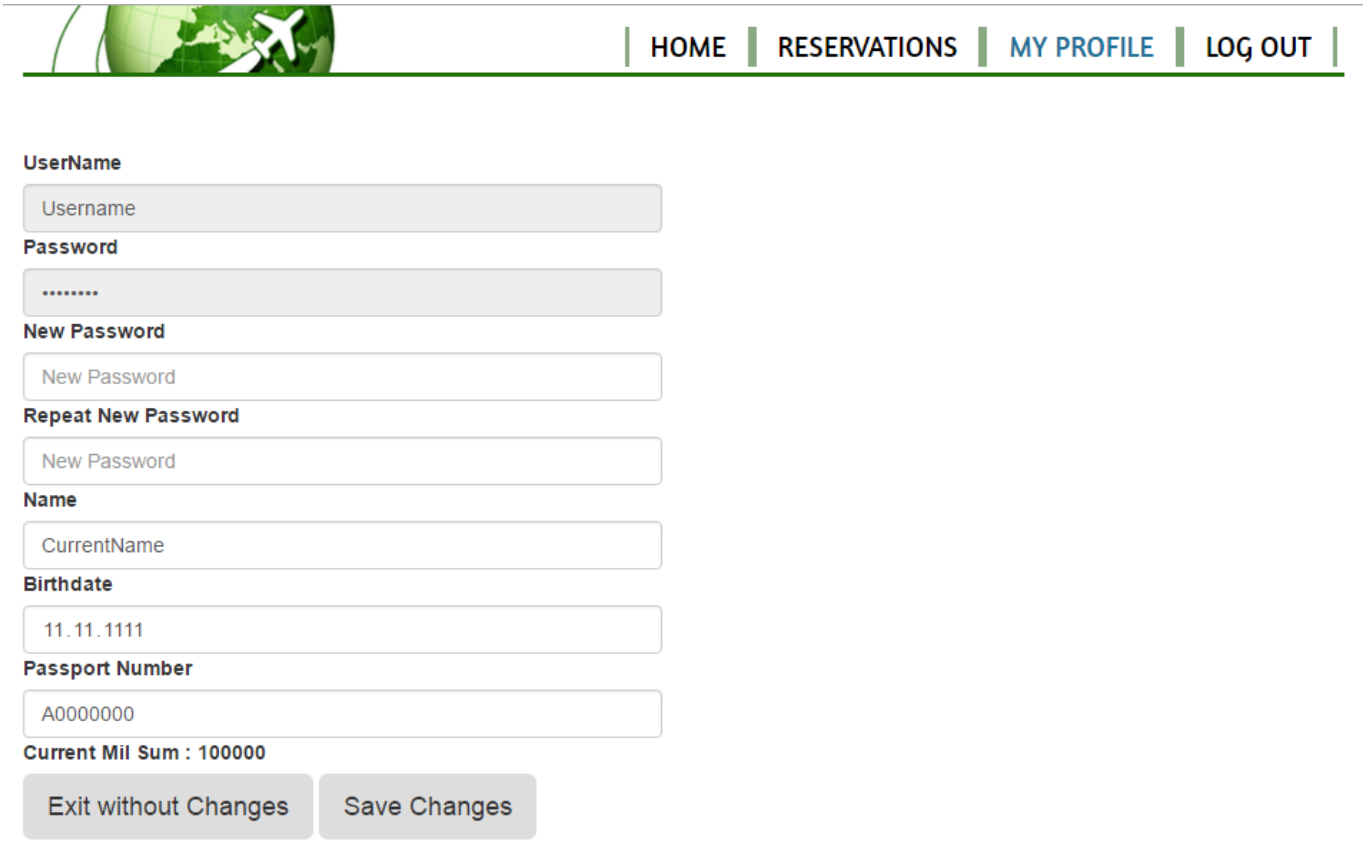
Process: The customer can view Create Account screen after clicking on “Register” button from the main menu. He/she enters username, password, name, birthday and passport no information. When “Register” is clicked the account would be created.

SQL Statements:

Create Account

```
INSERT INTO customer
VALUES(@username, @password, @name, @birthdate, GETDATE() - @birthdate,
@passportno, 0, 0)
WHERE @password = @passwordagain
```

5.1.6. Manage Account Screen



Inputs: @username, @newusername, @password, @passwordagain, @name, @birthdate, @passportno

Process: In this page that is provided for customers, customers are able to change their passwords, change the possible mistakes in their names, or in their birthdates and in their passport numbers. Lastly, they are shown their current mile sum so that they are informed about their situation.

SQL Statements:

View Customer Details

```
SELECT username, password, name, birthdate, passport_number
FROM customer
WHERE user_name = @username
```

Change Username

```
UPDATE customer
SET user_name = @newusername
WHERE user_name = @username
```

Change Password

```
UPDATE customer
SET password = @password
WHERE user_name = @username AND
        @password = @passwordAgain
```

Change Name

```
UPDATE customer
SET name = @name
WHERE user_name = @username
```

Change Birthdate

```
UPDATE customer
SET birthdate = @birthdate
WHERE user_name = @username
```

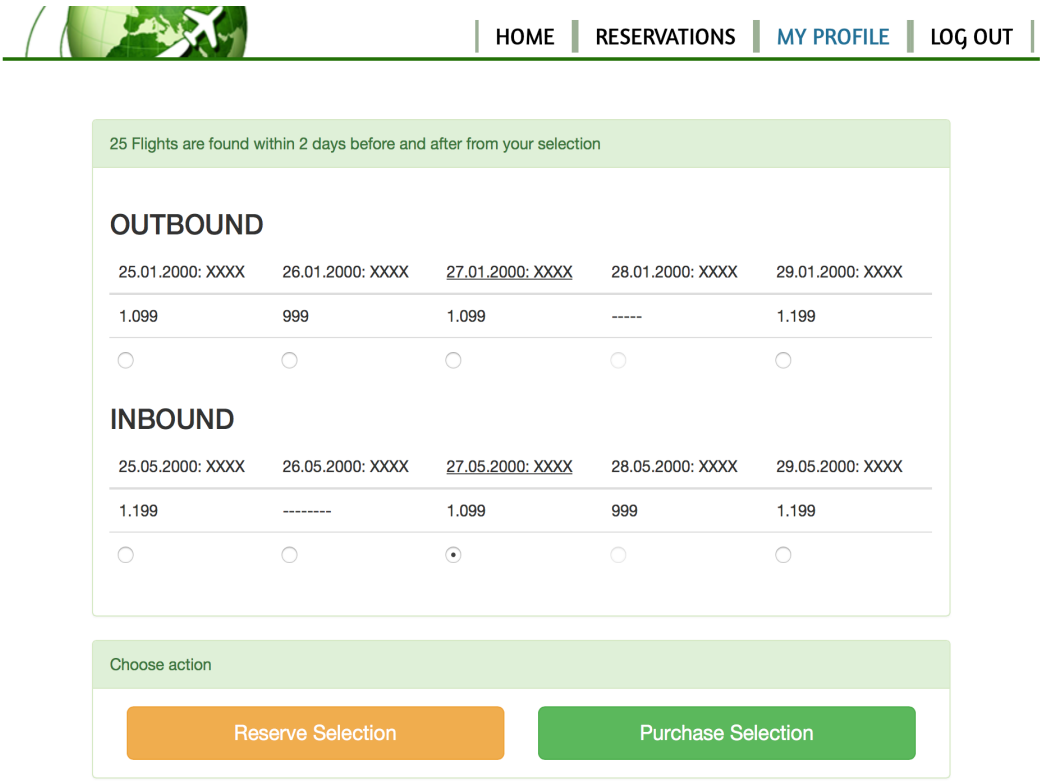
Change Passport Number

UPDATE customer

SET passport_no = @passportno

WHERE user_name = @username

5.1.7. Result of Flight Search Screen for Logged in Customers



Inputs: @to, @from, @departuredate, @departuretime, @class, @username

Process: When the user logs in to the system and enters flight details in pages 5.1.1. and 5.1.2. and clicks 'Search' button the list of available flights are displayed to him/her. As shown in the above page, the departure flights are listed under 'Outbound' and the arrival flights are listed under 'Inbound'. The number of available flights are also shown to user. The date, time and price of each flight is shown in detail where price is shown with respect to the previously selected class in search. 'Reserve Selection' button is clicked to reserve the selected flight. 'Purchase Selection' is used to directly buy the flight without prior

reservation. If the customer searches for a one-way flight in the search flight screen only outbound flights are shown to the customer.

SQL Statements:

The result of SQL statements in 5.1.1. and 5.1.2. are shown in this page.

Make Reservation

```
INSERT INTO reservation
FROM flight NATURAL JOIN route
SELECT (user_name, plane_name, route_id, date, departure_time, INDEX(reservation_no),
@class, 0 )
WHERE user_name = @username AND
        route_id in (SELECT route_id FROM route where departs = @from and arrives = @to)
        AND
        date = @departuredate AND
        time = @departuretime
```

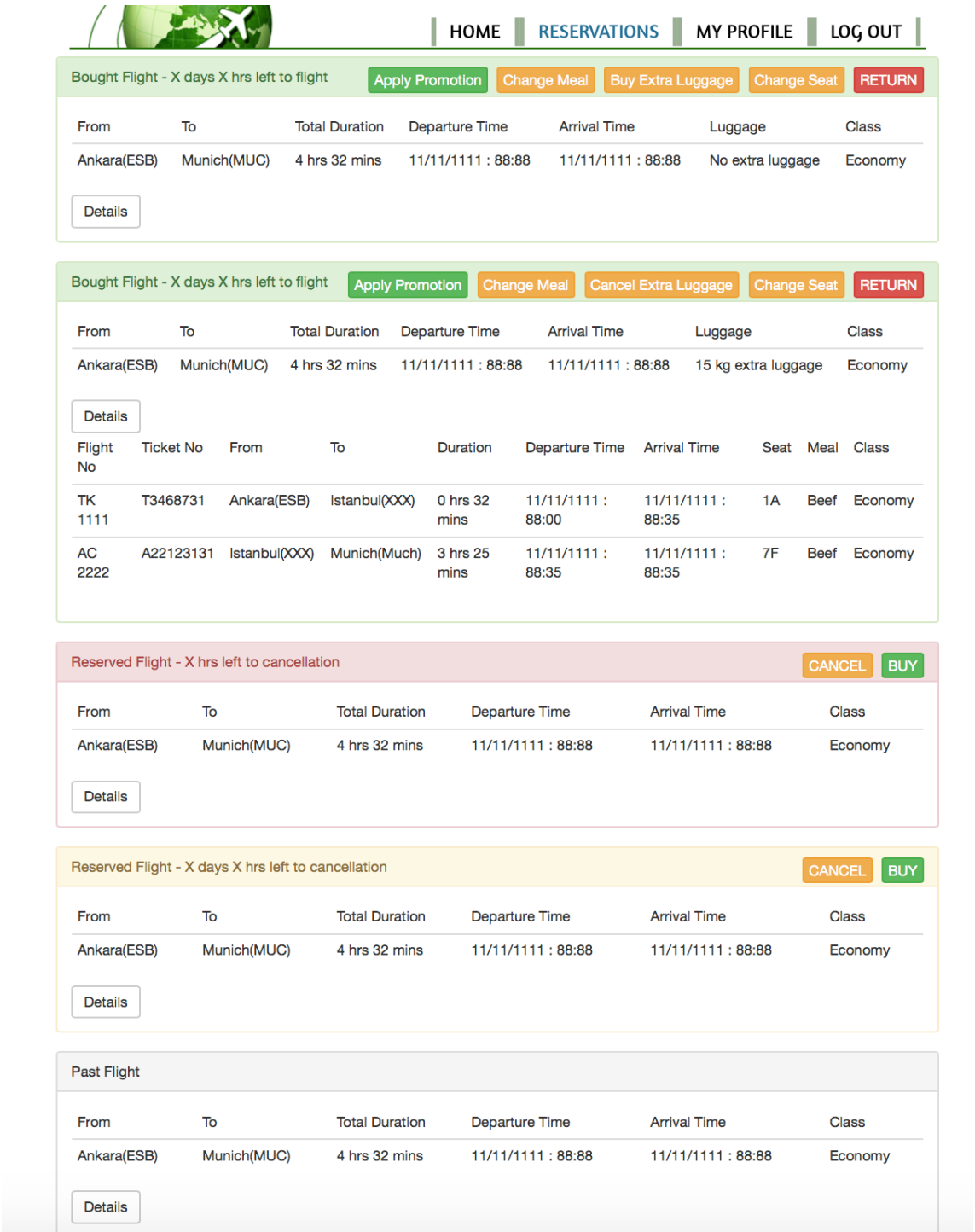
Purchase Ticket

```
INSERT INTO ticket
FROM flight NATURAL JOIN route
SELECT (user_name, plane_name, route_id, date, departure_time, INDEX(ticket_no), 0,
NULL, @class, 0, NULL, CASE WHEN @class = 1 business_price ELSE economy_price END)
WHERE user_name = @username AND
        route_id in (SELECT route_id FROM route where departs = @from and arrives = @to)
        AND
        date = @departuredate AND
        time = @departuretime
```

Executes 6.4.1. Mile Sum Trigger After Purchasing Ticket

Executes 6.4.4. Total Money Trigger After Purchasing Ticket

5.1.8. Customer Reservations & Tickets Screen



Inputs: @username (passed from login session), @reservationno, @ticketno, @selectedPromotion, @extraluggage, @meal, @class, @seat_no

Process: After clicking the 'Reservations' tab after logging in, the page above is shown to the customer. The customer can see their existing reservations in detail. When he/she clicks 'Details' button, detailed information about the ticket/reservation is shown. Beside these, he/she can also change his/her preferences on the tickets. On the upper right corner of every reservation, there exists the options of changing meal choice, buying/cancelling extra luggage and changing seats within the same class. The page lists both reserved and purchased flights. Also past flights are listed at the bottom of the page. For reservations 'Cancel' and 'Buy' buttons are available. The customer clicks 'Cancel' button to cancel the reservation and clicks 'Buy' button to purchase the ticket. The operations available for already purchased tickets are offered during purchase as well.

For tickets, 'Apply Promotion', 'Change Meal', 'Buy Extra Luggage', 'Cancel Extra Luggage', 'Choose Seat', 'Change Seat', 'Buy Meal', 'Return' buttons are available. The existence of these buttons depend on the status of the ticket. For example, if the meal is not bought for flight, 'Buy Meal' button appears but, if the meal is already selected 'Change Meal' button is shown instead.

Customer clicks 'Apply Promotion' button to select a campaign or sale to apply to the ticket from the list of available promotions. Customer clicks 'Buy Meal' to select a meal and 'Change Meal' to update the meal choice. He/she clicks 'Buy Extra Luggage' to specify the amount of extra luggage and clicks 'Cancel Extra Luggage' to delete the existing luggage. The customer clicks 'Choose Seat' to select a seat from the list of seats and clicks 'Change Seat' to update selection. When customer clicks 'Return' button the ticket is refunded.

SQL Statements:

View all Reservations

```
SELECT date, time, departs, arrives, flight_duration, class
FROM CustomerReservationView
```

View all Tickets

```
SELECT date, time, departs, arrives, flight_duration, extra_luggage, class
FROM CustomerTicketView
```

View Reservation Details

```
SELECT *
FROM CustomerReservationView
```

View Tickets Details

```
SELECT *
FROM CustomerTicketView
```

Cancel Reservation

```
UPDATE reservation
SET cancelled = 1
WHERE reservation_no = @reservationno AND
        user_name = @username
```

Return and Refund Ticket

```
DELETE FROM ticket
WHERE ticket_no = @ticketno AND
        user_name = @username
```

Executes 6.4.2. Mile Sum Trigger After Refunding Ticket

Executes 6.4.3. Cancel Reservation Trigger After Refunding Ticket

Executes 6.4.5. Total Money Trigger After Refunding Ticket

Executes 6.4.6. Pay Penalty Trigger After Refunding Ticket

List Promotions

```
SELECT *
FROM promotion
WHERE user_name = @username
```

Apply Promotion

```
UPDATE ticket
SET price = CASE
```

```
        WHEN @selectedPromotion in (SELECT promotion_id FROM sale WHERE user_name
        = @username) THEN  price * sale_amount
        WHEN @selectedPromotion in (SELECT promotion_id FROM campaign WHERE
user_name = @username) THEN  0
        ELSE price
        END
```

List Meals

```
SELECT meals
FROM flight NATURAL JOIN ticket
WHERE ticket_no = @ticketno AND
        user_name = @username
```

Buy/Change Meal

```
UPDATE ticket
SET meal = @meal
WHERE ticket_no = @ticketno AND
        user_name = @username
```

Executes 6.4.7. Total Money Trigger After Buying Meal

Choose/Change Seat

```
UPDATE ticket
SET seat_no = @seatno
WHERE ticket_no = @ticketno AND
        user_name = @username
```

Register Extra Luggage

```
UPDATE ticket
SET extra_luggage = @extraluggage
WHERE ticket_no = @ticketno AND
        user_name = @username
```

Cancel Extra Luggage

```
UPDATE ticket
SET extra_luggage = 0
WHERE ticket_no = @ticketno AND
        user_name = @username
```

Purchase Ticket

```
INSERT INTO ticket
FROM flight NATURAL JOIN route
SELECT (user_name, plane_name, route_id, date, departure_time, INDEX(ticket_no), 0,
NULL, @class, 0, NULL, CASE WHEN @class = 'Business' business_price ELSE economy_price
END)
WHERE user_name = @username AND
        route_id in (SELECT route_id FROM route where departs = @from and arrives = @to)
        AND
        date = @departuredate AND
        time = @departuretime
```

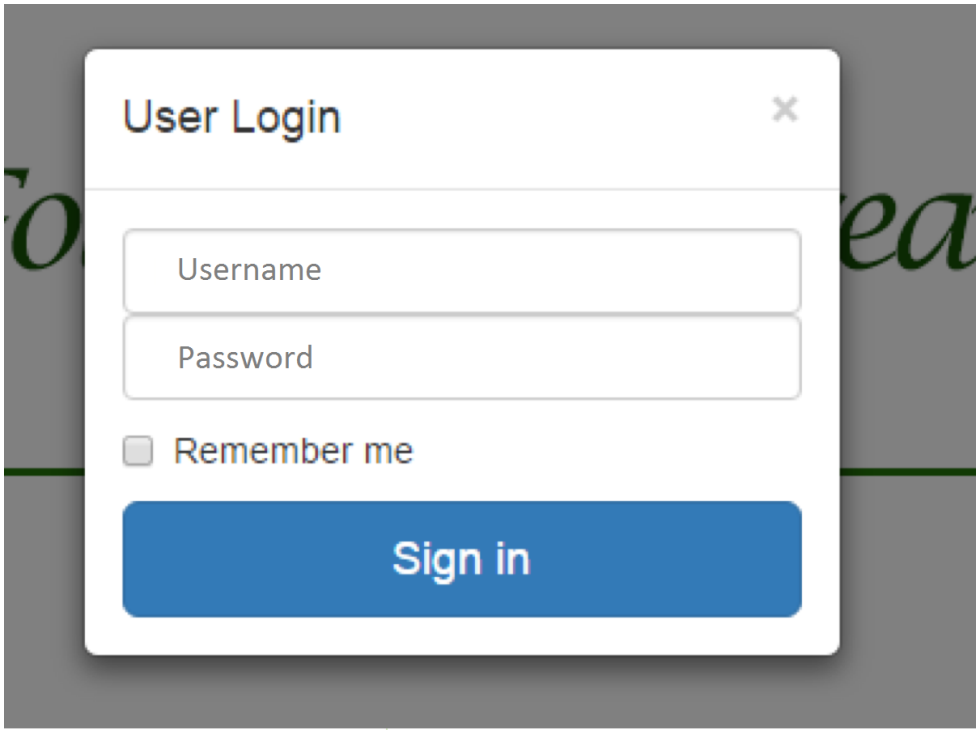
Executes 6.4.1. Mile Sum Trigger After Purchasing Ticket

Executes 6.4.4. Total Money Trigger After Purchasing Ticket

5.2. Manager User Interface Design

The screens manager can access are described in detail.

5.2.1. Login Screen



Inputs: @username, @password

Process: The manager clicks 'Login' button. He/she enters his/her username and password in order to access to manager operations.

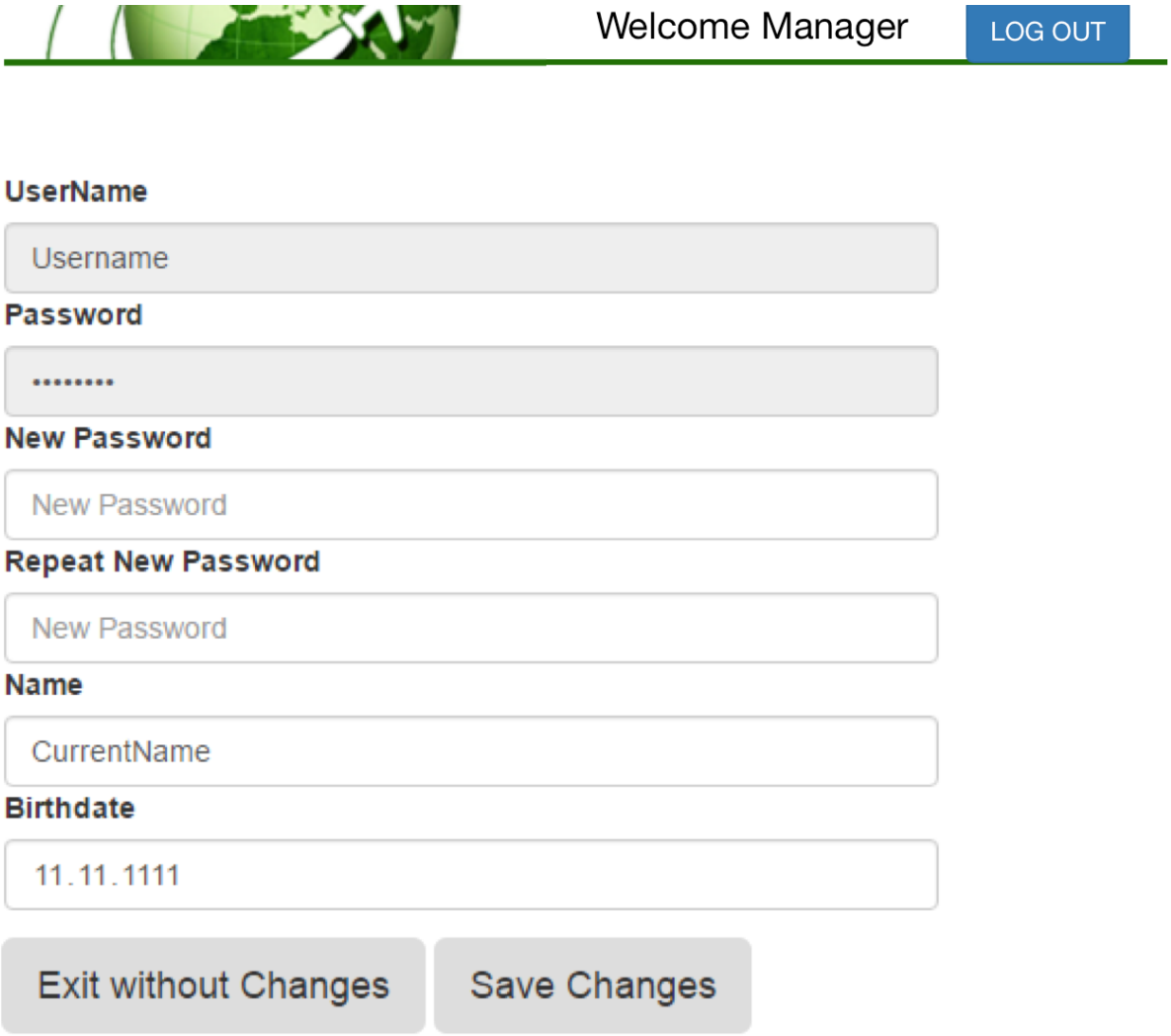
SQL Statements:

Login to System

```
SELECT *
FROM reservation_authority
WHERE user_name = @username AND
        password = @password AND
```

user_name IN (SELECT user_name FROM reservation_authority NATURAL JOIN manager)

5.2.2. Manager Manage Account Screen



Inputs: @username, @newusername, @password, @passwordagain, @name, @birthdate

Process: In this page that is provided for managers, managers are able to change their passwords, change the possible mistakes in their names, or in their birthdates. After updating the fields manager clicks on 'Save Changes' button to update his/her account.

SQL Statements:

View Manager Details

```
SELECT *
FROM reservation_authority NATURAL JOIN staff
WHERE user_name = @username
```

Change Username

```
UPDATE reservation_authority
SET user_name = @newusername
WHERE user_name = @username
```

Change Password

```
UPDATE reservation_authority
SET password = @password
WHERE user_name = @username AND
        @password = @passwordAgain
```

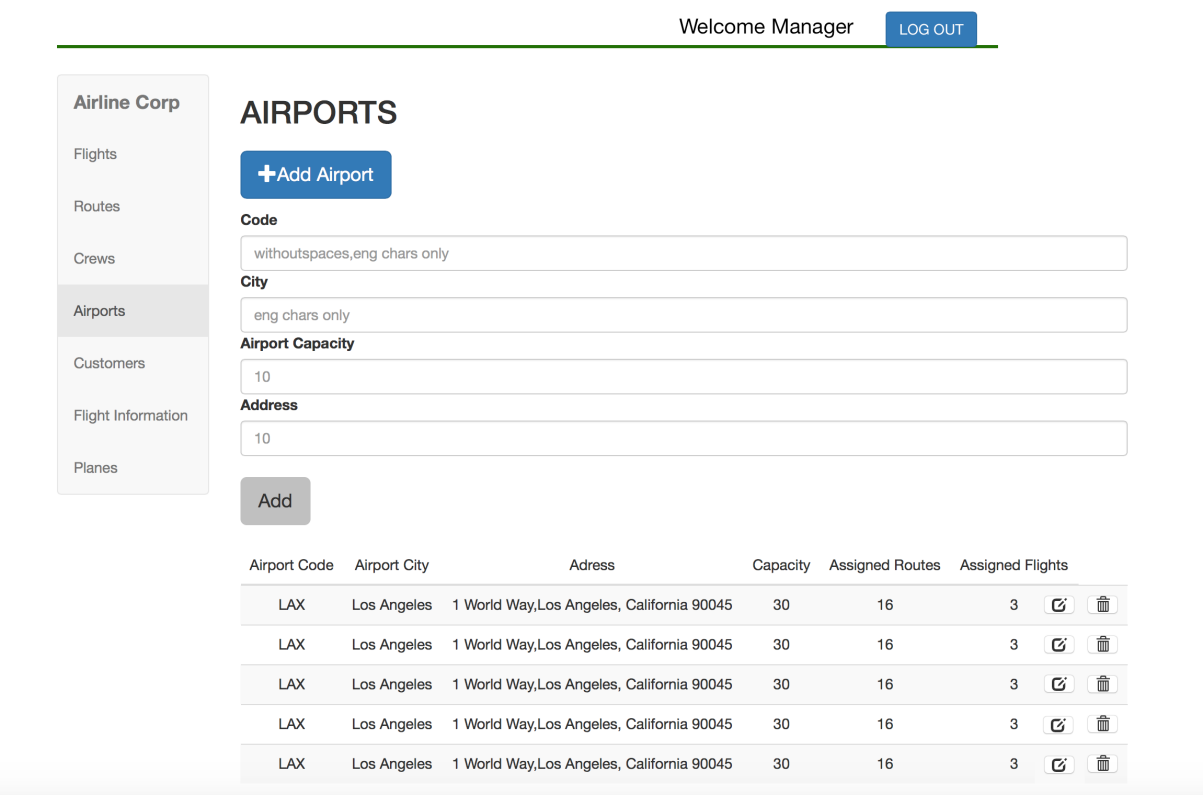
Change Name

```
UPDATE staff
SET name = @name
WHERE user_name = @username
```

Change Birthdate

```
UPDATE staff
SET birthdate = @birthdate
WHERE user_name = @username
```

5.2.3. Manage Airports Screen



Inputs: @airport_id, @airport_capacity, @address, @city_name

Process: The manager clicks on 'Airports' tab in order to view all airports registered to the system. The manager clicks on 'Add Airport' button and the airport fields appear on the screen. He/she enters code(id), city, capacity, address attributes and clicks 'Add' button to add a new airport. In order to edit the attributes of the airport the manager clicks on the edit symbol next to each entry. The edit operations are offered from a dialog box. Similarly, the manager clicks delete symbol to delete the airport from the system.

SQL Statements:

View Airports

SELECT *

FROM airport

Add a New Airport

INSERT INTO airport

VALUES(@airport_id, @airport_capacity, @address, @city_name)

Delete Airport

DELETE FROM airport

WHERE airport_id = @airport_id

Executes 6.2.3. Delete Airport Procedure

Update Airport Capacity

UPDATE airport

SET airport_capacity = @airport_capacity

WHERE airport_id = @airport_id

Update Airport Address

UPDATE airport

SET address = @address

WHERE airport_id = @airport_id

Update Airport City

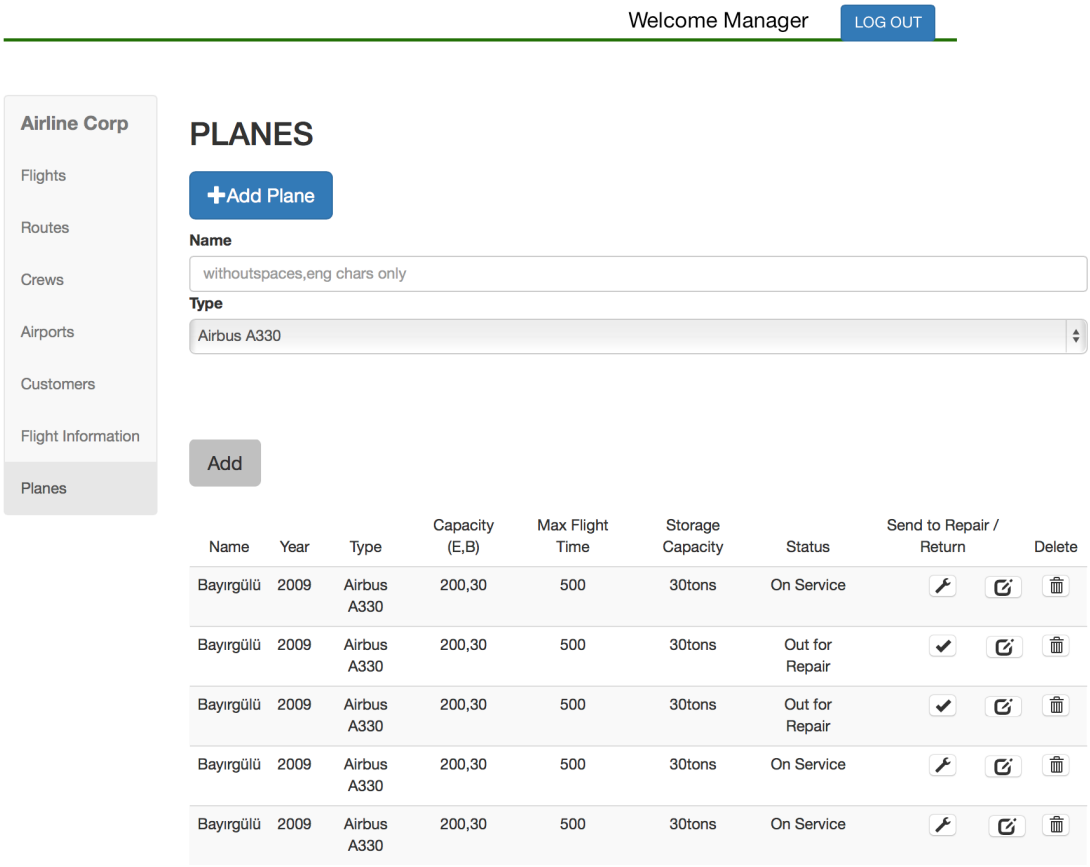
UPDATE airport

SET city_name = @city_name

WHERE airport_id = @airport_id

Report 6.3.5. 'Total Number of Tickets and Reservations Associated with Each Flight and the List of All Tickets and Reservations of the Flight' is used in the screen.

5.2.4. Manage Planes Screen



Inputs: @plane_name, @plane_type_id, @available, @max_flight_time, @capacity, @storage_capacity

Process: The manager clicks on 'Planes' tab in order to view all planes registered to the system. The manager clicks on 'Add Plane' button and the plane fields appear on the screen. He/she enters plane name, production year, and selects plane_type_id attributes and clicks 'Add' button to add a new plane. In order to edit the attributes of the plane the manager clicks on the edit symbol next to each entry. When edit is clicked the system enables manager to change the attributes such as capacity, flight time, and status. The edit operations are offered from a dialog box. Similarly, the manager clicks delete symbol to delete the plane from the system.

SQL Statements:

List All Planes

```
SELECT plane_name, production_year, plane_type_id, capacity, max_flight_time,
storage_capacity, available
FROM plane
```

Add New Plane

```
INSERT INTO plane
VALUES(@plane_name, 1, @plane_type_id)
```

Delete Plane

```
DELETE FROM plane
WHERE plane_name = @plane_name
```

Executes 6.2.7. Delete Plane Procedure

Update Plane Type

```
UPDATE plane
SET plane_type_id = @plane_type_id
WHERE plane_name = @plane_name
```

Update Plane Capacity

```
UPDATE plane_type
SET capacity = @capacity
WHERE plane_type_id = @plane_type_id AND
        plane_name = @plane_name
```

Update Plane Maximum Flight Time

```
UPDATE plane_type
SET max_flight_time = @max_flight_time
WHERE plane_type_id = @plane_type_id AND
        plane_name = @plane_name
```

Update Plane Storage Capacity

```
UPDATE plane_type
SET storage_capacity = @storage_capacity
WHERE plane_type_id = @plane_type_id AND
        plane_name = @plane_name
```

Send Plane to Repair

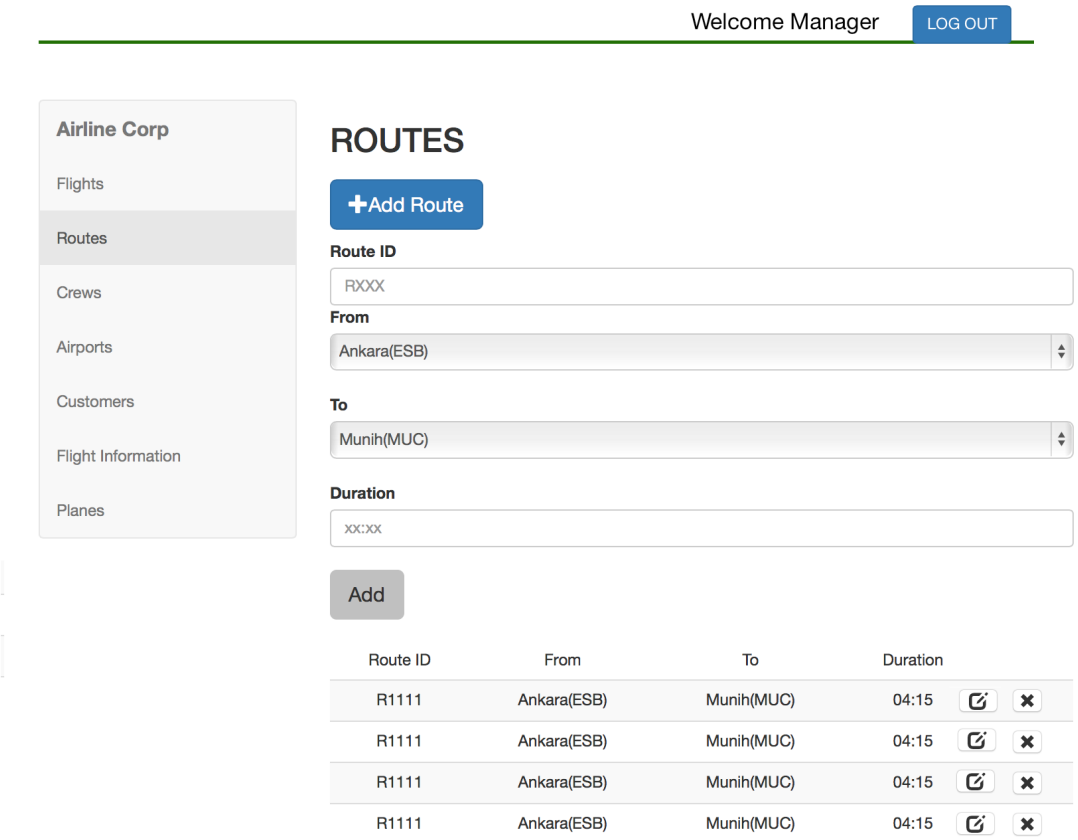
```
UPDATE plane
SET available = 0
WHERE plane_type_id = @plane_type_id AND
        plane_name = @plane_name
```

Executes 6.2.6. Send Plane to Repair Procedure

Mark Plane as Available After Repair

```
UPDATE plane
SET available = 1
WHERE plane_type_id = @plane_type_id AND
        plane_name = @plane_name
```

5.2.5. Manage Routes Screen



Inputs: @route_id, @flight_duration, @departs, @arrives

Process: The manager clicks on 'Routes' tab in order to view all routes registered to the system. The manager clicks on 'Add Route' button and the plane fields appear on the screen. He/she enters route id, arrival and departure airports, and duration attributes and clicks 'Add' button to add a new route. In order to edit the attributes of the route the manager clicks on the edit symbol next to each entry. When edit is clicked the system enables manager to change the attributes from a dialog box. Similarly, the manager clicks delete symbol to delete the route from the system.

SQL Statements:

View Routes

SELECT *

FROM route

Add a New Route

INSERT INTO route

VALUES(@route_id, @flight_duration, @departs, @arrives)

Delete Route

DELETE FROM route

WHERE route_id = @route_id

Executes 6.2.4. Delete Route Procedure

Update Route Duration

UPDATE route

SET flight_duration = @flight_duration

WHERE route_id = @route_id

Update Route Departure Airport

UPDATE route

SET departs = @departs

WHERE route_id = @route_id

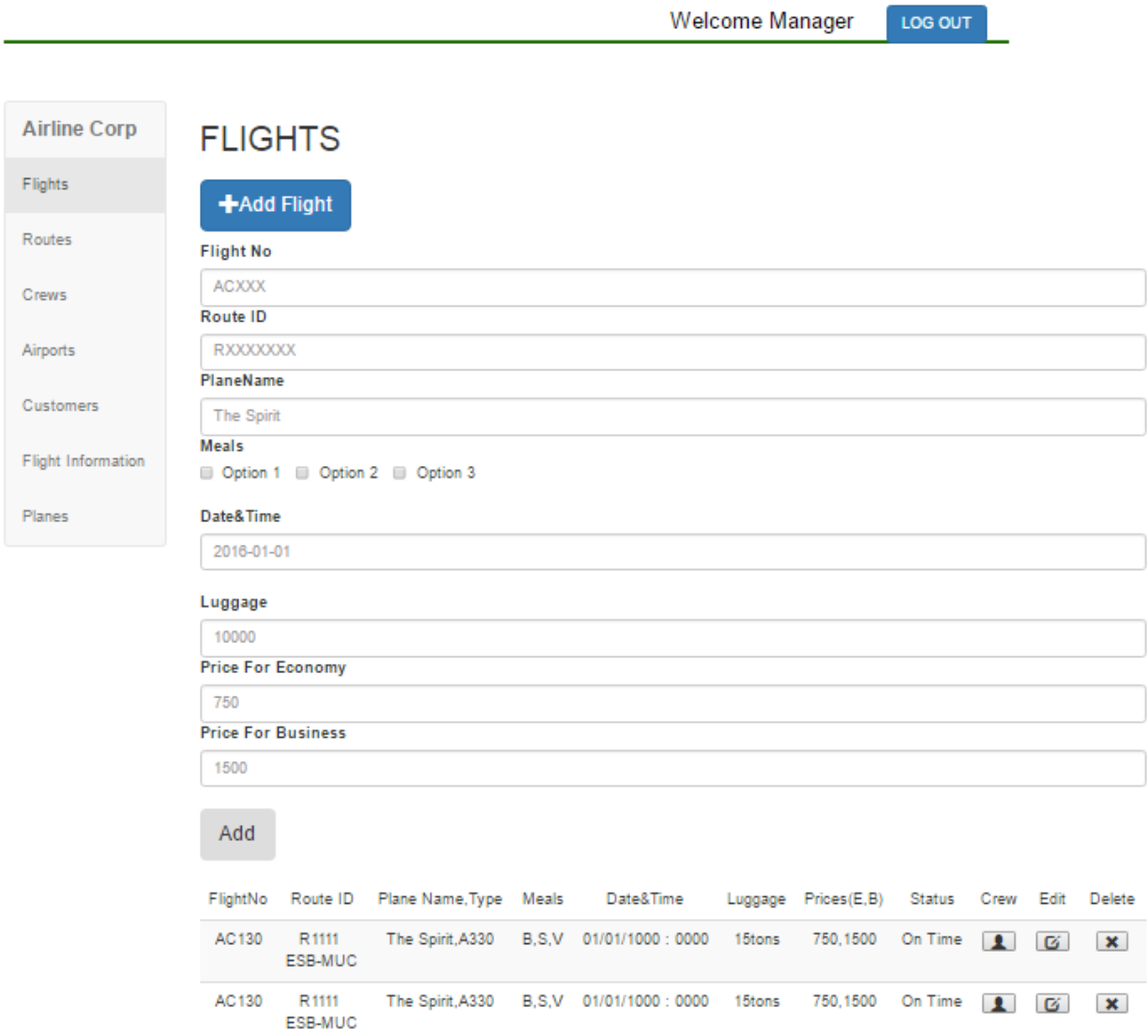
Update Route Arrival Airport

UPDATE route

SET arrives = @arrives

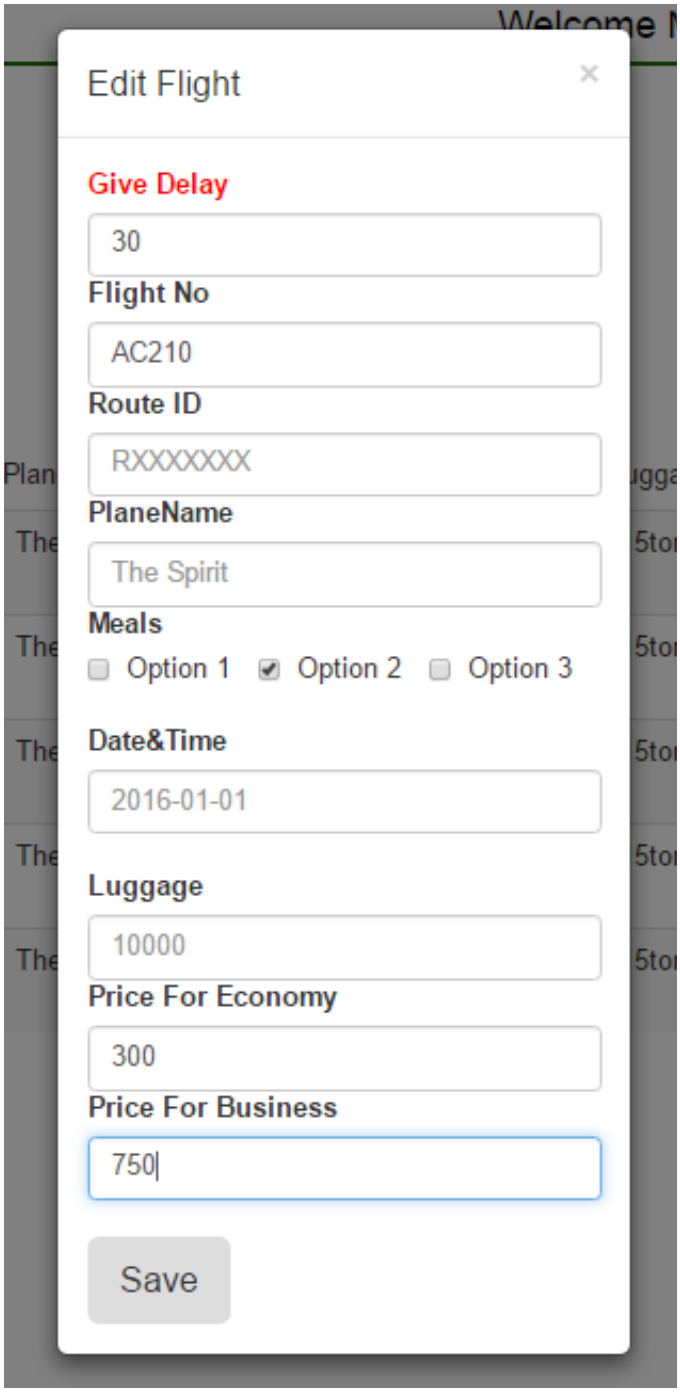
WHERE route_id = @route_id

5.2.6. Manage Flights Screen



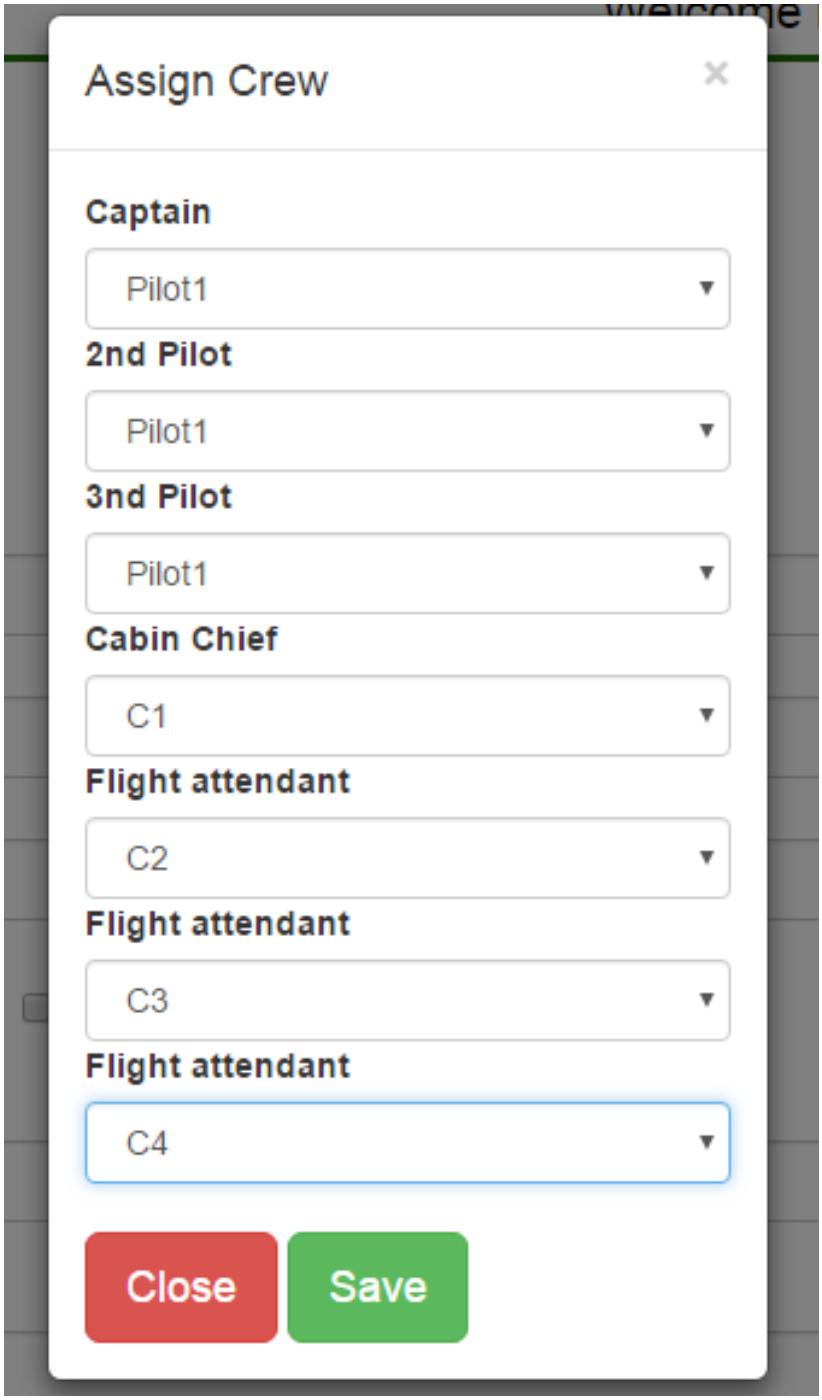
Inputs: @plane_name, @route_id, @date, @departure_time, @flight_id, @meals, @luggage, @price_bus, @price_econ, @staff_id

Process: The manager clicks on 'Flights' tab in order to view all flights registered to the system. The manager clicks on 'Add Flight' button and the flight fields appear on the screen. He/she enters flight number, route id, plane name, meal, date, time, luggage, and price attributes and clicks 'Add' button to add a new route. In order to edit the attributes of the route the manager clicks on the edit symbol next to each entry. Similarly, the manager clicks delete symbol to delete the flight from the system. When edit is clicked the system enables manager to change the attributes with the 'Edit Flight' box shown in the picture:



Edit Flight box appears when the edit icon is clicked.

Additionally, the delay amount can be set from the edit screen. The manager clicks crew icon next to each flight to see the Assign Crew box as shown in the below picture. The manager can select pilots and flight attendance to assign to the flight and click ‘Save’:



Assign Crew box appears when the crew icon is clicked.

SQL Statements:

List All Flights

SELECT *

FROM flight

Add a New Flight

```
INSERT INTO flight
VALUES(@plane_name, @route_id, @flight_id, @date, @departure_time, 0, @meals,
@luggage, @price_bus, @price_econ)
```

Delete Flight

```
DELETE FROM flight
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Executes 6.2.5. Cancel Flight Procedure

Update Flight Id

```
UPDATE flight
SET flight_id = @flight_id
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Business Price

```
UPDATE flight
SET business_price= @price_bus
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Economy Price

```
UPDATE flight
```

```
SET economy_price= @price_econ
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Meals

```
UPDATE flight
SET meals = @meals
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Luggage

```
UPDATE flight
SET luggage = @luggage
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Date

```
UPDATE flight
SET date = @date
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Time

```
UPDATE flight
```

```
SET departure_time = @time
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Flight Plane

```
UPDATE flight
SET plane_name= @plane_name
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Update Delay

```
UPDATE flight
SET delay = @delay
WHERE plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

Assign Crew to Flight

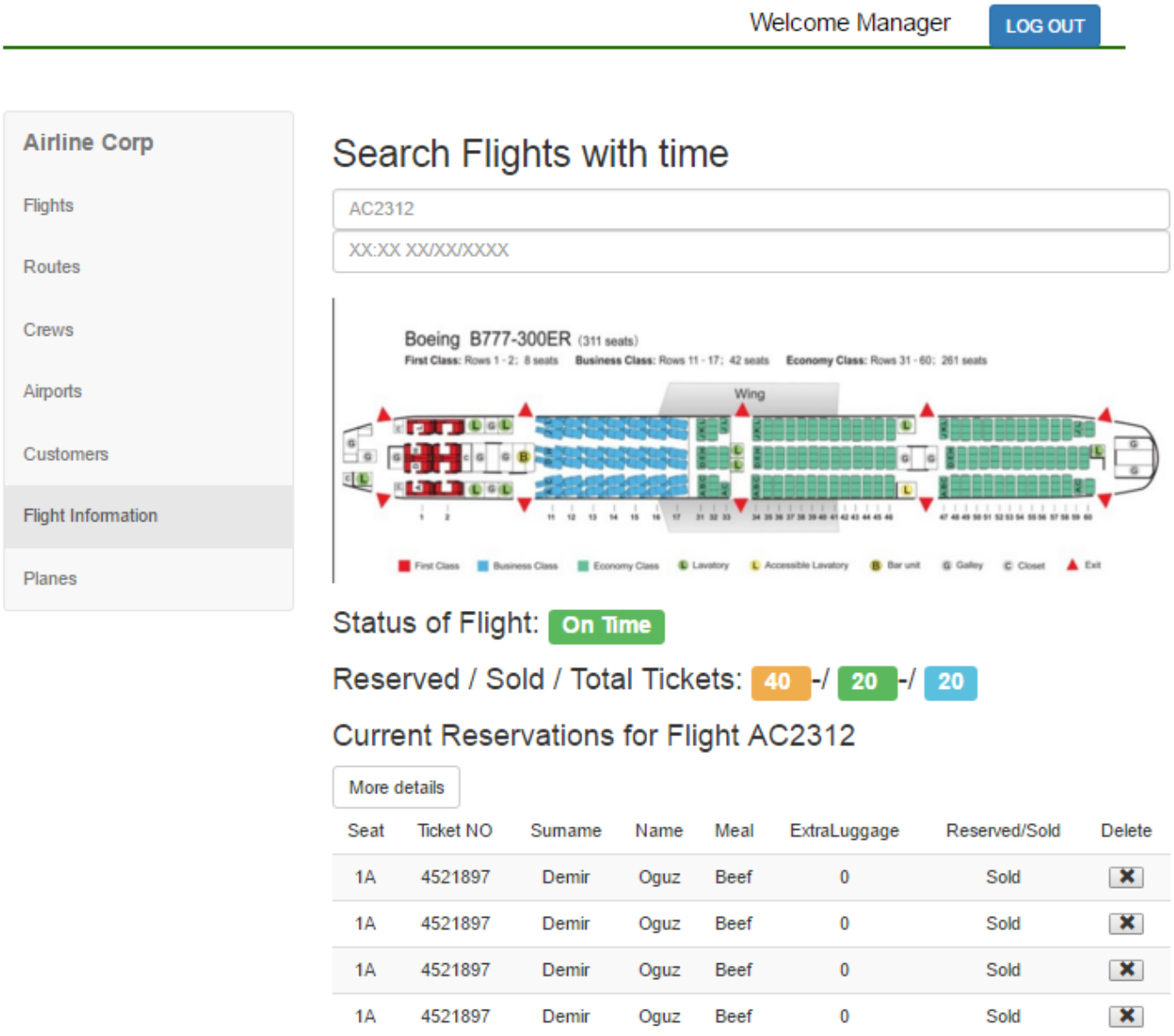
```
INSERT INTO flight_crew
SELECT C.staff_id, F.plane_name, F.route_id, F.date, F.departure_time
FROM crew C, flight F, route R
WHERE C.staff_id = @staff_id AND
        C.current_location = R.departs AND
        R.route_id = @route_id AND
        F.plane_name = @plane_name AND
        F.route_id = @route_id
```

Delete Crew from Flight

```
DELETE FROM flight_crew
WHERE staff_id = @staff_id AND
        plane_name = @plane_name AND
        route_id = @route_id AND
        date = @date AND
        departure_time = @departure_time
```

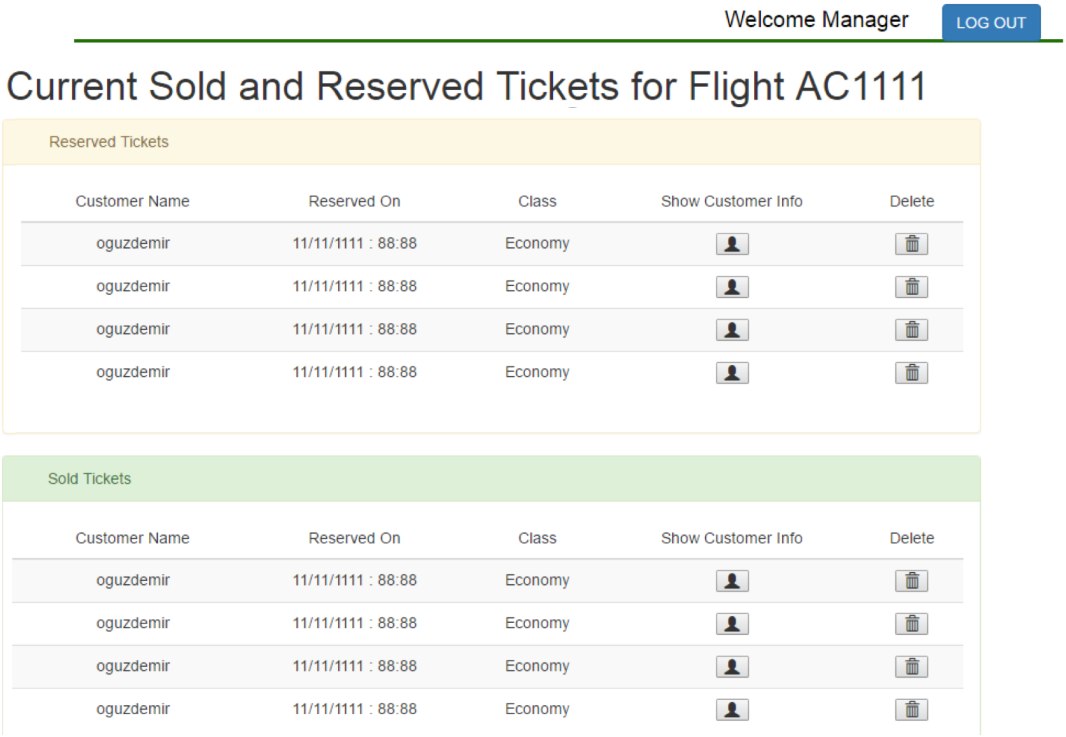
Report 6.3.5. Total Number of Assigned Routes and Flights to Each Airport is used in this screen.

5.2.7. View Flight Status Screen



Inputs: @username (from previous pages)

Process: The manager clicks 'Flight Information' tab to view all flights along with the status, reserved and sold ticket numbers and the list of tickets. The manager clicks on 'Show Customer Info' icon to view the customer details. He/she clicks delete icon to delete reservation or ticket. When the manager clicks 'More Details' button the second screen is displayed where the reservation and ticket information is shown in detail:



The above screen is shown when 'More Details' is clicked.

SQL Statements:

List All Flight Details

```
SELECT *
FROM CustomerManagerFlightDetailsView
```

List All Reservations&Tickets

```
(SELECT user_name, date, departure_time, class
FROM reservation
WHERE plane_name = @plane_name AND
        route_id = @route_id
        date = @date
        departure_time = @departure_time) UNION
(SELECT user_name, date, departure_time, class
FROM ticket
```

```
WHERE plane_name = @plane_name AND
        route_id = @route_id
        date = @date
        departure_time = @departure_time)
```

Show Customer Information

```
SELECT *
FROM ManagerCustomerView
```

Delete Reservation

```
DELETE FROM reservation
WHERE reservation_no = @reservationno AND
      user_name = @username
```

Delete Ticket

```
DELETE FROM ticket
WHERE ticket_no = @ticketno AND
      user_name = @username
```

Executes 6.4.2. Mile Sum Trigger After Refunding Ticket

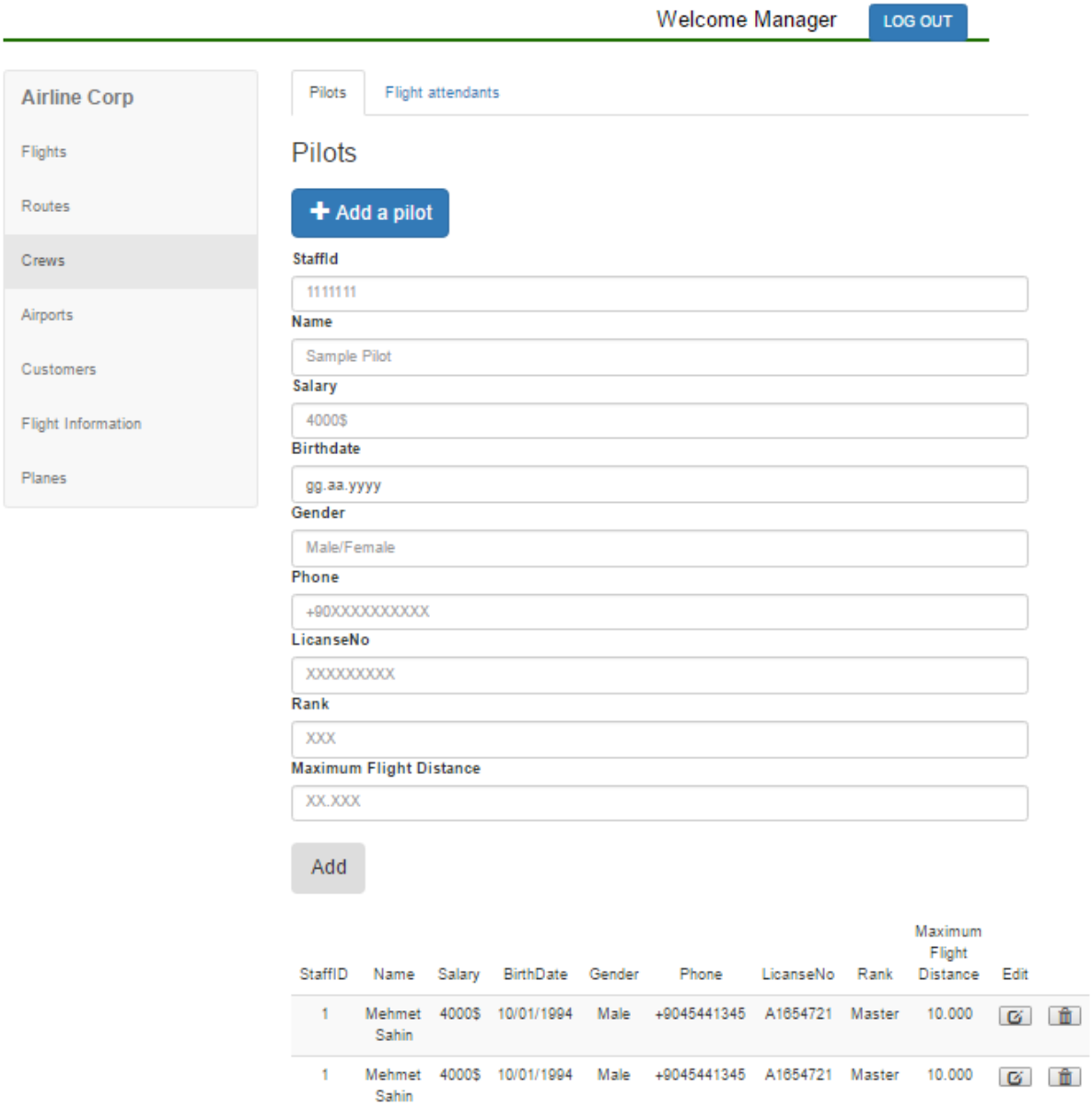
Executes 6.4.3. Cancel Reservation Trigger After Refunding Ticket

Executes 6.4.5. Total Money Trigger After Refunding Ticket

Executes 6.4.6. Pay Penalty Trigger After Refunding Ticket

5.2.8. Manage Staff Screens

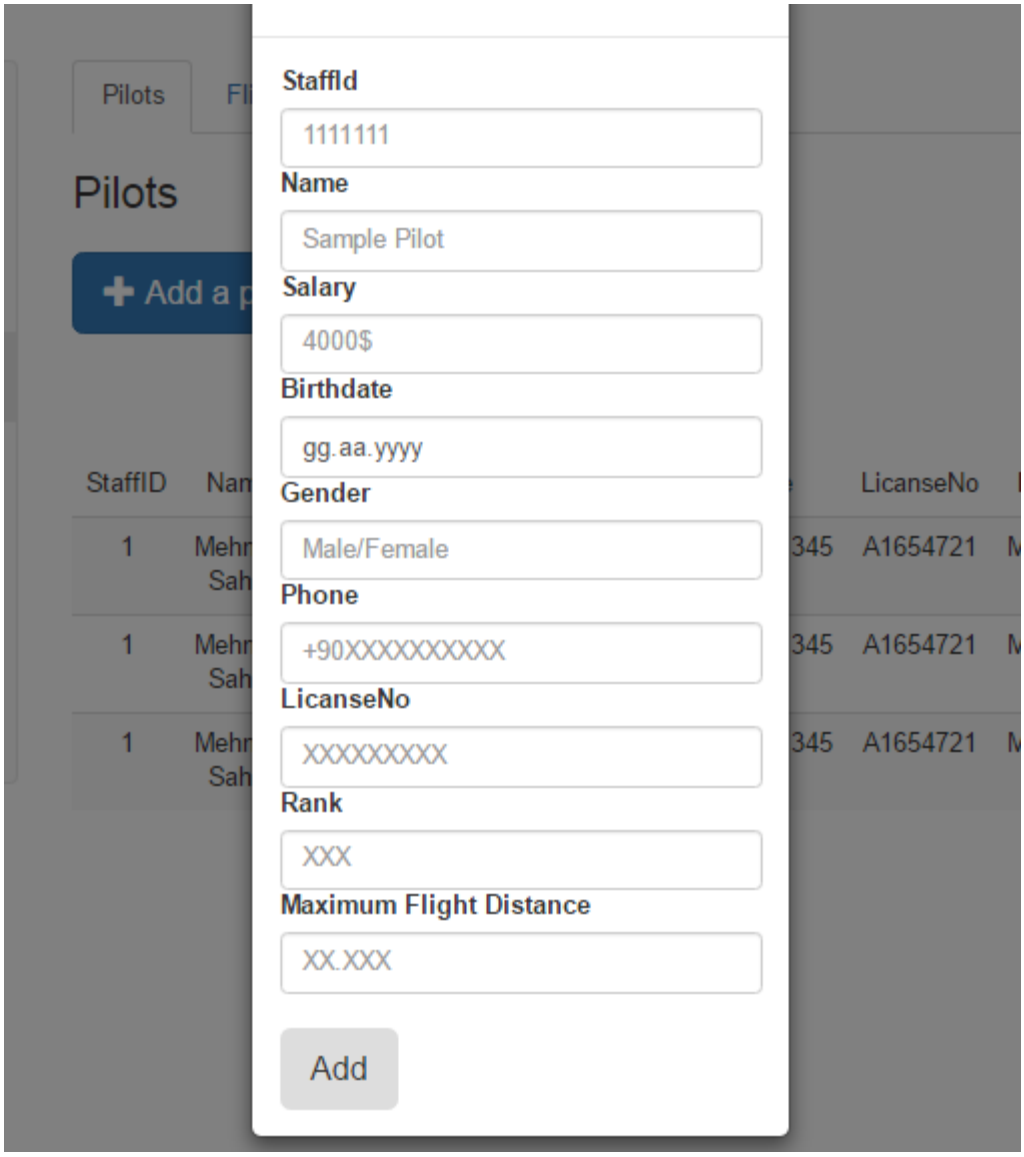
5.2.8.1. Manage Pilot Screen



Inputs: @staff_id, @name, @salary, @birthdate, @gender, @phone, @license_no, @rank, @max_flight_distance

Process: When manager click 'Pilots' tab, he/she sees the page above. The manager can add pilots to the system by clicking on the 'Add a pilot' button and the necessary fields shown above will be shown. The manager can fill in the fields and click 'Add' button to add a new

pilot. He/she can click on the delete icon to remove the corresponding pilot from the system. The manager can also edit pilots' information by clicking on the edit icon. Manager sees the pop-up window to edit as shown below:



With filling the required blanks, the manager can edit the pilot and save it. After saving the choices by clicking the button 'Add', he/she can return back to Pilots page.

SQL Statements:

View All Pilots

SELECT *

FROM pilot NATURAL JOIN crew NATURAL JOIN staff

Add a New Pİlot

INSERT INTO pilot

VALUES(@staff_id, @max_flight_distance)

INSERT INTO crew

VALUES(@staff_id, @license_no, @rank, NULL)

INSERT INTO staff

VALUES (@staff_id, @name, @salary, @birthdate, getYear() - @birthdate, @gender)

INSERT INTO staff_phones

VALUES(@staff_id, @phone)

Update Flight Distance of Pilot

UPDATE pilot

SET max_flight_distance = @max_flight_distance

WHEN staff_id = @staff_id

Update Rank of Pilot

UPDATE crew

SET rank = @rank

WHEN staff_id = @staff_id

Note: Update current_location and license_no queries are the same.

Update Name of Pilot

UPDATE staff

SET name = @name

WHEN staff_id = @staff_id

Note: Update salary, birthdate, gender queries are the same.

Delete Pilot

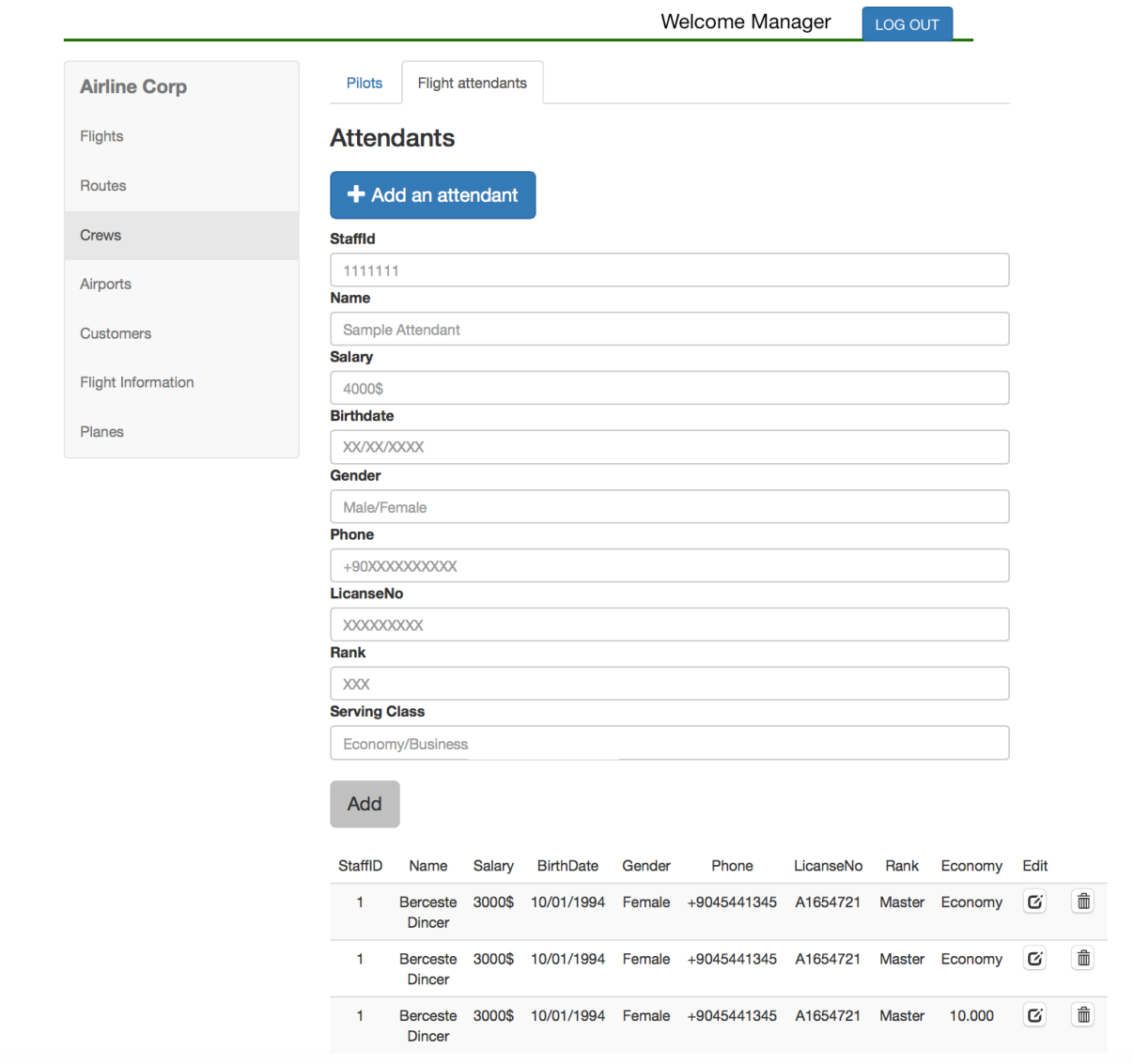
```
DELETE FROM pilot
WHERE staff_id = @staff_id

DELETE FROM crew
WHERE staff_id = @staff_id

DELETE FROM pilot
WHERE staff_id = @staff_id

DELETE FROM staff_phones
WHERE staff_id = @staff_id
```

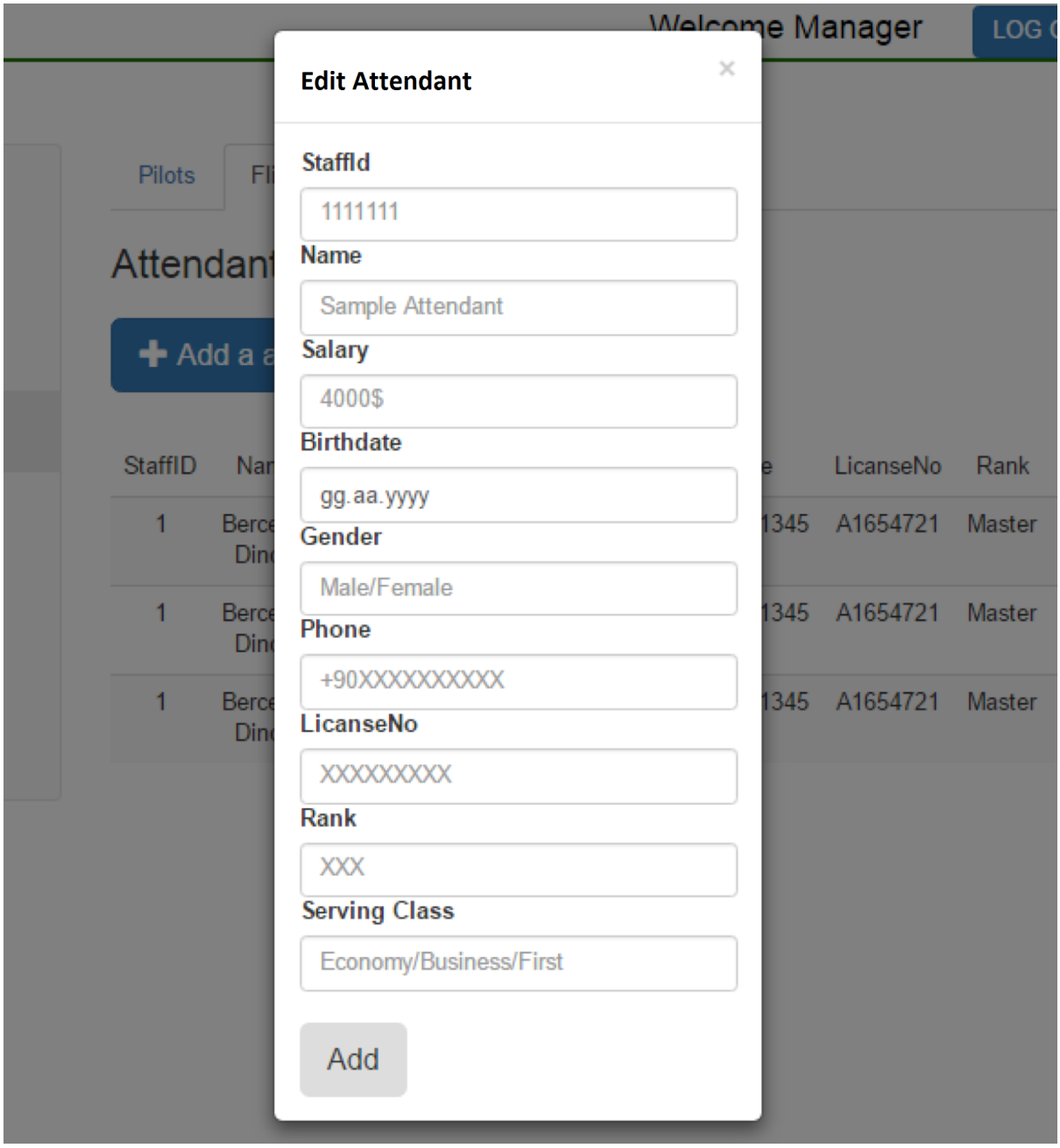
5.2.8.2. Manage Flight Attendant Screen



Inputs: @staff_id, @name, @salary, @birthdate, @gender, @phone, @license_no, @rank, @class_served

Process: When manager click 'Flight Attendants' tab, he/she sees the page above. The manager can add flight attendance to the system by clicking on the 'Add an attendant' button and the necessary fields shown above will be shown. The manager can fill in the fields and click 'Add' button to add a new flight attendance. He/she can click on the delete icon to remove the corresponding flight attendance from the system. The manager can also

edit flight attendance information by clicking on the edit icon. Manager sees the pop-up window to edit as shown below:



With filling the required blanks, the manager can edit the attendant and save it. After saving the choices by clicking the button ‘Add’, he/she can return back to Flight Attendance page.

SQL Statements:

View All Flight Attendants

```
SELECT *
FROM flight_attendance NATURAL JOIN crew NATURAL JOIN staff
```

Add a New Flight Attendant

```
INSERT INTO flight_attendance
VALUES(@staff_id, @class_served)

INSERT INTO crew
VALUES(@staff_id, @license_no, @rank, NULL)

INSERT  INTO staff
VALUES (@staff_id, @name, @salary, @birthdate, getYear() - @birthdate, @gender )

INSERT INTO staff_phones
VALUES(@staff_id, @phone)
```

Update Class Served of Flight Attendant

```
UPDATE flight_attendance
SET flight_class_served = @class_served
WHEN staff_id = @staff_id
```

Update Rank of Flight Attendant

```
UPDATE crew
SET rank = @rank
WHEN staff_id = @staff_id
```

Note: Update current_location and license_no queries are the same.

Update Name of Flight Attendant

```
UPDATE staff
SET name = @name
```

WHEN staff_id = @staff_id

Note: Update salary, birthdate, gender queries are the same.

Delete Flight Attendant

DELETE FROM flight_attendance

WHERE staff_id = @staff_id

DELETE FROM crew

WHERE staff_id = @staff_id

DELETE FROM pilot

WHERE staff_id = @staff_id

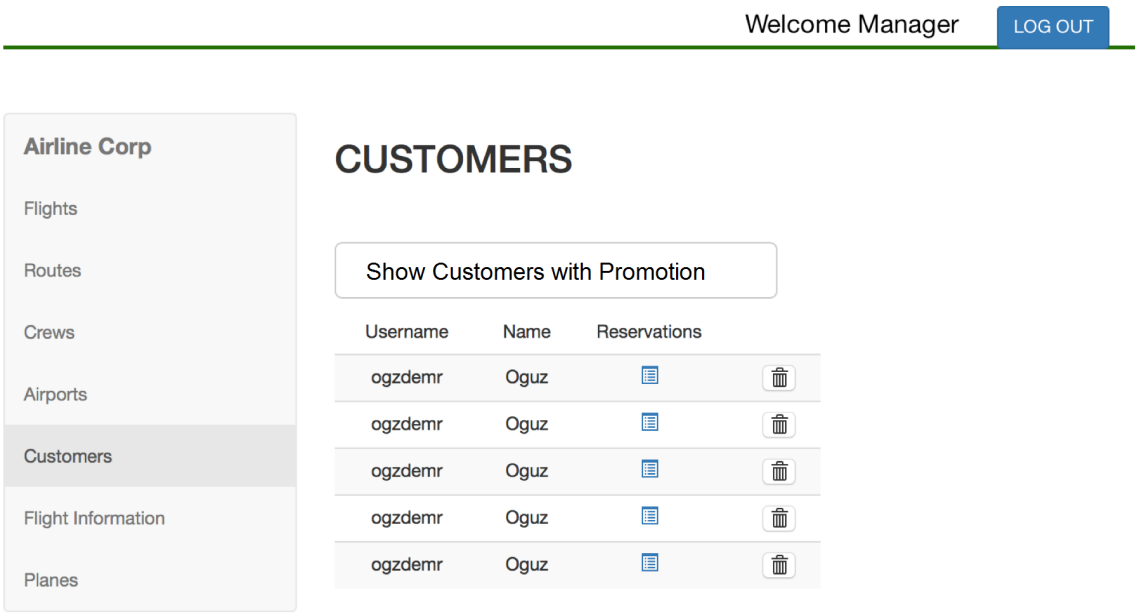
DELETE FROM staff_phones

WHERE staff_id = @staff_id

5.2.8.3. Manage Salesperson Screen

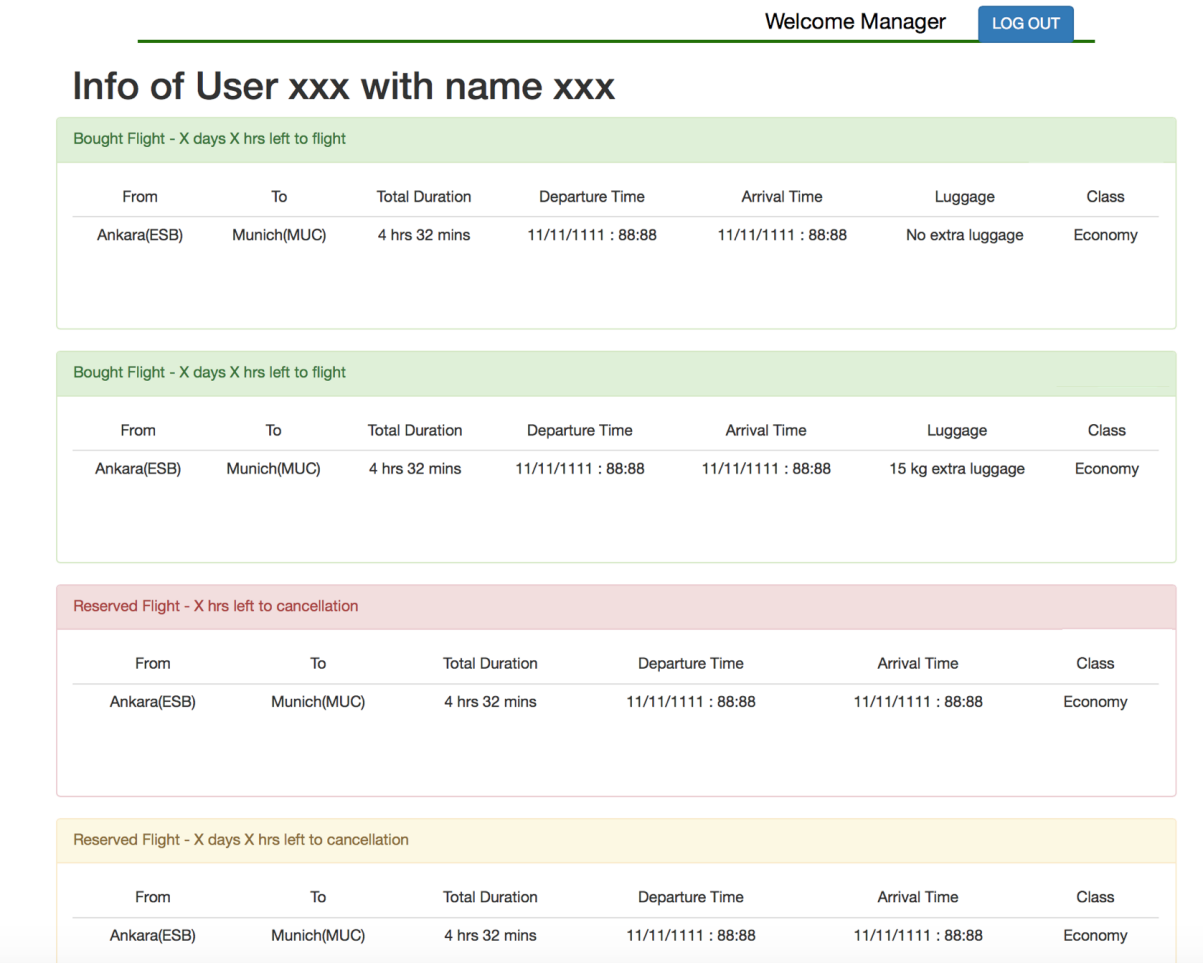
The screen for managing salesperson is the same as the pilot and flight attendant screens. Only the specific attributes are changed.

5.2.9. View Customers Screen



Inputs: @username (from previous pages), @customername

Process: The manager clicks 'Customers' tab to view all customers. He/she select 'Show Customers with Promotion' to view customers who earned promotions. When the delete icon is clicked the customer is deleted from the system. When reservation is clicked the below screen is shown:



The manager can view all reservations and tickets of a specific customer from this screen.

SQL Statements:

View All Customers

SELECT *

FROM ManagerCustomerView

View Tickets and Reservations of Customer

(SELECT date, time, departs, arrives, flight_duration, class

FROM CustomerReservationView) UNION

(SELECT date, time, departs, arrives, flight_duration, extra_luggage, class

FROM CustomerTicketView)

View Customers with Promotion

```
SELECT *
FROM CustomersWithPromotionView
```

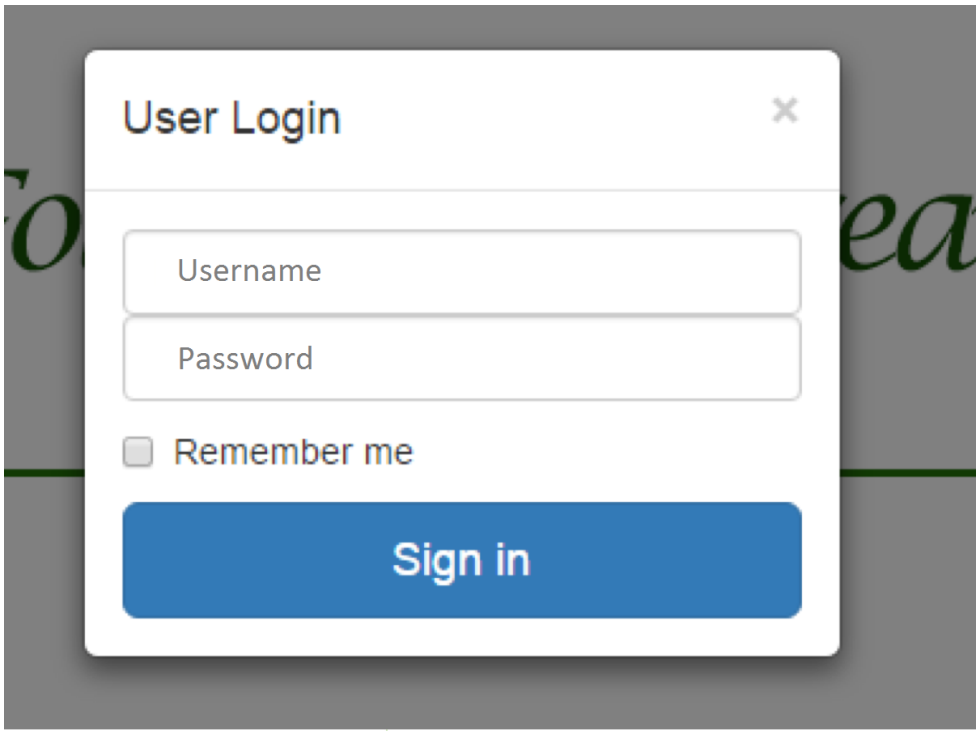
Delete Customer

```
DELETE FROM customer
WHERE user_name = @customername
```

5.3. Salesperson User Interface Design

The screens salesperson can access are described in detail.

5.3.1. Salesperson Login Screen



Inputs: @username, @password

Process: The salesperson clicks 'Login' button. He/she enters his/her username and password in order to access to salesperson operations.

SQL Statements:

Login to the System

```
SELECT *
FROM reservation_authority
WHERE user_name = @username AND
        password = @password AND
        user_name IN (SELECT user_name FROM reservation_authority NATURAL JOIN
salesperson)
```

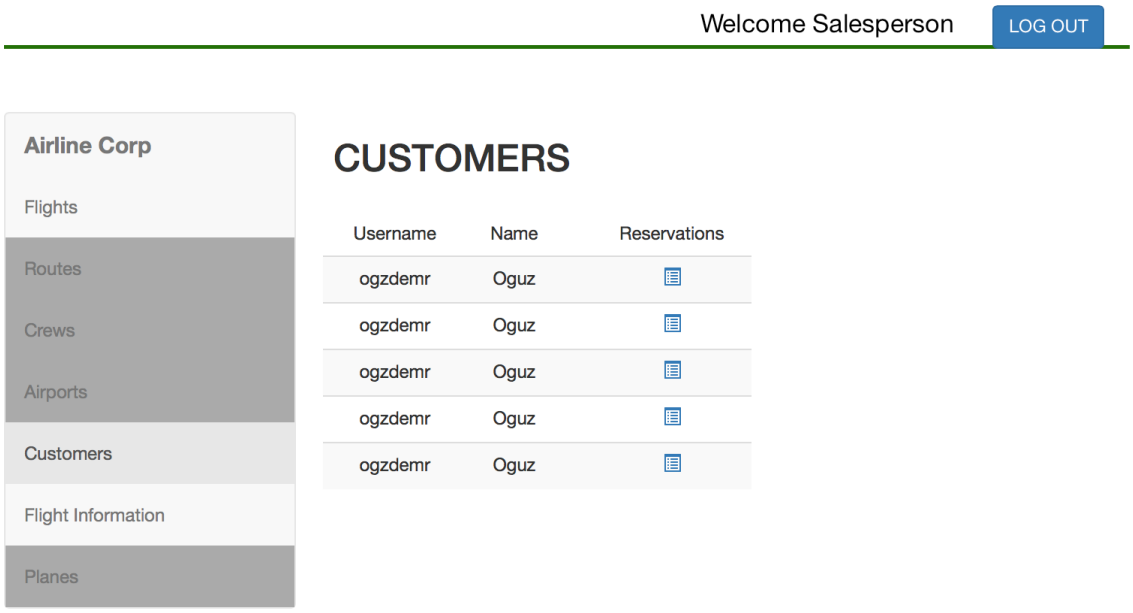
5.3.2. Salesperson Manage Account Screen

Since both manager and salesperson are reservation authoritative, the changes on account are reflected to staff and reservation_authoritative tables. Hence, the user interface design and the queries for salesperson manage account screen is exactly the same as the manager's. The user interface and queries can be found in section 5.2.2. of the report.

5.3.3. Salesperson View Flight Status Screen

Just like the manager, the salesperson can view all flights registered to the system and view the tickets and reservations for the flights. The user interface and queries for the salesperson view flight status is the same as the manager's flight details screen. The salesperson can also use this screen in order to inform the customer about the available flights, i.e. the salesperson can use this page to search for available flights. The user interface and queries can be found in section 5.2.7. of the report.

5.3.4. Salesperson Customer View



Inputs: @username (from previous pages), @customername

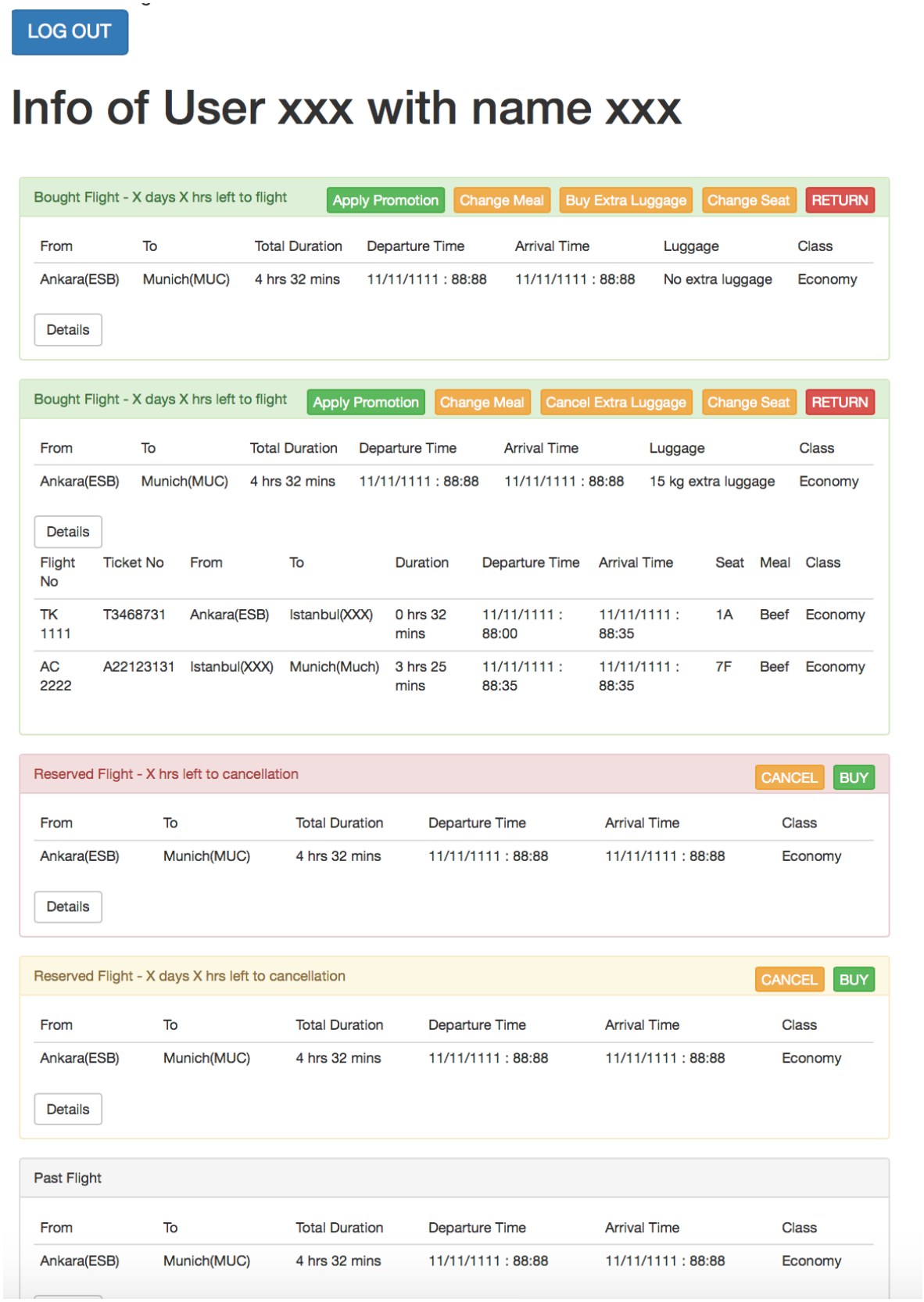
Process: The salesperson clicks ‘Customers’ tab to view all customers. The username and name of the customers are shown to the salesperson. Then salesperson clicks to ‘Reservations’ icon next to each customer in order to view all reservations and tickets of the selected customer. (Reservations&Tickets screen is explained in 5.3.5.)

SQL Statements:

View All Customers

```
SELECT *
FROM ManagerCustomerView
```

5.3.5. Salesperson Customer Reservations &Tickets View



Inputs: @curtomername (passed from salesperson customer view screen), @reservationno, @ticketno, @selectedPromotion, @extraluggage, @meal, @class, @seat_no

When salesperson selects reservations from the customer screen the page above is shown. The salesperson can see the existing reservations of the selected customer in detail. When he/she click 'Details' button, ticket's detailed information is provided. The salesperson is able to perform any operation the customer can perform in this page in order to help the customer with the process.
The salesperson clicks 'Cancel' button to cancel the reservation and clicks 'Buy' button to purchase the ticket. He/she clicks 'Apply Promotion' button to select a campaign or sale to apply to the ticket from the list of available promotions. Salesperson clicks 'Buy Meal' to select a meal and 'Change Meal' to update the meal choice. He/she clicks 'Buy Extra Luggage' to specify the amount of extra luggage and clicks 'Cancel Extra Luggage' to delete the existing luggage. The customer clicks 'Choose Seat' to select a seat from the list of seats and clicks 'Change Seat' to update selection. When customer clicks 'Return' button the ticket is refunded. He/she selects 'Return' button to refund the ticket. This page allows salesperson to handle reservation & purchasing operations on behalf of the customers.

SQL Statements:

View Tickets and Reservations Of Customer

```
(SELECT date, time, departs, arrives, flight_duration, class
FROM CustomerReservationView) UNION
(SELECT date, time, departs, arrives, flight_duration, extra_luggage, class
FROM CustomerTicketView)
```

View all Tickets

```
SELECT *
FROM CustomerTicketView
```

Cancel Reservation

```
UPDATE reservation
SET cancelled = 1
WHERE reservation_no = @reservationno AND
        user_name = @customername
```

Return and Refund Ticket

```
DELETE FROM ticket
WHERE ticket_no = @ticketno AND
        user_name = @customername
```

Executes 6.4.2. Mile Sum Trigger After Refunding Ticket

Executes 6.4.3. Cancel Reservation Trigger After Refunding Ticket

Executes 6.4.5. Total Money Trigger After Refunding Ticket

Executes 6.4.6. Pay Penalty Trigger After Refunding Ticket

List Promotions

```
SELECT *
FROM promotion
WHERE user_name = @customername
```

Apply Promotion

```
UPDATE ticket
SET price = CASE
        WHEN @selectedPromotion in (SELECT promotion_id FROM sale WHERE user_name
        = @username) THEN  price * sale_amount
        WHEN @selectedPromotion in (SELECT promotion_id FROM campaign WHERE
user_name      = @username) THEN  0
        ELSE price
        END
```

Buy/Change Meal

```
UPDATE ticket
```

```
SET meal = @meal
WHERE ticket_no = @ticketno AND
        user_name = @customername
```

Executes 6.4.7. Total Money Trigger After Buying Meal

Choose/Change Seat

```
UPDATE ticket
SET seat_no = @seatno
WHERE ticket_no = @ticketno AND
        user_name = @customername
```

Register Extra Luggage

```
UPDATE ticket
SET extra_luggage = @extraluggage
WHERE ticket_no = @ticketno AND
        user_name = @customername
```

Cancel Extra Luggage

```
UPDATE ticket
SET extra_luggage = 0
WHERE ticket_no = @ticketno AND
        user_name = @customername
```

Purchase Ticket

```
INSERT INTO ticket
FROM flight NATURAL JOIN route
SELECT (user_name, plane_name, route_id, date, departure_time, INDEX(ticket_no), 0,
NULL, @class, 0, NULL, CASE WHEN @class = 1 business_price ELSE economy_price END)
WHERE user_name = @customername AND
        route_id in (SELECT route_id FROM route where departs = @from and arrives = @to)
        AND
```

date = @departuredate AND

time = @departuretime

Executes 6.4.1. Mile Sum Trigger After Purchasing Ticket

Executes 6.4.4. Total Money Trigger After Purchasing Ticket

6. ADVANCED DATABASE COMPONENTS

6.1. Views

6.1.1. Customer Flight View

The customer can only see the flight id, flight time, date, and cities. The plane and assigned crew details should not be visible to the customer.

CREATE VIEW CustomerFlightView(flight_id, date, time, departs, arrives, price) AS
(SELECT flight_id, date, departure_time, departs, arrives CASE WHEN class = 1 THEN business_price ELSE economy_price END
FROM flight NATURAL JOIN route)

6.1.2. Customer Reservation View

The customer can only see the reservation details such as flight id, flight time, date, cities, class and cancelled. The plane and assigned crew details should not be visible to the customer. Moreover, customer can only see his/her own reservations.

CREATE VIEW CustomerReservationView(flight_id, date, time, departs, arrives, reservation_no, class, cancelled) AS
(SELECT flight_id, date, departure_time, departs, arrives, reservation_no, class, cancelled
FROM reservation NATURAL JOIN flight NATURAL JOIN route
WHERE user_name = @userName)
Note: @userName is the input, the username of the customer

6.1.3. Customer Ticket View

The customer can only see the ticket details such as flight id, flight time, date, cities, luggage, seat_no etc. The plane, penalty amount, assigned crew details should not be visible to the customer. Moreover, customer can only see his/her own tickets.

```
CREATE VIEW CustomerTicketView (flight_id, date, time, departs, arrives, ticket_no,
extra_luggage, meal, class, seat_no, price) AS
(SELECT flight_id, date, time, departs, arrives, ticket_no, extra_luggage, meal, class,
penalty_amount, seat_no, price
FROM ticket NATURAL JOIN flight NATURAL JOIN route
WHERE user_name = @userName)
```

Note: @userName is the input, the username of the customer

6.1.4. Manager Customer View

The manager cannot access to password or passport details of the customers. Other customer information can be accessed by the manager.

```
CREATE VIEW ManagerCustomerView(user_name, name, mile_sum) AS
(SELECT user_name, name, mile_sum
FROM customer )
```

6.1.5. Customers with Promotion View

The manager can view the information of the customers who earned a promotion, i.e. mile sum is larger than 5,000 miles for the customer.

```
CREATE VIEW CustomersWithPromotionView(user_name, name, mile_sum) AS
(SELECT user_name, name, mile_sum
FROM customer
WHERE mile_sum >= 5000)
```

6.2. Stored Procedures

In Airline Company Data Management System stored procedures are used to improve performance, manage consistency, improving security, and increasing robustness. For the procedures that are complex and repetitively executed, we created stored procedures.

6.2.1. Purchase Ticket Stored Procedure

When customer or salesperson purchases the ticket for the flight they made a reservation from, reservation and ticket entities are joined to indicate which reservation is sold. After the details of the ticket are indicated, if extra luggage is specified, the luggage amount for the flight is updated. Then, according to the class of the flight and the seat number the seat map plan of the plane is updated. This procedure is repeated whenever a ticket is purchased.

6.2.2. Refund Ticket Stored Procedure

When customer or salesperson cancels an already bought ticket, reservation and ticket entities are joined to indicate which reservation is involved and the reservation is marked as cancelled. Then, the meals registered to flight are updated. If extra luggage was specified, the luggage amount for the flight is updated. Then, according to the class of the flight and the seat number the seat map plan of the plane is updated. The amount of the ticket is refunded to the customer. Moreover, the penalty amount is paid by the customer. This procedure is repeated whenever a ticket is refunded.

6.2.3. Delete Airport Stored Procedure

When manager deletes an airport from the system first the operation is postponed until there is a current associated flight in the air. Afterwards, all the routes including the airport as a source or destination airport are deleted from the system. Then, the flights associated

with these routes are deleted from the system. The associated planes are marked as available again. Furthermore, all associated reservations are cancelled and the associated customers are notified. If there are sold tickets, the tickets are cancelled and the customers are paid back the ticket amount. This procedure is repeated whenever an airport is deleted from the system.

6.2.4. Delete Route Stored Procedure

When manager deletes a route from the system first the operation is postponed until there is a current associated flight in the air. Afterwards, the flights associated with these routes are deleted from the system. The associated planes are marked as available again. Furthermore, all associated reservations are cancelled and the associated customers are notified. If there are sold tickets, the tickets are cancelled and the customers are paid back the ticket amount. This procedure is repeated whenever a route is deleted from the system.

6.2.5. Cancel Flight Stored Procedure

When manager deletes a flight from the system first the operation is postponed until there is a current associated flight in the air. Afterwards, the associated planes are marked as available again. Furthermore, all associated reservations are cancelled and the associated customers are notified. If there are sold tickets, the tickets are cancelled and the customers are paid back the ticket amount. Finally, the manager page reservation/ticket details and available flights of the system is updated. This procedure is repeated whenever a flight is deleted from the system.

6.2.6. Send Plane to Repair Stored Procedure

When manager sends a plane to the repair, the plane is marked as unavailable. Then, the flights using these planes are cancelled. All associated reservations are cancelled and the associated customers are notified. If there are sold tickets, the tickets are cancelled and the

customers are paid back the ticket amount. This procedure is repeated whenever a plane is sent to repair.

6.2.7. Delete Plane Stored Procedure

When manager deletes a plane, the plane is removed from the system. Then, the flights using these planes are cancelled. All associated reservations are cancelled and the associated customers are notified. If there are sold tickets, the tickets are cancelled and the customers are paid back the ticket amount. This procedure is repeated whenever a plane is sent to repair.

6.3. Reports

6.3.1. Total Number of Customers Registered to the System, Total Number of Customers with Reservation, Total Number of Customers with Tickets

Calculates the number of customers that are registered to the Airline Company Data Management System, the number of customers that have reservation and the number of customers who has purchased ticket.

```
WITH allReservationsAndTickets( reservationCount, saleCount ) AS
        ( SELECT COUNT (distint R.user_name), COUNT(distinct T.user_name)
          FROM reservation R, ticket T)
SELECT COUNT(distinct C.user_name), reservationCount, saleCount
FROM allReservationsAndTickets RIGHT OUTER JOIN customer C using user_name
```

6.3.2. Total Number of Available Flights, Total Number of Current Reservations, Total Number of Purchased Tickets and The Total Amount of Money Spent by the Customers

Calculates the total number of available flights, the total number of current reservations to all flights, the number of sold tickets from all flights and the total amount of money the customers paid for tickets.

```
SELECT COUNT(distinct F.*), COUNT(distinct R.*), COUNT(distinct T.*), SUM(price)
FROM flight NATURAL JOIN ticket NATURAL JOIN reservation
```

6.3.3. Total Number of Employees in Each Role and the Average Salary of Each Role

Calculates the total number of employees in each role and the average value of their salaries.

```
WITH pilots(pilot_count, pilot_avg_sal) AS
        ( SELECT COUNT(*), AVG(salary)
          FROM Pilot )
        flightattendance(fa_count, fa_avg_sal) AS
        ( SELECT COUNT(*), AVG(salary)
          FROM  FlightAttendance)
        managers(manager_count, manager_avg_sal) AS
        ( SELECT COUNT(*), AVG(salary)
          FROM Manager )
        salespersons(salesperson_count, salesperson_avg_sal) AS
        ( SELECT COUNT(*), AVG(salary)
          FROM salesperson)
SELECT unique (pilot_count, pilot_avg_sal, fa_count, fa_avg_sal, manager_count,
manager_avg_sal salesperson_count, salesperson_avg_sal)
FROM pilots, flightattendance, managers, salepersons
```

6.3.4. Total Number of Tickets and Reservations Associated with a Particular Flight and the List of All Tickets and Reservations of the Flight

Calculates the total number of tickets and reservations for a particular flight and lists all tickets and reservations for the flight.

```
SELECT count(reservation_no, user_name), count(ticket_no, user_name), reservation.*,
ticket.*
FROM ticket NATURAL JOIN reservation
WHERE route_id = @route_id AND
        plane_name = @plane_name AND
        date = @date AND
        departure_time = @departuretime
```

Note: @route_id, @plane_name, @date, @departuretime are inputs coming from the selected flights

6.3.5. Total Number of Assigned Routes and Flights to Each Airport

Calculates the total number of assigned routes and flights for each airport.

```
SELECT count(route_id), count(*)
FROM flight NATURAL JOIN route
GROUP BY airport_name
```

6.4. Triggers

6.4.1. Mile Sum Trigger After Purchasing Ticket

After a tuple is inserted to ticket, the mile_sum attribute of the associated customer is increased by the total_mile amount of the associated flight.

6.4.2. Mile Sum Trigger After Refunding Ticket

After a ticket is refunded and the tuple is deleted from ticket, the mile_sum attribute of the associated customer is decreased by the total_mile amount of the associated flight.

6.4.3. Cancel Reservation Trigger After Refunding Ticket

After delete operation on ticket, the corresponding row will be updated as cancelled from reservations.

6.4.4. Total Money Trigger After Purchasing Ticket

After a tuple is inserted to ticket, the total_money attribute of the associated customer is decreased by the price amount of the associated flight.

6.4.5. Total Money Trigger After Refunding Ticket

After a ticket is refunded and the tuple is deleted from ticket, the total_money attribute of the associated customer is increased by the price amount of the associated flight.

6.4.6. Pay Penalty Trigger After Refunding Ticket

After a ticket is refunded and the tuple is deleted from ticket, the total_money attribute of the associated customer is decreased by the penalty_amount of the associated flight.

6.4.7. Total Money Trigger After Buying Meal

After a new tuple is inserted to the ticket, the constant price of the meal is deduced from the total_money attribute of customer.

6.4.8. Total Money Trigger After Registering Extra Luggage

After a luggage is registered to a ticket, the constant price of the extra luggage is deduced from the total_money attribute of customer.

6.4.9. Total Money Trigger After Cancelling Extra Luggage

After a luggage is cancelled, the constant price of the extra luggage is refunded to the total_money attribute of customer.

6.4.10. Give Promotion Trigger After Update on Mile_Sum

After the mile_sum attribute of the customer is changed, the system checks whether the mile_sum of the customer exceeds 10.000 miles. If the situation holds a free one-way Europe ticket is added to the customer promotions. If the total miles exceed 25.000 miles then a one-way free ticket is added to the customer promotions. These mile_sum promotions are applied when 10.000 and 25.000 values are multiplied. For instance, when the mile_sum is 10,000 one ticket is given. When mile exceeds 20,000 the second free ticket is given. Then the procedure is repeated.
Moreover, when mile_sum reaches to multiple of 5,000 miles than a 20% sale of 2 week-period is added to the customer promotions.

6.5. Constraints

6.5.1. Minimum Salary Constraint for Staff

The salary of a staff cannot be lower than the minimum wage 1300 TL.

6.5.2. Capacity Constraint for Planes Assigned to Flights

A plane with more than 500 passenger capacity cannot be assigned to a flight that has total_mile lower than 3000 miles.

Similarly, a plane with less than 500 passenger capacity cannot be assigned to a flight with total_mile higher than 3000.

6.5.3. Simultaneous Flights Constraint for Customer Flights

Ticket cannot have a pair of exact same date and departure_time values for the same customer.

6.5.4. Extra Luggage Constraint for Ticket

Ticket cannot have a more than two for extra_luggage value.

6.5.5. Passenger Capacity Constraint for Plane

A plane cannot be assigned to a flight if the total passengers for the plane (number of tickets) are larger than the capacity of the plane.

6.5.6. Maximum Travel Time Constraint for Plane

A plane cannot be assigned to a flight if the flight_duration of the flight is larger than the max_flight_time of the plane.

6.5.7. Seat Number Constraint for Flight Class

Seat numbers for the business class cannot be higher than 1/3 of the largest seat number. (Front seats are reserved for business class)

6.5.8. Location Constraint for Crew Assignment

The crew cannot be assigned to flights if their current_location is not the same as the departure airport of the flight.

6.5.9. Pilot Number Constraint for Pilot Assignment

The number of pilots assigned to a flight cannot be less than 2.

6.5.10. Purchasing Constraint for Customer

The customer can only purchase a ticket, meal or luggage if the total_money attribute of the customer is larger than or equal to the amount of the payment.

6.5.11. Total Money Constraint for Customer

The total_money attribute of customer cannot be below 0.

6.5.12. Not Purchased Reservation Constraint for Customer

The cancelled attribute of reservation cannot be 0 if the reservation is not purchased (turned into ticket) when only 24 hours are left before the associated flight.

7. IMPLEMENTATION PLAN

To manage the data flow in our project, we would like to use MySQL Server and we will be maintaining it with Java. For our application functionalities and user interface in our management system's website, we will be using PHP, Bootstrap, HTML, CSS and JavaScript.