

Bilkent University

Department of Computer Engineering

CS 353 - Database Management Systems



Airline Company Data Management System

**Design Report**

Group 16

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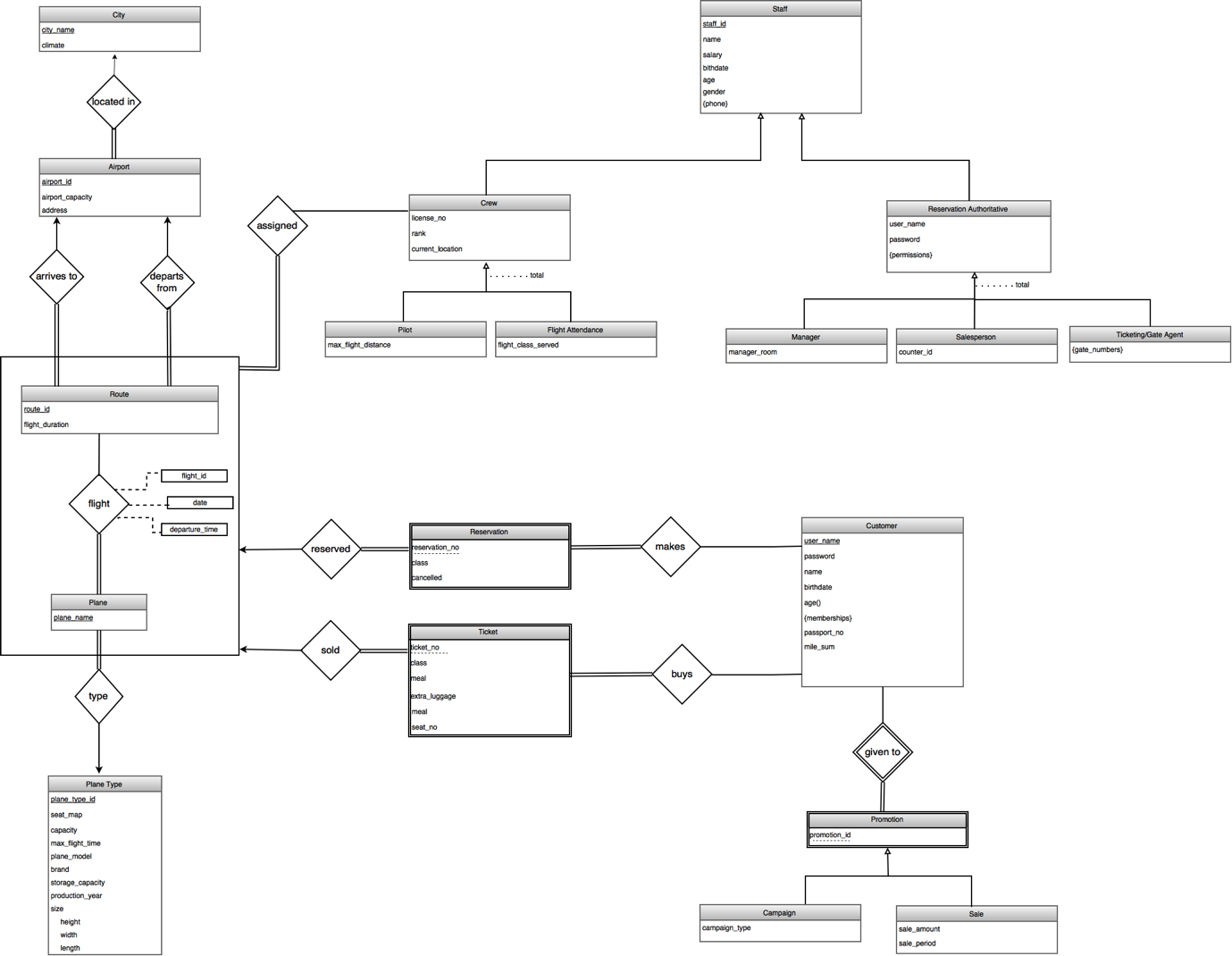
# Revised E/R Model

## Changes Made in the E/R Diagram

After we received feedback from pour 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 in order to allow customers to view the climate of the cities they are travelling to.
* 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.
* We added multi-valued attribute gate\_numbers to Ticketing/Gate Agent in order to track which gate the employee is currently assigned to. We used a multivalued attribute since a ticketing/gate agent can be responsible from controlling multiple gates.

## Revised E/R Diagram



# RELATION SCHEMAS

# 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.

# FUNCTIONAL COMPONENTS

## 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 4 users: Customer, Manager, Salesperson, and Ticketing/Gate Agent. Even though some services are common to all users, each user is allowed to access different functionalities of the system.

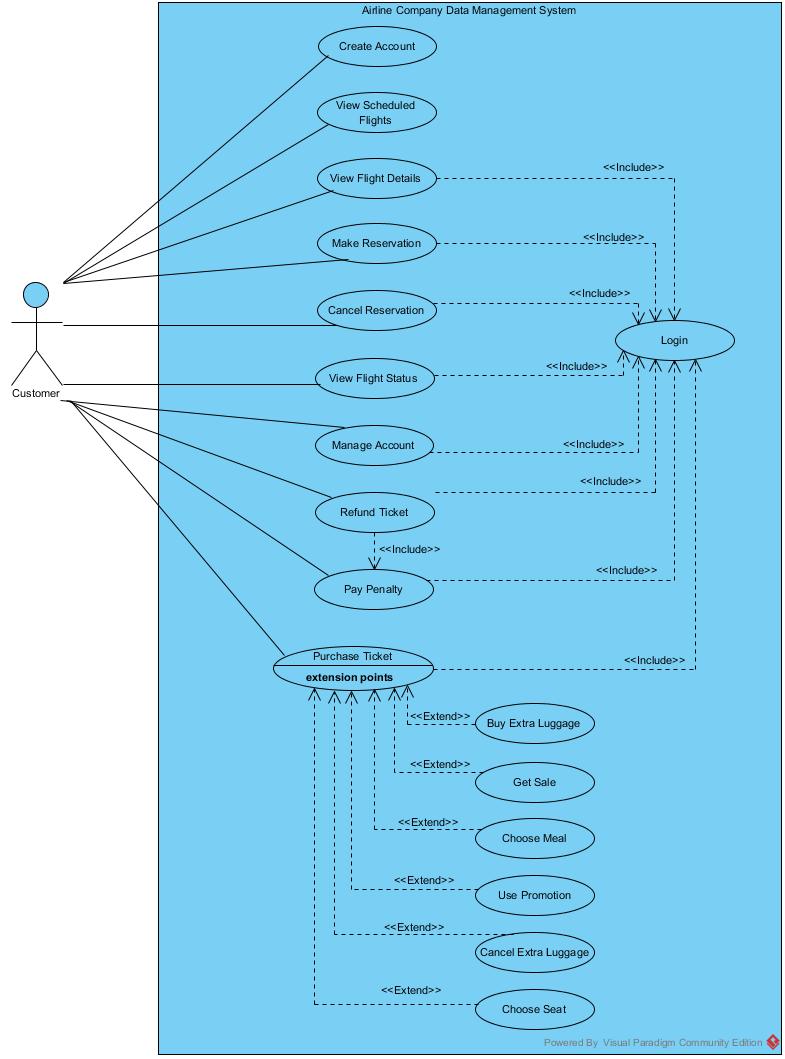
Customer is able to perform actions related to reservations such as viewing flight details and making payment.

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.

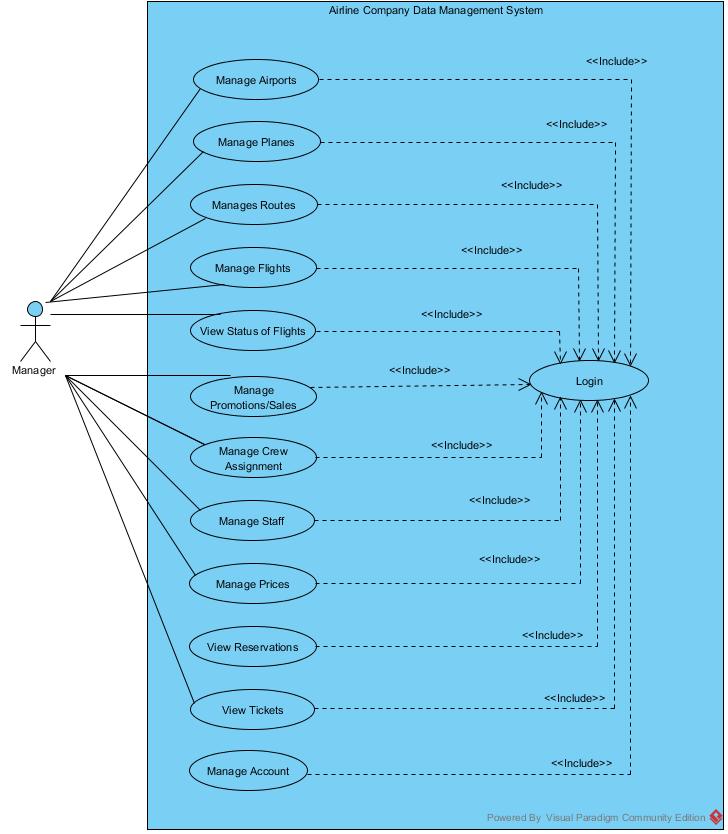
Ticketing/Gate Agent is responsible from finalizing flight details for customers.

### Customer Use Cases



* **Create Account:** The customers can create an account in the system by specifying their unique username, password, name, birthdate, credit card details, and membership details. The user can use this account information to login to the system for reservations.
* **Login:** The customers can login to the system using his/her username and password in order to be able make reservation/purchasing operations.
* **View Scheduled Flights:** The customers can view all flights that are registered to system. The user can specify date, arrival city and airport, and departure city and airport in order to view the flights he/she is interested in.
* **View Flight Details:** The customers can view flight details such as classes available, meals available, seat plan, and price. The customer is required to login to the system in order to be able to view flight details.
* **Make Reservation:** The customers can make reservations to the available flights by indicating the number and status of the passengers (child, student, etc.). The customers can also choose either one-way or return tickets. The customers need to login to the system to be able to make reservations.
* **Cancel Reservation:** The customers can cancel their reservations if the system allows them to. The customers need to login to the system to be able to cancel their reservations.
* **View Flight Status:** The customers can view the status of the flights they made reservation or purchased ticket for. The status information includes meals bought, class choice, seat choice, and delay amount of the flight. The customers need to login to the system to be able to view the status of their flights.
* **Manage Account:** The customers can update their account information. The username and password details, credit card details, and, membership information can be changed or deleted by the customer when it is necessary. The customers need to login to the system to be able to update their account details.
* **Refund Ticket:** The customers can refund their tickets if the system allows. They can cancel their ticket and their money will be refunded. The Refund Ticket use case includes paying the penalty. The customers need to login to the system to be able to refund their tickets.
* **Pay Penalty:** The customers can pay the penalty amount from their account when they refund a ticket. The customers need to login to the system to be able to pay the penalty.
* **Purchase Ticket:** The customers can purchase tickets from the flights they have reservation from. The date, airports, and number of passengers need to be indicated before purchase. The customers need to login to the system to be able to purchase ticket.
* **Buy Extra Luggage:** The customers can buy extra luggage for the flights they bought a ticket from. They can indicate the extra luggage amount and make the necessary payment.
* **Cancel Extra Luggage:** The customers can cancel the extra luggage they bought and their money will be refunded.
* **Choose Seat:** The customers can choose their seats for the flights they bought a ticket from. The chosen seat also indicates the flight class.
* **Choose Meal:** The customers can choose their meals from the available meal options for the flights they bought a ticket from and make the necessary payment.
* **Use Promotion:** The customers can benefit from the given promotions for the flights they bought a ticket from. The promotions can be used to earn free meals, gift miles, advantageous membership opportunities, or free lounge services.
* **Get Sale:** The customers can benefit from sales for the flights they bought a ticket from. The sales will allow customers to pay less for the ticket.

### Manager Use Cases



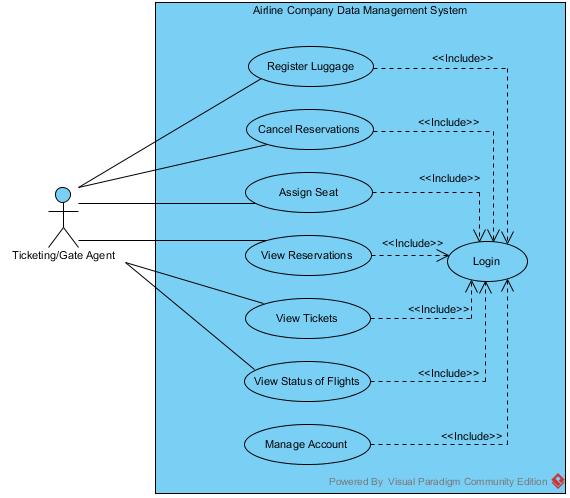
* **Login:** Manager can login to the system with his/her username and password. The manager will be given access to manager functions when the account details are approved. Manager needs to login to the system to be able to perform other operations.
* **Manage Airports:** The manager can view all airports registered to the system and their details. 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 details of the plane type such as size, capacity, seat map, model and delete the existing ones. Managers can also make changes in plane details such as passenger capacity, storage capacity, maximum flight time. 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. 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, update meal and class options.
* **View Status of Flights:** The manager can view status of all existing flights including their delay amount, class options and available meals.
* **Manage Promotion/Sales:** The manager can view all promotions and sales that exist in the system and for whom they can be applied. The campaign type and the sale amount and period are available for manager to see. He/she can add new sales or promotions according to the history of customers or flights by specifying the details of the promotions/sales.
* **Manage Crew Assignment:** The manager can assign crew to the flights according to the date and flight time of the flight and location and rank 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, salespersons, and ticketing/gate agents. 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, rise or lower their salaries, update their licenses, change their flight distance and flight class.
* **Manage prices:** The manager is able view the prices of all flights available in the system. He/she can assign prices to newly created flights and determine the price ranges according to airports, dates and times. The manager is also able to alter the prices of flights.
* **View Reservations:** The manager is able to view all current reservation and view the associated customer, date, route, plane, and, class details.
* **View Tickets:** The manager is able to view all current tickets and view the associated customer, date, route, plane, crew, meal, seat, luggage and, class 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, phone details.

### Salesperson Use Cases

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* **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.
* **View Flights:** The salesperson can view all flights that are registered to system. The user can specify date, arrival city and airport, and departure city and airport in order to help the customers to make reservations.
* **View Flight Details:** The salesperson can view flight details such as classes available, meals available, seat plan, and price. The salesperson is required to login to the system in order to be able to view flight details.
* **Sell Ticket:** The salesperson can complete the ticket purchasing operations for the customers. From the customer reservations, the salesperson can complete the purchasing operations using the credit card information of the customer.
* **Choose Ticket Details:** The salesperson can select the ticket details such as meal, class, seat number for the customer. He/she can also make the necessary payments 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.
* **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.
* **View Status of Flights:** 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 current reservation and view the associated customer, date, route, plane, and, class details.
* **View Tickets:** The salesperson is able to view all current tickets 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.

### Ticketing/Gate Agent Use Cases



* **Login:** The ticketing/gate agent can login to the system with his/her username and password. The ticketing/gate agents will be given access to Ticketing/gate agents functions when the account details are approved.
* **Assign Seat:** The ticketing/gate agent can assign seat for the ticket if the seat is not assigned yet. The seat is selected from the available seats.
* **Cancel Reservation:** The ticketing/gate agent can cancel customer reservations when necessary by deleting the reservation from the system.
* **View Status of Flights:** The ticketing/gate agent can view the status of all existing flights including their delay amount, class options and available meals.
* **View Reservations:** The ticketing/gate agent is able to view all current reservation and view the associated customer, date, route, plane, and, class details.
* **View Tickets:** The ticketing/gate agent is able to view all current tickets and view the associated customer, date, route, plane, crew, meal, seat, luggage and, class details.
* **Manage Account:** The ticketing/gate agent 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.
* **Register Luggage:** The ticketing/gate agent can register the luggage of the customers to the system.

## Algorithms

## 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.

# USER INTERFACE DESIGN AND CORRESPONDING SQL STATEMENTS

# ADVANCED DATABASE COMPONENTS

## Views

## 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.

### Make Reservation Stored Procedure

When a reservation is made by the customer or salesperson, the reservation is added to the current reservations. Then, the capacity of the plane is decreased by the amount of the customers. Finally, the information of reservations available to users of the system is updated. In manager screen the reservation details are also updated. This procedure is repeated whenever a new reservation is made.

### Cancel Reservation Stored Procedure

When a reservation is cancelled by the customer or salesperson, the reservation information is marked as cancelled. Then, the capacity of the plane is increased by the amount of the customers. Finally, the information of reservations available to users of the system is updated. In manager screen the reservation details are also updated. This procedure is repeated whenever a reservation is cancelled.

### 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, the meals registered to flight are updated. 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. The manager screen is also updated to include new tickets. This procedure is repeated whenever a ticket is purchased.

### 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 capacity available for the flight is increased by the customer amount. The amount of the ticket is refunded to the customer. Moreover, the penalty amount is paid by the customer. The manager screen is also updated to include new tickets. This procedure is repeated whenever a ticket is refunded.

### Delete Airport 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. Finally, the manager page reservation/ticket details and available flights of the system is updated. This procedure is repeated whenever an airport is deleted from the system.

### Delete Route 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. Finally, the manager page reservation/ticket details and available flights of the system is updated. This procedure is repeated whenever a route is deleted from the system.

### Cancel Flight 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.

### 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. Finally, the manager page reservation/ticket details and available flights of the system is updated. This procedure is repeated whenever a plane is sent to repair.

## Reports

## 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(C.user\_name), reservationCount, saleCount

FROM allReservationsAndTickets, cutomer C

## 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 these flights, the number of sold tickets from these flights and the total amount of money the customers paid for tickets.

WITH totalMoney( reservationCount, saleCount ) AS

( SELECT COUNT (R.\*), COUNT(distinct T.\*)

FROM reservation R, ticket T)

SELECT COUNT(F.\*), reservationCount, saleCount, SUM(price)

FROM Flight, totalMoney, Ticket

## 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)

agents (agent\_count, agent\_avg\_sal) AS

( SELECT COUNT(\*), AVG(salary)

FROM Ticketing/GateAgent)

SELECT unique (pilot\_count, pilot\_avg\_sal, fa\_count, fa\_avg\_sal, manager\_count, manager\_avg\_sal salesperson\_count, salesperson\_avg\_sal, agent\_count, agent\_avg\_sal)

FROM pilots, flightattendance, managers, salepersons, agents

## Total Number of Flights Associated with Each Airport, the Cities of the Airports, and the Number of Customers Using Each Airport

Calculates the total number flights arriving from/departing at each airport, the cities of the airports and the number of customers arriving at each airport.

## Triggers

## Constraints