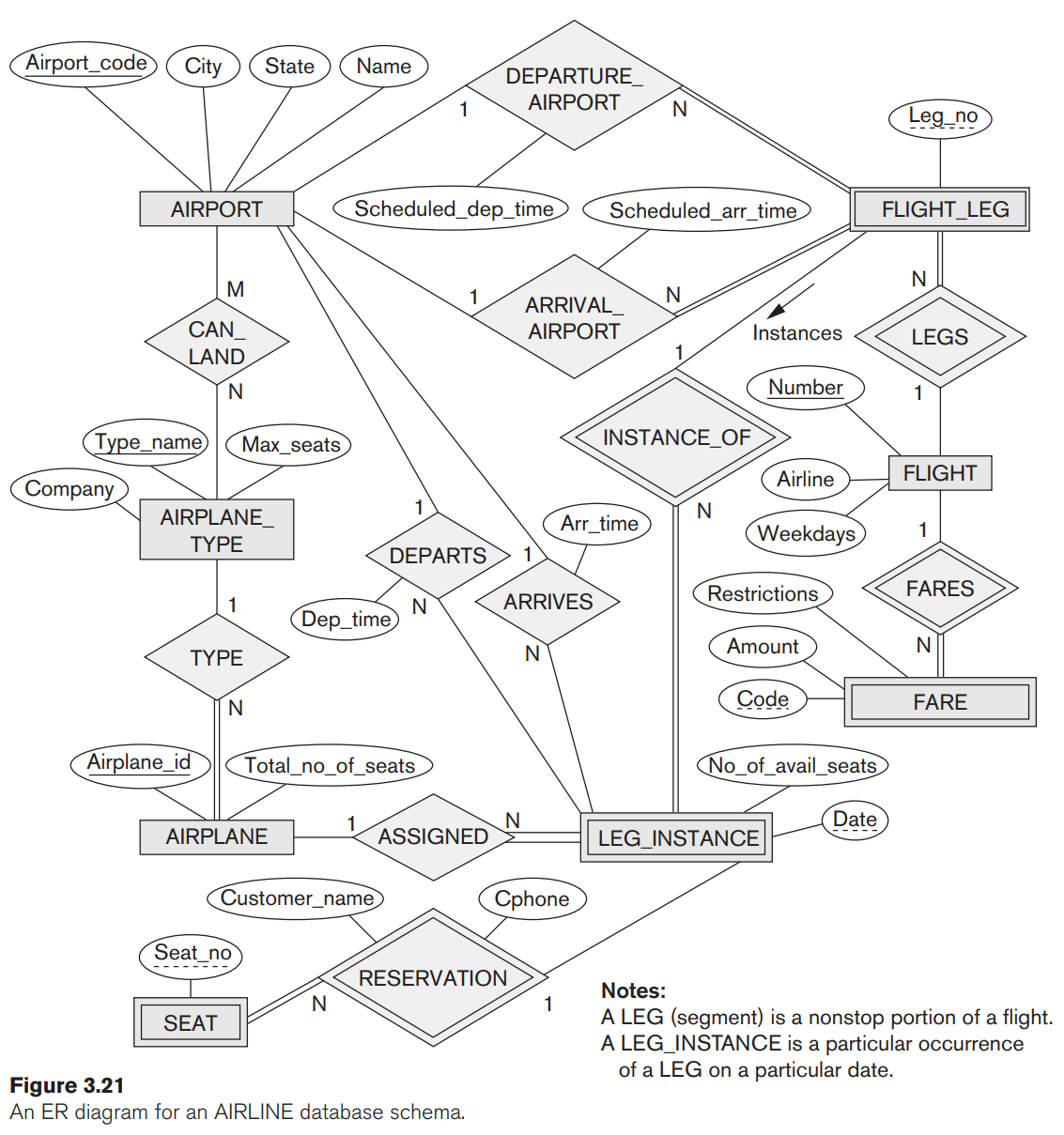


# Department of Computer Science and Engineering Database Management Systems — CMPS 451 Dr. Rehab Duwairi | Fall 2023 Course Team Project

|  |  |  |
| --- | --- | --- |
| ***STUDENT NAME OF SECTION L51*** | ***STUDENT QUID*** | ***STUDENT EMAIL*** |
| Fatma Ali Elbakry Elbadrawy | 201901981 | fe1901981@qu.edu.qa |
| Ferial Mohamed Zakaria Awadalla Marzouk | 201706475 | fm1706475@qu.edu.qa |
| Sara Metwally Ramadan Said | 202004852 | ss2004852@qu.edu.qa |

**Part A — Chosen Entity-Relationship Diagram (ERD) and Tools**

Chosen Diagram: Airline ERD

  
Chosen Tools:

For the Relational Schema Creation, we chose to work with Microsoft Excel[[1]](#footnote-1275). Oracle SQL Developer, our second tool, was used to create and populate the relations of the schema.

**Part B — Mapping the ER Schema to Relational Database Schema**

* First: We need to Identify all the “WEAK” and “STRONG” entities and the respective “Partial Key” and “Primary Key” of each one of the Entities.

|  |  |  |
| --- | --- | --- |
| **Entity** | **Primary/Partial Key** | **Entity Type** |
| AIRPORT | Airport\_Code | STRONG |
| AIRPLANE | Airplane\_ID | STRONG |
| AIRPLANE\_TYPE | Type\_Name | STRONG |
| FLIGHT | Number | STRONG |
| FLIGHT\_LEG | Leg\_NO | WEAK |
| LEG\_INSTANCE | Date | WEAK |
| FARE | Code | WEAK |
| SEAT | Seat\_NO | WEAK |

* Each STRONG entity will have its own relation (table), which will contain the primary key and the rest of the given attributes.
* Each WEAK entity, on the other hand, will have its own relation (table). However, since its partial key cannot stand on its own, the relation will contain a combined primary key which consists of the STRONG entity's primary key as a foreign key and the partial key. The given attributes will be added to the relation.
* Second: We need to map the relationship between entities and resolve them in the appropriate manner according to their connection and characteristics:

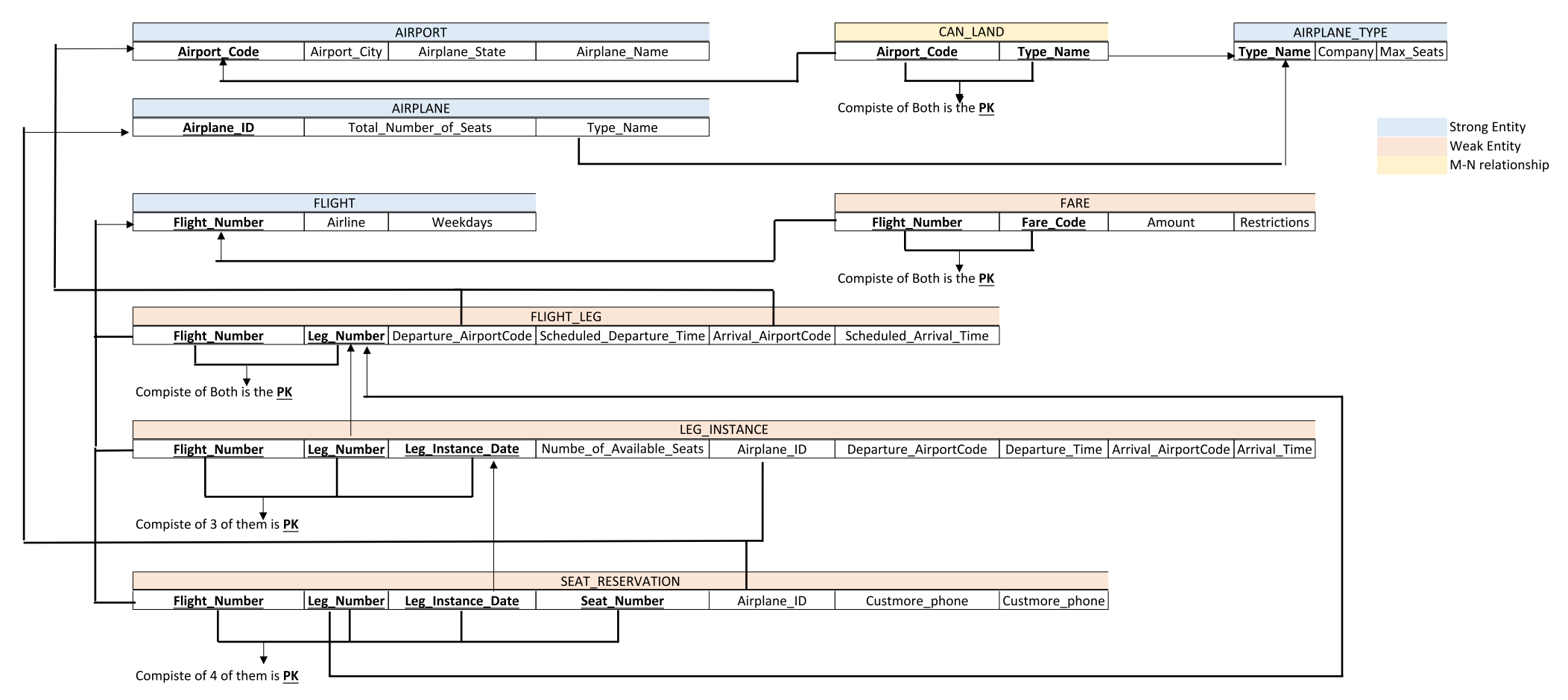
|  |  |  |
| --- | --- | --- |
| **Relationship** | **Cardinality** | **Attached Attributes** |
| CAN\_LAND | M:N | — |
| DEPARTURE\_AIRPORT | 1:N | Scheduled\_dep\_time |
| ARRIVAL\_AIRPLANE | 1:N | Scheduled\_arr\_time |
| DEPARTS | 1:N | Dep\_time |
| ARRIVES | 1:N | Arr\_time |
| TYPE | 1:N | — |
| INSTANCE\_OF | 1:N | — |
| LEGS | 1:N | — |
| FARES | 1:N | — |
| ASSIGNED | 1:N | — |
| RESERVATION | 1:N | Customer\_Name Cphone |

* 1:N with no Relationship Attributes: These were resolved using the most common approach, which is adding the Foreign Key to either of the relations connected.
* 1:N with Relationship Attributes: These were resolved by adding the attributes to either of the relations alongside the Foreign Key if it is required for the connection between the two relations.
* M:N These were resolved using the most common approach, which is creating a new relation with the Primary Keys of both and adding them as a Foreign Key as well.

The following notes were kept in mind as assumptions to reach possible solutions in order to create the submitted schema for the selected database:

* + The tails of the arrows are where the foreign keys lie.
  + The tips of the arrows are where the foreign keys originate from.
  + The primary keys are made to be bolder than the rest of the attributes.
  + The surrogate keys were considered as an option to eliminate using combined primary keys, however, after some research, we have found that it cannot be used as “Search up” keys and is more expensive compared to the original solution. Additionally, we feared the impossibility of being able to not use them as “search up” keys could conflict with future requirements of the following phases of this project.
  + The SEAT entity and RESERVATION relationship were combined, for it did not seem logical to separate the seat information from the customer. It seemed unnecessary and added more relations for interlinked data.
  + The FLIGHT\_LEG entity and DEPARTURE\_AIRPORT and ARRIVAL\_AIRPORT relationships were combined, for it seemed unnecessary and added more relations for data that are linked, since each flight leg departing, it must arrive.
  + The LEG\_INSTANCE entity and DEPARTURE\_TIME and ARRIVAL\_TIME relationships were combined, for it seemed unnecessary and added more relations for data that are linked, since each leg instance departing, it must arrive.
  + The Airplane\_ID was added to SEAT\_RESERVATION and LEG\_INSTANCE relations since it seemed necessary to connect such data together, for it would have not made sense without this addition.

The above rules of mapping of the STRONG and WEAK entities and the different relationships from the Entity-Relationship Diagram to a Relational Schema will give us the following different relations to make up our schema (Diagram is in the next page, it will also be attached as a PDF to the submission folder).



**Part C: SQL DDL statements to Create and Populate the Relations**

**C.1 — DDL Statements**

--DROPPING ALL TABLES IF NECESSARY

DROP TABLE AIRPORT;

DROP TABLE AIRPLANE;

DROP TABLE AIRPLANE\_TYPE;

DROP TABLE CAN\_LAND;

DROP TABLE FLIGHT;

DROP TABLE FLIGHT\_LEG;

DROP TABLE FARE;

DROP TABLE LEG\_INSTANCE;

DROP TABLE SEAT\_RESERVATION;

--1. Create the AIRPORT relation

CREATE TABLE Airport(

Airport\_Code CHAR(3) PRIMARY KEY,

Airport\_City VARCHAR2(30) NOT NULL,

Airport\_State VARCHAR2(30) NOT NULL,

Airport\_Name VARCHAR2(50) NOT NULL

);

--2. Create the AIRPLANE\_TYPE relation

CREATE TABLE AIRPLANE\_TYPE(

Type\_Name VARCHAR2(30) PRIMARY KEY,

Company VARCHAR2(30) NOT NULL,

Max\_Seats INT NOT NULL,

CONSTRAINT CHECK\_\_MAX\_SEATS\_\_AT CHECK (Max\_Seats > 0 AND Max\_Seats < 854),

CONSTRAINT CHECK\_\_Type\_Name\_\_AT CHECK (Type\_Name like 'Boeing 737'

OR Type\_Name like 'Boeing 747'

OR Type\_Name like 'Boeing 777'

OR Type\_Name like 'Boeing 787 Dreamliner'

OR Type\_Name like 'Airbus A320'

OR Type\_Name like 'Airbus A380'

OR Type\_Name like 'Embraer E175'

OR Type\_Name like 'Embraer E190'

OR Type\_Name like 'Bombardier CRJ900'

OR Type\_Name like 'Cessna 172'

OR Type\_Name like 'Gulfstream G650'

OR Type\_Name like 'Bombardier CRJ700'

OR Type\_Name like 'McDonnell Douglas MD-80'

OR Type\_Name like 'Beechcraft King Air'

OR Type\_Name like 'Lockheed C-130 Hercules')

);

--3. Create the CAN\_LAND relation for the many-to-many relationship

CREATE TABLE CAN\_LAND(

Airport\_Code CHAR(3),

Type\_Name VARCHAR2(30),

PRIMARY KEY (Airport\_Code, type\_name),

FOREIGN KEY (Airport\_Code) REFERENCES AIRPORT(Airport\_Code),

FOREIGN KEY (Type\_Name) REFERENCES AIRPLANE\_TYPE(Type\_Name)

);

--4. Create the FLIGHT relation

CREATE TABLE FLIGHT(

Flight\_Number VARCHAR2(6) NOT NULL,

Airline VARCHAR2(20) NOT NULL,

Weekdays VARCHAR2(21) NOT NULL,

PRIMARY KEY (Flight\_Number)

);

--5. Create the FARE relation

CREATE TABLE FARE(

Flight\_Number VARCHAR2(6) NOT NULL,

Fare\_Code VARCHAR2(10) NOT NULL,

Amount NUMBER(8, 2) NOT NULL,

Restrictions VARCHAR(50),

PRIMARY KEY (Flight\_Number, Fare\_Code),

CONSTRAINT FK\_\_FLIGHT\_NUMBER\_\_F FOREIGN KEY (Flight\_Number) REFERENCES FLIGHT(Flight\_Number)

);

--6. Create the AIRPLANE relation

CREATE TABLE AIRPLANE(

Airplane\_ID VARCHAR2(7) NOT NULL,

Total\_Number\_of\_Seats NUMBER(3) NOT NULL,

Type\_Name VARCHAR2(23) NOT NULL,

CONSTRAINT PK\_\_AIRPLANE\_\_A PRIMARY KEY (Airplane\_ID),

CONSTRAINT FK\_\_Type\_Name\_\_A FOREIGN KEY (Type\_Name) REFERENCES AIRPLANE\_TYPE(Type\_Name),

CONSTRAINT CHK\_\_TOTAL\_NO\_OF\_SEATS\_\_A CHECK (Total\_Number\_of\_SEATS > 0 AND Total\_Number\_of\_SEATS < 854)

);

--7. Create the FLIGHT\_LEG relation

CREATE TABLE FLIGHT\_LEG (

Flight\_Number VARCHAR2(6) NOT NULL,

Leg\_Number NUMBER(1) NOT NULL,

Departure\_AirportCode CHAR(3) NOT NULL,

Scheduled\_Departure\_Time VARCHAR2(4) NOT NULL,

Arrival\_AirportCode CHAR(3) NOT NULL,

Scheduled\_Arival\_Time VARCHAR2(4) NOT NULL,

PRIMARY KEY (Flight\_Number, Leg\_Number),

CONSTRAINT FK\_\_FLIGHT\_NUMBER\_\_FL FOREIGN KEY (Flight\_Number) REFERENCES FLIGHT(Flight\_Number),

CONSTRAINT FK\_\_AIRPORT\_CODE\_\_FL FOREIGN KEY (Departure\_AirportCode) REFERENCES Airport(Airport\_Code),

CONSTRAINT FK\_\_AIRPORT2\_CODE\_\_FL FOREIGN KEY (Arrival\_AirportCode) REFERENCES Airport(Airport\_Code)

);

--8. Create the LEG INSTANCE relation

CREATE TABLE LEG\_INSTANCE(

Flight\_Number VARCHAR2(6) NOT NULL,

Leg\_Number NUMBER(1) NOT NULL,

Leg\_Instance\_Date DATE NOT NULL,

Airplane\_ID VARCHAR2(8) NOT NULL,

Number\_of\_Avialable\_Seats NUMBER(3) NOT NULL,

Departure\_AirportCode VARCHAR2(3) NOT NULL,

Departure\_Time VARCHAR2(4) NOT NULL,

Arrival\_AirportCode VARCHAR2(3) NOT NULL,

Arrival\_Time VARCHAR2(4) NOT NULL,

CONSTRAINT PK\_\_LEG\_INSTANCE\_\_LI PRIMARY KEY (Flight\_Number, Leg\_Number, Leg\_Instance\_Date),

CONSTRAINT FK\_\_FLIGHT\_LEG\_NUMBER\_\_LI FOREIGN KEY (Flight\_Number, Leg\_Number) REFERENCES FLIGHT\_LEG(Flight\_Number, Leg\_Number),

CONSTRAINT FK\_\_AIRPLANE\_ID\_\_LI FOREIGN KEY (Airplane\_ID) REFERENCES Airplane(Airplane\_ID),

CONSTRAINT CHK\_\_NO\_OF\_AVAILABLE\_SEATS\_\_LI CHECK (Number\_of\_Avialable\_Seats > 0 AND Number\_of\_Avialable\_Seats < 854)

);

--9. Create the SEAT RESERVATION relation

CREATE TABLE SEAT\_RESERVATION(

Flight\_Number VARCHAR2(6) NOT NULL,

Leg\_Number NUMBER(1) NOT NULL,

Leg\_Instance\_Date DATE NOT NULL,

Seat\_Number VARCHAR(4) NOT NULL,

Customer\_Name VARCHAR2(35) NOT NULL,

Customer\_Phone VARCHAR2(15) NOT NULL,

AIRPLANE\_ID VARCHAR2(10) NOT NULL,

CONSTRAINT PK\_\_SEAT\_RESERVATION\_\_SR PRIMARY KEY (Flight\_Number, Leg\_Number, Leg\_Instance\_Date, Seat\_Number),

CONSTRAINT FK\_\_SEAT\_RESERVATION\_\_SR FOREIGN KEY (Flight\_Number, Leg\_Number, Leg\_Instance\_Date) REFERENCES LEG\_INSTANCE(Flight\_Number, Leg\_Number, Leg\_Instance\_Date),

CONSTRAINT FK\_\_AIRPLANE\_ID\_\_SR FOREIGN KEY (Airplane\_ID) REFERENCES Airplane(Airplane\_ID)

);

**C.2 — Populating Table**

--1. Populating the AIRPORT relation

INSERT INTO AIRPORT(Airport\_Code, Airport\_City, Airport\_State, Airport\_Name)

VALUES ('JFK', 'New York', 'NY', 'John F. Kennedy International Airport');

INSERT INTO AIRPORT(Airport\_Code, Airport\_City, Airport\_State, Airport\_Name)

VALUES ('LAX', 'Los Angeles', 'CA', 'Los Angeles International Airport');

INSERT INTO AIRPORT(Airport\_Code, Airport\_City, Airport\_State, Airport\_Name)

VALUES ('ORD', 'Chicago', 'IL', 'Los Angeles International Airport');

INSERT INTO AIRPORT(Airport\_Code, Airport\_City, Airport\_State, Airport\_Name)

VALUES ('DFW', 'Dallas', 'TX', 'Dallas/Fort Worth International Airport');

INSERT INTO AIRPORT(Airport\_Code, Airport\_City, Airport\_State, Airport\_Name)

VALUES ('ATL', 'Atlanta', 'GA', 'Hartsfield-Jackson Atlanta International Airport');

INSERT INTO AIRPORT(Airport\_Code, Airport\_City, Airport\_State, Airport\_Name)

VALUES('DOH', 'DOHA', 'DOHA', 'HAMAD INTERNATIONAL AIRPORT');

--2. Populating the AIRPLANE\_TYPE relation

INSERT INTO AIRPLANE\_TYPE(Type\_Name, Company, Max\_Seats)

VALUES ('Boeing 737', 'Boeing', 215);

INSERT INTO AIRPLANE\_TYPE(Type\_Name, Company, Max\_Seats)

VALUES ('Airbus A320', 'Airbus', 220);

INSERT INTO AIRPLANE\_TYPE(Type\_Name, Company, Max\_Seats)

VALUES ('Embraer E175', 'Embraer', 88);

INSERT INTO AIRPLANE\_TYPE(Type\_Name, Company, Max\_Seats)

VALUES ('Bombardier CRJ900', 'Bombardier', 76);

INSERT INTO AIRPLANE\_TYPE(Type\_Name, Company, Max\_Seats)

VALUES ('Bombardier CRJ700', 'Boeing', 550);

--3. Populating the CAN\_LAND relation

INSERT INTO CAN\_LAND(Airport\_Code, Type\_Name)

VALUES ('JFK', 'Boeing 737');

INSERT INTO CAN\_LAND(Airport\_Code, Type\_Name)

VALUES ('LAX', 'Airbus A320');

INSERT INTO CAN\_LAND(Airport\_Code, Type\_Name)

VALUES ('ORD', 'Embraer E175');

INSERT INTO CAN\_LAND(Airport\_Code, Type\_Name)

VALUES ('DFW', 'Bombardier CRJ900');

INSERT INTO CAN\_LAND(Airport\_Code, Type\_Name)

VALUES ('ATL', 'Bombardier CRJ700');

--4. Populating the FLIGHT relation

INSERT INTO FLIGHT (Flight\_Number, Airline, Weekdays )

VALUES('QA1306', 'QATAR AIRWAYS', 'SUN FRI' );

INSERT INTO FLIGHT (Flight\_Number, Airline, Weekdays )

VALUES('QA1505', 'QATAR AIRWAYS', 'TUE THU' );

INSERT INTO FLIGHT (Flight\_Number, Airline, Weekdays )

VALUES('DL1207', 'Delta Air Lines', 'SAT MON' );

INSERT INTO FLIGHT (Flight\_Number, Airline, Weekdays )

VALUES('AA1109', 'American Airlines', 'SUN WED' );

INSERT INTO FLIGHT (Flight\_Number, Airline, Weekdays )

VALUES('AS1104', 'Alaska Airlines', 'WED SAT' );

INSERT INTO FLIGHT (Flight\_Number, Airline, Weekdays )

VALUES('LAA1302', 'LOS ANGLES AIRWAYS', 'THR SAT' );

--5. Populating the FLIGHT\_LEG relation

INSERT INTO FLIGHT\_LEG (Flight\_Number, Leg\_Number,

Departure\_AirportCode, Scheduled\_Departure\_Time,Arrival\_AirportCode,

Scheduled\_Arival\_Time)

VALUES('QA1306', 1,'DOH', '1100', 'ORD','1320' );

INSERT INTO FLIGHT\_LEG (Flight\_Number, Leg\_Number,

Departure\_AirportCode, Scheduled\_Departure\_Time,Arrival\_AirportCode,

Scheduled\_Arival\_Time)

VALUES('QA1505', 1,'DOH', '1205', 'JFK','1425' );

INSERT INTO FLIGHT\_LEG (Flight\_Number, Leg\_Number,

Departure\_AirportCode, Scheduled\_Departure\_Time,Arrival\_AirportCode,

Scheduled\_Arival\_Time)

VALUES('LAA1302', 1,'LAX', '1030', 'DFW','1450' );

INSERT INTO FLIGHT\_LEG (Flight\_Number, Leg\_Number,

Departure\_AirportCode, Scheduled\_Departure\_Time,Arrival\_AirportCode,

Scheduled\_Arival\_Time)

VALUES('AA1109', 1,'JFK', '1515', 'ATL','1720' );

INSERT INTO FLIGHT\_LEG (Flight\_Number, Leg\_Number,

Departure\_AirportCode, Scheduled\_Departure\_Time,Arrival\_AirportCode,

Scheduled\_Arival\_Time)

VALUES('DL1207', 1,'DFW', '1905', 'ATL','2215' );

--6. Populating the Fare table

INSERT INTO FARE(Flight\_Number, Fare\_Code, Amount, Restrictions )

VALUES('QA1306', '10001', 5000, 'NO REFUND IF CANCELLED');

INSERT INTO FARE(Flight\_Number, Fare\_Code, Amount, Restrictions )

VALUES('QA1505', '10002', 6000, 'NO REFUND IF CANCELLED');

INSERT INTO FARE(Flight\_Number, Fare\_Code, Amount, Restrictions )

VALUES('LAA1302', '10003', 7000, 'NO REFUND IF CANCELLED');

INSERT INTO FARE(Flight\_Number, Fare\_Code, Amount, Restrictions )

VALUES('AA1109', '10004', 8000, 'NO REFUND IF CANCELLED');

INSERT INTO FARE(Flight\_Number, Fare\_Code, Amount, Restrictions )

VALUES('DL1207', '10005', 9000, 'NO REFUND IF CANCELLED');

--7. Populating the AIRPLANE relation

INSERT INTO AIRPLANE(Airplane\_ID, Total\_Number\_of\_Seats, Type\_Name)

VALUES ('JFK-101', 215, 'Boeing 737');

INSERT INTO AIRPLANE(Airplane\_ID, Total\_Number\_of\_Seats, Type\_Name)

VALUES ('JFK-102', 215, 'Boeing 737');

INSERT INTO AIRPLANE(Airplane\_ID, Total\_Number\_of\_Seats, Type\_Name)

VALUES ('LAX-101', 220, 'Airbus A320');

INSERT INTO AIRPLANE(Airplane\_ID, Total\_Number\_of\_Seats, Type\_Name)

VALUES ('ORD-101', 88, 'Embraer E175');

INSERT INTO AIRPLANE(Airplane\_ID, Total\_Number\_of\_Seats, Type\_Name)

VALUES ('DFW-101', 76, 'Bombardier CRJ900');

INSERT INTO AIRPLANE(Airplane\_ID, Total\_Number\_of\_Seats, Type\_Name)

VALUES ('ATL-101', 550, 'Bombardier CRJ700');

--8. Populating the LEG INSTANCE relation

INSERT INTO LEG\_INSTANCE(Flight\_Number, Leg\_Number, Leg\_Instance\_Date, Airplane\_ID,

Number\_of\_Avialable\_Seats, Departure\_AirportCode,

Arrival\_AirportCode, Departure\_Time, Arrival\_Time)

VALUES('DL1207', 1, '10-JAN-2023', 'JFK-101', 25, 'DFW', 'ATL', '1910','2230');

INSERT INTO LEG\_INSTANCE(Flight\_Number, Leg\_Number, Leg\_Instance\_Date, Airplane\_ID,

Number\_of\_Avialable\_Seats, Departure\_AirportCode,

Arrival\_AirportCode, Departure\_Time, Arrival\_Time)

VALUES('QA1505', 1, '10-JAN-2023', 'JFK-101', 26, 'DOH', 'JFK', '1210', '1445');

INSERT INTO LEG\_INSTANCE(Flight\_Number, Leg\_Number, Leg\_Instance\_Date, Airplane\_ID,

Number\_of\_Avialable\_Seats, Departure\_AirportCode,

Arrival\_AirportCode, Departure\_Time, Arrival\_Time)

VALUES('AA1109', 1, '10-JAN-2023', 'JFK-101', 26, 'JFK', 'ATL', '1515', '1720');

INSERT INTO LEG\_INSTANCE(Flight\_Number, Leg\_Number, Leg\_Instance\_Date, Airplane\_ID,

Number\_of\_Avialable\_Seats, Departure\_AirportCode,

Arrival\_AirportCode, Departure\_Time, Arrival\_Time)

VALUES('QA1306', 1, '10-JAN-2023', 'JFK-101', 26, 'DOH', 'ORD', '1100', '1320');

INSERT INTO LEG\_INSTANCE(Flight\_Number, Leg\_Number, Leg\_Instance\_Date, Airplane\_ID,

Number\_of\_Avialable\_Seats, Departure\_AirportCode,

Arrival\_AirportCode, Departure\_Time, Arrival\_Time)

VALUES('LAA1302', 1, '10-JAN-2023', 'JFK-101', 26, 'LAX', 'DFW', '1100', '1320');

--9. Populating the SEAT RESERVATION relation

INSERT INTO SEAT\_RESERVATION(Flight\_Number, Leg\_Number, Leg\_Instance\_Date,

Seat\_Number, Customer\_Name, Customer\_Phone, AIRPLANE\_ID)

VALUES('LAA1302', 1,'10-JAN-2023', 'J26', 'NORA JANE','66288188','JFK-101');

INSERT INTO SEAT\_RESERVATION(Flight\_Number, Leg\_Number, Leg\_Instance\_Date,

Seat\_Number, Customer\_Name, Customer\_Phone, AIRPLANE\_ID)

VALUES('LAA1302', 1,'10-JAN-2023', 'A25', 'FATMA ALAA','66218188','JFK-101');

INSERT INTO SEAT\_RESERVATION(Flight\_Number, Leg\_Number, Leg\_Instance\_Date,

Seat\_Number, Customer\_Name, Customer\_Phone, AIRPLANE\_ID)

VALUES('LAA1302', 1,'10-JAN-2023', 'B25', 'SARA BAHER','66218128','JFK-101');

INSERT INTO SEAT\_RESERVATION(Flight\_Number, Leg\_Number, Leg\_Instance\_Date,

Seat\_Number, Customer\_Name, Customer\_Phone, AIRPLANE\_ID)

VALUES('LAA1302', 1,'10-JAN-2023', 'C25', 'FARAH BAHEER','65218128','JFK-101');

INSERT INTO SEAT\_RESERVATION(Flight\_Number, Leg\_Number, Leg\_Instance\_Date,

Seat\_Number, Customer\_Name, Customer\_Phone, AIRPLANE\_ID)

VALUES('LAA1302', 1,'10-JAN-2023', 'D25', 'MARAH BAHOR','66248128','JFK-101');

**Part D: Screenshots of the Populating**

The screenshots are provided with the submission.

1. A Legend is going to be provided explaing the usage and meaning of each sybmol used by our Relational Schema designing tool. [↑](#footnote-ref-1275)