# AIRPORT MANAGEMENT SYSTEM

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# 1.Introduction

One of the major sectors affected by the current situation because of the COVID-19 pandemic is the airport and airline sector. The flight schedules keep changing and people have no option but to cancel plans unless unavoidable. Hence, it has become all the more important for airports and airlines both to streamline their operations.

The proposed system will give the authorities a holistic view of employees of the airport, passengers travelling through the airport and the incoming and outgoing flights.
The system is aimed to help aiports in the management of the various airport operations such as the different airlines, their flights, arrivals, departures and passengers.

It provides broad overview of underlying operational factors that influence the airport management. This will help keep a track of the ongoings at the airport.
The database is used to store the data of different airports located world wide.
Currently, because a lot of flights getting cancelled or delayed, and passengers are also cancelling their tickets, I have also included the features like flight status and ticket cancellation.

# 2.Requirements

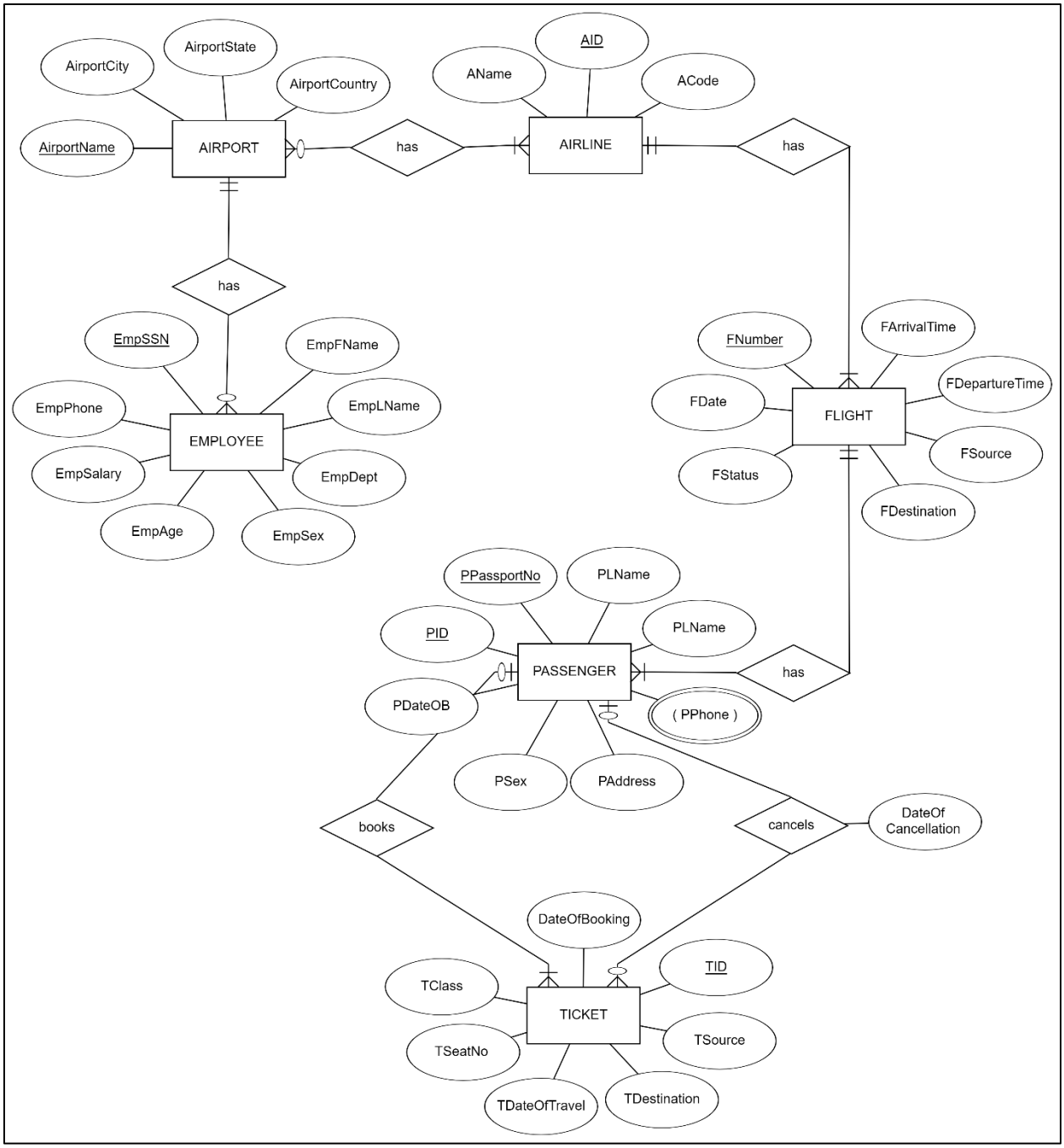
- Airports are located all over the world in particular cities of different countries and can be identified not only by their names but also by their unique 3-digit IATA code
- Every airport has employees working for it who are identified by their SSNs and work in different departments like Administrative support, technology and plaaning
- Every employee's information such as the first and last name, address, phone, age, sex, salary are stored
- There are hundreds of airlines operating, with both international as well as domestic flights
- Most of the airlines operate through various countries across the world and have their offices located in all major cities and airports. Hence, an airport may have many airline offices
- Every airline is identified uniquely by a 1-3 digit airline identifier
- Airlines also have a two-letter string which is also printed on their air ticket and is known as the Airline IATA Code
- Every airline has multiple flights which are uniquely identified with a unique flight number which is a combination of an airline IATA code and four-digit number
- Flights have an arrival time, departure time, date, source, destination and status (on-time, delayed or cancelled)
- They usually have three types of classes: business, economy and first class
- Flights carry passengers them from the source to destination
- A passenger is uniquely identified by a passenger id and a passport number
- The details of every passenger such as name, address, date of birth, sex, and phone are stored
- Every passenger needs to book a ticket to travel by a flight.

- A ticket or air ticket is used to confirm that an individual has reserved a seat on a flight and to verify his/her identity.
- With the ticket, a passenger is allowed to board the flight
- An air ticket has information such as the passenger's name, the issuing airline, ticket number, source, destination, journey date, seat no and class
- The date on which the ticket was booked is also stored
- The passenger can also cancel his/her ticket
- The day on which he cancels an air ticket is the cancellation date and there will be a cancellation fee that the passenger has to pay for cancelling the ticket

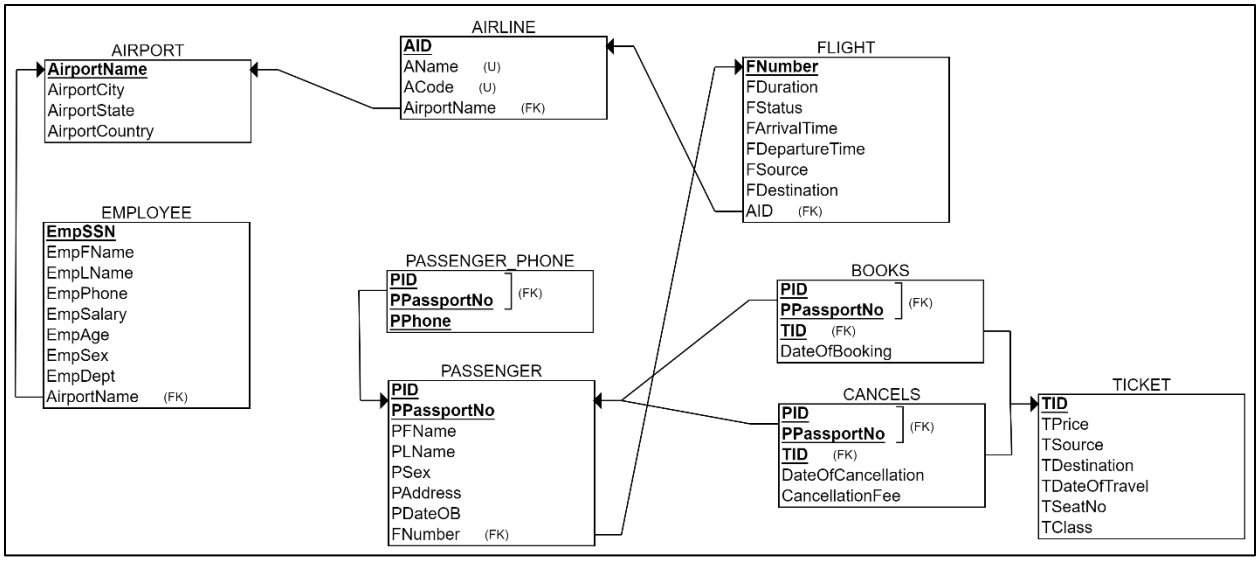
# 3.Software

The software that I have used for this project is MySQL- an open-source relational database management system. It is not only easy to use but also ideal for both small and large applications.

# 4.Entity Relationship Diagram



# 5. Relational Schema




# 6.Normalization

- The Passenger table violates 2NF because the passenger's first name, last name, address, phone number, date of birth and sex depend only on the passport number. The Flight number depends only on the passenger ID. Hence that can be modified into 2 tables:

  PASSENGER_ FLIGHT_INFO (PID, PPassportNo,FNumber)

  PASSENGER (PPassportNo, PFName, PLName, PSex, PAddress, PDateOB)
- The Airline table also violates 2NF as the airline information will be repeated multiple times along with the airport name. Hence, it can be divided into 2 tables:

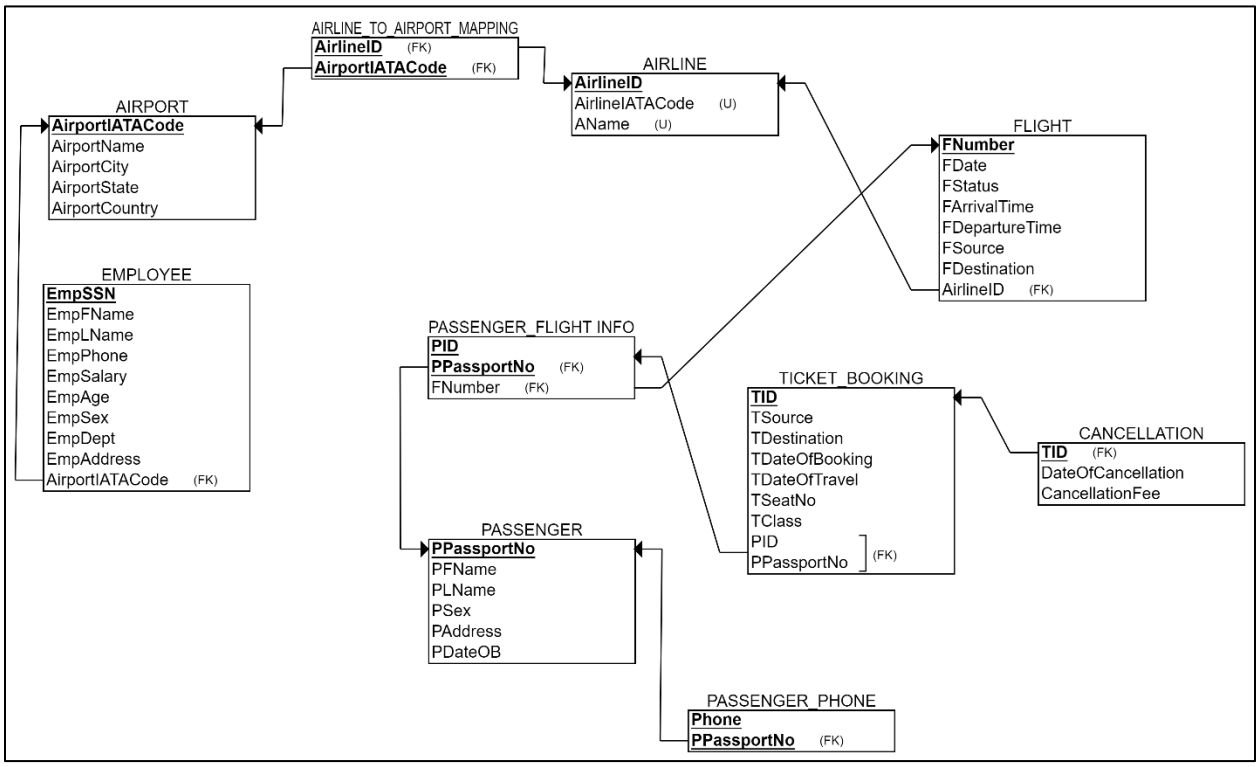
  AIRLINE (AID, AirlineIATACode, AName)

  AIRLINE_TO_AIRPORT_MAPPING (AirlineID, AirportIATACode)
- 3NF is violated in the ticket table when passenger books or cancels it. To resolve this, the following changes can be made:

TICKET_BOOKING (TID, TSource, TDestination, TDateOfBooking, TDateOfTravel, TSeatNo, TClass, PID, PPassportNo)

CANCELLATION (DateOfCancellation, CancellationFee)

# 7.Relational Schema after Normalization




After the requirement gathering, I thought about how to design the database. So first the AIRPORT table is created with the Airport name, its IATA code and location. Then there is an AIRLINE table to store all the airlines that operate worldwide with their IDs, names and IATA codes. Storing the airport code in the AIRLINE table violated the 2nf normalization rules. Hence, a new table AIRLINE_TO_AIRPORT_MAPPING is created to store a list of Airlines and the airports that they operate at. Another table called

EMPLOYEE stores all the data about the people who work at the airport with the Airport code as the foreign key.

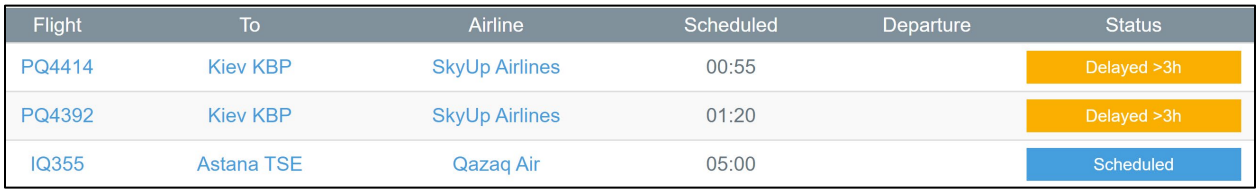
The table FLIGHT stores all the information about their arrival, departure, source, destination etc along with the airline ID that the flight operates for. Storing the passenger information along with their flight data in the same table creates redundancies. Hence, divided it into 2 tables i.e. PASSENGER_ FLIGHT_INFO and PASSENGER. While the PASSENGER table has a list of all the passengers and their personal information, the other table stores the passengers' flying information. The TICKET table is used to keep a track of flights and bookings of the passengers along with their Cancellation history if any stored in the Cancellation table.

# 8.Data

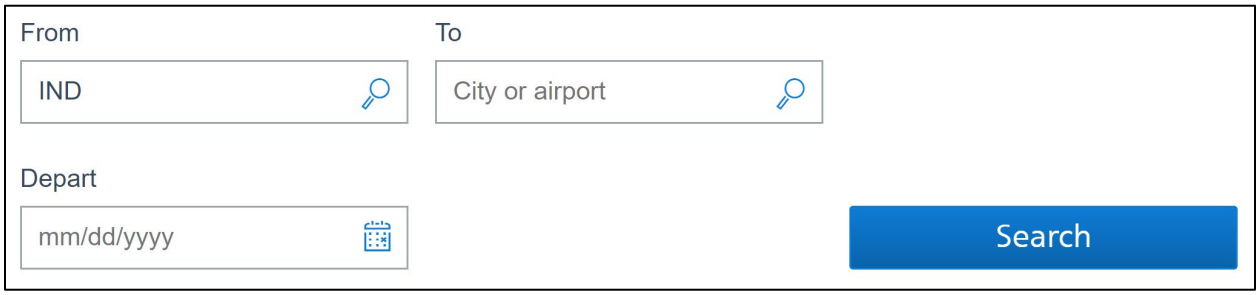
- The data for this project is mostly self populated
- I refered to various websites to accumulate the accurate data about the flights and airlines which are mentioned in the references section
- The employees and passenger history is self generated using excel formulas and a few online resources
- The data types that has been used:
    - INT to store the IDs of flights, passengers and so on.
    - BIGINT for the SSN and for the 13-digit flight ticket number as they were long and were exceeding the limit of INT
    - DATE for storing the date of birth and the flight dates
    - VARCHAR for everything else
- I also used CHECK constraints to get the correct input for the sex of passengers and employees- Sex VARCHAR (1) CHECK (Sex IN ('M','F'))

# 9.UI and Applications

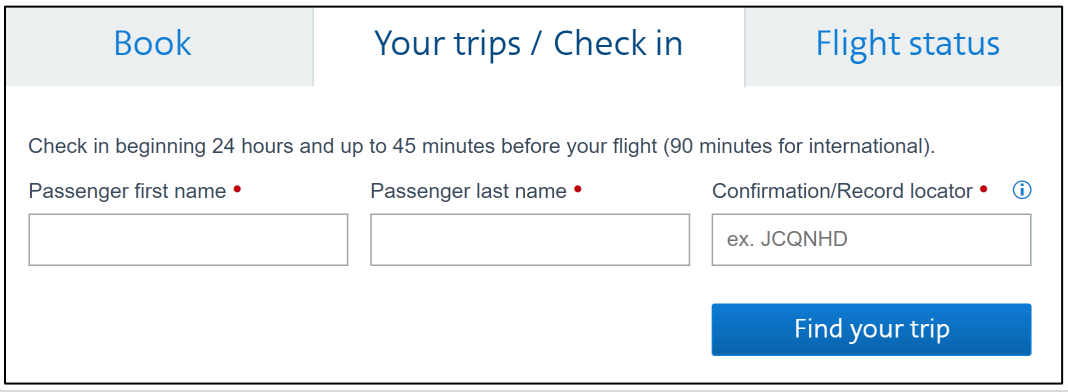
This system has multiple applications- Airport Information Store, Airline Database, Itinerary planner/ Tracking Portal, and a Ticket Booking Portal.



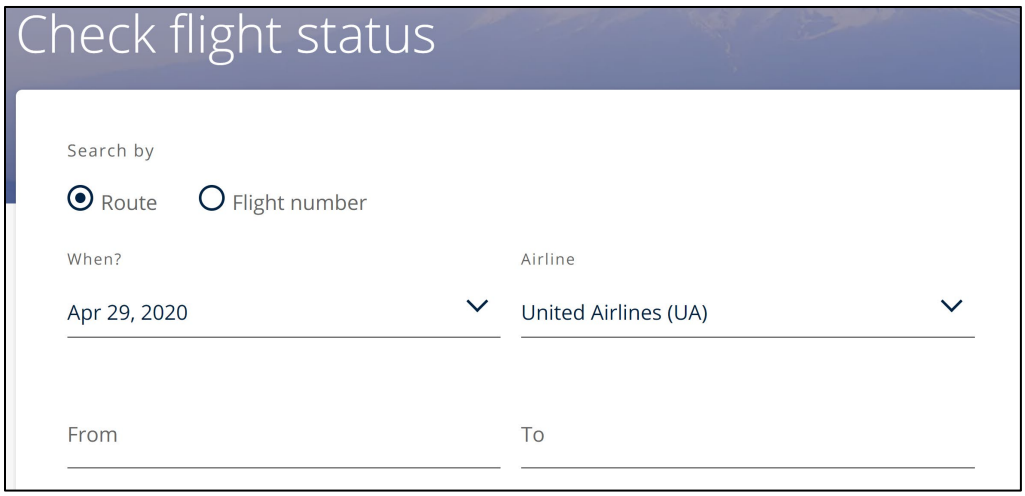

Firstly, it can be used by the airport authorities to keep track of its employees, the airlines that are being operated and the flights arriving and departing from the airport. It can also be used to track the passengers for a particular flight as well as the passengers who have cancelled.



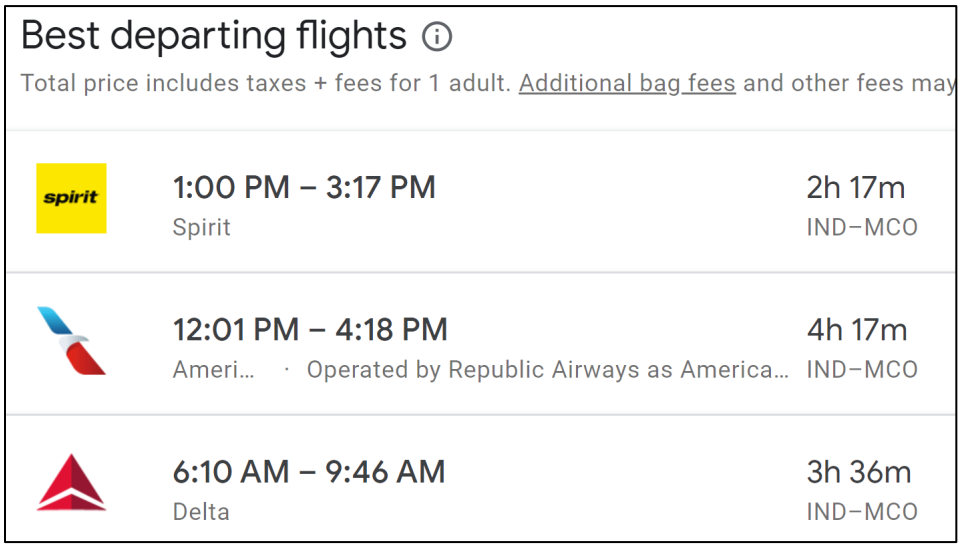

Secondly, it can be used by airlines. They can view the number of flights that are scheduled for the day and update their status as and when required. They can keep a tab of the number of passengers who will be flying on particular days and make arrangements accordingly. Filtering by the number of cancellations of passengers can also help in determining whether or not to cancel a particular flight.



Another application is that this system can also be highly useful to people who are planning to travel. It is very similar to all the airlines ticket booking webites where people can filter flights according to the source, destination and date of travel. They can also track the status of their flight after they have booked the tickets and can also set to be notified by email a few days before their flight.




This application can alos be used as a ticket booking portal by the passengers. They can filter the flights according to the source and destination as well as the date of the journey and the data can be stored in this system.



# 10. User actions and the SQL Queries

### Query 1: All airlines operating at JFK Airport:

A list of all the airlines operating from any airport.

```
SELECT a.AirlineID, a.AirportIATACode, airline.AirlineName
FROM airport_management.airline_to_airport_mapping AS a
INNER JOIN airline
ON  a.AirlineID=airline.AirlineID
WHERE AirportIATACode='JFK';
```

| AirlineID | AirportIATACode | AirlineName |
|---|---|---|
| 001 | JFK | American Airlines |
| 006 | JFK | DELTA AIR LINES, INC. |
| 020 | JFK | LUFTHANSA |
| 125 | JFK | BRITISH AIRWAYS |
| 157 | JFK | Qatar Airways |

### Query 2: All employees working at BOM Airport:

A list of all the employees working at an airport.

```
SELECT a.IATACode, b.SSN, b.FirstName, b.LastName
FROM airport_management.airport AS a
RIGHT JOIN employee AS b
ON a.IATACode=b.AirportIATACode
WHERE a.IATACode='BOM';
```

| IATACode | SSN | FirstName | LastName |
|---|---|---|---|
| BOM | 100-00-0030 | Cadman | Klein |
| BOM | 100-00-0050 | Oren | Reese |
| BOM | 100-00-0095 | Tyrone | Norris |
| BOM | 100-00-0105 | Cain | Coffey |
| BOM | 100-00-0125 | Richard | Ayala |

**Query 3: All employees working in the Technology department at Delhi Airport:**

Generating a list of employees who work in any department of an airports.

```
SELECT a.IATACode, b.SSN, b.FirstName, b.LastName
FROM airport_management.airport AS a
RIGHT JOIN employee AS b
ON a.IATACode=b.AirportIATACode
WHERE a.IATACode='DEL' AND b.Department='Technology';
```

| IATACode | SSN | FirstName | LastName |
|---|---|---|---|
| DEL | 100-00-0025 | Bruce | Donaldson |
| DEL | 100-00-0085 | Scott | Clarke |
| DEL | 300-00-0050 | Sara | Ferguson |

**Query 4: All American Airline flights which are on schedule:**

This will help passengers either when they are choosing airlines for booking flights in the future or they have already booked the flight and want to know its status by entering the flight number and date.

```
SELECT *
FROM airport_management.flight
WHERE AirlineID='001' AND Status='On-time';
```

| FlightNumber | AirlineID | Status | Source | Destination | ArrivalTime | DepartureTime | Date |
|---|---|---|---|---|---|---|---|
| AA3360 | 001 | On-time | CDG | BOM | 05:51 | 15:48 | 2020-10-05 |
| AA5326 | 001 | On-time | SFO | JFK | 09:31 | 15:03 | 2020-06-09 |
| AA7428 | 001 | On-time | BOM | DEL | 03:32 | 16:54 | 2020-08-13 |
| AA8202 | 001 | On-time | LHR | ORD | 01:33 | 17:07 | 2020-12-22 |

## Query 5: All flights from New York to Paris between July and December 2020:

A list of the flights from any source to any destination between a particular time period.

```
SELECT *
FROM airport_management.flight
WHERE Source='JFK' AND Destination='CDG'
AND Date BETWEEN '2020-07-10' AND '2020-12-17';
```

| FlightNumber | AirlineID | Status | Source | Destination | ArrivalTime | DepartureTime | Date |
|---|---|---|---|---|---|---|---|
| AA1 | 001 | Delayed | JFK | CDG | 09:05 | 18:45 | 2020-08-26 |
| AA3325 | 001 | Cancelled | JFK | CDG | 10:10 | 16:44 | 2020-11-25 |
| AA9266 | 001 | Delayed | JFK | CDG | 02:09 | 21:53 | 2020-08-09 |
| AI1049 | 098 | Cancelled | JFK | CDG | 03:03 | 20:26 | 2020-10-18 |
| AI2216 | 098 | Delayed | JFK | CDG | 05:26 | 20:00 | 2020-12-15 |

## Query 6: All passengers travelling by flight DL3669 on '2020-05-06':

A list of all passengers travelling by a particular flight on a particular date.

```
SELECT a.PID, a.PassportNo, b.FirstName, b.LastName
FROM airport_management.passenger_flight_info AS a
LEFT JOIN passenger as b
ON a.PassportNo=b.PassportNo
INNER JOIN flight AS c
ON a.FlightNumber=c.FlightNumber
WHERE a.FlightNumber='DL3669'
and c.Date='2020-05-06';
```

| PID | PassportNo | FirstName | LastName |
|---|---|---|---|
| 33 | MJ9239285 | Amelia | Giles |
| 72 | RM3522332 | Tucker | Nieves |
| 83 | EV2528933 | Felicia | Barlow |

## Query 7: Passengers who booked tickets in the year 2020:

Airlines have been giving refunds to passengers who booked flight tickets this year because of COVID-19 travel restrictions. This will help them in determining who is eligible for a refund.

```
SELECT *
FROM airport_management.ticket_booking
WHERE DateOfBooking BETWEEN '2020-01-01' AND '2020-04-29';
```

| TicketID | PassengerID | PassportNo | DateOfBooking | Source | Destination | DateOfTravel | SeatNo | Class |
|---|---|---|---|---|---|---|---|---|
| 1642773847629 | 5 | UZ1685752 | 2020-01-15 | SFO | JFK | 2020-06-09 | 51B | Economy |
| 1903444195471 | 8 | RS9391669 | 2020-04-22 | ORD | DFW | 2020-11-20 | 2F | Business |
| 1965548606550 | 9 | KU5070046 | 2020-01-07 | DFW | SFO | 2020-11-02 | 23H | Economy |
| 2778809175035 | 15 | JS4628933 | 2020-02-26 | BOM | DEL | 2020-12-21 | 30E | Economy |
| 3057633205811 | 18 | OX5420922 | 2020-04-26 | CDG | BOM | 2020-06-08 | 26I | Economy |

## Query 8: Passengers who had planned to travel in May or June and cancelled:

This will help airlines to determine the number of flights that should operate on schedule and the number of flights that need to be cancelled.

```
SELECT a.TicketID, b.PassportNo, a.DateOfCancellation, b.DateOfBooking
FROM airport_management.cancellation AS a
LEFT JOIN ticket_booking AS b
ON a.TicketID=b.TicketID
WHERE b.DateOfTravel BETWEEN '2020-05-01' AND '2020-07-01';
```

| TicketID | PassportNo | DateOfCancellation | DateOfBooking |
|---|---|---|---|
| 6020740800184 | KU5073332 | 2020-03-15 | 2019-08-15 |
| 6684629024629 | CL6244579 | 2020-03-01 | 2019-09-01 |
| 6730972733241 | QP1103996 | 2020-04-20 | 2020-04-08 |
| 6910878489354 | CW9876001 | 2020-04-20 | 2020-04-03 |
| 7701625607867 | ZG2572886 | 2020-04-13 | 2020-02-13 |

### Query 9: Passengers above 55 who will be travelling to United States:

This will help the airport authorities in determining out of all the passengers arriving at the airport, who are old and more prone to the Corona virus and hence need to be tested thoroughly.

```
SELECT a.PassportNo, a.FirstName, a.LastName, C.Destination,
TIMESTAMPDIFF( YEAR, DateOfBirth,  CURDATE()) AS Age
FROM airport_management.passenger AS a
LEFT JOIN passenger_flight_info AS b
ON a.PassportNo=b.PassportNo
INNER JOIN flight AS c
ON b.FlightNumber=c.FlightNumber
WHERE Destination='JFK'
OR Destination='SFO'
OR Destination='DFW'
HAVING Age>55;
```

| PassportNo | FirstName | LastName | Destination | Age |
|---|---|---|---|---|
| EU9904230 | Igor | Whitehead | SFO | 55 |
| UZ1685752 | Jana | Hester | JFK | 58 |
| QI5053797 | Karyn | Haynes | DFW | 59 |
| QJ9214178 | Gillian | William | SFO | 58 |

### Query 10: Status of a flight:

This will help passengers who have booked flight tickets view the status of their flight.

```
SELECT FlightNumber, AirlineID, Status, Source, Destination
FROM airport_management.flight
WHERE Date= '2020-05-17'
AND Source= 'DEL' AND Destination='LHR';
```

| FlightNumber | AirlineID | Status | Source | Destination |
|---|---|---|---|---|
| AI7822 | 098 | Delayed | DEL | LHR |

**Query 11: Flights which have already been cancelled:**

```
SELECT *
FROM airport_management.flight
WHERE Status='Cancelled';
```

| FlightNumber | AirlineID | Status | Source | Destination | ArrivalTime | DepartureTime | Date |
|---|---|---|---|---|---|---|---|
| AA2162 | 001 | Cancelled | BOM | DEL | 08:34 | 22:56 | 2020-07-28 |
| AA3325 | 001 | Cancelled | JFK | CDG | 10:10 | 16:44 | 2020-11-25 |
| AA4833 | 001 | Cancelled | DEL | JFK | 09:45 | 20:41 | 2020-08-07 |
| AA5328 | 001 | Cancelled | ORD | DFW | 02:54 | 22:40 | 2020-09-29 |
| AI1049 | 098 | Cancelled | JFK | CDG | 03:0 | 20:26 | 2020-10-18 |

02:54

# 11.References and Data Gathering Links


- https://en.wikipedia.org/wiki/List_of_international_airports_by_country
- https://emunix.emich.edu/~sverdlik/COSC472/RelationalModel_Normalization.html
- https://en.wikipedia.org/wiki/Lists_of_airlines
- https://www.kwe.co.jp/en/useful-contents/code1
- https://en.wikipedia.org/wiki/List_of_Cathay_Pacific_destinations
- https://en.wikipedia.org/wiki/List_of_Delta_Air_Lines_destinations
- https://www.ziprecruiter.com/g/10-Most-Popular-Types-of-Airport-Jobs
- https://en.wikipedia.org/wiki/List_of_American_Airlines_destinations