**Final Exam**

***Question 1***

Normalize to 3NF the following initial design. Your answer must include steps, reasoning.

AIRPORT(AirPortID, AirPortCode,(AirplaneID, Number\_of\_Seats, Arrival\_Date, Departure\_Date), LocationID, LocationName)

LOCATION(LocationID, Zone, LocationName)

AIRPLANE(AirplaneID, Number\_of\_Seats, Model)

Identify primary key, foreign key of each entity of the final design. Draw the Entity Relationship Diagram of the final design

The initial designs above, AIRPLANE and LOCATION, is in 1FN.

The initial design above, AIRPORT, is not in 1FN because there is a repeating group of columns which are AirplaneID, Number\_of\_Seats, Arrival\_Date and Departure\_Date.

1. 1st Normal Form

These following rules must be respected for the table to be in 1FN :

* Each column of the table must be single-valued.
* Each column should have a unique name.
* A column should contain the same type of values.
* The order of the data stored does not matter.

LOCATION

|  |  |  |
| --- | --- | --- |
| LocationID | Zone | LocationName |
| 2001 | A | QWE |
| 2002 | B | RTY |
| 2003 | C | UIO |

The primary key is LocationID because it is unique, not null and minimal.

AIRPLANE

|  |  |  |
| --- | --- | --- |
| AirplaneID | Number\_of\_Seats | Model |
| 201 | 20 | A1 |
| 202 | 30 | B1 |
| 203 | 40 | C1 |

The primary key is AirplaneID because it is unique, not null and minimal.

AIRPORT1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| AirPortID | AirPortCode | AirplaneID | Number\_of\_Seats | Arrival\_Date | Departure\_Date | LocationID | LocationName |
| 1 | ABC | 201 | 20 | 10/10 | 10/11 | 2001 | QWE |
| 2 | DEF | 202 | 30 | 11/11 | 11/12 | 2002 | RTY |
| 3 | GHI | 203 | 40 | 12/12 | 12/13 | 2003 | UIO |

The primary key is a composite key of AirPortID and AirplaneID because they are in a many-to-many relationship : an airport can be opted by more than one airplane, and an airplane can opt for more than one airport.

Now we have the following design in 1FN :

AIRPORT1(AirPortID, AirPortCode,AirplaneID, Number\_of\_Seats, Arrival\_Date, Departure\_Date, LocationID, LocationName)

LOCATION(LocationID, Zone, LocationName)

AIRPLANE(AirplaneID, Number\_of\_Seats, Model)

The design above, AIRPORT1, is not in 2FN because there are partial dependencies.

1. 2nd Normal Form

These following rules must be respected for the table to be in 2FN :

* The table should be in 1st Normal Form.
* The table should not have any partial dependencies.

By observing the table AIRPORT1, we notice four partial dependencies :

* The AirPortCode, LocationID and LocationName only depends on AirPortID and not necessarily on AirplaneID.
* The Number\_of\_Seats only depends AirplaneID and not necessarily on AirPortID.

We are to divide the table AIRPORT1 in 3 new tables to remove the partial dependencies :

* Airport2(AirPortID, AirPortCode, LocationID, LocationName)
* Airplane2(AirplaneID, Number\_of\_Seats)
* Details2(AirPortID ,AirplaneID,Arrival\_Date, Departure\_Date)

Details2

|  |  |  |  |
| --- | --- | --- | --- |
| AirPortID | AirplaneID | Arrival\_Date | Departure\_Date |
| 1 | 201 | 10/10 | 10/11 |
| 2 | 202 | 11/11 | 11/12 |
| 3 | 203 | 12/12 | 12/13 |

|  |  |
| --- | --- |
| AirplaneID | Number\_of\_Seats |
| 201 | 20 |
| 202 | 30 |
| 203 | 40 |

Airplane2

Airport2

|  |  |  |  |
| --- | --- | --- | --- |
| AirPortID | AirPortCode | LocationID | LocationName |
| 1 | ABC | 2001 | QWE |
| 2 | DEF | 2002 | RTY |
| 3 | GHI | 2003 | UIO |

PK in Airport2 = AirPortID

PK in Airplane2 = AirplaneID

PK in Details2 = AirPortID + AirplaneID (composite key)

FK1 in Details2 = AirPortID

FK2 in Details2 = AirplaneID

The following design is not in 3FN because there is a transitive dependency :

* AIRPORT2(AirPortID, AirPortCode, LocationID, LocationName)
* Airplane2(AirplaneID, Number\_of\_Seats)
* Details2(AirPortID ,AirplaneID,Arrival\_Date, Departure\_Date)

1. 3rd Normal Form

These following rules must be respected for the table to be in 3FN :

* The table should be in 2nd Normal Form.
* The table should not have any transitive dependencies.

By observing the table Airport2, we notice one transitive dependency :

* The LocationName only depends on LocationID and not necessarily on the primary key of AirPortID. LocationID is not part of the primary key in the table Airport2.

We are to divide the table Airport2 in two tables which results to this following design to remove the transitive dependency :

* AIRPORT3(AirPortID, AirPortCode, LocationID)
* LOCATION(LocationID, Zone, LocationName)
* AIRPLANE(AirplaneID, Number\_of\_Seats, Model)
* Details2(AirPortID ,AirplaneID, Arrival\_Date, Departure\_Date)

Note : Airplane3 (AirplaneID, Number\_of\_Seats) and Location3(LocationID, LocationName) have been replaced by AIRPLANE(AirplaneID, Number\_of\_Seats, Model) and LOCATION(LocationID, Zone, LocationName).

Details2

|  |  |  |  |
| --- | --- | --- | --- |
| AirPortID | AirplaneID | Arrival\_Date | Departure\_Date |
| 1 | 201 | 10/10 | 10/11 |
| 2 | 202 | 11/11 | 11/12 |
| 3 | 203 | 12/12 | 12/13 |

|  |  |  |
| --- | --- | --- |
| AirplaneID | Number\_of\_Seats | Model |
| 2ù01 | 20 | A1 |
| 202 | 30 | B1 |
| 203 | 40 | C1 |

AIRPLANE

Airport3

|  |  |  |
| --- | --- | --- |
| AirPortID | AirPortCode | LocationID |
| 1 | ABC | 2001 |
| 2 | DEF | 2002 |
| 3 | GHI | 2003 |

LOCATION

|  |  |  |
| --- | --- | --- |
| LocationID | Zone | LocationName |
| 2001 | A | QWE |
| 2002 | B | RTY |
| 2003 | C | UIO |

PK in Airport3 = AirPortID

FK in Airport3 = LocationID

PK in AIRPLANE = AirplaneID

PK in Details2 = AirPortID + AirplaneID (composite key)

FK1 in Details2 = AirPortID

FK2 in Details2 = AirplaneID

PK in LOCATION = LocationID