**Part-2: Normalization**

Q1: Identify the First Normal Form (1NF) violations in the provided tables. Explain how each table adheres to or violates 1NF.

* For 1NF, each column should contain only atomic values
* Each column in the table should have unique names
* The order in which the data is stored doesn’t matter
* The data in each row of a column should have same datatype

**Customer table:** In the customer table, all the data is in its atomicity form, columns are unique and each row in a column follows the same datatype of the entire column hence, customer table is in it’s INF.

**Order table:** In the order table all the data is in its atomicity form, columns are unique and each row in a column follows the same datatype of the entire column. In the ‘ShippingDate’ column the columns are allowed to have ‘NULL’ values, still it won’t change the data type of the entire column. Hence, order table is in it’s INF.

**OrderDetails table:** all the data is in its atomicity form, columns are unique and each row in a column follows the same datatype of the entire column hence, orderDetails table is in the INF

**Products table:** all the data is in its atomicity form, columns are unique and each row in a column follows the same datatype of the entire column hence, products table is in the INF

**Suppliers table:** all the data is in its atomicity form, columns are unique and each row in a column follows the same datatype of the entire column hence, suppliers table is in the INF

**ProductSuppliers table:** all the data is in its atomicity form, columns are unique and each row in a column follows the same datatype of the entire column hence, ProductSuppliers table is in the INF.

Q2: Determine the Second Normal Form (2NF) for each table. Explain any partial dependencies and provide solutions to achieve 2NF.

* A table to be in 2NF, the table should be in in 1NF
* There should not be any partial dependency. The partial dependency arises when the non-prime attribute depends on only one of the key in the composite key of the table.

**Customer table:** The customer table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘CustomerID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the customer table is in 2NF form.

**Order table:** The order table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘OrderID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the order table is in 2NF form.

**OrderDetails table:** The orderDetails table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘OrderDeatilsID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the orderDetails table is in 2NF form

**Products table:** The products table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘ProductID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the products table is in 2NF form

**Suppliers table:** The suppliers table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘SupplierID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the suppliers table is in 2NF form

**ProductSuppliers table:** The productSuppliers table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘productSupplierID and all the non prime attributes are depend on it. There is no partial dependency. Hence, the product supplier table is in 2NF form.

Q3: Identify and resolve any transitive dependencies to achieve Third Normal Form (3NF). Explain how each table complies with 3NF.

* The table should be in it’s 2NF
* There should not be any Transitive Dependencies. In a table transitive dependency occurs when the non prime attribute depends upon another non prime attribute. If A 🡪 B and B 🡪 C, then C is transitively dependent on A

**Customer table:** The customer table is in it’s 2NF. There is one primary key which is the ‘CustomerID’ and all the non prime attributes are depend on it. There is no transitive dependency. Hence, the customer table is in 3NF form.

**Order table:** The order table is in it’s 2NF. There is one primary key which is the ‘OrderID’ and all the non prime attributes are depend on it mostly. There is no partial dependency. Hence, the order table is in 2NF form.

**OrderDetails table:** The orderDetails table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘OrderDeatilsID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the orderDetails table is in 2NF form

**Products table:** The products table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘ProductID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the products table is in 2NF form

**Suppliers table:** The suppliers table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘SupplierID’ and all the non prime attributes are depend on it. There is no partial dependency. Hence, the suppliers table is in 2NF form

**ProductSuppliers table:** The productSuppliers table is in it’s 1NF and there is no composite key in this table. There is one primary key which is the ‘productSupplierID and all the non prime attributes are depend on it. There is no partial dependency. Hence, the product supplier table is in 2NF form.

Q4: Analyze the provided tables for Boyce-Codd Normal Form (BCNF) compliance. Discuss any violations and provide the necessary normalization steps.

Q5: For the table with the most complex dependencies, decompose it into 4NF if necessary. Explain the decomposition process and how it resolves multi-valued dependencies.

Q6: Discuss any denormalization considerations you would make for practical scenarios where performance optimization is crucial. Explain the trade-offs involved.