

### Example 1: Unnormalized Table (Violates 1NF)

CustomerID	Name	OrderID	ProductID	ProductName	Quantity
101	John Smith	O1, O2	P1, P2	Laptop, Mouse	2, 1

**1NF Violation:** The OrderID and ProductID columns contain multiple values in a single cell, violating the atomicity requirement of 1NF.

**1NF Normalization Reason:** To ensure each column contains only atomic values, eliminating repeating groups and simplifying data manipulation.

### 1NF Normalized Table:

CustomerID	Name	OrderID	ProductID	ProductName	Quantity
101	John Smith	O1	P1	Laptop	2
101	John Smith	O2	P2	Mouse	1

### Example 2: 1NF Table (Violates 2NF)

OrderID	ProductID	CustomerID	CustomerName	OrderDate	ProductName	Quantity	Price

O1	P1	101	John Smith	2023-0 1-15	Laptop	2	100 0
O1	P2	101	John Smith	2023-0 1-15	Mouse	1	20
O2	P3	102	Jane Doe	2023-0 2-20	Keyboard	1	75

**2NF Violation:**

- Primary Key: {OrderID, ProductID}
- CustomerName is dependent on CustomerID, which is only part of the primary key.
- OrderDate is dependent on OrderID, which is only part of the primary key.
- ProductName and Price are dependent on ProductID, which is only part of the primary key.

**2NF Normalization Reason:** To remove partial dependencies, ensuring that non-key attributes depend on the entire primary key, not just a part of it. This reduces redundancy (e.g., CustomerName repeating for the same customer) and avoids update anomalies.

## 2NF Normalized Tables:

OrderID	CustomerID	OrderDate
O1	101	2023-01-15
O2	102	2023-02-20

CustomerID	CustomerName
101	John Smith
102	Jane Doe

OrderID	ProductID	Quantity
O1	P1	2
O1	P2	1
O2	P3	1

ProductID	ProductName	Price
P1	Laptop	1000
P2	Mouse	20
P3	Keyboard	75

**Example 3: 2NF Table (Violates 3NF)**

EmployeeID	Name	DepartmentID	DepartmentName	Location
1	John Smith	10	Sales	New York
2	Jane Doe	20	Marketing	Los Angeles
3	Bob Johnson	10	Sales	New York

**3NF Violation:**

- Primary Key: EmployeeID
- DepartmentName and Location are dependent on DepartmentID, which is not a primary key. This is a transitive dependency: EmployeeID → DepartmentID → DepartmentName, Location

**3NF Normalization Reason:** To eliminate transitive dependencies, ensuring that non-key attributes depend only on the primary key and not on other non-key attributes. This prevents update anomalies (e.g., if the Sales department moves to Chicago, we only need to update one row) and deletion anomalies.

### **3NF Normalized Tables:**

<b>EmployeeID</b>	<b>Name</b>	<b>DepartmentID</b>
1	John Smith	10
2	Jane Doe	20
3	Bob Johnson	10

<b>DepartmentID</b>	<b>DepartmentName</b>	<b>Location</b>
10	Sales	New York
20	Marketing	Los Angeles