

# Python Course

## Tutorial 6 - Database and SQL Introduction

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Exercise

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# Exercise

Consider the following unnormalized table:

| OrderID | CustomerID | CustomerAddress | Item     | Quantity |
|---------|------------|-----------------|----------|----------|
| 1       | 1001       | 123 Main St     | Widget A | 2        |
|         |            |                 | Widget B | 1        |
| 2       | 1002       | 456 Elm St      | Widget C | 5        |
| 3       | 1001       | 123 Main St     | Widget A | 3        |
|         |            |                 | Widget D | 2        |

- 1 Convert the unnormalized table into First Normal Form (1NF).
- 2 Identify the functional dependencies and the primary key in your 1NF table.
- 3 Normalize the 1NF table into Second Normal Form (2NF).
- 4 Normalize the 2NF table into Third Normal Form (3NF).

Exercise

Solution

# Solution

**Definition (1NF):**

A table is in 1NF if it contains *no repeating groups* and all values are *atomic*.

In the given table, the repeating group arises because one **OrderID** contains multiple items on separate lines. We therefore create one row per item.

| OrderID | CustomerID | CustomerAddress | Item     | Quantity |
|---------|------------|-----------------|----------|----------|
| 1       | 1001       | 123 Main St     | Widget A | 2        |
| 1       | 1001       | 123 Main St     | Widget B | 1        |
| 2       | 1002       | 456 Elm St      | Widget C | 5        |
| 3       | 1001       | 123 Main St     | Widget A | 3        |
| 3       | 1001       | 123 Main St     | Widget D | 2        |

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**Key idea:** Functional dependencies describe which attributes determine others.

**Identifiable FDs from the 1NF table:**

- **OrderID** → CustomerID, CustomerAddress (each order is placed by exactly one customer)
- **CustomerID** → CustomerAddress (customer information is independent of the order)
- **{OrderID, Item}** → Quantity (the amount refers to a specific item in a specific order)

**Primary Key:** **{OrderID, Item}**

This composite key uniquely identifies each record.

**Definition (2NF):**

A table is in 2NF if it is in 1NF and contains *no partial dependencies*.

In our 1NF table, CustomerID and CustomerAddress depend only on **OrderID**, not on the full primary key {OrderID, Item}. → Violates 2NF.

Therefore, we decompose into:

**Order Table:**

| OrderID | CustomerID | CustomerAddress |
|---------|------------|-----------------|
| 1       | 1001       | 123 Main St     |
| 2       | 1002       | 456 Elm St      |
| 3       | 1001       | 123 Main St     |

**OrderItem Table:**

| OrderID | Item     | Quantity |
|---------|----------|----------|
| 1       | Widget A | 2        |
| 1       | Widget B | 1        |
| 2       | Widget C | 5        |
| 3       | Widget A | 3        |
| 3       | Widget D | 2        |

**Definition (3NF):**

A table is in 3NF if it is in 2NF and has *no transitive dependencies*.

In the **Order** table:

$$\text{CustomerID} \rightarrow \text{CustomerAddress}$$

Thus, CustomerAddress depends transitively on OrderID.  $\rightarrow$  Violates 3NF.

We therefore isolate customer information.

**Customer** Table:

| CustomerID | CustomerAddress |
|------------|-----------------|
| 1001       | 123 Main St     |
| 1002       | 456 Elm St      |

Updated **Order** Table:

| OrderID | CustomerID |
|---------|------------|
| 1       | 1001       |
| 2       | 1002       |
| 3       | 1001       |

**Order Table:**

| OrderID | CustomerID |
|---------|------------|
| 1       | 1001       |
| 2       | 1002       |
| 3       | 1001       |

**OrderItem Table:**

| OrderID | Item     | Quantity |
|---------|----------|----------|
| 1       | Widget A | 2        |
| 1       | Widget B | 1        |
| 2       | Widget C | 5        |
| 3       | Widget A | 3        |
| 3       | Widget D | 2        |

**Customer Table:**

| CustomerID | CustomerAddress |
|------------|-----------------|
| 1001       | 123 Main St     |
| 1002       | 456 Elm St      |