

Relational Databases Task

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1. What is normalisation?

Normalisation is restructuring tables in a database to make them more consistent, remove redundant entries, and reduce anomalies.

2. When is a table in 1NF?

A table is in the first normal form (1NF) when:

- Every cell has atomic or indivisible values. In other words, it has no lists, sets, or arrays in any column.
- Each column has a unique name, all values in a column are of the same data type, and there are no repeating groups or arrays.
- Each row is unique, although the order of rows is irrelevant (Codecademy, n.d.; DataCamp, 2025a).

3. When is a table in 2NF?

A table is in the second normal form (2NF) when:

- The requirements of 1NF are satisfied.
- There are no partial dependencies, as attributes (columns) do not depend on a part of a composite primary key (DataCamp, 2025b; Study Tonight, n.d.).

4. When is a table in 3NF?

A table is in the third normal form (3NF) when:

- The requirements of 1NF and 2NF are satisfied.
- All the attributes (columns) are fully functionally dependent on a primary key, and they are non-transitively dependent. Thus, none of the non-prime attributes (columns) depend on other non-prime attributes, but all non-prime attributes depend directly on the primary key (DataCamp, 2025c; Study Tonight, n.d.).

5. Using the INVOICE table given below, draw its dependency diagram and identify all dependencies (including transitive and partial dependencies). You can assume that the

table does not contain any repeating groups and that an invoice number references more than one product. Hint: This table uses a composite primary key.

| INV_NUM | PROD_NUM | SALE_DATE | PROD_LABEL | VEND_CODE | VEND_NAME | QUANT_SOLD | PROD_PRICE |
|---------|------------|-------------|--------------------|-----------|-----------------|------------|------------|
| 211347 | AA-E3522QW | 15-Jan-2018 | Rotary sander | 211 | NeverFail, Inc. | 1 | \$34.46 |
| 211347 | QD-300932X | 15-Jan-2018 | 0.25-in. Drill bit | 211 | NeverFail, Inc. | 8 | \$2.73 |
| 211347 | RU-995748G | 15-Jan-2018 | Band saw | 309 | BeGood, Inc. | 1 | \$31.59 |
| 211348 | AA-E3522QW | 15-Jan-2018 | Rotary sander | 211 | NeverFail, Inc. | 2 | \$34.46 |
| 211349 | GH-778345P | 16-Jan-2018 | Power drill | 157 | ToughGo, Inc. | 1 | \$69.32 |

The composite primary key is made up of INV_NUM and PROD_NUM in the INVOICE table. Each invoice can be split into several rows for multiple products ordered so that INV_NUM is not unique to a certain row. Also, products will appear on multiple invoices. But, when these are combined, they are specific to and make a row unique.

The INVOICE table is in 1NF because there are no repeating groups and the cells contain single, indivisible or atomic value types (although technically, PROD_PRICE could be split into cost and currency).

Full dependencies

1. The quantity sold is always determined or unique to the combination of a certain invoice and product the customer buys in the INVOICE table.

$$(INV_NUM, PROD_NUM) > QUANT_SOLD$$

Partial dependencies

1. The date of a sale and the vendor code are directly related to the invoice number, but not to product numbers. Thus, they are partial dependants on the composite key.

$$INV_NUM > SALE_DATE, VEND_CODE$$

2. Product labels and prices are related to the product number, but not to invoice numbers. Thus, they are partial dependants on the composite key.

PROD_NUM > PROD_LABEL, PROD_PRICE

Transitive dependencies

1. Vendor code is needed to find the vendor name and so it is a key for another table, but it is not part of the composite key for the INVOICE table.

VEND_CODE > VEND_NAME

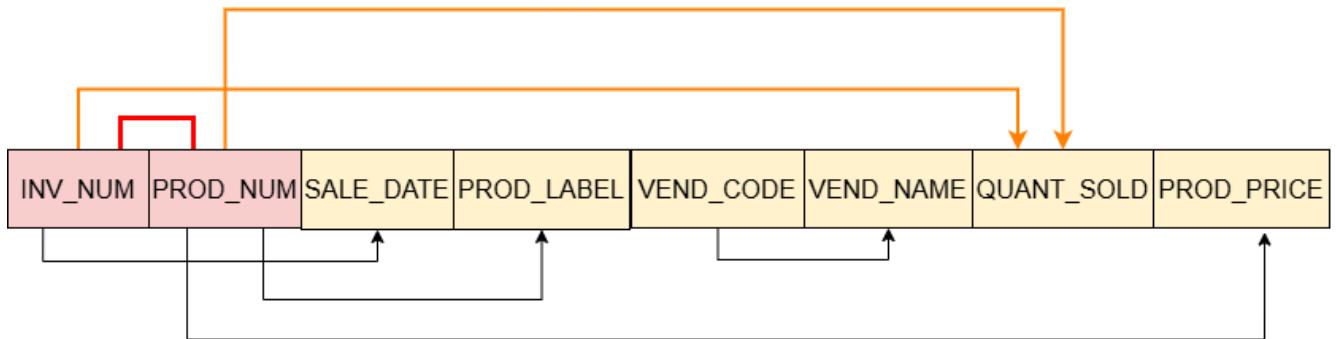


Figure 1: INVOICE table dependency diagram in 1NF

6. Using the answer to the above question, remove all partial dependencies and draw the new dependency diagrams.

The partial dependencies are split from the main table and new tables created as follows:

1. Invoice Table

(**INV_NUM, PROD_NUM, QUANT_SOLD**)

This table will show the unique products and quantity sold by invoice so that each row is unique. All attributes (columns) will be fully dependent on the composite key.

2. Sales Table

(**INV_NUM, SALE_DATE, VEND_CODE, VEND_NAME**)

This table stores invoice dates and codes for vendors associated with an invoice. The primary key is the invoice number, which the sales date and vendor code depend on, but not the product number. The vendor code is also needed to find the vendor name and so this is included in the Sales Table.

3. Products Table

(**PROD_NUM, PROD_LABEL, PROD_PRICE**)

This table stores information about each product, with the key being the product number to find labels and prices.

Table name: Invoice

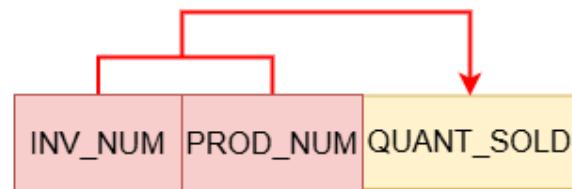


Table name: Sales

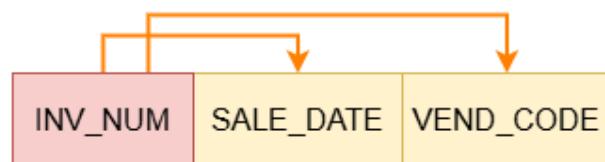


Table name: Products

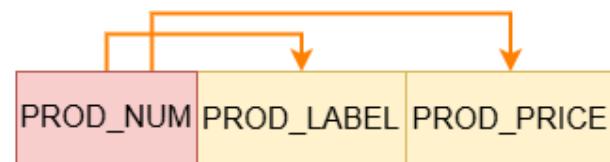


Table name: Vendors

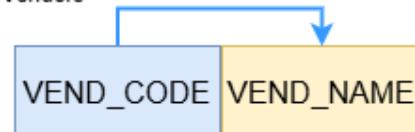


Figure 2: INVOICE table dependency diagrams in 2NF

- Using the answer to the above question, remove all transitive dependencies and draw the new dependency diagrams.

Transitive dependencies are dependencies on an element or column that is not part of the primary key at all. **VEND_CODE > VEND_NAME** is transitive as their relationship is

not dependent on either part of the primary key (INV_NUM, PROD_NUM) for the INVOICES table. So, vendor codes and names are split into their own table.

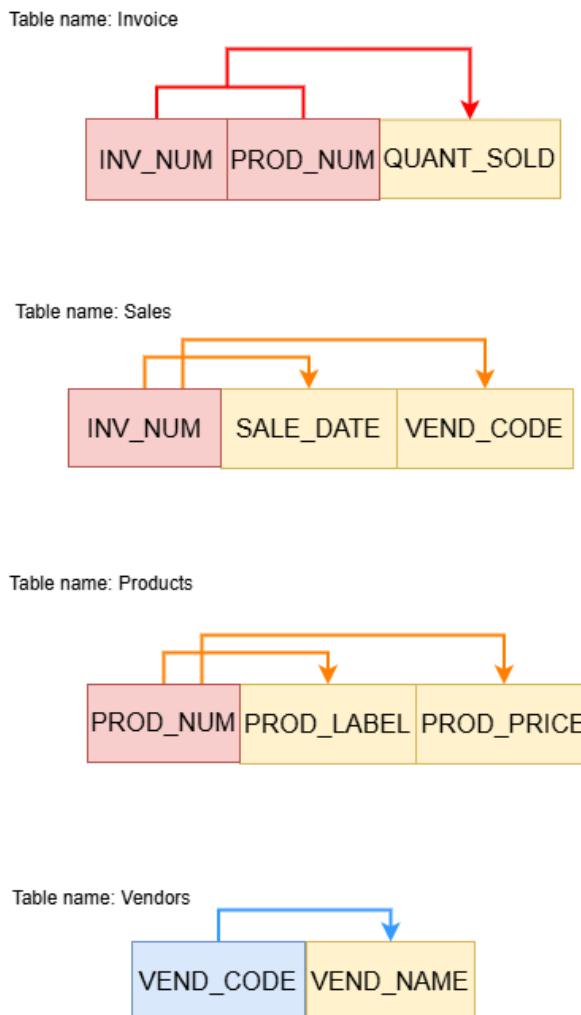


Figure 3: INVOICE table dependency diagrams in 3NF

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