

# Identify Normalization Issues

## 1NF Violations (Atomicity)

- author\_names contains multiple values (Alice Smith, Bob Jones) → violates atomicity.
- categories contain multiple values (Fiction, Drama) → violates atomicity.

**1NF requirement:** Each column must contain atomic (indivisible) values.

## 2NF Violations (Partial Dependency)

- book\_title, author\_names, categories, publisher\_name, publisher\_country depend **only on book\_id**, not the combination of member\_id + book\_id.
- member\_name depends only on member\_id.

**2NF requirement:** All non-key attributes must depend on the **whole primary key** (no partial dependencies).

## 3NF Violations (Transitive Dependency)

- publisher\_country depends on publisher\_name - transitive dependency.
- author\_names depend on book\_id, if book\_id is key for book, but must separate multi-authors.

**3NF requirement:** No non-key attribute depends on another non key attribute.

## Step 2: Normalize to 3NF

### Step 2a: 1NF

- Split multi-valued attributes (author\_names, categories) into separate rows.

#### Books Table (after 1NF)

book_id	book_title	publisher_name
B001	The Great Novel	ABC Press

#### BookAuthors Table

book_id	author_name
B001	Alice Smith
B001	Bob Jones

#### BookCategories Table

book_id	category
B001	Fiction
B001	Drama

#### Members Table

member_id	member_name
101	John Doe

#### Borrowing Table

member_id	book_id	borrow_date	return_date	fine_amount
101	B001	2025-10-01	2025-10-20	5.00

#### Publishers Table

publisher_name	publisher_country
ABC Press	USA

## Step 2b: 2NF

- Check partial dependencies:

**Borrowing Table:** composite key (member\_id, book\_id) → attributes (borrow\_date, return\_date, fine\_amount) depend on the full key, not part

**Other tables:** book\_title, publisher\_name depend fully on book\_id

**Publisher table:** publisher\_country depends on publisher\_name

## Step 2c: 3NF

- Remove transitive dependencies:

**Publisher table:** publisher\_country depends on publisher\_name → already separate → 3NF achieved.

**Authors table:** each author\_name depends directly on book\_id

**Categories table:** same

## Step 3: Explain Improvements

Normal Form	Improvement	Why It Matters
1NF	Split multi-valued fields (author_names, categories)	Each attribute is atomic - easier querying, avoids ambiguity
2NF	Removed partial dependencies (attributes depend on entire key)	Prevents redundant data and update anomalies
3NF	Removed transitive dependencies (publisher_country depends on publisher_name)	Ensures data consistency, reduces redundancy

## Step 4: Final Normalized Tables

### 1. Members

member_id	member_name
101	John Doe

### 2. Books

book_id	book_title	publisher_name
B001	The Great Novel	ABC Press

### 3. Publishers

publisher_name	publisher_country
ABC Press	USA

### 4. BookAuthors

book_id	author_name
B001	Alice Smith
B001	Bob Jones

### 5. BookCategories

book_id	category
B001	Fiction
B001	Drama

### 6. Borrowing

borrow_id	member_id	book_id	borrow_date	return_date
1	101	B001	2025-10-01	2025-10-20

## 7. Fines Table

<b>fine_id</b>	<b>borrow_id</b>	<b>fine_amount</b>	<b>status</b>
F001	1	5.00	Paid