Database Normalization

Database normalization is the process of organizing the fields and tables of a relational database to minimize redundancy and dependency. Its main goal is to reduce data redundancy and ensure data integrity. This process usually involves dividing a database into two or more tables and defining relationships between the tables. There are several normal forms (NFs), each with specific requirements:

1. **First Normal Form (1NF)**:
    - Ensures that each table cell contains only one value (atomicity).
    - Each record needs to be unique.
2. **Second Normal Form (2NF)**:
    - Meets all requirements of the first normal form.
    - All non-key attributes are fully functional dependent on the primary key.
3. **Third Normal Form (3NF)**:
    - Meets all requirements of the second normal form.
    - All attributes are only dependent on the primary key.
4. **Boyce-Codd Normal Form (BCNF)**:
    - A stricter version of the third normal form.
    - For any dependency $A \rightarrow B$, A should be a super key.
5. **Fourth Normal Form (4NF)**:
    - Meets all requirements of the Boyce-Codd normal form.
    - No multi-valued dependencies.
6. **Fifth Normal Form (5NF)**:
    - Meets all requirements of the fourth normal form.
    - Every join dependency in the table is implied by the candidate keys.

Normalization helps maintain the consistency of data by ensuring that there are no anomalies like update, insertion, and deletion anomalies. By following the principles of normalization, databases are more efficient, scalable, and easier to manage.