Database Constraints (SQL)

Introduction

Database constraints are rules applied to table columns to ensure the accuracy, consistency, and integrity of data stored in a database.

They prevent invalid data entry, duplicate records, and broken relationships between tables. Constraints are enforced automatically by the database system.

Why Database Constraints Are Important

- Maintain data integrity
- Reduce data inconsistency
- Prevent invalid data insertion
- Enforce business rules
- Improve overall database reliability

Types of Database Constraints

NOT NULL Constraint

Definition

The NOT NULL constraint ensures that a column cannot store NULL (empty) values.

Key Points

- Mandatory values must be provided
- NULL values are not allowed
- Commonly used for essential fields

Example

```
CREATE TABLE Users (
   UserID INT,
   Username VARCHAR(50) NOT NULL
);
```

UNIQUE Constraint

Definition

The UNIQUE constraint ensures that all values in a column are different.

Key Points

- Prevents duplicate values
- Multiple UNIQUE constraints can exist in a table
- NULL values may be allowed depending on the DBMS

Example

```
CREATE TABLE Users (
   Email VARCHAR(100) UNIQUE
);
```

PRIMARY KEY Constraint

Definition

The PRIMARY KEY uniquely identifies each record in a table.

Key Points

- Combination of UNIQUE and NOT NULL
- Only one PRIMARY KEY per table
- Cannot contain NULL values
- Can be composite (multiple columns)

Example

```
CREATE TABLE Students (
   StudentID INT PRIMARY KEY,
   Name VARCHAR(50)
);
```

FOREIGN KEY Constraint

Definition

The FOREIGN KEY constraint maintains a relationship between two tables.

Key Points

- Ensures referential integrity
- References a PRIMARY KEY in another table
- Prevents orphan records

Example

```
CREATE TABLE Orders (
    OrderID INT PRIMARY KEY,
    CustomerID INT,
    FOREIGN KEY (CustomerID) REFERENCES Customers(CustomerID)
);
```

CHECK Constraint

Definition

The CHECK constraint ensures that column values meet a specific condition.

Key Points

- Applies logical conditions
- Prevents invalid data
- Useful for range validation

Example

```
CREATE TABLE Users (
    Age INT CHECK (Age >= 18)
);
```

DEFAULT Constraint

Definition

The DEFAULT constraint assigns a default value when no value is provided.

Key Points

- Automatically assigns a value
- Useful for status, flags, and timestamps

Example

```
CREATE TABLE Orders (
    Status VARCHAR(20) DEFAULT 'Pending'
);
```

Using Multiple Constraints Together

Multiple constraints can be applied to a single column.

Example

```
CREATE TABLE Users (
   Email VARCHAR(100) UNIQUE NOT NULL
);
```

Constraints Summary Table

Constraint	Purpose
NOT NULL	Prevents empty values
UNIQUE	Prevents duplicate values
PRIMARY KEY	Uniquely identifies records
FOREIGN KEY	Maintains table relationships
CHECK	Enforces conditions
DEFAULT	Assigns default values