



Data Quality and Speed: Constraints, Keys, and Indexing

LEARN

1. Primary and Foreign Keys

Primary Key

- **Definition:** A unique identifier for every row in a table.
- **Features:**
 - Cannot have duplicate values.
 - Cannot contain null values.
 - Ensures data integrity and uniqueness.

Example:

```
CREATE TABLE Employee (  
    EmployeeID INT PRIMARY KEY,  
    Name VARCHAR(50) NOT NULL,  
    Age INT  
);
```

Foreign Key

- **Definition:** Links tables together by referencing a primary key in another table.
- **Purpose:** Ensures referential integrity between related tables.

Example:

```
CREATE TABLE Department (  
    DeptID INT PRIMARY KEY,  
    DeptName VARCHAR(50)
```



```
);
```

```
CREATE TABLE Employee (  
    EmployeeID INT PRIMARY KEY,  
    Name VARCHAR(50) NOT NULL,  
    DeptID INT,  
    FOREIGN KEY (DeptID) REFERENCES Department(DeptID)  
);
```

2. SQL Constraints (Detailed)

Constraint	Purpose	Example Usage
PRIMARY KEY	Unique identification for records	ID fields
FOREIGN KEY	Establishes relationship between tables	Employee linked to Department
UNIQUE	Ensures all values in column are different	Email addresses, Usernames
NOT NULL	Prevents null values	Mandatory fields
CHECK	Validates data based on a logical expression	Age > 18
DEFAULT	Sets a default value if none provided	Status = 'Active'

Detailed Examples:

- **UNIQUE:**



```
CREATE TABLE Users (  
    UserID INT PRIMARY KEY,  
    Email VARCHAR(50) UNIQUE  
);
```

- **NOT NULL:**

```
CREATE TABLE Accounts (  
    AccountID INT PRIMARY KEY,  
    Username VARCHAR(50) NOT NULL,  
    Password VARCHAR(50) NOT NULL  
);
```

- **CHECK:**

```
CREATE TABLE Products (  
    ProductID INT PRIMARY KEY,  
    Price DECIMAL(10, 2) CHECK (Price > 0)  
);
```

- **DEFAULT:**

```
CREATE TABLE Orders (  
    OrderID INT PRIMARY KEY,  
    OrderDate DATE DEFAULT GETDATE()  
);
```

3. Indexes in SQL

Indexes improve query performance by enabling faster data retrieval.



Advantages:

- Faster SELECT queries.
- Efficient search capabilities.

Disadvantages:

- Increased storage requirement.
- Slightly slower INSERT, UPDATE, DELETE operations.

Creating Indexes:

- **Single-column index:**

```
CREATE INDEX idx_employee_name ON Employee(Name);
```

- **Composite index:**

```
CREATE INDEX idx_employee_dept ON Employee(Name, DeptID);
```

Removing Indexes:

```
DROP INDEX idx_employee_name ON Employee;
```

PRACTISE

Task 1: Constraints Implementation

Create a table **Students** with appropriate constraints (PRIMARY KEY, NOT NULL, UNIQUE, CHECK, DEFAULT):

```
CREATE TABLE Students (  
    StudentID INT PRIMARY KEY,  
    Name VARCHAR(50) NOT NULL,  
    Email VARCHAR(50) UNIQUE NOT NULL,
```



```
Age INT CHECK (Age >= 18),  
EnrollmentStatus VARCHAR(10) DEFAULT 'Active'  
);
```

Task 2: Relationships Creation

Create tables **Teachers** and **Subjects** linked via a foreign key:

```
CREATE TABLE Teachers (  
    TeacherID INT PRIMARY KEY,  
    TeacherName VARCHAR(50)  
);  
  
CREATE TABLE Subjects (  
    SubjectID INT PRIMARY KEY,  
    SubjectName VARCHAR(50),  
    TeacherID INT,  
    FOREIGN KEY (TeacherID) REFERENCES Teachers(TeacherID)  
);
```

Task 3: Index Creation

Create an index to improve search speed on the **TeacherName** column:

```
CREATE INDEX idx_teacher_name ON Teachers(TeacherName);
```

FAQ

- **Q:** Can a table have multiple UNIQUE constraints?
 - **A:** Yes, multiple columns can have UNIQUE constraints.



- **Q:** What's the main difference between PRIMARY KEY and UNIQUE?
 - **A:** PRIMARY KEY cannot have NULL values and uniquely identifies records; UNIQUE can have multiple NULLs but ensures non-null values are unique.
- **Q:** Is indexing always recommended?
 - **A:** Indexing is beneficial for frequently queried columns but less ideal for columns regularly updated or rarely searched.
- **Q:** Can CHECK constraints reference other columns?
 - **A:** Yes, CHECK constraints can reference multiple columns within the same table.
- **Q:** Can we modify constraints after table creation?
 - **A:** Yes, using ALTER TABLE commands to add, modify, or remove constraints.