Database Programming – Lecture 3

MS SQL Data Types

BY

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MS SQL Server Data Types

A data type in SQL Server defines the type of data that a column can store. It determines storage size, allowed values, and supported operations. Choosing the correct data type improves performance, storage efficiency, and data integrity.

1. Categories of SQL Server Data Types

SQL Server data types are grouped into the following categories:

- Numeric Data Types
- Character (String) Data Types
- Date and Time Data Types
- Binary Data Types
- Special Data Types

2. Numeric Data Types

A. Exact Numeric Types

Data Type	Storage	Range	Example
BIT	1 bit	0 or 1	1
TINYINT	1 byte	0 to 255	200
SMALLINT	2 bytes	-32,768 to 32,767	15000
INT	4 bytes	±2 billion	1000
BIGINT	8 bytes	Very large integers	9000000000
DECIMAL(p,s)	Variable	Exact decimal	12.50
NUMERIC(p,s)	Variable	Same as DECIMAL	99.99
MONEY	8 bytes	Currency values	1500.75
SMALLMONEY	4 bytes	Smaller currency	500.25

B. Approximate Numeric Types

Data Type	Description
FLOAT	Approximate floating number
REAL	Smaller floating number

4. Character (String) Data Types

A. Non-Unicode

Data Type	Description
CHAR(n)	Fixed-length string
VARCHAR(n)	Variable-length string
VARCHAR(MAX)	Up to 2GB text

B. Unicode (Supports Multiple Languages)

- Use Unicode when storing:
  - Arabic
  - Chinese
  - Multiple languages

Data Type	Description
NCHAR(n)	Fixed Unicode
NVARCHAR(n)	Variable Unicode
NVARCHAR(MAX)	Large Unicode text

5. Date and Time Data Types

Data Type	Description
DATE	Stores date only
TIME	Stores time only
DATETIME	Date + time
DATETIME2	More precise datetime
SMALLDATETIME	Smaller datetime
DATETIMEOFFSET	Date + time + time zone

6. Binary Data Types

Data Type	Description
BINARY(n)	Fixed binary
VARBINARY(n)	Variable binary
VARBINARY(MAX)	Large binary (files, PDFs)

7. Special Data Types

- UNIQUEIDENTIFIER – Stores GUID values
- SQL_VARIANT – Stores multiple data types in a single column
- XML – Stores XML-formatted data

8. Data Type Selection Guidelines

- Use INT for primary keys and IDs
- Use DECIMAL for financial data
- Use DATETIME2 instead of DATETIME
- Use NVARCHAR for multilingual systems
- Avoid FLOAT for money calculations
- Avoid VARCHAR(MAX) unless necessary

Creating relations using FKs

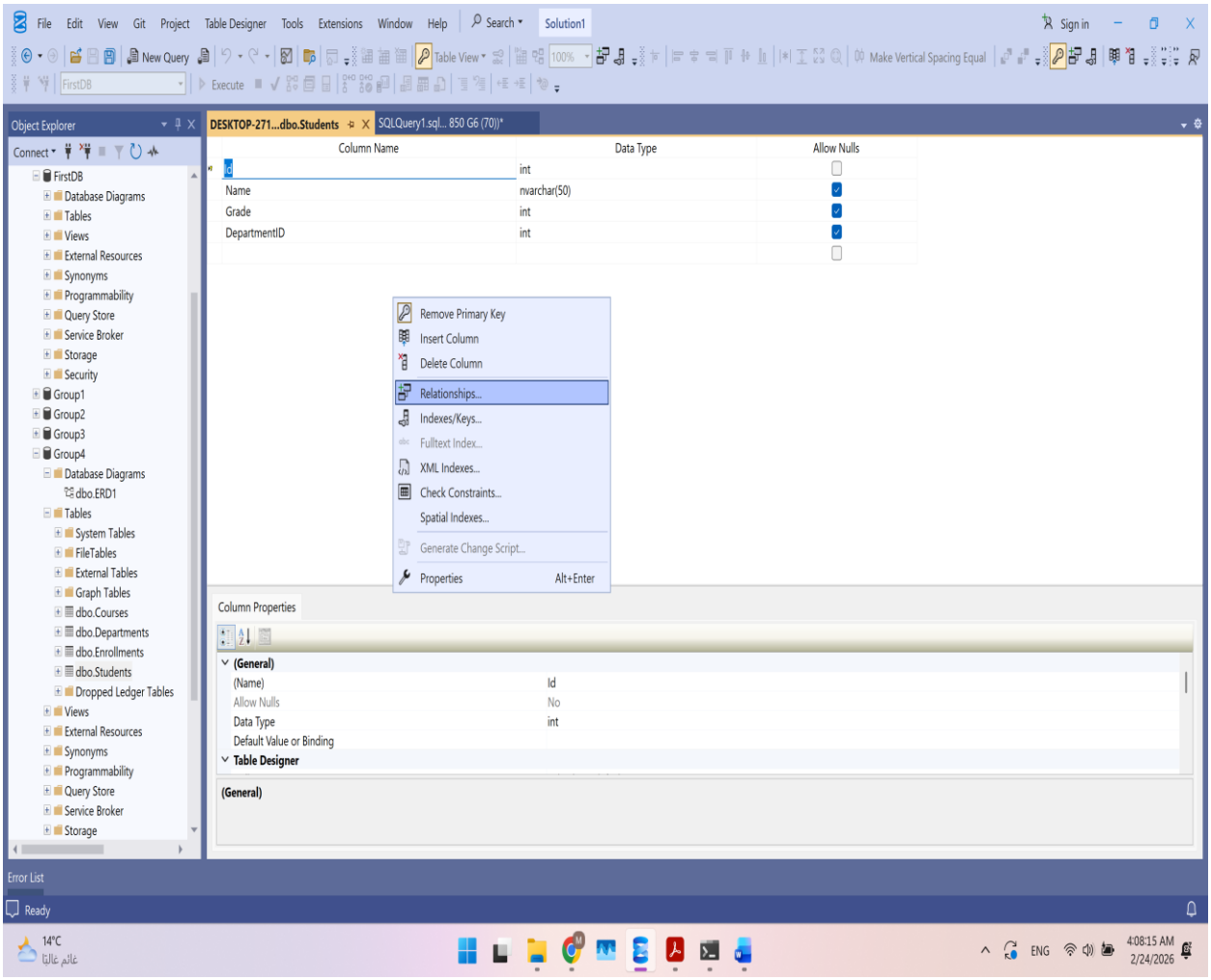
A Foreign Key (FK) column in a relational database is a column or set of columns in one table ("child" table) that references the Primary Key (PK) column(s) in another table ("parent" table)

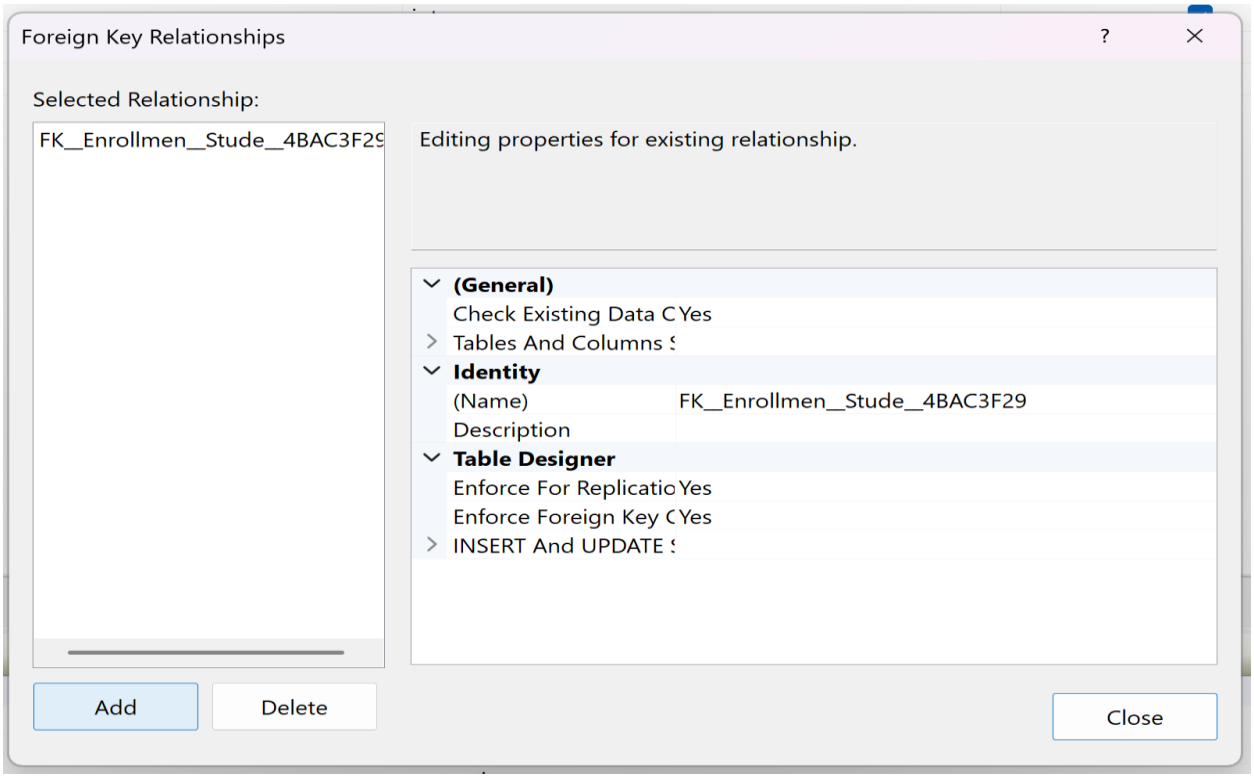
- **Purpose:** Ensures data consistency and prevents invalid data from being entered into the table.
- **Relationship Definition:** Acts as a link between two tables, commonly in a one-to-many relationship.
- **Constraints:** Prevents deleting or changing data in the parent table if related rows exist in the child table, depending on defined ON DELETE or ON UPDATE actions (e.g., CASCADE, SET NULL, NO ACTION).

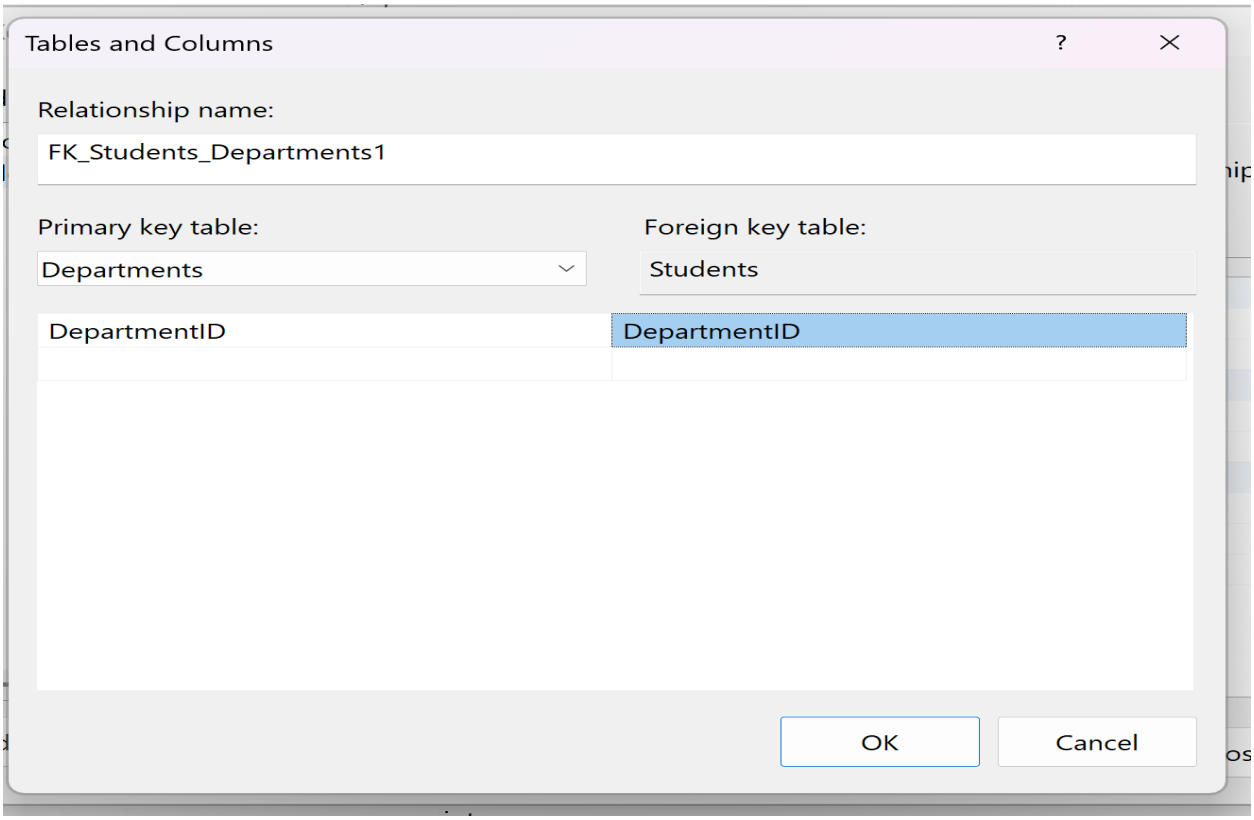
Action	Description
CASCADE	Automatically delete or update child rows when the parent row changes.
SET NULL	Sets the child column to NULL when the parent row is deleted or updated.
SET DEFAULT	Sets the child column to its default value.
NO ACTION	Prevents deleting or updating the parent row if related child rows exist.

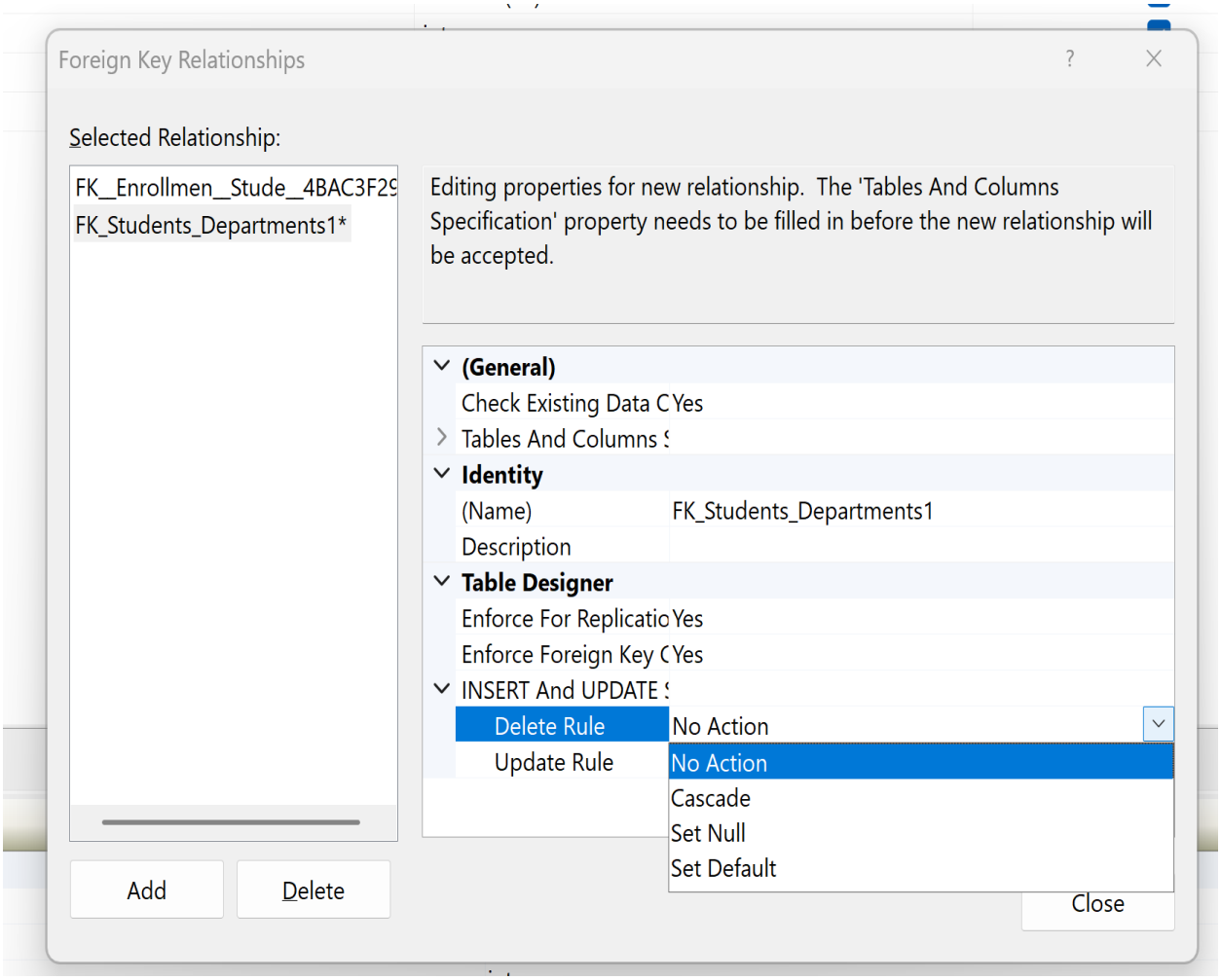
```
CREATE TABLE Courses (
    CourseID INT PRIMARY KEY,
    CourseName NVARCHAR(100)
);

CREATE TABLE Students_2 (
    ID INT PRIMARY KEY,
    Name NVARCHAR(50),
     DepartmentID INT
);


CREATE TABLE Enrollments (
    EnrollmentID INT PRIMARY KEY,
    StudentID INT,
    CourseID INT,
    FOREIGN KEY (StudentID) REFERENCES Students(Id),
    FOREIGN KEY (CourseID) REFERENCES Courses(CourseID)
);

CREATE TABLE Departments (
    DepartmentID INT PRIMARY KEY,
    DepartmentName NVARCHAR(100)
);


ALTER TABLE Students
ADD CONSTRAINT FK_Students_2_Departments
FOREIGN KEY (DepartmentID)
REFERENCES Departments(DepartmentID);
```

Creating Relations Using GUI




Foreign Key Relationships
Selected Relationship:
FK__Enrollmen__Stude__4BAC3F29
Editing properties for existing relationship.
(General)
Check Existing Data C Yes
Tables And Columns S
Identity
(Name) FK__Enrollmen__Stude__4BAC3F29
Description
Table Designer
Enforce For Replicatio Yes
Enforce Foreign Key C Yes
INSERT And UPDATE S
Add
Delete
Close


Tables and Columns
Relationship name:
FK_Students_Departments1
Primary key table:
Departments
Foreign key table:
Students
DepartmentID
DepartmentID
OK
Cancel


Foreign Key Relationships
Selected Relationship:
FK__Enrollmen__Stude__4BAC3F29
FK_Students_Departments1*
Editing properties for new relationship. The 'Tables And Columns Specification' property needs to be filled in before the new relationship will be accepted.
(General)
Check Existing Data C Yes
Tables And Columns S
Identity
(Name) FK_Students_Departments1
Description
Table Designer
Enforce For Replicatio Yes
Enforce Foreign Key C Yes
INSERT And UPDATE S
Delete Rule No Action
Update Rule
No Action
Cascade
Set Null
Set Default
Add
Delete
Close