SQL, Variables, If, While, functions (Day 7)

Variables in SQL Server

- **Local variables**: Used within stored procedures, functions, or batches to hold temporary data.
- **Global variables**: Predefined by SQL Server and provide information about the system state (e.g., server name, row counts, errors).
- **Dynamic SQL**: Allows execution of SQL code dynamically based on variable input.

1. Local Variables:

Local variables are used to store data temporarily in a session, procedure, or batch. You can define and manipulate local variables within a batch, function, or stored procedure.

- **Batch**: A block of code that is highlighted and executed together.
- **Function**: Variables can be used inside user-defined functions.
- **Stored Procedure**: Variables are commonly used within stored procedures to hold temporary data.
- **To define a variable**:

```
DECLARE @x INT; -- Declares a variable @x of type INT. The initial valu
e is NULL.
```

- **To assign a value to a variable**:
  - Using `SET`:

    ```
    SET @x = 10; -- Assigns the value 10 to the variable @x.
    ```

  - Using `SELECT`:

    ```
    SELECT @x = 100; --Assigns the value 100 to the variable @x.
    ```

  - From a query result:

    ```
    SELECT @x = (SELECT AVG(Salary) FROM Employees WHERE Empl
    oyeeID = 1);
    -- Fetches the average salary of EmployeeID 1 and assigns it to @x.
    ```

  - During an `UPDATE` statement:

    ```
    UPDATE Employees
    SET EmployeeName = 'Omar', @x = Salary
    WHERE EmployeeID = 9;
    -- Updates the EmployeeName of EmployeeID 9 to 'Omar' and assi
    gns their Salary to @x.
    ```

- **To print the value of a variable**:

```
SELECT @x; -- Displays the value stored in @x.
```

Examples of Local Variables:

1. **Calculate and assign the average salary to a variable**:

```
USE CompanyDB;
-- Switch to the CompanyDB database.
-- ⇒ 1, 2, and 3 must excute together
```

```
1⇒ DECLARE @x INT;
-- Declare a variable @x of type INT.

2⇒ SELECT @x = AVG(Salary) FROM Employees;
--Calculate the average salary of all employees and assign it to @x.

3⇒ SELECT @x;
-- Display the value of @x.
```

2. **Handling cases where a query returns no result**:
   If a query doesn't return a result, the variable retains its previous value:

```
DECLARE @x INT = 100;
-- Declare @x with an initial value of 100.

SELECT @x = Salary FROM Employees WHERE EmployeeID = 12131231
2;
-- No Employee with this ID, so the variable remains 100.

SELECT @x;
-- Output will still be 100.
```

3. **Handling multiple row results**:
   When a query returns multiple rows, the variable is assigned the last value:

```
DECLARE @x INT;
-- Declare @x without an initial value.

SELECT @x = Salary FROM Employees WHERE EmployeeID > 1;
-- If multiple employees are returned, @x will hold the last Salary.

SELECT @x;
-- Outputs the last salary from the result set.
```

4. **Using multiple variables**:

```
DECLARE @EmpSalary INT, @EmpName VARCHAR(50);
-- Declare two variables: @x (int) and @y (string).
```

```
SELECT @EmpSalary = Salary, @EmpName = EmployeeName FROM E
mployees WHERE EmployeeID = 1;
-- Assign the salary and first name of EmployeeID 1 to @x and @y, resp
ectively.

SELECT @EmpSalary, @EmpName;
-- Display the values of @x and @y.
```

5. **Using variables in an `UPDATE` statement**:

```
DECLARE @DeptID INT;
-- Declare a variable @x.

UPDATE Employees
SET EmployeeName = 'Gazal', @DeptID = DepartmentID
WHERE EmployeeID = 1;
-- Update the EmployeeName of EmployeeID 1 and assign their Depart
mentID to @x.

SELECT @DeptID;
-- Display the value of @x.
```

6. **Using table variables**:
   Table variables can be used to temporarily store multiple rows in memory:

```
DECLARE @SalaryTable TABLE (Salary INT);
-- Declare a table variable @SalaryTable with a Salary column of type I
NT.

INSERT INTO @SalaryTable
SELECT Salary FROM Employees WHERE EmployeeID > 1;
-- Insert the salaries of employees with ID > 1 into the table variable.

SELECT * FROM @SalaryTable;
-- Select all rows from the table variable @SalaryTable.
```

7. **Table variable with multiple columns**:

```
DECLARE @Emp_ID_Salary_table TABLE (EmployeeID INT, Salary INT);
-- Declare a table variable @Emp_ID_Salary_table with EmployeeID and
Salary columns.

INSERT INTO @Emp_ID_Salary_table
SELECT EmployeeID, Salary FROM Employees WHERE EmployeeID > 1;
-- Insert EmployeeID and Salary into the table variable.

SELECT * FROM @Emp_ID_Salary_table;
-- Select all rows from the table variable @Emp_ID_Salary_table.
```

8. **Using variables with the `TOP` clause**:

```
DECLARE @Top_var INT = 4;
-- Declare @Top_var with an initial value of 4.

SELECT TOP (@Top_var) * FROM Employees;
-- Select the top 4 rows from the Employees table.
```

9. **Dynamic SQL Execution**:
   Dynamic SQL allows you to execute SQL queries constructed at runtime:

```
DECLARE @x INT = 4;
-- Declare @x with an initial value of 4.

EXEC ('SELECT TOP (' + CAST(@x AS VARCHAR) + ') * FROM Employe
es');
-- Executes a query that selects the top 4 rows from the Employees tab
le.
```

10. **Dynamic SQL with column and table names**:
    This demonstrates how you can use variables to define column and table names dynamically:

```
DECLARE @column VARCHAR(50) = 'Salary', @table VARCHAR(50) =
'Employees';
-- Declare variables for the column and table names.
```

```
EXEC ('SELECT ' + @column + ' FROM ' + @table);
-- Executes a query selecting the Salary column from the Employees ta
ble
```

The command you're using:

```
EXEC('SELECT * FROM Employees');
```

This is an example of **dynamic SQL** in SQL Server. Dynamic SQL allows you to build and execute SQL statements at runtime as a string.

Explanation:

- `EXEC` **(or** `EXECUTE` **)**: Executes a dynamically constructed SQL query or stored procedure. The SQL query is passed as a string.
- `'SELECT * FROM Employees'` : This string contains the actual SQL query to be executed, in this case, selecting all rows from the `Employees` table.

Use Cases for Dynamic SQL:

- **Conditional Execution**: You might use dynamic SQL when you need to build queries dynamically based on variable inputs (e.g., table names, column names, or filtering conditions).
- **Flexibility**: It is useful when you don't know the exact query at compile time but need to decide it at runtime.

Security Consideration:

Dynamic SQL can lead to **SQL injection attacks** if not used properly, especially when user inputs are directly embedded in the query string. Always validate and sanitize inputs to avoid security vulnerabilities. Using **parameterized queries** is a better alternative to mitigate this risk.

Example with Dynamic Column Name:

If you want to dynamically specify the column name, here's an example:

```
DECLARE @column VARCHAR(50) = 'EmployeeName';
EXEC('SELECT ' + @column + ' FROM Employees');
```

2. Global Variables:

Global variables in SQL Server provide system information and cannot be declared or assigned manually. They always start with `@@`.

- **Examples of Global Variables**:

1. **Server name**:

```
SELECT @@SERVERNAME;
-- Returns the name of the server.
```

2. **Row count of the last operation**:

```
UPDATE Employees
SET Salary = Salary + 1;
-- Increases the salary of all employees by 1.

SELECT @@ROWCOUNT;
-- Returns the number of rows affected by the last operation (in this cas
e, the update).
```

3. **SQL Server version**:

```
SELECT @@VERSION;
-- Returns the version of SQL Server you're using.
```

4. **Error code of the last operation**:
   If the last operation resulted in an error, the global variable `@@ERROR` returns the error number:

```
UPDATE Employeess
-- Intentional typo in the table name to generate an error.

SET Salary += 1;

SELECT @@ERROR;
```

```
-- Returns the error code for the last operation (e.g., 208 for an invalid t
able name).
```

5. **Last identity value inserted**:

```
INSERT INTO Employees (FirstName, LastName, Email, HireDate, JobTit
le, Salary)
VALUES ('John', 'Doe', 'john.doe@example.com', '2024-01-01', 'Manag
er', 5000);
-- Inserts a new employee.

SELECT @@IDENTITY;
-- Returns the last inserted identity value (EmployeeID) from the Emplo
yees table.
```

Example combining local and global variables:

```
DECLARE @x VARCHAR(50);
-- Declare a local variable @x of type VARCHAR.

SET @x = @@VERSION;
-- Assign the value of the global variable @@VERSION to @x.

SELECT @x;
-- Display the value of @x (which now holds the SQL Server version).
```

Security Consideration for Dynamic SQL

Dynamic SQL, while flexible, can introduce significant security risks, especially **SQL injection attacks**, if not handled correctly. This occurs when malicious users manipulate the input to execute unintended SQL commands, potentially gaining unauthorized access to or altering the database.

Example of SQL Injection:

Suppose a dynamic SQL query includes unsanitized user input:

```
DECLARE @userID VARCHAR(50) = '1 OR 1=1';
EXEC('SELECT * FROM Employees WHERE EmployeeID = ' + @userID);
```

This would generate the query:

```
SELECT * FROM Employees WHERE EmployeeID = 1 OR 1=1;
```

Here, the condition `1=1` is always true, so it retrieves all rows in the `Employees` table, bypassing the intent of the query.

Mitigating SQL Injection in Dynamic SQL

1. **Avoid Directly Embedding User Inputs:**
   Never directly concatenate user input into dynamic SQL. This exposes the system to malicious injections.
2. **Use Parameterized Queries:**
   Whenever possible, use parameterized queries to safely inject variables into SQL statements, preventing malicious data from being treated as executable code.

Example of a Safe Parameterized Query:

Instead of constructing the query dynamically with string concatenation, use parameters:

```
DECLARE @userID INT = 1;
EXEC sp_executesql
   N'SELECT * FROM Employees WHERE EmployeeID = @userID',
   N'@userID INT',
   @userID;
```

- `sp_executesql`: A system-stored procedure that executes a SQL statement with parameters. This allows for safely passing values without risking SQL injection.
- **Parameters**: The variable `@userID` is treated as data, not code, ensuring that any user input is not executed as part of the SQL query.

Other Practices to Improve Security:

1. **Input Validation**: Always validate user inputs to ensure they conform to expected formats (e.g., numeric values, valid email addresses).
2. **Least Privilege Principle**: Ensure that the user executing the dynamic SQL has only the minimal required database privileges, reducing the risk of damage in case of an attack.
3. **Escaping Inputs**: If for some reason dynamic SQL must be used, ensure that all user inputs are properly escaped or sanitized.

The query `SELECT * FROM Employees WHERE EmployeeID = 1 OR 1=1;` is a typical example of **SQL injection** vulnerability.

Query Explanation:

- **`SELECT * FROM Employees`**: This part of the query retrieves all columns from the `Employees` table.
- **`WHERE EmployeeID = 1`**: This part is supposed to filter the records to return only the row where the `EmployeeID` is 1.
- **`OR 1=1`**: This condition essentially makes the query unsafe. Here's why:
  - `1=1` is a logical expression that is always **true**.
  - The `OR` operator means that if either of the conditions is true, the row will be selected.
  - So, no matter what the value of `EmployeeID` is, the expression `1=1` will always return `TRUE`. Therefore, the query will **ignore the actual filtering condition** (`EmployeeID = 1`) and will return **all rows** from the `Employees` table.

Why is This a Problem?

- **SQL Injection Vulnerability**: This kind of query can occur if an application allows user input without proper sanitization or validation. If an attacker can inject `1=1` into the query, it essentially bypasses the filtering conditions and returns all rows from the table.
  - For example, in a login form, if the query were:
    The query would bypass authentication entirely and return all users, allowing an attacker unauthorized access to the system.

```
SELECT * FROM Users WHERE Username = 'user' AND Password = 'pass' OR 1=1;
```

Impact:

- **Data Leakage**: An attacker could retrieve confidential information from the entire table when they were only supposed to see specific rows.
- **Security Breach**: If this kind of query is used in authentication systems, an attacker could gain access to sensitive user accounts.

Proper Query:

The query should only return the row where `EmployeeID = 1`:

```
SELECT * FROM Employees WHERE EmployeeID = 1;
```

Prevention:

To avoid such vulnerabilities, you should always:

1. **Use parameterized queries** or **prepared statements**.
2. **Validate and sanitize user input**.
3. Ensure that dynamic SQL queries are constructed securely to prevent unauthorized data access.

Control of Flow Statements in SQL Server

1. IF Statement

The `IF` statement checks a condition and executes a block of code based on whether the condition is `TRUE` or `FALSE`.

Example:

```
USE CompanyDB;
DECLARE @NumRows INT;
UPDATE Employees
SET Salary += 1
WHERE EmployeeID > 5;
```

```
SELECT @NumRows = @@ROWCOUNT;
IF @NumRows > 0
   SELECT 'There are affected rows';
ELSE
   SELECT 'There are no affected rows';
```

- Here, `@@ROWCOUNT` captures the number of rows affected by the `UPDATE` statement. If rows are updated (`@NumRows > 0`), it outputs "There are affected rows"; otherwise, it outputs "There are no affected rows."

2. BEGIN & END

`BEGIN` and `END` mark a block of SQL code to be executed together, often used in `IF` or `WHILE` statements.

Example:

```
USE CompanyDB;
DECLARE @NumRows INT;
UPDATE Employees
SET Salary += 1
WHERE EmployeeID > 5;

SELECT @NumRows = @@ROWCOUNT;
IF @NumRows > 0
BEGIN
   SELECT 'There are affected rows';
   SELECT 'This is the second message for affected rows';
END
ELSE
BEGIN
   SELECT 'There are no affected rows';
END
```

- The `BEGIN...END` ensures multiple statements are executed as a block inside the `IF` or `ELSE`.

3. IF EXISTS / IF NOT EXISTS

These are used to check whether a certain condition (such as the existence of a record or table) is met before executing a statement.

Example 1: **IF EXISTS**

```
IF EXISTS (SELECT name FROM sys.tables WHERE name = 'Employees')
   SELECT 'Table exists';
ELSE
   CREATE TABLE Employees (
      EmployeeID INT,
      Name VARCHAR(50)
   );
```

- This checks if the `Employees` table exists. If it does, it prints "Table exists"; otherwise, it creates the table.

Example 2: **IF NOT EXISTS**

```
IF NOT EXISTS (SELECT DepartmentID FROM Employees WHERE Departm
entID = 40)
   DELETE FROM Departments WHERE DepartmentID = 40; -- Safe delete
ELSE
   SELECT 'Department 40 has relation';
```

- This deletes the department if no employees are linked to it, otherwise it displays a message.

4. TRY...CATCH (Exception Handling)

This is used to handle errors that occur during SQL execution.

Example:

```
BEGIN TRY
   DELETE FROM Departments WHERE DepartmentID = 10;  -- Safe delete
END TRY
BEGIN CATCH
   SELECT 'Department 10 has a relation';
   SELECT ERROR_LINE(), ERROR_NUMBER(), ERROR_MESSAGE();
END CATCH;
```

- If the `DELETE` fails due to a foreign key constraint, the `CATCH` block is executed, showing the error details.

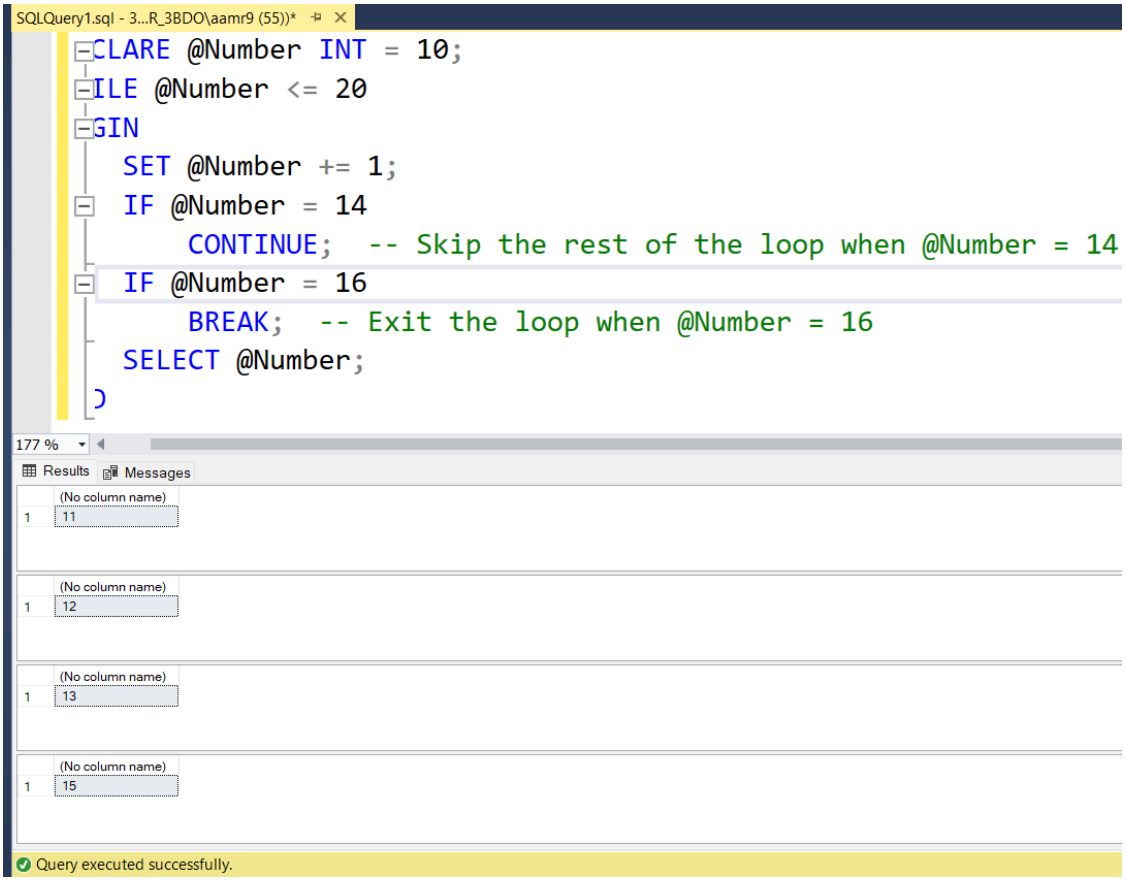
5. WHILE Loop

The `WHILE` loop repeatedly executes a block of code as long as a condition is `TRUE`.

Example:

```
DECLARE @Number INT = 10;
WHILE @Number <= 20
BEGIN
   SET @Number += 1;
   IF @Number = 14
      CONTINUE;  -- Skip the rest of the loop when @Number = 14
   IF @Number = 16
      BREAK;  -- Exit the loop when @Number = 16
   SELECT @Number;
END
```

- The `WHILE` loop increments `@Number` by 1 in each iteration. `CONTINUE` skips to the next loop cycle if `@Number = 14`, and `BREAK` stops the loop if `@Number = 16`.



6. CASE Statement

`CASE` allows you to apply conditional logic to columns in an `UPDATE` or `SELECT` statement.

Example:

```
UPDATE Employees
SET Salary =
   CASE
      WHEN Salary <= 800 THEN Salary * 1.2
      WHEN Salary <= 1500 THEN Salary * 1.3
      WHEN Salary > 1500 THEN Salary * 1.4
      ELSE 0
   END;
```

- This example updates employee salaries based on conditions.

7. IIF Function

`IIF` is a shorthand for `IF...ELSE` in a `SELECT` query.

Example:

```
SELECT EmployeeName, IIF(Salary >= 1600, 'High', 'Low') AS SalaryLevel
FROM Employees;
```

- This assigns 'High' or 'Low' to each employee depending on their salary.

8. CHOOSE Function

`CHOOSE` selects a value from a list based on an index.

Example:

```
SELECT CHOOSE(2, 'Omar', 'Nasr', 'Ali') AS Name;  -- Returns 'Nasr'
```

9. WAITFOR

`WAITFOR` delays execution for a specified amount of time.

Example:

```
WAITFOR DELAY '00:00:10';  -- Waits for 10 seconds
```

Batch, Script, and Transaction in SQL Server

- **Batch**: A batch is a collection of SQL statements executed together. Multiple SQL commands can be grouped and run in a single execution.
- **Script**: A script is a collection of SQL queries, but it can't execute conflicting statements together (like `CREATE TABLE` and `DROP TABLE`). You need to use the `GO` keyword to separate them.
- **Transaction**: A transaction ensures that a series of operations either all succeed or all fail. Use `BEGIN TRANSACTION`, `COMMIT`, and `ROLLBACK` to control transaction behavior.

Batch

A **batch** is a collection of SQL statements that are sent to the SQL Server for execution as a single unit. When a batch is executed, all the statements within it are processed together.

- **Example**:

```
CREATE TABLE Employees (
    EmployeeID INT PRIMARY KEY,
    Name VARCHAR(50)
);
GO
DROP TABLE Employees;  -- This will execute after the previous batch
```

- The `GO` keyword indicates the end of a batch. The statements before `GO` are executed before any that follow it.

Script

A **script** is a collection of SQL queries that cannot be run together due to their nature (like creating or dropping tables). To separate these types of statements, the `GO` keyword is used.

- **Example**:

```
CREATE RULE SalaryRule AS CHECK (Salary > 0);
GO
SP_BINDRULE Employees.Salary, SalaryRule;
```

- Scripts often include various operations that need to be executed sequentially but in different batches.

Transaction

A **transaction** ensures that a series of SQL statements are executed as a single unit. If any statement fails, the entire transaction can be rolled back, ensuring data integrity.

Types of Transactions

1. **Implicit Transaction**:
    - Every `INSERT`, `UPDATE`, or `DELETE` statement operates as its own transaction. SQL Server automatically wraps each of these operations in a transaction (i.e., it starts a transaction, commits it, or rolls it back).
2. **Explicit Transaction**:

- You can define the beginning and end of a transaction using `BEGIN TRANSACTION`, followed by `COMMIT` or `ROLLBACK`.

Example of Transactions

1. **Creating Tables and Inserting Data**:

```
USE CompanyDB;

CREATE TABLE Parent (
    PID INT PRIMARY KEY
);

CREATE TABLE Child (
    CID INT REFERENCES Parent(PID)
);

INSERT INTO Parent VALUES (1);
INSERT INTO Parent VALUES (2);
INSERT INTO Parent VALUES (3);
INSERT INTO Parent VALUES (4);
```

1. **Using Explicit Transactions**:

```
BEGIN TRANSACTION;
INSERT INTO Child VALUES (1);
INSERT INTO Child VALUES (2);
INSERT INTO Child VALUES (3);
ROLLBACK;
```

- In this example, since a `ROLLBACK` is executed, none of the inserted values are added to the `Child` table. The changes are reverted.

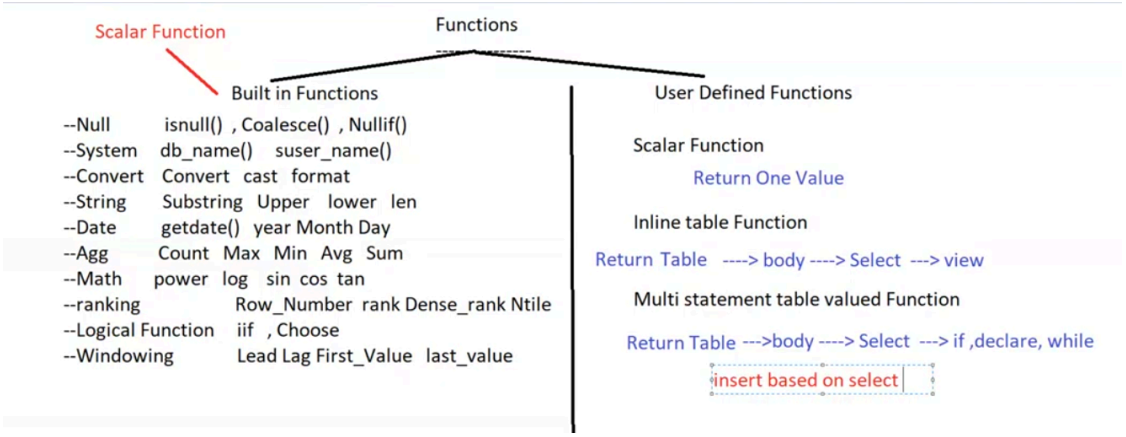
1. **Handling Errors with TRY...CATCH**:

```
BEGIN TRY
    BEGIN TRANSACTION;  -- Start a transaction
    INSERT INTO Child VALUES (1);  -- First insert
    INSERT INTO Child VALUES (6);  -- Second insert
```

```
    INSERT INTO Child VALUES (2);  -- This may cause a primary key violatio
n
    COMMIT;  -- If all inserts are successful, commit the transaction
END TRY
BEGIN CATCH
    ROLLBACK;  -- If an error occurs, roll back the transaction
    SELECT ERROR_MESSAGE() AS ErrorMessage;  -- Display the error mes
sage
END CATCH;
```

- In this case, if the insert into the `Child` table fails (due to a primary key violation, for instance), the `CATCH` block executes, rolling back any changes made during the transaction.

SQL Functions: Built in functions



1. NULL Functions

ISNULL

Returns a specified replacement value if the expression is NULL.

```
SELECT Fname, ISNULL(PhoneNumber, 'No Phone') AS Phone FROM Empl
oyee;
```

COALESCE

Returns the first non-NULL value in the list of expressions.

```
SELECT Fname, COALESCE(Email, 'No Email', Lname) AS Contact FROM E
mployee;
```

NULLIF

Returns NULL if the two expressions are equal.

```
SELECT Fname, NULLIF(Salary, 0) AS AdjustedSalary FROM Employee;
```

---

2. System Functions

DB_NAME()

Returns the name of the current database.

```
SELECT DB_NAME() AS CurrentDatabase;
```

SUSER_NAME()

Returns the login name of the current user.

```
SELECT SUSER_NAME() AS CurrentUser;
```

---

3. Conversion Functions

CONVERT

Converts an expression from one data type to another.

```
SELECT Fname, CONVERT(VARCHAR(20), HireDate, 101) AS HireDateForm
atted FROM Employee;
```

CAST

Similar to CONVERT, but ANSI SQL compliant.

```
SELECT Fname, CAST(Salary AS DECIMAL(10, 2)) AS SalaryDecimal FROM
Employee;
```

FORMAT

Formats a value based on a specified format.

```
SELECT Fname, FORMAT(Salary, 'C', 'en-US') AS SalaryFormatted FROM E
mployee; -- Formats salary as currency
```

---

4. String Functions

SUBSTRING

Extracts a substring from a string.

```
SELECT Fname, SUBSTRING(Lname, 1, 3) AS LnamePrefix FROM Employe
e;
```

UPPER

Converts a string to uppercase.

```
SELECT UPPER(Fname) AS UpperFname FROM Employee;
```

LOWER

Converts a string to lowercase.

```
SELECT LOWER(Lname) AS LowerLname FROM Employee;
```

LEN

Returns the length of a string.

```
SELECT Fname, LEN(Fname) AS FnameLength FROM Employee;
```

---

5. Date Functions

GETDATE()

Returns the current date and time.

```
SELECT GETDATE() AS CurrentDateTime;
```

YEAR, MONTH, DAY

Extracts the year, month, and day from a date.

```
SELECT Fname, YEAR(HireDate) AS HireYear, MONTH(HireDate) AS HireMo
nth, DAY(HireDate) AS HireDay FROM Employee;
```

---

6. Aggregate Functions

COUNT

Counts the number of rows that match a specified condition.

```
SELECT COUNT(*) AS TotalEmployees FROM Employee;
```

MAX

Returns the maximum value.

```
SELECT MAX(Salary) AS MaxSalary FROM Employee;
```

MIN

Returns the minimum value.

```
SELECT MIN(Salary) AS MinSalary FROM Employee;
```

AVG

Returns the average of a numeric column.

```
SELECT AVG(Salary) AS AverageSalary FROM Employee;
```

SUM

Returns the total sum of a numeric column.

```
SELECT SUM(Salary) AS TotalSalaries FROM Employee;
```

---

7. Mathematical Functions

POWER

Raises a number to a specified power.

```
SELECT Fname, POWER(Salary, 2) AS SalarySquared FROM Employee;
```

LOG

Returns the logarithm of a number.

```
SELECT Fname, LOG(Salary) AS SalaryLog FROM Employee;
```

SIN , COS

Returns the sine and cosine of an angle (in radians).

```
SELECT Fname, SIN(Salary) AS SalarySine FROM Employee;
```

---

8. Ranking Functions

ROW_NUMBER

Assigns a unique number to each row based on the specified order.

```
SELECT Fname, ROW_NUMBER() OVER (ORDER BY Salary DESC) AS RowN
um FROM Employee;
```

DENSE_RANK

Assigns ranks to rows in a result set with no gaps.

```
SELECT Fname, DENSE_RANK() OVER (ORDER BY Salary DESC) AS Dense
Rank FROM Employee;
```

RANK

Similar to DENSE_RANK but allows gaps in ranking values.

```
SELECT Fname, RANK() OVER (ORDER BY Salary DESC) AS Rank FROM Em
ployee;
```

---

9. Logical Functions

IIF

Returns one of two values based on the evaluation of a Boolean expression.

```
SELECT Fname, IIF(Salary >= 1600, 'High', 'Low') AS SalaryStatus FROM E
mployee;
```

CHOOSE

Returns the item at the specified index from a list of values.

```
SELECT CHOOSE(2, 'Finance', 'HR', 'IT', 'Sales') AS Department; -- Returns
'HR'
```

---

10. Windowing Functions

LEAD

Returns the value of a column from a subsequent row.

```
SELECT Fname, LEAD(Salary) OVER (ORDER BY Salary) AS NextSalary FRO
M Employee;
```

LAG

Returns the value of a column from a previous row.

```
SELECT Fname, LAG(Salary) OVER (ORDER BY Salary) AS PrevSalary FRO
M Employee;
```

FIRST_VALUE

Returns the first value in an ordered set.

```
SELECT Fname, FIRST_VALUE(Salary) OVER (ORDER BY Salary) AS FirstSal
ary FROM Employee;
```

`LAST_VALUE`

Returns the last value in an ordered set.

```
SELECT Fname, LAST_VALUE(Salary) OVER (ORDER BY Salary ROWS BET
WEEN UNBOUNDED PRECEDING AND UNBOUNDED FOLLOWING) AS Last
Salary FROM Employee;
```

1. Using LAG and LEAD

- `LAG` retrieves the value of a specified column from the previous row within the result set.
- `LEAD` retrieves the value of a specified column from the next row.

Example: Get Previous and Next Employee Names Based on Salary

```
SELECT
    Lname,
    Salary,
    PrevLname = LAG(Lname) OVER (ORDER BY Salary),
    NextLname = LEAD(Lname) OVER (ORDER BY Salary)
FROM
    Employee;
```

2. LAG and LEAD with Salary

Example: Get Previous and Next Salaries

```
SELECT
    Lname,
    Salary,
    PrevSalary = LAG(Salary) OVER (ORDER BY Salary),
```

```
    NextSalary = LEAD(Salary) OVER (ORDER BY Salary)
FROM
    Employee;
```

3. Using Subquery with LAG and LEAD

Example: Get Previous and Next Names for a Specific Employee

```
SELECT *
FROM (
    SELECT
        Lname,
        Salary,
        PrevLname = LAG(Lname) OVER (ORDER BY Salary),
        NextLname = LEAD(Lname) OVER (ORDER BY Salary)
    FROM
        Employee
) AS NewTable
WHERE
    Lname = 'Ahmed';
```

4. Using PARTITION BY with LAG and LEAD

Example: Get Previous and Next Names by Department

```
SELECT
    Lname,
    Salary,
    Dno,
    PrevLname = LAG(Lname) OVER (PARTITION BY Dno ORDER BY Salary),
    NextLname = LEAD(Lname) OVER (PARTITION BY Dno ORDER BY Salar
y)
FROM
    Employee;
```

5. Using FIRST_VALUE and LAST_VALUE

- `FIRST_VALUE` retrieves the first value in an ordered set of values.
- `LAST_VALUE` retrieves the last value in an ordered set of values.

Example: Get First and Last Employee Names Based on Salary

```
SELECT
   Lname,
   Salary,
   Dno,
   FirstName = FIRST_VALUE(Lname) OVER (ORDER BY Salary),
   LastName = LAST_VALUE(Lname) OVER (ORDER BY Salary
                              ROWS BETWEEN UNBOUNDED PRECEDING AND U
NBOUNDED FOLLOWING)
FROM
   Employee;
```

6. Combined Example with LAG, LEAD, FIRST_VALUE, and LAST_VALUE

Example: Combine All Functions for Employee Analysis

```
SELECT
   Lname,
   Salary,
   Dno,
   PrevLname = LAG(Lname) OVER (ORDER BY Salary),
   NextLname = LEAD(Lname) OVER (ORDER BY Salary),
   FirstName = FIRST_VALUE(Lname) OVER (ORDER BY Salary),
   LastName = LAST_VALUE(Lname) OVER (ORDER BY Salary
                              ROWS BETWEEN UNBOUNDED PRECEDING AND U
NBOUNDED FOLLOWING)
FROM
   Employee;
```

2- User defined functions

1. Scalar Function

A scalar function returns a single value. It can be used to encapsulate logic that needs to be reused.

Example: Get Employee First Name by SSN

```
CREATE FUNCTION dbo.getsname(@id INT)
RETURNS VARCHAR(20)
AS
BEGIN
   DECLARE @name VARCHAR(20);
   SELECT @name = EmployeeName FROM Employee WHERE SSN = @id;
   RETURN @name;
END;
GO

-- Usage
SELECT dbo.getsname(112233) AS EmployeeFirstName;
```

2. Inline Table-Valued Function

An inline table-valued function returns a table and consists of a single SELECT statement. It cannot contain any control-of-flow language like `IF` or `TRY...CATCH`.

Example: Get Employees Working in a Specific Department

```
CREATE FUNCTION dbo.people_work_in_dep(@Dep_id INT)
RETURNS TABLE
AS
RETURN
(
   SELECT EmployeeName, Salary * 12 AS TotalSalary
   FROM Employees
   WHERE DepartmentID = @Dep_id
);
GO
```

```
-- Usage
SELECT * FROM dbo.people_work_in_dep(10);
SELECT SUM(TotalSalary) FROM dbo.people_work_in_dep(10);
SELECT Fname FROM dbo.people_work_in_dep(10);
```

3. Multi-Statement Table-Valued Function

A multi-statement table-valued function can contain multiple statements, including `IF` conditions and loops. It returns a table variable that you define within the function.

Example: Get Employees Based on Format

```
CREATE FUNCTION dbo.getemployees(@format VARCHAR(20))
RETURNS @t TABLE (id INT, ename VARCHAR(20))
AS
BEGIN
   IF @format = 'first'
      INSERT INTO @t SELECT SSN, Fname FROM Employees;
   ELSE IF @format = 'last'
      INSERT INTO @t SELECT SSN, Lname FROM Employees;
   ELSE IF @format = 'full'
      INSERT INTO @t SELECT SSN, Fname + ' ' + Lname FROM Employees;
   RETURN;
END;
GO

-- Usage
SELECT * FROM dbo.getemployees('full');
```

Notes on User-Defined Functions

- The type of function you create depends on the return type you need (scalar or table).
- Only `SELECT` statements can be used inside these functions.
- You can find user-defined functions under `Company_DB` → `Programmability` → `Functions`.

⇒ To get max name length

```
DECLARE @max_name_length INT;

SELECT @max_name_length = MAX(LEN(EmployeeName))
FROM Employees;

SELECT EmployeeName
FROM Employees
WHERE LEN(EmployeeName) = @max_name_length;



SELECT TOP 1 EmployeeName
FROM Employees
ORDER BY LEN(EmployeeName) DESC;
```