

Functions and Stored Procedures

Database Programmability



SoftUni Team
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Software University

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Table of Contents

1. User-Defined Functions
2. Stored Procedures
3. Stored Procedures with Parameters
4. Error Handling



sli.do

#csharp-db



User-Defined Functions

Definition, Usage, Syntax

Functions: Basic Definition

- At its core, a function **receives an input** and **produces an output**




Types of User-Defined Functions

- **Scalar functions**
 - Similar to the **built-in functions**
 - Returns a **single value**
- **Table-valued functions**
 - Similar to **a view with parameters**
 - **Returns a table** as a result of a single **SELECT** statement
 - Inline table-valued function (TVF)
 - Multi-statement table-valued function (MSTVF)



Functions: Limitations

- 
- User-defined functions **cannot** be used to perform actions that **modify** the database state
 - User-defined functions **cannot** return **multiple** result sets
 - User-defined functions cannot make use of **dynamic SQL** or **temp tables**. Table variables are allowed.
 - User-defined functions can be nested up to 32 levels
 - Error handling is restricted in a user-defined function
UDF does not support **TRY...CATCH**, **@ERROR** or **RAISERROR**

Create Functions (Scalar)

```
CREATE FUNCTION udf_ProjectDurationWeeks (@StartDate DATETIME,  
@EndDate DATETIME)  
RETURNS INT  
AS  
BEGIN  
    DECLARE @projectWeeks INT;  
    IF (@EndDate IS NULL)  
    BEGIN  
        SET @EndDate = GETDATE()  
    END  
    SET @projectWeeks = DATEDIFF(WEEK, @StartDate, @EndDate)  
    RETURN @projectWeeks;  
END
```

Function Name

Parameters

Return Type

Variable

IF Statement

Return Value

Create Functions (Table-Valued Function)

```
CREATE FUNCTION udf_AverageSalaryByDepartment()  
RETURNS TABLE AS  
RETURN  
(  
    SELECT d.[Name] AS Department, AVG(e.Salary) AS AverageSalary  
    FROM Departments AS d  
    JOIN Employees AS e ON d.DepartmentID = e.DepartmentID  
    GROUP BY d.DepartmentID, d.[Name]  
)
```

Function Name

Return Type

No Parameters

Return Value

Create Functions (Multi-statement TVF)

```
CREATE FUNCTION udf_EmployeeListByDepartment(@DepName nvarchar(20))
RETURNS @result TABLE(
    FirstName nvarchar(50) NOT NULL,
    LastName nvarchar(50) NOT NULL,
    DepartmentName nvarchar(20) NOT NULL) AS
BEGIN
    WITH Employees_CTE (FirstName, LastName, DepartmentName)
    AS(
        SELECT e.FirstName, e.LastName, d.[Name]
        FROM Employees AS e
        LEFT JOIN Departments AS d ON d.DepartmentID = e.DepartmentID)

    INSERT INTO @result SELECT FirstName, LastName, DepartmentName
    FROM Employees_CTE WHERE DepartmentName = @DepName
    RETURN
END
```

- Functions are called using **schemaName.functionName**

```
SELECT [ProjectID],  
       [StartDate],  
       [EndDate],  
       dbo.udf_ProjectDurationWeeks([StartDate],[EndDate])  
AS ProjectWeeks  
FROM [SoftUni].[dbo].[Projects]
```

Call the Function

ProjectID	StartDate	EndDate	ProjectWeeks
1	2016-09-01	2016-10-07	5
2	2016-10-01	2016-10-07	1
3	2015-10-07	NULL	52

Problem: Salary Level Function

- Write a function **ufn_GetSalaryLevel(@Salary MONEY)** that receives salary of an employee and returns the level of the salary
 - If salary is < 30000 return "Low"
 - If salary is between 30000 and 50000 (inclusive) returns "Average"
 - If salary is > 50000 return "High"

	FirstName	LastName	Salary	SalaryLevel
1	Guy	Gilbert	12500.00	Low
2	Kevin	Brown	13500.00	Low
3	Roberto	Tamburello	43300.00	Average
4	Rob	Walters	29800.00	Low
5	Thierry	D'Hers	25000.00	Low



Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1025#4>

Solution: Salary Level Function (1)

Function Name

Input Parameters

```
CREATE FUNCTION
ufn_GetSalaryLevel(@Salary MONEY)
RETURNS NVARCHAR(10)
AS
BEGIN
    -- Function logic here
END;
```

Return Type

Function Body

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1025#4>

Solution: Salary Level Function (2)

```
DECLARE @salaryLevel VARCHAR(10)
```

Variable

```
IF (@Salary < 30000)
```

IF Statement

```
    SET @salaryLevel = 'Low'
```

```
ELSE IF (@Salary <= 50000)
```

```
    SET @salaryLevel = 'Average'
```

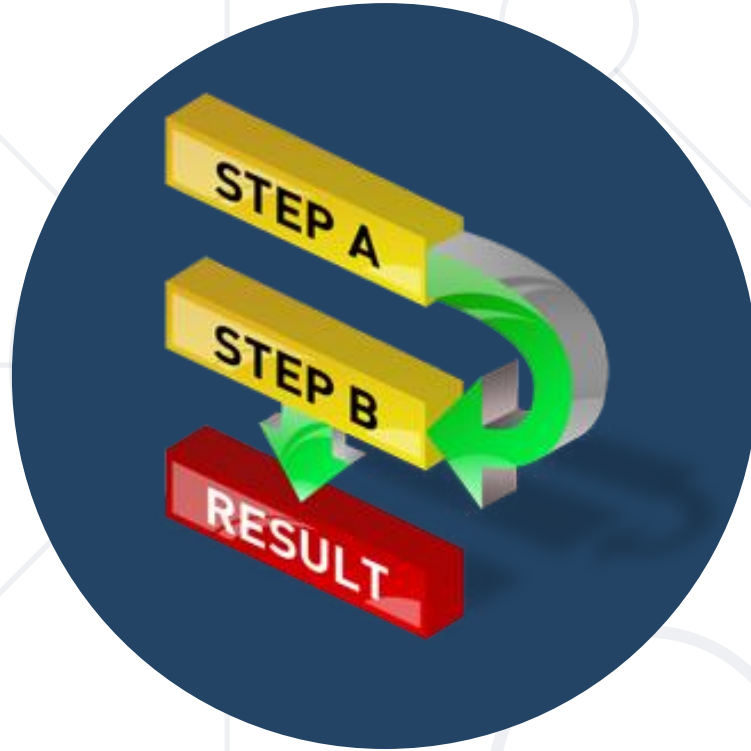
```
ELSE
```

```
    SET @salaryLevel = 'High'
```

```
RETURN @salaryLevel
```

Return Result

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1025#4>



Stored Procedures

What Are Stored Procedures?

- **Stored procedures** are **named sequences** of **T-SQL statements**
 - **Encapsulate** repetitive program **logic**
 - Can **accept input parameters**
 - Can **return output results**
- **Benefits** of stored procedures
 - **Share** application logic
 - Improved **performance**
 - **Reduced** network **traffic**
 - They can be used as a **security** mechanism

- **User-defined**

- Can be created in a **user-defined database** or in all system databases except the **Resource** database
- Can be developed in either **Transact-SQL** or as a reference to a **Microsoft .NET Framework** method

- **Temporary**

- A form of user-defined procedures stored in **tempdb**

Creating Stored Procedures

- Syntax: **CREATE PROCEDURE ... AS ...**
- Example:

```
USE SoftUni  
GO
```

Procedure Name

```
CREATE PROC dbo.usp_SelectEmployeesBySeniority  
AS
```

Procedure Logic

```
    SELECT *  
    FROM Employees  
    WHERE DATEDIFF(Year, HireDate, GETDATE()) > 20  
GO
```

- Executing a stored procedure by **EXEC**

```
EXEC usp_SelectEmployeesBySeniority
```

- Executing a stored procedure within an **INSERT** statement

```
INSERT INTO Customers  
EXEC usp_SelectEmployeesBySeniority
```

Altering Stored Procedures

- Use the **ALTER PROCEDURE** statement

```
USE SoftUni  
GO
```

```
ALTER PROC usp_SelectEmployeesBySeniority  
AS
```

```
    SELECT FirstName, LastName, HireDate,  
           DATEDIFF(Year, HireDate, GETDATE()) as Years  
    FROM Employees  
    WHERE DATEDIFF(Year, HireDate, GETDATE()) > 20  
    ORDER BY HireDate  
GO
```



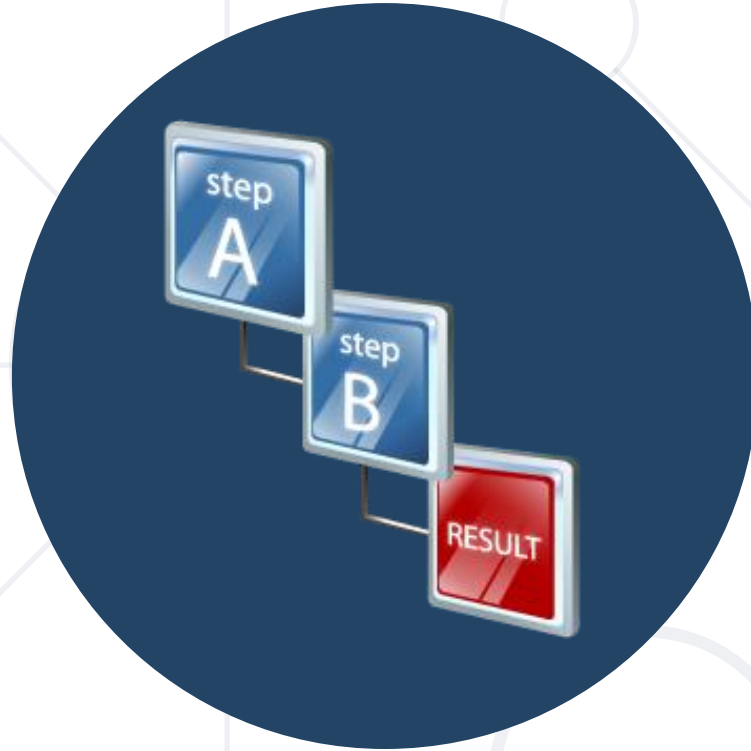
Procedure Name

- **DROP PROCEDURE**

```
DROP PROC usp_SelectEmployeesBySeniority
```

- You could **check** if any objects **depend** on the stored procedure by executing **the system stored procedure sp_depends**

```
EXEC sp_depends 'usp_SelectEmployeesBySeniority'
```



Stored Procedures with Parameters

- To define a **parameterized procedure**, use the syntax:

```
CREATE PROCEDURE usp_ProcedureName  
  (@parameter1Name parameterType,  
   @parameter2Name parameterType,...) AS
```

- Choose the parameter types carefully and provide **appropriate default values**

```
CREATE PROC  
usp_SelectEmployeesBySeniority(  
  @minYearsAtWork int = 5) AS ...
```

Parameterized Stored Procedures - Example

```
CREATE PROC usp_SelectEmployeesBySeniority  
    (@minYearsAtWork int = 5)
```

Procedure Name

```
AS
```

```
    SELECT FirstName, LastName, HireDate,  
           DATEDIFF(Year, HireDate, GETDATE()) as Years
```

```
    FROM Employees
```

```
    WHERE DATEDIFF(Year, HireDate, GETDATE()) > @minYearsAtWork
```

```
    ORDER BY HireDate
```

```
GO
```

Procedure Logic

```
EXEC usp_SelectEmployeesBySeniority 10
```

Usage

- Passing values by **parameter name**

```
EXEC usp_AddCustomer  
    @customerID = 'ALFKI',  
    @companyName = 'Alfreds Futterkiste',  
    @address = 'Obere Str. 57',  
    @city = 'Berlin',  
    @phone = '030-0074321'
```

- Passing values by **position**

```
EXEC usp_AddCustomer 'ALFKI2', 'Alfreds  
Futterkiste', 'Obere Str. 57', 'Berlin',  
'030-0074321'
```

Returning Values Using OUTPUT Parameters

```
CREATE PROCEDURE dbo.usp_AddNumbers  
    @firstNumber SMALLINT,  
    @secondNumber SMALLINT,  
    @result INT OUTPUT
```

Creating procedure

```
AS
```

```
    SET @result = @firstNumber + @secondNumber
```

```
GO
```

```
DECLARE @answer smallint
```

```
EXECUTE usp_AddNumbers 5, 6, @answer OUTPUT
```

```
SELECT 'The result is: ', @answer
```

Executing procedure

```
-- The result is: 11
```

Display results

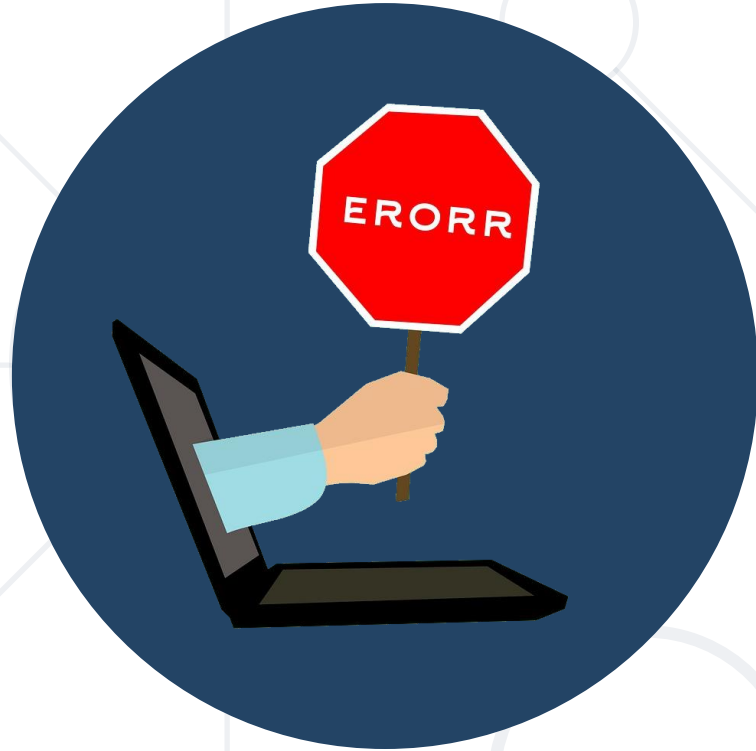
Returning Multiple Results

Checks if procedure exists
and then Creates or Alters it

```
CREATE OR ALTER PROC usp_MultipleResults
AS
SELECT FirstName, LastName FROM Employees
SELECT FirstName, LastName, d.[Name] AS Department
FROM Employees AS e
JOIN Departments AS d ON e.DepartmentID = d.DepartmentID;
GO

EXEC usp_MultipleResults
```

Multiple SELECT
statements



Error Handling

■ **THROW**

- Raises an exception and transfers execution to a **CATCH** block
- Arguments:
 - error_number - **INT** (between **50000** and **2147483647**)
 - message - **NVARCHAR(2048)**
 - state - **TINYINT** (between **0** and **255**)

```
IF(@candidateAge < @minimalCandidateAge)
BEGIN
    THROW 50001, 'The candidate is too young!', 1;
END
```

■ TRY...CATCH

- SQL Statements can be enclosed in a **TRY** block
- If an error occurs in the **TRY** block, control is passed to another group of statements that is enclosed in a **CATCH** block

```
BEGIN TRY
    { sql_statement | statement_block }
END TRY
BEGIN CATCH
    [ { sql_statement | statement_block } ]
END CATCH
[ ; ]
```

```
BEGIN TRY
    -- Generate a divide-by-zero error.
    SELECT 1/0
END TRY
BEGIN CATCH
    SELECT
        ERROR_NUMBER() AS ErrorNumber
        ,ERROR_SEVERITY() AS ErrorSeverity
        ,ERROR_STATE() AS ErrorState
        ,ERROR_PROCEDURE() AS ErrorProcedure
        ,ERROR_LINE() AS ErrorLine
        ,ERROR_MESSAGE() AS ErrorMessage;
END CATCH
GO
```

- @@ERROR
 - Returns 0 if the previous Transact-SQL statement encountered no errors
 - Returns an error number if the previous statement encountered an error
 - @@ERROR is cleared and reset on each statement executed, check it immediately following the statement being verified, or save it to a local variable that can be checked later

- **Functions** allow for complex calculations
 - Usually return a scalar value

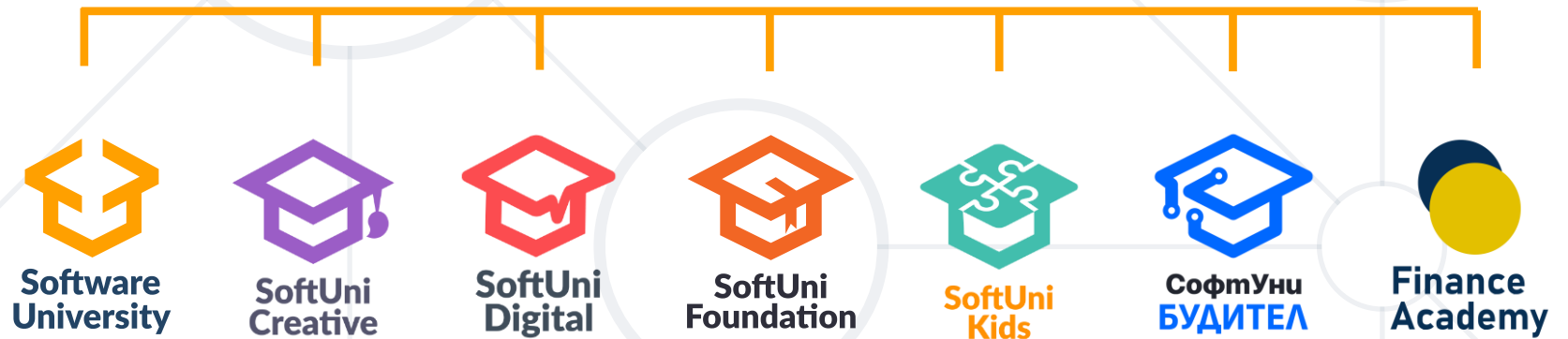
```
CREATE FUNCTION f_ProcedureName  
RETURNS ...  
AS  
...
```

- **Stored Procedures** allow us to save time by
 - Shortening code
 - Simplifying complex tasks

```
CREATE PROC usp_ProcedureName  
AS ...
```



Questions?



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