Scalar user defined functions

WRITING FUNCTIONS AND STORED PROCEDURES IN SQL SERVER

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User defined functions (UDFs)

What?

Routines that

- Can accept input parameters
- Perform an action
- Return result (single scalar value or table)

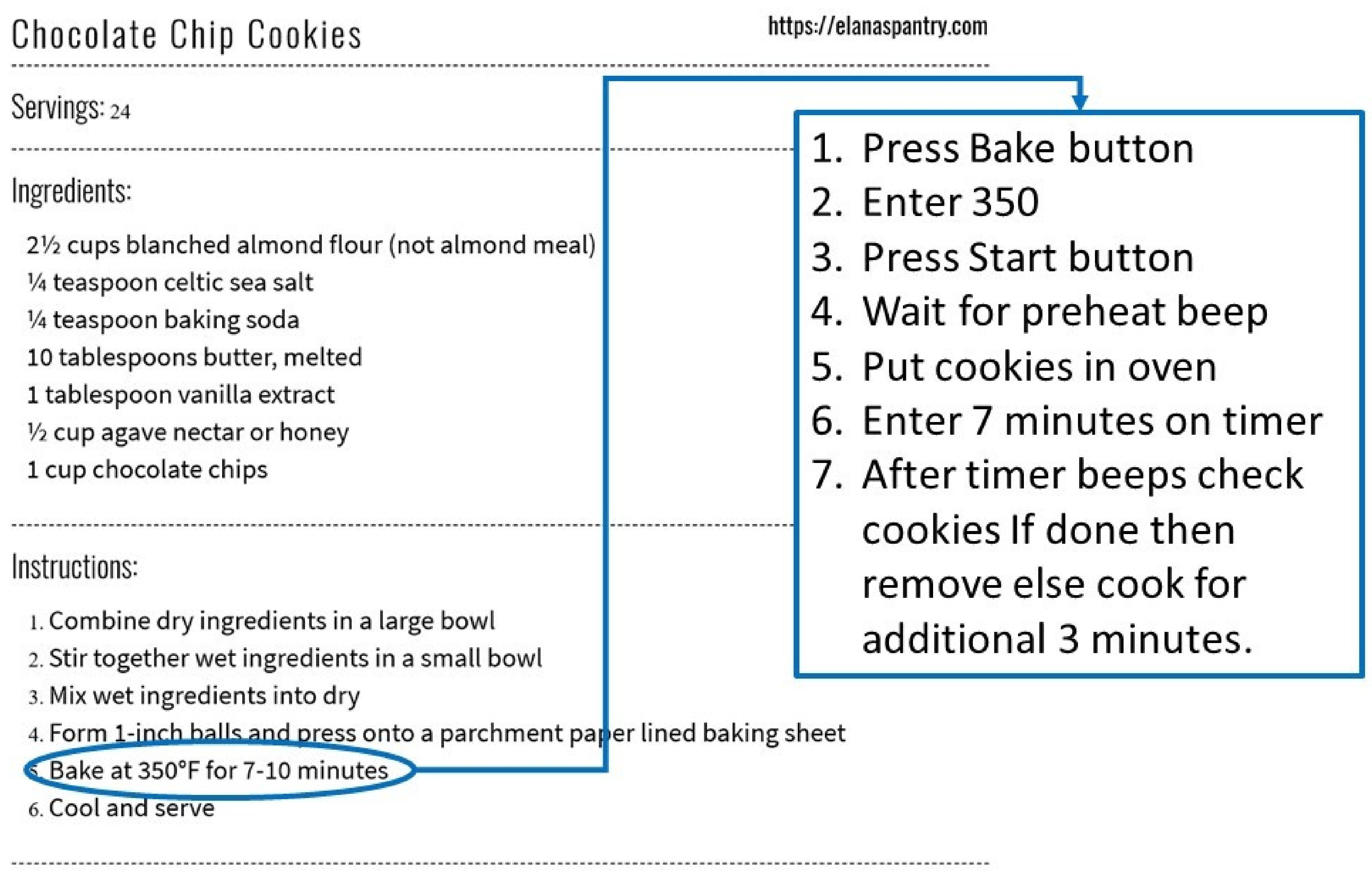
Why?

- Can reduce execution time
- Can reduce network traffic
- Allow for Modular Programming

What is modular programming?

- Software design technique
- Separates functionality into independent, interchangeable modules
- Allows code reuse
- Improves code readability

Functions in recipes



Chocolate Chip Cookies

https://elanaspantry.com

Servings: 24

Ingredients:

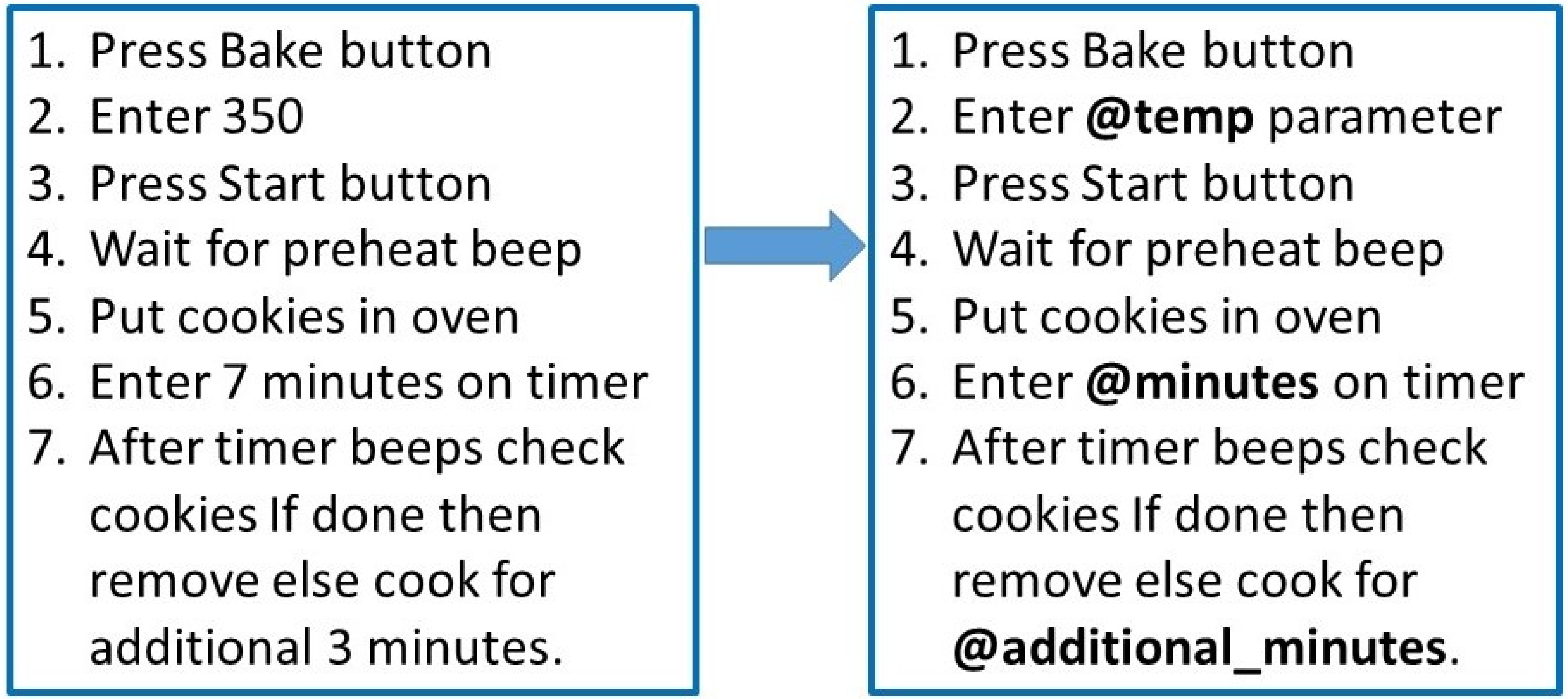
2½ cups blanched almond flour (not almond meal)
¼ teaspoon celtic sea salt
¼ teaspoon baking soda
10 tablespoons butter, melted
1 tablespoon vanilla extract
½ cup agave nectar or honey
1 cup chocolate chips

Instructions:

1. Combine dry ingredients in a large bowl
2. Stir together wet ingredients in a small bowl
3. Mix wet ingredients into dry
4. Form 1-inch balls and press onto a parchment paper lined baking sheet
5. Bake at 350°F for 7-10 minutes
6. Cool and serve

1. Press Bake button
2. Enter 350
3. Press Start button
4. Wait for preheat beep
5. Put cookies in oven
6. Enter 7 minutes on timer
7. After timer beeps check cookies If done then remove else cook for additional 3 minutes.

Bake function input parameters



1. Press Bake button
2. Enter 350
3. Press Start button
4. Wait for preheat beep
5. Put cookies in oven
6. Enter 7 minutes on timer
7. After timer beeps check cookies If done then remove else cook for additional 3 minutes.

1. Press Bake button
2. Enter **@temp** parameter
3. Press Start button
4. Wait for preheat beep
5. Put cookies in oven
6. Enter **@minutes** on timer
7. After timer beeps check cookies If done then remove else cook for **@additional_minutes**.

Scalar UDF with no input parameter

```
-- Scalar function with no input parameters
CREATE FUNCTION GetTomorrow()
    RETURNS date AS BEGIN
RETURN (SELECT DATEADD(day, 1, GETDATE()))
END
```

Scalar UDF with one parameter

```
-- Scalar function with one parameter
CREATE FUNCTION GetRideHrsOneDay (@DateParm date)
    RETURNS numeric AS BEGIN
RETURN (
  SELECT
    SUM(
      DATEDIFF(second, PickupDate, DropoffDate)
    )/ 3600
  FROM
    YellowTripData
  WHERE
    CONVERT (date, PickupDate) = @DateParm
) END;
```

All user defined function names should contain a verb and parameter names must begin with an @ sign.

Scalar UDF with two input parameters

```
-- Scalar function with two input parameters
CREATE FUNCTION GetRideHrsDateRange (
  @StartDateParm datetime, @EndDateParm datetime
) RETURNS numeric AS BEGIN RETURN (
  SELECT
    SUM(
      DATEDIFF(second, PickupDate, DropOffDate)
    )/ 3600
  FROM YellowTripData
  WHERE
    PickupDate > @StartDateParm
    AND DropoffDate < @EndDateParm
) END;
```

It's your turn to create UDFs!

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Table valued UDFs

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Inline table valued functions (ITVF)

```
CREATE FUNCTION SumLocationStats (
  @StartDate AS datetime = '1/1/2017'
) RETURNS TABLE AS RETURN
SELECT
  PULocationID AS PickupLocation,
  COUNT(ID) AS RideCount,
  SUM(TripDistance) AS TotalTripDistance
FROM YellowTripData
WHERE CAST(PickupDate AS Date) = @StartDate
GROUP BY PULocationID;
```

Scalar functions require the use of the BEGIN END block, regardless of whether it's single statement, but a table valued function doesn't require BEGIN END if the function body is a single statement.

Column names need to be assigned in the SELECT statement because a table is being return.

```sql
CREATE FUNCTION CountTripAvgFareDay (
  @Month char(2),
  @Year char(4)
) RETURNS @TripCountAvgFare TABLE(
  DropOffDate date, TripCount int, AvgFare numeric
) AS BEGIN INSERT INTO @TripCountAvgFare
SELECT
  CAST(DropOffDate as date),
  COUNT(ID),
  AVG(FareAmount) as AvgFareAmt
FROM YellowTripData
WHERE
  DATEPART(month, DropOffDate) = @Month
  AND DATEPART(year, DropOffDate) = @Year
GROUP BY CAST(DropOffDate as date)
RETURN END;
```

Differences - ITVF vs. MSTVF

Inline

- RETURN results of SELECT
- Table column names in SELECT
- No table variable
- No BEGIN END needed
- No INSERT
- Faster performance

Multi statement

- DECLARE table variable to be returned
- BEGIN END block required
- INSERT data into table variable
- RETURN last statement within BEGIN/END block

Your turn!

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UDFs in action

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Execute scalar with SELECT

```
-- Select with no parameters
SELECT dbo.GetTomorrow()
```

The dbo. that precedes the function name is the schema where the function exists.
The schema must be specified when executing a UDF.
If a schema is not specified when creating the function SQL will automatically assign it the user's default schema.

```
+------------+
| 2019-02-28 |
-------------+
```

Execute scalar with EXEC & store result

```
-- EXEC & store result in variable
DECLARE @TotalRideHrs AS numeric
EXEC @TotalRideHrs = dbo.GetRideHrsOneDay @DateParm = '1/15/2017'
SELECT
  'Total Ride Hours for 1/15/2017:',
  @TotalRideHrs
```

We use the EXEC keyword to execute the GetRideHrsOneDay() function and assign the result to the @TotalRideHrs variable.

```
+---------------------------------+-------+
| Total Ride Hours for 1/15/2017: | 71626 |
+---------------------------------+-------+
```

SELECT parameter value & scalar UDF

```
-- Declare parameter variable
-- Set to oldest date in YellowTripData
-- Pass to function with select
DECLARE @DateParm as date =
(SELECT TOP 1 CONVERT(date, PickupDate)
    FROM YellowTripData
    ORDER BY PickupDate DESC)
SELECT @DateParm, dbo.GetRideHrsOneDay (@DateParm)
```

When using SELECT to execute the UDF, the parameter is listed within parenthesis after the function name.

```
+------------+-------+
| 2017-01-31 | 75519 |
+------------+-------+
```

```sql
SELECT TOP 10 *
FROM dbo.SumLocationStats ('1/09/2017')
ORDER BY RideCount DESC
```

```
+----------------+-----------+-------------------+
| PickupLocation | RideCount | TotalTripDistance |
|----------------+-----------+-------------------|
| 237            |13254      |  22281.95         |
| 161            |13206      |  28208.49         |
| 236            |13200      |  24224.69         |
| 162            |11859      |  26169.46         |
| 186            |10587      |  22415.43         |
| 230            |10257      |  26139.16         |
| 234            |10234      |  19758.23         |
| 170            |9963       |  20931.97         |
| 132            |9230       | 144778.90         |
| 48             |8361       |  18978.80         |
+----------------+-----------+-------------------+
DECLARE @CountTripAvgFareDay TABLE(
     DropOffDate    date,
     TripCount      int,
     AvgFare        numeric)
INSERT INTO @CountTripAvgFareDay
SELECT TOP 10 *
FROM dbo.CountTripAvgFareDay (01, 2017)
ORDER BY DropOffDate ASC

SELECT * FROM @CountTripAvgFareDay
```

```
+-------------+-----------+---------+
| DropOffDate | TripCount | AvgFare |
|-------------+-----------+---------|
| 2017-01-01  |279198     | 15.37   |
| 2017-01-02  |225224     | 12.65   |
| 2017-01-03  |277980     | 12.27   |
| 2017-01-04  |289050     | 12.33   |
| 2017-01-05  |323885     | 11.89   |
| 2017-01-06  |339158     | 11.72   |
| 2017-01-07  |306508     | 11.31   |
| 2017-01-08  |292649     | 12.33   |
| 2017-01-09  |302120     | 12.49   |
| 2017-01-10  |305611     | 12.27   |
+-------------+-----------+---------+
```

See your functions in action!

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Maintaining user defined functions

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ALTER Function

```sql
ALTER FUNCTION SumLocationStats (@EndDate as datetime = '1/01/2017')
RETURNS TABLE AS RETURN
SELECT
  PULocationID as PickupLocation,
  COUNT(ID) as RideCount,
  SUM(TripDistance) as TotalTripDistance
FROM YellowTripData
WHERE CAST(DropOffDate as Date) = @EndDate
GROUP BY PULocationID;
```

CREATE OR ALTER

```sql
CREATE OR ALTER FUNCTION SumLocationStats (
 @EndDate AS datetime = '1/01/2017')
 RETURNS TABLE AS RETURN
SELECT
  PULocationID as PickupLocation,
  COUNT(ID) AS RideCount,
  SUM(TripDistance) AS TotalTripDistance
FROM YellowTripData
WHERE CAST(DropOffDate AS Date) = @EndDate
GROUP BY PULocationID;
```

If you want to change a table valued function from a Multi Statement to an Inline or vice versa, you can't use ALTER.

```
-- Delete function
DROP FUNCTION dbo.CountTripAvgFareDay
```

```
-- Create CountTripAvgFareDay as Inline TVF instead of MSTVF
CREATE FUNCTION dbo.CountTripAvgFareDay(
  @Month char(2),
  @Year char(4)
) RETURNS TABLE AS RETURN (
  SELECT
    CAST(DropOffDate as date) as DropOffDate,
    COUNT(ID) as TripCount,
    AVG(FareAmount) as AvgFareAmt
  FROM YellowTripData
  WHERE
    DATEPART(month, DropOffDate) = @Month
    AND DATEPART(year, DropOffDate) = @Year
  GROUP BY CAST(DropOffDate as date));
```

Determinism improves performance

- A function is deterministic when it returns the same result given
  - the same input parameters
  - the same database state

```
SELECT
  OBJECTPROPERTY(
    OBJECT_ID('[dbo].[GetRideHrsOneDay]'),
    'IsDeterministic'
  )
```

```
+---+
| 1 |
+---+
```

```
SELECT
  OBJECTPROPERTY(
    OBJECT_ID('[dbo].[GetTomorrow]'),
    'IsDeterministic'
  )
```

```
+---+
| 0 |
+---+
```

Schemabinding

- Specifies the schema is bound to the database objects that it references
- Prevents changes to the schema if schema bound objects are referencing it

```
CREATE OR ALTER FUNCTION dbo.GetRideHrsOneDay (@DateParm date)
RETURNS numeric WITH SCHEMABINDING
AS
BEGIN
RETURN
(SELECT SUM(DATEDIFF(second, PickupDate, DropoffDate))/3600
FROM dbo.YellowTripData
WHERE CONVERT (date, PickupDate) = @DateParm)
END;
```

Let's practice!

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