Recursive CTE on Databricks

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Introduction

SQL at Databricks is one of the most popular languages for data modeling, data acquisition, and reporting. A somewhat common question we are asked is if we support Recursive Common Table Expressions (CTE). A recursive CTE is the process in which a query repeatedly executes, returns a subset, unions the data until the recursive process completes.

Here is an example of a TSQL Recursive CTE using the Adventure Works database:

```
CREATE PROCEDURE [dbo].[uspGetBillOfMaterials]
    @StartProductID [int],
    @CheckDate [datetime]
AS
BEGIN
    SET NOCOUNT ON;

    -- Use recursive query to generate a multi-level Bill of Material
(i.e. all level 1
    -- components of a level 0 assembly, all level 2 components of a
```

```
level 1 assembly)
    -- The CheckDate eliminates any components that are no longer
used in the product on this date.
    WITH [BOM_cte]([ProductAssemblyID], [ComponentID],
[ComponentDesc], [PerAssemblyQty], [StandardCost], [ListPrice],
[BOMLevel], [RecursionLevel]) -- CTE name and columns
    AS (
        SELECT b.[ProductAssemblyID], b.[ComponentID], p.[Name], b.
[PerAssemblyQty], p.[StandardCost], p.[ListPrice], b.[BOMLevel], 0 --
Get the initial list of components for the bike assembly
        FROM [Production].[BillOfMaterials] b
            INNER JOIN [Production].[Product] p
            ON b.[ComponentID] = p.[ProductID]
        WHERE b.[ProductAssemblyID] = @StartProductID
            AND @CheckDate >= b.[StartDate]
            AND @CheckDate <= ISNULL(b.[EndDate], @CheckDate)
        UNION ALL
        SELECT b.[ProductAssemblyID], b.[ComponentID], p.[Name], b.
[PerAssemblyQty], p.[StandardCost], p.[ListPrice], b.[BOMLevel],
[RecursionLevel] + 1 -- Join recursive member to anchor
        FROM [BOM_cte] cte
            INNER JOIN [Production].[BillOfMaterials] b
            ON b.[ProductAssemblyID] = cte.[ComponentID]
            INNER JOIN [Production].[Product] p
            ON b.[ComponentID] = p.[ProductID]
        WHERE @CheckDate >= b.[StartDate]
            AND @CheckDate <= ISNULL(b.[EndDate], @CheckDate)
        )
    -- Outer select from the CTE
    SELECT b.[ProductAssemblyID], b.[ComponentID], b.[ComponentDesc],
SUM(b.[PerAssemblyQty]) AS [TotalQuantity] , b.[StandardCost], b.
[ListPrice], b.[BOMLevel], b.[RecursionLevel]
    FROM [BOM_cte] b
    GROUP BY b.[ComponentID], b.[ComponentDesc], b.
[ProductAssemblyID], b.[BOMLevel], b.[RecursionLevel], b.
[StandardCost], b.[ListPrice]
    ORDER BY b.[BOMLevel], b.[ProductAssemblyID], b.[ComponentID]
    OPTION (MAXRECURSION 25)
END;
GO
```

Recursive CTEs are most commonly used to model hierarchical data. In the case above, we are looking to get all the parts associated with a specific assembly item. Another common use case is organizational structures.

Recursive Common Table Expression on Databricks

Unfortunately, Spark SQL does not natively support recursion as shown above. But luckily Databricks users are not restricted to using only SQL! Using PySpark we can reconstruct the above query using a simply Python loop to union dataframes.

In the TSQL example, you will notice that we are working with two different tables from the Adventure Works demo database: BillOfMaterials and Product.

Using PySpark the SQL code translates to the following:

```
i = 1
check_date = '2010-12-23'
start_product_id = 972 # provide a specific id

# bill_df corresponds to the "BOM_CTE" clause in the above query
df = spark.sql("""

SELECT b.ProductAssemblyID, b.ComponentID, p.Name, b.PerAssemblyQty,
p.StandardCost, p.ListPrice, b.BOMLevel, 0 as RecursionLevel

FROM BillOfMaterials b
    INNER JOIN Product p ON b.ComponentID = p.ProductID

WHERE b.ProductAssemblyID = {} AND '{}' >= b.StartDate AND '{}' <=
IFNULL(b.EndDate, '{}')
""".format(start_product_id, check_date, check_date, check_date))


# this view is our 'CTE' that we reference with each pass
df.createOrReplaceTempView('recursion_df')

while True:
# select data for this recursion level
bill_df = spark.sql("""

SELECT b.ProductAssemblyID, b.ComponentID, p.Name, b.PerAssemblyQty,
p.StandardCost, p.ListPrice, b.BOMLevel,  {} as RecursionLevel

FROM recursion_df cte
    INNER JOIN BillOfMaterials b ON b.ProductAssemblyID =
cte.ComponentID
    INNER JOIN Product p ON b.ComponentID = p.ProductID
```

```
    WHERE '{}' >= b.StartDate AND '{}' <= IFNULL(b.EndDate, '{}')
    """.format(i, check_date,check_date,check_date))

    # this view is our 'CTE' that we reference with each pass
    bill_df.createOrReplaceTempView('recursion_df')

    # add the results to the main output dataframe
    df = df.union(bill_df)

    # if there are no results at this recursion level then break
    if bill_df.count() == 0:
        df.createOrReplaceTempView("final_df")
        break
    else:
        i += 1
```

This may seem overly complex for many users, and maybe it is. However, if you notice we are able to utilize much of the same SQL query used in the original TSQL example using the **spark.sql** function. Additionally, the logic has mostly remained the same with small conversions to use Python syntax.

Conclusion

While the syntax and language conversion for Recursive CTEs are not ideal for SQL only users, it is important to point that it is possible on Databricks. So you do not lose functionality when moving to a Lakehouse, it just may change and in the end provide even more possibilities than a Cloud Data Warehouse.

Edit 10.03.22—check out this blog with a similar idea but with list comprehensions instead!

Disclaimer: these are my own thoughts and opinions and not a reflection of my employer

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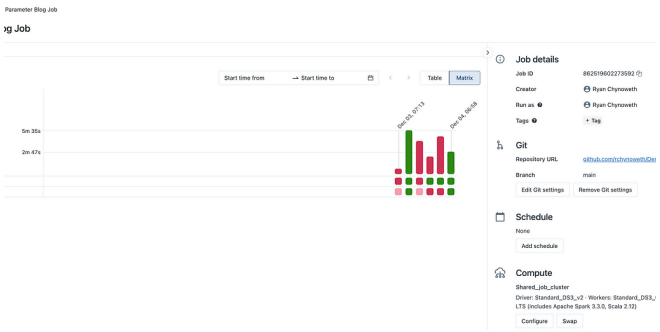

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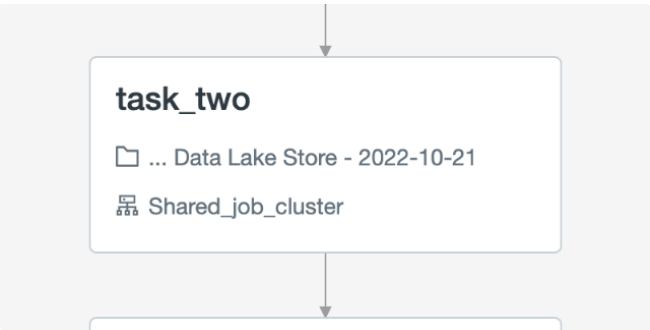

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Special thanks to co-author Kyle Hale, Sr. Specialist Solutions Architect at Databricks.

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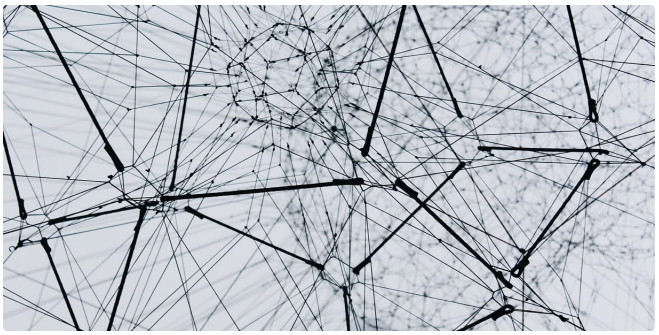

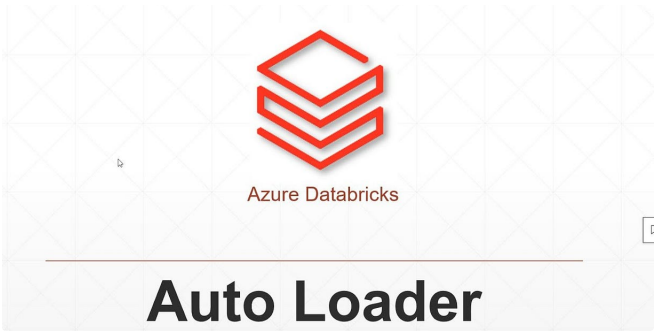

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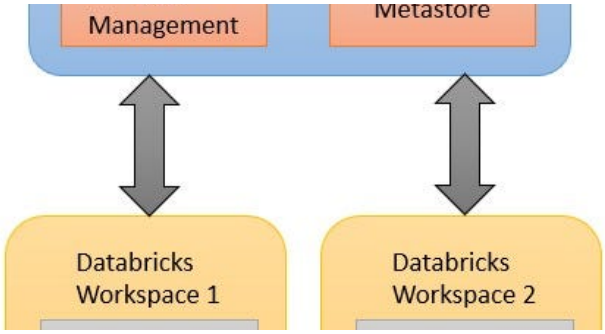

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