Introduction to recursive CTE

HIERARCHICAL AND RECURSIVE QUERIES IN SQL SERVER

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The recursive CTE

Consists of 4 parts:

```
WITH cte_name AS (
    -- Anchor member
   initial_query
   UNION ALL
   -- Recursive member
   recursive_query
 )
SELECT *
    FROM cte_name
```

Guide to use recursive CTE

- For more than 200 recursion steps, increase the number of recursion steps,
  - set `OPTION(MAXRECURSION 32767)`
- The following SQL statements are not allowed: `GROUP BY` , `HAVING` , `LEFT JOIN` , `RIGHT JOIN` , `OUTER JOIN` , `SELECT DISTINCT` , `Subqueries` , `TOP`
- The number of columns for anchor and recursive member are the same.
- The data types of anchor and recursive member are the same

Simple recursive example

Calculating the factorial:

> The factorial of `n` is defined by the product of all positive integers less than or equal to `n` :

```
3! = 1 x 2 x 3 = 6
```

The factorial `n!` is defined recursively as follows:

- `0! = 1 for iteration = 1`
- `(n+1)! = n! * (iteration+1) for iteration > 1`

Simple recursive example

```
WITH recursion AS
     (SELECT 1 AS iterationCounter,1 AS factorial
     UNION ALL
     SELECT iterationCounter+1,factorial * (iterationCounter+1)
         FROM recursion
         WHERE iterationCounter < 10 )
SELECT factorial
    FROM recursion
```

```
3628800
```

Let's practice!

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Working with recursive queries

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The hierarchy of an IT-organization

The organization is described by:

- `ID` - Employee ID
- `Name` of Employee
- `JobTitle` in the company
- `Department` in the company
- `Supervisor` in the company

Fields describing hierarchy:

1. `ID`
2. `Supervisor`

The IT-organization

```
+----------------------+---------------------+------------+------------+
|ID | Name             | Position            | Department | Supervisor |
|----------------------|---------------------|------------|------------|
| 1 | Heinz Griesser   | IT Director         | IT         | 0          |
| 2 | Andreas Sitter   | Security Manager    | IT         | 1          |
| 3 | Thomas Bergman   | Innovation Manager  | IT         | 1          |
| 4 | Hannes Berg      | Operation Manager   | IT         | 1          |
| 5 | Anna Kruggel     | Administrator       | IT         | 4          |
| 6 | Karin Pacher     | Developer           | IT         | 4          |
+----------------------+---------------------+------------+------------+
```

Common tasks for hierarchical data

Get the hierarchy of a record

> Who is your supervisor?

Get the level of the hierarchy

> Get the hierarchy level of an organization

Combine recursion results into one field

> Which supervisors do I have?

Get the hierarchy

```
WITH hierarchy AS (
    SELECT ID,Supervisor
        FROM employee
        WHERE supervisor = 0
    UNION ALL
    SELECT emp.ID,emp.Supervisor
        FROM employee emp
    JOIN employeeHierarchy
      ON emp.Supervisor = employeeHierarchy.ID)
SELECT *
    FROM hierarchy
```

Get the hierarchy

```
+---+-----------+
|ID |Supervisor |
|---|-----------|
|1  | 0         |
|2  | 1         |
|3  | 2         |
+---+-----------+
```

Get the level of the hierarchy

```
WITH hierarchy AS (
    SELECT ID, Supervisor, 1 as LEVEL
        FROM employee
           WHERE Supervisor = 0
    UNION ALL
    SELECT emp.ID, emp.Supervisor, LEVEL + 1
        FROM employee emp
    JOIN hierarchy
    ON emp.Supervisor = hierarchy.ID
)
SELECT *
    FROM hierarchy
```

Get the level of the hierarchy

```
+---+-----------+-------|
|ID |Supervisor | Level |
|---|-----------|-------|
|1  | 0         | 0     |
|2  | 1         | 1     |
+---+-----------+-------+
```

Combine recursion results into one field

```
WITH hierarchy AS (
    SELECT ID, Supervisor, CAST('0' AS VARCHAR(MAX)) as PATH
        FROM employee
        WHERE Supervisor = 0
    UNION ALL
    SELECT emp.ID, emp.Supervisor, Path + '->' + CAST(emp.Supervisor AS VARCHAR(MAX))
        FROM employee emp
    INNER JOIN hierarchy
    ON emp.Supervisor = hierarchy.ID
)
SELECT *
    FROM hierarchy
```

Combine recursion results into one field

```
+-----+--------+
| PATH         |
|--------------|
| 0 -> 1 -> 4  |
+-----+--------+
```

Let's query the IT-organization

HIERARCHICAL AND RECURSIVE QUERIES IN SQL SERVER

Analyze the family tree

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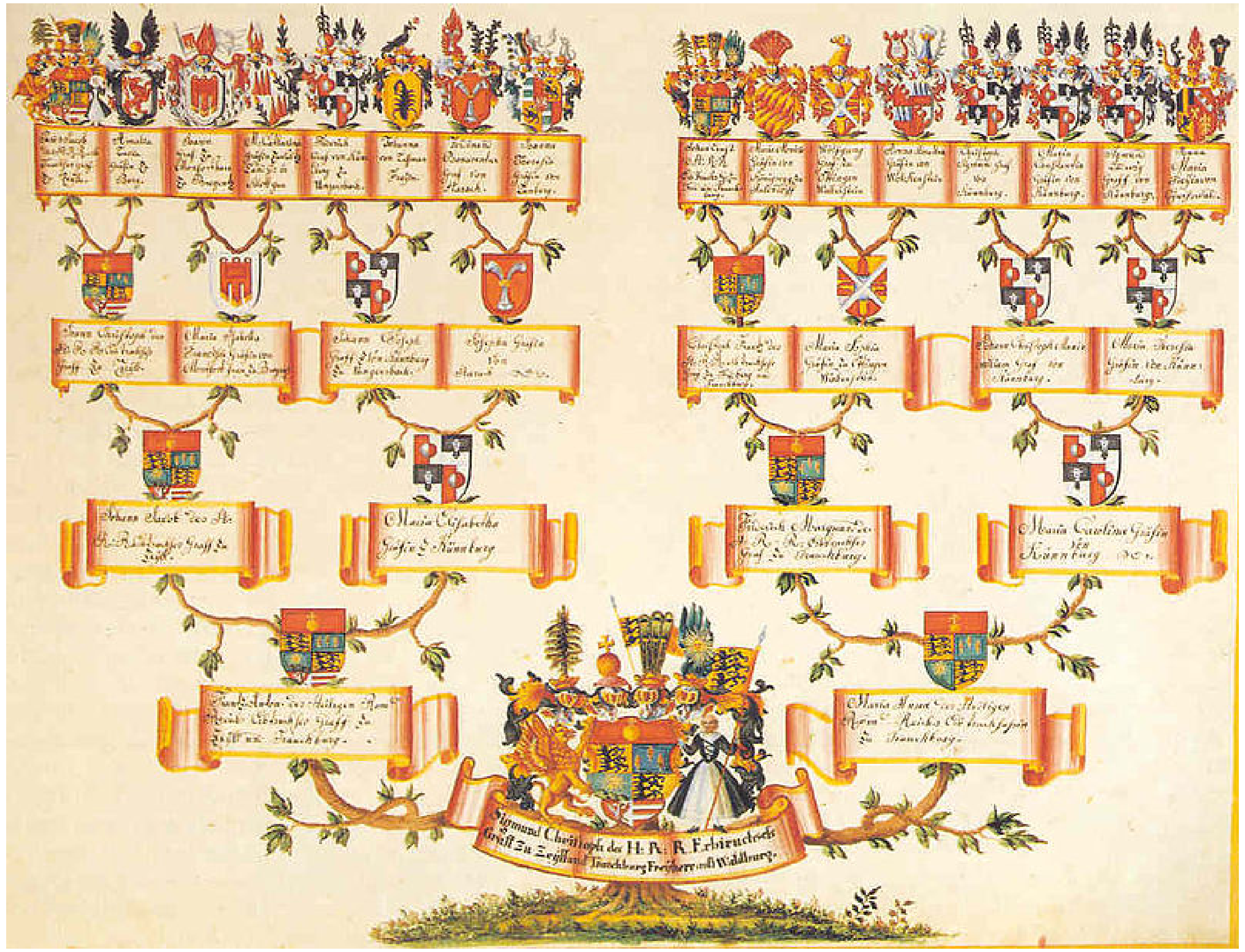
The family tree

The family tree is described by:

- `ID` of the person
- `Name` of the person
- `parentID` the ID of the parent

The elements describing the hierarchy:

- `ID`
- `parentID`



Putting it all together

Remember the following principles about recursive CTEs:

- Initialize the recursion in the anchor member
- Implement the recursion function in the recursion member
- Define a termination condition

Remember the following working principles:

- Get the level of recursion
- Combine the recursion function into one field

Questions about the family tree

Get the number of generations

- Define the `LEVEL`

```
-- Anchor member
0 as LEVEL
-- Recursive member
LEVEL + 1
```

- Count the number of LEVELS to get generations `COUNT(LEVEL)`

```
Generations:
100
```

Questions about the family tree

Get all possible parents in one field

- Combine recursion results into one field

```
-- Anchor member
CAST(ID AS VARCHAR(MAX)) as Parent
-- Recursive member
Parent + ' -> ' + CAST(parentID AS VARCHAR(MAX))
```

```
+----------------------------------------+
| Name            | Parent                |
|-----------------|-----------------------|
|Dominik Egarter  | 100 -> 101 -> 102 ->103  |
+----------------------------------------+
```

Let's check the family tree

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