Advanced Common Table Expressions

Presented by Steve Stedman

About the Speaker/Author

(Steve Stedman)

- Working at Emergency Reporting as CTO
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  - Author of the Common Table Expression Book
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- 23 Years of database work (Microsoft 1990-1991)
- Developer of the Database Health Application
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Downloadable Content

- This presentation and all samples are available at:
- http://SteveStedman.com

Common Table Expressions Book

- Published May 2013
- Available at Amazon.com and at Joes2Pros.com
- Print and Kindle versions both available.

Today's topic comes from Chapter 5, 8, 10 and 11
of
SQL Server Common Table Expression

Audience Survey

- How many people have heard of CTEs?
- How many people have used CTEs?
- How many people have used recursive CTEs?
- How many people have deleted data with a CTE?
- How many people use CTEs every day?
- How many people have used recursive CTEs with multiple anchor queries?
- How many people are planning on taking the 70-461 Microsoft Exam

CTE – Benefits coming your way!

1. Hierarchical Recursive CTEs
2. Manipulating Data
3. Common Use Cases
4. CTE Performance Considerations

Chapter 5

Recursion made to look good.

Hierarchical CTEs

Chapter 5 – Recursion made to look good – Hierarchical CTEs.

Editor | Results | Messages

	Department
1	Camping
2	. Backpacks
3	. Cooking
4	. Sleeping Bags
5	. Tents
6	. . 1 Person
7	. . 2 Person
8	. . . Backpacking
9	. . . Family Camping
10	. . . Mountaineering
11	. . . . Lightweight
12	. . . . Standard
13	. . . . Ultra-lightweight
14	. . 3 Person
15	. . 4 Person
16	Clearance

	id	Department	parent	lvl
1	1	Camping	NULL	1
2	2	Cycle	NULL	1
3	3	Snowsports	NULL	1
4	4	Fitness	NULL	1
5	28	Gifts	NULL	1
6	29	Clearance	NULL	1
7	15	Running	4	2
8	16	Swimming	4	2
9	17	Yoga	4	2
10	12	Ski	3	2
11	13	Snowboard	3	2
12	14	Snowshoe	3	2
13	9	Bikes	2	2
14	10	Helmets	2	2
15	11	Locks	2	2
16	5	Tents	1	2
17	6	Backpacks	1	2
18	7	Sleeping ...	1	2
19	8	Cooking	1	2
20	18	1 Person	5	3
21	19	2 Person	5	3
22	20	3 Person	5	3
23	21	4 Person	5	3

Hierarchy in Multiple Recursive Queries possible.

Editor | Results | Messages

	(No column name)
1	Root: William Arthur Phillip Windsor
2	. Father: Charles Philip Arthur Windsor
3	. . Father: Phillip Mountbatten, Duke of Edinburgh
4	. . . Father: Andreas, Prince of Greece
5	. . . . Father: William George I of the Hellenes
6	. . . . Mother: Olga Konstantinovna Romanova
7	. . . Mother: Alice, Princess of Battenbugr
8	. . . . Father: Louis Alexander von Battenburg
9	. . . . Mother: Victoria von Hessen und bei Rhein
10	. . Mother: Elizabeth II Windsor, Queene of England
11	. . . Father: George VI Windsor, King of England
12	. . . . Father: George V, King of England
13	. . . . Mother: Mary, Princess of Teck
14	. . . Mother: Elizabeth Angela Marguerite Bowes-Lyon
15	. . . . Father: Claude George Bowes-Lyon
16	. . . . Mother: Nina Cecilia Cavendish-Bentinck
17	. Mother: Diana Frances (Lady) Spencer
18	. . Father: Edward John Spencer
19	. . Mother: Frances Ruth Burke Roche

Hierarchy with advanced formatting.

	(No column name)
1	. . . . Father: William George I of the Hellenes
2	. . . Father: Andreas, Prince of Greece
3	. . . . Mother: Olga Konstantinovna Romanova
4	. . Father: Phillip Mountbatten, Duke of Edinburgh
5	. . . . Father: Louis Alexander von Battenburg
6	. . . Mother: Alice, Princess of Battenbugr
7	. . . . Mother: Victoria von Hessen und bei Rhein
8	. Father: Charles Philip Arthur Windsor
9	. . . Father: George V, King of England
10	. . . Father: George VI Windsor, King of England
11	. . . Mother: Mary, Princess of Teck
12	. . Mother: Elizabeth II Windsor, Queene of England
13	. . . . Father: Claude George Bowes-Lyon
14	. . . Mother: Elizabeth Angela Marguerite Bowes-Lyon
15	. . . . Mother: Nina Cecilia Cavendish-Bentinck
16	Top: William Arthur Phillip Windsor
17	. . Father: Edward John Spencer
18	. Mother: Diana Frances (Lady) Spencer
19	. . Mother: Frances Ruth Burke Roche

Demo

Chapter 5

Chapter 8

Manipulating Data:

Insert

Update

Delete

Chapter 8 – DELETE

```
DELETE FROM CTE;
```

1. Are the following SQL Statements valid?
2. Can you delete from a CTE?
3. What does that mean?

```
;WITH CustomerCTE AS
(
  SELECT *
    FROM Customer
   WHERE LastName like 'Williams'
)
DELETE FROM CustomerCTE;
```

```
;WITH CustomerCTE AS
(
 SELECT c.*
   FROM Customer AS c
  INNER JOIN SalesInvoice AS si
     ON si.CustomerID = c.CustomerID
  WHERE c.LastName like 'Williams'
)
DELETE FROM CustomerCTE;
```

Demo

Chapter 8 –

DELETE FROM CTE;

Chapter 8 – INSERT

INSERT INTO CTE;

1. Are the following SQL Statements valid?
2. Can you INSERT INTO a CTE?
3. What does that mean?

```
;WITH CustomerCTE AS
(
  SELECT *
    FROM Customer
   WHERE LastName like 'Stedman'
)
INSERT INTO CustomerCTE
   (CustomerID,FirstName,LastName)
VALUES (99999, 'Steve', 'Stedman');
```

```
;WITH CustomerCTE AS
(
 SELECT c.*
   FROM Customer AS c
  INNER JOIN SalesInvoice AS si
     ON si.CustomerID = c.CustomerID
  WHERE c.LastName like 'Stedman'
)
INSERT INTO CustomerCTE
   (CustomerID, FirstName, LastName)
VALUES (99999, 'Steve', 'Stedman');
```

Demo

Chapter 8 –

INSERT INTO CTE;

Chapter 8 – UPDATE

UPDATE CTE;

1. Are the following SQL Statements valid?
2. Can you UPDATE a CTE?
3. What does that mean?

```sql
;WITH CustomerCTE AS
(
  SELECT c.*
    FROM Customer AS c
   WHERE c.LastName like 'Williams'
)
UPDATE CustomerCTE
   SET LastName = 'Willie';
```

```sql
;WITH CustomerCTE AS
(
 SELECT c.*, si.Comment
   FROM Customer AS c
  INNER JOIN SalesInvoice AS si
     ON si.CustomerID = c.CustomerID
  WHERE c.LastName like 'Williams'
)
UPDATE CustomerCTE
   SET Comment = 'Some Comment',
       CompanyName = 'Willies Toys';
```

Demo

Chapter 8 –

UPDATE CTE;

INSERT, UPDATE, DELETE Notes

- Insert, Update, and Delete all work against a CTE with only a single base table.
- Delete does not work for any CTE with multiple base tables referenced in the CTE query.
- Insert and Update works against a CTE with multiple base tables as long as only one base table is being udpated.

Chapter 10

Common Use Cases:

Alternative to a Numbers table

Finding Holes

Scrubbing duplicates

Alternative to a Numbers Table.

- **Demo**

```
;WITH Numbers (N) AS
(
  SELECT 1
   UNION ALL
  SELECT 1 + N FROM Numbers
   WHERE N < 1000
)
SELECT *
  FROM Numbers
OPTION (MAXRECURSION 1000);
```

Finding Holes.

- **Demo**

```
;WITH Numbers (N) AS
(  SELECT 0
   UNION ALL
  SELECT 1 + N FROM Numbers
   WHERE N < 23)
, OrderHours (HourOfDay, TheCount) AS
(  SELECT DATEPART(HOUR, OrderDate) as HourOfDay,
          COUNT(1) AS TheCount
    FROM SalesInvoice
   WHERE OrderDate < '02/01/2006'
   GROUP BY DATEPART(HOUR, OrderDate)   )
SELECT n.N AS HourOfDay, ISNULL(oh.TheCount, 0) OrderCount
  FROM OrderHours oh
 RIGHT JOIN Numbers n ON n.N = oh.HourOfDay
 ORDER BY TheCount ASC;
```

Scrubbing duplicates.

- **Demo**

```
WITH CustomerCTE AS
(
  SELECT *,
  ROW_NUMBER() OVER(PARTITION BY LastName,
                    FirstName ORDER BY CustomerID) AS DupNum
  FROM Customer
)
DELETE
  FROM CustomerCTE
 WHERE DupNum > 1;
```

Chapter 11

The need for speed

Understanding CTE performance

11. CTE Performance

- Non-Recursive Performance
  - Multiple references to a single CTE
  - CTEs vs. Derived Tables
  - CTEs vs. Views
  - Multiple CTEs in a query
- Recursive Performance
  - Deep Recursion

Multiple references to a single CTE

CTEs vs. Derived Tables

CTEs vs. Views

Multiple CTEs in a query

Nested CTEs

- Take it to the extreme

```
with cte0 as
(  select 1 as num )
, cte1 AS (SELECT * FROM cte0)
, cte2 AS (SELECT * FROM cte1)
```

Repeated from 2 to 254.

```
, cte255 AS (SELECT * FROM cte254)
, cte256 AS (SELECT * FROM cte255)
, cte257 AS (SELECT * FROM cte256)
select * from cte257;
```

Nested CTEs

Memory
24.0 GB DDR3
Memory usage
24.0 GB
Memory spike from 1000 levels nested
60 seconds
0
Memory composition
In use
4.5 GB
Available
19.4 GB
Speed:
1600 MHz
Slots used:
4 of 4
Form factor:
DIMM

Nested CTEs

Memory
24.0 GB DDR3
Memory usage
24.0 GB
Spike from 2000
Spike from 1500
60 seconds
0
Memory composition
In use
15.9 GB
Available
8.0 GB
Speed:
1600 MHz
Slots used:
4 of 4
Form factor:
DIMM

Nested CTEs

Memory
24.0 GB DDR3
Memory usage
24.0 GB
Spike from 2000
Spike from 1500
60 seconds
0
Memory composition
In use
15.9 GB
Available
8.0 GB
Speed:
1600 MHz
Slots used:
4 of 4
Form factor:
DIMM

Nested CTEs

Memory
24.0 GB DDR3
Memory usage
24.0 GB
Memory spike by nesting 2500 CTEs.
60 seconds
0
Memory composition

Editor
Messages
Msg 701, Level 17, State 123, Line 2
There is insufficient system memory in resource pool 'default' to run this query.
100 %

Recursive Performance

Recursive Performance

Deep Recursion

Editor | Results | Messages | Execution plan

```
   CPU time = 0 ms,  elapsed time = 0 ms.

(10001 row(s) affected)
Table 'Worktable'. Scan count 2, logical reads 60007, physical reads 0, read

(1 row(s) affected)

 SQL Server Execution Times:
   CPU time = 94 ms,  elapsed time = 124 ms.
SQL Server parse and compile time:
   CPU time = 0 ms, elapsed time = 0 ms.

 SQL Server Execution Times:
   CPU time = 0 ms,  elapsed time = 0 ms.
```

100 %

Demo

Chapter 11

More Information

- Follow me on Twitter
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