SINGLE STATEMENT, MANY CHANGES

How One Statement Can Modify Multiple Tables

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NESQL User Group
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WHO AM I?

- 20 years as a DBA
- Mainly work with SQL Server
- Mainly work with OLTP but have worked with some data marts.
- NESQL Board Member
- SQL Saturday\User Group Speaker
- IDERA ACE Class of 2020
- Speaker Idol Winner 2019
- Microsoft MVP – Data Platform

Random facts:

- I'm the alto section leader in my choir.
- I go to bluegrass jams regularly.
- I've been learning guitar and now mandolin.
- I am a bit of a musical theater geek.

AGENDA

- EXPLICIT CHANGES
- IMPLICIT CHANGES
- CHANGES AFTER THE CHANGES

EXPLICIT CHANGES

CHANGES THAT ARE INCLUDED DIRECTLY IN THE STATEMENTS

INSERTED \ DELETED

- Internal System Tables that exist during a transaction to store the data as existed before the change and as it will exist after the transaction is committed.
  - The table structure matches the table.
  - You cannot modify the inserted or deleted tables.
  - They are stored in memory.

OUTPUT INTO

- Part of the DML statement
- Directs the output to variables, table variables, tables
- Limitations:
  - Cannot insert into a table that is any part of a foreign key constraint
  - Cannot insert into a table that has a trigger on it
  - Some restrictions with replication
  - Target cannot be a remote table, view or common table expression
  - Will always use a serial plan
  - Target table not eligible for parallelism

OUTPUT INTO

```
UPDATE Alter_Ego
SET Person_ID = Person.Person_ID
    OUTPUT  inserted.Person_ID, deleted.Person_ID
    INTO #Superhero_Changeover (New_Secret_ID, Old_Secret_ID)
FROM Person
WHERE First_Name = 'Deborah'
AND Last_Name = 'Melkin'
AND Alter_Ego.Alter_Ego_Name = 'Wonder Woman'
;
```

TRIGGERS

- Stored Procedures attached to a table or view executed as part of the data change
  - After the change
  - Instead of the change
  - Part of the same transaction as the data change statement
- Can be assigned to execute for INSERT, UPDATE or DELETE
- Can have multiple triggers for the same or different actions on a single table
  - Can assign trigger to be the first or last trigger fired but no control in between

TRIGGERS

```
CREATE TRIGGER TR_Alter_Ego_Insert
    ON Alter_Ego
    FOR UPDATE
AS BEGIN

DECLARE @corp_id int;

-- Get Batman's Company ID
SELECT @corp_id = Corporation_ID
FROM Corporation
WHERE Corporation_Name = 'Wayne Enterprises';

INSERT INTO Employment
    (Person_ID, Corporation_ID, Corporate_Position_ID, From_Date)
SELECT ins.Person_ID, @corp_id, cp.Corporate_Position_ID, getdate()
FROM Corporate_Position cp
    JOIN inserted as ins ON cp.Corporate_Position_Name = ins.Alter_Ego_Name;

END
GO
```

TRIGGERS

```
CREATE TRIGGER TR_Alter_Ego_Insert
    ON Alter_Ego
    INSTEAD OF UPDATE
AS BEGIN

DECLARE @corp_id int;

SELECT @corp_id = Corporation_ID
FROM Corporation
-- (tstark) Forget Batman, use Iron Man's company
WHERE Corporation_Name = 'Stark Industries';

INSERT INTO Employment
    (Person_ID, Corporation_ID, Corporate_Position_ID, From_Date)
SELECT ins.Person_ID, @corp_id, cp.Corporate_Position_ID, getdate()
FROM Corporate_Position cp
    JOIN inserted as ins ON cp.Corporate_Position_Name = ins.Alter_Ego_Name;

END
GO
```

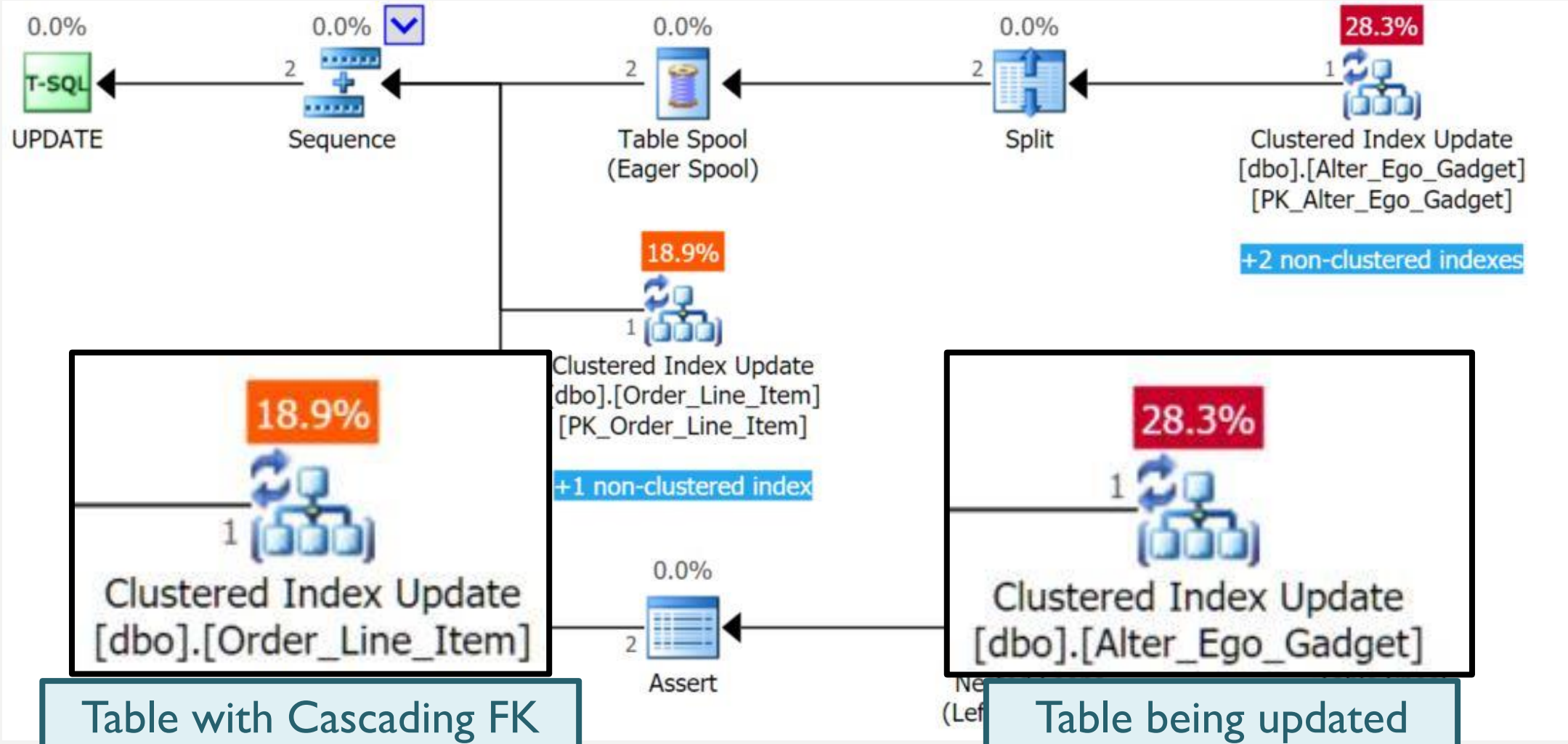
IMPLICIT CHANGES

CHANGES THAT ARE BUILT INTO THE DATABASE SCHEMA

CASCADING FOREIGN KEYS

- Defines actions that should be taken on the referencing columns when the referenced column is updated or referenced row is deleted
  - SET NULL
    - Sets the referencing column to NULL
  - SET DEFAULT
    - Sets the referencing column to a default value
  - CASCADE
    - Updates the referencing column to the same value as the referenced column
    - Deletes the referencing record when the referenced record is deleted
  - NO ACTION

CASCADING FOREIGN KEYS



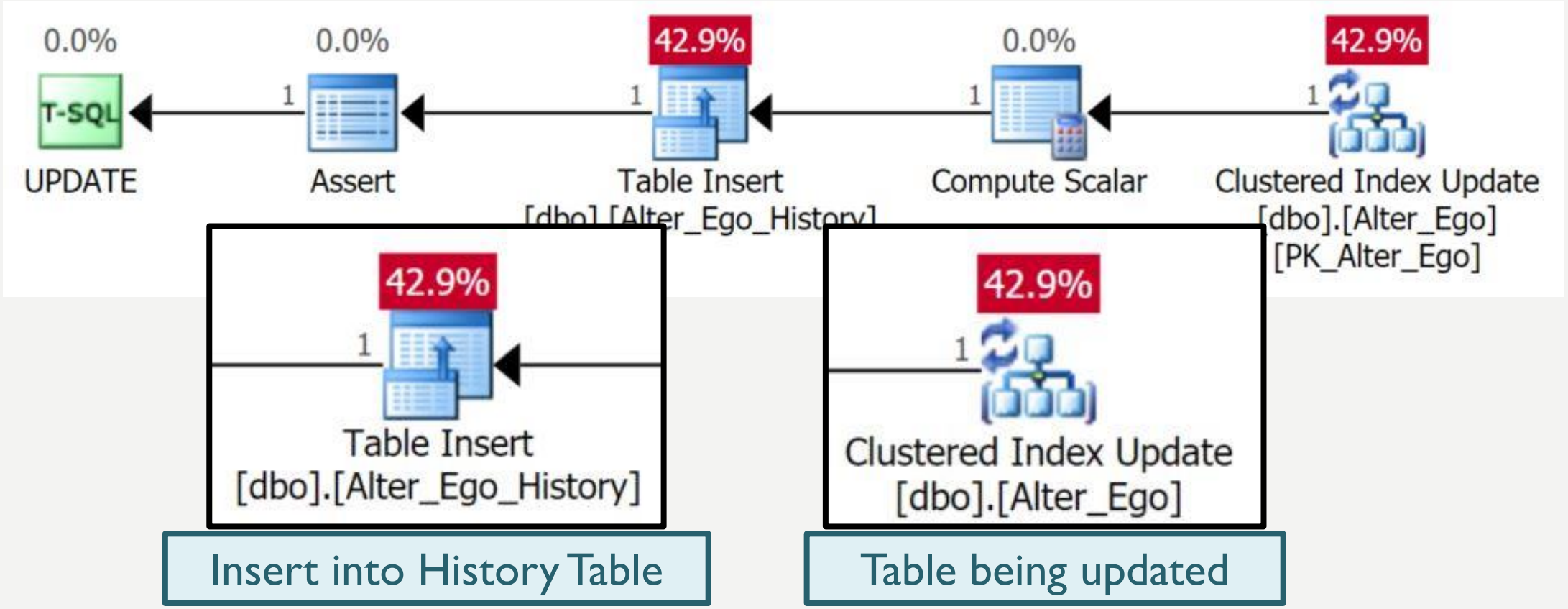
TEMPORAL TABLES

- Creates system version of the changes to a table
  - Only records UPDATEs and DELETEs
- Versioning is managed by the system
- History table can be created automatically by SQL Server or it can be specified
- Retention for data in the history table can be specified start with SQL 2017
- Limitations:
  - The history table must exist in the same database
  - Cannot manually modify the system date columns on the table being versioned.
  - No direct data modification of the history table
  - Some restrictions with Replication

TEMPORAL TABLES

- Can query the table to return the data as it existed at a point in time
- Options for querying data:
  - AS OF
  - FROM
  - BETWEEN
  - CONTAINED IN
  - ALL

TEMPORAL TABLES



AFTER THE TRANSACTION

CHANGES THAT HAPPEN BECAUSE OF THE CHANGE

LOG READERS

Results | Messages

	Current LSN	Operation	Context	Transaction ID	LogBlockGeneration	Tag Bits	Log Re
6	00000032:00001390:0001	LOP_PREP_XACT	LCX_NULL	0000:00001479	0	0x0000	64
7	00000032:00001398:0001	LOP_COMMIT_XACT	LCX_NULL	0000:00001479	0	0x0000	80
8	00000032:000013a0:0001	LOP_MODIFY_ROW	LCX_SCHEMA_VERSION	0000:00000000	0	0x0000	62
9	00000032:000013a0:0002	LOP_BEGIN_XACT	LCX_NULL	0000:0000147a	0	0x0000	76
10	00000032:000013a0:0003	LOP_INSERT_ROWS	LCX_CLUSTERED	0000:0000147a	0	0x0000	62
11	00000032:000013a0:0004	LOP_COMMIT_XACT	LCX_NULL	0000:0000147a	0	0x0000	80
12	00000032:000013a8:0001	LOP_BEGIN_XACT	LCX_NULL	0000:0000147b	0	0x0000	76
13	00000032:000013a8:0002	LOP_INSERT_ROWS	LCX_CLUSTERED	0000:0000147b	0	0x0000	62
14	00000032:000013a8:0003	LOP_COMMIT_XACT	LCX_NULL	0000:0000147b	0	0x0000	80

Query executed successfully.

REPLICATION

- Data changes in the publication database are sent to one or more subscription databases
- The distribution database stores metadata and history data for all types of replication, and transactions for transactional replication
- Tables can be part of multiple subscriptions
- Uses SQL Server Agent jobs to run the various tasks needed for Replication

REPLICATION

- Multiple types of replication
  - Snapshot
  - Transactional
  - Peer-to-Peer
  - Merge
- Subscriptions can be Push or Pull

CHANGE DATA CAPTURE (CDC)

- "Before" and "After" data are written to system created tables for future use
- Limitations
  - Cannot rename the objects or schemas
  - Default retention policy

OTHER TRANSACTION LOG READERS

- Database Change Tracking
  - "lightweight" version of CDC
- Availability Groups
  - Full replicas of the database
  - Synchronous and Asynchronous
  - The transaction log records of the primary database are sent to the secondary replicas

DEMOS

LET'S REVIEW

TAKE-AWAYS

- Not all data modifications can be seen by traces
- Not all data modifications occur in the same database
- The amount of data that changes affects more than just the table but everything having to do with the transaction logs
- Troubleshooting data modifications may not have to do with the initial update but changes that occur because of the updates

ADDITIONAL RESOURCES

- OUTPUT
  - https://tinyurl.com/output-clause-transact-sql
  - https://tinyurl.com/insert-data-returned-output
  - https://www.erikdarlingdata.com/2020/01/an-unfortunate-side-effect-of-output/
  - https://www.sql.kiwi/2020/07/a-bug-with-halloween-protection-and.html
- Temporal Tables
  - https://docs.microsoft.com/en-us/sql/relational-databases/tables/temporal-tables?view=sql-server-ver15
  - https://www.erikdarlingdata.com/sql-server/tracking-row-changes-with-temporal-columns/

ADDITIONAL RESOURCE (CONT'D)

- CDC
  - https://tinyurl.com/about-change-data-capture
  - https://www.sqlshack.com/change-data-capture-for-auditing-sql-server/
- Database Change Tracking:
  - https://www.sqlshack.com/creating-a-sql-server-audit-using-sql-server-change-tracking/
  - https://tinyurl.com/about-change-tracking

MORE QUESTIONS? LET ME KNOW!

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Thanks for coming!