

Tempdb – a database developer's perspective

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Who is this guy?

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- Independent/freelance/contractor/consultant
- 15+ years SQL Server
- Moderator at ask.sqlservercentral.com

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Data Platform



redgate
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What this session will cover

- What is tempdb?
- What is tempdb used for?
- Using tempdb efficiently

What is tempdb?

- System database (dbid = 2)
- SQL Server's workspace
- BOL :
 - global resource that is available to all users connected to the instance
- Only 1 for the whole instance
- Recreated every time SQL starts

Tempdb is special

- Simple recovery only
- No backups
- No restores
- Cannot change owner
- Cannot drop database
- Cannot Enable CDC / Mirroring / Snapshot / Availability Groups

DEMO

What's in tempdb?

- Temporary user objects
- Internal objects (hidden)
- Version stores

Temporary User Objects

- # local temporary table
- ## global temporary tables
- @ table variables
- Table-valued function
- Cursors

Internal Objects

- Intermediate SORT results
- Intermediate HASH JOIN and HASH AGGREGATE
- Intermediate results (spools)
- XML variables
- LOB variables
- Cursors / Triggers

Version Stores

- aka Row versioning
- Triggers – inserted and deleted
- MARS – data modification
- Online index rebuilds
- Isolation levels
 - Snapshot Isolation
 - Read Committed Snapshot

Features that use tempdb

- Index maintenance (SORT_IN_TEMPDB)
- SQL2012+ AlwaysOn readable secondaries
- DBCC CHECK
- Service Broker
- Event Notifications
-

Where do we fit in all this?

- Lots going on in tempdb
- Leads to tempdb contention
- Some usage is just background
- Some is DBA controlled
 - files
 - disk
- Some is developer controlled.....

Reducing tempdb usage

- SORT operations (especially if bad stats)
 - ORDER BY
 - GROUP BY
 - UNION
 - MERGE JOIN
 - Ranking functions
 - RANK()
 - DENSE_RANK()
 - ROW_NUMBER()
 - NTILE()

Reducing tempdb usage

- Spools
 - Data needed again
 - Data isolated from original source
 - Recursive CTEs
 - Windowing functions
- Join types
 - HASH JOIN
 - MERGE JOIN

Improving tempdb usage

- Temporary tables vs table variables
 - @table variables < 100 rows
 - #temporary tables > 100 rows
 - Better statistics, better query plan

Improving tempdb usage

- Multi-Statement Table Valued Functions

- MSTVF

```
RETURNS @return_variable TABLE  
<table_type_definition>  
BEGIN  
    function_body  
RETURN  
END
```

- Rewrite as inline table-valued function

```
RETURNS TABLE  
RETURN (  
    select statement  
)
```


Improving tempdb usage

- Who does this?

```
create procedure MyProc
as
begin
create table #customers (...)
...
drop table #customers
end
```

- Pre SQL 2005 – bad!
- Post SQL2005 – better, but not needed
 - Cached metadata

Improving tempdb usage

- Caching temporary objects
- Prevents repetitive allocation/deallocation
- Improve query times
- Reduce contention
 - System tables
 - Allocation pages
- Do not Truncate!!!

DEMO

A quick word on collation

- tempdb collation is server default
- If different to user database collation, may get
Cannot resolve collation conflict ... in the equal to operation
- Resolutions
 - Specify collation on #table creation
 - Use `collate database_default`

DEMO

Improvements in SQL 2014

- Eager writes
 - Behaviour has been relaxed
 - tempdb operations as not as 'eager' to cause disk I/O
 - performance gain

brentozar.com/archive/2014/04/memory-ssd-tempdb-temp-table-sql-2014/

blogs.msdn.com/b/psssql/archive/2014/04/09/sql-server-2014-tempdb-hidden-performance-gem.aspx

- Back ported to SQL2012 sp1 cu10
support2.microsoft.com/kb/2958012

Improvements in SQL 2014

- MSTVF cardinality estimate 100
(previously 1)

blogs.msdn.com/b/psssql/archive/2014/04/01/sql-server-2014-s-new-cardinality-estimator-part-1.aspx

- Table variables remains at 1

Improvements coming in SQL 2016

- Trace flags 'enabled' by default
 - TF1117 - consistent autogrowth
 - TF1118 - reduces SGAM and PFS contention
- Multiple files configurable during installation

In summary

- Tempdb is a shared resource
- Be aware of your usage
- Use tempdb efficiently

Further Resources

- Itzik Ben-Gan
 - sqlmag.com/sql-server/caching-temporary-objects
- Paul White - sqlblog.com/blogs/paul_white
 - sqlblog.com/blogs/paul_white/archive/2012/08/17/temporary-object-caching-explained.aspx
- Monitoring tempdb Trans and Space usage
 - blogs.msdn.com/b/deepakbi/archive/2010/04/14/monitoring-tempdb-transactions-and-space-usage.aspx
- Working with tempdb in SQL Server 2005
 - technet.microsoft.com/en-us/library/cc966545.aspx

Thanks for listening



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