

Performance Troubleshooting tempdb

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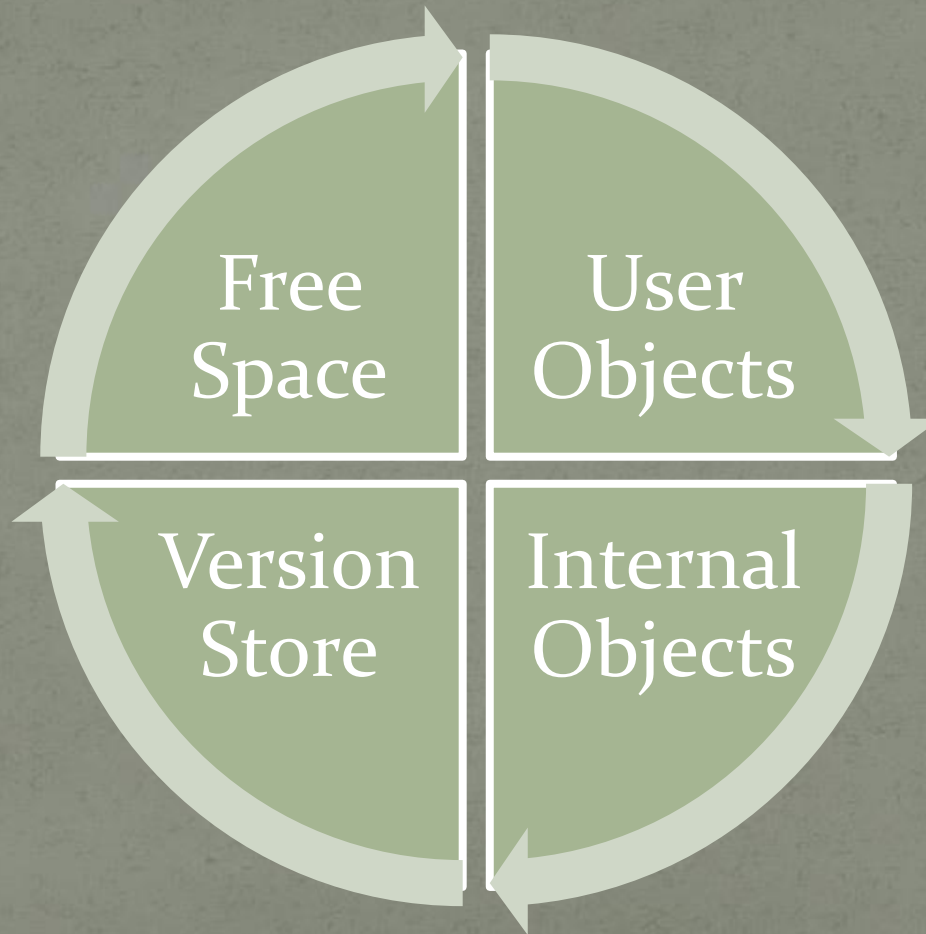
Agenda

- What is tempdb?
- How space is used in tempdb
- Troubleshooting issues in tempdb
- Restrictions in tempdb
- Best Practices

What is tempdb

- One of the system database, used for all temporary operations
- Data in tempdb doesn't persist after SQL Server shutdown, it creates copy from model database
- Only one file group in tempdb is allowed for data and one file group for log
- It's a global resource available to all user connections

How Space is used in tempdb



Tempdb – User Objects

- These are explicitly created by user sessions and are tracked in system catalog.
- They include the following:
 - **Table and index.**
 - Global temporary table (##t1) and index.
 - Local temporary table (#t1) and index. Session scoped. Stored procedure scoped in which it was created.
- Table variable (@t1). Session scoped. Stored procedure scoped in which it was created.

Tempdb – Internal Objects

- To store intermediate runs for sort.
- To store intermediate results for hash joins and hash aggregates.
- To store XML variables or other large object (LOB) data type variables. The LOB data type includes all of the large object types: text, image, ntext, varchar(max), varbinary(max), and all others.
- By queries that need a spool to store intermediate results.
- By keyset cursors to store the keys.
- By static cursors to store a query result.
- By Service Broker to store messages in transit.
- By INSTEAD OF triggers to store data for internal processing.

Tempdb – Version Store

- MARS
- Online index
- Triggers
- Snapshot-based isolation levels

Troubleshooting

- IO bottleneck
- Allocation Contention
- DDL Contention
- Running out of space
 - User objects
 - Internal Objects
 - Version Store

- IO bottleneck
 - Use sys.dm_io_virtual_file_stats DMV to find out the IO statistics of database files
 - Based on latency check for processes utilizing temp
 - Make corrective action on query \ process
 - If nothing can be done in query then try to add additional files to tempdb
 - Try to push tempdb in different drive other than where you user database resides

- Allocation Contention
 - PFS, GAM, SGAM
 - Detect pagelatch (GAM,SGAM or PFS) wait stats for tempdb database
 - If you find more page latch then check for the query which does creation and dropping of tempb objects frequently
 - Enable Trace flag 1118
 - Try to increase tempdb data file with equal size

- DDL Contention

- Check pagelatch wait other than GAM,SGAM or PFS
- SQLServer:General Statistics: Temp Tables Creation Rate
- SQLServer:General Statistics: Temp Tables For Destruction
- Make sure user objects are getting cached
- Ultimate aim is to remove creations of temp tables

- User & Internal Objects
 - Check for the SPID which is consuming tempdb and take appropriate action
 - **sys.dm_db_session_space_usage** and **sys.dm_db_task_space_usage**, to track **tempdb** space that is allocated to sessions and tasks, respectively.
- Version Store
 - $[\text{Size of version store}] = 2 * [\text{version store data generated per minute}] * [\text{longest running time (minutes) of the transaction}]$
 - Properly calculate space for tempdb while using version store

- You can also monitor the following Performance Monitor counters for any unusual increase in the temporary objects allocation/deal location activity:
 - SQL Server:Access Methods\Workfiles Created /Sec
 - SQL Server:Access Methods\Worktables Created /Sec
 - SQL Server:Access Methods\Mixed Page Allocations /Sec
 - SQL Server:General Statistics\Temp Tables Created /Sec
 - SQL Server:General Statistics\Temp Tables for destruction

Restrictions

- Backing up or restoring the database.
- Changing collation. The default collation is the server collation.
- Changing the database owner. tempdb is owned by dbo.
- Creating a database snapshot.
- Dropping the database.
- Dropping the guest user from the database.
- Enabling change data capture.
- Participating in database mirroring.
- Removing the primary filegroup, primary data file, or log file.
- Renaming the database or primary filegroup.
- Running DBCC CHECKALLOC.
- Running DBCC CHECKCATALOG.
- Setting the database to OFFLINE.
- Setting the database or primary filegroup to READ_ONLY.

Best Practice

- Pre-Size your tempdb database. Enable autogrow on with instant file initialization
- Follow general IO recommendation for fast IO
- If your TempDB experiences metadata contention (waitresource = 2:1:1 or 2:1:3), you should split out your data onto multiple files
- All TempDB data files should be of equal size.
- If possible spread your tempdb data files to different drives
- Utilize trace flag 1118 if you see allocation contention
- Try not to shrink your tempdb data file

References

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