Seminar 7
Performance Tuning in SQL Server (II)

Stored Procedures

- Advantages
  - Performance advantages
  - Server side
  - Reuse of execution plans
- Note: Requirements for plan reuse
  - Plan reuse is not always a good thing
- New in SQL Server 2005:
  - OPTIMIZE FOR / RECOMPILE query hints

Stored Procedures – Optimization Tips

- **SET NOCOUNT ON**
  - Number of affected rows is not displayed
  - Reduces network traffic

- Use **schema name** with **object name**
  - Helps finding directly the compiled plan

```
SELECT * FROM dbo.MyTable
EXEC dbo.StoredProcedure
```

Stored Procedures – Optimization Tips

- Do not use **sp_** prefix
  - SQL Server first searches in the **master** database and then in the **current** database

- use UNION to implement an "OR" operation

- Avoid joins between two types of columns
  - Index is not used for a converted column!

Stored Procedures – Optimization Tips

- **sp_executesql** vs **exec**
  - Execution plan of a dynamic statement can be reused if ALL characters of two consecutive executions are exactly the same

- `EXEC ('Select * from Categories where ID = 1')`
- `EXEC ('Select * from Categories where ID = 2')`

- `EXECUTE sp_executesql N'Select * from Categories where ID = @ID', N'@ID int', @ID=1;`

Stored Procedures – Optimization Tips

Cursors

- Generally use a lot of SQL Server resources and reduce the performance and scalability of applications

- Scenarios where cursors are suitable/better:
  - Procedural logic / must access the data in a row-by-row manner
  - Ordered calculations

Stored Procedures – Optimization Tips

- Do not use COUNT() in a subquery to do an existence check

- Use `IF EXISTS (SELECT 1 FROM….)`
  - The output of nested select is not used
  - Reduces processing time and network transfer

- Keep transactions short
  - Transactions' length affects blocking and deadlocking

Stored Procedures – Optimization Tips

Reuse execution plans

```
CREATE PROCEDURE test (@pid int)
AS
      SELECT * FROM Sales.SalesOrderDetail
      WHERE ProductID = @pid
```

exec test(897)

exec test(870)

Stored Procedures – Optimization Tips

OPTIMIZE FOR / RECOMPILE query hints

```
ALTER PROCEDURE test (@pid int)
AS
      SELECT * FROM Sales.SalesOrderDetail
      WHERE ProductID = @pid
      OPTION (OPTIMIZE FOR (@pid = 870))
```

```
ALTER PROCEDURE test (@pid int)
AS
      SELECT * FROM Sales.SalesOrderDetail
      WHERE ProductID = @pid
      OPTION (RECOMPILE)
```

Stored Procedures – Optimization Tips

OPTIMIZE FOR UKNOWN

- local variables are not known at optimization time

- example below: always generates the same execution plan

```
ALTER PROCEDURE test (@pid int)
AS
    DECLARE @lpid int
    SET @lpid = @pid
    SELECT * FROM Sales.SalesOrderDetail
    WHERE ProductID = @lpid
```

Stored Procedures – Optimization Tips

OPTIMIZE FOR UKNOWN

- local variables are not known at optimization time
- example below: always generates the same execution plan

```
ALTER PROCEDURE test (@pid int)
AS
      SELECT * FROM Sales.SalesOrderDetail
      WHERE ProductID = @pid
      OPTION (OPTIMIZE FOR UNKNOWN)
```

Stored Procedures – Optimization Tips

OPTIMIZE FOR query hints

```
DECLARE @city_name nvarchar(30);
DECLARE @postal_code nvarchar(15);

SELECT * FROM Person.Address
WHERE City = @city_name AND PostalCode =
@postal_code OPTION
(OPTIMIZE FOR (@city_name = 'Seattle',
@postal_code UNKNOWN) );
```

Stored Procedures – Optimization Tips

Other query hints

- HASH GROUP / ORDER GROUP

```
SELECT ProductID, OrderQty,SUM(LineTotal) AS Total
FROM Sales.SalesOrderDetail
WHERE UnitPrice < $5.00
GROUP BY ProductID, OrderQty
ORDER BY ProductID, OrderQty
OPTION (HASH GROUP, FAST 10);
```

Stored Procedures – Optimization Tips

Other query hints

- MERGE UNION / HASH UNION / CONCAT UNION

```
SELECT  ...
UNION
SELECT  ...

OPTION  ( MERGE UNION   )
```

Stored Procedures – Optimization Tips

Join hints

- LOOP JOIN / MERGE JOIN / HASH JOIN

```
SELECT * FROM Sales.Customer AS c
INNER JOIN Sales.vStoreWithAddresses AS sa
      ON c.CustomerID = sa.BusinessEntityID
WHERE TerritoryID = 5
OPTION (MERGE JOIN);
GO
```

Stored Procedures – Optimization Tips

Join hints

- FAST n - focus on returning the first ‘n’ rows as fast as possible

```
SELECT * FROM Sales.Customer AS c
INNER JOIN Sales.vStoreWithAddresses AS sa
      ON c.CustomerID = sa.BusinessEntityID
WHERE TerritoryID = 5
OPTION (FAST 10);
GO
```

Stored Procedures – Optimization Tips

Join hints

- FORCE ORDER – “force” the optimizer to use the order of joins as they are listed in the query

```
SELECT * FROM Table1
INNER JOIN Table2 ON Table1.a = Table2.b
INNER JOIN Table3 ON Table2.c = Table3.d
INNER JOIN Table4 ON Table3.e = Table4.f
OPTION (FORCE ORDER);
```

Stored Procedures – Optimization Tips

More about Controlling Execution Plans with Hints: https://www.simple-talk.com/sql/performance/controlling-execution-plans-with-hints/

Dynamic Execution

- Disadvantages:
  - Ugly code; hard to maintain
  - Requires direct permissions (in 2000)
  - Security risk of SQL Injection

- Use smartly:
  - Dynamic filters and sorting to get good plans
  - And more….

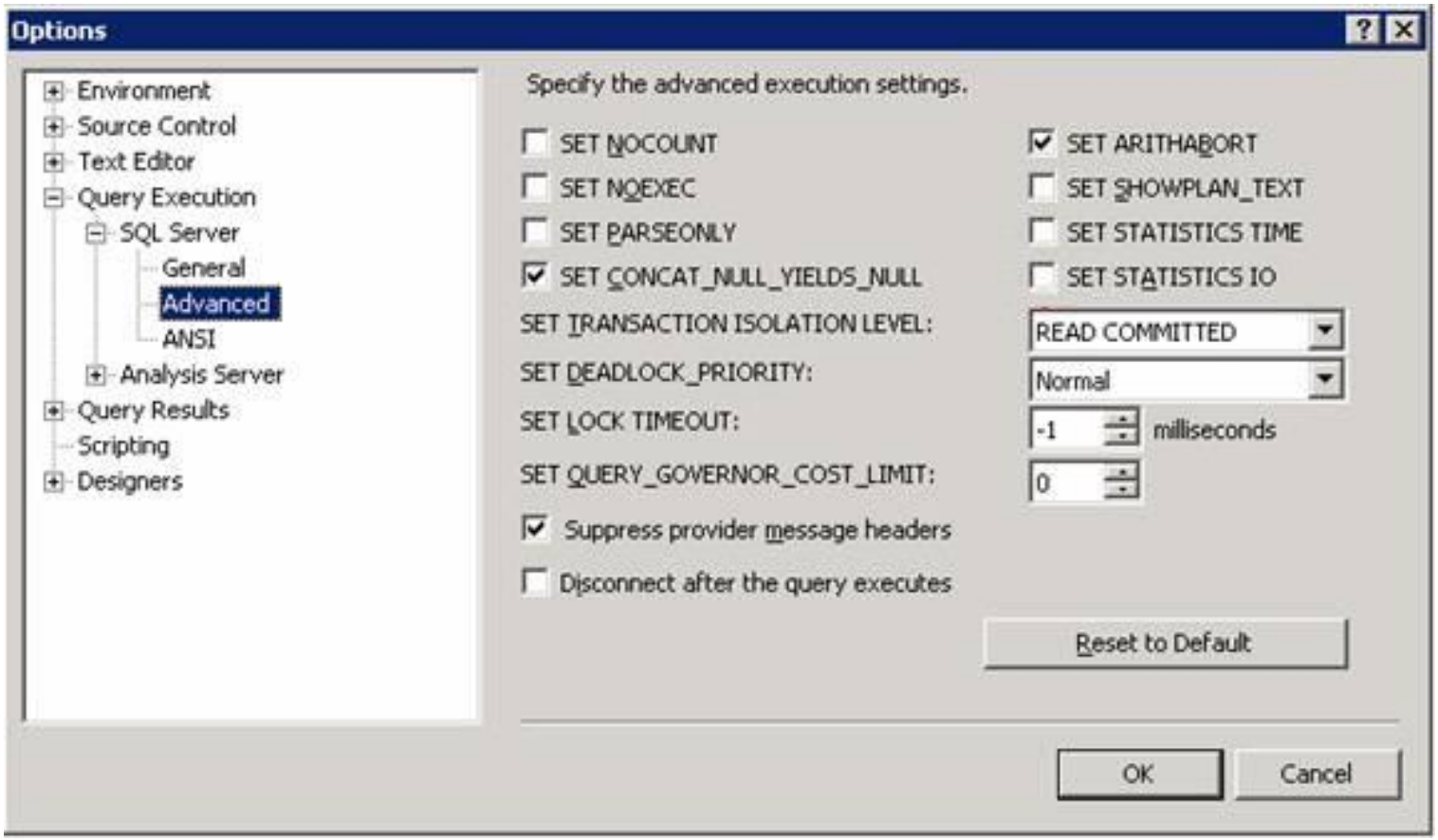
Temporary Tables

- Useful when:
  - You have intermediate result sets that need to be accessed several times
  - You need a temporary storage area for data while running procedural code
- Use temp tables when:
  - You are handling large volumes of data, where plan efficiency is important and non-trivial
- Use table variables when:
  - You are handling small volumes of data, or when plans are trivial

Triggers

- Expensive
- Main performance impact: accessing *inserted* and *deleted*
  - SQL Server 2000: transaction log
  - SQL Server 2005: row versioning (tempdb)
- Try to utilize set-based activities
- Identify affected rows and react accordingly
- UPDATE triggers record deletes followed by inserts in the log

SQL Server Options



Fragmentation

- Fragmentation: has a significant effect on query performance
  - *Logical fragmentation*: percent of *out-of-order* pages
  - *Page density*: page population

- Use DBCC SHOWCONTIG to get fragmentation statistics, and examine LogicalFragmentation and Avg. Page Density (full)
- Use the *sys.dm_db_index_physical_stats* function, and examine AvgFragmentation
- Rebuild indexes to handle fragmentation

Other statistics

- Update statistics asynchronously
  - ***String summary statistics***: frequency distribution of substrings is maintained for character columns
  - ***Asynchronous auto update statistics*** (default off)
  - **Computed column statistics**

Other statistics

- *sys.dm_exec_query_stats* - performance statistics for cached query plans
  - *total_logical_reads / total_logical_writes* - total number of logical reads/writes performed by executions of a plan since it was compiled
  - *total_physical_reads* - total number of physical reads performed by executions of this plan since it was compiled
  - *total_worker_time* - total amount of CPU time, in microseconds, that was consumed by executions of plan since it was compiled
  - *total_elapsed_time* - total elapsed time, in microseconds, for completed executions of the plan