Performance Tuning with Execution Plans

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GOAL

- Show where, how and why performance issues appear within execution plans in order to better understand how to use execution plans to troubleshoot SQL Server query performance

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Let's Talk

Microsoft MVP Most Valuable Professional

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Today's Agenda

- Introduction to Execution Plans
- Common T-SQL Code Smells
- Worked Examples
- Querying the Plan Cache
- More Worked Examples
- Parameter Sniffing
- Additional Tools

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Introduction to Execution Plans

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WHY?

Execution Plans

- Execution plans are a representation of the processes used by the query engine to perform the query submitted to SQL Server.

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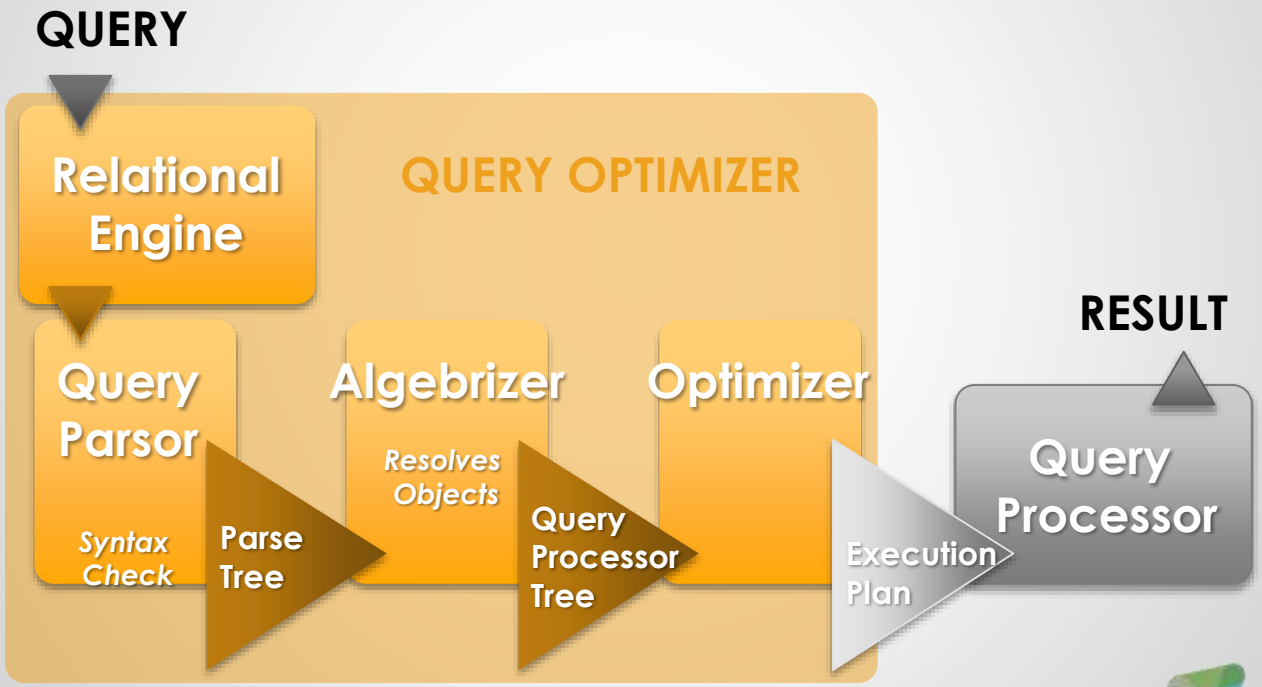
Relational Engine



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Optimizer

- Cost-Based
  - Just an estimate
  - Not based on your computer
- Statistics
  - Defined in indexes and tables
  - Must be maintained to ensure a good execution plan
- Cache
  - Every query goes to cache (almost)

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Generating a Plan

- SQL Server Management Studio
  - Estimated
  - Actual
- Procedure Cache
  - Estimated (sort of)
- Extended Events
  - Estimated
  - Actual
- Trace Events (not recommended)
  - Estimated
  - Actual

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Tune the Query

- Small to medium, look at the query first
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- Watch for low-hanging fruit
- Fix syntax over stats
- Stats over indexing
  - Indexing over restructuring
    - Restructuring
- Read the execution plan
- Understand the business needs

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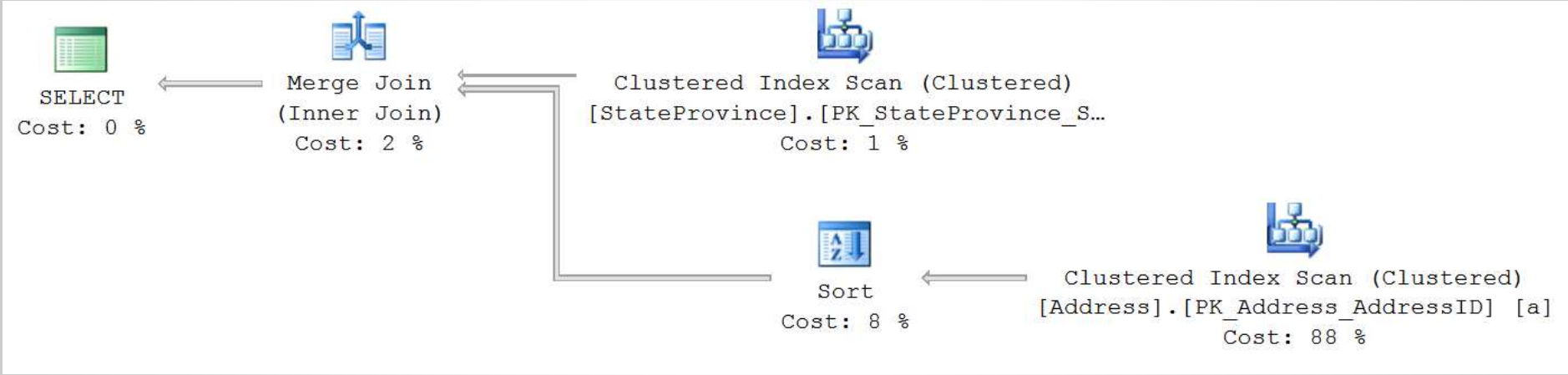
Where To Start?



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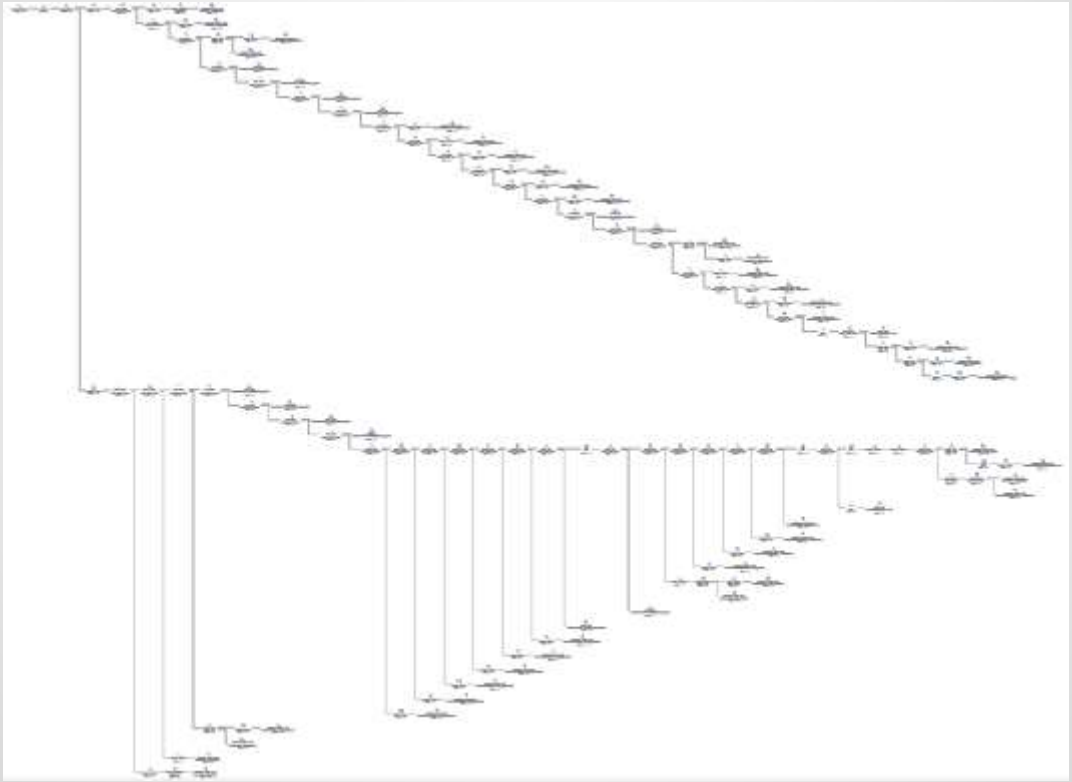
Where To Start?



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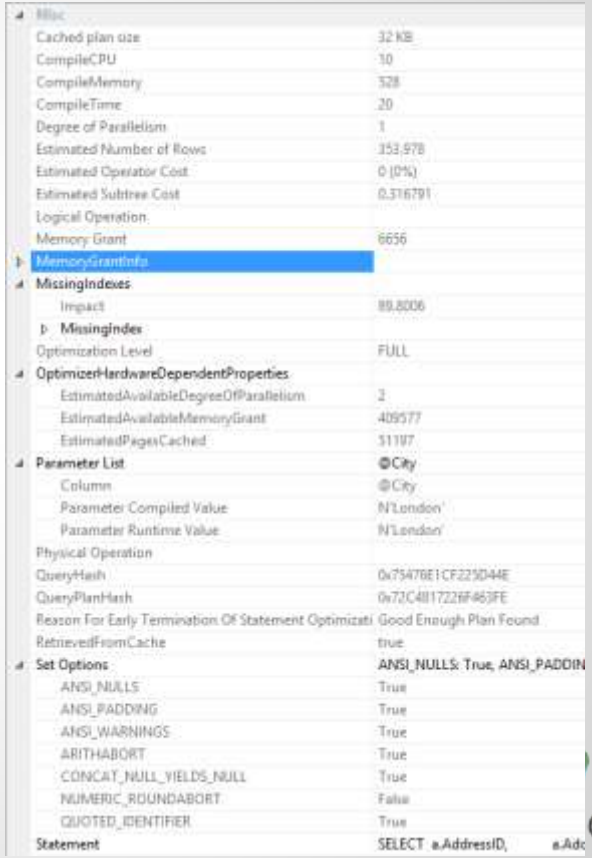
First Operator

- Plan size
- Compile time
- Memory grant
- Missing Indexes
- Optimization level
- Parameter
  - Compiled value
  - Runtime Value
- Query hash
- Reason for early termination
- ANSI settings



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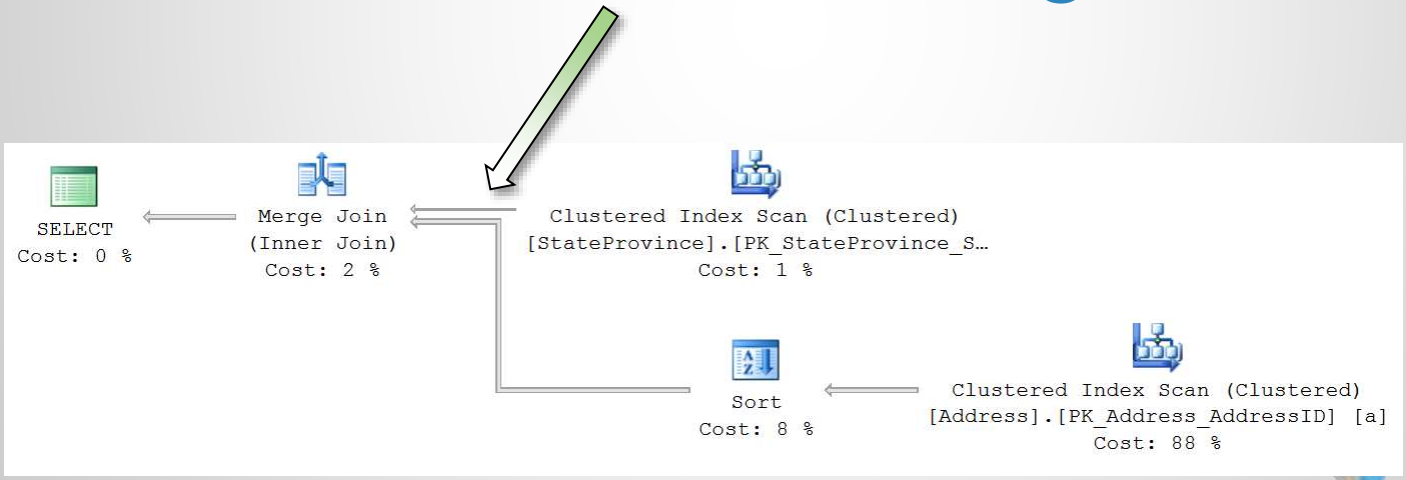
Right to Left or Left to Right?

- A clue: English
- Another clue: These things



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Left to Right or Right to Left

- Answer: Both
- Logical processing order:
  - Represents how the optimizer sees the query
  - Reading it from Left to Right
- Physical processing order
  - Represents the flow of data
  - Follow the arrows/pipes from Right to Left
- Both are necessary to understand certain plans

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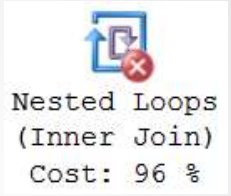
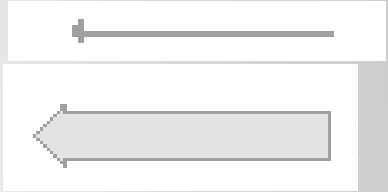
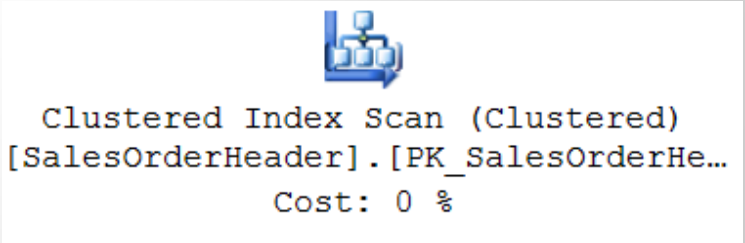
What Else to Look For

- Warnings
- Most Costly Operations
- Fat Pipes
- Extra Operations
- Scans
- Estimated vs. Actual








NUMISKULL
PIMPSATAN
FROM

Summary

- Execution plans are your view into the optimizer
- You can capture plans multiple ways
- You start with the first operator
- Additional things to look for include:
  - Warnings
  - Most costly operations
  - Fat pipes
  - Extra operations
  - Scans
  - Estimated vs. Actual
- Remember that these are just representations

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Common T-SQL Code Smells

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ELLE

Code Smells

- A code smell is a piece of code that functions, but doesn't function in the best possible way within a given set of circumstances

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T-SQL Code Smells

- Functions on Predicates
- Data Conversion (Implicit & Explicit)
- Cursors
- Nested Views
- IF Logic
- Multi-Statement Table-Valued User Defined Functions

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Worked Examples

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Querying the Plan

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RECOVERED
FROM WESTERN
SOCIETY...
.ERIN..

Execution Plans From Cache

```
SELECT TOP 10
SUBSTRING(dest.text, (deqs.statement_start_offset / 2) + 1,
  (CASE deqs.statement_end_offset
 WHEN -1 THEN DATALENGTH(dest.text)
 ELSE deqs.statement_end_offset
  - deqs.statement_start_offset
   END) / 2 + 1) AS querystatement,
deqp.query_plan,
deqs.query_hash,
deqs.execution_count
FROM sys.dm_exec_query_stats AS deqs
CROSS APPLY sys.dm_exec_query_plan(deqs.plan_handle) AS deqp
CROSS APPLY sys.dm_exec_sql_text(deqs.sql_handle) AS dest
ORDER BY deqs.total_elapsed_time DESC;
```

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Inside Execution Plans

```
SELECT  DB_NAME(deqp.dbid),
      SUBSTRING(dest.text, (deqs.statement_start_offset / 2) + 1,
              (CASE deqs.statement_end_offset
                WHEN -1 THEN DATALENGTH(dest.text)
                ELSE deqs.statement_end_offset
               END - deqs.statement_start_offset) / 2 + 1) AS StatementText,
      deqs.statement_end_offset,
      deqs.statement_start_offset,
      deqp.query_plan,
      deqs.execution_count,
      deqs.total_elapsed_time,
      deqs.total_logical_reads,
      deqs.total_logical_writes
FROM    sys.dm_exec_query_stats AS deqs
      CROSS APPLY sys.dm_exec_query_plan(deqs.plan_handle) AS deqp
      CROSS APPLY sys.dm_exec_sql_text(deqs.sql_handle) AS dest
WHERE   CAST(deqp.query_plan AS NVARCHAR(MAX)) LIKE '%StatementOptmEarlyAbortReason="TimeOut"%';
```

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Interesting Dynamic Management Objects

- Sys.dm_exec_query_plan
- sys.dm_exec_query_profiles
- Sys.dm_exec_text_query_plan

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Additional Resources

- Sp_whoisactive – Adam Machanic
- Diagnostic Queries – Glen Berry
- Performance Tuning with SQL Server Dynamic Management Views – Louis Davidson and Tim Ford

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More Worked Examples

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Parameter Sniffing

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SNIFF

Parameter Sniffing

- It's a good thing… except when it isn't
- Automatic
- Only works on parameters (with an exception)
- It's all about statistics
  - Average vs. Specific

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Bad Parameter Sniffing

- Differentiate from parameter sniffing
- Still about statistics
- Intermittent
- Different plans
- Focus on the compiled value
- Compare to runtime
- When it's bad, it's very bad

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Local Variables

- Eliminate parameters
- Turn parameters into local variables
- Produces “generic” plan

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Variable Sniffing

- The exception to parameters
- Same process
- Only works in a recompile situation
- Invisible killer or guardian angel

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OPTIMIZE FOR <value>

- Specific and accurate
- Changes over time
- Produces “precise” plan

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OPTIMIZE FOR UNKNOWN

- For when you're not sure
- Changes over time
- Produces "generic" plan

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WITH RECOMPILE

- Specific every time
- Increases overhead
- May be more costly than

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Statistics

- After all, it's all about the statistics
- Stats can age w/o updating
- You may have auto-update turned off
- Sampled updates may be inadequate
- Filtered statistics may help

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Plan Guides

- Just a different way to use hints
- Produces whatever plan you define

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Turn Sniffing Off

- Dangerous choice
- Last for a reason
- Very dangerous
- Turns it all off
- Everywhere
- Did I mention it's dangerous?

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Additional Tools

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BRAMIL
DANGER
BARBED
SECURITY FENCE
DANGER
HIGH VOLTAGE
KEEP OUT

Supratimas

- Web based
- Free
- Easy to use
- Limited Functionality

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SQL Sentry Plan Explorer

- Application
- Free and Paid Version
- Easy to Use
- Extensive Funtionality

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Query Store

- Azure SQL Database
- SQL Server 2016
- Guaranteed to change how you monitor and tune queries

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Conclusion

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Why?

Resources

- Scarydba.com/resources

- SQL Server Execution Plans
- SQL Server Query Performance Tuning

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