Banishing Slow Queries with Intelligent Query Processing

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SQL Day

DCAC

Denny Cherry & Associates

Certified IT professionals to help achieve IT goals

Clients ranging from small business to Fortune 10 corporations

Help save on costs while improving IT reliability and solving challenges

My Slides & Demos

https://bit.ly/mypresentationfiles

Strategic Partner

Agenda

What is IQP?

Challenges

Table Deferred Compilation

Parameter Sensitive Plans

Degree of Parallelism Feedback

Artist Formerly Known As

Prince

Adaptive Query Processing

CHALLENGES

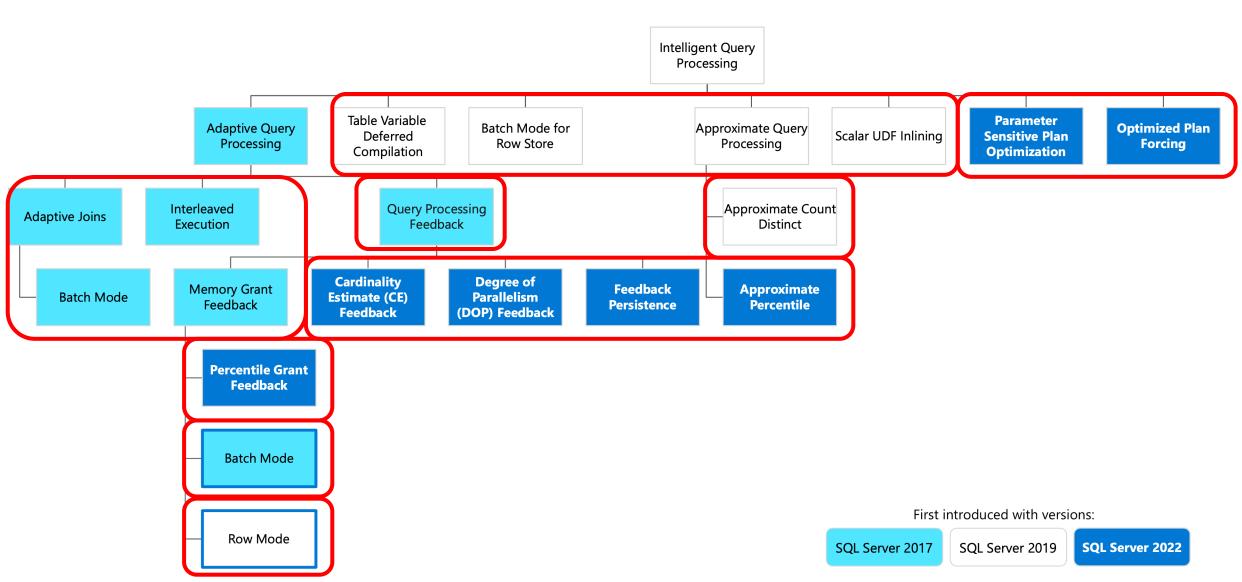CHALLENGE ACCEPTED!

CHALLENGE ACCEPTED

Lightweight Query Profiling

Provides framework for performance improvements

< SQL Server 2019 = Opted In

Query Store utilized in most cases

SQL Server 2022 IQP

Intelligent Query Processing

- Adaptive Query Processing
  - Adaptive Joins
  - Interleaved Execution
  - Batch Mode
  - Memory Grant Feedback
    - Percentile Grant Feedback
    - Batch Mode
    - Row Mode
- Table Variable Deferred Compilation
- Batch Mode for Row Store
- Query Processing Feedback
  - Cardinality Estimate (CE) Feedback
  - Degree of Parallelism (DOP) Feedback
  - Feedback Persistence
- Approximate Query Processing
  - Approximate Count Distinct
  - Approximate Percentile
- Scalar UDF Inlining
- Parameter Sensitive Plan Optimization
- Optimized Plan Forcing

First introduced with versions:
- SQL Server 2017
- SQL Server 2019
- SQL Server 2022

https://learn.microsoft.com/en-us/sql/relational-databases/performance/intelligent-query-processing?view=sql-server-ver16

COMPATIBILITY LEVEL

DMVs

Query Inflight - 2016 SP1 or higher

sys.dm_exec_query_statistics_xml(sessionID)

Query Completion – 2019+

sys.dm_exec_query_plan_stats(plan_handle)

Database Scoped Configuration
    LAST_QUERY_PLAN_STATS

Table Variables Issues

Estimated Subtree Cost 0.0092031

Number of Executions	1
Estimated Number of Executions	1
Estimated Number of Rows to be Read	1
Estimated Number of Rows Per Execution	1
Estimated Row Size	15 B
Actual Rebinds	0
Actual Rewinds	0
Ordered	False
Node ID	4

Object

[@table] [a]

Output List

@table.objectid

Table Variable Deferred Compilation

< SQL Server 2019 = 1 row fixed estimate

Too many rows = bad execution plan

Temporary Table vs Table Variable

Table Variable Deferred Compilation

Compilation is shifted to first actual execution of a statement

Utilizes actual cardinality vs wild guess

Mimics temporary table behavior

Parameter Sensitive Plan

Parameter Sensitive Plan

Helps solve parameter sniffing issues

Parameter sniffing issues is not bad; it's working as designed

Only works on equality predicates

Cardinality values are divided into three predicate "buckets" via Dispatcher.

Parameter Sensitive Plan

Uses High, Medium, Low predicate boundary values

Child queries are then compiled and executed generating query variants. They have their own execution plan in Query Store.
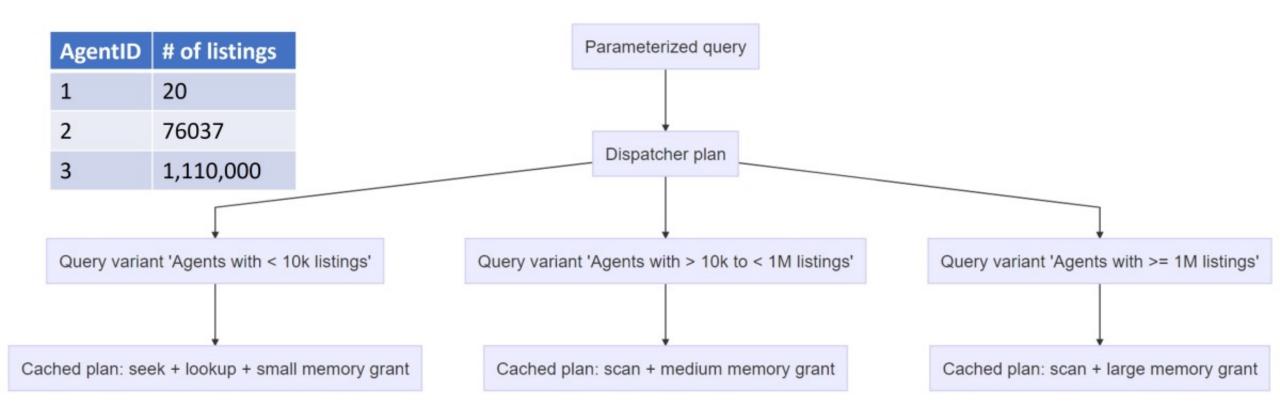
Dispatcher plans are recompiled after large data distribution changes

Variant plans will recompile independently

Parameter Sensitive Plan

AgentID	# of listings
1	20
2	76037
3	1,110,000

Parameterized query

Dispatcher plan

Query variant 'Agents with < 10k listings'

Query variant 'Agents with > 10k to < 1M listings'

Query variant 'Agents with >= 1M listings'

Cached plan: seek + lookup + small memory grant

Cached plan: scan + medium memory grant

Cached plan: scan + large memory grant

Sys.query_store_plan
Sys.query_store_query_variant

DOP Feedback

Uses elapsed time and waits to identify inefficient parallelism for repeating queries

Query store is required

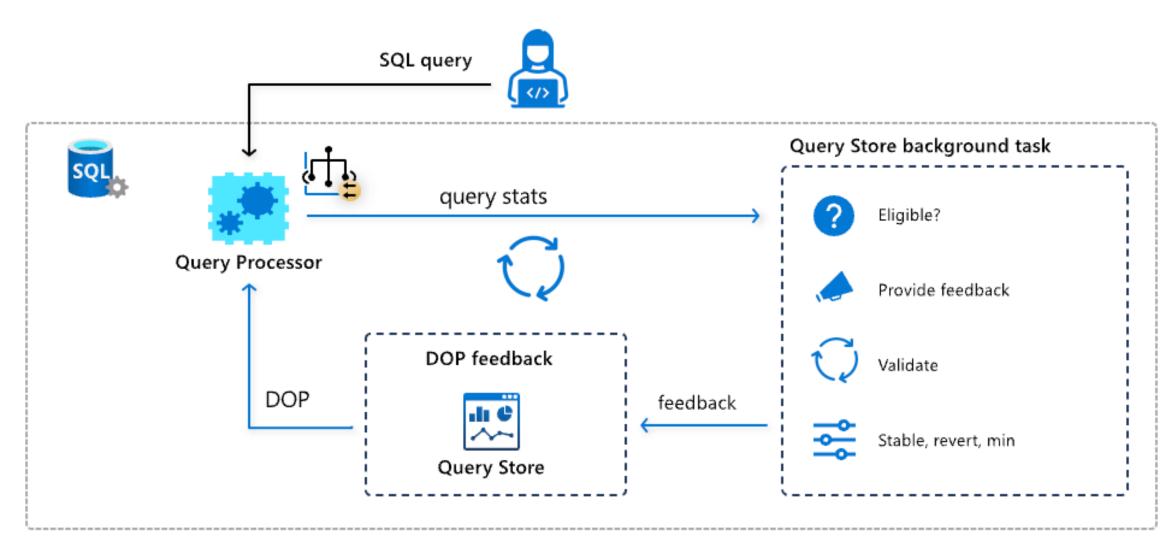Plan regression = last known good DOP

Honors Plan forcing

DOP Feedback Architecture

DOP Feedback

Won't rotate up unless reverting

DOP of 2 is the minimum value

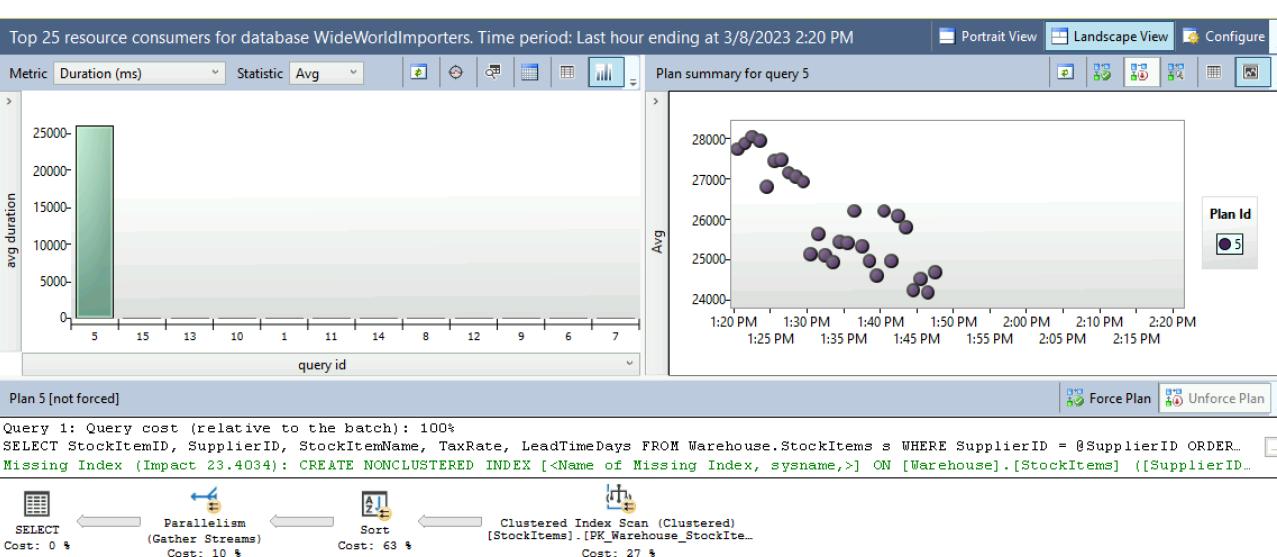Query Hints will be the new ceiling limit if > 2

DOP Feedback is Replica aware

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DEMO

Displaying 16 Events

	name	timestamp	feedback_dop	query_dop
▶	dop_feedback_eligible_query	2023-03-08 13:16:55.7877502	NULL	16
	dop_feedback_provided	2023-03-08 13:23:30.4246819	12	16
	dop_feedback_validation	2023-03-08 13:23:58.8934144	12	NULL
	dop_feedback_validation	2023-03-08 13:24:26.7528532	12	NULL
	dop_feedback_validation	2023-03-08 13:28:58.6556280	12	NULL
	dop_feedback_provided	2023-03-08 13:29:26.7178994	8	12
	dop_feedback_validation	2023-03-08 13:29:52.5435216	8	NULL
	dop_feedback_validation	2023-03-08 13:31:34.9902149	8	NULL
	dop_feedback_validation	2023-03-08 13:35:47.0307650	8	NULL
	dop_feedback_provided	2023-03-08 13:36:13.8242589	6	8
	dop_feedback_validation	2023-03-08 13:36:39.4556774	6	NULL
	dop_feedback_validation	2023-03-08 13:38:20.4270055	6	NULL
	dop_feedback_validation	2023-03-08 13:42:35.0200419	6	NULL
	dop_feedback_provided	2023-03-08 13:42:59.9480367	4	6
	dop_feedback_validation	2023-03-08 13:43:24.4562714	4	NULL
	dop_feedback_validation	2023-03-08 13:45:04.2911374	4	NULL

Duration

Metric Duration (ms) ˅   Statistic Avg ˅   📊 ⏱ 📑 ▦ ▤ 📊 ‗   Plan summary for query 5   📤 📊 📊 📊 ▦ 🖼

avg duration (left chart, y-axis 0–25000+)
query id (x-axis): 5, 15, 13, 10, 1, 11, 14, 8, 12, 9, 6, 7

Avg (right chart, y-axis 24000–28000)
x-axis: 1:20 PM, 1:25 PM, 1:30 PM, 1:35 PM, 1:40 PM, 1:45 PM, 1:50 PM, 1:55 PM, 2:00 PM, 2:05 PM, 2:10 PM, 2:15 PM, 2:20 PM

Plan Id
● 5

Plan 5 [not forced]   🔒 Force Plan 🔓 Unforce Plan

```
Query 1: Query cost (relative to the batch): 100%
SELECT StockItemID, SupplierID, StockItemName, TaxRate, LeadTimeDays FROM Warehouse.StockItems s WHERE SupplierID = @SupplierID ORDER…
Missing Index (Impact 23.4034): CREATE NONCLUSTERED INDEX [<Name of Missing Index, sysname,>] ON [Warehouse].[StockItems] ([SupplierID…
```

SELECT   Parallelism   Sort   Clustered Index Scan (Clustered)
Cost: 0 %   (Gather Streams)   Cost: 63 %   [StockItems].[PK_Warehouse_StockIte…
                Cost: 10 %   Cost: 27 %

CPU Time

Feature Availability

Feature	Enterprise	Standard
Table Variable Deferred Compilation	Yes	Yes
Parameter Sensitive Plan	Yes	Yes
Degrees of Parallelism Feedback*	Yes	No

https://learn.microsoft.com/en-us/sql/sql-server/editions-and-components-of-sql-server-2022

Summary

Performance Game Changer

Compatibility Levels are Important

Increased flexibility

Minimal Intrusion

BYE BYE BAD ANTI-PATTERNS!!

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Slides

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Denny Cherry & Associates Consulting

Feedback always appreciated!!!

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