Advanced Transact-SQL Querying, Programming and Tuning Training

Duration: **5 Day**

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The **Advanced Transact-SQL Querying, Programming and Tuning** course is designed for professionals who want to strengthen their advanced T-SQL querying, programming, and performance tuning capabilities.

The programme focuses on developing efficient and scalable solutions using T-SQL across SQL Server 2014, 2016, 2017, 2019, 2022, and Azure SQL Database.

Participants learn not only how to write complex queries, but also how SQL Server processes those queries internally and how different design decisions can influence performance.

The course covers advanced areas including Logical Query Processing, Query Tuning, Subqueries, Table Expressions, Recursive Queries, the APPLY operator, Joins, Set Operators, Aggregation, Pivoting, Window Functions, Data Modification, Date and Time handling, Programmable Objects, Transactions, Concurrency, Dynamic SQL, and In-Memory OLTP.

Query performance is a major theme throughout the programme. Learners examine execution plans, indexing strategies, cardinality estimation, Query Store, temporary tables, plan reuse, and different methods for improving poorly performing queries.

Core Areas Covered

The programme explores:

- Logical Query Processing
- Query Tuning
- SQL Server internal structures
- Index tuning
- Columnstore indexes
- Query Store
- New Cardinality Estimator
- Temporary tables
- Sets versus cursors
- Query tuning through query revisions
- Derived tables
- Common Table Expressions
- Views
- Inline Table-Valued Functions
- Recursive queries
- APPLY operator
- Joins
- Set operators
- Aggregations
- Pivoting and unpivoting
- Window functions
- Ranking functions
- Offset functions
- Custom aggregates
- STRING_AGG
- TOP
- OFFSET-FETCH
- Data modification

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- Date and time processing
- System-versioned temporal tables
- Dynamic SQL
- User Defined Functions
- Stored Procedures
- Triggers
- Transactions
- Concurrency
- Exception handling
- In-Memory OLTP

Practical Querying and Programming Problems

Throughout the course, participants use T-SQL to solve practical business and data-processing problems.

Examples include:

- Relational Division
- Missing and Existing Ranges
- Gaps and Islands
- Separating Elements
- Pivoting and Unpivoting
- Ranking
- Offset calculations
- Running Totals
- Moving Averages
- Year-to-Date calculations
- Custom Aggregations
- TOP and OFFSET-FETCH problems
- Paging
- Top N Per Group
- Median calculation
- Data De-Duplication
- Sequence handling
- Merging data
- Temporal interval processing
- Interval intersections
- Maximum concurrent intervals
- Interval packing
- Dynamic search conditions
- Dynamic filtering
- Migrating on-disk data to memory-optimized structures

Query Tuning and Performance Optimisation

A dedicated section of the course focuses on query tuning and SQL Server internals.

Topics include:

- Internal SQL Server structures
- Index access methods
- Index tuning

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- Columnstore data
- Cardinality estimation
- Legacy and new cardinality estimators
- Query Store
- Temporary tables
- Set-based versus cursor-based solutions
- Query revisions
- Execution plan analysis
- Compilation and recompilation
- Plan caching
- Plan reuse

Query tuning is also integrated into the rest of the programme rather than treated as a completely separate topic.

For each querying and programming task, participants compare:

- Logical correctness
- Set-based approaches
- Iterative or procedural approaches
- Execution plans
- Resource usage
- Performance implications

Prerequisites

Participants are recommended to have at least **one year of T-SQL querying and programming experience** using SQL Server or Azure SQL Database.

Familiarity with the following areas will be helpful:

- SELECT queries
- Joins
- GROUP BY
- Subqueries
- Basic stored procedures
- SQL Server data types
- Basic indexing concepts

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Who Should Attend

This course is intended for:

- T-SQL Developers
- Database Administrators
- BI Specialists
- Data Scientists
- Data Analysts
- SQL Server developers
- Azure SQL Database professionals
- Anyone responsible for writing or reviewing advanced T-SQL code

The programme is relevant to professionals working with SQL Server 2014–2022 or Azure SQL Database.

What You Will Learn

By the end of the course, participants will be able to:

- Understand Logical Query Processing
- Explain key SQL Server internal data structures
- Analyse query performance
- Tune poorly performing queries
- Read and interpret execution plans
- Explain differences between legacy and new cardinality estimators
- Solve complex querying and programming problems
- Understand compilation and recompilation behaviour
- Explain plan caching and reuse
- Work effectively with transactions and concurrency
- Handle hierarchical data
- Write recursive queries
- Think in terms of sets
- Compare set-based and iterative solutions
- Apply window functions to improve analytical queries
- Work effectively with date and time data
- Handle temporal intervals
- Create system-versioned temporal tables
- Explain performance issues related to User Defined Functions
- Apply alternative approaches when UDF performance becomes problematic
- Migrate on-disk data to memory-optimized structures
- Describe important T-SQL enhancements introduced across SQL Server versions

Training Outline

Module 01: Logical Query Processing

This module examines how SQL Server logically processes a query.

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Topics include:

- Logical query processing phases
- Logical processing order of SELECT queries
- Filtering
- Grouping
- Aggregation
- Windowing
- Ordering
- Query semantics

Participants learn to distinguish between the written order of query clauses and the order in which they are logically processed.

Module 02: Query Tuning

This module provides the foundation for systematic performance analysis.

Topics include:

- SQL Server internals
- Internal data structures
- Index access methods
- Index tuning
- Covering indexes
- Columnstore indexes
- Cardinality estimation
- Legacy cardinality estimator
- New cardinality estimator
- Query Store
- Temporary tables
- Sets versus cursors
- Query revisions
- Execution plans
- Compilation
- Recompilation
- Plan caching
- Plan reuse

Participants learn how to identify performance bottlenecks and evaluate alternative solutions.

Module 03: Multi-Table Queries

This module focuses on retrieving and combining data from multiple sources.

Topics include:

- Joins
- Inner joins
- Outer joins
- Cross joins
- Set operators
- APPLY operator

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- Subqueries
- Derived tables
- Common Table Expressions
- Views
- Inline Table-Valued Functions
- Recursive queries

Participants compare different techniques in terms of readability, maintainability, and performance.

Module 04: Grouping, Pivoting and Windowing

This module focuses on aggregation and analytical querying.

Topics include:

- Aggregate functions
- Grouping
- Custom aggregates
- Pivot
- Unpivot
- STRING_AGG
- Window functions
- Aggregate window functions
- Ranking functions
- Offset functions
- Running totals
- Moving averages
- Year-to-Date calculations
- Top N per group
- Median calculations

Participants use window functions to produce more concise and efficient analytical solutions.

Module 05: TOP and OFFSET-FETCH

This module examines techniques for limiting and paging result sets.

Topics include:

- TOP
- TOP WITH TIES
- OFFSET
- FETCH
- Paging
- Top N scenarios
- Top N per group
- Ordering and result-set limitation problems

Module 06: Data Modification

This module focuses on efficient data-change operations.

Topics include:

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- INSERT
- UPDATE
- DELETE
- MERGE
- Sequence handling
- Data merging
- Data de-duplication
- Set-based data modification
- Data integrity considerations

Participants evaluate approaches for modifying large sets of data efficiently.

Module 07: Working with Date and Time

This module focuses on effective date and time processing.

Topics include:

- SQL Server date and time data types
- Date calculations
- Date filtering
- Temporal intervals
- Interval intersections
- Maximum concurrency
- Packing intervals
- System-versioned temporal tables
- Temporal queries

Participants solve common business problems involving time-based and interval-based data.

Module 08: Programmable Objects

This module examines programmable components within SQL Server.

Topics include:

- Dynamic SQL
- Secure Dynamic SQL
- User Defined Functions
- Stored Procedures
- Triggers
- Transactions
- Isolation levels
- Concurrency
- Exception handling
- Dynamic search conditions
- Dynamic filtering

Participants learn how to create reusable and efficient database routines.

The course also examines performance challenges associated with User Defined Functions and possible alternatives or workarounds.

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Module 09: In-Memory OLTP

This module explores SQL Server memory-optimized technologies.

Topics include:

- In-Memory OLTP architecture
- Memory-optimized tables
- Differences between on-disk and memory-optimized structures
- Data migration
- Performance considerations
- Appropriate use cases

Participants evaluate when existing disk-based data structures can benefit from migration to memory-optimized designs.