

# T-SQL Fundamentals

Fourth Edition



 Professional

Itzik Ben-Gan

# T-SQL Fundamentals

Itzik Ben-Gan

# T-SQL Fundamentals

## Table of Contents

Cover

Title Page

Copyright Page

Contents at a Glance

Contents

Acknowledgments

About the Author

Introduction

Chapter 1: Background to T-SQL querying and programming

- Theoretical background

  - SQL

  - Set theory

  - Predicate logic

  - The relational model

  - Types of database workloads

- SQL Server architecture

  - On-premises and cloud RDBMS flavors

  - SQL Server instances

  - Databases

  - Schemas and objects

- Creating tables and defining data integrity

  - Creating tables

  - Defining data integrity

# **Table of Contents**

Conclusion

## **Chapter 2: Single-table queries**

Elements of the SELECT statement

The FROM clause

The WHERE clause

The GROUP BY clause

The HAVING clause

The SELECT clause

The ORDER BY clause

The TOP and OFFSET-FETCH filters

A quick look at window functions

Predicates and operators

CASE expressions

NULLs

The GREATEST and LEAST functions

All-at-once operations

Working with character data

Data types

Collation

Operators and functions

The LIKE predicate

Working with date and time data

Date and time data types

Literals

Working with date and time separately

Filtering date ranges

Date and time functions

Querying metadata

# **Table of Contents**

Catalog views

Information schema views

System stored procedures and functions

## **Conclusion**

## **Exercises**

Exercise 1

Exercise 2

Exercise 3

Exercise 4

Exercise 5

Exercise 6

Exercise 7

Exercise 8

Exercise 9

Exercise 10

## **Solutions**

Exercise 1

Exercise 2

Exercise 3

Exercise 4

Exercise 5

Exercise 6

Exercise 7

Exercise 8

Exercise 9

Exercise 10

## **Chapter 3: Joins**

### **Cross joins**

SQL-92 syntax

# Table of Contents

SQL-89 syntax

Self cross joins

Producing tables of numbers

## Inner joins

SQL-92 syntax

SQL-89 syntax

Inner join safety

## More join examples

Composite joins

Non-equi joins

Multi-join queries

## Outer joins

Outer joins, described

Including missing values

Filtering attributes from the nonpreserved side of an outer join

Using outer joins in a multi-join query

Using the COUNT aggregate with outer joins

## Conclusion

## Exercises

Exercise 1-1

Exercise 1-2

Exercise 2

Exercise 3

Exercise 4

Exercise 5

Exercise 6

Exercise 7

Exercise 8

Exercise 9

# **Table of Contents**

## **Solutions**

- Exercise 1-1
- Exercise 1-2
- Exercise 2
- Exercise 3
- Exercise 4
- Exercise 5
- Exercise 6
- Exercise 7
- Exercise 8
- Exercise 9

## **Chapter 4: Subqueries**

### **Self-contained subqueries**

- Self-contained scalar subquery examples
- Self-contained multivalued subquery examples

### **Correlated subqueries**

- The EXISTS predicate

### **Returning previous or next values**

### **Using running aggregates**

### **Dealing with misbehaving subqueries**

- NULL trouble
- Substitution errors in subquery column names

## **Conclusion**

## **Exercises**

- Exercise 1
- Exercise 2
- Exercise 3
- Exercise 4

# **Table of Contents**

Exercise 5  
Exercise 6  
Exercise 7  
Exercise 8  
Exercise 9  
Exercise 10

## **Solutions**

Exercise 1  
Exercise 2  
Exercise 3  
Exercise 4  
Exercise 5  
Exercise 6  
Exercise 7  
Exercise 8  
Exercise 9  
Exercise 10

## **Chapter 5: Table expressions**

### **Derived tables**

Assigning column aliases  
Using arguments  
Nesting  
Multiple references

### **Common table expressions**

Assigning column aliases in CTEs  
Using arguments in CTEs  
Defining multiple CTEs  
Multiple references in CTEs  
Recursive CTEs



# **Table of Contents**

## Views

Views and the ORDER BY clause

View options

## Inline table-valued functions

## The APPLY operator

## Conclusion

## Exercises

Exercise 1

Exercise 2-1

Exercise 2-2

Exercise 3-1

Exercise 3-2

Exercise 4

Exercise 5-1

Exercise 5-2

Exercise 6-1

Exercise 6-2

## Solutions

Exercise 1

Exercise 2-1

Exercise 2-2

Exercise 3-1

Exercise 3-2

Exercise 4

Exercise 5-1

Exercise 5-2

Exercise 6-1

Exercise 6-2

## Chapter 6: Set operators

# **Table of Contents**

## The UNION operator

- The UNION ALL operator

- The UNION (DISTINCT) operator

## The INTERSECT operator

- The INTERSECT (DISTINCT) operator

- The INTERSECT ALL operator

## The EXCEPT operator

- The EXCEPT (DISTINCT) operator

- The EXCEPT ALL operator

## Precedence

## Circumventing unsupported logical phases

## Conclusion

## Exercises

- Exercise 1

- Exercise 2

- Exercise 3

- Exercise 4

- Exercise 5

- Exercise 6

## Solutions

- Exercise 1

- Exercise 2

- Exercise 3

- Exercise 4

- Exercise 5

- Exercise 6

## Chapter 7: T-SQL for data analysis

### Window functions

# **Table of Contents**

- Ranking window functions
- Offset window functions
- Aggregate window functions
- The WINDOW clause

## **Pivoting data**

- Pivoting with a grouped query
- Pivoting with the PIVOT operator

## **Unpivoting data**

- Unpivoting with the APPLY operator
- Unpivoting with the UNPIVOT operator

## **Grouping sets**

- The GROUPING SETS subclause
- The CUBE subclause
- The ROLLUP subclause
- The GROUPING and GROUPING\_ID functions

## **Time series**

- Sample data
- The DATE\_BUCKET function
- Custom computation of start of containing bucket
- Applying bucket logic to sample data
- Gap filling

## **Conclusion**

## **Exercises**

- Exercise 1
- Exercise 2
- Exercise 3
- Exercise 4
- Exercise 5
- Exercise 6

# Table of Contents

Exercise 7

Exercise 8

## Solutions

Exercise 1

Exercise 2

Exercise 3

Exercise 4

Exercise 5

Exercise 6

Exercise 7

Exercise 8

## Chapter 8: Data modification

### Inserting data

The INSERT VALUES statement

The INSERT SELECT statement

The INSERT EXEC statement

The SELECT INTO statement

The BULK INSERT statement

The identity property and the sequence object

### Deleting data

The DELETE statement

The TRUNCATE statement

DELETE based on a join

### Updating data

The UPDATE statement

UPDATE based on a join

Assignment UPDATE

### Merging data

Modifying data through table expressions

# **Table of Contents**

Modifications with TOP and OFFSET-FETCH

The OUTPUT clause

INSERT with OUTPUT

DELETE with OUTPUT

UPDATE with OUTPUT

MERGE with OUTPUT

Nested DML

Conclusion

Exercises

Exercise 1

Exercise 2

Exercise 3

Exercise 4

Exercise 5

Exercise 6

Solutions

Exercise 1

Exercise 2

Exercise 3

Exercise 4

Exercise 5

Exercise 6

Chapter 9: Temporal tables

Creating tables

Modifying data

Querying data

Conclusion

Exercises

# **Table of Contents**

Exercise 1

Exercise 2

Exercise 3

Exercise 4

## **Solutions**

Exercise 1

Exercise 2

Exercise 3

Exercise 4

## **Chapter 10: Transactions and concurrency**

### **Transactions**

### **Locks and blocking**

Locks

Troubleshooting blocking

### **Isolation levels**

The READ UNCOMMITTED isolation level

The READ COMMITTED isolation level

The REPEATABLE READ isolation level

The SERIALIZABLE isolation level

Isolation levels based on row versioning

Summary of isolation levels

### **Deadlocks**

### **Conclusion**

### **Exercises**

Exercise 1

Exercise 2

Exercise 3

## **Chapter 11: SQL Graph**

# **Table of Contents**

## Creating tables

- Traditional modeling

- Graph modeling

## Querying data

- Using the MATCH clause

- Recursive queries

- Using the SHORTEST\_PATH option

- SQL Graph querying features that are still missing

## Data modification considerations

- Deleting and updating data

- Merging data

## Conclusion

## Exercises

- Exercise 1

- Exercise 2

- Exercise 3

- Exercise 4

## Solutions

- Exercise 1

- Exercise 2

- Exercise 3

- Exercise 4

## Cleanup

## Chapter 12: Programmable objects

### Variables

### Batches

- A batch as a unit of parsing

- Batches and variables

- Statements that cannot be combined in the same batch

# **Table of Contents**

A batch as a unit of resolution

The GO n option

## **Flow elements**

The IF . . . ELSE flow element

The WHILE flow element

## **Cursors**

## **Temporary tables**

Local temporary tables

Global temporary tables

Table variables

Table types

## **Dynamic SQL**

The EXEC command

The sp\_executesql stored procedure

Using PIVOT with Dynamic SQL

## **Routines**

User-defined functions

Stored procedures

Triggers

## **Error handling**

## **Conclusion**

## **Appendix: Getting started**

## **Index**