# Module 4

## Querying Multiple Tables

## Module Overview

- Understanding Joins
- Querying with Inner Joins
- Querying with Outer Joins
- Querying with Cross Joins and Self Joins

# Lesson 1: Understanding Joins

- The FROM Clause and Virtual Tables
- Join Terminology: Cartesian Product
- Overview of Join Types
- T-SQL Syntax Choices
- Demonstration: Understanding Joins

## The FROM Clause and Virtual Tables

- FROM clause determines source tables to be used in SELECT statement
- FROM clause can contain tables and operators
- Result set of FROM clause is virtual table
  - Subsequent logical operations in SELECT statement consume this virtual table
- FROM clause can establish table aliases for use by subsequent phases of query

# Join Terminology: Cartesian Product

- Characteristics of a Cartesian product
  - Output or intermediate result of FROM clause
  - Combine all possible combinations of two sets
  - In T-SQL queries, usually not desired
    - Special case: table of numbers

| Name |
|---|
| Davis |
| Funk |
| King |

| Product |
|---|
| Alice Mutton |
| Crab Meat |
| Ipoh Coffee |

| Name | Product |
|---|---|
| Davis | Alice Mutton |
| Davis | Crab Meat |
| Davis | Ipoh Coffee |
| Funk | Alice Mutton |
| Funk | Crab Meat |
| Funk | Ipoh Coffee |
| King | Alice Mutton |
| King | Crab Meat |
| King | Ipoh Coffee |

# Overview of Join Types

- Join types in FROM clauses specify the operations performed on the virtual table:

| Join Type | Description |
|---|---|
| Cross | Combines all rows in both tables (creates Cartesian product) Produto Cartesiano - Multiplicação entre tabelas |
| Inner | Starts with Cartesian product; applies filter to match rows between tables based on predicate ON ( PK = FK) |
| Outer | Starts with Cartesian product; all rows from designated table preserved, matching rows from other table retrieved. Additional NULLs inserted as placeholders |

Se não encontrar valor, preenche com NULL

# T-SQL Syntax Choices

- ANSI SQL-92
  - Tables joined by JOIN operator in FROM Clause

```
SELECT ...
FROM   Table1 JOIN Table2
       ON <on_predicate>
```

- ANSI SQL-89
  - Tables joined by commas in FROM Clause
    - Not recommended: accidental Cartesian products!

```
SELECT ...
FROM   Table1, Table2
WHERE  <where_predicate>
```

# Demonstration: Understanding Joins

In this demonstration, you will see how to:

- Use joins

## Understanding Inner Joins

- Returns only rows where a match is found in both input tables
- Matches rows based on attributes supplied in predicate
  - ON clause in SQL-92 syntax (preferred)
  - WHERE clause in SQL-89 syntax
- Why filter in ON clause?
  - Logical separation between filtering for purposes of join and filtering results in WHERE
  - Typically no difference to query optimizer
- If join predicate operator is =, also known as equi-join

## Inner Join Syntax

- List tables in FROM Clause separated by JOIN operator
- Table aliases preferred
- Table order does not matter

```
FROM t1 JOIN t2
    ON t1.column = t2.column
```

```
SELECT o.orderid,
       o.orderdate,
       od.productid,
       od.unitprice,
       od.qty
FROM Sales.Orders AS o
      JOIN Sales.OrderDetails AS od
      ON o.orderid = od.orderid;
```

# Inner Join Examples

- Join based on single matching attribute

```
SELECT ...
FROM Production.Categories AS C
    JOIN Production.Products AS P
        ON C.categoryid = P.categoryid;
```

- Join based on multiple matching attributes (composite join)

```
-- List cities and countries where both --
customers and employees live
SELECT DISTINCT e.city, e.country
FROM Sales.Customers AS c
JOIN    HR.Employees AS e
    ON c.city = e.city AND
    c.country = e.country;
```

# Understanding Outer Joins

- Returns all rows from one table and any matching rows from second table
- One table's rows are "preserved"
  - Designated with LEFT, RIGHT, FULL keyword
  - All rows from preserved table output to result set
- Matches from other table retrieved
- Additional rows added to results for nonmatched rows
  - NULLs added in places where attributes do not match
- Example: return all customers and, for those who have placed orders, return order information; customers without matching orders will display NULL for order details

# Outer Join Syntax

- Return all rows from first table, only matches from second:

```
FROM t1 LEFT OUTER JOIN t2 ON
    t1.col = t2.col
```

- Return all rows from second table, only matches from first:

```
FROM t1 RIGHT OUTER JOIN t2 ON
    t1.col = t2.col
```

- Return only rows from first table, with no match in second:

```
FROM t1 LEFT OUTER JOIN t2 ON
    t1.col = t2.col
WHERE     t2.col IS NULL
```

# Outer Join Examples

- All customers with order details if present:

```
SELECT c.custid, c.contactname, o.orderid,
o.orderdate
FROM Sales.Customers AS C
LEFT OUTER JOIN Sales.Orders AS O
    ON c.custid = o.custid;
```

- Customers who did not place orders:

```
SELECT c.custid, c.contactname, o.orderid,
o.orderdate
FROM Sales.Customers AS C LEFT OUTER JOIN
Sales.Orders AS O
    ON c.custid = o.custid
WHERE o.orderid IS NULL;
```

## Understanding Cross Joins

- Combine each row from first table with each row from second table
- All possible combinations output
- Logical foundation for inner and outer joins
  - Inner join starts with Cartesian product, adds filter
  - Outer join takes Cartesian output, filtered, adds back nonmatching rows (with NULL placeholders)
- Due to Cartesian product output, not typically a desired form of join
- Some useful exceptions:
  - Table of numbers, generating data for testing

## Cross Join Syntax

- No matching performed, no ON clause used
- Return all rows from left table combined with each row from right table (ANSI SQL-92 syntax):

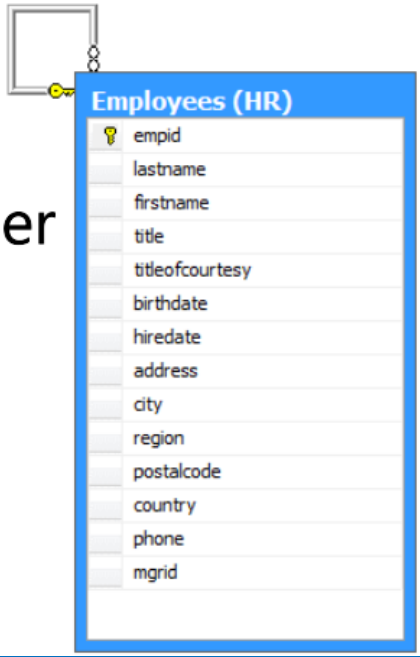
```
SELECT  ...
FROM t1 CROSS JOIN t2
```

- Return all rows from left table combined with each row from right table (ANSI SQL-89 syntax):

```
SELECT  ...
FROM t1, t2
```

# Understanding Self Joins

- Why use self joins?
  - Compare rows in same table to each other
- Create two instances of same table in FROM clause
  - At least one alias required
- Example: Return all employees and the name of the employee's manager




# Self Join Examples

- Return all employees with ID of employee's manager when a manager exists (inner join):

```
SELECT  e.empid, e.lastname,
        e.title, e.mgrid, m.lastname
FROM    HR.Employees AS e
JOIN HR.Employees AS m
ON e.mgrid=m.empid;
```

- Return all employees with ID of manager (outer join). This will return NULL for the CEO:

```
SELECT  e. empid, e.lastname,
            e.title, m.mgrid
FROM HR.Employees AS e
LEFT OUTER JOIN HR.Employees AS m
ON e.mgrid=m.empid;
```