SQL SELECT Query: Intermediate

IT 4153 Advanced Database

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Overview

- SQL Select
  - Expression
  - Alias revisit
  - Aggregate functions - complete
  - Table join - complete
  - Sub-query in where
  - Limiting results: TOP, DISTINCT
- All examples can be used with the "Northwind" database

1. Expression

- Expression is a combination of symbols and operators that returns a single value
- An expression can be
  - a single constant, variable, column, or scalar function
    - 10
    - 3.14
    - 'John Doe'
    - '10/10/2010'
    - CompanyName
    - GetDate()
  - columns, numbers, literals, functions connected by operators
    - 10*3+3
    - 'John' + 'Doe'
    - Address + ', ' + City + ', ' + ZipCode
    - Quantity * SalePrice
    - 1.2 * ListPrice

SQL Operators

- Comparison operators
  - >, <, >=, <=, <>, !=, =
  - LIKE, IN, BETWEEN…AND, IS (NULL)
- Logical operators
  - AND, OR, NOT
- Arithmetic operators
  - +, -, *, /, %
- Concantenation
  - +
- T-SQL Reference
  - http://msdn.microsoft.com/en-us/library/ms174986.aspx

Expressions used as Columns

- Expressions can be used as derived columns
- Examples

A text constant which will be the same for every record

```
SELECT CompanyName, 'Supplier' as Type FROM Suppliers;

SELECT ProductName, UnitPrice*1.2  AS 'New Price'
FROM Products;
```

String concatenation

```
SELECT FirstName+'  '+LastName FROM Employees;

SELECT UPPER(ProductName) FROM Products;

SELECT GETDATE();
```

A system function not related to any table.

Expressions used for Comparison

- Expressions can be used in the WHERE clause
- Examples

```
SELECT * from Products
WHERE UnitsInStock-ReorderLevel<0;

SELECT * FROM Products
WHERE UnitsInStock + UnitsOnOrder < ReorderLevel;

SELECT ProductName, UnitPrice * 1.1 AS Discount
   FROM Products
WHERE UnitPrice * 1.1 >= 20
```

Comparison between columns

2. Alias

- Column alias: representing derived and constant columns

```
SELECT CategoryID, AVG(UnitPrice) Price
FROM Products
GROUP BY CategoryID
ORDER BY Price;
```

Column alias can be used in ORDER BY

```
SELECT ProductName, UnitPrice * 0.9 Discount
FROM Products
WHERE UnitPrice * 0.9 > 20;
```

Column alias can NOT be used in WHERE or HAVING clause (SQL Server)

- Table alias: commonly used in table joins and sub-queries

“AS” is optional.

```
SELECT ProductName, CategoryName
FROM Products AS p, Categories c
Where p.CategoryID = c.CategoryID
```

If an alias is assigned, it must be used instead of the original table name

Alias Symbol

- Column alias: use [ ] or ' '

```
SELECT ProductName, UnitPrice * 0.9 AS 'Discount Price'
FROM Products
ORDER BY 'Discount Price';

SELECT ProductName, UnitPrice * 0.9 AS [Discount Price]
FROM Products
ORDER BY [Discount Price];
```

- Table alias: use [ ]

```
SELECT ProductName, CategoryName
FROM Products AS [table p], Categories c
Where [table p].CategoryID = c.CategoryID
```

3. Aggregate Functions

- Using aggregate functions for row calculation

MIN	(minimum of all or selected values)
MAX	(maximum of all or selected values)
COUNT	(number of all or selected rows)
AVG	(average of all or selected values)
SUM	(sum of all or selected values)

- 2.1 Calculation for all or selected rows

```
SELECT COUNT(ProductID) AS NumberOfProducts FROM Products;

SELECT AVG(UnitPrice) AS 'Average Price for Category 1'
    FROM Products
WHERE CategoryId = 1;
```

This criterion limits the records to be averaged.

Expression in Aggregation

- Expressions can be used with aggregate functions

- Example
  - What is the total payment for each line item?

```
SELECT SUM(UnitPrice * Quantity) AS LineItemTotal
FROM [Order Details];
```

Grouping

- GROUP BY: aggregation with groups
  - To get aggregation results for different groups of records
- Example
  - What is the average unit price of products in each category?

```
SELECT CategoryID, AVG(UnitPrice)
FROM Products
GROUP BY CategoryID;
```

Limitations of GROUP BY

- Columns or expressions (except the aggregate function) can be in the SELECT clause only if they are in the GROUP BY clause.

Good! Country is in the GROUP BY clause

```
SELECT Country, Region, COUNT(CustomerId)
FROM Customers
GROUP BY Country
```

WRONG! Region is not in the GROUP BY clause

Sorting Aggregation Result

- You can sort by the aggregation results
  - Example: what is the average unit price of products in each category? Sort by the average unit price

```
SELECT CategoryID, AVG(UnitPrice) FROM Products
GROUP BY CategoryID
ORDER BY AVG(UnitPrice)
```

Using aggregate function

```
SELECT CategoryID, AVG(UnitPrice) AS Price FROM Products
GROUP BY CategoryID
ORDER BY Price
```

Using alias.

```
SELECT CategoryID, AVG(UnitPrice) AS Price FROM Products
GROUP BY CategoryID
ORDER BY 2
```

Using column index

Filtering Aggregation Result

- Use “HAVING” clause to filter aggregation result (after aggregation)
  - What is the average unit price of products in each category? Only return those with an average price greater than 10.
  - Important: aggregate functions cannot be used in WHERE clause!

```
SELECT CategoryID, AVG(UnitPrice) FROM Products
GROUP BY CategoryID
Having AVG(UnitPrice) > 10;
```

This is wrong:

```
SELECT CategoryID, AVG(UnitPrice)
FROM Products
WHERE AVG(UnitPrice) > 10
GROUP BY CategoryID
```

- Use “WHERE” clause to filter records to be aggregated (before aggregation)
  - What is the average unit price of products whose unit price is greater than 10?

```
SELECT CategoryID, AVG(UnitPrice) FROM Products
WHERE UnitPrice > 10
GROUP BY CategoryID;
```

4. Table Join

- How do rows match from different tables?
  - Cross Join: no need to match.
  - Inner Join: use the foreign key constraint as the matching criteria
- Inner join (equal join)
  - Only include records that have matching records (based on PK/FK pair) from two tables (either direction)
  - Records that do not have matching ones in the other table are not included in the results.
- Outer join (usually needed when minimum cardinality is optional on a table)
  - Left join: include all qualified records from the left table in the join condition even if they do not have matching records in the right table.
  - Right join: include all qualified records from the right table in the join condition even if they do not have matching records in the left table.
  - Full join: include all qualified records from both tables in the join condition

Table Join Effect - Cross Join

FK

Product	Category
A	1
B	2

Category	Name
1	Canned
2	Drink
3	Fresh

Join

Product	Category
A	Canned
A	Drink
A	Fresh
B	Canned
B	Drink
B	Fresh

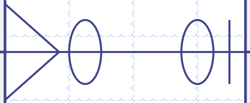
Cross Join: no row matching

Product	Category
A	Canned
B	Drink

Inner Join: row matching based on foreign key

Table Join Effect - Outer Join

Product	CategoryId
A	1
B	2
C	



CategoryId	Name
1	Canned
2	Drink
3	Fresh

Inner join

Product	Category
A	Canned
B	Drink

Left Join

Product	Category
A	Canned
B	Drink
C	(Null)

Full Join

Product	Category
A	Canned
B	Drink
C	(Null)
(Null)	Fresh

Right Join

Product	Category
A	Canned
B	Drink
(Null)	Fresh

Equal Join Syntax

- What is the category name for each product?

```
SELECT ProductName, CategoryName
   FROM Products, Categories
Where Products.CategoryID = Categories.CategoryID
AND Discontinued = 0;
```

VS.

```
SELECT ProductName, CategoryName
FROM Products INNER JOIN Categories ON
   Products.CategoryID = Categories.CategoryID
WHERE Discontinued = 0;
```

1. Joining/matching criteria: very important, don't forget!
2. Table.Cloumn format is used to avoid ambiguity.

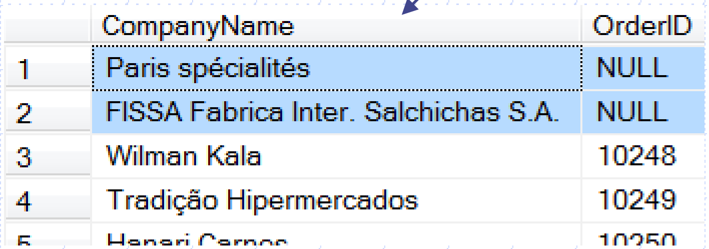
Outer Join Example

- Get customers and their orders; also include customers who have never placed an order

```
SELECT CompanyName, OrderID
FROM Customers LEFT JOIN Orders ON
   Customers.CustomerID = Orders.CustomerID
ORDER BY OrderID
```

The first two rows will not be included for an inner join.

- Execution result



	CompanyName	OrderID
1	Paris spécialités	NULL
2	FISSA Fabrica Inter. Salchichas S.A.	NULL
3	Wilman Kala	10248
4	Tradição Hipermercados	10249
5	Hanari Carnes	10250

5. Sub-Query

- Use the output of a “SELECT” query (sub-query, or inner query) as an input for another “SELECT” query

```
SELECT * FROM Products
   WHERE CategoryId =
     (SELECT CategoryId FROM Categories
           WHERE CategoryName = 'Seafood');
```

The sub query returns a single value (scalar value); use “=”

```
SELECT * FROM Products
   WHERE CategoryId IN
     (SELECT CategoryId FROM Categories
     WHERE CategoryName IN
   ('Seafood','Beverages','Produce'));
```

The sub query returns a list of values; use IN

Sub-Query and Table Join

- In the previous cases these statements can also be re-written as table joins

```
SELECT * FROM Products, Categories
WHERE Products.CategoryId = Categories.CategoryId
   AND CategoryName = 'Seafood';

SELECT * FROM Products, Categories
WHERE Products.CategoryId = Categories.CategoryId
AND CategoryName IN ('Seafood','Beverages','Produce');
```

Sub-Queries for Comparison

- Sub-queries can be used with other comparison operators >, <, >=, <=, etc.

```
SELECT * FROM Products
WHERE UnitPrice >
   (SELECT AVG(UnitPrice) FROM Products);
```

The sub query returns a single value (scalar value)

- In these cases, there is no equivalent table join format

TOP

- Use the keyword “TOP” to limit the number of rows returned (SQL Server)
- Example

Only returns 10 records.

```
SELECT TOP 10 * FROM Customers;

SELECT TOP 5 PERCENT * FROM Customers;
```

Only returns 5% of the total records in the original results.

- WITH TIES
  - Include records whose value is tied with the last record

```
SELECT TOP 9 with ties * from Products order by UnitPrice
```

Returns 10 records as the last two are the same price.

Uniqueness

- Use the keyword "DISTINCT" to eliminate duplicate rows in the results
  - In Oracle, "unique" also works

- Example

Without DISTINCT, it returns 91 rows; with DISTINCT, it returns only 21 rows.

```
SELECT DISTINCT Country from Customers
    ORDER BY country;

SELECT Count(DISTINCT Country)
    FROM Customers
```

DISTINCT can be used with aggregate functions. Without DISTINCT, the result is 91; with DISTINCT, the result is 21.

```
SELECT * FROM Suppliers
    WHERE SupplierId IN
      (SELECT DISTINCT SupplierId from Products WHERE CategoryId = 1)
```

Summary

- Key concepts
  - Expression
  - Alias
  - Aggregate function
  - Join, cross join, inner join, outer join, left join, right join, full join
  - Sub-query
- Key skills
  - Write SQL SELECT statement to retrieve desired data
  - Know the result of a given SQL SELECT statement

More SQL Query Resources

- W3Schools SQL Tutorial
  - http://www.w3schools.com/sql/
- SQL Course
  - http://sqlcourse2.com/
- A gentle introduction to SQL
  - http://sqlzoo.net/
- Other
  - http://www.youtube.com/watch?v=Rpp28U_K9Lk
  - http://www.1keydata.com/sql