Module 2
SQL Subtotal Operators
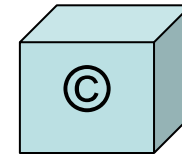
Lesson 2: SQL CUBE Operator

Lesson Objectives

- Write SELECT statements using the CUBE operator

- Write SELECT statements using the UNION operator to demonstrate equivalence

- Perform calculations to demonstrate understanding of the CUBE operator

- Reflect on the importance of the CUBE operator

CUBE Operator Characteristics

Complete set of subtotals

Appropriate for independent dimensions

Order independent column specification

CUBE / GROUP BY Comparison

SELECT State, Month, SUM(Sales)
GROUP BY CUBE(State, Month)

State	Month	SUM(Sales)
CA	Dec	100
CA	Feb	75
CO	Dec	150
CO	Jan	100
CO	Feb	200
CN	Dec	50
CN	Jan	75
CA	-	175
CO	-	450
CN	-	125
-	Dec	300
-	Jan	175
-	Feb	275
-	-	750

SELECT State, Month, SUM(Sales)
GROUP BY State, Month

State	Month	SUM(Sales)
CA	Dec	100
CA	Feb	75
CO	Dec	150
CO	Jan	100
CO	Feb	200
CN	Dec	50
CN	Jan	75

CUBE Example

- Summarize (sum, min, and count) store sales for USA and Canada in 2016 by store zip code and month
- Generate all possible subtotals by zip code and month

```
SELECT StoreZip, TimeMonth, SUM(SalesDollar) AS SumSales,
       MIN(SalesDollar) AS MinSales, COUNT(*) AS RowCount
 FROM SSSales, SSStore, SSTimeDim
 WHERE SSSales.StoreId = SSStore.StoreId
   AND SSSales.TimeNo = SSTimeDim.TimeNo
   AND (StoreNation = 'USA' OR StoreNation = 'Canada')
   AND TimeYear = 2016
 GROUP BY CUBE (StoreZip, TimeMonth)
 ORDER BY StoreZip, TimeMonth;
```

CUBE Operator Calculations

- ## GROUP BY CUBE(Col1, Col2)
  - *M* unique values in Col1
  - *N* unique values in Col2

- ## Result rows
  - Maximum of $M \times N$ rows: GROUP BY Col1, Col2
  - Maximum subtotal rows of $M + N + 1$ (CUBE)

- ## Subtotal groups
  - Three groups of subtotal rows (Col1, Col2, grand total)
  - Derive CUBE operation with UNION operations

CUBE using UNION Operations

```
SELECT StoreZip, TimeMonth, SUM(SalesDollar) AS
   SumSales
             …
GROUP BY StoreZip, TimeMonth
UNION
SELECT StoreZip, NULL, SUM(SalesDollar) AS SumSales
             …
GROUP BY StoreZip
UNION
SELECT NULL, TimeMonth, SUM(SalesDollar) AS SumSales
             …
GROUP BY TimeMonth
UNION
SELECT NULL, NULL, SUM(SalesDollar) AS SumSales
```

CUBE Calculations with 3 Columns

- GROUP BY Col1, Col2, Col3

- Result rows
  - Maximum GROUP BY rows: $M \times N \times P$
  - Maximum subtotal rows: $M + N + P + M \times N + M \times P + N \times P + 1$

- Subtotal groups
  - Normal GROUP BY totals (1)
  - Combinations of 2 columns (3)
  - Combinations of 1 column (3)
  - Grand total (1)
  - Number of subtotal groups: 8 (2^3)

Additional CUBE Problems

- SELECT statement with CUBE operator
  - Summarize (sum, min, and count) store sales for USA and Canada in 2016 by store zip code, month, and division identifier
  - Sort in a convenient order
  - Complete set of subtotals
- Equivalent SELECT statement without CUBE operator
- Documents in module 2 for lesson examples and additional practice problems

Summary

- Support subtotal computations common in pivot tables

- CUBE operator for complete set of subtotals

- Appropriate for independent columns

- Not primitive operator but strong advantages over UNION operations