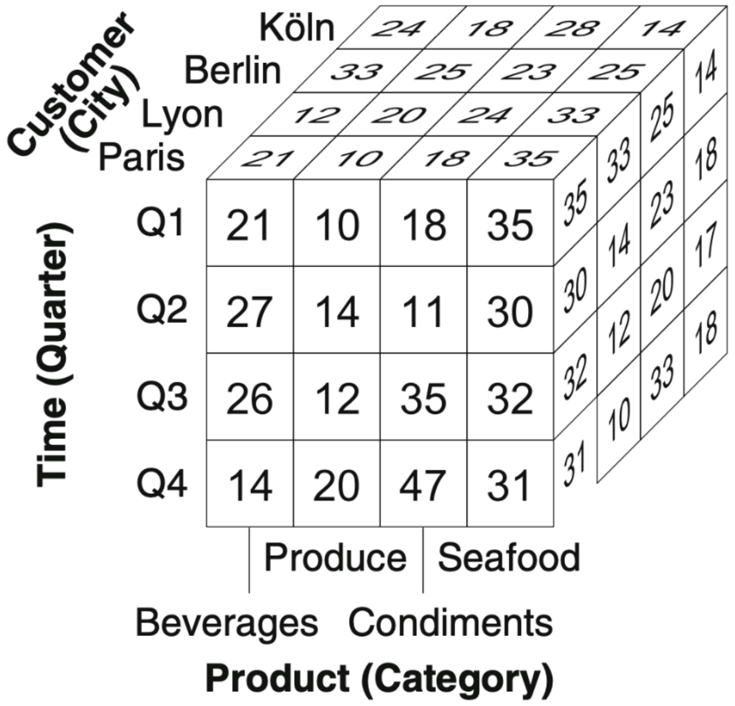
Chapter 4: Querying Data Warehouses

Data Warehouse

4.1 Introduction to MDX

4.1 Introduction to MDX

- 4.1.1 Tuples and Sets, Two fundamental concepts in MDX are tuples and sets. Intuitively, a tuple identifies a single cell in a multidimensional cube. A tuple is defined by stating one member from one or several dimensions of the cube.



4.1 Introduction to MDX

- 4.1.2 Basic Queries,
- The syntax of a typical MDX query is as follows:
  - SELECT ⟨ axis specification ⟩
  - FROM ⟨ cube ⟩
  - [WHERE⟨ slicer specification ⟩]
- As can be seen, at a first glance, MDX resembles SQL, but as we will see in this chapter, the two languages differ in several significant ways.

4.1 Introduction to MDX

- 4.1.3 Slicing, Removes a dimension from a cube by fixing a single value in a level of the dimension.
- To restrict the result to Belgium, we can write the following query:
  - SELECT Measures.MEMBERS ON COLUMNS, [Order Date].Year.MEMBERS ON ROWS
  - FROM Sales
  - WHERE (Customer.Country.Belgium)

- 4.1.4 Navigation
  - SELECT [Order Date].Year.MEMBERS ON COLUMNS,

    {Customer.Country.France,Customer.Country.Italy} ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]

  - SELECT [Order Date].Year.MEMBERS ON COLUMNS,

    NON EMPTY { Customer.France.CHILDREN, Customer.Italy.CHILDREN } ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]

4.1 Introduction to MDX

- 4.1.5 Cross Join
  - SELECT Product.Category.MEMBERS ON COLUMNS,
    CROSSJOIN(Customer.Country.MEMBERS,
    [Order Date].Calendar.Quarter.MEMBERS) ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]

  - SELECT Product.Category.MEMBERS ON COLUMNS,
    Customer.Country.MEMBERS *
    [Order Date].Calendar.Quarter.MEMBERS ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]

4.1 Introduction to MDX

- 4.1.6 Subqueries
  - SELECT Measures.[Sales Amount] ON COLUMNS,
    [Order Date].Calendar.Quarter.MEMBERS ON ROWS
  - FROM (SELECT { Product.Category.Beverages,
    Product.Category.Condiments } ON COLUMNS
    FROM Sales)

  - SELECT Measures.[Sales Amount] ON COLUMNS,
    [Order Date].Calendar.Quarter.MEMBERS *
    Product.Category.MEMBERS ON ROWS
  - FROM (SELECT { Product.Category.Beverages,
    Product.Category.Condiments } ON COLUMNS
    FROM Sales)

4.1 Introduction to MDX

- 4.1.7 Calculated Members and Named Sets
  - WITH MEMBER Measures.Profit% AS
    (Measures.[Sales Amount] - Measures.[Freight]) / (Measures.[Sales Amount]),
    FORMAT STRING = '#0.00%'
  - SELECT { [Sales Amount], Freight, Profit% } ON COLUMNS,
    Customer.Country ON ROWS
  - FROM Sales

  - WITH MEMBER Product.Categories.[All].[Meat & Fish] AS
    Product.Categories.[Meat/Poultry] + Product.Categories.[Seafood]
  - SELECT { Measures.[Unit Price], Measures.Quantity, Measures.Discount,
    Measures.[Sales Amount] } ON COLUMNS,
    Category.ALLMEMBERS ON ROWS
  - FROM Sales

- 4.1.8 Relative Navigation
  - WITH MEMBER Measures.[Percentage Sales] AS

    (Measures.[Sales Amount], Customer.Geography.CURRENTMEMBER) /

    (Measures.[Sales Amount], Customer.Geography.CURRENTMEMBER.PARENT),

    FORMAT STRING = '#0.00%’
  - SELECT {Measures.[Sales Amount], Measures.[Percentage Sales] }

    ON COLUMNS, DESCENDANTS(Customer.Europe,

    Customer.Country, SELF AND BEFORE) ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.8 Relative Navigation
  - SELECT Product.Category.MEMBERS ON COLUMNS,

    GENERATE({Customer.Belgium, Customer.France},

    DESCENDANTS(Customer.Geography.CURRENTMEMBER,

    [Company Name])) ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]

4.1 Introduction to MDX

- 4.1.9 Time Series Functions
  - WITH MEMBER Measures.[Previous Year] AS

    (Measures.[Net Sales],

    PARALLELPERIOD([Order Date].Calendar.Quarter, 4)),

    FORMAT STRING = '$###,##0.00'
  - MEMBER Measures.[Net Sales Growth] AS

    Measures.[Net Sales] - Measures.[Previous Year],

    FORMAT STRING = '$###,##0.00; $-###,##0.00'
  - SELECT { [Net Sales], [Previous Year], [Net Sales Growth] } ON COLUMNS,

    [Order Date].Calendar.Quarter ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.9 Time Series Functions
  - WITH MEMBER Measures.[Quantity Difference] AS

    (Measures.[Quantity]) - (Measures.[Quantity],

    OPENINGPERIOD([Order Date].Calendar.Month,

    [Order Date].Calendar.CURRENTMEMBER.PARENT))
  - SELECT { Measures.[Quantity], Measures.[Quantity Difference] } ON COLUMNS,

    [Order Date].Calendar.[Month] ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.10 Filtering
    - SELECT Product.Category.MEMBERS ON COLUMNS,

      FILTER(Customer.City.MEMBERS, (Measures.[Sales Amount],

      [Order Date].Calendar.[1997]) > 25000) ON ROWS
    - FROM Sales
    - WHERE (Measures.[Net Sales Growth], [Order Date].Calendar.[1997])

4.1 Introduction to MDX

- 4.1.10 Filtering
  - WITH MEMBER Measures.[Profit%] AS
    (Measures.[Sales Amount] - Measures.[Freight]) /
    (Measures.[Sales Amount]), FORMAT STRING = '#0.00%'
  - MEMBER Measures.[Profit%City] AS
    (Measures.[Profit%],
    Customer.Geography.CURRENTMEMBER.PARENT),
    FORMAT STRING = '#0.00%'
  - SELECT { Measures.[Sales Amount], Measures.[Freight], Measures.[Net Sales],
    Measures.[Profit%], Measures.[Profit%City] } ON COLUMNS,
    FILTER(NONEMPTY(Customer.Customer.MEMBERS),
    (Measures.[Profit%]) < (Measures.[Profit%City])) ON ROWS
  - FROM Sales
  - WHERE [Order Date].Calendar.[1997]

4.1 Introduction to MDX

- 4.1.11 Sorting
  - SELECT Measures.[Sales Amount] ON COLUMNS,

    NON EMPTY GENERATE(

    ORDER(Customer.Geography.Continent.ALLMEMBERS,

    Customer.Geography.CURRENTMEMBER.NAME, BASC),

    ORDER({ Customer.Geography.CURRENTMEMBER } *

    Product.Categories.Category.ALLMEMBERS,

    Product.Categories.CURRENTMEMBER.NAME, BASC)) ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.12 Top and Bottom Analysis
  - SELECT Measures.MEMBERS ON COLUMNS,

    HEAD(ORDER(Customer.Geography.City.MEMBERS,

    Measures.[Sales Amount], BDESC), 3) ON ROWS
  - FROM Sales

  - SELECT Measures.MEMBERS ON COLUMNS,

    TOPCOUNT(Customer.Geography.City.MEMBERS, 3,

    Measures.[Sales Amount]) ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.12 Top and Bottom Analysis
  - WITH SET SetTop3Cities AS TOPCOUNT(

    Customer.Geography.City.MEMBERS, 3, [Sales Amount])
  - MEMBER Customer.Geography.[Top 3 Cities] AS

    AGGREGATE(SetTop3Cities)
  - MEMBER Customer.Geography.[Other Cities] AS (Customer.[All]) –

    (Customer.[Top 3 Cities])
  - SELECT Measures.MEMBERS ON COLUMNS,

    { SetTop3Cities, [Top 3 Cities], [Other Cities], Customer.[All] } ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.13 Aggregation Functions
  - WITH MEMBER Measures.[Maximum Sales] AS
    MAX(DESCENDANTS([Order Date].Calendar.Year.[1997],
    [Order Date].Calendar.Month), Measures.[Sales Amount])
  - MEMBER Measures.[Minimum Sales] AS
    MIN(DESCENDANTS([Order Date].Calendar.Year.[1997],
    [Order Date].Calendar.Month), Measures.[Sales Amount])
  - MEMBER Measures.[Average Sales] AS
    AVG(DESCENDANTS([Order Date].Calendar.Year.[1997],
    [Order Date].Calendar.Month), Measures.[Sales Amount])
  - SELECT { [Sales Amount], [Maximum Sales],
    [Minimum Sales], [Average Sales] } ON COLUMNS,
    Product.Categories.Category.MEMBERS ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.13 Aggregation Functions
  - WITH MEMBER Measures.[Maximum Sales] AS

    MAX(DESCENDANTS([Order Date].Calendar.Year.[1997],

    [Order Date].Calendar.Month), Measures.[Sales Amount])
  - MEMBER Measures.[Maximum Period] AS

    TOPCOUNT(DESCENDANTS([Order Date].Calendar.Year.[1997],

    [Order Date].Calendar.Month), 1,

    Measures.[Sales Amount]).ITEM(0).NAME
  - SELECT { [Maximum Sales], [Maximum Period] } ON COLUMNS,

    Product.Categories.Category.MEMBERS ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.13 Aggregation Functions
  - WITH MEMBER Measures.[Maximum Sales] AS
    MAX(DESCENDANTS([Order Date].Calendar.Year.[1997],
    [Order Date].Calendar.[Month]), Measures.[Sales Amount])
  - MEMBER Measures.[Maximum Period] AS
    TOPCOUNT(DESCENDANTS([Order Date].Calendar.Year.[1997],
    [Order Date].Calendar.[Month]), 1,
    Measures.[Sales Amount]).ITEM(0).NAME
  - SELECT { [Maximum Sales], [Maximum Period] } ON COLUMNS,
    Product.Categories.Category.MEMBERS *
    Customer.Geography.Country.MEMBERS ON ROWS
  - FROM Sales

4.1 Introduction to MDX

- 4.1.13 Aggregation Functions
  - WITH MEMBER Measures.[Customer Count] AS

    COUNT({Measures.[Sales Amount] *

    [Customer].[Company Name].MEMBERS}, EXCLUDEEMPTY)
  - SELECT { Measures.[Sales Amount], Measures.[Customer Count] } ON COLUMNS,

    Product.Category.MEMBERS ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

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  - SELECT [Order Date].Year.CHILDREN ON COLUMNS,

    NON EMPTY Customer.[Company Name].CHILDREN *

    Product.[Category Name].CHILDREN ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]
  - SELECT [Order Date].Year.MEMBERS ON COLUMNS,

    NON EMPTY Customer.Country.MEMBERS *

    Supplier.Country.MEMBERS ON ROWS
  - FROM Sales
  - WHERE Measures.[Sales Amount]

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.[Previous Year] AS

    (Measures.[Sales Amount],

    PARALLELPERIOD([Order Date].Calendar.Month,12)),

    FORMAT STRING = '$###,##0.00'
  - SELECT { Measures.[Sales Amount], Measures.[Previous Year] } ON COLUMNS,

    NON EMPTY ORDER(Customer.Geography.State.MEMBERS,

    Customer.Geography.CURRENTMEMBER.NAME, BASC) *

    [Order Date].Calendar.Month.MEMBERS ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.[Previous Month] AS
    (Measures.[Sales Amount],
    [Order Date].Calendar.CURRENTMEMBER.PREVMEMBER),
    FORMAT STRING = '$###,##0.00’
  - MEMBER Measures.[Sales Growth] AS
    (Measures.[Sales Amount]) - (Measures.[Previous Month]),
    FORMAT STRING = '$###,##0.00; $-###,##0.00’
  - SELECT { Measures.[Sales Amount], Measures.[Previous Month],
    Measures.[Sales Growth] } ON COLUMNS,
    NON EMPTY ORDER(Product.Categories.Product.MEMBERS,
    Product.Categories.CURRENTMEMBER.NAME, BASC) *
    [Order Date].Calendar.Month.MEMBERS ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - SELECT Measures.[Sales Amount] ON COLUMNS,
    TOPCOUNT(Employee.[Full Name].CHILDREN, 3,
    Measures.[Sales Amount]) ON ROWS
  - FROM Sales

  - SELECT Measures.[Sales Amount] ON COLUMNS,
    { Customer.Geography.[All],
    TOPPERCENT([Customer].Geography.Country.MEMBERS, 50,
    Measures.[Sales Amount]) } ON ROWS
  - FROM Sales

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.[Avg Monthly Sales] AS

    AVG(DESCENDANTS([Order Date].Calendar.CURRENTMEMBER,

    [Order Date].Calendar.Month),Measures.[Sales Amount]),

    FORMAT STRING = '$###,##0.00'
  - SELECT { Measures.[Sales Amount], Measures.[Avg Monthly Sales] } ON COLUMNS,

    Employee.[Full Name].CHILDREN *

    [Order Date].Calendar.Year.MEMBERS ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.[TotalDisc] AS

    Measures.Discount * Measures.Quantity *

    Measures.[Unit Price], FORMAT STRING = '$###,##0.00'
  - SELECT { Measures.[Sales Amount], [TotalDisc] } ON COLUMNS,

    NON EMPTY ORDER(Product.Categories.Product.MEMBERS,

    Product.Categories.CURRENTMEMBER.NAME, BASC) *

    [Order Date].Calendar.Month.MEMBERS ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.YTDSales AS

    SUM(PERIODSTODATE([Order Date].Calendar.[Year],

    [Order Date].Calendar.CURRENTMEMBER),

    Measures.[Sales Amount]), FORMAT STRING = '###,##0.00'
  - SELECT DESCENDANTS([Order Date].[1996], [Order Date].[Month])

    ON COLUMNS, Product.[Category].MEMBERS ON ROWS
  - FROM Sales
  - WHERE (Measures.YTDSales)

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.MovAvg3Months AS

    AVG([Order Date].Calendar.CURRENTMEMBER.LAG(2):

    [Order Date].Calendar.CURRENTMEMBER,

    Measures.[Sales Amount]), FORMAT STRING = '$###,##0.00'
  - SELECT [Order Date].Calendar.Month.MEMBERS ON COLUMNS,

    Product.[Category].MEMBERS ON ROWS
  - FROM Sales
  - WHERE (Measures.MovAvg3Months)

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.[Personal Sales] AS

    (Employee.Supervision.DATAMEMBER, [Measures].[Sales Amount]),

    FORMAT STRING = '$###,##0.00'
  - SELECT { Measures.[Personal Sales], Measures.[Sales Amount] } ON COLUMNS,

    ORDER(Employee.Supervision.MEMBERS - Employee.Supervision.[All],

    Employee.Supervision.CURRENTMEMBER.NAME, BASC) ON ROWS
  - FROM Sales
  - WHERE [Order Date].Calendar.Year.[1997]

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - SELECT Measures.[Sales Amount] on COLUMNS,

    Employee.[Full Name].CHILDREN ON ROWS
  - FROM Sales
  - WHERE [Order Date].Calendar.Year.[1997]
  - WITH MEMBER Measures.[NbProducts] AS

    COUNT(NONEMPTY([Order].[Order No].CURRENTMEMBER *

    [Order].[Order Line].MEMBERS))
  - SELECT { Measures.[Sales Amount], NbProducts, Quantity } on COLUMNS,

    [Order].[Order No].CHILDREN ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER Measures.AvgSales AS

    Measures.[Sales Amount]/Measures.[Order No],

    FORMAT STRING = '$###,##0.00'
  - SELECT { Measures.[Order No], [Sales Amount], AvgSales } ON COLUMNS,

    NON EMPTY [Order Date].Calendar.Month.MEMBERS ON ROWS
  - FROM Sales

4.2 Querying the Northwind Cube in MDX

- 4.2 Querying the Northwind Cube in MDX
  - WITH MEMBER NoCities AS

    Measures.[Territories Count]
  - MEMBER NoStates AS

    DISTINCTCOUNT(Employee.[Full Name].CURRENTMEMBER *

    City.Geography.State.MEMBERS)
  - SELECT { Measures.[Sales Amount], Measures.NoCities, Measures.NoStates }

    ON COLUMNS, Employee.[Full Name].CHILDREN ON ROWS
  - FROM Sales

4.3 Querying the Northwind Data Warehouse in SQL

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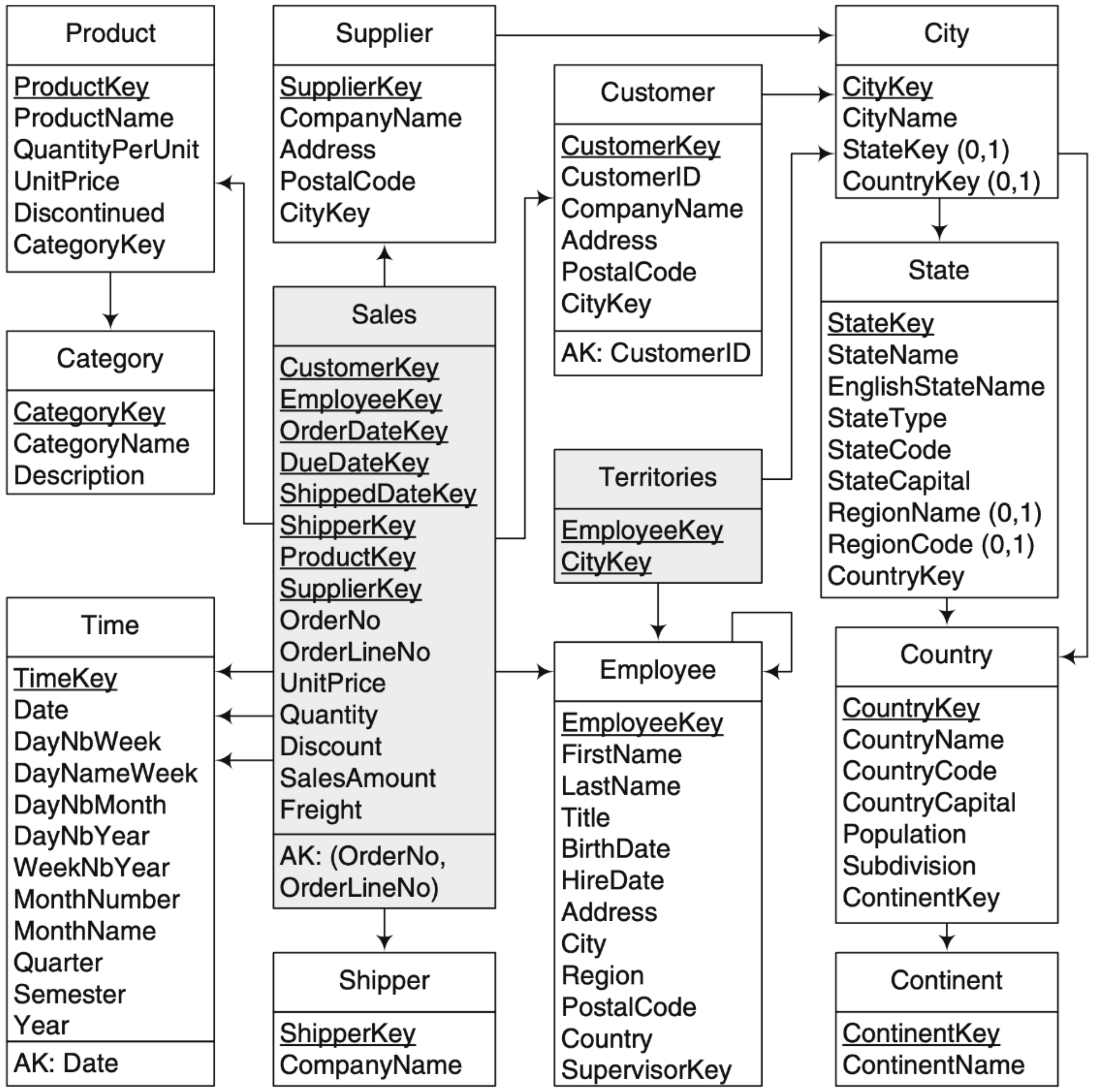

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.1 Total sales amount per customer, year, and product category
  - SELECT C.CompanyName, T.Year, A.CategoryName,

    FORMAT(SUM(SalesAmount),'$###,##0.00') AS SalesAmount
  - FROM Sales S, Customer C, Time T, Product P, Category A
  - WHERE S.CustomerKey = C.CustomerKey AND

    S.OrderDateKey = T.TimeKey AND

    S.ProductKey = P.ProductKey AND P.CategoryKey = A.CategoryKey
  - GROUP BY C.CompanyName, T.Year, A.CategoryName

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.2 Yearly sales amount for each pair of customer country and supplier countries
  - SELECT CO.CountryName AS CustomerCountry,
    SO.CountryName AS SupplierCountry, T.Year,
    FORMAT(SUM(SalesAmount),'$###,##0.00') AS SalesAmount
  - FROM Sales F, Customer C, City CC, State CS, Country CO,
    Supplier S, City SC, State SS, Country SO, Time T
  - WHERE F.CustomerKey = C.CustomerKey AND C.CityKey = CC.CityKey AND
    CC.StateKey = CS.StateKey AND CS.CountryKey = CO.CountryKey AND
    F.SupplierKey = S.SupplierKey AND S.CityKey = SC.CityKey AND SC.StateKey = SS.StateKey AND
    SS.CountryKey = SO.CountryKey AND F.OrderDateKey = T.TimeKey
  - GROUP BY CO.CountryName, SO.CountryName, T.Year
  - ORDER BY CO.CountryName, SO.CountryName, T.Year

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.3 Three best-selling employees
  - SELECT TOP(3) E.FirstName + ' ' + E.LastName AS EmployeeName,

    FORMAT(SUM(F.SalesAmount), '$###,##0.00') AS SalesAmount
  - FROM Sales F, Employee E
  - WHERE F.EmployeeKey = E.EmployeeKey
  - GROUP BY E.FirstName, E.LastName
  - ORDER BY SUM(F.SalesAmount) DESC

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.4 Best-selling employee per product and year
  - WITH SalesProdYearEmp AS (
    SELECT P.ProductName, T.Year, SUM(S.SalesAmount) AS SalesAmount,
    E.FirstName + ' ' + E.LastName AS EmployeeName
    FROM Sales S, Employee E, Time T, Product P
    WHERE S.EmployeeKey = E.EmployeeKey AND
    S.OrderDateKey = T.TimeKey AND S.ProductKey = P.ProductKey
    GROUP BY P.ProductName, T.Year, E.FirstName, E.LastName)
  - SELECT ProductName, Year,
    FORMAT(SalesAmount,'$###,##0.00') AS TopSales, EmployeeName AS TopEmployee
  - FROM SalesProdYearEmp S1
  - WHERE S1.SalesAmount = (
    SELECT MAX(SalesAmount) FROM SalesProdYearEmp S2
    WHERE S1.ProductName = S2.ProductName AND S1.Year = S2.Year)

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.5 For each month, total number of orders, total sales amount, and average sales amount by order
  - WITH OrderAgg AS (

    SELECT OrderNo, OrderDateKey, SUM(SalesAmount) AS SalesAmount Sales

    FROM Sales GROUP BY OrderNo, OrderDateKey)
  - SELECT MonthYear(MonthNumber,Year) AS Month, COUNT(OrderNo) AS NoOrders,

    FORMAT(SUM(SalesAmount), '$###,##0.00') AS SalesAmount,

    FORMAT(AVG(SalesAmount), '$###,##0.00') AS AvgAmount
  - FROM OrderAgg O, Time T
  - WHERE O.OrderDateKey = T.TimeKey
  - GROUP BY Year, MonthNumber
  - ORDER BY Year, MonthNumber

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.6 For each employee, total sales amount, number of cities, and number of states to which she is assigned
  - SELECT FirstName + ' ' + LastName AS FullName,

    FORMAT(SUM(SalesAmount) / COUNT(DISTINCT CityName), '$###,##0.00') AS TotalSales,

    COUNT(DISTINCT CityName) AS NoCities,

    COUNT(DISTINCT StateName) AS NoStates
  - FROM Sales F, Employee E, Territories T, City C, State S
  - WHERE F.EmployeeKey = E.EmployeeKey AND

    E.EmployeeKey = T.EmployeeKey AND T.CityKey = C.CityKey AND C.StateKey = S.StateKey
  - GROUP BY FirstName + ' ' + LastName
  - ORDER BY FirstName + ' ' + LastName

4.3 Querying the Northwind Data Warehouse in SQL

- 4.3.7 Countries that account for top 50% of the sales amount.
- 4.3.8 Total sales and average monthly sales by employee and year.
- 4.3.9 Total sales amount and total discount amount per product and month.
- 4.3.10 Monthly year-to-date sales for each product category.
- 4.3.11 Moving average over the last 3 months of the sales amount by product category.
- 4.3.12 Personal sales amount made by an employee compared with the total sales amount made by herself and her subordinates during 1997.
- 4.3.13 Total sales amount, number of products, and sum of the quantities sold for each order.
- 4.3.14 For each month, total number of orders, total sales amount, and average sales amount by order.
- 4.3.15 For each employee, total sales amount, number of cities, and number of states to which she is assigned.

4.4 Comparison of MDX and SQL

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MDX	SQL
Advantages • Data modeling: definition of dimensions, hierarchies, measure groups, from various data sources • Simple navigation within time dimension and hierarchies • Relatively simple expressions for often used business requests • Fast, due to the existence of aggregations	**Advantages** • Large user base • Easy-to-understand semantics of queries • Results are easy to visualize: scalars or 2D tables • Various ways of relating tables: joins, derived tables, correlated queries, common table expressions, etc.
Disadvantages • Extra effort for designing a cube and setting up aggregations • Steep learning curve: manipulating an *n*-dimensional space • Hard-to-grasp concepts: current context, execution phases, etc. • Some operations are difficult to express, such as ordering on multiple criteria	**Disadvantages** • Tables must be joined explicitly inside a query • Sometimes not intuitive and complex syntax for expressing analytical queries • No concept of row ordering and hierarchies: navigation dimensions may be complex • Not so performant for the types of queries used in data analysis

Enjoy the Course…!