



**MDX Solutions: With Microsoft SQL Server Analysis Services 2005 and  
Hyperion Essbase  
HDT809  
Four Days**

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**Prerequisites**

Students should have some experience with relational databases, data warehouses, and star schemas.

**Who Should Attend**

This course is targeted at business power users, business analysts, software developers, data modelers, data base analysts, and any other technical or business person who needs to understand how to use MDX to do multidimensional analysis with OLAP cubes.

**Course Description**

This course provides students with the skills necessary to use MDX to do multidimensional analysis with OLAP cubes. It is based on the book MDX Solutions: With Microsoft SQL Server Analysis Services 2005 and Hyperion Essbase published March 6, 2006 by Wiley Publishing, Inc, written by George Spofford, Sivakumar Harinath, Christopher Webb, Dylan Hai Huang, and Francesco Civardi, ISBN: 0-471-74808-0. The book describes how to use MDX to do multidimensional analysis with OLAP cubes.

**Course Topics**

- Chapter 1: A First Introduction to MDX
- Chapter 2: Introduction to MDX Calculated Members and Named Sets
- Chapter 3: Common Calculations and Selection in MDX
- Chapter 4: MDX Query Context and Execution
- Chapter 5: Named Sets and Set Aliases
- Chapter 6: Sorting and Ranking in MDX
- Chapter 7: Advanced MDX Application Topics
- Chapter 8: Using the Attribute Data Model of Microsoft Analysis Services
- Chapter 9: Using Attribute Dimensions and Member Properties in Hyperion Essbase
- Chapter 10: Extending MDX through External Functions
- Chapter 11: Changing the Cube and Dimension Environment through MDX
- Chapter 12: The Many Ways to Calculate in Microsoft Analysis Services
- Chapter 13: MDX Scripting in Analysis Services 2005
- Chapter 14: Enriching the Client Interaction
- Chapter 15: Client Programming Basics
- Chapter 16: Optimizing MDX
- Chapter 17: Working with Local Cubes



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### **Chapter 1: A First Introduction to MDX**

What Is MDX?

Query Basics

Axis Framework: Names and Numbering

Case Sensitivity and Layout

Simple MDX Construction

Comma and Colon

.Members

Getting the Children of a Member with .Children

Getting the descendants of a Member with Descendants()

Removing Empty Slices from Query Results

Comments in MDX

The MDX Data Model: Tuples and Sets

Tuples

Sets

Queries

Queries with Zero Axes

Axis-Only Queries

More Basic Vocabulary

CrossJoin()

Filer()

Order()

Querying for Member Properties

Querying Cell Properties

Client Result Data Layout

### **Chapter 2: Introduction to MDX Calculated Members and Named Sets**

Dimensional Calculation As Calculated Members

Calculated Member Scopes

Calculated Members and WITH Sections in Queries

Formula Precedence (Solve Order)

Basic Calculation Functions

Arithmetic Operators

Summary Statistical Operators

Avg()

Count(), .Count

DistinctCount() (Microsoft Extension)

Sum()

Max()

Median()

Min()

NonEmptyCount() (Hyperion Extension)



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Stdev(), Stddev()  
StdevP(), StddevP() (Microsoft Extension)  
Var(), Variance()  
VarP(), VarianceP(), (Microsoft Extension)  
Additional Functions  
Introduction to Named Sets  
Named Set Scopes

### Chapter 3: Common Calculations and Selection in MDX

Metadata Referencing Functions in MDX  
Many Kinds of Ratios, Averages, Percentages, and Allocations  
Percent Contribution (Simple Ratios between Levels in a Hierarchy)  
    Percent Contribution to Total  
    Using the .CurrentMember Function  
    Using the .Parent Function  
    Taking the Share-of-Parent Using .CurrentMember and .Parent  
    Using the Ancestor() Function  
    Calculating the Share-of-Ancestor using .CurrentMember and Ancestor()  
    Handling Division by Zero  
Basic Allocations  
    Proportional Allocation of One Quantity Based on Ratios of Another  
    Unweighted Allocations Down the Hierarchy  
Averages  
    Simple Averages  
    Weighted Averages  
Time-Based References and Time-Series Calculations  
    Period-to-Period References and Calculations  
    Same-Period-Last-Year References and Calculations  
    Year-to-Date (Period-to-Date) Aggregations  
    Rolling Averages and 52-Week High/Low  
Using LastPeriods() to Select Time Ranges Based on a Target Member  
Different Aggregations Along Different Dimensions (Semi-Additive Measures Using MDX)  
    Mixing Aggregations: Sum across Non-Time, Average/Min/Max along Time  
    Mixing Aggregations: Sum across Non-Time, Opening/Closing Balance along Time  
    Carryover of Balances for Slowly Changing Values and Reporting of Last Entered Balance  
        Finding the Last Child/Descendant with Data  
        Finding the Last Time Member for Which Any Data Has Been Entered  
Using Member Properties in MDX Expressions (Calculations and Sorting)  
Handling Boundary Conditions (Members Out of Range, Division by Zero, and More)



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- Handling Insufficient Range Size
- Handling Insufficient Hierarchical Depth
- Handling a Wrong-Level Reference
- Handling Division by Zero

### Chapter 4: MDX Query Context and Execution

- Cell Context and Resolution Order in Queries

  - The Execution Stages of a Query

    - The .DefaultMember Function

    - Default Context and Slicers

    - The Simplest Query: All Context, Nothing Else

    - The WHERE Clause: Default Context and Slicers

    - Adding Axes to a Query

    - Cell Context When Resolving Axes

    - Overriding Slicer Context

  - Cell Evaluation (For Any Cell)

    - Drilling in on Solve Order and Recursive Evaluation

  - Resolving NON EMPTY Axes

  - Resolving the HAVING Clause in AS2005

  - Looping Context and .CurrentMember

  - Interdependence of Members in AS2005: Strong Hierarchies, Autoexists, and Attribute Relationships

    - Strong Hierarchies

    - Autoexists

  - Modifying the Cube Context in AS2005

    - CREATE SUBCUBE Described

      - Subcube Restrictions and Attribute Relations

      - Further details of Specifying a Subcube

      - Tuple Specifications for Subcubes

    - Subcubes Based on Data Values

    - Subcubes for Iterative Query Refinement

    - Points to Consider When Using Subcubes

  - Using SELECT in the FROM Clause in AS2005

  - Infinite Recursion: A “Gotcha” Related to Calculation Context

  - Product-Specific Solve Order Use

    - Use of Solve Order between Global, Session, and Query Calculations in Analysis Services 2005

    - Use of Solve Orders in Essbase

    - Use of Solve Orders in Analysis Services 2000

  - Nodata: Invalid Numbers, NULLs, and Invalid Members

  - Invalid Calculations: Division by Zero and Numerical Errors

  - Semantics of Empty Cells



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NULLs in Comparisons and Calculations

Invalid Locations

Precedence of Cell Properties in Calculations

Precedence of Display Formatting

Data Types from Calculated Cells

Cube Context in Actions

Cube Context in KPIs

Visibility of Definitions between Global, Session, and Query-Specific Calculations in  
Analysis Services 2005

### **Chapter 5: Named Sets and Set Aliases**

Named Sets: Scopes and Context

Common Uses for Named Sets

Set Aliases

An Example of a Set Alias

Set Aliases in More Detail

When Set Aliases Are Required

### **Chapter 6: Sorting and Ranking in MDX**

The Function Building Blocks

Classic Top-N Selections

Adding Ranking Numbers (Using the Rank() Function)

Handling Tied Ranks: Analysis Services

Taking the Top-N Descendants or Other Related Members across a Set

Getting the Fewest/Most Tuples to Reach a Threshold

Retrieving the Top N Percent of Tuples

Retrieving the Top N Percent of the Top N Percent

Putting Members/Tuples in Dimension Order (Ancestors First or Last)

Reversing a Set

### **Chapter 7: Advanced MDX Application Topics**

Arranging Parents/Ancestors after Children, Not Before

Returning the Subtree under a Member and the Ancestors of That Member Along with  
the Member

Using Generate() to Turn Tuple Operations into Set Operations

Calculating Dates/Date Arithmetic

Defining Ratios against the Members Selected on Rows/Columns/Axes, Instead of  
against a Specific Dimension

Report-Based Totals-to-Parent, Percentage Contribution to Report Totals

Technique 1: Only Standard MDX Techniques

Technique 2: Considering Using VisualTotals() in Analysis Services

Using VisualTotals in Analysis Services 2000



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- Using VisualTotals in AS2005
- Technique 3: Using AS2005 Subcubes
- Hierarchical Sorting That Skips Levels in the Hierarchy
- Sorting a Single Set on Multiple Criteria
- Multiple Layers or Dimensions of Sorting
  - Sort Nested Dimensions with the Same Sorting Criterion for Each Dimension
  - Sort Nested Dimensions by Different Criteria
- Pareto Analysis and Cumulative Sums
- Returning the Top-Selling Product (or Top-Selling Month or Other Most-Significant Name) As a Measure
- Most Recent Event for a Set of Selected Members
- How Long Did It Take to Accumulate This Many? (Building a Set That Sums Backward or Forward in Time)
- Aggregating by Multiplication (Product Instead of Sum)
  - One Member Formula Calculating Different Things in Different Places
- Including All Tuples with Tied Ranking in Sets
- Time Analysis Utility Dimensions
- A Sample Analysis

### **Chapter 8: Using the Attribute Data Model of Microsoft Analysis Services**

- The Unified Dimensional Model (UDM)
- Dimensions
  - Attributes, Hierarchies, and Relationships
    - Attributes
    - Hierarchies and Levels
    - Relationships
  - Querying Dimensions
  - Member Properties
  - Parent-Child Hierarchies
  - Time Dimension
  - Cubes
    - Dimension Relationships
    - Role-Playing Dimensions
    - Perspectives
    - Drill-Through
- The Calculation Model in UDM
- Defining Security on UDM



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**Chapter 9: Using Attribute Dimensions and Member Properties in Hyperion Essbase**

UDAs and Attributes

Retrieving UDAs and Attribute Values on Query Axes Predefined Attributes

Using UDA and Attribute Values in Calculations

Selecting Base Dimension Members Based on UDA and Attribute Values

    Using Attribute() to Select Members Based on Shared Attribute Values

    Using WithAttr() to Select Members Based on Attribute Values

    Using UDA() to Select Members Sharing a UDA Value

Connecting Base Members to the Attribute Hierarchy with IN

    Connecting Base Members to Their Actual Attribute Member

    Connecting Attribute Members to Their Attribute Values



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### Chapter 10: Extending MDX through External Functions

Using Stored Procedures with MDX

.NET Stored Procedures

.NET Stored Procedure Parameters and Return Values

ADOMD Server Objects

Expression

TupleBuilder

SetBuilder

MDX

Context

Server Metadata Objects

AMO.NET Management Stored Procedures

Performance Considerations of Static Functions and Nonstatic Functions

Debugging .NET Stored Procedures

Additional Programming Aspects NULL, ERROR(), and Exception

NULL Value AS an Input Parameter

NULL Value As an Output Parameter

Exceptions during Execution

Error() Function

Using Stored Procedures for Dynamic Security

COM DLL Stored Procedures

Argument and Return-Type Details

Passing Arrays of Values to COM Stored Procedures

MDX Functions for Use with COM Stored Procedures

SetToStr(), TupleToStr()

Members(), StrToSet(), StrToTuple()

External Function Example: Time Span until Sum

Loading and Using Stored Procedures

Security of Stored Procedures

Stored Procedure Name Resolution

Invoke Stored Procedures in MDX

Additional Considerations for Stored Procedures



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### **Chapter 11: Changing the Cube and Dimension Environment through MDX**

- Altering the Default Member for a Dimension in Your Session
- Dimension Writeback Operations
  - Creating a New Member
  - Moving a Member within Its Dimension
  - Dropping a Member
  - Updating a Member's Definition
- Refresh Cell Data and Dimension Members
- Writing Data Back to the Cube
- Standard Cell Writeback
- Commit and Rollback
- Using UPDATE CUBE

### **Chapter 12: The Many Ways to Calculate in Microsoft Analysis Services**

- Overview of Calculation Mechanisms
  - Intrinsic Aggregation for a Measure
  - Rollup by Unary Operator
  - Custom Member Formula
  - Calculated Member
    - Defining a Calculated Member
    - Dropping a Calculated Member
  - Cell Calculation
    - Defining a Cell Calculation
    - Dropping a Cell Calculation
  - Conditional Formatting
- How Types of Calculations Interact
  - Interaction without Any Cell Calculations
    - Precedence of Custom Member Formulas on Multiple Dimensions
    - Precedence of Unary Operators on Multiple Dimensions
  - Cell Calculation Passes
    - Equation Solving and Financial Modeling
  - Using Solve Order to Determine the Formula in a Pass
  - Calculated Members Not Themselves Aggregated
  - Intrinsic Aggregation of Custom Rollups, Custom Members, and Calculated Cell Results
- Tips on Using the Different Calculation Techniques



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### **Chapter 13: MDX Scripting in Analysis Services 2005**

#### MDX Scripting Basics

- What Is an MDX Script?
- The Calculate Statement
- Subcubes
- Assignments and Aggregation
- Assignments and Calculated Members
- Assignments and Named Sets

#### MDX Scripting and More Complex Cubes

- Multiple Attribute Hierarchies
- User Hierarchies
- Parent/Child Attribute Hierarchies
- Many-to-Many Dimensions
- Fact Dimensions and Reference Dimensions
- Semi-additive and Nonadditive Measures
- Unary Operators and Custom Member Formulas

#### Advanced MDX Scripting

- Defining Subcubes with SCOPE
- Assignments That Are MDX Expressions
- Assigning Error Values to Subcubes
- Assigning Cell Property Values to Subcubes
- Conditional Assignments

#### Real-World MDX Scripts

- The Time Intelligence Wizard
- Basic Allocations Revisited

### **Chapter 14: Enriching the Client Interaction**

#### Using Drill-Through

- Improvements and Changes in Microsoft Analysis Services 2005 for Drill-Through
- MDX for Drill-Through I
- Programmatic Aspects of Drill-Through
- MDX for Drill-Through II
- Drill-Through Security

#### Using Actions

- What Can You Do with an Action?
- Targets for Actions
- Defining an Action
- Programmatic Aspects of Actions
- Dropping an Action

#### Using KPIs

- Creating KPI



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MDX KPI Function  
Using KPI

**Chapter 15: Client Programming Basics**

ADOMD.NET Basics

Prerequisites

Making a Connection

Working with Metadata

Retrieving Schema Rowsets

Interoperability Considerations When Using Schema Rowsets

Working with the Metadata Object Model

Interoperability Considerations When Working with the Metadata Object Model

Dimension Particularities

Handling ADOMD.NET Metadata Caching

Executing a Query

Executing Commands

Parameterized Commands

Working with the CellSet Object

OlapInfo Holds Metadata

Axes Hold Axis Information

Cells Hold Cell Information

Further Details on Retrieving Information from a Query

Retrieving Member Property Information

Retrieving Additional Member Information

Further Details about Retrieving Cell Data

Retrieving Drill-Through Data As a Recordset

Key Performance Indicators

Executing Actions

Handling "Flattened" MDX Results

DataReader and Tabular Results for MDX Queries

Axis 0

Other Axes



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### **Chapter 16: Optimizing MDX**

Architecture Change from Analysis Services 2000 to 2005

Optimizing Set Operations

- Sums along Cross-Joined Sets

- Filtering across Cross-Joined Sets

- Optimizing TopCount() and BottomCount()

- NonEmpty Function In Analysis Services 2005

- Optimizing Sorting: Order()

- UnOrder Function for a Query with a Large Dataset

Optimizing Summation

Designing Calculations into Your Database (Putting Member Properties into Measures and the New MDX Function MemberValue)

MDX Script Optimization

- Scope the Calculation in Detail

- Avoid Leaf-Level Calculations

- Cube Design to Avoid Leaf-Level Calculation

- Measure Expression to Optimize Leaf-Level Calculations

- MDX Script Optimization for Leaf-Level Calculation

  - Avoid Unnecessary Leaf-Level Calculation

  - Using NONEMPTY for Higher-Level Calculations

  - Using NonemptyBehavior to Provide a Hint for Server Calculations

- Analysis Services 2005: Use Attribute Hierarchy Instead of Member Property

- Avoid Slow Functions in MDX Scripts

- Change the Calculation Logic for Better Performance: FlowA Calculation

- Use Server Native Features Rather Than Scripts for Aggregation-Related Calculations



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### Chapter 17: Working with Local Cubes

- Choosing Which Syntax to Use

- Using the CREATE CUBE Statement

  - Overview of the Process

  - Anatomy of the CREATE CUBE Statement

  - Defining Dimensions

    - Overall dimension

    - Named Hierarchies

    - Levels

    - Member Properties

    - FORMAT\_NAME and FORMAT\_KEY

  - Defining Measures

  - Adding Commands

  - ROLAP and MOLAP

  - Anatomy of the INSERT INTO Statement

  - Cube Targets

    - Regular Dimension Levels

    - Parent-Child Dimensions

    - Member Properties

    - Custom Rollups

    - Measures

    - Column Placeholders in the Targets

  - Options for the INSERT INTO

    - The SELECT Clause

      - Select Statements That Are Not SQL

      - More Advanced Programming: Using Rowsets in Memory

    - Tips for Construction

    - Local Cubes from Server Cubes

    - Rollups and Custom Member Formulas

  - Using the CREATE GLOBAL CUBE Statement

    - Overview of the Process

    - Anatomy of the CREATE GLOBAL CUBE Statement

    - Defining Measures

    - Defining Dimensions

    - Defining Levels

    - Defining Members for Slicing

    - Things to Look Out For

  - Using Analysis Services Scripting Language

    - Overview of the Process

    - Anatomy of an ASSL Statement

    - Security