BUSINESS INTELLIGENCE

SSAS - SQL Server Analysis Services

Business Informatics Degree

BI Architecture

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Figure 1. Typical business intelligence architecture.



SSAS: SQL Server Analysis Services

- It is both an OLAP Server and a Data Mining Server
 - Distinct from the RDBMS engine
 - Can access ODBC, OLE DB, CSV, XML data sources
- Most OLAP concepts are covered
 - Dimensions, hierarchies, measures, attributes, calculated metrics, key performance indexes, actions (URL links, drill-through, report launch), ...
 - Query language (MDX) for querying data cubes
- Docs and samples
 - Documentation
 - <u>http://msdn.microsoft.com/en-us/library/bb522607.aspx</u>
 - Tutorial from Books on Line
 - <u>http://msdn.microsoft.com/en-us/library/ms170208.aspx</u>

SSAS architetture



Business Intelligence Lab

SSAS projects

Developing environment is SSDT

Project type: Analysis services multidimensional and data mining
 IMPORTANT!

Name of SSAS projects must be prefixed by your account

<account>_<name>

SSAS Server for deployment

- Right click on project name
 - **\square** Properties \rightarrow Deployment

ruggieri_FoodMart Property Pages		? ×
Configuration: Active(Development)	Platform: N/A	Configuration Manager
 Configuration Properties Build Debugging Deployment 	 Options Deployment Mode Processing Option Transactional Deployment Target Server Database Server Analysis Services server to deploy 	Analysis Services objects to
	[OK Cancel <u>A</u> pply

Business Intelligence Lab

SSAS project folders

Data source

- Sets the data sources
 - Use your login and password to SQL Server
 - Use OLE DB for SQL Server if client/server are different versions (eg., you are using a version < SQL 2016)
- Impersonification credentials
 - Specify 'Use the service account'
- Data source view (DSV)
 - A view of data sources
 - Disconnected access to data sources
 - Names of attributes/tables can be changed (without affecting the source!)
 - Calculated attributes and tables (without affecting the source!)
 - External keys (without affecting the source!)

SSAS project folders

Dimensions

- Type: standard / time
 - Time is useful to derive hierarchies directly from a 'datetime' attribute
- Create new wizard
 - Select existing table
 - Key column: primary key (surrogate key)
 - Name column: descriptive key
 - Attributes
 - Select none at the wizard stage
- Organize attributes into hierarchies
 - in the dimension structure pane

Useful attribute properties

- AttributeHierarchyVisible
 - Flat hiearchies with only the attribute is visibile
 - This is by default
- OrderBy
 - Default ordering method in visualization
- DiscretizationMethod
 - Discretization of continuous attributes into bins
- 🗆 Туре
 - Leave 'regular'
- Usage
 - Modes: key, regular and parent

Build-deploy-processing

🗆 Build

- Syntactic check of correctness of the SSAS project
- Run by the SSDT client environment
- Deploy
 - The project is copied on the deployment SSAS server
 - Data cubes are not re-processed
 - Nevertheless, features that do not depend on data re-processing are updated, eg., formatting of numbers, calculated metrics

Processing

The deployment server re-computes the data cubes by accessing the data sources

Build-deploy-processing

- 11
- Issue with current SQL server installation:
 - A delay of about 30 seconds is experienced at each deploy and at each process operations
 - Hope it will be solved with a future service pack.
 - Be patient!



Business Intelligence

Data exploration

- Panel: browsing
 - Pivot table + filters
- □ Since SQL Server 2012
 - Data exploration in Excel

Calculated members

- Calculated metrics:
 - Net sales
 - Margin
 - Sum year to date
 - Average sale amount per customer
 - Average sale amount per sale
 - Rank of products wrt sales
 - ••••
- Calculated members:
 - Top 5 selling products
 - ••••
- They do not exist on the data cube
 - They are calculated at run-time



MultiDimensional eXpressions Language for querying OLAP cubes

and for defining calculated members

Standard de-facto

Drill-through actions (rightclick -> 'show details' in Excel)

14

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Business Intelligence Lab

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Data cube storage model



ROLAP (Relational OLAP)

- relational engine enhanced with CUBE BY and analytic SQL
 - materialized views + bitmap/columnstore indexes + star-join optimization
 - performance
 - scalability

MOLAP (Multidimensional OLAP)

- multidimensional array store on disk/memory in binary format
 - very efficient for a small number of hierarchies
 - do not scale well on space data

HOLAP (Hybrid OLAP)

- trade-off between the previous two solutions
 - most accessed cuboids on MOLAP, others on ROLAP

					OLAP Server \$	MOLAP +	ROLAP 🗢	HOLAP 🗢	Offline \$
Ih	ρ		$\Delta P cc$	ASC	Essbase	Yes	Yes	Yes	
					icCube	Yes	No	No	Offline Cubes 🗗
16					Microsoft Analysis Services	Yes	Yes	Yes	Local cubes, PowerPivot for Excel
					MicroStrategy Intelligence Server	Yes	Yes	Yes	MicroStrategy Office &, Dynamic Dashboards &
					Mondrian OLAP server	No	Yes	No	
					Oracle Database OLAP Option	Yes	Yes	Yes	
					Palo	Yes	No	No	
					SAS OLAP Server	Yes	Yes	Yes	
					TM1	Yes	No	No	
		Figure 20: RO	AP Meets Applicat	ion Requirements	SAP NetWeaver BW	Yes	Yes	No	
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Storage model

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Can be set for whole cube or for single dimensions

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torage mode:	MOLAP			
	🔽 Enable proa	ctive caching		
General Notifications	1			
Cache Settings —				
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Sįlence inl	terval:	10	Seconds	-
Silence ov	verride interval:	10	Minutes	-
Drop outd	ated cache			
Latency:			(Not enabled)	2
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Proactive caching

- Proactive caching
 - Latence time for refresh
 - Silence time (after refresh)



Other features of SSAS

- KPI Key performance index
 - Metrics with target values shown
- Perspectives
 - Subsets of objects, e.g., sub-cubes for product manager, store manager ...
- Roles
 - Access rights management

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- Self-service Business Intelligence
 - PowerPivot for Excel/SharePoint
 - Tabular data model (evolution of PowerPivot)
 - Different instance of SSAS, different SSDT project type, different query language (DAX – Data Analysis eXpressions)

BUSINESS INTELLIGENCE LABORATORY

SSAS Practice

Business Informatics Degree

Data analysts: final user

- Explore a report produced from a multidimensional view, using:
 - a reporting tool
 - Browser, Excel, Microstrategy, ...
 - only data exploration primitives:
 - Drill down and roll-up over pre-defined hierarchies
 - Existing calculated measures
 - Slide and dice
 - Filter and sort

Q0 on foodmart

What is the distribution of sales

- by quarter?
- and by customer city?
- in absolute value
- □ in percentage wrt the total
- in percentage wrt the country of residence of customers

Q1 on foodmart

- What are the 5 best product categories
 - as per total sales?
 - as per number of items sold?
 - as per number of distinct customers?
 - in each quarter of 1998 and gender?
 - in the CA state?

Q1 on foodmart

- What are the 5 best product categories
 - as per total sales?
 - as per number of items sold?
 - as per number of distinct customers?
 - in each quarter of 1998 and gender?
 - in the CA state?

Data analysts: OLAP designer

- Design data cubes and reports
 - by defining
 - existing hierarchies from the DW
 - existing metrics from the DW
 - calculated members
 - and reprocessing data cubes
 - using a tool for OLAP design
 - with read-only rights on the DW

Q2 on foodmart

- Which stores are the most profitable
 - mean profit wrt customers
 - (total sales total cost) / number of customers
 - mean profit wrt baskets
 - (total sales total cost) / number of baskets
- evaluated
 - in each quarter of 1998 and gender?
 - in the CA state?
 - in each month wrt previous month? MDX

Q2 on foodmart

- Which stores are the most profitable
 - mean profit wrt customers
 - (total sales total cost) / number of customers
 - mean profit wrt baskets
 - (total sales total cost) / number of baskets
- evaluated
 - in each quarter of 1998 and gender?
 - □ in the CA state?
 - in each month wrt previous month? MDX

Q3 on foodmart

- Which are the 5 product categories with the best margin
 - □ for each age-range of customers?
- evaluated
 - in each quarter of 1998 and gender?
 - in the CA state?
 - in each month wrt previous month? MDX

Data analysts: DW designer

- Design and maintain the DW to satisfy new requirements
 - by re-designing conceptual and logical shemata
 - adding new dimensions and attributes
 - adding new data marts
- and managing the population of data
 using ETL tools

Q4 on foodmart

- What quantity (in Kg) has been sold
 - in each quarter of 1998 and gender?
 - in the CA state?
 - in each month wrt previous month? MDX

Q5 on foodmart

- In September 1998, store 7 changed its type
 - from 'Supermarket' to 'Deluxe Supermarket'
 - with new store_id = 25, but it is the same store!
- Which stores are the most profitable
 in each quarter of 1998?

BUSINESS INTELLIGENCE LABORATORY

MultiDimensional eXpressions (MDX)

Business Informatics Degree

MDX Queries

[WITH < formula > [, < formula > ...]] SELECT [< axis > , [< axis > ...]] FROM [< cube >] [WHERE <set>]



Members of hierarchies & nav. functions



Syntax: [DimensionName].[HierarchyName].[LevelName].[MemberName] Example: [Store].[Time].[Quarter].&[Quarter 1]

Syntax: [DimensionName].[HierarchyName].[Path from root] Example: [Store].[Time]. [All].[2004].[Quarter 1]

Tuples, Sets, Axis

[WITH < formula > [, < formula > ...]] SELECT [< axis > , [< axis > ...]] FROM [< cube >] [WHERE <set>]

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Axis

axis ::= [NONEMPTY] Set ON (alias | AXIS(number) | number)
 aliases COLUMNS, ROWS, PAGES, SECTIONS, and CHAPTERS

Sets

Set := tuple | {tuple, ..., tuple} | set + set | set - set |

set_function(parameters)

Denotes a set of members/tuples

Tuples

- Tuple ::= Member | (Member, ..., Member)
- Denotes a data cube cell by its coordinates
- No two members over the same hierarchy
 - Two member over the same dimension is OK
- Cube
 - subselects are admitted

Calculations

[WITH < formula > [, < formula > ...]] SELECT [< axis > , [< axis > ...]] FROM [< cube >] [WHERE <set>]

- Calculated member
 - Formula ::= MEMBER alias_name AS mdx_expr
- Named set formula
 - Formula ::= SET alias_name AS set
- Syntax of MDX expressions

```
mdx_expr ::= Numeric | (Tuple, Numeric)
Numeric ::= [Measures].[measure name]
```

| numeric_function(Parameters) | Numeric + Numeric | Numeric - Numeric | Numeric / Numeric | Numeric * Numeric

Meaning:

Numeric: the expression Numeric is evaluated on the current cell (Tuple, Numeric): the expression Numeric is evaluated on the cell Tuple

Calculations in SSDT + Excel



TopCount([Product].[Product SKU].Members , 10, [Measures].[Profitability])

Exercise on the FoodMart cube

- Re-do the explorative data analysis exercise (queries Q0-Q3) using MDX instead of Excel/BIDS
- Extra queries
 - Qlextra: top 5 categories wrt sales since 1 Jan 1998 in CA in March 1998
 - extra: how many cities per sales region had more than
 4.000 dollars of total sales in March 1998