The Pentaho Analysis Guide

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Introduction

This guide helps BI administrators prepare their data for use with the Pentaho Analyzer, Pentaho Report Designer, and JPivot client tools. The collection of analysis components in the Pentaho BI Suite (referred to generally as Pentaho Analysis) enables you to visualize data trends and reveal useful information about your business. You can do this by creating static reports from an analysis data source, traversing an analysis cube through an Analyzer report, showing how data points compare by using charts, and monitor the status of certain trends and thresholds with dashboards.

Before you can begin using any client tools, you must consolidate data from disparate sources into one canonical source; create an analysis schema to describe the data; iteratively improve that schema so that it meets your users' needs; and possibly also create aggregation tables to enhance performance.

ROLAP Defined

Pentaho Analysis is built on the Mondrian relational online analytical processing (**ROLAP**) engine. ROLAP relies on a multidimensional data model that, when queried, returns a dataset that resembles a grid. The rows and columns that describe and bring meaning to the data in that grid are **dimensions**, and the hard numerical values in each cell are the **measures** or **facts**. In Pentaho Analyzer, dimensions are shown in yellow and measures are in blue.

ROLAP requires a properly prepared data source in the form of a star or snowflake schema that defines a logical multi-dimensional database and maps it to a physical database model. Once you have your initial data structure in place, you must design a descriptive layer for it in the form of a Mondrian schema, which consists of one or more cubes, hierarchies, and members. Only when you have a tested and optimized Mondrian schema is your data prepared on a basic level for end-user tools like Pentaho Analyzer and JPivot. See *Workflow Overview* on page 5 for a more comprehensive overview of the Pentaho Analysis data preparation workflow, including which Pentaho tools you will need to execute this process.

For concise definitions of ROLAP terms, refer to *Mondrian Schema Element Quick Reference* on page 31 and the individual element pages it references.

Workflow Overview

To prepare data for use with the Pentaho Analysis (and Reporting, to a certain extent) client tools, you should follow this basic workflow:

Design a Star or Snowflake Schema

The entire process starts with a data warehouse. This guide will not attempt to explain how to build this structure -- there are entire books on the subject, and an entire consulting industry dedicated to it already. The end result should be data model in the star or snowflake schema pattern. You don't have to worry too much about getting the model exactly right on your first try. Just cover all of your anticipated business needs; part of the process is going back and making changes to your initial data model after you've discovered what your operational needs are.

Populate the Star/Snowflake Schema

Once your data model is designed, the next step is to populate it with actual data, thereby creating your data warehouse. The best tool for this job is Pentaho Data Integration, an enterprise-grade extract, transform, and load (ETL) application.

Build a Mondrian Schema

Now that your initial data warehouse project is complete, you must build a Mondrian schema to organize and describe it in terms that Pentaho Analysis can understand. This is also accomplished through Pentaho Data Integration by using the Agile BI plugin. Just connect to your data warehouse and auto-populate your schema with the Modeler graphical interface.

Initial Testing

At this point you should have a multi-dimensional data structure with an appropriate metadata layer. You can now start using Pentaho Analyzer and JPivot to drill down into your data and see if your first attempt at data modelling

was successful. In all likelihood, it will need some adjustment, so take note of all of the schema limitations that you're unhappy with during this initial testing phase.

Do not be concerned with performance issues at this time -- just concentrate on the completeness and comprehensiveness of the data model.

Adjust and Repeat Until Satisfied

Use the notes you took during the testing phase to redesign your data warehouse and Mondrian schema appropriately. Adjust hierarchies and relational measure aggregation methods. Create virtual cubes for analyzing multiple fact tables by conforming dimensions. Re-test the new implementation and continue to refine the data model until it matches your business needs perfectly.

Test for Performance

Once you're satisfied with the design and implementation of your data model, you should try to find performance problems and address them by creating aggregation tables. The testing can only be reasonably done by hand, using Pentaho Analyzer and/or JPivot. Take note of all of the measures that take an unreasonably long time to calculate. Also, enable SQL logging and locate slow-performing queries, and build indexes for optimizing query performance.

Create Aggregation Tables

Using your notes as a guide, create aggregation tables in Pentaho Aggregation Designer to address performance issues. Re-test and create new aggregation tables as necessary.

If you are working with a relatively small data warehouse or a limited number of dimensions, you may not have a real need for aggregation tables. However, be aware of the possibility that performance issues may come up in the future. Check in with your users occasionally to see if they have any particular concerns about the speed of their BI content.

Deploy to Production

Your data warehouse and Mondrian schema have been created, tested, and refined. You're now ready to put it all into production. You may need to personally train or purchase Pentaho training for anyone in your organization who needs to create traditional reports, dashboards, or Analyzer reports with Pentaho's client tools.

Preparing Your Data

This section deals primarily with Pentaho Data Integration (the Kettle project), a graphical tool that helps you consolidate many data sources into one. Because data warehouse and ROLAP schema design can vary wildly among implementations, there is no specific advice on them here.

Consult the *Pentaho Data Integration User Guide* and *Pentaho Data Integration Administrator's Guide* for more information about extract, transform, and load (ETL) processes for data warehouse creation.

Dimensional Modeling

Dimensional modeling is the process of transforming data from multiple sources in non-human-friendly formats into a single data source that is organized to support business analytics. The workflow for developing a dimensional model is along these lines:

1. Collect user requirements for business logic and processes
2. Considering the entirety of your data, break it down into subjects
3. Isolate groups of facts into one or more fact tables
4. Design dimensional tables that draw relationships between levels (fact groups)
5. Determine which members of each level are useful for each dimensional table
6. Build and publish a Mondrian (Pentaho Analysis) schema and collect feedback from users
7. Refine your model based on user feedback, continue iterating through this list until users are productive

Or, expressed as a series of questions:

1. What topics or subjects are important to the users who are analyzing the data? What do your users need to learn from the data?
2. What are the important details your users will need to examine in the data?
3. How should each data column relate to other data columns?
4. How should datasets be grouped and organized?
5. What are some useful short descriptions for each dimensional level in a hierarchy (for each element, decide what is useful within that element; for instance, in a dimensional table representing time, your levels might be year, month, and day, and your members for the year level might be 2003, 2004, 2005).
6. How effective is this dimensional model for the intended userbase? How can it improve?

The Agile BI tools in Pentaho Data Integration make dimensional modeling much easier than the traditional methods. Through PDI, you can quickly adjust your business logic, the granularity of your fact tables, and the attributes of your dimension tables, then generate a new model and push it out to a test environment for evaluation.

Virtual ROLAP Cubes

Another name for a dimensional model is a **cube**. Each cube represents one fact table and several dimensional tables. This model should be useful for reporting and analysis on the subject of the data in the fact table. However, if you want to cross-reference this data with another cube -- if you need to analyze data across two or more cubes, or need to combine information from two fact tables on the same subject but with different granularity -- then you must create a **virtual cube**. The XML elements that compose a virtual cube are explained in detail below.

Note: Virtual cubes cannot presently be created through Pentaho Data Integration's model perspective; you must use Schema Workbench instead.

The **<CubeUsages>** element specifies the cubes that are imported into the virtual cube. It holds <CubeUsage> elements.

The **<CubeUsage>** element specifies the base cube that is imported into the virtual cube. Alternatively you can define a **<VirtualCubeMeasure>** and use similar imports from the base cube without defining a <CubeUsage>.The **cubeName** attribute specifies the name of the base cube. The **ignoreUnrelatedDimensions** attribute determines whether or not the measures from this base cube will have non-joining dimension members pushed to the top level member. This attribute is false by default because it is still experimental.

The **<VirtualCubeDimension>** element imports a dimension from one of the constituent cubes. If you do not specify the cubeName attribute, this means you are importing a shared dimension.

Note: If a shared dimension is used more than once in a cube, there is no way to determine which usage of the shared dimension you intend to import.

The **<VirtualCubeMeasure>** element imports a measure from one of the constituent cubes. It is imported with the same name. If you want to create a formula or rename a measure as you import it, use the **<CalculatedMember>** element instead.

Virtual cubes are useful for situations where there are fact tables of different granularities (for instance, one Time fact table might be configured on a Day level, another at the Month level), or fact tables of different dimensionalities (for

instance one on Products, Time and Customer, another on Products, Time and Warehouse), and you need to present the results to users who don't know how the data is structured.

Any common dimensions -- shared dimensions which are used by both constituent cubes -- are automatically synchronized. In this example, [Time] and [Products] are common dimensions. So if the context is ([Time].[2005].[Q2], [Products].[Productname].[P-51-D Mustang]), measures from either cube will relate to this context.

Dimensions which only belong to one cube are called **non-conforming dimensions**. The [Gender] dimension is an example of this; it exists in the Sales cube, but not Warehouse. If the context is ([Gender].[F], [Time].[2005].[Q1]), it makes sense to ask the value of the [Unit Sales] measure (which comes from the [Sales] cube) but not the [Units Ordered] measure (from [Warehouse]). In the context of [Gender].[F], [Units Ordered] has value NULL.

```
<VirtualCube name="Warehouse and Sales">
    <CubeUsages>
        <CubeUsage cubeName="Sales" ignoreUnrelatedDimensions="true"/>
        <CubeUsage cubeName="Warehouse"/>
    </CubeUsages>
    <VirtualCubeDimension cubeName="Sales" name="Customers"/>
    <VirtualCubeDimension cubeName="Sales" name="Education Level"/>
    <VirtualCubeDimension cubeName="Sales" name="Gender"/>
    <VirtualCubeDimension cubeName="Sales" name="Marital Status"/>
    <VirtualCubeDimension name="Product"/>
    <VirtualCubeDimension cubeName="Sales" name="Promotion Media"/>
    <VirtualCubeDimension cubeName="Sales" name="Promotions"/>
    <VirtualCubeDimension name="Store"/>
    <VirtualCubeDimension name="Time"/>
    <VirtualCubeDimension cubeName="Sales" name="Yearly Income"/>
    <VirtualCubeDimension cubeName="Warehouse" name="Warehouse"/>
    <VirtualCubeMeasure cubeName="Sales" name="[Measures].[Sales Count]"/>
    <VirtualCubeMeasure cubeName="Sales" name="[Measures].[Store Cost]"/>
    <VirtualCubeMeasure cubeName="Sales" name="[Measures].[Store Sales]"/>
    <VirtualCubeMeasure cubeName="Sales" name="[Measures].[Unit Sales]"/>
    <VirtualCubeMeasure cubeName="Sales" name="[Measures].[Profit
 Growth]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Store
 Invoice]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Supply
 Time]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Units
 Ordered]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Units
 Shipped]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Warehouse
 Cost]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Warehouse
 Profit]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Warehouse
 Sales]"/>
    <VirtualCubeMeasure cubeName="Warehouse" name="[Measures].[Average
 Warehouse Sale]"/>
    <CalculatedMember name="Profit Per Unit Shipped" dimension="Measures">
        <Formula>[Measures].[Profit] / [Measures].[Units Shipped]</
Formula>
    </CalculatedMember>
</VirtualCube>
```

Prototyping With Pentaho Data Integration

As of version 4.0, Pentaho Data Integration offers rapid prototyping of analysis schemas through a mix of processes and tools known as **Agile BI**. The Agile BI functions of Pentaho Data Integration are explained in this section, but there is no further instruction here regarding PDI installation, configuration, or use beyond ROLAP schema creation. If you need information related to PDI in general, consult the *Pentaho Data Integration Installation Guide* and/or the *Pentaho Data Integration User Guide* in the Pentaho Knowledge Base.

Creating a Prototype Schema With a Non-PDI Data Source

Your data sources must be configured, running, and available before you can proceed with this step.

Follow the below procedure to create a ROLAP schema prototype from an existing database, file, or data warehouse.

Note: If you are already using PDI to create your data source, skip these instructions and refer to *Creating a Prototype Schema With a PDI Data Source* on page 10 instead.

1. Start Spoon and connect to your repository, if you are using one.
   ```
   cd ~/pentaho/design-tools/data-integration/ && ./spoon.sh
   ```
2. Go to the **File** menu, then select the **New** sub-menu, then click on **Model**.

   The interface will switch over to the **Model** perspective.
3. In the **Properties** pane on the right, click **Select**.

   A data source selection window will appear.
4. Click the round green **+** icon in the upper right corner of the window.

   The **Database Connection** dialogue will appear.
5. Enter in and select the connection details for your data source, then click **Test** to ensure that everything is correct. Click **OK** when you're done.
6. Select your newly-added data source, then click **OK**.

   The **Database Explorer** will appear.
7. Traverse the database hierarchy until you get to the table you want to create a model for. Right-click the table, then select **Model** from the context menu.

   The Database Explorer will close and bring you back to the Model perspective.
8. Drag items from the **Data** pane on the left and drop them into either the **Measures** or **Dimensions** groups in the **Model** pane in the center.

   The Measures and Dimensions groups will expand to include the items you drag into them.
9. Select each new measure and dimension item, and modify its details accordingly in the **Properties** pane on the right.
10. Save your model through the **File** menu, or publish it to the BI Server using the **Publish** icon above the Model pane.

You now have a basic ROLAP schema. You should test it yourself before putting it into production. To do this, continue on to *Testing With Pentaho Analyzer and Report Wizard* on page 11.

Creating a Prototype Schema With a PDI Data Source

Context for the current task

1. Start Spoon and connect to your repository, if you are using one.
   ```
   cd ~/pentaho/design-tools/data-integration/ && ./spoon.sh
   ```
2. Open the transformation that produces the data source you want to create a ROLAP schema for.
3. Right-click your output step, then select **Model** from the context menu.
4. Drag items from the **Data** pane on the left and drop them into either the **Measures** or **Dimensions** groups in the **Model** pane in the center.

   The Measures and Dimensions groups will expand to include the items you drag into them.

5. Select each new measure and dimension item, and modify its details accordingly in the **Properties** pane on the right.
6. Save your model through the **File** menu, or publish it to the BI Server using the **Publish** icon above the Model pane.

You now have a basic ROLAP schema. You should test it yourself before putting it into production. To do this, continue on to *Testing With Pentaho Analyzer and Report Wizard* on page 11.

Testing With Pentaho Analyzer and Report Wizard

You must have an analysis schema with at least one measure and one dimension, and it must be currently open and focused on the Model perfective in Spoon.

This section explains how to use the embedded Analyzer and Report Design Wizard to test a prototype analysis schema.

1. While in the Model perspective, select your visualization method from the drop-down box above the Data pane (it has a **New:** to its left), then click **Go**.

   The two possible choices are: **Pentaho Analyzer** and **Report Wizard**. You do not need to have license keys for Pentaho Analysis or Pentaho Reporting in order to use these preview tools.
2. Either the Report Design Wizard will launch in a new sub-window, or Pentaho Analyzer will launch in a new tab. Use it as you would in Report Designer or the Pentaho User Console.
3. When you have explored your new schema, return to the Model perspective by clicking **Model** in the upper right corner of the Spoon toolbar, where all of the perspective buttons are.

   Do not close the tab; this will close the file, and you will have to reopen it in order to adjust your schema.
4. If you continue to refine your schema in the Model perspective, you must click the **Go** button again each time you want to view it in Analyzer or Report Wizard; the Visualize perspective does not automatically update according to the changes you make in the Modeler.

You now have a preview of what your model will look like in production. Continue to refine it through the Model perspective, and test it through the Visualize perspective, until you meet your initial requirements.

Prototypes in Production

Once you're ready to move your analysis schema to production, use the **Publish** button above the Model pane in the Model perspective, and use it to connect to your production BI Server.

You can continue to refine your schema if you like, but it must be republished each time you want to redeploy it.

Working With Mondrian Schemas

Now that you have a physical data model in place, you must create a logical model that maps to it. A Mondrian schema is essentially an XML file that performs this mapping, thereby defining a multidimensional database structure.

In a very basic scenario, you will create a Mondrian schema with one cube that consists of a single fact table and a few dimensions, each with a single hierarchy consisting of a handful of levels. More complex schemas may involve multiple virtual cubes, and instead of mapping directly to the single fact table at the center of a star schema, they might map to views or inline tables instead.

All of the Mondrian XML elements are documented in this section in both a single quick reference list and a full individual reference piece for each element. Primarily you will be using Pentaho Schema Workbench to create Mondrian schemas graphically, though advanced schema design may require hand-editing of the bare XML later on; this is also possible within the Schema Workbench interface.

Schema Workbench Notes

Before you start using Schema Workbench, you should be aware of the following points:

- You start Schema Workbench by executing the `/pentaho/design-tools/schema-workbench/workbench` script. On Linux and OS X, this is a **.sh** file; on Windows it's **.bat**.
- You must be familiar with your physical data model before you use Schema Workbench. If you don't know which are your fact tables and how your dimensions relate to them, you will not be able to make significant progress in developing a Mondrian schema.
- When you make a change to any field in Schema Workbench, the change will not be applied until you click out of that field such that it loses the cursor focus.
- Schema Workbench is designed to accommodate multiple sub-windows. By default they are arranged in a cascading fashion. However, you may find more value in a tiled format, especially if you put the JDBC Explorer window next to your Schema window so that you can see the database structure at a glance. Simply resize and move the sub-windows until they are in agreeable positions.

Adding a Data Source in Schema Workbench

Your data source must be available, its database driver JAR must be present in the `/pentaho/design-tools/schema-workbench/drivers/` directory, and you should know or be able to obtain the database connection information and user account credentials for it.

Follow the below process to connect to a data source in Schema Workbench.

1. Establish a connection to your data source by going to the **Options** menu and selecting **Connection**.

   The **Database Connection** dialogue will appear.
2. Select your database type, then enter in the necessary database connection information, then click **Test**. When you've verified that the connection settings work, click **OK**.

   The database connection information includes the database name, port number, and user credentials. If you don't know what to type into any of these fields, consult your database administrator or database vendor's documentation.

   Note: The **Require Schema** checkbox, when selected in the Options menu, puts Schema Workbench into a mode where unpopulated elements appear in the schema.

Your data is now available to Schema Workbench, and you can proceed with creating a Mondrian schema.

Adding a Simple JNDI Data Source

Rather than add individual JDBC data source connections to each Pentaho client tool and server, sometimes it's easier to establish a single global JNDI connection that can be used across all Pentaho BI Suite products. JNDI connections can be configured at the application server level if you want to share them among several deployed applications; to learn how to do this you should consult your application server documentation. Pentaho provides an alternative method for defining a JNDI connection that exists only for its locally installed client tools and servers. Follow the directions below to establish a simple JNDI connection.

1. Navigate to the **.pentaho** directory in your home or user directory.

   For a user name of **fbeuller**, typically in Linux and Solaris this would be `/home/fbeuller/.pentaho/`, and in Windows it would be `C:\Users\fbeuller\.pentaho\`
2. Switch to the `~/.pentaho/simple-jndi/` subdirectory. If it does not exist, create it.
3. Edit the **default.properties** file found there. If it does not exist, create it now.
4. Add a data source by declaring a JNDI name followed by a forward slash, then a JNDI parameter and its proper value.

   Refer to *Simple JNDI Options* on page 13 for more information on parameter options.

   ```
   SampleData/type=javax.sql.DataSource
   SampleData/driver=org.hsqldb.jdbcDriver
   SampleData/user=pentaho_user
   SampleData/password=password
   SampleData/url=jdbc:hsqldb:mem:SampleData
   ```
5. Save and close the file.

You now have a global Pentaho data source that can be used across all of the client tools and servers installed on this machine. You must restart any running Pentaho program in order for this change to take effect.

Simple JNDI Options

Each line in the data source definition must begin with the JNDI name and a forward slash (/), followed by the required parameters listed below.

Parameter	Values
type	**javax.sql.DataSource** defines a JNDI data source type.
driver	This is the driver class name provided by your database vendor.
user	A user account that can connect to this database.
password	The password for the previously declared user.
url	The database connection string provided by your database vendor.

```
SampleData/type=javax.sql.DataSource
SampleData/driver=org.hsqldb.jdbcDriver
SampleData/user=pentaho_user
SampleData/password=password
SampleData/url=jdbc:hsqldb:mem:SampleData
```

Adding a JDBC Driver

Before you can connect to a data source in any Pentaho server or client tool, you must first install the appropriate database driver. Your database administrator, CIO, or IT manager should be able to provide you with the proper driver JAR. If not, you can download a JDBC driver JAR file from your database vendor or driver developer's Web site. Once you have the JAR, follow the instructions below to copy it to the driver directories for all of the BI Suite components that need to connect to this data source.

Note: Microsoft SQL Server users frequently use an alternative, non-vendor-supported driver called JTDS. If you are adding an MSSQL data source, ensure that you are installing the correct driver.

Backing up old drivers

You must also ensure that there are no other versions of the same vendor's JDBC driver installed in these directories. If there are, you may have to back them up and remove them to avoid confusion and potential class loading problems. This is of particular concern when you are installing a driver JAR for a data source that is the same database type as your Pentaho solution repository. If you have any doubts as to how to proceed, contact your Pentaho support representative for guidance.

Installing JDBC drivers

Copy the driver JAR file to the following directories, depending on which servers and client tools you are using (Dashboard Designer, ad hoc reporting, and Analyzer are all part of the BI Server):

Note: For the DI Server: before copying a new JDBC driver, ensure that there is not a different version of the same JAR in the destination directory. If there is, you must remove the old JAR to avoid version conflicts.

- **BI Server:** `/pentaho/server/biserver-ee/tomcat/lib/`
- **Enterprise Console:** `/pentaho/server/enterprise-console/jdbc/`
- **Data Integration Server:** `/pentaho/server/data-integration-server/tomcat/webapps/pentaho-di/WEB-INF/lib/`
- **Data Integration client:** `/pentaho/design-tools/data-integration/libext/JDBC/`
- **Report Designer:** `/pentaho/design-tools/report-designer/lib/jdbc/`
- **Schema Workbench:** `/pentaho/design-tools/schema-workbench/drivers/`
- **Aggregation Designer:** `/pentaho/design-tools/agg-designer/drivers/`
- **Metadata Editor:** `/pentaho/design-tools/metadata-editor/libext/JDBC/`

Note: To establish a data source in the Pentaho Enterprise Console, you must install the driver in both the Enterprise Console and the BI Server or Data Integration Server. If you are just adding a data source through the Pentaho User Console, you do not need to install the driver to Enterprise Console.

Restarting

Once the driver JAR is in place, you must restart the server or client tool that you added it to.

Connecting to a Microsoft SQL Server using Integrated or Windows Authentication

The JDBC driver supports Type 2 integrated authentication on Windows operating systems through the **integratedSecurity** connection string property. To use integrated authentication, copy the **sqljdbc_auth.dll** file to all the directories to which you copied the JDBC files.

The **sqljdbc_auth.dll** files are installed in the following location:

```
<installation directory>\sqljdbc_<version>\<language>\auth\
```

Note: Use the **sqljdbc_auth.dll** file, in the x86 folder, if you are running a 32-bit Java Virtual Machine (JVM) even if the operating system is version x64. Use the **sqljdbc_auth.dll** file in the x64 folder, if you are running a 64-bit JVM on a x64 processor. Use the **sqljdbc_auth.dll** file in the IA64 folder, you are running a 64-bit JVM on an Itanium processor.

Removing Mondrian Data Sources

Every time you publish a schema from Schema Workbench or Pentaho Data Integration, a new XMLA data source entry is created in `/pentaho/server/biserver-ee/pentaho-solutions/system/olap/datasources.xml`. If you modify a schema and republish it, the data source entry will be updated accordingly. You do not have to manually add anything to this file, and under most circumstances you won't have to modify or remove anything from it, either. However, there is no automatic method to expire a registered data source, so each time you publish a new schema, a new entry is permanently added to datasources.xml.

The Pentaho User Console uses datasources.xml to populate a schema drop-down selection list that appears when users create new analysis views and Analyzer reports. As you phase out old analysis schemas, you will have to manually remove their <DataSource> entries in datasources.xml.

Below is the example datasources.xml that ships with a default Pentaho configuration:

datasources.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<DataSources>
  <DataSource>
    <DataSourceName>Provider=Mondrian;DataSource=Pentaho</DataSourceName>
    <DataSourceDescription>Pentaho BI Platform Datasources</DataSourceDescription>
    <URL>http://localhost:8080/pentaho/Xmla?userid=joe&amp;password=password</URL>
    <DataSourceInfo>Provider=mondrian</DataSourceInfo>
    <ProviderName>PentahoXMLA</ProviderName>
    <ProviderType>MDP</ProviderType>
```

```
    <AuthenticationMode>Unauthenticated</AuthenticationMode>
    <Catalogs>
        <Catalog name="SteelWheels">
            <DataSourceInfo>Provider=mondrian;DataSource=SampleData</DataSourceInfo>
                        <Definition>solution:steel-wheels/analysis/
steelwheels.mondrian.xml</Definition>
                </Catalog>
        <Catalog name="SampleData">
            <DataSourceInfo>Provider=mondrian;DataSource=SampleData</DataSourceInfo>
            <Definition>solution:steel-wheels/analysis/SampleData.mondrian.xml</
Definition>
        </Catalog>
    </Catalogs>
  </DataSource>
</DataSources>
```

Creating a Mondrian Schema

In order to complete this process, you should have already connected to your data source in Schema Workbench.

This section explains the basic procedure for creating a barebones Mondrian schema using Schema Workbench. If you are confused about the definition or application of any of the elements discussed below, refer to the *Mondrian Schema Element Quick Reference* on page 31 and the individual reference pieces it links to.

1. To create a new Mondrian schema, click the New button, or go to the **File** menu, then select **New**, then **Schema**.

   A new schema sub-window will appear. Resize it to fit your preference.
2. It's easier to visualize your physical data model if you have it in front of you. Turn on the JDBC Explorer from the **New** section of the **File** menu and position it according to your preference. If you have a third-party database visualization tool that you are more familiar with, use that instead.

   The JDBC Explorer is not interactive; it only shows the table structure of your data source so that you can see at a glance what the names of the columns and rows in it.
3. Typically your first action when creating a schema is to add a cube. Right-click the Schema icon in the schema window, then select **Add cube** from the context menu. Alternatively you can click the New Cube button in the toolbar.

   A new default cube will show up in your schema.
4. Give your cube a name.
5. Add a table by clicking the New Table button, or by right-clicking your cube, then selecting **Add Table**.

   This will be your fact table. Alternatively you can select **View** or **Inline Table** if these are the data types you need for your fact table.
6. Click the **Table** entry in the **name** field of your new table, and select or type in the name of the table in your physical model that you want to use for this cube's fact table.
7. Add a dimension by right-clicking the cube, then selecting **Add Dimension**, or by clicking the New Dimension button.
8. Type in a friendly name for this dimension in the **name** field.
9. Select a foreign key for this dimension from the **foreignKey** drop-down box, or just type it into the field.
10. When you add a dimension, a new hierarchy is automatically created for it. To configure the hierarchy, expand the dimension by clicking the lever icon on the left side of the dimension's tree entry, then click on **New Hierarchy 0**. Choose a **primaryKey** or **primaryKey Table**.
11. Add a table to the hierarchy by right-clicking the hierarchy, then selecting **Add Table** from the context menu.
12. Choose a column for the **name** attribute.
13. Add a level to the hierarchy by right-clicking the hierarchy, then selecting **Add Level** from the context menu.
14. Give the level a **name** and choose a **column** for it.
15. Add a *member property* to the level by right-clicking the level, then selecting **Add Property** from the context menu.
16. Give the property a **name** and choose a **column** for it.
17. Add a measure to the cube by right-clicking the cube and selecting **Add Measure** from the context menu.
18. Choose a **column** that you want to provide values for, then select an **aggregator** to determine how the values should be calculated.

These instructions have shown you how to use Schema Workbench's interface to add and configure basic Mondrian schema elements.

When your schema is finished, you should test it with a basic MDX query such as:

```
select {[Dim1].[All Dim1s]} on rows, {[Measures].[Meas1]} on columns from [CubeName]
```

In order to use your schema as a data source in any Pentaho BI Suite client tools, you must publish it to the BI Server. To do this, select **Publish** from the **File** menu, then enter in your BI Server connection information and credentials when requested.

Using MDX Mode and Hand-Editing a Schema

There are two advanced tools in Schema Workbench that enable you to work with raw MDX and XML. The first is the MDX query editor, which can query your logical data model in real time. To open this view, go to the **File** menu, select **New**, then click **MDX Query**.

The second is XML viewing mode, which you can get to by clicking the rightmost icon (the pencil) in the toolbar. This replaces the name/value fields with the resultant XML for each selected element. To see the entire schema, select the top-level schema entry in the element list on the left of the Schema Workbench interface. Unfortunately you won't be able to edit the XML in this view; if you want to edit it by hand, you'll have to open the schema in an XML-aware text editor.

Adding Business Groups

The available fields list in Analyzer organizes fields in folders according to the **AnalyzerBusinessGroup** annotation. To implement business groups, add these annotations to your member definitions appropriately. If no annotation is specified, then the group defaults to "Measures" for measures and the hierarchy name/caption for attributes.

Below is an example that puts Years, Quarters and Months into a "Time Periods" business group:

```
...
<Level name="Years" ... >
   <Annotations><Annotation name="AnalyzerBusinessGroup">Time Periods</Annotation></
Annotations>
</Level>
<Level name="Quarters" ... >
   <Annotations><Annotation name="AnalyzerBusinessGroup">Time Periods</Annotation></
Annotations>
</Level>
<Level name="Months" ... >
   <Annotations><Annotation name="AnalyzerBusinessGroup">Time Periods</Annotation></
Annotations>
</Level>
...
```

The AnalyzerBusinessGroup annotation is supported on the following schema elements:

- Level
- Measure
- CalculatedMember
- VirtualCubeMeasure

Adding Field Descriptions

By adding **description** attributes to your Mondrian schema elements, you can enable tooltip (mouse-over) field descriptions in Analyzer reports.

```
<Level name="Store Country" column="store_country" uniqueMembers="true"
 caption="%{foodmart.dimension.store.country.caption}" description="%{foodmart.dimension.stor
>
```

This attribute can be set on the following schema elements:

- Level
- Measure
- CalculatedMember

Building a Schema and Detecting Errors

Analysis schemas are built by publishing them to the BI Server. Each schema is validated to make sure that there are no errors before it is built; if there are any, they'll be shown to you and the schema will fail to publish. If you want to see the errors marked in Schema Workbench before you publish, go to the **Options** menu and select **Require Schema**. When this option is checked, schema validation will happen as new elements are added, and any errors will show as a red **x** next to the offending element.

Adapting Mondrian Schemas to Work with Pentaho Analyzer

The following Mondrian features are not yet functional in Pentaho Analyzer, but are scheduled to be added in the future:

- **Parent-child hierarchies** will render the entire set of members instead of showing them as parents and children.
- **Ragged hierarchies** currently throw an exception when using them in Analyzer
- Additional Mondrian features not yet available: **cube captions**, **drill-through**, **parameterization**

To adjust for these limitations and to enable some Analyzer functions to work properly, you must make the changes explained in the subsections below.

Applying Relative Date Filters

Pentaho Analyzer supports many types of relative date filters, but in order to apply them for a given level, you need to define the format string used to construct MDX members for that level. This is because each data warehouse implementation may have a different date format and set of hierarchy levels. For example, in the Steel Wheels sample data cube provided by Pentaho for evaluation and testing, the Month level uses abbreviated three-letter month names. Furthermore, the Month level sits under the Quarter level. In Steel Wheels, the format string for an MDX member from the Month level would look like this:

```
[yyyy].['QTR'q].[MMM]
```

Some other common date formats:

- **[yyyy]** (Year)
- **[yyyy].[q]** (Quarter)
- **[yyyy].[q].[M]** (Month)
- **[yyyy].[q].[M].[w]** (Week)
- **[yyyy].[q].[M].[w].[yyyy-MM-dd]** (Day)

The **Day** line above also specifies a format to represent the entire date. Without this format, a simple **[d]** parameter would be difficult to put into context. For more information on date format strings, refer to the SimpleDateFormat page on the ICU Project site: *http://icu-project.org/apiref/icu4j/com/ibm/icu/text/SimpleDateFormat.html*.

To setup relative date filtering, for each level, you need to do the following:

- In your Mondrian schema file, set the **levelType** XML attribute to TimeYears, TimeMonths, TimeQuarters, TimeWeeks or TimeDate
- Define the MDX date member format as an annotation with the name **AnalyzerDateFormat**.

Here is an example from the Pentaho sample data (Steel Wheels) Time dimension:

```
<Level name="Years" levelType="TimeYears" ... >
   <Annotations><Annotation name="AnalyzerDateFormat">[yyyy]</Annotation></Annotations>
</Level>
<Level name="Quarters" levelType="TimeQuarters" ... >
   <Annotations><Annotation name="AnalyzerDateFormat">[yyyy].['QTR'q]</Annotation></
Annotations>
</Level>
<Level name="Months" levelType="TimeMonths" ... >
   <Annotations><Annotation name="AnalyzerDateFormat">[yyyy].['QTR'q].[MMM]</
Annotation></Annotations>
</Level>
```

Adjusting for Calculated Members and Named Sets

If your Mondrian schema defines calculated members or named sets that reference MDX members without the dimension prefix, then you must set **mondrian.olap.elements.NeedDimensionPrefix** to **false** in your **mondrian.properties** file. Under all other conditions you would want to set this property to **true** because it increases Mondrian performance, as well as the readability of the schema XML file.

Localization/Internationalization of Analysis Schemas

You can create internationalized message bundles for your analysis schemas and deploy them with the Pentaho Web application. This enables Pentaho Analyzer and JPivot to access localized schemas.

1. Edit your analysis schema and tokenize all values that you want to localize.

   Typically you would create variables for all caption and description values.

   ```
   <Schema measuresCaption="%{foodmart.measures.caption}">
       <Dimension name="Store" caption="%{foodmart.dimension.store.caption}"
    description="%{foodmart.dimension.store.description}">
           <Hierarchy hasAll="true" allMemberName="All Stores"
    allMemberCaption="%{foodmart.dimension.store.allmember.caption =All Stores}"
    primaryKey="store_id"  caption="%{foodmart.hierarchy.store.country.caption}"
    description="%{foodmart.hierararchy.store.country.description}>
               <Table name="store"/>
               <Level name="Store Country" column="store_country"
    uniqueMembers="true" caption="%{foodmart.dimension.store.country.caption}"
    description="%{foodmart.dimension.store.country.description}"/>
   ```

2. Stop the BI Server.
3. Edit your `/pentaho/server/biserver-ee/pentaho-solutions/system/mondrian/mondrian.properties` file and add this line (or modify it if it's already there):

   ```
   mondrian.rolap.localPropFile=com.pentaho.messages.MondrianMessages
   ```

4. Save and close the file.
5. Edit your `/pentaho/server/biserver-ee/pentaho-solutions/system/olap/datasources.xml` file and modify the **Provider** line to declare the default locale, include the i18n dynamic schema processor (this enables message token replacement), and refresh the schema when Analyzer detects that the checksum is different than the cached version:

   ```
   Provider=mondrian; Locale=en_US; DynamicSchemaProcessor=
    mondrian.i18n.LocalizingDynamicSchemaProcessor; UseContentChecksum=true; Jdbc=
    jdbc:odbc:MondrianFoodMart; Catalog= /WEB-INF/FoodMart.xml
   ```

6. Save and close the file.
7. Create localized **MondrianMessages.properties** files in the `/WEB-INF/classes/com/pentaho/messages/` directory inside of the Pentaho WAR, and define each token you used in the analysis schema.

   Note: JBoss users will have to delete the unpacked Pentaho WAR directory if it exists, then unpack the pentaho.war file with an archive utility, create the message bundles in the proper location, then repack it into a WAR again.

   If you need further assistance in creating localized message bundles, refer to *Replacing Or Translating Message Bundles* on page 19.

   ```
   foodmart.measures.caption=Measures
   foodmart.dimension.store.country.caption=Store Country
   foodmart.dimension.store.name.property_type.column=store_type
   foodmart.dimension.store.country.member.caption=store_country
   foodmart.dimension.store.name.property_type.caption=Store Type
   foodmart.dimension.store.name.caption=Store Name
   foodmart.dimension.store.state.caption=Store State
   foodmart.dimension.store.name.property_manager.caption=Store Manager
   foodmart.dimension.store.name.property_storesqft.caption=Store Sq. Ft.
   foodmart.dimension.store.allmember.caption=All Stores
   foodmart.dimension.store.caption=Store
   foodmart.cube.sales.caption=Sales
   foodmart.dimension.store.city.caption=Store City
   ```

```
foodmart.cube.sales.measure.unitsales=Unit Sales
```

8. Start the BI Server.

Your analysis schemas will now be localized to whatever language is currently selected in the Pentaho User Console, if a message bundle for that locale was copied to the proper directory as explained above.

Replacing Or Translating Message Bundles

Note: Stop the Pentaho application server before editing anything inside of the Pentaho WAR file.

You can internationalize the Pentaho User Console, Pentaho Analyzer, and Dashboard Designer by creating locale- and language-specific message bundles within the Pentaho Web application.

For brevity's sake, only the default Pentaho User Console files will be explained in detail. The file naming convention is identical among all message bundles in the Pentaho BI Suite. The following files are located in the /mantle/messages/ directory:

- **mantleMessages.properties**: The default message bundle for the Pentaho User Console. In its initial condition, it is a copy of **mantleMessages_en.properties**. If you want to change the default language and dialect, copy your preferred message bundle file over this one.
- **mantleMessages_en.properties**: The English-language version of the standard message bundle. This is an identical copy of **mantleMessages.properties**.
- **mantleMessages_fr.properties**: The French-language version of the standard message bundle.
- **mantleMessages_de.properties**: The German-language version of the standard message bundle.
- **mantleMessages_supported_languages.properties**: Contains a list of localized message bundles and the native language names they correspond to; this relieves the BI Server of the burden of having to discover them on its own. A supported_languages.properties file should be created for every message bundle that you intend to localize.

Example of mantleMessages_supported_languages.properties

```
en=English
de=Deutsch
fr=Français
```

New files are created in the following format: **mantleMessages_xx_YY.properties** where **xx** represents a lowercase two-letter language code, and **YY** represents a two-letter locale code, where applicable. So, for instance, U.S. and British English could have two separate message bundles if you wanted to draw a distinction between the two dialects:

- mantleMessages_en_US.properties
- mantleMessages_en_GB.properties

The language and country codes must be in standard ISO format. You can look up both sets of codes on these pages:

- *http://en.wikipedia.org/wiki/List_of_ISO_639-1_codes*
- *http://www.iso.org/iso/english_country_names_and_code_elements*

You can edit the default message bundle directly if you need to make surgical changes to the content inside of it. If you plan to translate it into another language, it makes more sense to copy the file and change the name appropriately, then translate it line by line. Be sure to update supported_languages.properties with the new country and dialect code and the native language name that it corresponds to.

Note: All message bundles must be UTF-8 encoded.

Configuring Analysis Options

The Pentaho Analysis (Mondrian) engine is configurable through a properties file. Mondrian options allow for enhanced engine and data source performance and functionality under certain conditions. Pentaho Analyzer is also configurable, but more in terms of adjusting the functionality of the Analyzer client tool itself.

Managing Analysis Data Sources

In order to use a properly prepared data source with Pentaho Analysis, it must be established in either the Pentaho Enterprise Console as a Pentaho data connection, or in your Web application server as a JNDI data source. Whichever method you choose, you will have to know the name of the data source later on when you're asked to supply it in Pentaho Schema Workbench.

Schema Workbench can only work with one data source for each Mondrian schema; this is a structural limitation in the software that will be remedied at a later time. You can have multiple JNDI data sources or Pentaho data connections established, but only one at a time can be used with Schema Workbench.

Configuring the Mondrian Engine (mondrian.properties)

Purpose: mondrian.properties is a configuration file referenced by the Pentaho Analysis (Mondrian) engine to determine performance and usability settings.

Location: `/pentaho/server/biserver-ee/pentaho-solutions/system/mondrian/mondrian.properties`

Note: This section is specific to maximizing Mondrian performance with Pentaho Analyzer. For all available settings, see *http://mondrian.pentaho.org/documentation/configuration.php*.

Performance

One of the key performance goals for Analyzer is to push as many operations to the database as possible. This is particularly important when querying many high-cardinality dimensions because you want Mondrian to only process the combinations that make sense and not a huge cartesian product which is sparsely populated.

```
mondrian.expCache.enable=true
```

Improves the performance of summary numbers such as ranks and running sums.

```
mondrian.native.crossjoin.enable=true
```

This is an essential property which enabes pushdown to the database so that Mondrian does not perform large cross joins in memory.

```
mondrian.native.filter.enable=true
```

Particularly important for pushdown of Not In and Excludes filters.

```
mondrian.native.nonempty.enable=false
```

This should be set to false to optimize Mondrian SQL generation given the MDX patterns generated by Analyzer. Analyzer uses non-empty cross joins to push down joins between high cardinality attributes to the database. If this property is set to false, there are many non-empty cross joins which would get evaluated by Mondrian instead because Mondrian pushes down the individual arguments such as **dimension.members**.

```
mondrian.rolap.maxConstraints=1000
```

Used in conjunction with the **mondrian.native.ExpandNonNative** property. This should be set to as large as the underlying DB can support.

```
mondrian.native.ExpandNonNative=true
```

Allows pushdown of even more crossjoins by materializing the crossjoin inputs into IN lists. For example, a crossjoin whose inputs are MDX functions can first have their inputs evaluated to members and then convert the crossjoin into native evaluation.

```
mondrian.olap.elements.NeedDimensionPrefix=true
```

Analyzer and JPivot always generate dimension qualified members so no need to spend time searching for members on different dimensions.

Usability

```
mondrian.result.limit=5000000
```

In the event that pushdown cannot occur, this is the largest crossjoin size that Mondrian should try to process. Anything that exceeds this will likely send the CPU for a toss and result in long server hangs. If this limit is hit, Analyzer will present the user a nice warning suggesting options to simplify the report.

```
mondrian.olap.case.sensitive=true
```

This is important for "Equals" filters because the UI will preserve the casing of filter values. If the user defines a filter on "John Doe", then the filter should only applies to "John Doe" and not "john doe"

```
mondrian.rolap.ignoreInvalidMembers=true
```

This is important for saved reports because the user may build a report with a filter on 10 sales rep and after the next ETL, one of them is gone. The report should continue to run and return just the 9 remaining sales reps.

```
mondrian.rolap.ignoreInvalidMembersDuringQuery=true
```

See mondrian.rolap.ignoreInvalidMembers

```
mondrian.rolap.iterationLimit=5000000
```

Similar to mondrian.result.limit except for controlling limits on aggregate evaluation.

```
mondrian.rolap.compareSiblingsByOrderKey=true
```

This is required for sorting members in a dimension A->Z or Z->A. This property fixes a bug in Mondrian but was added for backward compatibility.

```
mondrian.olap.NullDenominatorProducesNull=true
```

The best way to understand this property is via an example. Suppose you want to see quota attainment for your sales reps which is computed as Booked Deals / Quota. Some reps may not have quotas and so quota attainment is either infinity or null. By treating divide by null as infinity, Mondrian will return these sales reps in the report. Otherwise, if divide by null evaluates to null, then Mondrian will filter those reps out (due to the NON EMPTY).

Configuring Pentaho Analyzer (analyzer.properties)

Purpose: This property file contains low-level configuration options for the Analyzer plugin. It's sufficiently documented through inline comments, for the most part. Notes for unusual or under-documented properties are printed below.

Location: `/pentaho/server/biserver-ee/pentaho-solutions/system/analyzer/analyzer.properties`

Note: You must restart the BI Server to enact any changes you make to this file.

Refer to the sections below for more information on specific Analyzer property settings.

Adjusting Drill Link Limitations

To increase or decrease the number of records shown in drill link output, set the **report.drill.max.rows** option in **analyzer.properties** to the maximum number of rows you want to display. The default value is **10000**.

PDF Logo and Cover Page Customization

Analyzer PDF exports can be personalized with a company logo and a cover page. These image files need to placed in the `/pentaho-solutions/system/analyzer/resources/` directory. You then need to update

analyzer.properties with the names of these images given to the keys below. If the file names are left blank, then no images are used.

- **PDF cover image:** renderer.pdf.cover.image
- **PDF logo image:** renderer.logo.image

Setting Query Limits

To set the maximum number of cells to show for a pivot table when rendered in the browser, change the value of the **renderer.browser.max.pivot.cells** property in **analyzer.properties**. The default value is **2000**)

To set the maximum number of rows to export to a PDF or Excel spreadsheet, change the value of **renderer.export.max.rows**. The default is **10000**.

Divide by Zero Display

The **renderer.infinite.nan.value.display** property in **analyzer.properties** determines what is shown to users when a "divide by zero" error occurs in an Analyzer report. You can put any string (no quotes necessary) here; Excel uses **!DIV/0**. The default value is **N/A**.

Visualizing Your Data

Pentaho provides two end-user client tools that are designed specifically for traversing an analysis schema: JPivot, an open source analysis viewer that is useful for creating MDX queries; and Pentaho Analyzer, a highly interactive and easy to use analysis slicer-dicer.

Once you have JPivot or Pentaho Analyzer content, you can use Dashboard Designer to create a dashboard that includes your analysis view or Analyzer report plus any other content in a variety of configurations and styles.

It is also possible to use your analysis schema as a data source in Pentaho Report Designer, though you will have to create your own MDX query to refine the data for reporting.

Introduction to the Multidimensional Expression Language (MDX)

The Multidimensional Expression Language (MDX) is an OLAP database query and calculation language similar to SQL. It is the method by which a dataset is retrieved from a ROLAP database. While you do not necessarily have to know MDX in order to use Pentaho's client tools, you should be somewhat familiar with it for the purpose testing your Mondrian schema.

Note: The JPivot analysis viewer built into the Pentaho User Console is an excellent way to quickly generate a valid MDX query without having to write any of it by hand.

If you are already familiar with SQL, then much of the MDX syntax will look familiar, and the rest should be relatively easy to learn.

There are six MDX data types:

1. Dimension or hierarchy
2. Level
3. Member
4. Tuple
5. Scalar
6. Set

Below is an example of a very simple MDX query:

```
SELECT
   { [Measures].[Salesfact] } ON COLUMNS,
   { [Date].[2004], [Date].[2005] } ON ROWS
FROM Sales
```

Further Reading

MDX was initially developed by Microsoft for its SQL Server analysis products, though it has since become an independent standard. It's been around long enough now that there are many MDX tutorials and references, most notably:

- *http://msdn2.microsoft.com/en-us/library/ms145506.aspx*
- *http://en.wikipedia.org/wiki/Multidimensional_Expressions*
- *http://www.anselmiconsulting.com/webtools/WTContent/ACDR/Tutorials/MDXReportTutorial/MDXTutorial/mdx_tutorial.htm*

Note: MDX implementations vary, and many MDX documentation resources are specific to certain niche products or standards. Not all MDX functions and extensions are supported in Pentaho Analysis.

Creating Analyzer Reports and Analysis Views

Pentaho offers two primary slicer-dicer tools: **Pentaho Analyzer** and **JPivot**.

Pentaho Analyzer is a powerful and extremely easy-to-use visualization tool that is delivered as a plugin to the Pentaho User Console. This is by far the preferred client tool for generating analysis content.

JPivot is an open source slicer-dicer with a simple, lightweight interface and good native Mondrian support. It's not nearly as user-friendly as Analyzer is, but it is still useful for generating good MDX queries.

The sections below explain how to use these tools on a basic level.

Creating a New Analyzer Report

Pentaho Analyzer reports are similar to standard reports, except that they are designed to be completely interactive and dynamic. Unlike standard reports which tend to be static or minimally interactive after they are created, Pentaho Analyzer reports allow you to explore your data dynamically and to drill down into the data to discover previously hidden details.

In this exercise, you will be creating a report that displays the actual versus budgeted expenses by region for each department in the fictitious Steel Wheels company (SampleData).

Follow the instructions below to start creating the Analyzer report.

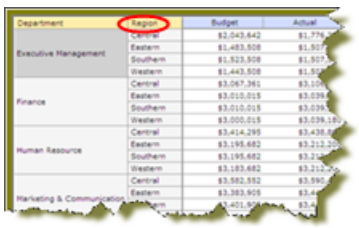
1. In the Pentaho User Console menubar, go to **File** -> **New** and select **Analyzer Report**.
   Pentaho Analyzer opens.
2. Select your **Schema** and **Cube** from the corresponding lists. For the purposes of this exercise, select **SampleData** and **Quadrant Analysis**, respectively.

   Note: The list of available schemas and cubes are provided by your administrator. A **schema** is the structure of the relational database and includes tables, fields, views, and more. A **cube** is a data structure that allows information in a database to be analyzed quickly and from multiple perspectives.
3. In the list of fields, click and drag **Department** to the **Analyzer** workspace in the left pane.
   The **Department** column appears in the workspace.
4. In the list of fields (on the right), click and drag **Department** to the **Analyzer** workspace in the left pane.
   The **Department** column appears in the workspace.
5. Right-click the **Budget** column to display the **Edit Column** dialog box. Select **Column Name and Format** -> **Currency ($)** from the **Format** list so that your values display as dollar amounts. Repeat this step for the **Actual** column.
6. Click and drag the **Region** column to the report. (Read the note below.)

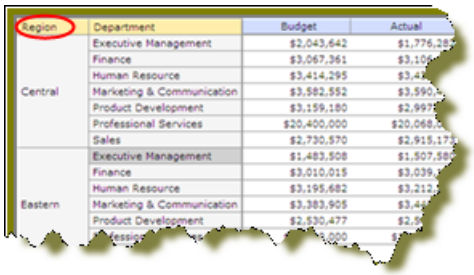
   

   Note: Notice that the **Region** column appears in the workspace; however, you want this column to be the first column in the report.



7. In the workspace, click and drag the **Region** column to the left of the **Department** column.

   Pentaho Analyzer is designed to provide you with great flexibility when designing the visual structure of your report.



8. At this point you have a functioning report and you can view your data in chart form. Click (Switch to Chart Format) to examine your report data in a chart format. The default display is a bar chart but if you click (Choose Chart Type) you can select a different chart type to display your data.

9. Save your report before continuing the exercise. In the Pentaho User Console, click  (Save As). When the **Save As** dialog box appears, save your report as **Regional Expense Report** under `/steel wheels/analysis` and click **OK**.

Adding Query Parameters to Analyzer Reports

You must be logged into the Pentaho User Console, and have an Analyzer report open for editing in order to continue.

Follow the below procedure to parameterize your MDX query in Analyzer.

1. Right-click on the dimension member you want to create a parameter for, and select **Filter** from the context menu.
2. Select the level you want to set as the default parameter value, then click the right arrow to move it to the list on the right.
3. Click the checkbox at the bottom of the window, then type in a name for the parameter in the **Parameter Name** field.
4. Click **OK**.

Your parameter is now created as a filter in Pentaho Analyzer. Whenever this Analyzer report is run, users will have a selection of columns to filter by.

Note: If you create a dashboard with this Analyzer report, then this filter can be used by Dashboard Designer as a parameter as well.

Configuring Drill-Down Links

To create reports based on specific number value data, you can implement drill-down links in Pentaho Analyzer. This will turn all non-calculated number fields into links which, when clicked, bring up a configurable data grid that enables you to quickly view more details for that data point without having to reconfigure your report. Follow the directions below to turn on drill-linking.

Note: Calculated members are unavailable for drill-down at this time.

Note: Drill-down links will not work in reports that have filters that are not being used. If you have any filters in an Analyzer report, they must be used in the report in order to view drill-down links.

1. Open the Analyzer report that you want to add drill links to.
2. Go to the **More** menu in the upper right corner of the report, and select **Set Report Options** from it.
3. Select the **Show drillthrough links on Number cells** checkbox, then click **OK**.

   The number fields in your report will turn into links.
4. Click on a drill-down link to see a data grid that shows all of the available details for that value.
5. To add or remove columns from the grid, click on the down arrow on the right side of any column and select the **Columns** sub-menu. From there you can select which columns you want to appear. You can also sort by ascending or descending values for any column through this menu.

You now have drill-down links for numeric, non-calculated members.

Filtering by Member Properties

If a dimension has a number in parenthesis next to it in the field list, that means that it has **member properties** associated with it. To constrain a dimension by controlling its member properties, follow the instructions below.

1. Open the field layout by clicking **Show Field Layout** button above the grid.

   Depending on how you have them oriented, you will see your selected dimensions in either the **Row Labels** or **Col Headers** fields.
2. Right-click on a dimension in the row label or column header fields, then select **Show Properties** from the context menu.

   A sub-menu with all available member properties will appear.
3. Check or un-check the member property boxes to add or remove them from the report, then click **OK**.

The analyzer report will refresh and show the filter choices you've selected.

Number Formatting

Analyzer can format number fields in a few different ways:

- **Default**: Uses the cell formatter specified in the Mondrian schema
- **General Number**: A number that can be separated by commas and decimal places, but has no sign. Pound symbols represent number places if they exist, and zeroes represent potential holders for places that do not exist. So for a definition of **00#,###.00**, the number 11223.4 would be represented in Analyzer as 011,223.40.
- **Percentage**: A number that can be separated by commas and decimal places, followed by a percent sign. Pound symbols represent number places if they exist, and zeroes represent potential holders for places that do not exist. So for a definition of **00#,###.00%**, the number 11223.4 would be represented in Analyzer as 011,223.40%.
- **Currency**: A number that can be separated by commas and decimal places, preceded by a currency sign. Pound symbols represent number places if they exist, and zeroes represent potential holders for places that do not exist. So for a definition of **$00#,###.00**, the number 11223.4 would be represented in Analyzer as $011,223.40.
- **Expression**: A custom format defined by some user-supplied logic. See *Advanced Conditional Formatting With MDX Expressions* on page 27 for more information.

To change the formatting of a measure, right-click on it in the grid, then select **Column Name and Format...** from the context menu.

Note: Formatting options apply to both the report viewer and exports (PDF, XLS).

Conditional Formatting

Conditional formatting in the Analyzer data grid means that cells will be physically affected by the data they contain. The most common form of conditional formatting is stoplight reporting, where cell backgrounds are colored red, green, or yellow depending on user-defined thresholds. Analyzer offers some simple pre-defined methods of conditionally altering visual cues for numeric data in a variety of formats, and the ability to use a custom MDX expression to implement fine-grained conditions.

Simple Conditional Formatting of Measures

Conditional formatting in the Analyzer data grid means that cells will be physically affected by the data they contain. The most common form of conditional formatting is stoplight reporting, where cell backgrounds are colored red, green, or yellow depending on user-defined thresholds. Analyzer offers some simple pre-defined methods of conditionally formatting numeric data. Follow the directions below to implement conditional cell formatting.

1. Right-click a measure in the grid, then select **Conditional Formatting** from the context menu.
   A sub-menu with conditional formatting types will appear.
2. Select your preferred number format from the list.
   Consult *Conditional Formatting Types* on page 26 for more information on simple conditional formatting types.

The analyzer report will refresh and apply the formatting choice you specified.

Conditional Formatting Types

Indicator Type	Description
Color scale	The background cell color will be shaded according to the value of the cell relative to the highest and lowest recorded values in that measure. There are several color progressions to choose from.
Data bar	The cell background is partially filled with a solid color proportional to the scale of the cell's value relative to the highest and lowest recorded values in that measure.
Trend arrow	An upward or downward arrow is displayed to the right of the cell value depending on whether it is above or

Indicator Type	Description
	below the median value of the selected measure.

Advanced Conditional Formatting With MDX Expressions

If the premade conditional formatting options in Analyzer are not precise enough for your needs, you can apply custom formatting to a measure by using an MDX expression, as explained below.

1. Right-click a measure in the grid, then select **Column Name and Format...** from the context menu.

   The **Edit Column** dialogue will appear.
2. Select **Expression** from the **Format** drop-down list.

   A default MDX expression that prints green or red arrows in cells if their values are greater than or less than zero, respectively, will appear in the **MDX Format Expression** field:

```
Case
When [Measures].CurrentMember > 0
Then '|#,##0|arrow=up'
When [Measures].CurrentMember < 0
Then '|#,##0|arrow=down'
Else '|#,##0'
End
```

3. Modify the expression to suit your needs. Consult *Conditional Formatting Expressions* on page 27 for more information on conditional formatting syntax and options.

   Note: If the MDX expression is invalid, an **invalid report definition** error will appear at the top of the dialogue.
4. Click **OK** to commit the change.

The analyzer report will refresh and apply the formatting choices you specified.

Conditional Formatting Expressions

Valid MDX format strings contain properties that apply special rendering for the HTML pivot tables. A format string follows this syntax:

`|#,###|style = red`

The leading **|** (pipe) tells Analyzer that this format string contains properties. The **#,###** is the measure's value format, which in this example is one number separated from three further places or decimal places by a comma (for instance: 3,667). **style=red** is a key/value pair; all possible keys and values are explained in the table below.

The following properties are supported by Analyzer:

Indicator Type	Description	Values
style	Changes the cell background color.	red, yellow, green
arrow	Shows a trend arrow that points up or down. A value of **none** will not render the arrow; this is useful in situations in which you only want to show one directional arrow instead of two.	up, down, none
link	Creates an HTML link which will open in a new window when clicked in Analyzer.	Any browser-renderable URL
image	Renders a custom image that you specify. This image file must be stored in the `/pentaho-solutions/system/analyzer/resource/image/report/` directory.	An image file name, with extension

Creating a New Analysis View

To create a new analysis view, follow this process.

1. In the **File** menu, select **New Analysis View...**.

This is one of several ways to create a new analysis view; all methods lead to the same screen in the Pentaho User Console.

2. Select the appropriate schema and cube from the drop-down lists.
3. Click **OK** to continue.

   A fresh analysis view will open in a new tab.
4. Click the **+** icons next to each column you want to drill down into.
5. To change the filter, column, and row data, click the **Open OLAP Navigator** button, on the left end of the toolbar.

   The OLAP Navigator will appear above your analysis view.
6. To add a dynamic chart, click the **Chart** button toward the right side of the toolbar.

   A new chart will appear below your analysis view. It will change dynamically according to the drill-down you select.
7. When you're finished exploring your data through an analysis view, you can selecting **Save** from the **File** menu, or by clicking the disk icon in the left side of the toolbar.

You now have an analysis view, which enables you to drill down to the minutest of details stored in your database. Using this analysis view, you can create an interactive dashboard, or share your findings with other Pentaho User Console users.

Using Analysis Cubes in Report Designer

Pentaho Report Designer is typically used with raw data sources, or with databases that have a metadata layer through a tool like Pentaho Metadata Editor. However, you can also use an MDX query to retrieve a data set from a multidimensional database. The sections below explain how to set up a Pentaho Analysis data source and add an MDX query in Pentaho Report Designer.

Note: For more information on Report Designer, consult the Report Designer User Guide in the Pentaho Knowledge Base, or through the **Documentation** link in the **Help** menu in Report Designer.

Adding an OLAP Data Source

You must have a report file open in order to proceed, and your data source must be accessible before you can connect to it in Report Designer. You may need to obtain database connection information from your system administrator, such as the URL, port number, JDBC connection string, database type, and user credentials.

Follow this procedure to add a Pentaho Analysis (Mondrian) data source in Report Designer.

1. Select the **Data** tab in the upper right pane.

   By default, Report Designer starts in the **Structure** tab, which shares a pane with **Data**.
2. Click the yellow cylinder icon in the upper left part of the Data pane, or right-click **Data Sets**.

   A drop-down menu with a list of supported data source types will appear.
3. Select **OLAP** from the drop-down menu, then select one of the following: **Pentaho Analysis**, **Pentaho Analysis (Denormalized)**, or **Pentaho Analysis (Legacy)**.

   The **Mondrian Datasource Editor** window will appear.
4. If you want to provide parameters that contain different Mondrian connection authentication credentials, click the **Edit Security** button in the upper left corner of the window, then type in the fields or variables that contain the user credentials you want to store as a parameter with this connection.

   The role, username, and password will be available as a security parameter when you are creating your report.
5. Click **Browse**, navigate to your Mondrian schema XML file, then click **Open**.
6. Above the **Connections** pane on the left, click the round green **+** icon to add a new data source.

   If you installed the Pentaho sample data, several **SampleData** entries will appear in the list. These sample data sources are useless if you do not have the Pentaho HSQLDB sample database installed, so if you don't have that, you can safely delete the SampleData entries. If you do have Pentaho's HSQLDB samples installed, it may be advantageous to leave the sample data sources intact in the event that you want to view the sample reports and charts at a later time.
7. In the subsequent **Database Connection** dialogue, type in a concise but reasonably descriptive name for this connection in the **Connection Name** field; select your database brand from the **Connection Type** list; select the

access type in the **Access** list at the bottom; then type in your database connection details into the fields in the **Settings** section on the right.

The Access list will change according to the connection type you select; the settings section will change depending on which item in the access list you choose.

8. Click the **Test** button to ensure that the connection settings are correct. If they are not, the ensuing error message should give you some clues as to which settings need to be changed. If the test dialogue says that the connection to the database is OK, then click the **OK** button to complete the data source configuration.

Now that your data source is configured, you must enter an MDX query before you can finish adding the data source. See *Creating an MDX Query* on page 29 for details.

Creating an MDX Query

You must be in the Data Source Configuration window to follow this process. You should also have configured a JNDI data source connection.

Follow this process to add a Mondrian cube definition (multidimensional expression) as a data source.

1. At the bottom of the Data Source Configuration window, click **Use Mondrian Cube Definition (MDX)**.

   The **Browse** button will become active.
2. Click **Browse**, navigate to the location of your cube definition file, click to select it, then click **Open**.
3. Type an MDX query into the **Query** pane on the right.
4. Click **OK**.

Your data source is now properly configured and refined according to the Mondrian definition you specified.

Troubleshooting

Old Analysis Schemas Still Show Up in Pentaho User Console

If you have unwanted analysis schemas in the schema list in the Pentaho User Console -- this is the list that appears when you create a new analysis view or Analyzer report -- then you must edit the `datasources.xml` file and remove the unwanted entries as explained in *Removing Mondrian Data Sources* on page 14.

Mondrian Schema Element Quick Reference

All of the possible Mondrian schema elements are defined in brief below, listed in the hierarchy in which they are used. To see a more detailed definition and a list of possible attributes and content, click on an element name.

Element	Definition
<Schema>	A complete Mondrian schema; a collection of cubes, virtual cubes, shared dimensions, and roles.
<Cube>	A collection of dimensions and measures, all centered on a fact table.
<VirtualCube>	A cube defined by combining the dimensions and measures of one or more cubes. A measure originating from another cube can be a <CalculatedMember>.
<CubeUsages>	Base cubes that are imported into a virtual cube.
<CubeUsage>	Usage of a base cube by a virtual cube.
<VirtualCubeDimension>	Usage of a dimension by a virtual cube.
<VirtualCubeMeasure>	Usage of a measure by a virtual cube.
<Dimension>	Defines a dimension -- a collection of hierarchies.
<DimensionUsage>	Usage of a shared dimension by a cube.
<Hierarchy>	Specifies a predefined drill-down.
<Level>	A level of a hierarchy.
<KeyExpression>	SQL expression used as key of the level, in lieu of a column.
<NameExpression>	SQL expression used to compute the name of a member, in lieu of Level.nameColumn.
<CaptionExpression>	SQL expression used to compute the caption of a member, in lieu of Level.captionColumn.
<OrdinalExpression>	SQL expression used to sort members of a level, in lieu of Level.ordinalColumn.
<ParentExpression>	SQL expression used to compute a measure, in lieu of Level.parentColumn.
<Property>	A member property. The definition is contained in a hierarchy or level, but the property will be available to all members.
<PropertyExpression>	SQL expression used to compute the value of a property, in lieu of Property.column.
<Measure>	Specifies an aggregated numeric value.
<CalculatedMember>	A member whose value is derived using a formula, defined as part of a cube.
<NamedSet>	A set whose value is derived using a formula, defined as part of a cube.
<Table>	A fact or dimension table.
<View>	Defines a table by using an SQL query, which can have different variants for different underlying databases.

Element	Definition
<Join>	Defines a table by joining a set of queries.
<InlineTable>	Defines a table using an inline dataset.
<Closure>	Maps a parent-child hierarchy onto a closure table.
<AggExclude>	Exclude a candidate aggregate table by name or pattern matching.
<AggName>	Declares an aggregate table to be matched by name.
<AggPattern>	Declares a set of aggregate tables by regular expression pattern.
<AggFactCount>	Specifies name of the column in the candidate aggregate table which contains the number of fact table rows.
<AggIgnoreColumn>	Tells Mondrian to ignore a column in an aggregate table.
<AggForeignKey>	Maps a foreign key in the fact table to a foreign key column in the candidate aggregate table.
<AggMeasure>	Maps a measure to a column in the candidate aggregate table.
<AggLevel>	Maps a level to a column in the candidate aggregate table.
<Role>	An access-control profile.
<SchemaGrant>	A set of rights to a schema.
<CubeGrant>	A set of rights to a cube.
<HierarchyGrant>	A set of rights to both a hierarchy and levels within that hierarchy.
<MemberGrant>	A set of rights to a member and its children.
<Union>	Definition of a set of rights as the union of a set of roles.
<RoleUsage>	A reference to a role.
<UserDefinedFunction>	Imports a user-defined function.
<Parameter>	Part of the definition of a hierarchy; passed to a MemberReader, if present.
<CalculatedMemberProperty>	Property of a calculated member.
<Formula>	Holds the formula text within a <NamedSet> or <CalculatedMember>.
<ColumnDefs>	Holder for <ColumnDef> elements.
<ColumnDef>	Definition of a column in an <InlineTable> dataset.
<Rows>	Holder for <Row> elements.
<Row>	Row in an <InlineTable> dataset.
<Value>	Value of a column in an <InlineTable> dataset.
<MeasureExpression>	SQL expression used to compute a measure, in lieu of Measure.column.
<SQL>	The SQL expression for a particular database dialect.

AggExclude

This element excludes a candidate aggregate table via name or pattern matching.

Attributes

Attribute	Data type	Definition
pattern	String	A Table pattern not to be matched.
name	String	The Table name not to be matched.
ignorecase	Boolean	Whether or not the match should ignore case.

AggFactCount

Specifies name of the column in the candidate aggregate table which contains the number of fact table rows.

Attributes

Attribute	Data type	Definition
N/A	N/A	N/A

AggForeignKey

Maps foreign key in the fact table to a foreign key column in the candidate aggregate table.

Attributes

Attribute	Data type	Definition
factColumn	String	The name of the base fact table foreign key.
aggColumn	String	The name of the aggregate table foreign key.

AggIgnoreColumn

Tells Mondrian to ignore a column in an aggregate table.

Attributes

Attribute	Data type	Definition
N/A	N/A	N/A

AggLevel

Maps a level to a column in the candidate aggregate table.

Attributes

Attribute	Data type	Definition
column	String	The name of the column mapping to the level name.
name	String	The name of the Dimension Hierarchy level.

AggMeasure

Maps a measure to a column in the candidate aggregate table.

Attributes

Attribute	Data type	Definition
column	String	The name of the column mapping to the measure name.
name	String	The name of the Cube measure.

AggName

Declares an aggregate table to be matched by name.

Attributes

Attribute	Data type	Definition
name	String	The table name of a specific aggregate table.

AggPattern

Declares a set of aggregate tables by regular expression pattern.

Attributes

Attribute	Data type	Definition
pattern	String	A Table pattern used to define a set of aggregate tables.

Constituent elements

Element	Definition
AggExclude	

AggTable

A definition of an aggregate table for a base fact table. This aggregate table must be in the same schema as the base fact table.

Attributes

Attribute	Data type	Definition
ignorecase	Boolean	Whether or not the match should ignore case.

Constituent elements

Element	Definition
AggFactCount	Describes what the fact_count column looks like.
AggIgnoreColumn	
AggForeignKey	
AggMeasure	
AggLevel	

CalculatedMember

A member whose value is derived using a formula, defined as part of a cube.

Attributes

Attribute	Data type	Definition
name	String	Name of this calculated member.
formatString	String	Format string with which to format cells of this member. For more details, see {@link mondrian.util.Format}.
caption	String	A string being displayed instead of the name. Can be localized from Properties file using #{propertyname}.
formula	String	MDX expression which gives the value of this member. Equivalent to the Formula sub-element.
dimension	String	Name of the dimension which this member belongs to.
visible	Boolean	Whether this member is visible in the user-interface. Default true.

Constituent elements

Element	Definition
Formula	MDX expression which gives the value of this member.
CalculatedMemberProperty	

CalculatedMemberProperty

Property of a calculated member defined against a cube. It must have either an expression or a value.

Attributes

Attribute	Data type	Definition
name	String	Name of this member property.
caption	String	A string being displayed instead of the Properties's name. Can be localized from Properties file using #{propertyname}.
expression	String	MDX expression which defines the value of this property. If the expression is a constant string, you could enclose it in quotes, or just specify the 'value' attribute instead.
value	String	Value of this property. If the value is not constant, specify the 'expression' attribute instead.

CaptionExpression

SQL expression used to compute the caption of a member, in lieu of **Level.captionColumn**.

Attributes

Attribute	Data type	Definition
N/A	N/A	N/A

Closure

Specifies the transitive closure of a parent-child hierarchy. Optional, but recommended for better performance. The closure is provided as a set of (parent/child) pairs: since it is the transitive closure these are actually (ancestor/descendant) pairs.

Attributes

Attribute	Data type	Definition
parentColumn	String	The parent column
childColumn	String	The child column

Constituent elements

Element	Definition
Table	

ColumnDef

Column definition for an inline table.

Attributes

Attribute	Data type	Definition
name	String	Name of the column.
type	String	Type of the column: String, Numeric, Integer, Boolean, Date, Time or Timestamp.

ColumnDefs

Holder for an array of ColumnDef elements.

Constituent elements

Element	Definition
ColumnDef	The columns to include in the array

Cube

A cube is a collection of dimensions and measures, all centered on a fact table.

Attributes

Attribute	Data type	Definition
name	String	Name of this cube.
caption	String	A string being displayed instead of the cube's name. Can be localized from Properties file using #{propertyname}.
defaultMeasure	String	The name of the measure that would be taken as the default measure of the cube.
cache	Boolean	Should the Fact table data for this Cube be cached by Mondrian or not. The default action is to cache the data.

Attribute	Data type	Definition
enabled	Boolean	Whether element is enabled - if true, then the Cube is realized otherwise it is ignored.

Constituent elements

Element	Definition
Relation (as *<Table>*, *<View>*, or *<InlineTable>*)	The fact table is the source of all measures in this cube. If this is a Table and the schema name is not present, table name is left unqualified.
CubeDimension	
Measure	
CalculatedMember	Calculated members in this cube.
NamedSet	Named sets in this cube.

CubeGrant

Grants (or denies) this role access to a cube. access may be "all" or "none".

Attributes

Attribute	Data type	Definition
cube	String	The unique name of the cube

Constituent elements

Element	Definition
DimensionGrant	
HierarchyGrant	

CubeUsage

Usage of a base cube by a virtual cube.

Attributes

Attribute	Data type	Definition
cubeName	String	Name of the cube which the virtualCube uses.
ignoreUnrelatedDimensions	Boolean	Unrelated dimensions to measures in this cube will be pushed to top level member.

CubeUsages

List of base cubes used by the virtual cube.

Constituent elements

Element	Definition
CubeUsage	

Dimension

A Dimension is a collection of hierarchies. There are two kinds: a public dimension belongs to a Schema, and be used by several cubes; a private dimension belongs to a Cube. The foreignKey field is only applicable to private dimensions.

Attributes

Attribute	Data type	Definition
name	String	The name of this dimension.
type	String	The dimension's type may be one of "Standard" or "Time". A time dimension will allow the use of the MDX time functions (WTD, YTD, QTD, etc.). Use a standard dimension if the dimension is not a time-related dimension. The default value is "Standard".
caption	String	A string being displayed instead of the dimensions's name. Can be localized from Properties file using #{propertyname}.
usagePrefix	String	If present, then this is prepended to the Dimension column names during the building of collapse dimension aggregates allowing 1) different dimensions to be disambiguated during aggregate table recognition. This should only be set for private dimensions.

Constituent elements

Element	Definition
Hierarchy	The hierarchies (pre-defined drill-downs) for this dimension.

DimensionGrant

Grants (or denies) this role access to a dimension. access may be "all" or "none". Note that a role is implicitly given access to a dimension when it is given acess to a cube. See also the "all_dimensions" option of the "SchemaGrant" element.

Attributes

Attribute	Data type	Definition
dimension	String	The unique name of the dimension

DimensionUsage

A DimensionUsage is usage of a shared Dimension within the context of a cube.

Attributes

Attribute	Data type	Definition
source	String	Name of the source dimension. Must be a dimension in this schema. Case-sensitive.

Attribute	Data type	Definition
level	String	Name of the level to join to. If not specified, joins to the lowest level of the dimension.
usagePrefix	String	If present, then this is prepended to the Dimension column names during the building of collapse dimension aggregates allowing 1) different dimension usages to be disambiguated during aggregate table recognition and 2) multiple shared dimensions that have common column names to be disambiguated.

Formula

Holds the formula text within a <NamedSet> or <CalculatedMember>.

Attributes

Attribute	Data type	Definition
N/A	N/A	N/A

Hierarchy

Defines a hierarchy, which is a pre-defined drill-down.

Note: You must specify at most one <Relation> or memberReaderClass. If you specify none, the hierarchy is assumed to come from the same fact table of the current cube.

Attributes

Attribute	Data type	Definition
name	String	Name of the hierarchy. If this is not specified, the hierarchy has the same name as its dimension.
hasAll	Boolean	Whether this hierarchy has an 'all' member.
allMemberName	String	Name of the 'all' member. If this attribute is not specified, the all member is named 'All hierarchyName', for example, 'All Store'.
allMemberCaption	String	A string being displayed instead as the all member's name. Can be localized from Properties file using #{propertyname}.
allLevelName	String	Name of the 'all' level. If this attribute is not specified, the all member is named '(All)'. Can be localized from Properties file using #{propertyname}.
primaryKey	String	The name of the column which identifies members, and which is referenced by rows in the fact table. If not specified, the key of the lowest level is used. See also CubeDimension.foreignKey.

Attribute	Data type	Definition
primaryKeyTable	String	The name of the table which contains primaryKey. If the hierarchy has only one table, defaults to that; it is required.
defaultMember	String	
memberReaderClass	String	Name of the custom member reader class. Must implement the mondrian.rolap.MemberReader interface.
caption	String	A string to be displayed in the user interface. If not specified, the hierarchy's name is used. Can be localized from Properties file using #{propertyname}.

Constituent elements

Element	Definition
RelationOrJoin (as *<Table>*, *<View>*, *<Join>*, or *<InlineTable>*)	The Table, Join, View, or Inline Table that populates this hierarchy.
Level	

HierarchyGrant

Grants (or denies) this role access to a hierarchy. access may be "all", "custom" or "none". If access is "custom", you may also specify the attributes topLevel, bottomLevel, and the member grants.

Attributes

Attribute	Data type	Definition
hierarchy	String	The unique name of the hierarchy
topLevel	String	Unique name of the highest level of the hierarchy from which this role is allowed to see members. May only be specified if the HierarchyGrant.access is "custom". If not specified, role can see members up to the top level.
bottomLevel	String	Unique name of the lowest level of the hierarchy from which this role is allowed to see members. May only be specified if the HierarchyGrant.access is "custom". If not specified, role can see members down to the leaf level.
rollupPolicy	String	Policy which determines how cell values are calculated if not all of the children of the current cell are visible to the current role. Allowable values are 'full' (the default), 'partial', and 'hidden'.

Constituent elements

Element	Definition
MemberGrant	

InlineTable

Defines a table using an inline dataset.

Attributes

Attribute	Data type	Definition
alias	String	Alias to be used with this table when it is used to form queries. If not specified, defaults to the table name, but in any case, must be unique within the schema. (You can use the same table in different hierarchies, but it must have different aliases.)

Constituent elements

Element	Definition
ColumnDefs	
Rows	

Join

Defines a 'table' by joining a set of queries.

Attributes

Attribute	Data type	Definition
leftAlias	String	Defaults to left's alias if left is a table, otherwise required.
leftKey	String	
rightAlias	String	Defaults to right's alias if right is a table, otherwise required.
rightKey	String	

Constituent elements

Element	Definition
RelationOrJoin (as *<Table>*, *<View>*, *<Join>*, or *<InlineTable>*)	There must be two defined; a **left**, and a **right**

KeyExpression

SQL expression used as key of the level, in lieu of a column.

Attributes

Attribute	Data type	Definition
N/A	N/A	N/A

Level

Level of a hierarchy.

Attributes

Attribute	Data type	Definition
approxRowCount	String	The estimated number of members in this level. Setting this property improves the performance of MDSCHEMA_LEVELS,

Attribute	Data type	Definition
		MDSCHEMA_HIERARCHIES and MDSCHEMA_DIMENSIONS XMLA requests
name	String	
table	String	The name of the table that the column comes from. If this hierarchy is based upon just one table, defaults to the name of that table; otherwise, it is required. Can be localized from Properties file using #{propertyname}.
column	String	The name of the column which holds the unique identifier of this level.
nameColumn	String	The name of the column which holds the user identifier of this level.
ordinalColumn	String	The name of the column which holds member ordinals. If this column is not specified, the key column is used for ordering.
parentColumn	String	The name of the column which references the parent member in a parent-child hierarchy.
nullParentValue	String	Value which identifies null parents in a parent-child hierarchy. Typical values are 'NULL' and '0'.
type	String	Indicates the type of this level's key column: String, Numeric, Integer, Boolean, Date, Time or Timestamp. When generating SQL statements, Mondrian encloses values for String columns in quotation marks, but leaves values for Integer and Numeric columns un-quoted. Date, Time, and Timestamp values are quoted according to the SQL dialect. For a SQL-compliant dialect, the values appear prefixed by their typename, for example, "DATE '2006-06-01'".
uniqueMembers	Boolean	Whether members are unique across all parents. For example, zipcodes are unique across all states. The first level's members are always unique.
levelType	String	Whether this is a regular or a time-related level. The value makes a difference to time-related functions such as YTD (year-to-date).
hideMemberIf	String	Condition which determines whether a member of this level is hidden. If a hierarchy has one or more levels with hidden members, then it is possible that not all leaf members are the same distance from the root, and it is termed a ragged hierarchy.
formatter	String	Name of a formatter class for the member labels being displayed. The class must implement the mondrian.olap.MemberFormatter interface. Allowable values are: Never (a member always appears; the default); IfBlankName (a member

Attribute	Data type	Definition
		doesn't appear if its name is null or empty); and IfParentsName (a member appears unless its name matches the parent's.
caption	String	A string being displayed instead of the level's name. Can be localized from Properties file using #{propertyname}.
captionColumn	String	The name of the column which holds the caption for members.

Constituent elements

Element	Definition
KeyExpression	The SQL expression used to populate this level's key.
NameExpression	The SQL expression used to populate this level's name. If not specified, the level's key is used.
OrdinalExpression	The SQL expression used to populate this level's ordinal.
ParentExpression	The SQL expression used to join to the parent member in a parent-child hierarchy.
Closure	
Property	

Measure

A measure is an aggregated numeric value. Typically it is a sum of selected numbers in a column, or a count of the number of items in a list.

Attributes

Attribute	Data type	Definition
name	String	Name of this measure.
column	String	Column which is source of this measure's values. If not specified, a measure expression must be specified.
datatype	String	The datatype of this measure: String, Numeric, Integer, Boolean, Date, Time or Timestamp. The default datatype of a measure is 'Integer' if the measure's aggregator is 'Count', otherwise it is 'Numeric'.
formatString	String	Format string with which to format cells of this measure. For more details, see the mondrian.util.Format class.
aggregator	String	Aggregation function. Allowed values are "sum", "count", "min", "max", "avg", and "distinct-count". ("distinct count" is allowed for backwards compatibility, but is deprecated because XML enumerated attributes in a DTD cannot legally contain spaces.)
formatter	String	Name of a formatter class for the appropriate cell being displayed.

Attribute	Data type	Definition
		The class must implement the mondrian.olap.CellFormatter interface.
caption	String	A string being displayed instead of the name. Can be localized from Properties file using #{propertyname}.
visible	Boolean	Whether this member is visible in the user-interface. Default true.

Constituent elements

Element	Definition
MeasureExpression	The SQL expression used to calculate a measure. Must be specified if a source column is not specified.
CalculatedMemberProperty	

MeasureExpression

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

MemberGrant

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

NamedSet

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

NameExpression

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

OrdinalExpression

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

Parameter

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

ParentExpression

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition

Constituent elements

Element	Definition

Property

Member property that enables you to create subcategories for levels and hierarchies.

Attributes

Attribute	Data type	Definition
name	String	The display name of this property.
column	String	The data column that will determine this subcategory's content.
type	String	Data type of this property: String, Numeric, Integer, Boolean, Date, Time or Timestamp.
formatter	String	Name of a formatter class for the appropriate property value being displayed. The class must implement the mondrian.olap.PropertyFormatter interface.
caption	String	A string being displayed instead of the name. Can be localized from Properties file using #{propertyname}.

PropertyExpression

SQL expression used to compute the value of a property, in lieu of Property.column.

Attributes

Attribute	Data type	Definition
N/A	N/A	N/A

Role

A role defines an access-control profile. It has a series of grants (or denials) for schema elements.

Attributes

Attribute	Data type	Definition
name	String	The name of this role

Constituent elements

Element	Definition
SchemaGrant	
Union	

RoleUsage

Usage of a Role in a union Role.

Attributes

Attribute	Data type	Definition
roleName	String	The name of the role

Row

Row definition for an inline table. Must have one Column for each ColumnDef in the InlineTable.

Constituent elements

Element	Definition
Value	

Rows

Holder for an array of Row elements

Constituent elements

Element	Definition
Row	

Schema

A schema is a collection of cubes and virtual cubes. It can also contain shared dimensions (for use by those cubes), named sets, roles, and declarations of user-defined functions.

Attributes

Attribute	Data type	Definition
name	String	Name of this schema
measuresCaption	String	Label for the measures dimension. Can be localized from Properties file using #{propertyname}.
defaultRole	String	The name of the default role for connections to this schema

Constituent elements

Element	Definition
Parameter	This schema's parameter definitions.
Dimension	Shared dimensions in this schema.
Cube	Cubes in this schema.
VirtualCube	Virtual cubes in this schema.
NamedSet	Named sets in this schema.
Role	Roles in this schema.
UserDefinedFunction	Declarations of user-defined functions in this schema.

SchemaGrant

Grants (or denies) this role access to this schema. access may be "all", "all_dimensions", or "none". If access is "all_dimensions", the role has access to all dimensions but still needs explicit access to cubes.

Constituent elements

Element	Definition
CubeGrant	

SQL

The SQL expression for a particular database dialect.

Attributes

Attribute	Data type	Definition
dialect	String	Dialect of SQL the view is intended for. Valid values include, but are not limited to: • generic • access • db2 • derby • firebird • hsqldb • mssql • mysql • oracle • postgres • sybase • teradata • ingres • infobright • luciddb

Table

A fact or dimension table.

Attributes

Attribute	Data type	Definition
name	String	The name of the table
schema	String	Optional qualifier for table.
alias	String	Alias to be used with this table when it is used to form queries. If not specified, defaults to the table name, but in any case, must be unique within the schema. (You can use the same table in different hierarchies, but it must have different aliases.)

Constituent elements

Element	Definition
SQL	The SQL WHERE clause expression to be appended to any select statement
AggExclude	
AggTable	

Union

Body of a Role definition which defines a Role to be the union of several Roles. The RoleUsage elements must refer to Roles that have been declared earlier in this schema file.

Constituent elements

Element	Definition
RoleUsage	

UserDefinedFunction

A UserDefinedFunction is a function which extends the MDX language. It must be implemented by a Java class which implements the interface mondrian.spi.UserDefinedFunction.

Attributes

Attribute	Data type	Definition
name	String	Name with which the user-defined function will be referenced in MDX expressions.
className	String	Name of the class which implemenets this user-defined function. Must implement the mondrian.spi.UserDefinedFunction interface.

Value

Column value for an inline table. The CDATA holds the value of the column.

Attributes

Attribute	Data type	Definition
column	String	Name of the column.

View

Defines a 'table' using a SQL query, which can have different variants for different underlying databases.

Attributes

Attribute	Data type	Definition
alias	String	

Constituent elements

Element	Definition
SQL	

VirtualCube

A cube defined by combining the dimensions and measures of one or more cubes. A measure originating from another cube can be a <CalculatedMember>.

Attributes

Attribute	Data type	Definition
enabled	Boolean	Whether this element is enabled - if true, then the Virtual Cube is realized otherwise it is ignored.
name	String	
defaultMeasure	String	The name of the measure that would be taken as the default measure of the cube.
caption	String	A string being displayed instead of the cube's name. Can be localized from Properties file using #{propertyname}.

Constituent elements

Element	Definition
CubeUsages	
VirtualCubeDimension	
VirtualCubeMeasure	
CalculatedMember	Calculated members that belong to this virtual cube. (Calculated members inherited from other cubes should not be in this list.)
NamedSet	Named sets in this cube.

VirtualCubeDimension

A VirtualCubeDimension is a usage of a Dimension in a VirtualCube.

Attributes

Attribute	Data type	Definition
cubeName	String	Name of the cube which the dimension belongs to, or unspecified if the dimension is shared.
name	String	Name of the dimension.

VirtualCubeMeasure

A VirtualCubeMeasure is a usage of a Measure in a VirtualCube.

Attributes

Attribute	Data type	Definition
cubeName	String	Name of the cube which the measure belongs to.
name	String	Unique name of the measure within its cube.
visible	Boolean	Whether this member is visible in the user-interface. Default true.