BI-Tools Frontend:
Online Analytic Processing OLAP

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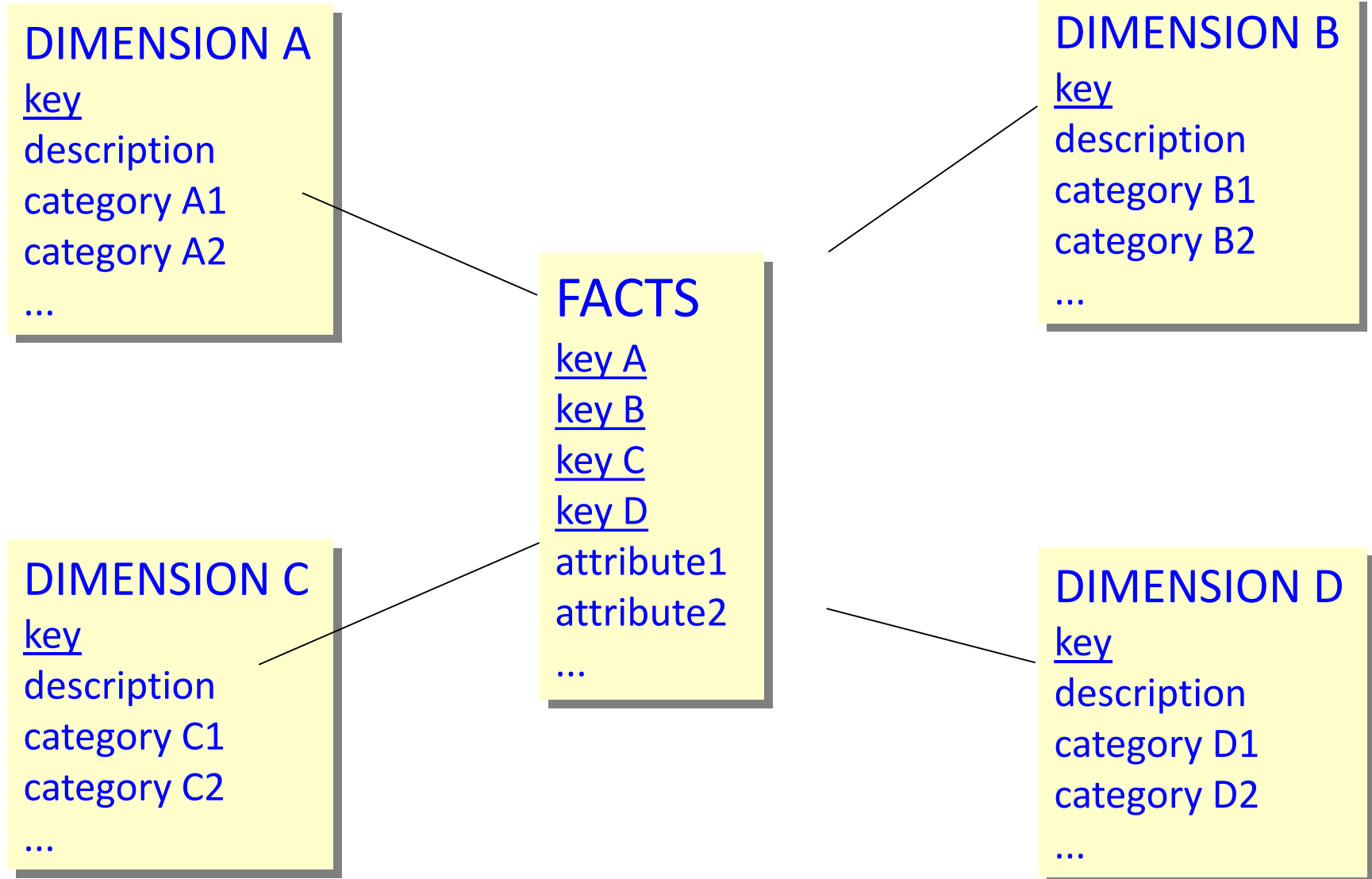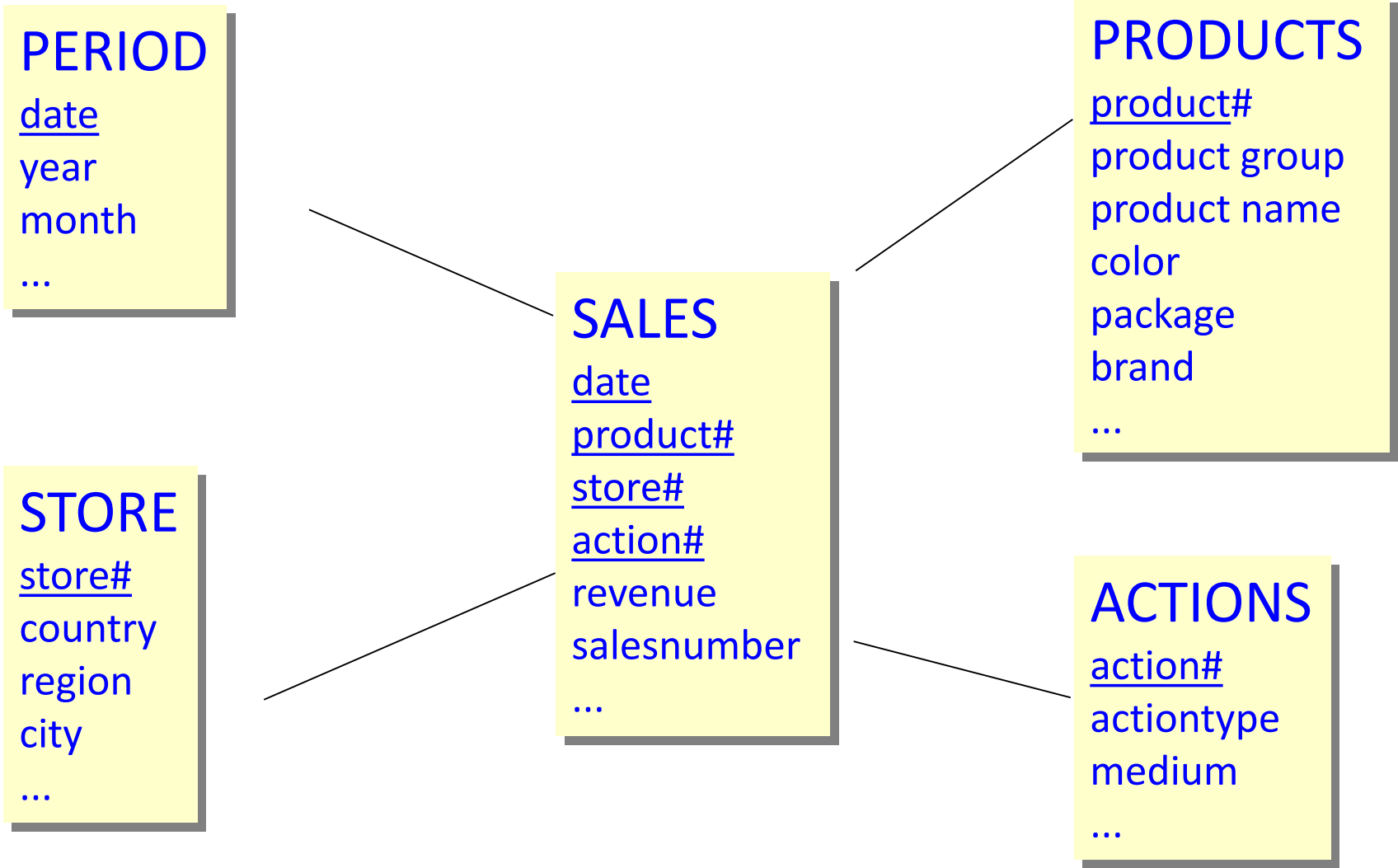# Star Schema for Relational Data Warehouses /Marts to support OLAP
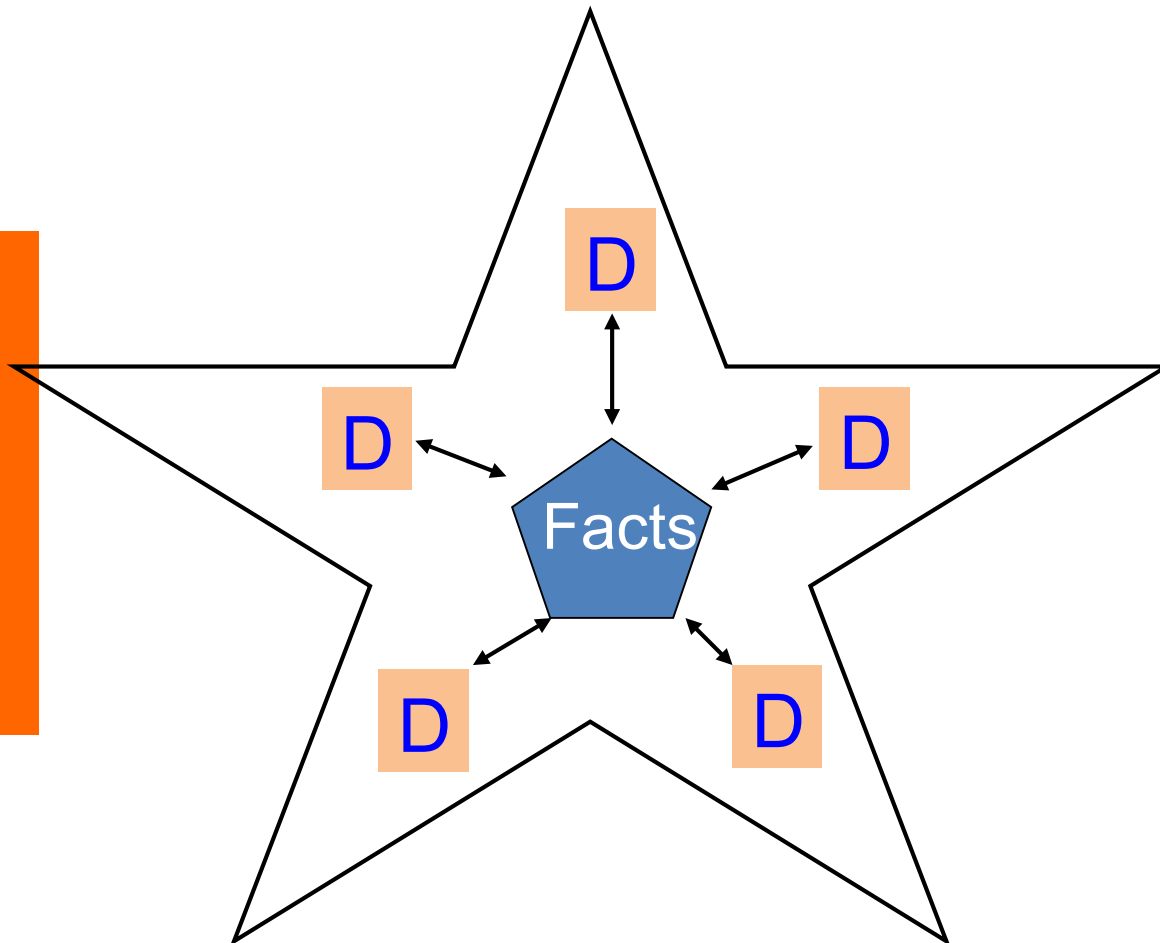
Star Schema:

logical database schema, which places dimension tables of a relational database aroung a fact table for easy querying

Maping of multidimensional data to two-dimensional tables.

Star Schema

DIMENSION A
key
description
category A1
category A2
...

DIMENSION B
key
description
category B1
category B2
...

FACTS
key A
key B
key C
key D
attribute1
attribute2
...

DIMENSION C
key
description
category C1
category C2
...

DIMENSION D
key
description
category D1
category D2
...

Example of a Start Schema for Retail

PERIOD
date
year
month
...

PRODUCTS
product#
product group
product name
color
package
brand
...

SALES
date
product#
store#
action#
revenue
salesnumber
...

STORE
store#
country
region
city
...

ACTIONS
action#
actiontype
medium
...

SALES: Key from the four foreign keys give 1:n relation to dimension tables

# MULTIDIMENSIONAL ANALYSIS: OLAP

Dicing and Slicing
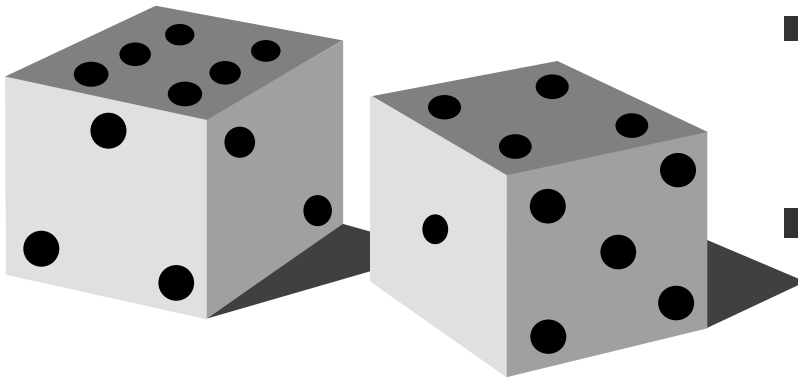
- An OLAP cube can be regarded as a multidimensional cube

- From a cube only two dimensions are visible on a two-dimensional interfact (e.g. as a table)

- Slicing
  - ♦ Contraining one dimension

- Dicing
  - ♦ Constraining several dimensions

- Pivoting
  - ♦ "turning" the cube to show other dimension

- Roll-up/Drill-down – Split/Merge

  - Aggregate or detailing views

OLAP Operation - Slicing

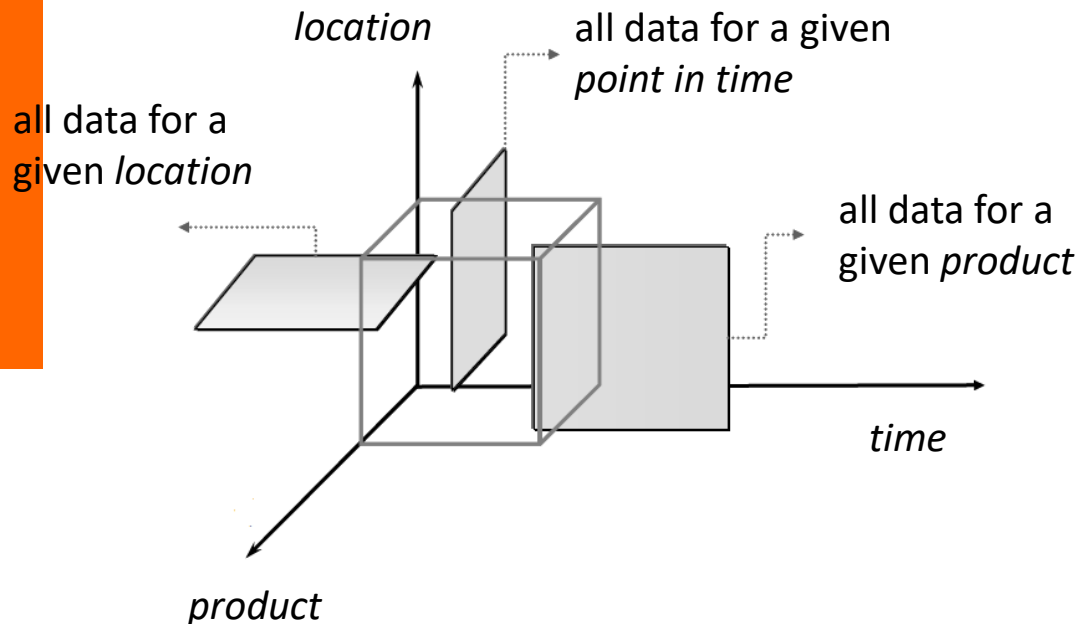Reduction of the dimensions in a multi-dimentional cube

- Constraining one dimension to a particular value

Example: Constraining time
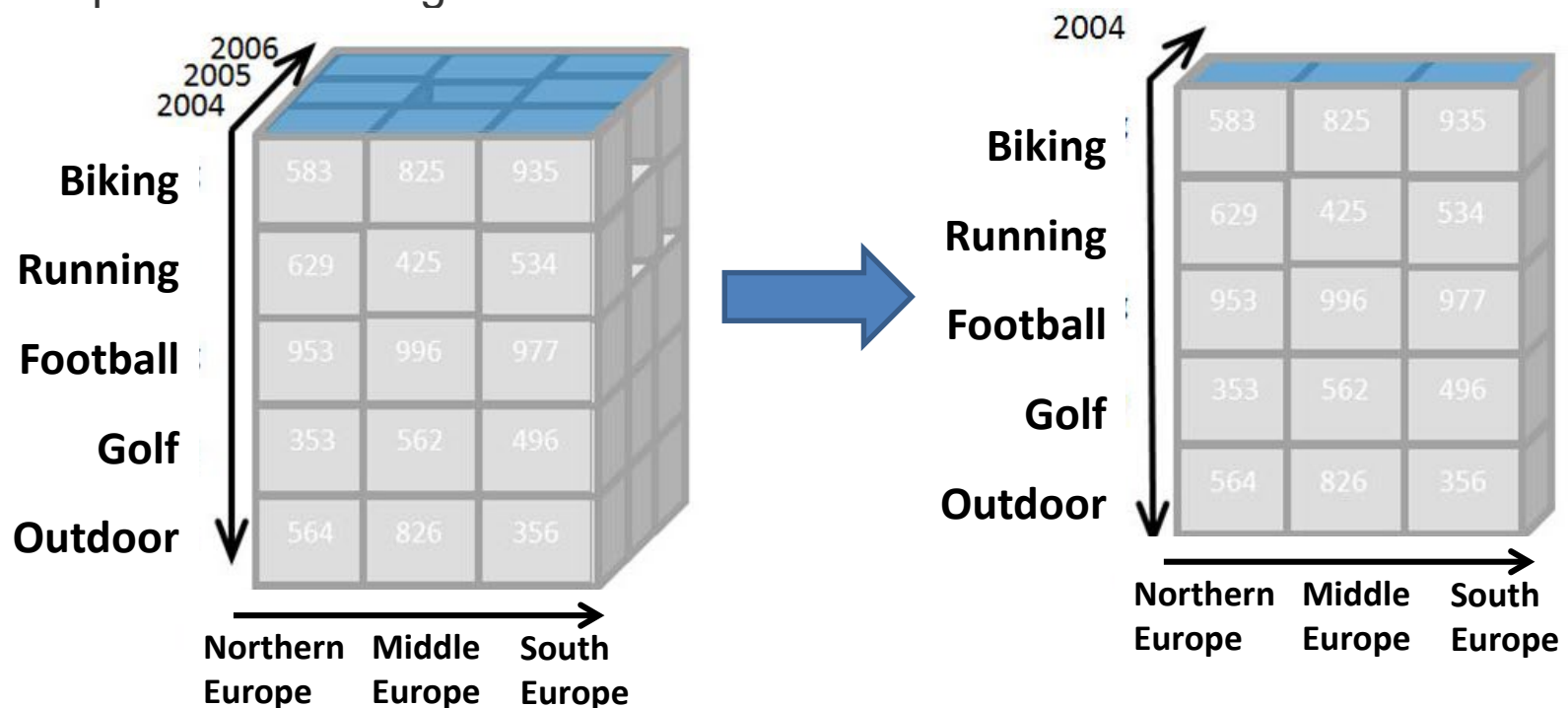
OLAP Operation – Slicing

■ **Slicing** is selecting a group of cells from the entire cube by constraining one dimension to *a particular value*.

	Date	
	⊞ Q3	⊞ Q4
Product	● Revenue	● Revenue
⊟ All Products	8.925,00	34.925,00
⊞ accessories	1.810,00	3.150,00
⊞ mountain bikes	7.115,00	31.775,00

slice: Country = Austria

	Date	
	⊞ Q3	⊞ Q4
Product	● Revenue	● Revenue
⊟ All Products	215,00	7.230,00
⊞ accessories	215,00	170,00
⊞ mountain bikes		7.060,00

Slicer: [Country=Austria]

location

all data for a given *point in time*

all data for a given *location*

all data for a given *product*

time

product

Layers as Additional Dimensions

- **Layers**:
  - ♦ Showing 3 (instead of only 2) dimensions
  - ♦ For each value of the third dimions an additional layer (Drag and Drop Fiscal Year to the layer symbol)

- Example
  - ♦ Showing Branch and Country of HQ
  - ♦ Slicing: Change to a different Fiscal Year
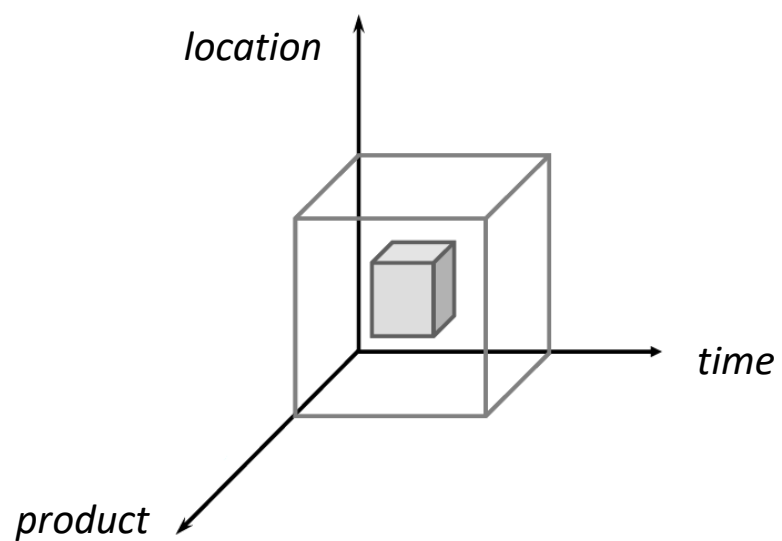
OLAP Operation - Dicing

Slicing in several dimensions

♦ Creating a smaller cube , showing only part of the cube
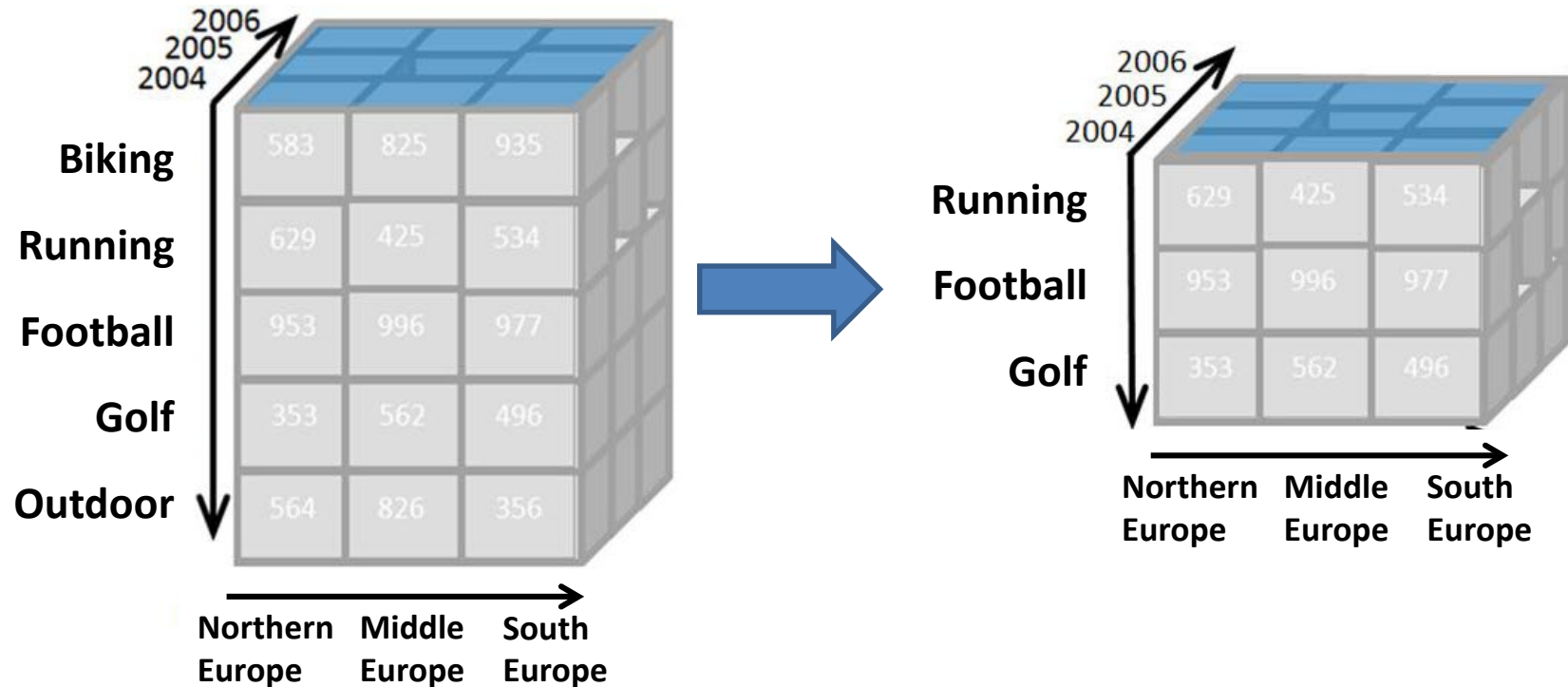
OLAP Operations – Dicing

- **Dicing** involves selecting a subset of cells by specifying a *range of attribute values for more than one dimension*.

	Date	
	⊞ Q3	⊞ Q4
Product	● Revenue	● Revenue
⊟ All Products	8.925,00	34.925,00
⊞ accessories	1.810,00	3.150,00
⊞ mountain bikes	7.115,00	31.775,00

dice: month = {September, October}
products = {SB123, SB234}

	Date	
	⊞ September	⊞ October
Product	● Revenue	● Revenue
Mountain Bike SB123	2.300,00	13.800,00
Mountain Bike SB234	1.765,00	8.825,00

location

time

product
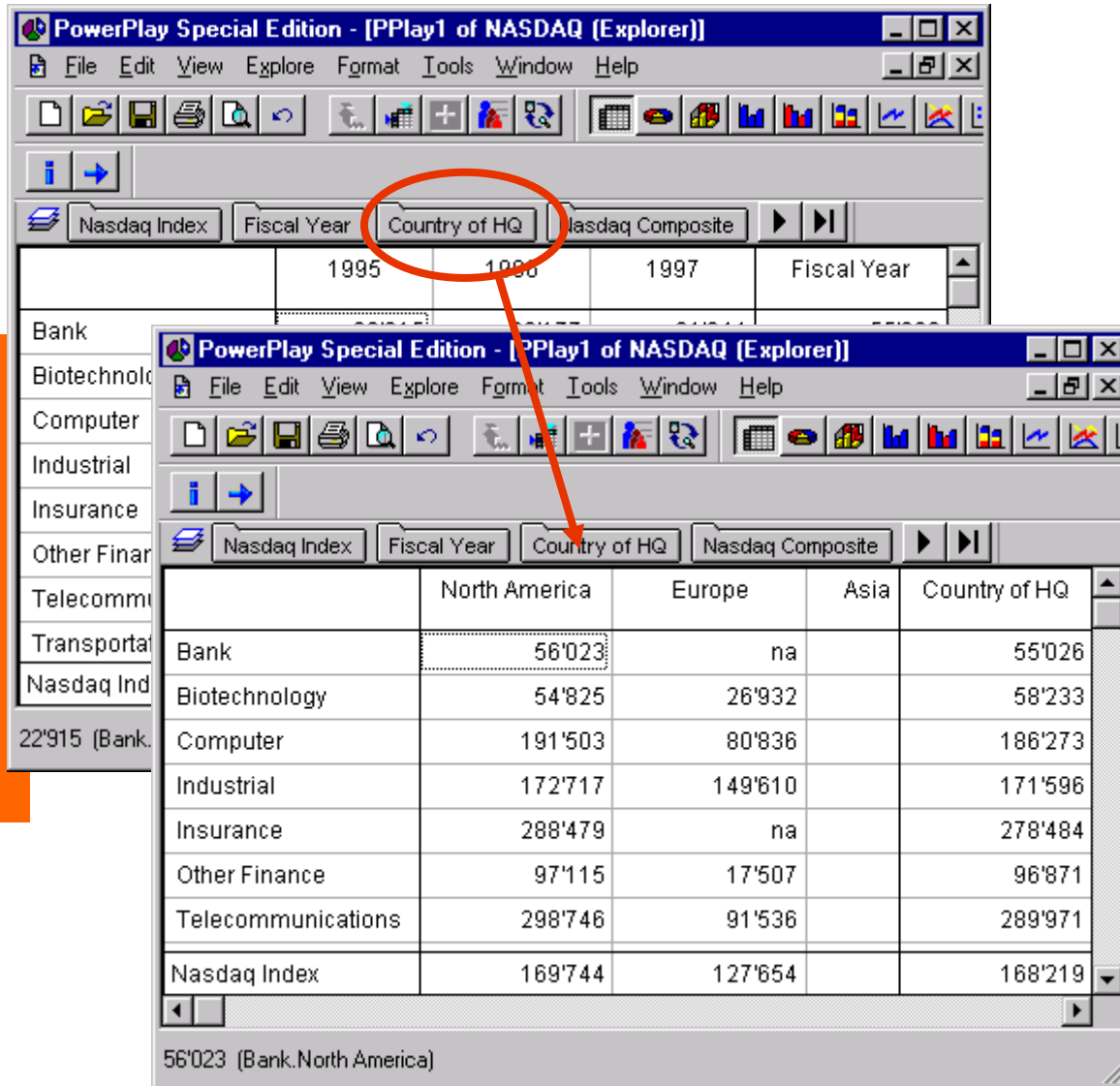
OLAP Operation - Pivoting

Rotating the cube to show other dimensions

OLAP Operation - Pivoting

- Selection of dimensions

- Drag and Drop a dimension of the horizontal line to the window

- Example: Drag and Drop the dimension Country of HQ in the column headers and thus exchange Fiscal Year

OLAP Operations – roll-up/drill-down

■ Attribute values often have a hierarchical structure.

- ♦ e.g. products can be organised into product categories

- ♦ For sales quantities, we can aggregate (**roll up**) the expenses across all the products in a group.

- ♦ Conversely, we could split the total quantities (**drill down**) into ones for each product in the group

screenshots taken from Pentaho CE)

OLAP Operation – split/merge

■ **Split** = show details for a value by *adding a dimension*

  ♦ e.g. split sales by region

■ **Merge** = remove a dimension such that data is aggregated for that dimension

Product	Date Q3 Revenue	Q4 Revenue
All Products	8.925,00	34.925,00
accessories	1.810,00	3.150,00
mountain bikes	7.115,00	31.775,00

Product	Q3 All Store.Store names Revenue	Q3 Austria Revenue	Q3 Germany Revenue	Q3 Switzerland Revenue	Q4 All Store.Store names Revenue	Q4 Austria Revenue	Q4 Germany Revenue	Q4 Switzerland Revenue
All Products	8.925,00	215,00	90,00	8.620,00	34.925,00	7.230,00	2.730,00	24.965,00
accessories	1.810,00	215,00	90,00	1.505,00	3.150,00	170,00	430,00	2.550,00
mountain bikes	7.115,00			7.115,00	31.775,00	7.060,00	2.300,00	22.415,00

OLAP beyond the cube – drill-through

- **Drill-through** = enable viewing the original data (e.g. transactions) by changing to another data source or showing all relevant fact table rows

	Date	
	⊞ Q3	⊞ Q4
Product	● Revenue	● Revenue
⊟ All Products	8.925,00	34.925,00
⊞ accessories	1.810,00	3.150,00
⊞ mountain bikes	7.115,00	31.775,00

Ⓔ **Drill Through Table for revenue**

▲ year	● quarter	● month	● date	● product_category	● product_name	● country	● province	● store_name	● brand	● revenue
2013	Q3	September	28.09.2013	mountain bikes	Mountain Bike SB123	Switzerland	Bern	Store Bern	Swiss Bikes	2.300,00
2013	Q3	September	28.09.2013	mountain bikes	Mountain Bike SB234	Switzerland	Solothurn	Store Solothurn	Swiss Bikes	1.765,00
2013	Q3	September	29.09.2013	mountain bikes	Mountain Bike SB345	Switzerland	Bern	Store Bern	Swiss Bikes	3.050,00

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