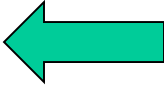


Lecture No. 13 – OLAP and Big Data

- BI and OLAP 
- The Data Warehouse Architecture
- Multidimensional Analysis
- OLAP Server Architectures
- From data warehousing to big data

Source: Marut Buranarach

Business Intelligence (BI) and OLAP (On-Line Analytical Processing)

- OLAP and Data Mining differ in what they offer the user
 - Complementary technologies
 - Online Analytical Processing (OLAP)
 - “top-down” analysis
 - Data Mining
 - “bottom-up” analysis
- Data warehouse (or data marts) together with tools such as OLAP and /or data mining are referred to as **Business Intelligence (BI) technologies**

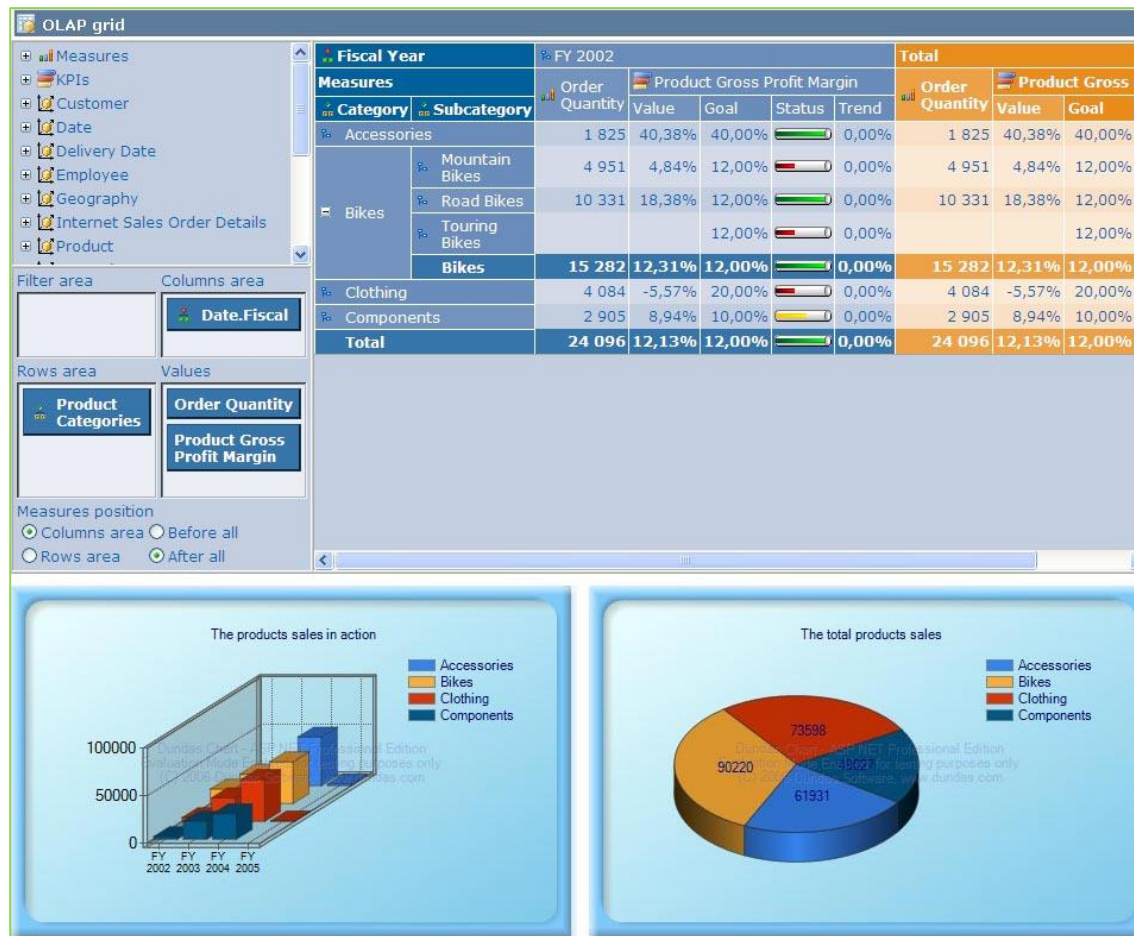
Source: Marut Buranarach

OLAP Applications

- OLAP applications usually have the following common features:
 - Multi-dimensional views of data
 - Data can be viewed from various perspectives, e.g. product, location, time, etc.
 - Support for complex calculations
 - e.g. sales forecasting, moving averages, percentage growth, etc.
 - Time intelligence
 - e.g. comparisons of sales performance between different time periods

Example 1: OLAP Cube Report

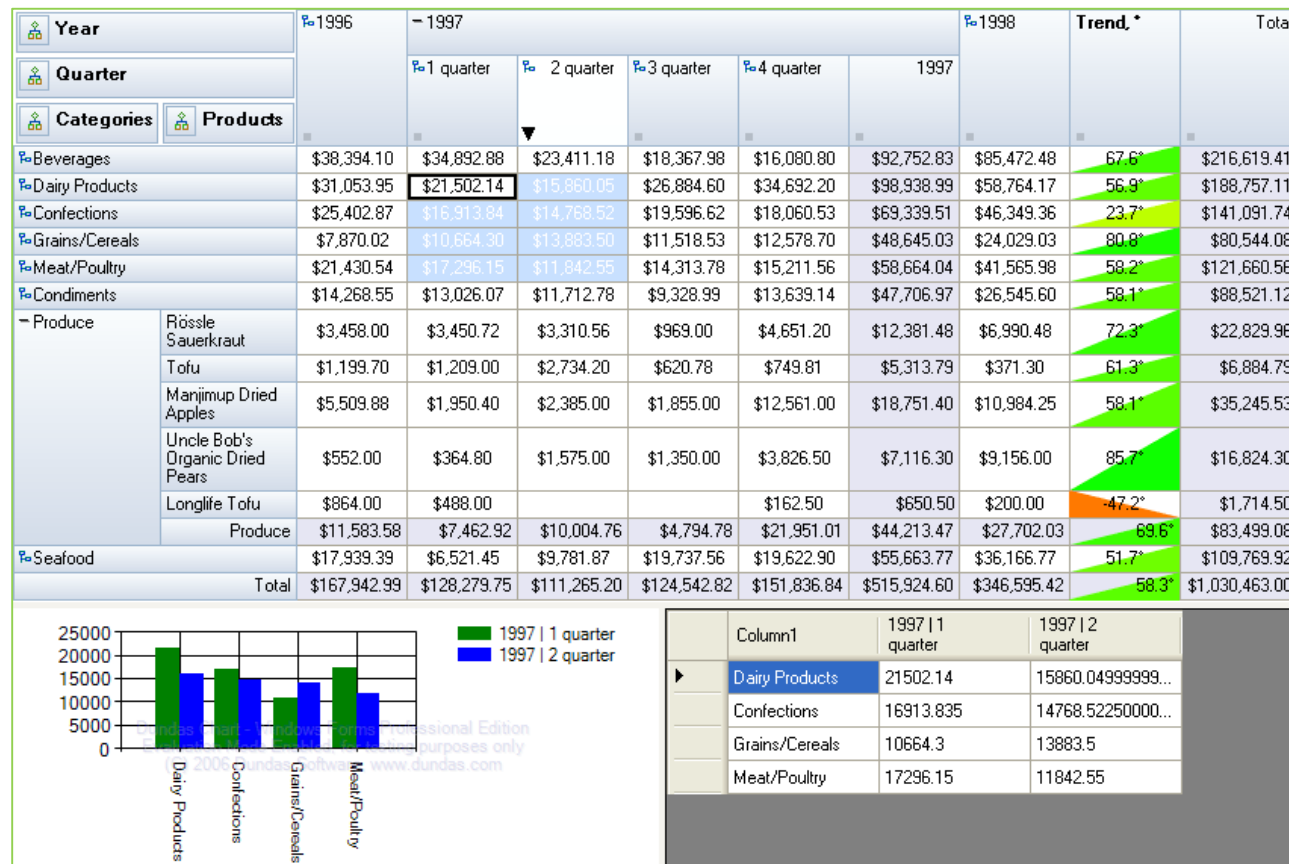
Source: http://www.filebuzz.com/findsoftware/Olap_Cube_Report/1.html



Example 2: RadarCube Windows

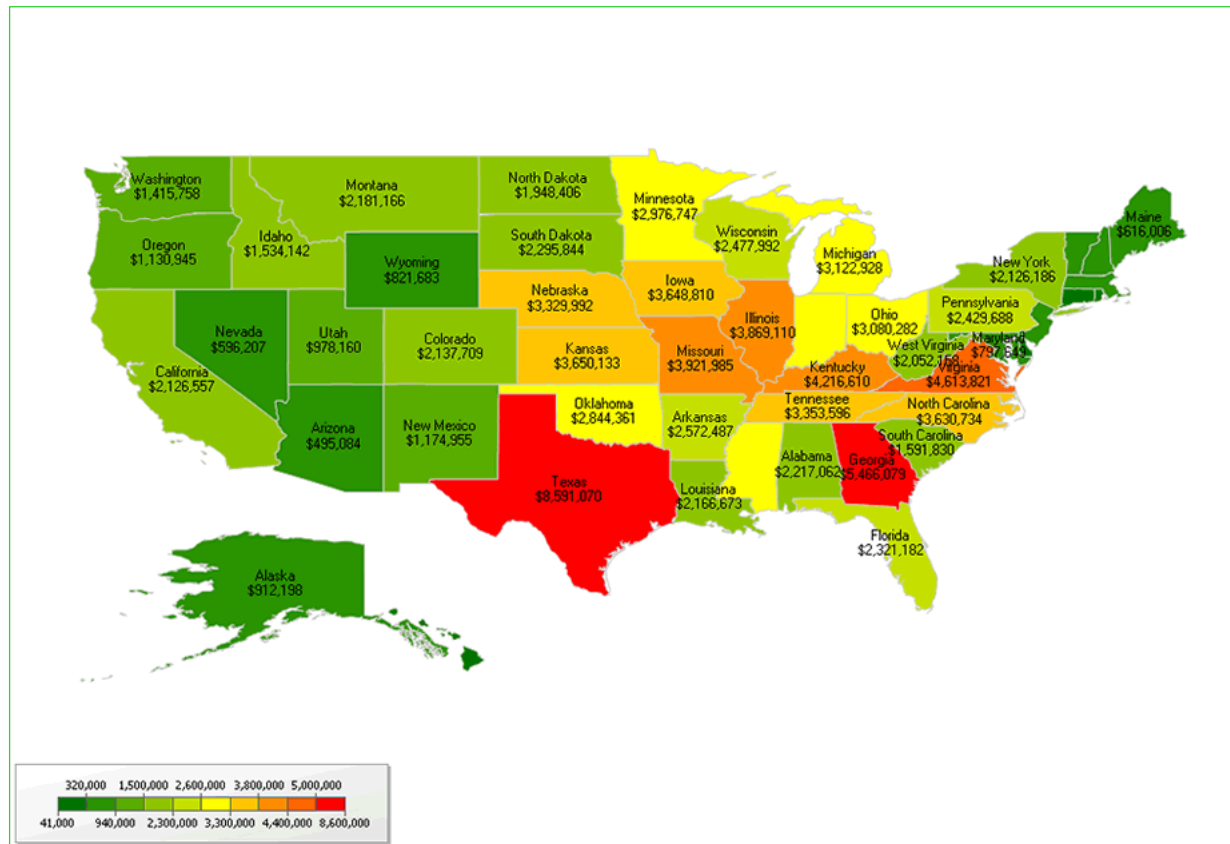
Forms Desktop OLAP v1.11

Source: http://www.filebuzz.com/fileinfo/23913/RadarCube_Windows_Forms_Desktop_OLAP.html



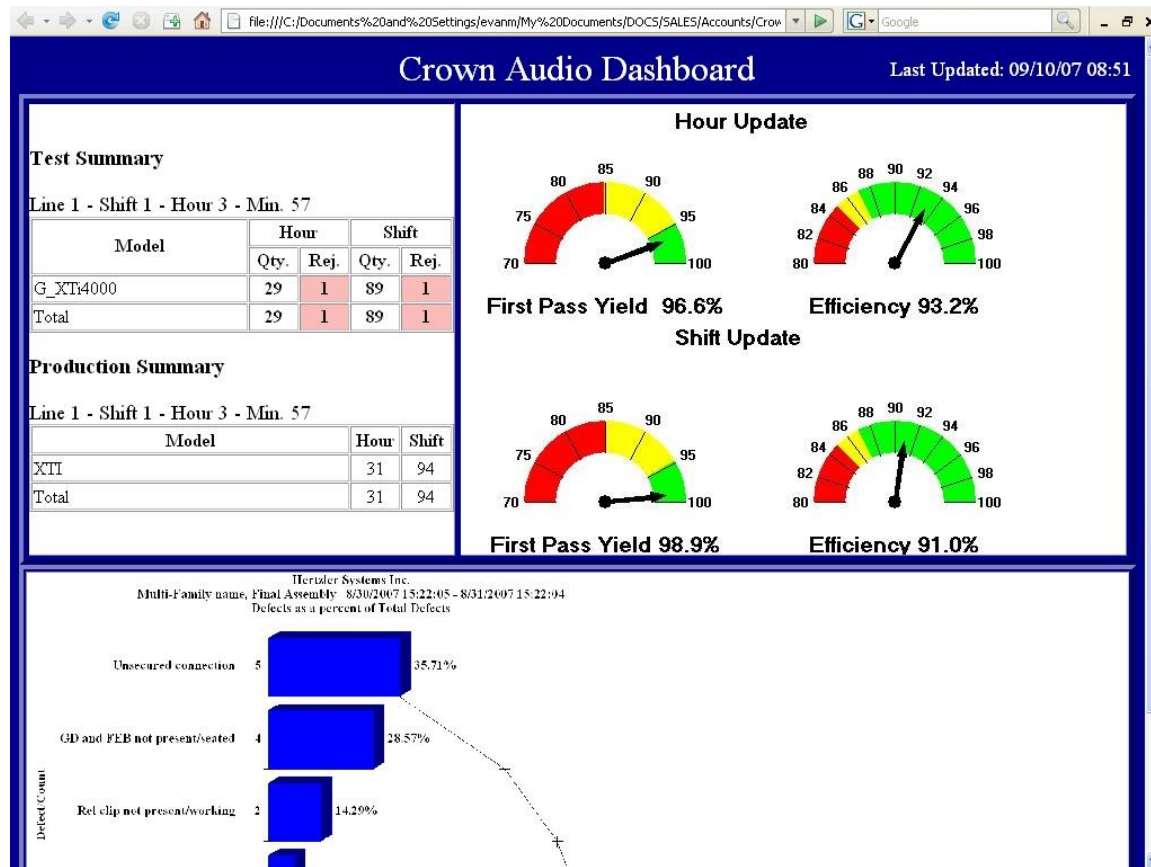
Example 3: Analyzer's Intelligent Mapping

Source: http://www.strategycompanion.com/mProduct/m_Dashboards.aspx



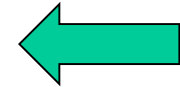
Example 4: The GainSeeker Enterprise Dashboard

Source: <http://www.hertzler.com/php/products/gainseeker/dashboard.php>

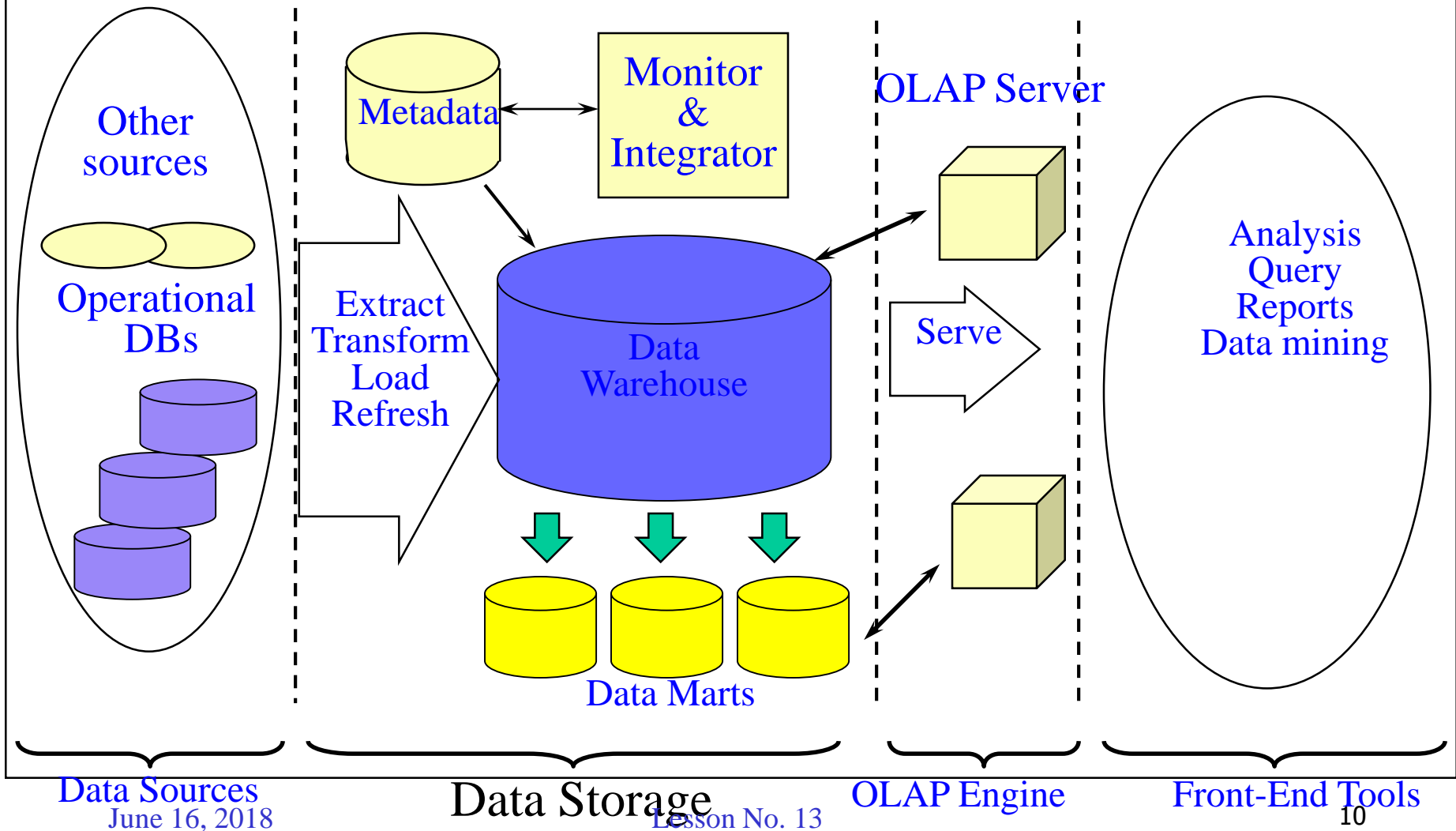


Lecture No. 13 – OLAP, Big Data, and BI

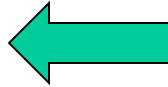
- BI and OLAP
- The Data Warehouse Architecture
- Multidimensional Analysis
- OLAP Server Architectures
- From data warehousing to big data



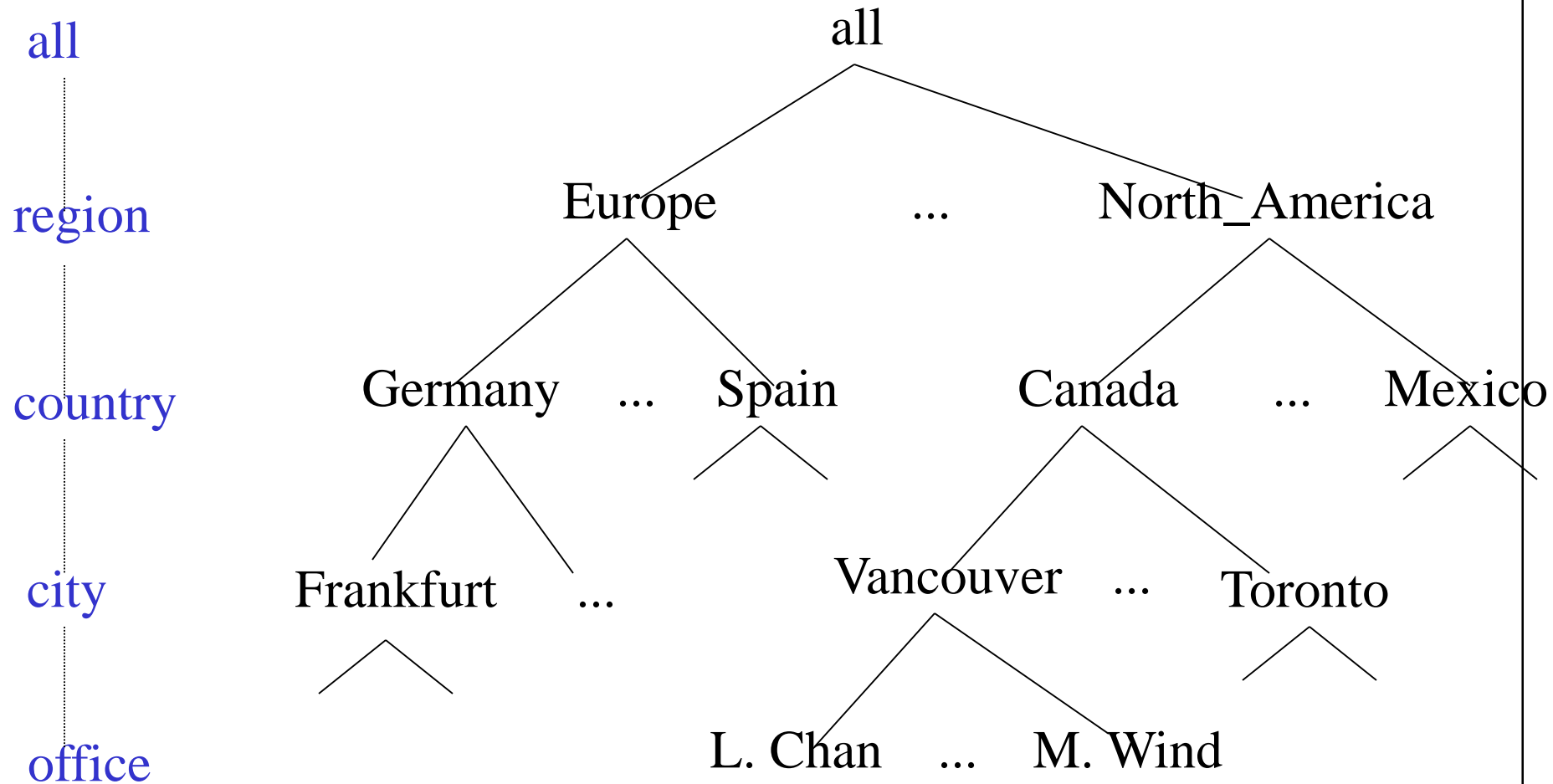
Data Warehouse: A Multi-Tiered Architecture



Lecture No. 13 – OLAP, Big Data, and BI

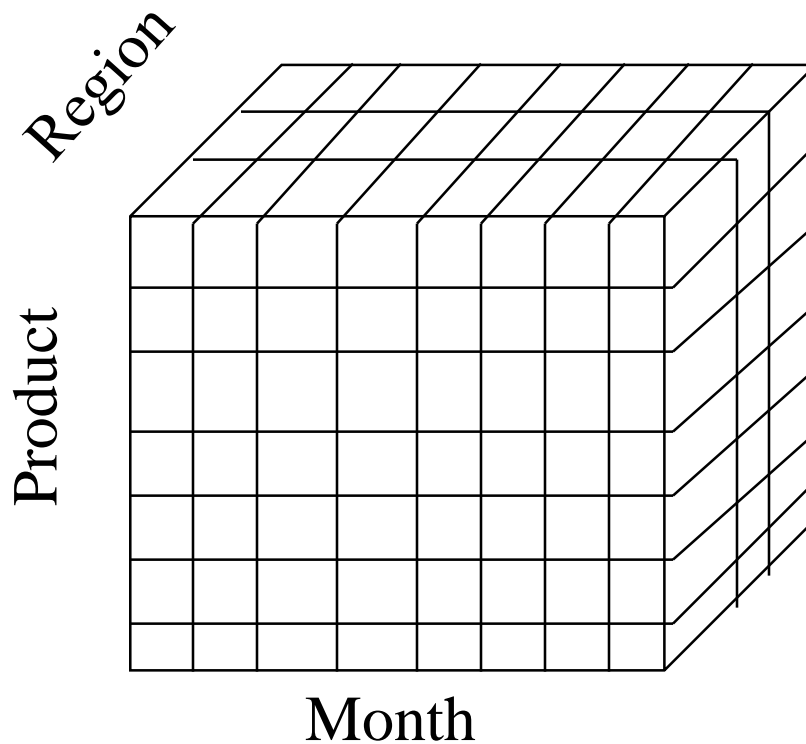
- BI and OLAP
- The Data Warehouse Architecture
- Multidimensional Analysis 
- OLAP Server Architectures
- From data warehousing to big data

A Concept Hierarchy: Dimension (location)

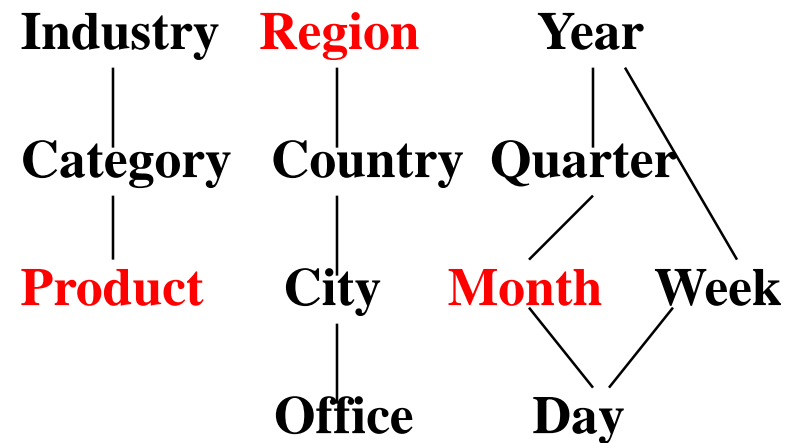


Multidimensional Data

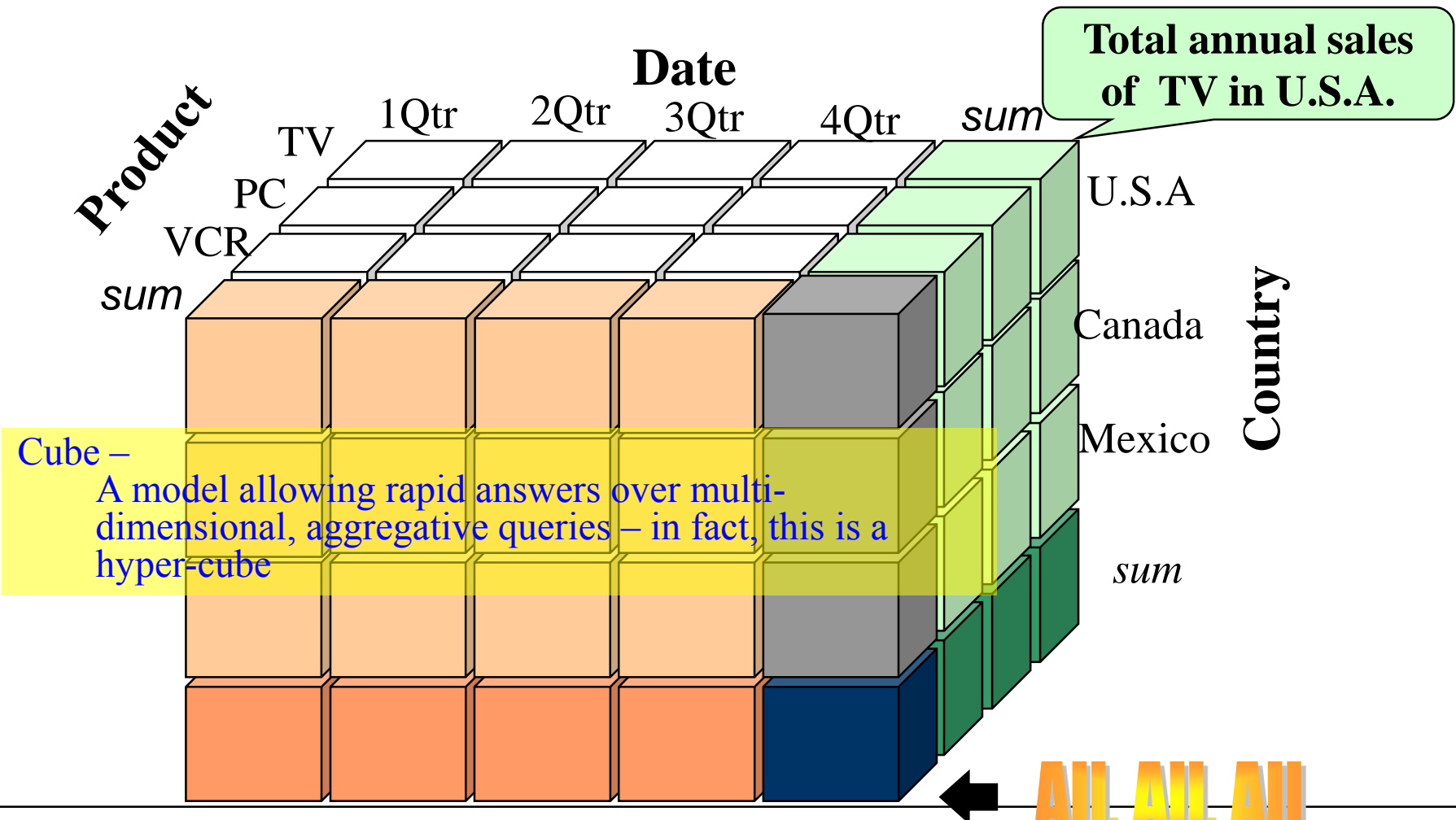
- Sales volume as a function of product, month, and region



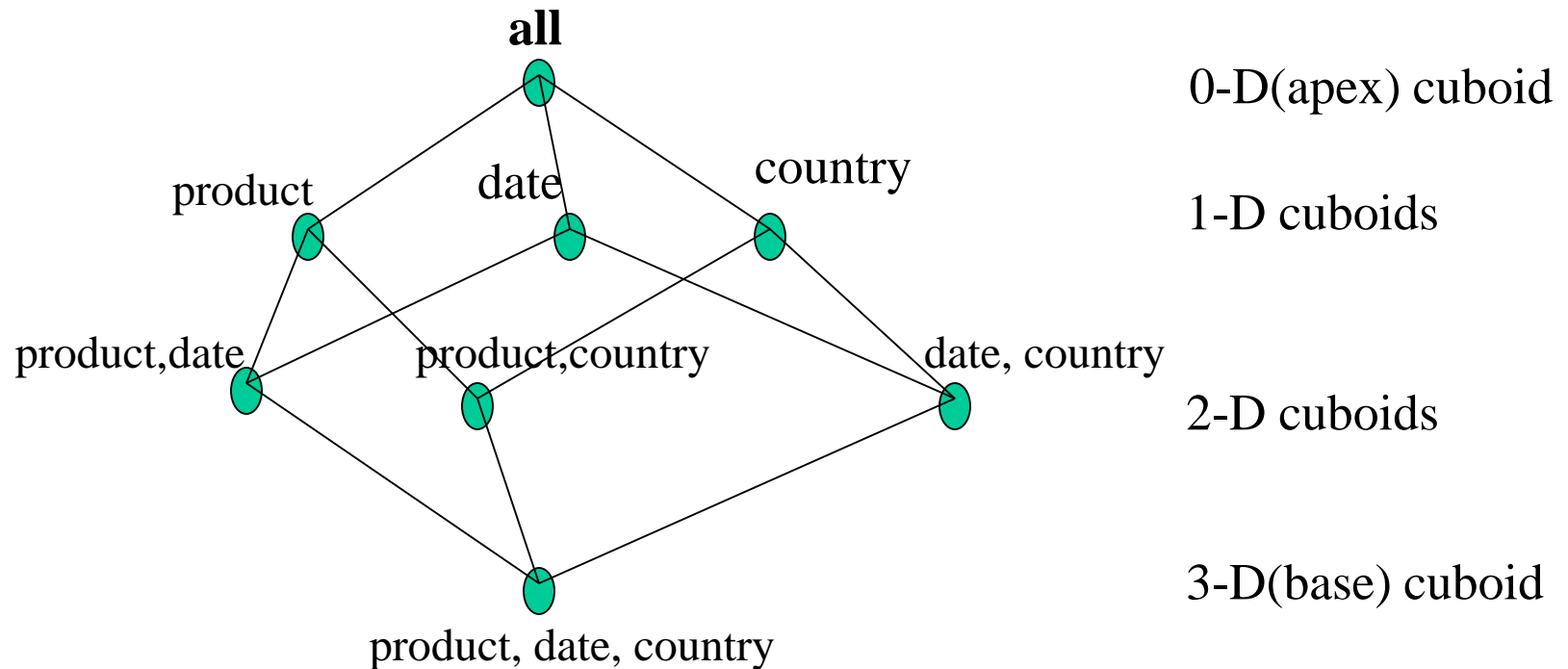
Dimensions: Product, Location, Time
Hierarchical summarization paths



A Sample Data Cube



Cuboids Corresponding to the Cube

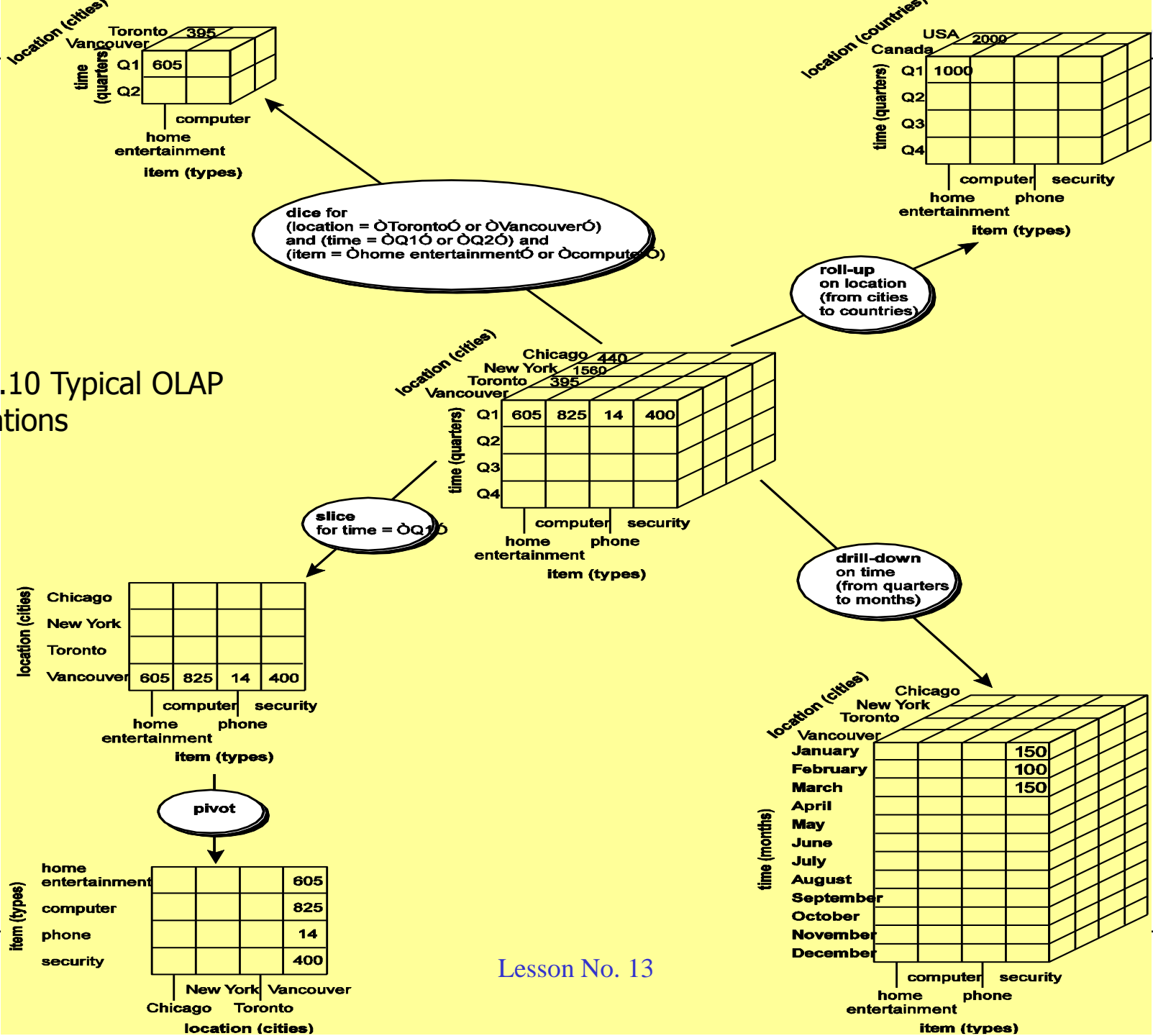


Base vs. aggregate cells; ancestor vs. descendant cells; parent vs. child cells

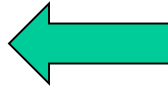
Typical OLAP Operations

- Roll up (drill-up): summarize data
 - *by climbing up hierarchy or by dimension reduction*
- Drill down (roll down): reverse of roll-up
 - *from higher level summary to lower level summary or detailed data, or introducing new dimensions*
- Slice and dice: *project and select*
- Pivot (rotate):
 - *reorient the cube, visualization, 3D to series of 2D planes*
- Other operations
 - *drill across: involving (across) more than one fact table*
 - *drill through: through the bottom level of the cube to its back-end relational tables (using SQL)*

Fig. 3.10 Typical OLAP Operations



Lecture No. 13 – OLAP, Big Data, and BI

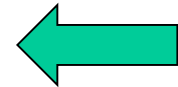
- BI and OLAP
- The Data Warehouse Architecture
- Main Characteristics of OLAP
- OLAP Server Architectures 
- From data warehousing to big data

OLAP Server Architectures

- Relational OLAP (ROLAP)
 - Use relational or extended-relational DBMS to store and manage warehouse data and OLAP middle ware
 - Include optimization of DBMS backend, implementation of aggregation navigation logic, and additional tools and services
 - Greater scalability
- Multidimensional OLAP (MOLAP)
 - Sparse array-based multidimensional storage engine
 - Fast indexing to pre-computed summarized data
- Hybrid OLAP (HOLAP) (e.g., Microsoft SQLServer)
 - Flexibility, e.g., low level: relational, high-level: array
- Specialized SQL servers
 - Specialized support for SQL queries over star/snowflake schemas

Lecture No. 13 – OLAP, Big Data, and BI

- BI and OLAP
- The Data Warehouse Architecture
- Main Characteristics of OLAP
- OLAP Server Architectures
- From data warehousing to big data



Data Warehouse Usage

- Three kinds of data warehouse applications
 - Information processing
 - supports querying, basic statistical analysis, and reporting using crosstabs, tables, charts and graphs
 - Analytical processing
 - multidimensional analysis of data warehouse data
 - supports basic OLAP operations, slice-dice, drilling, pivoting
 - OLAM (on-line analytical mining)
 - knowledge discovery from hidden patterns
 - supports associations, constructing analytical models, performing classification and prediction, and presenting the mining results using visualization tools

Summary: Data Warehouse and OLAP Technology

- Why data warehousing?
- A multi-dimensional model of a data warehouse
 - Star schema, snowflake schema, fact constellations
 - A data cube consists of dimensions & measures
- Data warehouse architecture
- OLAP servers: ROLAP, MOLAP, HOLAP
- OLAP operations: drilling, rolling, slicing, dicing and pivoting
- From OLAP to OLAM (on-line analytical mining)