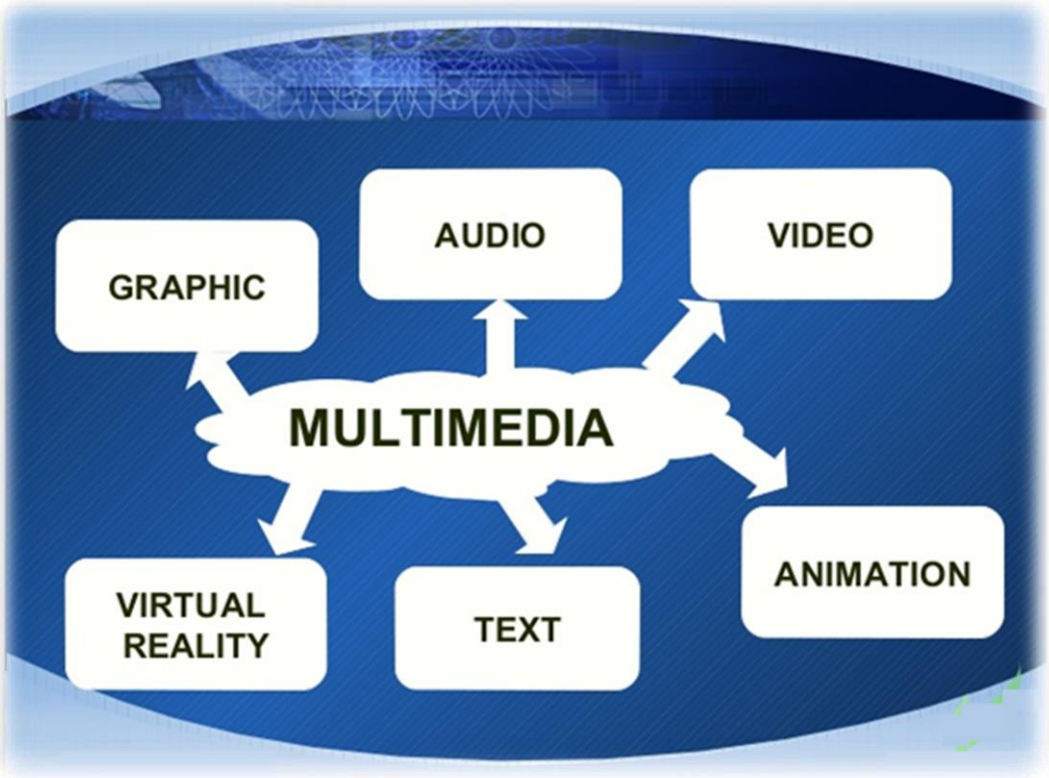

Tikrit University

Computer Science Dept.

Master Degree

Lecture 3

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- **Database** is a collection of interrelated data that helps in efficient retrieval of information, insertion and deletion of data from a database which organizes the data in the form of views, tables, schemas etc. For example, a university database organizes the data about students, admin, faculty, marks, events, schedules etc. that helps in efficient retrieval, insertion and deletion of data. The size of the database is not fixed and it can be varying based on user request, it can be generated and maintained manually or by computer. So, finally **a database is a collection of related data.**

- **Database schema** is the structure of a database described in a formal language supported typically by a relational database management system (RDBMS). The term "schema" refers to the organization of data as a blueprint of how the database is constructed (divided into database tables in the case of relational databases). The formal definition of a database schema is a set of formulas (sentences) called integrity constraints imposed on a database.

- **View and Table** both are integral parts of a relational database, and both terms are used interchangeably. The view is a result of an SQL query and it is a virtual table, whereas a Table is formed up of rows and columns that store the information of any object and be used to retrieve that data whenever required.

- **Data warehousing** is the process of constructing and using a data warehouse. A data warehouse is constructed by integrating data from multiple heterogeneous sources that support analytical reporting, structured and/or ad hoc queries, and decision making. Data warehousing involves data cleaning, data integration, and data consolidations.

- **OLAP** stands for Online Analytical Processing, which is a technology that enables multi-dimensional analysis of business data. It provides interactive access to large amounts of data and supports complex calculations and data aggregation. OLAP is used to support business intelligence and decision-making processes. Grouping of data in a multidimensional matrix is called **data cubes**. In Data warehousing, we generally deal with various multidimensional data models as the data will be represented by multiple dimensions and multiple attributes. This multidimensional data is represented in the data cube as the cube represents a high-dimensional space. The Data cube pictorially shows how different attributes of data are arranged in the data model as in **Figure 1** and their process described in **Figure 2.**

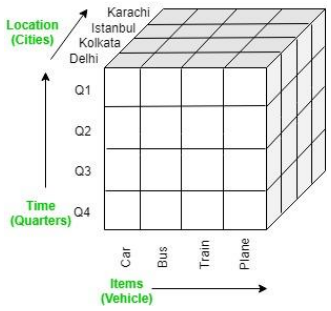

Figure 1: An example of a 3D cube having attributes

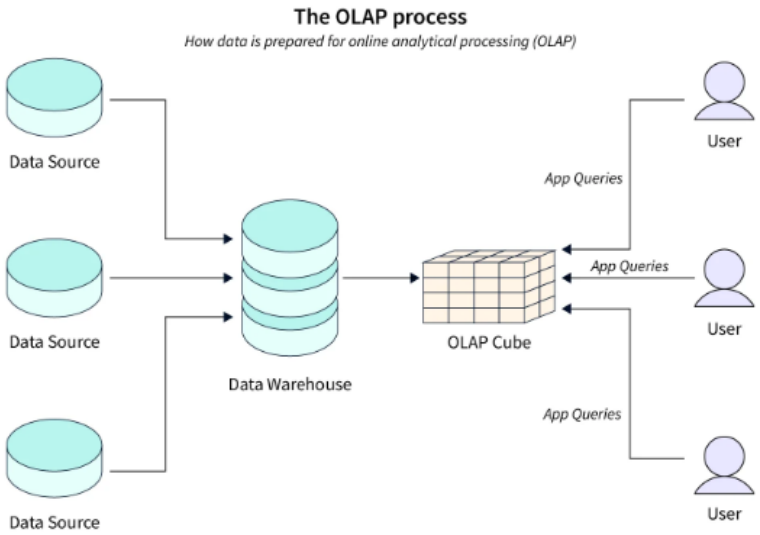

Figure 2: OLAP process

- Types of Servers in OLAP

1. **Relational OLAP (ROLAP)** is the latest and fastest-growing OLAP technology segment in the market. This method allows multiple multidimensional views of two-dimensional relational tables to be created, avoiding structuring record around the desired view. Some products in this segment have supported reliable SQL engines to help the complexity of multidimensional analysis.ROLAP can leverage functionalities inherent in the relational database. ROLAP Architecture includes the following components as shown in Figure 3.

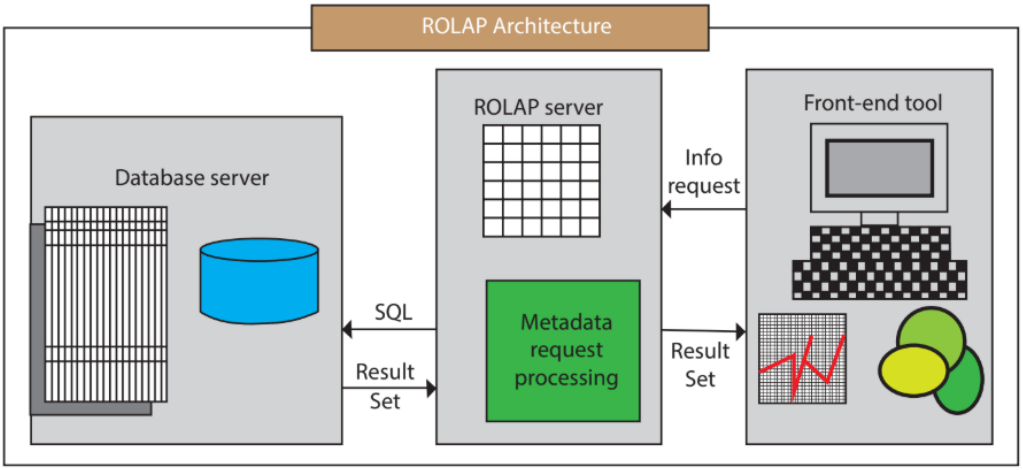

Figure 3: An example of ROLAP Architecture

2. Multidimensional OLAP (MOLAP) Server

A MOLAP system is based on a native logical model that directly supports multidimensional data and operations. Data are stored physically into multidimensional arrays, and positional techniques are used to access them. One of the significant distinctions of **MOLAP** against a **ROLAP** is that data are summarized and are stored in an optimized format in a multidimensional cube, instead of in a relational database. In MOLAP model, data are structured into proprietary formats by client's reporting requirements with the calculations pre-generated on the cubes. Applications requiring iterative and comprehensive time-series analysis of trends are well suited for MOLAP technology (e.g., financial analysis and budgeting). MOLAP Architecture includes the following components described in Figure 4.

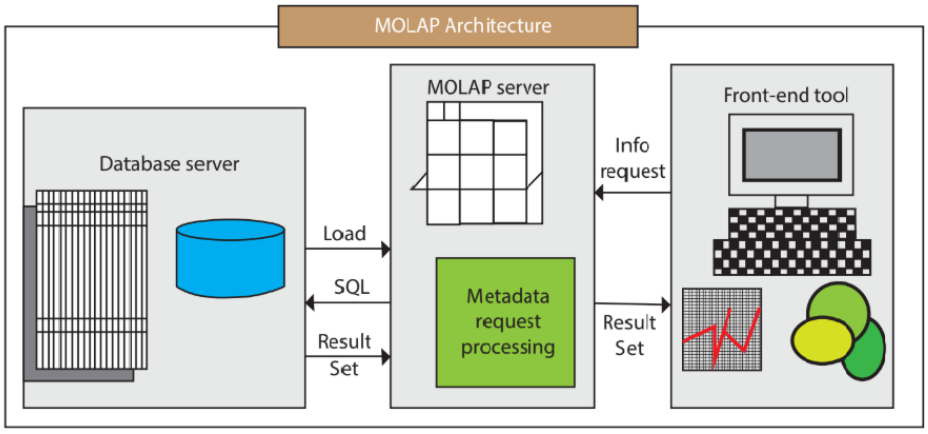

Figure 4: An example of MOLAP Architecture

3. Hybrid OLAP (HOLAP) Server

HOLAP incorporates the best features of **MOLAP** and **ROLAP** into a single architecture as presented in **Figure 5**. HOLAP systems save more substantial quantities of detailed data in the relational tables while the aggregations are stored in the pre-calculated cubes.

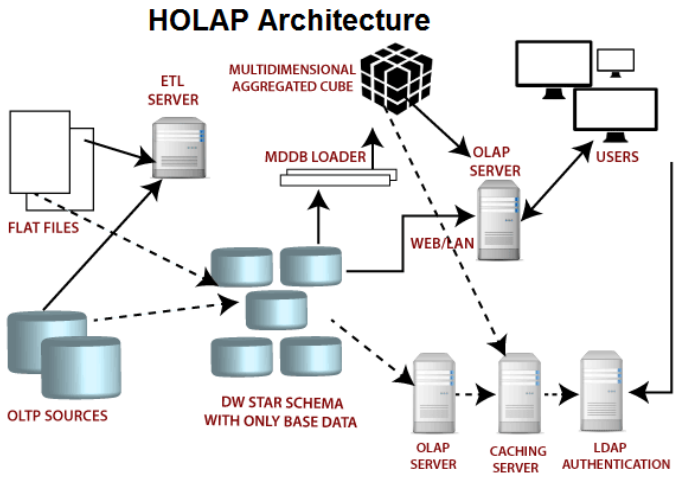

Figure 5: An example of HOLAP Architecture

4. **Web OLAP (WOLAP):** It is a Web browser-based technology. In traditional OLAP application is accessible by the client/server but this OLAP application is accessible by the web browser. It is a three-tier architecture that consists of a client, middleware, and database server. A Web-based application requires no deployment on the client machine. All that is needed is a Web browser and a network connection to the intranet or Internet.

5. **Desktop OLAP (DOLAP):** DOLAP stands for desktop analytical processing. Users can download the data from the source and work with the dataset, or on their desktop. Functionality is limited compared to other OLAP applications.

6. **Mobile OLAP (MOLAP):** MOLAP is wireless functionality for mobile devices. User work and access the data through mobile devices.

7. **Spatial OLAP (SOLAP):** Merge capabilities of both Geographic Information Systems (GIS) and OLAP into the single user interface, SOLAP egress. SOLAP is created because the data come in the form of alphanumeric, image, and vector. This provides the easy and quick exploration of data that resides in a spatial database.

8. **Real-time OLAP (ROLAP):** ROLAP technology combines the features of both OLTP and OLAP. It allows users to view data in real-time and perform analysis on data as it is being updated in the system. ROLAP also provides a single, unified view of data from different sources and supports advanced analytics like predictive modeling and data mining.

9. **Cloud OLAP (COLAP):** COLAP is a cloud-based OLAP solution that allows users to access data from anywhere and anytime. It eliminates the need for on-premise hardware and software installations, making it a cost-effective and scalable solution for businesses of all sizes. COLAP also offers high availability and disaster recovery capabilities, ensuring business continuity in the event of a disaster.

10. **Big Data OLAP (BOLAP):** BOLAP is an OLAP solution that can handle large amounts of data, such as data from Hadoop or other big data sources. It provides high-performance analytics on large datasets and supports complex queries that are impossible with traditional OLAP tools. BOLAP also supports real-time analysis of big data, allowing users to make informed decisions based on up-to-date information.

11. **In-memory OLAP (IOLAP):** IOLAP is an OLAP solution that stores data in memory for faster access and processing. It provides real-time analysis on large datasets and supports complex queries, making it an ideal solution for businesses that require fast and accurate analytics. IOLAP also supports advanced analytics like predictive modeling and data mining, allowing users to gain insights into their data and make informed decisions.