Data Mining & Data Warehouse

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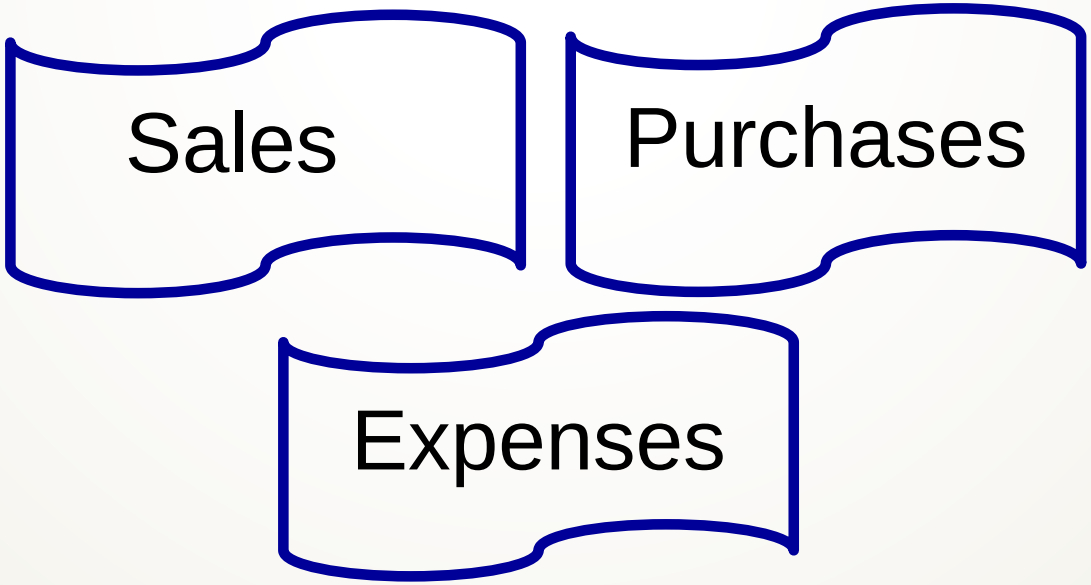
Why Do We Need Data Warehouses?

1. **Unification of information resources**. Improved query performance “Separate research and decision support functions from the operational systems.

2. **The data stored in the warehouse is uploaded from the operational systems**. The data may pass through an operational data store for additional operations before it is used in the DW for reporting.

Operational System

An **operational system** is a term used in data warehousing to refer to a **system** that is used to process the day-to-day transactions of an organization. These **systems** are designed in a manner that processing of day-to-day transactions is performed efficiently and the integrity of the transactional data is preserved.



What is Data Warehouse?

Defined in many different ways, but not rigorously:-

1. A decision support database that is maintained separately from the organization's operational database.

2. "A data warehouse is a **subject-oriented**, **integrated**, **time-variant**, and **nonvolatile** collection of data in support of management's decision-making process." by William H. Inmon

Data Warehouse—Subject-Oriented

- Organized around major subjects, such as customer, product, sales.
- Focusing on the modeling and analysis of data for decision makers, not on daily operations or transaction processing.
- Provide a simple and concise view around particular subject issues by excluding data that are not useful in the decision support process.

Data Warehouse—Integrated

1. **Constructed by integrating multiple, heterogeneous data sources**
   - relational databases, flat files, on-line transaction records

2. **Data cleaning and data integration techniques are applied.**
   - Ensure consistency in naming conventions, encoding structures, attribute measures, etc. among different data sources
     - E.g., Hotel price: currency, tax, breakfast covered, etc.
   - When data is moved to the warehouse, it is converted.

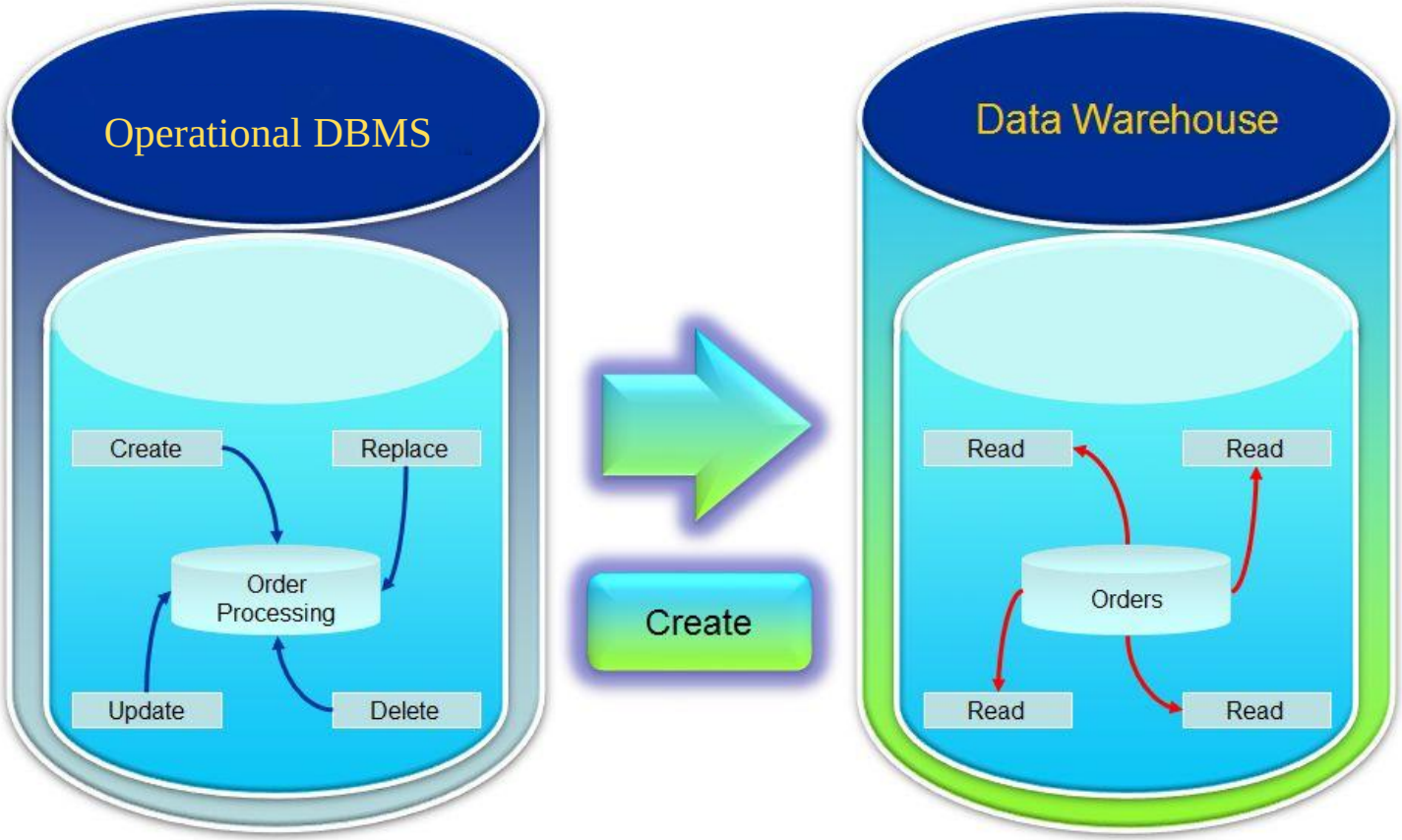
Data Warehouse—Time Variant

- **The time horizon for the data warehouse is significantly longer than that of operational systems.**
  - Operational database: current value data.
  - Data warehouse data: provide information from a historical perspective (e.g., past 5-10 years)
- **Every key structure in the data warehouse**
  - Contains an element of time, explicitly or implicitly
  - But the key of operational data may or may not contain "time element".

Data Warehouse—Non-Volatile

- A physically separate store of data transformed from the operational environment.
- Operational update of data does not occur in the data warehouse environment.
  - Does not require transaction processing, recovery, and concurrency control mechanisms
  - Requires only two operations in data accessing:
    - *initial loading of data* and *access of data*.

Data Warehouse Versus Operational DBMS



Data Warehouse Versus Operational DBMS

- **OLTP (on-line transaction processing)**

1. Major task of traditional relational DBMS
2. Day-to-day operations: purchasing, inventory, banking, manufacturing, payroll, registration, accounting, etc.

- **OLAP (on-line analytical processing)**

1. Major task of data warehouse system
2. Data analysis and decision making

Difference Between OLTP and OLAP

	OLTP	**OLAP**
users	Writer, IT professional	knowledge worker
function	day to day operations	decision support
DB design	application-oriented	subject-oriented
data	current, up-to-date detailed, flat relational isolated	historical, summarized, multidimensional integrated, consolidated
access	read/write index/hash on primary key	lots of scans
unit of work	short, simple transaction	complex query
# records accessed	tens	millions
#users	thousands	hundreds
DB size	100MB-GB	100GB-TB

Why Separate Data Warehouse?

- High performance for both systems
- Different functions and different data

Why Separate Data Warehouse (1)?

1. **High performance for both systems**

- DBMS— tuned for OLTP: access methods, indexing, concurrency control, recovery
- Warehouse—tuned for OLAP: complex OLAP queries, multidimensional view, consolidation.

Why Separate Data Warehouse(2)?

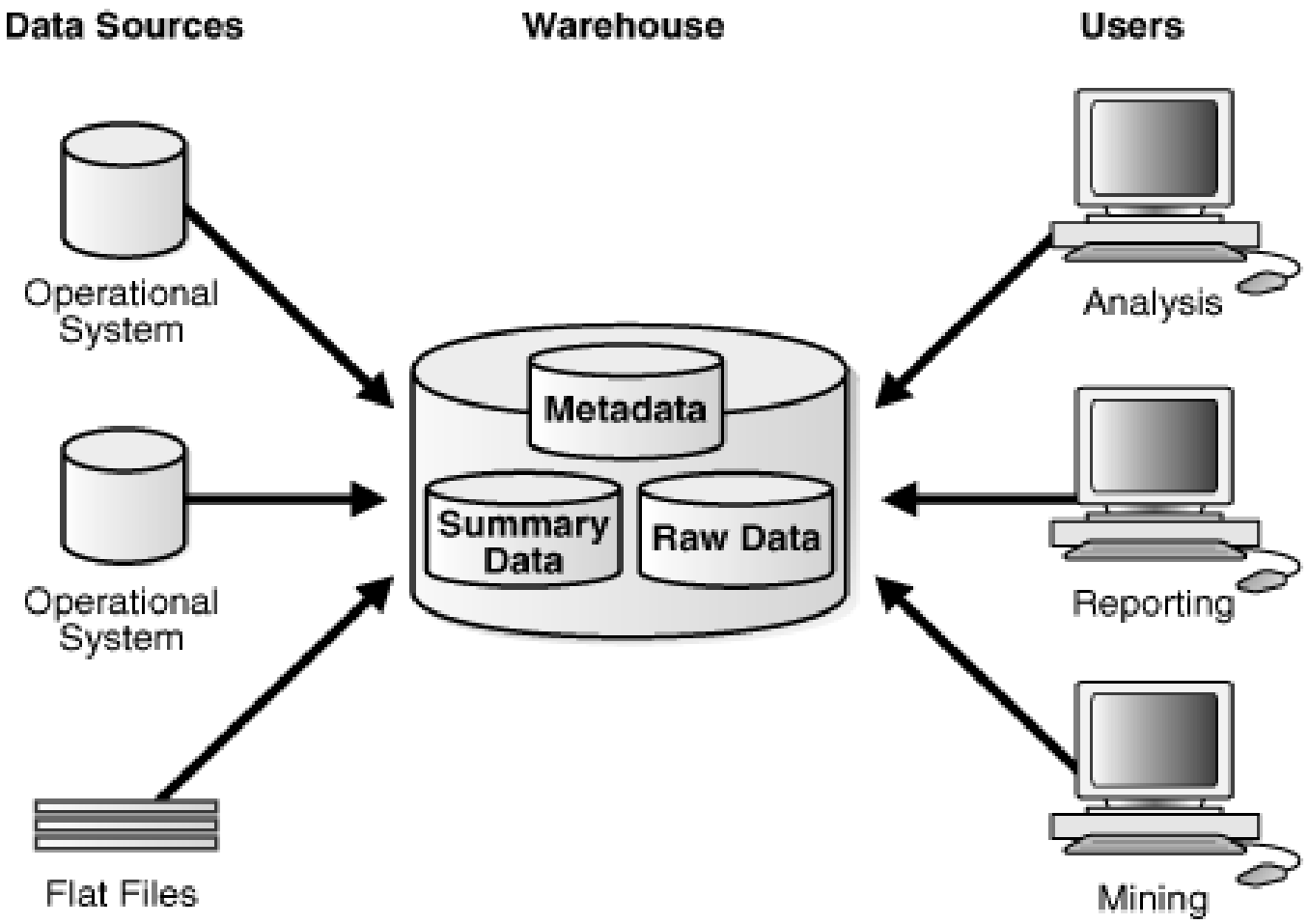
2. **Different functions and different data:**

Why Separate Data Warehouse(2)?

2. Different functions and different data:

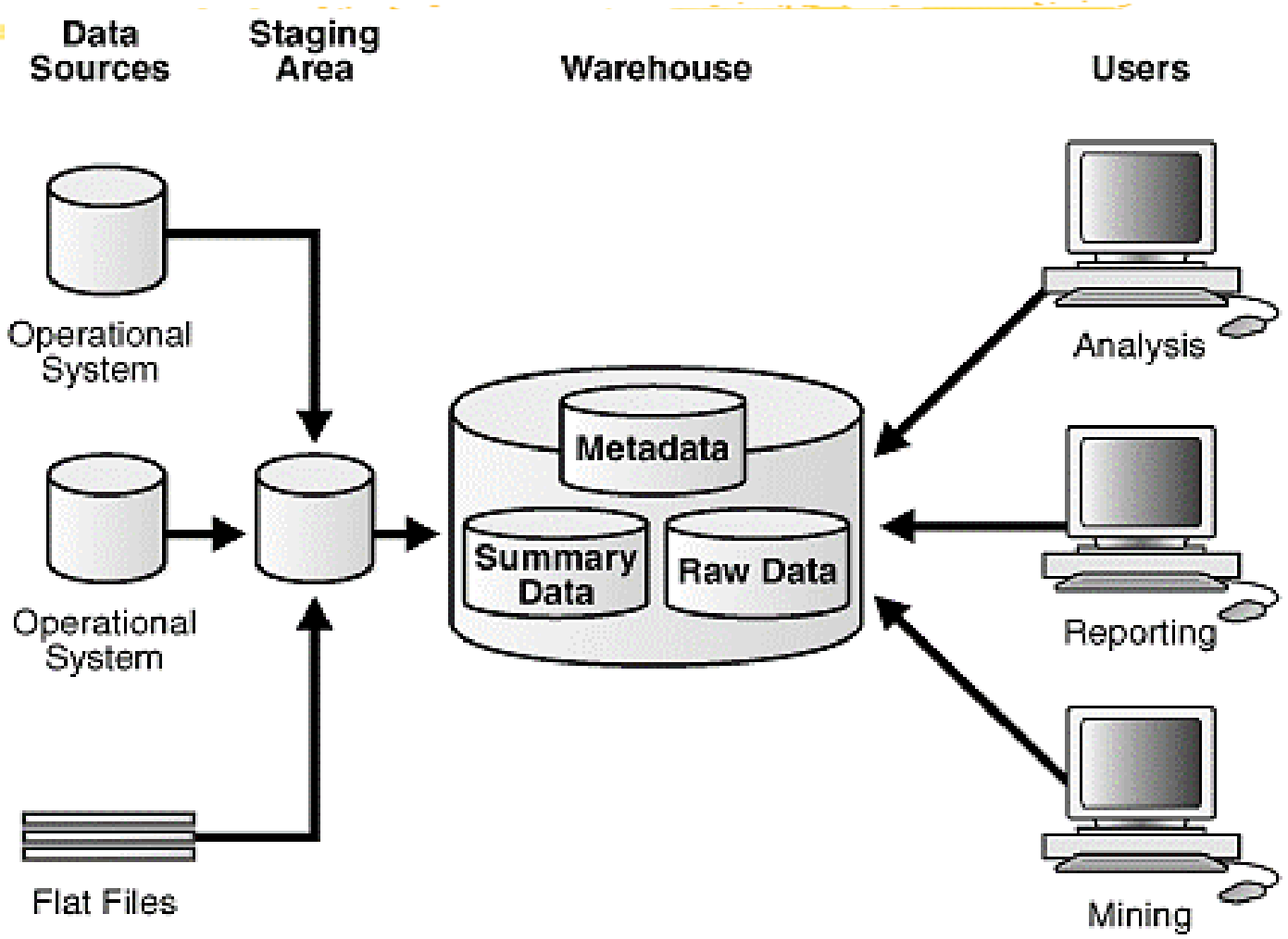
- **missing data**: Decision support requires historical data which operational DBs do not typically maintain
- **data consolidation**: DS requires consolidation (aggregation, summarization) of data from heterogeneous sources
- **data quality**: different sources typically use inconsistent data representations, codes and formats which have to be suitable.

Data Warehouse Architecture: Basic

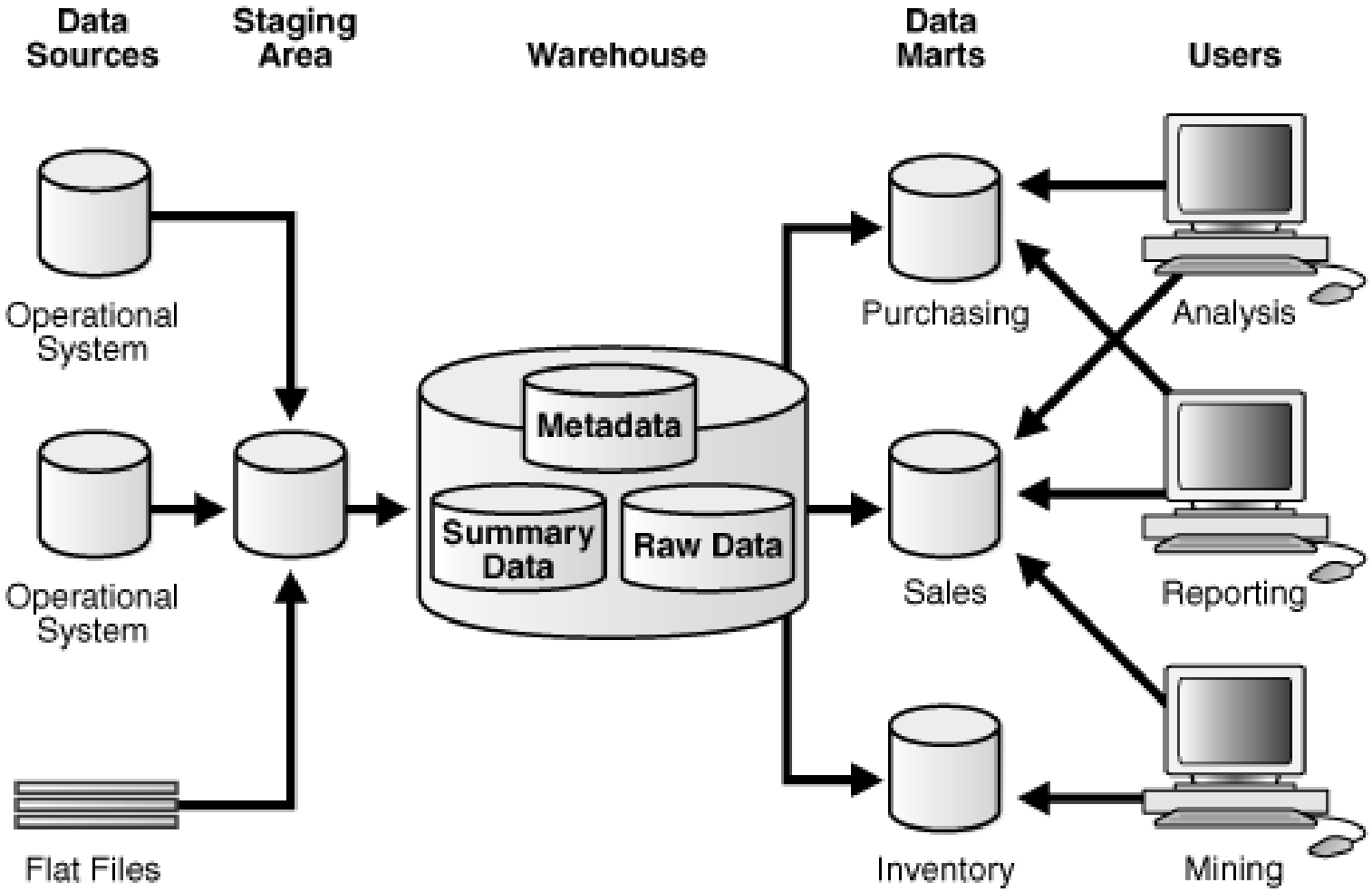


shows a simple architecture for a data warehouse. End users directly access data derived from several source systems through the data warehouse.

Data Warehouse Architecture: with a Staging Area



Data Warehouse Architecture: with a Staging Area and Data Marts



Data Marts

- is quite common, you may want to customize your warehouse's architecture for different groups within your organization. You can do this by adding **data marts**, which are systems designed for a particular line of business.
- This figure illustrates an example where purchasing, sales, and inventories are separated. In this example, a financial analyst might want to analyze historical data for purchases and sales or mine historical data to make predictions about customer behavior.


Thank
you