# Data Warehousing & Data Mining

Multidimensional OLAP (MOLAP)

# Recap

- OLAP introduction
- OLAP Architecture
- OLAP FASMI Test

# Outline

- MOLAP introduction
- Aggregations in MOLAP
- Cube Operations
- Advantages and Disadvantages

# OLAP Implementations

**1. MOLAP:** OLAP implemented with a multi-dimensional data structure.

**2. ROLAP:** OLAP implemented with a relational database.

# MOLAP Implementations

OLAP has historically been implemented using a multi_dimensional data structure or “cube”.

- Dimensions are key business factors for analysis:
  - Geographies (city, district, division, province,...)
  - Products (item, product category, product department,...)
  - Dates (day, week, month, quarter, year,...)

- Very high performance achieved by O(1) time lookup into “cube” data structure to retrieve pre-aggregated results

# MOLAP Implementations

- No standard query language for querying MOLAP
  - *No SQL !*

- Vendors provide proprietary languages allowing business users to create queries that involve pivots, drilling down, or rolling up.
  - E.g. MDX of Microsoft

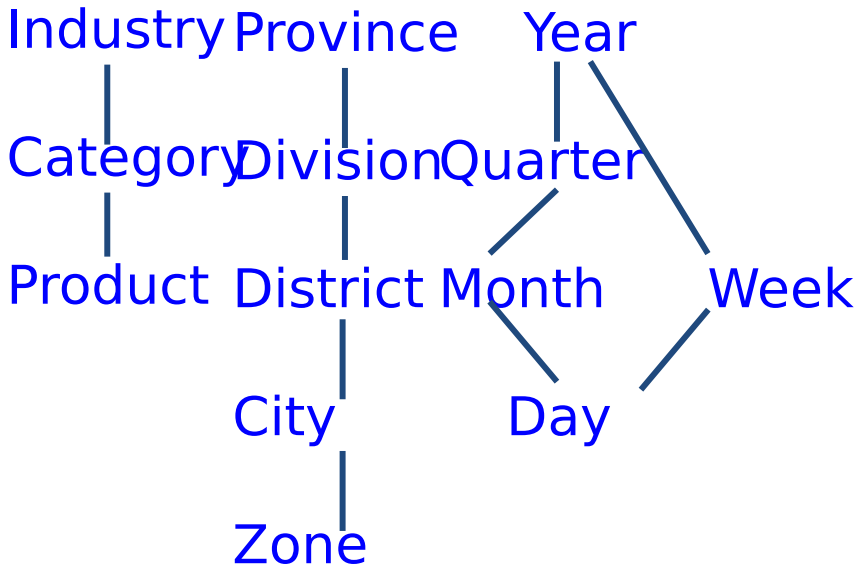
  - Application Programming Interface (API)’s also provided for probing the cubes.

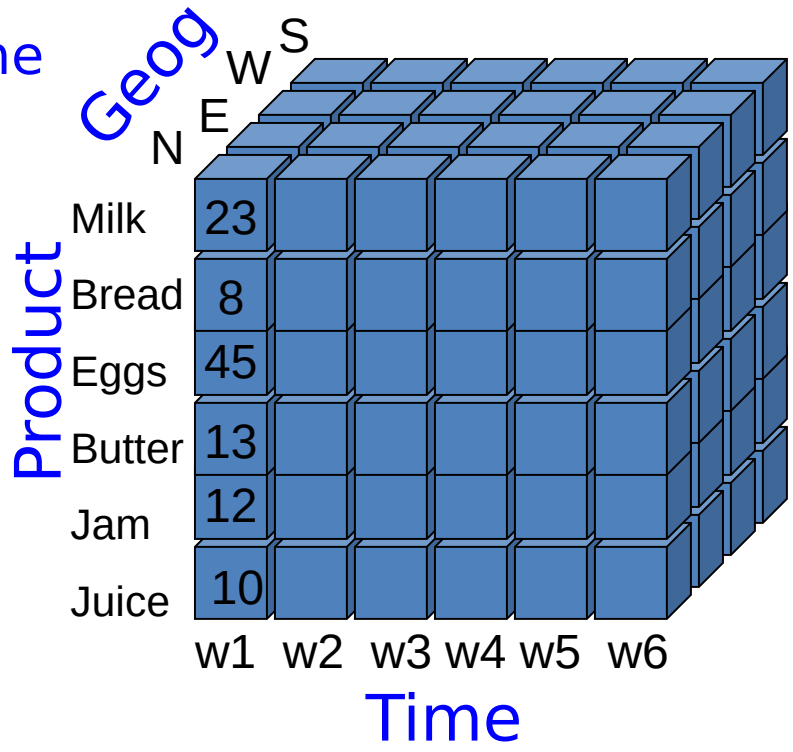
# Aggregations in MOLAP

- Sales volume as a function of (i) product, (ii) time, and (iii) geography
- A cube structure created to handle this.

Dimensions: Product, Geography, Time

Hierarchical summarization paths

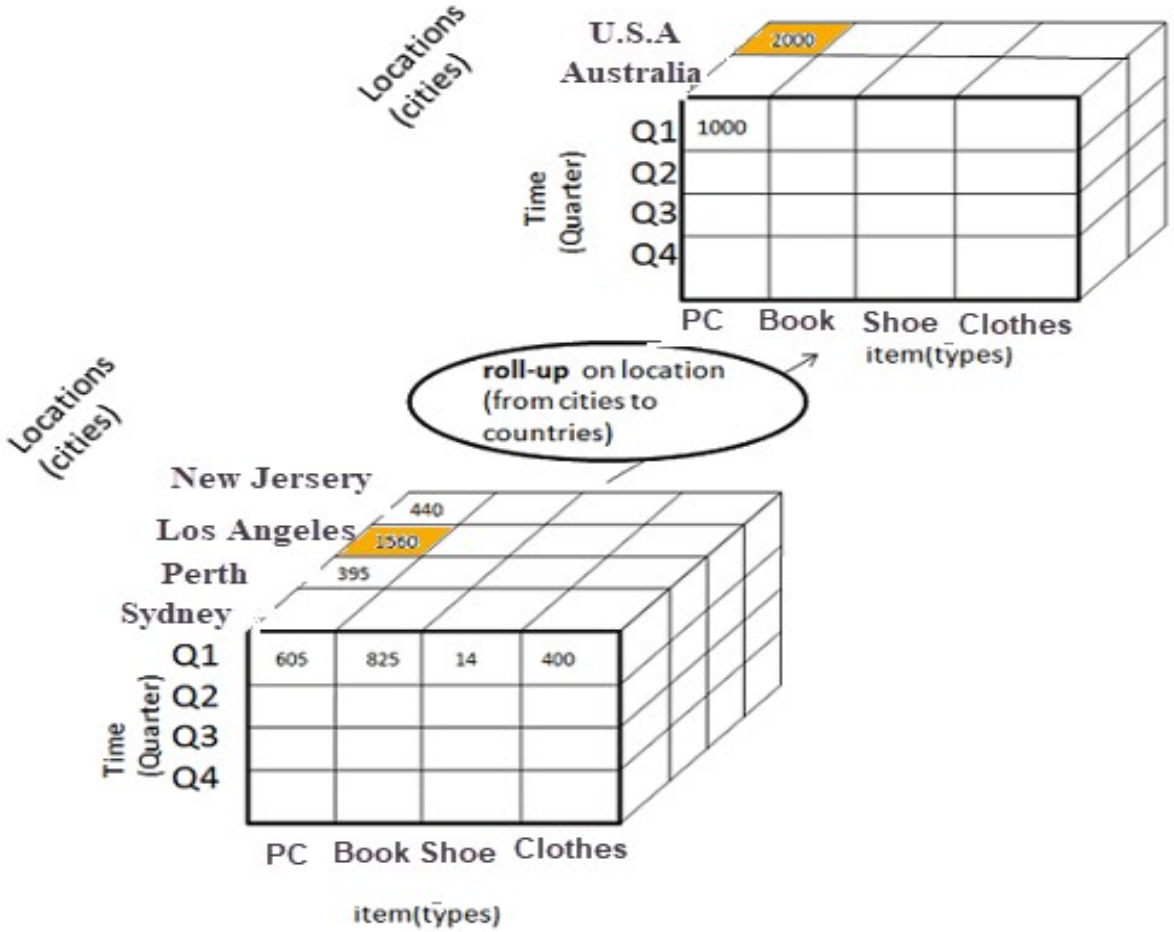


# Cube operations

There are four fundamental cubes operations

- **Rollup:** summarize data
  - The roll-up operation performs aggregation on a data cube either by climbing up the hierarchy or by dimension reduction.



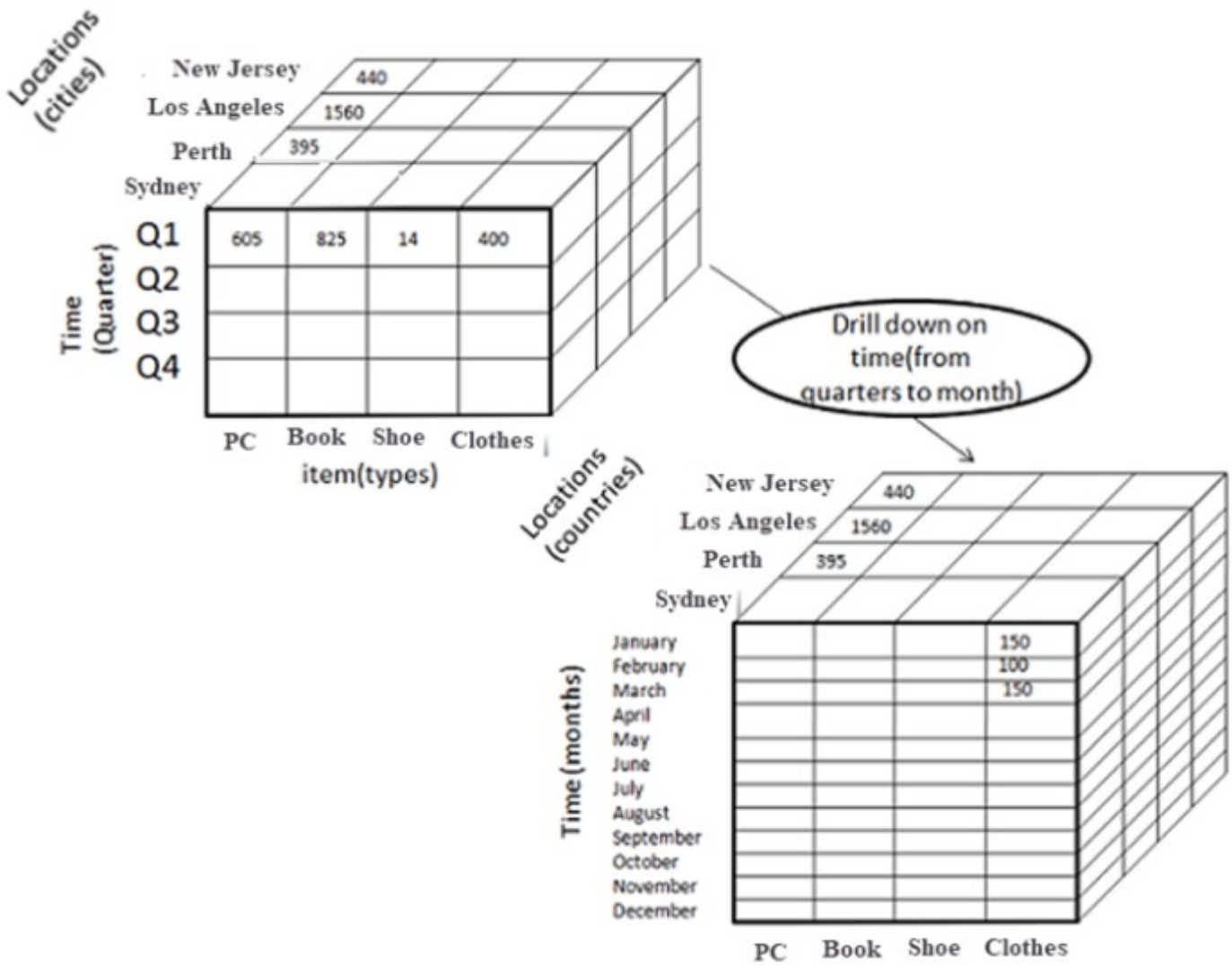
# Cube operations

- **Drill down:** get more details

Drill-down is the reverse of roll-up. It can be done via

-Moving down the concept hierarchy.

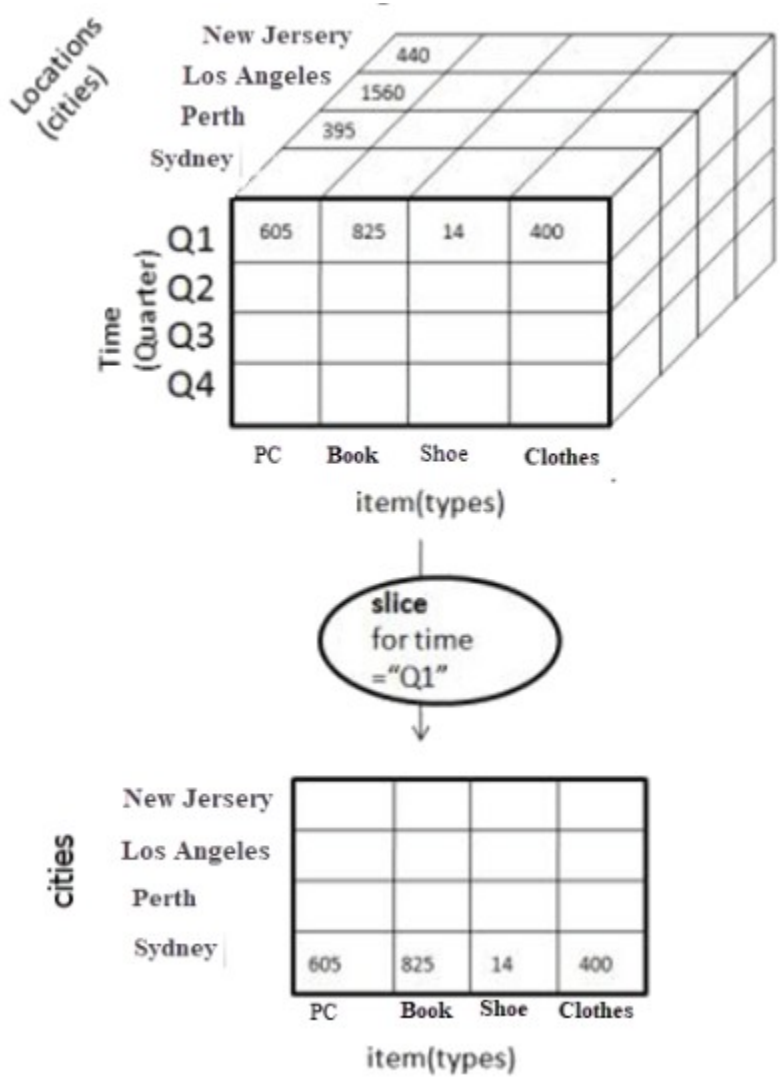
-Increasing a dimer



# Cube operations

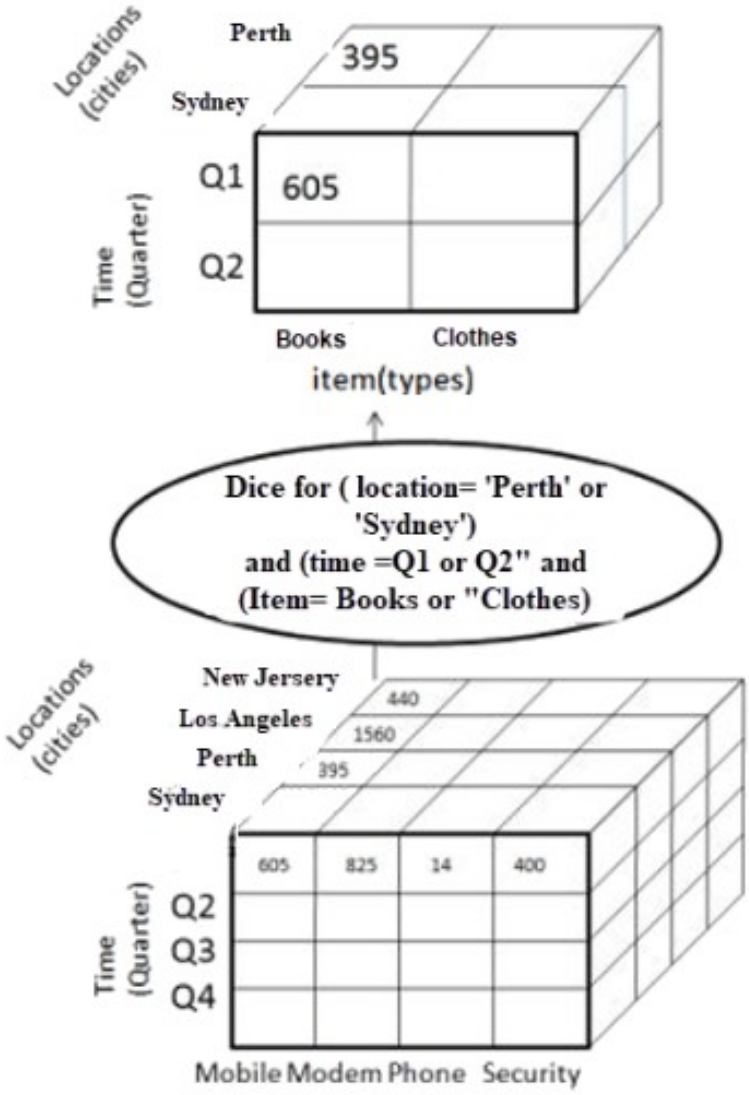
- **Slice and dice:** select and project

  **Slice:** one dimension is selected, and a new sub-cube is created.



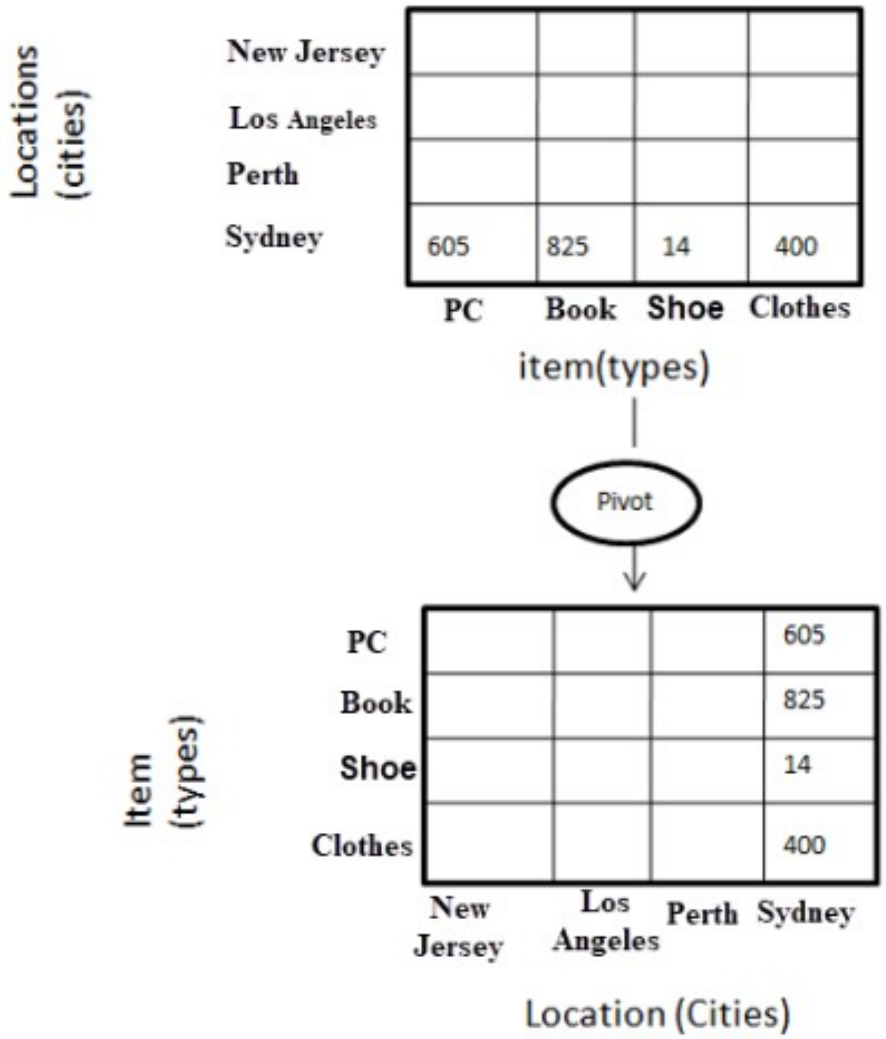
# Cube operations

- **Dice:** select 2 or more dimensions that result in the creation of a sub-cube

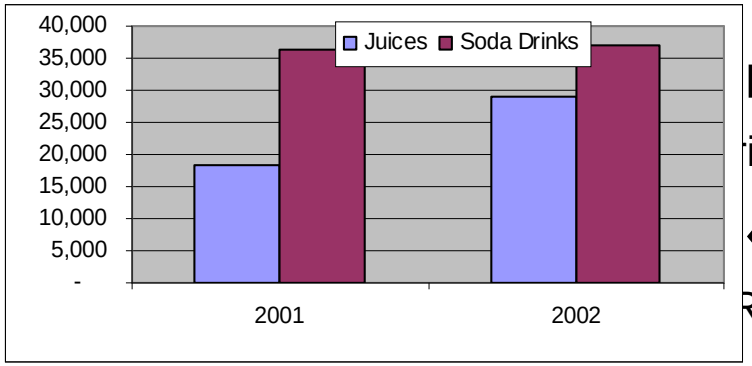


# Cube operations

- **Pivot**: you rotate the data axes to provide a substitute presentation of data.

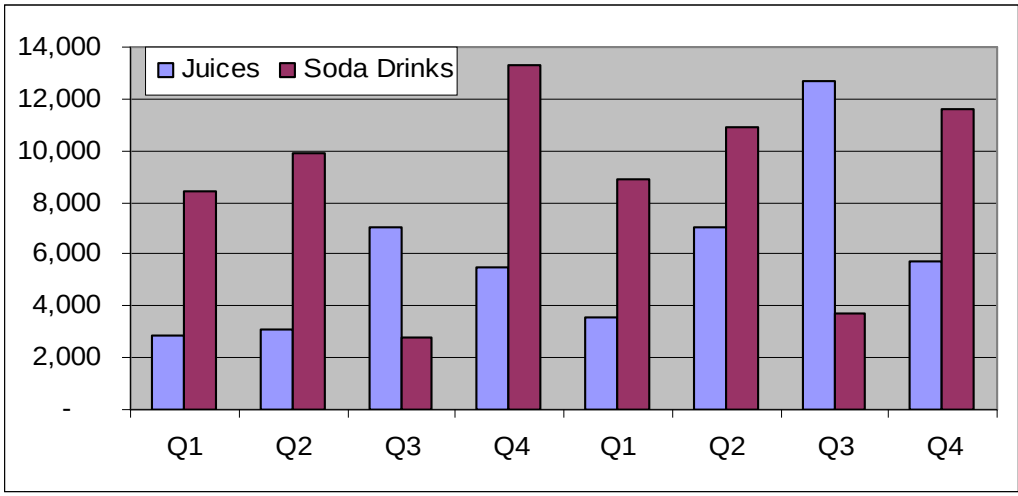


# Querying the cube

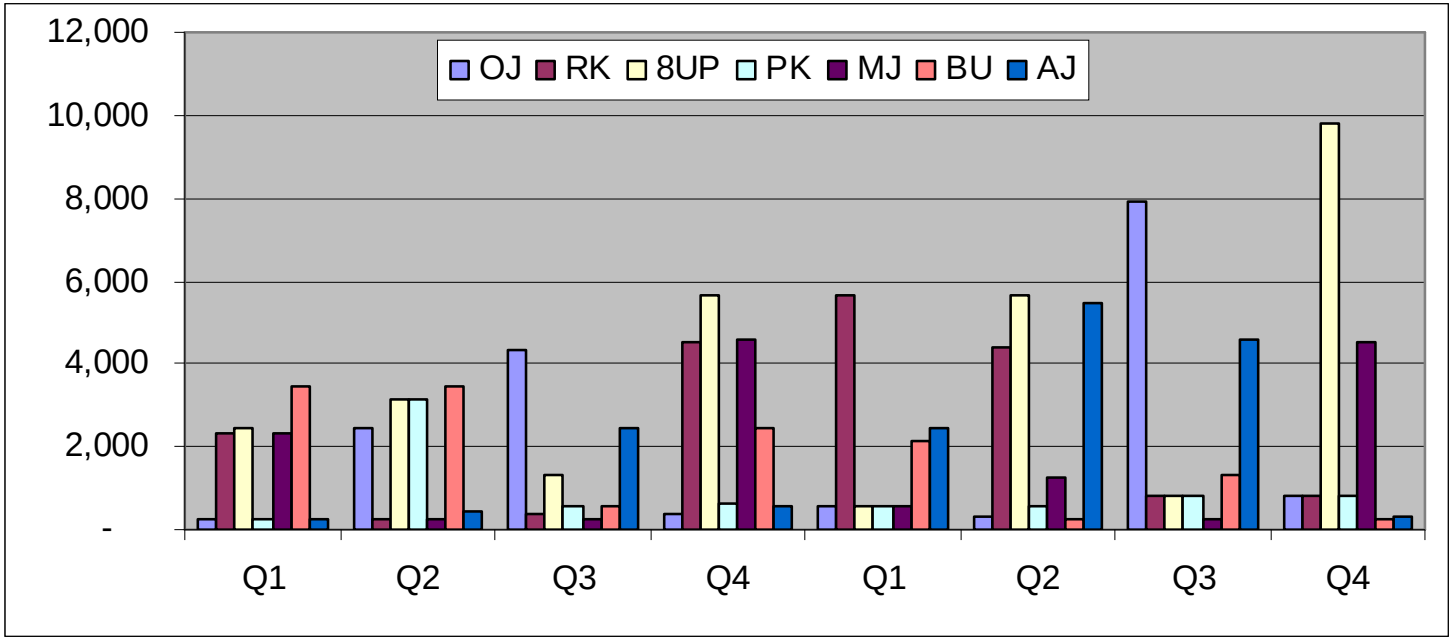



ill-Down

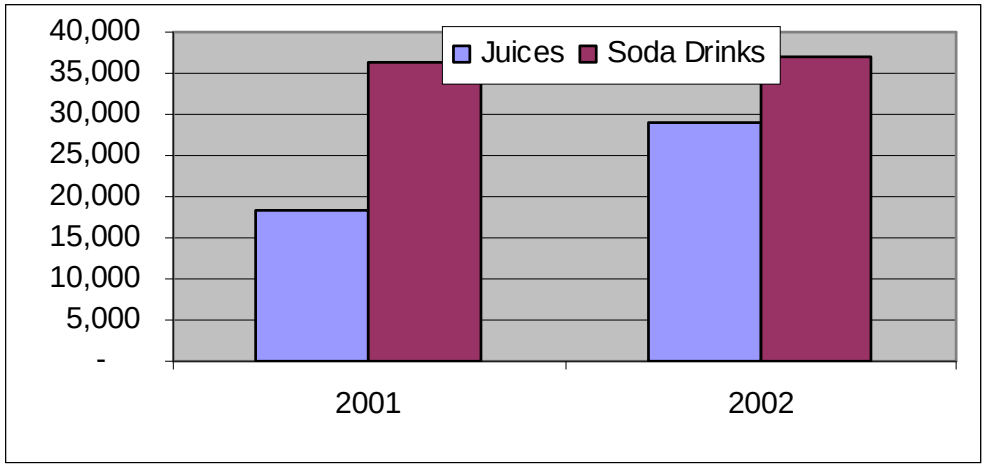
Roll-Up

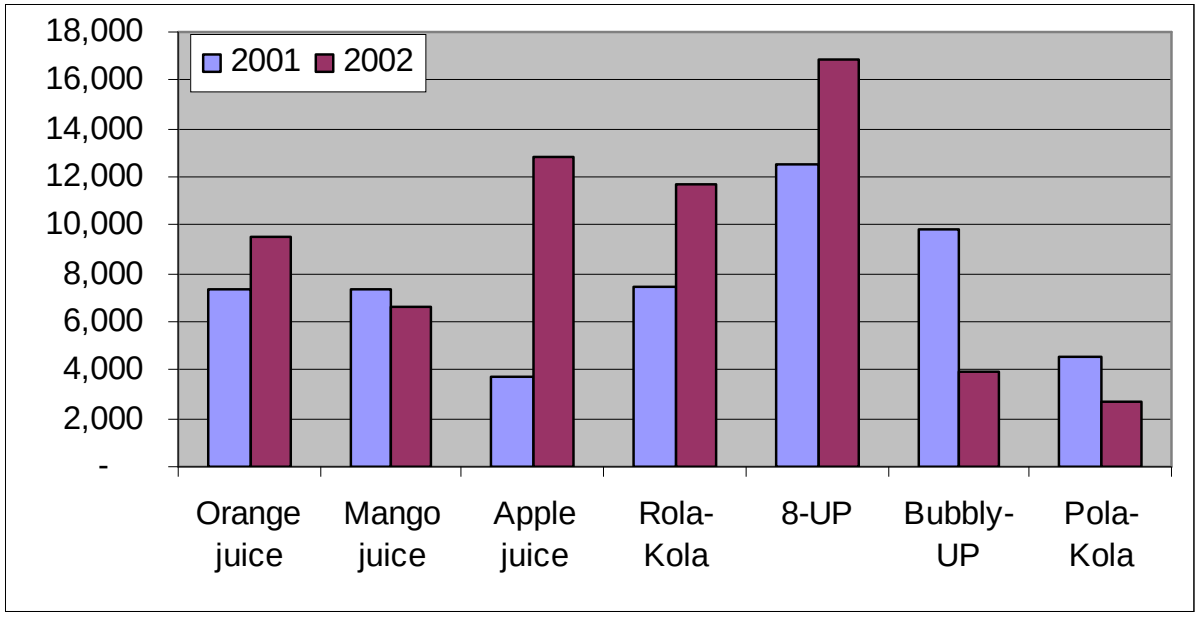



Drill-down



# Querying the cube: Pivoting



# MOLAP evaluation

## Advantages of MOLAP:

- Instant response (pre-calculated aggregates).
- Impossible to ask question without an answer.
- Value added functions (ranking, % change).

# MOLAP evaluation

## Drawbacks of MOLAP:

- Long load time ( pre-calculating the cube may take days!).
- Very sparse cube (wastage of space) for high cardinality (sometimes in small hundreds). e.g. number of heaters sold in Jacobabad or Sibi.
- MOLAP are not capable of containing detailed data.

# MOLAP Implementation issues

**Maintenance issue:** Every data item received must be aggregated into *every* cube (assuming "to-date" summaries are maintained). Lot of work.

# MOLAP vs ROLAP

| MOLAP | ROLAP |
| --- | --- |
| Information retrieval is fast. | Information retrieval is comparatively slow. |
| Uses sparse array to store data-sets. | Uses relational table. |
| MOLAP is best suited for inexperienced users, since it is very easy to use. | ROLAP is best suited for experienced users. |
| Maintains a separate database for data cubes. | It may not require space other than available in the Data warehouse. |
| DBMS facility is weak. | DBMS facility is strong. |

# Reference


- https://www.tutorialspoint.com/dwh/pdf/dwh_olap.pdf
- https://www.tutorialspoint.com/dwh/dwh_multidimensional_olap.htm