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Aim: Implementation of Dimension and Fact tables and perform OLAP operations.

Objective: OLAP stands for Online Analytical Processing. The objective of OLAP is to analyze information from multiple database systems at the same time. It is based on multidimensional data model and allows the user to query on multi-dimensional data.

Theory:

- Online Analytical Processing Server (OLAP) is based on the multidimensional data model.
- The main aim of OLAP is to provide multidimensional analysis to the underlying data.

Following is the list of OLAP operations:

1. Roll-up
2. Drill-down
3. Slice
4. Dice
5. Pivot (rotate)

Roll-up:

- The roll-up operation (also called the drill-up operation) performs aggregation on a data cube, either by climbing up a concept hierarchy for a dimension or by dimension reduction.
- Figure 2.1 shows the result of a roll-up operation performed on the central cube by climbing up the concept hierarchy for location.
- This hierarchy was defined as the total order "street < city < province or state < country."
- The roll-up operation aggregates the data by ascending the location hierarchy from the level of city to the level of country.
- In other words, rather than grouping the data by city, the resulting cube groups the data by country.

Drill-down:

- Drill-down is the reverse of roll-up. It navigates from less detailed data to more detailed data.
- Drill-down can be realized by either stepping down a concept hierarchy for a dimension or introducing additional dimensions.
- Figure 2.1 shows the result of a drill-down operation performed on the central cube by stepping down a concept hierarchy for time defined as "day < month < quarter < year."
- Drill-down occurs by descending the time hierarchy from the level of quarter to the more detailed level of month.
- The resulting data cube details the total sales per month rather than summarizing them by quarter.

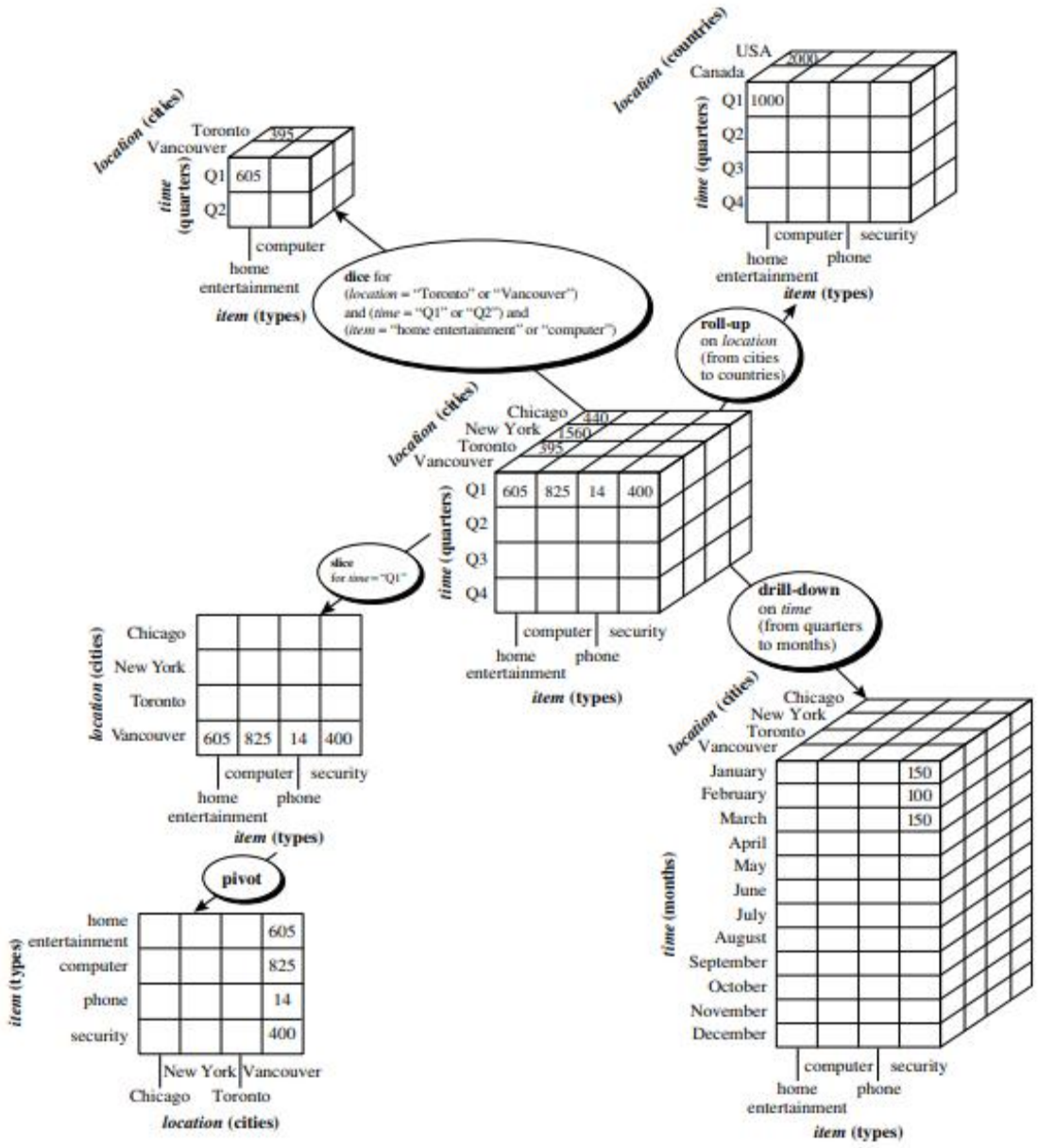

Figure 2.1: Examples of typical OLAP operations on multidimensional data.

Slice:

- The slice operation performs a selection on one dimension of the given cube, resulting in a sub cube.
- Figure 2.1 below shows a slice operation where the sales data are selected from the central cube for the dimension time using the criterion time = "Q1."

Dice:

- The dice operation defines a sub cube by performing a selection on two or more dimensions.
- Figure 2.1 shows a dice operation on the central cube based on the following selection criteria that involve three dimensions: (location = "Toronto" or "Vancouver") and (time = "Q1" or "Q2") and (item = "home entertainment" or "computer").

Pivot:

- Pivot (also called rotate) is a visualization operation that rotates the data axes in view to provide an alternative data presentation.
- Figure 2.1 shows a pivot operation where the item and location axes in a 2-D slice are rotated.

Problem Statement:

A retail company maintains sales data containing information about product categories, countries, cities, dates, and sales amounts. The company's management wants to analyze this data to make strategic business decisions.

The objective is to design a data warehouse model using Fact and Dimension tables in Google Sheets, based on the given dataset, and then perform OLAP operations (Roll-up, Drill-down, Slice, Dice, and Pivot) to gain insights.

Output:

1. Creating the Table in Excel.

Table1

Location (City)	Country	Quarter	Month	Item Type	# Sales
Toronto	Canada	Q1	January	Computer	150
Toronto	Canada	Q1	February	Computer	100
Vancouver	Canada	Q1	March	Home Entertainment	150
New York	USA	Q1	January	Security	200
Chicago	USA	Q1	February	Phone	180
Toronto	Canada	Q2	April	Computer	300
Vancouver	Canada	Q2	May	Home Entertainment	250
New York	USA	Q2	June	Security	275
Chicago	USA	Q3	July	Computer	350
Vancouver	Canada	Q4	October	Phone	400

2. Perform OLAP operations

- Roll up

SUM of Sales	Month				
Country	Q1	Q2	Q3	Q4	Grand Total
Canada	400	550		400	1350
USA	380	275	350		1005
Grand Total	**780**	**825**	**350**	**400**	**2355**

- Drill down

SUM of Sales	Item Type				
Month	Computer	Home Entertainm	Phone	Security	Grand Total
April	300				300
February	100		180		280
January	150			200	350
July	350				350
June				275	275
March		150			150
May		250			250
October			400		400
Grand Total	**900**	**400**	**580**	**475**	**2355**

- Slice

SUM of Sales	Item Type				
Location (City)	Computer	Home Entertainm	Phone	Security	Grand Total
Chicago			180		180
New York				200	200
Toronto	250				250
Vancouver		150			150
Grand Total	**250**	**150**	**180**	**200**	**780**

- Dice

	A	B	C	D
1	SUM of Sales	Item Type		
2	Location (City)	Computer	Home Entertainm	Grand Total
3	Toronto	550		550
4	Vancouver		400	400
5	**Grand Total**	**550**	**400**	**950**

- Pivot

SUM of Sales	Location (City)				
Item Type	Chicago	New York	Toronto	Vancouver	Grand Total
Computer	350		550		900
Home Entertainment				400	400
Phone	180			400	580
Security		475			475
Grand Total	**530**	**475**	**550**	**800**	**2355**

Conclusion:

Q1. What is the importance of OLAP operations?

OLAP (Online Analytical Processing) operations are important because they:

1. **Enable Multidimensional Analysis** – Allow users to view and analyze data from multiple perspectives such as time, location, and product.
2. **Support Decision-Making** – Provide aggregated and detailed views that help managers identify trends, patterns, and anomalies.
3. **Improve Query Performance** – Pre-aggregated data in OLAP cubes makes complex queries faster compared to transactional databases.
4. **Provide Flexibility** – Operations like Roll-up, Drill-down, Slice, Dice, and Pivot let users explore data interactively without modifying the underlying database.
5. **Enhance Data Visualization** – Facilitates clearer representation of data relationships, making insights more understandable.

Q2. What are the key features of OLAP?

. Key Features of OLAP

1. **Multidimensional Data Model** – Data is stored and analyzed in multiple dimensions for better insight.
2. **Complex Analytical Queries** – Can perform aggregations, calculations, and comparisons easily.
3. **Interactive and Fast Access** – Users can quickly navigate through large volumes of data.
4. **Time Intelligence** – Built-in support for analyzing data across time dimensions (e.g., by year, quarter, month).
5. **Aggregated and Detailed Views** – Supports both summarized (Roll-up) and granular (Drill-down) analysis.
6. **Data Consistency** – Maintains accuracy by using pre-aggregated, centralized data from the data warehouse.