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| **Experiment No.:** | 2 |
| **Title:** | Implementation of Dimension and Fact tables and perform OLAP operations. |
| **Date of Performance:** | 26/07/24 |
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| **Marks:** | |
| **Sign of Faculty:** | |

**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 a multidimensional data model and allows the user to query 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 of 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 the city to the level of the 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.

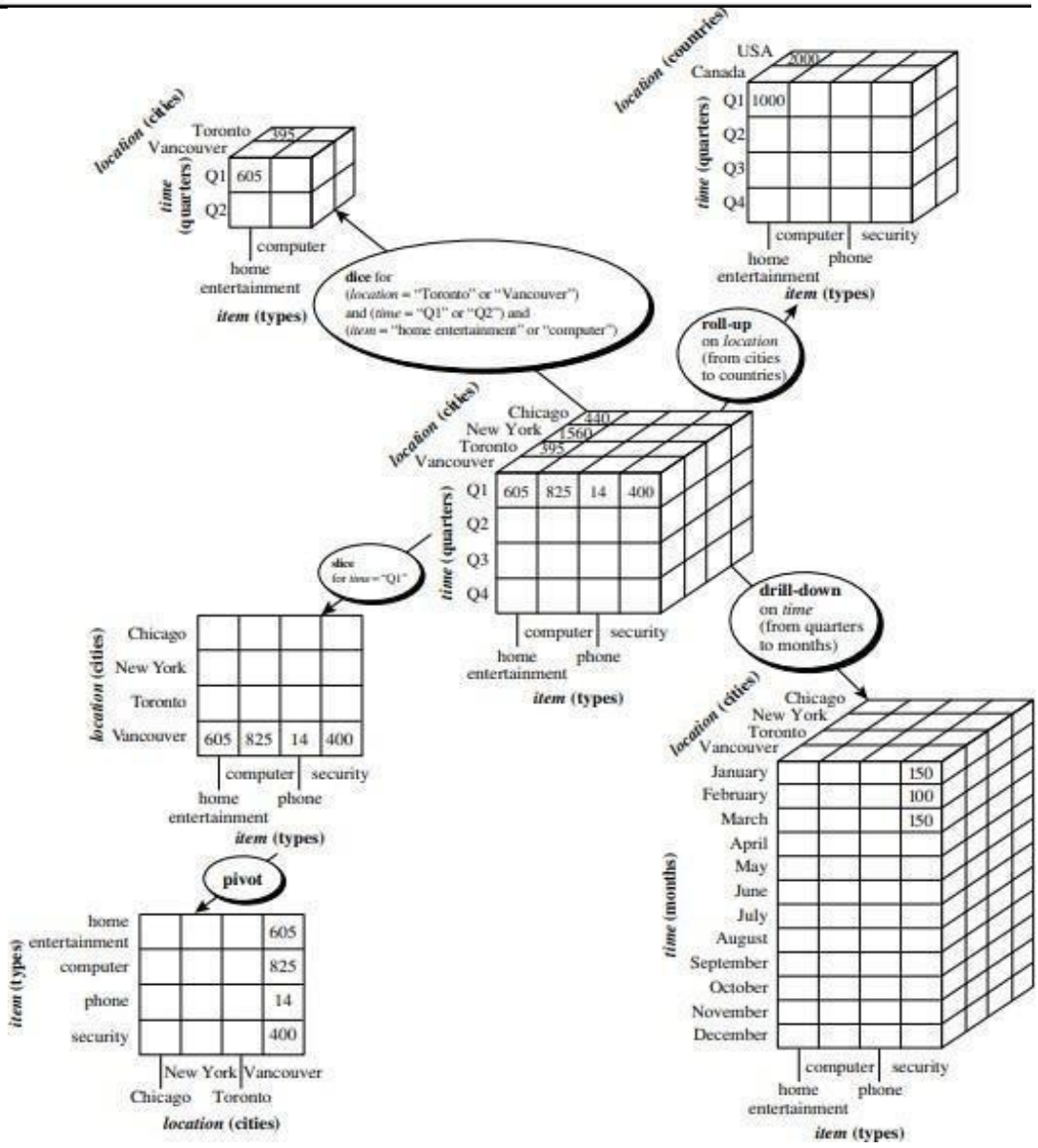



**Figure 2.1: Examples of typical OLAP operations on multidimensional data.**

**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.

**Output:**

1. Creating the Dimension Tables

**Solution:**

```
-- Creating the table
CREATE TABLE HotelBookings (
HotelId INT,
RoomID INT,
CustomerId INT,
Date1 DATE,
No_of_occupied_rooms INT,
No_of_vacant_rooms INT,
Revenue BIGINT );
```

2. Creating the Fact Table

**Solution:**

```
create table FactHotelOccupy5(
HotelId int,
RoomID int,
CustomerId int,
Date1 date,
No_of_occupied_rooms int,
No_of_vacant_rooms int, Revenue int, foreign key
(HotelId) references DimHotel2(HotelId)
);
```

3. Inserting values in both dimension and fact tables

**Solution:** insert into FactHotelOccupy5 values(1,2,6,'2012-12-21',60,240,111615674),
(2,5,4,'2015-06-01',150,50,875843568),
(3,3,1,'2016-03-08',325,175,888765327),
(4,4,3,'2019-04-04',236,214,777655532),
(5,6,2,'2018-06-27',284,416,334455522), (6,1,5,'2015-12-06',657,43,987654329);

INSERT INTO DimHotel2(HotelID, HotelName, Region, Country, State, City, StarRating, HotelType) VALUES
(1, 'Edeforsvägen 2A', 'Sweden', 'Sweden', 'Harads', 'Vid väg 97', 5, 'Hotel'),
(2, 'Edeforsvägen 2 A', 'Sweden', 'Sweden', 'Harads', 'Vid väg 97', 4, 'Hotel'),
(3, 'Edeforsvägen 2', 'Sweden', 'Sweden', 'Harads', 'Vid väg 97', 3, 'Hotel'),
(4, 'Kakslauttanen', 'Finland', 'Finland', 'Saariselkä', 'Kakslauttanen', 5, 'Hotel'),
(5, 'Kakslauttanen', 'Finland', 'Finland', 'Saariselkä', 'Kakslauttanen', 4, 'Hotel'),
(6, '77 1st Ave NW', 'Canada', 'Canada', 'Alberta', 'Edmonton', 3, 'Hotel');

4. Displaying the tables

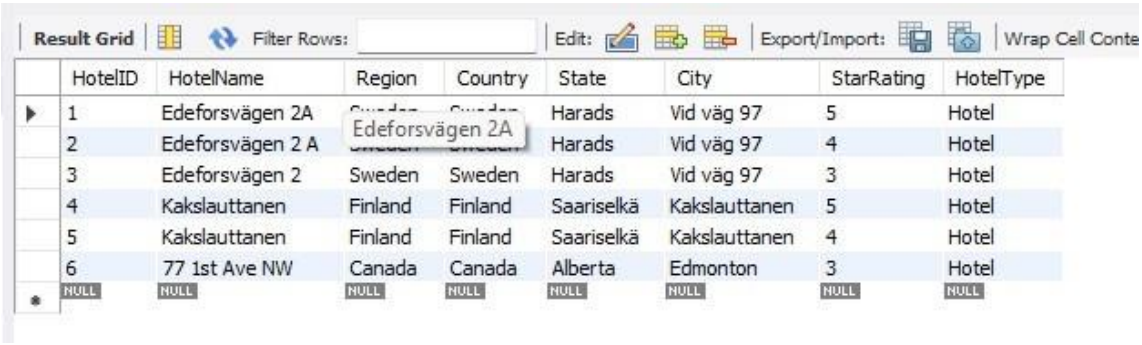
**Solution:**

select *from FactHotelOccupy5;

Result Grid | Filter Rows: | Export: | Wrap Cell Content:

| HotelId | RoomID | CustomerId | Date1 | No_of_occupied_rooms | No_of_vacant_rooms | Revenue |
|---|---|---|---|---|---|---|
| 1 | 2 | 6 | 2012-12-21 | 60 | 240 | 111615674 |
| 2 | 5 | 4 | 2015-06-01 | 150 | 50 | 875843568 |
| 3 | 3 | 1 | 2016-03-08 | 325 | 175 | 888765327 |
| 4 | 4 | 3 | 2019-04-04 | 236 | 214 | 777655532 |
| 5 | 6 | 2 | 2018-06-27 | 284 | 416 | 334455522 |
| 6 | 1 | 5 | 2015-12-06 | 657 | 43 | 987654329 |

select *from DimHotel2;



Result Grid | Filter Rows: | Edit: | Export/Import: | Wrap Cell Conte

| HotelID | HotelName | Region | Country | State | City | StarRating | HotelType |
|---|---|---|---|---|---|---|---|
| 1 | Edeforsvägen 2A | Sweden | Sweden | Harads | Vid väg 97 | 5 | Hotel |
| 2 | Edeforsvägen 2 A | Sweden | Sweden | Harads | Vid väg 97 | 4 | Hotel |
| 3 | Edeforsvägen 2 | Sweden | Sweden | Harads | Vid väg 97 | 3 | Hotel |
| 4 | Kakslauttanen | Finland | Finland | Saariselkä | Kakslauttanen | 5 | Hotel |
| 5 | Kakslauttanen | Finland | Finland | Saariselkä | Kakslauttanen | 4 | Hotel |
| 6 | 77 1st Ave NW | Canada | Canada | Alberta | Edmonton | 3 | Hotel |
| NULL | NULL | NULL | NULL | NULL | NULL | NULL | NULL |

5. Write SQL Queries for all the above OLAP operations.

**Solution :**

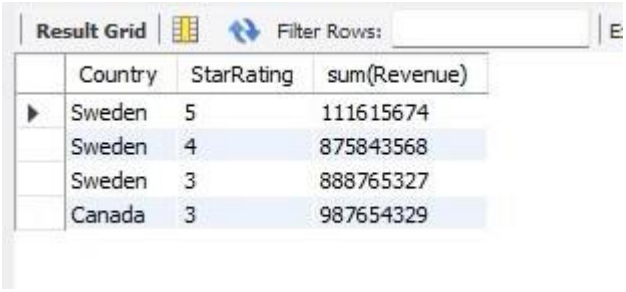
```
create database olapop;
use olapop;

CREATE TABLE DimHotel2(
    HotelID INT PRIMARY KEY,
    HotelName VARCHAR(255),
    Region VARCHAR(255),
    Country VARCHAR(255),
    State VARCHAR(255),
    City VARCHAR(255),
    StarRating INT,
    HotelType VARCHAR(255)
);

INSERT INTO DimHotel2(HotelID, HotelName, Region, Country, State, City, StarRating, HotelType) VALUES
(1, 'Edeforsvägen 2A', 'Sweden', 'Sweden', 'Harads', 'Vid väg 97', 5, 'Hotel'),
(2, 'Edeforsvägen 2 A', 'Sweden', 'Sweden', 'Harads', 'Vid väg 97', 4, 'Hotel'),
(3, 'Edeforsvägen 2', 'Sweden', 'Sweden', 'Harads', 'Vid väg 97', 3, 'Hotel'),
(4, 'Kakslauttanen', 'Finland', 'Finland', 'Saariselkä', 'Kakslauttanen', 5, 'Hotel'),
(5, 'Kakslauttanen', 'Finland', 'Finland', 'Saariselkä', 'Kakslauttanen', 4, 'Hotel'),
(6, '77 1st Ave NW', 'Canada', 'Canada', 'Alberta', 'Edmonton', 3, 'Hotel');
```

```
create table FactHotelOccupy5(
HotelId int,
RoomID int,
CustomerId int,
Date1 date,
No_of_occupied_rooms int,
No_of_vacant_rooms int, Revenue int, foreign key
(HotelId) references DimHotel2(HotelId)
);

insert into FactHotelOccupy5 values(1,2,6,'2012-12-21',60,240,111615674),
(2,5,4,'2015-06-01',150,50,875843568),
(3,3,1,'2016-03-08',325,175,888765327),
(4,4,3,'2019-04-04',236,214,777655532),
(5,6,2,'2018-06-27',284,416,334455522),
(6,1,5,'2015-12-06',657,43,987654329);

select *from FactHotelOccupy5;
select *from DimHotel2;

-- roll up operation
select Region, Country , State , City, sum(Revenue) from DimHotel2
inner join FactHotelOccupy5 on
DimHotel2.HotelID =
FactHotelOccupy5.HotelId group by
Region,Country, State , City with Rollup;
```

Result Grid | Filter Rows: | Export: | Wrap

| Region | Country | State | City | sum(Revenue) |
|---|---|---|---|---|
| Canada | Canada | Alberta | Edmonton | 987654329 |
| Canada | Canada | Alberta | NULL | 987654329 |
| Canada | Canada | NULL | NULL | 987654329 |
| Canada | NULL | NULL | NULL | 987654329 |
| Finland | Finland | Saariselkä | Kakslauttanen | 1112111054 |
| Finland | Finland | Saariselkä | NULL | 1112111054 |
| Finland | Finland | NULL | NULL | 1112111054 |
| Finland | NULL | NULL | NULL | 1112111054 |

-- *drill down operation* select Country , StarRating, sum(Revenue) from DimHotel2 inner join FactHotelOccupy5 on DimHotel2.HotelID = FactHotelOccupy5.HotelId where Country in ('Canada','Sweden') and StarRating in (1,2,3,4,5)



| Country | StarRating | sum(Revenue) |
|---|---|---|
| Sweden | 5 | 111615674 |
| Sweden | 4 | 875843568 |
| Sweden | 3 | 888765327 |
| Canada | 3 | 987654329 |

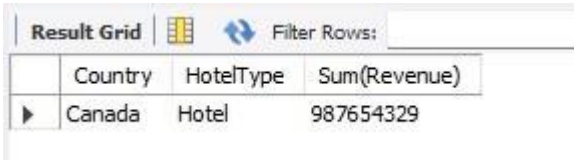
group by Country , StarRating;

-- *slice*
select Country, HotelType, Sum(Revenue) from DimHotel2 inner join FactHotelOccupy5 on DimHotel2.HotelID = FactHotelOccupy5.HotelId where HotelType='Hotel' group by Country;

| Country | HotelType | Sum(Revenue |
|---|---|---|
| Sweden | Hotel | 1876224569 |
| Finland | Hotel | 1112111054 |
| Canada | Hotel | 987654329 |

-- *dice*
select Country, HotelType, Sum(Revenue) from DimHotel2 inner join FactHotelOccupy5 on

```
DimHotel2.HotelID = FactHotelOccupy5.HotelId where HotelType='Hotel' and Country = 'Canada' group by Country;
```



Result Grid | Filter Rows:

| | Country | HotelType | Sum(Revenue) |
|---|---|---|---|
| ▶ | Canada | Hotel | 987654329 |

**Conclusion:**

How can the designed data warehouse and OLAP operations be applied to real-world business scenarios?

Ans. A well-designed data warehouse, combined with OLAP operations, enables businesses to efficiently analyze large datasets for decision-making. In real-world scenarios, companies use OLAP to perform operations like slice-and-dice, drill-down, and roll-up to explore sales trends, customer behaviors, and financial performance across different dimensions (e.g., time, region, product). For instance, a retailer can analyze product sales trends over time, drill down into specific locations, and adjust inventory accordingly. Similarly, marketing teams can evaluate campaign effectiveness by slicing data across demographics, enabling targeted strategies and improved customer satisfaction. These insights drive strategic decisions, optimizing business operations and profitability.

Provide an example of how a retail company can use the insights gained from OLAP operations to make strategic decisions.

Ans. A retail company can use OLAP to analyze sales data across dimensions like time, product category, and region. By slicing data by product category, the company identifies best-selling items, while drilling down by time shows peak sales periods. Rolling up data across regions highlights under-performing locations. Based on these insights, the company might increase inventory for popular products, launch targeted promotions during off-peak times, and address challenges in low-performing regions. These data-driven decisions optimize stock management, improve marketing efforts, and enhance overall profitability, ensuring the company remains competitive in the market.