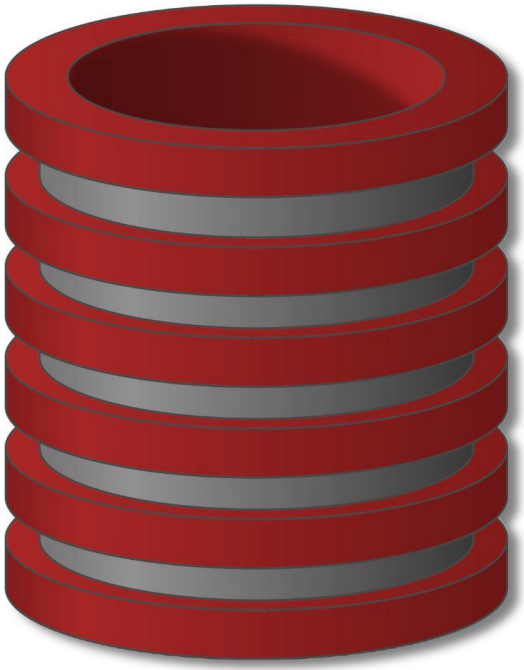


On-Line Analytical Processing (OLAP)

Introduction

Two broad types of database activity

- OLTP – Online Transaction Processing
  - Short transactions
  - Simple queries
  - Touch small portions of data
  - Frequent updates
- OLAP – Online Analytical Processing
  - Long transactions
  - Complex queries
  - Touch large portions of the data
  - Infrequent updates

More terminology

- Data warehousing

  Bring data from operational (OLTP) sources into a single "warehouse" for (OLAP) analysis

- Decision support system (DSS)

  Infrastructure for data analysis
  E.g., data warehouse tuned for OLAP

"Star Schema"

- Fact table

  Updated frequently, often append-only, very large

  Sales transactions, course enrollments, page views

- Dimension tables

  Updated infrequently, not as large

  - stores, items, customers
  - students, courses
  - web pages, users, advertisers

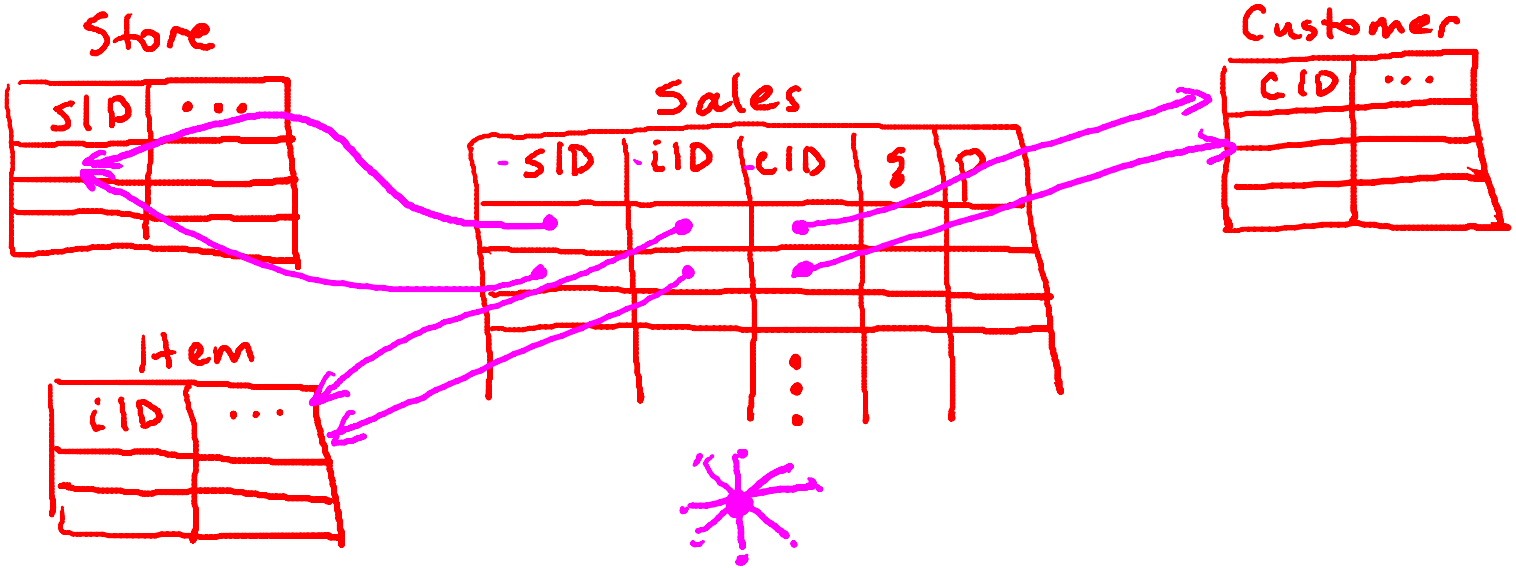
Star Schema – fact table references dimension tables

F Sales(storeID, itemID, custID, qty, price)

D
Store(storeID, city, state)
Item(itemID, category, brand, color, size)
Customer(custID, name, address)

Dimension attributes

Dependent attributes



OLAP queries

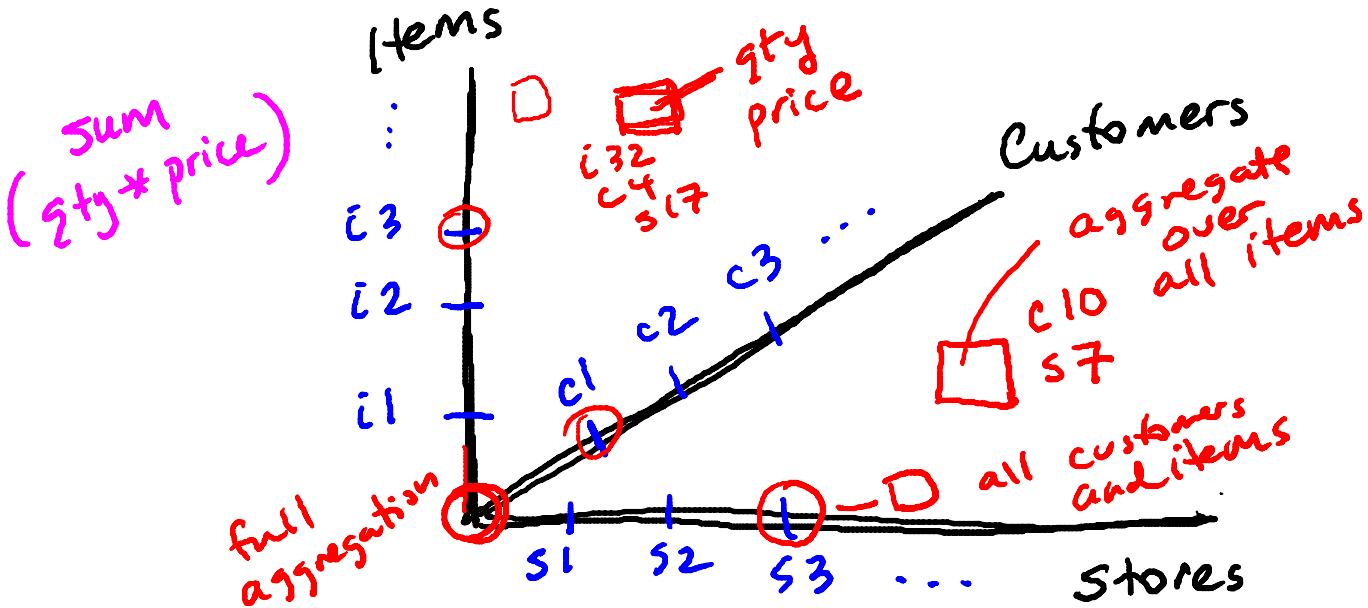
```
Sales(storeID, itemID, custID, qty, price)
Store(storeID, city, state)
Item(itemID, category, brand, color, size)
Customer(custID, name, address)
```

Join → Filter → Group → Aggregate

- Performance
  - Inherently very slow:
    special indexes, query processing techniques
  - Extensive use of materialized views

Data Cube (a.k.a. multidimensional OLAP)

- Dimension data forms axes of "cube"
- Fact (dependent) data in cells
- Aggregated data on sides, edges, corner



Fact table uniqueness for data cube

```
Sales(storeID, itemID, custID, qty, price)
```

- If dimension attributes not key, must aggregate
- **`Date`** can be used to create key

  Dimension or dependent?

Drill-down and Roll-up

Drill-down and Roll-up

Examining summary data, break out by dimension attribute

```
Select state, brand, Sum(qty*price)
From Sales F, Store S, Item I
Where F.storeID = S.storeID And F.itemID = I.itemID
Group By state, brand
```

category

Drill-down and **Roll-up**

Examining data, summarize by dimension attribute

```
Select state, brand, Sum(qty*price)
From Sales F, Store S, Item I
Where F.storeID = S.storeID And F.itemID = I.itemID
Group By state, brand
```

SQL Constructs

With Cube and With Rollup

```
Select dimension-attrs, aggregates
From tables
Where conditions
Group By dimension-attrs With Cube
```

Add to result: faces, edges, and corner of cube using NULL values

SQL Constructs

With Cube and With Rollup

```
Select dimension-attrs, aggregates
From tables
Where conditions
Group By dimension-attrs With Rollup
```

For hierarchical dimensions, portion of **With Cube**

Two broad types of database activity

- OLTP – Online Transaction Processing
  - Short transactions
  - Simple queries
  - Touch small portions of data
  - Frequent updates
- OLAP – Online Analytical Processing
  - Star schemas
  - Data cubes
  - `With Cube` and `With Rollup`
  - Special indexes and query processing techniques