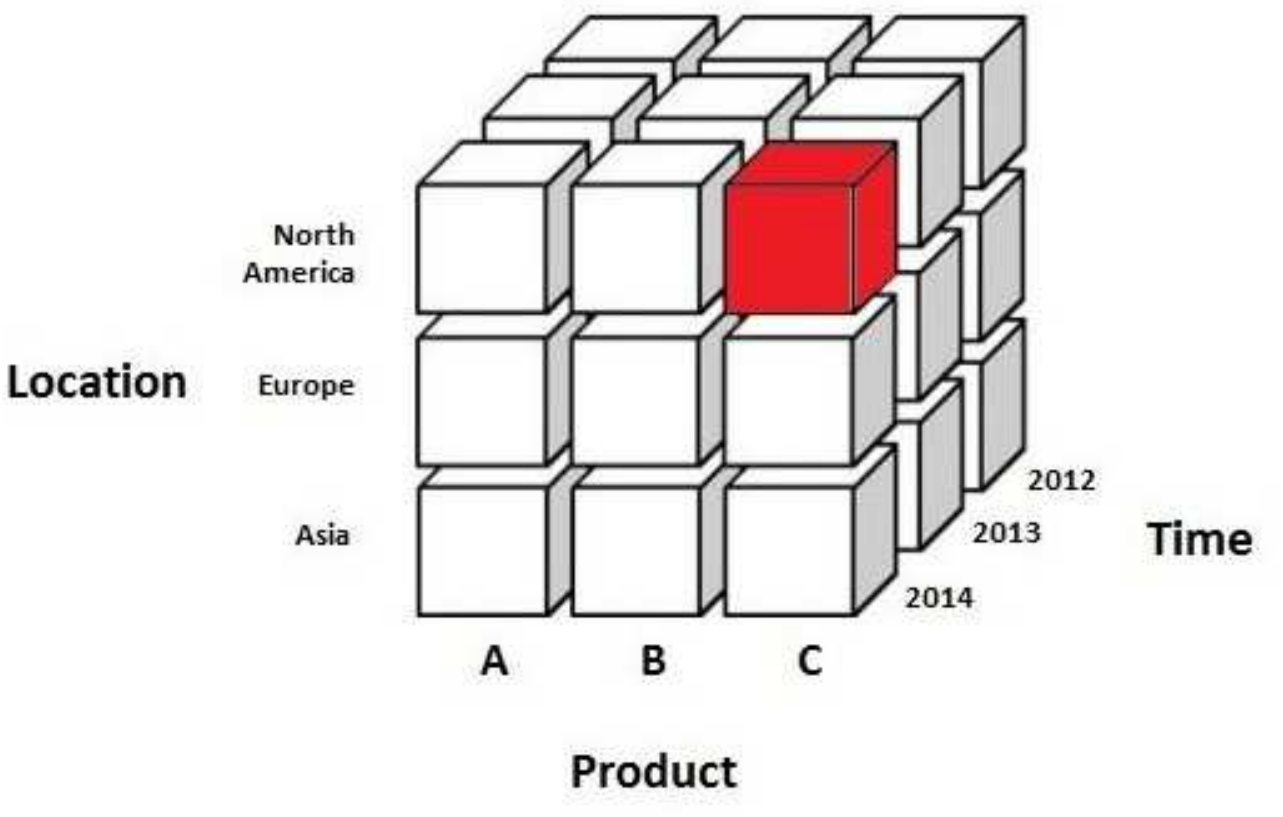
CS2102 Lecture 11b
DBMS Landscape

DBMS Landscape

- OLTP (On-Line Transaction Processing)
  - Characteristics:
    - Large data (Gigabytes to Terabytes)
    - ACID transactions
    - Workload: small update transactions
- Data Warehouse
  - a.k.a. OLAP (On-Line Analytical Processing)
  - Characteristics:
    - Very large data (Terabytes to Petabytes)
    - Workload: compex read-mostly queries (e.g., business intelligence, data mining)
- Everything else

OLAP: Multidimensional Data Model

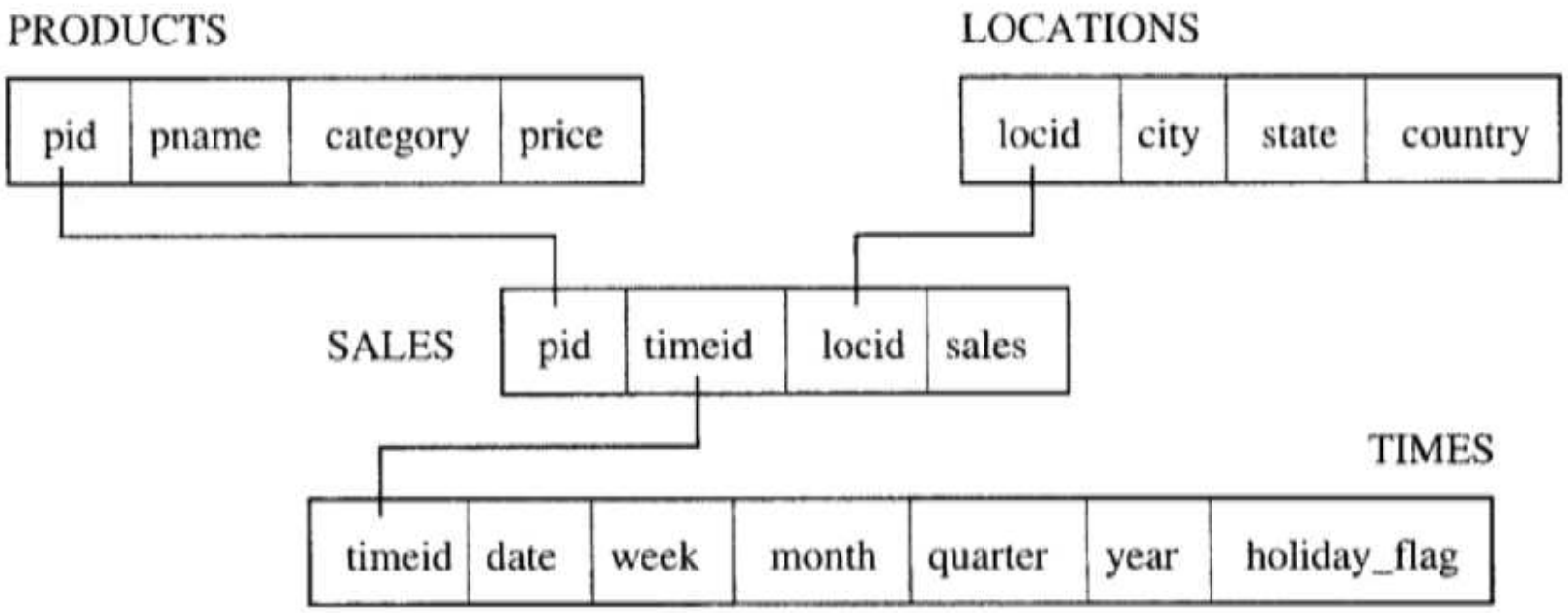
- Stores a collection of numeric measures
- Each measure depends on a set of dimensions



http://www.openit.com/faster-analysis-with-olap/

OLAP: Star Schema

- Data is modeled using a fact table & dimension tables



(Ramakrishnan & Gehrke, 2003)

OLAP: Multidimensional Aggregation

Find the total sales

```
SELECT SUM(sales) FROM Sales
```

Find the total sales for each state

```
SELECT L.state, SUM(S.sales)
FROM Sales S JOIN Locations L ON S.locid = L.locid
GROUP BY L.state
```

Find the total sales for each city and year

```
SELECT L.city, T.year, SUM(S.sales)
FROM Sales S JOIN Locations L ON S.locid = L.locid
JOIN Times T ON S.timeid = T.timeid
GROUP BY L.city, T.year
```

Find the total sales for each city, year, category

```
SELECT L.city, T.year, P.category, SUM(S.sales)
FROM Sales S JOIN Locations L ON S.locid = L.locid
JOIN Times T ON S.timeid = T.timeid JOIN Products P ON S.pid = P.pid
GROUP BY L.city, T.year, P.category
```

OLAP: Multidimensional Aggregation

Find the total sales for each city, year, category
Find the total sales for each city, year
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Find the total sales for each city
Find the total sales for each year
Find the total sales for each category
Find the total sales

```
SELECT      L.city, T.year, P.category, SUM(S.sales)
FROM        Sales S JOIN Locations L ON S.locid = L.locid
            JOIN Times T ON S.timeid = T.timeid
            JOIN Products P ON S.pid = P.pid
GROUP BY    CUBE (L.city, T.year, P.category)
```

`https://www.postgresql.org/docs/current/static/queries-table-expressions.html`

OLAP: Analytic Window Functions

For each state and month, compute its moving average sales over three months

```
SELECT   L.state, T.month, AVG(S.sales) OVER W AS movingAvg
FROM     Sales S, Times T, Location L
WHERE    S.timeid = T.timeid AND S.locid = L.locid
WINDOW   W AS (PARTITION BY L.state
               ORDER BY T.month
               RANGE BETWEEN INTERVAL '1' MONTH PRECEDING
               AND INTERVAL '1' MONTH FOLLOWING)
```

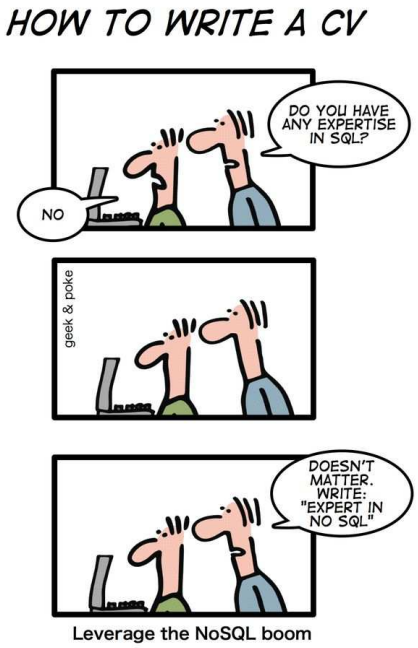
`https://www.postgresql.org/docs/current/static/tutorial-window.html`

Modern DBMSs: NoSQL & NewSQL

http://www.informationweek.com/big-data/big-data-analytics/16-nosql-newsql-databases-to-watch/d/d-id/1269559

NoSQL Systems

- Early NoSQL Systems
  - Google's Bigtable
  - Amazon's Dynamo
  - Yahoo!'s PNUTS
- Data Models:
  - Key-value
  - Document
  - Graph
  - etc.



- Features of many early NoSQL systems
  - Schema-less data
  - Simple access API (put & get) instead of query language
  - Limited/No ACID transactional support
  - Weak consistency for replicated data

NewSQL Systems

- Targeted at OLTP workloads
- Features
  - Relational data model
  - SQL query language
  - ACID transactions
  - Runs on distributed cluster of shared-nothing nodes
- Some examples:
  - Clustrix
  - CockroachDB
  - Google's Spanner
  - MemSQL
  - Microsoft's Azure Cosmos DB
  - VoltDB