Views

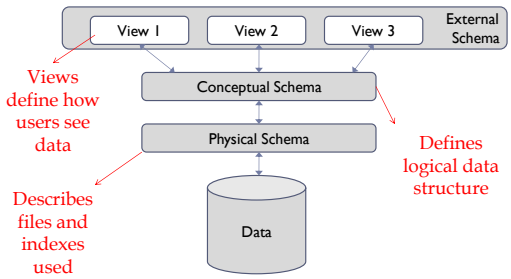
CS430/630
Lecture 11

Slides based on "Database Management Systems" 3rd ed, Ramakrishnan and Gehrke

Views

- So far, we have looked at SQL tables
  - Relations that are persistent
  - Physically stored in the DBMS
- It is also possible to have virtual relations, or views
  - Defined by an expression which is a SQL query
  - Do not exist physically in DBMS
    - Although it is possible to used materialized views
- Views can be queried directly
  - In some cases, it is also possible to modify views

Levels of Abstraction



Creating a view

View

```
CREATE VIEW RegionalSales (category, sales, state)
    AS SELECT P.category, S.sales, L.state
       FROM Products P, Sales S, Locations L
       WHERE P.pid=S.pid AND S.locid=L.locid
```

Defining Query (also referred to as View Subquery)

Base Tables

Querying views

Querying Views

```
SELECT R.category, R.state, SUM(R.sales)
FROM RegionalSales R GROUP BY R.category, R.state
```

- Views are queried just like regular tables
  - A view is just another relation (albeit a virtual one)
  - Queries can involve both views and base tables
  - Helps to think of views in terms of analogy with window on data

Views as subqueries

Equivalent Query (without views)

```
SELECT R.category, R.state, SUM(R.sales)
FROM (SELECT P.category, S.sales, L.state
      FROM Products P, Sales S, Locations L
      WHERE P.pid=S.pid AND S.locid=L.locid) R
GROUP BY R.category, R.state
```

SubQuery

Why are views useful?(1/3)

- Usability
  - Certain information must be retrieved from many tables
  - View abstraction can get all info in one (virtual) table
  - Queries are much easier to write on a single table
  - Subqueries that are often used can be included in queries without need for nesting

Why are views useful? (2/3)

- Compatibility
  - Shield users and application developer from changes
  - What if a schema changes? Define view that looks like the old schema
  - Users/applications access view, no changes needed in queries
  - "Obsolete" tables are preserved using views

Why are views useful? (3/3)

- Security
  - Restrict user access to certain data only
    - Managers and employees are given different "views" of same data
  - Both column- and row-level access control possible
  - Column-wise: students can only access `Name` and `Age` columns from a `Student` table
  - Row-wise: access only transactions above $10,000 value

Modifying views

- Is it possible to insert, update, delete tuples in a view?
  - Views are virtual …
  - … so modifications must be reflected in the base tables
- Why modifying views is a subtle issue?
  - Difficulty of translating view modifications in a unique way of updating base tables
    - Must be non-ambiguous in how to trace the base table tuple to update
- Views can be modified subject to restrictions
  - These are called updatable views
  - Still, many views are not updatable

Updatable Views

- SQL-92 provides formal definition of updatable view:

1. View involves a **single** relation *R*. If *R* is a view, it must also be updatable (relaxed in SQL-99)
2. Aggregate operations are **not** present in the view definition
3. The DISTINCT keyword is **not** specified in SELECT clause
4. All columns in subquery are simple columns, **not** expressions
5. The WHERE clause **must not** contain a subquery involving *R*
6. All attributes in *R* that are not in the SELECT clause of the view must **not** have both NOT NULL restriction and no default

Updatable Views (contd.)

- Insertion can be done directly on the base table
  - Other attributes in *R* set to NULL
- Deletion also possible
  - Delete tuple from base table
- Both insertion and deletion may cause problems!

Issues with insertion

View Definition

```
CREATE VIEW TopStudents (sname)
        AS SELECT Name
        FROM Students S
        WHERE S.gpa > 3.0;
```

- Now let's insert a new student

```
INSERT INTO TopStudents VALUES ('FirstLastName');
```

- GPA is set to NULL
  - Tuple falls outside view definition!
  - Not a mistake, but update will not be reflected in view!
    - WITH CHECK OPTION clause disallows such an insertion
  - One solution is to include GPA in view definition

Issues with deletion

```
CREATE VIEW TopStudents (sname)
        AS SELECT Name
        FROM Students S
        WHERE S.gpa > 3.0;
```

- Now let's delete students named Johnson

```
DELETE FROM TopStudents WHERE Name LIKE '%Johnson%';
```

- Must only affect tuples in the view!
  - Outside tuples must be inaccessible (views used for security, too)
  - DBMS appends WHERE clause in view definition to statement

```
DELETE FROM Students WHERE Name LIKE '%Johnson%'
        AND S.gpa > 3.0;
```


Deleting views

```
DROP VIEW RegionalSales;
```

- View deleted from the schema
  - Note that, underlying data still intact
  - Contrast this with DROP TABLE!

View Materialization

- Materialized views can help speed up popular queries
  - Result has to be maintained when base tables change
  - They are stored just like base tables
  - But their contents are not "independent"; they must constantly reflect base tables

Example

```
Movies (movie_id, title,     year,          studio)
Actors (actor_id, name,      nationality)
StarsIn(actor_id, movie_id, character)
```

Create view **ActorSummary** that lists for every actor the actor identifier, actor name, number of movies starred in, and the year of debut (i.e., the year of the earliest movie(s) the actor starred in). The view will have four columns with headings:
ID, ActorName, MovieCount and DebutYear

```
CREATE VIEW ActorSummary(ID, ActorName, MovieCount, DebutYear )
AS

SELECT A.actor_id, A.name, COUNT(M.movie_id), MIN(M.year)
FROM Actors A, StarsIn S, Movies M
WHERE A.actor_id = S.actor_id AND S.movie_id = M.movie_id
GROUP BY A.actor_id, A.name;
```

Example 2

```
Employee (eid:integer, ename:string, age:integer, salary:real)
Works (eid:integer, did:integer, pct_time:integer)
Department(did:integer, dname:string, budget:real, managerid:integer)
```

Create a view **ManagerSummary** that lists for every department the department name, manager ID and manager name, manager salary and the number of employees in that department. The view will have five columns with headings:
DeptName, MgrID, MgrName, MgrSalary and EmpCount.

```
CREATE VIEW ManagerSummary(DeptName, MgrName, MgrID,
        MgrSalary, EmpCount) AS

SELECT D.dname, D.managerid, E.ename, E.salary, COUNT(W.eid)
FROM Department D, Employee E, Works W
WHERE D.managerid = E.eid AND D.did = W.did
GROUP BY D.did, D.dname, D.managerid, E.ename, E.salary;
```