DATA INDEPENDENCE AND DATABASE VIEWS

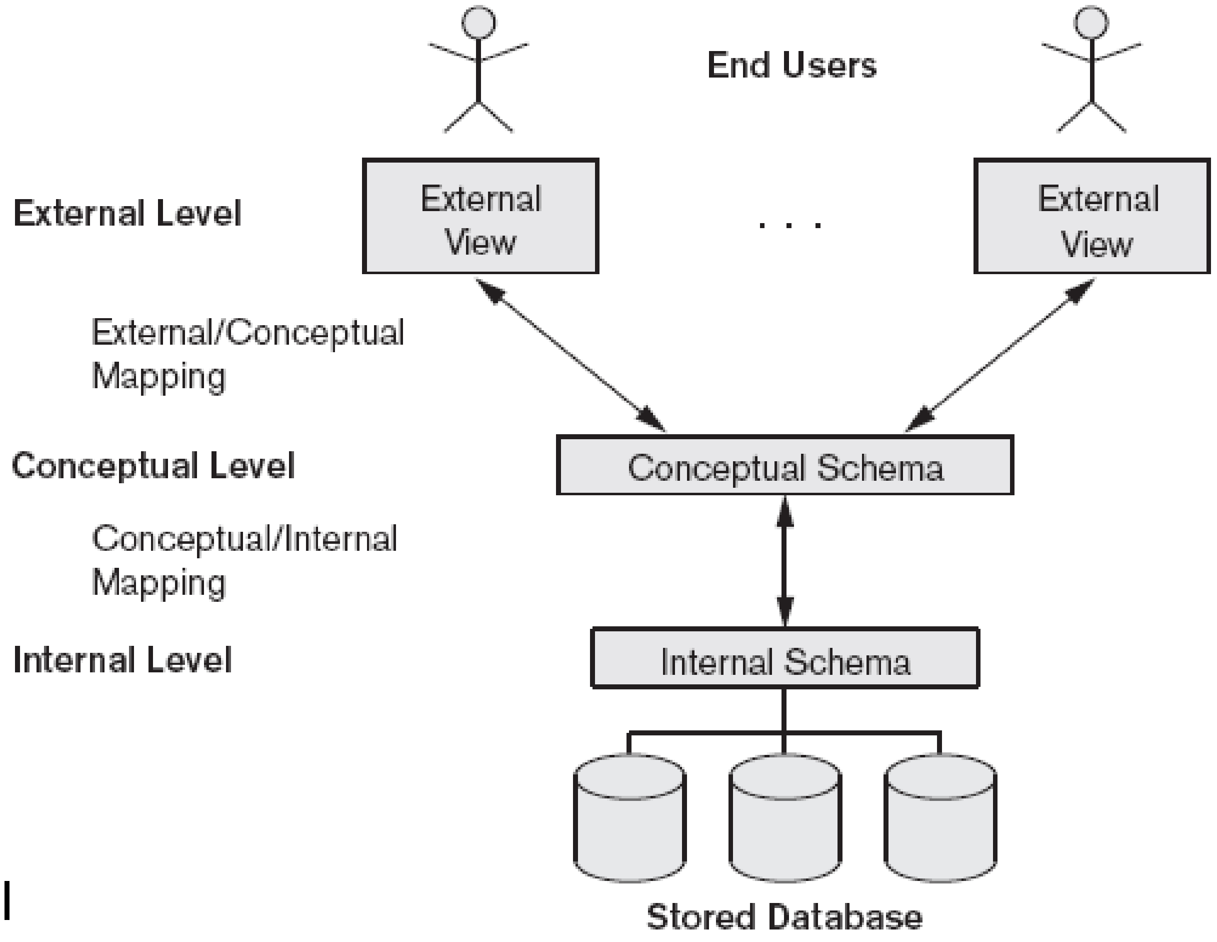
CHAPTER 5 (6/E)

CHAPTER 8 (5/E)

LECTURE OUTLINE

- Three-Schema Architecture and Data Independence
- Database views
- Materialized views

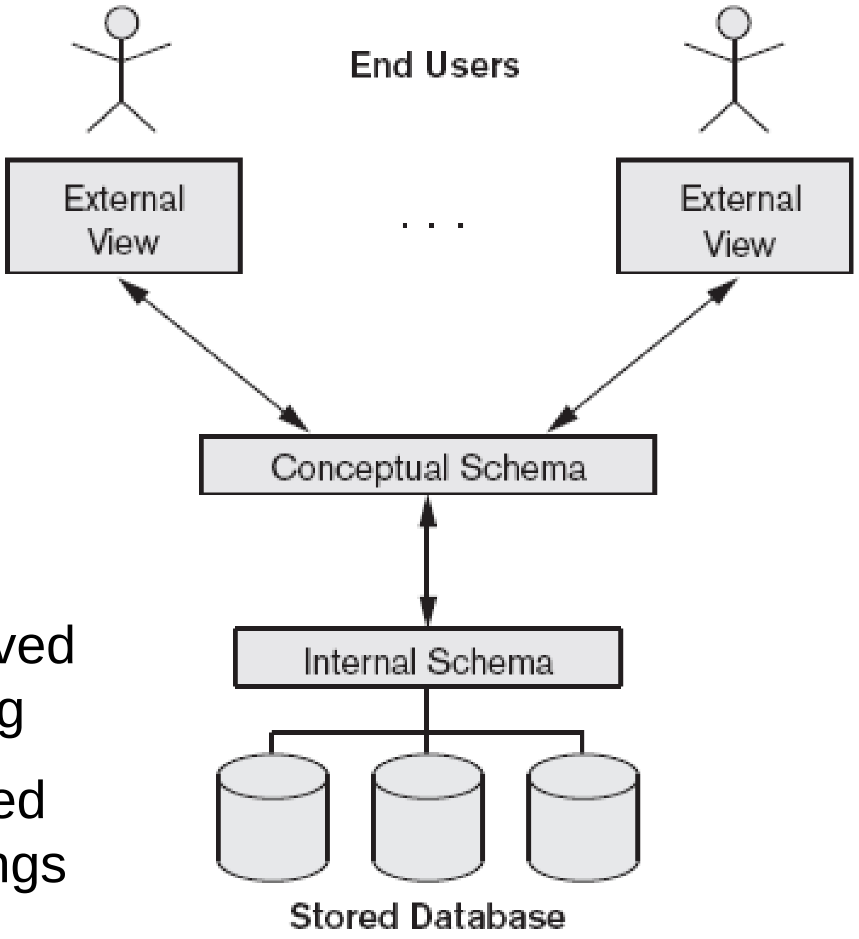
THREE-SCHEMA ARCHITECTURE



- **Internal** level
  - Describes physical storage structure of the database
- **Conceptual** level
  - Describes structure of the whole DB for the complete community of users
- **External** or **view** level
  - Describes part of the DB of interest to a particular user group

DATA INDEPENDENCE

- Capacity to change the schema at one level of a database system without having to change the schema at the next higher level
  - Change the mappings between schemas



- **Physical** data independence achieved through conceptual/internal mapping
- **Logical** data independence achieved through external/conceptual mappings

VIEWS FOR CUSTOMIZATION

- Consider database(s) describing university's activities
  - Academic institution
    - Students, professors, classes
    - Grades, transcripts
    - Admissions, convocations
    - Alumni
  - Corporate institution
    - Finances, human resources
    - Board of Governors
    - Capital assets
  - Charitable institution
    - Donors, fundraising activities
  - Research institution
    - Granting agencies, industrial/non-profits/academic partners
    - Grants and contracts, intellectual property, licensing
- Each user group provided appropriate "subset" of the data
  - e.g., some financial/scheduling info relevant to most groups; other info confidential
  - Underlying data *shared*, *not silo'd*
- Updates must be seen by all affected users

VIEWS (VIRTUAL TABLES)

- Consider again the query

```
SELECT title, year, genre
FROM Film
WHERE director = 'Steven Spielberg' AND year > 1990;
```

  - Returns all matching films currently in the database
  - If re-run after updates, will give revised table of matches

- A **view** is an *unexecuted query* that can be run on demand
  - Single table derived from other table(s)
  - A virtual table

USING VIEWS IN SQL

- **`CREATE VIEW`** command
  - View name and a query to specify the contents of the view

```
CREATE VIEW Big_Earners AS
   SELECT E.Ssn AS Ssn, E.Lname AS Name,
          E.Salary AS Salary, M.Lname AS Manager
   FROM EMPLOYEE E, EMPLOYEE M
   WHERE E.Super_ssn = M.Ssn
     AND E.Salary > M.Salary;
```

- Queries can use view as if it were a base table

```
SELECT *
FROM Big_Earners
WHERE Salary < 100000;
```

- View always up-to-date
  - (Re-)evaluated whenever a query uses the view
- **`DROP VIEW`** command: dispose of a view

UPDATING A VIEW

- What if an update is applied to a view as if it were a base table?

```
CREATE VIEW Big_Earners AS
   SELECT E.Ssn AS Ssn, E.Lname AS Name,
          E.Salary AS Salary, M.Lname AS Manager
   FROM EMPLOYEE E, EMPLOYEE M
   WHERE E.Super_ssn = M.Ssn
     AND E.Salary > M.Salary;

UPDATE Big_Earners
SET Salary = 100000
WHERE Name = 'Smith';
```

- Change corresponding tuple(s) in base table(s)
- Tuple might disappear from view!
  - **`WITH CHECK OPTION`** clause at end of view definition ensures new and updated tuples match view definition (else error)

UPDATING A VIEW (CONT'D)

- Deleting tuple from view might require update to base table instead of deletion from base table
  - e.g., deletion from CS338 view $\overset{?}{=}$ deletion from UW database?

- Not all views are updateable
  - What if `Salary` defined as sum of two base attributes or as aggregate such as `SUM` or `AVG`?
  - What if `Big_Earners` defined as a `UNION` of two tables?

MATERIALIZED VIEWS

- If the base tables do not change, neither does the view instance
  - Re-executing view definition each time the view is used is wasteful if base data has not been updated
- Solution: **view materialization**
  - Create a temporary view table when the view is first queried
  - Keep view table on the assumption that more queries using the view will follow
  - Use *materialized* view (if it exists) to answer future queries
- Requires efficient strategy for updating the view table *automatically* when the base tables are updated

Options when any base table is updated:

1. Delete the materialized view
2. Rematerialize the view
3. Incrementally update the view
    - DBMS determines what new tuples must be inserted, deleted, or modified in materialized view

LECTURE SUMMARY

- Three-schema architecture achieves:
  - physical data independence and
  - logical data independence

- Views
  - Virtual or derived tables
  - Can be used for any query wherever base table can appear
  - May or may not be updatable (Unions, joins, and aggregate functions are problematic)

- Materialized views used to save query time
  - Must be kept up-to-date if base table(s) updated