Chapter 4: Intermediate SQL[1]

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[1]This is based on Textbook, its companion slide and other sources

Chapter Outline

Joins: 2 types

- Inner Join (also called Natural join)
- Outer Join

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- Inner Join (also called Natural join)
- Outer Join

Inner Join

Combines two tables in a natural way

It splits one large table into two. It removes both Redundancy and Inconsistency.

ID	*name*	*salary*	*dept_name*	*building*	*budget*
22222	Einstein	95000	Physics	Watson	70000
12121	Wu	90000	Finance	Painter	120000
32343	El Said	60000	History	Painter	50000
45565	Katz	75000	Comp. Sci.	Taylor	100000
98345	Kim	80000	Elec. Eng.	Taylor	85000
76766	Crick	72000	Biology	Watson	90000
10101	Srinivasan	65000	Comp. Sci.	Taylor	100000
58583	Califieri	62000	History	Painter	50000
83821	Brandt	92000	Comp. Sci.	Taylor	100000
15151	Mozart	40000	Music	Packard	80000
33456	Gold	87000	Physics	Watson	70000
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Inner Join (Cont.)

So, we will create two separate tables as such:

```
1        CREATE TABLE STUDENTS(
2        ID NUMBER PRIMARY KEY,
3        NAME VARCHAR2(30),
4        SALARY NUMBER(8,0)
5        );
6
```

```
1        CREATE TABLE DEPTS(
2        DEPT_NAME VARCHAR2(6)
       PRIMARY KEY,
3        BUILDING VARCHAR2(20),
4        BUDGET NUMBER(10,0)
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```

Is this splitting OK?

No. Since there is no linking attribute from the first table to the second one.

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3        NAME VARCHAR2(30),
4        SALARY NUMBER(8,0),
5        DEPT VARCHAR2(6),
6        CONSTRANTS FKSTU FOREIGN KEY
     (DEPT)
7        REFERENCING DEPTS
8        );
9
```

```
1
2        CREATE TABLE DEPTS(
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Inner Joins (Cont.)

How to retrieve values?

Lets reproduce the large big table: Find out the name of the employees along with their ID, salary, their dept name, dept location and dept budget.

By a Natural Join

```
1    SELECT S.ID,S.NAME,S.SALARY,D.DEPT_NAME,D.BUILDING,D.BUDGET
2    FROM STUDENTS S, DEPTS D
3    WHERE S.DEPT=D.DEPT_NAME;
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```

You can add any valid condition you like in the SQL.

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Inner Joins (Cont.)or Natural Join Syntax

- List the names of instructors along with the course ID of the courses that they taught

```
1       select name, course_id
2       from students, takes
3       where student.ID = takes.ID;
4
```

- Same query in SQL with **natural join** construct

```
1       select name, course_id
2       from student natural join takes;
3
```

Danger of Natural Join Construct

- Beware of unrelated attributes with same name which get equated incorrectly:
  In older style we write: (it is more comprehensive and used by the programmer)

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It assumes that both tables have ID in common which corresponds the same attribute (i.e. Student ID). But it may happen that one ID implies book ID!!!

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It assumes that both tables have ID in common which corresponds the same attribute (i.e. Student ID). But it may happen that one ID implies book ID!!!

Outer Join: Left, Right and Full

- An extension of the join operation that avoids loss of information. only matched records are selected
- Sometimes it is necessary to know both matched and non-matched records.
- The non-matched values are replaced by NULL
- This type of joining is termed as "Outer Join"
- 3 types of Outer Joins:
  1. Left outer join
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Outer Join: Left, Right and Full (Cont.)

1. **Left outer join.** All records from the first table and only the matched part from the second one.
2. **Right outer join.** All records from the second table and only the matched part from the first one.
3. **Full outer join.** All records from both tables. (merge into one)

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Outer Join: Left, Right and Full (Cont.)

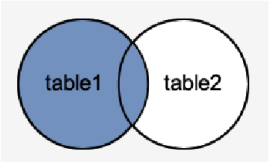

Figure: Left Outer Join

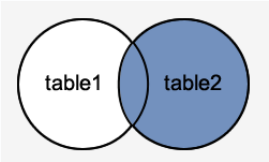

Figure: Right Outer Join

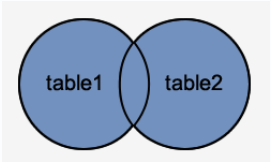

Figure: Full Outer Join

Lets do a simple implementation of the Joins!!

```
1      select name, course_id
2      from students Left Join
     takes
3      on student.ID = takes.ID;
4
```

Alternatively,

```
1      select name, course_id
2      from students, takes
3      where student.ID = takes.ID
     (+);
4
```

```
1      select name, course_id
2      from students Right Join
     takes
3      on student.ID = takes.ID;
4
```

Alternatively,

```
1      select name, course_id
2      from students, takes
3      where student.ID (+) =
     takes.ID ;
4
```

Views

What is a view?

Normally the relations are **stored** in the database. SQL allows a **virtual relation** to be defined by a query, and the relation conceptually contains the result of the query. The virtual relation is **not precomputed and stored**, but instead is **computed by executing the query whenever the virtual relation is used**.

Functions of a view:

1. Controls **security and access control** of sensitive information.
2. Helps to **reuse the code** (its calculated on the fly, avoiding writing complex query each time)

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How to create a view?

```
1    create view faculty as
2    select ID, name, dept name
3    from instructor;
4
```

DML through a view

Most SQL implementations allow updates only on simple views:

- The from clause has **only one database relation**.
- The select clause contains only attribute names of the relation, and does not have any expressions, **aggregates**, or distinct specification.
- Any attribute not listed in the select clause can be **set to null**.

The condition in general:

It suggests that when a view is essentially a subset of a single table, each attribute of the view has a 1-to-1 correspondence of its underlying base table's attribute and all the not-null attributes are included in the view.

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Materialized Views

Definition

Database systems allow view relations to be **stored**, but they make sure that, if the actual relations used in the view definition change, the view is **kept up-to-date**. Such views are called materialized views. Materialized views are updated through an **efficient batch process**. Used in **data warehousing** technology.

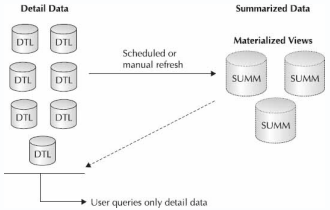

Figure: Materialized View

Benefits:

- For efficient and smooth running of the operational database (hence applications).
- Quick access time. (Local copy access is faster)

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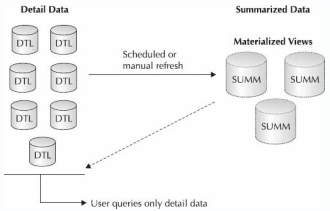

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Integrity Constraints

- These are the **set of restrictions and rules**. Integrity constraints guard against accidental damage to the database, by ensuring that authorized changes to the database do not result in a loss of data consistency.
- Integrity constraints are introduced **while designing the database schema**. The constraints are specified within the **SQL DDL** command like 'create table' and 'alter table' command.
- Note: It is possible to impose similar restrictions from the UI design, but it is generally recommended to impose them from the back-end (i.e. database) since it ensures better functionality of the system.

Some examples:

- A student must be attached to a department
- Phone number must be fulled up.

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Integrity Constraints on a Single Relation

- not null
- primary key
- unique
- check (P), where P is a predicate

Example: Integrity Constraints

```
1  CREATE TABLE EMP
2  (ID NUMBER PRIMARY KEY,
3  NAME VARCHAR2(20) NOT NULL,
4  SALARY NUMBER(10,2),
5  SHORTNAME VARCHAR2(10),
6  CONSTRAINT SAL_CHECK CHECK(SALARY>1000)
7  CONSTRAINT UNIQ_NAME UNIQUE(SHORTNAME)
8  );
9
```

Referential Integrity

Note: This refers to the Integrity Constraints on **Multiple Relations**

- Foreign Key
- Cascading actions (mostly supported in deletion, not in updating)

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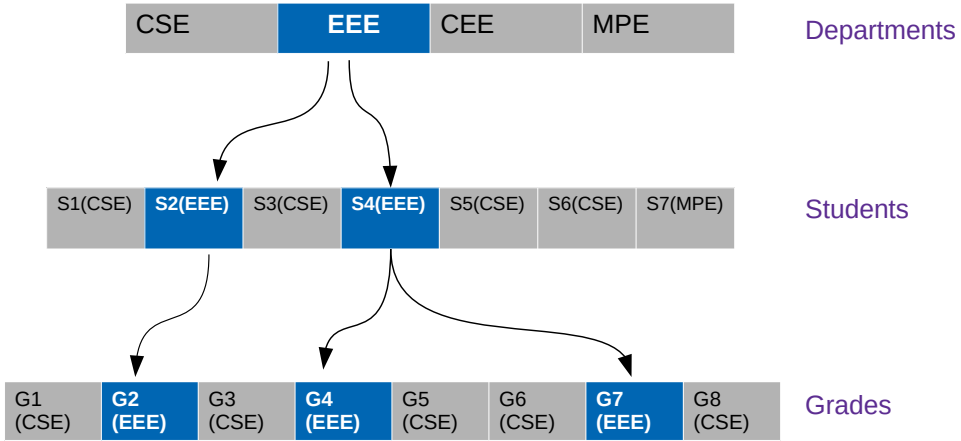
An example:

```
create table depts
(id number primary key,
name varchar2(10)
);
```

```
create table students
(sid number primary key,
name varchar2(10),
cgpa number(4,2),
dept number,
constraints fk_stu foreign key(dept)
references depts on delete cascade
);
```

Cascading Delete : Explained



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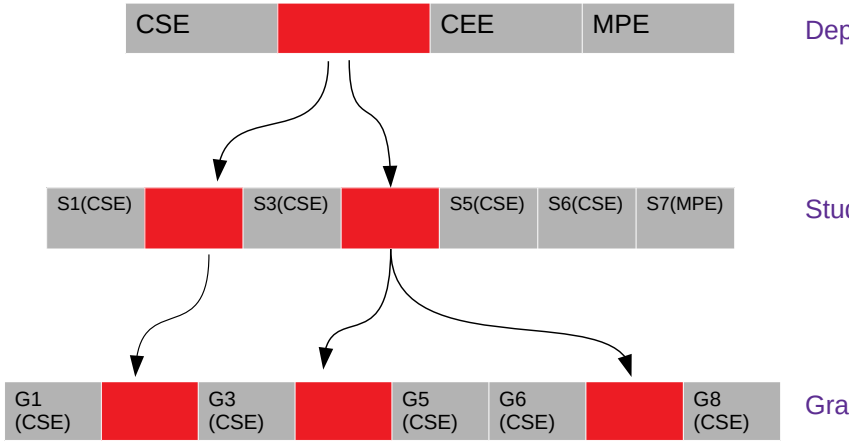

Demo of Cascading Action

Is it always good?

Integrity Constraint Violation During Transactions

- Consider:

```
1       create table person (
2       ID char(10) primary key,
3       name char(40),
4       mother char(10),
5       father char(10),
6       foreign key father references person,
7       foreign key mother references person)
8
```

- How to insert a tuple without causing constraint violation?
  - ✓ Insert father and mother of a person before inserting person
  - ✓ OR, set father and mother to null initially, update after inserting all persons (run a process to it..)
  - ✓ OR defer constraint checking

Date and Time Types in SQL

2 types of date related basic datatype: 1) Date 2)Timestamp. We will discuss only Date only. See details of Timestamp for your further interest.

DATE

The DATE data type allows you to store point-in-time values that include both date and time with a precision of one second. It includes Year, Month, Hour, Minute and Second. Default format is DD-MON-YY, example: 20-SEP-18.

Date (Cont.): *TO_CHAR()* function

TO_CHAR() function is used to change the default format:

Format Specifier	Meaning
YYYY	4-digit year
YY	2-digit year
MONTH	Month name (January - December)
MM	Month (1 - 12)
DD	Day (1 - 31)
DY	Abbreviated day (Sun - Sat)
Day	Day (Sunday, Monday)
HH24	Hour (0 - 23)
HH or HH12	Hour (1 - 12)
MI	Minutes (0 - 59)
SS	Seconds (0 - 59)

```
1
2
3
4
5
```

```
SELECT TO_CHAR(SYSDATE, 'YYYY-MM-DD')
FROM dual;

Output:  2012-07-19
```

Date (Cont.): ToDate function

Is used to a convert a string to a DATE datatype.
Example:

```
1
2
3       SELECT TO_DATE( '5 Jan 2017', 'DD MON YYYY' )
4       FROM dual;
5
6       Output: 05-JAN-17
7
8       --Now you can use any date function on it:
9
10      select to_date('5 Feb 2018','DD MON YYYY')+100
11      FROM DUAL;
12
13      Output: 16-MAY-18
14
15
```

Built-in (major) functions on Date

- ADD_MONTHS(date, n):
  SELECT ADD_MONTHS(SYSDATE,13) FROM DUAL;
  Output: 04-AUG-21
- NEXT_DAY(date,NameOfDay):
  SELECT NEXT_DAY(SYSDATE,'FRIDAY') FROM DUAL;
  Output: 10-JUL-20
- MONTHS_BETWEEN(date1, date2):
  SELECT MONTHS_BETWEEN('18-FEB-92','14-MAY-89')FROM DUAL;
  Output: 33.1290323

Large-Object Types

- Large objects (photos, videos, CAD files, etc.) are stored as a large object.
- blob: binary large object – object is a large collection of uninterpreted binary data (whose interpretation is left to an application outside of the database system)
- clob: character large object – object is a large collection of character data.
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- Large objects (photos, videos, CAD files, etc.) are stored as a large object.
- blob: binary large object – object is a large collection of uninterpreted binary data (whose interpretation is left to an application outside of the database system)
- clob: character large object – object is a large collection of character data.
- When a query returns a large object, a pointer is returned rather than the large object itself. Special programming is needed to manipulate it.

Create Table Extensions: (4.5.6)

- Need similar table structure often.
- We seek a shortcut to lend the structure from existing one.
- structure can be copied as well as data.
- Default it copies both structure and data.
- To exclude data use a clever trick in where clause.

Syntax:

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2     CREATE TABLE NEW_STUDENTS
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It creates a table similar to the selected attributes and copy all data into it.

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Authorization (4.6)

- Role-based Access Control.
- It is used to distribute a large system into a number of users with different access controls.
- Normally SELECT, UPDATE, DELETE, INSERT are the privileges on a database for tables or views.
- Additionally, EXECUTE is another privilege for sub-program (will be covered later).
- Role is created and customized (it is like a package of actions)
- Then the owner grant (opposite is itermrevoke) the created role to a specific user.
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Granting privileges: Syntax

```
1  grant <privilege list>
2  on <relation name or view name>
3  to <user/role list>;
4
5
6  --privilege list is:
7  SELECT, UPDATE, INSERT, DELETE, (AND EXECUTE)
8
```

Role-Based Access Control: Overview

Given Scenario: Result Processing System (RPS)

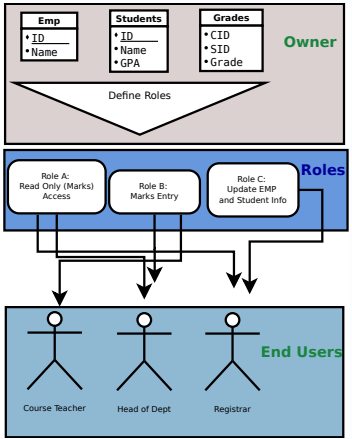

Figure: Role-based Access Control: Concept

Thank You.