Chapter 3: Introduction to SQL

Database System Concepts, 6th Ed.

Chapter 3: Introduction to SQL

- Overview of the SQL Query Language
- Data Definition
- Basic Query Structure
- Additional Basic Operations
- Set Operations
- Null Values
- Aggregate Functions
- Nested Subqueries
- Modification of the Database

History

- IBM Sequel language developed as part of System R project at the IBM San Jose Research Laboratory
- Renamed Structured Query Language (SQL)
- ANSI and ISO standard SQL:
  - SQL-86, SQL-89, SQL-92
  - SQL:1999, SQL:2003, SQL:2006, SQL:2008, SQL:2011, SQL:2016.
- Commercial systems offer most, if not all, SQL-92 features, plus varying feature sets from later standards and special proprietary features.
  - Not all examples here may work on your particular system.

Data Definition Language

The SQL **data-definition language (DDL)** allows the specification of information about relations, including:

- The schema for each relation.
- The domain of values associated with each attribute.
- Integrity constraints
- And as we will see later, also other information such as
  - The set of indices to be maintained for each relations.
  - Security and authorization information for each relation.
  - The physical storage structure of each relation on disk.

Domain Types in SQL

- **char(n).** Fixed length character string, with user-specified length *n.*
- **varchar(n).** Variable length character strings, with user-specified maximum length *n.*
- **int.** Integer (a finite subset of the integers that is machine-dependent).
- **smallint.** Small integer (a machine-dependent subset of the integer domain type).
- **numeric(p,d).** Fixed point number, with user-specified precision of *p* digits, with *d* digits to the right of decimal point.
  - → number(3,1) allows 44.5 to be store exactly, but neither 444.5 or 0.32
- **real, double precision.** Floating point and double-precision floating point numbers, with machine-dependent precision.
- **float(n).** Floating point number, with user-specified precision of at least *n* digits.
- More are covered in Chapter 4.

Built-in Data Types in SQL

date: Dates, containing a (4 digit) year, month and date

Example: **date** ‘2005-7-27’

time: Time of day, in hours, minutes and seconds.

Example: **time** ‘09:00:30’ **time** ‘09:00:30.75’

timestamp: date plus time of day

Example: **timestamp** ‘2005-7-27 09:00:30.75’

interval: period of time

Example: interval ‘1’ day

Subtracting a date/time/timestamp value from another gives an interval value

Interval values can be added to date/time/timestamp values

date, time functions:

current_date(), current_time()

year(x), month(x), day(x), hour(x), minute(x), second(x)

Create Table Construct

An SQL relation is defined using the **create table** command:

create table r (A_1 D_1, A_2 D_2, ..., A_n D_n,
(integrity-constraint$_1$),
...,
(integrity-constraint$_k$))

r is the name of the relation

each A_i is an attribute name in the schema of relation r

D_i is the data type of values in the domain of attribute A_i

Example:

create table *instructor* (
ID **char**(5),
name **varchar**(20) **not null,**
dept_name **varchar**(20),
salary **numeric**(8,2))

insert into *instructor* **values** ('10211', 'Smith', 'Biology', 66000);

insert into *instructor* **values** ('10211', null, 'Biology', 66000);

Integrity Constraints in Create Table

not null

primary key (A_1, ..., A_n)

foreign key (A_m, ..., A_n) **references** *r*

Example: Declare *ID* as the primary key for *instructor*

.

create table *instructor* (
ID **char**(5),
name **varchar**(20) **not null,**
dept_name **varchar**(20),
salary **numeric**(8,2),
primary key (*ID*),
foreign key *(dept_name*) **references** *department)*

primary key declaration on an attribute automatically ensures **not null**

And a Few More Relation Definitions

create table *student* (
ID **varchar**(5),
name **varchar**(20) not null,
dept_name **varchar**(20),
tot_cred **numeric**(3,0),
primary key (*ID*),
foreign key (*dept_name*) **references** *department)*);

create table *takes* (
ID **varchar**(5),
course_id **varchar**(8),
sec_id **varchar**(8),
semester **varchar**(6),
year **numeric**(4,0),
grade **varchar**(2),
primary key *(ID, course_id,* ***sec_id****, semester, year),*
foreign key (*ID*) **references** *student,*
foreign key (*course_id, sec_id, semester, year*) **references** *section*);

Note: ***sec_id*** can be dropped from primary key above, to ensure a student cannot be registered for two sections of the same course in the same semester

And more still

create table *course* (
    course_id **varchar**(8) **primary key**,
    title **varchar(**50),
    dept_name **varchar**(20),
    credits **numeric**(2,0),
    foreign key (*dept_name*) **references** *department*);

foreign key *(dept_name*) **references** *department)*

on delete cascade |set null |restrict |set default

on update cascade |set null |restrict |set default,

teaches

ID	*course_id*
10101	CS-101
12121	FIN-201
76766	BIO-101

instructor

ID	*name*	*dept_name*
10101	Srinivasan	Comp. Sci.
12121	Wu	Finance
76766	Mozart	Music

Drop and Alter Table Constructs

drop table *student*

Deletes the table and its contents

delete from *student*

Deletes all contents of table, but retains table

alter table

alter table *r* **add** *A D*

- where *A* is the name of the attribute to be added to relation *r* and *D* is the domain of *A.*
- All tuples in the relation are assigned *null* as the value for the new attribute.
- **alter table** *student* **add** *resume* ***varchar(256)****;*

alter table *r* **drop** *A*

- where *A* is the name of an attribute of relation *r*
- Dropping of attributes not supported by many databases

Basic Query Structure

The SQL **data-manipulation language (DML)** provides the ability to query information, and insert, delete and update tuples

A typical SQL query has the form:

select $A_1, A_2, ..., A_n$
from $r_1, r_2, ..., r_m$
where P

A_i represents an attribute

R_i represents a relation

P is a predicate.

The result of an SQL query is a relation.

The select Clause

The **select** clause list the attributes desired in the result of a query

corresponds to the **projection operation** of the relational algebra

Example: find the names of all instructors:

select *name*
from *instructor*

NOTE: SQL names are case insensitive (i.e., you may use upper- or lower-case letters.)

E.g. *Name* ≡ *NAME* ≡ *name*

Some people use upper case wherever we use bold font.

The select Clause (Cont.)

SQL allows duplicates in relations as well as in query results.

To force the elimination of duplicates, insert the keyword **distinct** after select**.**

Find the names of all departments with instructor, and **remove duplicates**

select distinct *dept_name*
from *instructor*

The keyword **all** specifies that duplicates not be removed.

select all *dept_name*
from *instructor*

The select Clause (Cont.)

An asterisk in the select clause denotes “all attributes”

select *

from *instructor*

The **select** clause can contain arithmetic expressions involving the operation, +, –, $*$, and /, and operating on constants or attributes of tuples.

The query:

select *ID, name, salary/12*
from *instructor*

would return a relation that is the same as the *instructor* relation, except that the value of the attribute *salary* is divided by 12.

The where Clause

The **where** clause specifies conditions that the result must satisfy

- Corresponds to the **selection predicate** of the relational algebra.

To find all instructors in Comp. Sci. dept with salary > 80000

select *name*
from *instructor*
where *dept_name* = ‘Comp. Sci.' **and** *salary* > 80000

Comparison results can be combined using the logical connectives **and, or,** and **not.**

Comparisons can be applied to results of arithmetic expressions.

Where Clause Predicates

SQL includes a **between** comparison operator

Example: Find the names of all instructors with salary between \$90,000 and \$100,000 (that is, $\geq$ \$90,000 and $\leq$ \$100,000)

select *name*
from *instructor*
where *salary* **between** 90000 **and** 100000

Tuple comparison

select *name*, *course_id*
from *instructor*, *teaches*
where (*instructor*.*ID*, *dept_name*) = (*teaches*.*ID*, 'Biology');

The from Clause

The **from** clause lists the relations involved in the query

- Corresponds to the **Cartesian product** operation of the relational algebra.

Find the Cartesian product *instructor X teaches*

select *
from *instructor, teaches*

- generates every possible instructor – teaches pair, with all attributes from both relations

Cartesian product not very useful directly, but useful combined with where-clause condition (selection operation in relational algebra)

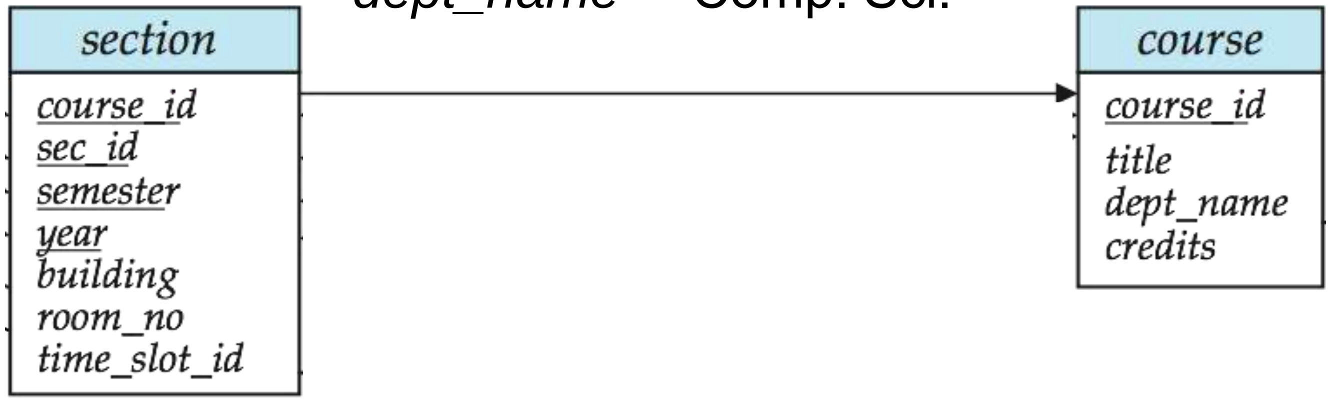
Joins

For all instructors who have taught some course, find their names and the course ID of the courses they taught.

select *name, course_id*
from *instructor, teaches*
where *instructor.ID = teaches.ID*

Find the course ID, semester, year and title of each course offered by the Comp. Sci. department

select *section.course_id, semester, year, title*
from *section, course*
where *section.course_id = course.course_id* **and**
dept_name = 'Comp. Sci.'



Natural Join

Natural join matches tuples with the same values for all common attributes, and retains only one copy of each common column

select * **from** *instructor* **natural join** *teaches*;

instructor(ID,name,dept_name,salary)

teaches(ID, course_id,sec_id,semester, year)

ID	*name*	*dept_name*	*salary*	*course_id*	*sec_id*	*semester*	*year*
10101	Srinivasan	Comp. Sci.	65000	CS-101	1	Fall	2009
10101	Srinivasan	Comp. Sci.	65000	CS-315	1	Spring	2010
10101	Srinivasan	Comp. Sci.	65000	CS-347	1	Fall	2009
12121	Wu	Finance	90000	FIN-201	1	Spring	2010
15151	Mozart	Music	40000	MU-199	1	Spring	2010
22222	Einstein	Physics	95000	PHY-101	1	Fall	2009
32343	El Said	History	60000	HIS-351	1	Spring	2010
45565	Katz	Comp. Sci.	75000	CS-101	1	Spring	2010
45565	Katz	Comp. Sci.	75000	CS-319	1	Spring	2010
76766	Crick	Biology	72000	BIO-101	1	Summer	2009
76766	Crick	Biology	72000	BIO-301	1	Summer	2010

Natural Join Example

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

select *name*, *course_id*
from *instructor, teaches*
where *instructor.ID* = *teaches.ID*;

select *name*, *course_id*
from *instructor* **natural join** *teaches*;

teaches(ID, course_id,sec_id,semester, year)

instructor(ID,name,dept_name,salary)

Natural Join (Cont.)

Beware of unrelated attributes with same name which get equated incorrectly

List the names of instructors along with the titles of courses that they teach

course(course_id,title, dept_name,credits)

teaches(ID, course_id,sec_id,semester, year)

instructor(ID,name, dept_name,salary)

Incorrect version (makes *course.dept_name* = *instructor.dept_name*)

- **select** *name*, *title*
  from *instructor* **natural join** *teaches* **natural join** *course*;

Correct version

- **select** *name*, *title*
  from *instructor* **natural join** *teaches*, *course*
  where *teaches*.*course_id* = *course*.*course_id*;

Another correct version

- **select** *name*, *title*
  from (*instructor* **natural join** *teaches*) **join** *course* **using**(*course_id*);

Natural Join Another Example

Find students who takes courses across his/her department.

> **select distinct** *student.id*
> **from** (*student* **natural join** *takes*)
>   **join** *course* **using** (*course_id*）
> **where** *student.dept_name* <> *course.dept_name*

student(ID, name, dept_name, tot_cred)

takes (ID, course_id, sec_id, semester,year.grade)

course(course_id, title, dept_name, credits）

The Rename Operation

The SQL allows renaming relations and attributes using the **as** clause:

old-name **as** *new-name*

E.g.

select *ID, name, salary/12* **as** *monthly_salary*
from *instructor*

Find the names of all instructors who have a higher salary than some instructor in 'Comp. Sci'.

select distinct *T. name*
from *instructor* **as** *T, instructor* **as** *S*
where *T.salary > S.salary* **and** *S.dept_name = 'Comp. Sci.'*

Keyword **as** is optional and may be omitted

instructor **as** *T* ≡ *instructor T*

Keyword **as** must be omitted in Oracle

String Operations

SQL includes a string-matching operator for comparisons on character strings. The operator "like" uses patterns that are described using two special characters:

- percent (%). The % character matches any substring.
- underscore (_). The _ character matches any character.

Find the names of all instructors whose name includes the substring "dar".

select *name*
from *instructor*
where *name* **like** '%dar%'

Match the string "100 %"

like '100 \%' **escape** '\'

String Operations (Cont.)

- Patters are case sensitive.
- Pattern matching examples:
  - 'Intro%' matches any string beginning with "Intro".
  - '%Comp%' matches any string containing "Comp" as a substring.
  - '_ _ _' matches any string of exactly three characters.
  - '_ _ _ %' matches any string of at least three characters.

- SQL supports a variety of string operations such as
  - concatenation (using "||")
  - converting from upper to lower case (and vice versa)
  - finding string length, extracting substrings, etc.

Ordering the Display of Tuples

List in alphabetic order the names of all instructors

select distinct *name*
from *instructor*
order by *name*

We may specify **desc** for descending(降) order or **asc** for ascending（升） order, for each attribute; ascending order is the default.

Example: **order by** *name* **desc**

Can sort on multiple attributes

Example: **order by** *dept_name, name*

The limit Clause

The limit clause can be used to constrain the number of rows returned by the select statement.

limit clause takes one or two numeric arguments, which must both be nonnegative integer constants:

limit offset, number

limit number == limit 0, number

List names of instructors whose salary is among top 3.

select *name*
from *instructor*
order by *salary* ***desc***

limit *3；* // ***limit*** *0,3*

Duplicates

In relations with duplicates, SQL can define how many copies of tuples appear in the result.

Multiset（多重集） versions of some of the relational algebra operators – given multiset relations r_1 and r_2:

1. $\boldsymbol{\sigma_\theta (r_1)}$: If there are c_1 copies of tuple t_1 in r_1, and t_1 satisfies selections σ_θ, then there are c_1 copies of t_1 in $\sigma_\theta (r_1)$.
2. $\boldsymbol{\Pi_A (r)}$: For each copy of tuple t_1 in r_1, there is a copy of tuple $\Pi_A (t_1)$ in $\Pi_A (r_1)$ where $\Pi_A (t_1)$ denotes the projection of the single tuple t_1.
3. $\boldsymbol{r_1 \times r_2}$: If there are c_1 copies of tuple t_1 in r_1 and c_2 copies of tuple t_2 in r_2, there are $c_1 \times c_2$ copies of the tuple $t_1. t_2$ in $r_1 \times r_2$

Duplicates (Cont.)

Example: Suppose multiset relations r_1 (A, B) and r_2 (C) are as follows:

$$r_1 = \{(1, a)\ (2,a)\} \qquad r_2 = \{(2), (3), (3)\}$$

$\Pi_B(r_1) = \{(a), (a)\}$

$\Pi_B(r_1) \times r_2 =$

$$\{(a,2), (a,2), (a,3), (a,3), (a,3), (a,3)\}$$

SQL duplicate semantics:

select $A_1, A_2, ..., A_n$
from $r_1, r_2, ..., r_m$
where P

is equivalent to the *multiset* version of the expression:

$$\Pi_{A_1, A_2, \ldots, A_n}(\sigma_P(r_1 \times r_2 \times \ldots \times r_m))$$

Set Operations

Find courses that ran in Fall 2009 or in Spring 2010

(**select** *course_id* **from** *section* **where** *sem* = ‘Fall’ **and** *year* = 2009)
union
(**select** *course_id* **from** *section* **where** *sem* = ‘Spring’ **and** *year* = 2010)

Find courses that ran in Fall 2009 and in Spring 2010

(**select** *course_id* **from** *section* **where** *sem* = ‘Fall’ **and** *year* = 2009)
intersect
(**select** *course_id* **from** *section* **where** *sem* = ‘Spring’ **and** *year* = 2010)

Find courses that ran in Fall 2009 but not in Spring 2010

(**select** *course_id* **from** *section* **where** *sem* = ‘Fall’ **and** *year* = 2009)
except
(**select** *course_id* **from** *section* **where** *sem* = ‘Spring’ **and** *year* = 2010)

Set Operations

- Set operations **union**, **intersect**, and **except**
  - Each of the above operations automatically eliminates duplicates
- To retain all duplicates use the corresponding multiset versions **union all, intersect all** and **except all.**

- Suppose a tuple occurs m times in r and n times in s, then, it occurs:
  - $m + n$ times in r **union all** s
  - min(m,n) times in r **intersect all** s
  - max(0, $m - n$) times in r **except all** s

Null Values

- *null* signifies an unknown value or that a value does not exist.
- The result of any arithmetic expression involving *null* is *null*
  - Example: 5 + *null* returns null
- The predicate **is null** can be used to check for null values.
  - Example: Find all instructors whose salary is null.

```
select name
from instructor
where salary is null
```

Aggregate Functions

These functions operate on the multiset of values of a column of a relation, and return a value

avg: average value
min: minimum value
max: maximum value
sum: sum of values
count: number of values

Aggregate Functions (Cont.)

Find the average salary of instructors in the Computer Science department

> **select avg** (*salary*)
> **from** *instructor*
> **where** *dept_name*= 'Comp. Sci.';

Find the total number of instructors who teach a course in the Spring 2010 semester

> **select count** (**distinct** *ID*)
> **from** *teaches*
> **where** *semester* = 'Spring' **and** *year* = 2010

Find the number of tuples in the *course* relation

> **select count** (*)
> **from** *course*;

Aggregate Functions – Group By

Find the average salary of instructors in each department

select *dept_name*, **avg** (*salary*)
from *instructor*
group by *dept_name*;

Note: departments with no instructor will not appear in result

ID	*name*	*dept_name*	*salary*
76766	Crick	Biology	72000
45565	Katz	Comp. Sci.	75000
10101	Srinivasan	Comp. Sci.	65000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000
12121	Wu	Finance	90000
76543	Singh	Finance	80000
32343	El Said	History	60000
58583	Califieri	History	62000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
22222	Einstein	Physics	95000

dept_name	*avg_salary*
Biology	72000
Comp. Sci.	77333
Elec. Eng.	80000
Finance	85000
History	61000
Music	40000
Physics	91000

Aggregation (Cont.)

- Attributes in **select** clause outside of aggregate functions must appear in **group by** list

  /* erroneous query */
  select *dept_name*, *ID*, **avg** (*salary*)
  from *instructor*
  group by *dept_name*;

Aggregate Functions – Having Clause

Find the names and average salaries of all departments whose average salary is greater than 42000

select *dept_name*, avg(salary)
from *instructor*
group by *dept_name*
having avg (*salary*) > 42000;

Note: predicates in the **having** clause are applied after the formation of groups whereas predicates in the **where** clause are applied before forming groups

select *dept_name*, **count** (*) as *cnt*
from *instructor*
where *salary >=100000*
group by *dept_name*
having count (*) > 10
order by *cnt*;

Null Values and Aggregates

Total all salaries

select sum (*salary*)
from *instructor*

- Above statement ignores null amounts
- Result is *null* if there is no non-null amount

All aggregate operations except **count(*)** ignore tuples with null values on the aggregated attributes

What if collection has only null values?

- count returns 0
- all other aggregates return null

Arithmetic expression with Aggregate functions

Find departments in which there is no duplicate name of students.

select *dept_name*

from *student*

group by *dept_name*

having count(distinct *name*) **= count(***id*)

What is the meaning of the following statement ?

select *dept_name*

from *student*

group by *dept_name*

having 1-**count(distinct** *name*)/ **count(***id*)<0.001 ;

Nested Subqueries

SQL provides a mechanism for the nesting of subqueries.

A **subquery** is a **select-from-where** expression that is nested within another query.

A common use of subqueries is to perform tests for set membership, set comparisons, and set cardinality.

Set Membership

Find courses offered in Fall 2009 and in Spring 2010

```
select distinct course_id
from section
where semester = 'Fall' and year= 2009 and
      course_id in (select course_id
                    from section
                    where semester = 'Spring' and year= 2010);
```

Find courses offered in Fall 2009 but not in Spring 2010

```
select distinct course_id
from section
where semester = 'Fall' and year= 2009 and
      course_id  not in (select course_id
                         from section
                         where semester = 'Spring' and year= 2010);
```

Set Membership

Find the total number of (distinct) students who have taken course sections taught by the instructor with *ID* 10101

```
select count (distinct ID)
from takes
where (course_id, sec_id, semester, year) in
                    (select course_id, sec_id, semester, year
                     from teaches
                     where teaches.ID= 10101);
```

Set Comparison

Find names of instructors with salary greater than that of some (at least one) instructor in the Biology department.

```
select distinct T.name
from instructor as T, instructor as S
where T.salary > S.salary and S.dept_name = 'Biology';
```

Same query using > **some** clause

```
select name
from instructor
where salary > some (select salary
                     from instructor
                     where dept_name = 'Biology');
```

Set Comparison

Find the names of all instructors whose salary is greater than the salary of all instructors in the Biology department.

select *name*
from *instructor*
where *salary* > **all** (**select** *salary*
from *instructor*
where *dept_name* = 'Biology');

Scalar Subquery

Scalar（标量） subquery is one which is used where a single value is expected

E.g. **select** *name*
  from *instructor*
  where *salary * 10 >*
   (**select** *budget* **from** *department*
    where *department*.*dept_name* = *instructor*.*dept_name*)

Runtime error if subquery returns more than one result tuple

Test for Empty Relations

The **exists** construct returns the value **true** if the argument subquery is nonempty.

exists $r \Leftrightarrow r \neq \varnothing$

not exists $r \Leftrightarrow r = \varnothing$

Correlation Variables

Yet another way of specifying the query "Find all courses taught in both the Fall 2009 semester and in the Spring 2010 semester"

select *course_id*
from *section* **as** *S*
where *semester* = 'Fall' **and** *year*= 2009 **and**
  exists (**select** *
    from *section* **as** *T*
    where *semester* = 'Spring' **and** *year*= 2010
      and *S*.*course_id*= *T*.*course_id*);

Correlated subquery

Correlation name or **correlation variable**

Not Exists

Find all students who have taken all courses offered in the Biology department.

select distinct *S.ID*, *S.name*
from *student* **as** *S*
where not exists ((**select** *course_id*
  from *course*
  where *dept_name* = 'Biology')
 except
  (**select** *T.course_id*
   from *takes* **as** *T*
   where *S.ID* = *T.ID*));

Note that $X - Y = \emptyset \iff X \subseteq Y$

Note: Cannot write this query using = **all** and its variants

Test for Absence of Duplicate Tuples

The **unique** construct tests whether a subquery has any duplicate tuples in its result.

(Evaluates to "true" on an empty set)

Find all courses that were offered at most once in 2009

```
select T.course_id
from course as T
where unique (select R.course_id
              from section as R
              where T.course_id= R.course_id
                    and R.year = 2009);
```

*With Clause

The **with** clause provides a way of defining a temporary view whose definition is available only to the query in which the **with** clause occurs.

Find all departments with the maximum budget

```
with max_budget (value) as
        (select max(budget)
         from department)
select dept_name
from department, max_budget
where department.budget = max_budget.value;
```

```
select dept_name
from department
where budget = (select (max(budget) from department))
```

*Complex Queries using With Clause

With clause is very useful for writing complex queries

Supported by most database systems, with minor syntax variations

Find all departments where the total salary is greater than the average of the total salary at all departments

```
with dept _total (dept_name, value) as
        (select dept_name, sum(salary)
         from instructor
         group by dept_name),
        dept_total_avg(value) as
        (select avg(value)
         from dept_total)
select dept_name
from dept_total, dept_total_avg
where dept_total.value >= dept_total_avg.value;
```

Modification of the Database

- Deletion of tuples from a given relation
- Insertion of new tuples into a given relation
- Updating values in some tuples in a given relation

Modification of the Database – Deletion

Delete all instructors

delete from *instructor*

Delete all instructors from the Finance department

delete from *instructor*
where *dept_name*= 'Finance';

Delete all tuples in the *instructor* relation for those instructors associated with a department located in the Watson building.

delete from *instructor*
where *dept_name* **in** (**select** *dept_name*
from *department*
where *building* = 'Watson');

Deletion (Cont.)

Delete all instructors whose salary is less than the average salary of instructors

delete from *instructor*
where *salary*< (**select avg** (*salary*) **from** *instructor*);

Problem: as we delete tuples from deposit, the average salary changes

Solution used in SQL:

1. First, compute **avg** salary and find all tuples to delete
2. Next, delete all tuples found above (without recomputing **avg** or retesting the tuples)

Modification of the Database – Insertion

Add a new tuple to *course*

insert into *course*
  values ('CS-437', 'Database Systems', 'Comp. Sci.', 4);

or equivalently

insert into *course* (*course_id*, *title*, *dept_name*, *credits*)
  values ('CS-437', 'Database Systems', 'Comp. Sci.', 4);

Add a new tuple to *student* with *tot_creds* set to null

insert into *student*
  values ('3003', 'Green', 'Finance', *null*);

Insertion (Cont.)

Add all instructors to the *student* relation with tot_creds set to 0

```
insert into student
    select ID, name, dept_name, 0
    from   instructor
```

The **select from where** statement is evaluated fully before any of its results are inserted into the relation。

otherwise queries like

insert into *table*1 **select** * **from** *table*1

would cause problems, if *table1* did not have any primary key defined.

Modification of the Database – Updates

Increase salaries of instructors whose salary is over $100,000 by 3%, and all others receive a 5% raise

Write two **update** statements:

update *instructor*
set *salary* = *salary* * 1.03
where *salary* > 100000;
update *instructor*
set *salary* = *salary* * 1.05
where *salary* <= 100000;

The order is important

Can be done better using the **case** statement (next slide)

Case Statement for Conditional Updates

Same query as before but with case statement

update *instructor*
set *salary* = **case**
when *salary* <= 100000 **then** *salary* * 1.05
else *salary* * 1.03
end

Updates with Scalar Subqueries

Recompute and update tot_creds value for all students

```
update student S
   set tot_cred = ( select sum(credits)
                    from takes natural join course
                    where S.ID= takes.ID and
                          takes.grade <> 'F' and
                          takes.grade is not null);
```

Sets *tot_creds* to null for students who have not taken any course

Instead of **sum**(*credits*), use:

```
case
    when sum(credits) is not null then sum(credits)
    else 0
end
```

End of Chapter 3