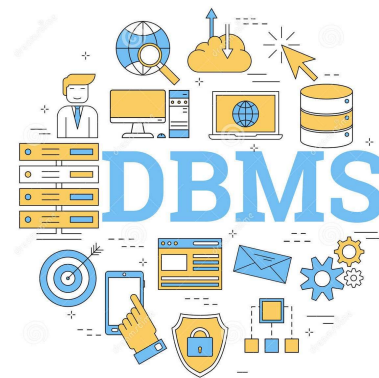
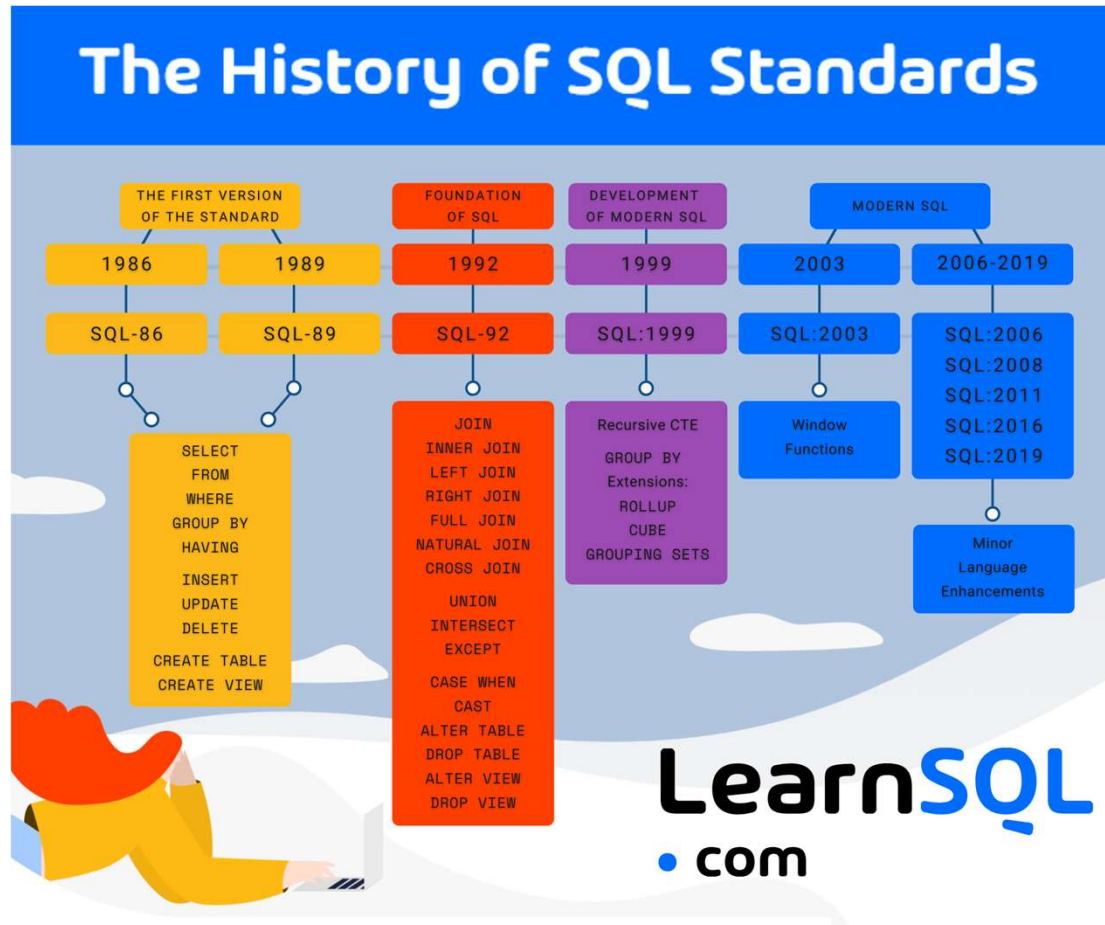


# Unit I – Relational Model

Relational Data Model - keys, referential integrity and foreign keys, Relational Algebra - **SQL fundamentals**- Introduction, data definition in SQL, table, key and foreign key definitions, update behaviors-Intermediate SQL-Advanced SQL features - Embedded SQL- Dynamic SQL, CASE Studies- Oracle: Database Design and Querying Tools; SQL Variations and Extensions

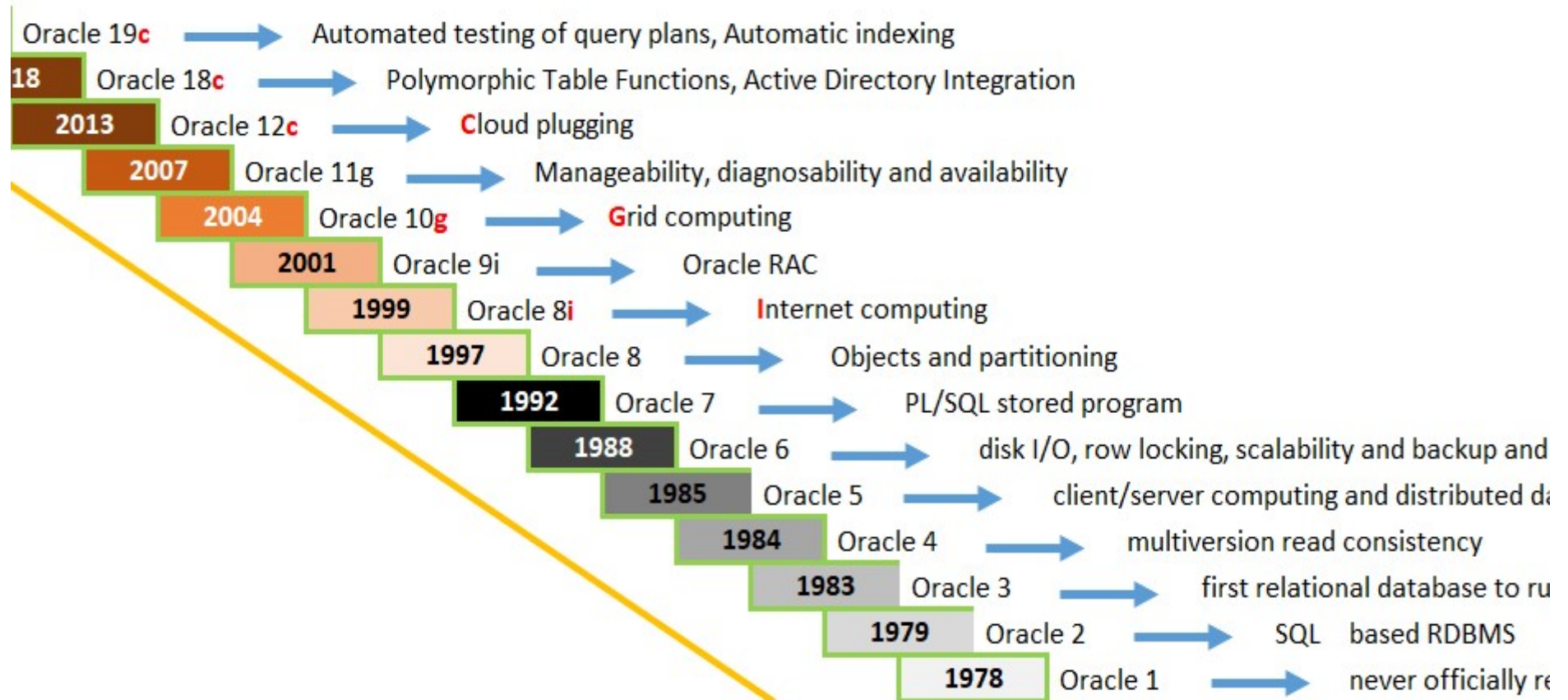


# History

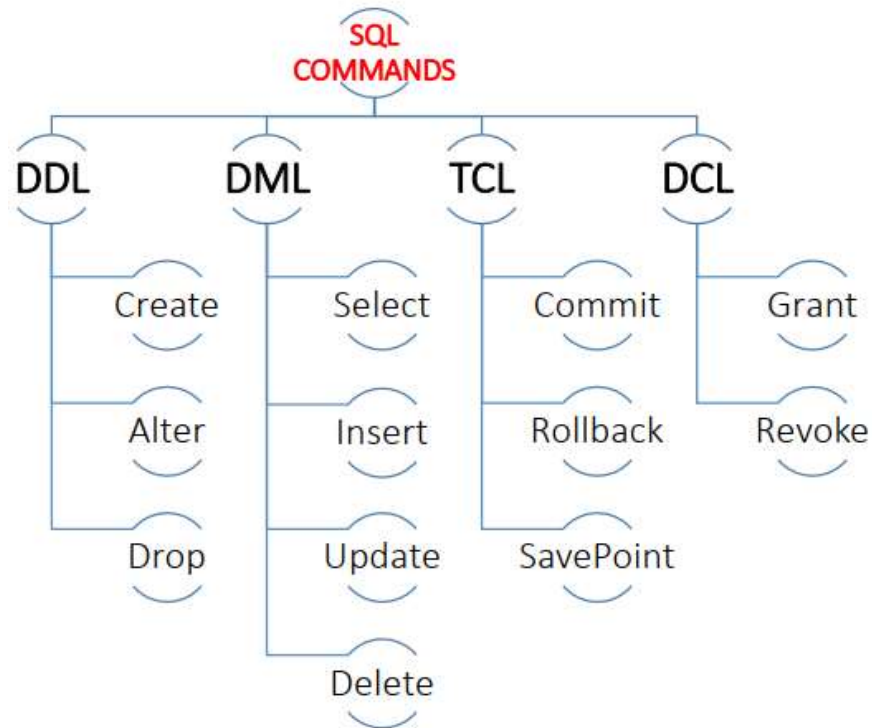




## History of Oracle Database Versions



# SQL Parts



- DML - Data Manipulation Language
- DDL - Data Definition Language
- DCL - Data Control Language
- TCL - Transaction Control Language
- DQL - Data Query Language



# Data Definition Language

- The SQL data-definition language (DDL) allows the specification of information about relations, including:
  - The schema for each relation.
  - The type of values associated with each attribute.
  - The Integrity constraints
  - The set of indices to be maintained for each relation.
  - Security and authorization information for each relation.
  - The physical storage structure of each relation on disk.



# Domain Types in SQL <sup>6/14</sup>

- **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. (ex., **numeric(3,1)**, allows 44.5 to be stored exactly, but not 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.

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

**create table** *r*

$(A_1 D_1, A_2 D_2, \dots, A_n D_n$   
(integrity-constraint<sub>1</sub>),  
...,  
(integrity-constraint<sub>k</sub>))

```
create table instructor (  
  ID          char(5),  
  name       varchar(20),  
  dept_name varchar(20),  
  salary    numeric(8,2))
```

- *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  $A_i$

## Integrity Constraints in Create Table

- Types of integrity constraints
  - **primary key**  $(A_1, \dots, A_n)$
  - **foreign key**  $(A_m, \dots, A_n)$  references  $r$
  - **not null**
- SQL prevents any update to the database that violates an integrity constraint.



## Integrity Constraints in Create Table

```
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);
```

## 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*);**

## Few More Relation Definitions

- **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*);

## Few More Relation Definitions

- **create table** *course* (  
*course\_id*     **varchar**(8),  
*title*         **varchar**(50),  
*dept\_name*    **varchar**(20),  
*credits*       **numeric**(2,0),  
**primary key** (*course\_id*),  
**foreign key** (*dept\_name*) **references** *department*);



# Updates to tables<sup>14</sup>

- **Insert**
  - **insert into** *instructor* **values** ('10211', 'Smith', 'Biology', 66000);
- **Delete**
  - Remove all tuples from the *student* relation
    - **delete from** *student*
- **Drop Table**
  - **drop table** *r*
- **Alter**
  - **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 existing tuples in the relation are assigned *null* as the value for the new attribute.
  - **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

- A typical SQL query has the form:

**select**  $A_1, A_2, \dots, A_n$

**from**  $r_1, r_2, \dots, r_m$

**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

15/14

- The **select** clause lists 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*  $\equiv$  *NAME*  $\equiv$  *name*
  - Some people use upper case wherever we use bold font.

- **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 department names of all instructors, and remove duplicates

```
select distinct dept_name  
from instructor
```

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

```
select all dept_name  
from instructor
```

dept_name
Comp. Sci.
Finance
Music
Physics
History
Physics
Comp. Sci.
History
Finance
Biology
Comp. Sci.
Elec. Eng.



- An asterisk in the select clause denotes “all attributes”

```
select  
from instructor
```

\*

- An attribute can be a literal with no **from** clause

```
select '437'
```

- Results is a table with one column and a single row with value “437”
- Can give the column a name using:

```
select '437' as FOO
```

- An attribute can be a literal with **from** clause

```
select 'A' from instructor
```

- Result is a table with one column and  $N$  rows (number of tuples in the *instructors* table), each row with value “A”

- 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.

- Can rename “*salary/12*” using the **as** clause:

```
select ID, name, salary/12 as monthly_salary
```



## The where Clause<sup>19/14</sup>

- 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

```
select name
from instructor
where dept_name = 'Comp. Sci.'
```

- SQL allows the use of the logical connectives **and, or, and not**
- The operands of the logical connectives can be expressions involving the comparison operators **<, <=, >, >=, =, and <>**.
- Comparisons can be applied to results of arithmetic expressions
- To find all instructors in Comp. Sci. dept with salary > 70000

```
select name
from instructor
where dept_name = 'Comp. Sci.' and salary > 70000
```

<i>name</i>
Katz
Brandt



# The from Clause <sup>20/14</sup>

- 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.
- For common attributes (e.g., *ID*), the attributes in the resulting table are renamed using the relation name (e.g., *instructor.ID*)
- Cartesian product not very useful directly, but useful combined with where-clause condition (selection operation in relational algebra).



# Assessment

21/14

- Find the names of all instructors who have taught some course and the course\_id
  - **select** *name, course\_id*  
**from** *instructor, teaches*  
**where** *instructor.ID = teaches.ID*
- Find the names of all instructors in the Art department who have taught some course and the course\_id
  - **select** *name, course\_id*  
**from** *instructor, teaches*  
**where** *instructor.ID = teaches.ID*  
**and** *instructor.dept\_name = 'Art'*

<i>name</i>	<i>course_id</i>
Srinivasan	CS-101
Srinivasan	CS-315
Srinivasan	CS-347
Wu	FIN-201
Mozart	MU-199
Einstein	PHY-101
El Said	HIS-351
Katz	CS-101
Katz	CS-319
Crick	BIO-101
Crick	BIO-301
Brandt	CS-190
Brandt	CS-190
Brandt	CS-319
Kim	EE-181

- The SQL allows renaming relations and attributes using the **as** clause:  
*old-name as new-name*
- 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*  $\equiv$  *instructor T*



- Relation *emp-super*

<i>person</i>	<i>supervisor</i>
Bob	Alice
Mary	Susan
Alice	David
David	Mary

- Find the supervisor of “Bob”
- Find the supervisor of the supervisor of “Bob”
- Can you find ALL the supervisors (direct and indirect) of “Bob”?

## Self Join Example



## String Operations <sup>24/14</sup>

- 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 '\'
```

in that above we use backslash (\) as the escape character.





## String Operations (Cont.)<sup>27/14</sup>

<https://www.geeksforgeeks.org/sql-string-functions/>

- Patterns 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 <sup>26/14</sup>

- List in alphabetic order the names of all instructors

**select distinct** *name*

**from** *instructor*

**order by** *name*

- We may specify **desc** for descending order or **asc** for ascending 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*



## Where Clause Predicates<sup>27/14</sup>

- 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'*);



## Set Operations

- Find courses that ran in Fall 2017 or in Spring 2018

**(select *course\_id* from *section* where *sem* = 'Fall' and *year* = 2017)**

**union**

**(select *course\_id* from *section* where *sem* = 'Spring' and *year* = 2018)**

- Find courses that ran in Fall 2017 and in Spring 2018

**(select *course\_id* from *section* where *sem* = 'Fall' and *year* = 2017)**

**intersect**

**(select *course\_id* from *section* where *sem* = 'Spring' and *year* = 2018)**



## Set Operations

Find courses that ran in Fall 2017 but not in Spring 2018

**(select *course\_id* from *section* where *sem* = 'Fall' and *year* = 2017)**

**except**

**(select *course\_id* from *section* where *sem* = 'Spring' and *year* = 2018)**

## Set Operations (Cont.)

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



- It is possible for tuples to have a null value, denoted by **null**, for some of their attributes
- **null** signifies an unknown value or that a value does not exist.
- The result of any arithmetic expression involving **null** is **null**
  - Example:  $5 + \mathbf{null}$  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
```

- The predicate **is not null** succeeds if the value on which it is applied is not 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 Examples <sup>33/14</sup>

- 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 2018 semester
  - **select count** (**distinct** *ID*)  
**from** *teaches*  
**where** *semester* = 'Spring' **and** *year* = 2018;
- Find the number of tuples in the *course* relation
  - **select count** (\*)  
**from** *course*;

- Find the average salary of instructors in each department
- **select** *dept\_name*, **avg** (*salary*) **as** *avg\_salary*  
**from** *instructor*  
**group by** *dept\_name*;

<i>dept_name</i>	<i>avg_salary</i>
Biology	72000
Comp. Sci.	77333
Elec. Eng.	80000
Finance	85000
History	61000
Music	40000
Physics	91000

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
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

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

```
select dept_name, avg (salary) as 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

- SQL provides a mechanism for the nesting of subqueries. A **subquery** is a **select-from-where** expression that is nested within another query.
- The nesting can be done in the following SQL query

```
select  $A_1, A_2, \dots, A_n$   
from  $r_1, r_2, \dots, r_m$   
where  $P$ 
```

as follows:

- **From clause:**  $r_i$  can be replaced by any valid subquery
- **Where clause:**  $P$  can be replaced with an expression of the form:

$B$  <operation> (subquery)

$B$  is an attribute and <operation> to be defined later.

- **Select clause:**

$A_i$  can be replaced by a subquery that generates a single value.



## Set Membership

- Find courses offered in Fall 2017 and in Spring 2018

```
select distinct course_id
from section
where semester = 'Fall' and year= 2017 and
      course_id in (select course_id
                    from section
                    where semester = 'Spring' and year= 2018);
```

- Find courses offered in Fall 2017 but not in Spring 2018

```
select distinct course_id
from section
where semester = 'Fall' and year= 2017 and
      course_id not in (select course_id
                    from section
                    where semester = 'Spring' and year= 2018);
```



## Set Membership (Cont.) <sup>38/14</sup>

- Name all instructors whose name is neither “Mozart” nor Einstein”

```
select distinct name  
from instructor  
where name not in ('Mozart', 'Einstein')
```

- 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);
```

- Note: Above query can be written in a much simpler manner. The formulation above is simply to illustrate SQL features



## Set Comparison – “some” Clause

39/14

- 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');
```

## Definition of “some” Clause

- $F \text{ <comp> some } r \Leftrightarrow \exists t \in r \text{ such that } (F \text{ <comp> } t)$   
Where <comp> can be: <, ≤, >, =, ≠

$$(5 \text{ < some } \begin{array}{|c|} \hline 0 \\ \hline 5 \\ \hline 6 \\ \hline \end{array}) = \text{true} \quad (\text{read: } 5 \text{ < some tuple in the relation})$$

$$(5 \text{ < some } \begin{array}{|c|} \hline 0 \\ \hline 5 \\ \hline \end{array}) = \text{false}$$

$$(5 = \text{ some } \begin{array}{|c|} \hline 0 \\ \hline 5 \\ \hline \end{array}) = \text{true}$$

$$(5 \neq \text{ some } \begin{array}{|c|} \hline 0 \\ \hline 5 \\ \hline \end{array}) = \text{true (since } 0 \neq 5)$$

$(= \text{ some}) \equiv \text{in}$

However,  $(\neq \text{ some}) \not\equiv \text{not in}$





## Set Comparison – “all” Clause <sup>41/14</sup>

- 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');
```

•  $F \langle \text{comp} \rangle \text{all } r \Leftrightarrow \forall t \in r (F \langle \text{comp} \rangle t)$  **Definition of “all” Clause**

$$(5 \langle \text{all} \begin{array}{|c|} \hline 0 \\ \hline 5 \\ \hline 6 \\ \hline \end{array} \rangle) = \text{false}$$

$$(5 \langle \text{all} \begin{array}{|c|} \hline 6 \\ \hline 10 \\ \hline \end{array} \rangle) = \text{true}$$

$$(5 \langle \text{all} \begin{array}{|c|} \hline 4 \\ \hline 5 \\ \hline \end{array} \rangle) = \text{false}$$

$$(5 \langle \text{all} \begin{array}{|c|} \hline 4 \\ \hline 6 \\ \hline \end{array} \rangle) = \text{true (since } 5 \neq 4 \text{ and } 5 \neq 6)$$

$(\neq \text{all}) \equiv \text{not in}$   
 However,  $(= \text{all}) \neq \text{in}$



## Test for Empty Relations

- The **exists** construct returns the value **true** if the argument subquery is nonempty.
- **exists**  $r \Leftrightarrow r \neq \emptyset$
- **not exists**  $r \Leftrightarrow r = \emptyset$



## Use of “exists” Clause

- Yet another way of specifying the query “Find all courses taught in both the Fall 2017 semester and in the Spring 2018 semester”

```
select course_id
from section as S
where semester = 'Fall' and year = 2017 and
exists (select *
from section as T
where semester = 'Spring' and year = 2018
and S.course_id = T.course_id);
```

- **Correlation name** – variable S in the outer query
- **Correlated subquery** – the inner query

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

## Use of “not exists” Clause

```
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));
```

- First nested query lists all courses offered in Biology
  - Second nested query lists all courses a particular student took
- Note that  $X - Y = \emptyset \Leftrightarrow X \subseteq Y$
  - Note: Cannot write this query using = all and its variants



## Test for Absence of Duplicate Tuples 46/14

- The **unique** construct tests whether a subquery has any duplicate tuples in its result.
- The **unique** construct evaluates to “true” if a given subquery contains no duplicates .
- Find all courses that were offered at most once in 2017

```
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 = 2017);
```



## Subqueries in the Form Clause <sup>47/14</sup>

- SQL allows a subquery expression to be used in the **from** clause
- Find the average instructors' salaries of those departments where the average salary is greater than \$42,000."

```
select dept_name, avg_salary
from ( select dept_name, avg (salary) as avg_salary
       from instructor
       group by dept_name)
where avg_salary > 42000;
```

- Note that we do not need to use the **having** clause
- Another way to write above query

```
select dept_name, avg_salary
from ( select dept_name, avg (salary)
       from instructor
       group by dept_name)
       as dept_avg (dept_name, avg_salary)
where avg_salary > 42000;
```



## With Clause <sup>48/14</sup>

- The **with** clause provides a way of defining a temporary relation 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 department.name  
from department, max_budget  
where department.budget = max_budget.value;
```



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

## Complex Queries using With Clause

```
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;
```



## Scalar Subquery <sup>50/14</sup>

- Scalar subquery is one which is used where a single value is expected
- List all departments along with the number of instructors in each department

```
select dept_name,  
      (select count(*)  
       from instructor  
       where department.dept_name = instructor.dept_name)  
       as num_instructors  
from department;
```

- Runtime error if subquery returns more than one result tuple



## Modification of the Database

51/14

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



## Deletion

52/14

- 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');

- 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 *instructor*, 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)



- 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);
```



- Make each student in the Music department who has earned more than 144 credit hours an instructor in the Music department with a salary of \$18,000.

**insert into** *instructor*

**select** *ID, name, dept\_name, 18000*

**from** *student*

**where** *dept\_name = 'Music' and total\_cred > 144;*

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

Otherwise queries like

**insert into** *table1 select \* from table1*

would cause problem



- Give a 5% salary raise to all instructors  
**update instructor**  
**set salary = salary \* 1.05**
- Give a 5% salary raise to those instructors who earn less than 70000  
**update instructor**  
**set salary = salary \* 1.05**  
**where salary < 70000;**
- Give a 5% salary raise to instructors whose salary is less than average  
**update instructor**  
**set salary = salary \* 1.05**  
**where salary < (select avg (salary)**  
**from instructor);**



- Increase salaries of instructors whose salary is over \$100,000 by 3%, and all others by a 5%
  - 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 <sup>59/14</sup>

- Recompute and update `tot_creds` value for all students

```
update student S  
set tot_cred = (select sum(credits)  
                from takes, course  
                where takes.course_id = course.course_id and  
                    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
```

**Thank You!**