

# Databases and Information Systems

## CS303

SQL

16-08-2023

# Nested Queries

- Using one query as a subquery for a larger query.

# Nested Queries - IN

- Find all the courses taught in the both the Fall 2009 and Spring 2010 semesters.

- (SELECT course\_id  
FROM section  
WHERE semester = 'Spring' AND year = 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);

course_id	sec_id	semester	year	building	room_number	time_slot_id
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
CS-319	2	Spring	2010	Taylor	3128	C
CS-347	1	Fall	2009	Taylor	3128	A
EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

section

# Nested Queries - IN

- Find all the courses taught in the Fall 2009 but **not** in Spring 2010 semesters.

- (SELECT course\_id  
FROM section  
WHERE semester = 'Spring' AND year = 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);

course_id	sec_id	semester	year	building	room_number	time_slot_id
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
CS-319	2	Spring	2010	Taylor	3128	C
CS-347	1	Fall	2009	Taylor	3128	A
EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

section

# Nested Queries - IN

- Find names of all instructors who are not Einstein or Mozart.
- SELECT DISTINCT name  
FROM instructor  
WHERE name NOT IN ('Einstein', 'Mozart');

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

instructor

# Nested Queries - SOME / ALL

- Find the names of all instructors whose salary is greater than at least one instructor in the Biology department.

- `SELECT name`  
`FROM instructor`  
`WHERE salary > SOME ( SELECT salary`  
`FROM instructor`  
`WHERE dept name = 'Biology');`

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

`instructor`

- `< SOME`   `<= SOME`   `>= SOME`   `<> SOME`
- `= SOME` and `IN` has same results  
But `<> SOME` and `NOT IN` give different results

# Nested Queries - SOME / ALL

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

- ```
SELECT name
FROM instructor
WHERE salary > ALL ( SELECT salary
                      FROM instructor
                      WHERE dept name = 'Biology');
```

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

instructor

- ```
< ALL      <= ALL      >= ALL      <> ALL
```
- ```
<> ALL and NOT IN has same results
But = ALL and IN give different results
```

# Nested Queries - SOME / ALL

- Find the departments that have the highest average salary.

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

instructor



# Nested Queries - TEST (NON) EMPTINESS

- 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 );
```

course_id	sec_id	semester	year	building	room_number	time_slot_id
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
CS-319	2	Spring	2010	Taylor	3128	C
CS-347	1	Fall	2009	Taylor	3128	A
EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

section

- If a subquery uses a table from outer query, such a subquery are called **correlated subquery**
- If same alias is used in inner and outer queries, then inner precedence takes priority

# Nested Queries - TEST (NON) EMPTINESS

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

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-315	Robotics	Comp. Sci.	3
CS-319	Image Processing	Comp. Sci.	3
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
MU-199	Music Video Production	Music	3
PHY-101	Physical Principles	Physics	4

course

ID	name	dept_name	tot_cred
00128	Zhang	Comp. Sci.	102
12345	Shankar	Comp. Sci.	32
19991	Brandt	History	80
23121	Chavez	Finance	110
44553	Peltier	Physics	56
45678	Levy	Physics	46
54321	Williams	Comp. Sci.	54
55739	Sanchez	Music	38
70557	Snow	Physics	0
76543	Brown	Comp. Sci.	58
76653	Aoi	Elec. Eng.	60
98765	Bourikas	Elec. Eng.	98
98988	Tanaka	Biology	120

student

ID	course_id	sec_id	semester	year	grade
00128	CS-101	1	Fall	2009	A
00128	CS-347	1	Fall	2009	A-
12345	CS-101	1	Fall	2009	C
12345	CS-190	2	Spring	2009	A
12345	CS-315	1	Spring	2010	A
12345	CS-347	1	Fall	2009	A
19991	HIS-351	1	Spring	2010	B
23121	FIN-201	1	Spring	2010	C+
44553	PHY-101	1	Fall	2009	B-
45678	CS-101	1	Fall	2009	F
45678	CS-101	1	Spring	2010	B+
45678	CS-319	1	Spring	2010	B
54321	CS-101	1	Fall	2009	A-
54321	CS-190	2	Spring	2009	B+
55739	MU-199	1	Spring	2010	A-
76543	CS-101	1	Fall	2009	A
76543	CS-319	2	Spring	2010	A
76653	EE-181	1	Spring	2009	C
98765	CS-101	1	Fall	2009	C-
98765	CS-315	1	Spring	2010	B
98988	BIO-101	1	Summer	2009	A
98988	BIO-301	1	Summer	2010	null

takes

- ```

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 )
);

```

# Nested Queries - TEST absence of duplicates

- Find all courses that were offered at most once in 2009

| course_id | title                      | dept_name  | credits |
|-----------|----------------------------|------------|---------|
| BIO-101   | Intro. to Biology          | Biology    | 4       |
| BIO-301   | Genetics                   | Biology    | 4       |
| BIO-399   | Computational Biology      | Biology    | 3       |
| CS-101    | Intro. to Computer Science | Comp. Sci. | 4       |
| CS-190    | Game Design                | Comp. Sci. | 4       |
| CS-315    | Robotics                   | Comp. Sci. | 3       |
| CS-319    | Image Processing           | Comp. Sci. | 3       |
| CS-347    | Database System Concepts   | Comp. Sci. | 3       |
| EE-181    | Intro. to Digital Systems  | Elec. Eng. | 3       |
| FIN-201   | Investment Banking         | Finance    | 3       |
| HIS-351   | World History              | History    | 3       |
| MU-199    | Music Video Production     | Music      | 3       |
| PHY-101   | Physical Principles        | Physics    | 4       |

course

| course_id | sec_id | semester | year | building | room_number | time_slot_id |
|-----------|--------|----------|------|----------|-------------|--------------|
| BIO-101   | 1      | Summer   | 2009 | Painter  | 514         | B            |
| BIO-301   | 1      | Summer   | 2010 | Painter  | 514         | A            |
| CS-101    | 1      | Fall     | 2009 | Packard  | 101         | H            |
| CS-101    | 1      | Spring   | 2010 | Packard  | 101         | F            |
| CS-190    | 1      | Spring   | 2009 | Taylor   | 3128        | E            |
| CS-190    | 2      | Spring   | 2009 | Taylor   | 3128        | A            |
| CS-315    | 1      | Spring   | 2010 | Watson   | 120         | D            |
| CS-319    | 1      | Spring   | 2010 | Watson   | 100         | B            |
| CS-319    | 2      | Spring   | 2010 | Taylor   | 3128        | C            |
| CS-347    | 1      | Fall     | 2009 | Taylor   | 3128        | A            |
| EE-181    | 1      | Spring   | 2009 | Taylor   | 3128        | C            |
| FIN-201   | 1      | Spring   | 2010 | Packard  | 101         | B            |
| HIS-351   | 1      | Spring   | 2010 | Painter  | 514         | C            |
| MU-199    | 1      | Spring   | 2010 | Packard  | 101         | D            |
| PHY-101   | 1      | Fall     | 2009 | Watson   | 100         | A            |

section

- ```
SELECT T.course
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 );
```
- NOT AVAILABLE IN POSTGRESQL

# Nested Queries - TEST absence of duplicates

- Find all courses that were offered at most once in 2009

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-315	Robotics	Comp. Sci.	3
CS-319	Image Processing	Comp. Sci.	3
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
MU-199	Music Video Production	Music	3
PHY-101	Physical Principles	Physics	4

course

course_id	sec_id	semester	year	building	room_number	time_slot_id
BIO-101	1	Summer	2009	Painter	514	B
BIO-301	1	Summer	2010	Painter	514	A
CS-101	1	Fall	2009	Packard	101	H
CS-101	1	Spring	2010	Packard	101	F
CS-190	1	Spring	2009	Taylor	3128	E
CS-190	2	Spring	2009	Taylor	3128	A
CS-315	1	Spring	2010	Watson	120	D
CS-319	1	Spring	2010	Watson	100	B
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EE-181	1	Spring	2009	Taylor	3128	C
FIN-201	1	Spring	2010	Packard	101	B
HIS-351	1	Spring	2010	Painter	514	C
MU-199	1	Spring	2010	Packard	101	D
PHY-101	1	Fall	2009	Watson	100	A

section

- ```
SELECT T.course
FROM course as T
WHERE 1 <= ( SELECT count( R.course_id)
              FROM section as R
              WHERE T.course_id = R.course_id AND R.year = 2009 );
```

# Nested Queries - TEST absence of duplicates

- Find all courses that were offered at most once in 2009

| course_id | title                      | dept_name  | credits |
|-----------|----------------------------|------------|---------|
| BIO-101   | Intro. to Biology          | Biology    | 4       |
| BIO-301   | Genetics                   | Biology    | 4       |
| BIO-399   | Computational Biology      | Biology    | 3       |
| CS-101    | Intro. to Computer Science | Comp. Sci. | 4       |
| CS-190    | Game Design                | Comp. Sci. | 4       |
| CS-315    | Robotics                   | Comp. Sci. | 3       |
| CS-319    | Image Processing           | Comp. Sci. | 3       |
| CS-347    | Database System Concepts   | Comp. Sci. | 3       |
| EE-181    | Intro. to Digital Systems  | Elec. Eng. | 3       |
| FIN-201   | Investment Banking         | Finance    | 3       |
| HIS-351   | World History              | History    | 3       |
| MU-199    | Music Video Production     | Music      | 3       |
| PHY-101   | Physical Principles        | Physics    | 4       |

course

| course_id | sec_id | semester | year | building | room_number | time_slot_id |
|-----------|--------|----------|------|----------|-------------|--------------|
| BIO-101   | 1      | Summer   | 2009 | Painter  | 514         | B            |
| BIO-301   | 1      | Summer   | 2010 | Painter  | 514         | A            |
| CS-101    | 1      | Fall     | 2009 | Packard  | 101         | H            |
| CS-101    | 1      | Spring   | 2010 | Packard  | 101         | F            |
| CS-190    | 1      | Spring   | 2009 | Taylor   | 3128        | E            |
| CS-190    | 2      | Spring   | 2009 | Taylor   | 3128        | A            |
| CS-315    | 1      | Spring   | 2010 | Watson   | 120         | D            |
| CS-319    | 1      | Spring   | 2010 | Watson   | 100         | B            |
| CS-319    | 2      | Spring   | 2010 | Taylor   | 3128        | C            |
| CS-347    | 1      | Fall     | 2009 | Taylor   | 3128        | A            |
| EE-181    | 1      | Spring   | 2009 | Taylor   | 3128        | C            |
| FIN-201   | 1      | Spring   | 2010 | Packard  | 101         | B            |
| HIS-351   | 1      | Spring   | 2010 | Painter  | 514         | C            |
| MU-199    | 1      | Spring   | 2010 | Packard  | 101         | D            |
| PHY-101   | 1      | Fall     | 2009 | Watson   | 100         | A            |

section

- ```
SELECT T.course
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 );
```
- What happens if Inner query has **NULL** when comparing tuples ?