CSIT115 Data Management and Security

CSIT882 Data Management Systems

SELECT Statement (4)

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SELECT statement (4)

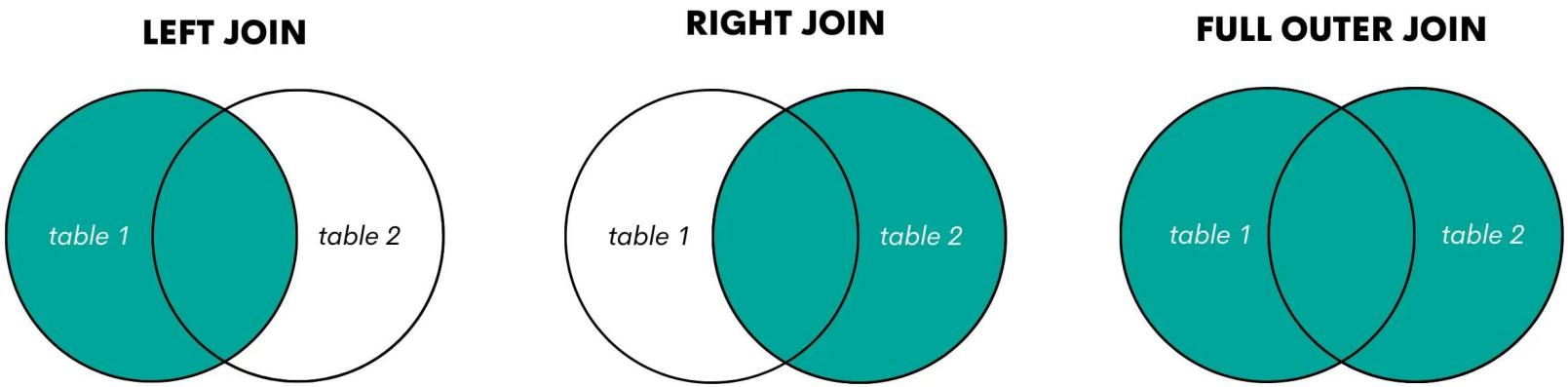
Outline

Outer Join queries

Left Outer Join operation joins the rows from two relational tables and appends to the results of join all rows from the left argument of the operation that cannot be joined with any row from the right argument of the operation with `NULL`s used in all places where the values are missing

Right Outer Join operation joins the rows from two relational tables and appends to the results of join all rows from the right argument of the operation that cannot be joined with any row from the left argument of the operation with `NULL`s used in all places where the values are missing

Full Outer Join operation unions the result of left outer join operation and the results of right outer join operation



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Outer join queries

Sample database

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name                VARCHAR(50)        NOT NULL,
 code                CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)          NOT NULL,
 chair               VARCHAR(50)            NULL,
 budget              DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

CREATE TABLE statement

```
CREATE TABLE COURSE(
 cnum                CHAR(7)           NOT NULL,
 title               VARCHAR(200)      NOT NULL,
 credits             DECIMAL(2)        NOT NULL,
 offered_by          VARCHAR(50)           NULL,
  CONSTRAINT course_pkey PRIMARY KEY(cnum),
  CONSTRAINT course_check1 CHECK (credits IN (6, 12)),
  CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
                        REFERENCES DEPARTMENT(name) ON DELETE CASCADE );
```

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Outer join queries

Consider the following query: find the names of departments together with the titles of all courses offered by each department

SELECT statement with JOIN operation

```
SELECT name, title
FROM DEPARTMENT JOIN COURSE
                ON name = offered_by;
```

What about the departments that offer no courses and what about the courses not assigned to any department ?

`JOIN` operation eliminates from the left argument all rows that cannot be joined with any row from the right argument and ...

`JOIN` operation eliminates from the right argument all rows that cannot be joined with any row from the left argument and ...

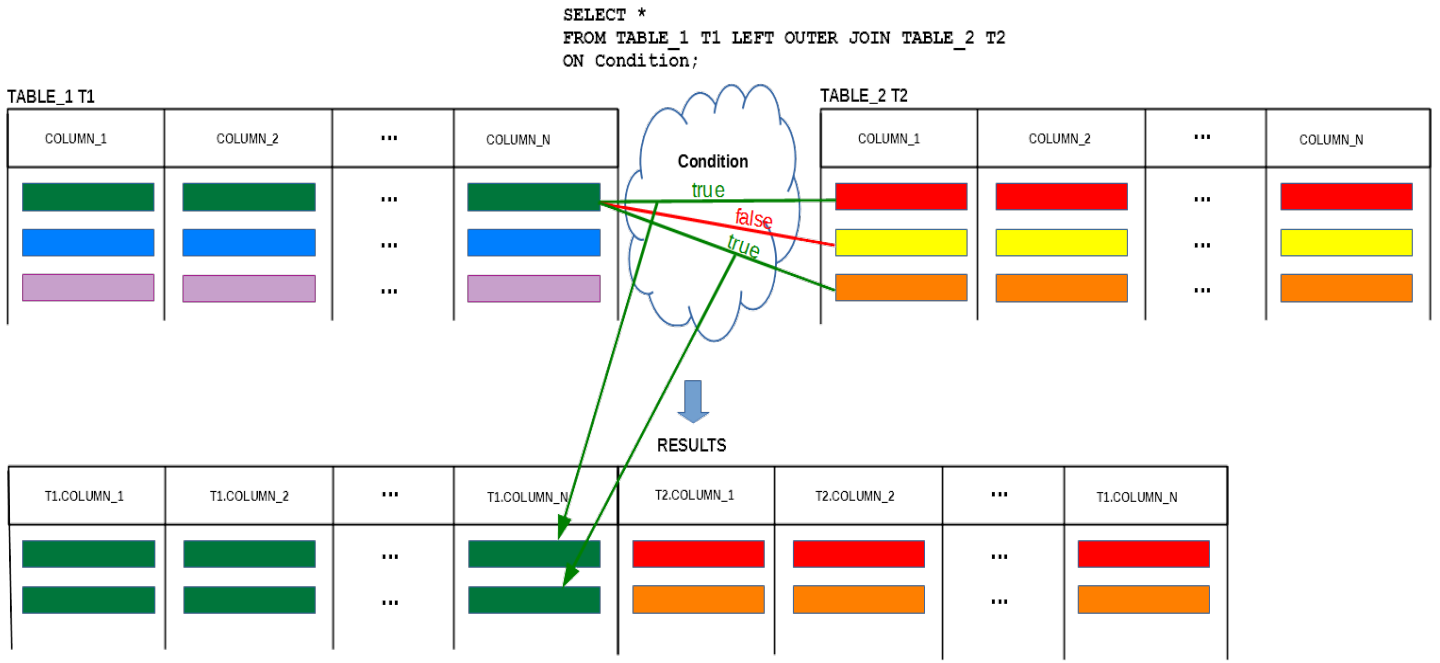
sometimes, we would like to include into an answer the rows from the left or right arguments, that cannot be joined with any row from the opposite argument

SELECT statement (4)

Outline

Left Outer Join queries

Left Outer Join operation joins the rows from two relational tables and appends to the results of join all rows from the left argument of the operation that cannot be joined with any row from the right argument of the operation with `NULL`s used in all places where the values are missing



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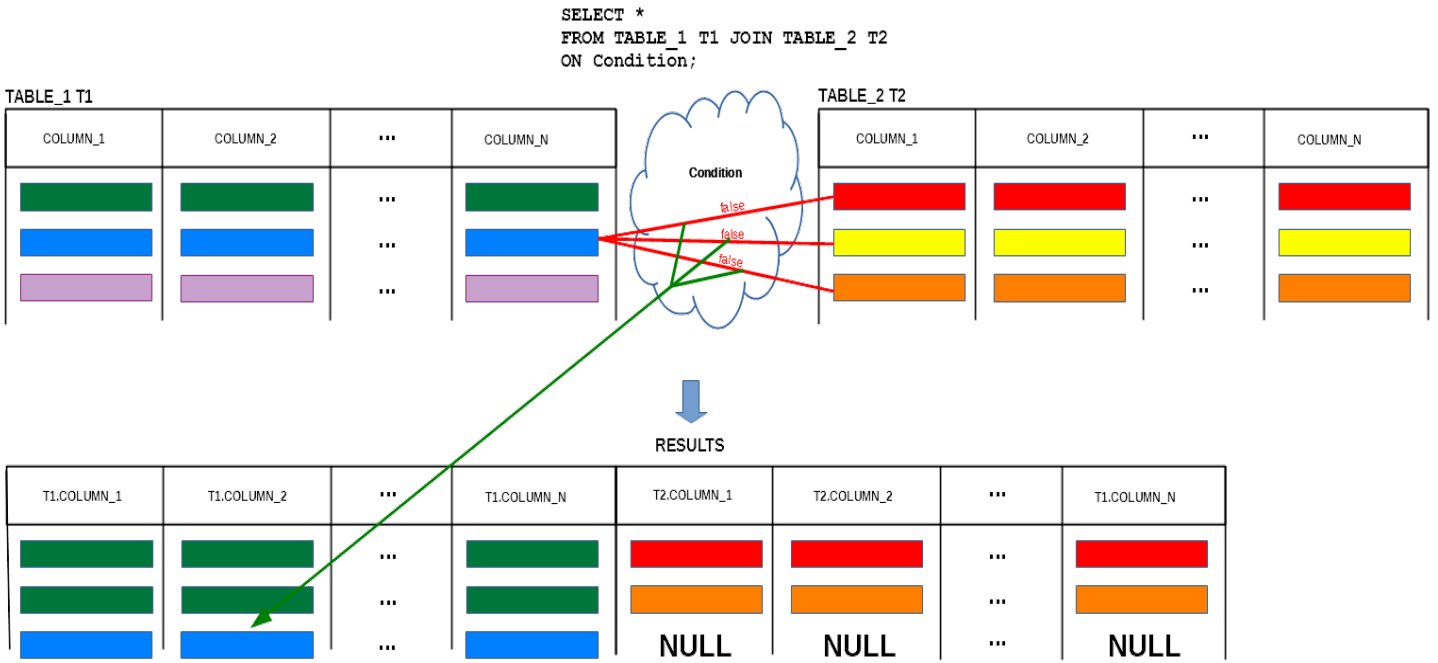
Left Outer Join queries

Left Outer Join operation joins the rows from two relational tables and appends to the results of join all rows from the left argument of the operation that cannot be joined with any row from the right argument of the operation with `NULL`s used in all places where the values are missing



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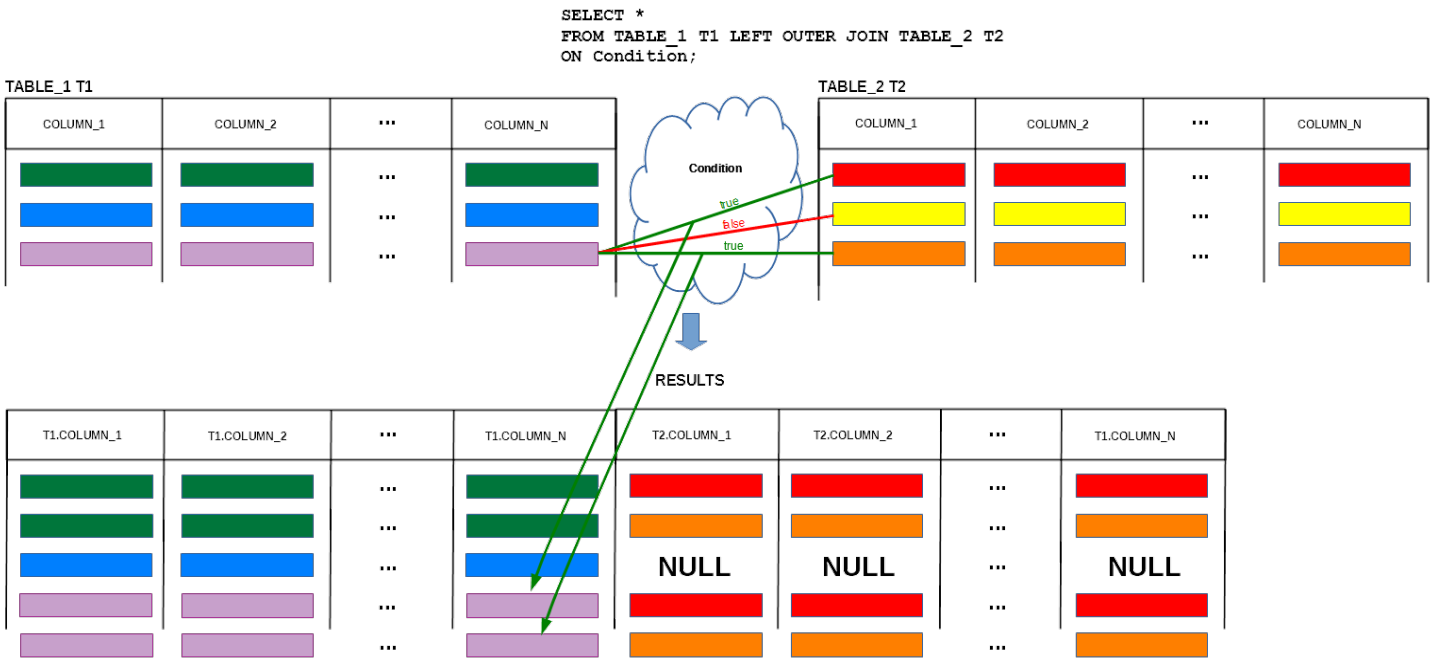
Left Outer Join queries

Left Outer Join operation joins the rows from two relational tables and appends to the results of join all rows from the left argument of the operation that cannot be joined with any row from the right argument of the operation with `NULL`s used in all places where the values are missing



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Left outer join queries

Consider an extended version of the previous query: Find the names of departments together with the titles of all courses offered by each department and include the names of departments that offer no courses at all

SELECT statement with LEFT OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON name = offered_by;
```

An operation of `LEFT OUTER JOIN` includes into the results all rows from the left argument of the operation

If a row from the left argument of the operation cannot be joined with any row from the right argument of the operation then it is extended with `NULL`s and it is appended to the result

Left outer join queries

What are the outcomes of the following `SELECT` statement ?

SELECT statement with LEFT OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON name = offered_by;
```

Relational tables

```
+-------------+------+-------+--------+--------+     +---------+-----------+---------+-------------+
| name        | code | t_s_n | chair  | budget |     | cnum    | title     | credits | offered_by  |
+-------------+------+-------+--------+--------+     +---------+-----------+---------+-------------+
| Mathematics | MATH |     7 | Peter  |  200.0 |     | MATH101 | Calculus  |       6 | Mathematics |
| Physics     | PHY  |     5 | Albert |  100.1 |     | PHYS101 | Mechanics |       6 | Physics     |
| Biology     | BIOL |     0 | Mary   |    0.0 |     | MATH300 | Topology  |      12 | NULL        |
+-------------+------+-------+--------+--------+     +---------+-----------+---------+-------------+
```

The results of `LEFT OUTER JOIN` operation

Results of LEFT OUTER JOIN

```
+-------------+------+-------+--------+--------+---------+-----------+---------+-------------+
| name        | code | t_s_n | chair  | budget | cnum    | title     | credits | offered_by  |
+-------------+------+-------+--------+--------+---------+-----------+---------+-------------+
| Mathematics | MATH |     7 | Peter  |  200.0 | MATH101 | Calculus  |       6 | Mathematics |
| Physics     | PHY  |     5 | Albert |  100.1 | PHYS101 | Mechanics |       6 | Physics     |
| Biology     | BIOL |     0 | Mary   |    0.0 | NULL    | NULL      |    NULL | NULL        |
+-------------+------+-------+--------+--------+---------+-----------+---------+-------------+
```

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Left outer join queries

What are the outcomes of the following `SELECT` statement ?

SELECT statement with LEFT OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON name = offered_by;
```

The final results of `PROJECTION` on the columns `name` and `title`

The results from processing of SELECT statement above

```
+-------------+-----------+
| name        | title     |
+-------------+-----------+
| Mathematics | Calculus  |
| Physics     | Mechanics |
| Biology     | NULL      |
+-------------+-----------+
```

SELECT statement (4)

Outline

Right outer join queries

Consider the following query: find the names of departments together with the titles of all courses offered by each department and include the titles of all courses do not assigned to any department

SELECT statement with RIGHT OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT RIGHT OUTER JOIN COURSE
ON name = offered_by;
```

An operation of `RIGHT OUTER JOIN` includes into the results all rows from the right argument of the operation

If a row from the right argument of the operation cannot be joined with any row from the left argument of the operation then it is extended with `NULL`s and it is appended to the result

Right outer join queries

What are the outcomes of the following `SELECT` statement ?

SELECT statement with RIGHT OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT RIGHT OUTER JOIN COURSE
                ON name = offered_by;
```

The releational tables

```
+-------------+------+-------+--------+--------+     +---------+-----------+---------+-------------+
| name        | code | t_s_n | chair  | budget |     | cnum    | title     | credits | offered_by  |
+-------------+------+-------+--------+--------+     +---------+-----------+---------+-------------+
| Mathematics | MATH |     7 | Peter  |  200.0 |     | MATH101 | Calculus  |       6 | Mathematics |
| Physics     | PHY  |     5 | Albert |  100.1 |     | PHYS101 | Mechanics |       6 | Physics     |
| Biology     | BIOL |     0 | Mary   |    0.0 |     | MATH300 | Topology  |      12 | NULL        |
+-------------+------+-------+--------+--------+     +---------+-----------+---------+-------------+
```

The results of `RIGHT OUTER JOIN` operation

The results of processing RIGHT OUTER JOIN operation

```
+-------------+------+-------+--------+--------+---------+-----------+---------+-------------+
| name        | code | t_s_n | chair  | budget | cnum    | title     | credits | offered_by  |
+-------------+------+-------+--------+--------+---------+-----------+---------+-------------+
| Mathematics | MATH |     7 | Peter  |  200.0 | MATH101 | Calculus  |       6 | Mathematics |
| Physics     | PHY  |     5 | Albert |  100.1 | PHYS101 | Mechanics |       6 | Physics     |
| NULL        | NULL |  NULL | NULL   |   NULL | MATH300 | Topology  |      12 | NULL        |
+-------------+------+-------+--------+--------+---------+-----------+---------+-------------+
```

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Right outer join queries

What are the outcomes of the following `SELECT` statement ?

SELECT statement with RIGHT OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT RIGHT OUTER JOIN COURSE
                ON name = offered_by;
```

The final results of `PROJECTION` on the columns `name` and `title`

The results from processing SELECT statement above

```
+-------------+-----------+
| name        | title     |
+-------------+-----------+
| Mathematics | Calculus  |
| NULL        | Topology  |
| Physics     | Mechanics |
+-------------+-----------+
```

SELECT statement (4)

Outline

Full outer join queries

Full outer join SQL query is equivalent to a union of the results from left outer join and right outer join

Consider the following query: find the names of departments together with the titles of all courses offered by each department, and ...

... include the names of departments that offer no courses and ...

... include the titles of courses not offered by any department

SELECT statement with FULL OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT FULL OUTER JOIN COURSE
                ON name = offered_by;
```

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Full outer join queries

MySQL does not support full outer join

Full outer join can be simulated in MySQL by `UNION` of `SELECT` statements that implement left outer join and right outer join

SELECT statement with LEFT OUTER JOIN and RIGHT OUTER JOIN operation equivalent to FULL OUTER JOIN operation

```
SELECT name, title
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON name = offered_by
UNION
SELECT name, title
FROM DEPARTMENT RIGHT OUTER JOIN COURSE
                  ON name = offered_by;
```

SELECT statement (4)

Outline

Grouping revisited

Do you remember the following query: Find the names of all departments together with the total number of all courses offered by each department

SELECT statement with GROUP BY clause and aggregation function COUNT

```
SELECT offered_by, COUNT(*)
FROM COURSE
GROUP BY offered_by;
```

What about the departments that offer no courses ?

Find the names of all departments together with the total number of all courses offered by each department and list the names of departments that offer no courses with a value 0

SELECT statement with LEFT OUTER JOIN operation, GROUP BY clause, and aggregation function COUNT

```
SELECT name, count(title)
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON DEPARTMENT.name = COURSE.offered_by
GROUP BY name;
```

Grouping revisited

Find the names of all departments together with the total number of all courses offered by each department and list the names of departments that offer no courses with a value 0

SELECT statement with LEFT OUTER JOIN operation, GROUP BY clause, and aggregation function COUNT

```
SELECT name, count(title)
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON DEPARTMENT.name = COURSE.offered_by
GROUP BY name;
```

Note, that:

- we must use a relational table `DEPARTMENT` to get the names of all departments
- we must use `LEFT OUTER JOIN` (or `RIGHT OUTER` join if a name of relational table `DEPARTMENT` is on the right hand side of `OUTER JOIN` operation) to include the names of departments that offer no courses
- we must count the values in a column `title` with `COUNT(title)` in the results of `LEFT OUTER JOIN` (and not the rows with `COUNT(*)`)

References

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T. Connoly, C. Begg, Database Systems, A Practical Approach to Design, Implementation, and Management, Chapters 6.3.7 Multi-table Queries, Pearson Education Ltd, 2015

D. Darmawikarta, SQL for MySQL A Beginner's Tutorial, Chapter 6, pages 62 - 63 Brainy Software Inc. First Edition: June 2014

How to ... ? Cookbook, How to implement queries in SQL ? (Part 2) Recipe 6.2 How to implement outer joins ?