Joins, Subqueries and Indices

Data Retrieval and Performance

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Questions

sli.do

#java-db

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JOINs

Gathering Data from Multiple Tables

Data from Multiple Tables

- Sometimes you need data from several tables:

Employees

employee_name	department_id
Edward	3
John	NULL

Departments

department_id	department_name
3	Sales
4	Marketing
5	Purchasing

employee_name	department_id	department_name
Edward	3	Sales

Cartesian Product

- This will produce **Cartesian product**:

```
SELECT last_name, name AS department_name
FROM employees, departments;
```

- The result:

last_name	department_name
Gilbert	Engineering
Brown	Engineering
…	…
Gilbert	Sales
Brown	Sales

Cartesian Product

- Each row in the first table is paired with **all** the rows in the second table
  - When there is **no relationship** defined between the two tables
- Formed when:
  - A join condition is omitted
  - A join condition is invalid
- To avoid, always include a valid **JOIN condition**

JOINS

- **JOINS** – used to collect data from **two** or **more** tables
- Types:

INNER JOIN

LEFT JOIN

RIGHT JOIN

OUTER (UNION) JOIN

CROSS JOIN

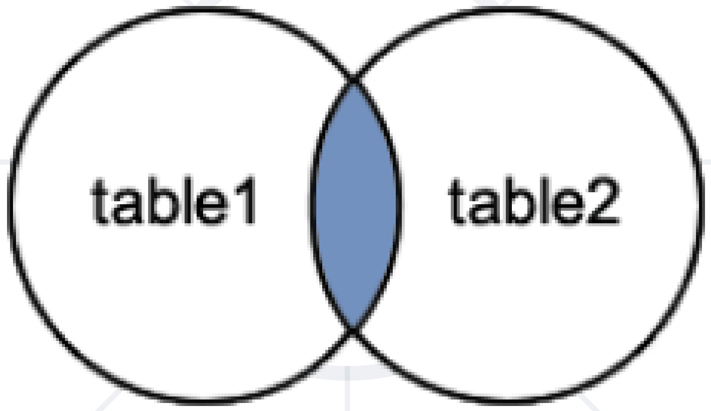
Tables

id	name	course_id
1	Alice	1
2	Michael	1
3	Caroline	2
4	David	5
5	Emma	NULL

id	name
1	HTML5
2	CSS3
3	JavaScript
4	PHP
5	MySQL

INNER JOIN

- Produces a set of records which **match in both tables**



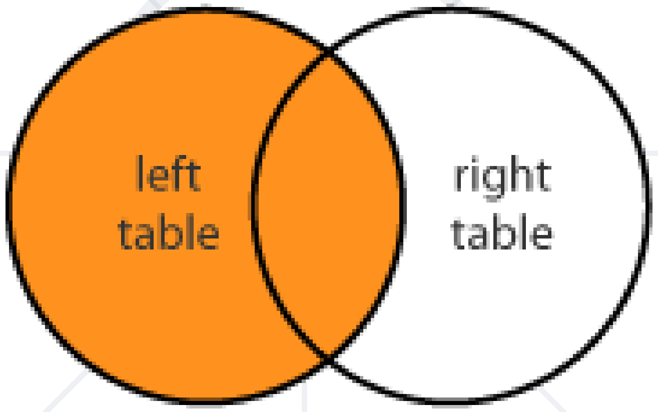
```
SELECT students.name, courses.name
FROM students
INNER JOIN courses #or just JOIN
ON students.course_id = courses.id
```

Join Conditions

students_name	courses_name
Alice	HTML5
Michael	HTML5
Caroline	CSS3
David	MySQL

LEFT JOIN

- Matches every entry in **left** table regardless of match in the **right**



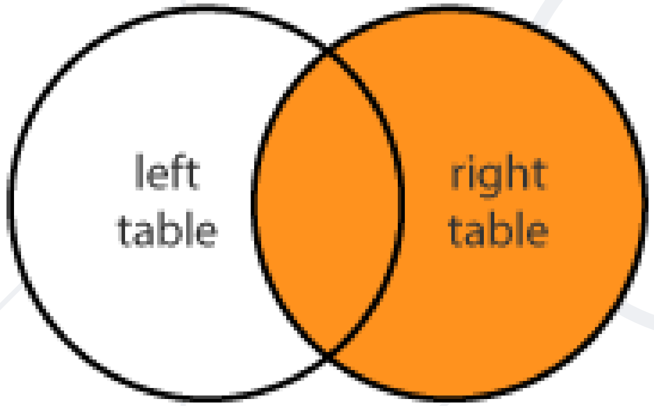
```
SELECT students.name, courses.name
FROM students
LEFT JOIN courses
ON students.course_id = courses.id
```

Join Conditions

students_name	courses_name
Alice	HTML5
Michael	HTML5
Caroline	CSS3
David	MySQL
Emma	NULL

RIGHT JOIN

- Matches every entry in **right** table regardless of match in the **left**



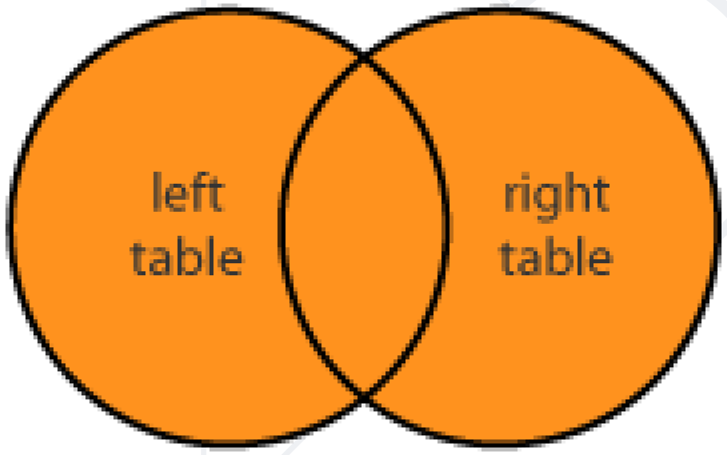
```
SELECT students.name, courses.name
FROM students
RIGHT JOIN courses
ON students.course_id = courses.id
```

Join Conditions

students_name	courses_name
Alice	HTML5
Michael	HTML5
Caroline	CSS3
NULL	JavaScript
NULL	PHP
David	MySQL

OUTER (FULL JOIN)

- Returns all records in both tables regardless of **any** match
  - Less useful than **`INNER`**, **`LEFT`** or **`RIGHT JOINs`** and it's **not implemented in MySQL**
  - We can use **`UNION`** of a **`LEFT`** and **`RIGHT JOIN`**



UNION of LEFT and RIGHT JOIN

```
SELECT students.name, courses.name
FROM students
LEFT JOIN courses
ON students.course_id = courses.id

UNION

SELECT students.name, courses.name
FROM students
RIGHT JOIN courses
ON students.course_id = courses.id
```

students_name	courses_name
Alice	HTML5
Michael	HTML5
Caroline	CSS3
David	MySQL
Emma	NULL
NULL	JavaScript
NULL	PHP

Cross Join

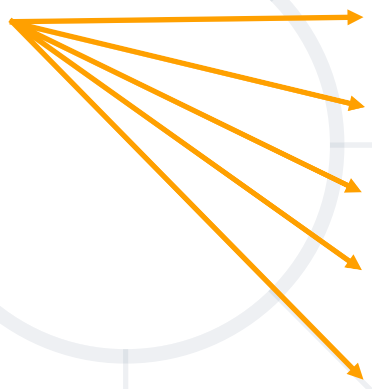
- Produces a set of associated rows of two tables
  - Multiplication of each row in the first table with each in second
  - The result is a **Cartesian** product, when there's **no condition** in the **WHERE** clause

```
SELECT * FROM courses AS c
 CROSS JOIN students AS s;
```

No Join Conditions

Cross Join

id	name
1	HTML5
2	CSS3
3	JavaScript
4	PHP
5	MySQL



id	name	course_id
1	Alice	1
2	Michael	1
3	Caroline	2
4	David	5
5	Emma	NULL

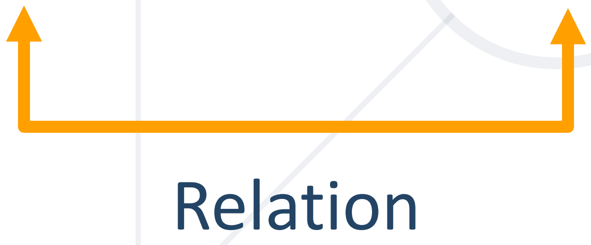
Result

course_id	course_name	student_id	student_name
1	HTML5	1	Alice
1	HTML5	2	Michael
1	HTML5	3	Caroline
…	…	…	…

Join Overview

employee_name	department_id
Sally	13
John	10
Michael	22
Bob	11
Robin	7
Jessica	15

department_id	department_name
7	Executive
8	Sales
10	Marketing
12	HR
18	Accounting
22	Engineering



Join Overview: INNER JOIN

employee_name	department_id
Sally	13
John	10
Michael	12
Bob	22
Robin	7
Jessica	8

department_id	department_name
9	Executive
8	Sales
11	Marketing
12	HR
18	Accounting
22	Engineering

employee_name	department_id	department_name
Michael	12	HR
Bob	22	Engineering
Jessica	8	Sales

Join Overview: LEFT JOIN

employee_name	department_id
Sally	13
Jessica	8
Michael	22
Bob	11

department_id	department_name
8	Sales
12	HR
18	Accounting
22	Engineering

employee_name	department_id	department_name
Sally	13	NULL
Jessica	8	Sales
Michael	22	Engineering
Bob	11	NULL

Join Overview: RIGHT JOIN

employee_name	department_id
Sally	13
Jessica	8
Michael	22
Bob	11

department_id	department_name
8	Sales
12	HR
18	Accounting
22	Engineering

employee_name	department_id	department_name
Jessica	8	Sales
NULL	12	HR
NULL	18	Accounting
Michael	22	Engineering

Problem: Managers

- Get information about the **first 5 managers** in the "soft_uni" database
  - **`id`**
  - **`full_name`**
  - **`department_id`**
  - **`department_name`**

employee_id	full_name	department_id	name
3	Roberto Tamburello	10	Finance
4	Rob Walters	2	Tool Design
6	David Bradley	5	Purchasing
12	Terri Duffy	1	Engineering
21	Peter Krebs	8	Production Control

Solution: Managers

```
SELECT e.employee_id, CONCAT(first_name, ' ',
last_name) AS 'full_name', d.department_id,
d.name
FROM employees AS e
RIGHT JOIN departments AS d
ON d.manager_id = e.employee_id
ORDER BY e.employee_id LIMIT 5;
```

Subqueries

Query Manipulation On Multiple Levels

Subqueries

- Subqueries – SQL query inside a larger one
- Can be nested in **SELECT**, **INSERT**, **UPDATE**, **DELETE**
  - Usually added within a **WHERE** clause

```
SELECT * FROM students
WHERE course_id = 1;
```

id	name	course_id
1	Alice	1
2	Michael	1

Subquery

Problem: Higher Salary

- **Count** the number of employees who receive salary, **higher** than the average
  - Use "soft_uni" database

employee_id	first_name	last_name	…
216	Mike	Seamans	…
178	Barbara	Moreland	…
…	…	…	…

Table "employees"

count
88

Solution: Higher Salary

```
SELECT COUNT(e.employee_id) AS 'count'
FROM employees AS e
WHERE e.salary >
(
    SELECT AVG(salary) AS
    'average_salary' FROM employees
);
```

Indices

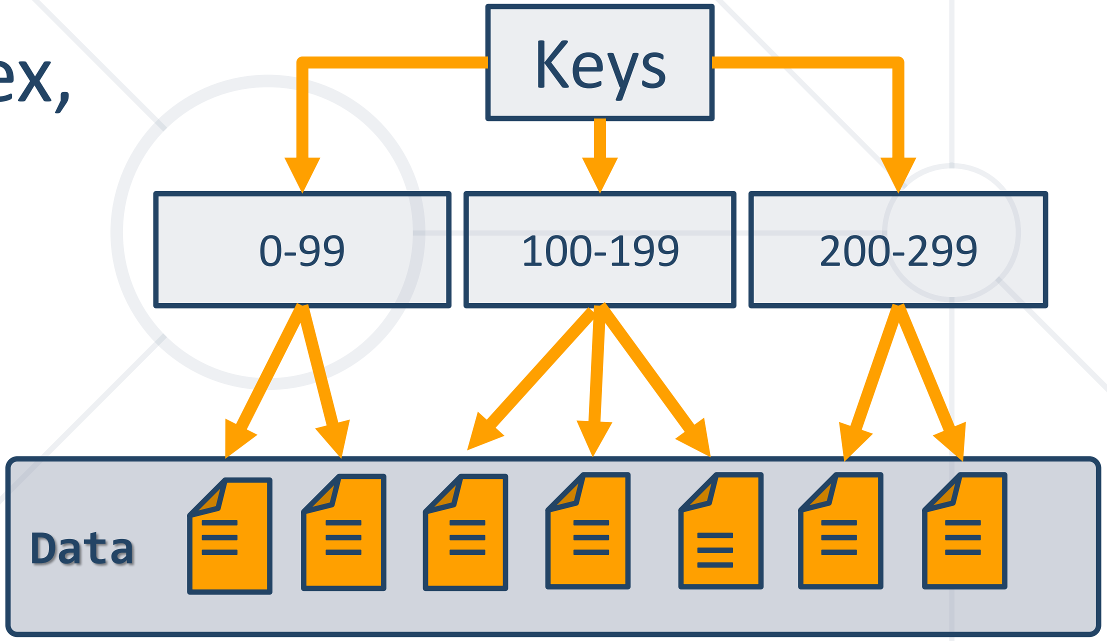
Clustered and Non-Clustered Indices

Indices

- Structures associated with a table or view that speeds retrieval of rows
  - Usually implemented as **B-trees**
- Indices can be built-in the table (**clustered**) or stored externally (**non-clustered**)
- Adding and deleting records in indexed tables is slower!
  - Indices should be used for big tables only (e.g. 50 000 rows)

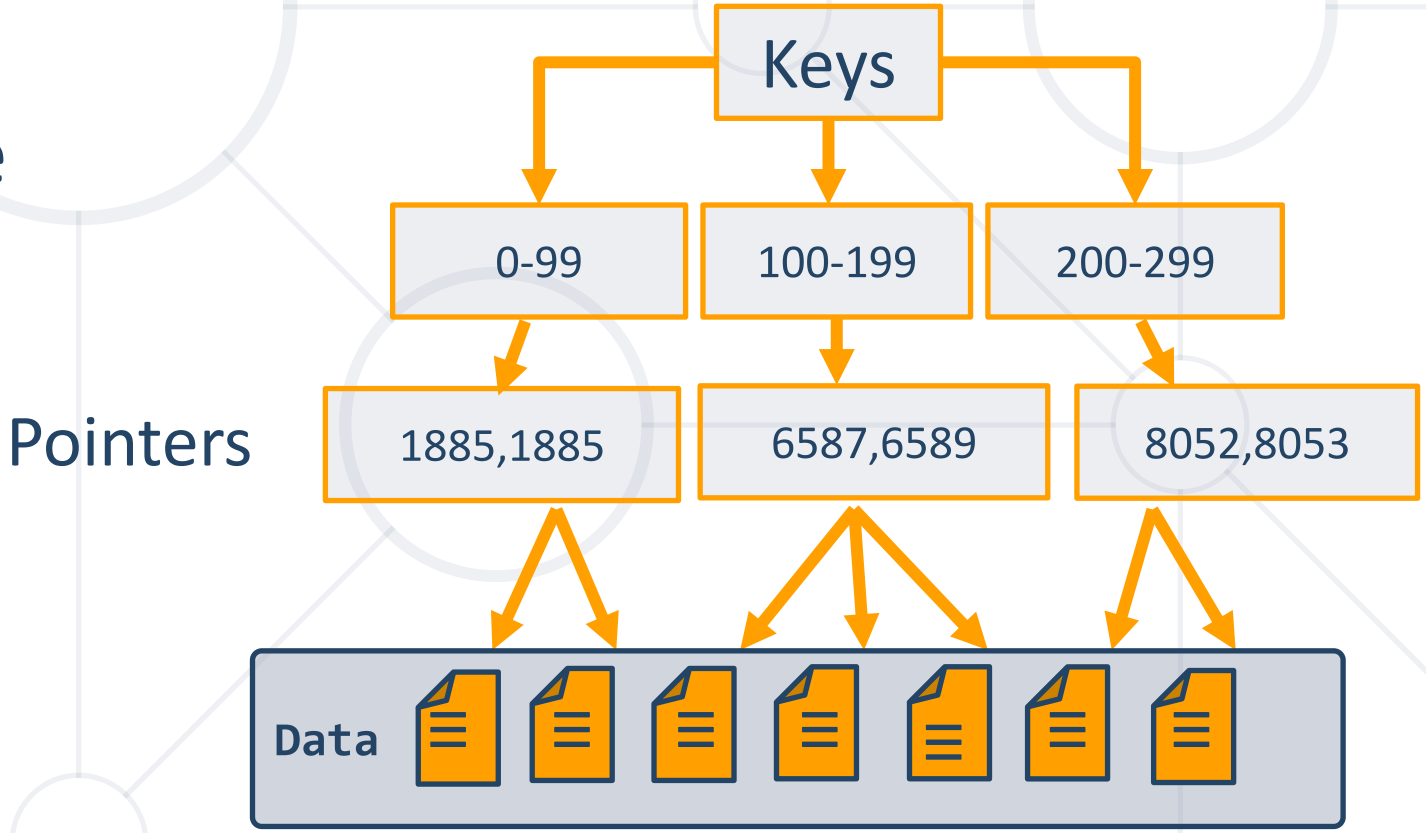
Clustered Indices

- **Clustered** index **determine the order** of data
  - Very useful for fast execution of **WHERE**, **ORDER BY** and **GROUP BY** clauses
- Maximum 1 clustered index per table
  - If a table has no clustered index, its data rows are stored in an **unordered structure** (heap)



Non-Clustered Indices

- Useful for fast retrieving a **single record** or a **range** of records
  - Each **key value entry** has a pointer to the data row that contains the key value
- Maintained in a separate
- Structure in the DB



Indices Syntax

```
CREATE INDEX
  ix_users_first_name_last_name
ON users(first_name, last_name);
```

Table Name

Columns

Summary

- Joins

```
SELECT * FROM employees AS e
  JOIN departments AS d ON
d.department_id = e.department_id
```

- **Subqueries** are used to nest queries
- Indices improve SQL search **performance** if used properly

Questions?

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