

# Joins, Subqueries and Indices

Data Retrieval and Performance



**SoftUni Team**

**Technical Trainers**



**SoftUni**

**Software University**

<https://softuni.org/>

## 1. JOINS

- Gathering Data From Multiple Tables

## 2. Subqueries

- Query Manipulation on Multiple Levels

## 3. Indices

- Clustered and Non-Clustered Indices

sli.do

#



# 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 (1)

- 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

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

**INNER JOIN**

**LEFT JOIN**

**RIGHT JOIN**

**OUTER  
(UNION)  
JOIN**

**CROSS JOIN**

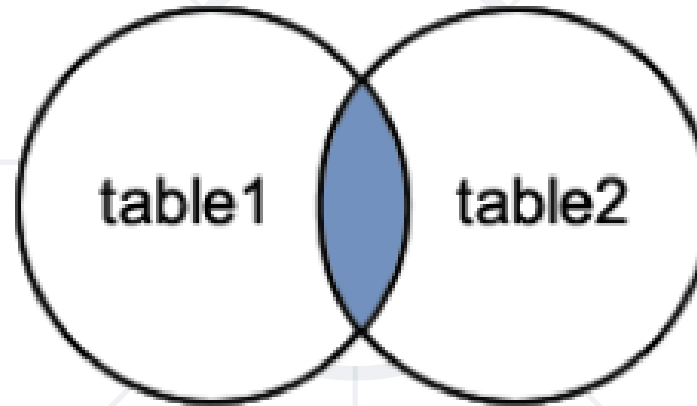


id	name	course_id
1	Alice	1
2	Michael	1
3	Caroline	2
4	David	5
5	Emma	NULL

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
```

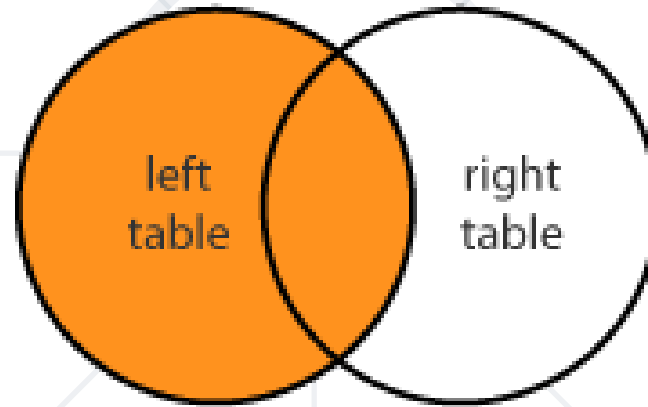
Join Conditions



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
```

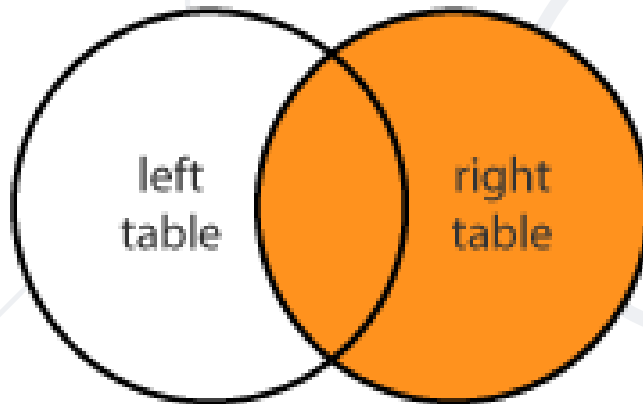
Join Conditions



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
```

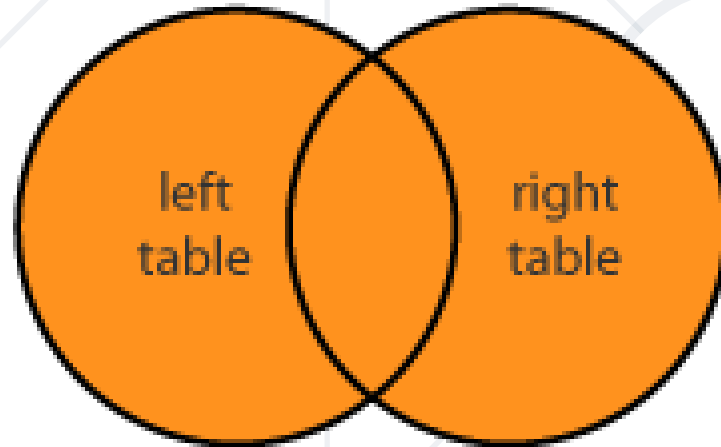
Join Conditions



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

- 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 (2)

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



Relation

# 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

```
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 – 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	...
...	...	...	...



count
88

Table "employees"

# 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  
);
```

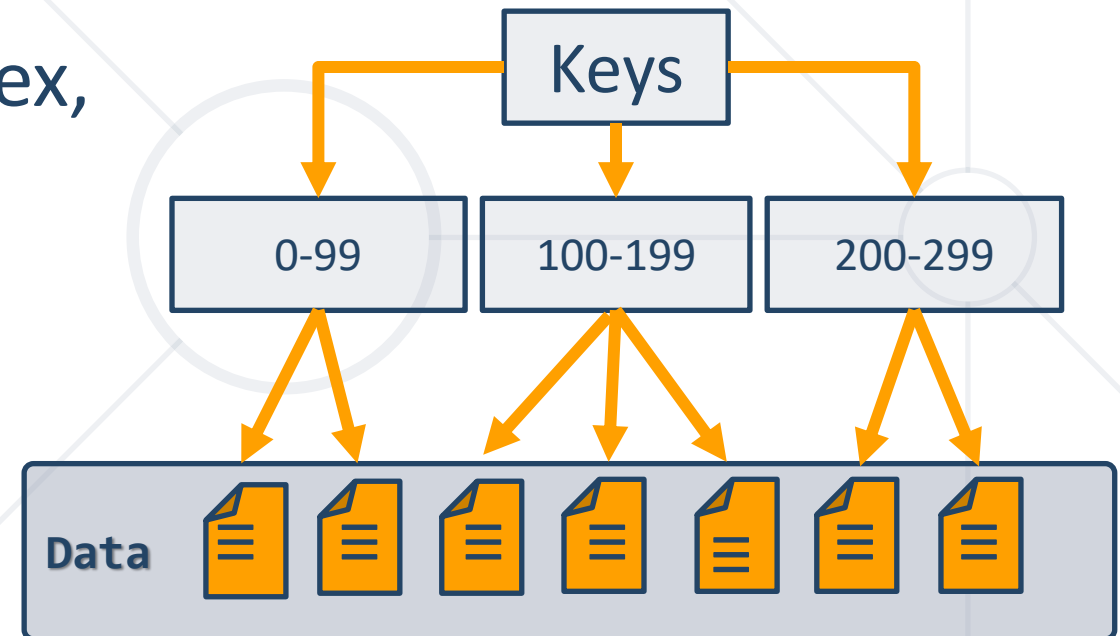


# Indices

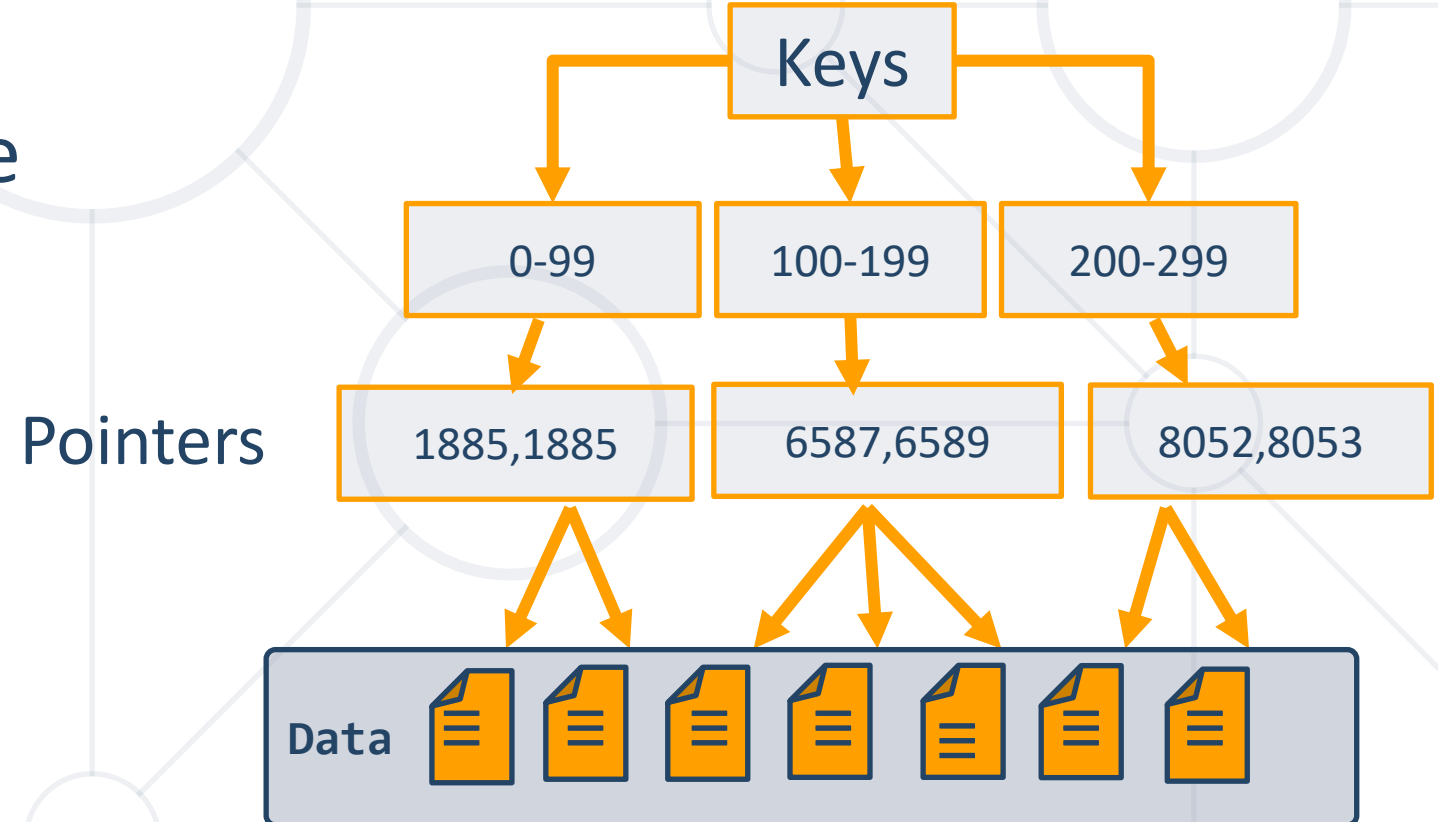
Clustered and Non-Clustered Indices

- 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** 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)



- 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



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

Table Name

Columns

- Joins

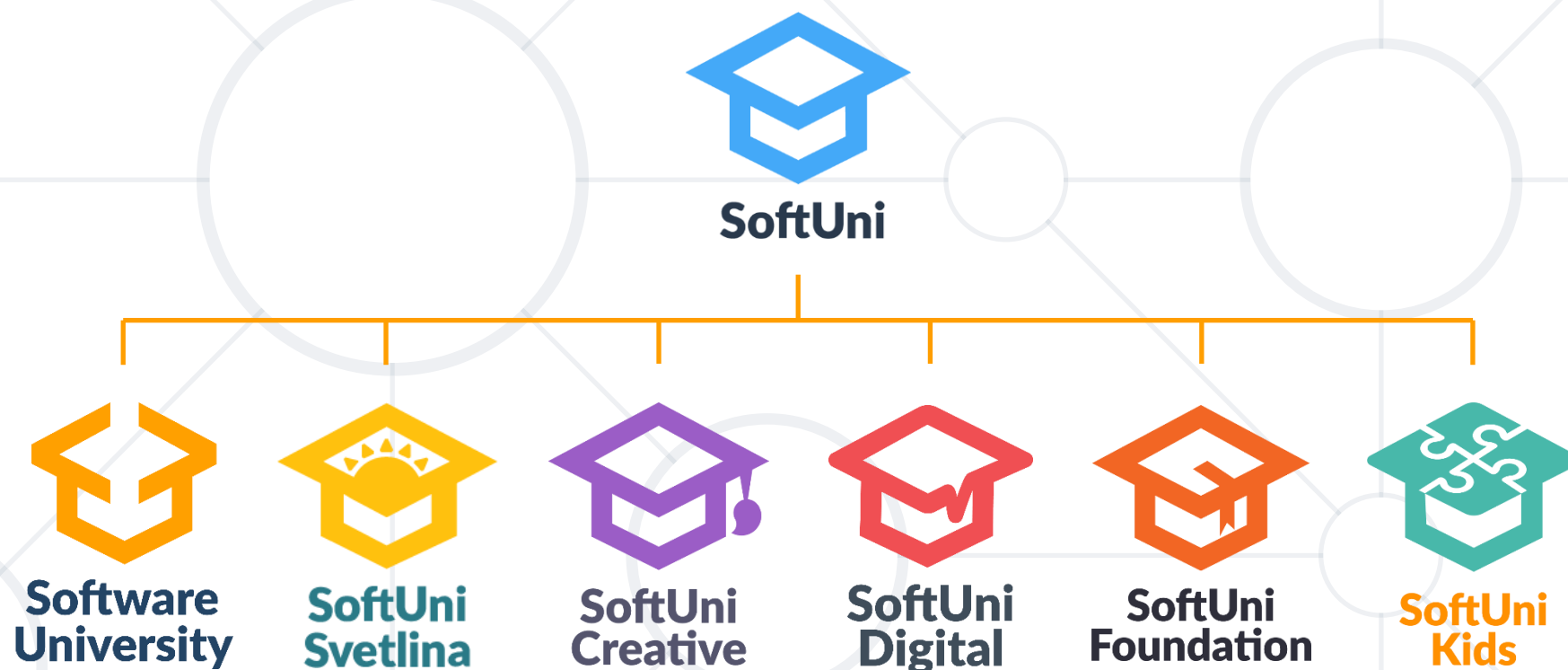
```
SELECT * FROM employees AS e  
  JOIN departments AS d ON  
d.department_id = e.department_id
```

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





# Questions?



# SoftUni Diamond Partners



**SCHWARZ**



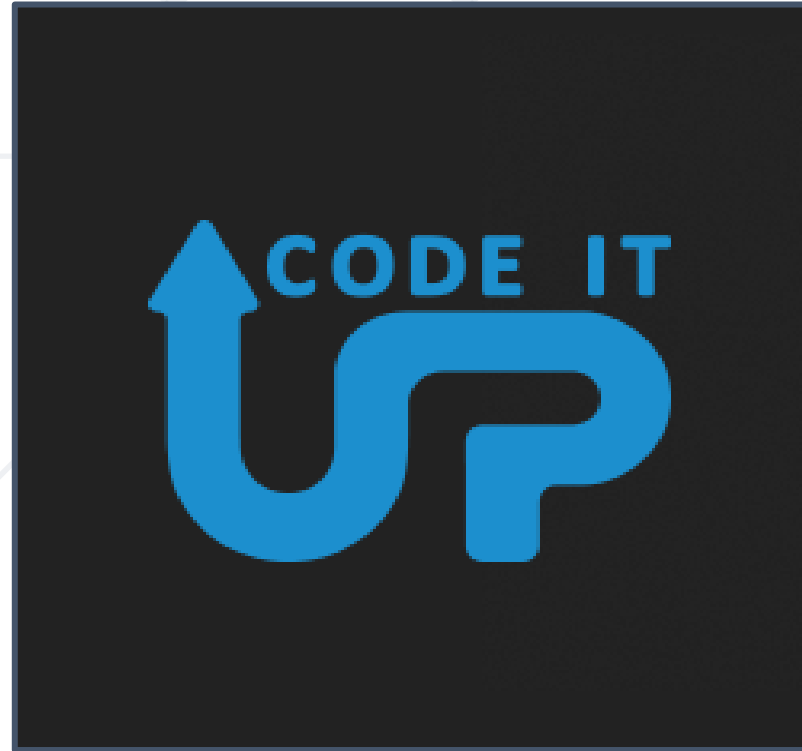
**SUPER  
HOSTING  
.BG**



**INDEAVR**  
Serving the high achievers

**Bosch.io**





- Software University – High-Quality Education, Profession and Job for Software Developers
  - [softuni.bg](https://softuni.bg)
- Software University @ Facebook
  - [facebook.com/SoftwareUniversity](https://facebook.com/SoftwareUniversity)
- SoftUni Global
  - [softuni.org](https://softuni.org)



Software University



SoftUni Global

- This course (slides, examples, demos, exercises, homework, documents, videos and other assets) is **copyrighted content**
- Unauthorized copy, reproduction or use is illegal
- © SoftUni – <https://about.softuni.bg/>
- © Software University – <https://softuni.bg>
- © SoftUni Global – <https://softuni.org>

