# Grouping the aggregated rows and using sub queries

- The learning objectives for this week are:
  - Knowing how the GROUP BY clause operates and how it is related to the aggregate functions
  - Knowing what are sub queries and how to use them with the SELECT clause

## Grouping the aggregated rows

- So, an aggregate function performs a calculation for multiple rows so that the end result is a single value
- If the result table always contains just a single row, how can we write a query such as, "what's the average grade from each course?"
- To achieve this, we need to *group* the rows based on a specific column and perform the aggregate function for each group separately
- This can be done using the GROUP BY clause

```
GROUP BY column_list [ HAVING group_filtering_condition ]
```

• The GROUP BY clause uses a column or a group of columns in a SELECT statement to form groups of rows which the aggregate function operators on:

```
-- what's the average grade from each course?
SELECT course_code, AVG(grade) as average_grade FROM CourseGrade
-- form the groups based on the course_code
GROUP BY course_code
```

- The result table will have a row for *each distinct column value* of the GROUP BY column
- Each row has the corresponding aggregate function result for that group
- In the example's case the result table would contain the average grade for each distinct course\_code :

course_code	average_grade
a290	2.5
a450	3.0
•••	•••

- As mentioned, the GROUP BY clause can have multiple columns
- In this case the result table will have a row for each distinct combination of column values of the GROUP BY columns

```
-- what's the average grade from each course instance?
SELECT course_code, instance_number, AVG(grade) as average_grade FROM CourseGrade
-- form the groups based on the course_code and instance_number
GROUP BY course_code, instance_number
```

• In the example's case the result table would contain the average grade for each distinct combination of course\_code and instance\_number:

SELECT course\_code, instance\_number, AVG(grade) as average\_grade FROM CourseGrade GROUP BY course\_code, instance\_number

course_code	instance_number	average_grade
a290	1	4.5
a290	2	3.0
a450	1	2.9
	•••	•••

• It is worth noting that in the SELECT statement we can only select columns that are either aggregate functions or columns used in the GROUP BY clause:

```
-- X student_number is not an aggreagate function, nor it is in the GROUP BY clause.
-- This will lead into an error

SELECT course_code, student_number, AVG(grade) as average_grade FROM CourseGrade

GROUP BY course_code
```

This causes the following error:

"Column 'CourseGrade.student\_number' is invalid in the select list because it is not contained in either an aggregate function or the GROUP BY clause"

### Combining with the WHERE clause

• We can use the WHERE clause to apply filtering before the grouping is done by the GROUP BY clause:

```
-- how many employees whose salary is above 10000 there are in each department?

SELECT deptno, COUNT(*) AS number_of_employees

FROM Employee

WHERE salary > 10000 -- The WHERE clause is applied before grouping is done

GROUP BY deptno

ORDER BY deptno
```

### Using aggregate functions in filtering

- The WHERE clause can't use aggregate functions because it is *applied before* the GROUP BY clause while the query is executed
- Instead, we can use the HAVING clause to filter based on aggregate functions:

```
-- which departments have more than 10 employees?
-- X can't use aggregate functions with the WHERE clause, this won't work

SELECT deptno, COUNT(*) AS "number of employees"

FROM Employee

WHERE COUNT(*) > 10

GROUP BY deptno

-- ✓ we should use the HAVING clause instead

SELECT deptno, COUNT(*) AS "number of employees"

FROM Employee

GROUP BY deptno HAVING COUNT(*) > 10
```