Exercise walk-through

8.2
Relational algebra and SQL

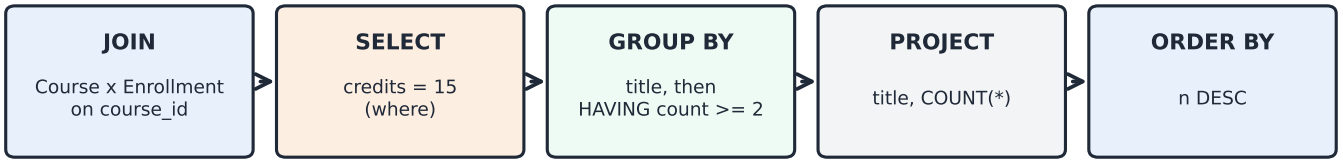
University Computer Science

Relational algebra and SQL: the pipeline

1. **Pipeline Join** Course x Enrollment, select credits = 15, group by title, keep groups of 2 or more: executed result - Databases | 3.
2. **Joins** A plain join drops the 2 empty courses; LEFT JOIN keeps them at n = 0 - 6 rows; COUNT(col) skips NULLs, COUNT(*) does not.
3. **Order** FROM builds rows, WHERE filters, GROUP BY partitions, HAVING filters groups, SELECT projects, ORDER BY sorts.

Table pipeline

one query, five operators, left to right



clause order is semantic: FROM builds rows, WHERE filters rows, GROUP BY partitions, HAVING filters groups

pipeline of the course query:

SELECT c.title, COUNT(*) AS n FROM Course c JOIN Enrollment e ON c.course_id = e.course_id

WHERE c.credits = 15 GROUP BY c.title HAVING COUNT(*) >= 2 ORDER BY n DESC;

executed result: Databases | 3

> One query as a pipeline of the five algebra operators, left to right.

Exercises 2.1·2.3

2.1 Name the operator: `WHERE credits = 15`. [3]

2.2 Name the operator: `SELECT title FROM …`. [3]

2.3 WHERE versus HAVING, one line each. [3]

Exercises 2.1·2.3

2.1 Name the operator: `WHERE credits = 15`. [3]

2.1

- Selection σ (a WHERE filter on rows) ✓.

2.2 Name the operator: `SELECT title FROM …`. [3]

2.2

- Projection π (keeping the named columns) ✓.

2.3 WHERE versus HAVING, one line each. [3]

2.3

- WHERE filters rows before grouping; HAVING filters groups after ✓.

Exercise 3.1

3.1 The sample schema: Student(8 rows), Course(6), Enrollment(14); Databases (course 1, 15 credits) has 3 enrollments; Compilers and Topology have none.

Write the result table (rows and values) of the course query with HAVING COUNT(*) $\geq$ 2. Write the result of the LEFT JOIN version listing every course with its count, ordered by title. State the row count of `SELECT student_id FROM Enrollment` and of its DISTINCT version on data where 8 students enrolled exactly 14 times with 6 repeat enrollees. [8]

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3.1

- Course query result: one row – `Databases | 3` ✓.
- LEFT JOIN: Algorithms 2, Calculus 5, Compilers 0, Databases 3, Linear Algebra 4, Topology 0 – 6 rows ✓.
- `SELECT student_id FROM Enrollment`: 14 rows ✓.
- DISTINCT: 8 rows – the 6 repeats collapse ✓.

Exercise 3.2

3.2 Explain, in clause order, what this query does at each step:

```
SELECT d.name, COUNT(*) AS n
FROM Department d JOIN Course c ON d.dept_id = c.dept_id
WHERE c.credits >= 12
GROUP BY d.name
ORDER BY n DESC;
```

Name the clause that would change if only departments with at least 2 such courses should appear, and write that clause. State the result row count before and after that change (2 departments, 4 courses of ≥ 12 credits split 2 and 2). [7]

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3.2

- FROM/JOIN builds Department x Course rows following the foreign key ✓.
- WHERE keeps courses with credits ≥ 12 ✓.
- GROUP BY partitions by department name; SELECT projects name and the count; ORDER BY sorts descending ✓.
- The change is a HAVING clause: `HAVING COUNT(*) >= 2` ✓.
- Before: 2 result rows (one per department); after: still 2 rows – each department has exactly 2 such courses, so both survive the filter ✓.