

DSME 6751 (Spring 2024): Assignment #1

Deadline: Wednesday, Jan 24 at 11:59 PM.

Download the PDF file titled “DSME6751_Assignment1.pdf” from Blackboard.

Submission Guidelines

- Craft your solutions using a Word or LaTeX file, clearly marking each solution with its corresponding question number.
- For submission, convert and save your Word or LaTeX file as a PDF, naming it “YourStudentID_assignment1.pdf” (e.g., “1155123456_assignment1.pdf”).

Note: While AI tools can be used to check solutions, avoid relying on them initially to foster genuine understanding. Over-relying on AI without thoughtful engagement won't be beneficial in the long term.

Question 1. Database Concept (60 points)

The *company* database comprises two relations: *employee* and *department*, with the following schema:

employee (*employee_id*, *department_id*, *first_name*, *last_name*, *salary*, *age*, *email*, *phone*)

department (*department_id*, *name*, *building*, *room*, *budget*)

Answer the following questions using this database.

- (a) Identify the entities (2 points) and the number of attributes in each relation (2 points).
- (b) Propose the most plausible primary key for each relation (2 points). Identify the foreign key(s), child table, and parent table (4 points). Given that each employee is affiliated with only one department (with the smallest department having at least five employees), describe a possible relationship between the two relations (4 points).
- (c) For the relation *employee*, provide two super key examples and justify your choices (4 points). If the phone number could be a candidate key, what conditions must it meet (3 points)? What integrity constraint does it represent (2 points)? Discuss the appropriateness of using the phone number as a primary key (3 points).
- (d) Offer examples of tuple insertions and deletions in these relations that would violate referential integrity constraints (8 points).

(e) Use the *company* database to exemplify the three abstraction levels—physical, logical, and view—and physical data independence. Incorporate specific examples rather than relying solely on definitions (6 points).

(f) Using relational algebra, formulate expressions for the following queries on the *company* database:

- 1) Find the first name and last name of each employee whose salary is greater than \$100000 (5 points).
- 2) Find emails of employees younger than 40 with salaries above \$100000 (5 points).
- 3) List employee_ids of individuals in the “human resource” department (5 points).

(g) A database designer is contemplating adding an “employee_number” field to the *department* relation to indicate each department's employee count. Evaluate this idea (5 points).

Question 2. Queries (40 points)

In this question, you are required to develop SQL queries to address the given scenarios, utilizing the *university* database. After crafting each query, execute them within the Navicat environment. This step is crucial to ensure both the accuracy and functionality of your SQL code. It is possible to write the same query several ways in SQL. For instance, when dealing with multiple relations, you can use either:

- Implicit Join: Utilize the Cartesian Product combined with a WHERE clause.
- Explicit Join: Employ the JOIN keyword. (Note: This method will be covered in more detail in upcoming lessons.)

Your queries will be evaluated based on their correctness and efficiency. Any query that produces the correct output, regardless of the method used, will be deemed correct.

(a) Retrieve the names and salaries of instructors whose salary is above 70,000 and are in the 'Comp. Sci.' department. (5 points)

(b) Retrieve distinct department names where there are instructors with names that start with the letter 'S'. (5 points)

(c) Retrieve the IDs and calculated salaries (increased by 10%) of instructors in the 'Finance' department, and represent the increased salary as new_salary. (5 points)

(d) Retrieve all fields in instructor ordered by department name (in ascending order) and salary (in descending order). (5 points)

(e) Find the average salary for each department where the department has more than 2 instructors, display department name and average salary. (10 points)

(f) Retrieve the names of students and the titles of courses they have taken in 2017. Hint: rename the tables to *s* for *student*, *t* for *takes*, and *c* for *course*. (10 points)

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