Database Management Systems, February 2024

Homework 2: SQL

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Introduction

The goal of this homework assignment is to train you in writing SQL queries against a previously unknown database. To that end, we give you a database script and a description of 10 queries, and you must produce two files, one with the SQL queries, and the other with the output of the SQL queries, produced using psql. Since this project description document has much detail, both regarding the database and your submission, we recommend **reading it carefully**. If you have any questions, please ask us on Piazza.

Database description

In this homework you will work with the Gym Management database for the *Awesome Gym* franchise. There is a **new database instance** (new database file), however, so make sure that you do not use the same database as before. The schema for the database is the same as before. The database contains information on gyms, members, instructors, classes, types of classes, equipment and all their relationships. The database represents data for the gym's operations in January 2023. The data is artificially and randomly generated and may, or may not, reflect reality.

The following is the **database schema** and **ER-diagram** of the database:

Instructor *(ID, name, phone)*
Member *(ID, name, phone, start_date, quit_date, IID)*
Gym *(ID, address, email)*
Type *(ID, name, capacity)*
Equipment *(ID, name, price)*
Class *(ID, IID, TID, GID, date, minutes)*

Attends *(MID, CID, rating)*
Needs *(TID, EID, quantity)*

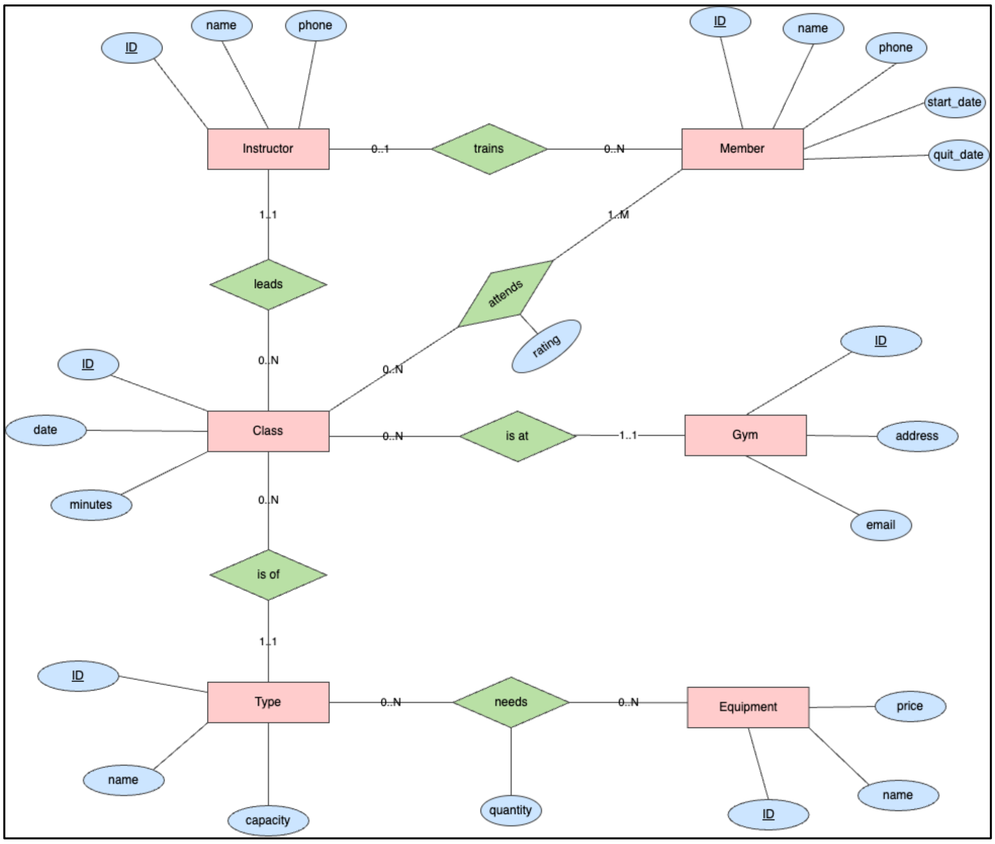


Figure 1: ER Diagram for the Gym Management database.

To better understand the database and its tables, you should study the DDL commands (the CREATE TABLE statements are at the top of the HW2-DB.sql file), study the database schema and ER-diagram in *Figure 1* and inspect the table data using SQL queries. Primary and foreign keys are defined in the DDL. Entities, attributes, and relationships are largely self-explanatory, but further details are below.

The following list states noteworthy features of the database as well as some limitations (simplifications of the real world). Read this **carefully**.

- Instructors can both lead classes (such as yoga and spinning) and have members in personal training (see 'trains' relation).
- Classes can only have one instructor, be of one type and be located at one gym. This is why there is an Instructor ID, Type ID and Gym ID in the Class table; these are a One-To-Many relationships.

Instructions

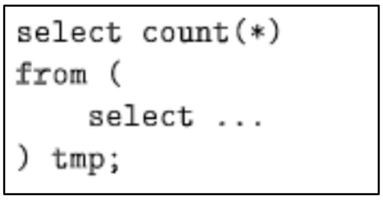
To start working with the database, you must first create it, and then run the database script *HW2-DB.sql* against the database using psql on your laptop, as discussed in class.

Write SQL queries to retrieve the information requested below from your PostgreSQL database. The queries should not return anything except the requested answers. The queries should also be as simple and readable as possible and consistently formatted, as SQL queries are generally part of your code base. To make the most of the homework assignment, you should take time to not only solve the queries, but test variants.

While subqueries are fine (and sometimes necessary), you should not produce a sequence of several queries that allow you to answer the question, you should only write a single query for each question. Queries should avoid system-specific features, including the LIMIT keyword and you should not use magic constants. Note that occasionally, some incorrect variants of some queries could return the same results as a correct query. The fact that a query returns the correct answer thus does not necessarily mean that the query itself is correct. In short, the query must work for *any instance of the schema*.

It is very useful to insert additional data to test your queries adequately. Of course, if you add test data, you can always return to the original data by re-running the database installation script. It is also very useful to use the **hints** provided in some of the problems to check whether you are on the right track. If you are unable to complete a query you can still include your **attempt**, along with a brief description in comments, as it may be given partial points.

Many queries ask you to count the rows that satisfy some criteria. We highly recommend starting by creating a query to return all the rows satisfying the given criteria. Once your query is ready, you can then turn it into a counting query, either by replacing the output columns with a *count(*)* statement, or by enveloping the query with a counting query as shown in *Figure 2*:



```
select count(*)
from (
    select ...
) tmp;
```

Figure 2: A counting query enveloping another query.

In some queries, you may need to use PostgreSQL built-in operators. Here is a list of some useful operators. You should study the functionality of the operators to understand where they may be useful.

avg()	extract()	cast()
count()	lower()	sum()
substring()	max()	min()

Deliverables

This project is a group project, with **3** students per group (you must form your own groups). Individual submissions will not be accepted, unless you have been granted permission by the teachers. The deadline is at **23:59 on Sunday, February 18th**. Late submissions will **not be accepted.**

Each group must submit two files to **Gradescope** (See submission instructions on Canvas):

- An sql file named QUERIES.sql, containing all the queries used to retrieve the requested data. The queries should be in the correct order, with a **comment** preceding each query with the query number (A…J) **as well as 1-3 sentences explaining your solution**. It must be possible to run the QUERIES.sql file using **psql** without errors. We recommend using the provided template for your submission, but remember to rename your file to QUERIES.sql.
- A txt file named RESULTS.txt, containing the results of all queries, produced by running QUERIES.sql with psql.

Queries

A. 447 different members attended at least one class on January 10th. How many different members attended at least one class on January 15th?

B. 4 different class types require more than 20 light dumbbells. How many class types require more than 20 yoga mats?

C. Oh no! Some member hacked the database and is still attending classes but has quit according to the database. Write a query to reveal their name!

D. How many members have a personal trainer with the same first name as themselves, but have never attended a class that their personal trainer led?

E. For every class type, return its name and whether it has an average rating higher or equal to 7, or lower than 7, in a column named "Rating" with values "Good" or "Bad", respectively.

F. Out of the members that have not quit, member with ID 6976 has been a customer for the shortest time. Out of the members that have not quit, return the ID of the member(s) that have been customer(s) for the longest time.

G. How many class types have at least one equipment that costs more than 100.000 and at least one other equipment that costs less than 5.000?

H. How many instructors have led a class in all gyms on the same day?

I. How many instructors have not led classes of all different class types?

J. The class type "Circuit training" has the lowest equipment cost per member, based on full capacity. Return the name of the class type that has the highest equipment cost per person, based on full capacity.

K. (BONUS): The hacker revealed in query C has left a message for the database engineers. This message may save the database! Return the 5th letter of all members that started the gym on December 24th of any year and have at least 3 different odd numbers in their phone number, in a descending order of their IDs, followed by the 8th letter of all instructors that have not led any "Trampoline Burn" classes, in an ascending order of their IDs.