

Database-Systems-236363 Homework 2 Report

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Part I

Wet

1 Entities

The entities relevant to our DB are:

- Photos: `phtable(photoID, description, size)`
- Disks: `dtable(diskID, company, speed, free_space, cost)`
- RAMs: `rtable(ramID, company, size)`

2 Relations

The relations that we will store directly in our DB are:

- Photo On Disk: `(podtable(photoID, diskID))`
- RAM On Disk: `(roddtable(ramID, diskID))`

3 Relations & Properties

Note that for each of the Entity tables, the ID is used as a primary key, and that each of these ID's are used as foreign keys in the tables that link the Disks table to both the RAMs table and the Photos table.

Also, we note that we have a 'many to one' relation in two cases:

1. $photoID \rightarrow diskID$ (in the `podtable`)
2. $ramID \rightarrow diskID$ (in the `roddtable`)

4 ERD Design Considerations

Our main considerations upon choosing this design were its ability to be very space efficient, since there are no duplicates in a non-key field and there are also no potential NULL attributes allowed in our table.

This design also made sense to us due to the requirement of the CRUD API - to which this design enabled a elegant implementation.

Moreover - with this implementation we were also capable of implementing the more advanced APIs efficiently.

5 API Implementation Design Considerations

5.1 CRUD API

Most of the CRUD API functions were simple Getters & Setters and hence did not require much in terms of design; yet, we were able to simplify the implementation of the CRUD API by having implicit deletes thanks to proper usage of CASCDE semantics in the definition of our tables.

Additionally, some of the methods required more sophisticated implementations; notably `deletePhoto()` had a more complex implementation since we had to be able to recognize when an update shouldnt be made AND make an update if nessecery - all in one query.

5.2 Basic API

In the Basic API there were a few methods with interesting design constraints:

- `removePhotoFromDisk()`: In this method - the main issue was we need to update the free space of the associated disk properly - even if the photo did not actually exist. While the trivial implementation of this method is quite simple - this edge case required us to find a much more complicated implementation - in which we rely on the properties of the 'SUM' aggregation operator to handle the 'empty case'.
- `isCompanyExclusive()`: In this method, we are provided with a specific disk (id), and we want to check if the disk's company matches that of all of its associated RAMs. The tricky part was that we need to be able to check if an entire group (nested query) matches the same value (which was also a nested query); to solve this - we used the 'ALL' quantifier - which was actually its only use case for us in this project.

5.3 Advanced API

The interesting method in the Advanced API was `getClosePhotos()` which not only required the longest query we have made so far, but also required us to utilize the 'GROUP' operator while filtering the associated groups using a nested query that counts the number of matching photos - in order to be able

to determine the proportion of the photos which were in the same group as the one associated with the argument `photoID`.

Moreover - the hardest part of the design of this method (and perhaps the project) was the requirement to handle the 'empty case' - in which we have to return all photos if the provided photo is not on any disk.

This essentially required a branching in the logic - but since we were only allowed to use a single atomic sequence of queries - we have created a modular query that uses the 'UNION' operator to effectively implement an 'if' statement without actually using 'if'.

Part II

Dry

6 Why is ChatGPT wrong

The current solution by ChatGPT works as follows:

- It returns pairs of students in lexicographic order - in which:
- If we look at the set of courses taken by both students take - the minimal grade of the first student is smaller than that of the second student

7 Mistake Illustration - Counter Example

One possible counter example to the sol of ChatGPT is:

StudentName	Course	Grade	Semester
adam	db	99	winter23
bob	db	88	winter23

His solution on this table would be \emptyset (which is wrong) - since adam is smaller than bob lexicographically but adam's grade is higher than that of bob.

Instead, the correct solution would be $\{adam, bob\}$.

Hence ChatGPT's solution is wrong.

8 A correct implementation

Our alternative implementation is:

```
(
    SELECT 11.StudentName, 12.StudentName
    FROM Learns 11, Learns 12
    WHERE 11.StudentName!=12.StudentName
          AND 11.Semester=12.Semester
```

```
        AND 11.Grade<12.Grade
        AND 11.Course=12.Course
    )
    -
    (
        SELECT 11.StudentName, 12.StudentName
        FROM Learns 11, Learns 12
        WHERE 11.Semester!=12.Semester
              OR 11.Course!=12.Course
    )
```