Dry homework#1

Submission until November 23rd at 13:30, pairs only, in the course’s cell on the first floor.

Teaching assistant in charge: Hadar Frenkel.

For questions please contact hfrenkel@cs.technion.ac.il with the subject HW1.

Students’ details:

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Please return to cell:________

Final grade:_______________
Question 1: ERD, 40 points

Given the following requirements for a libraries database:

- Every library has an opening hours and a unique name.
- The library can be either a mobile library or a stationary library.
- For stationary libraries we need to remember the address of the library.
- Every book has a title, an author, a copy number and an ISBN number.
- Every book belongs to one library only.
- There may be several copies of the same book at one library. There cannot be two books with the same ISBN and copy number within the same library. There may be two books with the same ISBN and copy number in different libraries.
- Every reader has a name and a unique ID.
- In addition, there are readers that are members of the "Book Club" of a certain library. For these readers we need to remember also a unique club member number.
- There are books that are labeled as “General”, “Elite” or both. Regular readers can only borrow “General” books while club members can borrow every book.
- We want to keep information about current borrowings (no need to keep information about the past). At any given moment a specific copy of a book can be borrowed by at most one reader.
a. 18 point - Draw an ERD that describes the database in the best way and follows the given requirements. Make sure that you mark the keys in the diagram.
b. 9 points - Translate the ERD from section a into tables (for entities, relationships...). Remember to mention keys.
c. 6 points – according to the diagram you drew in section a, can a book stand on its own (not as a book in the library)? If so, explain how to change the diagram so that this cannot happen (you can explain in words, but we prefer it if you drew). If not, explain why.

d. 7 points - Explain how to modify the diagram in section a, so that we can keep information about borrowings that happened in the past - that is, for anyone who borrowed a book, we want to know the dates of the borrowing.
Question 2: RA, 40 points
In this question you need to use the tables derived from the translation of the ERD of question 1.

a. 10 points – write an RA query that finds all readers so that all their borrowed books are from the same library.

b. 10 points – write an RA query that finds all books in the “book club” that were read by all of the readers in system, and were written by “Meir Shalev”.

c. 7 points - Prove or refute: for every relation schemas R and S and a subset X of the attributes of $R \cup S$ it holds that: let $X_1 = R \cap X, X_2 = S \cap X$ then
$$\pi_X(R \bowtie S) = \pi_{X_1}R \bowtie \pi_{X_2}S$$

d. In the lecture you have learned 6 primitive operators: projection, selection, renaming, union, difference and Cartesian product. Prove formally the following independencies:
1. 5 points – the Cartesian product operator, $\times$, is independent of all other operators.
2. 8 points – the difference operator, \, is independent of all other operators.
   (hint: prove that without difference, RA is monotonic).
Question 3: SQL, 20 points

Build a legal SQL script (a series of SQL commands that run in that order and not fail) that executes the following actions (in that order) – you might need more than one SQL command in order to implement one action:

- Create two tables:
  1. A table with residents that have a unique ID (a positive number), and at least two more fields as you choose.
  2. A table that keeps the history of places the residents lived in, with the following conditions:
     - Each resident can live in each place at most once.
     - You have to keep the date the resident moved to that address.
- Add history for two residents.
- Delete one of the residents from the system