CSC 4710/6710: Introduction to Database Systems

Spring 2023, Assignment 2

Due date: Sunday, 04/9/2023, 11:59pm

Total 100+20(bonus)

Problem 1 [35' = 5' + 5' + 5' + 5'+ 15']

- Student (PantherID, Name, Major, Level, Age)
- Course (Course Number, Section, CourseName, Department, Time, Venue, FacultyID)
- Faculty (FacultyID, Name, Department)
- Enrollment (PantherID, CourseName, score)

Consider the relations **Student, Course, Faculty,** and **Enrollment** . Write SQL statements for each of the following queries:

1. For each faculty in the faculty table, insert a new research course with number 6000. Give a difference section number to each faculty (section number is increasing incrementally for each course).
2. Remove all professors from Faculty, who are not teaching any course;
3. Update the name of the student with Okey as joey7, to Joe;
4. Create a view BusyProfessors, containing the names of all professors for whom the number of students they teach across their courses is greater than 100 (Note: if a student is enrolled in two different courses of the same professor, we count the student only once.).
5. Add required constraints into table creation commands for the following conditions;
    a) We wish to forbid null values for Student name.
    b) Major attribute of Student table can be from this list {Math, CS, History}
    c) If we delete a student, tuples in enrolment that refer to the student should be deleted.

d) If we update a course name in the course table, it should be updated in the enrolment table.
e) If we delete a faculty, FacultyId of corresponding tuples in the course table should be set null.

Problem 2 [10' = 5'+ 5']

Consider the following enrollment database:

- Student (PantherID, Name, Major, Level, Age)
- Course (CourseName, Department, Time, Venue, FacultyID)
- Faculty (FacultyID, Name, Department)
- Enrollment (PantherID, CourseName, score)

Write the following queries in SQL. No duplicate tuples should be returned in any of the answers.

1. For each course taught by Professor Esra Akbas, find the course name and the average score of that course;
2. Find the names of faculty members for whom the combined enrollment in the courses they teach is less than 50 (Hint: you are encouraged to define and use views to break down the task).

Problem 3 [20=5*4]

We have designed an eBay-like on-line auction database. (Note: Every auction listed in the system, sold, expired, or ongoing, is listed in Auction table. Auctions, whose items have been sold out, are also listed in Sold table.)

- Item (ItemID, ItemName, Description)
- User (Username, Email, Rating)
- Auction (AuctionID, ItemID, SellerUsername, Price, StartTime, EndTime)
- Sold (AuctionID, BuyerUsername, DateSold)

Answer the following queries with SQL

1. Find a distinct list of *usernames* of the users who participate in an auction. Note that a user may participate in an auction as either a buyer or a seller;
2. Find a list of *usernames* of the sellers whose items have been sold;
3. Find a list of *AuctionIDs* for the auctions that have been expired. (Hint: An expired auction is the one whose item is not sold and *EndTime* < *CurrentTime*. You can use "*CurrentTime*" in the query to indicate the current system time.);
4. Find the *ItemName* of the highest priced item, along with the *Username* of the corresponding user selling the item. Note that there may be more than one item at the highest price, in which case, you must return the information for all items.

Problem 4 [20 =5*4]

Consider a relation with four attributes ABCD and functional dependencies

S= {AB → C, C → D, D → A} :

1. (5) Compute the closure for the attribute set {A, C}.
2. (5) Compute the closure for the attribute set {B, D}.
3. (10) Compute the closer set of S, S'
4. (5) What are **all** keys of the relation?

Problem 5 [10=5*2]

Consider a relation R with five attributes ABCDE. The following dependencies are given: A→ B, BC → E, DE → A.

1. List **all** keys for R;
2. Is R in BCNF? If yes, please explain why. Otherwise, decompose R into relations that are in BCNF.

Problem 6 [25’ = 10’ + 5’ + 5’ + 5’]

Consider the following B+ Tree, as shown below, of order d = 2 (i.e., each index node can hold at most 2 * d keys and 2 * d + 1 pointers). Modify this B+ tree given each of the following modifications

1. What will the tree look like if we insert key 8, 10, 12, 13, 14 to the original tree?
   (show only final tree not intermediate output)
2. What will the tree look like if we insert key 2 to the tree **after (1)?**
3. What will the tree look like if we delete key 44 from the **original tree**?
4. What will the tree look like if we delete key 34 from the **original tree**?

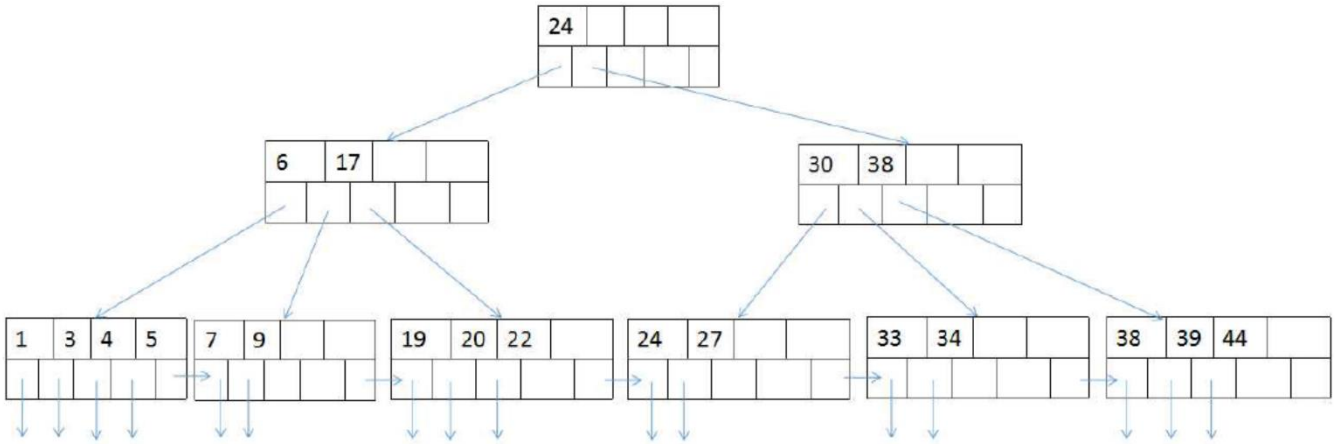

Figure 1: A B+ Tree