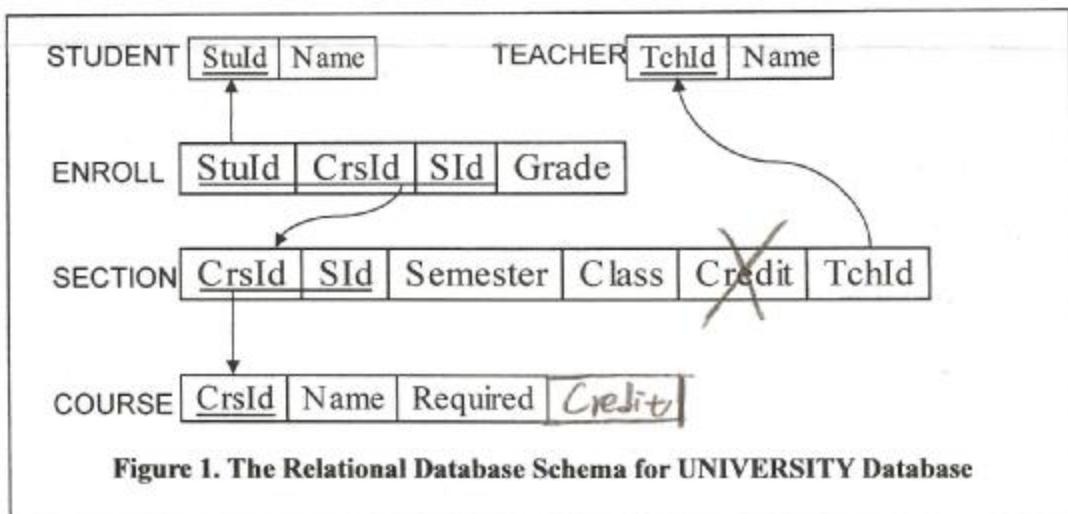


1. For the UNIVERSITY database which schema is shown in Figure 1, please write the following queries in relational algebra and SQL, respectively. (40 points)

(1~5)

- (1) Create a grade report for the student Tom Cruise which includes the credit of every course he has ever taken and the final score he got in every semester. The grade report is made semester by semester.
- (2) For every student, retrieve the number of courses and total credits that he plans to take in the 971 semester.
- (3) For each student, retrieve the total credits of the courses he has passed up to now.
- (4) If a student has already passed a course, he cannot take the same course once again. Write a SQL statement to see if there is someone violating this constraint.
- (5) Retrieve the students who have not passed all the required courses yet.
- (6) Write a SQL statement to delete a SECTION record which course ID is B570886 and section ID is 133.
- (7) Write a SQL statement to modify all the scores in a class which course ID is B570988 and section ID is 124 where  $new\_score = 60 + 0.4 \times old\_score$ .



2. What are update anomalies? (10 points)
  3. Define the following terms: (15 points)
    - (1) Prime attribute
    - (2) Functional dependency
    - (3) Partial dependency
    - (4) Transitive dependency
    - (5) Lossless join property
  4. Give the general definitions of the 1st, the 2nd, and the 3rd normal forms. (12 points)
  5. Given a relation schema  $R = \{A, B, C, D, E\}$  and a set of functional dependencies  $F = \{fd1: A \rightarrow B, fd2: CD \rightarrow E, fd3: B \rightarrow \emptyset, fd4: C \rightarrow A\}$ :
    - (1) Prove that  $CD \rightarrow ABCDE$ , i.e.  $CD$  is a key. (5 points)
    - (2) Find another candidate key  $K$  of  $R$ . You should prove that  $K \rightarrow ABCDE$ . (5 points)
    - (3) If we select  $CD$  as the primary key of  $R$ , which functional dependency violates which normal form test? (5 points)
    - (4) Decompose  $R$  into several relations in 3NF. (10 points)
    - (5) Check the decomposition possesses lossless join property. (8 points)
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