CS43002 : Database Management Systems

Mid-semester Examination, Spring 2013

Time= 2 hrs, Marks = 40, Answer all questions.

Q1.A. Define the following: *(i)*. Candidate key, *(ii)*. Foreign key

Q1.B. Suppose we have two relations $R(\underline{A}, B)$ and $S(\underline{A}, B)$ with the same schema. The only key of R is *{A}*; the only key of S is *{A}* also. Let relation $T(A, B)$ be the set union of R and S, i.e., $T = R \cup S$. What are the keys of T? Explain.

Q1.C. Consider the following ER diagram. If A has 100 entities, B has 1000 entities and C has 10 entities what is the maximum number of entities *(A, B, C)* that could be in the ternary relationship set R? Explain.
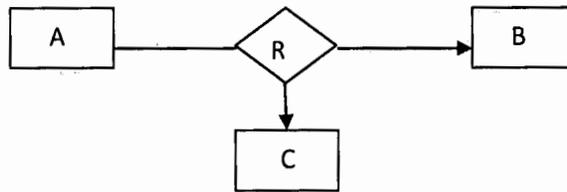
[3 + 3 + 4]

Q2.A. We can represent a linked list by a relation *List(element, position)*, where a tuple such as *(e,i)* means that element *e* is at position *i* on the list.

(i) Suppose first that a selection condition can be any conditional expression, including logical connectives like *AND*, comparisons like = or <, and arithmetic, like $x = y+1$. Write an expression of relational algebra, using only the basic operations: union, intersection, difference, select, project, product, natural join, theta-join, and renaming, to produce the relation *Succ(a,b)*, meaning that element b is the successor of element a on the list.

(ii) Now suppose that selection conditions (and also conditions in theta-joins) can only take the form of a single attribute or constant compared to another single attribute or constant. In particular, no arithmetic like + is allowed. Write a relational algebra expression (using basic operations) for *Succ(a,b)* as defined in part (i).

You may use a sequence of steps in which the results of intermediate expressions are assigned to temporary relations if you like. [3 + 3]

Q2.B. Consider a relation *Student(roll, CGPA)*. Write a SQL query to find the rank of the students (with result table having attributes *roll*, and *rank*). The students having the highest CGPA have a *rank* of 1; students having the second highest CGPA have a *rank* of 2 and so on. [4]

Q3.A. State the Armstrong Axioms. Derive the union and pseudo-transitivity rules from the axioms. [4]

Q3.B. Suppose you are given a relation R with four atomic attributes $ABCD$. For the set of functional dependencies F: *{AB→ C, AB→ D, C→ A, D→ B}* that hold on R, do the following: [12]
(a) Identify the candidate key(s) for R. Show your derivation.
(b) Identify the highest normal form that R satisfies (1NF, 2NF, 3NF, or BCNF). Explain.
(c) If R is not in BCNF, decompose it into a set of BCNF relations that preserve the dependencies. Explain.

Q3.C. Prove that, if any relation R has only one key, it is in BCNF if and only if it is in 3NF. [4]