1 Short Answer

a) Given that strict 2PL is enforced in SQL, why might a dirty read still be possible?

b) In the SQLite locking scheme, at what point does the DBMS refuse to issue new read locks?

c) A unary operator is said to be *idempotent* if applying the same operator two or more times yields the same result as a single time. For example, repeated applications of the δ (duplicate elimination) operator yields the same result as a single application and therefore is idempotent. For each of the following operations, indicate whether or not they are idempotent

$$\sigma_{a=3} \ , \ \gamma_{A}, \ \gamma_{A,sum(B)\rightarrow C}, \ \gamma_{A,sum(B)\rightarrow B}$$

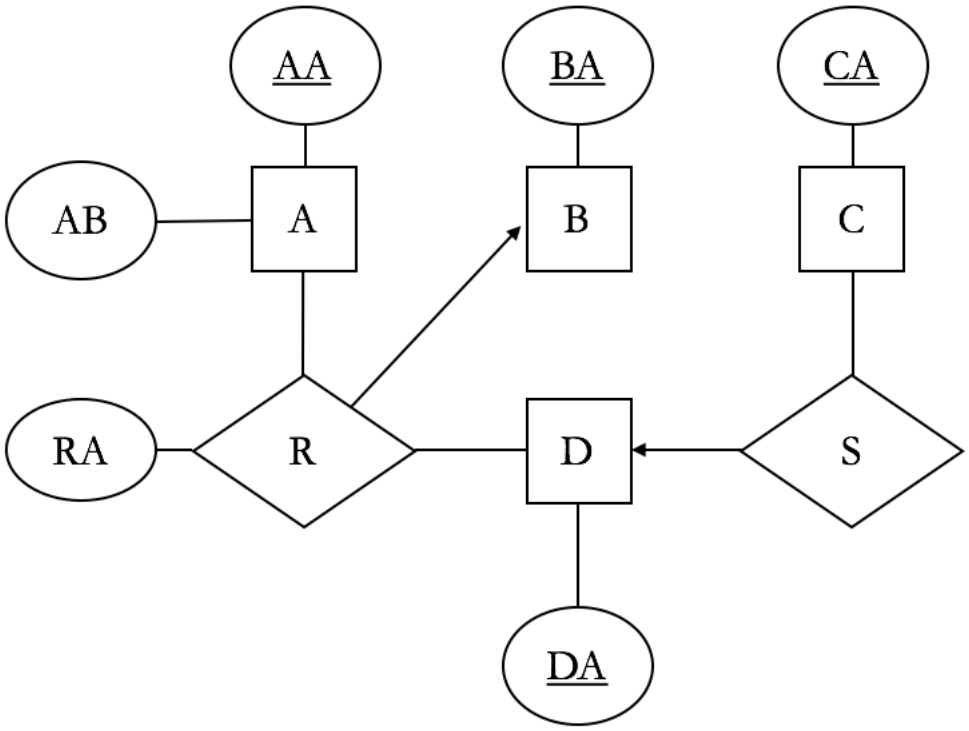
d) Give two SQL transactions that might suffer from the phantom problem.

e) Given a relation R = $\{A, B, C, D, E, F\}$ and a set of functional dependencies, FD = $\{A \to B, D \to B, B \to F, D \to A, F \to C\}$ what is $\{A\}^+$

f) Why are some decompositions from BCNF excluded in 3NF?

2 E/R Diagrams

Produce a schema for the following E/R Diagram. Underline primary keys and circle foreign keys. Additionally, indicate which attributes or pairs of attributes must be unique.



3 Decompositions

a) Let R(A,B,C,D,E) be decomposed into relations with the following three sets of attributes. $R1(A, B, C)$, $R2(B, C, D)$ and $R3(A, C, E)$. Use the chase test to tell whether the decomposition of R is lossless given the following functional dependencies. Show your work.

$$AC \rightarrow E \text{ and } BC \rightarrow D$$

b) Given the schema R(A,B,C,D,E), perform BCNF decomposition given the following functional dependencies. For each decomposition, give the functional dependency which violates BCNF.

(a) $A \rightarrow C$, $B \rightarrow D$, $D \rightarrow A$

4 Transactions

a) Draw the precedence graph for the following schedules. Indicate all resources that create a conflict for each edge. For example, if T_1 must come before T_2 because of both resources A and B, then indicate this. *Do not stop just because you have found a cycle*

(a) $r_1(A), r_2(A), w_1(B), w_2(B), r_1(B), r_2(B), w_2(C), w_1(D)$

(b) $r_1(A), r_2(A), r_1(B), r_2(B), r_3(A), r_4(B), w_1(A)$

b) Write two unique schedules from the following transactions that are conflict-serializable but not serial.

$$T_1 : r(A), w(B), r(C) \qquad\qquad T_2 : w(A), w(B), r(A)$$

c) Given that there are two transactions i and j and three resources A,B,and C, fill in the following schedule with **all** single operations which make this schedule non-conflict-serializable.

$$r_i(A), r_j(B), \qquad\qquad , w_i(C), w_j(A)$$