Comprehensive Exam
Databases
Spring 2014

1) (25 points) Circle T or F for each of the following.

— "SQL" stands for Structured Query Language. T F

— A disadvantage of SQL over other query languages is that SQL does not have transactions. T F

— SQL was first proposed by Microsoft in early 2010. T F

— The *select* clause of an SQL statement corresponds to the relational algebra *selection* operation. T F

— The *from* clause of an SQL statement corresponds to the relational algebra *project* operation. T F

— The *where* clause of an SQL statement corresponds to the relational algebra *selection* operation. T F

— The *group-by* clause of an SQL statement is used to sort the results of a query. T F

— The *having* clause of an SQL statement is used to select a subset of groups formed by a *group-by* clause. T F

— SQL queries can be nested. T F

— The main purpose of a query optimizer is to improve query performance. T F

— Every superkey is also a candidate key. T F

— Suppose a one-to-one relationship set R exists between two entity sets E1 and E2. In addition, let K1 and K2 be candidate keys for E1 and E2, respectively. Then the union of K1 and K2 forms a super key for R. T F

— The *union* operation is one of the six basic relational algebraic operators. T F

— The *natural join* of a relation with itself will result in an empty relation. T F

— All tuple calculus expressions are "safe," by definition. T F

— A universal quantifier is used in relational algebra to implement a natural join. T F

— An existential quantifier is used in relational algebra to implement a natural join. T F

— One disadvantage of predicate calculus is that there is no way to specify an *"if then"* logical expression. T F

— The closure of a set of attributes can be computed using Armstrong's axioms. T F

— Armstrong's axioms include *reflexivity*, *transitivity* and *augmentation*. T F

— Computing the closure of a set of attributes eliminates attributes from that set. T F

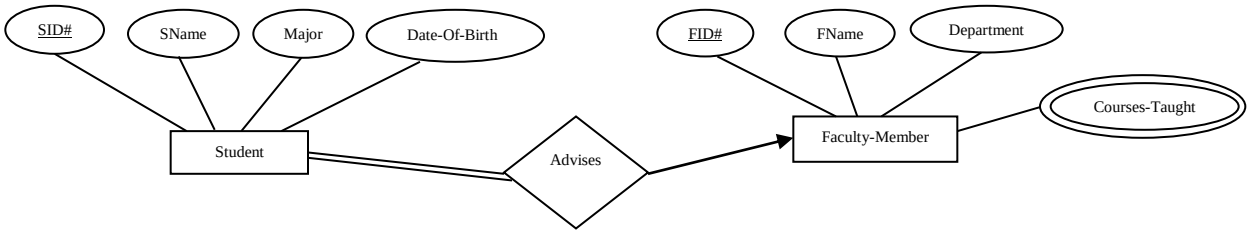
— The decomposition rule states that if AC->B and A->B and C->B. T F

— If a set of relational schemes is in BCNF, then that set also has a loss-less join. T F

— Let R be any relational scheme that is not in BCNF. Then R can always be decomposed into a collection of BCNF relational schemes that has a loss-less join.
T F

— Let R be any relational scheme that is not in 3NF. Then R can always be decomposed into a collection of BCNF relational schemes that has a loss-less join and preserves dependencies.
T F

2) (20 points) Consider the following ER diagram.



Give DDL for a collection of tables for the above ER diagram. Note that your answer should specify all attributes, types, primary keys and foreign keys.

3) (20 points) Let α, β and γ be sets of attributes. The *union rule* states that if $\alpha \rightarrow \beta$ and $\alpha \rightarrow \gamma$, then $\alpha \rightarrow \beta\gamma$.

(a) Prove the union rule using Armstrong's axioms.

Now suppose that δ is also a set of attributes. Then the *double union rule* states that if $\alpha \rightarrow \beta$, $\alpha \rightarrow \gamma$ and $\alpha \rightarrow \delta$, then $\alpha \rightarrow \beta\gamma\delta$.

(b) Prove the double union rule using Armstrong's axioms.

4) Consider the following set F of functional dependencies for the relational scheme R=(A,B,C,D,E,F,G).

A=>BD
C=>ABE
F=>G

(a) (15 points) Circle each of the following that is a super-key for the above relational scheme.

A C CF AF ABCDEFG

(b) (20 points) Assume the above set of functional dependencies is a canonical cover. Give a decomposition of the above relational scheme into a collection of relational schemes that are in 3NF, have a lossless join and preserves dependencies.