

## COMP 430 Assignment 5

1. (35 points for COMP 430, 40 points for COMP 533) Implement the Assignment 4's swimming ERD as schemas. For the sake of consistency, use the sample solution ERD, rather than your own. Explain any choices that you have to make.
2. (5 points – COMP 533 only) Identify which of the schemas in Problem 1 do not satisfy BCNF.
3. (5 points) Using only Armstrong's Axioms and the set of functional dependencies  $\{AB \rightarrow C, A \rightarrow BE, C \rightarrow D\}$ , give a complete derivation of the functional dependency  $A \rightarrow D$ .
4. (5 points – COMP 533 only) Assume we have a relation  $R(A,B,C)$ . Create an SQL query that expresses what it means for functional dependency  $B \rightarrow C$  to hold on  $R$ . It should be trivial to determine from the query's output whether or not the functional dependency holds. E.g., your query might return a table with just True/False, or it might return a non-empty/empty table.
5. (5 points – COMP 533 only) In class, we saw a quadratic algorithm to compute the closure of a set of attributes. The version here has been optimized from the original by removing each functional dependence from consideration once it has been applied. Briefly explain why this doesn't change the algorithm's correctness. Give and explain this version's asymptotic running time.

Let  $F$  be the set of functional dependences.

Closure( $A$ ) =

Result =  $A$

Remaining =  $F$

Repeat until Result doesn't change:

For each FD  $B \rightarrow C$  in Remaining:

if  $B \subseteq \text{Result}$ ,

then

Add  $C$  to Result

Remove  $B \rightarrow C$  from Remaining

Return Result

6. (40 points – 5 points for each relation/FD and part combination) For each of the following relations and sets of functional dependencies, do the following parts. While you can automate substeps like calculating closures, you must show enough of your work that the reasoning and correctness clearly follows. Let the in-class activities 07-keys and 07-bcnf guide you in terms of how much you can automate.
  - a.  $R(A,B,C,D)$ ,  $AB \rightarrow C$ ,  $C \rightarrow D$ ,  $D \rightarrow A$

- b.  $R(A,B,C,D), B \rightarrow C, B \rightarrow D$
- i. Show what the keys are.
  - ii. Show which FDs violate 3NF.
  - iii. Show which FDs violate BCNF.
  - iv. Decompose the relation into a collection of relations that are in BCNF.