

**CPSC 304 Midterm 1**  
**May 2009**  
**Total: 15 points**  
**Time allowed: 60 minutes**

**Question 1 (10 points)**

- a) (3 points) Draw an ER diagram for the following scenario:
- Entity set A has two attributes  $x_1$  and  $x_2$ , with  $x_1$  being the primary key.
  - Entity set B has two attributes  $x_3$  and  $x_4$ , with  $x_3$  being the primary key.
  - Entity set C has two attributes  $x_5$  and  $x_6$ , with  $x_5$  being the primary key.
  - There is a relationship set R, which is one-to-many from A to B.
  - B has two subclasses B1 and B2, which are non-covering and may overlap.
  - The relationship set, U, between B1 and C is one-to-one, whereas the relationship set, V, between B2 and C is many-to-many.

ER diagram

- b) (4 points) The optimal set of relations for the scenario in part a) consists of 4 relations. *Specify* the relational schema for the 4 relations.

$A(\underline{x_1}, x_2)$   
 $B(\underline{x_3}, x_4, Rx1, FlagB1, FlagB2)$   
 $C(\underline{x_5}, x_6, Ux3)$   
 $V(\underline{x_3}, \underline{x_5})$

- c) (3 points) Give the SQL create-table statements for the 4 relations in part b). Every attribute is an integer.

*Create table A (x1 integer, x2 integer, primary key(x1) )*  
*Create table B (x3 integer, x4 integer, Rx1 integer, FlagB1 boolean, FlagB2 boolean, primary key (x3), foreign key Rx1 references A(x1) )*  
*Create table C (x5 integer, x6 integer, Ux3 integer, primary key (x5), foreign key Ux3 references B(x3) )*  
*Create table V(x3 integer, x5 integer, primary key (x3, x5), foreign key x3 references B(x3), foreign key x5 references C(x5) )*

**Question 2 (5 points)** Consider the relation scheme  $R(A, B, C, D, E)$  which satisfies the following functional dependencies:

- (FD1)  $A \rightarrow B$
  - (FD2)  $B \rightarrow C$
  - (FD3)  $C \rightarrow A$
  - (FD4)  $D \rightarrow E$
- a) Identify all the candidate keys of R.  
 $AD, BD, CD.$

- b) Why is R not in BCNF?  
*D is a functional determinant but is not a superkey.*
- c) Is R in 3NF? Explain your answer.  
*No, FD4 represents a partial dependency. Thus, R is not even in 2NF.*
- d) Decompose R so that the resultant set of relations is in BCNF.  
*R1(A,C), R2(B,C), R3(B,D) and R4(D, E).*

**--- The End ---**