Introduction to Database Management Systems 343
Problem Set 4

Both hard copy and electronic submission (using name A4.pdf or A4.txt) must be submitted.

1. **Normal Forms 15pt** For each relation schema and set of functional dependencies, state whether the schema is in: 1NF, 2NF, 3NF or BCNF. State *all* that apply. Also, specify the number of candidate keys and the attributes in each candidate key.

    (a) Embassy [Country, Location, Ambassador, President]

    $Country, Location \rightarrow Embassador$
    $Country \rightarrow President$

    (b) Ambassador [Country, Name, Station, YearsOfService]

    $Country, Station \rightarrow Name, YearsOfService$
    $Name \rightarrow Country, Station$

    (c) Province [Name, President, Country, Export]

    $President \rightarrow Country$
    $Country \rightarrow President$
    $Name \rightarrow President$
    $Name \rightarrow Export$

2. **Decomposition 15pt** Consider the following relation schema and set of functional dependencies.

    R [A, B, C, D, E, F, G, H] $D \rightarrow EF$ $F \rightarrow C$ $DG \rightarrow AB$

    (a) How many candidate keys are there in R? What are they?

    (b) Decompose the relation R into a 3NF schema. Be sure to indicate all functional dependencies and foreign keys that exist in your decomposition. State whether your decomposition is in BCNF.

3. **30 pt - Relation DB Design**

    (a) Design a relational schema to represent the following information in an order-entry system. State any assumptions you make.

    For each customer: customer number (unique); ship-to addresses (several per customer); Balance; Credit limit; Discount. Assume that on average each customer has three ship-to addresses.

    For each order: a unique order number; a customer number; a ship-to address; a date of order; and any number of detail lines (each containing an item number and quantity ordered).

    For each item: a unique item number; a set of manufacturing plants for the item (each represented by a unique plant number); the quantity of the item on hand at each plant; the stock danger level for each plant; and an item description.

    (b) Suppose that the requirements from Part a are changed so that very few customers, say less than one percent, actually have more than one ship-to address. State any drawbacks of using the schema you designed for Part a for data that conforms to the changed description. Change the design from Part a to better model this information.