CS4604 Midterm Exam

October 18, 2000

Please enter the following information:

- **Name:**

- **ID:**

GOOD LUCK!
Do not write below this line

Problem	Max Score	Score
1	15	
2	20	
3	20	
4	20	
5	10	
6	15	
Total	100	

1. (15 points) Design an E/R diagram for the following situation: We wish to model airports, airlines, cities, and flights in the United States. Every airport is located in a unique city. A city can have many airports (e.g. Washington DC has three airports). Each city must have at least one airport (we will model only major cities in our database, so this condition is realistic). Assume that airport names are unique and that city names are also unique. Airlines are the companies that run flights (e.g., United, Delta etc.). An airline is uniquely identified by its name. Every flight is operated by a unique airline. Flights have numbers but these numbers are unique only within an airline (e.g., both Delta and SAS have flights numbered 3785). Flights run from one airport to another, perhaps with stopovers and brief landings (for fueling purposes). For each flight, we wish to store its airport of origin and airport of destination, and also the origin and destination times. In addition, information needs to be stored about the airports where stopovers and brief landings are made (and the times these are made) for each flight. Try to model as much as you can and write *Notes*, if necessary. Failing to write *Notes* indicates that your E/R diagram is *exact*.

2. (20 points) An E/R diagram when converted into relations (using the method that we now know so well), produces the following schema (without normalization):

   R(a,b)
   S(c,d)
   T(a,c)

   You may assume that the same symbols refer to the same attributes and that different symbols refer to different attributes (e.g., the a in R and T are the same). Give at least *two* different E/R diagrams that could have produced these relations.

3. (20 points) Assume that a relation $R(A)$ has been decomposed into two other relations — $S(B)$ and $T(C)$, where A is the set of attributes of R, B is the set of attributes of S and C is the set of attributes of T. State a general rule to determine if this decomposition is lossless.

4. (20 points) Consider the relation $R(A, B, C, D, E, G)$ with FDs given by $\{AB \rightarrow C$, $AC \rightarrow B$, $AD \rightarrow E$, $B \rightarrow D$, $BC \rightarrow A$, $E \rightarrow G\}$. Consider the decomposition of R into {ABC,ACDE,ADG}. Does this decomposition preserve FDs? Is this a lossless decomposition? Give reasons. Just saying 'Yes' or 'No' to these two questions, without explanations, is worth zero points.

5. (5+5=10 points) For the three-column relation given below, give *at least* four tuples of example data, such that the relation is in 4NF. Explain how your solution satisfies the conditions of 4NF. Just giving (correct) sample data without explanations is worth 5 points only.

A	B	C

6. (15 points) Consider the following set of E/R diagrams. It is obvious that diagram (2) is obtained from diagram (1) by the familiar operation of 'push-out.' Thus, (1) and (2) are equivalent.

   Is it possible to complete diagram (3) so that it is equivalent to diagram (4)? Notice that not all relationships in diagram (4) are many-one, so this is not a push-out operation. You are not allowed to add any extra entity sets to (3), but you can add any number of relationships that you want and in any variety (many-many, many-one etc.). If it is possible to do this, complete diagram (3). If it is not possible, explain why not.