CS 457 - Database Systems Final Examination

This exam is open book/notes. Observe Emory Honor Code while doing this examination.

If you think that a question is **ambiguous**, ask for clarification. Since I'm in the class room during the exam, I will not accept any dispute on ambiguity after the examination if you do not ask for clarification.

Question 1. (20 pts)

Give brief answers to these questions, 2 pts each.

- 1. Which technique discussed in class is an example of embedding SQL?
- 2. Which technique discussed in class in an example of *extending SQL*?
- 3. Which technique discussed in class in an example of *libery functions*?
- 4. Which technique discussed in class in an example of server side execution ?
- 5. How is logical data independence realised in SQL ?
- 6. Suppose A and B are two attributes in a relation R. What does "A functionally determines B" mean ?
- 7. Let the relation R = (A, B, C) and it is given that $AB^+ = ABC$, $B^+ = BC$ and $C^+ = BC$. List all the *possible* keys of R.

- 8. Let the relation R = (A, B, C) and it is given that the *only* functional dependency is $B \to C$. Is R in BCNF ?
- 9. Let the relation R = (A, B, C) and it is given that the *only* functional dependency is $B \to AC$. Is R in BCNF ?
- 10. Let the relation R = (A, B, C) and it is given that the *only* functional dependency is $AB \to C$. Is R in BCNF ?

Question 2. (10 pts)

Formulate the following queries in **Relational Algebra** on the Company database **Note:** the definition of the Company database can be found at the **end** of this test.

1. Find names of projects that is worked on by the most number of employees. (5 pts) Note: *not* the most number of hours.

2. Find name(s) of the department that only employs female employees. (5 pts)

Question 3. (30 pts)

Formulate the following queries in **SQL** on the Company database (the definition of the Company database can be found at the end of this test).

NOTE: Do NOT use anything but SQL commands. (Do not use PL/SQL, embedded SQL, JDBC, PHP, etc). Also, you cannot use "CONTAIN" as an SQL operator. You get no credits if you do.

1. Find names of projects that is worked on by the most number of employees. (5 pts)

2. Find name(s) of the department that only employs female employees. (5 pts)

3. Find name of projects that are worked by more female employees than male employees. (5 pts)

4. Find name of employees that work on the project 'ProjectX' but not on the project 'ProjectY'

5. Find the name of departments where *all* (every single one) its employees work on the project with project name 'ProjectX'

6. Find the name of departments whose employees only work on the projects controlled by their own department (i.e., projects that every employee in the department works must be controlled by his/her department)

Question 4. (10 pts)

Write a PL/SQL program that prints out the fname, lname and salary of the employee that earn the next higher and the next lower salary to that of the employee 'John Smith'.

Note: In writing the code, you can assume that both employees exist (so John Smith is not earning the highest nor the lowest overall salary).

Question 5. (10 pts)

The following HTML form is used to retrieve information from department in the company database:

```
<form action="http://cs377.mathcs.emory.edu/~cs377000/findStats.php"
method="post">
Department: <input type="text" name="dept" />
<input type="submit" />
</form>
```

In the "Department" field, the user would enter a Department name. The "findStats.php" PHP program will return:

- the mean (average) salary of employees in the given department.
- the median (middle) salary of employees in the given department (you can use $\left(\frac{n}{2}\right)^{th}$ value for median).

Question:

Write the PHP code for the above application.

Note: you may use only *one* oci_execute (...) call in the PHP program to find the above information. Make one pass through the result to find the mean and the median.

Question 6. (20 pts)

Given a relation schema R = (A, B, C, D, E, F) and the following set of functional dependencies on R:

$$egin{array}{ccc} C & o & B \ AB & o & CD \ DE & o & A \ AD & o & E \ BD & o & F \end{array}$$

1. Compute the closure of AC (i.e., AC^+) (4 pts)

2. Show using Armstrong's Axioms that: $CD \to F~(4~{\rm pts})$

3. Find all the keys in R (Hint: there are multiple keys, less than 6 total). (4 pts)

4. We decompose the relation R into $R_1 = (A, B, C, D)$ and $R_2 = (B, D, E, F)$ Determine if this decomposition is lossless or lossy and explain how you determine this fact (4 pts).

5. We decompose the relation R into $R_1 = (A, B, C, D)$ and $R_2 = (A, D, E, F)$ Determine if this decomposition is lossless or lossy and explain how you determine this fact (4 pts).



Figure 6.5