Database Systems, CSCI 4380-01 Exam #1
Thursday October 2, 2010 at 2 pm

1 (24)	2 (16)	3 (12)	4 (8)	5 (8)	6 (6)	7 (12)	8 (14)	TOTAL

Note. The exam is open book and open notes. Use your own book and notes only, sharing is not allowed. Electronic gadgets are NOT allowed during the exam. Write your answers clearly, legibly and explain your reasoning as much as you can. If I cannot read or understand your answers, you will not get points.

Question 1 (24 points). Answer this question using the data model in the appendix. Answer (1) and (2) below using <u>relational algebra</u>.

(a) Find the name of all artists who contributed to (wrote and composed) the song titled: "Bohemian Rhapsody".

(b) Find the name of all artists who have not released an album after '12-31-20000'.

(c) What does the following relational algebra expression return (for T3)? Write it using a succint English sentence (i.e. do not use words like join, project, etc. in your answer.) Show your work for partial credit.

$$T1(id1, name1, bio1, birthYear1) := Artists$$
$$T2 := \Pi_{id} (T1 \bowtie_{birthYear1 > birthYear} Artists)$$
$$T3 := \Pi_{id}(Artists) - T2$$

Question 2 (16 points). Are the following true or false? Explain with a short sentence.

(a) Whenever $A \to BC, CD \to E$ are both in a set of functional dependencies F, then $AD \to CE$ is implied by F.

(b) If two relations have the same keys, then they also have the same set of functional dependencies.

(c) All relations have a key.

(d) Relation $R(A, B, C)$ and the result of the query $\Pi_{A,B} R$ always have the same number of tuples.

Question 3 (12 points). Are the following relations in 3NF, BCNF or 4NF? Briefly describe why or why not.

1. $R1(A, B, C, D, E)$, $F1 = \{AB \rightarrow CDE, D \rightarrow A\}$

2. $R2(A, B, C, D, E)$, $F2 = \{AB \rightarrow C, CD \rightarrow E\}$

3. $R3(A, B, C, D, E)$, $F3 = \{ABC \twoheadrightarrow DE\}$

Question 4 (8 points). Decompose the following relation to find a 3NF decomposition.
$R(A, B, C, D, E, F)$, $F = \{AB \rightarrow DE, CD \rightarrow AF\}$

Question 5 (8 points). Is the following decomposition of $R(A, B, C, D, E, F, G)$ lossless? Show your work using the Chase algorithm.

$F = \{CD \rightarrow F, D \rightarrow E, C \rightarrow D, BF \rightarrow AC\}$
Decomposition: $R1(A, B, C, D)$, $R2(C, D, E, F)$, $R3(B, F, G)$

Question 6 (6 points). Are the two models (a) and (b) in Figure 1 equivalent? In other words, can they store the same data? Explain why or why not.
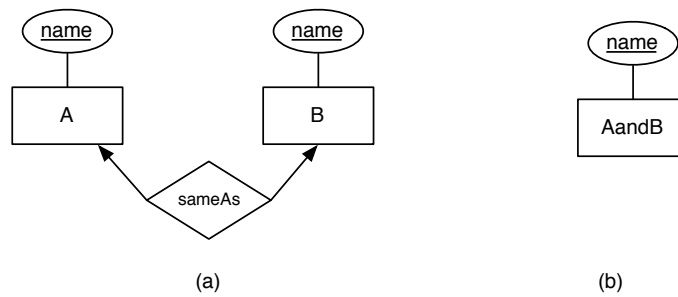

Figure 1: E-R Diagram for Question 6

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Question 7 (12 points). Convert the ER diagram in Figure 2 to the relational data model.
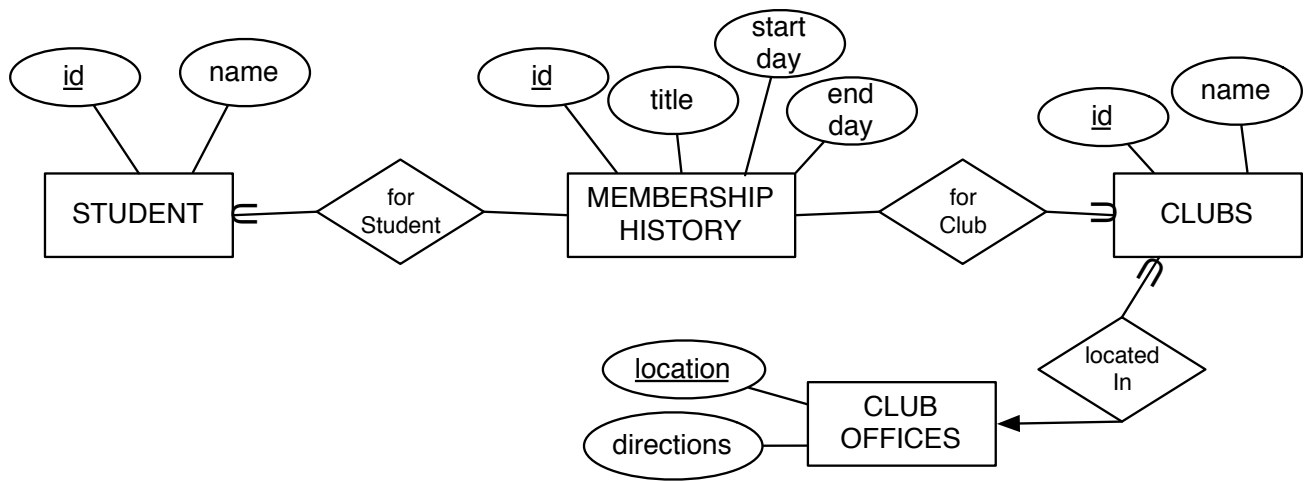

Figure 2: E-R Diagram for Question 7

Question 8 (14 points). Create an ER diagram for the following data model.

Suppose you are creating a database to store parking information at RPI. The database will store the following details about people who hold parking permits: their RIN, name, address (building name and room number) and status (student, faculty, etc.). In addition, lots and parking permit types must be stored. Lots have names and locations, and permit types have names and the types of people who can have them. People are eligible for permits based on their status (for example, permit A is for students, B is for faculty and staff, etc.). Permit types may be applicable to multiple lots, and a lot may have multiple permit types. People own permits for a specific car and a specific permit type. A person may have more than one permit; each permit is for a different car. Cars are distinguished by their license plate number. It is possible for a person to have multiple permits, one for each different car.

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Appendix

Suppose you are given the below data model for an application providing music services. This is the same data model that we have created in class (except I did not include the data relating to the users).

Note that, albumId refers to Albums(id), songId refers to Songs(id), artistId refers Artists(id), recordingId refers to Recordings(id) and characteristingsId refers to Characteristings(id).

DATA MODEL.

Artists(<u>id</u>, name, bio, birthYear)

Albums(<u>id</u>, name, releaseDate)

Songs(<u>id</u>, name, lyrics)

Recordings(<u>id</u>, trackNum, length, songId, albumId)

Characteristics(<u>id</u>, name)

RecordingHasCharacteristics(<u>recordingId, characteristicId</u>)

AlbumsReleasedBy(<u>albumId, artistId</u>)

SongComposedBy(<u>songId, artistId</u>)

SongWrittenBy(<u>songId, artistId</u>)