

Database and Information Systems

Homework 3

Due on October 22, 2007

Problem 1 [15 points]: Consider a relation R with four attributes $ABCD$. You are given the following dependencies: $A \rightarrow B$, $BC \rightarrow D$, $C \rightarrow AB$.

1. List all keys for R . (other than superkeys)
2. Is R in 3NF? Why?
3. Is R in BCNF? Why?

Problem 2 [30 points]: The task is to design an apartment search mash-up system. This system will integrate maps with apartment rental listings. A user will create an account, subscribe to the apartment RSS feeds, search apartments based on keywords, and view the apartments on the maps.

- Each user will have a unique numeric ID. Additionally, the first and last names, email address, and billing address will need to be stored.
- Each user is either an unregistered user or a registered user.
- Original users of the system (some still unregistered users and others registered) are further classified as beta testers.
- Each user may subscribe to one or more apartment RSS feeds. One RSS feed may be shared among multiple users.
- RSS feeds have URLs and titles.
- RSS feeds have multiple RSS posts.
- RSS posts have a title, location, price, the number of rooms and a URL.
- Each RSS post consists of a set of word occurrences and their positions. An inverted index on words is needed to support keyword search.

- The map can translate a location to several possible geocode locations (namely, latitude and longitude).

Draw an ER diagram for the apartment search mash-up system. The ER diagram should include various attributes, keys, participation constraints, overlap and covering constraints.

Problem 3 [25 points]: Consider a relation R with six attributes $ABCDYZ$ and the FD set $F = \{AB \rightarrow Y, AC \rightarrow D, Y \rightarrow C, ZB \rightarrow D, BD \rightarrow Z\}$. Let F^+ denote the closure set of F .

1. For each of the following attribute sets, do the following: (i) write down a minimal cover of the subset of F^+ that holds over the set; (ii) name the strongest normal form that is not violated by the relation containing these attributes; (iii) decompose it into a collection of BCNF relations if it is not already in BCNF.

(a) $ABDYZ$

(b) $ABCD$

2. For each of the following decompositions of $R = ABCDYZ$, with the same set of functional dependencies F , say whether the decomposition is (i) dependency preserving, and (ii) lossless join.

(a) $\{ABYD, ABCZ\}$

(b) $\{ACD, ABYZ, ABDZ\}$

Problem 4 [20 points]: Suppose you are given a relation $R(A, B, C, D, E)$. For each of the following (complete) sets of FDs, (i) identify the candidate key(s) for R , and (ii) state whether or not the proposed decomposition of R into smaller relations is a “good” decomposition and briefly explain why or why not.

1. $A \rightarrow B, B \rightarrow CE, C \rightarrow D$. Decompose into AB , BCE , and CD .

2. $C \rightarrow A, B \rightarrow D$. Decompose into ACE and BD .

Problem 5 [15 points]: Why do commercial DBMSs support keys and foreign keys, but not general FDs?