

CSE 462: Test #2 (03/26/10)

Problem 1 (20 pts)

Design an Entity-Relationship schema for a database of tourist information. The database should contain the information about:

- cities: name, state, population;
- services: name, city, street address;
- tourist guides: title, featured services with the associated ratings.

Each city is only in a single state. City names are unique within each state. Each service has a unique name. A service is a hotel or a restaurant. For each restaurant the information about its cuisine (American, Chinese, Italian,...) is kept. The ratings are captured as numbers of stars (between 1 and 5). Different guides may rate the same service differently. *You can make any other additional assumptions that make sense in the real world.*

Solution.

Entity types:

- City with attributes **Name**, **State** and **Population**, and key (**Name**,**State**);
- Service with attributes **Name**, **Address**, and key **Name**;
- Hotel with attribute **Name** which is a key;
- Restaurant with attributes **Name** (key) and **Cuisine**;
- Guide with attribute **Title**.

Relationship types:

- Location(**Service**,**City**), N:1;
- Listing(**Guide**,**Service**), N:M, with attribute **Stars**.

isa relationships:

- Hotel **isa** Service;
- Restaurant **isa** Service.

Problem 2 (20 pts)

Produce a relational schema in BCNF from the E-R schema obtained in Problem 1. Identify keys and foreign keys. Eliminate redundancies.

Solution. Keys are underlined.

Relations:

- CITY(CNAME,STATE,POPULATION);

- `SERVICE(SNAME, ADDRESS)`;
- `HOTEL(SNAME)`, foreign key `SNAME` referencing `SERVICE(SNAME)`;
- `RESTAURANT(SNAME)`, foreign key `SNAME` referencing `SERVICE(SNAME)`;
- `GUIDE(TITLE)`;
- `LOCATION(SNAME, CNAME, STATE)`, foreign keys: `SNAME` referencing `SERVICE(SNAME)` and `(CNAME, STATE)` referencing `CITY(CNAME, STATE)`;
- `LISTING(TITLE, SNAME, STARS)`, foreign keys: `TITLE` referencing `GUIDE(TITLE)` and `SNAME` referencing `SERVICE(SNAME)`.

The relations `SERVICE` and `LOCATION` can be merged to yield a single relation

`SERVICE(SNAME, ADDRESS, CNAME, STATE)`

with foreign keys: `SNAME` referencing `SERVICE(SNAME)` and `(CNAME, STATE)` referencing `CITY(CNAME, STATE)`.

Problem 3 (20 pts)

Let $R(ABC)$ be a relation schema together with the set of dependencies $F = \{A \rightarrow B, B \rightarrow C, C \rightarrow B\}$.

1. Find the keys of R and check whether R is in BCNF or 3NF. Explain the answers, using the appropriate definitions.
2. If R is not in BCNF, provide a lossless join decomposition of R into BCNF and check which dependencies in F^+ it preserves.

Solution.

Answers:

- One key: A ,
- Check that BC is not a key using a counterexample $r = \{(3, 1, 2), (4, 1, 2)\}$ which satisfies F but not $BC \rightarrow A$.
- R is not in BCNF because there is a nontrivial, nonkey FD $B \rightarrow C$ in F . ($C \rightarrow B$ also violates BCNF.) It is not in 3NF because C does not belong to any key.
- A lossless-join decomposition into BCNF, (AB, BC) , preserves all FDs. (Note that another lossless-join decomposition, (AC, BC) , also preserves all FDs, while (AC, AB) is also lossless-join but loses $B \rightarrow C$ and $C \rightarrow B$.)