Design Theory Book Notes

4/3/21

Functional Dependencies:

A FD on a relation R is a statement of the form, if two tuples of R agree on all of their attributes then they must also agree on all of another list of attributes

Keys of Relations:

We say a set of one or more attributes is a key for a relation if:

1. Those attributes functionally determine all other attributes of the relation
2. No proper subset of attributes functionally determines all other attributes of R (Key is minimal)

Superkeys:

- A set of attributes that contain a key(s) is a super key

Rules about Functional Dependencies:

☆ Transitive rule

Splitting/Combining Rule:

- We can replace an FD

$A_1 \cdots A_n \to B_1 \cdots B_m$

by a set of FD's

$A_1 \cdots A_n \to B_i$ for $i = 1, 2, \ldots, m$

This transformation is called the <u>splitting rule</u>

We can reverse this rule, call it the <u>combining rule</u>

Trivial Functional Dependencies:

- A constraint is said to be trivial if it holds for every instance of the relation, regardless of what other constraints are assumed

Computing the Closure of Attributes:

- The closure of $A_1 \cdots A_n$ under the FD's in S is the set of attributes B s.t. every relation that satisfies all the FD's in set S also satisfy $A_1 \cdots A_n \to B$

denoted $\cdot^+$

The Transitive Rule:

- If $A_1 \cdots A_n \to B_1 \cdots B_m$ and $B_1 \cdots B_m \to C_1 \cdots C_k$

hold in relation R, then
$A_1 \cdots A_n \to C_1 \cdots C_k$ also
holds in R

Closing Sets of Functional Dependencies:

- A minimal basis for a relation is a basis B s.t.
  1. All the FD's in B have singleton right sides
  2. If any FD is removed from B, the result is no longer a basis
  3. If for any FD in B we remove one or more attributes from the left side of F, the result is no longer a basis

Projecting Functional Dependencies:

- All FD's that....
  1. Follow from S
  2. Involve only attributes of R_i

Design of Relational Database Schema's:

Anomalies:

1. Redundancy
2. Update Anomalies

3. Deletion Anomalies

Decomposing Relations:

Given a relation $R(A_1, \ldots, A_n)$, we may decompose R into two relations $S(B_1, \ldots, B_m)$ and $T(C_1, \ldots, C_k)$ s.t.

1. $\{A_1, \ldots, A_n\} = \{B_1, \ldots, B_m\} \cup \{C_1, \ldots, C_k\}$
2. $S = \pi_{B_1, \ldots, B_m}(R)$
3. $T = \pi_{C_1, \ldots, C_k}(R)$

Boyce-Codd Normal Form:

- A relation R is in BCNF

iff whenever there is a nontrivial FD $A_1 \cdots A_n \rightarrow B_1 \cdots B_m$ for R, it is the case that $\{A_1, \ldots, A_n\}$ is a superkey for R

Decomposition of BCNF:

- By repeatedly choosing suitable decompositions:
  1. These subsets are the schemas of relations in BCNF
  2. The data in the original relation is represented faithfully by the data in the relations that are the result of the decomposition

Decomposition: The good, bad, and ugly:

we want decomposition to have these properties:

1. Elimination of Anomalies
2. Recoverability of Information
3. Preservation of Dependencies

Third Normal Form:

- A relation R is in 3NF if whenever

$A_1 \cdots A_n \to B_1 \cdots B_m$ is a nontrivial FD, either

$\{A_1 \cdots A_n\}$

is a superkey, or those of

B_1,.......B_m that are not among the A's, are each a member of some key

Multivalued Dependencies:

- A MVD is an assertion that two attributes or sets of attributes are independent of one another