Lecture 2: Relational Model

一. What is relational Model

1. relational database
2. relation
3. relationship.

二. Structure of Relational Database.

1. By cartesian product
2. attribute, domains, atomic. { not multivalued / not composite
3. relation schema and relation instance
4. properties of relation.
5. key: Superkey ; candidate key ; primary key, Foreign key

三: Relational - Algebra Operations.

1. Fundamental

1) select: $\sigma_{p}(r) = \{t \mid t \in r \text{ and } p(t)\}$

eg. $\sigma_{A=B}(r)$.

2) project: $\Pi_{A_1, A_2 \cdots A_K}(r)$

eg: $\Pi_{A,C}(r)$

3) Union $r \cup s = \{t \mid t \in r \text{ or } t \in s\}$

4) Set difference: $r - s = \{t \mid t \in r \text{ and } t \notin s\}$.

5) Cartesian - Product Operation

$r \times s = \{tq \mid t \in r \text{ and } q \in s\}$

① disjoint → done

②. not disjoint → renaming for attributes

6) Rename Operations

$\rho_x(E)$ rename E to x.

$\rho_{x(A_1 A_2, \cdots A_n)}(E)$

2. Additional.

1) Set - Intersection.

$r \cap s = \{t \mid t \in r \text{ and } t \in s\}$.

2) Natural Join

$r \bowtie s$

eg: $R = (A, B, C, D)$ $S = (B, D, E)$

$r \bowtie s = \Pi_{r.A, r.B, r.C, r.D, s.E}(\sigma_{r.B = s.B \wedge r.D = s.D}(r \times s))$

3) Division.

$r \div s = \{t \mid t \in \Pi_{R-S}(r) \wedge \forall u \in s (tu \in r)\}$.

Characteristic

4) Assignment

$\leftarrow$.

双目等元: Union; Set difference; Set intersection.

双目运算: Cartesian product, Natural join; Division.

单目运算: Project. Select

3. Extended:

1) Generalized Projection.

$\Pi_{F_1, F_2 \cdots F_n}(E)$ $F_1, F_2, \cdots F_n$: arithmetic expressions involving constants and attributes

2) Aggregate

$G_1 G_2 \cdots G_n \, g_{F_1(A_1)\, F_2(A_2) \cdots F_n(A_n)}(E)$.

- E: relational-algebra expression
- G_i: attributes
- F_i: aggregate function
- A_i: attribute name

avg
min
max
sum
count

eg. $_B g_{avg(c)}(r)$

3) Outer Join

⟕
⟖
⟗

10: Modification of the DataBase.

1. Deletion: $r \leftarrow r - E$

eg: account $\leftarrow$ account $- \sigma_{branch\text{-}name = 'Perridge'}$ (account).

2. Insertion: $r \leftarrow r \cup E$.

eg: account $\leftarrow$ account $\cup$ {('Perryridge', A-973, 1200)}

3. Update $r \leftarrow \Pi_{F_1, F_2, \cdots F_n}(r)$

eg: account $\leftarrow \Pi_{account\text{-}number,\ branch\text{-}name,\ balance * 1.05}$ (account).