04 Feb 2024 - DBMS-II - Week 05

→ Practice exercises

Algorithm for dependencies using functional dependencies

$R = (A, B, C, D, E)$

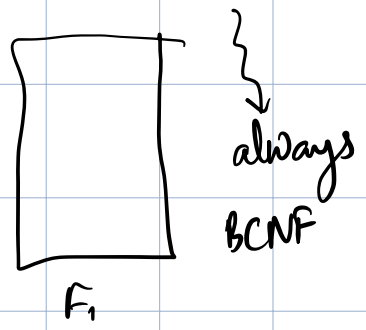
with $F = \{A \rightarrow B, BC \rightarrow D\}$ → f⁺ dep: $AC \rightarrow D$

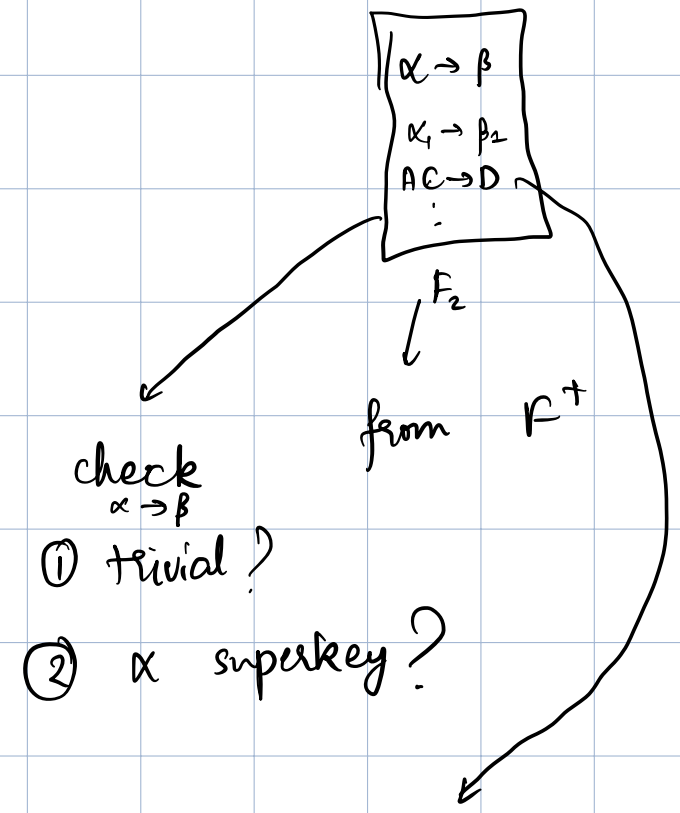
- decompose R into $R_1 = (A, B)$ ⇝ BCNF ✓
- $R_2 = (A, C, D, E)$ ⇝ $BC \rightarrow D$ ✓

F^+: $A \rightarrow B$, $BC \rightarrow D$, $AC \rightarrow D$

BCNF
↓
trivial/superkey

Decompose R into $R_1 = (A, B)$ and $R_2 = (A, C, D, E)$





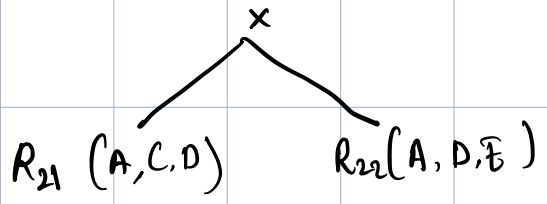
$F^+ : \{$

$\equiv$

$\}$

$R_1(A, B)$ ✓

$R_2(A, C, D, E)$



Algorithm

result := {R} << set of all decomposition)

↳ see PDF bye :(

- lossless by not dependency preservation.
- exponential time complexity: finding already done relations in BCNF.

- You don't need to compute F^+.

A^+ C^+ D^+ E^+

AC^+ CD^+

} → compute all still exponential but saves time.

→ BCNF is not dependency preserving. So check dependencies at run time since finding BCNF is expensive.

3NF decomposition algorithm

Example: $R = (A, B, C)$

$F = \{ A \to BC,\ B \to C,\ A \to B,\ AB \to C \}$

$F^c = \{ A \to B,\ B \to C \}$

R_1 (B C) R_2 (A B)

Comparision of BCNF and 3NF

- 3NF decomposition may not be unique. (different F_c)

Design Goals

05 Feb 2025

Multivalued Dependencies

→ One kind of redundancy that cannot be removed, even using BCNF.

→ inst_child (ID, child_name) ; inst_phone (ID, phone_no)

inst_info (ID, child_name, phone_no.)

→ an instructor can have multiple phone numbers and multiple children

9999,	D,	99341
9999,	W	94321
9999	D,	94321
9999	W,	99341

→ This relation is in BCNF

Multivalued dependency : definition

→ every functional dependency is a multivalued dependency.

→ $\alpha \rightarrow \beta \Rightarrow \alpha \twoheadrightarrow \beta$

$\alpha \twoheadrightarrow \beta \Rightarrow \alpha \twoheadrightarrow R - \alpha - \beta$

→ D ⇝ set of multivalued and functional dependencies

→ D^+ ⇝ closure

x7m72y

Fourth Normal form

* $\alpha \twoheadrightarrow \beta$ is trivial ($\beta \subseteq \alpha$ or $\alpha \cup \beta = R$)

  or α is a superkey

R1 (ABCD)

$A \twoheadrightarrow BDG \cap R1$

$A \twoheadrightarrow BD$

* 4NF $\Rightarrow$ BCNF

$R(A, B, C, G, H, I)$

$F = \{ \quad A \twoheadrightarrow B$

$\quad\quad B \twoheadrightarrow HI$

$\quad\quad CG \twoheadrightarrow H \}$

→ not in 4NF : $A \twoheadrightarrow B$ and A is not a superkey.

a) $R_1 = (A, B)$ → 4NF

b) $R_2 = (A, C, G, H, I)$

→ R_2 is not in 4NF, decompose into R_3 & R_4.

c) $R_3 = (C, G, H)$

d) $R_4 = (A, C, G, I)$

$A \rightarrow\!\!\rightarrow B \rightarrow\!\!\rightarrow HI$

$A \rightarrow\!\!\rightarrow I$

e) $R_5 = (A, I)$

f) $R_6 = (A, C, G)$

→ 8.8 Database Design Process