

数据库原理CH7作业

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P357-7.30

7.30 Consider the following set F of functional dependencies on the relation schema (A, B, C, D, E, G) :

$$A \rightarrow BCD$$

$$BC \rightarrow DE$$

$$B \rightarrow D$$

$$D \rightarrow A$$

- Compute B^+ .
- Prove (using Armstrong's axioms) that AG is a superkey.
- Compute a canonical cover for this set of functional dependencies F ; give each step of your derivation with an explanation.
- Give a 3NF decomposition of the given schema based on a canonical cover.
- Give a BCNF decomposition of the given schema using the original set F of functional dependencies.

Answer:

a.

$$B \rightarrow BD(B \rightarrow D) \quad (1)$$

$$BD \rightarrow ABD(D \rightarrow A)$$

$$ABD \rightarrow ABCD(A \rightarrow BCD)$$

$$ABCD \rightarrow ABCDE(BC \rightarrow DE)$$

$$\text{所以 } B^+ = ABCDE$$

b.

$$A \rightarrow BCD \quad (2)$$

$$A \rightarrow ABCD$$

$$BC \rightarrow DE$$

$$ABCD \rightarrow ABCDE$$

$$A \rightarrow ABCDE$$

$$AG \rightarrow ABCDEG$$

c.

$A \rightarrow BCD$ 和 $BC \rightarrow DE$ 说明 D 为第一个依赖的无关项，所以化简为 (3)

$$\begin{aligned} A &\rightarrow BC \\ BC &\rightarrow DE \\ B &\rightarrow D \\ D &\rightarrow A \end{aligned}$$

由 $BC \rightarrow DE$ 和 $B \rightarrow D$ 说明 D 是无关项，化简为

$$\begin{aligned} A &\rightarrow BC \\ BC &\rightarrow E \\ B &\rightarrow D \\ D &\rightarrow A \end{aligned}$$

因为 $B^+ = ABCDE$

所以 $B \rightarrow C$ ，故 $BC \rightarrow E$ 可化简为 $B \rightarrow E$ ，和 $B \rightarrow D$ 结合为

$$\begin{aligned} A &\rightarrow BC \\ B &\rightarrow DE \\ D &\rightarrow A \end{aligned}$$

d.

由c题知函数的正则依赖为： (4)

$$\begin{aligned} A &\rightarrow BC \\ B &\rightarrow DE \\ D &\rightarrow A \end{aligned}$$

所以3NF分解为 $\{ABC\}, \{BDE\}, \{DA\}, \{AG\}$

e.

由 $A \rightarrow BCD$ ，分解为 $\{ABCD\}, \{AEG\}$ (5)

因为前两个函数依赖能够推出 $A \rightarrow E$

所以将 $\{AEG\}$ 分解为 $\{AE\}, \{AG\}$

故BCNF分解为 $\{ABCD\}, \{AE\}, \{AG\}$

P360-7.40

7.40 Given a relational schema $r(A, B, C, D)$, does $A \twoheadrightarrow BC$ logically imply $A \twoheadrightarrow B$ and $A \twoheadrightarrow C$? If yes prove it, or else give a counter example.

Answer:

考虑下面这个表，符合 $A \twoheadrightarrow BC$

A	B	C	D
a1	b1	c1	d2
a1	b2	c2	d1
a1	b1	c1	d1
a1	b2	c2	d2

很明显，为了满足 $A \twoheadrightarrow B$ 的条件 $t_1[B] = t_3[B]$ ，则只有如下四种可能的情况：

1. $t_1 = r_1, t_3 = r_3$

那么 $t_3[CD] = c_1 d_1$

当 $t_2 = r_2$ 时， $t_2[CD] = c_2 d_1$ ，不满足 $t_3[CD] = t_2[CD]$

当 $t_2 = r_4$ 时， $t_2[CD] = c_2 d_2$ ，不满足 $t_3[CD] = t_2[CD]$

$$2. t_1 = r_3, t_3 = r_1$$

$$\text{那么 } t_3[CD] = c_1 d_2$$

$$\text{当 } t_2 = r_2 \text{ 时, } t_2[CD] = c_2 d_1, \text{不满足 } t_3[CD] = t_2[CD]$$

$$\text{当 } t_2 = r_4 \text{ 时, } t_2[CD] = c_2 d_2, \text{不满足 } t_3[CD] = t_2[CD]$$

$$3. t_1 = r_2, t_3 = r_4$$

$$\text{那么 } t_3[CD] = c_2 d_2$$

$$\text{当 } t_2 = r_1 \text{ 时, } t_2[CD] = c_1 d_2, \text{不满足 } t_3[CD] = t_2[CD]$$

$$\text{当 } t_2 = r_3 \text{ 时, } t_2[CD] = c_1 d_1, \text{不满足 } t_3[CD] = t_2[CD]$$

$$4. t_1 = r_4, t_3 = r_2$$

$$\text{那么 } t_3[CD] = c_2 d_1$$

$$\text{当 } t_2 = r_1 \text{ 时, } t_2[CD] = c_1 d_2, \text{不满足 } t_3[CD] = t_2[CD]$$

$$\text{当 } t_2 = r_3 \text{ 时, } t_2[CD] = c_1 d_1, \text{不满足 } t_3[CD] = t_2[CD]$$

所以 $A \rightarrow \rightarrow B$ 不成立