

# 数据库作业4

2151140 王谦

## 7.1

7.1 Suppose that we decompose the schema  $R = (A, B, C, D, E)$  into

$$\begin{aligned} &(A, B, C) \\ &(A, D, E). \end{aligned}$$

Show that this decomposition is a lossless decomposition if the following set  $F$  of functional dependencies holds:

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

7.1

$$\begin{aligned} \text{记 } R_1 &= (A, B, C) \\ R_2 &= (A, D, E) \end{aligned}$$

$$R_1 \cap R_2 = A, \text{ A是候选码, 有 } R_1 \cap R_2 \rightarrow R_1$$

分解  $(R_1, R_2)$  是无损分解.

## 7.6

7.6 Compute the closure of the following set  $F$  of functional dependencies for relation schema  $R = (A, B, C, D, E)$ .

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

List the candidate keys for  $R$ .

7.6

$$\therefore A \rightarrow BC$$

$$\therefore A \rightarrow B \text{ 且 } A \rightarrow C$$

$$\text{又} \therefore B \rightarrow D$$

$$\therefore A \rightarrow D$$

$$\therefore A \rightarrow CD$$

$$\text{又} \therefore CD \rightarrow E$$

$$\therefore A \rightarrow E$$

$$\text{又} \therefore A \rightarrow A$$

$$\therefore A \rightarrow A \ B \ C \ D \ E$$

$$\therefore E \rightarrow A$$

$$\therefore E \rightarrow A \ B \ C \ D \ E$$

$$\therefore CD \rightarrow E$$

$$\therefore CD \rightarrow A \ B \ C \ D \ E$$

$$\therefore B \rightarrow D$$

$$\therefore BC \rightarrow CD$$

$$\therefore BC \rightarrow A \ B \ C \ D \ E$$

综上, R 的候选码有 A, E, BC, CD.

## 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.

7.30

a.

$$\begin{aligned} B &\rightarrow BD \\ BD &\rightarrow ABD \\ ABD &\rightarrow ABCD \\ ABCD &\rightarrow ABCDE \\ B^+ &= ABCDE \end{aligned}$$

b.

$$\begin{aligned} A &\rightarrow BCD \\ A &\rightarrow ABCD \\ BC &\rightarrow DE \\ ABCD &\rightarrow ABCDE \\ A &\rightarrow ABCDE \\ Af &\rightarrow ABCDE \end{aligned}$$

故A<sup>+</sup>是超码

c.

由  $B \rightarrow D$ , 可得  $A \rightarrow BC$   
 $BC \rightarrow E$   
 $B \rightarrow D$   
 $D \rightarrow A$

由 (1) 得  $B^+ = ABCDE$

有  $B \rightarrow E$  且 C 可移除

得  $A \rightarrow BC$   
 $B \rightarrow DE$   
 $D \rightarrow A$

d.  $r_1(A, B, C)$   
 $r_2(B, D, E)$   
 $r_3(C, D, A)$

F 不依赖于其它. A 为超码, 添加  $r_4(A, F)$ .

得  $r_1(A, B, C)$   
 $r_2(B, D, E)$   
 $r_3(C, D, A)$   
 $r_4(A, F)$

e.  $r(A, B, C, D, E, F)$

由  $A \rightarrow BC \rightarrow D$ , 分为  $r_1(A, B, C, D)$ ,  $r_2(A, E, F)$

$F^+$  中由  $A \rightarrow E$ , 分为  $r_1(A, B, C, D)$ ,  $r_2(A, F)$ ,  $r_3(A, E)$ .

QIZE

a.  $\because AC \rightarrow BD$   
 $\therefore AC \rightarrow B$   
 $\because B \rightarrow E$   
 $\therefore AC \rightarrow E$ .

2/5/140 王谦

b.  $(A)^+ = \{A\}$   
 $(AC)^+ = \{A, B, C, D, E\}$

c.  $F_c = \{AC \rightarrow B, B \rightarrow C, C \rightarrow D, B \rightarrow E\}$ .

d. 候选码为 AC, AB.  
 判断为 1NF. (D 为候选码 AC 部分依赖)

e.  $U_1 = \{A, B, C\}, F_1 = \{AC \rightarrow B, B \rightarrow C\}$   
 $U_2 = \{C, D\}, F_2 = \{C \rightarrow D\}$   
 $U_3 = \{B, E\}, F_3 = \{B \rightarrow E\}$   
 $R_1 \langle U_1, F_1 \rangle$   
 $R_2 \langle U_2, F_2 \rangle$   
 $R_3 \langle U_3, F_3 \rangle$

f. 证明无损

	A	B	C	D	E
$R_1(A, B, C)$	$a_1$	$a_2$	$a_3$	$b_4$	$b_5$
$R_2(B, C, E)$	$b_{21}$	$a_2$	$a_3$	$b_{24}$	$a_5$
$R_3(C, D)$	$b_{31}$	$b_{32}$	$a_3$	$a_4$	$b_{35}$

$AC \rightarrow B, B \rightarrow C$  之后无变化

$C \rightarrow D$  之后变为:

	A	B	C	D	E
$R_1(A, B, C)$	$a_1$	$a_2$	$a_3$	$a_4$	$b_5$
$R_2(B, C, E)$	$b_{21}$	$a_2$	$a_3$	$a_4$	$a_5$
$R_3(C, D)$	$b_{31}$	$b_{32}$	$a_3$	$a_4$	$b_{35}$

$B \rightarrow E$ 之后变为:

	A	B	C	D	E
$R_1(A, B, C)$	$a_1$	$a_2$	$a_3$	$a_4$	$a_5$
$R_2(B, C, E)$	$b_{21}$	$a_2$	$a_3$	$a_4$	$a_5$
$R_3(C, D)$	$b_{31}$	$b_{32}$	$a_3$	$a_4$	$b_{35}$

第一行全为 $a$ . 该分解无损.

证明保持依赖.

对 $F$ 中的 $B \rightarrow CE$

执行

result = B

repeat

for each 分解后的 $R_i$

$t = (\text{result} \cap R_i)^+ \cap R_i$

result = result  $\cup$  t

until result 不变

最终 result 包含 $CE$ , 所以 $B \rightarrow CE$ 的依赖保持了.

同理可得其他依赖也保持, 故依赖保持.