1. (a) 成立

(b) 成立

(c) 成立

(d) 不成立，考虑下面两个关系

R:

Chr	Int
a	1
c	3

S:

Chr	Int
a	1
b	2

设 θ: $Chr = a$，则 $|\sigma_\theta(R) \times S| = 2$

$|R \times \sigma_\theta(S)| = 1$

所以命题不成立.

(e) 成立

(f) 不成立，考虑(d)中提及的 R、S和θ，则

$|\sigma_\theta(R) - S| = 0$，$|R - \sigma_\theta(S)| = 1$

所以命题不成立.

(g) 若$L_1 \subseteq L_2$，则成立；否则考虑(d)中的 R，L_1:{Chr}，L_2:{Int}，则

$\pi_{L_1}(\pi_{L_2}(R)) = \emptyset$，$\pi_{L_1}(R) = \{a, c\}$

(h) 成立

(i) 不成立，考虑下面两个关系

R:

Chr	Int
a	1
a	2

S:

Chr	Int
a	1
b	2

设 L: Int，则 $\pi_L(R-S) = \{1, 2\}$

$\pi_L(R) - \pi_L(S) = \emptyset$

所以命题不成立.

(j) 不成立，考虑下面三个关系

R: Chr	Int
a	0
b	1

S: Int	Bool
0	True
1	False

T: Chr	Str
a	"aa"
b	"bb"

则 $|(R \bowtie S) \bowtie T| = 2$，$|R \bowtie (S \bowtie T)| = 4$

所以命题不成立.

2. 表达式：$\Pi_K(\sigma_{amt>1}(\gamma_{K;\ count(*) \to amt}(R))) \cup \Pi_K(\sigma_{K=null}(R))$

若表达式为空,则关系R上属性K满足实体完整性。上式左边检查是否有重复的主键，右边检查是否有空的主键。

3. 表达式：$\Pi_F(\sigma_{F \neq null} S) - \Pi_K(R)$

若表达式为空,则R和S的实例满足参照完整性。该式首先选出非空外键,减后若非空则存在不在R中的外键。

4. 证明：设 $R(A_1, A_2, \cdots, A_n)$，$S(A_1, A_2, \cdots, A_n)$，我们要证明

$$R \bowtie S \subseteq R \cap S \text{ 且 } R \bowtie S \supseteq R \cap S.$$

(1) 证明 $R \bowtie S \subseteq R \cap S$.

对 $\forall t \in R \bowtie S$，设 $t = (t_1, t_2, \cdots, t_n)$，则

$\exists\ r = (r_1, r_2, \cdots r_n) \in R$，$s = (s_1, s_2, \cdots s_n) \in S$，s.t. $\forall_{i=1\ldots n}\ t_i = r_i = s_i$，

故 $t = r = s$，$t \in R \cap S$，所以 $R \bowtie S \subseteq R \cap S$

(2) 证明 $R \bowtie S \supseteq R \cap S$

对 $\forall t \in R \cap S$，设 $t = (t_1, t_2, \cdots, t_n)$，则

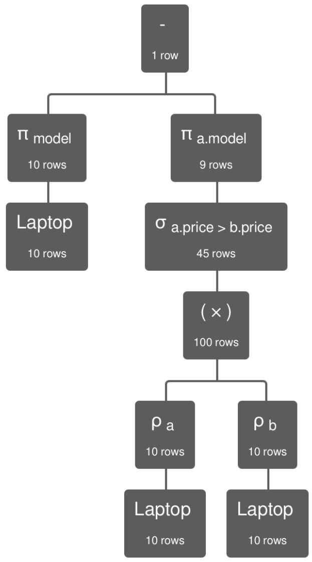
$\exists\ r = (r_1, r_2, \cdots, r_n) \in R$，$s = (s_1, s_2, \cdots, s_n) \in S$，s.t. $t = r = s$.

故 $\forall_{i=1,\cdots n}\ t_i = r_i = s_i$，所以 $t \in R \bowtie S$，所以 $R \bowtie S \supseteq R \cap S$.

综上所述，$R \bowtie S = R \cap S$

5. (a)

Result ×

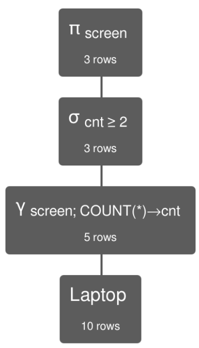


π_{model} Laptop - $\pi_{\text{a.model}}$ ($\sigma_{\text{a.price} > \text{b.price}}$ (ρ_{a} Laptop × ρ_{b} Laptop))

Laptop.model
2003

Close

(b)

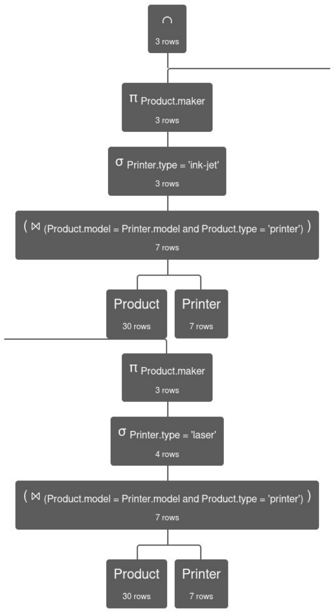


π_{screen} ($\sigma_{\text{cnt} \geq 2}$ ($\gamma_{\text{screen; COUNT(*)} \to \text{cnt}}$ Laptop))

Laptop.screen
17
15.4
13.3

Close

(C)



$\pi_{\text{Product.maker}} (\sigma_{\text{Printer.type = 'ink-jet'}} ((\text{Product}) \bowtie_{\text{(Product.model = Printer.model and Product.type = 'printer')}} (\text{Printer}))) \cap \pi_{\text{Product.maker}} (\sigma_{\text{Printer.type = 'laser'}} ((\text{Product}) \bowtie_{\text{(Product.model = Printer.model and Product.type = 'printer')}} (\text{Printer})))$

Product.maker
'D'
'E'
'H'

6. (a) $\{ t[\text{model}] \mid t \in \text{Laptop} \wedge \forall u \in \text{Laptop} (t[\text{price}] \leq u[\text{price}]) \}$

(b) $\{ t[\text{screen}] \mid t \in \text{Laptop} \wedge \exists u \in \text{Laptop} (t[\text{model}] \neq u[\text{model}] \wedge t[\text{screen}] = u[\text{screen}]) \}$

(C) $\{ t[\text{maker}] \mid t \in \text{Product} \wedge t[\text{type}] = \text{"printer"} \wedge \exists u \in \text{Printer} (t[\text{model}] = u[\text{model}] \wedge u[\text{type}] = \text{"ink-jet"}) \wedge \exists u \in \text{Printer} (t[\text{model}] = u[\text{model}] \wedge u[\text{type}] = \text{"laser"}) \}$

7. (a) $\{ (a) \mid \exists b,c,d,e,f ((a,b,c,d,e,f) \in \text{Laptop} \wedge \forall a',b',c',d',e',f' ((a',b',c',d',e',f') \in \text{Laptop} \wedge f \leq f')) \}$

(b) $\{ (e) \mid \exists a,b,c,d,f ((a,b,c,d,e,f) \in \text{Laptop} \wedge \exists a',b',c',d',e',f' ((a',b',c',d',e',f') \in \text{Laptop} \wedge a \neq a' \wedge e = e')) \}$

(c) $\{ (a) \mid \exists b,d,f ((a,b,\text{"printer"}) \in \text{Product} \wedge (b,d,\text{"ink-jet"},f) \in \text{Printer}) \cap \exists b',d',f' ((a,b',\text{"printer"}) \in \text{Product} \wedge (b',d',\text{"laser"},f') \in \text{Printer}) \}$