

Use predicates (vii) and (ix) to answer the following questions.

vii.  $p = (a \vee b) \wedge (c \vee d)$

ix.  $p = a \vee b \vee (c \wedge d)$

- List the clauses that go with predicate  $p$ .
- Compute (and simplify) the conditions under which each clause determines predicate  $p$ .
- Write the complete truth table for the predicate. Label your rows starting from 1. Use the format in the example underneath the definition of Combinatorial Coverage in Section 8.1.1. That is, row 1 should be all clauses true. You should include columns for the conditions under which each clause determines the predicate, and also a column for the value of the predicate itself.
- List **all** pairs of rows from your table that satisfy General Active Clause Coverage (GACC) with respect to each clause.
- List **all** pairs of rows from your table that satisfy Correlated Active Clause Coverage (CACC) with respect to each clause.
- List **all** pairs of rows from your table that satisfy Restricted Active Clause Coverage (RACC) with respect to each clause.

vii.

c)

	a	b	c	d	p	$p_a$	$p_b$	$p_c$	$p_d$
1	T	T	T	T	T	T	T	T	T
2	T	T	T	F	T	T	T	T	T
3	T	T	F	T	T	T	T	T	T
4	T	T	F	F	F	T	F	T	T
5	T	F	T	T	T	T	T	T	T
6	T	F	T	F	T	T	T	T	T
7	T	F	F	T	T	T	T	T	T
8	T	F	F	F	F	T	F	T	T
9	F	T	T	T	T	T	T	T	T
10	F	T	T	F	T	T	T	T	T
11	F	T	F	T	T	T	T	T	T
12	F	T	F	F	F	T	F	T	T
13	F	F	T	T	F	T	T	T	T
14	F	F	T	F	F	T	T	T	T
15	F	F	F	T	F	T	T	T	T
16	F	F	F	F	F	F	F	F	F

a)  $a, b, c, d$

b)  $p_a = \neg b \wedge (c \vee d)$

$p_b = \neg a \wedge (c \vee d)$

$p_c = \neg d \wedge (a \vee b)$

$p_d = \neg c \wedge (a \vee b)$

$p = (p_a \vee p_b) \wedge (p_c \vee p_d)$

$$b) p = (a \vee b) \wedge (c \vee d)$$

$$p_a = \text{true} = (T \vee b) \wedge (c \vee d) = c \vee d$$

$$p_a = \text{false} = (F \vee b) \wedge (c \vee d) = b \wedge (c \vee d)$$

$$p_a = p_a = \text{true} \oplus p_a = \text{false}$$

$$\begin{aligned} p_a &= (c \vee d) \oplus (b \wedge (c \vee d)) \\ &= ((c \vee d) \wedge \neg(b \wedge (c \vee d))) \vee (\neg(c \vee d) \wedge (b \wedge (c \vee d))) \\ &= ((c \vee d) \wedge (\neg b \vee \neg(c \vee d))) \vee (\neg(c \vee d) \wedge b \wedge (c \vee d)) \\ &= ((c \vee d) \wedge \neg b) \vee (\neg(c \vee d) \wedge b) \end{aligned}$$

$$p_a = \neg b \wedge (c \vee d)$$

$$p_b = \text{true} = (a \vee T) \wedge (c \vee d) = c \vee d$$

$$p_b = \text{false} = (a \vee F) \wedge (c \vee d) = a \wedge (c \vee d)$$

$$p_b = p_b = \text{true} \oplus p_b = \text{false}$$

$$\begin{aligned} p_b &= (c \vee d) \oplus (a \wedge (c \vee d)) \\ &= ((c \vee d) \wedge \neg(a \wedge (c \vee d))) \vee (\neg(c \vee d) \wedge (a \wedge (c \vee d))) \\ &= ((c \vee d) \wedge (\neg a \vee \neg(c \vee d))) \vee (\neg(c \vee d) \wedge a \wedge (c \vee d)) \\ &= ((c \vee d) \wedge \neg a) \vee (\neg(c \vee d) \wedge a) \end{aligned}$$

$$p_b = \neg a \wedge (c \vee d)$$

$$p_c = \text{true} = (a \vee b) \wedge (T \vee d) = a \vee b$$

$$p_c = \text{false} = (a \vee b) \wedge (F \vee d) = (a \vee b) \wedge d$$

$$p_c = p_c = \text{true} \oplus p_c = \text{false}$$

$$\begin{aligned} p_c &= (a \vee b) \oplus ((a \vee b) \wedge d) \\ &= ((a \vee b) \wedge \neg((a \vee b) \wedge d)) \vee (\neg(a \vee b) \wedge ((a \vee b) \wedge d)) \\ &= ((a \vee b) \wedge (\neg(a \vee b) \vee \neg d)) \vee (\neg(a \vee b) \wedge (a \vee b) \wedge d) \\ &= ((a \vee b) \wedge \neg(a \vee b)) \vee ((a \vee b) \wedge \neg d) \end{aligned}$$

$$p_c = \neg d \wedge (a \vee b)$$

vii. cont.

$$b) p = (a \vee b) \wedge (c \vee d)$$

$$p_{d=\text{true}} = (a \vee b) \wedge (c \vee T) = a \vee b$$

$$p_{d=\text{false}} = (a \vee b) \wedge (c \vee F) = (a \vee b) \wedge c$$

$$p_d = p_{d=\text{true}} \oplus p_{d=\text{false}}$$

$$p_d = (a \vee b) \oplus ((a \vee b) \wedge c)$$

$$p_d = ((a \vee b) \wedge \neg((a \vee b) \wedge c)) \vee (\neg(a \vee b) \wedge ((a \vee b) \wedge c))$$

$$= ((a \vee b) \wedge (\neg(a \vee b) \vee \neg c)) \vee (\neg(a \vee b) \wedge (a \vee b) \wedge c)$$

$$= (\cancel{(a \vee b)} \wedge \neg(a \vee b)) \vee (a \vee b) \wedge \neg c$$

$$p_d = \neg c \wedge (a \vee b)$$

d) GACC

$$\text{Clause } a: \{5, 6, 7\} \times \{13, 14, 15\}$$

$$\text{Clause } b: \{9, 10, 11\} \times \{13, 14, 15\}$$

$$\text{Clause } c: \{2, 6, 10\} \times \{4, 8, 12\}$$

$$\text{Clause } d: \{3, 7, 11\} \times \{4, 8, 12\}$$

e) CACC

$$\text{Clause } a: \{5, 6, 7\} \times \{13, 14, 15\}$$

$$\text{Clause } b: \{9, 10, 11\} \times \{13, 14, 15\}$$

$$\text{Clause } c: \{2, 6, 10\} \times \{4, 8, 12\}$$

$$\text{Clause } d: \{3, 7, 11\} \times \{4, 8, 12\}$$

f) RACC

$$\text{Clause } a: \{\{5, 13\}, \{6, 14\}, \{7, 15\}\}$$

$$\text{Clause } b: \{\{9, 13\}, \{10, 14\}, \{11, 15\}\}$$

$$\text{Clause } c: \{\{2, 4\}, \{6, 8\}, \{10, 12\}\}$$

$$\text{Clause } d: \{\{3, 4\}, \{7, 8\}, \{11, 12\}\}$$

(ix.)

c)

	a	b	c	d	p	p <sub>a</sub>	p <sub>b</sub>	p <sub>c</sub>	p <sub>d</sub>
1	T	T	T	T	T				
2	T	T	T	F	T				
3	T	T	F	T	T				
4	T	T	F	F	T				
5	T	F	T	T	T				
6	T	F	T	F	T	T			
7	T	F	F	T	T	T			
8	T	F	F	F	T	T			
9	F	T	T	T	T				
10	F	T	T	F	T		T		
11	F	T	F	T	T		T		
12	F	T	F	F	T		T		
13	F	F	T	T	T			T	T
14	F	F	T	F		T	T		T
15	F	F	F	T		T	T	T	
16	F	F	F	F		T	T		

a) a, b, c, d

b)  $p_a = \neg b \wedge \neg (c \wedge d)$

$p_b = \neg a \wedge \neg (c \wedge d)$

$p_c = d \wedge \neg (a \vee b)$

$p_d = c \wedge \neg (a \vee b)$

b)  $p = a \vee b \vee (c \wedge d)$

$p_{a=\text{true}} = T \vee b \vee (c \wedge d) = T$

$p_{a=\text{false}} = F \vee b \vee (c \wedge d) = b \vee (c \wedge d)$

$p_a = p_{a=\text{true}} \oplus p_{a=\text{false}}$

$p_a = T \oplus (b \vee (c \wedge d))$

$p_a = (T \wedge \neg (b \vee (c \wedge d))) \vee (F \wedge (b \vee (c \wedge d)))$   
 $= \neg (b \vee (c \wedge d))$

$p_a = \neg b \wedge \neg (c \wedge d)$

$p_{b=\text{true}} = a \vee T \vee (c \wedge d) = T$

$p_{b=\text{false}} = a \vee F \vee (c \wedge d) = a \vee (c \wedge d)$

$p_b = p_{b=\text{true}} \oplus p_{b=\text{false}}$

$p_b = T \oplus (a \vee (c \wedge d))$

$p_b = \neg (a \vee (c \wedge d))$

$p_b = \neg a \wedge \neg (c \wedge d)$

$T \oplus a = (T \wedge \neg a) \vee (F \wedge a)$   
 $= \neg a$

$F \oplus a = (F \wedge \neg a) \vee (T \wedge a)$   
 $= a$



(ix.) cont.

b)

$$p_{c=\text{true}} = a \vee b \vee (T \wedge d) = a \vee b \vee d$$

$$p_{c=\text{false}} = a \vee b \vee (F \wedge d) = a \vee b$$

$$p_c = p_{c=\text{true}} \oplus p_{c=\text{false}}$$

$$p_c = (a \vee b \vee d) \oplus (a \vee b)$$

$$p_c = ((a \vee b \vee d) \wedge \neg(a \vee b)) \vee (\neg(a \vee b \vee d) \wedge (a \vee b))$$

$$= (((a \vee b) \vee d) \wedge \neg(a \vee b)) \vee (\neg((a \vee b) \vee d) \wedge (a \vee b))$$

$$= (((a \vee b) \wedge \neg(a \vee b)) \vee (d \wedge \neg(a \vee b))) \vee ((\neg(a \vee b) \wedge \neg d) \wedge (a \vee b))$$

$$p_c = (d \wedge \neg(a \vee b)) \vee$$

$$p_{d=\text{true}} = a \vee b \vee (c \wedge T) = a \vee b \vee c$$

$$p_{d=\text{false}} = a \vee b \vee (c \wedge F) = a \vee b$$

$$p_d = p_{d=\text{true}} \oplus p_{d=\text{false}}$$

$$p_d = (a \vee b \vee c) \oplus (a \vee b)$$

$$p_d = ((a \vee b \vee c) \wedge \neg(a \vee b)) \vee (\neg(a \vee b \vee c) \wedge (a \vee b))$$

$$= (((a \vee b) \vee c) \wedge \neg(a \vee b)) \vee (\neg((a \vee b) \vee c) \wedge (a \vee b))$$

$$= (((a \vee b) \wedge \neg(a \vee b)) \vee (c \wedge \neg(a \vee b))) \vee ((\neg(a \vee b) \wedge \neg c) \wedge (a \vee b))$$

$$p_d = c \wedge \neg(a \vee b)$$

d) GACC

$$\text{Clause } a: \{6, 7, 8\} \times \{14, 15, 16\}$$

$$\text{Clause } b: \{10, 11, 12\} \times \{14, 15, 16\}$$

$$\text{Clause } c: \{13\} \times \{15\}$$

$$\text{Clause } d: \{13\} \times \{14\}$$

e) CACC

$$\text{Clause } a: \{6, 7, 8\} \times \{14, 15, 16\}$$

$$\text{Clause } b: \{10, 11, 12\} \times \{14, 15, 16\}$$

$$\text{Clause } c: \{13\} \times \{15\}$$

$$\text{Clause } d: \{13\} \times \{14\}$$

f) RACC

$$\text{Clause } a: \{\{6, 14\}, \{7, 15\}, \{8, 16\}\}$$

$$\text{Clause } b: \{\{10, 14\}, \{11, 15\}, \{12, 16\}\}$$

$$\text{Clause } c: \{\{13, 15\}\}$$

$$\text{Clause } d: \{\{13, 14\}\}$$