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Exercise Section 3.2. Problems 7 and 9, including (a) to (f).

(a) Identify the clauses that go with predicate p.
(b) Compute (and simplify) the conditions under which each of the clauses determines predicate p.
(c) Write the complete truth table for all clauses. Label your rows starting from 1. Use the format in the example underneath the definition of combinatorial coverage in Section 3.2. 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 predicate itself.
(d) Identify all pairs of rows from your table that satisfy general active clause coverage (GACC) with respect to each clause.
(e) Identify all pairs of rows from your table that satisfy correlated active clause coverage (CACC) with respect to each clause.
(f) Identify all pairs of rows from your table that satisfy restricted active clause coverage (RACC) with respect to each clause.

7. $p = (a \lor b) \land (c \lor d)$

a) The clauses the go with predicate P are a, b, c, d

b) $P_a = P_a = \text{true} \oplus p_{a=false}$

$P_a = \text{true} = (T \lor b) \land (c \lor d)$ $\qquad$ $P_a = \text{false} = (F \lor b) \land (c \lor d)$

$P_a = \text{true} = T \land (c \lor d)$ $\qquad\qquad$ $P_a = \text{false} = b \land (c \lor d)$

$P_a = \text{true} = (c \lor d)$

$\qquad$ $P_a = (c \lor d) \oplus b \land (c \lor d)$

$\qquad$ $P_a = ((c \lor d) \land \neg ((c \lor d) \land b)) \lor (\neg (c \lor d) \land ((c \lor d) \land b))$

$\qquad$ $P_a = ((c \lor d) \land \neg ((c \lor d) \land b)$

$\qquad$ $P_a = ((c \lor d) \land \neg ((c \lor d) \land b)$

$\qquad$ $\mathbf{P_a = \neg b \land (c \lor d)}$

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

$P_b = \text{true} = (a \lor T) \land (c \lor d)$ $P_b = \text{false} = (a \lor F) \land (c \lor d)$

$P_b = \text{true} = a \land (c \lor d)$ $P_b = \text{false} = a \land (c \lor d)$

     $P_b = a \land (c \lor d) \oplus a \land (c \lor d)$

     $P_b = ((c \lor d) \land \lnot ((c \lor d) \land a)) \lor (\lnot (c \lor d) \land ((c \lor d) \land a))$

     $P_b = ((c \lor d) \land \lnot ((c \lor d) \land a)$

     $P_b = ((c \lor d) \land \lnot (c \lor d) \land \lnot a$

     $P_b = \lnot a \land (c \lor d)$

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

$P_c = \text{true} = (a \lor b) \land (T \lor d)$ $P_c = \text{false} = (a \lor b) \land (F \lor d)$

$P_c = \text{true} = (a \lor b) \land T$ $P_c = \text{false} = (a \lor b) \land d$

$P_c = \text{true} = (a \lor b)$

     $P_c = (a \lor b) \oplus (a \lor b) \land d$

     $P_c = ((a \lor b) \land \lnot ((a \lor b) \land d)) \lor (\lnot (a \lor b) \land ((a \lor b) \land d))$

     $P_c = ((a \lor b) \land \lnot ((a \lor b) \land d)$

     $P_c = ((a \lor b) \land \lnot (a \lor b) \land \lnot d$

     $P_c = \lnot d \land (a \lor b)$

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

$P_d = \text{true} = (a \lor b) \land (c \lor T)$ $P_d = \text{false} = (a \lor b) \land (c \lor F)$

$P_d = \text{true} = (a \lor b) \land T$ $P_d = \text{false} = (a \lor b) \land c$

$P_d = \text{true} = (a \lor b)$

     $P_d = (a \lor b) \oplus (a \lor b) \land c$

     $P_d = ((a \lor b) \land \lnot ((a \lor b) \land c)) \lor (\lnot (a \lor b) \land ((a \lor b) \land c))$

     $P_d = ((a \lor b) \land \lnot ((a \lor b) \land c)$

     $P_d = ((a \lor b) \land \lnot (a \lor b) \land \lnot c$

     $P_d = \lnot c \land (a \lor b)$

C)

	a	b	c	d	P	P_a	P_b	P_c	P_d
1	T	T	T	T	T	F	F	F	F
2	T	T	T	F	T	F	F	T	F
3	T	T	F	T	T	F	F	F	T
4	T	T	F	F	F	F	F	T	T
5	T	F	T	T	T	T	F	F	F
6	T	F	T	F	T	T	F	T	F
7	T	F	F	T	T	T	F	F	T
8	T	F	F	F	F	F	F	T	T
9	F	T	T	T	T	F	T	F	F
10	F	T	T	F	T	F	T	T	F
11	F	T	F	T	T	F	T	F	T
12	F	T	F	F	F	F	F	T	T
13	F	F	T	T	F	T	T	F	F
14	F	F	T	F	F	T	T	F	F
15	F	F	F	T	F	T	T	F	F
16	F	F	F	F	F	F	F	F	F

d) GACC pairs for clause a are {5, 6, 7} x {13, 14, 15}
GACC pairs for clause b are {9, 10, 11} x {13, 14, 15}
GACC pairs for clause c are {2, 6, 10} x {4, 8, 12}
GACC pairs for clause d are: {3, 7, 11} x {4, 8, 12}

e) CACC pairs for all clauses a, b, c, and d are the same as the GACC pairs.

f) RACC pairs for clause a, (5, 13), (6, 14), (7, 15)
RACC pairs for clause b, (9, 13), (10, 14), (11, 15)
RACC pairs for clause c, (2, 4), (6, 8), (10, 12)
RACC pairs for clause d, (3, 4), (7, 8), (11, 12)

9. $p = a \lor b \lor (c \land d)$

a) The clauses the go with predicate P are a, b, c, d

b) $P_a = P_a = true \oplus p_{a=false}$

$P_a = true = T \lor b \lor (c \land d)$ $P_a = false = F \lor b \lor (c \land d)$

$P_a = true = T \lor (c \lor d)$ $P_a = false = b \lor (c \land d)$

$P_a = true = T$

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

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

$\mathbf{P_a = \neg b \wedge (\neg c \vee \neg d))}$

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

$P_b = \text{true} = a \vee T \vee (c \wedge d)$ $P_b = \text{false} = a \vee F \vee (c \wedge d)$

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

$P_b = \text{true}$

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

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

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

$\mathbf{P_b = \neg a \wedge (\neg c \vee \neg d))}$

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

$P_c = \text{true} = a \vee b \vee (T \wedge d)$ $P_c = \text{false} = a \vee b \vee (F \wedge d)$

$P_c = \text{true} = (a \vee b) \vee d$ $P_c = \text{false} = (a \vee b) \vee F$

                                        $P_c = \text{false} = (a \vee b)$

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

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

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

$\mathbf{P_c = \neg a \wedge \neg b \wedge d}$

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

$P_d = \text{true} = a \vee b \vee (c \wedge T)$ $P_d = \text{false} = a \vee b \vee (c \wedge F)$

$P_d = \text{true} = (a \vee b) \vee c$ $P_d = \text{false} = (a \vee b) \vee F$

                                        $P_d = \text{false} = (a \vee b)$

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

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

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

c)

	a	b	c	d	P	P_a	P_b	Pc	P_d
1	T	T	T	T	T	F	F	F	F
2	T	T	T	F	T	F	F	F	F
3	T	T	F	T	T	F	F	F	F
4	T	T	F	F	T	F	F	F	F
5	T	F	T	T	T	F	F	F	F
6	T	F	T	F	T	T	F	F	F
7	T	F	F	T	T	T	F	F	F
8	T	F	F	F	T	T	F	F	F
9	F	T	T	T	T	F	F	F	F
10	F	T	T	F	T	F	T	F	F
11	F	T	F	T	T	F	T	F	F
12	F	T	F	F	T	F	T	F	F
13	F	F	T	T	T	F	F	T	T
14	F	F	T	F	F	T	T	F	T
15	F	F	F	T	F	T	T	T	F
16	F	F	F	F	F	T	T	F	F

d) GACC pairs for clause a are {6, 7, 8} x {14, 15, 16}
   GACC pairs for clause b are {10, 11, 12} x {14, 15, 16}
   GACC pairs for clause c are 13 and 15
   GACC pairs for clause d are: 13 and 14

e) CACC pairs for all clauses a, b, c, and d are the same as the GACC pairs.

f) RACC pairs for clause a, (8, 16), (6, 14), (7, 15)
   RACC pairs for clause b, (12, 16), (10, 14), (11, 15)
   RACC pairs for clause c are 13 and 15
   RACC pairs for clause d are 13 and 14