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A4

Q1. Chapter 2, Section 2.4, Question 3 (pp. 74-75 43 of your textbook).

```
1 public void trash (int x)
2 {
3    int m, n;
4
5    m = 0;
6    if (x > 0)
7       m = 4;
8    if (x > 5)
9       n = 3*m;
10   else
11      n = 4*m;
12   int o = takeOut (m, n);
13   System.out.println ("o is: " + o);
14 }

15 public int takeOut (int a, int b)
16 {
17   int d, e;
18
19   d = 42*a;
20   if (a > 0)
21      e = 2*b+d;
22   else
23      e = b+d;
24   return (e);
25 }
```

(a) Call sites: line 12.
trash() -> takeOut()

(b) All pairs of last-def and first-uses:

	Last-def	First-uses
1	(trash(),m,5)	(takeOut(),a,19)
2	(trash(),m,7)	(takeOut(),a,19)
3	(trash(),n,9)	(takeOut(),b,21)
4	(trash(),n,9)	(takeOut(),b,23)
5	(trash(),n,11)	(takeOut(),b,21)
6	(trash(),n,11)	(takeOut(),b,23)
7	(takeOut(),e,21)	(trash(),o,13)
8	(takeOut(),e,23)	(trash(),o,13)

(c) Test input x <=0 (for example, x=0)satisfies TR 1, 6, 8.
Test input x > 5 (for example, x=6) satisfies TR 2, 3, 7.
Test input 1<=x <=5 (for example=3) satisfies TR 2,5,7.

TR 4 can not be satisfied because if x>5 , m=4 and n=12 , calling takeout(4,12) , making **a** in takeOut always >0 – forcing line 23 to never be called for last-def ((trash(),n,9)).

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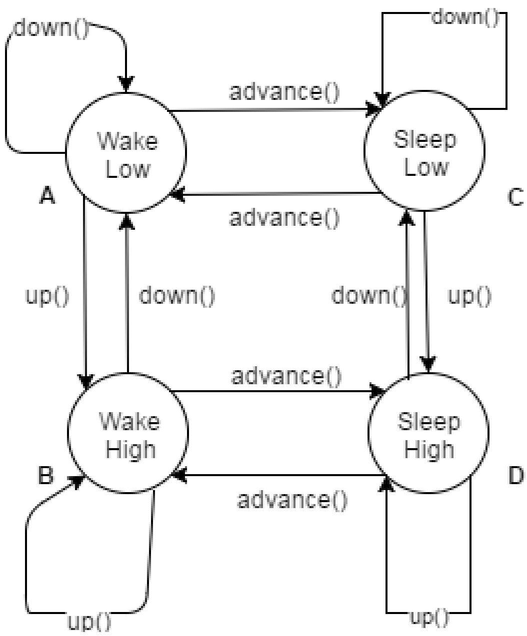
Q2. Chapter 2, Section 2.5, Question 2 (page 87 of your textbook).

(a) 4 states:
A = {Wake,Low}
B = {Wake, High}
C = {Sleep, Low}
D = {Sleep, High}

(b)



(c)

Edge coverage TR =

1	(A,A)	5	(B,D)	9	(C,D)
2	(A,B)	6	(D,B)	10	(C,C)
3	(B,A)	7	(D,D)	11	(C,A)
4	(B,B)	8	(D,C)	12	(A,C)

Test case = {2,4,5,7,6,3,1,12,9,8,10,11} satisfies edge coverage on the FSM. The sequence of calls from state A (Wake, Low) is up() →up()→advance()→up()→advance()→down() →down() →advance() →up() →down() →down() →advance() .
This sequence of calls ensure that the thermostat returns to the same state (before the test) after the test sequence ends.

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Q3. Chapter 3, Section 3.2; do parts (a)-(h) for the predicate in Question 7 (page 119 of your textbook).

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

a) Clauses: a, b, c, d

b) $p_a = p_{a=\text{true}} \oplus p_{a=\text{false}}$
$= (\text{true} \vee b) \wedge (c \vee d) \oplus (\text{false} \vee b) \wedge (c \vee d)$
$= (\text{true}) \wedge (c \vee d) \oplus (b) \wedge (c \vee d)$
$= (c \vee d) \oplus (b) \wedge (c \vee d)$
$\boldsymbol{= \neg b \wedge (c \vee d)}$

$p_b = p_{b=\text{true}} \oplus p_{b=\text{false}}$
$= (a \vee true) \wedge (c \vee d) \oplus (a \vee false) \wedge (c \vee d)$
$= (\text{true}) \wedge (c \vee d) \oplus (a) \wedge (c \vee d)$
$= (c \vee d) \oplus (a) \wedge (c \vee d)$
$\boldsymbol{= \neg a \wedge (c \vee d)}$

$p_c = p_{c=\text{true}} \oplus p_{c=\text{false}}$
$= (\text{a} \vee b) \wedge (true \vee d) \oplus (\text{a} \vee b) \wedge (false \vee d)$
$= (\text{a} \vee b) \wedge (true) \oplus (\text{a} \vee b) \wedge (d)$
$= (\text{a} \vee b) \oplus (\text{a} \vee b) \wedge (d)$
$\boldsymbol{= \neg d \wedge (a \vee b)}$

$p_d = p_{d=\text{true}} \oplus p_{d=\text{false}}$
$= (\text{a} \vee b) \wedge (c \vee true) \oplus (\text{a} \vee b) \wedge (c \vee false)$
$= (\text{a} \vee b) \wedge (true) \oplus (\text{a} \vee b) \wedge (c)$
$= (\text{a} \vee b) \oplus (\text{a} \vee b) \wedge (c)$
$\boldsymbol{= \neg c \wedge (a \vee b)}$

c) Truth Table:

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

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

e) With respect to clause a, CACC pairs are = {5,6,7}x{13,14,15}
With respect to clause b, CACC pairs are = {9,10,11}x{13,14,15}
With respect to clause c, CACC pairs are = {2,6,10}x{4,8,12}
With respect to clause d, CACC pairs are = {3,7,11}x{4,8,12}

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

g) With respect to clause A, GICC 4-tuples are = {1,2,3}x{9,10,11}x{4,8}x{12,16}
With respect to clause B, GICC 4-tuples are = {1,2,3}x{5,6,7}x{4,12}x{8,16}
With respect to clause C, GICC 4-tuples are = {1,5,9} x{3,7,11}x{13,14} x{15,16}
With respect to clause D, GICC 4-tuples are = {1,5,9}x{2,6,10}x{13,15}x{14,16}

h) With respect to clause A, RICC 4-tuples are = {(1,9),(2,10),(3,11)}**x**{(4,12),(8,16)}
With respect to clause B, RICC 4-tuples are = {(1,5),(2,6),(3,7)}**x**{(4,8),(12,16)}
With respect to clause C, RICC 4-tuples are = {(1,3),(5,7),(9,11)}**x**{(13,15) ,(15,16)}
With respect to clause D, RICC 4-tuples are = {(1,2),(5,6),(9,10)}**x**{(13,14) ,(15,16)}

Q4. Chapter 3, Section 3.3, Question 2 (page 130 of your textbook).

```
public String twoPred(int x, int y)     //line 1
{                                       //line 2
        boolean z;                      //line 3
        if(x<y)                         //line 4
                z=true;                 //line 5
        else                            //line 6
                z = false;              //line 7
        if(z && x+y==10)                //line 8
                return “A”;             //line 9
        else                            //line 10
                return “B”;             //line 11
}                                       //line 12
```

From line 3 and 4, the truth value of z depends on the predicate p=(x<y) on line 4.

If x<y == true, z = true and if x<y == false, z = false.

So, predicate at line 8 can be written as p = (x<y) && (x+y==10).

Say,

(x<y) is clause **a**

And

(x+y==10) is clause **b**

So , predicate at line 8 , p = a&&b.

Now, $\mathbf{p_a}$ (a major clause) = (true &&b) $\oplus$(false &&b) = b$\oplus$false = b.

And similarly, $\mathbf{p_b}$ (a major clause) = a.

So, RACC truth table for p,

a	b	
T	T	a major clause
F	T	
T	T	b major clause
T	F	

From this truth table, we can see that there are three unique clause combinations to satisfy RACC, (a,b)=(T,T),(T,F),(F,T)

a(x<y)	b(x+y==10)	possible value for x	Possible value for y	Test
T	T	3	7	twoPred(3,7)
T	F	3	8	twoPred(3,8)
F	T	7	3	twoPred(7,3)

So, for **RACC , test cases are** twoPred(3,7), twoPred(3,8), twoPred(7,3).

RICC:

For RICC, major clauses will not determine p.

We have already seen from RACC that when a is major clause, only b = true will make this clause determine p . If b=false, a will not determine p = a&&b .

For b=false, RICC will have no feasible pair for p=true. The truth table is

a	**b**	**P**
t	f	F
f	f	F

Similarly, when b is major clause, only a=true will make this clause determine p. If a = false, major clause b will be inactive.

For a=false, the truth table is

a	**b**	**p**
f	t	f
f	f	f

Similar to b=false, when a=false, RICC will have no feasible pair for p=true.

From these two truth tables, we see that the combinations (a,b)={(t,f),(f,t),(f,f)} satisfy the RICC requirements.

a(x<y)	b(x+y==10)	possible value for x	Possible value for y	Test
t	f	3	8	twoPred(3,8)
f	t	7	3	twoPred(7,3)
f	F	7	5	twoPred(7,5)

So, for RICC , test cases are twoPred(7,5), twoPred(3,8), twoPred(7,3).

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