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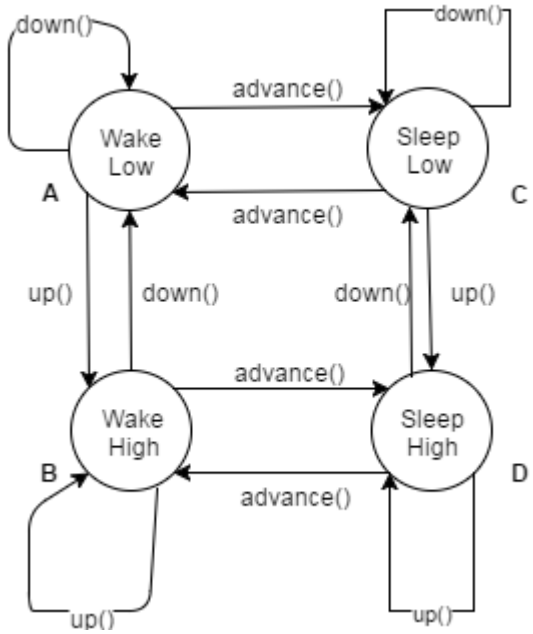
Q2. Chapter 2, Section 2.5, Question 2 (page 87 of your textbook).

(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).

***p* = (*a* ∨ *b*) ∧ (*c* ∨ *d*)**

a) Clauses: a, b, c, d

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

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

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

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

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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)}