5321 Software Testing Homework-2
Summer-2020

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Solutions:

Problem 1:

Test case table:

Test Case	Current State	Next State	Inputs				Exp outputs			
			D	G	P	Z	B	I	T	X
1	Start	OFF	0	0	0	0	0	0	0	0
2	OFF	OFF	0	0	0	1	0	0	0	0
3	OFF	U	0	0	1	0	1	0	0	1
4	OFF	L	0	1	0	0	1	0	1	0
5	OFF	OFF	1	0	0	0	0	0	0	0
6	L	L	0	0	0	1	1	0	1	0
7	L	OFF	0	0	1	0	0	0	0	0
8	L	L	0	1	0	0	1	0	1	0
9	L	L	1	0	0	0	1	0	1	0
10	U	X5	0	0	0	1	1	0	0	2
11	U	OFF	0	0	1	0	0	0	0	0
12	U	U	0	1	0	0	1	0	0	1
13	U	U	1	0	0	0	1	0	0	1
14	X5	X10	0	0	0	1	1	0	0	3
15	X5	X5	0	0	1	0	1	0	0	2
16	X5	X5	0	1	0	0	1	0	0	2
17	X5	N	1	0	0	0	1	1	0	2
18	X10	U	0	0	0	1	1	0	0	1
19	X10	X10	0	0	1	0	1	0	0	3
20	X10	X10	0	1	0	0	1	0	0	3
21	X10	X10	1	0	0	0	1	0	0	3
22	N	N	0	0	0	1	1	1	0	2
23	N	N	0	0	1	0	1	1	0	2
24	N	N	0	1	0	0	1	1	0	2
25	N	X5	1	0	0	0	1	0	0	2

Sequence Enumeration Table:

Test Case Number	Length	Sequence	Response	Equivalence	Carry to next level
1	0	Idle	B=0, I=0, T=0, X=0	-	
2	1	D	B=0, I=0, T=0, X=0	Idle	
3	1	G	T=1, B=1, I=0, X=0	-	Yes
4	1	P	X=1, B=1, I=0, T=0	-	Yes
5	1	Z	B=0, I=0, T=0, X=0	Idle	
6	2	GD	T=1, B=1, I=0, X=0	G	
7	2	GG	T=1, B=1, I=0, X=0	G	
8	2	GP	B=0, I=0, T=0, X=0	Idle	
9	2	GZ	T=1, B=1, I=0, X=0	G	
10	2	PD	X=1, B=1, I=0, T=0	P	
11	2	PG	X=1, B=1, I=0, T=0	P	
12	2	PP	B=0, I=0, T=0, X=0	Idle	
13	2	PZ	B=1, X=2, T=0, I=0	-	Yes
14	3	PZD	I=1, X=2, B=1, T=0	-	Yes
15	3	PZG	X=2, I=0, B=1, T=0	PZ	
16	3	PZP	X=2, I=0, B=1, T=0	PZ	
17	3	PZZ	B=1, I=0, T=0, X=3	-	Yes
18	4	PZDD	I=0, X=2, B=1, T=0	PZ	
19	4	PZDG	I=1, X=2, B=1, T=0	PZD	
20	4	PZDP	I=1, X=2, B=1, T=0	PZD	
21	4	PZDZ	I=1, X=2, B=1, T=0	PZD	
22	4	PZZD	X=3, B=1, I=0, T=0	PZZ	
23	4	PZZG	X=3, B=1, I=0, T=0	PZZ	
24	4	PZZP	X=3, B=1, I=0, T=0	PZZ	
25	4	PZZZ	X=1, B=1, I=0, T=0	PZZ	

Canonical sequences are: G, P, PZ, PZD, PZZ

Problem 2.

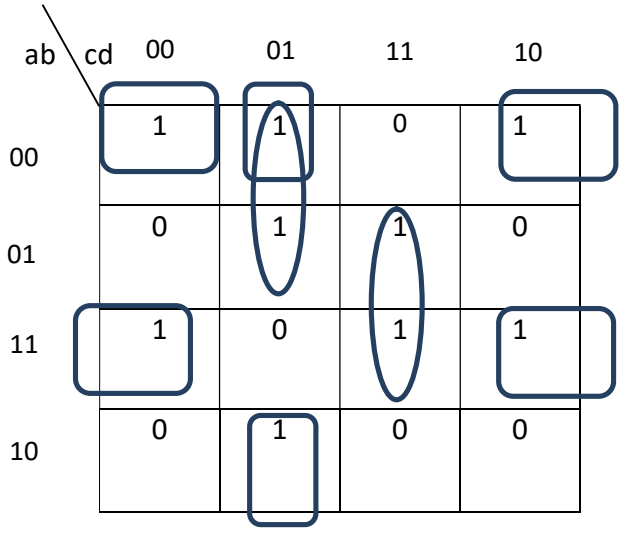
Answer in excels

Problem 3.

a. a'b'c' + abc + abc'd' + a'b'cd' + a'bc'd + a'bcd + ab'c'd

On converting 3 variable terms to 4 variable terms.

a'b'c'd+ a'b'c'd' + abcd+ abcd' + abc'd' + a'b'cd' + a'bc'd + a'bcd + ab'c'd

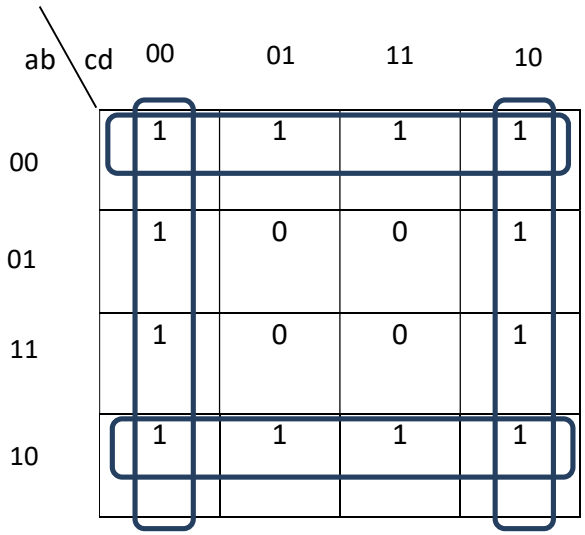


Solution: **a'b'd' + a'c'd + bcd + abd' + b'c'd**

b. a'b'c' + a'cd' + ac'd' + ab'c + a'b'cd + abcd' + ab'c'd + a'bc'd'

On converting 3 variable terms to 4 variable terms.

a'b'c'd'+ a'b'c'd + a'bcd'+ a'b'cd' + abc'd'+ ab'c'd' + ab'cd+ ab'cd' + a'b'cd + abcd' + ab'c'd + a'bc'd'

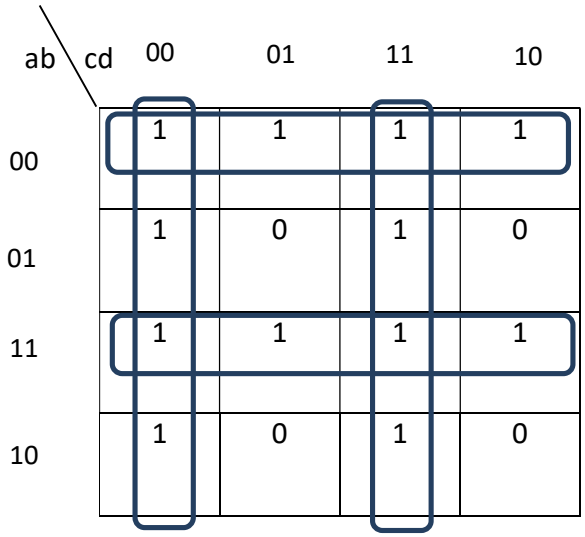


Solution: **b' + d'**

c. cd + a'b'c'd' + a'b'c'd + ab'cd + a'bcd+ a'b'cd' + ab'c'd' + a'bc'd' + ab

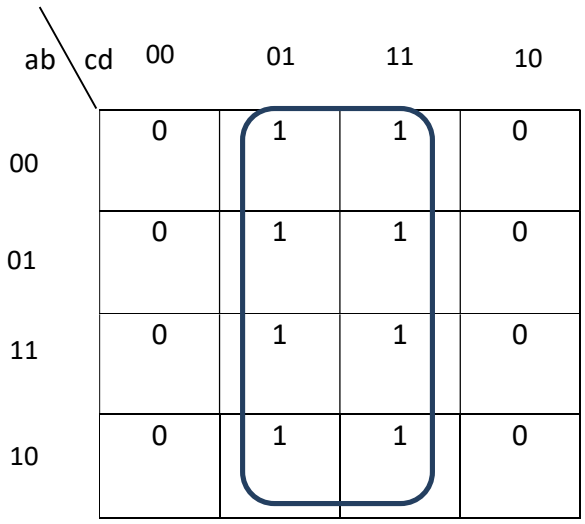
On converting 3 variable terms to 4 variable terms.

abcd + a'bcd + a'b'cd + abcd' + abc'd + abc'd'+ a'b'c'd'+ a'b'c'd+ ab'cd+ a'b'cd'+ ab'c'd'+ a'bc'd'



Solution: **c'd' + cd + ab + a'b'**

d. a'b'c'd + abcd + a'b'cd + abc'd + a'bc'd + ab'cd + a'bcd + ab'c'd



Solution: **d**

Problem 4.

a. a+b'c'

Truth table:

a	b	c	a+b'c'
F	F	F	T
F	F	T	F
F	T	F	F
F	T	T	F
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T

1)

- Condition Decision Coverage Pairs(c/d) = FTT, TFF
- Condition (only) Coverage Pairs(c) = FFF, TTT (considered FFF because other are in c/g)
- Decision (only) Coverage Pair(d) = FFF, FTF

2)

- Term Omission Faults (TOF's): a, b'c'
- Term Negation Faults (TNF's): a'+b'c', a+(b'c')'

b. a(c + d)

On converting given problem: ac + ad

Truth table:

a	c	d	ac + ad
F	F	F	F
F	F	T	F
F	T	F	F
F	T	T	F
T	F	F	F
T	F	T	T
T	T	F	T
T	T	T	T

1)

- Condition Decision Coverage Pairs(c/d) = FFT, TTF
- Condition (only) Coverage Pairs(c) = FTT, TFF
- Decision (only) Coverage Pair(d) = FFF, TFT

2)

- Term Omission Faults (TOF's): ac, ad
- Term Negation Faults (TNF's): ac+(ad)', (ac)'+ad

c. ab + c' + d

a	b	c	d	ab + c' + d
F	F	F	F	T
F	F	F	T	T
F	F	T	F	F
F	F	T	T	T
F	T	F	F	T
F	T	F	T	T
F	T	T	F	F
F	T	T	T	T
T	F	F	F	T
T	F	F	T	T
T	F	T	F	F
T	F	T	T	T
T	T	F	F	T
T	T	F	T	T
T	T	T	F	T
T	T	T	T	T

1)

- Condition Decision Coverage Pairs(c/d) = FTTF, TFFT
- Condition (only) Coverage Pairs(c) = FFFT, TTTF
- Decision (only) Coverage Pair(d) = FFFF, FFTF

2)

- Term Omission Faults (TOF's): c'+d, ab+d, ab+c'
- Term Negation Faults (TNF's): ab+c+d, ab+c'+d', (ab)'+c'+d

d. ab XOR (a + b)

= (ab)(a+b)' + (ab)' (a+b)
= (ab)(a'b') + (a'+b')(a+b)
= aa' + a'b + ab' + bb'
= a'b + ab'

a	b	a'b + ab'
F	F	F
F	T	T
T	F	T
T	T	F

1)

- Condition Decision Coverage Pairs(c/d) = No c/d coverage
- Condition (only) Coverage Pairs(c) = FT, TF
- Decision (only) Coverage Pair(d) = FF, FT

2)

- Term Omission Faults (TOF's): a'b, ab'
- Term Negation Faults (TNF's): (a'b)' + ab', a'b + (ab')'

Problem 5.

SOLUTION:

Question 1:

a. ab' + c

Condition of interest of a (COI's of a): XFF
Condition of interest of b (COI's of b): TXF
Condition of interest of c (COI's of c): FTX, FFX, TTX

Base set (BS) => TFF, FFF, TTF

Unique Cause Solution 1(UC 1): TFF, FFF, TTF, FFT
Unique Cause Solution 2(UC 2): TFF, FFF, TTF, TTT

b. a' + b + c

Condition of interest of a (COI's of a): XFF
Condition of interest of b (COI's of b): TXF
Condition of interest of c (COI's of c): TFX

Base set (BS): TFF, FFF, TTF,TFT

Unique Cause Solution 1(UC 1): TFF, FFF, TTF, FFT

c. a + bc + d'

Condition of interest of a (COI's of a): XFTT, XTFT, XFFT
Condition of interest of b (COI's of b): FXTT
Condition of interest of c (COI's of c): FTXT
Condition of interest of d (COI's of d): FFTX, FTFX, FFFX

Base set (BS): FTTT, FFTT, FTFT

Unique Cause Solution 1(UC 1): FTTT, FFTT, FTFT, TFTT, FFTF
Unique Cause Solution 2(UC 2): FTTT, FFTT, FTFT, TTFT,FTFF

Question 2:

a. abc XOR (ab'c')'

Solving given problem:

= (abc)(ab'c')+(abc)' (ab'c')'
= (abc)' (ab'c')'
= ((ab)'+c')((ab')'+c)
=(a'+b'+c')(a'+b+c)
=a'+b'c+bc'

Truth table for a'+b'c+bc':

a	b	c	a'+b'c+bc'
F	F	F	T
F	F	T	T
F	T	F	T
F	T	T	T
T	F	F	F
T	F	T	T
T	T	F	T
T	T	T	F

1)

- Condition Decision Coverage Pairs(c/d) = FTT, TFF
- Condition (only) Coverage Pairs(c) = FFT, TTF
- Decision (only) Coverage Pair(d) = FFF, TFF

2)

- Term Omission Faults (TOF's): a'+b'c, a'+bc', b'c+bc'
- Term Negation Faults (TNF's): a+b'c+bc', a'+(b'c)'+bc', a'+b'c+(bc')'

b. ((a+b)(b'+c))'

Solving given problem:
=(a+b)' + (b'+c)'
=a'b'+bc'

Truth Table:

a	b	c	a'b'+bc'
F	F	F	T
F	F	T	T
F	T	F	T
F	T	T	F
T	F	F	F
T	F	T	F
T	T	F	T
T	T	T	F

1)

- Condition Decision Coverage Pairs(c/d) = FTF, TFT
- Condition (only) Coverage Pairs(c) = FFT, TTF
- Decision (only) Coverage Pair(d) = FFF, FTT

2)

- Term Omission Faults (TOF's): bc', a'b'
- Term Negation Faults (TNF's): (a'b')'+bc', a'b'+(bc')'

c. (ab' + ac + c'd)'

Solving given problem:
= (ab')' + (ac)' + (c'd)'
= (a'+b)(a'+c')(c+d')
= (a'a'+a'c'+ba'+bc')(c+d')
= (a'+bc')(c+d')

=a'c+a'd'+bc'c+bc'd'
=a'c+a'd'+bc'd'

Truth Table:

a	b	c	d	a'c+a'd'+bc'd'
F	F	F	F	T
F	F	F	T	F
F	F	T	F	T
F	F	T	T	T
F	T	F	F	T
F	T	F	T	F
F	T	T	F	T
F	T	T	T	T
T	F	F	F	F
T	F	F	T	F
T	F	T	F	F
T	F	T	T	F
T	T	F	F	T
T	T	F	T	F
T	T	T	F	F
T	T	T	T	F

1)

- Condition Decision Coverage Pairs(c/d) = FFTF, TTFT
- Condition (only) Coverage Pairs(c) = FFFT, TTTF
- Decision (only) Coverage Pair(d) = FFFF, FFFT

2)

- Term Omission Faults (TOF's): a'd'+bc'd', a'c+bc'd', a'c+a'd'
- Term Negation Faults (TNF's): (a'c)'+a'd'+bc'd', a'c+(a'd')'+bc'd', a'c+a'd'+(bc'd')'

Question 3:

a. **(a'b'c' + a'b'd')'**
   Solving given problem:
   = (a'b'c')' (a'b'd')'

= ((a'b')'+c) ((a'b')'+d)
=(a+b+c)(a+b+d)
= a+b+cd

Condition of interest of a (COI's of a): XFFT, XFTF, XFFF
Condition of interest of b (COI's of b): FXFT, FXTF, FXFF
Condition of interest of c (COI's of c): FFXT
Condition of interest of d (COI's of d): FFTX

Base Set (BS) – FFFT, FFTT, FFTF
Unique Cause Solution 1(UC 1) - FFFT, FFTT, FFTF, TFFT, FTFT
Unique Cause Solution 2(UC 2) - FFFT, FFTT, FFTF, TFTF, FTFT
Unique Cause Solution 3(UC 3) - FFFT, FFTT, FFTF, TFFT, FTTF
Unique Cause Solution 4(UC 4) - FFFT, FFTT, FFTF, TFTF, FTTF

b. (a'c' + a'd' + a'b)'

Solving given problem:
= (a'c' +a'd')' (a'b)'
= (a'c')' (a'd')' (a'b)'
= (a+c)(a+d)(a+b')
= a+b'cd

Condition of interest of a (COI's of a): XFFF, XFFT, XFTF, XTFF, XFTT, XTTF, XTTT
Condition of interest of b (COI's of b): FXFF,FXFT,FXTF
Condition of interest of c (COI's of c): FTXF,FFXT,FTXT
Condition of interest of d (COI's of d): FFFX,FTFX,FTTX

Base Set (BS) – FTTT,FFTT,FFFT,FFTF
Unique Cause Solution 1(UC 1) - FTTT,FFTT,FFFT,FFTF,TFFT
Unique Cause Solution 2(UC 2) - FTTT,FFTT,FFFT,FFTF,TFTF
Unique Cause Solution 3(UC 3) - FTTT,FFTT,FFFT,FFTF,TTTT

c. (abd + acd)'

Solving given problem:
= (abd)' (acd)'
=(a'+b'+d')(a'+c'+d')
= a' + b'c' + d'

Condition of interest of a (COI's of a): XTTT,XTFT,XFTT
Condition of interest of b (COI's of b): TXFT
Condition of interest of c (COI's of c): TFXT
Condition of interest of d (COI's of d): TTTX,TTFX,TFTX

Base Set (BS) – TTFT,TFTT,TFFT

Unique Cause Solution 1 - TTFT,TFTT,TFFT,FTFT,TTFF
Unique Cause Solution 2 - TTFT,TFTT,TFFT,FTFT,TFTF
Unique Cause Solution 3 - TTFT,TFTT,TFFT,FFTT,TTFF
Unique Cause Solution 4 - TTFT,TFTT,TFFT,FFTT,TFTF

Bonus Point questions

Extra credits:

Problem b1)

a) ab' + c' + d'

Condition of interest of a (COI's of a): XFTT
Condition of interest of b (COI's of b): TXTT
Condition of interest of c (COI's of c): FFXT, FTXT, TTXT
Condition of interest of d (COI's of d): FFTX, FTTX, TTTX

Base Set (BS) – TFTT, FFTT, TTTT

Unique Cause Solution 1(UC 1) - TFTT, FFTT, TTTT, TTFT, TTTF

Unique Cause Solution 2(UC 2) - TFTT, FFTT, TTTT, FFFT, FFTF

Masking Solution 1 - TFTT, FFTT, TTTT, FTFT, FTTF

b) a + bc + d'

Condition of interest of a (COI's of a): XFFT, XFTT, XTFT
Condition of interest of b (COI's of b): FXTT
Condition of interest of c (COI's of c): FTXT
Condition of interest of d (COI's of d): FFFX, FFTX, FTFX

Base Set (BS) – FTTT, FFTT, FTFT

Unique Cause Solution 1(UC 1) - FTTT, FFTT, FTFT, TFTT, FFTF

Unique Cause Solution 2(UC 2) - FTTT, FFTT, FTFT, TTFT, FTFF

Masking Solution 1 - FTTT, FFTT, FTFT, TFFT, FFFT

Problem b2)

a. a = (b< 0) || c

From the above condition, Boundary values of b = -1,0.

	Inputs		Expected Outputs
Test Case	**b**	**c**	**a**
1	0	F	F
2	-1	T	T
3	-1	F	T

b. a = b && (c<5)

From the above condition, Boundary values of c = 4,5.

	Inputs		Expected Outputs
Test Case	**b**	**c**	**a**
1	T	5	F
2	F	4	F
3	T	4	T

c. a = (b >5) && (c<8)

From the above condition, Boundary values of b = 5,6.
From the above condition, Boundary values of c = 7,8.

	Inputs		Expected Outputs
Test Case	**b**	**c**	**a**
1	5	7	F
2	6	8	F
3	6	7	T

d. a = (b>5) && (b<10)

From the above condition, Boundary values of first b(b>5) = 5,6.

From the above condition, Boundary values of second b(b<10) = 9,10.

	Input	Expected Outputs
Test Case	**b**	**a**
1	5	F
2	6 or 9	T
3	10	F
4	9 or 6	T