5321 Software Testing Homework-2 Shaik Imtiyaz Aaresh

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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.**

1. 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

10

11

01

00

ab cd

10

11

01

00

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |

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

1. 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'

10

11

01

00

ab cd

10

11

01

00

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 |

Solution: **b' + d'**

1. 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'

10

11

01

00

ab cd

10

11

01

00

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 |

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

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

10

11

01

00

ab cd

10

11

01

00

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 |
| 0 | 1 | 1 | 0 |

Solution: **d**

**Problem 4.**

1. **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')'

1. **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

1. **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

1. **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:

1. **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

1. **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

1. **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:

1. **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')'

1. **((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')'

1. **(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:

1. **(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

1. **(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

1. **(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)

1. **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

1. **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)

1. **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 |

1. **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 |

1. **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 |

1. 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 |