CSE 5321
Homework 2
Fall 2019

Problem 1, 2 and 5 are 25 percent credit each. Problems 3-4 are 12.5 percent credit each. 100 percent total.

HW Discussion schedule - questions only answered according to the following schedule

Problems 1 and 2 - before 9/22
Problem 3 and 4 - before 9/27
Problem 5 - before 10/3

Problem 1.

Use Problem 6 from HW 1 to develop the following.

Submit the following for this problem:

1. The test case table - start with this first.
2. Sequence enumeration table
3. List the canonical states - in your pdf or word solution, not the table

Test Case Table

The format of the test case table is the following:

Test Case	Current	Inputs						Internal					Expected Outputs					Next
Number	State	N	V	E	C	U	L	D1	D2	D3	D4	D1D2D3D4=Code	B	R	Y	G	X	State
1	Start	-	-	-	-	-	-	null	null	null	null	-	F	F	F	F	T	S0

1. States are numbered S0 ... SN. The start event goes to state S0 as shown above.
2. For state S6, the unlock code test, you will need to figure out how to capture this based on the diagram. The inputs in the table above will help give you an idea.

Sequence enumeration table.

1. Use sequence enumeration to develop the canonical states. Show all sequences from length 0 to N. Note that I have pre-filled in the Length 0 response for you below.
2. Capture these in the attached table
3. For the "**Carry to next level**" column in the spreadsheet - use "Yes" or leave blank (for no).
4. Show all outputs for each - there will be no null responses
5. Mark each non-equivalence with a "-" enter in Excel as '-
6. Make a length 6a that is equivalent to State S6 in the test case table.

Length	Sequence	Response	Equivalence	Carry to next level
0	Idle	B=R=Y=G=F,D1=D2=D3=D4=null,X=T	-	

Solution:

Test Case Table:

TC No	Current State	Inputs						Internal					Expected Outputs					Next State
		N	V	E	C	U	L	D1	D2	D3	D4	D1D2D3D4 = CODE	B	R	Y	G	X	
TC1	Start	-	-	-	-	-	-	null	null	null	Null	null	F	F	F	F	T	S0
TC2	S0	V	V	-	-	-	-	V	null	null	Null	-	T	F	F	F	T	S1
TC3	S0	-	-	V	-	-	-	null	null	null	Null	-	F	F	F	F	T	S0
TC4	S0	-	-	-	V	-	-	null	null	null	Null	-	F	F	F	F	T	S0
TC5	S0	-	-	-	-	V	-	null	null	null	Null	-	F	F	F	F	T	S0
TC6	S0	-	-	-	-	-	V	null	null	null	Null	-	F	F	F	F	T	S0
TC7	S1	V	V	-	-	-	-	V	V	null	Null	-	F	T	F	F	T	S2
TC8	S1	-	-	V	-	-	-	V	null	null	Null	-	T	F	F	F	T	S1
TC9	S1	-	-	-	V	-	-	null	null	null	Null	-	F	F	F	F	T	S0
TC10	S1	-	-	-	-	V	-	V	null	null	Null	-	T	F	F	F	T	S1
TC11	S1	-	-	-	-	-	V	V	null	null	Null	-	T	F	F	F	T	S1
TC12	S2	V	V	-	-	-	-	V	V	V	Null	-	F	F	T	F	T	S3
TC13	S2	-	-	V	-	-	-	V	V	null	Null	-	F	T	F	F	T	S2
TC14	S2	-	-	-	V	-	-	V	null	null	Null	-	T	F	F	F	T	S1
TC15	S2	-	-	-	-	V	-	V	V	null	Null	-	F	T	F	F	T	S2
TC16	S2	-	-	-	-	-	V	V	V	null	Null	-	F	T	F	F	T	S2
TC17	S3	V	V	-	-	-	-	V	V	V	V	-	F	F	F	T	T	S4
TC18	S3	-	-	V	-	-	-	V	V	V	Null	-	F	F	T	F	T	S3
TC19	S3	-	-	-	V	-	-	V	V	null	Null	-	F	T	F	F	T	S2
TC20	S3	-	-	-	-	V	-	V	V	V	Null	-	F	F	T	F	T	S3
TC21	S3	-	-	-	-	-	V	V	V	V	Null	-	F	F	T	F	T	S3
TC22	S4	V	V	-	-	-	-	V	V	V	V	-	F	F	F	T	T	S4
TC23	S4	-	-	V	-	-	-	V	V	V	V	-	F	F	F	F	T	S5
TC24	S4	-	-	-	V	-	-	V	V	V	Null	-	F	F	T	F	T	S3
TC25	S4	-	-	-	-	V	-	V	V	V	V	-	F	F	F	T	T	S4
TC26	S4	-	-	-	-	-	V	V	V	V	V	-	F	F	F	T	T	S4
TC27	S5	V	V	-	-	-	-	V	V	V	V	-	F	F	F	T	T	S5
TC28	S5	-	-	V	-	-	-	V	V	V	V	-	F	F	F	T	T	S5
TC29	S5	-	-	-	V	-	-	V	V	V	V	-	F	F	F	T	T	S5

TC30	S5	-	-	-	-	V	-	null	null	null	Null	-	F	F	F	F	T	S6
TC31	S5	-	-	-	-	-	V	V	V	V	V	-	F	F	F	T	T	S5
TC32	S6	-	-	-	-	V	-	null	null	null	Null	F	F	F	F	F	T	S0
TC33	S6	-	-	-	-	-	V	null	null	null	Null	T	T	T	T	T	F	S7
TC34	S7	V	V	-	-	-	-	null	null	null	Null	-	T	T	T	T	F	S7
TC35	S7	-	-	V	-	-	-	null	null	null	Null	-	T	T	T	T	F	S7
TC36	S7	-	-	-	V	-	-	null	null	null	Null	-	T	T	T	T	F	S7
TC37	S7	-	-	-	-	V	-	null	null	null	Null	-	T	T	T	T	F	S7
TC38	S7	-	-	-	-	-	V	null	null	null	Null	-	F	F	F	F	T	S0

Sequence Enumeration:

Length	Sequence	Response	Equivalence	Carry to Next Level
0	Idle	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	-	Yes
1	**N**	**B = T, R = F, Y = F, G = F, D1 = V, D2D3D4 = null, X = T**	**-**	**Yes**
	E	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	Idle	No
	C	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	Idle	No
	U	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	Idle	No
	L	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	Idle	No
2	**NN**	**B = F, R = T, Y = F, G = F, D1D2=V, D3D4 = null, X = T**	**-**	**Yes**
	NE	B = T, R = F, Y = F, G = F, D1 = V, D2D3D4 = null, X = T	N	No
	NC	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	Idle	Yes
	NU	B = T, R = F, Y = F, G = F, D1 = V, D2D3D4 = null, X = T	N	No
	NL	B = T, R = F, Y = F, G = F, D1 = V, D2 D3D4 = null, X = T	N	No
3	**NNN**	**B = F, R = F, Y = T, G = F, D1D2D3 = V, D4 = null, X = T**	**-**	**Yes**
	NNE	B = F, R = T, Y = F, G = F, D1D2 = V, D3D4 = null, X =T	NN	No
	NNC	B = T, R = F, Y = F, G = F, D1 = V, D2D3D4 = null, X =T	N	No
	NNU	B = F, R = T, Y = F, G = F, D1D2 = V, D3D4 = null, X =T	NN	No
	NNL	B = F, R = T, Y = F, G = F, D1D2 = V, D3D4 = null, X =T	NN	No
4	**NNNN**	**B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T**	**-**	**Yes**
	NNNE	B = F, R = F, Y = T, G = F, D1D2D3 = V, D4 = null, X = T	NNN	No
	NNNC	B = F, R = T, Y = F, G = F, D1D2 = V, D3D4 = null, X = T	NN	No
	NNNU	B = F, R = F, Y = T, G = F, D1D2D3 = V, D4 = null, X = T	NNN	No
	NNNL	B = F, R = F, Y = T, G = F, D1D2D3 = V, D4 = null, X = T	NNN	No
5	NNNNN	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNN	No
	NNNNE	**B = F, R = F, Y = F, G = F, D1D2D3D4 = V, X = T**	**-**	**Yes**
	NNNNC	B = F, R = F, Y = T, G = F, D1D2D3= V, D4 = null, X = T	NNN	No
	NNNNU	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNN	No
	NNNNL	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNN	No

6	NNNNEN	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNNE	No
	NNNNEE	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNNE	No
	NNNNEC	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNNE	No
	NNNNEU	**B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T**	**-**	**Yes**
	NNNNEL	B = F, R = F, Y = F, G = T, D1D2D3D4 = V, X = T	NNNNE	No
6a	NNNNEU	B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T	Idle	No
	NNNNEU	**B = T, R = T, Y = T, G = T, D1D2D3D4 = null, X = F**	**-**	**Yes**
7	NNNNEUN	B = T, R = T, Y = T, G = T, D1D2D3D4 = null, X = F	NNNNEU	No
	NNNNEUE	B = T, R = T, Y = T, G = T, D1D2D3D4 = null, X = F	NNNNEU	No
	NNNNEUC	B = T, R = T, Y = T, G = T, D1D2D3D4 = null, X = F	NNNNEU	No
	NNNNEUU	B = T, R = T, Y = T, G = T, D1D2D3D4 = null, X = F	NNNNEU	No
	NNNNEUL	**B = F, R = F, Y = F, G = F, D1D2D3D4 = null, X = T**	**Idle**	**No**

Canonical States are

N
NN
NNN
NNNN
NNNNE
NNNNEU

Problem 2.

You have 5 input parameters to a method that is used to compute the cost of a drink ordered in store as specified by the following table. The inputs are **Number of drinks**, **discount type**, **drink type**, **size**, and **payment type**.

Discount Type	**Drink Type**	**Size**	**Payment Type**
None	Coffee	Small	Cash
Student	Tea	Regular	CreditCard
Teacher	Soda	Large	DebitCard
Military	Slushy	Grande	
Frequent	Cappuccino		
Coupon			
Employee			

Size	**Cost multiplier**
Small	1.0

Regular	1.15
Large	1.35
Grande	1.85

DrinkType	**Base Cost**
Coffee	$1.59
Tea	$0.99
Soda	$1.29
Slushy	$1.19
Cappuccino	$2.59

Payment Type	**Surcharge**
Cash	-3%
CreditCard	3%
DebitCard	0%

Discount Type	**Discount Amount**
None	0%
Student	10%
Teacher	5%
Military	15%
Frequent	20%
Coupon	10%
Employee	25%

The unit test plan calls for the following values of **Number of Drinks** to be used.

Number of Drinks
1
4
7
12
17
20
31
50

The method takes these four input parameters and returns the value of the following equation:

(number_of_drinks * (1-DiscountType) * DrinkType * Size * (1+PaymentType))*1.0825

To simplify this problem, carry out the previous equation in Excel **without truncation**. The result is significant to the Cent.

Develop the test to fully test all pair-wise combinations of these four specified parameters. **Please use Excel to develop your expected outputs and supply your Excel test case tables with the homework submission. The function VLOOKUP in Excel could be helpful, but there are many simply ways to solve this problem.**

Your test case table is as follows.

Test Case Number	Inputs					Exp Out
	Number of Drinks	Discount Type	Drink Type	Size	Payment Type	Return

Instructions

1. Download the allpairs tool from the following site http://www.satisfice.com/tools/pairs.zip and follow the instructions.
2. Use the following order of variables to define the inputs to the allpairs tool: **Number of drinks**, **discount type**, **drink type**, **size**, and **payment type**
3. Use the previous table (test case table) to develop the test cases needed to test all pairs.
4. Supply item 2 as a single test case table in Excel. You do NOT need to show the output of the allpairs tool - just the test cases it generates and in the order it provides.

PLEASE MAKE SURE TO SAVE A COPY OF THE TEST CASE TABLE ABOVE AS A TAB DELIMITED TXT FILE. In Excel -> Save As... -> tab delimited txt file. This will allow the GTAs to use WinMerge to compare your test case table with the output. 50% deduction if not supplied.

Also, please make sure to show the enumeration values {cash, credit, debit} and not their actual values {-0.3%,0.3%,0.0%}

Test Case Number	Inputs					Expected Output
	Number of Drinks	Discount Type	Drink Type	Size	Payment Type	Return
1	1	None	Coffee	Small	Cash	1.66953975
2	1	Student	Tea	Regular	Credit Card	1.142459134
3	1	Teacher	Soda	Large	Debit Card	1.790915063

4	4	None	Tea	Large	Cash	5.61343365
5	4	Student	Coffee	Grande	Debit Card	11.4630255
6	4	Teacher	Slushy	Small	Credit Card	5.04191695
7	7	None	Soda	Regular	Credit Card	11.57845789
8	7	Student	Slushy	Large	Cash	10.62725052
9	7	Teacher	Coffee	Regular	Cash	12.76780524
10	7	Military	Tea	Small	Debit Card	6.37646625
11	12	None	Slushy	Grande	Debit Card	28.597485
12	12	Military	Coffee	Large	Credit Card	24.41159714
13	12	Frequent	Soda	Small	Cash	13.0035096
14	17	Military	Cappuccino	Regular	Cash	45.19236723
15	17	Frequent	Tea	Grande	Credit Card	27.77224329
16	17	Coupon	Soda	Grande	Cash	38.34003534
17	17	Employee	Slushy	Regular	Debit Card	18.88786594
18	20	Frequent	Cappuccino	Large	Debit Card	60.55938
19	20	Coupon	Cappuccino	Small	Credit Card	51.9801345
20	20	Employee	Coffee	Grande	Cash	46.32972806
21	31	Coupon	Coffee	Regular	Debit Card	55.22389988
22	31	Employee	Cappuccino	Small	Credit Card	67.14100706
23	31	Student	Soda	Small	Cash	37.79144978
24	50	Teacher	Cappuccino	Grande	Cash	238.9817524
25	50	Military	Soda	Large	Credit Card	82.52348091
26	50	Frequent	Coffee	Regular	Debit Card	79.17405
27	1	Military	Slushy	Grande	Credit Card	2.086424843
28	4	Coupon	Tea	Regular	Cash	4.303632465
29	7	Coupon	Slushy	Large	Credit Card	11.28460623
30	7	Employee	Tea	Grande	Debit Card	10.40864344
31	12	Employee	Soda	Regular	Credit Card	14.88658871
32	17	None	Coffee	Small	Credit Card	30.13777425
33	20	None	Soda	Regular	Debit Card	32.117775
34	31	Teacher	Tea	Large	Debit Card	42.60711881
35	31	Frequent	Slushy	Grande	Cash	57.32842493
36	50	Student	Cappuccino	Small	Debit Card	126.165375
37	1	Employee	Cappuccino	Large	Cash	2.753559309
38	4	Military	Soda	Grande	Debit Card	8.78351325
39	4	Frequent	Cappuccino	Regular	Credit Card	10.62704972
40	12	Student	Tea	Small	Cash	11.2268673
41	12	Teacher	Cappuccino	Grande	Credit Card	60.90339092
42	17	Student	Coffee	Large	Credit Card	36.61739571
43	20	Military	Slushy	Small	Cash	21.24200575
44	20	None	Tea	Large	Credit Card	29.80328175

45	50	None	Slushy	Regular	Cash	71.84796063
46	50	Coupon	Tea	Small	Debit Card	48.225375
47	7	None	Cappuccino	Grande	Debit Card	36.30759125
48	1	Frequent	Slushy	Small	Debit Card	1.03054
49	12	Coupon	Coffee	Large	Debit Card	25.0947315
50	17	Teacher	Tea	Small	Debit Card	17.30755125
51	31	Military	Coffee	Regular	Credit Card	53.7205826
52	50	Employee	Coffee	Large	Credit Card	89.74851891
53	1	Coupon	Soda	Grande	Credit Card	2.394799054
54	4	Employee	Soda	Small	Cash	4.06359675
55	7	Frequent	Coffee	Small	Cash	9.3494226
56	20	Student	Soda	Regular	Debit Card	28.9059975
57	20	Teacher	Slushy	Regular	Credit Card	28.99102246
58	31	None	Cappuccino	Large	Cash	113.8137848

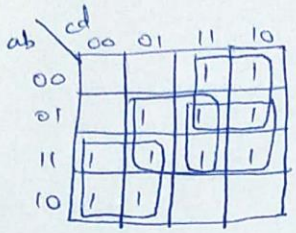
Problem 3.

Minimize the following expressions using a K-map. Show all work including the K-map.

a. a'b'c + bc + bd + ac'
b. a'b'c'd' + a'b'cd + a'b +ac'd' + acd
c. a'b'c' + a'bd + a'bc' + abd + acd' + acd' + ab'cd
d. a'b'c' + a'b'd + c'd' + ac' + c'd + ab'cd
e. a'c' + abd + a'c + ac

5.

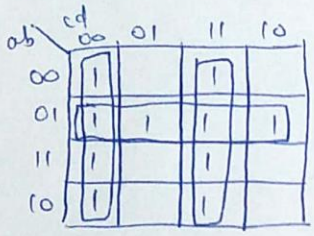
a. $a'b'c + bc + bd + ac'$



$ac' + a'c + bc + bd$ → Ans

~~$= bc + bd$~~

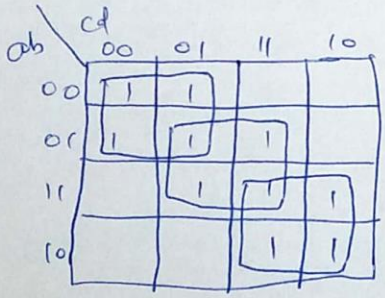
b. $a'b'c'd' + a'b'cd + a'b + ac'd' + acd$



$cd + a'b + c'd'$ → Ans

~~$= a'b$~~

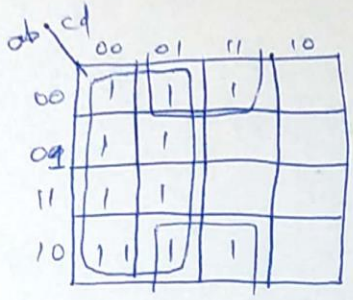
c. $a'b'c' + a'bd + a'bc' + acd' + ab'cd + abd$



$a'c' + bd + ac$ → Ans

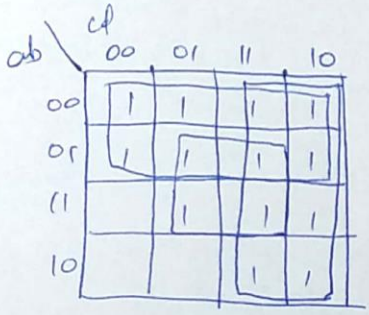
~~$= bd$~~

d. $a'b'c' + a'b'd + c'd' + ac' + c'd + ab'cd$



$= c' + b'd$

e. $a'c' + abd + a'c + ac$



$= a' + c + bd$

Problem 4

For each of the following expressions develop the terms below. Make sure to reduce each to the minimum logical expression before solving. Reduce all answers also.

a. a'b' + c'
b. a'(b' + c)
c. abc + c'd' + a'b'
d. (a'b'c' XOR (a'b)') + abcd

1. The condition coverage, decision coverage, condition/decision coverage terms (one pair per coverage). Write solutions in terms of n-tuples - (FFF, FFT) as appropriate. Clearly indicate your answers for each. **FOR DECISION COVERAGE USE THE FIRST TERM AS FFF or FFFF**
2. The TOFs (Term Omission Faults) and TNFs (Term Negation Faults) for each. Separate each possible answer by a comma.

4. a. $a'b' + c'$

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

c: T, T, F, T — dd: T, F — cld: T, F

cld = {FFF, TTT}

c = {FFT, TTF}

d = {FTT, TTF}

TNF → $(a'b')' + c'$ → $\boxed{a+b+c'}$

$(a'b') + (c')'$ → $\boxed{a'b'+c}$

TOF → c', $a'b'$

b. $a'(b'+c)$ → $a'b' + a'c$

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

c: F, T, F, F — dd: T, F — cld: T, F

cld = {FFF, TTT}

c = {FTF, TFT}

d = {FTF, FTT}

TNF → $(a'b')' + a'c$ → $\boxed{a+b+a'c}$

$a'b' + (a'c)'$ → $\boxed{a'b'+a+c'}$

TOF → $a'c$, $a'b'$

c. $abc + c'd' + a'b'$

a	b	c	d	$abc+c'd'+a'b'$
F	F	F	F	T
F	F	F	T	T
F	F	T	F	T
F	F	T	T	T
F	T	F	F	T
F	T	F	T	F
F	T	T	F	F
F	T	T	T	F
T	F	F	F	T
T	F	F	T	F
T	F	T	F	F
T	F	T	T	T
T	T	F	F	F
T	T	F	T	T
T	T	T	F	F
T	T	T	T	T

c | d

$c/d = \{FFTF, TTFT\}$

$c = \{FFFF, TTTT\}$

$d = \{FTFT, TFFF\}$

TNF → $(abc)' + c'd' + a'b'$

$\boxed{a'+b'+c'+c'd'+a'b'}$

→ $abc + (c'd')' + a'b'$

→ $\boxed{abc + c + d + a'b'}$

→ $abc + c'd' + (a'b')'$

$\boxed{abc + c'd' + a + b}$

TOF → $c'd' + a'b'$, $abc + a'b'$, $abc + c'd'$

d. $(a'b'c'$ XOR $(a'b)')$ + abcd

$[(a'b'c')'(a'b)' + (a'b'c')(a'b)']$ + abcd

$[(a+b+c)(a'b)' + 0]$ + abcd

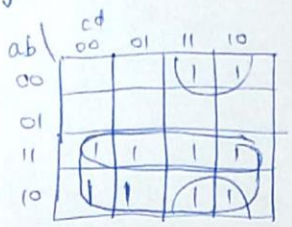
$[(a+b+c)(a+b')]$ + abcd

$[a + ab' + ab + ac + cb']$ + abcd

$a + a(b'+b) + ac + b'c$ + abcd

$a + ab + ac + b'c$ + abcd

Reducing using K-Map



→ $a+b'c$

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

c

cd

cd = {FFF, TTT}

c = {FFT, TTF}

d = {FFF, FFT}

TNF → $\boxed{a' + b'c}$

$a + (b'c)' \rightarrow \boxed{a+b+c'}$

TOF → $b'c$, a

Problem 5

1) Use MC/DC logic and BV testing to determine the minimum test cases for each of the following requirements expressions. For each part, develop a test case table showing test case number, inputs, and expected outputs using the table as shown below.

a. a = (b < 10) || c
b. a = b || (c>=5)
c. a = (b <=5) & (c>=8)
d. a = (b>5) & (b<=15)

Express inputs in terms of numbers (for conditions with logical operators) and Booleans (for logical conditions) - e.g. the inputs are b (int) and/or c (int) when integer expressions are used, otherwise the inputs are Boolean.

	Inputs		**Expected Outputs**
Test Case	**b**	**C**	**a**
1			
2			
3			

b

1.

a. $a = (b < 10) \,||\, c$

$x = b < 10$

$y = c$

$(x + y)$

(b<10) x	(c) y	(a) = x+y
F	T	T
F	F	F
T	F	T

(b<10)
T 9
F 10

Test case	Inputs		Expected outputs
	b	c	a
1	10	T	T
2	10	F	F
3	9	F	T

b. $a = b \,||\, (c >= 5)$

$x = b$

$y = c >= 5$

$(x + y) = a$

(b) x	(c>=5) y	(a) x+y
F	T	T
F	F	F
T	F	T

(c>=5)
T 5
F 4

Test case	Inputs		Expected outputs
	b	c	a
1	F	5	T
2	F	4	F
3	T	4	T

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

$(x = (b <= 5))$

$y = (c >= 8)$

$(b<=5)$	x	y
T	5	8
F	6	7

x	y	x & y
F	T	F
T	T	T
T	F	F

Test case	Inputs		Expected outputs
	b	c	a
1	6	8	F
2	5	8	T
3	5	7	F

d. $a = (b > 5)\ \&\ (b <= 15)$

$x = (b > 5)$

$y = (b <= 15)$

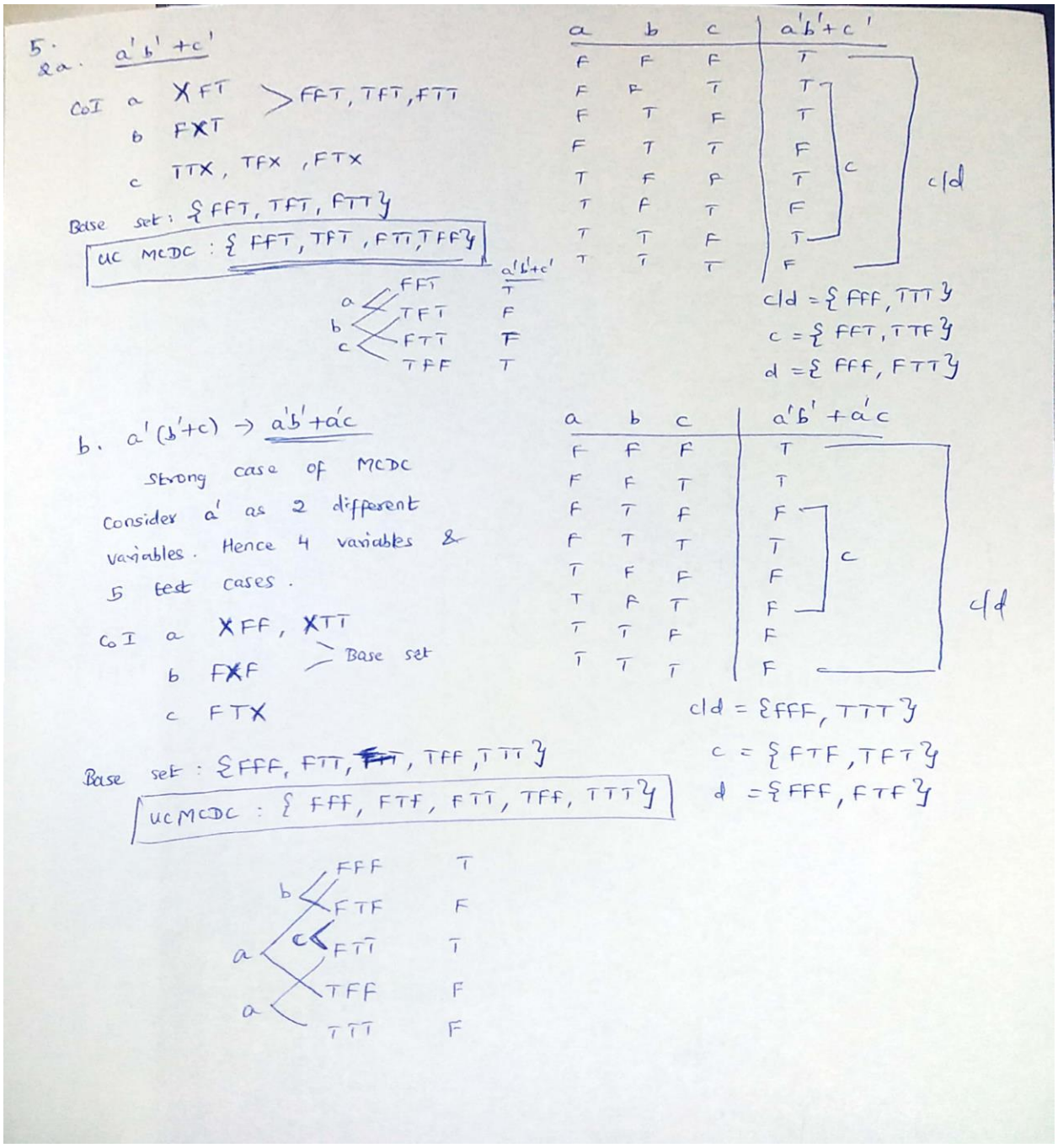
$(b>5)$	x	y
T	6	15
F	5	16

x	y	x & y
F	T	F
T	T	T
T	F	F

Test case	Inputs		Expected outputs
	b	c	a
1	5	15	F
2	6	15	T
3	6	16	F

2) Provide the UC MCDC solution for each expression (only 1 solution is needed for each).

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



c. $a + b' + cd'$

CoI a XTTT, (XTFT), XTTF

b FXTT, (FXTF), FXFT

c FTXF

d FTFX

> Base set

Base set : {FTFF, FTTF, FTFT}

$a+b'+c'd'$

c < FTFF T

FTTF } d F

b < FTFT } a F

TTFT T

FFTF T

a	b	c	d	$a+b'+c'd'$	
F	F	F	F	T	
F	F	F	T	T	
F	F	T	F	T	
F	F	T	T	T	
F	T	F	F	T	
F	T	F	T	F	
F	T	T	F	F	
F	T	T	T	F	
T	F	F	F	T	C
T	F	F	T	T	cd
T	F	T	F	T	
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	

uc MCDC : {FTFF, FTTF, FTFT, TTFT, FFTF}

cd : {FTFT, TFTF}

c : {FFFF, TTTT}

d : {FTFT, TFFF}

d. $(a'b'c'$ XOR $(a'b)')$ + abcd

$(a'b'c')'(a'b)' + a'b'c'((a'b)')' + abcd$

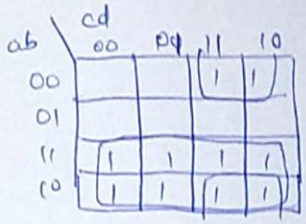
$(a+b+c)(a'b)' + a'b'c'(\cancel{a+b'})(a'b) + abcd$

$(a+b+c)(a+b') + 0 + abcd$

$a + ab' + ab + ac + b'c + abcd$

$a + ac + b'c + abcd$

Reducing this using K-Maps



→ $a+b'c$

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

c | d

$c|d = \{FFF, TTT\}$

$c = \{FFT, TTF\}$

$d = \{FFF, FFT\}$

a+b'c

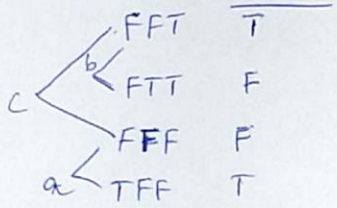
CoI a [XFF], XTF, XTT

b FXT

c FFX

> FFT, FTT, FFF

Base set : {FFT, FTT, FFF}



Uc MCDC : {FFT, FTT, FFF, TFF}

3) Develop the MC/DC solutions for the following expression - 2 UC solutions and 1 Masking solution (that is not a UC solution). Show which are Masking and which are Unique Cause.

a' + b'c + d