FNU Gauravdeep Singh
Student ID: 1001827248
CSE 5321-001 Homework 02
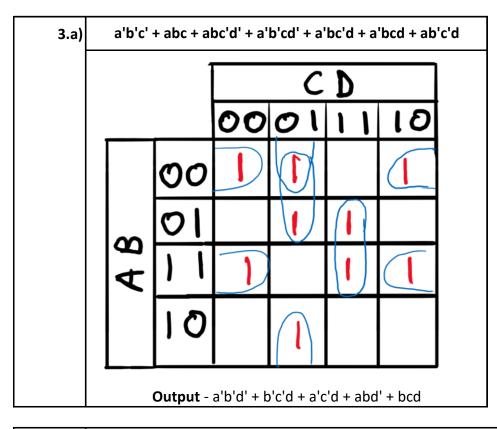
1.1

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

1.2	Length	Sequence	Response	Equivalence	Carry to next level
	0	Idle	B = 0, I = 0, T = 0, X = 0	idle	
	1	D	B = 0, I = 0, T = 0, X = 0	idle	
		G	B = 1, I = 0, T = 1, X = 0	-	Yes
		P	B = 1, I = 0, T = 0, X = 1	-	Yes
		Z	B = 0, I = 0, T = 0, X = 0	idle	
	2	PD	B = 1, I = 0, T = 0, X = 1	P	
		PG	B = 1, I = 0, T = 0, X = 1	P	
		PP	B = 0, I = 0, T = 0, X = 0	idle	
		PZ	B = 1, I = 0, T = 0, X = 2	-	Yes
		GD	B = 1, I = 0, T = 1, X = 0	G	
		GG	B = 1, I = 0, T = 1, X = 0	G	
		GP	B = 0, I = 0, T = 0, X = 0	idle	
		GZ	B = 1, I = 0, T = 1, X = 0	G	
	3	PZD	B = 1, I = 1, T = 0, X = 2	-	Yes
		PZG	B = 1, I = 0, T = 0, X = 2	PZ	
		PZP	B = 1, I = 0, T = 0, X = 2	PZ	
		PZZ	B = 1, I = 0, T = 0, X = 3	-	Yes
	4	PZDD	B = 1, I = 0, T = 0, X = 2	PZ	
		PZDG	B = 1, I = 1, T = 0, X = 2	PZD	
		PZDP	B = 1, I = 1, T = 0, X = 2	PZD	
		PZDZ	B = 1, I = 1, T = 0, X = 2	PZD	
		PZZD	B = 1, I = 0, T = 0, X = 3	PZZ	
		PZZG	B = 1, I = 0, T = 0, X = 3	PZZ	
		PZZP	B = 1, I = 0, T = 0, X = 3	PZZ	
		PZZZ	B = 1, I = 0, T = 0, X = 1	P	

Canonical sequence: **G, P, PZ, PZD, PZZ**

| Test Case | Inputs | | | Exp. Outputs |
No	Time Of Day	Call Length	Call Type	Cost
1	12:00:00 AM	1	International	**$0.24**
2	12:00:00 AM	5	Domestic	**$0.40**
3	12:00:00 AM	10	Conference	**$4.00**
4	7:59:59 AM	1	Domestic	**$0.08**
5	7:59:59 AM	5	International	**$1.20**
6	7:59:59 AM	10	International	**$2.40**
7	7:59:59 AM	15	Conference	**$6.00**
8	8:00:00 AM	1	Conference	**$1.25**
9	8:00:00 AM	5	International	**$3.75**
10	8:00:00 AM	10	Domestic	**$2.50**
11	7:00:00 PM	5	Conference	**$6.25**
12	7:00:00 PM	15	International	**$11.25**
13	7:00:00 PM	61	Domestic	**$15.25**
14	7:00:01 PM	15	Domestic	**$2.25**
15	7:00:01 PM	61	International	**$27.45**
16	7:00:01 PM	1	Conference	**$0.75**
17	9:59:59 PM	61	Conference	**$45.75**
18	9:59:59 PM	1	International	**$0.45**
19	9:59:59 PM	5	Domestic	**$0.75**
20	10:00:00 PM	1	Domestic	**$0.10**
21	10:00:00 PM	5	Conference	**$2.50**
22	10:00:00 PM	10	International	**$3.00**
23	11:59:59 PM	10	Domestic	**$1.00**
24	11:59:59 PM	15	International	**$4.50**
25	11:59:59 PM	61	Conference	**$30.50**
26	12:00:00 AM	15	Domestic	**$1.20**
27	12:00:00 AM	61	International	**$14.64**
28	7:59:59 AM	61	Domestic	**$4.88**
29	8:00:00 AM	15	Conference	**$18.75**
30	8:00:00 AM	61	International	**$45.75**
31	7:00:00 PM	10	Conference	**$7.50**
32	7:00:00 PM	1	International	**$0.45**
33	7:00:01 PM	5	International	**$3.75**
34	7:00:01 PM	10	Domestic	**$1.50**
35	9:59:59 PM	10	International	**$4.50**
36	9:59:59 PM	15	Domestic	**$2.25**
37	10:00:00 PM	15	International	**$4.50**
38	10:00:00 PM	61	Domestic	**$6.10**
39	11:59:59 PM	1	Domestic	**$0.10**
40	11:59:59 PM	5	Conference	**$2.50**

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

	CD			
AB	00	01	11	10
00	1	1		1
01		1	1	
11	1		1	1
10		1		

Output - a'b'd' + b'c'd + a'c'd + abd' + bcd

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

	CD			
AB	00	01	11	10
00	1	1	1	1
01	1			1
11	1			1
10	1	1	1	1

Output - c'd + a'b' + ab' + cd' = b' + d'

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

	CD			
	00	01	11	10
AB 00	1	1	1	1
AB 01	1		1	
AB 11	1	1	1	1
AB 10	1		1	

Output - a'b' + ab + c'd' + cd

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

	CD			
	00	01	11	10
AB 00		1	1	
AB 01		1	1	
AB 11		1	1	
AB 10		1	1	

Output - d

4.a)	Condition			Decision
	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
C/D	(FFT, TTF)			
C	(FFF, TTT)			
D	(FFF, FFT)			
TOF	a, b'c			
TNF	(a)'+b'c' = a'+b'c' , a+(b'c')' = a+b+c			

4.b)	Condition			Decision
	a	c	d	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
C/D	(FFF, TTT)			
C	(FTT, TFF)			
D	(FFF, TFT)			
TOF	ac, dc			
TNF	(ac)'+ad = a'+c'+ad , ac+(ad)'= ac+a'+d'			

4.c)	Condition				Decision
	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**
C/D	(FFTF, TTFT)				
C	(FFFF, TTTT)				
D	(FFFF, FFTF)				
TOF	c'+d, ab+d, ab+c'				
TNF	(ab)'+c'+d = a'+b'+c'+d , ab+(c')'+d = ab+c+d , ab+c'+(d)' = ab+c'+d'				

4.d)	Condition		Decision
	a	b	ab XOR (a + b)
			ab' + a'b
	F	F	**F**
	F	T	**T**
	T	F	**T**
	T	T	**F**
C/D	-		
C	(FF, TT)		
D	(FF, FT)		
TOF	a'b, ab'		
TNF	(ab')'+a'b = a'+b , ab'+(a'b)' = a+b'		

5.1.a)	ab' + c	
COI a:	XFF	
COI b:	TXF	
COI c:	FFX, FTX, TTX	
base set:	FFF, TFF, TTF	
UC:	FFF, TFF, TTF, FFT	

5.1.b)	a' + b + c	
COI a:	XFF	
COI b:	TXF	
COI c:	TFX	
base set:	TFF	
UC:	TFF, FFF, TTF, TFT	

5.1.c)	a + bc + d'	
COI a:	XFFT, XFTT, XTFT	
COI b:	FXTT	
COI c:	FTXT	
COI d:	FFFX, FFTX, FTFX	
base set:	FTTT, FFTT, FTFT	
UC:	FTTT, FFTT, FTFT, TFTT, FFTF	

5.2.a)	abc XOR (ab'c')' = a' + b'c + bc'			
	Condition			**Decision**
	a	**b**	**c**	**abc XOR (ab'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**
C/D	(FFF, TTT)			
C	(FFT, TTF)			
D	(FFF, TFF)			
TOF	b'c+bc', a'+bc, a+b'c			
TNF	(a')'+b'c+bc' = a+b'c+bc' a'+(b'c)'+bc' = a'+b+c' a'+b'c+(bc')' = a'+b'+c			

5.2.b)	((a+b)(b'+c))' = a'b' + a'c' + bc'		
	Condition		Decision
			((a+b)(b'+c))'
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
C/D	(FFF, TTT)		
C	(FFT, TTF)		
D	(FFF, FTT)		
TOF	a'b', bc'		
TNF	(a'b')'+bc' = a+b a'b'+(bc')' = b'+c		

5.2.c)	(ab' + ac + c'd)' = a'c + a'd' +bc'd'			
	Condition			Decision
				(ab' + ac + c'd)'
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
C/D	(FFFF, TTTT)			
C	(FFFT, TTTF)			
D	(FFFF, FFFT)			
TOF	a'd'+bc'd', a'c+bc'd', a'c+a'd'			
TNF	(a'c)'+a'd'+bc'd' = a+c'+a'd' a'c+(a'd')'+bc'd' = a'c+a+d+bc'd' a'c+a'd'+(bc'd')' = a'd'+ b'+c+d			

5.3.a)	(a'b'c' + a'b'd')' = a + b + cd	
	COI a:	XFFF, XFFT, XFTF
	COI b:	FXFF, FXFT, FXTF
	COI c:	FFXT
	COI d:	FFTX
	base set:	FFFT, FFTT, FFTF
	UC1:	FFFT, FFTT, FFTF, TFFT, FTFT
	UC2:	FFFT, FFTT, FFTF, TFFT, FTTF
	UC3:	FFFT, FFTT, FFTF, TFTF, FTFT
	UC4:	FFFT, FFTT, FFTF, TFTF, FTTF

5.3.b)	(a'c' + a'd' + a'b)' = a + b'cd	
	COI a:	XFFF, XFFT, XFTF, XTFT, XTTF, XTTT, XTFF
	COI b:	FXTT
	COI c:	FFXT
	COI d:	FFTX
	base set:	FFTT, FTTT, FFFT, FFTF
	UC1:	FFTT, FTTT, FFFT, FFTF, TFFT
	UC2:	FFTT, FTTT, FFFT, FFTF, TFTF
	UC3:	FFTT, FTTT, FFFT, FFTF, TTTT

5.3.c)	(abd + acd)' = a' + b'c' + d'	
	COI a:	XTTT, XTFT, XFTT
	COI b:	TXFT
	COI c:	TFXT
	COI d:	TTTX, TTFX, TFTX
	base set:	TFFT, TTFT, TFTT
	UC1:	TFFT, TTFT, TFTT, FTFT, TTFF
	UC2:	TFFT, TTFT, TFTT, FTFT, TFTF
	UC3:	TFFT, TTFT, TFTT, FFTT, TTFF
	UC4:	TFFT, TTFT, TFTT, FFTT, TFTF

Bonus Questions		

b.1.a)	ab' + c' + d'	
COI a:	XFTT	
COI b:	TXTT	
COI c:	FFXT, FTXT, TTXT	
COI d:	FFTX, FTTX, TTTX	
base set:	FFTT, TFTT, TTTT	
UC1:	FFTT, TFTT, TTTT, FFFT, FFTF	
UC2:	FFTT, TFTT, TTTT, FFFT, TTTF	
M:	FFTT, TFTT, TTTT, FTFT, FTTF	

b.1.b)	a + bc + d'	
COI a:	XFFT, XFTT, XTFT	
COI b:	FXTT	
COI c:	FTXT	
COI d:	FFFX, FFTX, FTFX	
base set:	FFTT, FTTT, FTFT	
UC1:	FFTT, FTTT, FTFT, TFTT, FFTF	
UC2:	FFTT, FTTT, FTFT, TFTT, FTFF	
M:	FFTT, FTTT, FTFT, TFFT, FFFF	

b.2.a)	a = (b< 0) || c		
Test Case	Inputs		Expected Outputs
	b	c	a
1	0	F	F
2	0	T	T
3	-1	F	T

b.2.b)	a = b && (c<5)		
Test Case	Inputs		Expected Outputs
	b	c	a
1	T	4	T
2	T	5	F
3	F	4	F

b.2.c)	a = (b >5) && (c<8)		
	Test Case	Inputs		Expected Outputs
		b	c	a
	1	6	7	T
	2	5	7	F
	3	6	8	F

b.2.d)	a = (b>5) && (b<10)		
	Test Case	Inputs		Expected Outputs
		b	c	a
	1	6	9	T
	2	6	10	F
	3	5	9	F