IDS - Homework 3

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1. a) $F(A,B,C,D) = D + A(CD + B) + \bar{B}C\bar{D}$

$= D + ACD + AB + \bar{B}C\bar{D}$ associative law

$= D + AB + \bar{B}C\bar{D}$ absorption law

$= D + \bar{B}C + AB$ absorption (variant) law

before	after
L = 8	L = 5
G = 12	G = 7
GN = 19	GN = 8

b) $F(A,B,C,D) = (\overline{DD} + AB).C + DC$

$= (\bar{D} + \bar{D} + AB)C + DC$ de morgan's law

$= (\bar{D} + AB)C + DC$ idempotency law

$= C(\bar{D} + AB + D)$ distributive law

$= C(1 + AB)$ inverse law

$= C$ one element law

before	after
L = 7	L = 1
G = 12	G = 1
GN = 13	GN = 1

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c) $F(A,B,C,D) = D(AC + C(\underset{B}{BB} + DA)) + AC$

$= D(AC + C(B + DA)) + AC$ idempotency law

$= D(AC + BC + ACD) + AC$ distributive law

$= D(C(A + B + AD)) + AC$ distributive law

$= D(C(B + A)) + AC$ absorption law

$= D(BC + AC) + AC$ distributive law

$= BCD + ACD + AC$ distributive law

$= BCD + AC$ absorption law

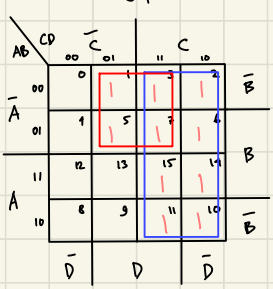
$= C(BD + A)$ distributive law

before	after
L = 10	L = 1
G = 18	G = 6
GN = 18	GN = 6

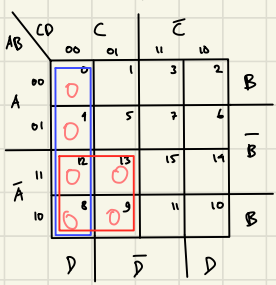
2. a) $F(A,B,C,D) = \Sigma m\,(1,2,3,5,6,7,10,11,14,15)$

$\Pi M\,(0,4,8,9,12,13)$

SOP



POS



Optimized SOP = $C + \bar{A}D$

Optimized POS = $(C + D)\cdot(\bar{A} + C)$

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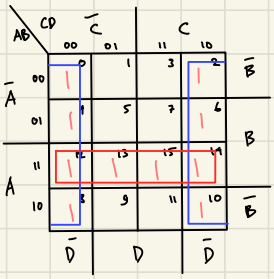
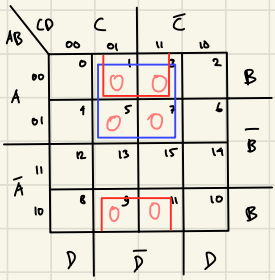
b) $F(A,B,C,D) = \prod M\,(1,3,5,7,9,11)$

$\sum m\,(0,2,4,6,8,10,12,13,14,15)$

SOP



POS



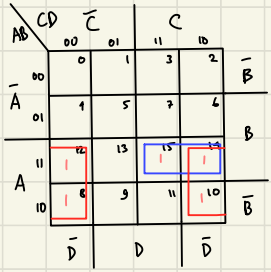
Optimized SOP = $\bar{D} + AB$

Optimized POS = $(A+\bar{D}) \cdot (B+\bar{D})$

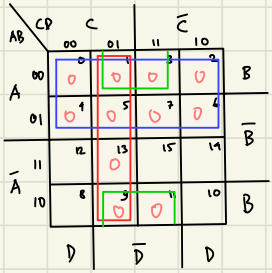
c) $F(A,B,C,D) = (\bar{A}.A + A.C).B + \bar{D}A$

$= ABC + \bar{D}A$ Inverse law

SOP



POS



Optimized SOP = $ABC + A\bar{D}$

Optimized POS = $A \cdot (C+\bar{D}) \cdot (B+\bar{D})$

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3. a) $F(A,B,C,D) = CD + (AB + \underset{C}{CC})C$

$= CD + (AB + C)C$ idempotency law

$= CD + C$ absorption law

$= C$ absorption law

A	B	C	D	F	
0	0	0	0	0	0
0	0	0	1	0	1
0	0	1	0	1	2
0	0	1	1	1	3
0	1	0	0	0	4
0	1	0	1	0	5
0	1	1	0	1	6
0	1	1	1	1	7
1	0	0	0	0	8
1	0	0	1	0	9
1	0	1	0	1	10
1	0	1	1	1	11
1	1	0	0	0	12
1	1	0	1	0	13
1	1	1	0	1	14
1	1	1	1	1	15

SOM: $F(A,B,C,D) = \sum_m (2,3,6,7,10,11,14,15)$

POM: $F(A,B,C,D) = \prod_M (0,1,4,5,8,9,12,13)$

b) $F(A,B,C,D) = \overline{D}A + B(CB + \underset{B}{DD})$

$= \overline{D}A + B(CB + D)$

$= \overline{D}A + CBB + BD$

$= \overline{D}A + CB + BD$

$= \overline{D}A + B(C + D)$

A	B	C	D	F	
0	0	0	0	0	0
0	0	0	1	0	1
0	0	1	0	0	2
0	0	1	1	0	3
0	1	0	0	0	4
0	1	0	1	1	5
0	1	1	0	1	6
0	1	1	1	1	7
1	0	0	0	1	8
1	0	0	1	0	9
1	0	1	0	1	10
1	0	1	1	0	11
1	1	0	0	1	12
1	1	0	1	1	13
1	1	1	0	1	14
1	1	1	1	1	15

SOM: $F(A,B,C,D) = \sum_m (5,6,7,8,10,12,13,14,15)$

POM: $F(A,B,C,D) = \prod_M (0,1,2,3,4,9,11)$

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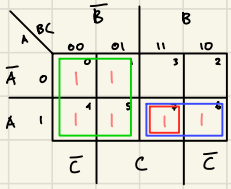
1. a) $F(A,B,C) = A(BA + BC) + \overline{BB}$

$= AAB + ABC + \overline{BB}$ distributive law

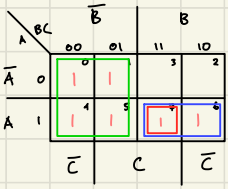
$= AB + ABC + \overline{B}$ idempotency law

SOP



optimize

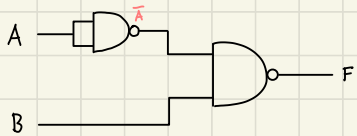
SOP



Optimized SOP: $F = A + \overline{B}$

$\overline{\overline{F}} = \overline{\overline{A + \overline{B}}}$ double complement (to make converting into NAND Gates easier)

$F = (\overline{\overline{A} \cdot B})$ involution & de morgan's law



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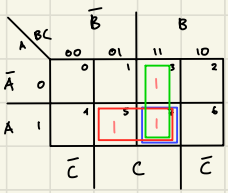
b) $F(A,B,C) = (BC + CC)A + CB$

$= (BC + C)A + CB$ idempotency law

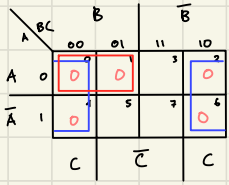
$= \boxed{ABC} + \boxed{AC} + \boxed{CB}$ distributive law

SOP



change to POS

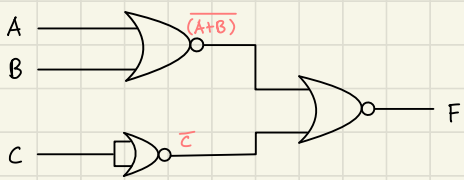
POS



Optimized POS : $F = C \cdot (A+B)$

$\overline{\overline{F}} = \overline{C \cdot (A+B)}$ double complement (to make converting into NOR Gates easier)

$F = \overline{\bar{C} + (A+B)}$ involution & de morgan's law



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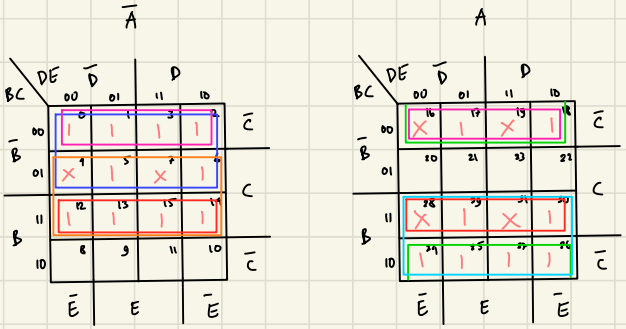
5. SOM : $F(A, B, C, D, E) = \sum_m (0, 1, 2, 3, 5, 6, 12, 13, 14, 15, 17, 18, 24, 25, 26, 27, 29, 30)$



Prime implicants : $\bar{A}\bar{B}$, $\bar{B}\bar{C}$, $\bar{A}C$, BC, $A\bar{C}$, AB

Essential Prime implicants : none