Cpr E 281 HW04
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Minimization and Karnaugh Maps
Assigned: Week 4
Due Date: Sep. 20, 2021

P1 (15 points): Produce the simplified sum-of-products (SOP) expressions for the following K-maps:

F_1

C \ AB	00	01	11	10
0	0	1	1	0
1	0	1	1	0

F_2

YZ \ WX	00	01	11	10
00	1	0	0	1
01	0	0	0	0
11	1	1	1	1
10	0	0	0	0

F_3

YZ \ WX	00	01	11	10
00	1	0	0	1
01	1	1	0	0
11	0	0	0	1
10	0	0	0	0

P2 (15 points): For each shorthand expression below, derive the simplest SOP expression:

a. $G_1(w,x,y,z) = \sum m(1,3,4,5,6,7,12,13,15)$
b. $G_2(x,y,z) = \sum m(0,1,2,6)$
c. $G_3(w,x,y,z) = \sum m(0,1,3,8,15)$

P3. (20 points) A four-variable function that is equal to 1 if any three or all four of its variables are equal to 1 is called a *majority* function.

a. Write the truth table for the majority function.

b. Use a K-map to derive the simplest SOP expression for this majority function.

c. Use a K-map to derive the simplest POS expression for this majority function.

d. Compare the costs of the circuits implementing the expressions in part(b) and part(c) in terms of the total number of gates plus the total number of inputs.

P4 (15 points): For each expression below, derive the simplest POS expression:

a. $H_1(a,b,c,d) = \prod M(0,2,5,7,8,10,13,15)$
b. $H_2(a,b,c) = \prod M(2,3,6,7)$
c. $H_3(a,b,c,d) = \prod M(0,4,5,7,8,11,12)$

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P5 (20 points): For the following truth table find the following:

a	b	c	d	f
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

(a) Use a K-map to derive the simplest SOP expression for this majority function.
(b) Use a K-map to derive the simplest POS expression for this majority function.
(c) Compare the costs of the circuits implementing the expressions in part (a) and part (b) in terms of the total number of gates plus the total number of inputs.

P6 (15 points): Use Karnaugh Maps to convert the following expressions to simplified SOP expressions:

I: $Q_1(A,B,C,D) = \bar{A}\bar{C}D + \bar{A}B\bar{C} + BD + A\bar{C}D + A\bar{B}C$

II: $Q_2(A,B,C,D) = \prod M(5,13)$

III: $Q_3(A,B,C,D) = (B + \bar{C} + D)(A + C + D)(\bar{B} + \bar{C} + D)$