Cpr E 281 HW04
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Minimization and Karnaugh Maps
Assigned: Week 4
Due Date: Sep. 19, 2022

P1 (20 points): Given the following K-maps:

F_1

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

F_2

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

a. Produce the simplified sum-of-products (SOP) expressions
b. Produce the simplified product-of-sums (POS) expressions

P2 (15 points): Find the minimized sum-of-products expression for the logical sum F = $G_1 + G_2$:

a. $G_1(w,x,y,z) = \sum m(1,4,5,6,7,12,13,15)$
   $G_2(w,x,y,z) = \sum m(5,8,9)$

b. $G_1(x,y,z) = \sum m(0,1,2,6)$
   $G_2(x,y,z) = \sum m(0,1,2,6,7)$

c. $G_1(a,b,c) = \prod M(0,1,2,7)$
   $G_2(a,b,c) = \prod M(1,3,4,5)$

P3 (20 points) Given the logic expression $F = ABCD + A\bar{B}CD + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D}$

a. Draw the circuit for the expression F.

b. Use a K-map to derive the simplest SOP expression for F

c. Redraw the circuit for F using the simplified SOP expression from b).

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.

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P4 (15 points): For each expression below, derive the simplest POS expression using don't care terms for simplification wherever possible:

a. $H_1(a,b,c,d) = \prod M(0,4,7,11,14) + D(6,8,9,13)$

b. $H_2(a,b,c) = \prod M(2,3,6,7) + D(1,4)$

c. $H_3(a,b,c,d) = \prod M(0,4,5,7,8,11,12) + D(1,2,3)$

P5 (15 points): Given the shorthand expression

Z(A,B,C,D) = $\prod M(0,1,3,4,5,7,9,13,15)$:

a. Derive the simplest POS expression for Z.
b. Derive the simplest SOP expression for Z.
c. Which expression would produce a lower cost? Why?

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

a. $Q_1(A,B,C,D) = \bar{A}\bar{C}D + \bar{A}B\bar{C} + BD + A\bar{C}D + A\bar{B}C$
b. $Q_2(A,B,C,D) = \prod M(5,7,14)$
c. $Q_3(A,B,C,D) = (B + \bar{C} + D)(A + C + D)(\bar{B} + \bar{C} + D)$