Expression Simplifications

For the following Boolean expressions: (a) fill out the truth table, (b) express the minterm sum of products equation, and the maxterm product of sums equation, and (c) minimize the expression using the theorems discussed in class.

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

D	C	B	A	OUT
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	

D	C	B	A	OUT
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

SOP

POS

Simplify Expression

b. $OUT = \bar{A}C + BD + \bar{A}B + A\bar{B}\bar{C}\bar{D}$

D	C	B	A	OUT
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	

D	C	B	A	OUT
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

SOP

POS

Simplify Expression

Karnaugh Maps

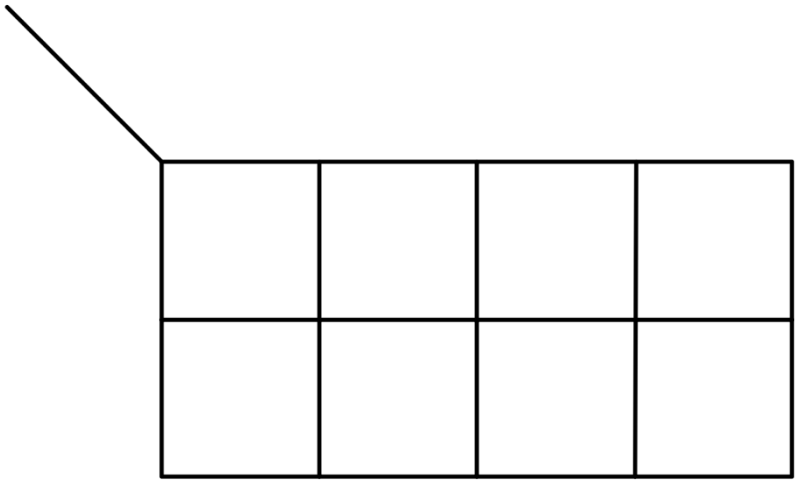
For the following expressions, complete the Truth Tables and Karnaugh Maps. List out the minterms, prime implicants and write the minimized sum-of-products expression.

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

Minterms

C	B	A	OUT
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Prime Implicants



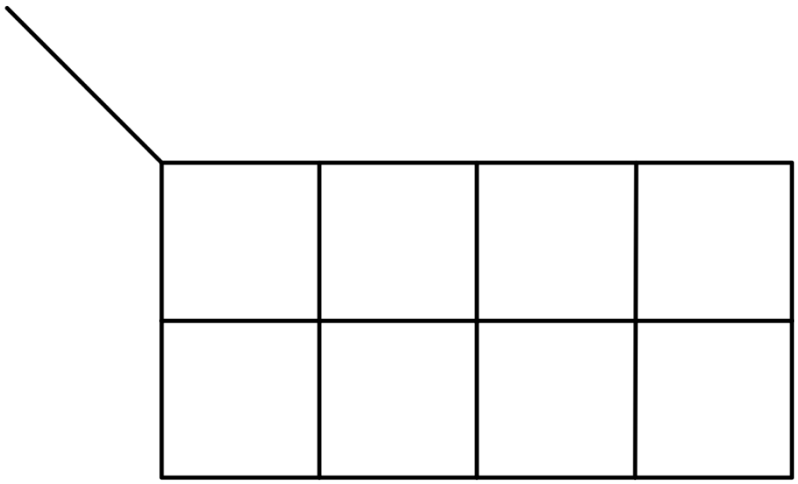
Minimized SOP

b. $F(A,B) = (\bar{A} + \bar{B})(A + B)$

C	B	A	OUT
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Minterms

Prime Implicants



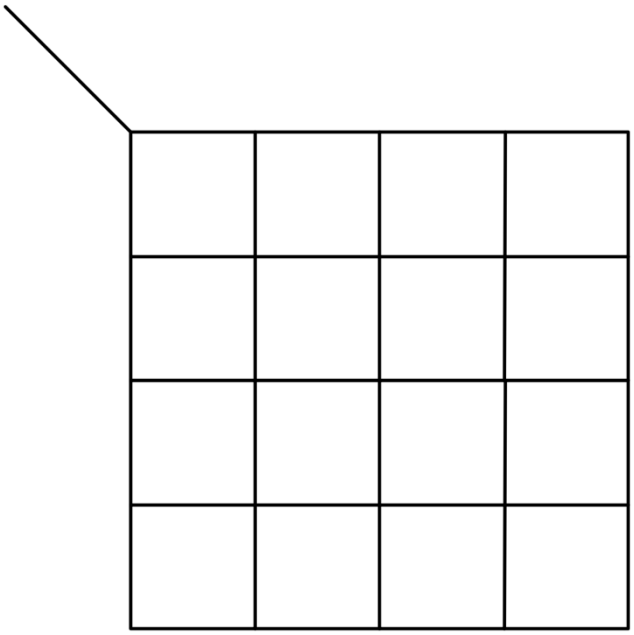
Minimized SOP

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

D	C	B	A	OUT
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

Minterms

Prime Implicants



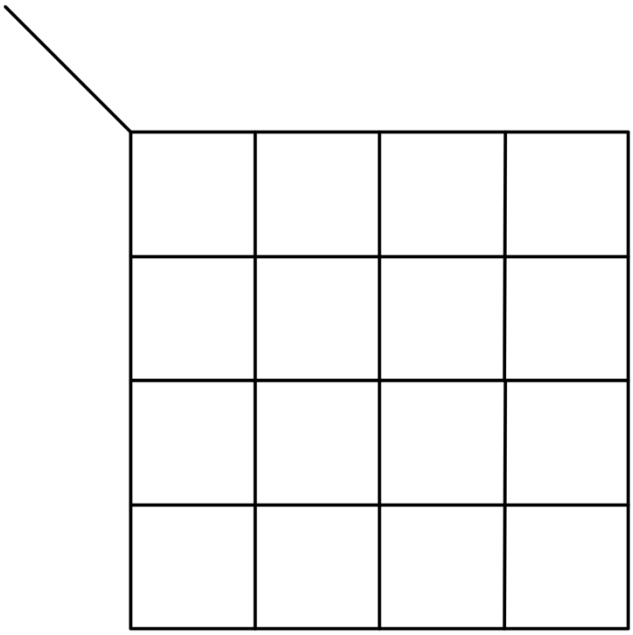
Minimized SOP

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

D	C	B	A	OUT
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

Minterms

Prime Implicants



Minimized SOP

Transistor-Level Circuit Design

For the following Boolean expressions, draw a transistor-level schematic using primitive gate. If possible, minimize the number of primitive gates used. Also draw a transistor-level schematic that is not required to use primitive gates and minimizes the number of transistors used.

a. Y = $\overline{(A \cdot B)}$

b. Y = $\overline{(A + B)}$

c. $Y = \overline{(A \cdot B)}$

d. Y = $A \oplus B$

e. $Y = B(A + C)$

f. $Y = \bar{A}(\bar{B} + \bar{C})$

g. $Y = \bar{A}\bar{B}(\bar{C} + D)$