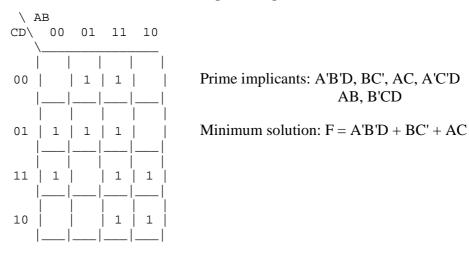
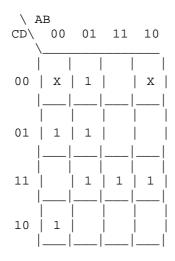
PRIME IMPLICANTS UNIT-3

PRIME IMPLICANTS

Any single 1 or group of 1's that can be combined together on Karnaugh map of the function F represents a product term which is called an IMPLICANT. A PRIME IMPLICANT is a product term that cannot be combined with another term to eliminate a variable. A single 1 is a prime implicant if it is not adjacent to any other 1's. Two adjacent 1's form a prime implicant if they are not contained in a group of four adjacent 1's. Four adjacent 1's form a prime implicant if they are not contained in a group of eight adjacent 1's. The minimum sum-of-products expression for a function consists of some (BUT NOT NECESSARILY ALL) of the prime implicants of a function.



To ensure that a minimum solution is found, select essential prime implicants first. Then find a minimum set of prime implicants that cover the remaining 1's on the map.



Essential prime implicants are: A'C', ACD, and A'B'D'

Either A'BD or BCD can be chosen for final minimum solution.

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PROBLEMS

For reference, this section introduces the terminology used in some texts to describe the minterms and maxterms assigned to a Karnaugh map. Otherwise, there is no new material here.

 Σ (sigma) indicates sum and lower case "m" indicates minterms. Σ m indicates sum of minterms. The following example is revisited to illustrate our point. Instead of a Boolean equation description of unsimplified logic, we list the minterms.

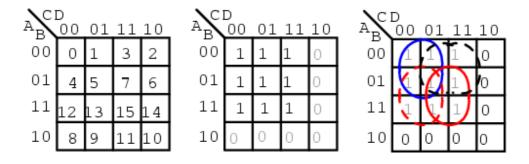
$$f(A,B,C,D) = \sum m(1, 2, 3, 4, 5, 7, 8, 9, 11, 12, 13, 15)$$
 or

$$f(A,B,C,D) = \Sigma(m_1,m_2,m_3,m_4,m_5,m_7,m_8,m_9,m_{11},m_{12},m_{13},m_{15})$$

The numbers indicate cell location, or address, within a Karnaugh map as shown below right. This is certainly a compact means of describing a list of minterms or cells in a K-map.

Out=
$$\overline{A}\overline{B}\overline{C}\overline{D}$$
 + $\overline{A}\overline{B}\overline{C}D$ + $\overline{A}\overline{B}CD$ + $\overline{A}BCD$ + $\overline{A}BCD$ + $\overline{A}BCD$ + $\overline{A}BCD$

$$f(A,B,C,D) = \sum m(0,1,3,4,5,7,12,13,15)$$



$$f(A,B,C,D) = \overline{AC} + \overline{AD} + \overline{BC} + \overline{BD}$$

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The Sum-Of-Products solution is not affected by the new terminology. The minterms, 1s, in the map have been grouped as usual and a Sum-OF-Products solution written.

Below, we show the terminology for describing a list of maxterms. Product is indicated by the Greek Π (pi), and upper case "M" indicates maxterms. Π M indicates product of maxterms. The same example illustrates our point. The Boolean equation description of unsimplified logic, is replaced by a list of maxterms.

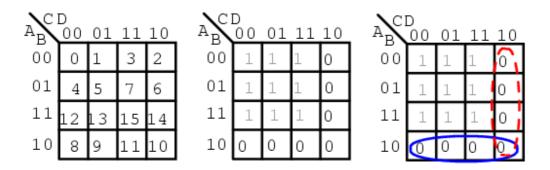
$$f(A,B,C,D) = \Pi M(2, 6, 8, 9, 10, 11, 14)$$
 or

$$f(A,B,C,D) = \Pi(M_2, M_6, M_8, M_9, M_{10}, M_{11}, M_{14})$$

Once again, the numbers indicate K-map cell address locations. For maxterms this is the location of **0**s, as shown below. A Product-OF-Sums solution is completed in the usual manner.

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

$$f(A,B,C,D) = \prod M(2,6,8,9,10,11,14)$$



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