Quaid-e-Awam University of Engineering, Science and Technology

بسم الله الرحمن الرحيم

In the name of Allah, the Most Merciful, the Most Kind

Date: 25-10-2021

BCS 103
Digital Logic & Computer Architecture

Lecture 23 and 24

Department of Computer Science

IN THE LAST LECTURE

We have discussed

- **Karnaugh Map (3 variables)**

TODAY

We will discuss about

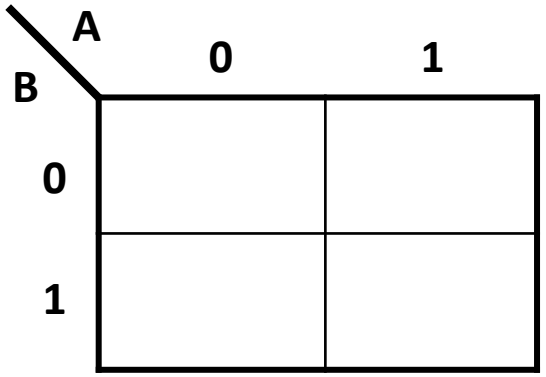
- **Karnaugh Map (4 variables)**

Review

- 2 variables Karnaugh map

Q: Simplify the following expressions

A’B’ + AB + A’B

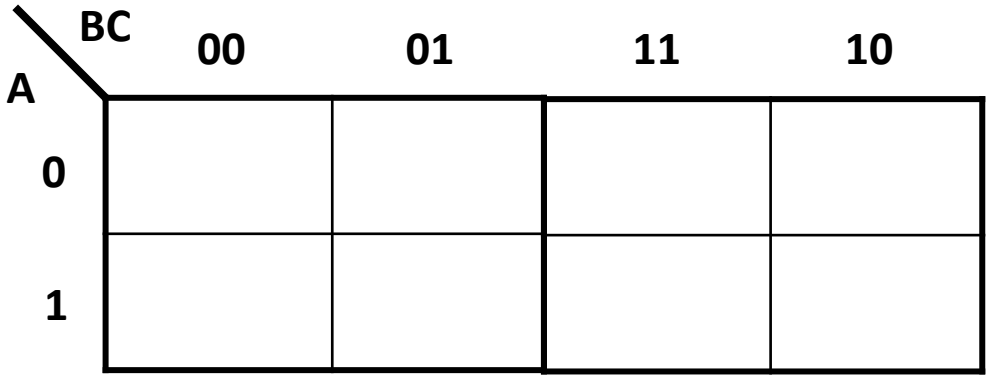


Review

- 3 variables Karnaugh map

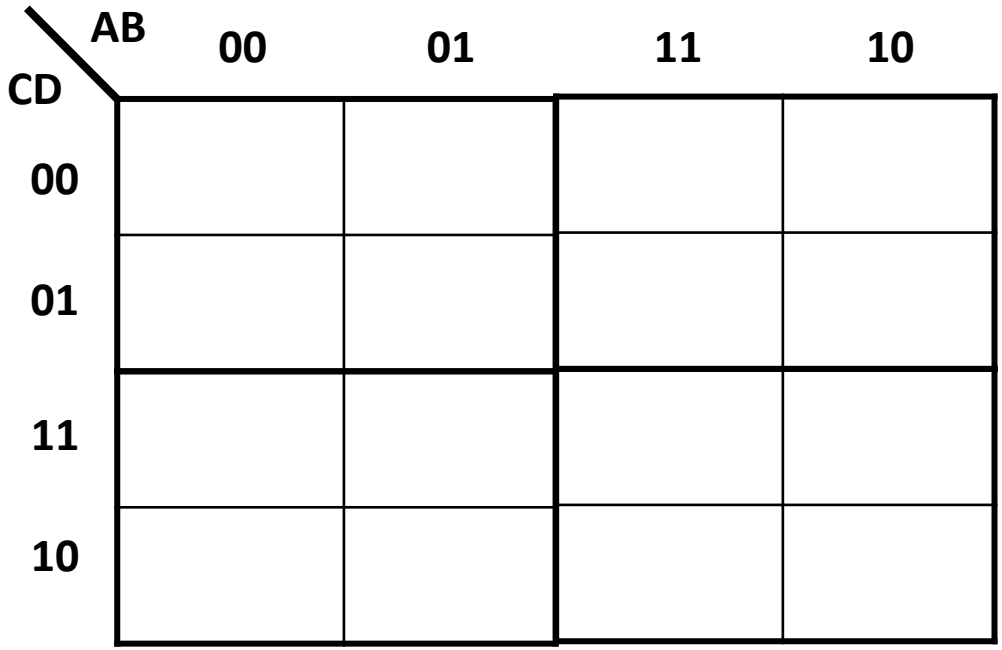
Q: Simplify the following expressions

AC + AB + B'C'

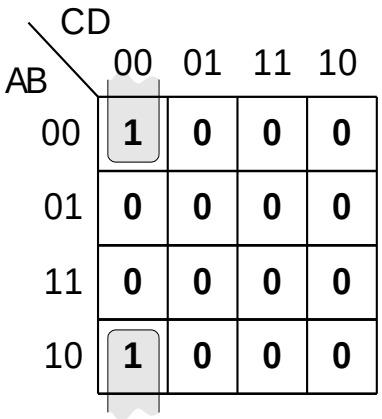


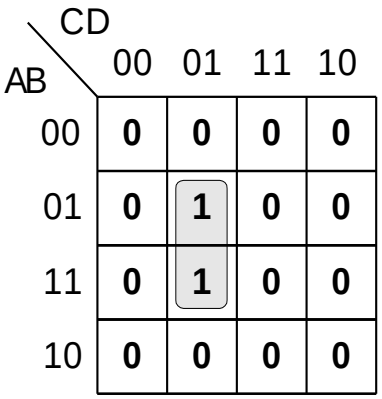
Karnaugh Maps

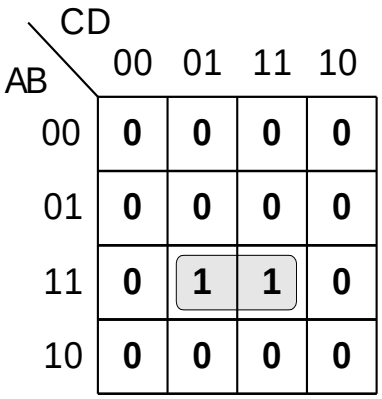
- **4 variables Karnaugh map**

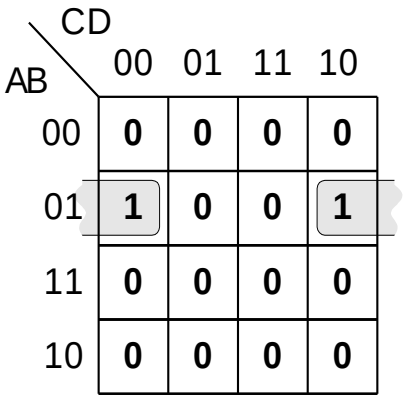


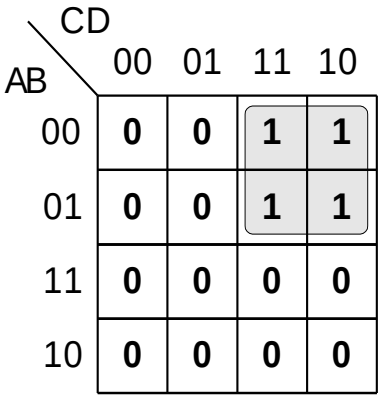
Four-Variable K-Maps

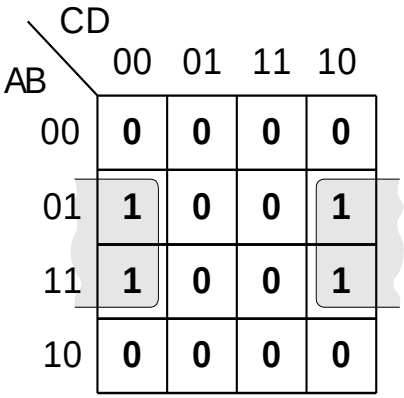


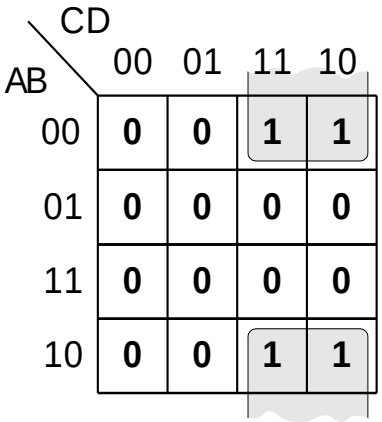


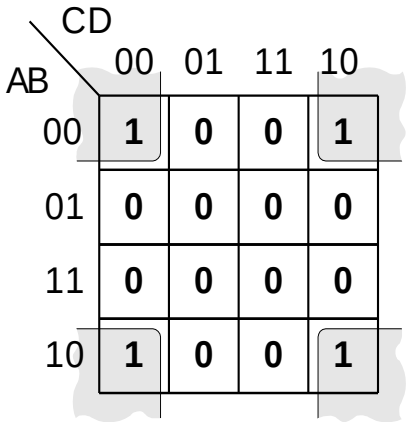




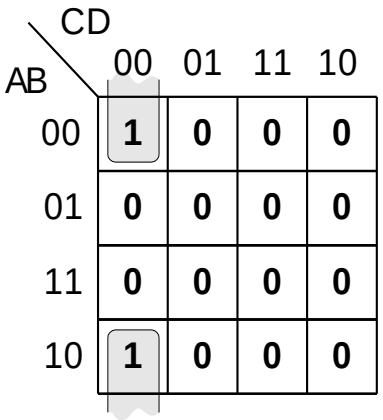




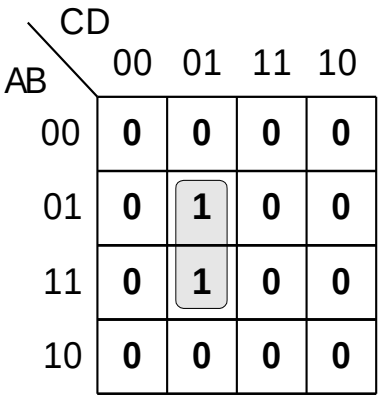




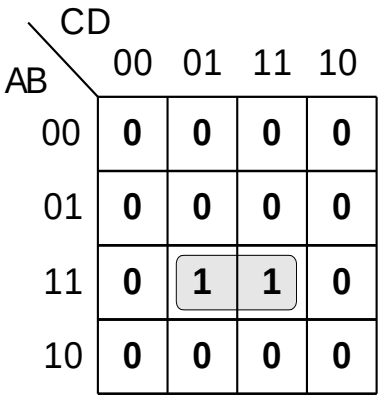
Four-Variable K-Maps



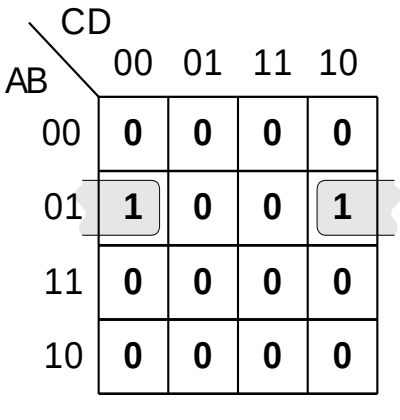
$f = \sum(0,8) = \overline{B} \bullet \overline{C} \bullet \overline{D}$



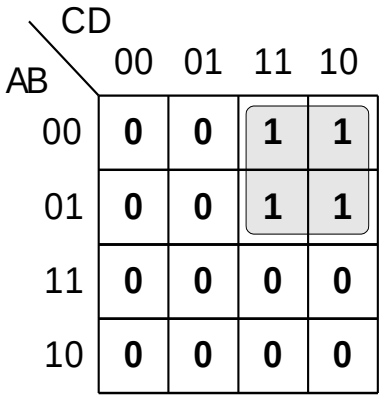
$f = \sum(5,13) = B \bullet \overline{C} \bullet D$



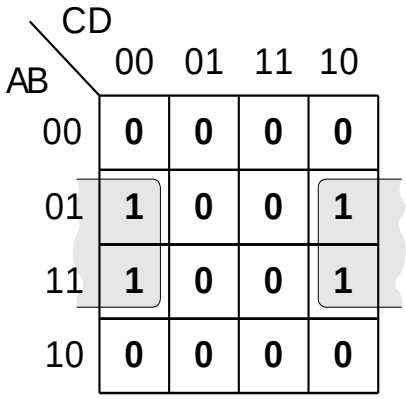
$f = \sum(13,15) = A \bullet B \bullet D$



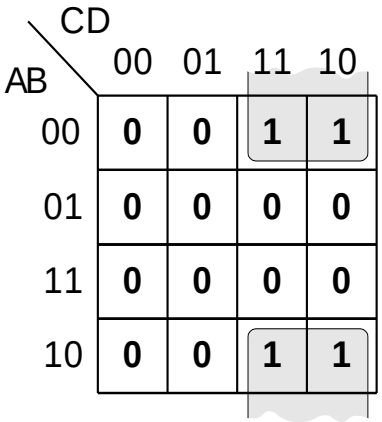
$f = \sum(4,6) = \overline{A} \bullet B \bullet \overline{D}$



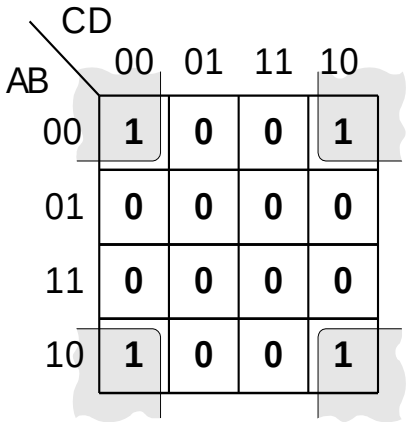
$f = \sum(2,3,6,7) = \overline{A} \bullet C$



$f = \sum(4,6,12,14) = B \bullet \overline{D}$

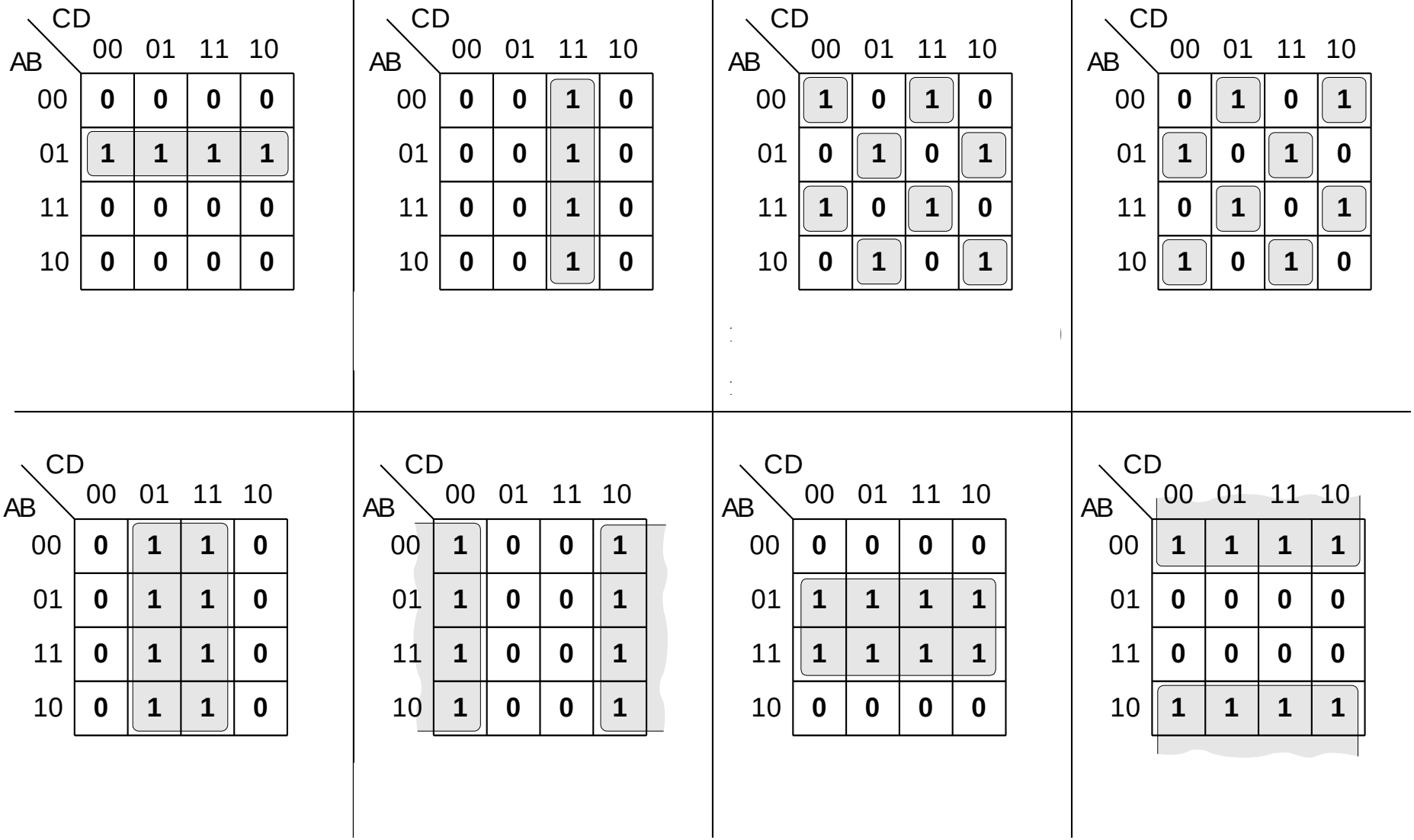


$f = \sum(2,3,10,11) = \overline{B} \bullet C$

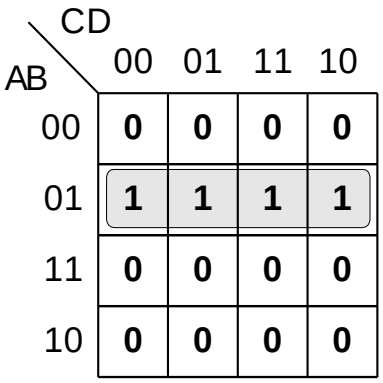


$f = \sum(0,2,8,10) = \overline{B} \bullet \overline{D}$

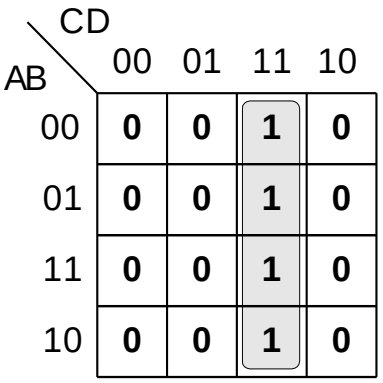
Four-Variable K-Maps



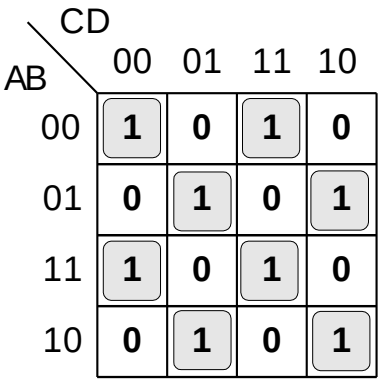
Four-Variable K-Maps



$f = \sum(4,5,6,7) = \overline{A} \bullet B$

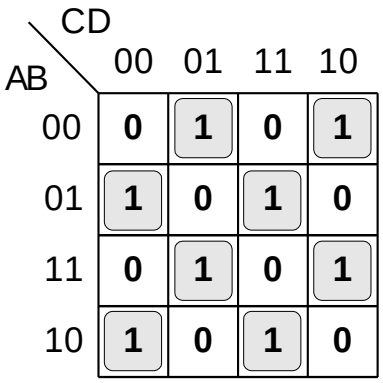


$f = \sum(3,7,11,15) = C \bullet D$



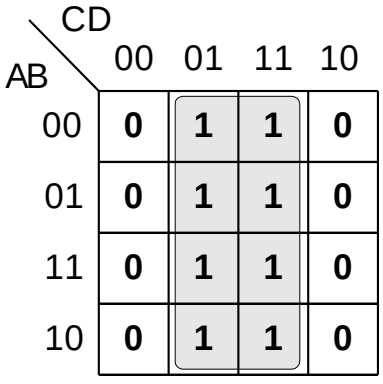
$f = \sum(0,3,5,6,9,10,12,15)$

$f = A \otimes B \otimes C \otimes D$



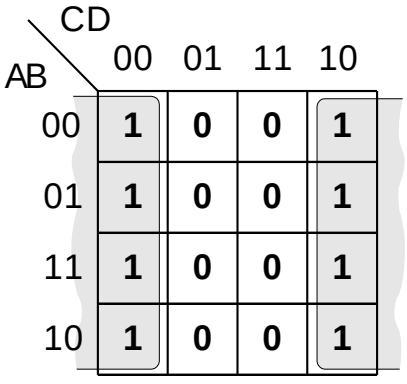
$f = \sum(1,2,4,7,8,11,13,14)$

$f = A \oplus B \oplus C \oplus D$



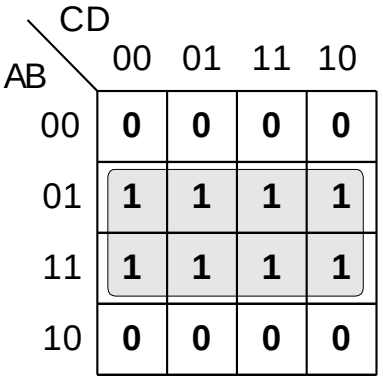
$f = \sum(1,3,5,7,9,11,13,15)$

$f = D$



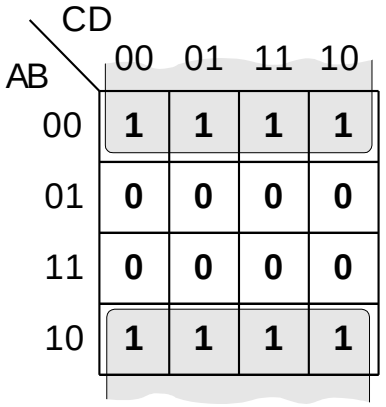
$f = \sum(0,2,4,6,8,10,12,14)$

$f = \overline{D}$



$f = \sum(4,5,6,7,12,13,14,15)$

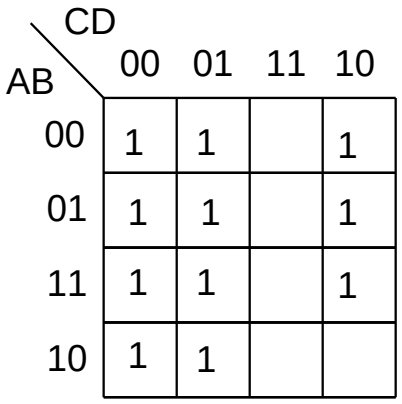
$f = B$

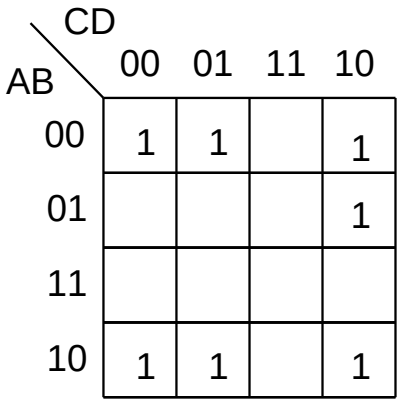


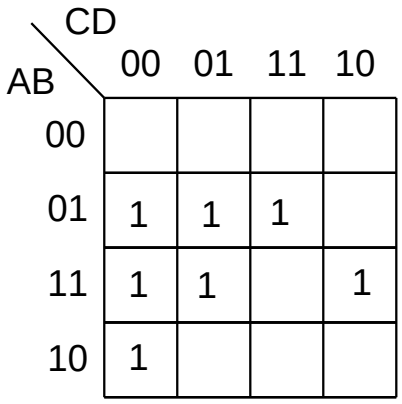
$f = \sum(0,1,2,3,8,9,10,11)$

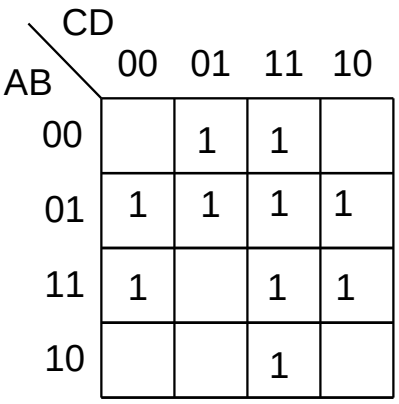
$f = \overline{B}$

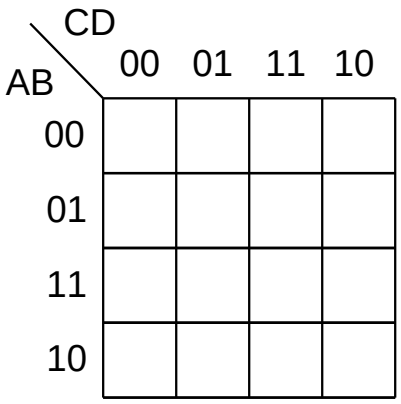
Four-Variable K-Maps

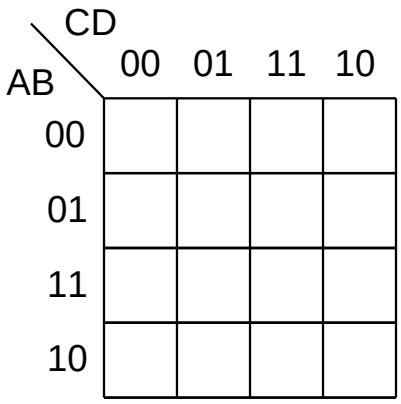




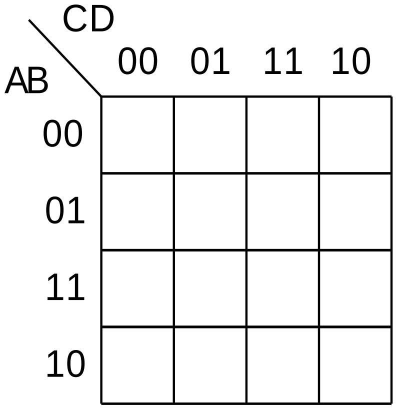


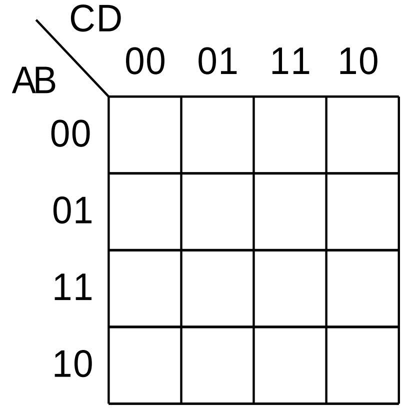


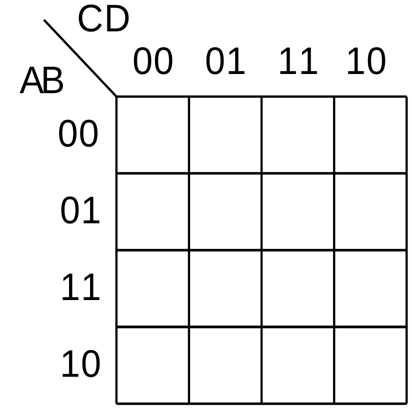


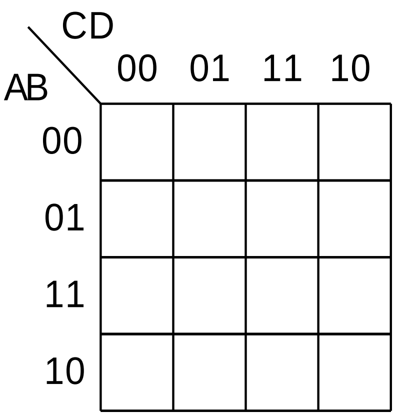


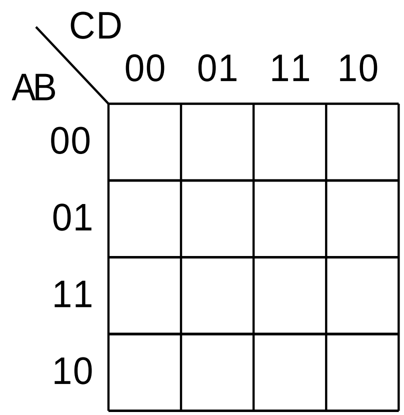
Four-Variable K-Maps

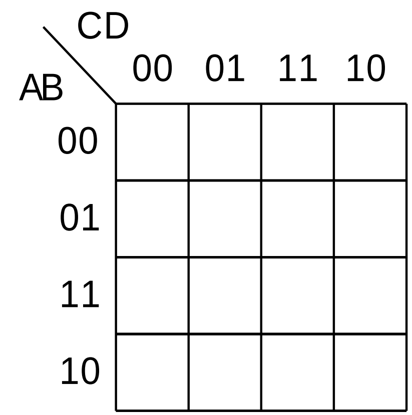












Exercise

4.7 Using a Karnaugh map, simplify the following functions and implement them with basic gates.

(*a*) $F(A, B, C, D) = \Sigma(0, 2, 3, 6, 7, 8, 10, 11, 12, 15)$

(*b*) $F(A, B, C, D) = \Sigma(0, 2, 3, 5, 7, 8, 13) + d(1, 6, 12)$ *

(*c*) $F(A, B, C, D) = \Sigma(1, 7, 9, 10, 12, 13, 14, 15) + d(4, 5, 8)$ *

(*d*) $F(A, B, C, D) = \pi(0, 8, 10, 11, 14) + d(6)$ *

(*e*) $F(A, B, C, D) = \pi(2, 8, 11, 15) + d(3, 12, 14)$ *

(*f*) $F(W, X, Y, Z) = \pi(0, 2, 6, 11, 13, 15) + d(1, 9, 10, 14)$ *

4.8 Prepare a Karnaugh map for the following functions.

(*a*) $F = ABC + A'BC + B'C'$

(*b*) $F = A + B + C'$

(*c*) $Y = AB + B'CD$

4.9 Using the Karnaugh map method, simplify the following functions, obtain their sum of the products form, and product of the sums form. Realize them with basic gates.

(*a*) $F(W, X, Y, Z) = \Sigma(1, 3, 4, 5, 6, 7, 9, 12, 13)$

(*b*) $F(W, X, Y, Z) = \Sigma(1, 5, 6, 7, 11, 12, 13, 15)$

* Questions with don't care conditions

Thanks