

# Karnaugh maps.

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- The disjunctive normal form
- The conjunctive normal form
- Functional completeness
- Karnaugh maps

## Exercise 1

Find the disjunctive normal form of the Boolean function  $f(x, y, z)$  that has the value 1 if and only if

- a)  $x = 0$ ,
- b)  $x + y = 0$ ,
- c)  $xy = 0$ ,
- d)  $xyz = 0$ .

## Exercise 2

Find the disjunctive normal form of the Boolean function  $f(x, y, z, u, w)$  that has the value 1 if and only if three or more of the variables  $x, y, z, u, w$  have the value 1.

## Exercise 3

Express the Boolean function  $x + \bar{y}(\bar{x} + z)$  using the operators  $+$  and  $\bar{\quad}$ .

## Exercise 4

Express the Boolean function  $x + y + z$  using the operators  $\cdot$  and  $\bar{\phantom{x}}$ .

## Exercise 5

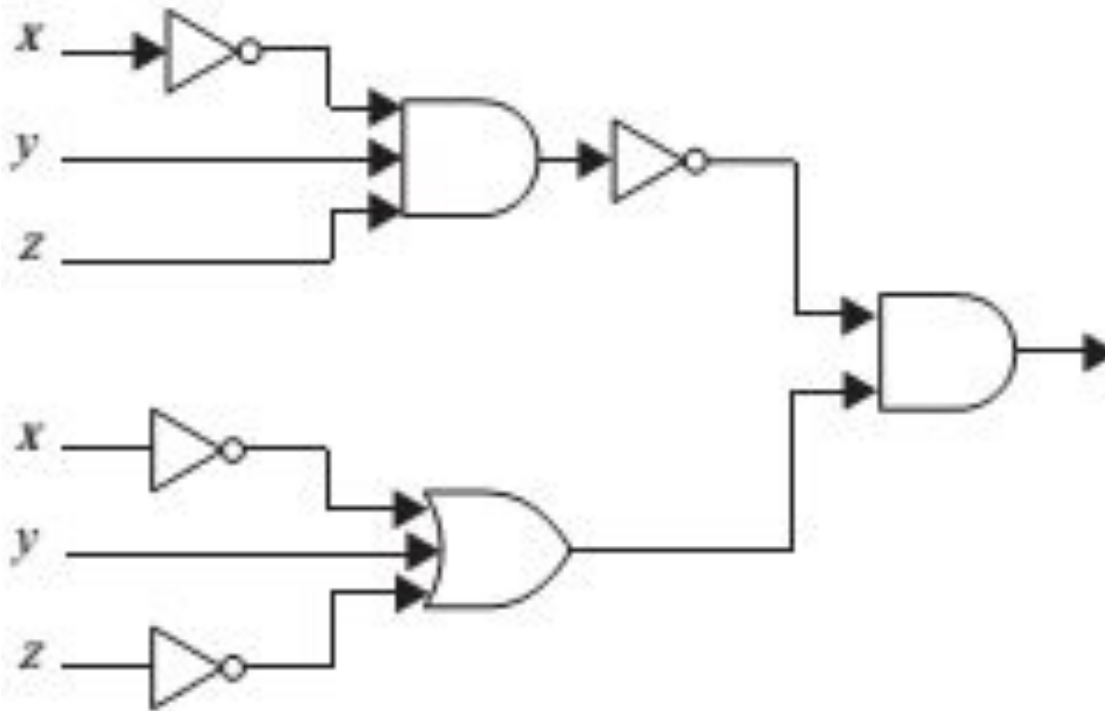
Use  $K$ -maps to find a minimal sum-of-products expansion that represents each of the Boolean functions:

a)  $xyz + \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}\bar{z} + \bar{x}\bar{y}z,$

b)  $xyzw + xyz\bar{w} + \bar{x}yz\bar{w} + x\bar{y}zw + x\bar{y}z\bar{w} + \bar{x}\bar{y}z\bar{w}.$

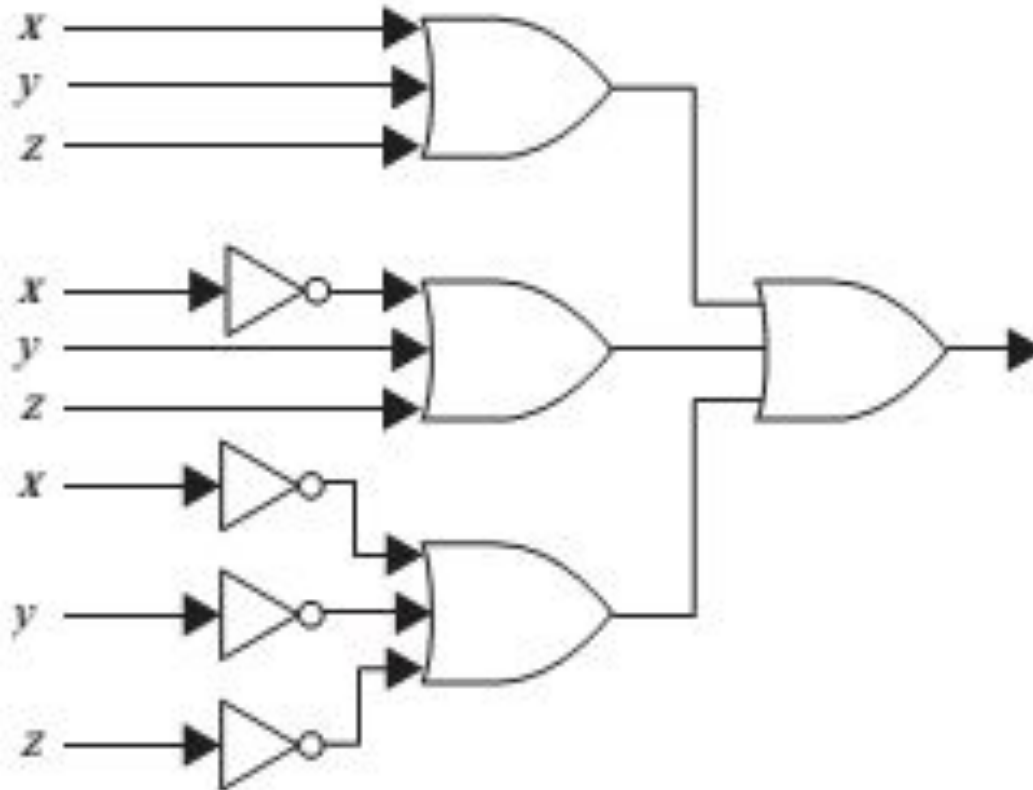
## Exercise 6

Use K-maps to find simpler circuit with the same output as the circuit shown.



## Exercise 7

Use K-maps to find simpler circuit with the same output as the circuit shown.





## Exercise 8

Use  $K$ -maps to find a minimal sum-of-products expansion that represents the Boolean function which is given in the following table:

1	1	1	1
1	1	0	0
1	0	1	1
1	0	0	1
0	1	1	0
0	1	0	0
0	0	1	1
0	0	0	0

## Exercise 9

Use  $K$ -maps to find a minimal sum-of-products expansion that represents the Boolean function which is given by the following vector of values:

$$f(\bar{x}^3) = (10101100).$$