

# Exercices

- **Exercice :**
- Le circuit réalise la commande de trois lampes LED par un clavier numérique 0-9;
  - trois lampes sont allumées si le chiffre tapé est multiple de 3,
  - 2 sont allumées(2<sup>ere</sup> lampe et 3<sup>ème</sup> lampe) si le chiffre est multiple de 2
  - une seule lampe est allumée(3<sup>ème</sup> lampe) si le chiffre tapé est 1 ou 0,
  - aucune lampe n'est allumée pour les autres chiffres
- ❖ trouver les fonctions simplifiées des sorties (lampes); puis dresser le schéma logique

# Solution

| <b>a</b> | <b>b</b> | <b>c</b> | <b>d</b> | <b>chiffre</b> | <b>X</b> | <b>Y</b> | <b>Z</b> |
|----------|----------|----------|----------|----------------|----------|----------|----------|
| 0        | 0        | 0        | 0        | 0              | 0        | 0        | 1        |
| 0        | 0        | 0        | 1        | 1              | 0        | 0        | 1        |
| 0        | 0        | 1        | 0        | 2              | 0        | 1        | 1        |
| 0        | 0        | 1        | 1        | 3              | 1        | 1        | 1        |
| 0        | 1        | 0        | 0        | 4              | 0        | 1        | 1        |
| 0        | 1        | 0        | 1        | 5              | 0        | 0        | 0        |
| 0        | 1        | 1        | 0        | 6              | 1        | 1        | 1        |
| 0        | 1        | 1        | 1        | 7              | 0        | 0        | 0        |
| 1        | 0        | 0        | 0        | 8              | 0        | 1        | 1        |
| 1        | 0        | 0        | 1        | 9              | 1        | 1        | 1        |
| 1        | 0        | 1        | 0        | 10             | X        | X        | X        |
| 1        | 0        | 1        | 1        | 11             | X        | X        | X        |
| 1        | 1        | 0        | 0        | 12             | X        | X        | X        |
| 1        | 1        | 0        | 1        | 13             | X        | X        | X        |
| 1        | 1        | 1        | 0        | 14             | X        | X        | X        |
| 1        | 1        | 1        | 1        | 15             | X        | X        | X        |

# Solution

| ab<br>cd | 00 | 01 | 11 | 10 |
|----------|----|----|----|----|
| 00       | 0  | 0  | x  | 0  |
| 01       | 0  | 0  | x  | 1  |
| 11       | 1  | 0  | x  | x  |
| 10       | 0  | 1  | x  | x  |

$\bar{b}cd$


$bcd\bar{d}$

$ad$

$$X = ad + \bar{b}cd + bcd\bar{d}$$

$$X = ad + c(\bar{b}d + bd\bar{d})$$

$$X = ad + c(b \oplus d)$$



| a | b | c | d | chiffre | X | Y | Z |
|---|---|---|---|---------|---|---|---|
| 0 | 0 | 0 | 0 | 0       | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1       | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 2       | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 3       | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 4       | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 5       | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 6       | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 7       | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 8       | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 9       | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 10      | x | x | x |
| 1 | 0 | 1 | 1 | 11      | x | x | x |
| 1 | 1 | 0 | 0 | 12      | x | x | x |
| 1 | 1 | 0 | 1 | 13      | x | x | x |
| 1 | 1 | 1 | 0 | 14      | x | x | x |
| 1 | 1 | 1 | 1 | 15      | x | x | x |

# Solution

| ab<br>cd | 00 | 01 | 11 | 10 |   |
|----------|----|----|----|----|---|
| 00       | 0  | 1  | x  | 1  | a |
| 01       | 0  | 0  | x  | 1  |   |
| 11       | 1  | 0  | x  | x  |   |
| 10       | 1  | 1  | x  | x  |   |

$Y = a + \bar{b}c + b\bar{d}$

$b\bar{d}$

$\bar{b}c$

↓

| a | b | c | d | chiffre | X | Y | Z |
|---|---|---|---|---------|---|---|---|
| 0 | 0 | 0 | 0 | 0       | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1       | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 2       | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 3       | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 4       | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 5       | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 6       | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 7       | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 8       | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 9       | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 10      | X | X | X |
| 1 | 0 | 1 | 1 | 11      | X | X | X |
| 1 | 1 | 0 | 0 | 12      | X | X | X |
| 1 | 1 | 0 | 1 | 13      | X | X | X |
| 1 | 1 | 1 | 0 | 14      | X | X | X |
| 1 | 1 | 1 | 1 | 15      | X | X | X |

# Solution

| ab<br>cd | 00 | 01 | 11 | 10 |
|----------|----|----|----|----|
| 00       | 1  | 1  | x  | 1  |
| 01       | 1  | 0  | x  | 1  |
| 11       | 1  | 0  | x  | x  |
| 10       | 1  | 1  | x  | x  |

$\bar{d}$

$$Z = \bar{d} + \bar{b}$$

$\bar{b}$

| a | b | c | d | chiffre | X | Y | Z |
|---|---|---|---|---------|---|---|---|
| 0 | 0 | 0 | 0 | 0       | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1       | 0 | 0 | 1 |
| 0 | 0 | 1 | 0 | 2       | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 3       | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 4       | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 | 5       | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 | 6       | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 7       | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 8       | 0 | 1 | 1 |
| 1 | 0 | 0 | 1 | 9       | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 10      | X | X | X |
| 1 | 0 | 1 | 1 | 11      | X | X | X |
| 1 | 1 | 0 | 0 | 12      | X | X | X |
| 1 | 1 | 0 | 1 | 13      | X | X | X |
| 1 | 1 | 1 | 0 | 14      | X | X | X |
| 1 | 1 | 1 | 1 | 15      | X | X | X |

# exercice

- On a 4 interrupteurs et 2 lampes (Rouge et vert)
  - La lampe rouge s'allume si les deux interrupteurs voisins sont activés,
  - La lampe verte s'allume si les deux interrupteurs non voisins sont activés
  - Dresser leur circuit logique simplifier?


# solution

Si  $A=1$  and  $B=1$   
 Or  $b=1$  and  $c=1$   
 Or  $c=1$  and  $d=1$

| ab<br>cd | 00 | 01 | 11 | 10 |
|----------|----|----|----|----|
| 00       | 0  | 0  | 1  | 0  |
| 01       | 0  | 0  | 1  | 0  |
| 11       | 1  | 1  | 1  | 1  |
| 10       | 0  | 1  | 1  | 0  |

Diagram illustrating the Karnaugh map for the function  $R$ . The map shows the values of  $R$  for all combinations of  $a, b, c, d$ . The map is a 4x4 grid. The columns are labeled  $ab$  (00, 01, 11, 10) and the rows are labeled  $cd$  (00, 01, 11, 10). The values of  $R$  are shown in the cells. The map is simplified to the expression  $R = ab + cd + bc$ .

$$R = ab + cd + bc$$




| a | b | c | d | R | V |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 | 0 |

# solution

| ab<br>cd | 00 | 01 | 11 | 10 |
|----------|----|----|----|----|
| 00       | 0  | 0  | 0  | 0  |
| 01       | 0  | 1  | 1  | 1  |
| 11       | 0  | 0  | 0  | 1  |
| 10       | 0  | 0  | 0  | 1  |

$$V = b\bar{c}d + a\bar{c}d + a\bar{b}c$$



| a | b | c | d | R | V |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 0 | 0 |