# Mappe di *Karnaugh (Esempi)*

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# Comparatore a 1 bit

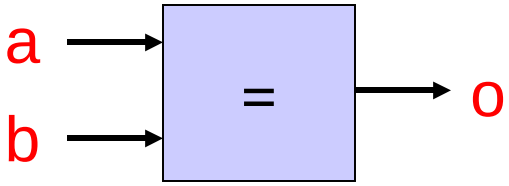



Tavola della verità

| a | b | o |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Mappa di *Karnaugh*

| | | a | |
|---|---|---|---|
| | | 0 | 1 |
| b | 0 | 1 | |
| | 1 | | 1 |

E' già in forma minima
o(a,b) = $\underline{ab}$ + ab

# Comparatore a 1 bit

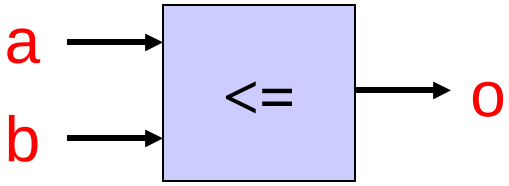
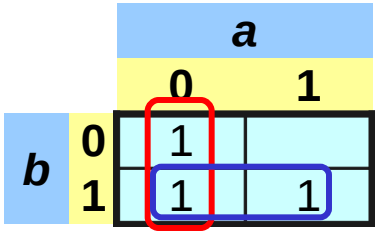



Tavola della verità

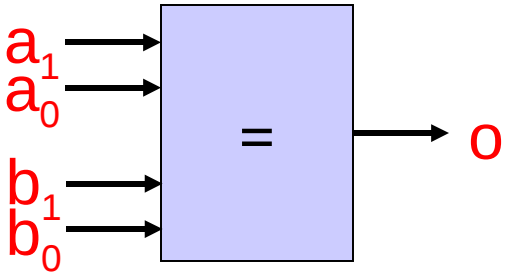
| a | b | o |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

Mappa di *Karnaugh*




L'espressione minima è:
o(a,b) = a + b

# Comparatore a 2 bit




## Descrizione

```
if (a1==b1 && a0==b0)
    o = 1;
else
    o = 0;
```

Mappa di *Karnaugh*

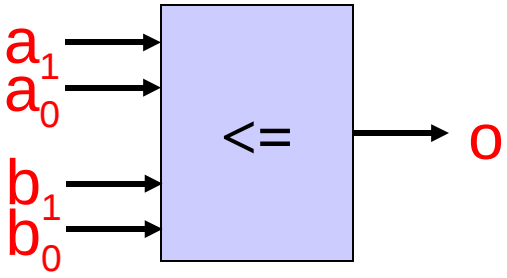
| *b1b0* \ *a1a0* | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | | | |
| 01 | | 1 | | |
| 11 | | | 1 | |
| 10 | | | | 1 |

Tavola della verità

| a1 | a0 | b1 | b0 | o |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

$o(a_1,a_0,b_1,b_0) = \underline{a}_1\underline{a}_0\underline{b}_1\underline{b}_0 + \underline{a}_1 a_0 \underline{b}_1 b_0 + a_1 a_0 b_1 b_0 + a_1 \underline{a}_0 b_1 \underline{b}_0$

# Comparatore a 2 bit




## Descrizione

```
if ((a1==b1 && a0<=b0)||
     (a1<=b1))
    o = 1;
else
    o = 0;
```

Mappa di *Karnaugh*

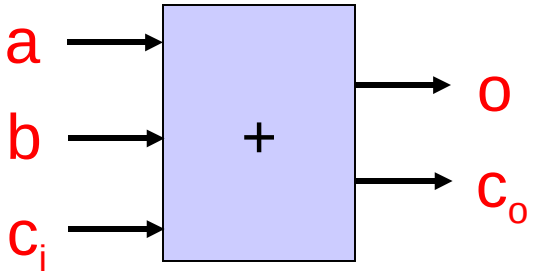
| *b1b0* \ *a1a0* | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | | | |
| 01 | 1 | 1 | | |
| 11 | 1 | 1 | 1 | 1 |
| 10 | 1 | 1 | | 1 |

Tavola della verità

| a1 | a0 | b1 | b0 | o |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

$o(a_1,a_0,b_1,b_0) = \underline{a_1}\underline{a_0}+b_1b_0+\underline{a_0}b_1+\underline{a_1}b_0+\underline{a_1}b_1$

# Sommatore a 1 bit




| a | b | ci | co | o |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 |

Mappa di *Karnaugh* ($c_o$)

| ci \ ab | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | | | 1 | |
| 1 | | 1 | 1 | 1 |

$c_o(a,b,c_i) = ab + bc_i + ac_i$

Mappa di *Karnaugh* (o)

| ci \ ab | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | | 1 | | 1 |
| 1 | 1 | | 1 | |

$o(a,b,c_i) = \underline{a}b\underline{c_i} + a\underline{bc_i} + \underline{ab}c_i + abc_i$

# Esercizio

Mappa di *Karnaugh*

| *cd* \ *ab* | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | | 1 | | |
| 01 | 1 | 1 | | 1 |
| 11 | | 1 | 1 | 1 |
| 10 | | 1 | 1 | |

L'espressione minima è:

$f(a,b,c,d) = \underline{a}b + bc + abc + \underline{bc}d$

- 1 + 1 + 2 + 2 = 6 porte AND a due ingressi
- 3 porte OR a 2 ingressi
- Cammino critico 2+3=5 porte

} Area: 9 porte logiche