

Tutorial/Practical 3 - *Tutoriaal/Prakties 3*

Memo

1 Venn Diagram

$$x \cdot \bar{y} \cdot \bar{z} + \bar{x} \cdot y \cdot z + x \cdot \bar{y} \cdot z + \bar{x} \cdot y \cdot \bar{z} + x \cdot y \cdot z$$

2 Simplification

$$\begin{aligned} f &= (\bar{x}_1 x_2)(\bar{x}_2 + x_3) + x_3(\bar{x}_2 + x_3) \\ &= (\bar{x}_1 x_2)(\bar{x}_2 + x_3) + x_3 && \text{T9} \\ &= \bar{x}_1 x_2 x_3 + x_3 && \text{T12'} \\ &= x_3 && \text{T9'} \end{aligned}$$

3 Dual

$$(x_1 + \bar{x}_2 + \bar{x}_1 x_3) \cdot \overline{x_3 \bar{x}_2}$$

4 Product of Sums

$$\begin{aligned} f &= (x + y + \bar{z})(x + \bar{y} + z)(x + \bar{y} + \bar{z})(\bar{x} + \bar{y} + z)(\bar{x} + \bar{y} + \bar{z}) \\ &= (x + y + \bar{z})[x + (\bar{y} + z)(\bar{y} + \bar{z})][\bar{x} + (\bar{y} + z)(\bar{y} + \bar{z})] && \text{T8'} \\ &= (x + y + \bar{z})(\bar{y} + z)(\bar{y} + \bar{z}) && \text{T10'} \\ &= (x + y + \bar{z})\bar{y} && \text{T10'} \\ &= \bar{y}(x + \bar{z}) && \text{T13'} \end{aligned}$$

5 Sum-of-minterms

x	y	z	f
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

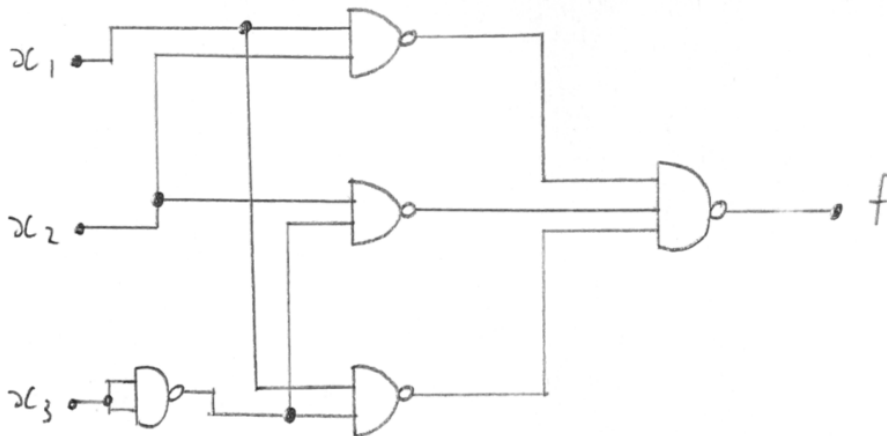
$$f = \bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + \bar{x}y\bar{z} + \bar{x}yz + xy\bar{z} + xyz$$

6 NAND Gates

$$\begin{aligned}
 f &= \bar{x}_1 x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 \bar{x}_3 + x_1 x_2 x_3 \\
 &= (\bar{x}_1 + x_1) x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 x_3 \\
 &= x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 x_3 \\
 &= x_2 (\bar{x}_3 + x_1 x_3) + x_1 \bar{x}_2 \bar{x}_3 \\
 &= x_2 (\bar{x}_3 + x_1) + x_1 \bar{x}_2 \bar{x}_3 \\
 &= x_1 x_2 + x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 \\
 &= x_1 (x_2 + \bar{x}_2 \bar{x}_3) + x_2 \bar{x}_3 \\
 &= x_1 (x_2 + \bar{x}_3) + x_2 \bar{x}_3 \\
 &= x_1 x_2 + x_1 \bar{x}_3 + x_2 \bar{x}_3 \\
 &= \overline{(\bar{x}_1 \bar{x}_2)} \overline{(\bar{x}_1 \bar{x}_3)} \overline{(x_2 \bar{x}_3)}
 \end{aligned}$$

Alternative simplification (using T3', product terms can be repeated):

$$\begin{aligned}
 f &= \bar{x}_1 x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 \bar{x}_3 + x_1 x_2 x_3 \\
 &= \bar{x}_1 x_2 \bar{x}_3 + x_1 \bar{x}_2 \bar{x}_3 + x_1 x_2 \bar{x}_3 + \textcolor{blue}{x_1 x_2 \bar{x}_3} + x_1 x_2 x_3 \\
 &= x_2 \bar{x}_3 (\bar{x}_1 + x_1) + x_1 \bar{x}_3 (x_2 + \bar{x}_2) + x_1 x_2 x_3 \\
 &= x_2 \bar{x}_3 + x_1 \bar{x}_3 + x_1 x_2 x_3 \\
 &= x_2 \bar{x}_3 + x_1 (\bar{x}_3 + x_2 x_3) \\
 &= x_2 \bar{x}_3 + x_2 (\bar{x}_3 + x_2) \\
 &= x_1 x_2 + x_1 \bar{x}_3 + x_2 \bar{x}_3 \\
 &= \overline{(\bar{x}_1 \bar{x}_2)} \overline{(\bar{x}_1 \bar{x}_3)} \overline{(x_2 \bar{x}_3)}
 \end{aligned}$$



7 Light Status-Truth Table

x_1	x_2	x_3	y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

8 Light Status-C Function

```

bool LightStatus (bool x1, bool x2, bool x3)
{
    bool term1 = (!x1) && (!x2) && (x3);
    bool term2 = (!x1) && (x2) && (!x3);
    bool term3 = (x1) && (!x2) && (!x3);
    bool term4 = (x1) && (x2) && (x3);
    return term1 || term2 || term3 || term4;
}

```

9 Light Status-Digital

