Homework on simplifying expressions using Karnaugh Maps and designing circuits using NAND and NOR gates from them

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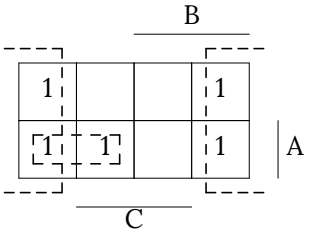
(Serial No.: 571)

1. $f = \sum(0, 2, 4, 5, 6)$

The K-Map for this boolean expression of 3 variables is

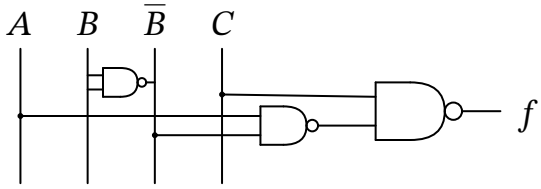


The simplified form is

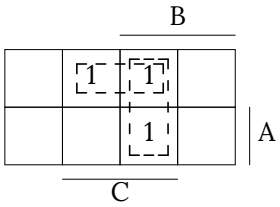
$f = A\overline{B} + \overline{C}$

The expression suitable to form a circuit using NAND gate is

$$f = \overline{\overline{f}} = \overline{\overline{A\overline{B} + \overline{C}}}$$
$$= \overline{\overline{A\overline{B}} \cdot \overline{\overline{C}}}$$
$$= \overline{\overline{A \cdot \overline{B} \cdot C}}$$



The K-map for $\overline{f}$ is



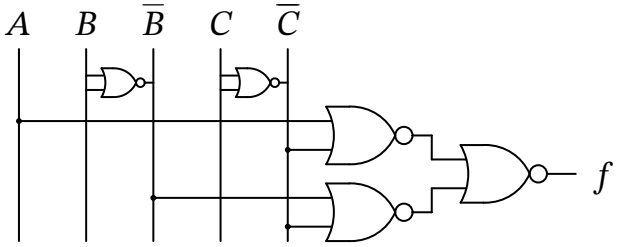
The simplified expression for $\overline{f}$ is

$\overline{f} = \overline{A}C + BC$

The expression suitable to implement the given expression using NOR gates is calculated as follows:

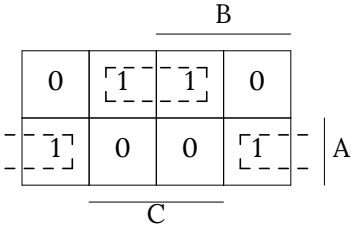
$$\overline{\overline{f}} = \overline{\overline{A}C + BC}$$

$$f = \overline{\overline{A}C} \cdot \overline{BC}$$
$$f = \overline{\overline{f}} = \overline{\overline{\overline{A}C} \cdot \overline{BC}}$$
$$= \overline{\overline{\overline{A}C} + \overline{BC}}$$
$$= \overline{\overline{A} + \overline{C} + \overline{B} + \overline{C}}$$



2. $f = \prod(0, 2, 5, 7)$

The K-Map for this boolean expression of 3 variables is

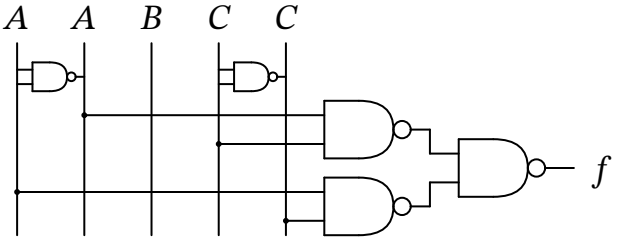


The simplified form is

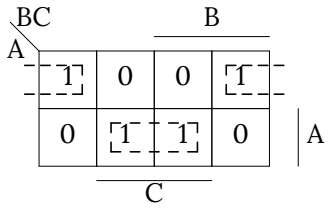
$f = \overline{A}C + A\overline{C}$

The expression suitable to form a circuit using NAND gate is

$$f = \overline{\overline{f}} = \overline{\overline{\overline{A}C + A\overline{C}}}$$
$$= \overline{\overline{\overline{A} \cdot C} \cdot \overline{A \cdot \overline{C}}}$$



The K-map for $\overline{f}$ is



The simplified form of $\overline{f}$ is

$$\overline{f} = \overline{A}\,\overline{C} + AC$$

The expression suitable to implement the given expression using NOR gates is calculated as follows:

$$\overline{\overline{f}} = \overline{\overline{A}\,\overline{C} + AC}$$

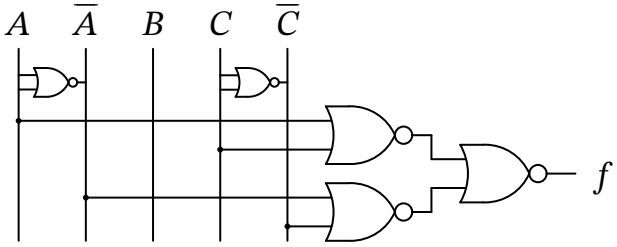
$$f = \overline{\overline{A}\,\overline{C}} \cdot \overline{AC}$$

$$f = \overline{\overline{f}} = \overline{\overline{A}\,\overline{C} \cdot \overline{AC}}$$

$$= \overline{\overline{\overline{A}\,\overline{C}} + \overline{\overline{AC}}}$$

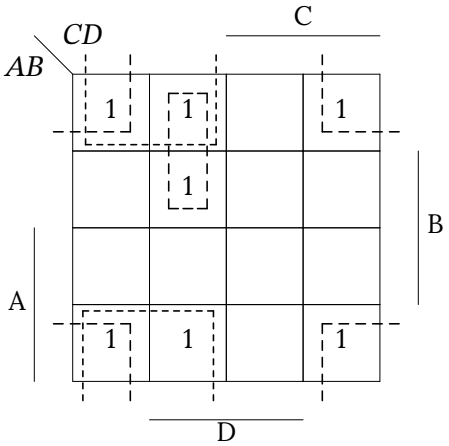
$$= \overline{\overline{\overline{A}} + \overline{\overline{C}} + \overline{\overline{A}} + \overline{\overline{C}}}$$

$$= \overline{\overline{A + C} + \overline{\overline{A} + \overline{C}}}$$



3. $f = \sum(0,1,2,5,8,9,10)$

The K-Map of this boolean function of 4 variables is



The simplified form is

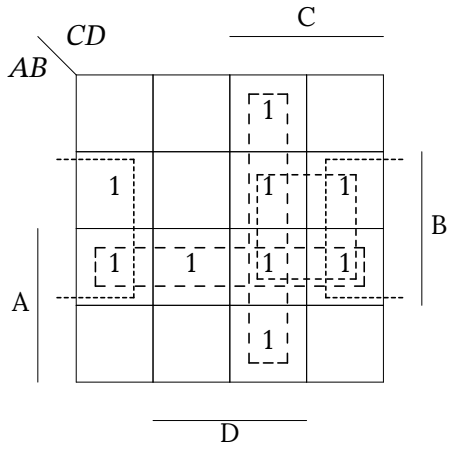
$$f = \overline{B}\,\overline{D} + \overline{B}\,\overline{C} + \overline{A}\,\overline{C}\,D$$

The expression suitable to form a circuit using NAND gate is

$$f = \overline{\overline{f}} = \overline{\overline{B}\,\overline{D} + \overline{B}\,\overline{C} + \overline{A}\,\overline{C}\,D}$$

$$= \overline{\overline{\overline{B}\,\overline{D}} \cdot \overline{\overline{B}\,\overline{C}} \cdot \overline{\overline{A}\,\overline{C}\,D}}$$

The K-map for $\overline{f}$ is



The simplified expression for $\overline{f}$ is

$$\overline{f} = AB + BC + CD + B\overline{D}$$

The expression suitable to implement the given expression using NOR gates is calculated as follows:

$$\overline{\overline{f}} = \overline{AB + BC + CD + B\overline{D}}$$

$$f = \overline{AB} \cdot \overline{BC} \cdot \overline{CD} \cdot \overline{B}\,\overline{\overline{D}}$$

$$f = \overline{\overline{f}} = \overline{\overline{AB} \cdot \overline{BC} \cdot \overline{CD} \cdot \overline{B}\,\overline{\overline{D}}}$$

$$= \overline{\overline{\overline{AB}} + \overline{\overline{BC}} + \overline{\overline{CD}} + \overline{\overline{B}}\,\overline{\overline{D}}}$$

$$= \overline{\overline{\overline{A} + \overline{B} + \overline{B} + \overline{C} + \overline{C} + \overline{D} + \overline{B} + D}}$$

Figure: The boolean function $\sum(0,1,2,5,8,9,10)$ implemented using NAND gates

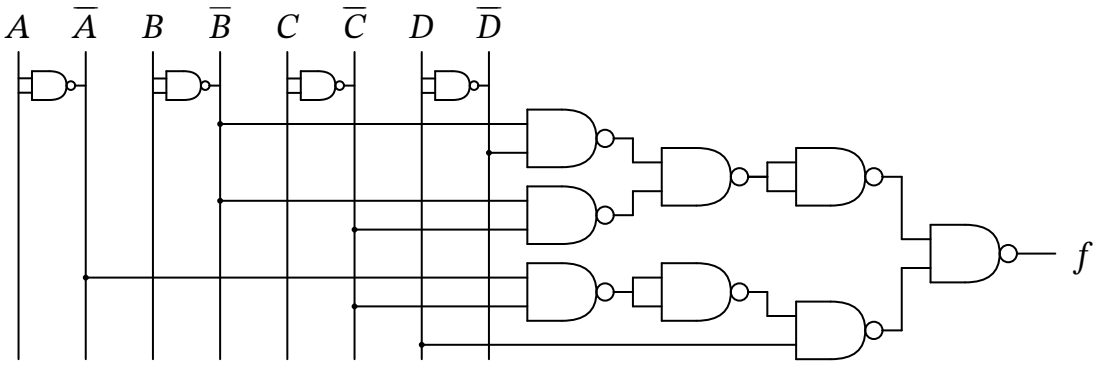


Figure: The boolean function $\sum(0,1,2,5,8,9,10)$ implemented using NOR gates