Drill Problems

2.1 Perform the following number system conversions:

(a) $1101011_2 = ?_{16}$
(b) $174003_8 = ?_2$
(c) $10110111_2 = ?_{16}$
(d) $67.24_8 = ?_2$
(e) $10100.1101_2 = ?_{16}$
(f) $F3A5_{16} = ?_2$
(g) $11011001_2 = ?_8$
(h) $AB3D_{16} = ?_2$
(i) $101111.0111_2 = ?_8$
(j) $15C.38_{16} = ?_2$

2.2 Convert the following octal numbers into binary and hexadecimal:

(a) $1234_8 = ?_2 = ?_{16}$
(b) $174637_8 = ?_2 = ?_{16}$
(c) $365517_8 = ?_2 = ?_{16}$
(d) $2535321_8 = ?_2 = ?_{16}$
(e) $7436.11_8 = ?_2 = ?_{16}$
(f) $45316.7414_8 = ?_2 = ?_{16}$

2.3 Convert the following hexadecimal numbers into binary and octal:

(a) $1023_{16} = ?_2 = ?_8$ (b) $7E6A_{16} = ?_2 = ?_8$

(c) $ABCD_{16} = ?_2 = ?_8$ (d) $C350_{16} = ?_2 = ?_8$

(e) $9E36.7A_{16} = ?_2 = ?_8$ (f) $DEAD.BEEF_{16} = ?_2 = ?_8$

2.4 What are the octal values of the four 8-bit bytes in the 32-bit number with octal representation 32107654321_8?

2.5 Convert the following numbers into decimal:

(a) $1101011_2 = ?_{10}$ (b) $174003_8 = ?_{10}$

(c) $10110111_2 = ?_{10}$ (d) $67.24_8 = ?_{10}$

(e) $10100.1101_2 = ?_{10}$ (f) $F3A5_{16} = ?_{10}$

(g) $12010_3 = ?_{10}$ (h) $AB3D_{16} = ?_{10}$

(i) $7156_8 = ?_{10}$ (j) $15C.38_{16} = ?_{10}$

2.6 Perform the following number-system conversions:

(a) $125_{10} = ?_2$ (b) $3489_{10} = ?_8$

(c) $209_{10} = ?_2$ (d) $9714_{10} = ?_8$

(e) $132_{10} = ?_2$ (f) $23851_{10} = ?_{16}$

(g) $727_{10} = ?_5$ (h) $57190_{10} = ?_{16}$

(i) $1435_{10} = ?_8$ (j) $65113_{10} = ?_{16}$

2.7 Add the following pairs of binary numbers, showing all carries:

(a) $\begin{array}{r} 110011 \\ +\ 11010 \\ \hline \end{array}$ (b) $\begin{array}{r} 100111 \\ +\ 101010 \\ \hline \end{array}$ (c) $\begin{array}{r} 11100011 \\ +\ 1011101 \\ \hline \end{array}$ (d) $\begin{array}{r} 1100110 \\ +\ 1111001 \\ \hline \end{array}$

2.8 Repeat Drill 2.7 using subtraction instead of addition, and showing borrows instead of carries.

2.9 Add the following pairs of octal numbers:

(a) $\begin{array}{r} 1776 \\ +\ 1432 \\ \hline \end{array}$ (b) $\begin{array}{r} 57734 \\ +\ 1066 \\ \hline \end{array}$ (c) $\begin{array}{r} 252757 \\ +\ 465521 \\ \hline \end{array}$ (d) $\begin{array}{r} 511042 \\ +\ 57647 \\ \hline \end{array}$

2.10 Add the following pairs of hexadecimal numbers:

(a) $\begin{array}{r} 1776 \\ +\ 1432 \\ \hline \end{array}$ (b) $\begin{array}{r} 4F1A5 \\ +\ B8D5 \\ \hline \end{array}$ (c) $\begin{array}{r} F35B \\ +\ 27E6 \\ \hline \end{array}$ (d) $\begin{array}{r} 1B90F \\ +\ C44E \\ \hline \end{array}$

2.11 Write the 8-bit signed-magnitude, two's-complement, and ones'-complement representations for each decimal number: +25, +120, +82, −42, −6, −111.

2.12 Indicate whether or not overflow occurs when adding the following 8-bit two's-complement numbers:

(a) $\begin{array}{r} 11010100 \\ +\ 11101011 \\ \hline \end{array}$ (b) $\begin{array}{r} 10111111 \\ +\ 11011111 \\ \hline \end{array}$ (c) $\begin{array}{r} 01011101 \\ +\ 00110001 \\ \hline \end{array}$ (d) $\begin{array}{r} 01100001 \\ +\ 00011111 \\ \hline \end{array}$

The text states that a truth table or equivalent is the starting point for traditional combinational minimization methods. A Karnaugh map itself contains the same information as a truth table. Given a sum-of-products expression, it is possible to write the 1s corresponding to each product term directly on the map without developing an explicit truth table or minterm list, and then proceed with the map-minimization procedure. In this way, find a minimal sum-of-products expression for each of the following logic functions:

(a) $F = X' \cdot Z + X \cdot Y + X \cdot Y' \cdot Z$

(b) $F = A' \cdot C' \cdot D + B' \cdot C \cdot D + A \cdot C' \cdot D + B \cdot C \cdot D$

(c) $F = W' \cdot X \cdot Z' + W \cdot X \cdot Y \cdot Z + W' \cdot Z$

(d) $F = (W + Z') \cdot (W' + Y' + Z') \cdot (X + Y' + Z)$

(e) $F = A' \cdot B' \cdot C' \cdot D' + A' \cdot C' \cdot D + B \cdot C' \cdot D' + A \cdot B \cdot D + A \cdot B' \cdot C'$

5-variable Karnaugh map

A *5-variable Karnaugh map* can be drawn for a 5-variable function as shown in Figure X4.59. In such a map, cells that occupy the same relative position in the V = 0 and V = 1 submaps are considered to be adjacent. (Many worked examples of 5-variable Karnaugh maps appear in Section 7.4.4 and in Section JKSM.2 at DDPPonline.) Find a minimal sum-of-products expression for each of the following functions using a 5-variable map:

(a) $F = \Sigma_{V,W,X,Y,Z}(5,7,13,15,16,20,25,27,29,31)$

(b) $F = \Sigma_{V,W,X,Y,Z}(0,7,8,9,12,13,15,16,22,23,30,31)$

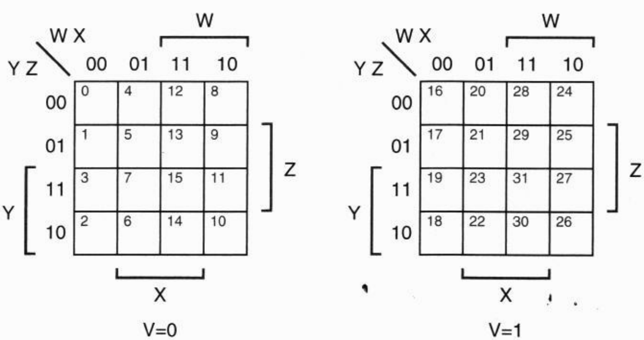
(c) $F = \Sigma_{V,W,X,Y,Z}(0,1,2,3,4,5,10,11,14,20,21,24,25,26,27,28,29,30)$

(d) $F = \Sigma_{V,W,X,Y,Z}(0,2,4,6,7,8,10,11,12,13,14,16,18,19,29,30)$

(e) $F = \Pi_{V,W,X,Y,Z}(4,5,10,12,13,16,17,21,25,26,27,29)$

(f) $F = \Sigma_{V,W,X,Y,Z}(4,6,7,9,11,12,13,14,15,20,22,25,27,28,30) + d(1,5,29,31)$

ure X4.59



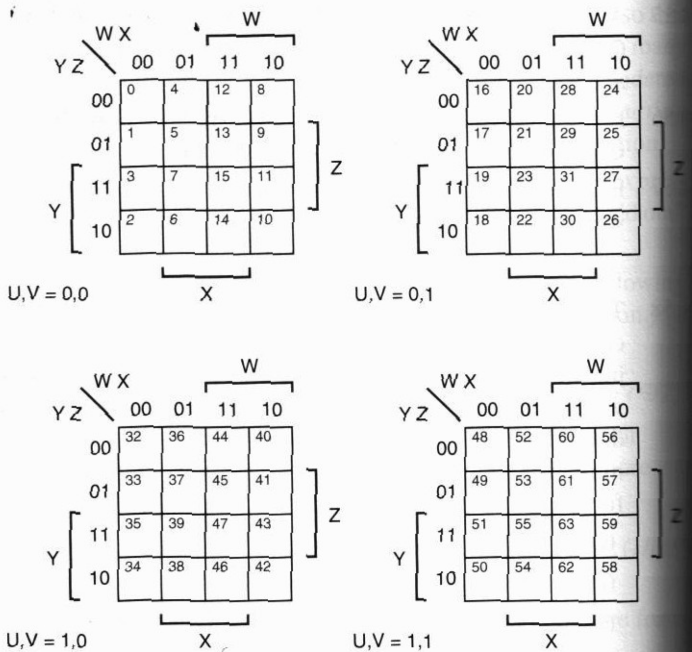


Figure X4.60

6-variable Karnaugh map

4.60 A Karnaugh map for a 6-variable function can be drawn as shown in Figure X4.60. In such a map, cells that occupy the same relative position in adjacent submaps are considered to be adjacent. Minimize the following functions using 6-variable maps:

(a) $F = \Sigma_{U,V,W,X,Y,Z}(1,5,9,13,21,23,29,31,37,45,53,61)$

(b) $F = \Sigma_{U,V,W,X,Y,Z}(0,4,8,16,24,32,34,36,37,39,40,48,50,56)$

(c) $F = \Sigma_{U,V,W,X,Y,Z}(2,4,5,6,12\text{–}21,28\text{–}31,34,38,50,51,60\text{–}63)$