DLD

Department of Computer Science & IT
Hazara University Mansehra

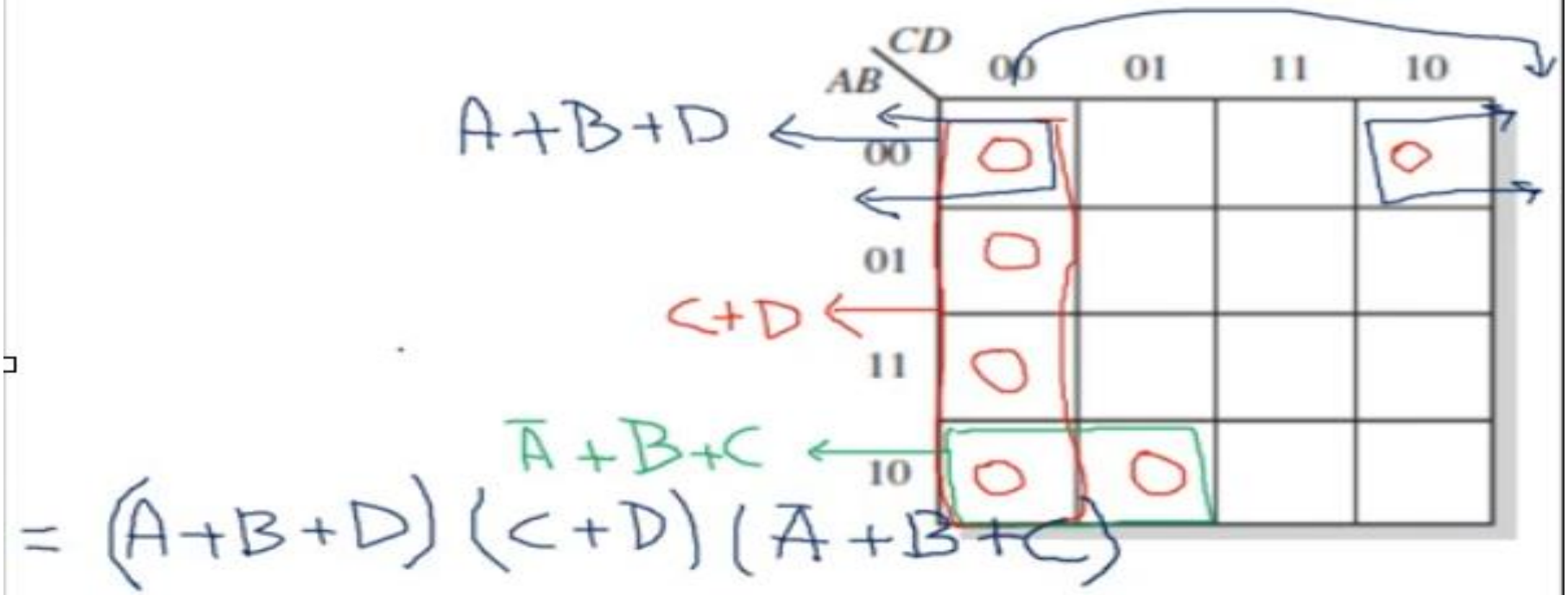
Simplification of POS Expression using K-Map

EXAMPLE 4–35

Use a Karnaugh map to minimize the following POS expression:

$$(B + C + D)(A + B + \overline{C} + D)(\overline{A} + B + C + \overline{D})(A + \overline{B} + C + D)(\overline{A} + \overline{B} + C + D)$$

0000 0010 1011 0100 1100 1000



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

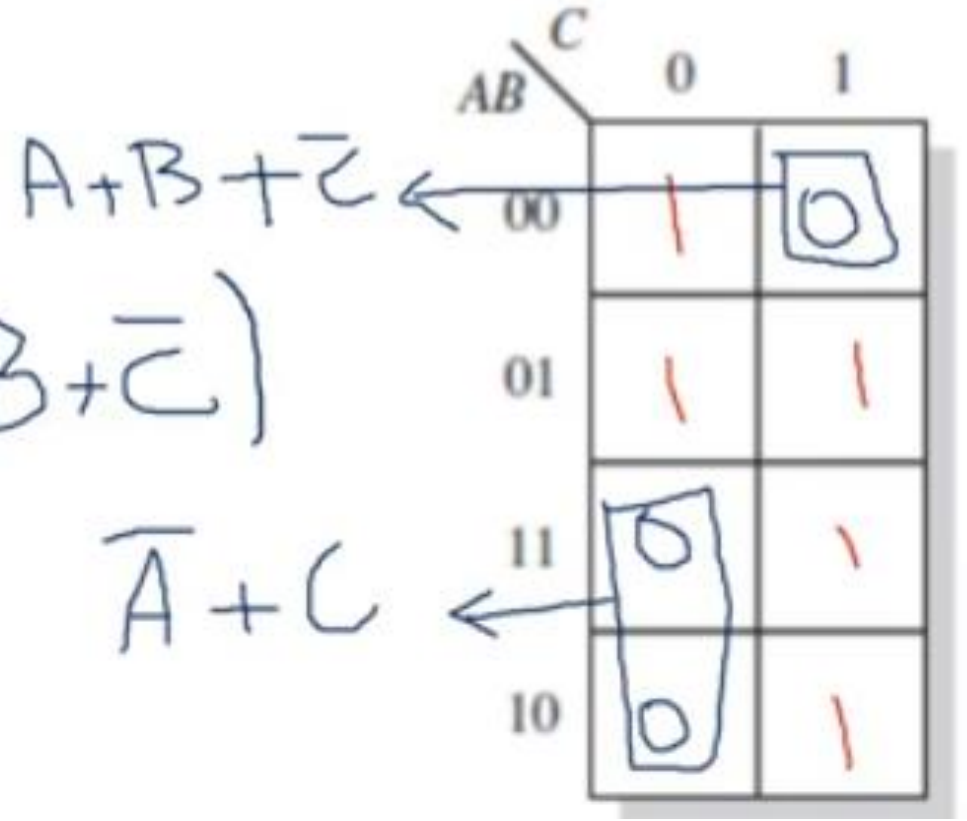
SOP to POS Conversion (Vice Versa) Using K-Map

EXAMPLE 4–19

Convert the following SOP expression to an equivalent POS expression:

$$\bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + \bar{A}BC + A\bar{B}C + ABC$$

000 010 011 101 111

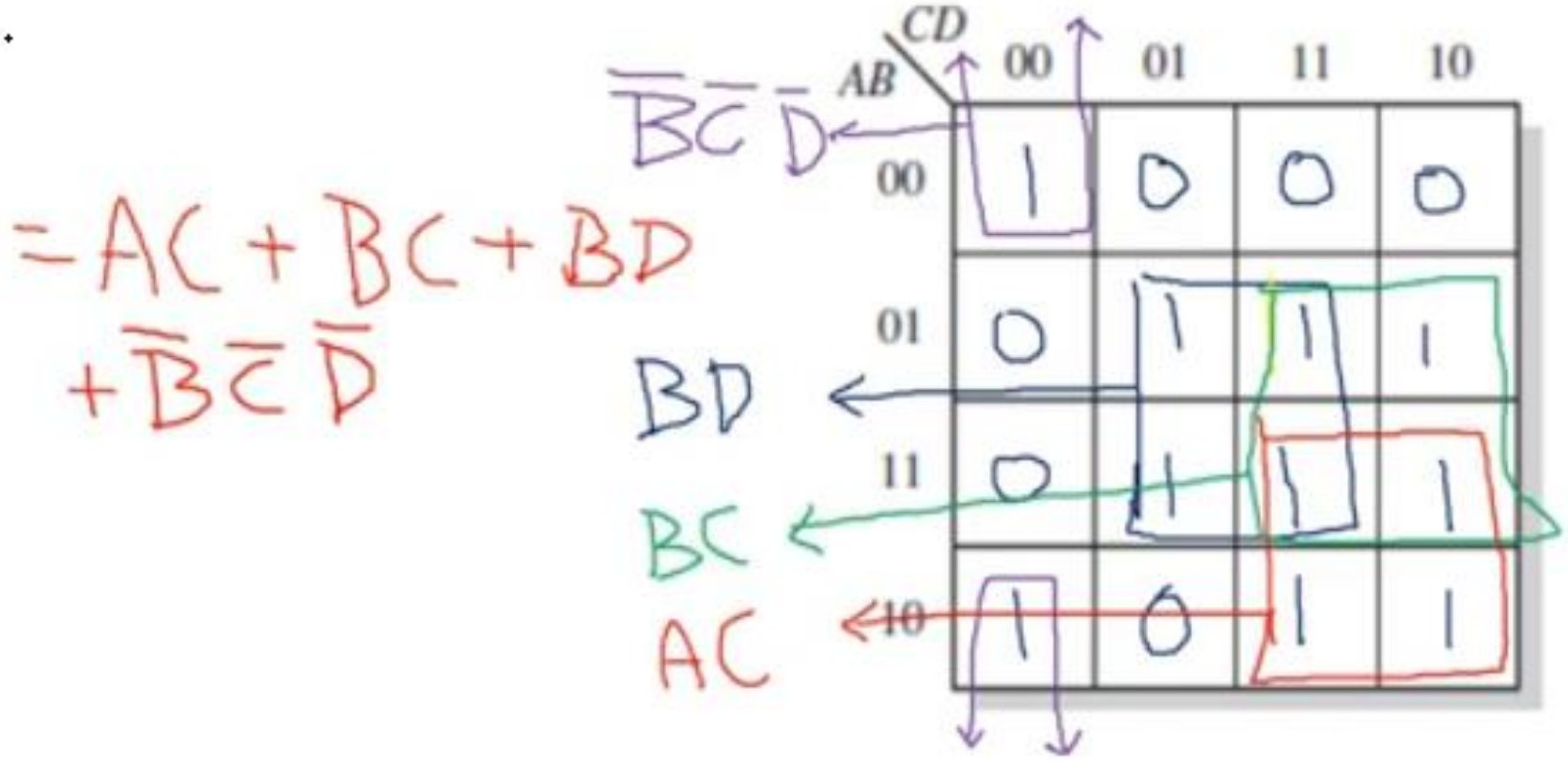


$= (\bar{A} + C)(A + B + \bar{C})$

EXAMPLE 4–36

Using a Karnaugh map, convert the following standard POS expression into a minimum SOP expression.

$(\overline{A} + \overline{B} + C + D)(A + \overline{B} + C + D)(A + B + C + \overline{D})(A + B + \overline{C} + \overline{D})(\overline{A} + B + C + \overline{D})(A + B + \overline{C} + D)$



“Don’t Care” Conditions in k-Map

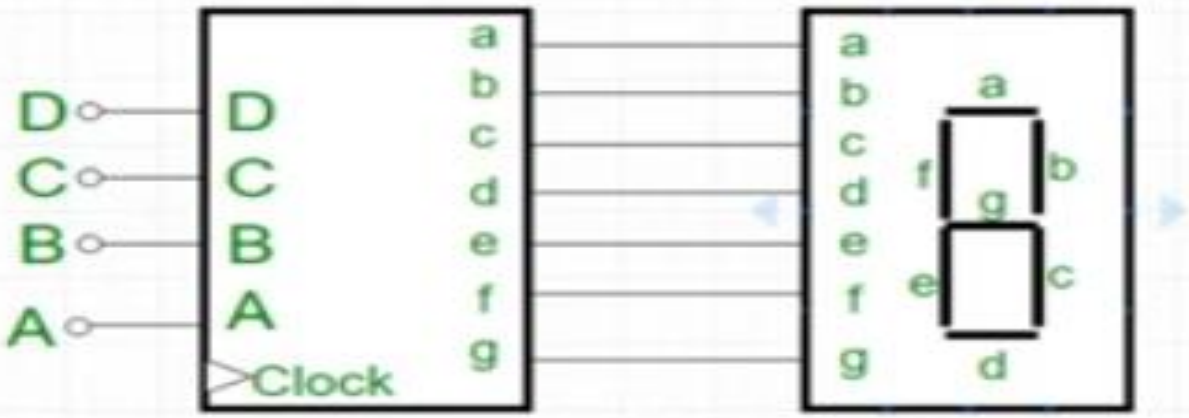
“Don’t Care” Conditions

- Sometimes a situation arises in which some input variable combinations are not allowed.
- For example, recall that in the BCD code, there are six invalid combinations: 1010, 1011, 1100, 1101, 1110, and 1111.
- Since these unallowed states will never occur in an application involving the BCD code, they can be treated as **“don’t care”** terms with respect to their effect on the output.
- That is, for these “don’t care” terms either a 1 or a 0 may be assigned to the output; it really does not matter since they will never occur.

"Don't Care" Conditions

- The "don't care" terms can be used to advantage on the Karnaugh map.
- For each "don't care" term, an X is placed in the cell. When grouping the 1s, the Xs can be treated as 1s to make a larger grouping.
- The larger a group, the simpler the resulting term will be.

7 Segment Display



BCD to 7 Segment Decoder

7- Segment LED Display

7 Segment Truth Table

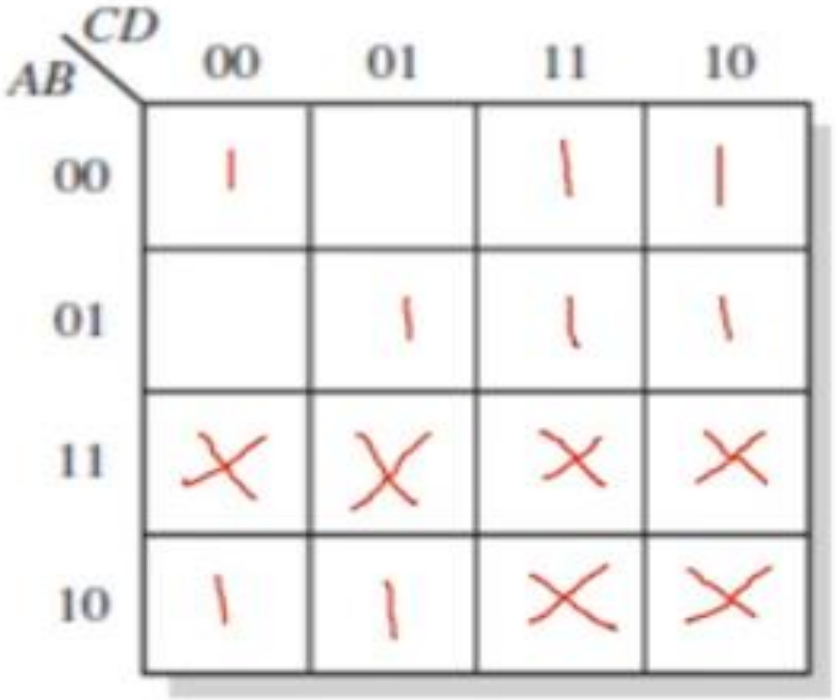
A	B	C	D	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	1	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1

EXAMPLE 4–32

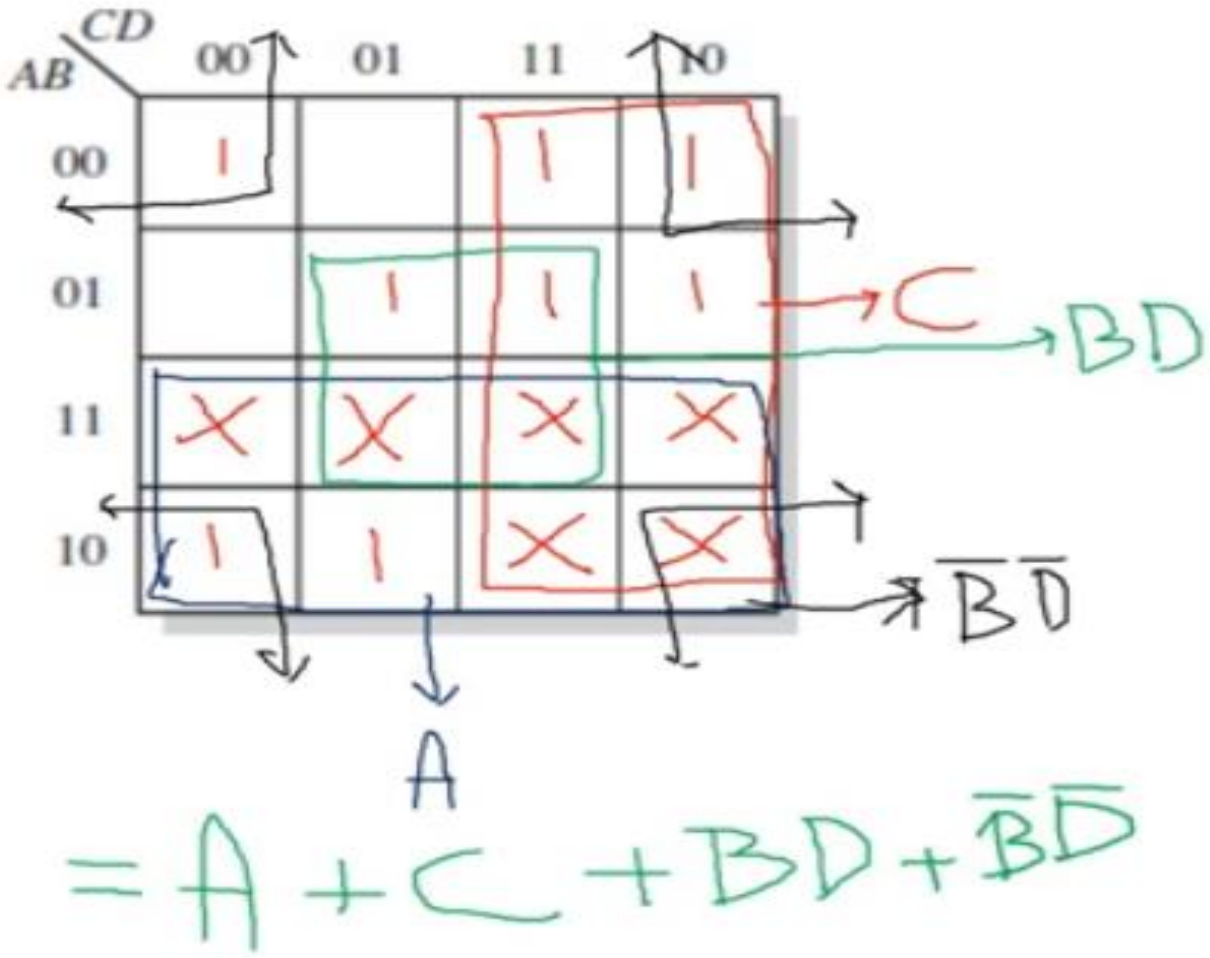
In a 7-segment display, each of the seven segments is activated for various digits. For example, segment *a* is activated for the digits 0, 2, 3, 5, 6, 7, 8, and 9, as illustrated in Figure 4–41. Since each digit can be represented by a BCD code, derive an SOP expression for segment *a* using the variables *ABCD* and then minimize the expression using a Karnaugh map.

FIGURE 4–41 7-segment display.

A	B	C	D	a
0	0	0	0	1
0	0	0	1	0
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	1
1	0	0	1	1
1	0	1	0	X
1	0	1	1	X
1	1	0	0	X
1	1	0	1	X
1	1	0	1	X
1	1	1	0	X
1	1	1	1	X

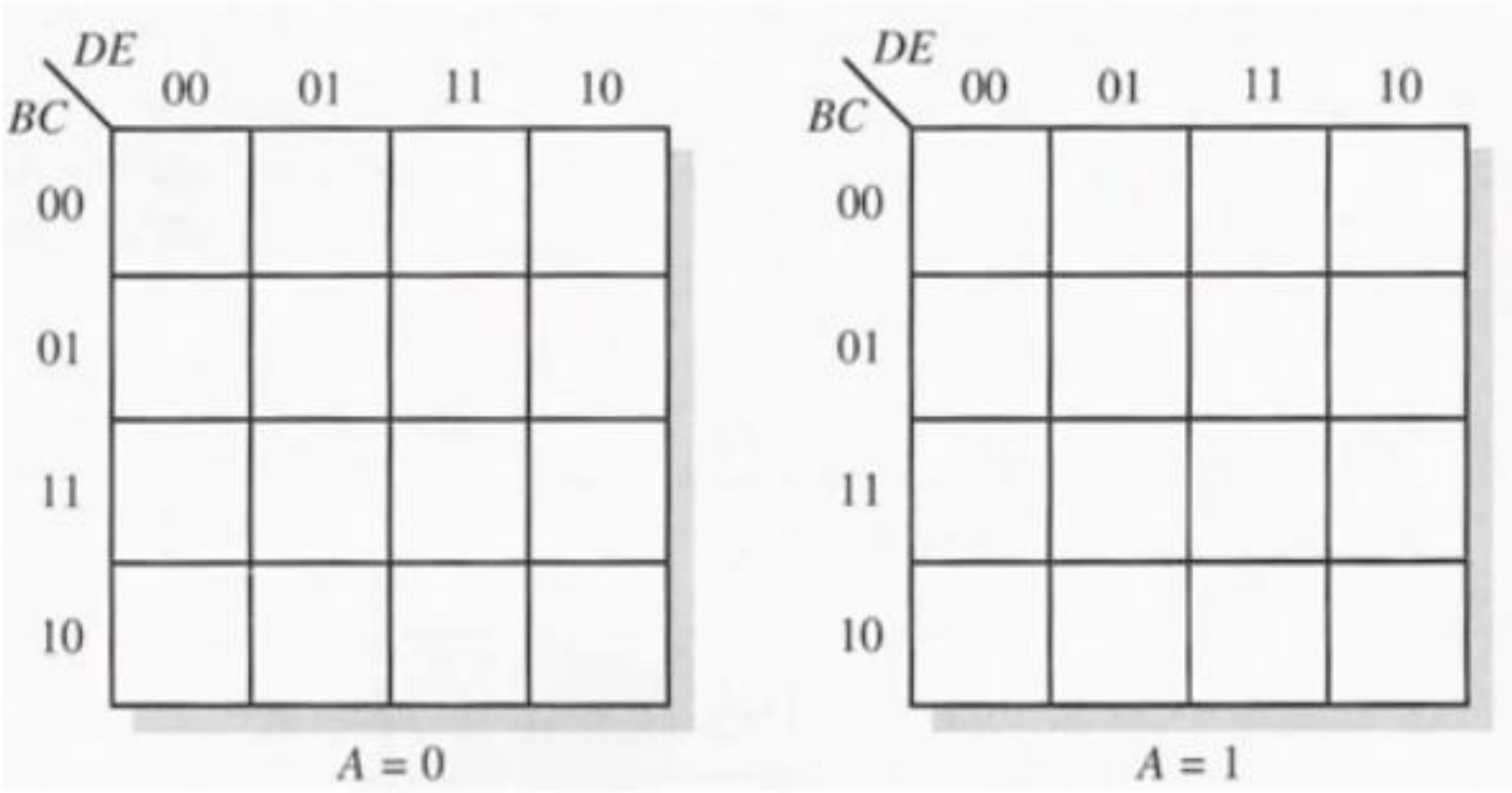


A	B	C	D	a
0	0	0	0	1
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	X
1	0	1	1	X
1	1	0	0	X
1	1	0	1	X
1	1	1	0	X
1	1	1	1	X

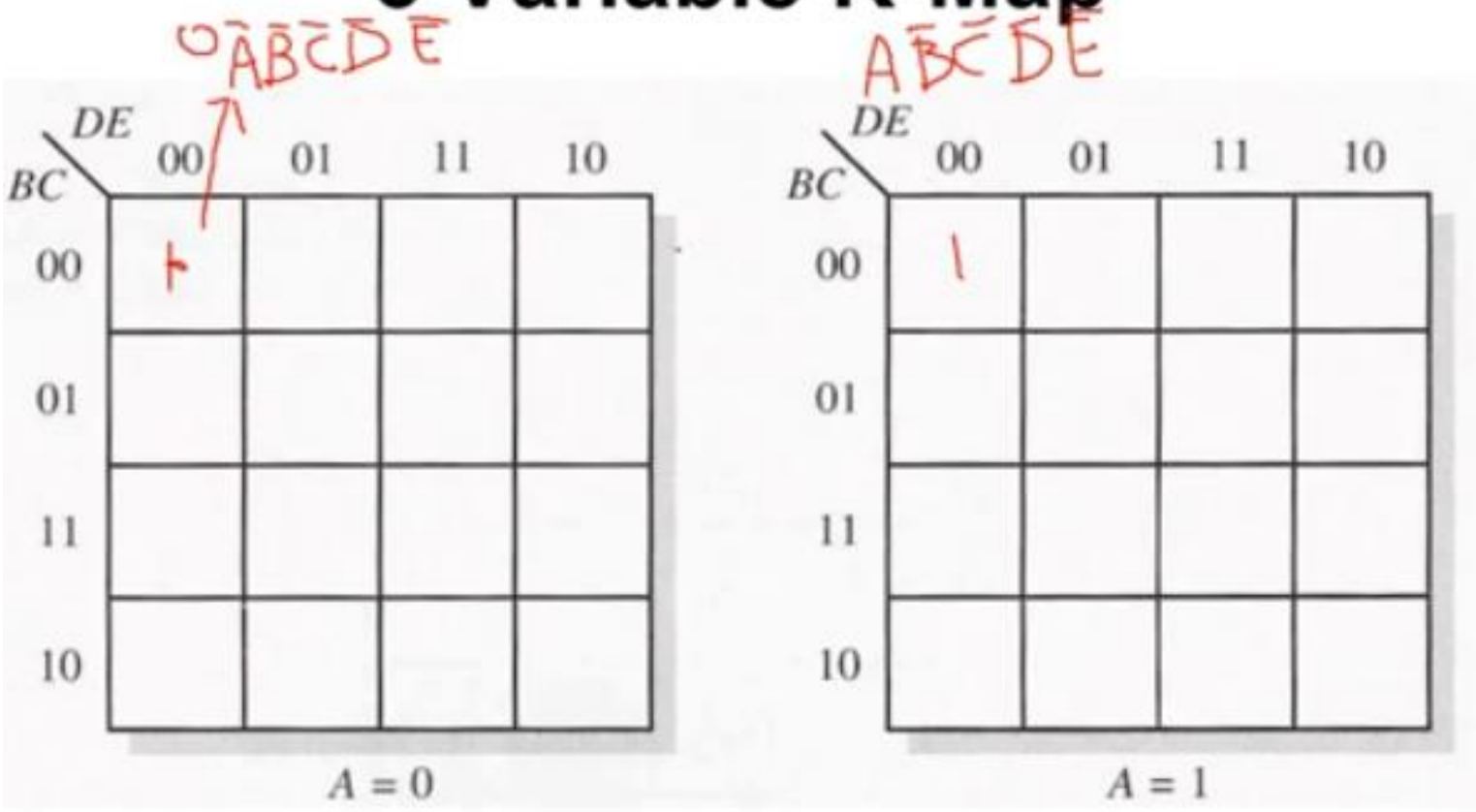


5 Variable Karnaugh Map

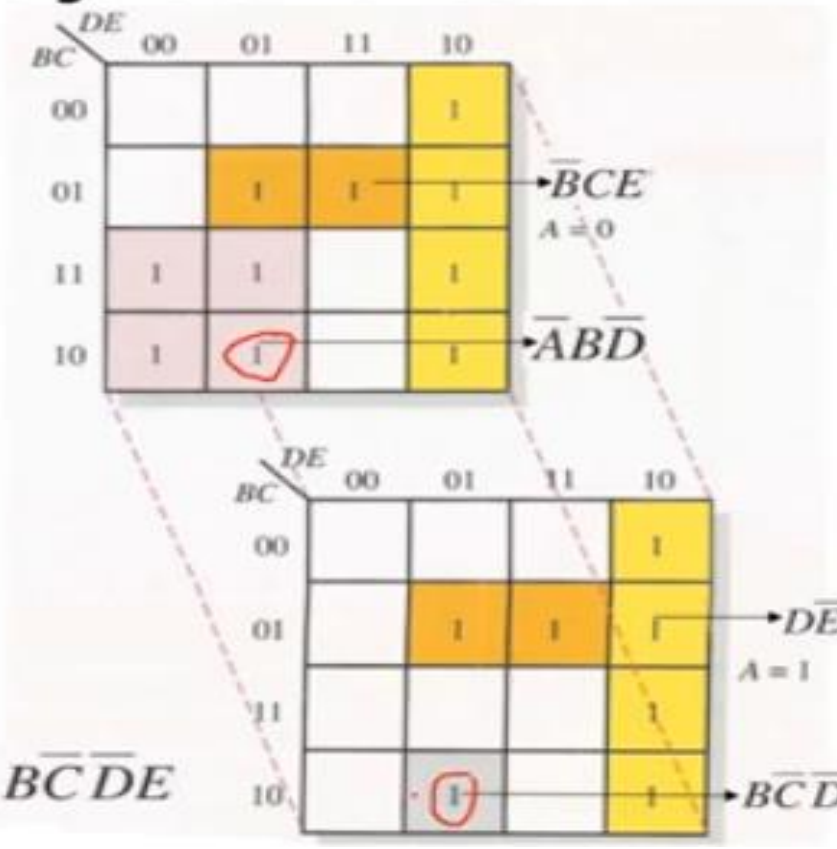
5 Variable K-Map



5 Variable K-Map



Cell Adjacencies

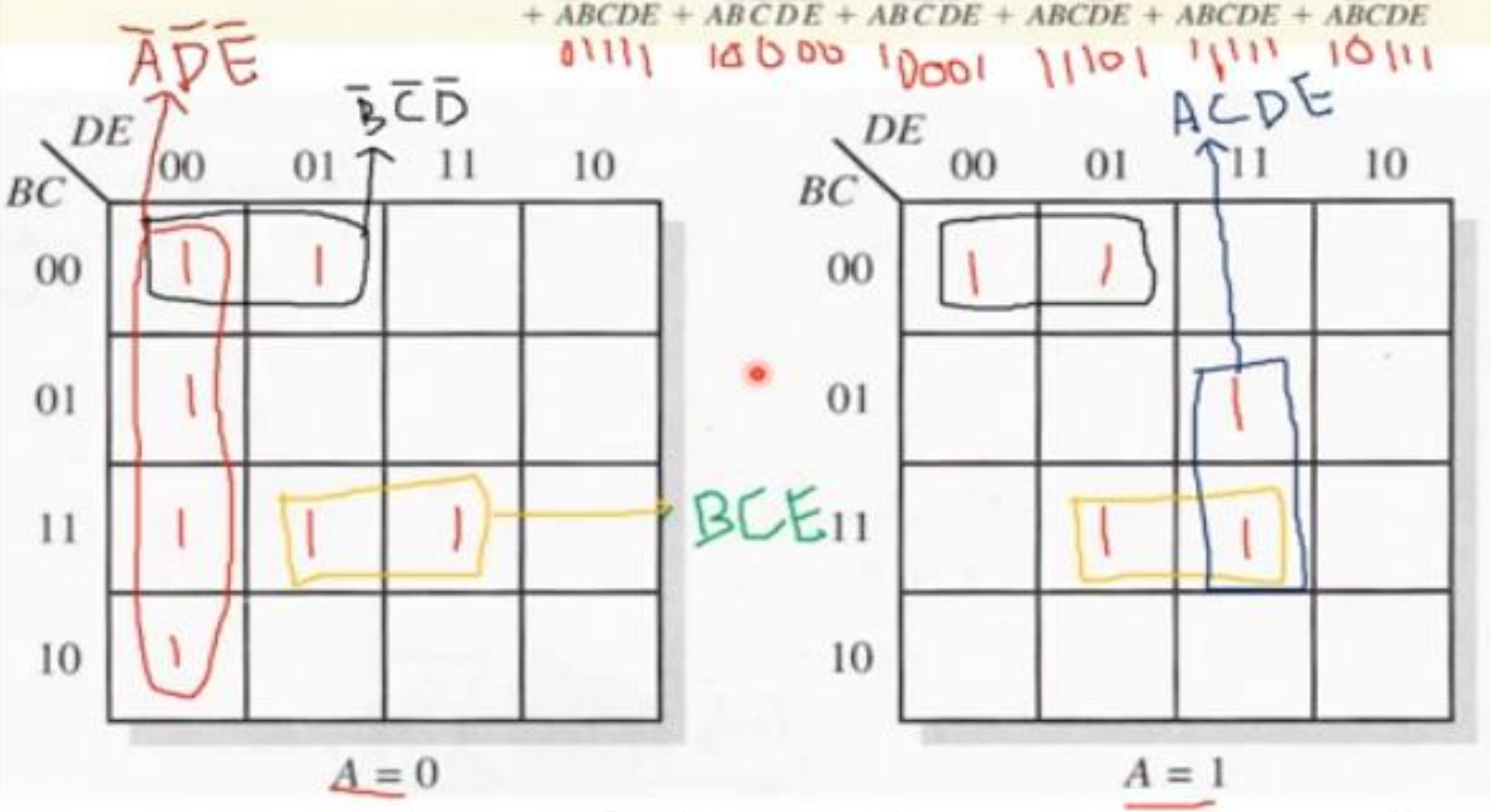


$$X = D\overline{E} + \overline{B}CE + \overline{A}B\overline{D} + B\overline{C}\,\overline{D}E$$

EXAMPLE 4–34

Use a Karnaugh map to minimize the following standard SOP 5-variable expression:

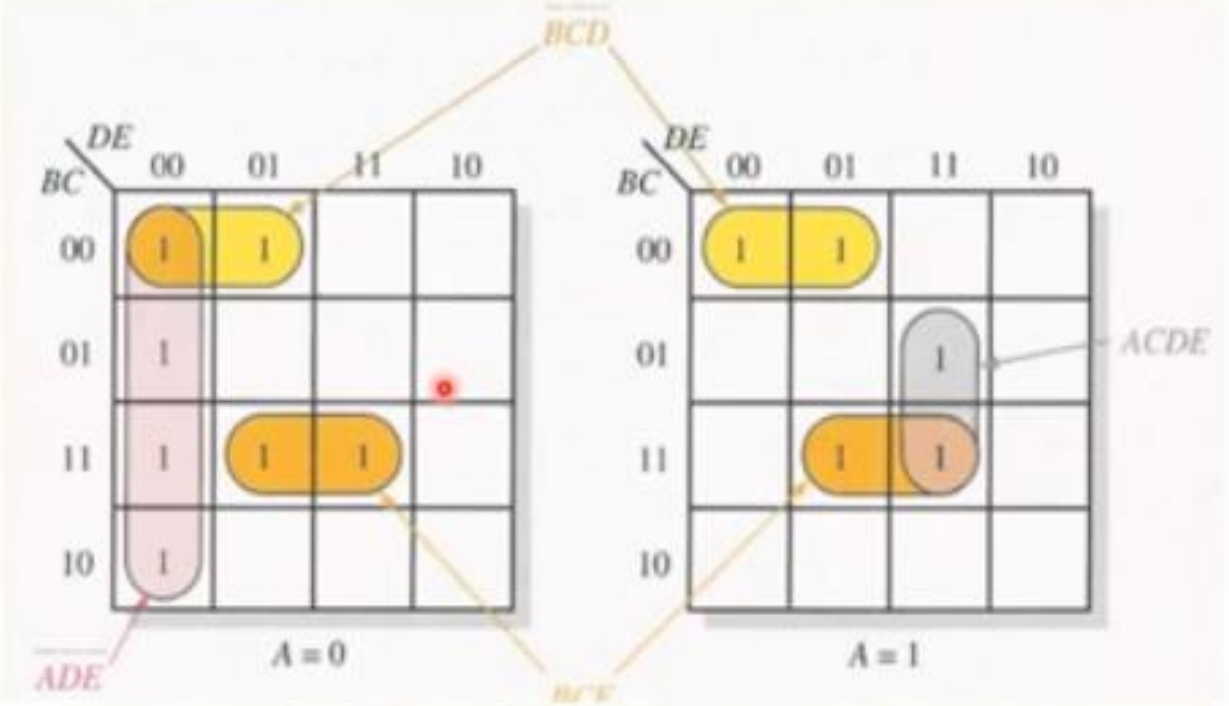
$$X = \bar{A}B\bar{C}D\bar{E} + \bar{A}BCD\bar{E} + ABCD\bar{E} + ABC\bar{D}\bar{E} + A\bar{B}C\bar{D}\bar{E} + \bar{A}BCDE$$
$$+ \bar{A}\bar{B}CDE + A\bar{B}\bar{C}D\bar{E} + A\bar{B}C\bar{D}E + ABC\bar{D}E + ABCDE + A\bar{B}CDE$$



EXAMPLE 4–34

Use a Karnaugh map to minimize the following standard SOP 5-variable expression:

$$X = \overline{A}B\overline{C}D\overline{E} + \overline{A}BCD\overline{E} + \overline{A}BC\overline{D}\overline{E} + \overline{A}BCD\overline{E} + A\overline{B}\overline{C}D\overline{E} + \overline{A}BCDE + \overline{A}\overline{B}\overline{C}D\overline{E} + A\overline{B}\overline{C}DE + ABC\overline{D}E + ABCDE + A\overline{B}CDE$$



$$X + \overline{A}D\overline{E} + \overline{B}\overline{C}D + BCE + ACDE$$