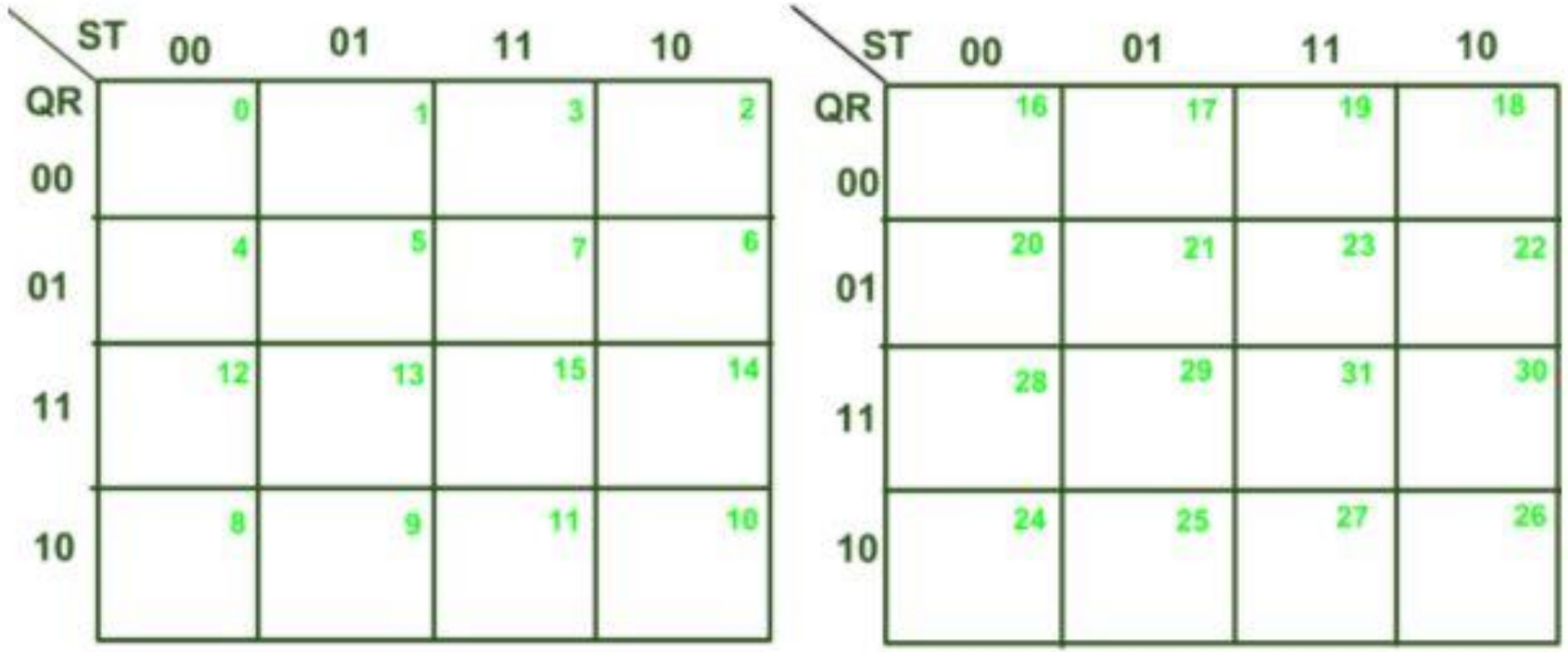
Digital Design

Lecture 8: Five Variable K-map

5- Variable K -Map

The structure of such a K-Map for SOP expression is given below :



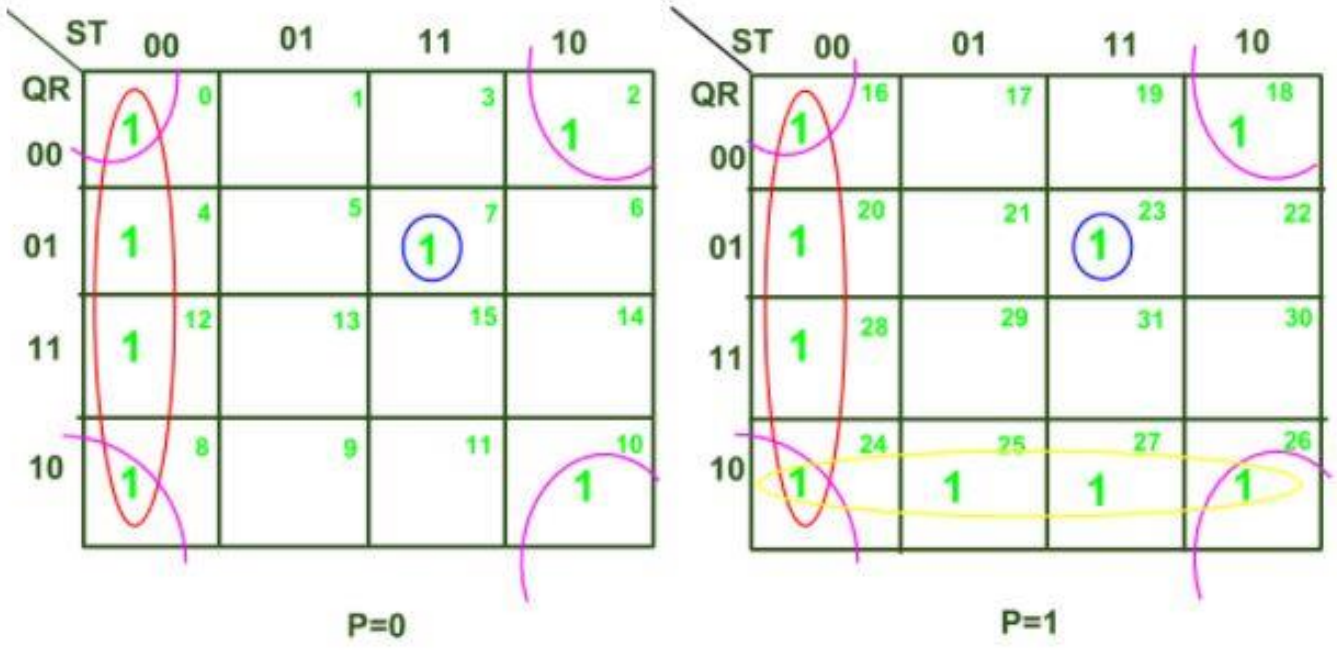
P=0 F(P,Q,R,S,T) P=1

Minimization of Boolean Expression by 5 Variable K-Map (SOP form)

I. Solving SOP function –

For clear understanding, let us solve the example of SOP function minimization of 5 Variable K-Map using the following expression :

$$\sum m(0, 2, 4, 7, 8, 10, 12, 16, 18, 20, 23, 24, 25, 26, 27, 28)$$



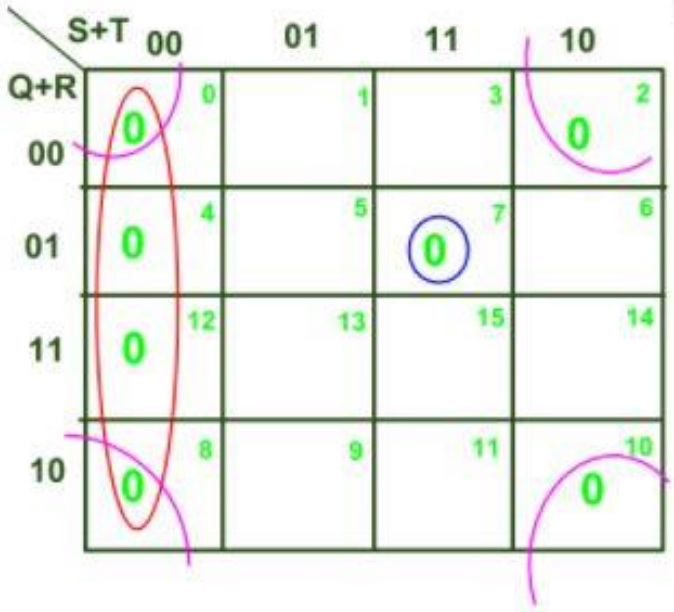
F(PQRST) = S'T' +Q'RST + PQR' +R'T'

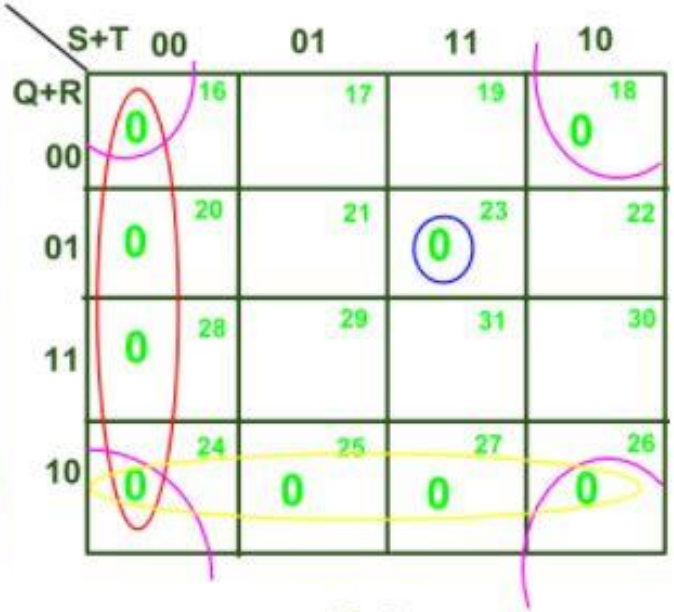
Minimization of Boolean Expression by 5 Variable K-Map (POS form)

II. Solving POS function –

Now, let us solve the example of POS function minimization of 5 Variable K-Map using the following expression :

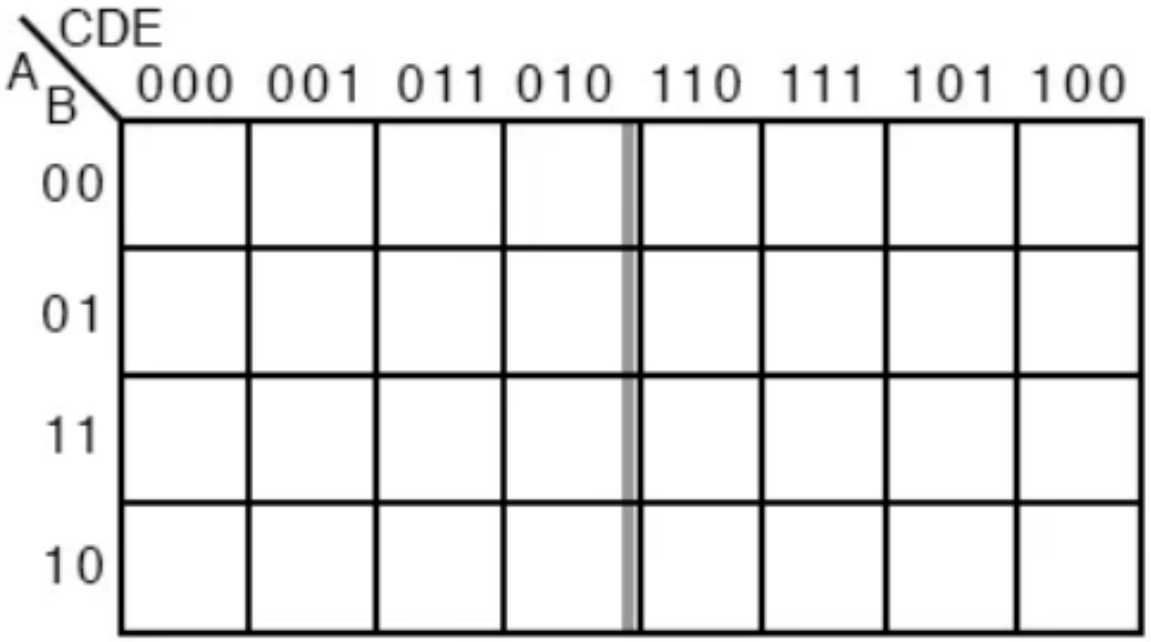
$$\prod M(0, 2, 4, 7, 8, 10, 12, 16, 18, 20, 23, 24, 25, 26, 27, 28)$$





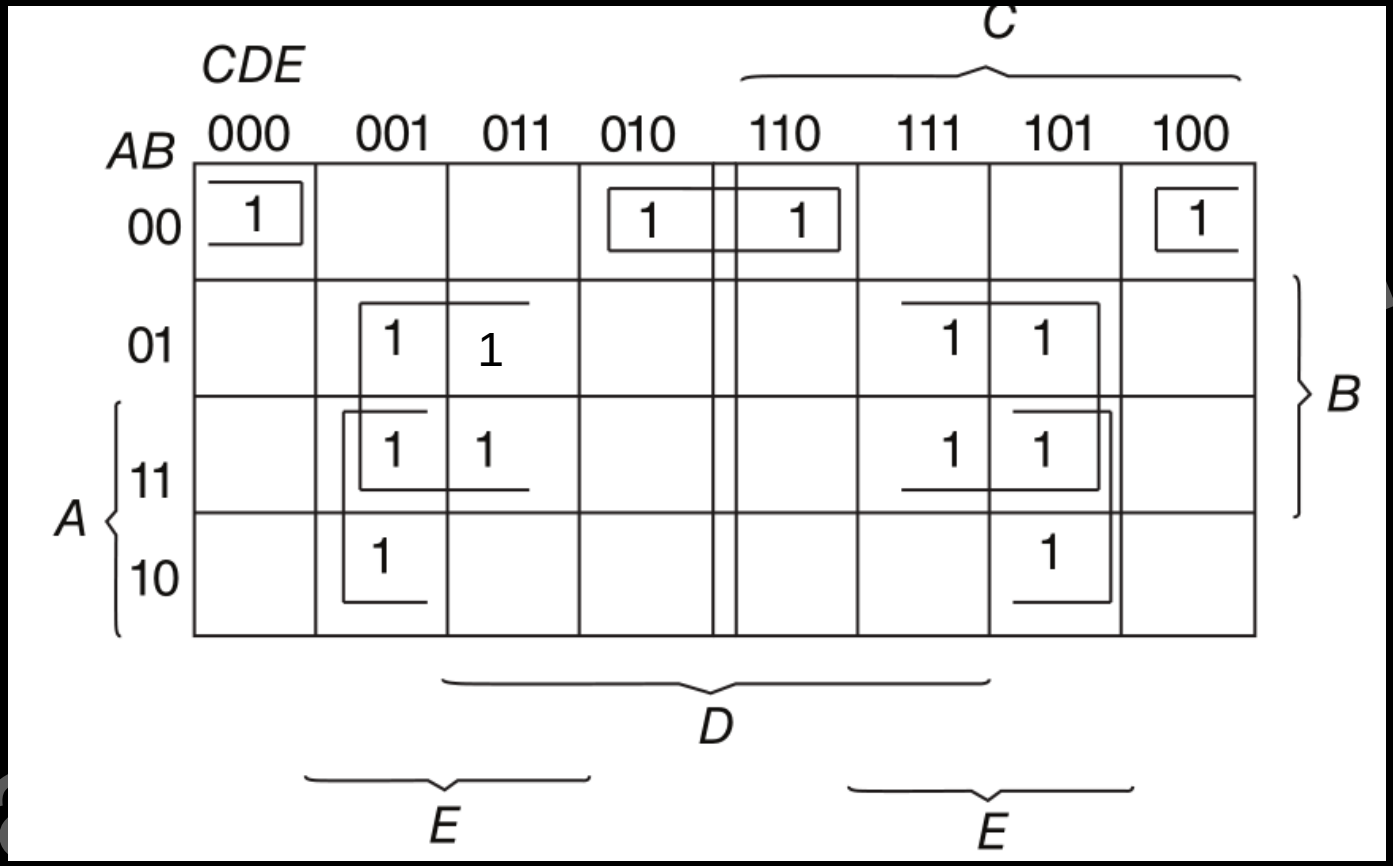
f(PQRST) = (S+T) . (R+T) . (Q+R'+S'+T') . (P'+Q'+R)

Five Variable K-map

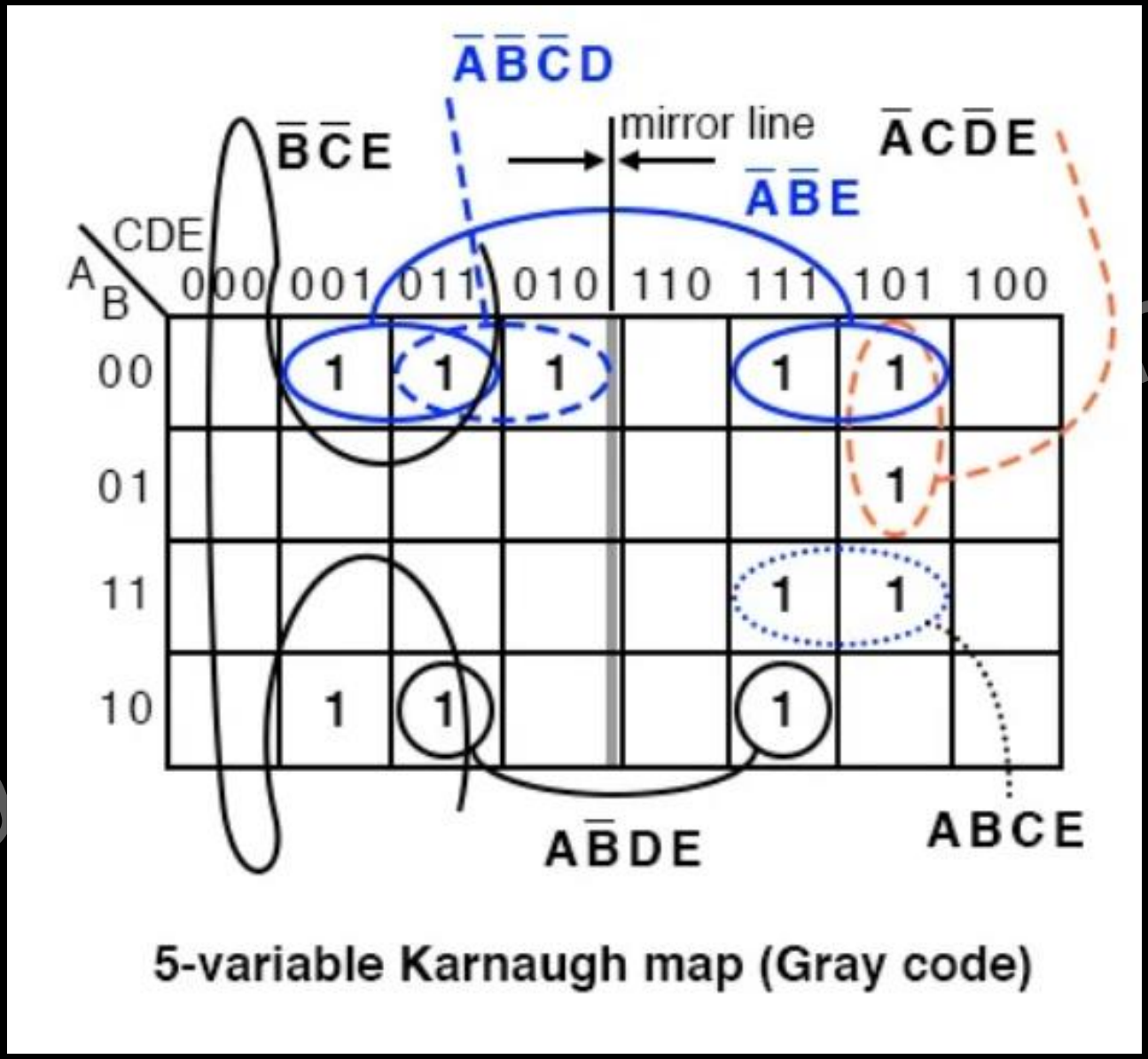


5-variable Karnaugh map (Gray code)

$F(A, B, C, D, E) = \sum(0, 2, 4, 6, 9, 11, 13, 15, 17, 21, 25, 27, 29, 31)$

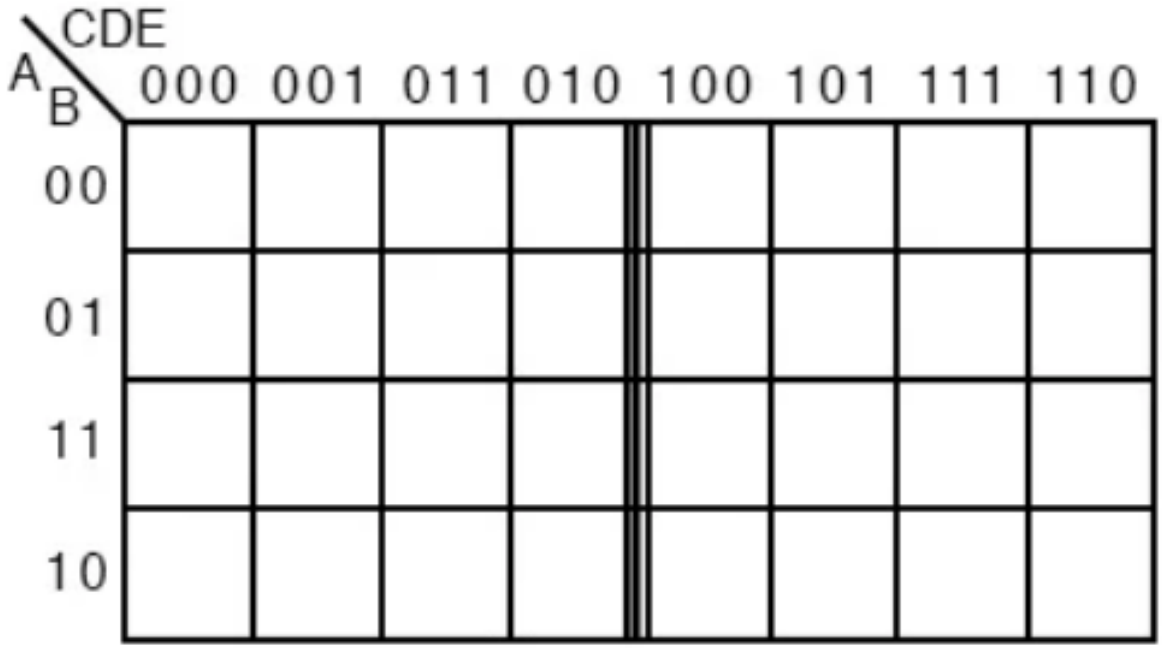


$BE + AD'E + A'B'E'$

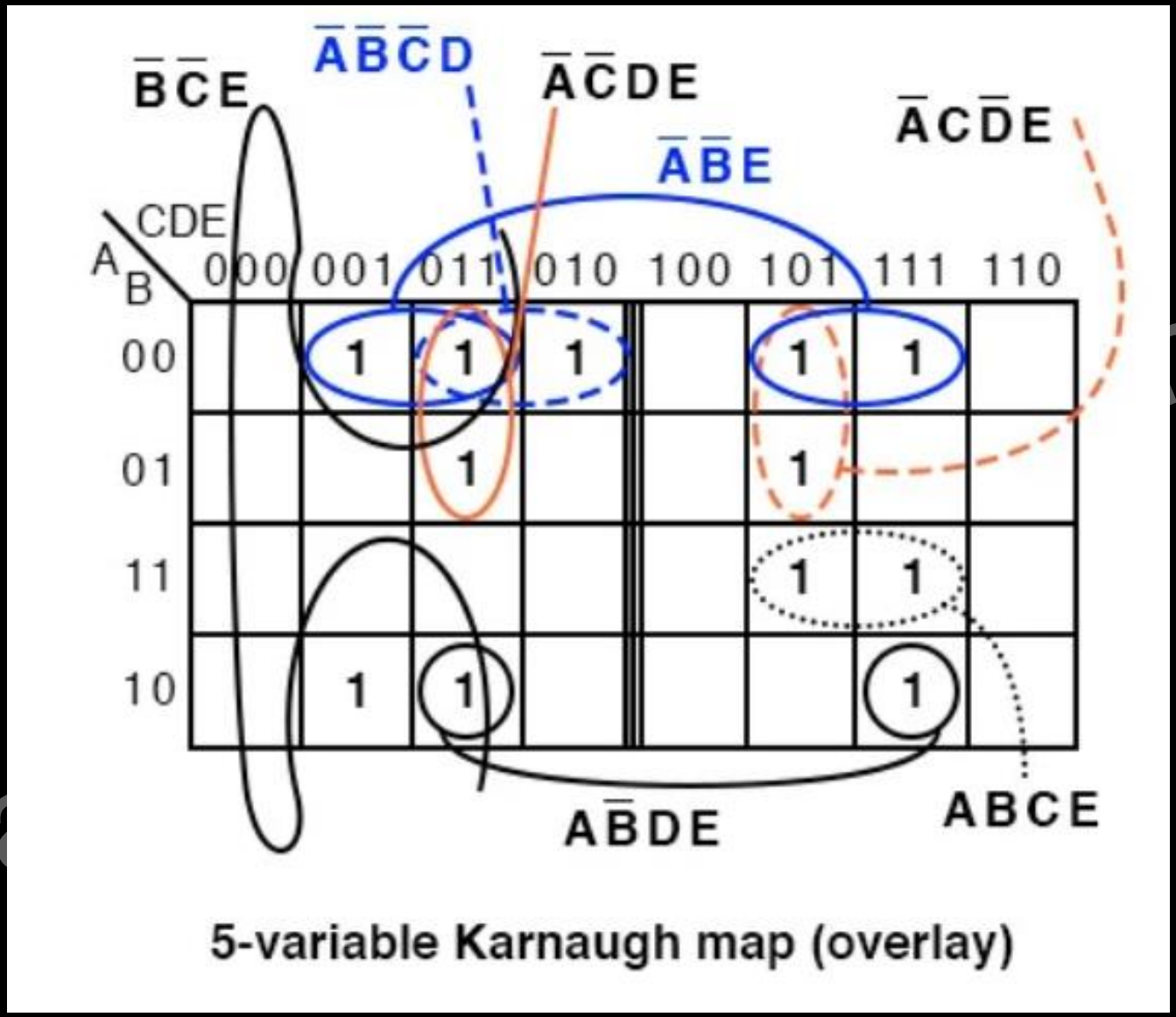


5-variable Karnaugh map (Gray code)

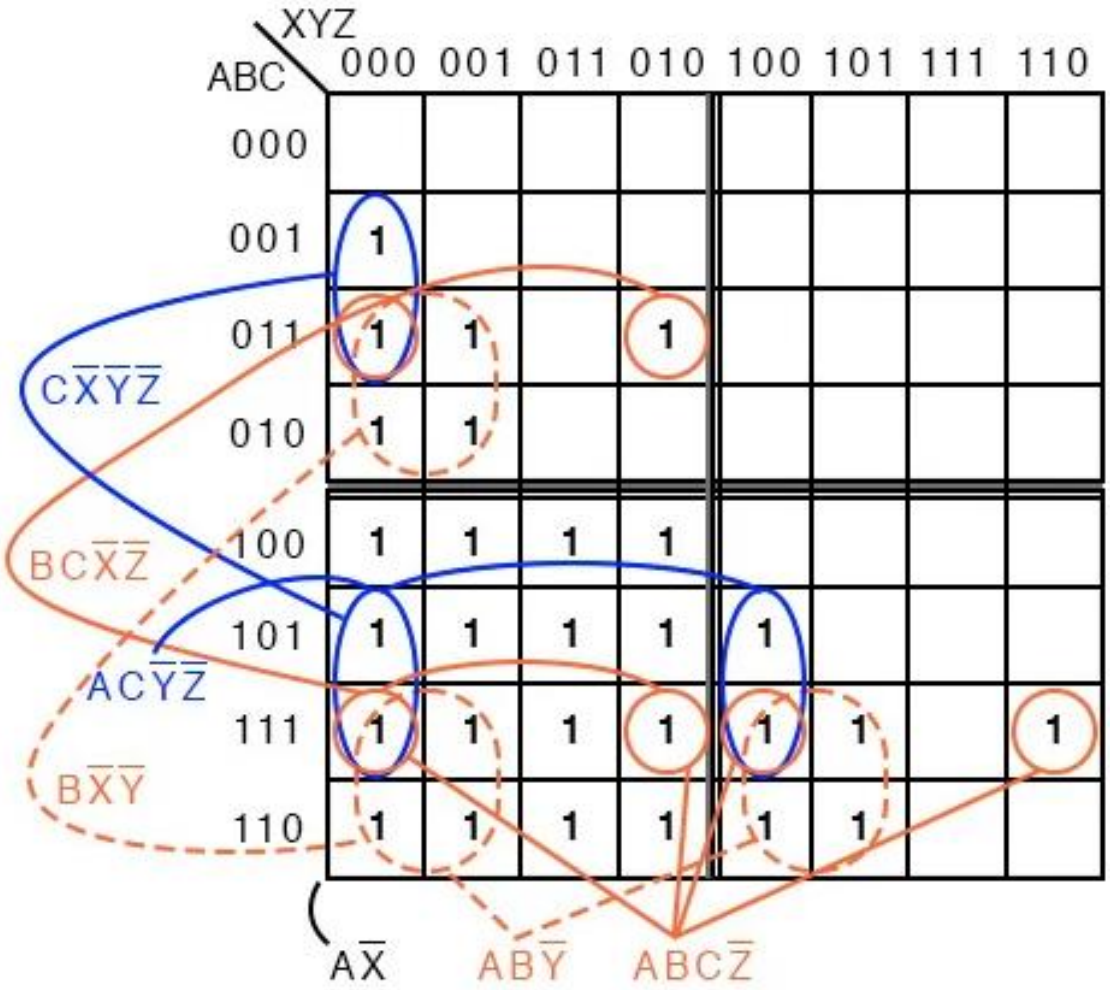
Overlay Version of the K-map



5-variable Karnaugh map (overlay)



5-variable Karnaugh map (overlay)



$$\text{Out} = A\bar{X} + AB\bar{Y} + B\bar{X}\bar{Y} + ABC\bar{Z} + AC\bar{Y}\bar{Z} + BC\bar{X}\bar{Z} + C\bar{X}\bar{Y}\bar{Z}$$

6 - variable Karnaugh map (overlay)

Complements

Decimal	S.M.	1's comp.	2's comp.
7	0111	0111	0111
6	0110	0110	0110
5	0101	0101	0101
4	0100	0100	0100
3	0011	0011	0011
2	0010	0010	0010
1	0001	0001	0001
0	0000	0000	0000
-0	1000	1111	–
-1	1001	1110	1111
-2	1010	1101	1110
-3	1011	1100	1101
-4	1100	1011	1100
-5	1101	1010	1011
-6	1110	1001	1010
-7	1111	1000	1001
-8	–	–	1000

Advantages of 2's Complement

- **Two Zeros**
- **No End-around-carry-bit addition**

Add 4 & -7

0100
1001
1101

Add 4 & -3

0100
1101
1 0001

Complements

Overflow in 2's Complement

Add 4 & -3

```
  0100
  1101
1 0001
```

Add -4 & -5

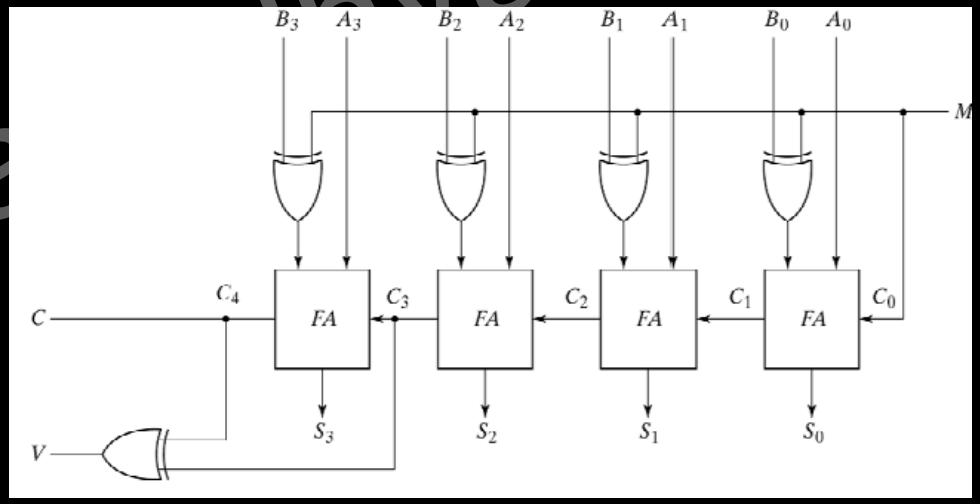
```
  1100
  1011
1 0111
```

Add -8 & 4

```
  1000
  0100
  1100
```

Add 4 & 4

```
  0100
  0100
  1000
```



Thank You