

Offline - 3

1 bit full SubTRACTOR

Given

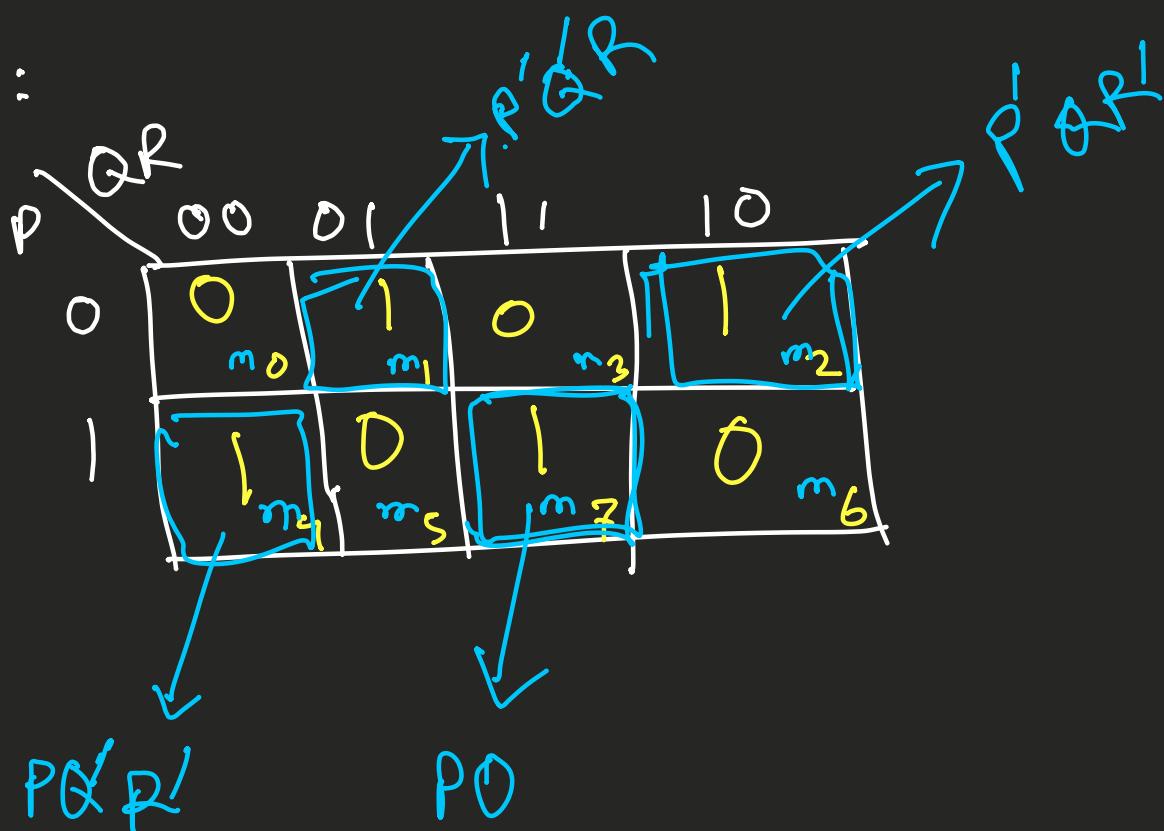
P	minuend
Q	Subtrahend
R	previous borrow
D	Difference
B	Output borrow

truth table

P	Q	R	D	B
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

K-map for minimal SOP form of

$D :$



$$\begin{aligned}
 D &= PQR + P'Q'R' + P'Q'R' + P'Q'R \\
 &\equiv R(PQ + P'Q') + R'(P'Q + PQ') \\
 &= R \cdot \overline{P \oplus Q} + R' \cdot \underbrace{P \oplus Q}_{\begin{cases} A \oplus B = \overline{AB} + \overline{A}\overline{B} \\ \overline{A \oplus B} = \overline{\overline{AB}} + A\overline{B} \end{cases}} \\
 &= P \oplus Q \oplus R
 \end{aligned}$$

Logical Expression for B

$$\begin{aligned}
 B &= P'Q'R + P'QR' + P'QR + PQR \\
 &= P'Q'R + PQR + P'QR' + P'QR \\
 &= R(P'Q' + P \cdot Q) + P'Q(R' + R) \\
 &= R(P \oplus Q) + P'Q
 \end{aligned}$$

