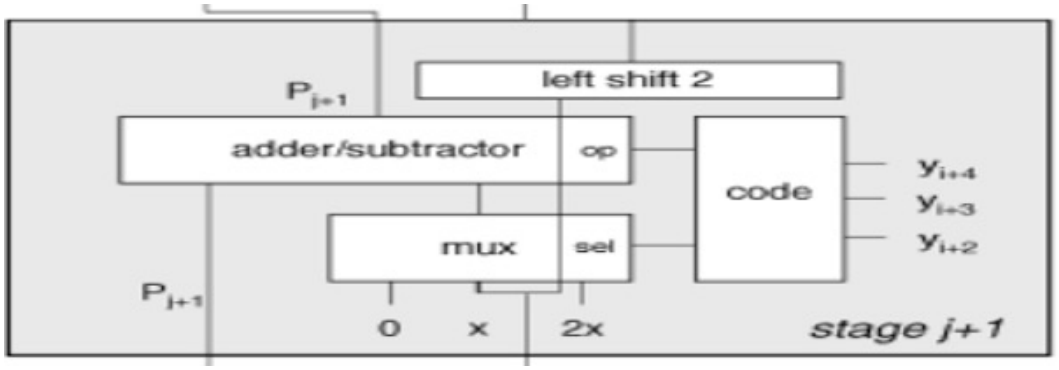
# Booth Multiplier Hardware Design

# Booth Encoder Hardware Design

| $y_i\ y_{i-1}\ y_{i-2}$ | increment |
|---|---|
| 0 0 0 | 0 |
| 0 0 1 | x |
| 0 1 0 | x |
| 0 1 1 | 2x |
| 1 0 0 | -2x |
| 1 0 1 | -x |
| 1 1 0 | -x |
| 1 1 1 | 0 |

***OP=1 -> subtraction***

***OP=0 -> addition***




| A | B | C | OP | S1 | S0 |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 | 0 | 0 |

X=001010 ($10_{10}$) & Y=101011 ($-21_{10}$)

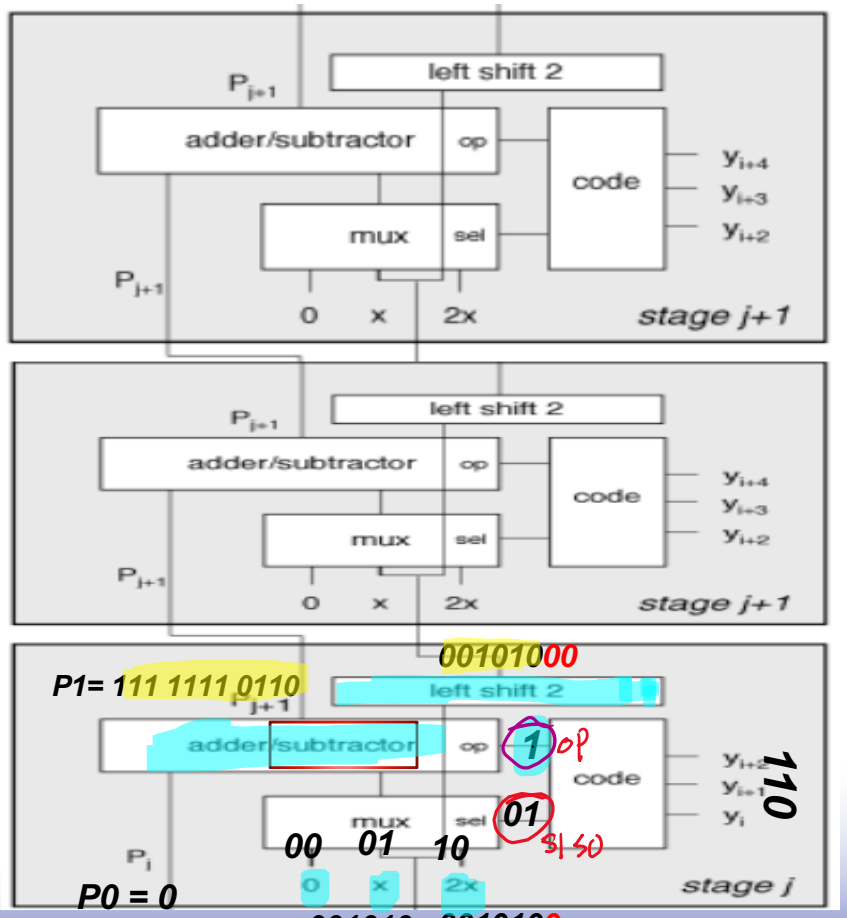
$Y_1Y_0Y_{-1} = 110$, $P_1 = P_0 – (001010)$
$= 111\ 1111\ 0110$
$Y_3Y_2Y_1 = 101$, $P2 = P1 – (00101000)$
$= 111\ 1100\ 1110$
$Y_5Y_4Y_3 = 101$, $P3 = P2 – (0010100000)$
$= 111\ 0010\ 1110$
$= -210_{10}$

X=001010 ($10_{10}$) & Y=101011 ($-21_{10}$)

**Step 1**

$Y_1Y_0Y_{-1} = 110$, $P_1 = P_0 - (001010)$
$= 111\ 1111\ 0110$
$Y_3Y_2Y_1 = 101$, $P2 = P1 - (00101000)$
$= 111\ 1100\ 1110$
$Y_5Y_4Y_3 = 101$, $P3 = P2 - (0010100000)$
$= 111\ 0010\ 1110$
$= -210_{10}$

| $y_i\ y_{i-1}\ y_{i-2}$ | increment |
|---|---|
| 0 0 0 | 0 |
| 0 0 1 | x |
| 0 1 0 | x |
| 0 1 1 | 2x |
| 1 0 0 | -2x |
| 1 0 1 | -x |
| 1 1 0 | -x |
| 1 1 1 | 0 |




**Step 1**

***OP=1 -> subtraction***
***OP=0 -> addition***

X=001010 ($10_{10}$) & Y=101011 ($-21_{10}$)

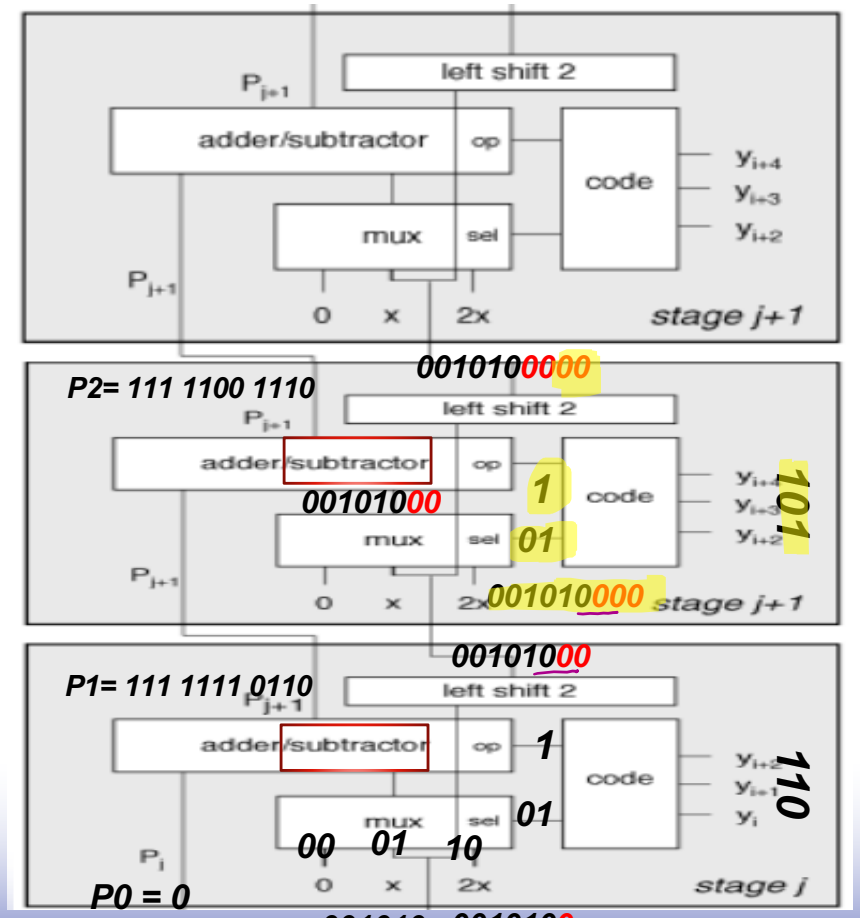
$Y_1Y_0Y_{-1} = 110$, $P_1 = P_0 - (001010)$
$= 111\ 1111\ 0110$

**Step 2** $Y_3Y_2Y_1 = 101$, $P2 = P1 - (00101000)$
$= 111\ 1100\ 1110$

$Y_5Y_4Y_3 = 101$, $P3 = P2 - (0010100000)$
$= 111\ 0010\ 1110$
$= -210_{10}$

| $y_i\ y_{i-1}\ y_{i-2}$ | increment |
|---|---|
| 0 0 0 | 0 |
| 0 0 1 | x |
| 0 1 0 | x |
| 0 1 1 | 2x |
| 1 0 0 | -2x |
| 1 0 1 | -x |
| 1 1 0 | -x |
| 1 1 1 | 0 |

**Step 2**




*OP=1 -> subtraction*
*OP=0 -> addition*

X=001010 ($10_{10}$) & Y=101011 ($-21_{10}$)

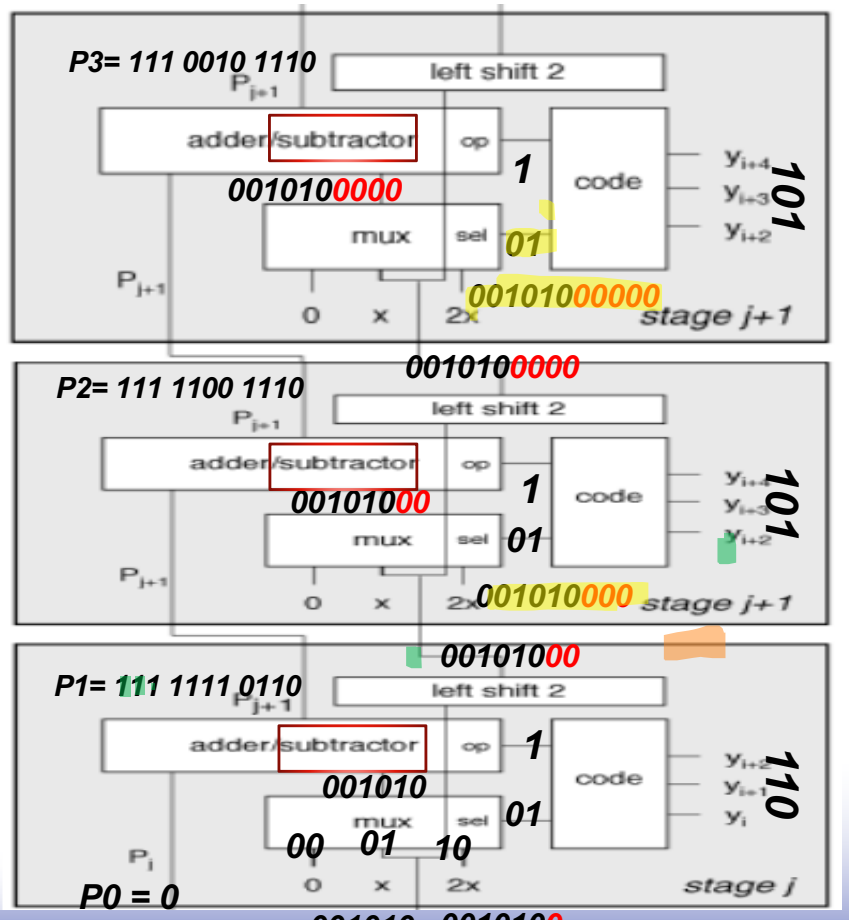
$Y_1Y_0Y_{-1} = 110$, $P_1 = P_0 - (001010)$
$= 111\ 1111\ 0110$

$Y_3Y_2Y_1 = 101$, $P2 = P1 - (00101000)$
$= 111\ 1100\ 1110$

**Step 3** $Y_5Y_4Y_3 = 101$, $P3 = P2 - (0010100000)$
$= 111\ 0010\ 1110$
$= -210_{10}$

| $y_i\ y_{i-1}\ y_{i-2}$ | increment |
|---|---|
| 0 0 0 | 0 |
| 0 0 1 | x |
| 0 1 0 | x |
| 0 1 1 | 2x |
| 1 0 0 | -2x |
| 1 0 1 | -x |
| 1 1 0 | -x |
| 1 1 1 | 0 |

**Step 3**




***OP=1 -> subtraction***
***OP=0 -> addition***