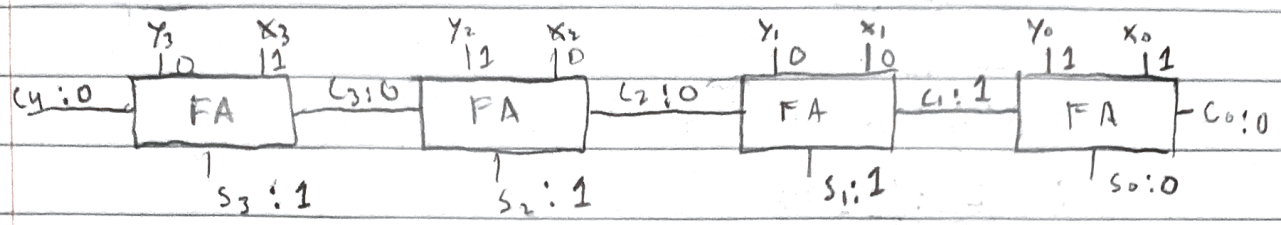
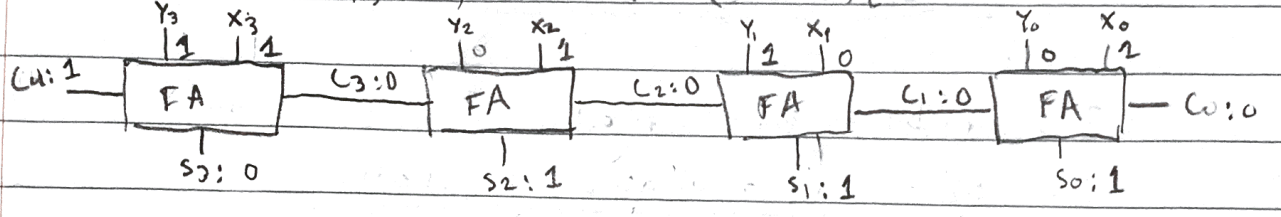
Homework 4

1a. $X = (9)_{10} = (1001)_2$, $Y = (5)_{10} = (0101)_2$



1b) $S_3S_2S_1S_0 = (1110)_2 = (14)_{10}$ carry_out : 0

1c) $X = (13)_{10} = (1101)_2$, $Y = (10) = (1010)_2$



$S_3S_2S_1S_0 = (0111)_2 = (7)_{10}$ carry_out : 1

The sum is not correct, because the 4-bit input values sums are higher than the max value of a 4 bit binary number. We also know that the sum is incorrect by the fact that the carry-out is 1.

1d. $\Delta T_g(2N)$ From c_0 4 bit Adder = $N = 4$

$\Delta T_g(2N+1)$ From x_0 or y_0

$\Delta T_g(2(4)) = 8$

$\Delta T_g(2(4)+1) = 9$

It has an 8 to 9 gate delays

2a. $r0 = a0 \oplus b0 \oplus c0$ ... $c0 = 0$

$\therefore$ $\underline{r0 = a0 \oplus b0}$

$c1 = a0b0 + b0c0 + a0c0$ $\quad c0 = 0$

$\therefore$ $\underline{c1 = a0 \cdot b0}$

2b. $r1 = a1 \oplus b1 \oplus c1$ $\quad c1 = a0 \cdot b0$

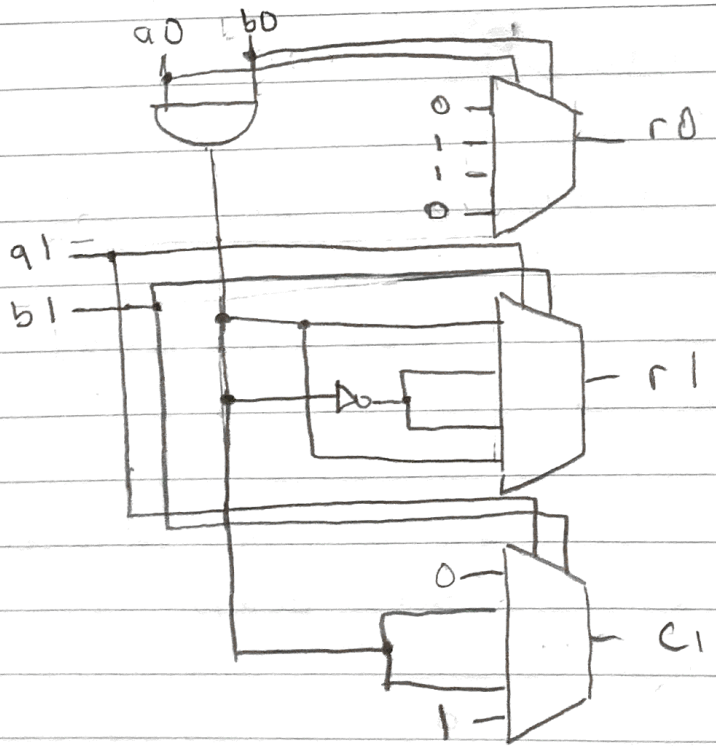
$\therefore$ $\underline{r1 = a1 \oplus b1 \oplus (a0b0)}$

$c2 = a1b1 + b1c1 + a1c1$ $\quad c1 = a0 \cdot b0$

$\therefore$ $\underline{c2 = a1b1 + b1a0b0 + a1a0b0}$

$\underline{\text{or } c2 = a1b1 + (a0b0)(a1 \oplus b1)}$

2c



3 aii) $A = (7)_{10} = (0111)_2$ $B = (7)_{10} = (0111)_2$ B complement $= (1000)_2$

c_in = 1, so $B' = 1001$

$$\begin{array}{r} {\scriptstyle 1\ 1\ 1\ \ } \\ 0111 \\ +\ 1001 \\ \hline 10000 \end{array} \rightarrow (0000)_2 = 0$$

1 omitted

3 aiii) $A = (7)_{10} = (0111)_2$ $B = (0)_{10} = (0000)_2$ B complement $= (1111)_2$

c_in = 1, so $\begin{array}{r} {\scriptstyle 1\ 1\ 1\ 1\ } \\ 1111 \\ +\ \ \ 1 \\ \hline 10000 \end{array}$

$$\begin{array}{r} 0111 \\ +\ 10000 \\ \hline 10111 \end{array} \rightarrow (0111)_2 = 7$$

1 omitted

3 aiii) $A = (0)_{10} = (0000)_2$ $B = (7)_{10} = (0111)_2$ B complement $= (1000)_2$

$$\begin{array}{r} 0000 \\ +\ 1000 \\ \hline 1000 \end{array} \rightarrow (1000)_2 = -7$$

3 aiv $A = (0)_{10} = (0000)_2$ $B = (0)_{10} = (0000)_2$ B-complement $= (1111)_2$

c_in = 1, so $\begin{array}{r} {\scriptstyle 1\ 1\ 1\ 1\ } \\ 1111 \\ +\ \ \ 1 \\ \hline 10000 \end{array}$

$$\begin{array}{r} 0000 \\ +\ 10000 \\ \hline 10000 \end{array} \rightarrow (0000)_2 = 0$$

1 omitted

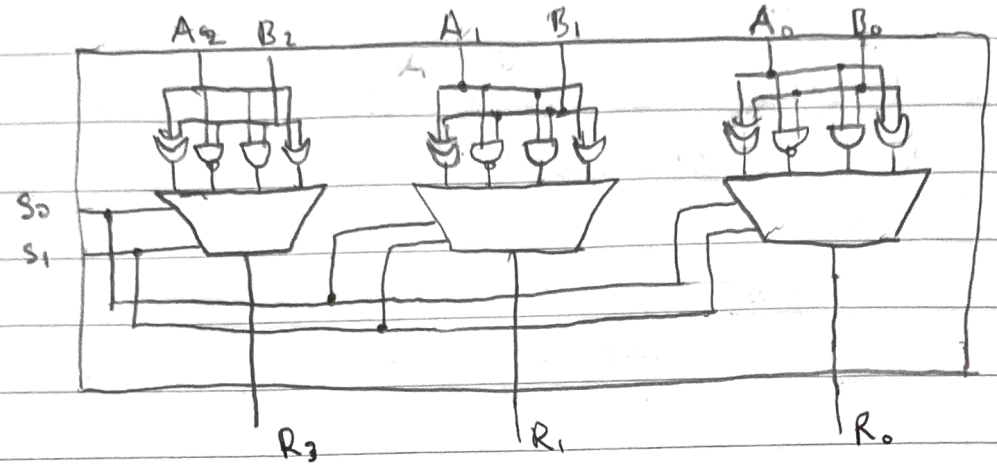
3 b. $A = (7)_{10} = (111)_2$ $B = (7)_{10} = (111)_2$ B complement $= (000)_2$

c_in = 1 so $\begin{array}{r} 000 \\ +\ \ 1 \\ \hline 001 \end{array}$ $\begin{array}{r} {\scriptstyle 1\ 1\ 1\ \ } \\ 111 \\ 001 \\ \hline 1000 \end{array} \rightarrow (000)_2 = 0$

1 omitted

same result as ai but only with 3-bits

4.



5a. $(A6)_{16} = (10100110)_2 = (166)_{10}$

A = 1010

6 = 0110

1 0 1 0 0 1 1 0
7 6 5 4 3 2 1 0
128 32 4 2 = 166

5b. $(14B)_{16} = (101001011)_2 = (331)_{10}$

1 4 = 10100

B = 1011

1 0 1 0 0 1 0 1 1
8 7 6 5 4 3 2 1 0
256 64 8 2 1

5c. $(20D)_{16} = (1000001101)_2 = (525)_{10}$

20 = 100000

D = 1101

1 0 0 0 0 0 1 1 0 1
9 8 7 6 5 4 3 2 1 0
512 8 4 1

6. $X = (2)_{10}$, $Y = (5)_{10}$

$(2)_{10} = 0010$

$(5)_{10} = 0101$

0010
+0101
0111

$(0111)_2 = (7)_{10}$

C = 0
V = 0
Z = 0
N = 0

$X = (4)_{10}$, $Y = (-4)_{10}$

$(4)_{10} = 0100$

$(-4)_{10} = 1011$

1011
+ 1
1100

0100
+1100
0000

$(0000)_2 = 0$

C = 1
V = 0
Z = 1
N = 0

$X = (6)_{10}$, $Y = (7)_{10}$

$(6)_{10} = (0110)_2$

$(7)_{10} = (0111)_2$

$$\begin{array}{r} 0110 \\ +\ 0111 \\ \hline 1101 \end{array}$$

$(1101)_2 =$

C = 0
V = 1
Z = 0
N = 0

$X = (-6)_{10}$, $Y = (-7)_{10}$

$(-6)_{10} = (1001)_2$

$(-7)_{10} = (1000)_2$

$$\begin{array}{r} 1001 \\ +\ 1000 \\ \hline 1\ 1001 \end{array}$$

(1001)

C = 0
V = 1
Z = 0
N = 0