LAB 5

Question 1

a) Half adder adds two 1-bit inputs only, no carry input
Outputs: Sum(S), Carry (C)

Full adder add three 1-bit inputs, takes carry input
Outputs: Sum(S), Carry-out (Cout)

Truth table

Half adder

A	B	Sum	Carry	Boolean Expression
0	0	0	0	
0	1	1	0	
1	0	1	0	
1	1	0	1	

$S = A \oplus B$

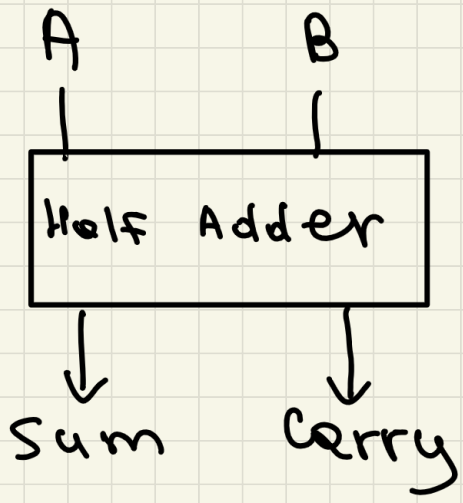
$C = A \cdot B$

Full adder

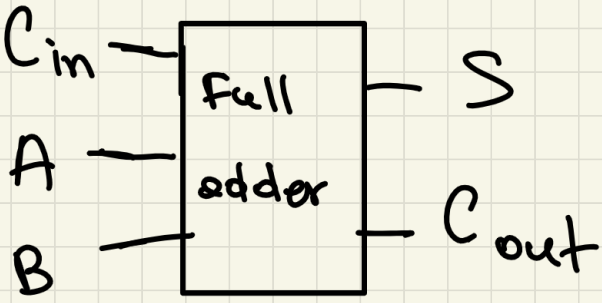
A	B	C_{in}	Sum	C_{out}
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Diagram

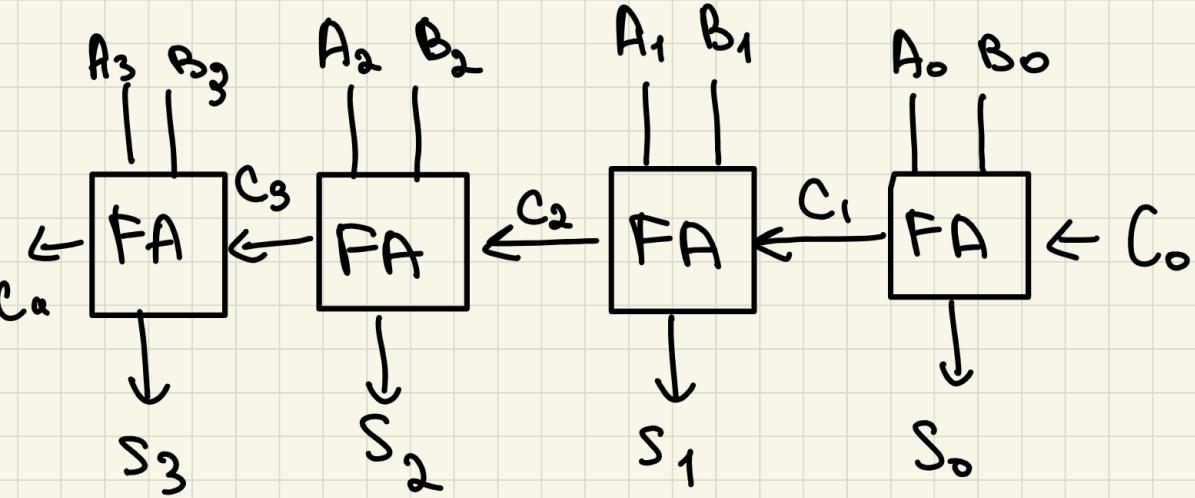
Half adder



Full adder



b) It is called Ripple Adder because the carry "ripples" From the least significant bit to the most significant bit. Each Full adders Cout is connected to the Cin of the next stage



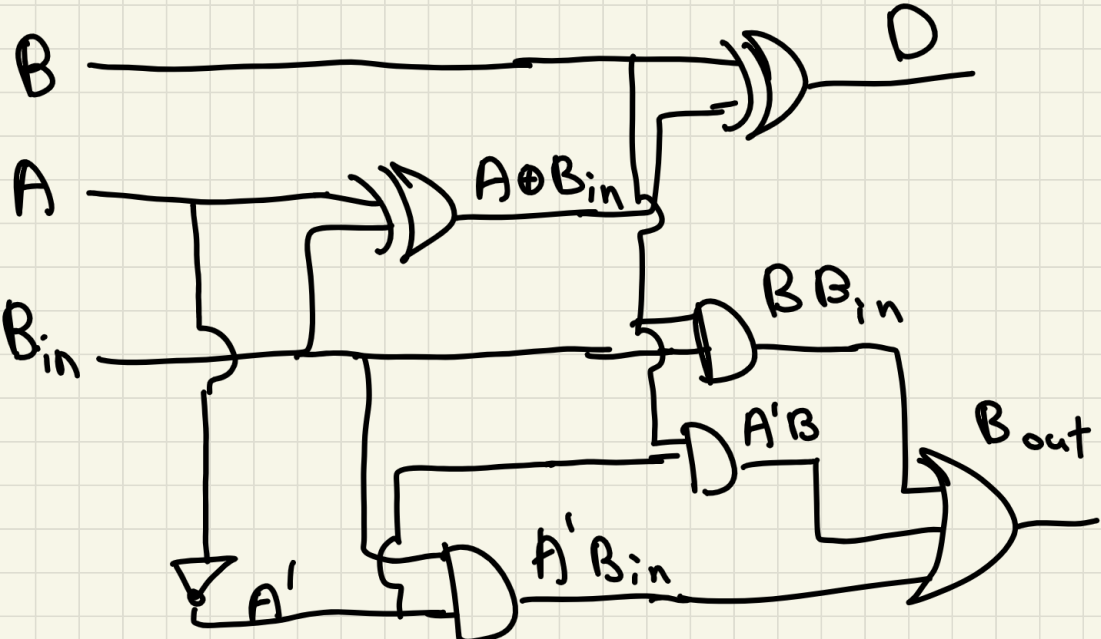
Question 2

Full subtractor

A	B	B_{in}	Diff	B_{out}
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

$$Diff = A \oplus B \oplus B_{in}$$

$$B_{out} = A'B + A'B_{in} + B B_{in}$$



Question 3

a)

i) for 1 select line

$2^1 = 2$ inputs

S	Output
0	I0
1	I2

Boolean exp. $Y = S'I0 + SI1$

ii) for 3 select lines

$2^3 = 8$ inputs

S_2	S_1	S_0	Output
0	0	0	L0
0	0	1	L1
0	1	0	L2
0	1	1	L3
1	0	0	L4
1	0	1	L5
1	1	0	L6
1	1	1	L7

b) 1:4 demux with Enable

E	S1	S0	Y0	Y1	Y2	Y3
0	X	X	0	0	0	0
1	0	0	L	0	0	0
1	0	1	0	L	0	0
1	1	0	0	0	L	0
1	1	1	0	0	0	L

$Y_0 = L.E.S'1.S0'$

$Y_1 = L.E.S'1.S0'$

$Y_2 = L.E.S1.S'0$

$Y_3 = L.E.S1.S0$

when Enable is inverted (E'=0)

$$Y_0 = L.E.S'1.S'0$$

Question 4

a) Truth table for G(A>B)

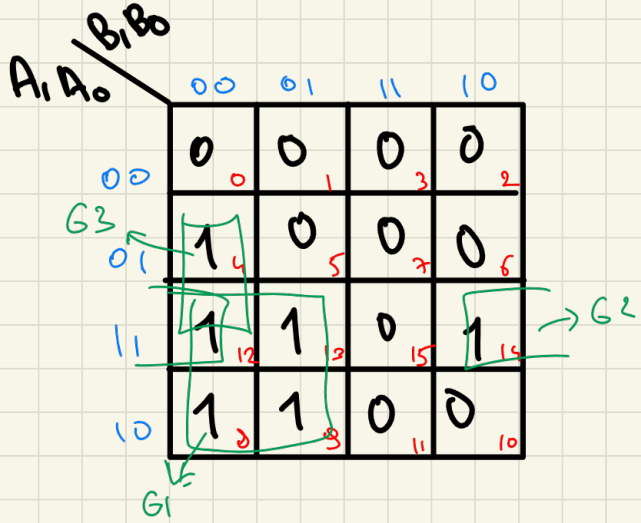
$A = A_1, A_0$ $B = B_1, B_0$

A_1	A_0	B_1	B_0	A_{dec}	B_{dec}	G(A>B)
0	0	0	0	0	0	0
0	0	0	1	0	1	0
0	0	1	0	0	2	0
0	0	1	1	0	3	0
0	1	0	0	1	0	1
0	1	0	1	1	1	0
0	1	1	0	1	2	0
0	1	1	1	1	3	0
1	0	0	0	2	0	1
1	0	0	1	2	1	1
1	0	1	0	2	2	0
1	0	1	1	2	3	0
1	1	0	0	3	0	1
1	1	0	1	3	1	1
1	1	1	0	3	2	1
1	1	1	1	3	3	0

$G(A_1, A_0, B_1, B_0) = \Sigma m(4, 8, 9, 12, 13, 14)$

K-map

b)



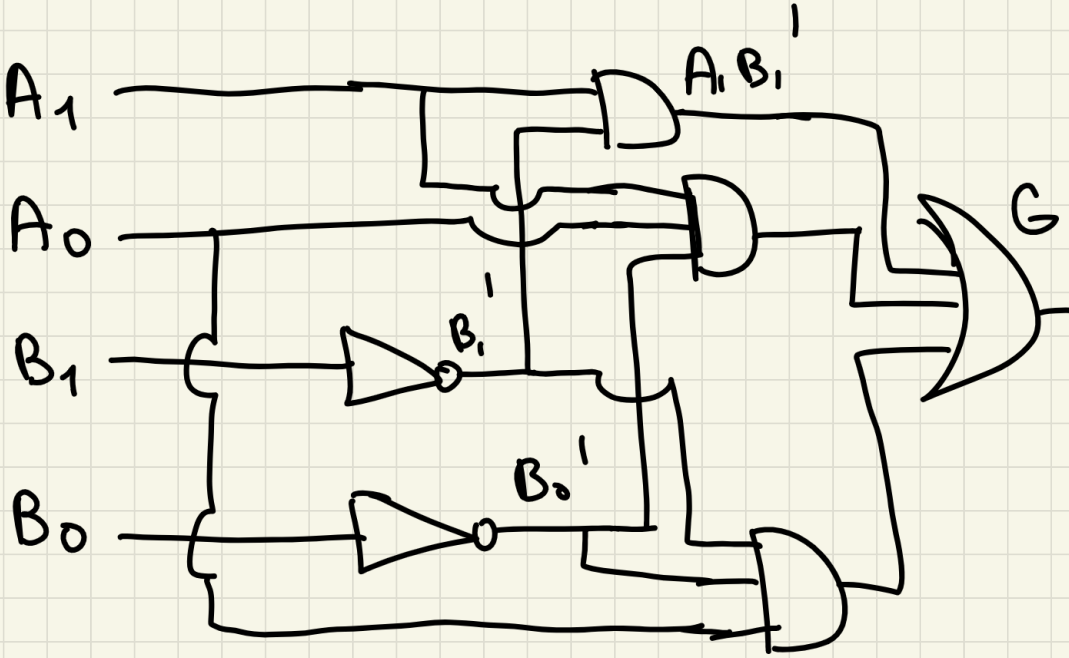
$$G1 = A_1 B_1'$$

$$G2 = A_1 A_0 B_0'$$

$$G3 = A_0 B_1' B_0'$$

$$G = A_1 B_1' + A_1 A_0 B_0' + A_0 B_1' B_0'$$

c)



Question 5

a) $+66$ $\quad 66 \rightarrow 0100\ 0010$
$+(+13)$ $\quad 13 \rightarrow 0000\ 1101$

$$\begin{array}{r} 0100\ 0010 \\ +\ 0000\ 1101 \\ \hline 0100\ 1111 \end{array} \quad (+79)$$

result = 79

overflow: NO, both positive

b) $+66 \rightarrow 0100\ 0010$
$+(-13) \rightarrow 1111\ 0011$

$0011\ 0101 \rightarrow +53$

carry out

overflow: NO, different signs

c) $-66 \rightarrow 1011\ 1110$
$+(+13) \quad\quad 0000\ 1101$

$1100\ 1011 \rightarrow -53$

overflow: NO, different signs

d) $-66 \rightarrow 1011\ 1110$

$+(-13) \quad 1111\ 0011$

$1011\ 0001 \rightarrow -79$

Overflow: No, both negative, result is negative