

ECE 310 - Project 1

Ohm Patel

Legend

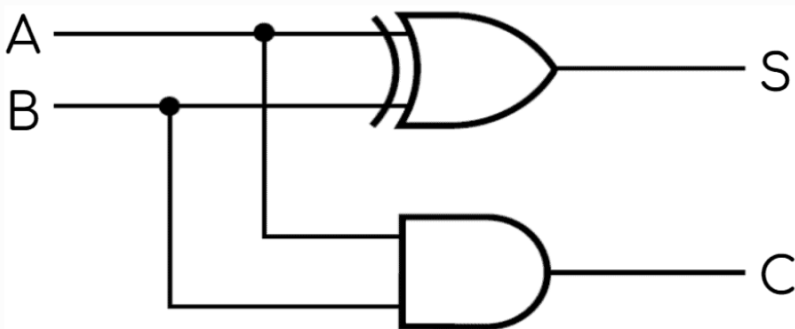
Integers

F = Full Adder

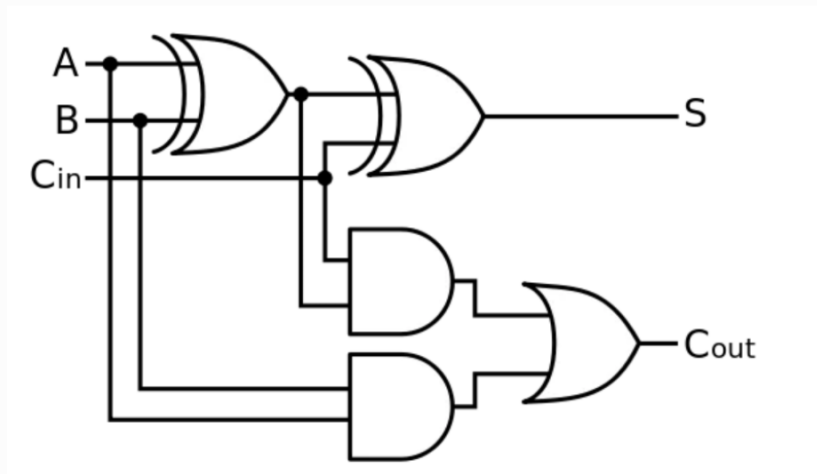
H = Half Adder

Full Adders and Half Adders will be represented by $F_x(s/c)$.
Where x is the adder number and s/c is sum or carry.
E.g. H2C (Half adder 2 carry)

Half Adder



Full Adder



A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
B_7	B_6	B_5	B_4	B_3	B_2	B_1	B_0
A_7B_0	A_6B_0	A_5B_0	A_4B_0	A_3B_0	A_2B_0	A_1B_0	A_0B_0

← $HA1, FA5 - FA0, HA0$

A_7B_1	A_6B_1	A_5B_1	A_4B_1	A_3B_1	A_2B_1	A_1B_1	A_0B_1
A_7B_2	A_6B_2	A_5B_2	A_4B_2	A_3B_2	A_2B_2	A_1B_2	A_0B_2
A_7B_3	A_6B_3	A_5B_3	A_4B_3	A_3B_3	A_2B_3	A_1B_3	A_0B_3

← $HA3, FA11 - FA6, HA2$

A_7B_4	A_6B_4	A_5B_4	A_4B_4	A_3B_4	A_2B_4	A_1B_4	A_0B_4
A_7B_5	A_6B_5	A_5B_5	A_4B_5	A_3B_5	A_2B_5	A_1B_5	A_0B_5
A_7B_6	A_6B_6	A_5B_6	A_4B_6	A_3B_6	A_2B_6	A_1B_6	A_0B_6

A_7B_7	A_6B_7	A_5B_7	A_4B_7	A_3B_7	A_2B_7	A_1B_7	A_0B_7
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← $FA18 - FA12, HA4$

A_3B_6	A_2B_6	A_1B_6	A_0B_6	F_2C	F_1C	A_0B_3	H_0C	H_0S	A_0B_0
A_2B_2	A_1B_2	A_0B_2	F_3C	H_2C	F_2S	F_0C	F_0S		
A_7B_5	A_5B_6	A_4B_6	A_7B_2	F_5C	F_4C	F_6C	F_3S	H_2S	F_1S

← $HA6, FA24 - FA19, HA5$

A_6B_6	A_4B_7	A_3B_7	H_1C	F_8C	F_7C	F_4S	F_6S		
A_7B_6	A_5B_7	$F_{11}C$	$F_{10}C$	F_9C	H_1S	F_5S	F_7S		
A_7B_7	A_6B_7	H_3C	H_3S	$F_{11}S$	$F_{10}S$	F_9S	F_8S		

← $HA10-9, FA30-25, HA8-7$

A_4B_6	$F_{17}C$	$F_{16}C$	$F_{15}C$	$F_{14}C$	F_6S	$F_{12}C$	H_4C	H_4S	H_0S	A_0B_0
A_7B_5	A_5B_6	$F_{18}C$	$F_{20}C$	$F_{19}C$	H_5C	$F_{15}S$	$F_{13}C$	$F_{13}S$	$F_{12}S$	
A_7B_7	$F_{24}C$	$F_{23}C$	$F_{22}C$	$F_{21}C$	$F_{18}S$	$F_{17}S$	$F_{16}S$	H_5S	$F_{14}S$	
H_6C	H_6S	$F_{24}S$	$F_{23}S$	$F_{22}S$	$F_{21}S$	$F_{20}S$	$F_{19}S$			

$F_{24}C$	$F_{24}S$	$F_{23}S$	$F_{22}S$	$F_{21}S$	$F_{20}S$	$F_{19}S$	$F_{25}C$	H_8C	H_7C	H_7S	H_4S	H_0S	A_0B_0
A_7B_7	H_6S	H_9C	$F_{30}C$	$F_{29}C$	$F_{28}C$	$F_{27}C$	$F_{26}C$	$F_{26}S$	$F_{25}S$	H_8S			
H_6C	$H_{10}C$	$H_{10}S$	H_9S	$F_{30}S$	$F_{29}S$	$F_{28}S$	$F_{27}S$						

← $HA14, FA37-31, HA13-11$

$H_{14}C$	$F_{37}C$	$F_{36}C$	$F_{35}C$	$F_{34}C$	$F_{33}C$	$F_{32}C$	$F_{31}C$	$H_{13}C$	$H_{12}C$	$H_{11}C$	$H_{11}S$	H_7S	H_4S	H_0S	A_0B_0
$H_{14}S$	$F_{37}S$	$F_{36}S$	$F_{35}S$	$F_{34}S$	$F_{33}S$	$F_{32}S$	$F_{31}S$	$H_{13}S$	$H_{12}S$						

From the top we bring the single values down and Ripple Carry
Add the remaining partial sum. Carries

$F_{46}C$	$F_{45}C$	$F_{44}C$	$F_{43}C$	$F_{42}C$	$F_{41}C$	$F_{40}C$	$F_{39}C$	$F_{38}C$	$H_{15}C$						
$H_{14}C$	$F_{37}C$	$F_{36}C$	$F_{35}C$	$F_{34}C$	$F_{33}C$	$F_{32}C$	$F_{31}C$	$H_{13}C$	$H_{12}C$	$H_{11}C$	$H_{11}S$	H_7S	H_4S	H_0S	A_0B_0
	$H_{14}S$	$F_{37}S$	$F_{36}S$	$F_{35}S$	$F_{34}S$	$F_{33}S$	$F_{32}S$	$F_{31}S$	$H_{13}S$	$H_{12}S$					

← HA16, FA46-38, HA15

$H_{16}C \rightarrow$ does not matter as 8×8 will always be 16 bits

Final Answer:

$H_{16}S$	$F_{46}S$	$F_{45}S$	$F_{44}S$	$F_{43}S$	$F_{42}S$	$F_{41}S$	$F_{40}S$	$F_{39}S$	$F_{38}S$	$H_{15}S$	$H_{11}S$	H_7S	H_4S	H_0S	A_0B_0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

In total the Wallace tree has
15 Half Adders and 38 Full Adders.

If we include the Ripple Carry Adder, then in total we have
17 Half Adders and 47 Full Adders

Thus in total we have

17×1 (HA) + 47×2 (FA) = 111 AND Gates and 111 XOR Gates
47 OR Gates as each Full adder has 1.