Computer Architecture

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HA+ HA- HA–

Full Adder--

Half Adder

- Half Adder (recall):
- A Half Adder is a circuit that takes two inputs, A and B, and produces two outputs, S (the sum of A and B) and C out (the carry out). It uses an XOR gate and an AND gate to perform the addition. However, unlike a full adder, it does not have an input for the carry out from the previous column.
- The Truth table of HA follows:
- C (Cout or Carry or Carry out)=AB
- S (Sum) = AB' + A'B = A XOR B

A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Half Adder Plus (HA+)

- Half Adder Plus:

- A Half Adder Plus is a circuit that takes two inputs, A and B, and produces two outputs. The result is the addition of A ,B and 1 (A + B+1). It uses an XNOR gate and an OR gate to perform the addition. Adding 1 to the sum of A and B is done by default.

- The Truth table of HA+ follows:

- C = A + B

- S= AB +A'B' =A XNOR B

A	B	C	S
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	1

Half Adder Minus (HA-)

- Half Adder Minus:

- A Half Adder Minus is a circuit that takes two inputs, A and B, and produces two outputs, C and S. The result is the addition of A ,B minus 1 (A + B-1). It uses an XNOR gate and a NOR gate to perform the addition. Subtracting 1 from the sum of A and B is done by default.

- The truth table of HA- follows:

- C= (A+B)'= $\overline{A + B}$

- S= AB + A'B' = A XNOR B

A	B	C	S
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	1

Half Adder Minus Minus (HA- -)

- Half Adder Minus Minus:
- A Half Adder Minus Minus is a circuit that takes two inputs, A and B, and produces two outputs, C and S. The result is the addition of A ,B minus 2 (A + B-2). It uses an XOR gate and a NAND gate to perform the addition. Subtracting 1 from the sum of A and B is done by default.
- The truth table of HA- follows:
- C= (AB)' = $\overline{AB}$
- S= AB' + A'B = A XOR B

A	B	C	S
0	0	1	0
0	1	1	1
1	0	1	1
1	1	0	0

Full Adder

- Full Adder (recall):

- Full Adder is the circuit that adds three inputs and produces two outputs. The first two inputs are A and B and the third input is an input carry as C-IN. The output carry is designated as C-OUT and the normal output is designated as S which is SUM.

- The truth table of Full adder follows:

- C= AB+AC+BC= Majority Gate

- S= A XOR B XOR C= A'B'C + A'BC'+ AB'C' + ABC

a	b	c	c	s
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Full Adder Minus Minus

- Full Adder Minus Minus:

- Full Adder Minus Minus is the circuit that adds three inputs and produces two outputs then subtracts 2 from the addition. The first two inputs are A and B and the third input is an input carry as C-IN. The output carry is designated as C-OUT and the normal output is designated as S which is SUM.

- The truth table of Full adder follows:

- C= (AB+AC+BC)'= Minority Gate= $\overline{AB + AC + BC}$

- S= A XOR B XOR C= A'B'C + A'BC'+ AB'C' + ABC

a	b	c	c	s
0	0	0	1	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	0
1	0	0	1	1
1	0	1	0	0
1	1	0	0	0
1	1	1	0	1