

VE270 Lecture 12 Arithmetic Components

Carry Look-ahead Adder

Check the Carry-Ripple Adder, it is created with full adders.

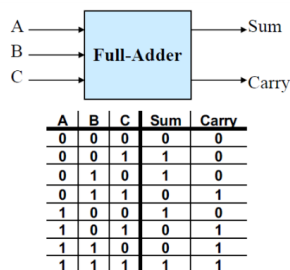
For 4-bit adder, we add two 4-bit numbers and generate a 5-bit number (4-bit sum and 1-bit carry).

Faster Adder

Use two-level combinational logic design process.

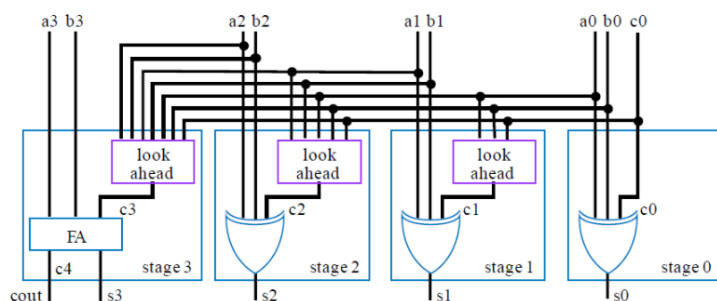
- pro: fast
 - 2 gate level delays
- con: large
 - 9 inputs and 5 outputs.
 - Truth table would have $2^{4+4+1} = 512$ rows

Full Adder



sum is $\sum m(1, 2, 4, 7) = A \oplus B \oplus C$, carry is $\sum m(3, 5, 6, 7) = AB + AC + BC = (A \oplus B)C + AB$

Faster Adder - Intuitive Attempt at "Look ahead"



Notice – no rippling of carry

Then we produce carries directly and recursively: $c_{n+1} = a_n b_n + a_n c_n + b_n c_n$

Two layer SOP logic.

Better Form of Look Ahead

Since we get the **Carry** $= ab + (a \oplus b)c$ then we define **Propagate** $P = a \oplus b$ and **Generate** $G = ab$.

Then **Cout** $= G + Pc$, $c_{n+1} = G_n + P_n c_n$

