Class Exercise—Building a 3-bit Lookahead Adder

10/26/15

Recall: The i-th binary adder has inputs x_i, y_i, c_i
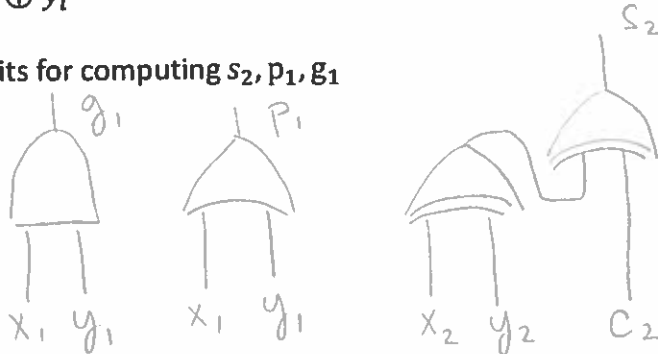
For $i > 1$, instead of waiting for c_i to propagate, we would like to compute it ahead of time. We have the following formulas:

$$g_i = x_i y_i$$
$$p_i = x_i + y_i$$
$$c_{i+1} = g_i + p_i c_i$$

Finally, $s_i = c_i \oplus x_i \oplus y_i$

1. Draw the circuits for computing s_2, p_1, g_1

2. Draw the circuit for computing c_2 given input wires corresponding to p_0, g_0, p_1, g_1, c_0.

$$c_2 = g_1 + p_1 c_1$$
$$= g_1 + p_1 (g_0 + p_0 c_0)$$
$$= g_1 + p_1 g_0 + p_1 p_0 c_0$$

3. Draw the circuit diagram for the 3-bit lookahead adder by combining 1 and 2 and the 2-bit lookahead adder (you can add on to your diagram from the previous page).

4. How many time steps does it take to compute the final 4-bit sum?

$$4 \begin{cases} 1 \text{ time unit to compute } p_0, g_0, p_1, g_1 \\ 2 \text{ time units to compute } c_1, c_2, c_3 \\ 1 \text{ time unit to propagate } c_1, c_2 \text{ to final outputs } s_2, s_1 \end{cases}$$

Class Exercise—Building a 2-bit Lookahead Adder

10/26/15

Recall: The i-th binary adder has inputs x_i, y_i, c_i

For $i > 1$, instead of waiting for c_i to propagate, we would like to compute it ahead of time.
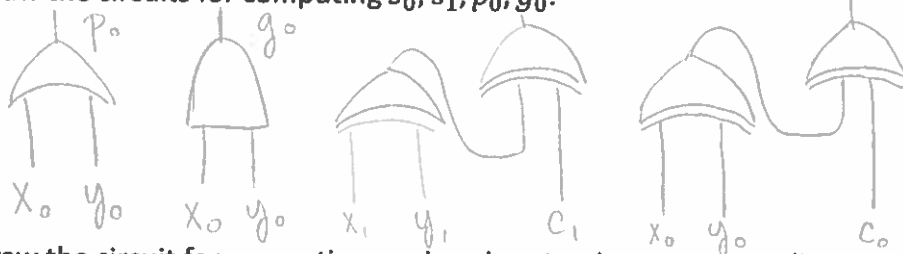
We have the following formulas:

$$g_i = x_i y_i$$
$$p_i = x_i + y_i$$
$$c_{i+1} = g_i + p_i c_i$$

Finally, $s_i = c_i \oplus x_i \oplus y_i$

1. Draw the circuits for computing s_0, s_1, p_0, g_0.

2. Draw the circuit for computing c_1 given inputs wires corresponding to p_0, g_0, c_0.

3. Draw the circuit diagram for the 2-bit lookahead adder by combining 1 and 2.