Homework 4 Solutions for Computer Logic and Circuit Design: PHYS306/COSC330

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April 11, 2020

1 6-2,6-3: Parallel Binary Adders, and Ripple-Carry and Look-Ahead Adders

1. Exercise 4: Consulting the truth table, we should get $\vec{\Sigma} = (1, 1, 0, 0)$ and $\vec{C}_{out} = (0, 1, 1)$. The fourth carry out is the MSB of Σ. 111+101 = 1100.
2. Exercise 7: Given that the switch line is high, the XNOR gates just pass the original value of $\vec{B}$. Thus, it turns into an *adder* rather than a *subtracter*. The output is 10101 (final carry-out is 1, with $\vec{\Sigma} = (0, 1, 0, 1)$.
3. Exercise 11: The book says 40 ns + 6 * 25 ns + 35 ns = 225 ns, for each stage adding all 1's. I would also accept 8 * 40 ns if you were thinking about the cumulative delay vs. the time between first input and last output.

2 6-4: Comparators

1. Exercise 15: a) $A > B$ true, else false, b) $A < B$ true, else false, c) $A = B$ true, else false

3 6-5: Decoders

1. Exercise 20: See Fig. 1, left. The key is generating first the SOP and evaluating it by time-steps.
2. Exercise 21: See Fig. 1, right. The key is decoding each binary number and assigning it to the correct output line. Remember that these decoders are active LOW.

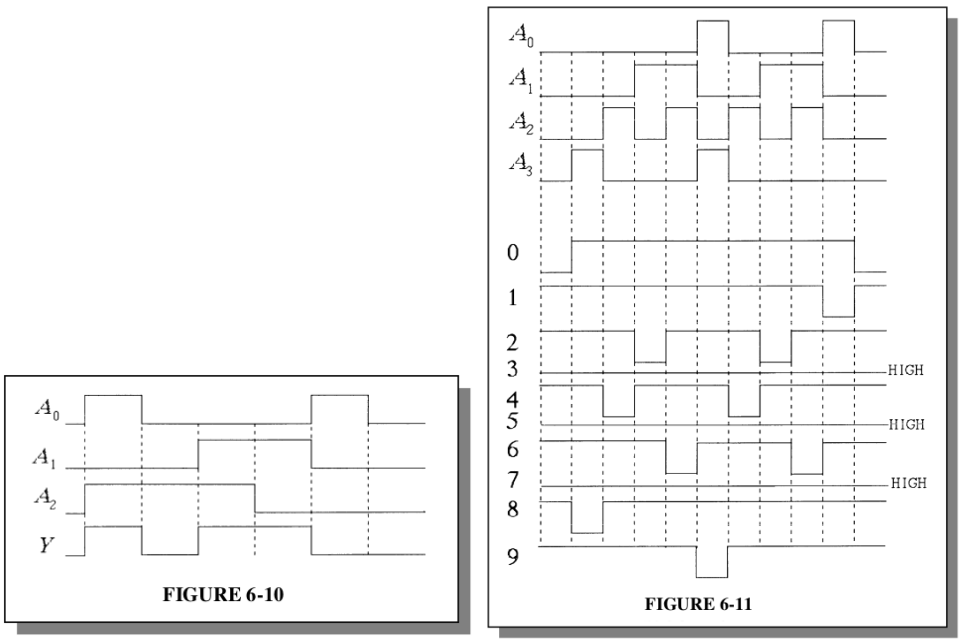

Figure 1: Solution to Exercise 20.

4 6-6: Encoders

1. Exercise 23: The result is 1011, which is not a valid BCD code.

5 6-9: Multiplexers

1. See Fig. 2).

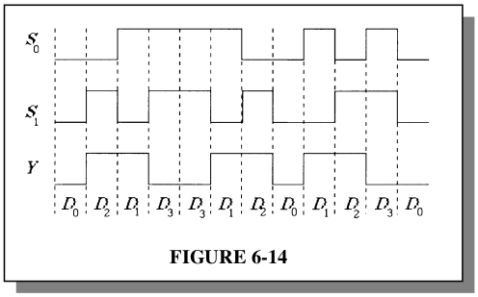

Figure 2: Solution to Exercise 29.

6 6-11: Troubleshooting

1. In this example, we see right away that the output pins don't correspond to the regular results of an adder. The results suggest that C_{in} is always HIGH, regardless of the *input* to C_{in}.

7 Special Design Problem

1. Exercise 45: The Karnaugh Map for C_{out} yields $BC_{in} + AC_{in} + AB$. The Karnaugh Map for Σ yields $\bar{A}\bar{B}C_{in} + \bar{A}B\bar{C}_{in} + ABC_{in} + A\bar{B}\bar{C}_{in}$. THe first is a simplification but the second is not. See Fig. 3 for the attachments to 8-to-1 mux inputs that yield these expressions.

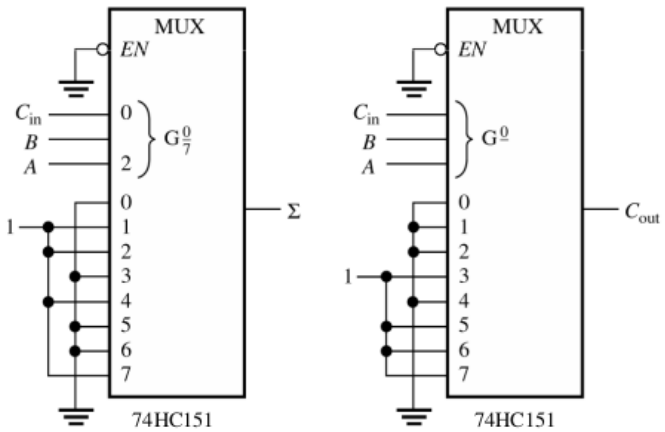

Figure 3: Solution to Exercise 45.