CprE 281 HW7

ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Multiplexers, Decoders, and Encoders
Assigned Date: eighth Week
Finish by Oct. 18, 2021

P1 (5 points). Write the POS expression for the 2-to-1 MUX

P2 (20 points). Consider construing a 2^n-to-1 multiplexer using only 2-to-1 multiplexers, with n being a positive integer:

a. How many 2-to-1 multiplexers would a 2^n-to-1 multiplexer require? (Give the answer in terms of n)
b. Design an 8-to-1 multiplexer using a minimal number of 2-to-1 multiplexers. Label all signals clearly.

P3 (10points). Answer the following questions about decoders and MUXes:

a. How many 2-to-4 decoders are necessary to create a 4-to-16 decoder?
b. How many 3-to-8 decoders are necessary to create a 6-to-64 decoder?
c. How many 1-bit 2-to-1 MUXes are necessary to create a 1-bit 8-to-1 MUX?
d. How many 1-bit 2-to-1 MUXes are necessary to create an 8-bit 2-to-1 MUX?

P4 (20 points). Consider a function F with 4 bits of input A3, A2, A1, A0 such that the output of F is 1 if the unsigned binary number represented by A3 A2 A1A0 is prime (i.e. 2, 3, 5, 7, 11, or 13). Otherwise, the output of F is 0.
Write the truth table for F.
Implement F using only a 16-to-1 MUX.
Implement F using an 8-to-1 MUX, and some AND, OR, and NOT gates.
Implement F using an 4-to-1 MUX, and some AND, OR, and NOT gates.
Using Shannon's expansion, implement F using a 2-to-1 MUX, and some AND, OR, and NOT gates.

P5 (20 points). Implement the following functions using Shannon's expansion:
Implement F = w1w2 + w1w3 + w2w3 using only 2-to-1 MUXs
Implement F = w1w2 + w1w3 + w2w3 using only 4-to-1 MUXs

P6 (10points). Given a supply of 1-to-2 decoders, show how to get a 3-to-8 decoder circuit. Assume each of the 1-to-2 decoders has an ENABLE input (ENABLE = 1 enables the decoder), but you do not need to include enable capability on the 3-to-8 decoder circuit.

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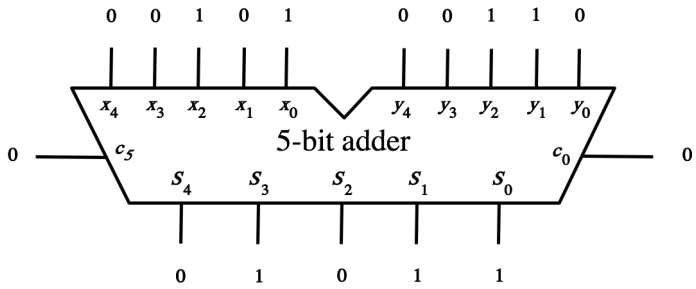
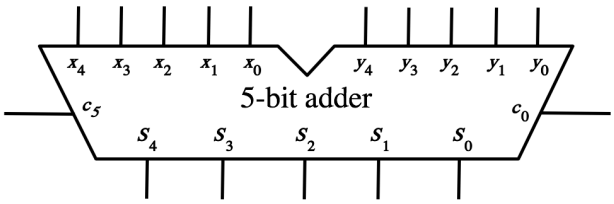
P7. (15 points) For each of the following, assign either a 0 or a 1 to each input and output of the 5-bit adder such that it computes the given expression. In all problems, the binary numbers are stored in 2's complement representation. The problem in a) is already solved.

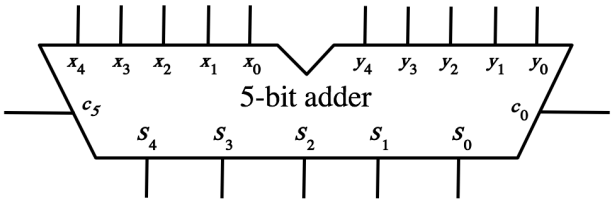
a) **(+5) + (+6) = +11**



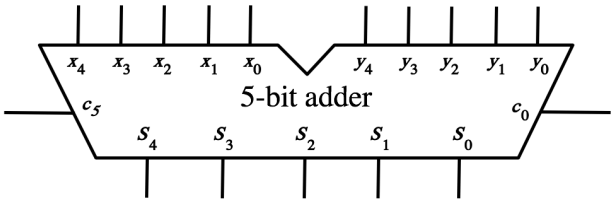
b) **(+11) + (+3) =**



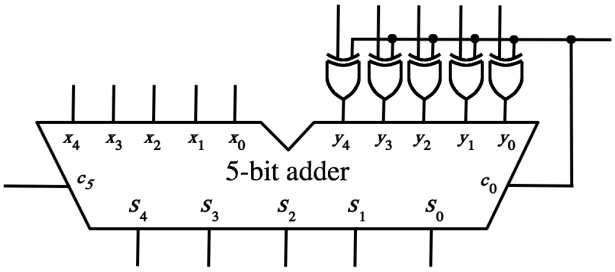
c) **(-13) + (+4) =**



d) **(+14) + (-6) =**



e) **(+8) + (-12) =**



f) **(-7) - (-11) =**