

Logic Homework

Due: October 4, 2023

Name:1. (20 points) **2-to-4 Decoder**

A 2-to-4 decoder converts a 2-bit binary numerical input into a 4-bit “one-hot” output. The one-hot coded output has only one bit set at a time. The bit that is set corresponds to the two-bit coded binary input—when the input is 00, bit 0 of the output is set to 1 and the other bits are cleared (0). A complete truth table for the 2-to-4 decoder is shown below.

AB	S_0	S_1	S_2	S_3
00	1	0	0	0
01	0	1	0	0
10	0	0	1	0
11	0	0	0	1

Your job is to design a logic circuit that computes S_0 , S_1 , S_2 , S_3 from the 2-bit binary coded input AB .

(a) (10 points) Write the logic expressions for S_0 , S_1 , S_2 , S_3 below.

(b) (10 points) Draw a logic circuit for each of the expressions you wrote out in part (a).

2. (30 points) **4-to-2 Priority Encoder**

The 4-to-2 Priority encoder is the opposite of the 2-to-4 decoder. It takes a 4-bit one-hot input and finds the most significant bit that is set to a 1. For example, if the input is 0101, bits 0 and 2 are set. The priority encoder generates a 2-bit output 10, which encodes 2, the most significant bit that is set on the input.

S_3	S_2	S_1	S_0	AB
0	0	0	0	00
0	0	0	1	00
0	0	1	0	01
0	0	1	1	01
0	1	0	0	10
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

(a) (10 points) I have started filling out the truth table for the 4-to-2 encoder below, highlighting the highest-priority set bits in bold in each of the first few columns. Fill out the remainder of the table.

- (b) (10 points) Write logic expressions for A and B as a function of S_0, S_1, S_2, S_3 .
- (c) (10 points) Draw a logic circuit that implements the logic expressions from part (b).