

Introduction to Computer Science, Winter Semester 2017
 Practice Assignment 10

Discussion: 30.12.2017 - 4.1.2018

Exercise 10-1 To be Discussed in Tutorial

Given the following truth table, where $P, X,$ and Y are the input variables and S and C are the output variables:

P	X	Y	S	C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Use the sum-of-products-algorithm to determine the Boolean expressions that correspond to the truth table.

Solution:

Using the sum-of-products-algorithm

$$S = P'X'Y + P'XY' + PX'Y' + PXY$$

$$C = P'XY + PX'Y + PXY' + PXY$$

Exercise 10-2

Using truth tables, show that:

$$X'Y + Y'Z + XZ' = XY' + YZ' + X'Z$$

Solution:

- Truth table for $X'Y + Y'Z + XZ'$

X	Y	Z	$X'Y$	$Y'Z$	XZ'	$X'Y + Y'Z + XZ'$
0	0	0	0	0	0	0
0	0	1	0	1	0	1
0	1	0	1	0	0	1
0	1	1	1	0	0	1
1	0	0	0	0	1	1
1	0	1	0	1	0	1
1	1	0	0	0	1	1
1	1	1	0	0	0	0

- Truth table for $XY' + YZ' + X'Z$

X	Y	Z	XY'	YZ'	$X'Z$	$XY' + YZ' + X'Z$
0	0	0	0	0	0	0
0	0	1	0	0	1	1
0	1	0	0	1	0	1
0	1	1	0	0	1	1
1	0	0	1	0	0	1
1	0	1	1	0	0	1
1	1	0	0	1	0	1
1	1	1	0	0	0	0

Exercise 10-3

A circuit should be designed to perform the modulus operation of two numbers consisting of two bits each.

Assume that for any number N , $N\%0 = 3$.

- a) How many input and output variables are needed?

Solution:

Four input variables and two output variables are needed.

- b) Construct the truth table for this circuit

Solution:

A	B	C	D	O1	O2
0	0	0	0	1	1
0	0	0	1	0	0
0	0	1	0	0	0
0	0	1	1	0	0
0	1	0	0	1	1
0	1	0	1	0	0
0	1	1	0	0	1
0	1	1	1	0	1
1	0	0	0	1	1
1	0	0	1	0	0
1	0	1	0	0	0
1	0	1	1	1	0
1	1	0	0	1	1
1	1	0	1	0	0
1	1	1	0	0	1
1	1	1	1	0	0

- c) Using the sum-of-products method, find the Boolean expressions that correspond to the constructed truth table.

Solution:

$$O1 = A'B'C'D' + A'BC'D' + AB'C'D' + AB'CD + ABC'D'$$

$$O2 = A'B'C'D' + A'BC'D' + A'BCD' + A'BCD + AB'C'D' + ABC'D' + ABCD'$$

Exercise 10-4 To be Discussed in Tutorial

Given the following truth tables, find the functionality of the designated circuits.

a)

A	B	C	O1
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

Solution:

The circuit with the truth table above checks if the number ABC is a power of 2.

b)

A1	A0	B1	B0	O1	O2	O3
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	0	0	1	0
0	0	1	1	0	1	1
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	0	1	1
0	1	1	1	1	0	0
1	0	0	0	0	1	0
1	0	0	1	0	1	1
1	0	1	0	1	0	0
1	0	1	1	1	0	1
1	1	0	0	0	1	1
1	1	0	1	1	0	0
1	1	1	0	1	0	1
1	1	1	1	1	1	0

Hint: A1A0 and B1B0 are both two numbers consisting of 2 bits each

Solution:

The circuit with the truth table above calculates the sum of number A and number B.

c)

A	B	C	D	O1
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Solution:

The circuit with the truth table above checks whether the number represented in ABCD is divisible by 3.