# Homework 4 - Logic Circuits and Number Representations

- Template file for submitting the solutions:
  https://grader.eecs.jacobs-university.de/courses/320241/2019_2/lectures/template_hw.tex

- The TAs are grading solutions to the problems according to the following criteria:
  https://grader.eecs.jacobs-university.de/courses/320241/2019_2/Grading_Criteria_CAPL.pdf

Problem 4.1 *Determine input*   (1 point)
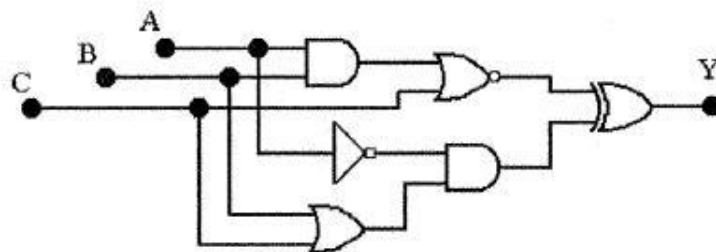
Determine the input condition needed to produce $X = 1$ in the logic circuit below. The first two gates are representations for XOR and XNOR.
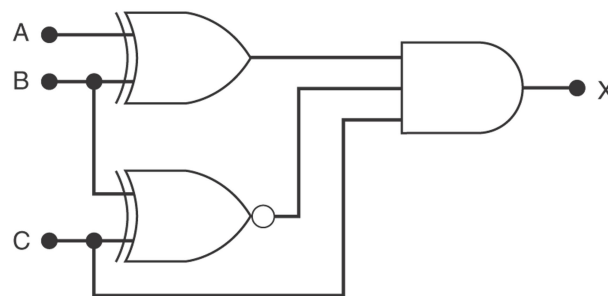
Problem 4.2 *A logic circuit*   (1 point)

Consider the logic circuit from the following figure:

(a) Write down the corresponding truth table.

(b) Write down the corresponding sum of products.

Problem 4.3 *Decimal to 2's complement*   (2 points)

Write down the following signed decimal numbers in binary representation using 2's complement. Always use 8 bits including the sign bit. Write down your calculations. You will receive points for intermediate results.

(a) $+27$

(b) $+66$

(c) -18

(d) $+127$

(e) -127

(f) -128

(g) $+131$

(h) -7

Problem 4.4 *2′s complement to decimal*   (2 points)

The following numbers are signed decimal integers in 2's complement form. Determine the corresponding decimal numbers. Write down your calculations. You will receive points for intermediate results.

(a) 00011000

(b) 11110101

(c) 01011011

(d) 10110110

(e) 11111111

(f) 01101111

(g) 10000001

(h) 10000000

Problem 4.5 *BCD addition*   (1 point)

Please write down your calculations for solving the following problems. You will receive points for intermediate results.

(a) Compute $27 + 36$ using BCD addition.

(b) Compute $73 + 29$ using BCD addition.

Problem 4.6 *Bits*   (1 point)

Write short explanations for your answers to the following questions:

(a) What is the range of unsigned decimal numbers that can be represented by using 8 bits?

(b) What is the range of signed decimal numbers that can be represented by using 8 bits (including the sign bit)?

(c) What is the range of unsigned decimal numbers that can be represented by using 11 bits?

(d) What is the range of signed decimal numbers that can be represented by using 11 bits (including the sign bit)?

(e) What is the range of signed decimal numbers that can be represented by using 16 bits (including the sign bit)?

How to submit your solutions

You can submit your solutions via *Grader* at **https://grader.eecs.jacobs-university.de** as a generated PDF file from the given template TEX file.
If there are problems with *Grader* (but only then), you can submit the file by sending mail to
k.lipskoch@jacobs-university.de **with a subject line that starts with CO20-320241**.

Please note, that after the deadline it will not be possible to submit solutions. It is useless to send solutions by mail, because they will not be graded.

This homework is due by Monday, October 7th, 23:00.