## **Mathematical Foundations of Computer Science**

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## **Problem Sheet #5**

**Problem 5.1:** *b-complement* 

(1+1+1 = 3 points)

Module: CH-233

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Due: 2025-10-10

We use a b-complement number system with the base b = 7 and n = 4 digits (b7n4).

- a) What are the smallest and the largest numbers that can be represented and why?
- b) What is the representation of -1 and -8 in b7n4 notation?
- c) Add the numbers -1 and -8 in b7n4 representation. What is the result in the b-complement representation? Convert the result from b-complement representation back into the decimal number system.

Problem 5.2: sudoku with ternary numbers

(1+1+1 = 3 points)

A sudoku puzzle is a 9×9 grid where some of the squares in the grid contain numbers. The rules are simple: every column can only contain the numbers 1 to 9, every row can only contain the numbers 1 to 9 and every 3×3 box can only contain the numbers 1 to 9. Below is a sudoku puzzle given in the ternary number system.

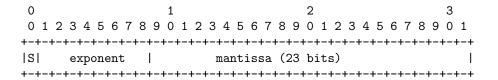
	2					1		20
		20				12		
		10			21			2
				20				21
	10		22	11	12		1	
1				2				
20			100			21		
		100				11		
10		21					22	

- a) Convert the sudoku into a regular sudoku using the decimal number system
- b) Solve the regular sudoku in the decimal number system.
- c) Convert the solution back into the ternary number system.

## **Problem 5.3:** *IEEE 754 floating point numbers*

(4 points)

IEEE 754 floating point numbers (single precision) use the following format (the numbers on the top of the box indicate bit positions, the fields in the box indicate what the various bits mean).



The encoding starts with a sign bit, followed by the biased exponent (8 bits), followed by the mantissa (23 bits). For single-precision floating-point numbers, the exponents in the range of -126 to +127 are biased by adding 127 to get a value in the range 1 to 254 (0 and 255 have special meanings).

Explain step by step how the decimal fraction 9876.4321 is converted into a single precision floating point number.