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Exercises for
Rechnerstrukturen
Winter semester 2015

Exercise Sheet 2

(16 Points)

Submission until Wednesday, 4th November 2015, 16:00 pm
Discussion begins on Tuesday, 10th November 2015

Please see notes at the end of the document for the submission.

2.1 Representation of Integer Numbers (4 Points)

a. The decimal integer number -12 should be transferred into a five bit binary representation. Please give the equivalent bit pattern for the following binary representations.

- Signed absolute value (Vorzeichen-Betrag)
- Ones' complement (Einerkomplement)
- Two's complement (Zweierkomplement)
- Offset binary (Exzessdarstellung), Bias 15

b. The bit pattern $1001\ 1001$ should be represented as decimal integer number. Please give the equivalent decimal integer if the bit pattern is using the following representation.

- Signed absolute value (Vorzeichen-Betrag)
- Ones' complement (Einerkomplement)
- Two's complement (Zweierkomplement)
- Offset binary (Exzessdarstellung), Bias 127

2.2 Representation of Rational Numbers (4 Points)

a. Please transfer $-16,75$ als floating point number in the format IEEE 754-1985 with 32 Bits ($\ell = 1+8+23, b = 127$).

b. Please give the decimal rational number that is represented by the 1 1000 0011 100 1010 0000 0000 0000 0000 in format IEEE 754-1985 ($\ell = 1+8+23, b = 127$).

2.3 Algebraic Manipulation (4 Points)

Boolean formulas are possibility to represent Boolean functions. They can be algebraically manipulated using Boolean computational rules. Use these manipulations to simplify the following formulas.

Simplify the following Boolean formulas as much as possible. Only use brackets, variables, constants and the operations $\wedge$, $\vee$ and negation. Please only use horizontal lines for negations, if needed over a complete subterm.

a. $a \wedge (a \oplus b)$

b. $\overline{\overline{a} \wedge \overline{b} \wedge \overline{c}} \vee \overline{\overline{a} \wedge b \wedge c} \vee \overline{a \wedge \overline{b} \wedge \overline{c}}$

2.4 Normal Form (4 Points)

a. The Boolean functions $f : B^3 \to B$ and $g : B^3 \to B$ are given by the following table of values.

a	b	c	$f(a,b,c)$
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

x	y	z	$g(x,y,z)$
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Please give either the disjoint normal form (DNF) or the conjunct normal form (KNF) of f and g. Always choose the representation that is "easier". Give an argumentation why you choose that representation.

b. The Boolean function $f : B^3 \to B$ with $f(x,y,z) = (x \wedge \overline{y}) \vee (\overline{x} \wedge y \wedge z)$ is given. Please give the disjoint normal form (DNF) of f.

Notes:
Submission until Wednesday, 4th November 2015, 16:00 pm in the mailbox number 46 at Otto-Hahn-Straße 12.

You can find the mailboxes in the first floor of the Otto-Hahn-Straße 12 near the transition to the ground floor of the Otto-Hahn-Straße 14. The mailboxes are labeled with "Rechnerstrukturen", the exercise group number and time/place of the exercise. The English exercise group is number 30 and the mailbox is number 46.

Please write your **name**, your **student registration number** and your **exercise group number** at the top right corner of your submission. You can make submissions in teams with up to two more students. To make a team submission put names, student registrations numbers and group numbers of all members of the team on the submission. Only one submission per team has to be made.

Tack you submission. Please do not fold your submission and do not put it into an envelope. Use the correct mailbox, you will need your exercise group number for that.

In total there are 12 exercises in 3 blocks (A, B, C). In each block you have to achieve at least 30 points of 64 possible ones to get access to the exam.