Eidgenössische Technische Hochschule Zürich
Ecole polytechnique fédérale de Zurich
Politecnico federale di Zurigo
Swiss Federal Institute of Technology Zurich

Institut für Theoretische Informatik
Dr. B. Gärtner, Prof. Dr. J. Hromkovič

26. Oktober 2010

Informatik für Mathematiker und Physiker Serie 5 HS 10

URL: http://www.ti.inf.ethz.ch/ew/courses/Info1_10/

Skript-Aufgabe 30 (4 Punkte)

Show that the following sets of functions are complete for the set of binary Boolean functions.

b) $\{\text{OR}, \text{NOT}\}$

c) $\{\text{NAND}\}$

d) $\{\text{NOR}\}$, where $\text{NOR} := \text{NOT} \circ \text{OR}$.

e) $\{\text{XOR}, \text{AND}\}$

You may use the fact that $\{\text{AND}, \text{OR}, \text{NOT}\}$ is a complete set of binary Boolean functions.

Skript-Aufgabe 32 & 33 (4 Punkte)

Parenthesize the following expressions according to operator precedences and associativities. Then, evaluate the expressions step-by-step, assuming that `x`, `y`, and `z` are all of type `int` with `x==0`, `y==1`, and `z==2`.

b) `z > 1 && ! x != 2 - 2 == 1 && y`

c) `3 * z > z || 1 / x != 0 && 3 + 4 >= 7`

Skript-Aufgabe 49 (4 Punkte)

Write a program `perfect.cpp` to test whether a given natural number n is perfect. A number $n \in \mathbb{N}$ is called *perfect* if and only if it is equal to the sum of its proper divisors, that is, $n = \sum_{k \in \mathbb{N},\, \text{s.t. } k<n \,\wedge\, k|n} k$. For example, $28 = 1+2+4+7+14$ is perfect, while $12 < 1+2+3+4+6$ is not.

Extend the program to find all perfect numbers between 1 and n. How many perfect numbers exist in the range $[1, 50000]$?

Skript-Aufgabe 52 (4 Punkte)

We heard in the lecture that it took Frank Nelson Cole around three years to find the factorization

$$761838257287 \cdot 193707721$$

of the Mersenne number $2^{67}-1$ by hand calculations. Write a program `cole.cpp` that performs the same task (hopefully in less than three years).

Hint: You will need the type `ifm::integer`.

Die **Aufgaben 36** und **55** aus den Vorlesungsunterlagen sind **Challenge Aufgaben** und geben jeweils 8 Punkte, wenn sie vollständig gelöst werden.

Abgabe: Bis 2. November 2010, 15.15 Uhr.