



Mathematics for computer science 1

Winterterm 2019/20

Hand in your solution sheet in the mailboxes (next to Zeichensaal U.39, building E2 5) by Nov. 20 **before the lecture**.

All exercise sheets and course information can be found at: www.math.uni-sb.de/ag/schreyer/

Sheet 4

13. November 2019

Exercise 1 (Common divisor). Use a computer algebra software, e.g. MAPLE, in order to implement the following experiment: Choose 10.000 random pairs of numbers between 0 and 10^6 and count how many of these pairs have a common divisor strictly greater than one. Repeat the experiment for 10.000 pairs between 0 and 10^9 and 0 and 10^{12} , respectively. Print out your code and results.

Exercise 2 (Finite fields). (a) Show that there exists a field with exactly 4 elements by providing the Cayley tables.

(b) Show that there does not exist a field with exactly 6 elements.

Exercise 3 (Irrational numbers). Show that

(a) $\sqrt{3}$, $\sqrt{15}$, $\sqrt{45}$ are irrational.

(b) $\sqrt[3]{2}$ and $\sqrt{2} + \sqrt{3}$ are irrational.

(c) Let $n \in \mathbb{Z}_{>0}$. The square root \sqrt{n} is irrational if and only if n is not a square number.

Exercise 4 (Quantifiers and ε). Let (a_n) be a sequence in \mathbb{R} and let $a \in \mathbb{R}$. Provide all implications between the following five statements.

(a) $\forall \varepsilon > 0 \exists n_0 : |a_n - a| < \varepsilon, \forall n \geq n_0$

(b) $\exists \varepsilon > 0 \exists n_0 : |a_n - a| < \varepsilon, \forall n \geq n_0$

(c) $\forall \varepsilon > 0 \forall n_0 : |a_n - a| < \varepsilon, \forall n \geq n_0$

(d) $\exists \varepsilon > 0 \forall n_0 : |a_n - a| < \varepsilon, \forall n \geq n_0$

(e) $\exists n_0 \forall \varepsilon > 0 : |a_n - a| < \varepsilon, \forall n \geq n_0$

Give examples of sequences which show that there are no further implications.

Please note:

You can download the computer algebra software MAPLE for free under the following webpage: <https://unisb.asknet.de/cgi-bin/product/P11605>. You have to register in HIZ-Softwareportal with your student email address.

You can also use MAPLE on computers in the *CIP-pool* (rooms 012, 103 till 106, building E1 3). All further information to the *CIP-pool* can be found on the following webpage: *Rechnerbetriebsgruppe der Informatik*: <https://w3rbg.cs.uni-saarland.de/>.