

1. EXERCISE "DATENSTRUKTUREN UND EFFIZIENTE ALGORITHMEN",
WS 18/19

Exercise 1: 3+(1.5+1.5)+3= (9 Credits)

- (a) Let $f(n)$ and $g(n)$ be asymptotically nonnegative functions. Using the basic definition of Θ -notation, prove that $\max\{f(n), g(n)\} = \Theta(f(n) + g(n))$.
- (b) Is $2^{n+1} = O(2^n)$? Is $2^{2n} = O(2^n)$?
- (c) Explain why the statement: "*The running time of algorithm A is at least $O(n^2)$.*" is meaningless.

Exercise 2: (4+3+4=11 Credits)

Let $G = (V, E)$ be an undirected graph. Edges $\{x, y\} \in E$ are written as xy .

- (a) Let $|V| \geq 2$. Show that G has two vertices of the same degree.
- (b) Show that if G is a forest, then G has $|V| - |E|$ connected components.
- (c) Assume now that $V = \{0, 1, 2, a, b, c\}$ and $E = \{01, 02, 12, 2a, ab, ac, bc\}$. Show that $H \simeq G$ for $H = (\{x, y, z, a, b, c\}, \{xy, xz, zy, xa, ab, ac, bc\})$.

How many isomorphism are there?

How many spanning trees does G have?

Exercise 3: (10 Credits)

Give a pseudocode and a C++-implementation of a recursive algorithm to compute the coefficients of the polynom

$$(x + y)^n = \sum_{k=0}^n \binom{n}{k} x^{n-k} y^k.$$

Turn in your code. Turn in the output of your program for $n = 1, \dots, 10$.

When handing in programming exercises, always document how to compile and run your program.

Deadline: Wednesday - October 24, 2018 - 12.15pm