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Algorithms and Data Structures
Winter Term 2019/2020
Exercise Sheet 2

Remark: For this exercise sheet, watch the third video lecture given on the lecture website.

Exercise 1: $\mathcal{O}$-Notation

State whether the following claims are correct or not and prove it using the formal definition of the $\mathcal{O}, \Omega, \Theta$-notations.

(a) $n(n-1) \in O(n^2)$

(b) $n! \in \Omega\big(n^2\big)$

(c) $n \in \Theta(\log_2 3^n)$

(d) $\sqrt{n^3} \in \mathcal{O}(n \log n)$ ***Hint**: For all $\varepsilon > 0$ there is an $n_0 \in \mathbb{N}$ such that for all $n \geq n_0 :\ \log_2 n \leq n^{\varepsilon}$.*

Exercise 2: Sort Functions by Asymptotic Growth

Use the definition of the $\mathcal{O}$-notation to give a sequence of the functions below, which is ordered by asymptotic growth (ascending). Between two consecutive functions g and f in your sequence, insert either $\prec$ (in case $g \in \mathcal{O}(f)$ *and* $f \notin \mathcal{O}(g)$) or $\simeq$ (in case $g \in \mathcal{O}(f)$ *and* $f \in \mathcal{O}(g)$).

n^2	$\sqrt{n}$	$2^{\sqrt{n}}$	$\log(n^2)$
$2^{\sqrt{\log_2 n}}$	$\log(n!)$	$\log(\sqrt{n})$	$(\log n)^2$
$\log n$	$10^{100} n$	$n!$	$n \log n$
$2^n/n$	n^n	$\sqrt{\log n}$	n