Universität Erlangen-Nürnberg
Department of Computer Science 7
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Introduction to Data Structures and Algorithms

Exercise sheet 4

Exercise 5:

Find two functions *f* and *g* (both of type $\mathrm{N} \rightarrow \mathrm{N}$) such that neither $f(n) = O(g(n))$ nor $f(n) = \Omega(g(n))$. Show that your claim is correct!

Exercise 5a:

Given be the function $f(n) = n^3 - 3n + 10$

a) Define a non-tight asymptotic upper bound $o(g(n))$ for $f(n)$!

b) Give a formal justification using the definition of non-tight asymptotic upper bound!

c) Define an asymptotic upper bound and an asymptotic lower bound for $f(n)$ that is also a tight bound !

d) Give a formal justification using the definition of asymptotic tight bound!

Exercise 5b:

Prove by using
the rules for Landau notation that the following equation
holds: $4n^3 - 100n + 1500 = \Theta(n^3 + 2n^2 + 3n + 4)$

Hint: Do not use the definition of Θ, but use the fact that polynomials are bounded asymptotically tight by n to the highest power of the polynomial.

Exercise 6:

Illustrate how the algorithm Insertion_sort works on the input sequence $\langle 77,16,35,37,100,20,59 \rangle$!

Exercise 7:

Let $f(n) = \log(n!)$. Show that $f(n) = O(n \log n)$ and $f(n) = \Omega(n)$.

In the exercise class an improved asymptotic lower bound for $f(n)$ will be shown ($f(n) = \Omega(n \log n)$). Assuming this result had already been proved: What is the asymptotic growth of $f(n)$?