Hasso Plattner Institut
IT Systems Engineering | Universität Potsdam

Summer Term 2017

Project 2 – "Nature-Inspired Algorithms"

https://hpi.de/en/friedrich/teaching/ss17/natinsalg.html

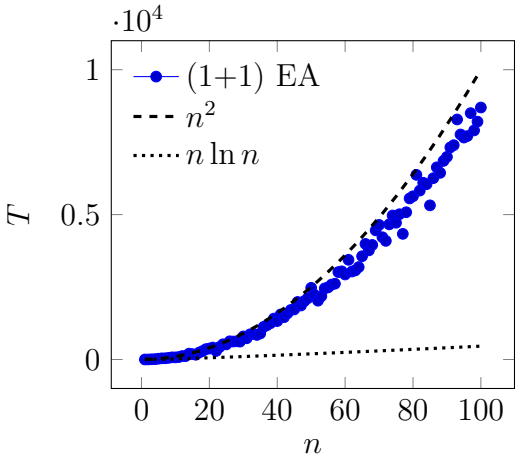
In Project 1 we implemented different nature-inspired search heuristics and empirically measured their running times on a number of toy problems. In this project, we will prove asymptotic bounds on some of the running times we found in Project 1. Recall the following definitions.

$$\textsc{LeadingOnes} : \{0,1\}^n \to \mathbb{R}, x \mapsto \text{number of 1s before the first 0 in } x;$$

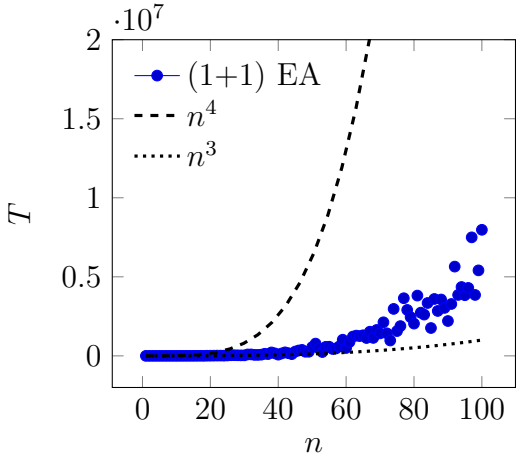
$$\forall k < n : \textsc{Jump}_k : \{0,1\}^n \to \mathbb{R}, x \mapsto \begin{cases} |x|, & \text{if } |x| < n-k; \\ n-k, & \text{if } n-k \leq |x| < n; \\ n, & \text{if } |x| = n; \end{cases}$$

For each of the functions, the goal is to find a bit string with maximal value. Here is an example of several empirical runtime measurements of the (1+1) EA on each problem along with some proposed bounds.

(1+1) EA on LeadingOnes



(1+1) EA on Jump$_4$



Assignment. For this assignment, the analysis methods introduced in Lectures 3 and 4 (slides online) will be useful. Prove the following.

(a) The runtime of the (1+1) EA on $\textsc{LeadingOnes}$ is $O(n^2)$.

(b) The runtime of the (1+1) EA on $\textsc{Jump}_k$ is $O(n^k)$.

The results of the project are submitted via Moodle:

`https://hpi.de/friedrich/moodle`

Each team submits a single pdf file named `LastnameA-LastnameB-LastnameC.pdf` (where `LastnameX` denotes the last (family) name of a team member) containing clear and correct proofs of the above statements. You may typeset the assignment, or write the assignment (legibly) by hand and scan it.