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Project 3 – "Heuristic Optimization"

https://hpi.de/friedrich/teaching/ss15/heuristic-optimization.html

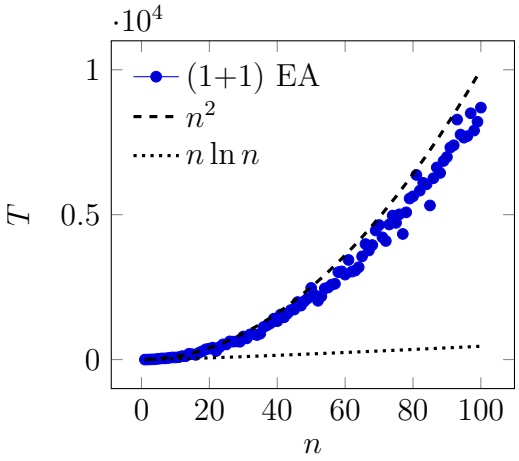
In Project 1 we implemented two different randomized search heuristics and empirically measured their running times on a number of toy problems. In this project, we will prove asymptotic bounds on some of the running times we found in Project 1. Recall the following definitions.

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

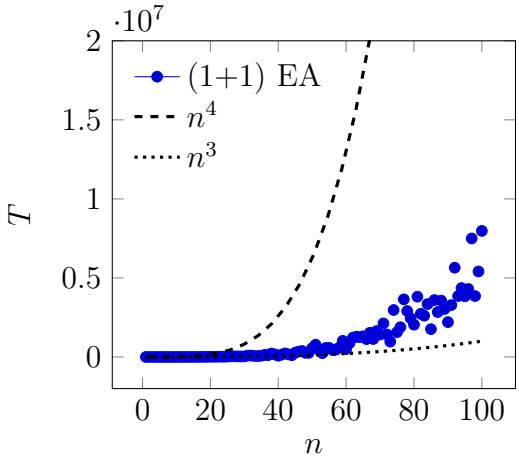
$$\forall k < n : \textsc{Jump}_k : \{0,1\}^n \to \mathbb{R}, x \quad \mapsto \quad \begin{cases} |x|, & \text{if } |x| < n-k; \\ n-k, & \text{if } n-k \leq |x| < n; \\ n, & \text{if } |x| = n; \end{cases}$$

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 Lecture 6 (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 $O(n^k)$.