technische universität dortmund

Dept. of Computer Science
Chair of Algorithm Engineering

Tutorial for

Introduction to Computational Intelligence in Winter 2009/10

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http://ls11-www.cs.tu-dortmund.de/people/rudolph/teaching/lectures/CI/WS2009-10/lecture.jsp

Sheet 11, Block C

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Exercise 11.1: Runtime Analysis (10 Points)

Use the method of fitness-based partitions (see lecture 12b) to calculate an upper bound for the expected runtime of the (1+1)-EA (with standard-bit-mutation) on the following maximization problems. Give the partitioning and comment your calculations detailedly. Describe what kind of steps are helpful (which bits shall flip) in what kind of situations (state of the individual).

Let $\mathbf{x} = (x_1, \ldots, x_n)$ with $x_i \in \{0, 1\}$ for $i \in \{1, 2, \ldots, n\}$.

a)

$$f(\mathbf{x}) = \sum_{i=1}^{n} \prod_{j=i}^{n} (1 - x_j)$$

b)

$$g(\mathbf{x}) = \begin{cases} n + i & \text{if } x = 1^i 0^{n-i} \text{ with } i \in \{1, 2, \ldots, n\} \\ n - \sum_{i=1}^{n} x_i & \text{otherwise} \end{cases}$$

c)

$$h_k(\mathbf{x}) = \begin{cases} n - \sum_{i=1}^{n} x_i & \text{if } n - k < \sum_{i=1}^{n} x_i < n \\ k + \sum_{i=1}^{n} x_i & \text{otherwise} \end{cases}$$

$k \in \{1, \ldots, n\}$ is a parameter of the function family and shall be fixed before the optimization starts. Hint: Choose a constant value, e.g. $k = 5$ to make the function more accessible, then consider the general case with arbitrary k.