technische universität dortmund

Dept. of Computer Science
Chair of Algorithm Engineering

Tutorial for

Introduction to Computational Intelligence in Winter 2009/10

Günter Rudolph, Nicola Beume

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

Sheet 10, Block C

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Exercise 10.1: Basic Probability Theory (5 Points)

Consider standard-bit-mutation on a bitstring of length n where the probability of flipping is $p = 1/n$ for each bit.

a) Calculate the expected number of flipping bits per mutation.

b) Calculate the probability that exactly k bits of the bitstring are flipped in one mutation.

c) Calculate the probability that a certain bit is flipped at least once within t mutations.

d) Given a bitstring x, calculate the probability that a certain bitstring y is the result of one mutation of x. Hint: Use the Hamming distance to relate bitstrings to each other.

Exercise 10.2: Metric-based EA for Natural Numbers (5 Points)

We represent natural numbers $z \in \{0, 1, \ldots, 2^n - 1\}$ by their standard binary encoding with n bits. Consider an EA on the search space $S = \{0, 1\}^n$. Let $z(x)$ be the natural number represented by $x \in \{0, 1\}^n$.

a) Let $d\colon S \times S \to \mathbb{R}_0^+$ be defined by $d(x, y) = |z(x) - z(y)|$. Proof that d is a metric on the search space S.

b) Check whether standard-bit-mutation here fulfills the guidelines for metric-based EA.