Exercises for the lecture

Collaborative transmission in wireless sensor networks

Term: Summer 2010 Stephan Sigg (sigg@ibr.cs.tu-bs.de) Exercise: 14.06.2010, 08:00 – 09:30

3 Evolutionary algorithms

3.1 Method of the fitness based partition

The artificial function ONEMAX is defined as

$$ONEMAX(x) = \sum_{i=1}^{n} x_i; x \in \mathbb{B}^n \tag{1}$$

Show that the expected optimisation time for an (1 + 1)-EA on ONEMAX is $\mathcal{O}(n \log n)$

3.2 Method of the expected progress

a) The artificial function $LONGPATH_k(x)$ is defined as

$$LONGPATH_k(x) = \begin{cases} n^3 + i & \text{if } x = v_i \\ n^3 - \left(n \cdot \sum_{i=1}^{k} x_i\right) - \sum_{i=k+1}^{n} & \text{else} \end{cases} \tag{2}$$

The variable v_i results from the definition of a long k-path of dimension r. The long k-path of dimension 1 is $P_d^1 = (0, 1)$. Let $P_k^{n-k} = (v_1, \ldots, v_l)$ be the long k-path of dimension $n - k$. The long k-path of dimension n is defined by

$$P_k^n = \left(o^k v_1, 0^k v_2, \ldots, 0^k v_l, 0^{k-1} 1 v_l, \ldots, 01^{k-1} v_l, 1^k v_l, 1^k v_{l-1}, \ldots, 1^k v_1\right) \tag{3}$$

Show that the expected optimisation time of the (1 + 1)-EA on $LONGPATH_{\sqrt{n-1}}$ is $\Theta\left(n^{\frac{3}{2}} 2^{\sqrt{n}}\right)$

b) The function LEADINGONES is defined as

$$LEADINGONES(x) = \sum_{i=1}^{n} \prod_{j=1}^{i} x_j; x \in \mathbb{B}^n \tag{4}$$

Show that the expected optimisation time of the (1+1)-EA on LEADINGONES is $\Theta\left(n^2 + n\right)$