Lukas Gesing, Patrick Kaster
MA-INF 4201 - Artificial Life
Exercise Sheet 7

Assignment 44

Assuming that the rules for the 2-point-cross-over recombination-operator are analogous to the 1-point-cross-over recombination-operator there can only be two cases: The genome is split at two points. Either:

1. The part up to point 1 is taken from parent A, the part between point 1 and point 2 is taken from parent B and the final part from point 2 to the end is again taken from parent A.
2. or the part up to point 1 is taken from parent B, the part between point 1 and point 2 is taken from parent A and the final part from point 2 to the end is again taken from parent B.

So, regardless of the genome sequence length L, there can only be two different offsprings. Thus, the diversity of the population has to be provided by the size of the population or a mutation operator.

■

Assignment 45

A binary genome of length L can be represented by a hypercube of dimension L of unit edge length. Every bit of the genome corresponds to an axis of the hypercube. Since the hypercube has unit edge length and the genome is binary, a genome corresponds to a specific corner of the hypercube. This is depicted for the three-bit-genomes $(0,0,1), (1,1,0), (1,0,1)$ in figure (1).

■

Assignment 46

Generating all possible sequences of L is equivalent to finding all permutations of L. Since every permutation can be expressed as a product of transpositions (the swapping of two elements), the algorithm can generate all sequences. ■

Assignment 47

$$
\begin{aligned}
Pr[\text{"a specific bit is not flipped"}] &= 1-p \\
Pr[\text{"L bits are not flipped"}] &= (1-p)^L \\
Pr[\text{"L bits of N individuals are not flipped"}] &= N \cdot (1-p)^{L \cdot N} \\
Pr[\text{"all L bits of all N indivduals are flipped"}] &= \\
Pr[\text{"none are identical to parent"}] &= 1-(1-p)^{L \cdot N}
\end{aligned}
$$

$Q = 1-(1-0.01)^{100 \cdot 20} = 0.99999999813624$ ■

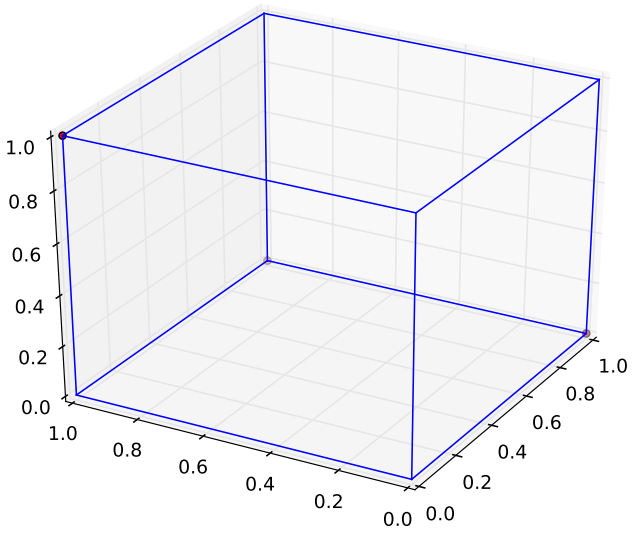


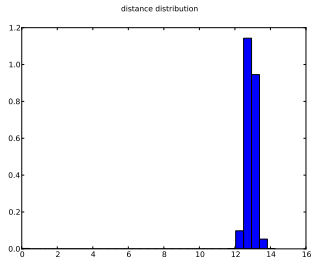
Figure 1: representation of three-bit-genomes by an three dimensional hypercube

Assignment 48

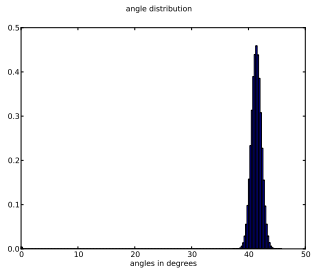
External selection selects the individuals to "survive", while the rest of the population is discarded. *Parent selection* selects those "survivors" which will generate new offspring to replenish the population. ■

Assignment 49

For an experimental run, we find a mean distance of: 12.8903802695 and the following distributions for angles and distances



(a) distance distribution



(b) angle distribution

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