

GAGP Tutorial 2 (week 4)

1. (Goldberg) You are asked to minimise a function $f(x,y,z)$ where $-20 < x < 125$, $0 < y < 1200000$, $-0.1 < z < 1.0$ and the desired precisions for x , y and z are 0.5, 10000 and 0.001 respectively. Using the 'customary' grid-based binary encoding idea of dividing ranges into some power-of-2 number of points, how many bits are needed?

2. You want to try to represent the value of some integer quantity n in some binary-encoded way, but n only ranges over the integers 1..17. How might you do it? Discuss the advantages and disadvantages.

3. Proteins are made up of sequences of amino acids connected by chemical bonds. The protein sequence "folds up" into a three-dimensional structure of low energy by rotation of the chemical bonds connecting the amino acid groups. The three-dimensional structure will then determine the biological function of the protein, so it is important to be able to predict this structure from the sequence of amino acids in the protein.

Consider how you could apply a genetic algorithm to find the three-dimensional structure of lowest energy for a given protein sequence. Pay particular attention to how you would represent the candidate structures, the fitness function you would use, and the crossover and mutation operators.

4. It has been observed that some organisms seem to pass on behaviours learned during their lifetime to their offspring. Lamarck's hypothesis was that traits acquired during the lifetime of an individual could somehow be passed on genetically to the individual's children. However, since there is no obvious biological mechanism for this, Lamarck's hypothesis is universally rejected.

One proposal for a non-Lamarckian mechanism explaining the passing on of learned behaviours was given by Baldwin, who pointed out that if learning helps survival, then the organisms best able to learn will have the most offspring. Further, if the environment remains constant, so that the best things to learn remain constant, then this can lead, via selection, to a genetic encoding of a trait that previously had to be learned.

Describe how you could use evolutionary computation as a model system to demonstrate the truth (or otherwise) of Baldwin's hypothesis.