NK - Landscapes Models

University of Geneva

Metaheuristics for Optimization
26 September 2022

NK - Landscapes Models

Fitness Landscapes

- Representation of a fitness function F(x).
- F(x) tells us the quality of a possible solution x_i

NK-Landscapes

- Introduced to generate **fitness landscapes** with a ruggedness dependable on one parameter only $\rightarrow$ K
- The number of local optima increses exponentially with K
- Systematic way to generate a fitness landscape
- Frequently used to test a metaheuristic

Definition of NK problems

Consider a sequence of N variables $x = (x_1, x_2, ..., x_N)$ with $x_i \in \{0, 1\}^N$ each linked to K other variables.
We want to optimize the **global fitness** function F(x): S $\rightarrow \mathbb{R}$

$$F(x) = \sum_{i=1}^{N-K} f_K(x_i, ..., x_{i+K})$$

F(x) is the sum of **local fitness** contributions $f_K(x_i, ..., x_{i+K})$.
Notice that f_K is not a function of the entire x, but a function of a subset of x made of K+1 elements, where K is the number of variables linked to each x_i.

Fundamental Search Methods - examples

Search methods - the *exploration operator* U - use the fitness values in the neighbourhood to generate the next possible solution starting from the current solution.

Deterministic Hill-Climbing

- U chooses the point in the neighbourhood with the best fitness value
- The search will likely get stuck at a local optimum if the fitness function is not unimodal or if the search space has a plateu

Probabilistic Hill-Climbing

- The next point is selected with a probability proportional to its fitness
- The search will not get stuck, you need to impose a stopping criteria