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Fundamentals and implementations of modeling and simulations.

Documentation of laboratory task no 6.

Title: Simple local search

Author: Artur Łukaszek

Field of studies: Informatics (sem.V)

Project Objective:

The goal of the project is to find local minimum and show the path of checking poonts by the program. The procedure starts in a randomly selected point of the domain, the next point is selected in the neighborhood of the previous one and if the new selected point is worse than the previous one, the procedure stays in the previous point. The procedure is repeated the assumed number of times.

Description:

Simple local search is a method dedicated for finding the local optimum (minimum - in the considered case) of given function. It is a simple method consisting in creation of a sequence of solutions so that every next single solution is not worse than the previous one.

In computer science, local search is a heuristic method for solving computationally hard optimization problems. Local search can be used on problems that can be formulated as finding a solution maximizing a criterion among a number of candidate solutions. Local search algorithms move from solution to solution in the space of candidate solutions (the *search space*) by applying local changes, until a solution deemed optimal is found or a time bound is elapsed.

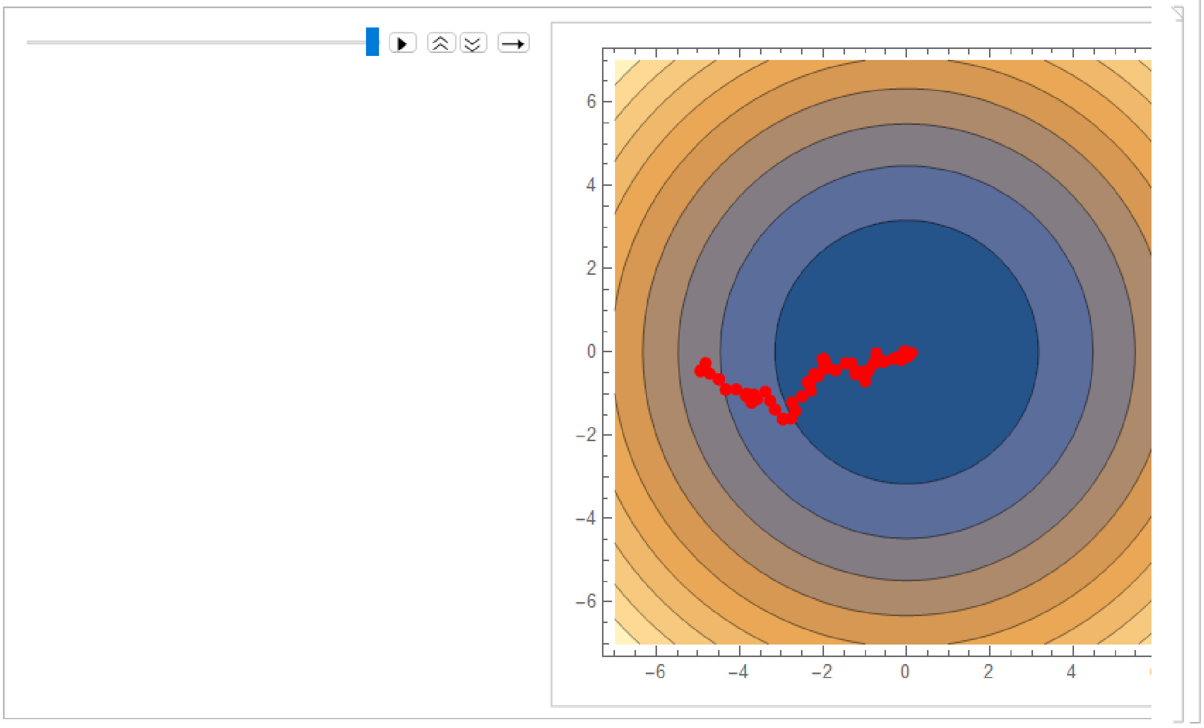
Local search algorithms are widely applied to numerous hard computational problems, including problems from computer science (particularly artificial intelligence), mathematics, operations research, engineering, and bioinformatics. Examples of local search algorithms are WalkSAT, the 2-opt algorithm for the Traveling Salesman Problem and the Metropolis–Hastings algorithm.

The algorithm of finding minimum:

1. Random selection of initial solution: $\mathbf{p}_1 = (x_1, y_1)$.
2. Random selection of new solution $\mathbf{p}_i = (x_i, y_i)$ in the neighbourhood of $\mathbf{p}_{i-1} = (x_{i-1}, y_{i-1})$ for given radius r (each coordinate can be selected separately: $x_i \in (x_{i-1} - r, x_{i-1} + r)$, $y_i \in (y_{i-1} - r, y_{i-1} + r)$).
3. If $f(\mathbf{p}_i) > f(\mathbf{p}_{i-1})$, then we replace $\mathbf{p}_i$ by $\mathbf{p}_{i-1}$ (we stay in $\mathbf{p}_{i-1}$).
4. Return to item 2.

Example of input and output:

```
localsearch[x^2 + y^2 , -7, 7, 0.25, 100]
Minimum of function is in: {-0.0051477, -0.0212501} = 0.000478066
```



Enclosures:

File with the program(Łukaszek_Artur_proj_6.nb)