LE09: Heuristic and greedy optimization

Hill climbing is a generic uphill optimization method and belongs to the category of **local** optimization techniques. A characteristic feature of this algorithm is that the result found is highly dependent on the chosen **starting point**. Since it only searches for improvements in the immediate vicinity, it typically yields a **local maximum** Such methods are particularly effective for **convex** optimization problems, as these have only a single optimum.

To avoid the problem of getting stuck in a local optimum, simulated annealing can be used. This method is modeled on an industrial process in which a solid is **heated and cooled**. Unlike hill climbing, this algorithm allows for downward movements as well as **upward movements**. The probability of such a movement depends on the current **temperature**. Since the method can leave a local optimum, it is classified as a **local** optimization method. The temperature is reduced stepwise according to a so-called **cooling plan**.

Another global approach involves **genetic algorithms** which operate on the model of **biological evolution**. Instead of managing a single solution, they manage a set of solutions called **population**. The process comprises three essential steps: **selection** individuals are chosen based on their fitness; **mutation** where an individual is replaced by a neighboring one; and **crossover** pairs are combined to produce new offspring.

Finally, there is the group of greedy algorithms, which includes Kruskal's algorithm. These select the currently **optimal improvement**. However, due to their **short-sightedness** they often end up in a local optimum. A greedy algorithm is only guaranteed to be optimal if the underlying problem can be characterized by **a matroid**.