Urban Planning Methodology

For a given map, the first step of both methods is to generate a solution randomly. The solution is a matrix containing the coordinates of different sites and their according type. The matrix is denoted by nested list in Python, the element in the list is a sub-list containing three digits, the first two digits represent the coordinate of the sites and the third digit is the category of the sites, classified by 1, 2 and 3 for industrial, commercial and residential site respectively.

Score Calculation

The score for each solution is calculated depending on the requirement illustrating in the problem part, which is determined the distance between different construction sites, the construction sites and the specific sites on map and the construction cost on different grids. In the program there is a function to calculate the score for each map configuration.

The score will be criteria judging the quality of the solution. The correlation between the score and the solution is positive, the higher score, the better solution. In the hill climbing algorithm, the program is to find the maximum score with the according map configuration; in the genetic algorithm, the fitness is exactly the score.

Successor Generation

Hill climbing and genetic algorithm both need to expand nodes to find the optimal solution. The generation of successors is to find all the possible solutions other than the parent solutions. Hill climbing will expand the nodes and choose the best child then expand for next until the peak value is found. In genetic algorithm, a sequence of initial states will be generated then the population will perform random crossover to generate the next population.

Hill Climbing

In the beginning only one possible coordinates sequence will be generated and then the expand nodes for all the other possible solutions. For each iteration, the node with highest score will be chosen to expand nodes. If the score is less than the score than the previous iteration, the program will stop.

Restart

In the restart process, an estimated upper bound of the score will be given according to the number of sites and the cost of the map. For each iteration, the program will determine whether the highest recorded score is less than the estimated score, if it’s smaller than the estimated score, the program continues until the program has ran 10 seconds already.

Genetic Algorithm

In genetic algorithm, the population size and the number of iterations are pre-determined value. The population will be random generated at the beginning, then for each iteration, selection, elitism, culling and crossover will be performed to find the optimal solution.