The Plant Propagation Algorithm for Discrete Optimisation: The Case of the Knapsack Problem

Birsen İrem Selamoğlu and Abdellah Salhi

Abstract The Plant Propagation Algorithm (PPA) has been demonstrated to work well on both unconstrained and constrained continuous optimization problems. PPA emulates the strategy that plants deploy to survive by colonising new places which have good conditions for growth. Plants, like animals, survive by overcoming adverse conditions. The strawberry plant, for instance, has a survival and expansion strategy which is to send short runners to exploit the local area if the latter has good conditions, and to send long runners to explore new and more remote areas. Recently PPA has been implemented to solve the Travelling Salesman Problem. In this paper we intend to implement it for the 0-1 Knapsack Problem (KP) in both its variants; single and multiple knapsacks. Given a set of n items and a set of m knapsacks $(m \leq n)$; the general form of the 0-1 KP is as follows.

$$max\ z = \sum_{i=1}^{m}\sum_{j=1}^{n} p_j x_{ij} \tag{1}$$

$$\begin{aligned} s.t.\ \sum_{j=1}^{n} w_j x_{ij} &\leq c_i,\ i \in M = \{1,\dots,m\}, \\ \sum_{i=1}^{m} x_{ij} &\leq 1,\ j \in N = \{1,\dots,n\}, \\ x_{ij} &= 0\ or\ 1,\ i \in M,\ j \in N, \end{aligned} \tag{2}$$

where, p_j shows the profit of item j, w_j is the weight of item j and c_i is the capacity of knapsack i. $x_{ij} = 1$ if item j is in knapsack i and 0, otherwise. The performance of the algorithm on a standard list of test problems is compared to that of the Genetic

Birsen İrem Selamoğlu
University of Essex, Wivenhoe Park, Colchester CO4 3SQ, e-mail: bisela@essex.ac.uk

Abdellah Salhi
University of Essex,e-mail: as@essex.ac.uk

Algorithm, Simulated Annealing, Particle Swarm Optimization and the more recent algorithms such as the Firefly Algorithm. Computational results are included.