A Hybrid Grouping Genetic Algorithm for Bin Packing

Emanuel Falkenauer

<https://www.macs.hw.ac.uk/~dwcorne/Teaching/falkenauer96hybrid.pdf>

**Problem**: The bin packing problem (BPP) is where items of different sizes must be

packed into a finite number of bins, each with a set capacity, in a way that

minimizes the number of bins used. The BPP is a NP-hard combinatorial optimization problem. Finding an optimal solution to it is exponentially difficult.

**Optimisation type:** A hybrid grouping genetic algorithm (HGGA) is used which is a heavily modified genetic algorithm.

**Representation**: The representation of a bin packing solution is written as a chromosome in two parts. The first is the *item* part which is explicitly written:

0 1 2 3 4 5

ADBCEB: …,

This means that item 0 is in the bin labelled A, item 1 is in the bin labelled D and so on. The second part of the chromosome is the *group* part which represents only the *groups* (bins in BPP). Like so:

…:BECDA

This part of the chromosome tells us that there are five bins within the solution. Bins A B C D and E.

So put together a chromosome representation of the BPP solution would be:

ADBCEB:BECDA

**Fitness Function:** The fitness function used is Faulkenauer’s fitness function. This fitness function is designed to determine how perfectly a problem is packed. If he constant, k, is kept at 1 a perfectly pack solution would return a 1 therefore it a maximisation.

**Results:** It was found that the HGGA works better than standard and ordering genetic algorithms since the HGGA exploits the suture of grouping problems. The HGGA was also compared to the MTP procedure used to solve the BPP and it was found to be superior to the MTP seen from the extensive experiments comparison in the paper.

Hybrid discrete particle swarm optimization algorithm for capacitated vehicle routing problem

CHEN Ai-ling, YANG Gen-ke, WU Zhi-ming

<https://pdfs.semanticscholar.org/66bc/5b4eefe22b5a599309b8295a55c0cf59de00.pdf>

**Problem:** The Capacitated Vehicle Routing Problem (CVRP) is a NP-hard combinatorial optimization problem where finding an optimal solution to it is exponentially difficult as the problem size increases. The problem is described as finding the minimum cost or distance of the combined vehicle routes for a fleet of vehicles which the must service a number of customers. These routes must originate and terminate at a central depot. Each customer must be visited exactly once and all customers must be visited in one vehicles route without exceeding a vehicles capacity constraint.

**Optimisation type:** Hybrid discrete particle swarm optimization algorithm (DPSO) is used which is based off discrete particle swarm optimization and a simulated annealing(SA) algorithm.

**Representation:** A particle or problem instance. is represented in a 2D array. Both dimensions for the array are *N*x*K* dimension vectors*.* Where *N* is the customers to be served and *K* is the vehicles**.** The first dimension represents the customers and vehicles. The second dimension represents if a customer will be served by a certain vehicle.

**Fitness Function:** The fitness function is used to evaluate the performance of particles in the swarm by essentially summing its total cost/distance. The object of the CVRP is to minimize the total cost or distance therefore we use the fitness function for minimization.

**Results:** The DPSO-SA was compared to a Genetic Algorithm (GA) and SA algorithms over several problem instances. Over all the problem instances used in this comparison the DPSO-SA found the shortest distance or found the same distance as the GA or SA. It was never out performed. When the DPSO-SA could not find a better solution than the GA or SA it did however find the solution faster proving its efficiency in run time. One area the DPSO-SA can be improved upon is its time taken to handle larger problems.