

Autor(es): Sotelo-Figueroa, Marco Aurelio; Puga Soberanes, Héctor José; Carpio, Juan Martín; Fraire Huacuja, Héctor J; Cruz Reyes, Laura; Soria-Alcaraz, Jorge Alberto

In recent years Grammatical Evolution (GE) has been used as a representation of Genetic Programming (GP) which has been applied to many optimization problems such as symbolic regression, classification, Boolean functions, constructed problems, and algorithmic problems. GE can use a diversity of searching strategies including Swarm Intelligence (SI). Particle Swarm Optimisation (PSO) is an algorithm of SI that has two main problems: premature convergence and poor diversity. Particle Evolutionary Swarm Optimization (PESO) is a recent and novel algorithm which is also part of SI. PESO uses two perturbations to avoid PSO's problems. In this paper we propose using PESO and PSO in the frame of GE as strategies to generate heuristics that solve the Bin Packing Problem (BPP); it is possible however to apply this methodology to other kinds of problems using another Grammar designed for that problem. A comparison between PESO, PSO, and BPP's heuristics is performed through the nonparametric Friedman test. The main contribution of this paper is proposing a Grammar to generate online and offline heuristics depending on the test instance trying to improve the heuristics generated by other grammars and humans; it also proposes a way to implement different algorithms as search strategies in GE like PESO to obtain better results than those obtained by PSO.

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APPLICATION OF FORMAL LANGUAGES IN POLYNOMIAL TRANSFORMATIONS OF INSTANCES BETWEEN NP-COMPLETE PROBLEMS

Autor(es): Ruiz-Vanoye, Jorge A; Pérez-Ortega, Joaquín; Pazos-Rangel, Rodolfo A; Díaz-Parra, Ocotlán; Fraire-Huacuja, Héctor J; Frausto-Solís, Juan; Reyes-Salgado, Gerardo; Cruz-Reyes, Laura

We propose the usage of formal languages for expressing instances of NP-complete problems for their application in polynomial transformations. The proposed approach, which consists of using formal language theory for polynomial transformations, is more robust, more practical, and faster to apply to real problems than the theory of polynomial transformations. In this paper we propose a methodology for transforming instances between NP-complete problems, which differs from Garey and Johnson's. Unlike most transformations which are used for proving that a problem is NP-complete based on the NP-completeness of another problem, the proposed approach is intended for extrapolating some known characteristics, phenomena, or behaviors from a problem A to another problem B. This extrapolation could be useful for predicting the performance of an algorithm for solving B based on its known performance for problem A, or for taking an algorithm that solves A and adapting it to solve B.

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CAPÍTULO

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VARIABLE NEIGHBORHOOD SEARCH ALGORITHM FOR THE VARIABLE COST AND SIZE BIN PACKING PROBLEM

Autor(es): Hector Joaquín Fraire Huacuja, Alejandro Estrada Padilla, Laura Cruz Reyes, Cláudia Gómez Santillán, Nelson Rangel Valdés, Lucila Morales Rodríguez, Juan Frausto Solís

A company that transports goods to supply customers usually needs to plan the routes that the fleet must follow, since the transportation means a high percentage of the value added to goods. To fill the orders requested by customers it is required loading the vehicles with the products located in the warehouse and included in the orders, and the vehicles must be routing and scheduling. The loading consists in the packing of different products type in vehicles with different capacities to picking the product orders. To improve the warehouse management, many enterprises use Order Batching and Picking Systems. In this chapter, a novel algorithm based on the methodology of variable neighborhood search for the variable cost and size bin packing problem (VCSBPP) is proposed. This problem considers that the sizes and costs of the bins can be different and that there is not correlation between the size and the cost of the bins, which is a realistic assumption for the order batching process in many applications. To validate this approach a series of computational experiments were done with a set of hard instances. The results show that the proposed algorithm outperform to the state of the art algorithm and a statistical hypothesis test is used to support the obtained conclusions.

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