Scope International Journal of Science, Humanities, Management and Technology. ISSN : 2455-068X
Vol.2 Issue 1 (2016) 27-29. Submitted 25/01/2016. Published 2/02/2016

PACKING ARBITRARY SIZED BIN PACKING USING HEURISTIC GENETIC ALGORITHM

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Abstract:

One of the obstacles to widespread adoption of automated material handling systems is inflexibility: once a system is designed and installed, making changes to its configu- ration is typically very difficult. The GridStore system overcomes this obstacle for high-density storage systems by implementing de- centralized control ,meaning that each convey Grid- Store system has its own, independent controller. 3D bin packing problem is to pack 'n' number of bins into a container of standard dimension in such a way as to maximize the container volume utilization and in turn minimize the packing cost. Genetic Algorithm (GA) is one of the evolutionary algorithms widely accepted for solving complex optimization problems. This developed heuristic GA will be used to select optimal bins, its position, sequence of loading and bin orientations.

Keywords – Grid store, GA, 3B bin.

1. INTRODUCTION

The transport and distribution process is done by the logistic firms. Logistic firms use containers for transporting the goods from one location to another by means of shipment cargo, air cargo, or by roadways. Bins are the smaller boxes or cartons used to pack the goods by the manufacturer to protect the goods from damages. Containers are the large steel rectangular prismatic bins of standard sizes used by the logistic firms to transport the bins from one location to another. Each container has its own volume and weight limits, based on which freight rates will be calculated by logistic firms. There were very few known algorithms for finding the optimal solution in polynomial models. But they typically took long time, when the size of the problem grows or when additional constraints are added. i.e. cubical bin packing is easier and took less time compared to cuboids packing. Similarly prismatic packing is entirely different from non-prismatic bin packing.

2. PROPOSED SYSTEM

The associated cost can be reduced by identifying and eliminating the factors which increase the product cost without adding value to that product. Some of those factors are the material handling, transportation, stocking, distribution, etc. Among these factors, transportation is one of the major factors which increase the cost of the product without adding value to that product and it cannot be eliminated. Packing constraints are the restrictions and limitations to pack the bins into the container and it will vary from bin to bin based on the items packed inside the bin. Based on the packing constraints, the bin packing problem is sub-categorized as constrained and unconstrained problem.Cargo cost is the cost pays out for transporting the goods from one location to another. It is also called as the transportation cost. Cargo cost depends on the number of containers rented, number of bins packed, its volume and its weight.

3. GENETIC ALGORITHM

For instance, in the knapsack problem one wants to maximize the total value of objects that can be put in a knapsack of some fixed capacity. A representation of a solution might be an array of bits, where each bit represents a different object, and the value of the bit (0 or 1) represents whether or not the object is in the knapsack. Not every such representation is valid, as the size of objects may exceed the capacity of the knapsack. The *fitness* of the solution is the sum of values of all objects in the knapsack if the representation is valid or 0 otherwise. In some problems, it is hard or even impossible to define the fitness expression; in these cases, interactive genetic algorithms are used.Recent revolutions in molecular genetics made clear that the modular organization of genes is highly important for evolution of complexity. A single point random swapping was implemented to expand the search space. Swapping site has to be selected at random and strings beyond the swapping point should swap to the front. Probability of swapping was set to 100%.

4. PERFORMANCE

Performanceof the GRIDSTORE system depends on a number of design and operational parameters. Here, we investigate the effects of the number of active requests(work-in-process,WIP) in the system and the number and distribution of empty modules per row . We also ran experiments with respect to the question of aspect ratio of the grid. Once requested, an item must make its way to the retrieval row south of the grid, where it immediately disappears.We make this assumption because we are interested in the performance of GRIDSTORE without respect to other material handling systems to which it might be connected. To initialize the simulation, we release the required level of work-in-process at once, therefore, there is no warm-up period during which WIP must be accumulated. In the analysis that follows, we assume that the new request is equally likely to be for any unrequested item in the system.

5. RESULT ANALYSIS

Input data to the bin packing problem is the bin specification (length, breadth and height), container specification and the constraints involved in packing. The output should be the optimal bin packing sequence which satisfies the constraints.

Fig.1. **Mutation Operation**

GA has been employed in this research to optimize the solution to the bin packing problem. The various stages of GA like initial parent generation, crossover, mutation, fitness function calculation and termination. In this stage, 'n' number of parents with 'm' numbers of strings have to be generated randomly. Various experiments will be conducted for the parent size of 75, 100, 135, 150, 175 and 200. Mutation is the operation of swapping an individual string from a parent by selecting the position of string randomly. Figure 1 explains the mutation overloading operation with a sample parent. The output module utilized the decoded data and generated the coordinate points of the bins, its position inside the container, volume occupied and empty space inside the container.

CONCLUSION

The researchers had also succeeded in using genetic approach for problems involved with discrete and continuous variables. None of the literature concentrated on weight constraint, load bearing constraint, placement constraint, stability constraint, boundary crossing constraint, orientation constraint all together. The researchers compared the developed algorithm with the lower bound values and have not considered much on the output format i.e. the format which the practitioners can easily understand and implement the model. Hence in this work, an attempt had been made to develop a conceptual framework for solving the problem in the field of bin packing. The framework could aid in developing an optimal solution for multi-objective problem by satisfying the major packing constraints.

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