Using Genetic Algorithms for Optimum Loading of a Standard Container

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ABSTRACT

This paper proposes a solution to the problems of loading a container. This paper describes the arrangement of a set of items into a container based on specific conditions. These problems are known as packaging problems. It is also known as recreational mathematics. The solution to this problem was found out using math and computer methods which means genetic algorithms. In packaging problem, each of the items was given a specific price, volume and weight and also the container was given volume maximum (Vmax) and weight maximum (Wmax) provided that no items inside the container increase more than Vmax and Wmax of the container..

Keyword : - *Key word1 , Genetic Algorithms, packaging problems, Exhaustive Search and optimal solution.*

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1. INTRODUCTION

Usually, there remain some empty spaces in the containers which lead to significant economic loss. Genetic Algorithms (GA) is one of the optimizing and research algorithms deductive based on the operation of evolution such as selection, mutation and inheritance. In this paper, this heuristic search algorithm (GA) was chosen to determine the fittest solutions for packaging problems. In this process, mostly, 28 items are taken to be packaged in a container with a maximum weight of 12210 and a maximum volume of 12 and each item will have a weight, volume and its price. In this program using 28 items were taken and their details are given in Table No.1.

Table -1: Dataset for items

Item	weight	volume	Price	item	weight	volume	Price
1	821	0.8	118	15	1636	0.9	117
2	1144	1	322	16	237	0.6	100
3	634	0.7	166	17	771	0.9	329
4	701	0.9	195	18	604	0.6	391
5	291	0.9	100	19	1078	0.6	100
6	1702	0.8	142	20	640	0.8	120
7	1633	0.7	100	21	1510	1	188
8	1086	0.6	145	22	741	0.6	271
9	124	0.6	100	23	1358	0.9	334
10	718	0.9	208	24	1682	0.7	153
11	976	0.6	100	25	993	0.7	130
12	1438	0.7	312	26	99	0.7	100
13	910	1	198	27	1068	0.8	154
14	148	0.7	171	28	1669	1	289

2. ANALYSIS OF DIFFERENT AI METHODS AVAILABLE

2.1 Hill Climbing

It is a testing process which deals with helping the generator decide the direction of the movement in search space however, it answers only in positive or negative. It's use is limited to the availability of a sufficient experi-mental function. The best technique to use it consists of certain easy steps which are given as under:
1. Assess the original state and if you find that it is not the goal state then continue with this process otherwise quit the process.
2. Continue or repeat the process again and again till you find the solution or
a) Choose an operator which has been unapplied to the current state and apply it to get a new state and then:
b) Assess and evaluate the new state. If you find that the new state is your target state then you return and stop the process. And if the new state is not the target state but is better than the current state, then make the new state your current state. However, if it is not better than the current state then repeat the process constantly [1].

2.2 Genetic Algorithms

Genetic Algorithms (GAs) are methods of computing based on natural mechanisms (Nature Genetics), where GAs select an initial set of solutions then reproduce the crossover of genes, with the mutation of the genes rando-mly, to produce the optimization or the best solution (maxima and minima) functions.

2.3 Ant Colony

Algorithm was first used on the natural behavior of ants for finding an ideal solution to an extensive range of mat-hematical issues [2].
As it is known that ants get back to their initial destination if they find any source of food so do the other ants upon getting any trails laid down by the previous ants from the food source. [3].

2.4Particle Swarm Optimization

It is a technique for achieving an optimal solution from a series of random solutions having resemblances with Genetic Algorithms (GAs) by updating generations although it lacks crossover and mutational evolution operators.
Particles, which hover across the problem space, are the potential solutions in Particle Swarm Optimization (PSO) [4].
PSO, which is a computational process, improves the quality of the solution by repeating the process of moving particles in the search space following usual mathematical formulas over the velocity and position of the particles again and again until a desired standard is achieved. In this process, position of the particles play very vital role as the movement of each particle is highly influenced by its local best identified position [3].

3. EXPLANATION OF METHODS CHOSEN

3.1 Exhaustive Search

Exhaustive search is a way of Brute Force to the synthetic issues.
Generate the partial groups of materials given (2n Group) and check to see if the restrictions have been met. If the restrictions are met, the total price will be calculated and stored. Evaluate possible solutions one by one, dis-qu alifying unworkable, for the optimization problem, and keep track of the best one found so far.
When you finish the check, declare the solution (s) found, these algorithms are implemented for the optimal solution for 28 items about (3) minutes.

3.2 Genetic Algorithms

In this method the optimal solution is selected from all the solutions available, and this solution
is both computationally simple and effective. Through
selection, crossover and mutation, we select random
chromosomes ranging the number from [0..1].
1 item is selected
0 item is not selected

Then evaluate fitness of each chromosome in the population in A set of solution.
We choose initialization of the population.
To Find the optimal solution we must do the following steps:
In reproduction, determine the fitness values by selecting randomly from the population and creation mating pool. Solve with optimal fitness to survive into the next generation (natural selection)with the following:
First, create a new generation inheriting the attributes of a gathering of a couple at random
Second: both pairs create two new generations

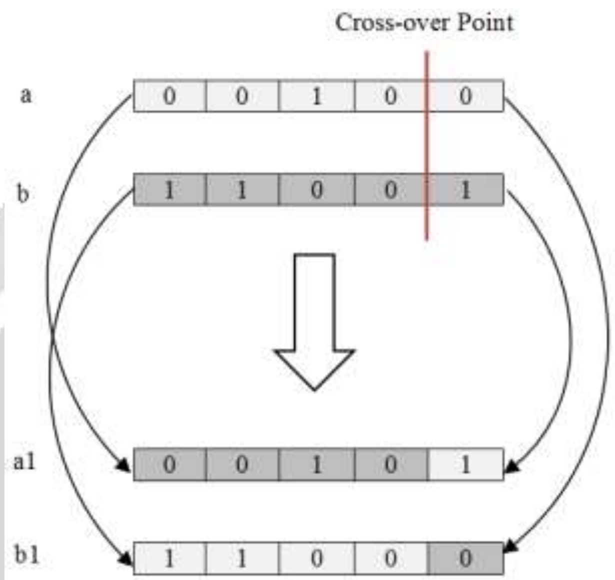

Fig -1: Selected parents

Figure 1 inherits (a1) attributes (a) from the left side of the crossing symbol (|), and inherits the right end of the attributes (b) to produce new generation (a1), and similarly for the new generation (b1) from this the resulting crossover two new generations.
"Unlike crossover, mutation involves altering the values of one or more loci. This creates new possibilities for gene combination that can be generated by crossover. Mutation can be carried out in either of two ways:
in a binary chromosome, randomly selected loci can be toggled, i.e., 1 becomes 0 and 0 becomes 1."[4]
GAs works:
1.[Start] to generate a random population of chromoso-mes N (appropriate solutions to this problem)
2.[fitness] is fitness assessment f(x) for each chromosome (X) in the population
3.[New population] It is a creation of a new population by repeatedly following steps until the completion of a new population.
4.[Selection] Select two parent chromosomes according to their fitness from a population.
5.[Crossover] It is the performance of crossover on the two chromosomes selected.
6.[Mutation] It is with the possibility of mutation which mutates new offspring at each place (the position in chromosome).
7.[Accepting] is new offspring locus in a new population.
8.[Replacing] is used for new generated population and to run further of the algorithm.
9.[Test] If the condition of the end is satisfied , stop , and return the better solution in current population.
10.[Loop] Go to step 2.

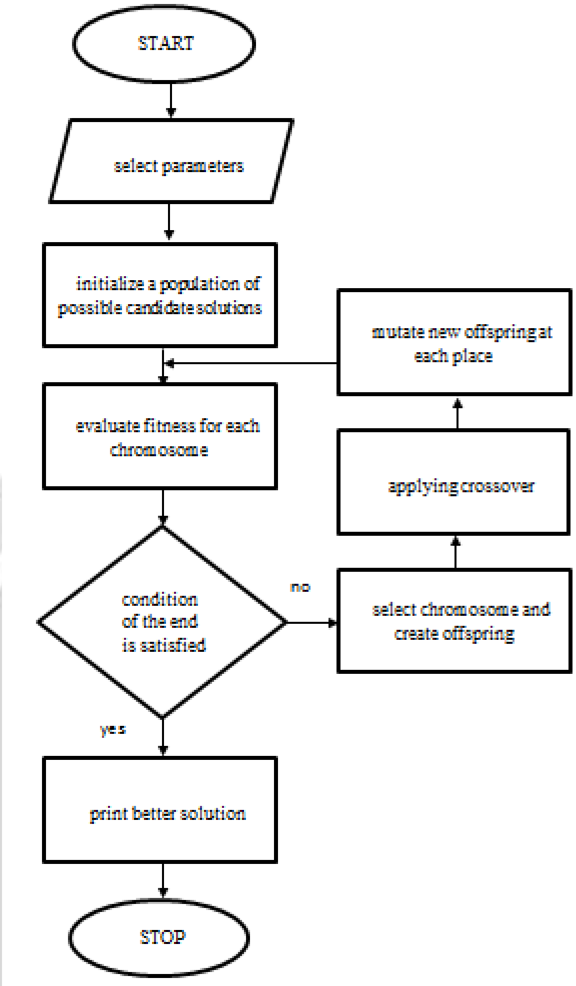

Fig -2: The Genetic algorithm

4. JUSTIFICATION FOR CHOICE

4.1 Exhaustive Search

In such problems to find the optimal solution, arrange a set of items into a shipping container, and select the appropriate search method in the test following the initial set of items and then carry out generation and testing to reach the optimal solution.
The exhaustive search method is for solving this problem to research finding the optimum solution for (28) items and the constraint of that (the weight and volume), simplicity of implementation but slowly implement with more items.

4.2 Genetic Algorithms

To solve such problems to find the optimal solution, in the fastest time to arrange the collection of items from inside the container, and the selection of research method is following the test for a preliminary set of items and then carry out operations improvement (as mentioned above) to reach the optimal solution.
We chose the genetic algorithm to solve the problem of this research to find the optimal solution for (28) the items and the conditions on it (weight, volume).
The genetic algorithm method is very popular, which is suitable for our ambitions to solve the problem, because GAs look at a population of points and not a single point, and is used in payoff every time with no knowledge of derivatives or other additional.

5. SOME OF EXPERIMENTS CARRIED OUT

Exhaustive search algorithm is able to give a solution to the packaging problem without any difficulty to get the optimal solution, and this algorithm took about (3) minutes of time during the implementation of the program on the computer with the Windows 7 operating system.
At the same time it has given the genetic algorithm the optimal solution on the same problem and the same execution environment, execution time and it took about 11 seconds.
But the exhaustive search algorithm is impractical when there a large number of items. Therefore, genetic algorithm is better than the exhaustive search algorithm for these problems.

6. EXPERIMENTAL DISCUSSION OF RESULTES

The next Figure shown both Exhaustive search algorithm and genetic algorithm time taken (in seconds), the Exhaustive search algorithm has provided the desired results for (28) elements during the implementation of the program for the packaging problem. But this algorithm is useful for a limited number of items.
The genetic algorithm has given the optimal solution for the packaging problem and genetic algorithm is useful for a number of items when the program performs several times for both the algorithms. The exhaustive search algorithm takes more time than genetic algorithm for the optimal solution of the packaging problem.

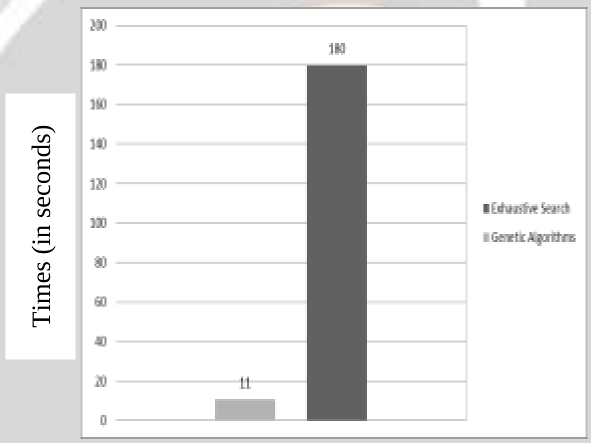

Fig -3: Experiments results

7. CRITICAL EVALUATION OF THE ALGORITHMS APPLIED

The solution that gave it the exhaustive search algorithm is the optimal solution to the packaging problem for the packing items inside a container. But this solution becomes impracticable when the number of items is more than h undreds. While the exhaustive search algorithm takes a few minutes to calculate the optimal solution. The genetic algorithm takes only a few seconds to calculate all possible solutions for the problem.

8. CONCLUSION

This study has reviewed some deferent methods in Artificial Intelligence which is based on natural systems. Therefore, it is used for real optimization solution (minimizing /maximizing), and implementation of two m-ethods to resolve the problem of arranging elements in a container, on being compared, exhaustive search accessed the optimal solution with specific elements, then genetic algorithm was applied on the same problem and showed the optimal solution in less time and more practical by the results listed for that. The comparison of the two methods clearly shows that the genetic algorithm is more effective than the exhaustive search.

9. REFERENCES

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