# A Review Paper on Solving 0-1 knapsack Problem with Genetic Algorithms

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*Abstract—* **the 0-1 knapsack problem is a combination optimization problem which is to maximize the profit of the objects in the knapsack without exceeding its capacity. In this paper we solve the 0-1 knapsack problem using Genetic Algorithms and optimized results. Knapsack problem is a computational Algorithm of Nondeterministic polynomial (NP) hard problem. Genetic algorithms are search approach based on natural selection and natural genetics. They randomly produce initial population of unique. Then, they use genetic operators to concede offspring. This paper shows a fast Genetic Algorithm to solve the knapsack problem.**

*Keywords—* **Genetic Algorithms; knapsack Problem; weight Value; and optimization Problem.**

## I. INTRODUCTION

Genetic Algorithms is optimization algorithms corresponding than calculus based optimization techniques and dynamic programming, backtracking, branch and bound, greedy method in implementation. These are not very useful for solving the problem. The knapsack problem is a traditional problem of association and optimization and has a collection of different application for capital budgeting, project selection, economic planning etc. knapsack problem is also called the Non deterministic polynomial hard problem. If the polynomial is the class of decision problem, that are also solved by algorithms that are run in the time polynomial in the length of the input string or guessing the solution. Genetic algorithms can be also used to solve the great size of NP problem easy. GAs is also generate and find optimal and appropriate results which closer to the exact solution in the polynomial time.

In this paper: Brief description of the basic conception and ingredients of the Genetic algorithms, explanation of 0-1 knapsack problem, and implementation of the 0-1 knapsack problem with genetic algorithms. There are three type of operation in Genetic algorithms: selection function. There are two types of selection function, roulette-wheel and group selection, crossover, and mutation.

## II. KNAPSACK PROBLEM

Knapsack problem consider an optimal solution. 0-1 knapsack problem can not solved by greedy method because it is not fill the capacity of knapsack and empty quantity lower the effective value per pound of the load, and we must estimate the solution to the sub problem in which the item is exclude before we can make the dainty. Fractional knapsack problem is also solved by greedy method because the 0-1 problem is not. The aim to fill the knapsack, the total weight of each item does not exceeded the capacity of knapsack, and maximized the total profit of the contain objects. Each items having a weight and profit of item pi and capacity of knapsack C. In this problem, the problem is called 0-1 problem because each item has been taken receive or ignore. The value of xi will be 1 if the item has been taken in the knapsack. If the value of xi will be 0 if the item has been ignore or not selected in knapsack.

0-1 knapsack problem is also known a binary value and also represent a vector value.

Condition is

$$\sum_{i=1}^{n} w_i x_i \leqslant C \qquad (1)$$

And subject to contain and total profit maximize (1≤i≤n)

$$\sum_{i=1}^{n} p_i x_i \qquad (2)$$

| Item | A | B | C |
|---|---|---|---|
| Profit (pi) | 10 | 8 | 30 |
| Weight (WI) | 3 | 2 | 4 |

We prosecute to maximize the total profit:

$$\sum_{i=1}^{n} p_i x_i = 10x1 + 8x2 + 30x3$$

Here the value of xi is 0or 1
Subject to the constraints

$$\sum_{i=1}^{n} w_i x_i = 3x1 + 2x2 + 4x3 \leqslant 7$$

Again the value of xi is 0or

| Xi | x2 | x3 | wi | Pi |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 4 | 30 |
| 0 | 1 | 0 | 2 | 8 |
| 0 | 1 | 1 | 6 | 38 |
| 1 | 0 | 0 | 3 | 10 |
| 1 | 0 | 1 | 7 | 40 |
| 1 | 1 | 0 | 5 | 18 |
| 1 | 1 | 1 | 9 | 48 |

In this table total possible solution is $2^n$.

In order to find the optimal solution for the exemplification of 0-1 knapsack problem is 40 for the given constraints (w=7) where the item of x1 with one quality and item of x2 with zero quality and then item x3 with one quality are selected in object of C and is 40. In this example to fill the knapsack, the total weight of each item does not exceeded the capacity (7) of knapsack, and maximized the total profit (40) of the contain objects, and the maximum possible solution is eight.

## III. LITERATURE REVIEW

Many Researchers has recorded applying genetic algorithms to solve 0-1 knapsack problems. Julstrom (2015) represent the greedy algorithms, genetic algorithms and greedy genetic algorithms solved the quadratic 0-1 knapsack problem. In this knapsack problem we have to find traditional knapsack problem and defining the object of each and single object. These results demonstrate the power of genetic algorithms gain with heuristic approach to gain optimal result on combination problem and to solve 0-1 knapsack problem using genetic algorithms.

Megha Gupta (2013) implemented an improved 0-1 knapsack problem using Hybrid Genetic Algorithms. Genetic algorithm is a computational algorithm and fast, efficient algorithms to implemente the 0-1 knapsack problem. In this paper we have to compare both of them hybrid genetic algorithm and traditional genetic algorithms to achieve improvement in the solution. The algorithms is also find optimal quality and efficient in the way of convergence forward best result. Using the "fcheck" function to produce efficient population and, select in generation. In this research paper to solved 0-1 knapsack problem on fast genetic algorithms and to presents possible solution and effectiveness concourse an example. We have to improve the speed of operation by many items in knapsack problem.

A.J. Umbarkar and M. S. Joshi (2014) present a modern approach to solve 0-1 knapsack problem using Dual Population Genetic Algorithms. Dual population genetic algorithms are also providing optimal solution to the problem. Genetic algorithms are computational algorithms and similar to the calculus based algorithms. DPGA is a combination of Simple Genetic algorithms and new version of genetic algorithm to solve the problem. Simple genetic algorithms are also used to solve knapsack problem to large data set. But in this paper the problem is convergence and population diversity. The solution of knapsack problem to compare the simple and dual population genetic algorithms and fortuitous data sets. The results represent dual population genetic algorithms to optimize and good performance in the 0-1 knapsack problem, and check more difficult knapsack problem. Therefore results are developed using genetic algorithms may or may not be best solution, and we have to also given optimal results every time. Simple genetic algorithms are also generating the mean value and Dual population genetic algorithms are weighty optimal value for knapsack problem.

Maya Hristakeva and Dipti Shresthna proposed the implementation of the 0-1 knapsack problem using the Genetic Algorithms. We have to find the optimal solution of the knapsack problem, and implementation of two function roulette-wheel function and selection function for solving the problem. In this paper the results are depends on the Elitism. Elitism is also improved the performance of the roulette-wheel function. We have to define the basic idea and implementation of the genetic algorithms to solved the 0-1 knapsack problem, and tested the program different cross cover ratio than select the optimal population. The selection and roulette wheel, mutation method are used to select the optimal population in new generation. Mutation is also preparing the genetic algorithms to the local and end of the operation. The probability of the mutation is 0.10 mean 10% of the chromosomes will select for reproduction. In this paper the Genetic algorithms can be used and find the good solution for knapsack problem with selection function and roulette wheel function. Elitism is method very important for find the optimal and accurate solution of the genetic algorithms.

Khuri, Back and Heitkotter (1994) represent the implementation of the 0-1 multiple knapsack problem using genetic algorithms. Genetic Algorithms using for discipline and involve of impossible input in the population for the genetic algorithms. The possible discipline involve for the searching the new population, help to contain the information for population. In this paper we have to increase the domain knowledge of the genetic algorithms, and description of the fitness function with the retribution.

Sakawa and kato (2002) represent the Genetic Algorithm using double string for solving 0-1 knapsack problem. Double string for solving the 0-1 knapsack problem and some modification new results are compute by genetic algorithm. Then the genetic algorithms using double string for 0-1 knapsack problem are increase or procreate 0-1 programming problem contain two type of value positive and negative. In this paper we have to use branch and bound method to find the accurate solution in this algorithms. This is array based on fast search to input value and give the feasible solution, compare the result of 0-1 knapsack problem and 0-1 programming through a number of mathematical experiments.

## IV. GENETIC ALGORITHMS

Genetic algorithms are a searching and maximize real time function algorithms. The process of made more efficient or more faster program through selection and design of data structure, algorithms and information sequence, similar than calculation based maximize techniques proposed by Darwin.

Genetic algorithms are more excellent at taking big, search and genetic, and navigation them found for maximize association or mixture compound of thing and results, which are capacity not find in a life time .Genetic algorithms are also design search space and dynamic programming (DP) implementation for most of traditional maximize techniques, We have produce many design at a time, and improve search algorithms.

Life Cycle of Genetic Algorithms based on

Population (chromosome)
Evalution (fitness)
Selection (mating pool)
Genetic operation

In this life cycle we have to take fitness chromosome in current population (parents) then we have to decode the chromosome and find the optimal fitness value for production, and new population find on this step. The optimal fitness value of the chromosome then goes through or select for reproduction, if the fitness value of chromosome is very less then neglect the value. we have to applied selection method, different crossover and mutation on the fitness chromosome then process repeatedly until to get best solution for this process.

### A. Fitness Function

Genetic algorithms are used for search space and solving optimization problem. Fitness value is optimal then goes through for reproduction in successive in genetic algorithms. In fitness function many conversion are possible in this process. The value of the fitness function produce a string, this string is also called string's fitness.

### B. Selection Method

Selection process is also used after the fitness function this also dependent on the fitness value. The value of fitness is optimal then select for reproduction, if the value of the fitness is less optimal the chromosome is not selected. Optimal fitness value of the chromosome is selected several times for reproduction further applied the different crossover and mutation method. Eitism is also improved the performance of the selection method, and optimize the genetic algorithms. Selection method can be simulated using the fitness value of chromosome of the input. We have to calculate the probability of the selecting of the string in selection method. There is following selection method for selecting the fitness value from the parents to the crossover.

> Roulette-wheel selection
> Rank selection
> Boltzmann selection
> Tournament selection

### C. Crossover Method

Crossover is also applied after the reproduction phase in mating pool to propose a good string. The data store in the parents string that search parameter space because impulse of better string made under reproduction. In crossover method we have to exchange the bit one passion to another passion by different crossover methods, and find optimal solution for population.

> Single site crossover
> Two-point crossover
> Multi-point crossover
> Uniform crossover
> Two dimensional
> Cross over rate

### D. Mutation Method

Mutation is also applied after the crossover to avoid the occurrence of an event all result in the population into a local extreme of solve problem. The probability of the mutation Pm is 0.01% which to find number of bits to be muted, it mean the 10% of the chromosome in reproduction are selected or goes through for reproduction. Filling bits from 1to 0 or 0 to 1, and the new solution according to the fitness value from chromosome is called offspring. The result of the coin flipping is optimal and to protect the diversity in the population to local extreme.

## V. CONCLUSION AND FUTURE SCOPE

Genetic algorithms appear to find the optimal solution for solving 0-1 knapsack problem. Genetic algorithm for the 0-1 knapsack problem and literature study shows that these operations are very helpful to find optimal solution in less time. One feature that we planning to add in this paper in near future is to incorporate a good search technique to the genetic algorithms, which may find optimal solution for 0-1 knapsack problem in less generation and time.

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