An Improved Method For Knapsack Problem.

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Introduction

- Knapsack problem consists of finding the best packing configuration to maximise benefit while abiding by the weight constraint
- Knapsack Problem cannot be solved in polynomial time

The Knapsack Problem

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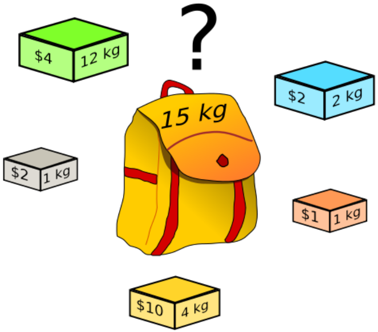

Mathematical Formulation

$$(KP): \qquad \max \sum_{i=1}^{n} b_i x_i$$

$$s.t. \qquad \sum_{i=1}^{n} \omega_i x_i \leq C$$

$$x_i \in \{0,1\}$$

Objective

- Brief review of existing methods
- Benefits and Pitfalls
- Implement an Algorithm
- Improve optimality while being mindful of time constraints

Brute Force Method

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- Enumerates every possible packing configuration
- Choose the best solution
- Optimality is ensured
- Extremely costly in time, for large n

Greedy Algorithm

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- The greedy algorithm first sorts items in the decreasing order with respect to their efficiency. i.e item i comes before item j if $e_i > e_j$.
- It then selects the most efficient item available and places it in the knapsack, reducing the knapsack's available capacity.

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- The Greedy Algorithm does not solve the problem to optimality.
- It rather finds a local optimal solution.
- It operates in linear time, which is extremely efficient
- Will occasionally produce the optimal result

Proposed Improvements

- Use Genetic Algorithm
- Include the Greedy Solution in the population

Genetic Algorithm

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- Generate Population

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- Generate Population
- Include Greedy Solution

Genetic Algorithm

- Generate Population
- Include Greedy Solution
- Selection

Genetic Algorithm

- Generate Population
- Include Greedy Solution
- Selection
- Crossover

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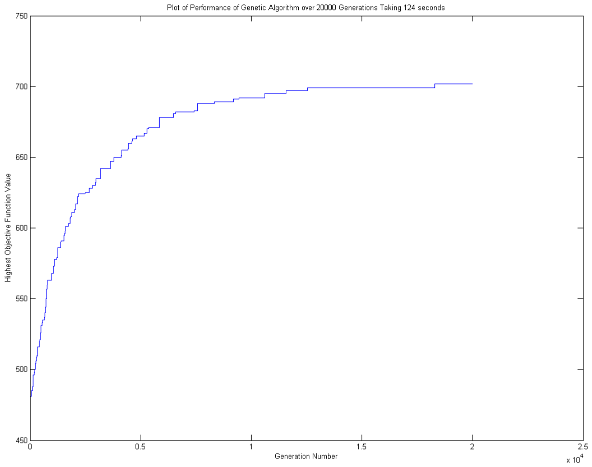
- Mutation

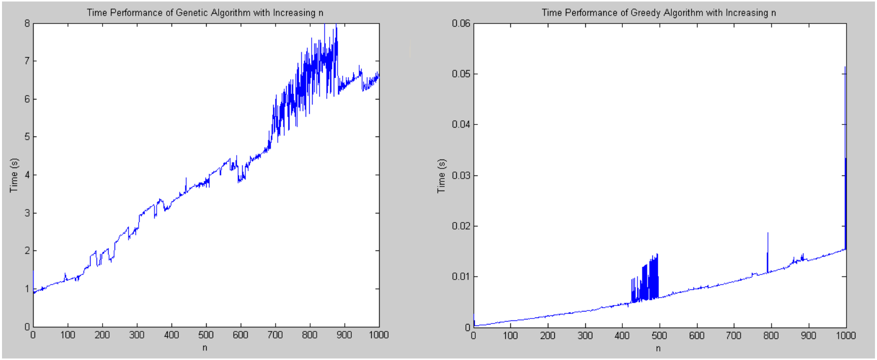
Genetic Algorithm

- Generate Population
- Include Greedy Solution
- Selection
- Crossover
- Mutation
- Next Generation

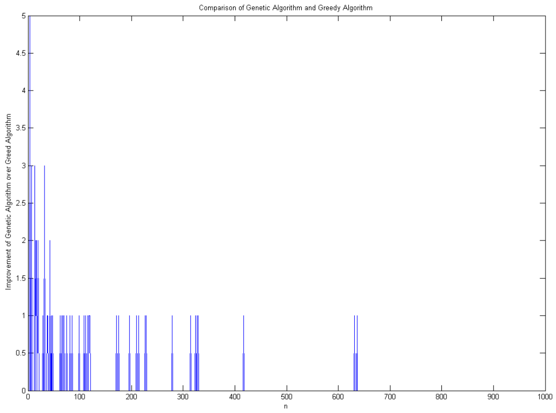
Improvement Over Generations



Time Comparison



Performance



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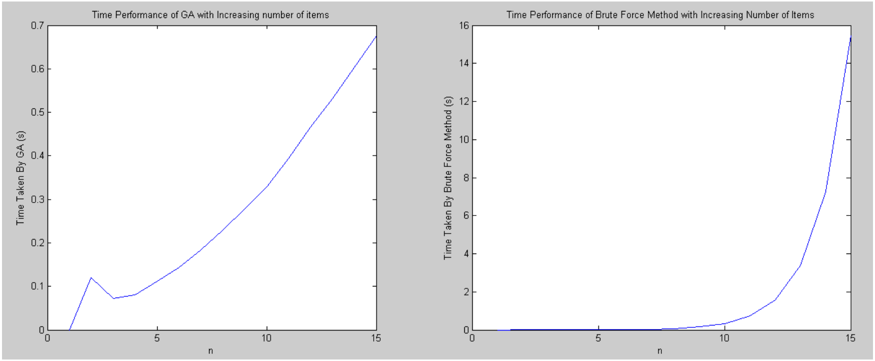

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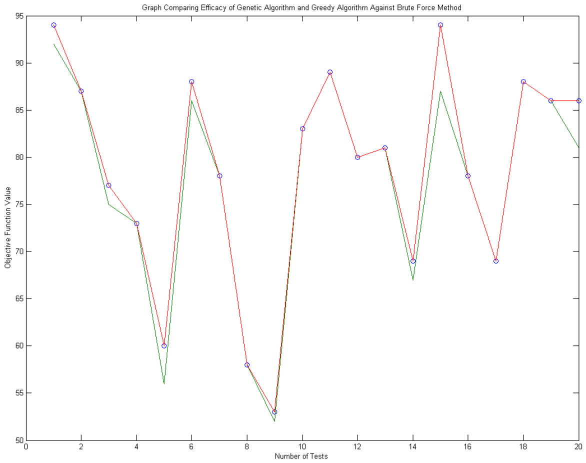

Conclusion

- Genetic Algorithm has a small time cost for a potential improvement
- Further improvements can be made to GA by generating a initially fit population, through small amounts of brute force
- The crossover technique can be further optimized for large n

Thank you!!!!

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Any question is most welcome!!!!