

# Research on Optimization Algorithm Design Techniques

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**Abstract**— This paper discusses various optimization algorithm design techniques. So, optimization techniques which are discussed in this paper are greedy method, dynamic programming and branch and bound. Problem comes under optimization are used to find either maximum or minimum. All these techniques we have multiple inputs and some constraints and we have to find feasible solution using these inputs and constraints. In greedy method we follow some predefined method. Using that predefined method, we reach to the solution. On contrary to this in dynamic programming we take decision at every step and in the end we reach to the solution. In branch and bound we create state space tree and explore all possibilities of live node. Based on some constraint we start killing some alive nodes. Here, firstly I will discuss all the design techniques. Then types of problems that can be solved under each design techniques and their time complexities.

**Keywords:** greedy method, dynamic programming, branch and bound, optimization, algorithm design techniques, maximum and minimum problems.

## I. INTRODUCTION

GREEDY METHOD is simplest design technique which is used to solve wide variety of applications. We have give number of inputs and some constraints. So based on input and constraints we have to find optimal solution. Greedy method follows one decision at every step and according to that decision it either going to include that particular input in solution or not [1].

```

General Greedy Method Algorithm[5]
Algorithm GreedyMethod(int array , int elements)
{
    OptimalSolution = {}
    For I = 0 to elements
    {
        Y= select (array)
        If(fesible(OptimalSolution,Y))
        OptimalSolution = OptimalSolution+Y
    }
    return OptimalSolution
}
    
```

DYNAMIC PROGRAMMING is another algorithm design technique in which we take decision at every step. Problems under dynamic programming can be solved using either bottom up or top down approach. Bottom up approach is known as tabulation method and top down approach is also

known as memorization [2].

General Dynamic Programming Algorithm[6]  
Algorithm Bottom Up Dynamic Programming ()

```

{
    for each input define the structure of optimal solution
    recursively fill the value in that structure compute value of
    optimal solution using backtracking
}
    
```

BRANCH & BOUND is another algorithm design technique for solving optimization problems but this is somehow similar to backtracking like backtracking we have to create state space tree for every possible alive node and it follows BFS contrary to it backtracking algorithm use DFS [3].

General Branch and Bound Algorithm[4]  
Algorithm LeastCostsB&B(int n)

```

{
    For each node I:= n
    While(1) do
    If (I is a leaf) then
    I is optimal solution and print the path from I to leaf
    return
    endIf
    Expand(I)
    If(I is empty) then
    There is no solution
    Return
    endIf
    endWhile
endFor
}
    
```

## II. ANALYSIS OF VARIOUS DESIGN TECHNIQUES

Method	Dynamic Programming	Branch & bound
Based on predefined decisions. For example, in kruskal algorithm we always select node with minimum cost and we keep doing this until we traversed all nodes and reach the result.	Based on sequence of decisions. For example, in 0/1 knapsack problem, 0 means we are not including that item and 1 means we are including that particular item. So we take decisions by adding every item one by one to check is it giving optimal solution.	Based upon state space tree. For example, 0/1 knapsack we draw state space tree by adding first item and by not adding first item. At every step we check for bounding function. We keep making until we find the solution.

Revised Version Manuscript Received on September 13, 2019.

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