
# An Empirical Evaluation of Algorithms for solving Subset Sum Problem in terms of Total Bit Length

## Dissertation

**Submitted To:**

Central Department of Computer Science & Information Technology

**Tribhuvan University**

Kirtipur, Kathmandu

Nepal

In partial Fulfillment of the requirements for the Degree of Master of Science in Computer Science & Information Technology

Submitted by:

**Rajendra Shrestha**

August, 2015

Supervisor

**Mr. Arjun Singh Saud**


# Tribhuvan University

# Institute of Science and Technology

# Central Department of Computer Science and Information Technology

## Student's Declaration

I hereby declare that I am the only author of this work and that no sources other than the listed here have been used in this work.

… … … … … … …
**Rajendra Shrestha**
**Date: 12 August, 2015**


# Tribhuvan University

# Institute of Science and Technology

# Central Department of Computer Science and Information Technology

## Supervisor's Recommendation

I hereby recommend that the dissertation prepared under my supervision by **Mr. Rajendra Shrestha** entitled "**An Empirical Evaluation of Algorithms for solving Subset Sum Problem in terms of Total Bit Length**" be accepted as in fulfilling partial requirement for the completion of Masters Degree of Science in Computer Science & Information Technology.

---

**Mr. Arjun Singh Saud**

Lecturer,
Central Department of Computer Science and Information Technology,
Institute of Science and Technology,
Kirtipur, Kathmandu, Nepal

**Date: 12 August, 2015**


# Tribhuvan University

## Institute of Science and Technology

## Central Department of Computer Science and Information Technology

## LETTER OF APPROVAL

We certify that we have read this dissertation work and in our opinion it is appreciable for the scope and quality as a dissertation in the partial fulfillment of the requirements of Masters Degree of Science in Computer Science & Information Technology.

### Evaluation Committee

**Asst. Prof. Nawaraj Paudel**
**Head of Department**
Central Department of Computer Science
& Information Technology
Tribhuvan University
Kirtipur

**Mr. Arjun Singh Saud**
**Lecturer**
Central Department of Computer Science
and Information Technology
(Supervisor)

**(External Examiner)**

**(Internal Examiner)**

**Date:**

# Acknowledgement

I would like to express my gratitude to all the people who supported and accompanied me during the preparation of this dissertation **"An Empirical Evaluation of Agorithms for solving Subset Sum Problem in terms of Total Bit Length".** This research work has been performed under Central Department of Computer Science and Information Technology (***Tribhuvan University***), Kirtipur. I am very grateful to my department for giving me an enthusiastic support.

First, I would like to express my gratitude to my supervisor **Mr. Arjun Singh Saud,** who gave me an enthusiastic support from the beginning to the end of the preparation of this dissertation. He is the one who listened to all my problems I faced during this thesis and showed me the way to overcome them.

Most importantly I would like to thank to respected Head of Department of Central Department of Computer Science and Information Technology, Asst. Prof. Nawaraj Paudel for his kind support, help and constructive suggestions. I am very much grateful and thankful to all the respected teachers Prof. Dr. Shashidharram Joshi, Prof. Sudarsan Karanjit, Prof. Dr. Subarna Sakya, Mr. Min Bahadur Khati, Mr. Bishnu Gautam, Mr. Jagdish Bhatta, Mr. Dheeraj Kedar Pandey, Mr. Sarbin Sayami, Mrs. Lalita Sthapit, Mr. Yog Raj Joshi and Mr. Bikash Balami of CDCSIT, TU, for providing me such a broad knowledge and inspirations.

Special thanks to my family and members of educational organizations that I have been working, for their endless motivation, constant mental support and love which have been influential in whatever I have achieved so far. All my class fellows are worthy of my gratefulness for their direct or indirect support in completion of my dissertation.

I have done my best to complete this research work. Suggestions from the readers are always welcomed, which will improve this work.

# Abstract

Subset Sum Problem is an important decision problem in complexity theory and cryptography. Subset sum problem can simply be described as: given a set of positive integers S and a target sum t, is there a subset of S whose sum is t? The complexity of subset sum can be viewed as depending on two parameters: n , the number of values, and m, the precision of the problem (number of bits required to state the problem). Backtracking algorithm for Subset Sum Problem can be modeled as a binary tree where each node represents a single activation of the recursive code. The worst-case time complexity is $O(2^n)$ when n is used as the complexity parameter [7]. Dynamic Programming breaks a problem down into smaller problems and solves them recursively as divide-and-conquer technique. It solves the problem in $O(m.n^2)$ time. Dynamic Dynamic Programming is the extension of the Dynamic Programming with a dynamically allocated list of target sums. It has the time complexity of $2^{O(x)}$ when the total bit length x of the input set is used as the complexity parameter.

The empirical analysis shows that time complexity of DP and DDP increase sub-exponentially when bit length, m, is increased by 1. At the same time BT is not sensitive to m and its time complexity increases exponentially when number of inputs, n, is increased by 1.



**Keywords:** Subset Sum Problem, Backtracking, Dynamic Programming, Dynamic Dynamic Programming, Total Bit Length

# Table of Contents

## CHAPTER 1

## Background & Problem Formulation

### Pages



## CHAPTER 2

## Literature Review & Methodology



## CHAPTER 3

## Design & Implementation

## CHAPTER 4

## Data Collection & Analysis



## CHAPTER 5

## Conclusion & Future Work

# List of Figures

# List of Tables

# List of Abbreviations

| | | |
|---|---|---|
| DDP | - | Dynamic Dynamic Programming |
| DP | - | Dynamic Programming |
| SSP | - | Subset Sum Problem |
| BT | - | Backtracking |
| .. | - | ranges (eg 1..5 ranges from 1 to 5) |