International Journal of Advanced Science and Research
ISSN: 2455-4227
Impact Factor: RJIF 5.12
www.allsciencejournal.com
Volume 3; Issue 1; January 2018; Page No. 24-26

Ant colony optimization based software cost estimation

Mandeep Kaur
Assistant Professor, Department of Computer Science, Khalsa College for Women, Civil Lines, Ludhiana, Punjab, India

Abstract
Software is a major component of computer system. Software cost estimation is the process of predicting the budget for software development. It is an important activity of software project planning. Before beginning the process of software development, software cost needs to be estimated almost approximately which depends upon the software size, effort, hardware, personnel requirements, etc. There are various models deployed to estimate the cost but accurate cost estimate still remains a major issue. Ant colony optimization is one of the nature inspired optimization technique that helps in evaluating the cost accurately by optimizing various parameters involved in calculation of software cost. This paper presents a review on the use of ant colony optimization to estimate software development cost.

Keywords: software cost estimation, COCOMO, ant colony optimization, MMRE (mean magnitude of relative error)

1. Introduction
In recent years, there has been an increase in demand, size and complexity of software [1] thereby adding to the cost of software. Software cost estimation is one of the important activities of software project planning. It needs to be measured accurately and timely as it forms the basis for project proposal, scheduling, monitoring and control.
Cost estimates include the following:
1. Estimation of effort: It is measured in person-month [2].
2. Estimation of project duration: It is time to complete the software project development activity [3].
3. Estimation of hardware, etc.

Underestimation of the software cost means a project has been approved which will exceed the budget resulting into incomplete functions, poor quality and failure to complete the project on time. On the other hand if software cost is overestimated, it results into allocation of more resources leading to their wastage where they could have been used somewhere else. The basic parameter for estimating the cost of software is size which can be measured in Lines of Code and Function Points.

1.1 Cost Estimation Methods
A few of the cost estimation techniques are as following:
1. Algorithmic models: These models are based on mathematical equation. LOC and Function Points, cost drivers, etc are used as inputs. E.g.: COCOMO [4], COCOMO II, Putnam's SLIM [5].
2. Estimation by Analogy: Estimation is based on estimates of similar projects [6].
3. Expert judgment: It is based on the experience and knowledge of the estimator. E.g.: Delphi model [7], Work Breakdown Structure.
4. Top-Down approach: Cost of the whole software is computed first and then it is partitioned into smaller components [8].
5. Bottom-Up approach: Cost of all software components is computed first and then the total cost of software as a whole is computed [9].

2. Ant Colony Optimization
Swarm intelligence [10] is a collective behavior of homogeneous individuals interacting with one another and the environment. Swarm intelligent systems include fish school, ant colonies, bird flocking, bee colony, etc. Ant colony algorithm is based on the natural behavior of ants and was proposed by Marco Dorigo [11]. The behavior of ants is directed towards survival of colony on the whole as compared to their individual needs. Ants set out of their nests in search of food. They leave a pheromone trial which has a property of quick evaporation so pheromone does not stay much on longer paths. On the contrary the pheromone on the shortest path remains intact which further attracts other ants thereby increasing the intensity of pheromone trial on that path. Hence this trial helps to find the shortest path to the food source. Ant Colony Optimization is a meta-heuristic technique that deals with finding an optimal path in the graph based on behavior of ants.

2.1 Applications of Ant Colony Optimization:
i) Travelling salesman problem,
ii) Graph coloring,
iii) Quadratic assignment problem,
iv) Vehicle routing,
v) Constraint satisfaction problem,
vi) Scheduling, etc.

2.2 Ant Colony Optimization Algorithm Procedure

Start

Initialize

While end criteria is not met **do**

Initialize each ant to starting node

Repeat

for each ant **do**

Select next node by applying transition rule

Apply pheromone update

end for

Until each ant has a local solution

Select best solution, update as global solution

end while

end

3. Related Work

Maleki *et al*. [12] proposed a multiple hybrid models for cost estimation based on ant colony optimization for optimization of COCOMO model. The models included Differential evolution-Ant Colony Optimization, Particle Swarm Optimization-Ant Colony Optimization and Artificial Bee Colony –Ant Colony Optimization. The models were evaluated for Mean Magnitude of Relative Error and it was observed the results obtained using the hybrid models were better than results obtained by COCOMO model.

Dewan and Sehra [13] used ant colony optimization to optimize the parameters of COCOMO model which is used to estimate the effort and therefore cost. The proposed research produced multiple paths and three generated paths were evaluated for Mean Magnitude of Relative Error and the result obtained was compared to COCOMO model. The results obtained showed that the path C generated using the proposed models produced lower MMRE values as compared to COCOMO model.

Sharma and Kaushik [14] proposed a model to compute the cost of project using Ant Colony Optimization Algorithm based on function points. The result of the proposed model was compared with K modes algorithm and it was observed that the proposed model gave better results thereby specifying ant colony optimization technique effectively estimates the project cost.

Pourali and Sangar [15] presented a model using Imperialist Competitive and ant colony algorithms. A hybrid of these algorithms was proposed. The model was tested for MMRE on NASA dataset and it was observed that imperialist competitive, ant colony optimization had minimized error and resulted in improved system's performance. The proposed model in conjunction with COCOMO model provided for better cost estimates.

Sharma *et al*. [16] conducted a search to evaluate the cost of the project using function points which were optimized using ant colony optimization technique. The outcome of the proposed model was compared with K modes algorithm and RF model and it was found that the results of the proposed model were better as compared to ones obtained by using RF model and K modes algorithm. Hence it was concluded that ant colony optimization is better technique to optimize the function points used to estimate the project cost thereby providing accurate cost estimates.

Manikavelan and Ponnusamy [17] implemented ant colony optimization over analogy to estimate the project cost. The research was conducted in three steps. In the first step, the matching projects based on some parameters were extracted from the dataset. Secondly the group projects were identified on the basis of size. Lastly the matching measures were improved to match the projects in the given dataset. It was observed that the cost estimation using analogy optimized by ant colony optimization produced better cost estimates.

4. Conclusion

Many models exist for estimating the software development cost but accurate cost estimation has been a major issue in the software industry. The cost estimates need to be near accurate as it affects the software planning activities, budgeting, project proposal acceptance and its development. Ant Colony Optimization is a nature inspired optimization technique based on natural behavior of ants searching for the shortest path to food source. In this paper, an overview of ant colony optimization is given and also its use for estimation of software cost is specified. The literature review suggests that ant colony optimization has been used by many researchers to make accurate cost estimates and technique has provided optimal solutions to cost estimation problem.

5. References

1. Kaur M, Sehra SK. Particle Swarm Optimization Based Effort Estimation Using Function Point Analysis, International Conference on Issues and Challenges in Intelligent Computing Techniques ICICT, 2014, 140-145.
2. Mall R. Fundamentals of Software Engineering, PHI Learning Private Limited, New Delhi, 2008.
3. Pressman RS. Software Engineering: A Practitioner's Approach, McGraw-Hill series III Computer Science, New York, 2001.
4. Boehm BW. Software Engineering Economics, Englewoods Cliffs, NJ, Prentice-Hall, 1981.
5. Putnam LH. A general empirical solution to the macro software sizing and estimating problem, IEEE transactions on Software Engineering, 2:345-361.
6. http://www.computing.dcu.ie/~renaat/ca421/LWu1.html
7. Khatibi V, Jawawi DN. A. Software Cost Estimation Methods: A Review, Journal of Emerging Trends in Computing and Information Sciences. 2011; 2(1):21-29.
8. Sharma N, Bajpai A, Litoriya R. A comparison of software cost estimation methods: A Survey The International Journal of Computer Science & Applications, 2012, 1(3).
9. Rajkumar G, Alagarsamy K. A Systematic Review of Cost Estimation Models, Journal of Global Research in Computer Science, 2013, 4(5).
10. Zhang Y, Agarwal P, Bhatnagar V, Balochian S, Yan J. Swarm Intelligence and Its Applications, The Scientific World Journal, 2013.
11. Dorigo M, Cargo GD, Gambardella LM. Ant colony optimization for distributed discrete optimization, Artificial Life, MIT Press, 1999.
12. Maleki I, Ebrahimi L, Japelaghi MK. Ant Colony based

Metaheuristic Algorithms for Software Cost Estimation, International Journal of Academic Research in Computer Engineering. 2016; 1(1):05-15.
13. Dewan N, Sehra SK. Ant Colony Optimization Based Software Effort Estimation International Journal of Computer Science and Technology. 2014; l(5):53-56.
14. Sharma S, Kaushik A. Enhancement in Software Cost Estimation Using Ant Colony Optimization, International Journal of Advanced Research in Computer Science and Software Engineering, 2016, 6(5).
15. Pourali A, Sangar A. A new approach in software cost estimation with hybrid of imperialist competitive algorithm and ant colony algorithm Amir Pourali, Amin Babazadeh Sangar, Academie Royale Des Sciences D Outre-Mer Bulletin Des Seances. 2015; 4(3):106-113.
16. Sharma S, Kaushik A, Tomar A. Software Cost Estimation using Hybrid Algorithm International Journal of Engineering Trends and Technology, 2016, 3(2).
17. Manikavelan D, Ponnusamy R. Improvised Analogy based Software Cost Estimation with Ant Colony Optimization, Research Journal of Applied Sciences, Engineering and Technology. 2015; 10(3):293-297.