

A Study of Solving Software Project Scheduling Problems with Ant Colony Optimization

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Abstract—Implementing an effective and efficient computer aided tools for project planning is an important and challenging task. Software planning is a people intensive activity and here main resource is HUMAN resource. To manage people on their skill and provide flexibility to that people is a main task. Here scheduling of task is not a single problem but also scheduling of people is also considered. Both problems are very complex. ACO approach is used to solve this problem. The approach represents a plan by employee allocation matrix and task list. ACO is a recent adaptive algorithm; this algorithm is used to solve many crucial problems. SPSP is a problem of scheduling the task and employee. SPSP is a NP-hard (Non Polynomial) problem. For solving such problem number of model has been developed. Number of Meta heuristic algorithm is also applied to solve such problem (e.g. GA).

Keywords—SPSP-Software Project Scheduling Problem, RCPSP-Resource-Constrained Project Scheduling Problems, GA-Genetic Algorithm, ACO-Ant Colony Optimization.

I. INTRODUCTION

Software project scheduling problem decide who does what kind of work within the software project lifetime. However, the problem defined here includes the concept of personal skills and employee with salary, also able of performing several tasks in a normal working day. It means for solving project scheduling problem we consider employees skill and his/her salary. Project scheduling problem means lack of quality of work and also project not completed within given time period. Because of this indirectly duration and project cost will increase. For this we develop SPSP with ant colony optimization, which reduces the cost and development time as well as increase the quality of work. Main reason behind increasing quality is we dedicate work according to the employees' skill and interest. It is based on interviews of employees. It means at interviews time developer take all details of employee and check the knowledge of employee. This tool is mainly used to generate a feasible schedule in less time along with hard constraint satisfactions. This tool is trying to minimize the cost and minimize the duration of the project. And also because of

graphical representation we easily identified the work dedication of particular employee to their work. In SPSP model, the most important resource is the software engineers with multiple software skills. In this paper, we utilize ACO to handle the SPSP and present our new algorithm called ACS-SPSP. Our motivations of applying ACO to the SPSP in this paper are twofold. The mechanism of ACO provides good support of the use of domain-based heuristics to improve the performance.

II. LITERATURE SURVEY

A. RCPSP Model:

The RCPSP is a 1st model in project management which is used to solve NP-hard problem. It is used to schedule the tasks of a project subject to precedence and resource constraints. To generate a schedule, it needs to determine order of tasks which satisfy task precedence constraint and make task list.

B. Multi-Skill Scheduling Model:

This model uses the reference of RCPSP model for scheduling the employee and task for executing the sequence of task. Branch and bound algorithms and tabu search were developed for the problem compared with the models aforementioned. MSS model is derived from the RCPSP and combination of above model. This model solve both problem of employee allocation matrix and task scheduling problem. This model only consider the allocation of employee to task at only one time, no conflict is occur but they does not consider the preemption of task. This model reduce the human resource allocation flexibility. If one of the employee is busy in other task that time the whole team has to wait till that employee is released. This drawback reduce the efficiency of the project.

C. Time Line Based Model:

To solve the problem of human resource allocation and task scheduling using very efficient way, the new technique that combine both the solution together is a time line based model. Different from the previous models, this model generate the time-line axis to solution representation and make a feasible plan which is three-dimensional employee

allocation matrix. The three-dimensional representation is able to overcome the disadvantages of the RCPSP and the employee allocation models. This model has two problems. First, assign workload period by period instead of task by task; the plans produced by this model may assign two completely different groups of employees to the same task in different periods.

III. SYSTEM ARCHITECTURE

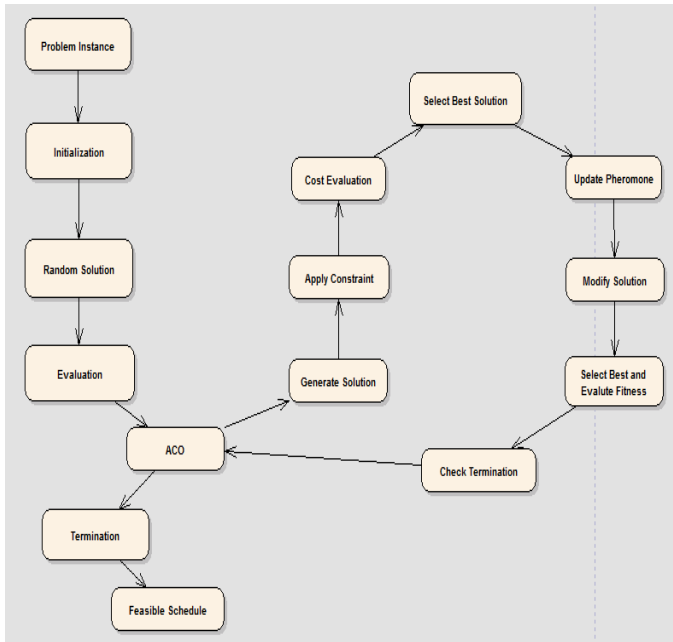


Fig. 2 System Architecture

Meta Heuristic Approach is used for Software Project Scheduling Problem and java programming is used for its implementation purpose .four interconnected Modules are used for solve this problem.

A. Input Processing:-

In this module, system is reading the problem instance supplied as input to project and then outputs different relationship matrix as described in section. This module is responsible to process the available data set. Here process means read the content of data set accurately and then prepare the required meta data from that reading.

B. Draw CG and Initialization:-

All matrix are initializes in this module. Such as solution matrix, pheromone matrix as well as initialize ACS parameter. Split Algorithm is used to draw construction graph after initializing all values.

C. ACO:-

Which solution is generated by previous phase is evaluated in this module. After that checking values and apply ACO on that Solution. Meaning of this is that if solutions is best according to constraint then updates pheromone and calculate new heuristic information. This process will continue till we not get termination condition.

D. Improvement Phase:-

This is the Final Module. In this phase we print Solution employee as well as Task wise. We also print this schedule Month Wise. In this Module we modify solution to reduce cost and duration. Sometimes this phase is considered as an optional phase.

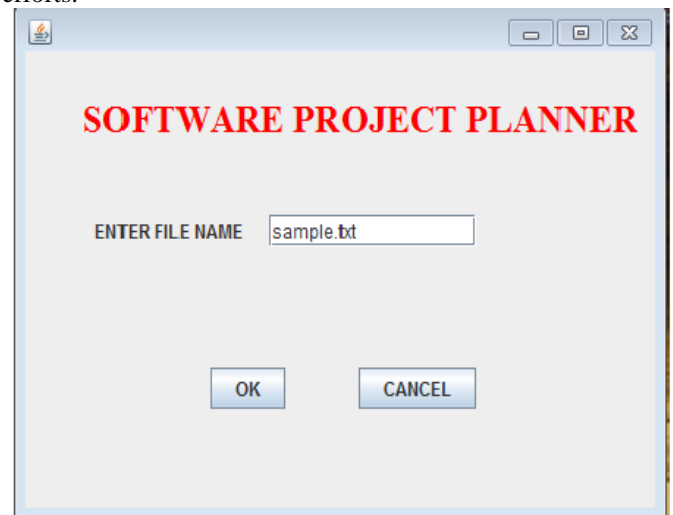
IV. ALGORITHMIC STUDY

In this project we use two main algorithms i.e. Ant Colony Optimization (ACO) and Splitting Task. Ant colony optimization studies artificial systems that take inspiration from the behavior of real ant colonies and it is first employed to solve discrete optimization problems Especially difficult combinatorial optimization problems successfully. By using ACO algorithm we find out the shortest and best path for this global updating method is used. We also use Genetic algorithms output for result comparison. Input for ACO is Heuristic information, previous pheromone, text file and CG. Here we calculate the cost, duration and overwork of the solution and comparing this solution with previous solution. And update pheromone and heuristic information.

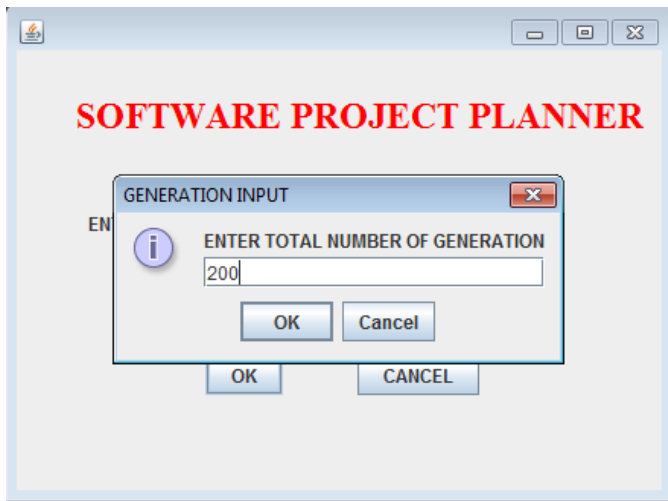
Output of this given input is optimized solution. Complexity of ACO is Number of generation *Number of task. And input for Splitting Task is number of employee and number of tasks. Split operation for contribution of employees for the Particular task. Output is Calculate the Detection Contribution of employees for Task. Complexity of splitting task is Employee*Task. Efficiency of both algorithms is they give polynomial solution.

V. FINAL RESULT

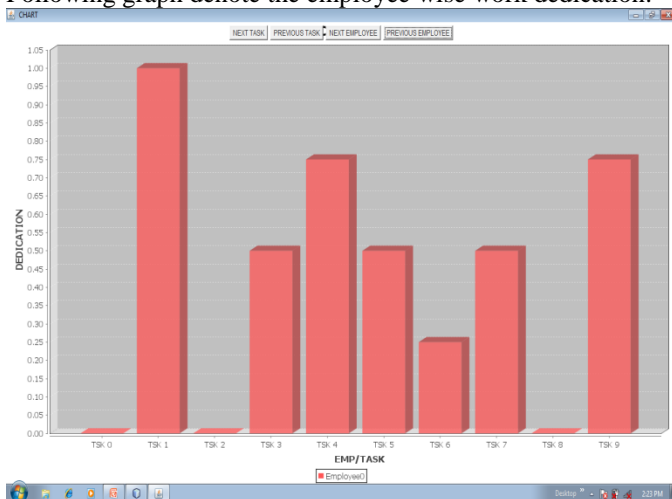
Final result of our system is finding optimal solution to given problem. The solution may be perfect or near to perfect. That should be in minimum cost and minimum efforts.



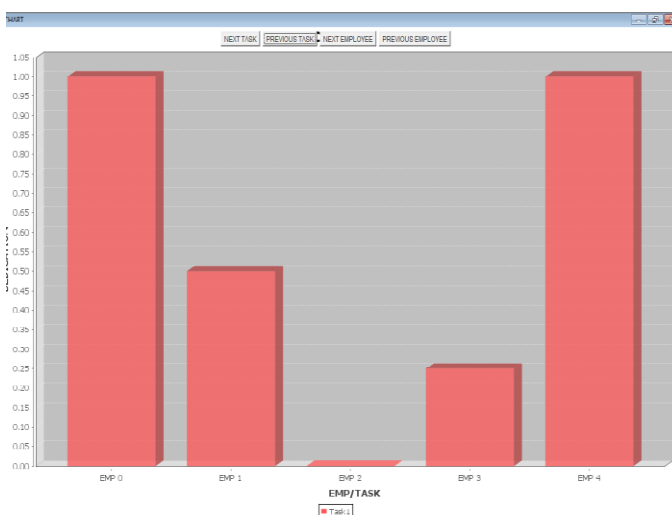
First we take input text file which managed by developer then given to system which perform following operation.



Here number of generation means number of ways to find optimal solution. Following graph denote the employee wise work dedication.



Following graph denote task wise work dedication.



VI. FINAL ANALYSIS

As we know most of software industries collapse their project development process because of improper management of scheduling of work that's why we decided to develop a project to solve this problem. Expected Output of our system is finding best solution for given problem. That should be in minimum cost and minimum efforts [1].

VII. ADVANTAGES

SPSP is a problem of finding an optimal schedule for software project so that all the constraint such as precedence constraint and satisfied and this schedule minimizes the salary and duration [1].

VIII. LIMITATIONS

1. In our system we can't divide one project into 30 modules if we divide then it decrease the performance.
2. It requires employee skill collection to find out proper solution [1].

IX. CONCLUSION

Project Scheduling Problem is NP-hard problem. For scheduling task and employee is not a simple task. Its time complexity is very high. Due to its complexity there are very few algorithms implemented to solve such problem. For solving this problem we use ACO. This Tool gives optimal solution and also trying to minimize the cost and minimize the duration of the project.

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