A Survey on Software Project Scheduling Methods

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Abstract - Software project managers are often faced with challenges when trying to effectively staff and schedule projects. Incorrectly planning and estimating the execution of tasks frequently causes software projects to be delivered late and/or over budget. Also selecting the appropriate developers to carry out tasks may produce lower-quality, defective software products. Thus, an adequate model for software project planning has to deal with not only the problem of project task scheduling but also the problem of human resource allocation. Here is a review on different methods used for solving the issues related with software project scheduling.

Keywords - Software project planning, Project scheduling, project management, staffing and scheduling.

1. Introduction

Software project scheduling is an activity that distributes estimated effort across the planned project duration by allocating the effort to specific software engineering task. The objective of project scheduling tool is to enable the project manager to define work tasks, establish their dependencies, assign human resources to tasks and to develop a structure that helps in tracking and control of the software project. Software project scheduling is traditionally one of the major problems faced by software project managers. It is easy to define, but hard to solve. With the rapid development of the software industry, software companies are now facing a highly competitive market. To succeed, companies have to make efficient project plans.

To plan a software project, the project manager needs to estimate the project workload and cost and decide the project schedule and resource allocation. Project planning is an important activity of project manager. The project attributes such as cost, duration and effort are estimated. Based on estimations of effort and duration, the schedules for manpower are developed. Researchers in the area of Software Engineering, therefore, have focused their attention on finding ways to provide software development companies with various tools and technologies, in the hope of mitigating the risks of a software project failing or being challenged. Also, these techniques minimize the cost and completion time of the software project. Software projects are mainly people-intensive activity and its related resources are mainly human resources. Also, different software project tasks require employees with different skills. So assigning employees to the best fitted tasks is challenging for software project managers, and human resource allocation has become a crucial part in software project planning. The task preemption is also a major challenge in project scheduling. Employees have a maximum dedication, which must be respected to avoid overwork.

2. Literature survey

Research attempt related to software project scheduling have employed a number of different techniques and methods focusing mainly on providing solutions as a means of optimizing goals in order to best schedule the tasks and allocate employees efficiently.

A. Genetic Algorithm (GA)

Genetic Algorithm (GA) uses biological principle of evolution to artificial systems. Genetic algorithm is used to solve resource constrained project scheduling problem. It is an iterative procedure that searches for the best solution of a given problem among a population, represented by a finite string of symbols. It begins with population of randomly selected solutions and at each evolutionary step, individuals are evaluated using a fitness function. Each individual is represented by a certain number of genes. The major genetic operators that reflect nature's evolutionary process are reproduction, crossover, and mutation. The GA approach is denoted as hybrid GA (HGA), and it integrates the concepts of natural selection and adaptation with existing scheduling methodology. The steps involved in GA are: Encoding, reproduction, crossover and mutation. The chromosomes are encoded using priority rules and representations. Reproduction is a pure selection procedure. Crossover operator takes two parent solutions and swaps over features from each,
leaving offspring with attributes of both parents. Mutation randomly modifies an individual’s genome. GA is useful for solving complex problems and it is based on population instead of a single point. But it uses a large search space.

B. Particle Swarm Optimization (PSO)

Particle swarm optimization is a meta-heuristic algorithm that solves the resource constrained project scheduling problem. PSO is a population based stochastic optimization technique. This algorithm is inspired by the social behavior of bird flocking. Tasks can be subdivided to subtasks which can performed serially, synchronously or in parallel. It minimizes average duration of the multiple concurrent projects. The individual in the population is called the particle and the population is called the swarm. The performance of each particle is measured according to a predefined fitness function. Particles are assumed to y over the search space in order to find promising regions of the landscape. Each particle adjusts its own flying according to its flying experience as well as the flying experience of the other companion particles. PSO is relatively simple to implement and high quality solution are obtained. Also it can handle multiple projects.

C. Search Based Techniques

It uses the search based software engineering techniques to address problems associated with optimal allocation of work packages. There is a growing demand for search based techniques for solving the scheduling problem. For formulating the problem as a search based problem, it uses two different genome representations for encoding and three heuristics such as Genetic algorithm, hill climbing and simulated annealing. It minimize the number of constraint violation. It manage human resource well. But it handles task scheduling and employee allocation separately. It allocate unlimited employee to one task and one employee to unlimited tasks.

D. Tabu Search Approach

Tabu search based methods are relatively simple for multi skill scheduling problems. RCPSP could be extended by the skills domain to Multi Skill Resource Constrained Project Scheduling Problem. Here several elements can be variously implemented. It is based on different neighbourhood generation methods. Neighbourhood can be created by swapping or inserting activities in the task order list. The tabu list size is dependent on the number of critical tasks to be scheduled in a project. A starting solution is obtained using the minimal slack heuristic rule. The approach assumes regarding move as an exchange of two activities positions in the activity list. If the move is on a tabu list, but produced solution (S) is better than the best (B) found so far, S replaces B. It avoid cycles of unwanted moves by avoiding a path already investigated. The different steps are Initial solution generation, Neighbourhood generation and Move description. Initial solution is loaded from a file that contains the project data. To generate a neighbourhood, a new solution generation method has to be provided. A move describes how the solution B has been created in the base of solution A.

E. Time-line Based Model

Time line model accompanied with Genetic algorithm produces optimal or near optimal schedules. It introduces the time-line axis. The time-line axis, considers more human resource factors in project management. It is breaking down a task into smaller components of time sliced activity. Hence it assigns employees to tasks for discrete time units during the duration of a task, instead of assigning them to the entire duration of the task. In this way, the calculation of the fitness function can be performed at the time of assignment, which allows us to incrementally update various parameters. The time expands the two dimensional (task and employee) model into a three-dimensional one, showing the effort of each employee applied to each task in each time unit. The time-line became necessary due to the requirements to represent re-assignment of employees, learning, the suspension and resumption of tasks, and the introduction of hard and intermediate (that is, task-specific) deadlines. But here it assign different groups to same task in different period and the search space increases.

F. IntelliSPM

Intelligent software project management tool (IntelliSPM) is a tool to support software project management activities with optimization mechanisms from the area of computational intelligence. It offer additional resources. It is helpful for mitigating the risks of software project failures. IntelliSPM makes use of single- and multi-objective GAs as well as a single objective PSO algorithm.

3. Performance Analysis

A comparative study of the methods and tools discussed so far is presented here. The task allocation and employee allocation are taken as the parameters for comparison. The performance comparison are summarized in the following table:
4. Conclusion

Software Project Scheduling is one of the most important tasks for Software Project management team. Some activities of the project are very critical that delay the overall project completion time and cost. By adopting any software project scheduling technique is the step every software project manager can take to more effectively manage software development. Here a review of some of these software project scheduling techniques is done using various research papers in this field.

References