The Need of Genetic Algorithms (GAs) in Project Scheduling

Nile Tushar Rambhau[1], Kanneti Lakshmi Tanuja[2,] [3]Murlidhar Revu Rathod, [4]Mohammed Yaser Noaman

[1,2,3,4]*PG Student. At Mandava Institute of Engineering and Technology, Jaggayyapeta, Krishna, AP (India).*

Abstract *- The first and foremost objective of this paper is to provide an effective solution for software project scheduling i.e. through implementation of Genetic Algorithms in project scheduling techniques. The main theme of software project scheduling is to break a complete project into several subtasks, which in whole will be a complete project. The software project manager has to keep track the schedule and has to stick on that schedule to the maximum. The schedule has to be strictly followed which can be achieved by periodic project status meeting with the members involved in the project. This is achieved with the help of Genetic Algorithm. The Existing techniques are increasingly considered to be inadequate for modeling the unique characteristics of today's software projects. The main reason is that, differently from other projects, a software project is a people-intensive activity and its related resources are mainly human resources. The tools based on the traditional project management techniques usually regard task scheduling and human resource allocation as two separated activities and leave the job of human resource allocation to be done by project managers manually resulting in inefficient resource allocation and poor management performance. Hence, authors are recommended to implement Genetic Algorithm in project scheduling for effective results.*

Keywords: *Genetic Algorithms (GAs), Project Scheduling, Evolutionary Computing (EC), Genetic Programming*

I. INTRODUCTION

Today research into developing operative computer aided techniques for planning and scheduling software projects always plays a vital role and challenging for software engineering field. When compared with the projects from the other fields, software projects are people-intensive activities and their related resources are mainly human resources. Hence, suitable model for project scheduling has to deal with problem of human resource allocation.

Several works have been done on developing search-based approaches for project scheduling, According to Duggan [2] and Barreto [3] built models for staffing problem of software projects and proposed genetic algorithm approaches. These models effectively focused on staffing and task scheduling.

Solving problems mean looking for solutions, which is best among others Finding a solution to a problem, is often thought: In software development, as a process of search through the space of possible solutions. The set of possible solutions defines the search space (also called the state space) for a given problem. Solutions or partial solutions are viewed as points in the search space.

In engineering and mathematics, as a process of optimization. The problems are first formulated as mathematical models expressed in terms of functions and then to find a solution, discover the parameters that optimize the model or the function components that provide optimal system performance.

Generic algorithms mimic natural evolution, by acting on a population to favor the creation of new individuals that 'perform' better than their predecessors, as evaluated using some criteria, such as an objective function as stated in [5].Project scheduling techniques based on Genetic algorithms (GA) that automatically determines, using a programmable goal function, a near-optimal allocation of resources and resulting schedule that satisfies a given task structure and resource pool. Generalizing the results of Chao's solution, the new GA algorithms can operate on much more complex scheduling networks involving multiple projects. They also can deal with more realistic programmatic and organizational assumptions.

II. PROJECT SCHEDULING

Project Scheduling is an activity that distributes the estimated effort across the planed project duration by allocating the effort to specific software engineering tasks. The Schedule connects the scope, work estimates and deadline into a network of SE tasks and Must Manage Parallelism (tasks can be undertaken simultaneously) & Dependency (task has an effect on subsequent tasks). Failure by project management to recognize that the project is falling behind schedule. A project schedule is required to ensure that required project commitments are met and to track progress toward achieving these commitments.

According to Wei-Nengchen, C K Chang [1] and [4] few of the existing notable Project Scheduling Techniques are Program Evaluation and Review Technique (PERT), Critical Path Method (CPM), Resource Constrained Project Scheduling Problem (RCPSP) Model, Search based techniques, Event Based Scheduler , Software Project Management Net (SPMnets) Model.

Techniques like PERT and CPM lack the consideration of resource allocation and scheduling models like the RCPSP do not consider the allocation of employees with various skills.

As stated in [1], The Existing techniques are increasingly considered to be inadequate for modeling the unique characteristics of today's software projects.

In order to face a highly competitive market and to succeed, companies have to make efficient project plans, and further projects have to be completed in time. According to authors point of view genetic algorithms might be helpful for effective result of project scheduling.

III. GENETIC ALGORITHM

Today wildly used term Genetic Algorithm in scientific and engineering circles, almost universally abbreviated to GA, was developed by John Holland, University of Michigan in 1970's. Genetic Algorithms are the heuristic search and optimization techniques that mimic the process of natural evolution. Genetic Algorithms plays vital role in achieving the objectives of project scheduling. Genetic Algorithms are the main paradigm for evolutionary computing. These are inspired by Darwin's theory about evolution for the survival of fittest. These are intelligent exploitation of random search used in optimization problems, although randomized exploit historical information to direct the search into the region of better performance with in the search space.

Development history of Evolutionary computing:

Evolutionary Computation (EC) represents the authoritative search and optimization paradigm influenced by biological mechanism of evolution that of natural selection and genetic. Evolutionary Algorithms (EA) refers to evolutionary computational models using randomness and genetics inspired operations. It involves selection, recombination, random variation, and competition of the individuals in population of adequately represented potential solutions. Genetic Algorithm simulates the survival of the fittest among individuals over consecutive generation for solving a problem. Gases are the ways of solving problems by mimicking processes nature uses. i.e Selection, Cross over, Mutation, and accepting to evolve a solution to a problem.

Selection replicates the most successful solutions found in a population at a rate proportional to their relative quality .Cross over/Recombination decomposes two distinct solutions and then randomly mixes their parts to form novel solutions. Mutation randomly perturbs a candidate solution. Accepting place new offspring in new population.

The main components of GA are listed in the table.

Components of GA	
1	Encoding technique(*gene, chromosome*)
2	Initialization procedure *(creation)*
3	Evaluation function *(environment)*
4	Selection of parents *(reproduction)*
5	Genetic operators *(mutation, recombination)*
6	Parameter settings *(practice and art)*

Table 1. Components of GA

Good example is the traveling salesman must visit every city in his territory exactly once and then return to the starting point; given the cost of travel between all cities, how should he plan his itinerary for minimum total cost of the entire tour? Now the solution is with GAs.

WHY WE NEED GENETIC ALGORITHMS?

✓ It is more robust

✓ Genetic algorithms are good at taking large, potentially huge search spaces and navigating them, looking for optimal combination of things, the solutions one might not otherwise find in a life time (Salvatore Mangano Computer Design May 1995)

✓ While performing search in large state space or multi-model state space or n-dimensional surface, a generic algorithm offer significant benefits over many other typical search optimization techniques like linear-programming heuristic , depth-first , breath-first.

EC Evolutionary Computing	=	GP Genetic Programming	+	ES Evolution Strategies	+	EP Evolution Programming	+	GA Genetic Algorithms

- ✓ Genetic Algorithms do not break easily even if the inputs changed slightly, or in the presence of reasonable noise.

IV. CLASSES OF SEARCH TECHNIQUES DIAGRAM

A genetic algorithm maintains a population of candidate solutions for the problem at hand, and makes it evolve by iteratively applying a set of stochastic operators.

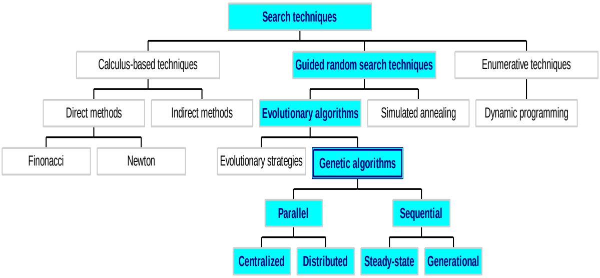

Fig.1. Taxonomy of search optimization techniques

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{
Initialize Population;
Evaluate Population;
While TerminationCriteriaNotSatisfied
{
Select parents for reproduction;
Perform recombination and mutation;
Evaluate population;
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Simple Genetic Algorithm

V. BENEFITS AND APPLICATIONS OF GA

Genetic Algorithms have several benefits over other search techniques; the following benefits of GA are identified:

√ Concept is easy to understand Modular √ separate from application
√Supports multi-objective optimization √Good for "noisy" environments
√Always an answer; answer gets better with time √Inherently parallel; easily distributed
√Many ways to speed up and improve a GA-based application as knowledge about problem domain is gained
√Easy to exploit alternate solutions √Flexible building blocks for hybrid applications
√Substantial history and range of use

Apart from project scheduling techniques, Genetic Algorithms have been implemented in various applications, few of the notable applications are Artificial creativity, automated design of mechatronics systems using bond graphs and genetic programming, design of water distributed systems, electronic circuit design, distributed computer network topologies, code breaking using the GA to search large solution spaces of ciphers for the one correct decryption, travelling salesman problem, mobile communication infrastructure optimization, file allocation for distributed systems, Java genetic algorithms package, also include support for genetic programming.

VI. CONCLUSION

According to authors point of view Genetic Algorithm solves many different software project scenarios and are quite flexible& accurate for achieving project scheduling objectives. A Project Scheduling Problem consists in deciding who does what during the software project lifetime. This is a capital application in the practice of software engineering, since the total budget and human resources involved must be managed optimally in order to end in a successful project. In short, companies are principally concerned with reducing the duration and cost of a project, and these two goals are in conflict with each other. This can be solved with help of GA and produces accurate results. Developing effective approaches for software project scheduling and employee allocation remains a challenging problem and deserves further research.

Evolutionary algorithms have been around since the early sixties. They apply the rules of nature: evolution through selection of the fittest individuals, the individuals representing solution to a mathematical problem. GAs are so far generally the best and most robust kind of evolutionary algorithms. As per the study of the work, for achieving effective results and challenging complexities in project scheduling authors are suggested to implement Genetic Algorithms for project scheduling.

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1. Nile Tushar Rambhau is pursuing M.Tech(CSE) at the Department of Computer Science & Engineering , Mandava Institute of Engineering and Technology,Andhra Pradesh. He received B.Tech (CSE) from Dr. BAM Univeristy, Aurangabad, Maharashtra. His research intrests are at the area of Computer Networks.

2. Kanneti Lakshmi Tanuja is pursuing M.Tech(CSE) at the Department of Computer Science & Engineering , Mandava Institute of Engineering and Technology,Andhra Pradesh. She received B.Tech (CSE) degree from JNTU -Kakinada, Andhra Pradesh. Tanuja research intrests are at the area of Software Engineering and Operating Systems.

3. **Murlidhar Revu Rathod is** pursuing M.Tech(CSE) at the Department of Computer Science & Engineering , Mandava Institute of Engineering and Technology,Andhra Pradesh. Mr.Rathod received B.Tech (CSE) degree from Visweswarayya Technical University-Belguam, Karnataka and his research intrests are at the area of Software Engineering and Operating Systems.

4.Mohammed Yaser Noaman is pursuing M.Tech(CSE) at the Department of Computer Science & Engineering , Mandava Institute of Engineering and Technology,Andhra Pradesh. Mr.Yasar received B.Tech (CSE) degree from JNTU –Hyderabad and his research intrests are at the area of Software Engineering and Computer Networks