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Project Scheduling using Event Based Scheduler with ABC

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***Abstract**: Scheduling is the first and foremost step for every project implementation. Project scheduling could be a mechanism to communicate what tasks has to be compelled to get done and which resources are going to be allotted to finish those tasks in what timeframe. Project scheduling occurs during the planning phase of the project. The problem comprises the correct assignment of employees to the various tasks that frame a software project, casing in time and cost limitations. To accomplish this objective, this paper presents and discusses the EBS with ACO, FCM clustering and EBS with ABC and the conclusions are drawn from it. First, to schedule human resources to tasks we implement Event based scheduler with the Ant colony optimization algorithm (ACO) for probabilistic optimization, second, for fast scheduling we implemented Fuzzy c means clustering to assign similar data points of employees to clusters so that the searching space will be reduced. Third, for optimum scheduling we apply Artificial Bee Colony algorithm with Event Based Scheduler. Artificial bee colony (ABC) is an optimization algorithm based on stochastic calculation which has demonstrated good search capacities on numerous advancement issues. Based on these findings we briefly describe the scheduling with FCM-EBS with ABC prompt optimum values.*

***Keywords**: Artificial Bee Colony (ABC), Event Based Scheduler (EBS), Fuzzy C Means (FCM), Resource Constrain Project Scheduling (RCPS), task scheduling.*

I. INTRODUCTION

Software project planning plays a vital role in the efficiency of project and further the software construction cost will be reduced. The objective of Project Planning in software industry is to identify the scope of the project, project workload estimation, resources identification, calculating the cost and create project schedule. Project scheduling contains number of tasks to be done, dependencies among the tasks, planning the resources to tasks. Project Scheduling schedules when each activity should be done, what activity has been completed and the order in which things need to be finished. Project Scheduling assists for efficient project plan, assigns time, provides dependencies among the task and keep track of project.

Assigning of employees to the best fitted tasks is a challenging job for project managers. Techniques like Program Evaluation and Review Technique (PERT) [15] and Critical Path Method [16] (CPM) are the scheduling models for Resource Constrained Project Scheduling Problem (RCPSP) [17]. Many software engineering activities like module clustering, cost estimation, design, testing, and software release planning has stated as events and search-based approaches can be used for software project planning. There are traditional techniques for project management like Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) and Resource Constrained Project Scheduling Problem (RCPSP). The PERT and CPM technique defines the significant activities in a project, develop relationships among activities, assigns time and decide cost for each activity but lack the consideration of resource allocation and scheduling models like RCPSP involves project scheduling subject to precedence and resource constraints .

Task list is prepared by the Ant Colony Optimization and Event based scheduler is implemented to schedule the employees for the particular tasks. For further reducing the search space, Fuzzy C Means Clustering Algorithm was implemented and Artificial Bee Colony algorithm with EBS promotes optimized scheduling compared to ACO and EBS.

II. RELATED WORK

A novel Multi Objective Evolutionary Algorithm (MOEA) based dynamic scheduling method was proposed [4] for dynamic project scheduling. It generated a robust schedule predicatively and adapted to conventional scheduling algorithms in response to critical dynamic events during project execution. A tool named IntelliSPM was proposed [5] to assist software project managers in completing the most complex activities of project scheduling and staffing. This tool comprised of various optimization mechanisms. It supports schedule based optimal staffing using a multi objective Genetic Algorithm approach. Knowledge based evolutionary approach [6] for software development project scheduling process. This approach assists the project managers at the early stage to schedule the project at an early stage. A time line based model for software project scheduling was proposed [7] with the genetic algorithm. This model was capable of more realistically simulating real world situations. Reinforcement learning was presented [8] to compute the optimal scheduling policies for software project scheduling problem. This approach was based on a stochastic, formal scheduling model which captured the strong feedback between tasks in software development.

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A novel approach with an Event based Scheduler (EBS) was developed [9] for software project scheduling and staffing. The proposed approach signified a planned employee allocation matrix and a plan by a task list.

Through this approach the issues of employee allocation and task scheduling were considered. In EBS, events are considered based on the starting time and ending time of the project. Improved Evolutionary algorithm was proposed [10] for project scheduling problem. This proposed approach overcame issues related to the hit rate and to improve the solution quality of the software projects. Several Meta heuristic algorithms were proposed [11] to address the problem of software project scheduling. The Meta heuristic algorithms approached the software project scheduling problem with their multi objective formulation, where both the project cost duration and project cost had been minimized.

III. MATERIALS AND METHODS

The Fuzzy C-Means (FCM) algorithm [12] is a typical clustering algorithm, which is used in a wide variety of engineering and scientific disciplines. The Artificial Bee Colony (ABC) algorithm is a swarm based, meta-heuristic algorithm based on the foraging behavior of honey bee colonies. There are three groups of ABC named, scout bees, onlooker bees and employed bees. The scout bee carrying out random search, the employed bee goes to food sources that already visited by it previously is employed bee. The bee waiting and the onlooker bee will be hold-up at the dance area. The unemployed bees are the onlooker bees and scout bees [13].This study contains an effective approach for the task scheduling and human allocation issue, in the software project planning, with FCM-EBS and Artificial Bee Colony (ABC) algorithm. The proposed method is characterized by the following features. Initially, the representation scheme Fuzzy C Means (FCM) clustering methods for Event Based Scheduler (EBS) will be developed in which the similar employee characteristics data are grouped into cluster based on the task completion time and experience time of each one of the employee in the software projects. The representation scheme is composed of a task list based on the employee experience for each task and a planned employee allocation matrix. The task list delineates the priorities of tasks to consume resources, and the planned employee allocation matrix states the originally premeditated workload assignments. Later, project scheduling problem is solved using the Artificial Bee Colony (ABC) algorithm. Finally, FCM-EBS with ABC promises prompting results.

The study discusses about the issues of human resource allocation and task scheduling of a software project planning model. By recording the employees' information which contains wages, experience, skills and working constraints the software project planning model knows the working nature and behavior of the employees.

Consider that 'n' number of the employees working in the project, for the i^{th} employee (i=1,2,….,N) the following attributes are considered.

- b_s-The employee basic salary for time period (e.g., week /month).
- h_{si}-The employee salary for per-hour.
- oh_{si}-The employee salary for overtime work.(e.g., per hour)
- Nh-Normal working hours per period (e.g., per month).
- $maxh_i$- For project, employee possible maximum working hours per month .
- $[join_i;leave_i]$- Employee join and leave time for the project.
- $\{s_i^1, s_i^2 \ldots s_i^\Phi\}$ —The skill set for the employee, where Φ is the number of skills and $s^j_i \varepsilon [0,5]$ is the proficiency score of the i^{th} employee for j^{th} task. S^j_i =0 means the employee does not have any skills to do the job and s^j_i = 5 means the employee is most proficient to do the job.
- $Taskexp_e$ -- Experience level of Employee.
- pwh_i -- Planned working hours of i^{th} employee.
- Weh_i ---- Experienced i^{th} employee working hours.

The fitness f_j^t of the employees for task t_j on the t^{th} month is given by Eq.(1):

$$f_j^t = \frac{\sum_{i=1}^{m} prof_{ij} . wh_{ij}^t}{\sum_{i=1}^{m} wh_{ij}^t} + \frac{\sum_{i=1}^{m} taskexp_e weh_{ij}^t}{\sum_{i=1}^{m} weh_{ij}^t} \qquad (1)$$

This study deliberates cost minimization as the objective function, which is given by Eq. (2):

$$minf = \sum_{t=1}^{end} salari_i^t + \sum_{j=1}^{n} penality_j + \sum_{j=1}^{n} \mu \qquad (2)$$

This offers a representation scheme with a novel event-based scheduler. Similarly to the representation in Yannibelli and Amandi's recent work [7] for the multi skill scheduling problem.

Task list : $(t_{p1}, .. , t_{pn})$

Planned employee allocation matrix :

$$\begin{Bmatrix} pwh_{11}\, pwh_{12} \ldots pwh_{1n} \\ pwh_{21}\, pwh_{22} \ldots pwh_{2n} \\ \vdots \quad \vdots \quad \ddots \quad \vdots \\ pwh_{m1}\, pwh_{m2} \ldots pwh_{mn} \end{Bmatrix}$$

Planned experienced employee allocation matrix :

$$\begin{Bmatrix} weh_{11}\, weh_{12} \ldots weh_{1n} \\ weh_{21}\, weh_{22} \ldots weh_{2n} \\ \vdots \quad \vdots \quad \ddots \quad \vdots \\ weh_{m1}\, weh_{m2} \ldots weh_{mn} \end{Bmatrix} \qquad (3)$$

The Event Based Scheduler(EBS)amends a plan in the form of (3) into an actual timetable by two rules. First, if there is resource conflict between two tasks, the task that appears earlier in the task list has a higher priority to use the resource. Second, new workload assignments are only made when events occur. If no employees join or leave the project or no human resource is released by the tasks just finished, the workload assignments remain the same as the previous time period.

In this anticipated system, the event based scheduler framework based on the clustering results is performed. In typical FCM clustering methods distance measure only ganges the difference between two individual employee which attributes to clutch similar user experience. From this point of view it igoners the global view clustering resutls .

Given an employee e_i = 1,2,…,n, for every data e_i, the dot density is usually defined as Eq.(4)

$$z_i = \frac{1}{\min(\{d_{ij}\})} \; d_{ij} \le e, 1 \le i \le n \quad (4)$$

Where d_{ij} denotes the distance between the two employees attributes.

Each one of the employee cluster density is the weighted linear combination of dot densities as expressed in Eq. (5).

$$\hat{z}_I = \frac{\sum_{j=1}^{n} a_{ij} w_{ij} z_{ij}}{\sum_{j=1}^{n} a_{ij} w_{ij}} \; d_{ij} \le e, 1 \le i \le n \quad (5)$$

Where

a_{ij} - The category is the label of employee data

e_j and w_{ij} - The weight of e_j .

$a_{ij=1}$ - When e_j most likely fits to the cluster i, otherwise $a_{ij} = 0$.

w_{ij} - A positive constant which can be attuned by users.

Using the cluster density,z_i $\hat{z}_i$ the distance measure is revised as Eq. (6)

$$\hat{d}_{ij}^2 = \frac{\|e_j - v_i\|^2}{\hat{z}_i} \; 1 \le i \le c, 1 \le j \le n \quad (6)$$

Thus, the optimization expression can be written as follows base on Eqs. (7):

$$J_{FCM-CD}(U, V, X) = \sum_{i=1}^{c} \sum_{j}^{n} u_{ij}^{m} \|e_j - v_i\|^2 \quad (7)$$

Where v_i and u_{ij} are

$$v_i = \frac{\sum_{j=1}^{n} u_{ij}^{m} e_j}{\sum_{j=1}^{n} u_{ij}^{m}} \; 1 \le i \le c \quad (8)$$

$$v_i = \frac{\sum_{j=1}^{n} u_{ij}^{m} e_j}{\sum_{j=1}^{n} u_{ij}^{m}} \; 1 \le i \le c \quad (8)$$

In fundamental, essential difference between existing and proposed scheme is the metaphor of planning. The RCPSP and employee assignment models plan with the metaphor of the task. Thus it cannot deal with task preemption but it can make plan with each task having the fixed workload assignment. This model is fine-grained and workload assignment and large search space is desultory. The process of stepwise regression involves these steps are as follows:

Algorithm 1:Fuzzy C Means(FCM) clustering

Step 1: Elect the number of clusters c, fuzziness index m, iteration error, maximum iterations T, and initialize the membership degree matrix $U^{(0)}$.

Step 2: Get the initial centroids using Eq. (9).

Step 3: Calculate the dot density of every employee data points using Eq. (5). And when the iteration index is t(t = 1,2, .. , T),

Step 4: Update the membership degree matrix $U^{(t)}$ and cluster centroids $V^{(t)}$using Eqs. (8) & (9).

Step 5: Calculate the value of the objective function $J^{(t)}$using Eq. (7).

Step 6: If $|U^{(t)} - U^{(t+1)}| < \varepsilon$or t = T, then stop the iteration and get the membership degree matrix Uand the cluster centroidsV, otherwise set and return to step (4).

To decipher the software project planning problem, this paper propositions an Artificial Bee Colony (ABC) approach.

The core idea of ABC is to simulate the foraging behavior of honey bees. When bee searches for food, they usually deposit a special dancing behavior of bees.ABC has been efficaciously used for project scheduling problem as it is easy to develop and fix many optimization problems with only a few controls of parameters.

The heuristic of choosing the i^{th} employee to work for the task t_j is denoted as $\gamma_e^{(i,j)} = prof_{ij}/hs_{i..}$.The connotation of this heuristic definition is the rate between the proficiency $prof_{ij}$ of the i^{th} employee for the task t_j and the hour salary of the employee. An employee with a lower salary and a higher proficiency score for $t_j$is more probable to be chosen to work for t_j. If an employee's experience level on a task is $join_i$ at the beginning of a time unit and they work for a fraction of the time (b) on this task:

$$\delta_e(i,j) = \frac{Taskexp_e}{hs_i * Lthr} \quad (10)$$

These parameters are those which belong to single cluster employee attributes. Then construction of the employee allocation matrix is based on the following steps:

Set all values in the employee allocation matrix to 0.

For each task t_j (j = 1; 2; …; m), ascribe the workloads for t_j by the following sub steps:

Step b-1: Evaluate the value of $\gamma_e^{(i,j)}$,$\delta_e(i,j)$ for all employees, and then check on fitness value for each employee bees by,

$$fit_i = \frac{1}{1 + f_i} \quad (11)$$

The fitness of each employee bee is premeditated based on the parameters from (18). An artificial onlooker bee software project planning problem based on the probability value p_i, is estimated by the following expression,

$$p_i = \frac{fit_i}{\sum_{n=1}^{SN} fit_n} \quad (12)$$

Where fit_i epitomizes the fitness value of the task to each employee i in the location and SN is the sizeof the population. The nominated task position updates a following equation (13)

$$v_{ij} = x_{ij} + \theta_{ij}(x_{ij} - x_{kj}) \quad (13)$$

Where k and j are randomly selected different task ε {1,2,…,SN} & j ε {1,2,….,D}. ϕ_{ij} ε [-1.1], From this result, the parameter value of x_{ij} exceeds its threshold value, the upshot of scheduling problem is acceptable else it is not acceptable as best scheduling results, it is also replaced by the scouts bees. In ABC, if a bee position does not recover the result within a pre - specified number of iterations, then the current task position is assumed to be neglected and it is updates as:

$$x_i^j = x_{min}^j + rand(0,1)(x_{max}^j - x_{min}^j) \quad (14)$$

Algorithm 2: Artificial Bee Colony (ABC) optimization for Software Project Scheduling

1. Initialize the population of solutions x_i, i = 1, …..,SN, ,each population as a number of tasks for each employee
2. Appraise the population
3. Set cycle = 1
4. Repeat
5. Produce new Software Project Scheduling v_i for employed bees (tasks) by using (12)
6. Relate the greedy selection process for the employed bees
7. Compute the probability values P_i for software project scheduling solutions x_I by (13).
8. Produce the Software Project Scheduling solutions v_i for the onlookers from the solutions X_i designated depending on P_i and evaluate them.
9. Apply the greedy selection process for the onlookers .
10. Adopt the abandoned task results in the scout, if exists, and replace it with a new randomly produced solution χ^j_i by (13).
11. Memorize the best solution achieved so far by(14).
12. cycle = cycle + 1
13. until cycle = MCN

IV. RESULTS AND DISCUSSION

The data set taken for the experiment from departmental stores as real instances. The four kinds of personnel in a group those are regular chosen staff, regular usual staff, temporary skilful and temporary usual staff. These are the four main types in a project team where one can develop the project with this team itself. The chosen staffs are the one who have more skills and the employer has to pay huge sum for them. Normal staffs are also skilful but they are not well versed in all aspects.

These kinds of staffs have stuff in some major areas but not completely in all areas like chosen members. Therefore the usual staffs are the major staffs of the team. Temporary staffs are equal to usual staffs but their service will be required for some specific jobs and they will be sent back once when the work is done. According to the staff type and employee properties are randomly engendered using the haphazard instance generator. Feasibility check is the last process to ensure the skill sets of the employee are matched to the requirements of the project. The Task information and Employee information is given in Table 1 and 2.

Table1: Task data

TID	TNAME	SKILLSET	DURARION	COST	NEMP	PENALTY
1	NetworkConnection	Network	30	4200	10	2
2	Programming	Oops	40	5200	15	3
3	Programming	DotNet	20	3500	16	4
4	WebServices	DotNet	25	4000	18	5
5	ImageProject	Matlab	36	4200	12	3
6	DataMining	Java,Documentation	78	7500	20	6
7	ResearchPaper	Analyst	45	6000	16	5
8	ResearchPaper	Analyst	15	2600	5	2
9	Programming	Java,Documentation	25	4000	9	3
10	Business	Marketing	35	4100	13	4
11	DataMining	Java	34	3400	10	3

Table 2. Employee data

E_id	E_Name	BS	HS	OHS	LWH	MAXH	DEDICATED_H	JOINTIME	LEAVETIME	SALARY
1	Emp1	35000	190	194	197	360	210	9	5	74952
2	Emp2	25000	150	140	170	355	210	9	6	54400
3	Emp3	15000	150	94	147	360	210	9	6	42972
4	Emp4	5000	140	28	145	380	220	9	9	27400
5	Emp5	10000	180	56	280	360	210	9	9	47800

6	Emp6	7000	120	40	230	370	220	9	8	33400
7	Emp7	9000	150	50	250	365	230	9	6	43500
8	Emp8	13000	160	72	230	345	220	9	7	48200
9	Emp9	17000	170	94	147	265	200	9	7	46972
10	Emp10	13000	160	72	136	245	210	9	6	40088
11	Emp11	11000	110	62	220	236	210	9	7	35200
12	Emp12	8500	140	48	240	345	310	9	8	45460
13	Emp13	9500	170	54	270	355	310	9	8	57560
14	Emp14	10500	190	58	290	345	310	9	8	66760
15	Emp15	21000	180	116	258	360	250	9	8	66000
16	Emp16	23000	140	128	260	360	320	9	5	67080
17	Emp17	26000	120	140	270	335	305	9	5	63300
18	Emp18	28000	180	156	310	325	305	9	5	82900
19	Emp19	31000	160	172	320	340	310	9	5	80600
20	Emp20	14000	190	78	239	360	320	9	7	65728
21	Emp21	12000	140	68	330	345	310	9	6	55400

Table 3: Skill set of employees for the task.

T_ID	TNAME	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	E 9	E 10	E 11	E 12	E 13	E 14	E 15	E 16	E 17	E 18	E 19	E 20	E 21
1	NetworkConnection	1	1	2	2	1	2	2	1	2	1	2	1	1	0	0	1	2	1	2	1	5
2	Programming	1	1	5	1	1	1	2	2	2	0	0	1	1	4	1	1	1	0	0	1	1
3	Programming	3	1	1	1	1	2	2	1	3	2	1	0	0	0	0	1	1	1	1	5	1
4	WebServices	4	1	2	1	2	1	1	3	1	2	2	2	1	1	1	1	4	0	0	5	1
5	ImageProject	1	1	1	1	1	1	5	0	0	1	1	1	1	1	1	0	2	0	1	1	1
6	DataMining	2	2	2	3	2	2	2	2	2	2	2	2	1	1	1	1	3	5	0	2	2
7	ResearchPaper	1	1	2	1	2	1	1	3	1	2	2	2	1	1	1	1	4	0	5	4	3
8	ResearchPaper	4	2	1	0	0	0	0	0	1	1	1	2	1	1	1	1	0	0	0	1	0
9	Programming	1	1	2	1	2	1	1	3	1	2	2	2	1	1	1	1	4	5	3	2	1
10	Business	2	2	2	3	2	2	2	2	2	2	2	2	1	5	1	0	2	0	1	1	1
11	DataMining	1	2	1	0	0	0	0	0	1	1	1	2	1	1	1	1	0	0	0	1	0
12	Designing	4	2	1	3	3	4	4	2	1	1	1	2	1	3	4	3	2	3	2	1	5
13	Requirement Gathering	3	4	5	1	2	1	1	3	1	2	2	2	1	1	1	1	4	0	1	2	1
14	Testing	1	1	2	1	2	1	1	3	1	2	2	2	1	1	1	1	4	0	1	5	2
15	Accountant	2	2	2	3	2	2	2	2	2	2	2	2	1	2	2	2	3	2	2	5	3
16	Implementation	3	4	3	3	2	1	5	1	1	2	2	1	2	2	1	2	1	2	1	1	0
17	Coding	1	1	2	2	1	2	2	1	2	1	2	1	1	0	0	1	2	5	3	3	2
18	BusinessLogic	2	2	2	3	2	2	2	2	2	2	2	2	1	2	2	2	3	2	5	3	2

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ACO has been implemented with EBS and the

T_ID	T_Name	E_Name	SKILLSET	Duratio	Cost	MAXH	JOINTI	LEAVETIME
Task 1	NetworkConnection	Emp21	Network	30	4200	345	9	6
Task 2	Programming	Emp3	Oops	40	5200	360	9	6
Task 3	Programming	Emp20	DotNet	20	3500	360	9	7
Task 4	WebServices	Emp20	DotNet	25	4000	360	9	7
Task 5	ImageProject	Emp7	Matlab	36	4200	365	9	6
Task 6	DataMining	Emp18	Java,Docume	78	7500	325	9	5
Task 7	ResearchPaper	Emp19	Analyst	45	6000	340	9	5
Task 9	Programming	Emp18	Java,Docume	25	4000	325	9	5
Task 10	Business	Emp14	Marketing	35	4100	345	9	8
Task 11	DataMining	Emp60	Java	34	3400	325	9	5
Task 12	Designing	Emp21	Network	30	4200	345	9	6
Task 13	Requirement Gathering	Emp3	Oops	40	5200	360	9	6
Task 14	Testing	Emp20	DotNet	20	3500	360	9	7
Task 15	Accountant	Emp20	DotNet	25	4000	360	9	7
Task 16	Implementation	Emp7	Matlab	36	4200	365	9	6
Task 17	Coding	Emp18	Java,Docume	78	7500	325	9	5
Task 18	BusinessLogic	Emp19	Analyst	45	6000	340	9	5

FCM clustering algorithm has been implemented and the clusters are as follows:

Cluster 1:

E_Name	BS	HS	OHS	NH	MAXH	JOINTIME	LEAVETIME	SKILLSET
Emp5	10000	28	56	28	360	9	9	DotNet
Emp13	9500	27	54	27	355	9	8	C
Emp4	5000	14	28	14	380	9	9	Network
Emp12	8500	24	48	24	345	9	8	C++
Emp7	9000	25	50	25	365	9	6	Matlab
Emp6	7000	20	40	20	370	9	8	Ns2
Emp14	10500	29	58	29	345	9	8	Marketing
Emp20	14000	39	78	39	360	9	7	DotNet
Emp21	12000	34	68	34	345	9	6	Network

Cluster 2:

E_Name	BS	HS	OHS	NH	MAXH	JOINTIME	LEAVETIME	SKILLSET
Emp2	2500	70	140	70	355	9	6	Java,Documentation
Emp18	2800	78	156	78	325	9	5	Java,Documentation
Emp1	3500	97	194	97	360	9	5	Presentation

Cluster 3:

E_Name	BS	HS	OHS	NH	MAXH	JOINTIME	LEAVETIME	SKILLSET
Emp8	13000	36	72	36	345	9	7	PHP
Emp3	15000	47	94	47	360	9	6	Oops
Emp10	13000	36	72	36	245	9	6	Documentation
Emp11	11000	31	62	31	236	9	7	Java

Cluster 4:

E_Name	BS	HS	OHS	NH	MAXH	JOINTIME	LEAVETIME	SKILLSET
Emp15	21000	58	116	58	360	9	8	Analyst
Emp9	17000	47	94	47	265	9	7	Analyst
Emp16	23000	64	128	64	360	9	5	Analyst
Emp17	26000	72	144	72	335	9	5	Analyst
Emp19	31000	86	172	86	340	9	5	Analyst

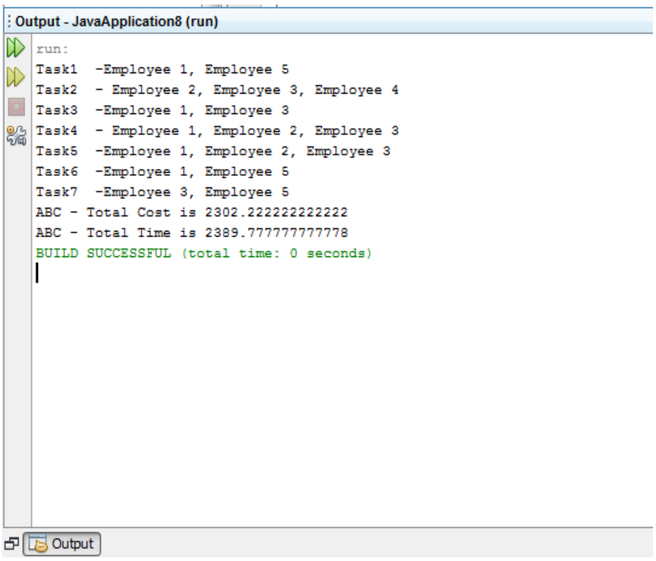
EBS with ABS implemented and the result as follows:

T_Name	E_Name	SKILLSET	Duration	Cost	MAXH	JOIN TIME	LEAVE TIME
ImageProject	Emp7	Matlab	36	4200	365	9	6
Programming	Emp3	Oops	40	5200	360	9	6
WebServices	Emp20	DotNet	25	4000	360	9	7
Implementation	Emp7	Matlab	36	4200	365	9	6
DataMining	Emp60	Java	34	3400	325	9	5
BusinessLogic	Emp19	Analyst	45	6000	340	9	5
ResearchPaper	Emp19	Analyst	45	6000	340	9	5
Coding	Emp18	Java,Documentation	78	7500	325	9	17
Accountant	Emp20	DotNet	25	4000	360	9	7
Designing	Emp21	Network	30	4200	345	9	6
Programming	Emp20	DotNet	20	3500	360	9	7
DataMining	Emp18	Java,Documentation	78	7500	325	9	6
Testing	Emp20	DotNet	20	3500	360	9	7
ResearchPaper	Emp19	Analyst	15	2600	340	9	5
ToolDesign	Emp3	Oops	40	5200	360	9	6
Business	Emp14	Marketing	35	4100	345	9	8
Programming	Emp18	Java,Documentation	25	4000	325	9	9
Network Connection	Emp21	Network	30	4200	345	9	6

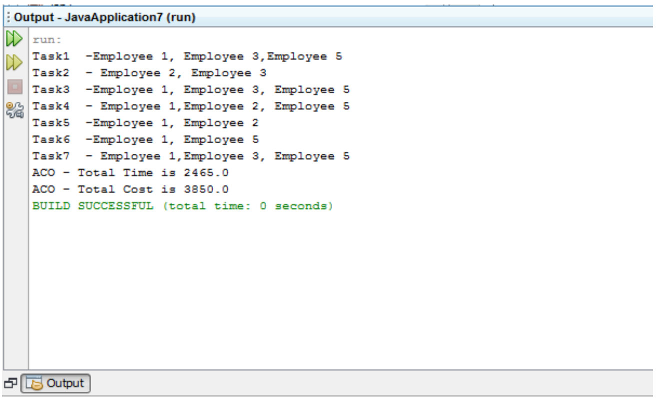
Cost and Time performance of different optimization approaches

	COST	TIME
EBS	**4747**	**2778**
ACO	**3850**	**2465**
EBS with ABC	**2302**	**2389**

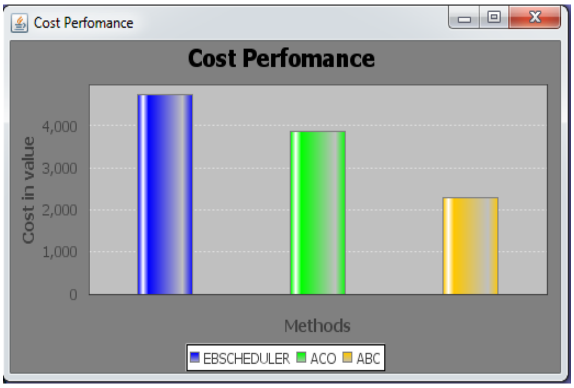
ACO work allocations as follows:



ABC work allocation as follows:



Cost performance of ABC and ACO:



V. CONCLUSION & FUTURE WORK

In this study, we present a novel plan for software project scheduling problem. Foremost contribution of the proposed methods is following perspective. At first, the strategy presents a Fuzzy C Means (FCM) grouping technique for occasion based scheduler. Afterward, the technique achieves the Artificial Bee Colony enhancement strategy to take care of the schedule. Provisional results confirm that the representation, in the foreseen work, the comparable features and experienced employee data are gathered into same cluster to improve the consequences of the event based scheduler, then execute the ABC method to solve and optimize the issue.

The proposed algorithm impacts better plans with lower costs in brief time and produce steady work appointment collated with particular subsistent strategies, since it additionally considers the attributes of employee experience, skills. Future work may incorporate better system dynamics integrated with the modeling of progress of tasks where better training and experience models will be encompassed. In addition, we can investigate the effect of team size on these themes.

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