1. Hello. We are Team 12. We will present the paper <Ant Colony Optimization for   
   Software Project Scheduling and Staffing with an Event-Based Scheduler>.
2. Here is our table of contents. We will first introduce the motivation, the model authors and previous works suggested, event based scheduler, ant colony optimization, and the result with discussion.
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4. Nowadays, software development is the main stream of the world. Unlike other works, software development is a people-intensive activities that has lots of dependency of tasks with different skillsets. There are already many examples that inefficient planning made awful results. The whole or the partial project may be delayed, or it will have quite a low quality. It also causes the waste of human resource and budget, for instance, a frequent overtime. We have also experienced a lot. It means that software development project needs careful scheduling before it starts.
5. Let’s look at what is a project scheduling problem. This problem wants an optimal order of the tasks as an output, which minimizes the time. This simple statement is already an NP complete problem, though.
6. For the software project managing, we have more constraints about human resources. They have different salary, different maximal working hours, different skillset, and so on. Each employee will be allocated to each task, mainly depending on what skills they have.
7. About these problems, traditional techniques considered that task scheduling and human resource allocation are separated activities. Because of that, project managers allocated each employee to each task manually, which indicated the inefficient allocation and poor performance. Also, some models have the assumption that each employee can only be assigned to a single task at a time, which is practically incorrect. Thus many researchers have approached this problem as search-based optimization problem.
8. However, previous works have missed some important components for the software project planning problem. For instance, the resource constrained project scheduling problem model didn’t consider about employee allocation. Other model, which focused on employee allocation, didn’t care about the order of tasks. Some models made employees can only be allocated into one task; other model increased the search space rapidly. Therefore, this paper suggested a new model which adapts Event-Based Scheduler and Ant Colony Optimization technique to overcome the above weakness.
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10. Now let’s define the model. Suppose we have m employees. They have basic salary, and they also get hour-based salary which take cares about overtime. They can work at most maxh time. If some employees work longer than the normal, they have to be rewarded by overtime salary. Also, each employee may not be available for whole term. Finally, each employees have different skills and different abilities.
11. About the tasks, some tasks can be started only after some prerequisites have been done. We can estimate the work effort for each tasks in person months, which requires their own skillset. We also have to regulate tasks not to consume too many employees because of the higher communication overhead. Also, deadline exists not only for the entire project but also for each tasks. Each delay makes each corresponding penalty as a term of the money.
12. To estimate the actual duration for each task, we have to set up how much work can be done in one month. It mainly depends on the proficiency of each participating employee. We first compute the proficiency as the multiplication of the ability of each required skills. Then the fitness for the task can be computed as the ratio of the weighted sum of each employees working hours to the sum of working hours. We then take the approximate inverse of the fitness to represent the achievement A\_j on the t-th month. If the summation of A\_j exceeds the tasks’ estimated person month, we can say that the task is finished.
13. To order the tasks, we have to specify when each task starts and finishes, which have to satisfy the topological priority of the tasks. Also, each employee can work at most maxh hours for each month. Each tasks have to maintain their status with not too many employees. Finally, all tasks have to be completed before its planned due, finish\_j.
14. With these constraints, our main objective is minimizing the expected budget consumption including salary and the penalty.
15. Now let’s review the previous models. The first one is resource constrained project scheduling problem. It uses the ordered task list representation to decide which task can take the resource before the other task takes. However, it doesn’t take care about human resources, so it is inadequate.
16. On the other hand, employee allocation models assign each employee to each task with proper working hours. It manages a 2D employee allocation matrix. However, since the duration of each task depends on what employees are participating, some tasks may take too much time, and also may wait too long to start. Also, this model cannot deal with the resource conflict. It made this model to assume that resources are unlimited and every employee can participate into an unlimited number of tasks at the same time, which is not practical.
17. Next, Multiskill Scheduling Models extended the resource constrained project scheduling problem which concerns different combinations of employees. This model can be actually represented by task list representation and employee allocation matrix, so it seems to resolve the issues on each model. Still, each employee can only be allocated into one task at one time. For instance, if an employee participates into the two team for task 1 and task 2, respectively, the whole team 2 have to wait when the employee works for the task 1. It reduces the resource efficiency of the project.
18. The last previous model is time-line-based model. This model defines the employee allocation matrix for each time t. As a result, it actually enabled to overcome the disadvantages of the resource constrained project scheduling problem model and the employee allocation models. But it also increased the complexity rapidly. For instance, this approach may assign two completely different groups of employees to the same task for the consequent time. Also, since this model has three-dimensional structure, the search space is increased quite a lot. Now the next presenter will explain about the event based scheduler.