Calendar Scheduling with Action Items

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Statement of Interest

In this note, we summarize our research interests in the general area of integrating planning capabilities into scheduling technologies. Our recent work has focused on the development of an agent-based calendar scheduling system, where intelligent agents schedule meetings on behalf of busy users. In accomplishing this task, the principal objective to date has been to schedule meetings in a way that best satisfies user preferences. However, recently we have been considering the broader idea of integrating time management into the calendar scheduling context. This does not change the overall objective of satisfying user preferences. But it does introduce the complementary need for goal-directed reasoning, to determine which additional meetings should be placed on the user's calendar to accomplish outstanding action items.

In the sections below, we first summarize the prior context of our work in calendar scheduling and then sketch the idea of layering in time management capabilities.

Previous Work

For the past two years we have been investigating the problem of automating the process of calendar scheduling, hoping to free up busy users so that they can have more time to do more productive work. This has led to the development of CMRadar (Modi *et al.* 2004), a distributed calendar management agent system which learns user's scheduling decision criteria and preferences. In CMRadar, individual agents initiate meetings and respond to meeting requests on behalf of their respective users, and negotiate meeting times and participants with each other that best satisfy their respective users' preferences. CMRadar agents manage calendars in an incremental and continuous fashion. An agreement to a new meeting can bump an existing meeting on the schedule, and whenever this happens, relevant CMRadar agents re-engage to attempt to reschedule the lower priority meeting.

Within CMRadar, we have taken a machine learning approach to the problem of acquiring user preferences. A given CMRadar agent learns user preferences by observing the user engaging in a series of scheduling episodes, and then extrapolating preference utility functions from these observations (Oh & Smith 2004). For instance, a CMRadar agent learns which timeslots user prefers having meetings or which meetings should be given higher priority in the case of highly constrained users.

Time Management

Considered strictly from a scheduling perspective, calendar management is a problem of placing meetings on a time line with the overall performance objective of satisfying meeting constraints and user preferences. Now we look at a slightly different but closely related problem of time management. We assume that each user has a set of goals with deadlines, e.g., a to-do list of action items. In order to achieve these goals, an appropriate amount of time needs to be allocated to work through the details of each task. If we view the tasks in one's schedule as the sequence of actions that must be performed to achieve those goals then this naturally leads us into an integration of planning and scheduling paradigms.

We extend our agent's schedule quality metric to include the quality of pending action items, in order to take future rewards into account when making scheduling decisions. We make several simplifying assumptions in order to formalize this model. First, we assume that the performance quality of an action item is accumulated as a non-decreasing function of time over a discrete set of timeslots, e.g., a set of relevant meetings. Second, given an action item - a task with a set of collaborators - we assume that the quality is measured by the amount of time allocated to meetings that involve a subset of these collaborators. The user may also set some time for working alone to concentrate on certain goals and in such cases those timeslots will be considered as less preferred time for other meetings.

In our previous work, CMRadar aimed at learning exactly how its user schedules meetings, thus the agent's time management performance is bounded by the user's time management skills. In other words, if the user doesn't use time wisely, so will his agent be. By linking planning of action items with calendar scheduling we now aim to assist the user in producing a better organized schedule that at the same time maximizes user preferences.

As in many other real world problems we see that there lies an interesting tradeoff between planning decisions and scheduling decisions. Planning decisions related to goal revision can affect scheduling decisions by updating priority of tasks according to current status of action items. For instance, if the deadline for a certain task is close at hand and current performance quality of this task is too poor then the goal will be dropped, i.e. fail early to release resources for other tasks. It is also interesting to note that such decisions

are made dynamically at execution time. Each time a change is made to a schedule it affects the execution of the plan, thus the plan has to be validated, and vice versa. In general, the integration of time management into calendar scheduling raises several interesting research issues.

References

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