Development of Iterative Scheduler to Planner Feedback

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The traditional scheduling problem can be reformulated in an agent-oriented paradigm. A *manager* agent proposes a set of tasks to schedule along with scheduling constraints among these tasks. A *scheduler* agent receives this data and attempts to build a schedule which satisfies all scheduling constraints. Ideally, if the scheduler solves the problem as the manager requests, a successful schedule will be returned. If the scheduler is unable to satisfy the manager's request, it might return NULL, forcing the manager to blindly modify and resubmit its request.

Our scheduler is designed to return feedback to the manager regarding *why* a successful schedule could not be produced from the original request. This additional knowledge can then be used by the manager to direct its modification of tasks and/or relaxation of constraints for a subsequent scheduling request. This process iterates until a successful schedule with well-utilized resources is obtained.

In this scheme, achieving the appropriate division of knowledge between the manager and scheduler is crucial. The manager is an expert at building the task set and determining the associated scheduling constraints for the global problem at hand, while the scheduler is an expert at manipulating the tasks into a specific order such that constraints are not violated. Ideally, the scheduler should know *only* how to manipulate tasks into a sequence which does not violate constraints, while the manager knows details about the global problem at hand, but *not* the details of how to organize the tasks into a schedule. For scheduler feedback to work effectively, however, the two must share some knowledge. Complete sharing of knowledge, resulting in a single system devoid of the benefits of an agent-based paradigm, is undesirable. Which knowledge is shared and how to represent it is not clear.

While scheduler feedback could be realized within any architecture that fits the agent-based model described above, our implementation was constructed within CIRCA (Musliner, Durfee, and Shin 1995). CIRCA's modular Planner/Scheduler/Real-time design (Figure 1) fits the model well, providing an ideal test bed for scheduler feedback algorithm and system development. CIRCA's Planner expands states in a best-first probability search (Atkins, Durfee, and Shin 1996), thus current feedback from the Scheduler is restricted to a simple probability cut-off threshold which prunes the Planner's search space. The Planner shares its probabilistic knowledge with the Scheduler in the form of task priorities.

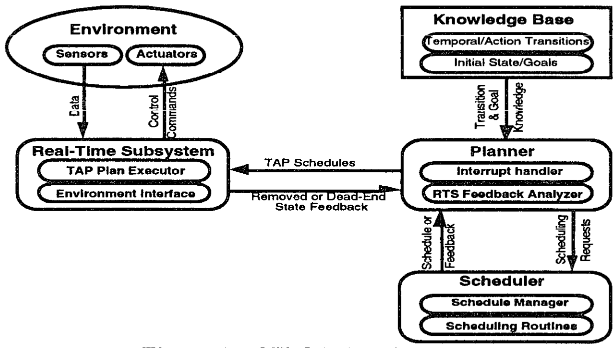

Figure 1: CIRCA Architecture.

The Scheduler includes a Schedule Manager sub-module, a rule-based system responsible for directing the entire scheduling process. Depending on the Planner's request, the Schedule Manager may perform a variety of actions: scheduling a request, relaxing simple constraints and rescheduling, modifying scheduling parameters, and returning either a valid schedule or a suggested modification to the probability cut-off threshold. Tests show this iterative scheduling-replanning cycle typically results in fast convergence to a schedule with efficient utilization of available resources. In some cases, however, the feedback from the Scheduler has been too aggressive, resulting in under-utilized schedules. We hope to address this case and explore further scheduler feedback options to help the Planner with all decisions affected by scheduling processes.

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References

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