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The Application of Artificial Intelligence to Astronomical Scheduling Problems

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Abstract

Efficient utilization of expensive space- and ground-based observatories is an important goal for the astronomical community: the cost of modern observing facilities is enormous, and the available observing time is much less than the demand from astronomers around the world. The complexity and variety of scheduling constraints and goals has led several groups to investigate how artificial intelligence (AI) techniques might help solve these kinds of problems. The earliest and most successful of these projects was started at Space Telescope Science Institute in 1987 and has led to the development of the *Spike* scheduling system to support the scheduling of Hubble Space Telescope (HST). The aim of Spike at STScI is to allocate observations to timescales of days to a week, observing all scheduling constraints, and maximizing preferences that help ensure that observations are made at optimal times. Spike has been in use operationally for HST since shortly after the observatory was launched in April 1990. Although developed specifically for HST scheduling, Spike was carefully designed to provide a general framework for similar (activity-based) scheduling problems. In particular, the tasks to be scheduled are defined in the system in general terms, and no assumptions about the scheduling timescale are built in. The mechanisms for describing, combining, and propagating temporal and other constraints and preferences are quite general. The success of this approach has been demonstrated by the application of Spike to the scheduling of other satellite observatories: changes to the system are required only in the specific constraints that apply, and not in the framework itself. In particular, the Spike framework is sufficiently flexible to handle both long-term and short-term scheduling, on timescales of years down to minutes or less. This talk will discuss recent progress made in scheduling search techniques, the lessons learned from early HST operations, the application of Spike to other problem domains, and plans for the future evolution of the system.