Use of Tcl/Tk in DTS, an Interactive Optimization and Scheduling System* (*Abstract*)

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Tcl finds several important uses in the Decision-Theoretic Scheduler (DTS), an interactive scheduling system being developed for NASA.

Tcl provides the following functions in DTS:

- Scheduling problems are specified through calls to Tcl procedures. This is in contrast to existing optimization and mathematical programming software, which have special purpose syntax (GAMS, LINDO) or AT&T-style "little languages" (AMPL). The advantages of being able to programmatically define problem components reduces user tedium and offers improved possibilities for consistency checking.

- Tcl's primary advantage over little languages is flexibility. For example, DTS is also being applied to Bin Packing and Graph Coloring, which beg for a more concise problem specification format. With Tcl procedures, the specification format can be tailored in a straightforward manner to the problem at hand. A side effect of this is that some "foreign" problem specifications can be translated using simple sed scripts (to replace delimiters and stringify) and Tcl procedures. The latest version of the main problem translator (from NASA's SPIKE format to ours) was written in this style in a single afternoon.

- Callbacks (e.g., from the GUI) in DTS go to TCL procedures, permitting the user to add customization hooks. For example, callbacks can be used to animate the execution of the underlying search algorithms in DTS. Callbacks are also used to determine the graphical attributes of tasks, resources, etc., when displayed – this permits attributes with user-defined semantics (such as task "priority") to influence the graphical presentation.

- Once a solution is found, Tcl is used to access it for custom visualization and flexible report generation. Alterations to report formats represent a significant maintenance cost in NASA operations systems, and delegating that task to the extension language reduces initial development time as well as the risks associated with subsequent maintenance.

- Like many other Tcl/Tk applications, DTS uses Tcl to provide "save", "undo" and "logging" facilities. All loggable user actions in the GUI have Tcl equivalents.

- Although the majority of the interface has been developed using another toolkit, small pieces (e.g., PERT chart browsers) and user extensions have been coded using Tk.

As a customization language for the power-users of optimization software, we have found Tcl to be more full-featured than previous "little languages" while being less intimidating than alternatives such as LISP. In addition, Tcl/Tk has reduced our own software development time significantly – some experimental preprocessing and optimization techniques have been written, visualized and debugged entirely in Tcl/Tk.

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