Building a Constraint Solver that Learns

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Abstract

FORR (FOrr the Right Reasons) is a cognitively plausible architecture for the rapid development of expertise (Epstein, 1992). To produce an adaptive, robust problem solver, FORR exploits many techniques observable in human learners. FORR itself is domain independent; a FORR-based application requires a set of domain-specific state representations and heuristics. Hoyle, a FORR-based game player, learned to play19 different two-dimensional, finite-board games as well or better than the best human experts (Epstein, 2001). Ariadne, a FORR-based pathfinder for two-dimensional mazes, learned to find its way efficiently through complex mazes modeled on real-world spaces (Epstein, 1998).

This talk highlights the human-like facets of FORR, illustrating them with its most ambitious application to date: *ACE* (the Adaptive Constraint Engine) (Epstein, Freuder and Wallace, 2005). ACE learns to solve constraint satisfaction problems and can explain the rationales underlying each of its decisions during search. ACE has rediscovered an important graph-coloring heuristic (Epstein and Freuder, 2001). It also discovered a new search heuristic on a class of relatively small and easy problems, one which, when exported to a conventional solver, improved search performance by more than 96% on a class of larger, more difficult problems (Epstein et al., 2002). ACE now serves both as a test-bed for cognitive theories (e.g., fast and frugal reasoning (Epstein and Ligorio, 2004)) and as a vehicle for the development of new approaches to constraint solving (e.g., (Epstein et al., 2005; Epstein and Wallace, 2006)). ACE is a joint project with Eugene Freuder and Richard Wallace of the Cork Constraint Computation Centre.

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