PhD Dissertation in Information Technology, School of Information Technology and Engineering, George Mason University, Fairfax Virginia, 2002.

Abstract

Our research goal is to allow subject matter experts who have no prior knowledge engineering experience to build intelligent agents that incorporate their problem solving expertise. Such an instructable agent will face the challenge of working with an incomplete and therefore evolving representation space. This thesis presents an integrated set of methods for knowledge representation, modeling, learning, and problem solving with incomplete knowledge. These methods are synergistically integrated to compensate for each other's weaknesses with their complementary strengths. First, we present a new form of plausible version space rules, based on a new method of concept learning in an incomplete generalization hierarchy of objects. We prove that this method converges almost monotonically to the version space of the best approximations of the target concept. Then, we describe new methods for modeling and learning an expert's problem solving knowledge. These methods have been implemented in the context of the Disciple approach, in three different systems that have been successfully applied to three complex domains, as demonstrated by nine intensive experiments. The experimental results proved that our proposed methods advance the state of the art in instructable agents, giving hope that in the near future typical computer users will be able to train their own personal software assistants.