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Planning and Learning by Analogical Reasoning

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Preface

This book describes the integration of analogical reasoning into general problem solving as a method of learning at the strategy level to solve problems more effectively. The method, based on derivational analogy, has been fully implemented in PRODIGY/ANALOGY and proven empirically to be amenable to scaling up both in terms of domain and problem complexity.

Reasoning by analogy involves a set of challenging problems, namely: how to accumulate episodic problem solving experience, how to define and decide when two problem solving situations are similar, how to organize large amounts of episodic knowledge so that it may be efficiently retrieved, and finally the ultimate problem of how to successfully transfer chains of reasoning from past experience to new problem solving situations when only a partial match exists among the corresponding problems.

In this work, the strategy-level learning process is cast for the first time as the automation of the complete cycle of constructing, storing, retrieving, and flexibly reusing problem solving experience. This book presents the interconnected algorithms designed for the generation, storage, retrieval and replay of derivational traces of problem solving episodes. The integrated learning system reduces the problem solving search effort incrementally as more episodic experience is compiled into the library of accumulated learned knowledge.

A primary goal of this work was to demonstrate an integrated view of the flexible learning and problem solving methods in large and complex domains. Scaling up the system proved to be very demanding. The current system has thus far been demonstrated in multiple domains, including a complex logistics transportation domain where it generated a library of 1000 cases. In addition to the analogical reasoning method, the book presents empirical results showing how PRODIGY/ANALOGY improved the problem-solving performance manyfold, actually increased the quality of the solutions generated, and pushed the solvability envelope to increasingly more complex classes of nonlinear planning problems.

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Allen Newell was not in my thesis committee. Still he shaped my thinking. We had several long meetings where we discussed my work. Allen Newell was always there pointing out the interesting points, forcing me to clarify my ideas, making sure I myself would understand well the concepts, the algorithms, the implementation. From Allen Newell I learned every day more and more what research is. Through him I understood how to work dynamically towards my research goals. He was a real mentor and friend.

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